RADIOSONDE REPLACEMENT SYSTEM (RRS)
Workstation User Guide

For

RWS software versions 2.5 through 4.0

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U.S. DEPARTMENT OF COMMERCE
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1 Introduction

1.1 Purpose

This users guide is designed to illustrate how to take upper air observations with the Radiosonde Replacement System (RRS) workstation software (RWS). In reading this guide, a basic knowledge of taking an observation with the RRS Telemetry Receiving System (TRS) is assumed. This knowledge may be gained by reading the sections of NWS-10-1401 relating to the Telemetry Receiving System, from the RRS Training Video, and hands-on training. Previous experience with a Windows based personal computer is also assumed.

1.2 Organization

This user guide has 17 chapters and six appendices. Chapter 2 provides a brief description of the RRS system and the RRS workstation. Chapter 3 uses actual flight data to allow the operator to become familiar with user features by running a simulated flight. Chapter 4 walks the user through both the Preflight and Release sequences. Chapter 5 describes the process of checking and editing data during a flight. Chapter 6 describes the possible check and status messages that a user will encounter during a typical flight. Chapters 7, 8 & 9 discuss the selection and management of plots. Chapter 10 deals with the coding and transmitting of messages. Chapter 11 and 12 describe the process of terminating a flight and how to archive the files during post processing. Chapter 13 describes in detail some of the most common in-flight data problems. Chapter 14 describes how to rework a flight. Chapter 15 discusses station data and the responsibility of maintaining it. Chapter 16 describes the various utilities available to users. Finally, chapter 17 covers checking the system status.

- **Appendix A** provides a list of abbreviations and acronyms used with RRS and the upper-air program.
- **Appendix B** provides codes for the Clouds/Weather entry in the prerelease data.
- **Appendix C** provides brief instructions on using the RRS Offline Maintenance software for providing maintenance personnel with more detailed information of equipment problems.
- **Appendix D** provides helpful hints in troubleshooting problems during Pre-flight, In-flight and Post-flight activities.
- **Appendix E** provides RWS Quick Guides at tools for observers. The guides give an overview of certain tasks, but do not contain all the details of the processes.
- **Appendix F** provides instructions on preparing the GPS radiosonde.

Operators should read the manual in its entirety. Each chapter has valuable information meant to ensure quality soundings. This guide is also meant to be used for reference long after training is completed. Chapters 5, 13 and Appendix D address how to handle a variety of in-flight situations.

NOTE: An easy way to search for topics of interest in this manual is to select the “Edit” function in the Adobe Reader toolbar and enter the query under “Find” or “Advanced Search”.

1.3 RRS Software Adjustments For New Radiosondes

RRS workstation software (RWS) versions 2.5 through 4.0 are designed to operate with a variety of radiosondes. It is configured for the Lockheed Martin Sippican LMS-6, and Vaisala RS-92 NGP radiosondes. Future versions of RWS software will be configured for other radiosonde types.

2 System Description

This chapter provides an introduction to the RRS system. While completely understanding the system hardware isn't necessary to use the operational RRS, understanding the basic functions for the hardware will provide valuable insight into the flight process, and for troubleshooting problems that may occur.

2.1 System Overview

The RRS tracking and receiving equipment tracks and receives the radiosonde signals. The signals are received from the Telemetry Receiving System (TRS) and Global Positioning System (GPS) and transmitted via the Signal Processing System (SPS) through a fiber optic cable to the workstation. The Signal Processing System (SPS), housed within the TRS pedestal, converts these signals to a digital format that can be used by the RRS Workstation (RWS) software. The RWS has a user interface that allows you to display and edit upper air data during the flight. When the coded messages are ready for transmission, they are sent from the RRS workstation to the local or remote AWIPS via LAN, or a modem.

2.2 System Hardware

The RRS system hardware consists of the following items (Exhibit 2-1):

Telemetry Receiving System (TRS)

Signal Processing System (SPS)

RRS Workstation (CPU/Monitor/Keyboard)

Printer

External Hard Drive (Backup)

RSOIS

Precision Digital Barometer (PDB)

Cables to RRS Tracking Equipment

GPS Base Antenna

Multiplexer (DCE)

GPS Repeater

Control Display Unit (CDU)

GPS Radiosonde

Cables to the RSOIS and PDB

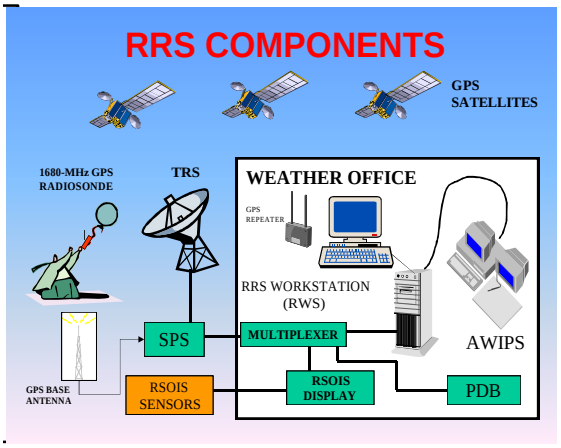

Exhibit 2-1 RRS Components

2.2.1 Telemetry Receiving System (TRS)

The TRS consists of three units (Exhibit 2-2): The antenna unit, the workstation unit, and launch area unit. The TRS workstation unit consists of the Digital Communication Equipment (DCE) and the workstation intercom. The TRS launch area unit consists of the Launch Area Control Display Unit (CDU) and launch area intercom and ringer.

The antenna is a 2 meter parabolic dish consisting of two halves for ease of transportation and assembly. Within the antenna unit, there are three major groups. They are the Radio Frequency (RF) group, Yoke group, and the Rack group.

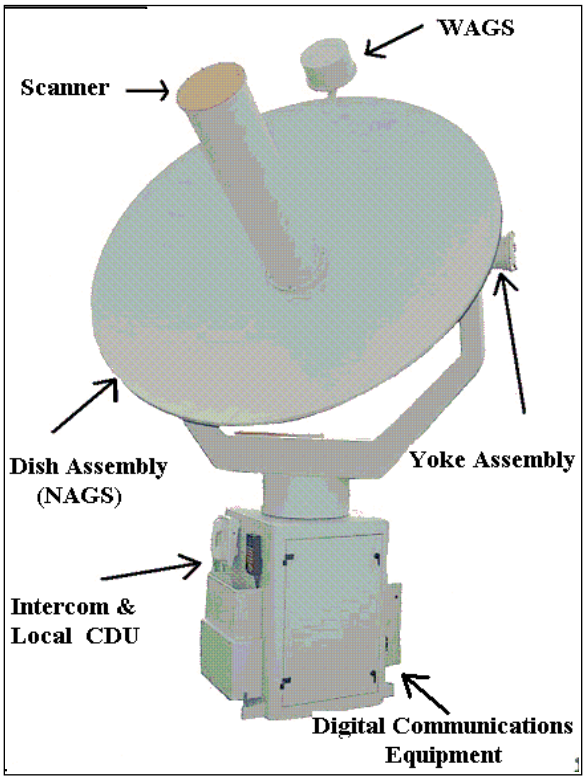

Exhibit 2-2 Telemetry Receiving System (TRS)

The RF group consists of the following six RF sensitive elements plus associated cables:

- Dish - Narrow Angle Gathering Sensor (NAGS) - 15 degree beam width
- Receiver assembly
- Scanner low noise amplifier (LNA) assembly
- Helix assembly
- Wide Angle Gathering Sensor (WAGS) - 100 degree beam width
- Counter-weights
- Associated cables

The Yoke group consists of six major assemblies plus associated cables. These assemblies and cables are the physical motion elements:

- Yoke
- Elevation motor drive assembly
- Motor Control Unit
- Associated cables
- Cross-member
- Azimuth motor drive assembly
- Slip-ring assembly

The Rack group consists of thirteen major assemblies plus associated cables. The assemblies and cables are the remaining elements within the antenna unit:

- 19 inch Rack
- Interconnection box
- Two heater assemblies
- Signal Processing System (SPS)
- Uninterruptible power supply (UPS)
- Local Control Display Unit (CDU)
- Antenna Digital Communication Equipment (DCE)
- Bulkhead
- System communication assembly (SCA)
- Air conditioner (AC)
- Power supply assembly (PSA)
- Local area intercom
- Associated cables

2.2.2 Signal Processing System (SPS)

The TRS is designed to receive telemetry from any radiosonde that meets the RRS specifications. The TRS delivers the radiosonde telemetry signal as 10.7 MHz IF to the SPS located in the 19 inch Rack below the antenna. The SPS includes a power supply, GPS receiver, 10.7 MHz IF front end, and a processor.

The SPS provides baseband conversion of the modulation on the Intermediate Frequency (IF) input. This baseband data is provided to the processor within the SPS. The GPS receiver provides the reference position and velocity data to the processor within the SPS. The processor within the SPS provides the corrections to the radiosonde data and provides it to the workstation.

2.2.3 Radiosonde Replacement System Workstation

The RRS workstation, at a minimum will have a 3.2 GHz Pentium 4 processor and motherboard. The memory will be at least 1024 megabytes (Mb) RDRAM memory with a 160 gigabyte (Gb) hard drive. It will have a rewritable CD-RW along with a 3.5 inch floppy diskette drive. The workstation will use Windows XP as an operating system. The workstation will have a 19 inch monitor, a telecommunications modem, 104 key PS2 keyboard, a mouse, and an external 160 gigabyte (Gb) hard drive for backup of all flight data. These specific characteristics will change with time, but will not be less than what has been described. The RWS is stored on the hard disk, along with the data, archive, and station data files. The Offline Maintenance software is also placed on the hard drive to help identify equipment problems.

2.2.4 RRS Workstation Software

The system is very interactive and allows a high degree of control over the data products that are generated and transmitted. RWS allows the user to enter preflight information, baseline the radiosonde, control the TRS and display and interact with flight data. Flight data is stored automatically, and flights may be reworked in RWS. In the event of a power failure, the flight data can be reworked allowing the data (to the point where the power was lost) to be transmitted. The flight data can also be Archived and transmitted to the National Climatic Data Center (NCDC).

2.2.4.1 Operator Commands

Commands to the RWS are entered through the mouse or the keyboard. The mouse and keyboard function with the RRS software similar to their operation with any other typical Windows based program. The RWS is not case sensitive.

2.2.4.2 Compact Disk Drive

The CD drive reads and writes data to a CD. This disk drive is also referred to as the D: drive. The disk drive is located at the top slot of the tower. A CD is inserted into the CD drive by pressing the button to the right and below the opening or slot. Each CD can hold 650 Mb of data. The light on the lower left part of the disk drive turns on when the CD drive is either reading or writing data.

2.2.5 Different Compact Disks

There are two CDs for the systems, the RWS CD (Exhibit 2-3) and the RRS Training CD (Exhibit 2-4). The RWS CD is used to install the RWS software and RRS Offline Utility software. The RRS Training CD contains operational flight data. CDs can be used for semi-monthly backups of the flight files (see Section 2.2.5.3 for details). The following sections describe the software, training and data CDs

2.2.5.1 RWS CD

The RRS CD (Exhibit 2-3) contains the RWS Software and the RRS Offline Maintenance Suite (OMS). For RWS and OMS installation instructions, see the latest RRS System Administration Manual (EHB 9-904).

2.2.5.2 Training CD

A substantial part of the RRS training will involve displaying and marking data from previously recorded flights using the Simulated and Rework Flight Options (Chapters 3 and 14). The Training CD contains training exercises and flight data files (files with a **.mdf** extension) that can Reworked after they are imported into RWS. The Training CD will also be used to demonstrate normal flight operations and possible options within the Tools option in Chapter 3. The Training CD should be loaded on the RRS workstation and used in conjunction with the RRS User Guide to become familiar with the various operator features before doing Live Flights. (Exhibit 2-4)

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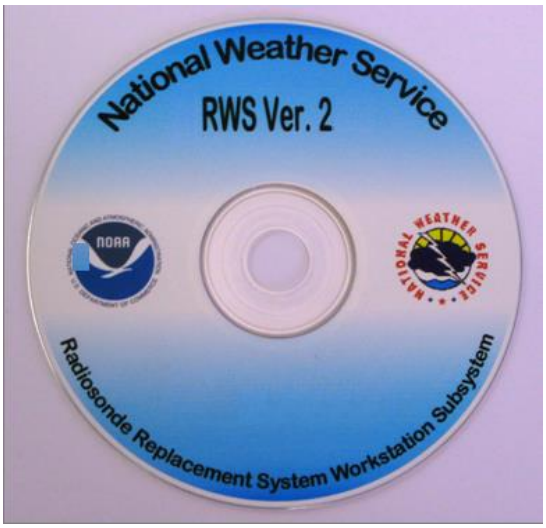

Exhibit 2-3 RRS Software CD

Exhibit 2-4 RRS Training CD

2.2.5.3 Data CD

A data CD can be created at anytime to provide a secondary backup of existing flights. WSH policy is to keep the RRS Archive data on station for at least three months. After this time, a data CD can be created to backup the Archive flight files and RWS flight files. A label for the data CD made by the site should clearly state on the disk or on an attached sheet of paper, the files contained on the disk.

NOTE: Anytime a flight has unusual meteorological or other events which may include tracking problems, software issues, or possible problems with the radiosonde or sensors, use the Capture utility to upload data to the RRS team for analysis.

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	CD Type	Data on CD	Input Data	Output Data
1	Training	Training Data	1-second flight data	
2	Data	Flight Data	1-second flight data	Used to Archive, Rework or Analysis Flight Performance

2.2.6 Printer

The RRS Workstation will have a color printer to enable the operators to print color copies of the plot and tabular data. This will make quality control and training an easier task with items of importance highlighted by the software or the operator prior to printing.

2.2.7 External Hard Drive

Once a flight has been terminated and closed, the data is backed up to the external hard drive in case of a hard drive failure of the RRS computer. In case of such a failure previous flights will be available from the external hard drive once the workstation has been replaced.

2.2.8 RSOIS Sensors

The surface observing sensors will be located within 200 meters of the release point unless a waiver has been issued by WSH. The RSOIS will report:

- Temperature
- Dewpoint/RH
- Wind Speed/Direction/Gusts

If RSOIS is not available or inoperative, a site may use the ASOS sensors or manually take the observations using a combination of handheld and fixed equipment if authorized. See NWS Manual 1401, Appendix E, Section 8.3 for more information.

2.2.9 Precision Digital Barometer (PDB)

The station pressure is measured by the Precision Digital Barometer (PDB). It is located at the baseline point and used to check the accuracy of the radiosonde pressure sensor. The radiosonde pressure sensor must be within ± 5 hPa of the PDB reading or the instrument must be rejected. If the PDB has failed, refer to NWS Manual 1401, Appendix E, Section 8.3 for more information.

2.2.10 GPS Base Station Antenna

The GPS base station antenna is located inside the radome above the TRS. The GPS base station provides Global Positioning System data from up to 12 satellites all in geo-synchronized orbit. The GPS antenna must receive data from at least four satellites to compute positional data including height.

Location is determined by positional change in the radiosonde's location in relationship to the satellites. This information is transmitted via the radiosonde's GPS antenna back to the GPS ground station. Accuracy of wind data improves as much as five times that of wind calculations using RDF equipment.

2.2.11 GPS Repeater

A GPS repeater is installed at all stations. The GPS repeater is located inside the office and surveyed for an established location at the baseline location to ensure GPS lock-on is acquired during the baseline check.

NOTE: GPS repeater location and baseline location are established and should not be moved without prior WSH approval. Each site will have a primary and backup location surveyed.

2.2.12 GPS Radiosonde

GPS radiosondes transmit a signal that provides pressure, temperature, relative humidity readings, wind and position information. Wind data is calculated by a change in radiosonde GPS position relative to the GPS Base Station location. Data is transmitted from the radiosonde at 1-second intervals back to the ground tracking system.

3 Simulated Flight - Overview of Operations

This chapter provides instructions on using the Simulated Flight function of RWS. The Simulated Flight mode is used in training to provide as close to Live Flight operations and commands as possible. The Simulated Flight mode contains nearly all of the capabilities for displaying and editing data that are available in the Live Flight mode. Learning to use the Simulated Flight mode will allow you to become familiar with many RRS features before you take an actual observation.

Before you begin training in the Simulated Flight mode, you should have a basic knowledge of using a Windows based computer and should have read Chapter 2 of this user guide.

3.1 Pre-flight Sequence

Before the radiosonde is released, information about the flight must be supplied to RRS. In this section you will see an example of these prerelease data for a sample flight and get some experience in manipulating the data. The prerelease data is entered through a sequence of several screens. The steps below will start a Simulated Flight.

1. Log onto the RRS workstation using your individual Username and Password.
2. Double click the RWS desktop icon (Exhibit 3-1).

Exhibit 3-1 RWS Icon

3. The RWS Window will appear with the Security Warning message. Read the message, and click on the **OK** button. (Exhibit 3-2)

Exhibit 3-2 RWS Window with Security Warning Message

NOTE: Other pop-up windows may appear after the Security warning. For example, No Data Message prompt if a synoptic flight hasn't been conducted for an extend amount of time.

4. Flight Options Window appears (Exhibit 3-3).
5. Select the icon next to *Run a simulated flight.*

Exhibit 3-3 Flight Options Window

6. The Simulated preflight displays will open. This includes the Administrative Display, Antenna Orientation/TRS Display, Hardware Status, SPS Status Window and Status Message Display (Exhibit 3-4).

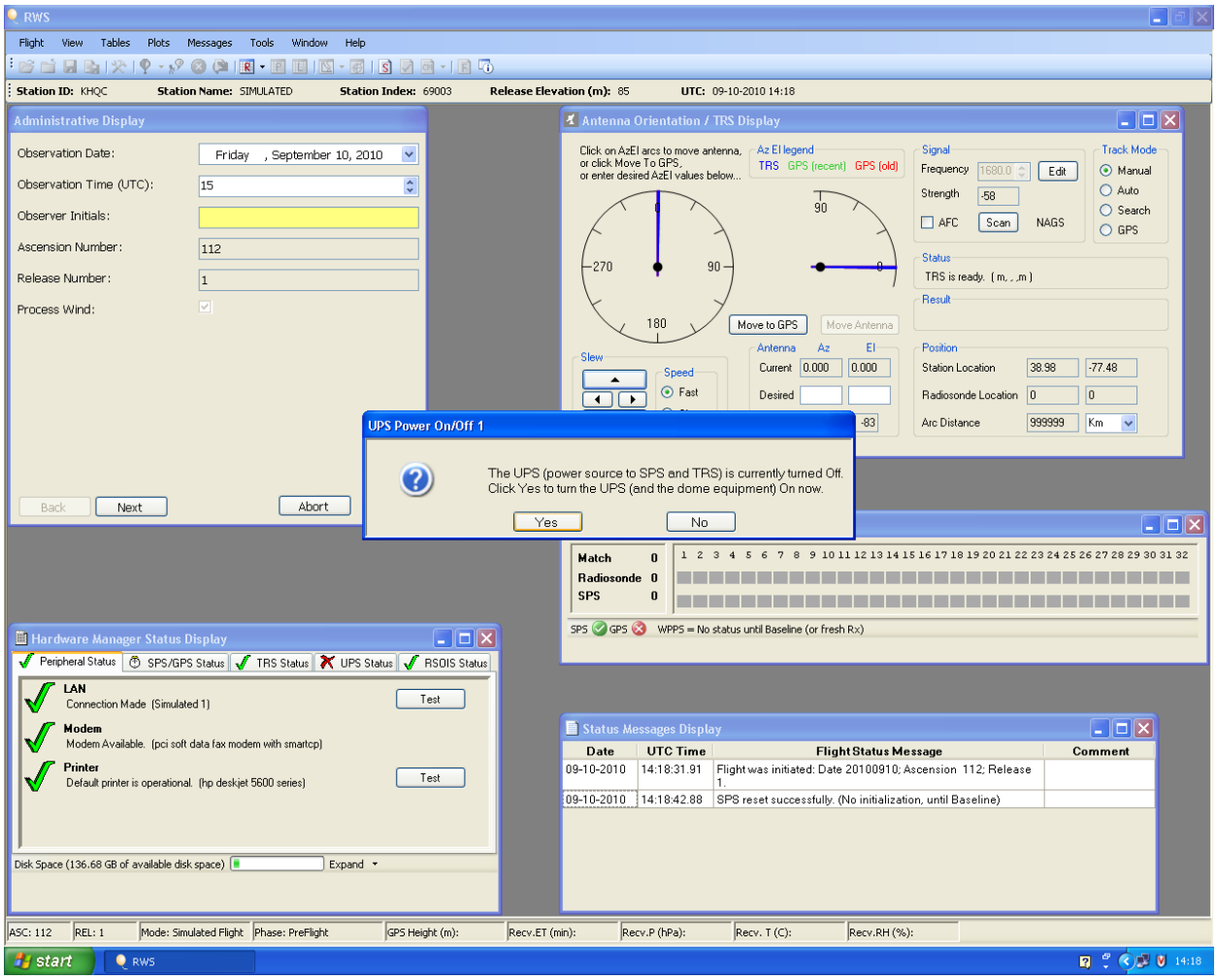


Exhibit 3-4 Simulated Preflight Display

7. The UPS Power On/Off 1 prompt will appear (Exhibit 3-5). Click **Yes** to simulate powering on the UPS.

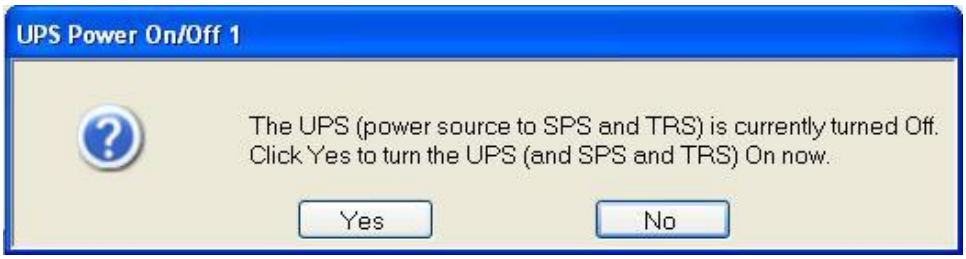


Exhibit 3-5 UPS Power On/Off window 1

8. In the Hardware Status Display, the UPS Status will change as it turns on from a question mark to a red X and finally to a green check mark (Exhibit 3-6).
9. Hardware Status window, (Exhibit 3-6) shows the status of the various components. Throughout a flight, each of the components will report their current status. Chapter 17

provides detailed information on the various hardware components checked and recommended actions.

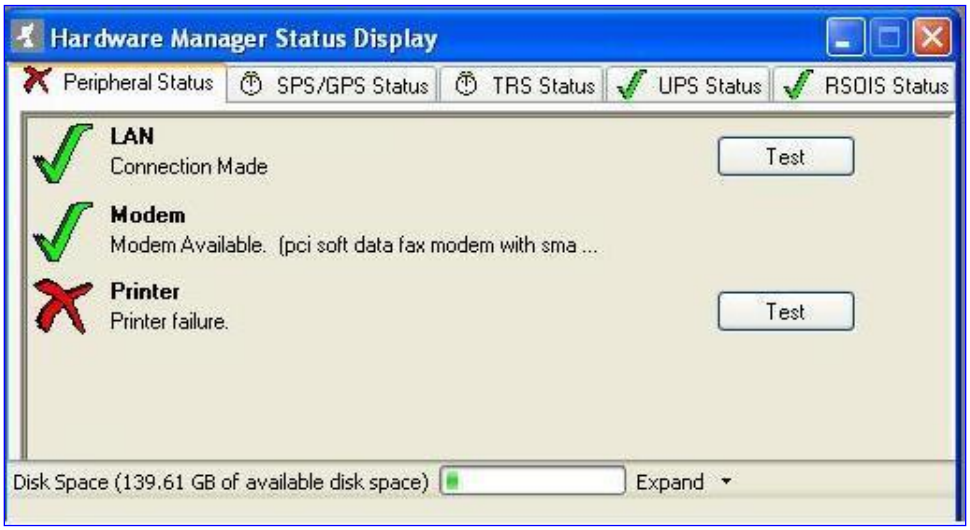


Exhibit 3-6 Hardware Status window

NOTE: During an actual live flight, the UPS must be powered on before receiving status from the TRS and SPS

10. In the Administrative Display, enter your initials and then click the **Next** button (Exhibit 3-7).

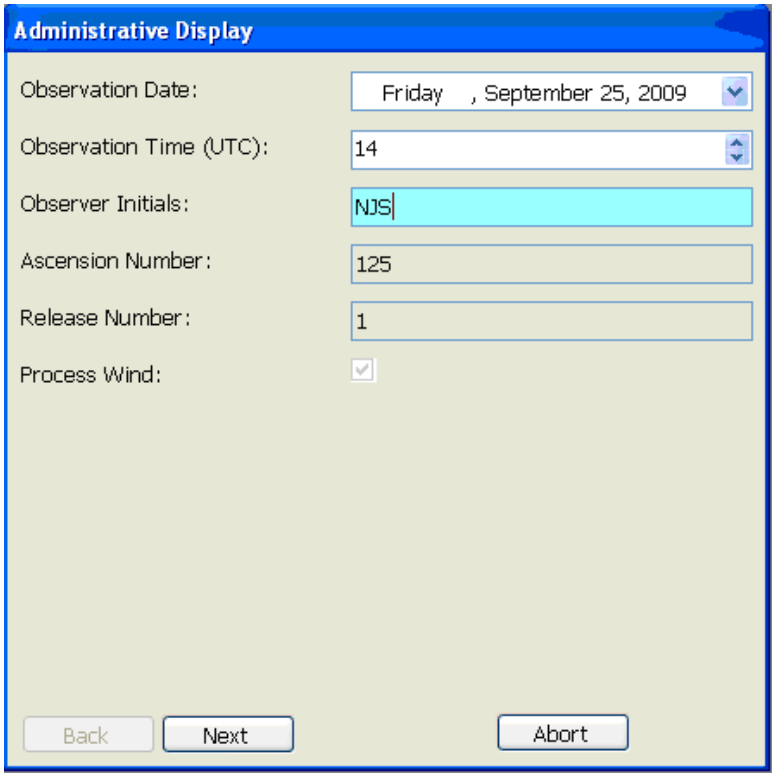


Exhibit 3-7 Administrative Display

11. The Equipment Display appears; fill in the blocks. (Exhibit 3-8) All blocks except the Calibration File Location must be completed. This calibration data is transmitted from the radiosonde at baseline. The radiosonde serial number is on the label at the bottom of the instrument. Some of the balloon information may be obtained from the balloon box label. The Nozzle Lift is the amount of gas used. The train length is the total length of the flight train and should be between 70 – 120 feet. The cells for Train Regulator, Lighting Unit, and Parachute are all Yes or No responses. The operator may toggle to get the desired answer. Click the **Next** button when done.

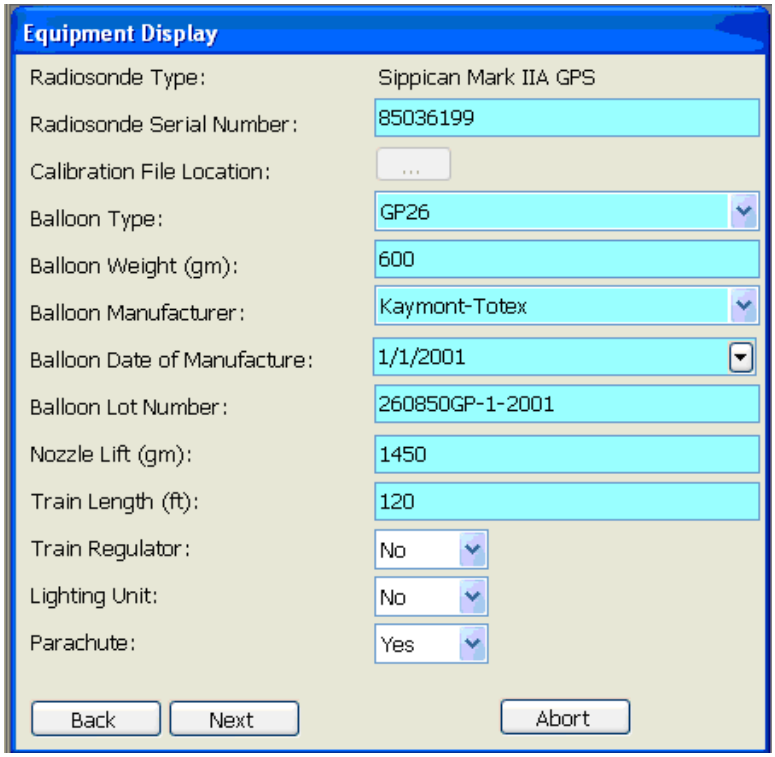


Exhibit 3-8 Equipment Display

12. The Surface Observation Display appears (Exhibits 3-9) Clicking Refresh will repopulate all cells, except the Cloud/WX block and Previous Temperature. Fill in the Cloud/WX block using codes provided in Appendix B. Entering the correct cloud data is imperative; because it directly influences the temperature radiation correction applied. This in turn impacts the RADAT and all Coded Messages. The Previous Temperature is the surface temperature 12 hours ago. The Previous Temperature is only required when the surface pressure is less than 1000 hPa (e.g. 998 hPa).

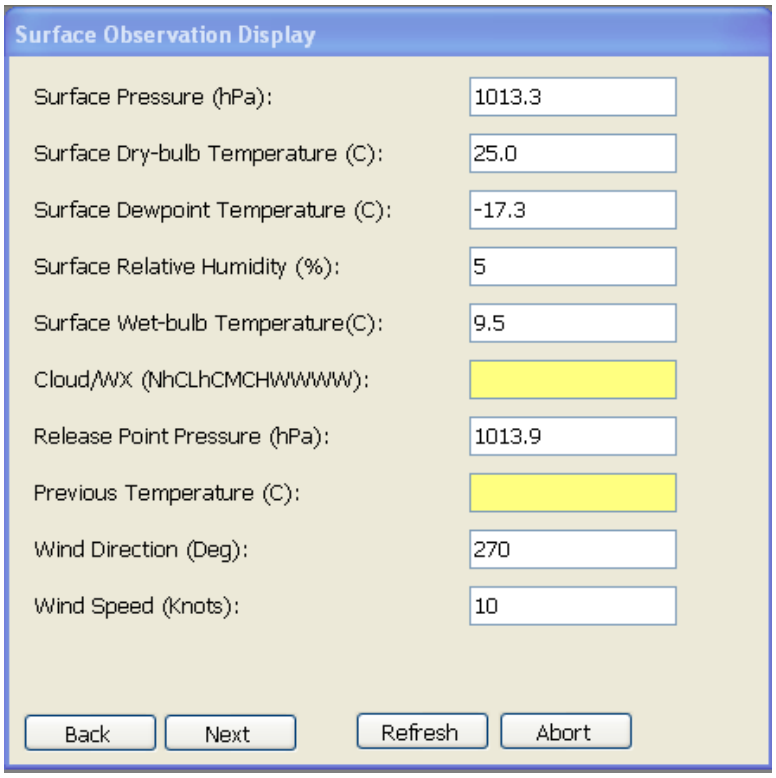


Exhibit 3-9 Surface Observation Display

13. During an actual flight, the radiosonde would now be prepared in accordance with the vendor instructions (See Appendix F).

IMPORTANT: Special attention should be paid to the wait times required during the preparation of the radiosonde.

14. Before clicking **Next** in the Surface Observation Display, it is important to tune and orientate the TRS. In the Antenna Orientation/TRS Display, position the antenna to the azimuth and elevation for radiosonde baseline. This is accomplished by entering the Desired Azimuth and Desired Elevation in the blocks and then clicking the **Move Antenna** button, or by using the *Slewing* arrows (Exhibits 3-10 and 3-11).

NOTE: 0 degrees azimuth is north.

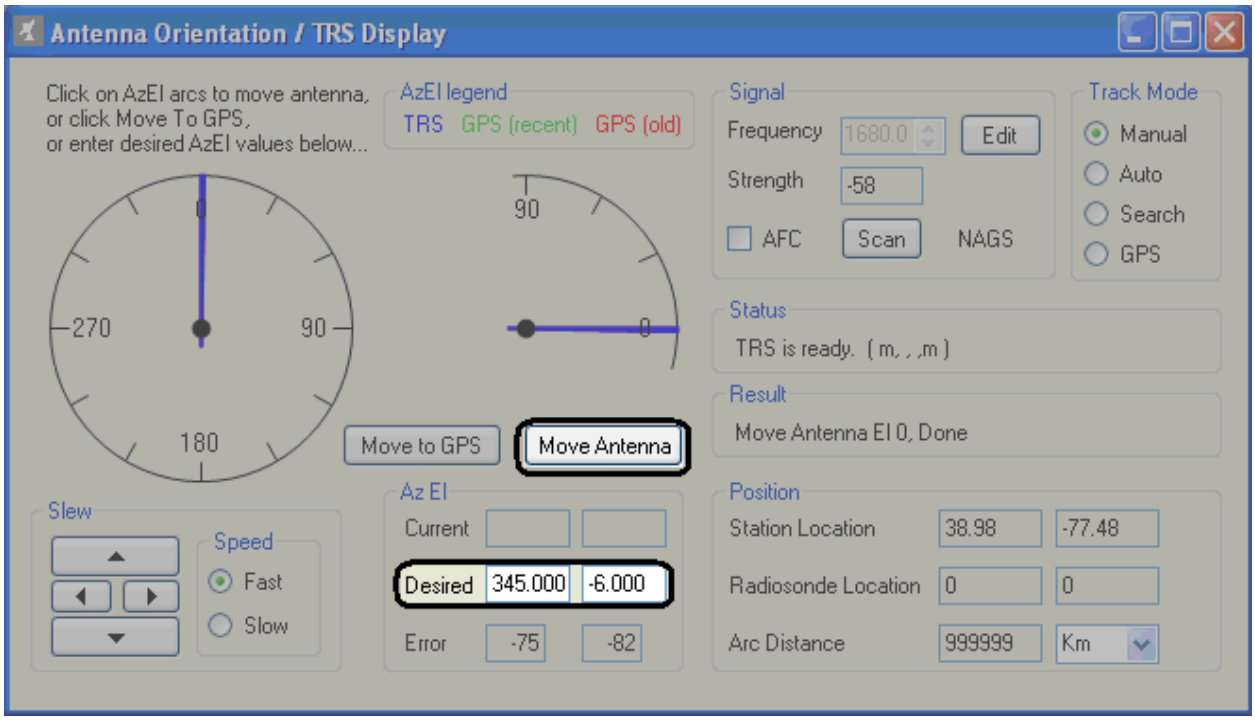


Exhibit 3-10 TRS Display

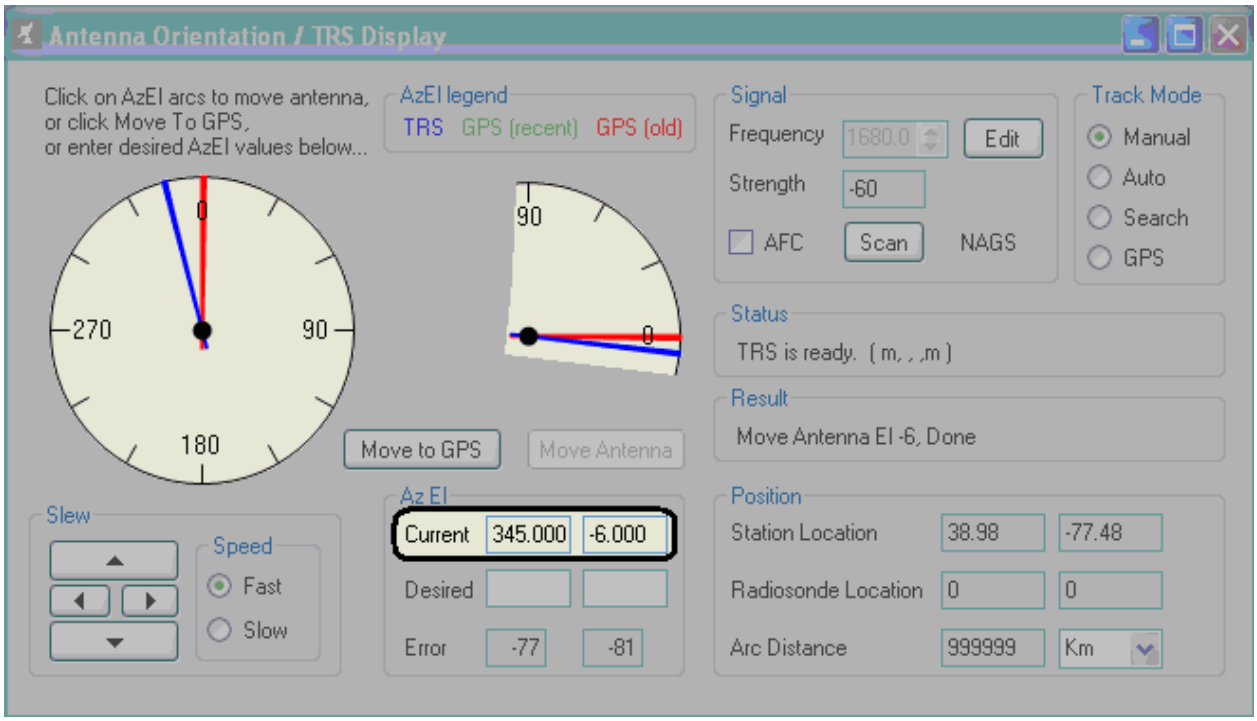


Exhibit 3-11 TRS pointed for baseline

15. The next step is to set the TRS frequency. There are 4 possible frequencies to choose from. They are 1676, 1678, 1680 and 1682 MHz. The TRS default frequency is 1680 MHz. During a simulated flight the frequency setting will not affect the data.

NOTE: Chapter 15 describes how RWS can be set to automatically change the TRS frequency to a predefined frequency.

16. To change the TRS frequency in the Antenna Orientation/TRS Display, click the **Edit** button to enable editing of the TRS frequency (Exhibit 3-12a). In the Frequency cell, type the desired frequency, and then click the **Set** button. (Exhibit 3-12b) Once the frequency is set, ensure the AFC box is checked (Exhibit 3-12c).

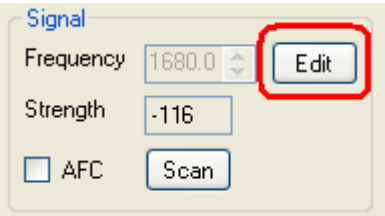


Exhibit 3-12a Edit Frequency

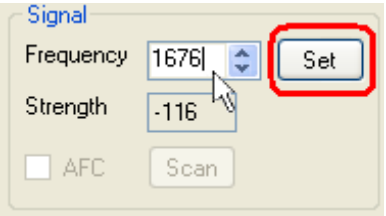


Exhibit 3-12b Entering Frequency

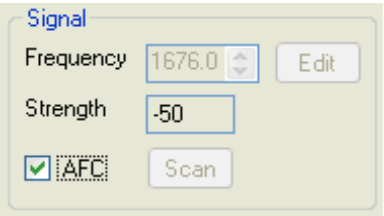


Exhibit 3-12c Frequency Set

NOTE: Do not use the <u>Scan</u> button if doing a second or third release. The receiver may lock-on to the previous radiosonde causing the invalid calibration data to be used.

17. Once the antenna has been positioned and the radiosonde signal acquired, click the **Next** button on the Surface Observation Display. (Exhibit 3-13)

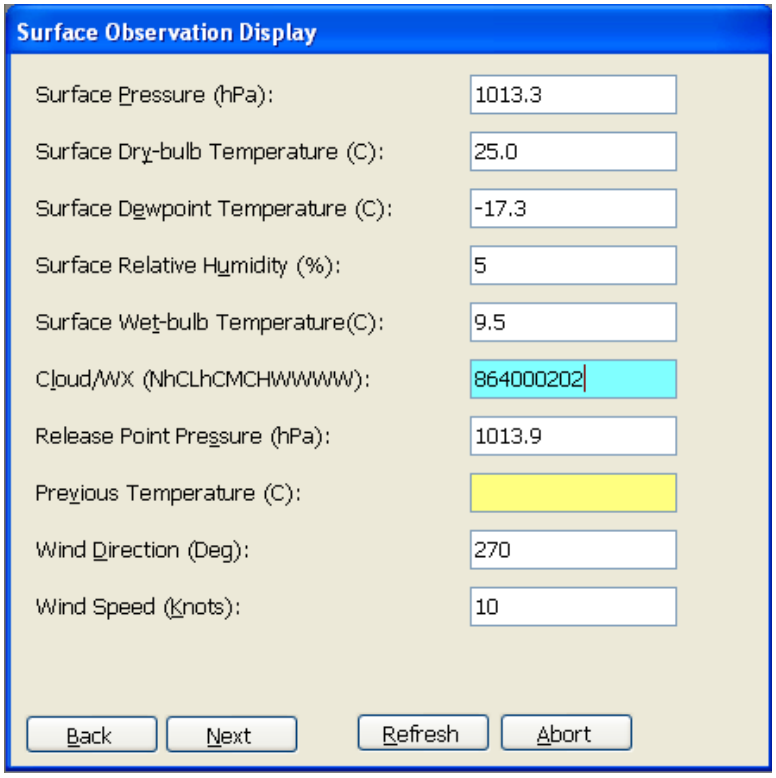


Exhibit 3-13 Surface Observation Display

18. The Baseline Display and the Waiting for SPS to Initialize windows appear (Exhibits 3-14 and 3-15). The Waiting for SPS to Initialize window will close once the SPS initializes and the Baseline Display will begin to be populated with data.

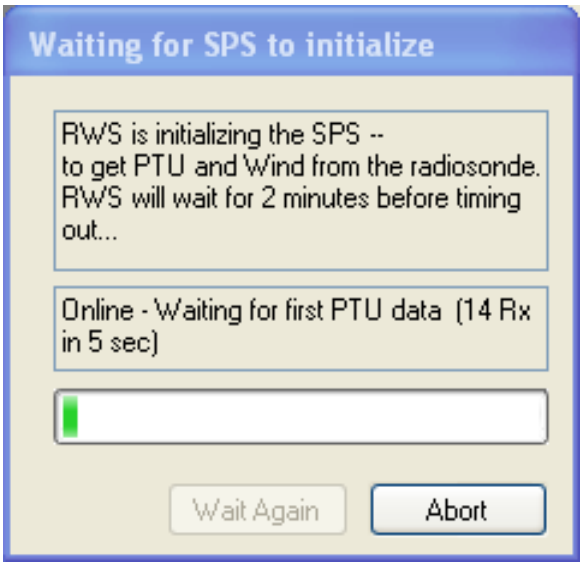
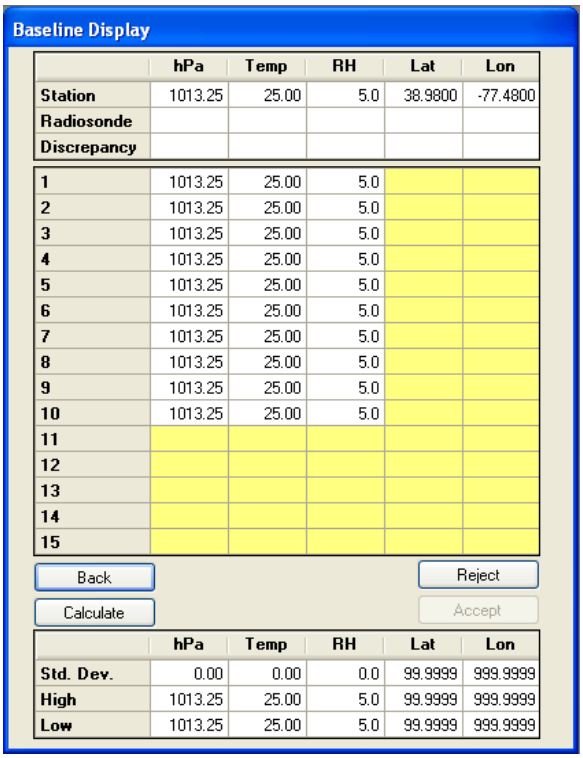


Exhibit 3-14 SPS Initialization



	hPa	Temp	RH	Lat	Lon
Station	1013.25	25.00	5.0	38.9800	-77.4800
Radiosonde					
Discrepancy					
1	1013.25	25.00	5.0		
2	1013.25	25.00	5.0		
3	1013.25	25.00	5.0		
4	1013.25	25.00	5.0		
5	1013.25	25.00	5.0		
6	1013.25	25.00	5.0		
7	1013.25	25.00	5.0		
8	1013.25	25.00	5.0		
9	1013.25	25.00	5.0		
10	1013.25	25.00	5.0		
11					
12					
13					
14					
15					

	hPa	Temp	RH	Lat	Lon
Std. Dev.	0.00	0.00	0.0	99.9999	999.9999
High	1013.25	25.00	5.0	99.9999	999.9999
Low	1013.25	25.00	5.0	99.9999	999.9999

Exhibit 3-15 Start of Baseline

19. The SPS Status Window indicates the SPS and GPS status and the number of satellites seen by the SPS and radiosonde (Exhibit 3-16). The circles next to the SPS and GPS indicate the status of PTU data and GPS/Wind data respectively. A red circle (or X) indicates no data, while a green circle (or checkmark) indicates data is being received.
20. The WPPS indicates the SPS' Winds and Position Processor Status. The WPPS will not display a status until the baseline process.
21. The number next to Radiosonde indicates the number of satellites seen by the Radiosonde. The number next to Base indicates the number of satellites seen by the SPS. The number next to Match indicates the number of satellites seen by both the Radiosonde and Base. The 32 grey cells will display the satellites for each and any matches.
22. During a Simulated flight, no GPS matches are shown in the SPS Status window. Typically expect to see at least 6 matches in this window during a live flight.

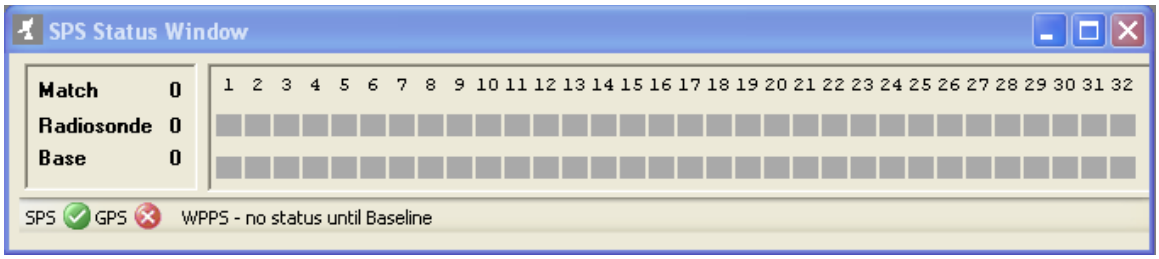
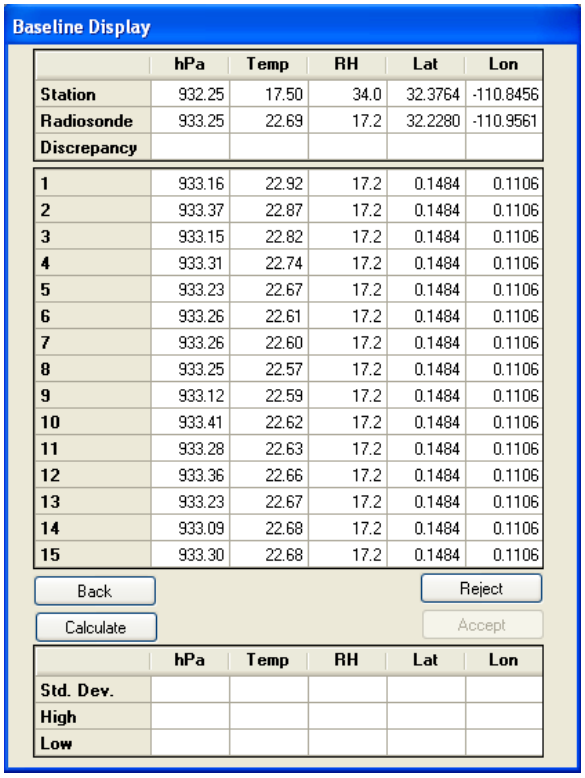


Exhibit 3-16 SPS Status Window

23. Once the PTU and GPS data have been received, wait 5 minutes before clicking the **Calculate** button (Exhibit 3-17). This will allow the data to stabilize and will increase the accuracy of the pressure discrepancy used for the pressure correction. The Pressure Discrepancy must be within the tolerance specified in Exhibit 4-18 and the Temp and RH values should be reasonably close to the office conditions (Exhibit 3-18). Remember, there may be a significant temperature and humidity difference between the surface sensors readings and the values inside the office where the instrument is located. If readings look reasonable, click the Accept button (Exhibit 3-18).

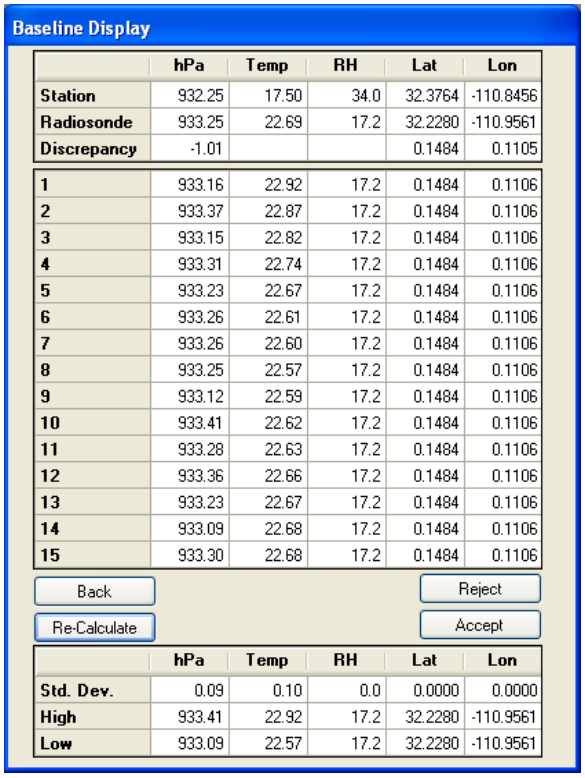
NOTE: Clicking the Calculate button will automatically update the surface observation pressure prior to calculating the baseline pressure discrepancy. If the PDB is not connected, the surface pressure must be re-entered in the surface observation.



	hPa	Temp	RH	Lat	Lon
Station	932.25	17.50	34.0	32.3764	-110.8456
Radiosonde	933.25	22.69	17.2	32.2280	-110.9561
Discrepancy					
1	933.16	22.92	17.2	0.1484	0.1106
2	933.37	22.87	17.2	0.1484	0.1106
3	933.15	22.82	17.2	0.1484	0.1106
4	933.31	22.74	17.2	0.1484	0.1106
5	933.23	22.67	17.2	0.1484	0.1106
6	933.26	22.61	17.2	0.1484	0.1106
7	933.26	22.60	17.2	0.1484	0.1106
8	933.25	22.57	17.2	0.1484	0.1106
9	933.12	22.59	17.2	0.1484	0.1106
10	933.41	22.62	17.2	0.1484	0.1106
11	933.28	22.63	17.2	0.1484	0.1106
12	933.36	22.66	17.2	0.1484	0.1106
13	933.23	22.67	17.2	0.1484	0.1106
14	933.09	22.68	17.2	0.1484	0.1106
15	933.30	22.68	17.2	0.1484	0.1106

	hPa	Temp	RH	Lat	Lon
Std. Dev.					
High					
Low					

Exhibit 3-17 Baseline Ready to Calculate



	hPa	Temp	RH	Lat	Lon
Station	932.25	17.50	34.0	32.3764	-110.8456
Radiosonde	933.25	22.69	17.2	32.2280	-110.9561
Discrepancy	-1.01			0.1484	0.1105
1	933.16	22.92	17.2	0.1484	0.1106
2	933.37	22.87	17.2	0.1484	0.1106
3	933.15	22.82	17.2	0.1484	0.1106
4	933.31	22.74	17.2	0.1484	0.1106
5	933.23	22.67	17.2	0.1484	0.1106
6	933.26	22.61	17.2	0.1484	0.1106
7	933.26	22.60	17.2	0.1484	0.1106
8	933.25	22.57	17.2	0.1484	0.1106
9	933.12	22.59	17.2	0.1484	0.1106
10	933.41	22.62	17.2	0.1484	0.1106
11	933.28	22.63	17.2	0.1484	0.1106
12	933.36	22.66	17.2	0.1484	0.1106
13	933.23	22.67	17.2	0.1484	0.1106
14	933.09	22.68	17.2	0.1484	0.1106
15	933.30	22.68	17.2	0.1484	0.1106

	hPa	Temp	RH	Lat	Lon
Std. Dev.	0.09	0.10	0.0	0.0000	0.0000
High	933.41	22.92	17.2	32.2280	-110.9561
Low	933.09	22.57	17.2	32.2280	-110.9561

Exhibit 3-18 Baseline Calculated

NOTE: The values displayed in the Baseline Lat & Long columns are not actual locations, but are differences between the station location and radiosonde location.

24. Once the baseline has been accepted, a window will appear asking if you would like to continue. Click the **Yes** button (Exhibit 3-19).

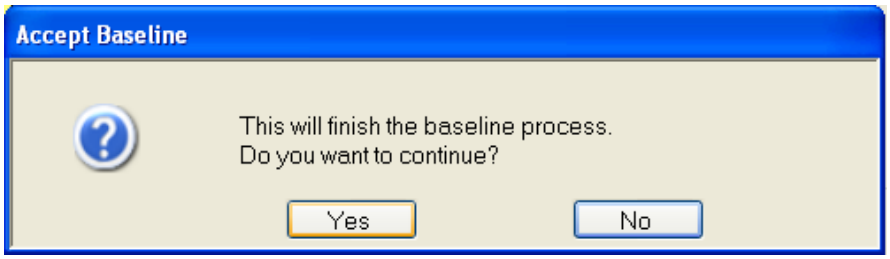


Exhibit 3-19 Accept Baseline

25. Shortly thereafter the *Waiting for Balloon Release Display* appears (Exhibit 3-21).
26. After Baseline is concluded, the observer should monitor the raw data in the Waiting for Balloon Release Display or the *Status Bar* at the bottom of the screen (Exhibits 3-20 and 3-21) to ensure the radiosonde sensors are working properly prior to leaving the office to go to the inflation building.

Exhibit 3-20 Status Bar with Current Radiosonde PTU Values

NOTE: During a live flight, the TRS Antenna would be positioned to face the direction the balloon is expected to travel. The motors should be left in *Manual track mode* until the instrument is released.

27. In an actual flight, RWS automatically detects release. In the simulated flight, start the flight by clicking on the Icon with the Yellow Balloon (Exhibit 3-22). The *Waiting for Balloon Release Display* will indicate that the release was detected.

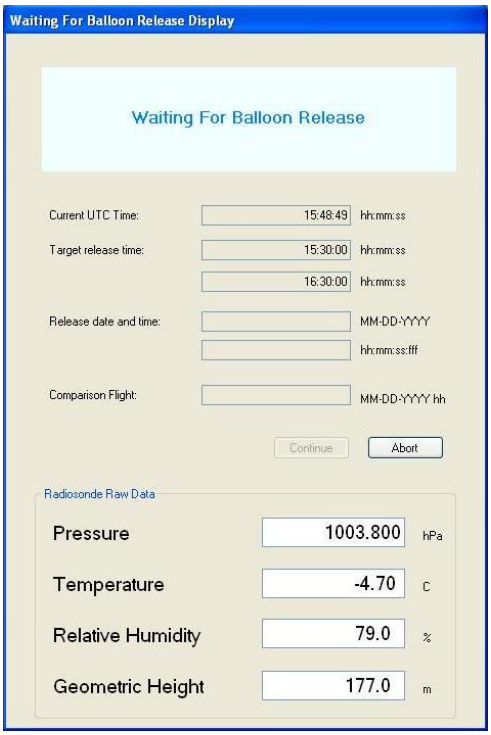


Exhibit 3-21 Waiting for Balloon Release

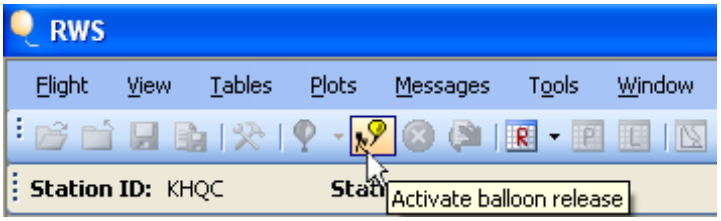


Exhibit 3-22 Simulate Release

28. Once the balloon release is detected, click the **Continue** button to move forward into the flight (Exhibit 3-23).

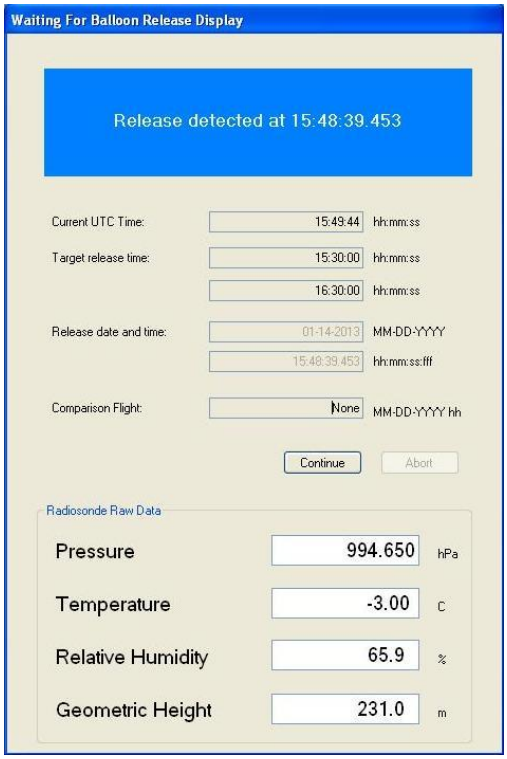


Exhibit 3-23 Release Detected

3.2 In-Flight Procedures

Once the radiosonde has been launched the in-flight procedures can be divided into several main areas:

- Post release Surface Observation
- TRS Tracking
- Flight Release Detection
- Data transition from surface into flight
- Checking/Marking flight data
- Transmitting coded messages

It is important to remember there are four basic operator tasks to ensure data quality. They should normally be performed in order to ensure changes are saved.

1) Validate Surface Observation
2) Verify Release Point was selected correctly
3) Mark Data if needed.
4) Validate Termination Time and Reason.

1. The Surface Observation Display will appear after clicking the **Continue** button in the Waiting for Balloon Release Display (Exhibit 3-23). The Surface Observation Display contains the surface observation (RSOIS/PDB data). RWS uses the release surface observation data as the first data point of the sounding. The operator may edit any block of the release surface observation except the calculated Release Point Pressure. Clicking **OK** will place the changes in the release surface observation into the data shown at release or at 0.0 minutes (elapsed time) of the flight.

NOTE: Recheck the Cloud Data for accuracy. The Solar Radiation Temperature Correction is derived from the Cloud Data. It significantly impacts the RADAT and Coded Messages.

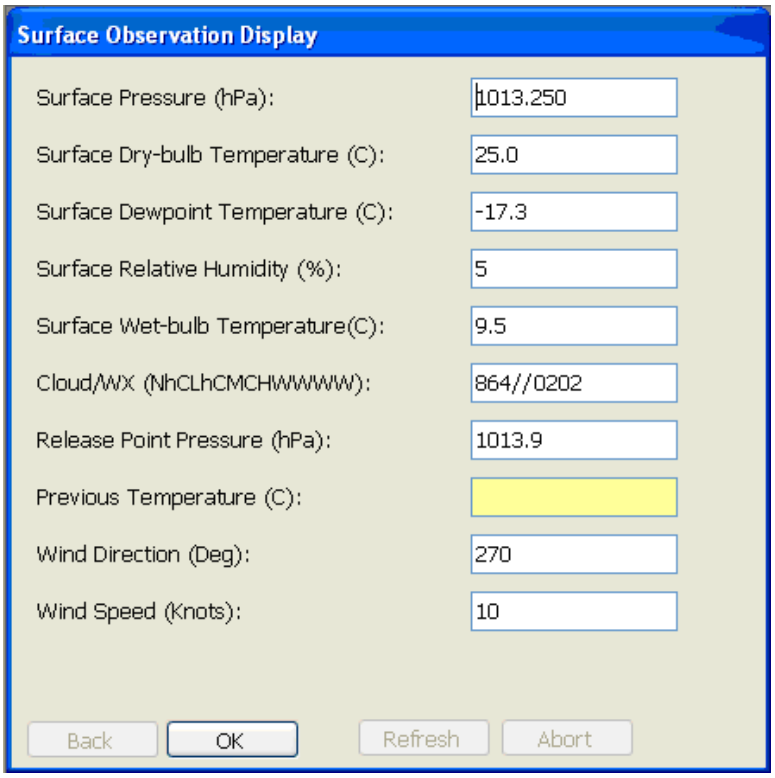


Exhibit 3-24 Surface Observation

2. The Status Message Display will record the time release was detected (Exhibit 3-25).

Exhibit 3-25 Balloon Release Detected

3. After release, it can take up to 90 seconds for the *Processed Tabular Display* to become available. During this time, a limited amount of tables are available. Once the *Processed Tabular Display* appears, all the tables and plots are available. There are a few windows which are preferable to open after release to ensure the flight is proceeding and to make any necessary adjustments (Exhibit 3-26). These include:
   - TRS Display
   - Raw PTU Tabular Display
   - Processed Tabular Display
   - Processed Bar

NOTE: Displays and plots can be viewed simultaneously by selecting <u>Tile</u> under the Window pull-down menu.

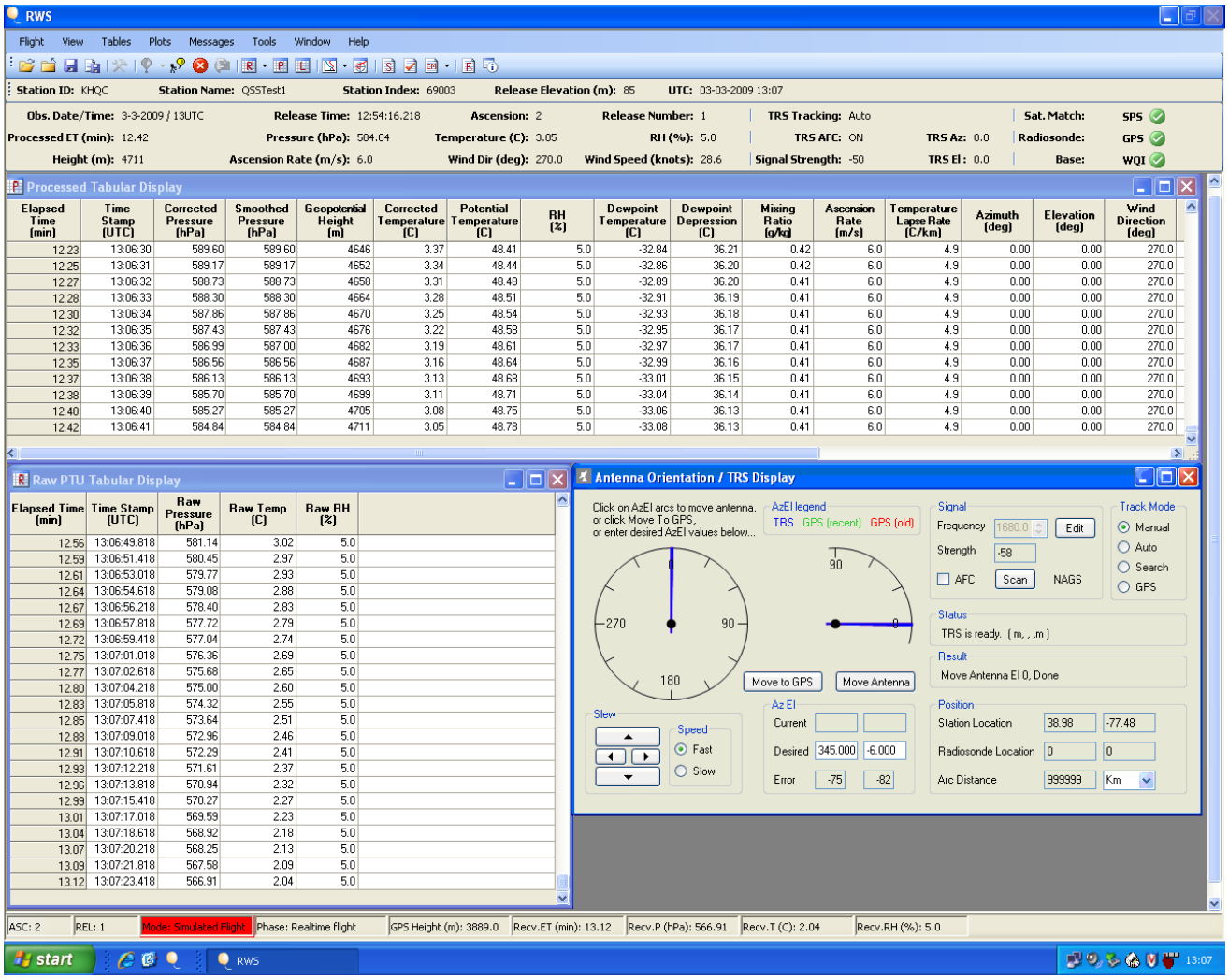


Exhibit 3-26 Initial Displays and Plots to View after Release

NOTE: The WQI circle on the right side of the Processed Bar is the overall Wind Quality Indicator.

4. The *TRS Display* is the most essential display to first view (Exhibit 3-27). This display allows the operator to verify that the TRS is tracking and if necessary take corrective action. Appendix E of NWS Manual 10-1401 provides guidance in TRS tracking.

NOTE: To prevent missing data or a failed flight, it is critical that the operator ensures in RWS that the TRS is tracking the radiosonde. Section 4.7 provides more information.

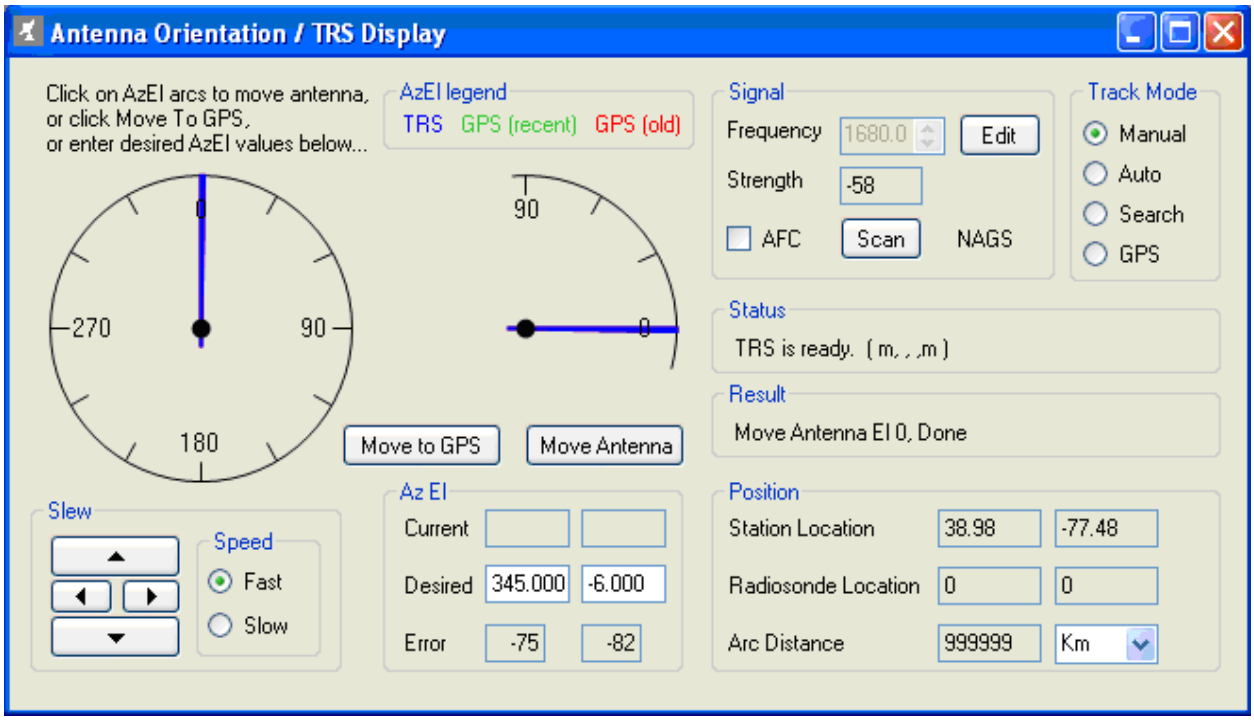


Exhibit 3-27 Antenna Orientation/TRS Display

5. Validating the release point is typically the second task that the operator should perform after release. Even though the software detects release it is critical that the observer verify that RWS selected the correct release point. Use the Raw PTU Tabular Display and Processed Tabular Display to determine if RWS detected release correctly (Exhibits 3-28 and 3-29).
6. In the Raw PTU Tabular Display, the release detection is indicated by a green line above elapsed time 0.00. The pressure data above the green line should be relatively constant (preflight) and the pressure data below the green line should show decreasing pressure (flight).
7. In the Processed Tabular Display, the first data point (0.00) is the surface observation and the second data point (0.02) and subsequent are the data from the radiosonde. See Chapter 5 for more details on adjusting the release time.

Raw PTU Tabular Display

Elapsed Time (min)	Time Stamp (UTC)	Raw Pressure (hPa)	Raw Temp (C)	Raw RH (%)
-0.26	18:13:49.581	1,013.25	25.00	5.0
-0.23	18:13:51.181	1,013.25	25.00	5.0
-0.20	18:13:52.781	1,013.25	25.00	5.0
-0.18	18:13:54.381	1,013.25	25.00	5.0
-0.15	18:13:55.981	1,013.25	25.00	5.0
-0.12	18:13:57.581	1,013.25	25.00	5.0
-0.10	18:13:59.181	1,013.25	25.00	5.0
-0.07	18:14:00.781	1,013.25	25.00	5.0
-0.04	18:14:02.381	1,013.25	25.00	5.0
-0.02	18:14:03.981	1,013.25	25.00	5.0
0.00	18:14:04.978	1,013.25	25.00	5.0
0.03	18:14:06.578	1,012.05	24.95	5.0
0.05	18:14:08.178	1,010.86	24.91	5.0
0.08	18:14:09.778	1,009.67	24.86	5.0
0.11	18:14:11.378	1,008.48	24.81	5.0
0.13	18:14:12.978	1,007.29	24.77	5.0
0.16	18:14:14.578	1,006.10	24.72	5.0
0.19	18:14:16.178	1,004.91	24.67	5.0
0.21	18:14:17.778	1,003.73	24.63	5.0
0.24	18:14:19.378	1,002.54	24.58	5.0

Exhibit 3-28 Raw PTU Tabular Data at Release

Processed Tabular Display

Elapsed Time (min)	Time Stamp (UTC)	Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)
0.00	18:14:05	1013.85	1013.85	85	25.00	23.83	5.0
0.02	18:14:06	1012.50	1012.71	95	24.91	23.84	5.0
0.03	18:14:07	1011.75	1011.90	102	24.88	23.88	5.0
0.05	18:14:08	1011.01	1011.12	109	24.85	23.91	5.0
0.07	18:14:09	1010.26	1010.34	115	24.82	23.95	5.0
0.08	18:14:10	1009.52	1009.57	122	24.80	23.99	5.0
0.10	18:14:11	1008.78	1008.77	129	24.77	24.02	5.0
0.12	18:14:12	1008.03	1008.03	135	24.74	24.06	5.0
0.13	18:14:13	1007.29	1007.29	142	24.71	24.09	5.0
0.15	18:14:14	1006.55	1006.55	148	24.68	24.12	5.0
0.17	18:14:15	1005.80	1005.80	155	24.65	24.16	5.0
0.18	18:14:16	1005.06	1005.06	161	24.62	24.19	5.0
0.20	18:14:17	1004.32	1004.32	167	24.59	24.22	5.0
0.22	18:14:18	1003.58	1003.58	174	24.56	24.26	5.0
0.23	18:14:19	1002.84	1002.84	180	24.53	24.29	5.0
0.25	18:14:20	1002.10	1002.10	187	24.50	24.32	5.0
0.27	18:14:21	1001.36	1001.36	193	24.47	24.36	5.0
0.28	18:14:22	1000.62	1000.62	200	24.44	24.39	5.0
0.30	18:14:23	999.88	999.88	206	24.42	24.43	5.0

Exhibit 3-29 Processed Tables at Release

8. The Processed Bar automatically appears after release (Exhibit 3-30). The Processed Bar provides the most recent processed data, TRS status and GPS status. The GPS Status in Exhibit 3-30 shows the number of satellites seen by the Radiosonde, the number of satellites seen by the SPS (Base) and the number of satellites seen by both (Sat. Match). In order for GPS winds to be calculated, there must be at least 4 satellites matches between the SPS (Base) and the Radiosonde. During a simulated flight, this window may show no matches. In a live flight, typically 4 – 10 matches can be expected.

Exhibit 3-30 Processed Bar

NOTE: Green √ SPS Icon indicates PTU Data being received
Green √ GPS Icon indicates Wind Data being received

9. The easiest method to monitor flight data is to use the plots. The Skew-T Plot displays temperature, dew point and wind barbs (Exhibit 3-31A). The Flight Monitor Plot displays pressure, temperature, dew point, relative humidity and winds barbs (Exhibit 3-31B). Any abrupt deviation in the profile lines should be reviewed. If the data is erroneous, the operator must go in and Mark the data in question. The data can be Marked using the Processed Tabular Display or the plots. See Chapters 5 and 9 for more details for Marking data.

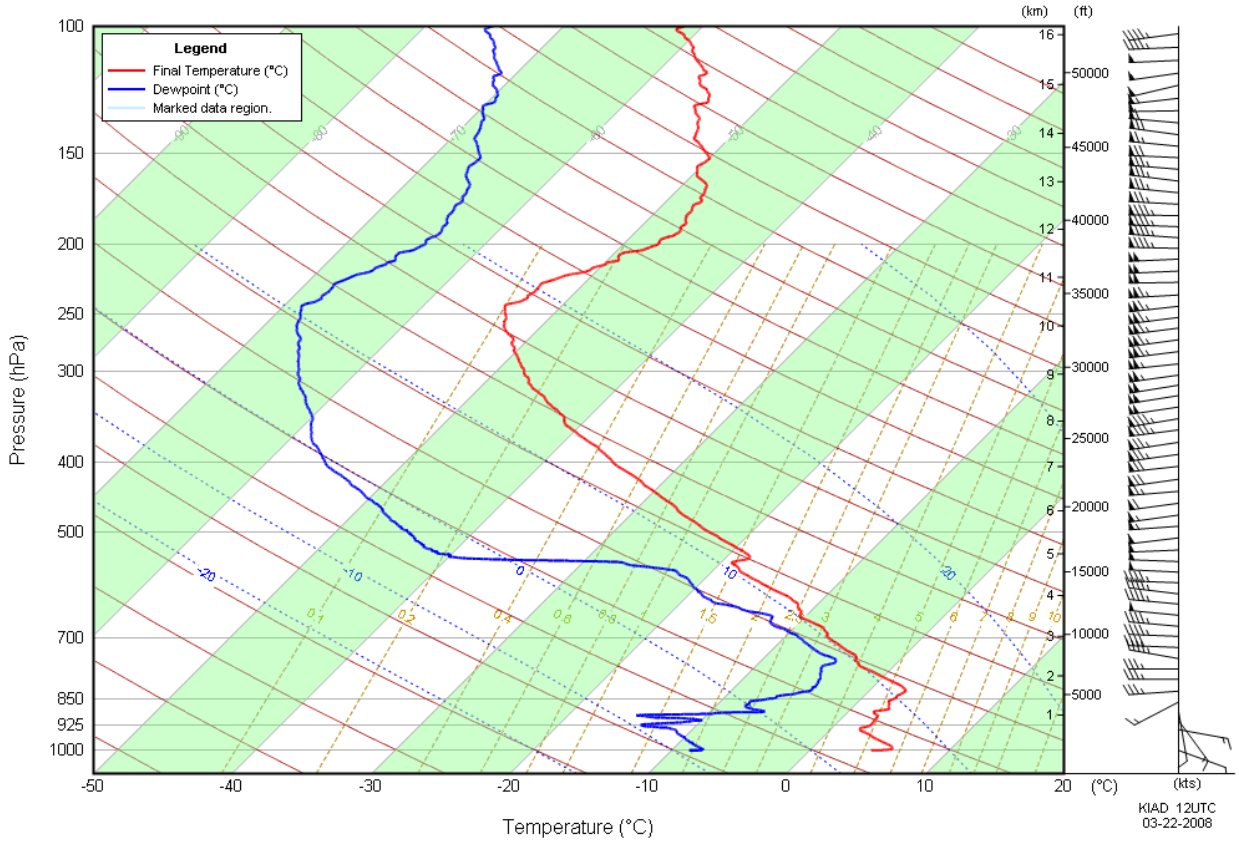


Exhibit 3-31A Skew-T Plot

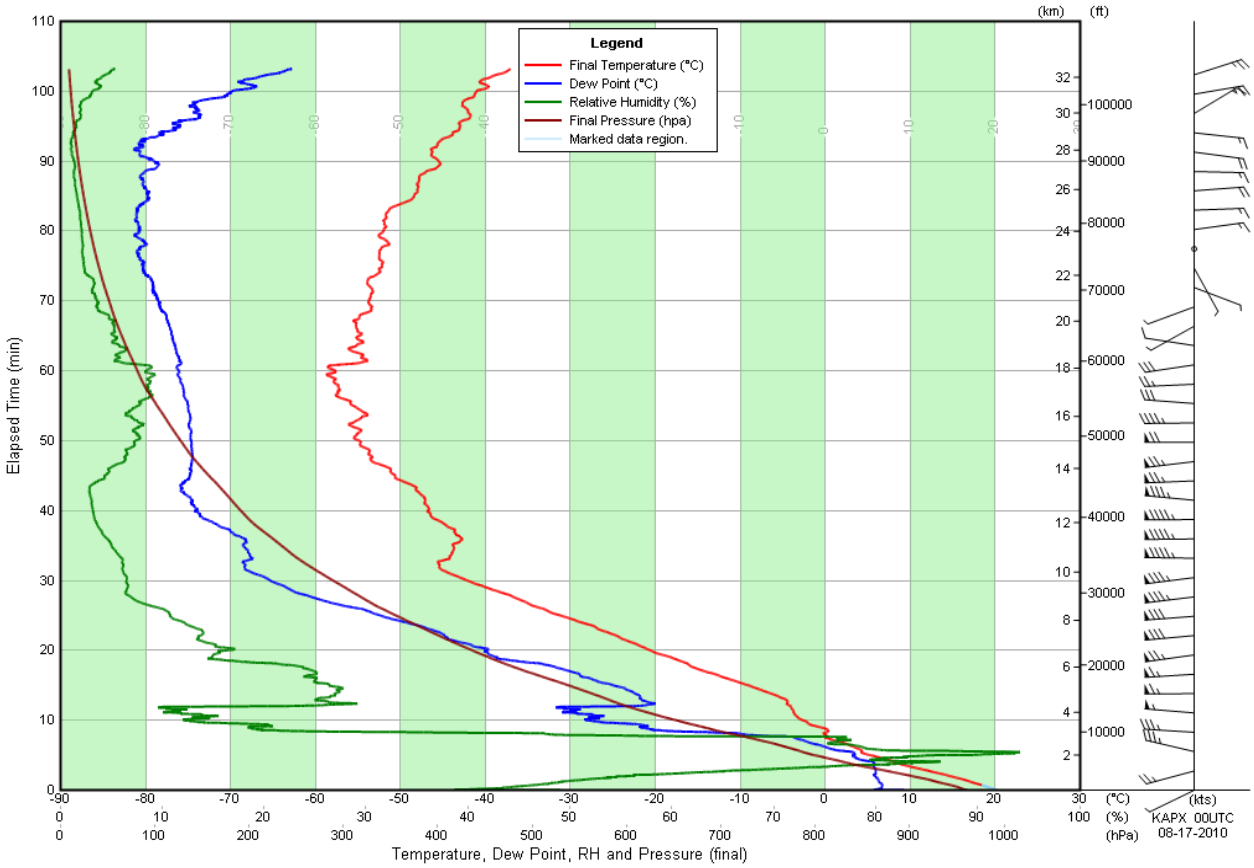


Exhibit 3-31B Flight Monitor Plot

10. If there is questionable data or possibly bad data a closer look is desired. To zoom in on an area, click and hold the left mouse button, while dragging over the area of interest (Exhibit 3-32). The plot will then zoom to the desired area (Exhibit 3-33). See Chapters 8 and 9 for more details on using the plots.

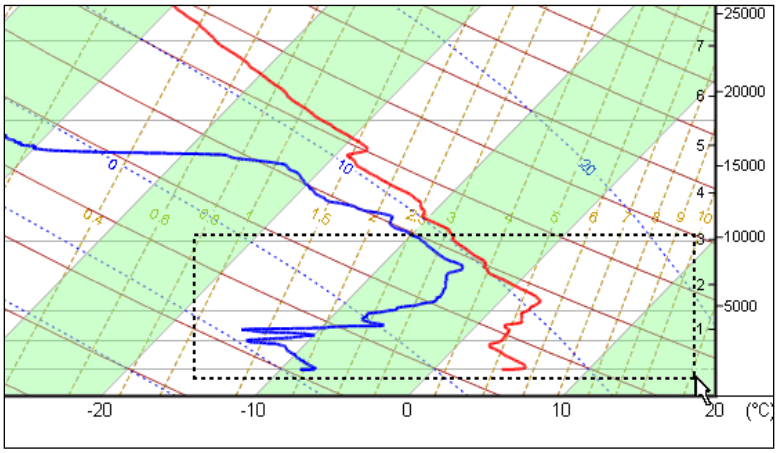


Exhibit 3-32 Zooming in on plot

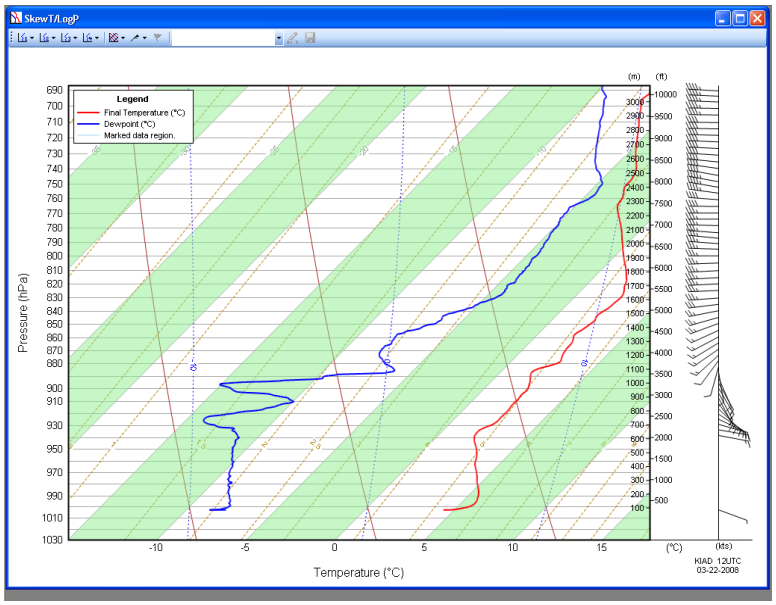
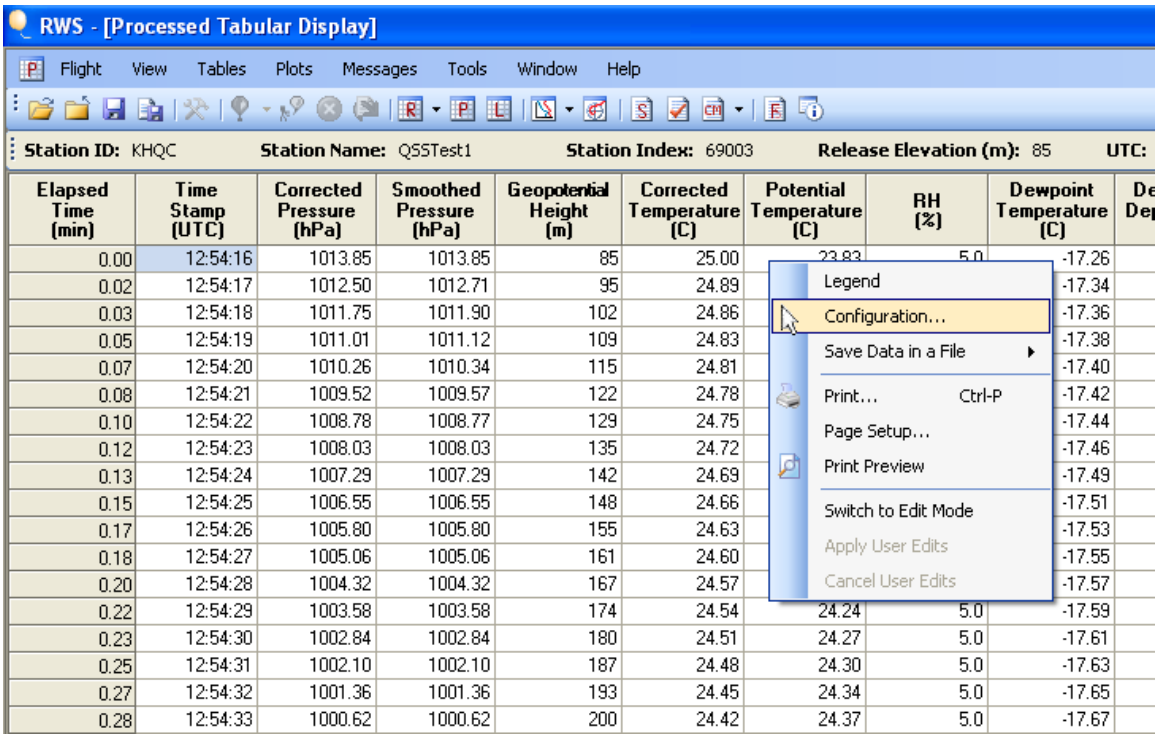


Exhibit 3-33 Zoomed plot

11. Looking at the Processed Tabular Display is the next step after viewing a plot and finding data that may need attention. The Processed Tabular Display can be opened by clicking **Processed** under the Tables pull-down menu.
12. The Processed Tabular Display may be configured to show only certain parameters and also have the data points spaced at a greater time interval than 1 per second. Move the cursor inside the Processed Tabular Display and right click and select Configuration. Using Configuration to hide certain columns can make quality control and data editing an easier task. (Exhibit 3-34 and Exhibit 3-35).

NOTE: Data cannot be "Marked" in data intervals greater than 1 second.



Elapsed Time (min)	Time Stamp (UTC)	Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)	Dewpoint Temperature (C)	De Dep
0.00	12:54:16	1013.85	1013.85	85	25.00	23.83	5.0	-17.26	
0.02	12:54:17	1012.50	1012.71	95	24.89			-17.34	
0.03	12:54:18	1011.75	1011.90	102	24.86			-17.36	
0.05	12:54:19	1011.01	1011.12	109	24.83			-17.38	
0.07	12:54:20	1010.26	1010.34	115	24.81			-17.40	
0.08	12:54:21	1009.52	1009.57	122	24.78			-17.42	
0.10	12:54:22	1008.78	1008.77	129	24.75			-17.44	
0.12	12:54:23	1008.03	1008.03	135	24.72			-17.46	
0.13	12:54:24	1007.29	1007.29	142	24.69			-17.49	
0.15	12:54:25	1006.55	1006.55	148	24.66			-17.51	
0.17	12:54:26	1005.80	1005.80	155	24.63			-17.53	
0.18	12:54:27	1005.06	1005.06	161	24.60			-17.55	
0.20	12:54:28	1004.32	1004.32	167	24.57			-17.57	
0.22	12:54:29	1003.58	1003.58	174	24.54	24.24	5.0	-17.59	
0.23	12:54:30	1002.84	1002.84	180	24.51	24.27	5.0	-17.61	
0.25	12:54:31	1002.10	1002.10	187	24.48	24.30	5.0	-17.63	
0.27	12:54:32	1001.36	1001.36	193	24.45	24.34	5.0	-17.65	
0.28	12:54:33	1000.62	1000.62	200	24.42	24.37	5.0	-17.67	

Exhibit 3-34 Configuring Processed Tabular Display

- Elapsed Time
- Time Stamp
- Corrected Pressure
- Smoothed Pressure (Editable)
- Geopotential Height
- Corrected Temperature (Editable)
- Potential Temperature
- RH (Editable)
- Dewpoint Temperature
- Dewpoint Depression
- Mixing Ratio
- Ascension Rate
- Temperature Lapse Rate
- Azimuth
- Elevation
- Wind Direction
- Wind Speed
- Wind U Component (Editable)
- Wind V Component (Editable)
- Radiosonde Latitude (Editable)
- Radiosonde Longitude (Editable)
- Geometric Height
- Arc Distance

The column titles underlined above are considered essential to taking timely corrective action during a flight.

Exhibit 3-35 Processed Tabular Display columns

13. Marking data requires the Processed Tabular Display be switched to Edit Mode. To switch to Edit Mode, right click in the Processed Tabular Display and select **Switch to Edit Mode** from the menu (Exhibit 3-36).

14. To Mark data, left click in an editable column and drag over the data cells in which changes are desired. The cells marked will change background color to blue (Exhibit 3-37). To apply the user edits, right click in the Processed Tabular Display and select **Apply User Edits** (Exhibit 3-38). Once the User Edits are applied, the Marked cells will have a blue background (Exhibit 3-39).

NOTE: Data Marked for less than a minute will be interpolated. If a minute or more of Temperature or RH data is Marked, the data will be Marked rejected (red background) and not used.

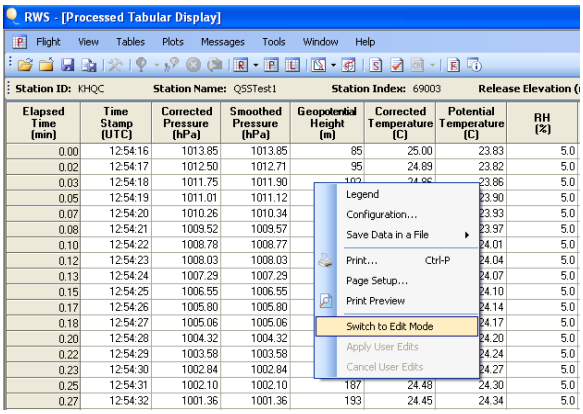


Exhibit 3-36 Switch to Edit Mode

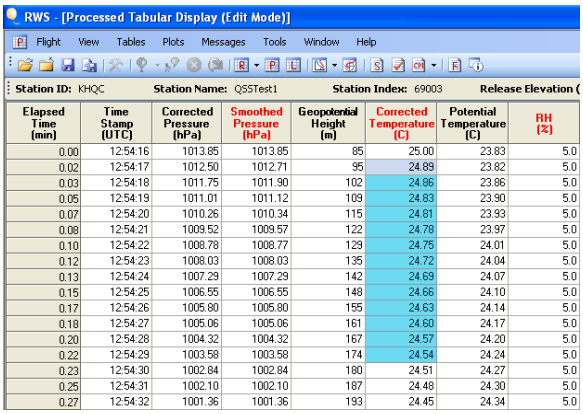


Exhibit 3-37 Highlighting cells

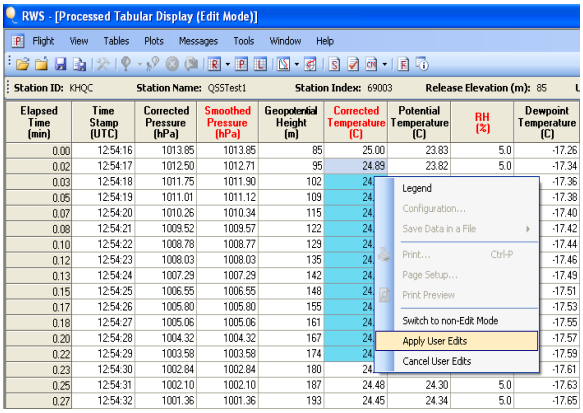


Exhibit 3-38 Applying User Edits

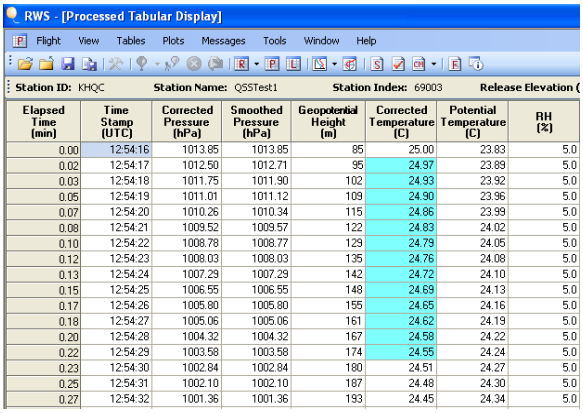


Exhibit 3-39 Marked Data

15. To Unmark data, left click and drag over the data cells in which changes are desired. The cells Unmarked will change background color to white. Then click on **Apply User Edits**. See Chapters 5 and 13 for more details on Marking data.

NOTE: Marking data should be done after verifying the Surface Observation and Release Point. This is the 3rd operator task typically performed. All data Marking will be lost if the Surface Observation or Release Point is changed after Marking data.

NOTE: When more than 1 minute is marked, the plotted and tabular data will be missing. However, missing data will not be reflected in the coded messages until the missing data is > 20 hPa thick of PTU or > 1500 meters thick of winds data.

16. Besides using the plot displays, the Check and Status Messages may provide assistance in finding areas of the flight that have questionable or bad data. The Check Messages are designed to alert the operator of unusual or abnormal flight occurrences (Exhibit 3-40).
17. The Check and Status Messages however do not catch all flight problems and the operator must use these alerts in conjunction with the plots and other tools to monitor the flight. See Chapter 6 for more details on Check and Status Messages.

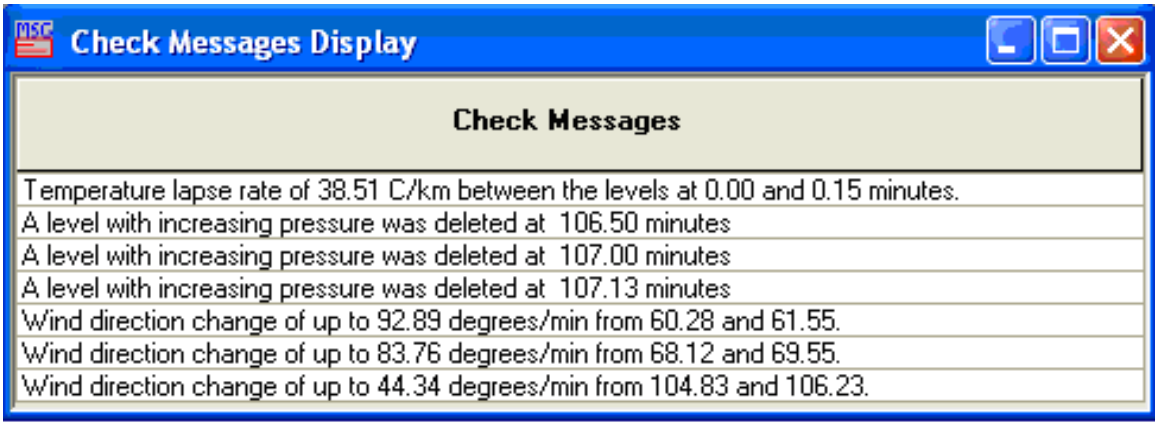
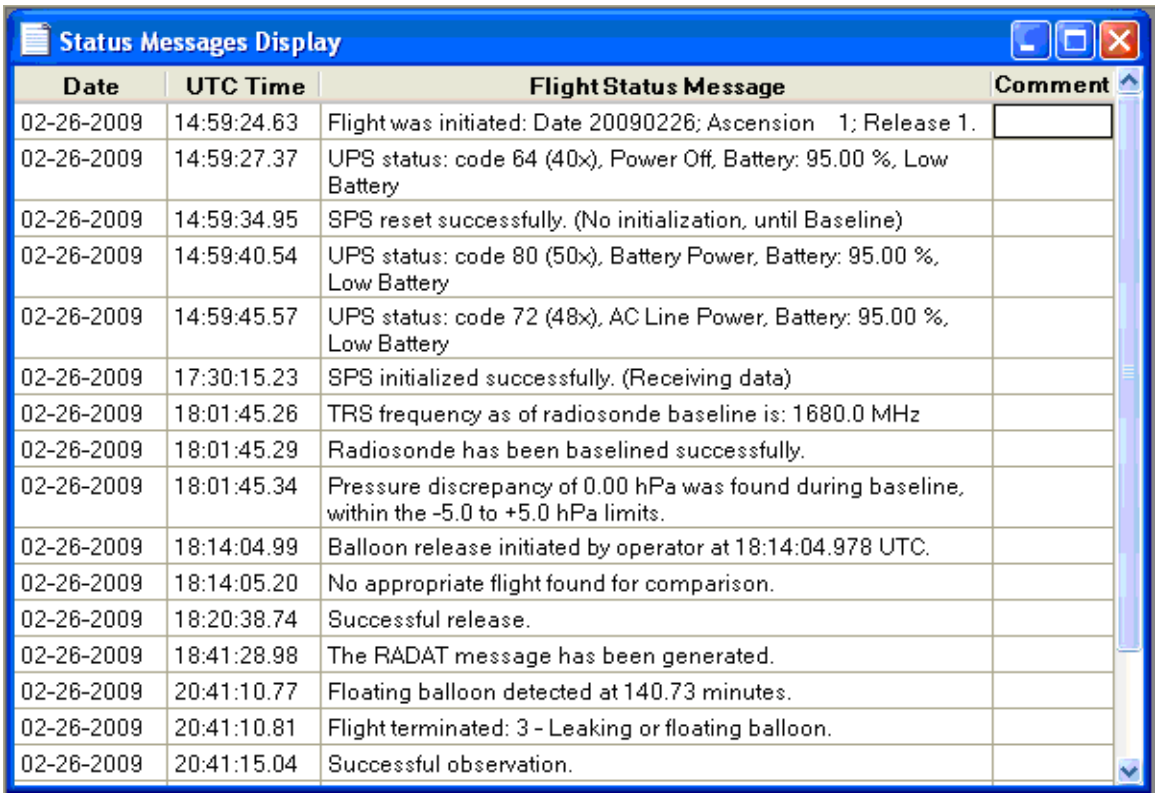


Exhibit 3-40 Check Messages

18. Status Messages provide information on flight events (Exhibit 3-41). There are some Status Messages such as Balloon Descending and Re-ascending messages that alert the observer that a closer look at the data is required to determine if some data must be edited or marked.



Status Messages Display

Date	UTC Time	Flight Status Message	Comment
02-26-2009	14:59:24.63	Flight was initiated: Date 20090226; Ascension 1; Release 1.	
02-26-2009	14:59:27.37	UPS status: code 64 (40x), Power Off, Battery: 95.00 %, Low Battery	
02-26-2009	14:59:34.95	SPS reset successfully. (No initialization, until Baseline)	
02-26-2009	14:59:40.54	UPS status: code 80 (50x), Battery Power, Battery: 95.00 %, Low Battery	
02-26-2009	14:59:45.57	UPS status: code 72 (48x), AC Line Power, Battery: 95.00 %, Low Battery	
02-26-2009	17:30:15.23	SPS initialized successfully. (Receiving data)	
02-26-2009	18:01:45.26	TRS frequency as of radiosonde baseline is: 1680.0 MHz	
02-26-2009	18:01:45.29	Radiosonde has been baselined successfully.	
02-26-2009	18:01:45.34	Pressure discrepancy of 0.00 hPa was found during baseline, within the -5.0 to +5.0 hPa limits.	
02-26-2009	18:14:04.99	Balloon release initiated by operator at 18:14:04.978 UTC.	
02-26-2009	18:14:05.20	No appropriate flight found for comparison.	
02-26-2009	18:20:38.74	Successful release.	
02-26-2009	18:41:28.98	The RADAT message has been generated.	
02-26-2009	20:41:10.77	Floating balloon detected at 140.73 minutes.	
02-26-2009	20:41:10.81	Flight terminated: 3 - Leaking or floating balloon.	
02-26-2009	20:41:15.04	Successful observation.	

Exhibit 3-41 Status Messages

19. The Coded Messages and RADAT are automatically coded at 400 hPa for RADAT, 70 hPa for TTAA, TTBB, and PPBB Messages and at Flight Termination for TTCC, TTDD, and PPDD. The observer can also initiate the **Code** command at anytime during the flight by selecting **Code** under the **Messages** pull-down menu.

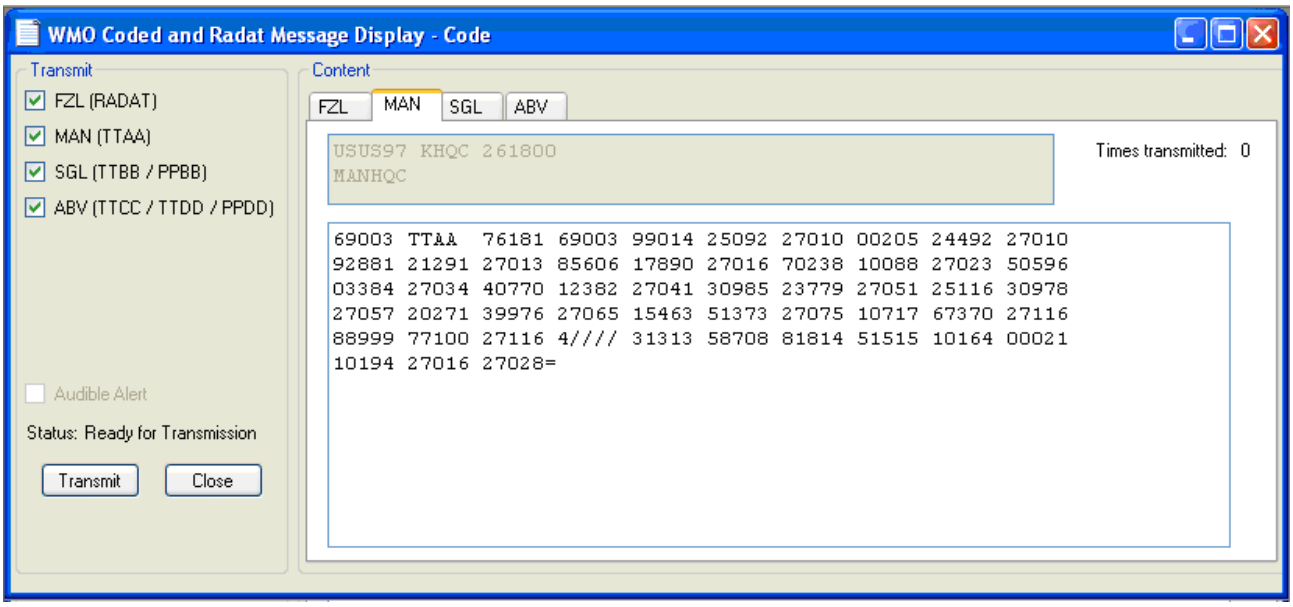


Exhibit 3-42 Coded Messages

20. The FZL, MAN (TTAA), SIG (TTBB and PPBB), and the ABV (TTCC, TTDD, and PPDD) are available in WMO Coded Message Display (Exhibit 3-42). During a simulated flight, WMO message transmission is not available. Exhibit 3-43 shows examples of partial MAN and SIG messages. Chapter 10 provides more detailed information on groups within the coded messages.

```
69003 TTAA  74014 69003 99022 24056 00000 00269 22458 12503
92941 16439 12007 85656 12458 10004 70255 05699 01014 50592
11577 05523 40759 24778 06029 88999 77999 31313 08708 80031
51515 10159 10164 00007 10194 11005 01008=

69003 TTBB  74010 69003 00022 24056 11018 23861 22974 20050
33919 15831 44918 15831 55861 13058 66860 13058 77838 11457
88831 11057 99823 10244 11799 08428 22796 08225 33791 08456
44778 08059 55776 07859 66753 05659 77733 03656 88722 04471
99715 05071 11712 05489 22711 05695 33709 05699 44700 05499
55674 04099 66659 02676 77654 02276 88643 02499 99640 02499
11622 00890 22611 00276 33609 00076 44569 04774 55563 04974
66540 06777 31313 08708 80031 41414 00900 51515 10159=

PPBB  74010 69003 90012 00000 12502 10506 90346 12007 11507
08505 90789 00507 34511 36012 91123 01014 35517 35512 91468
04520 04021 03022 919// 06024 92012 04523 04530 06528 925//
06530=
```

Exhibit 3-43 Partial MAN and SIG Coded Messages

21. The Trajectory Plot is a plot of the radiosonde position in relation to the TRS using the radiosonde GPS data (Exhibit 3-44). It can be useful in aligning the TRS azimuth with the radiosonde position. Since this plot is created from GPS data it will be blank when the GPS data is missing.

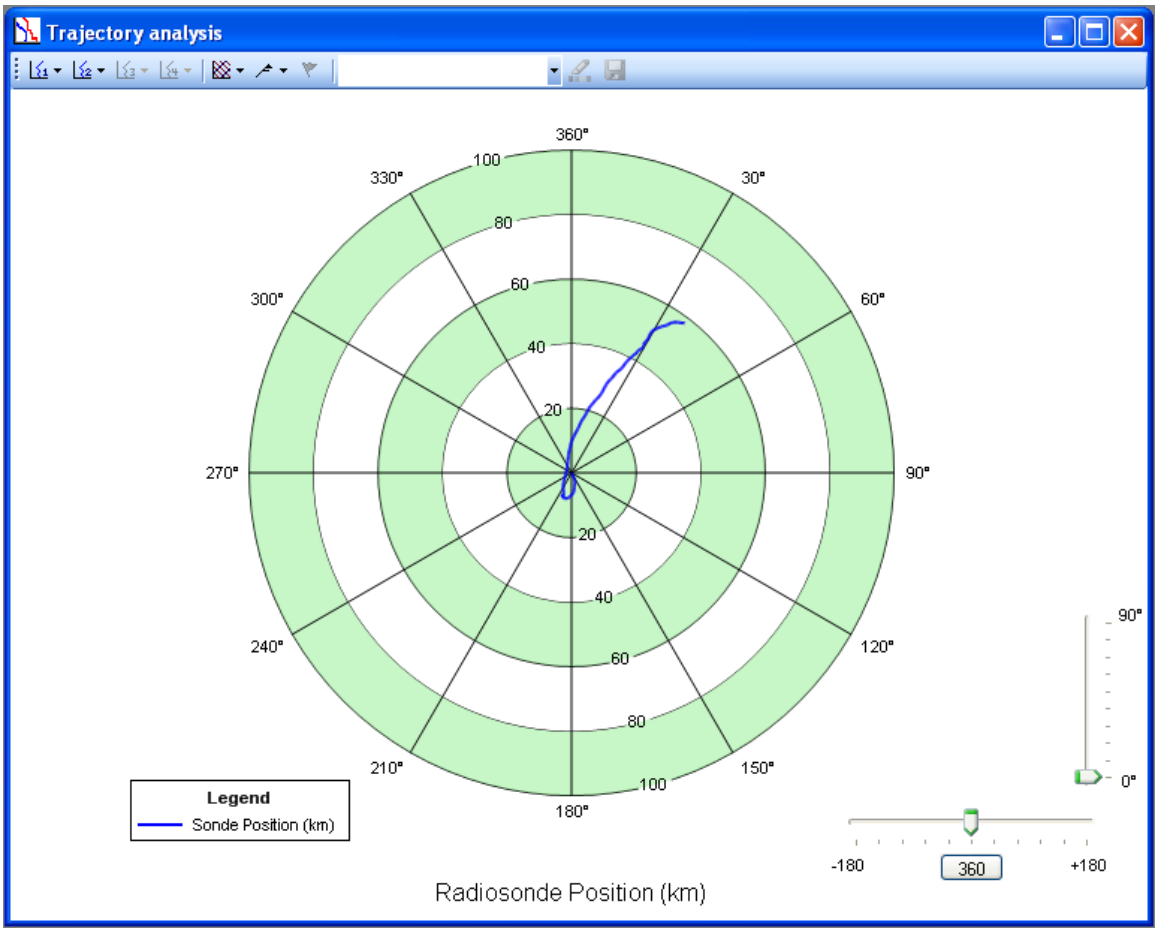
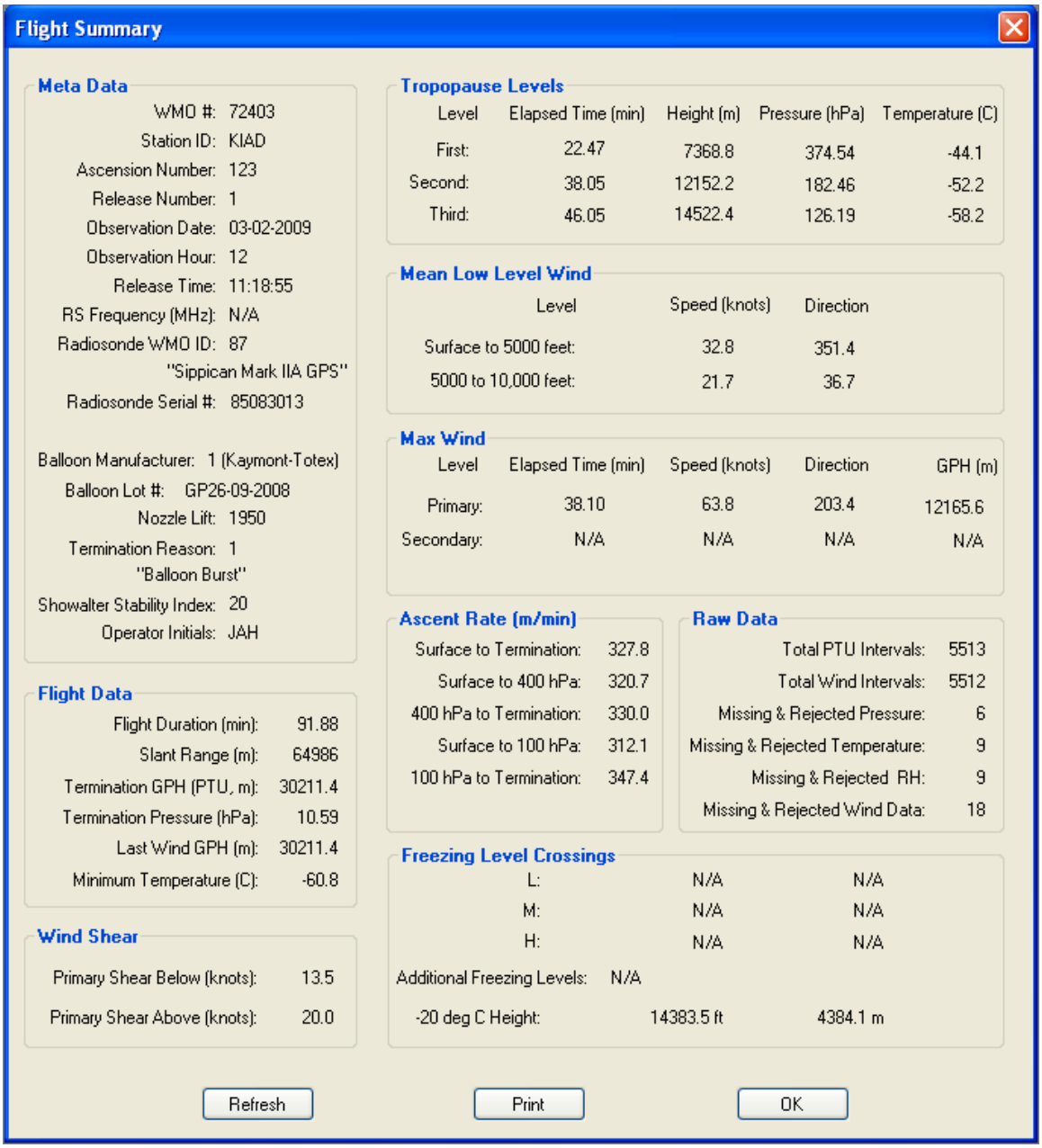


Exhibit 3-44 Trajectory Plot

22. Another valuable tool for gathering flight information during and after the flight is concluded is the Flight Summary. To open the Flight Summary click on the **View** pull-down menu and select **Flight Summary** (Exhibit 3-45).



Flight Summary

Meta Data

WMO #:	72403
Station ID:	KIAD
Ascension Number:	123
Release Number:	1
Observation Date:	03-02-2009
Observation Hour:	12
Release Time:	11:18:55
RS Frequency (MHz):	N/A
Radiosonde WMO ID:	87
	"Sippican Mark IIA GPS"
Radiosonde Serial #:	85083013
Balloon Manufacturer:	1 (Kaymont-Totex)
Balloon Lot #:	GP26-09-2008
Nozzle Lift:	1950
Termination Reason:	1
	"Balloon Burst"
Showalter Stability Index:	20
Operator Initials:	JAH

Flight Data

Flight Duration (min):	91.88
Slant Range (m):	64986
Termination GPH (PTU, m):	30211.4
Termination Pressure (hPa):	10.59
Last Wind GPH (m):	30211.4
Minimum Temperature (C):	-60.8

Wind Shear

Primary Shear Below (knots):	13.5
Primary Shear Above (knots):	20.0

Tropopause Levels

Level	Elapsed Time (min)	Height (m)	Pressure (hPa)	Temperature (C)
First:	22.47	7368.8	374.54	-44.1
Second:	38.05	12152.2	182.46	-52.2
Third:	46.05	14522.4	126.19	-58.2

Mean Low Level Wind

Level	Speed (knots)	Direction
Surface to 5000 feet:	32.8	351.4
5000 to 10,000 feet:	21.7	36.7

Max Wind

Level	Elapsed Time (min)	Speed (knots)	Direction	GPH (m)
Primary:	38.10	63.8	203.4	12165.6
Secondary:	N/A	N/A	N/A	N/A

Ascent Rate (m/min)

Surface to Termination:	327.8
Surface to 400 hPa:	320.7
400 hPa to Termination:	330.0
Surface to 100 hPa:	312.1
100 hPa to Termination:	347.4

Raw Data

Total PTU Intervals:	5513
Total Wind Intervals:	5512
Missing & Rejected Pressure:	6
Missing & Rejected Temperature:	9
Missing & Rejected RH:	9
Missing & Rejected Wind Data:	18

Freezing Level Crossings

L:	N/A	N/A
M:	N/A	N/A
H:	N/A	N/A
Additional Freezing Levels:	N/A	
-20 deg C Height:	14383.5 ft	4384.1 m

Refresh Print OK

Exhibit 3-45 Flight Summary Displays

23. For convenience, RWS allows operators to save the arrangement of the currently open windows, known as a workspace. Several workspaces can be saved for use during various portions of the flight. Experiment with the windows and their options, as well as the *Tile* and *Cascade* functions to create useful workspace. To save the workspace, click **Save Workspace** from the **Flight** pull-down menu (Exhibit 3-46).

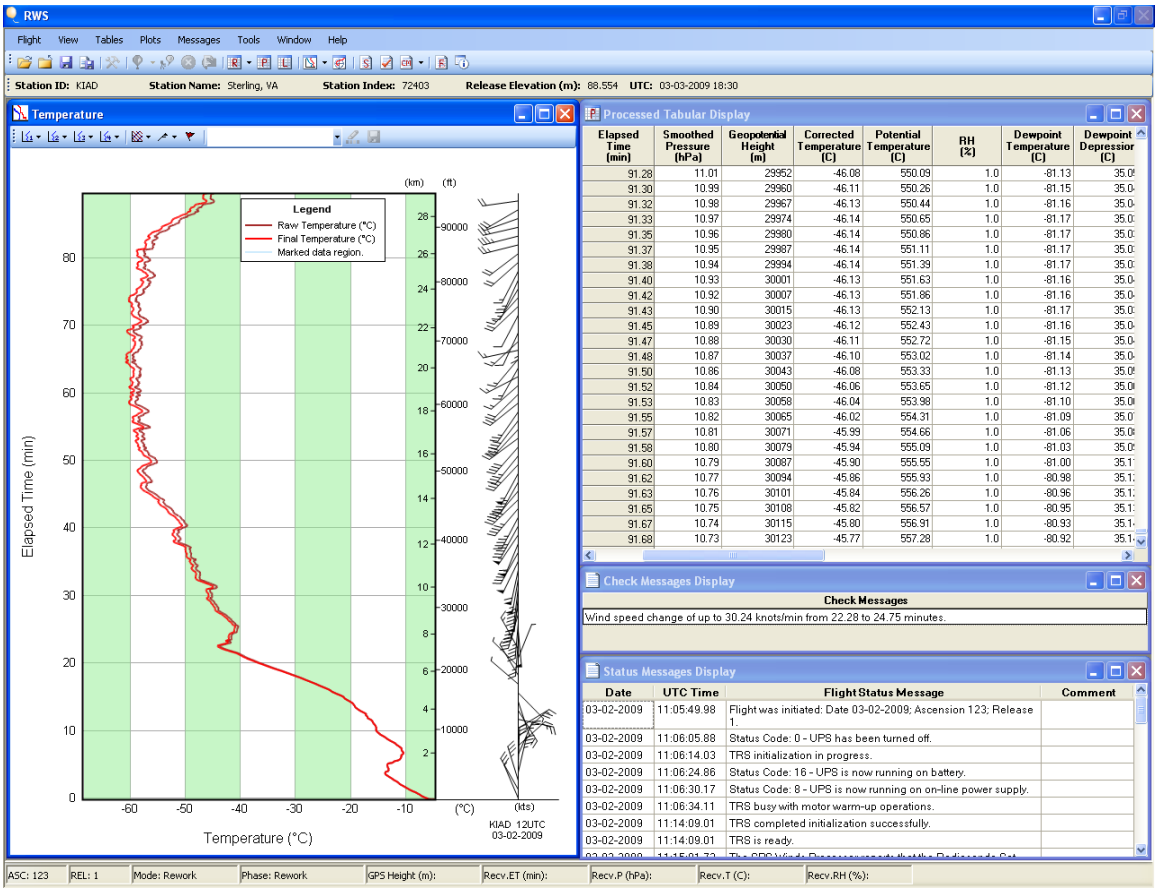


Exhibit 3-46 Tiled Displays and Plots Selected by Observer

3.3 Flight Termination

RWS will automatically detect termination and assign a reason for termination. The operator may also manually terminate the flight prior to the automatic termination. Once the flight is terminated, the operator should review and change, if necessary, the point of termination and the termination reason. To change the termination time or reason, select **Termination Time** or **Termination Reason** from the **Tools** pull-down menu. Validating the Termination Time and Reason is the final major operator task that should normally be performed. Chapter 11 contains more information on flight termination.

NOTE: The observer may not change the termination time later than the time determined by the software.

NOTE: Data Marked within 3 minutes of the termination point is lost if the Termination Time is changed.

4 RRS Observation-Preflight / Release Sequence

This chapter describes the prerelease sequence of a RRS upper air observation. The prerelease sequence consists of six steps:

1. Powering on the TRS
2. Preparing Balloon and Flight Train during TRS warm-up
3. Preparing the Radiosonde
4. Completing the Preflight
5. Baselining the Radiosonde
6. Launching the Balloon

The sections in this chapter describe these steps in detail.

The standard times for scheduled synoptic observations are 00:00 and 12:00 UTC. Release times should be scheduled as close as conditions permit to 23:00 UTC and 11:00 UTC, but not earlier. On rare occasions synoptic observations may be released early (before 23:00 or 11:00) as directed by the office Lead Forecaster or NCEP SDM. See Chapter 13, Section 13.1, for more information.

Delayed synoptic releases often occur owing to bad weather, radiosonde or ground equipment problems or when a 2nd release is required. Releases may be made after the standard times of observation, but no later than 00:29 UTC and 12:29 UTC. This schedule ensures the upper air data are available to initialize numerical weather prediction models and other NWS operational products.

Special soundings taken at 06:00 and 18:00 should be released between 05:00 to 06:29 UTC and 1700 to 18:29 UTC. For all other Special observation times, the release window, in regard to the recorded time of the observation, is from 30 minutes before to 29 minutes after the hour of assigned observation time. Ex: release at 02:31 UTC would be for the 03:00 UTC observation, a launch at 1510 UTC would be for the 15:00 UTC observation.

4.1 Turning on Power to the TRS

NOTE: It is recommended, that observers log on to the RWS Workstation at least 10 minutes ahead of running the RWS Software to allow Windows Startup and Updates to stabilize before flight. See Section 17.5 for more information.

1. Log onto the RRS workstation using your individual Username and Password.

2. Double click the RWS Icon on the desktop.
3. The RWS Window will appear with the Security Warning message. Read the message and click on the **OK** button. Respond to any other RWS pop-ups (i.e. No Data).
4. The Flight Options Window appears. Select **Run a live flight**.
5. To power on the TRS, the observer should click **Yes** button in the prompt to power on the UPS. The UPS provides uninterrupted power to the TRS & SPS.
6. Once the UPS has been powered on, multiple Status messages will appear. The Hardware Status display will indicate a green check mark for the UPS after it is powered on.

   The normal UPS Status Message sequence is (Exhibit 4-1):
   1. **UPS status: code…, Power Off**. (Indicates the UPS is off).
   2. **UPS status: code…, Battery Power.** (Indicates the UPS battery is powering the TRS).
   3. **UPS status: code…, AC Line Power.** (Indicates AC line power supply is powering the TRS)

Status Messages Display

Date	UTC Time	Flight Status Message
02-26-2009	14:59:24.63	Flight was initiated: Date 20090226; Ascension 1; Release 1.
02-26-2009	14:59:27.37	UPS status: code 64 (40x) Power Off, Battery: 95.00 %, Low Battery
02-26-2009	14:59:34.95	SPS reset successfully. (No initialization, until Baseline)
02-26-2009	14:59:40.54	UPS status: code 80 (50x) Battery Power, Battery: 95.00 %, Low Battery
02-26-2009	14:59:45.57	UPS status: code 72 (48x) AC Line Power, Battery: 95.00 %, Low Battery

Exhibit 4-1 UPS Status Messages

7. After the UPS is powered on, the TRS may perform both Motor Warm-Up Operations and an Initialization or simply just an Initialization, depending on the ambient temperature. The TRS Display, Status Messages and Hardware Status will indicate which process the TRS is performing (Exhibits 4-2 through 4-5a-b). The Hardware Status and TRS Display will indicate either:

   - TRS reset warm-up in progress. (Usually performed before initialization in ambient temperatures below 50°F)

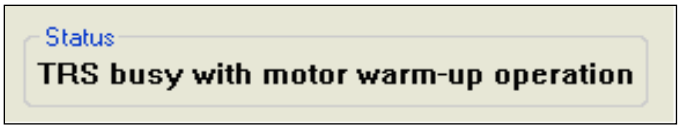


Exhibit 4-2 TRS Display Status: Motor Warm-Up

   - TRS reset initialization in progress. (Always performed before a flight)

Exhibit 4-3 TRS Display Status: Initialization

- TRS is Ready. (When the initialization has completed)

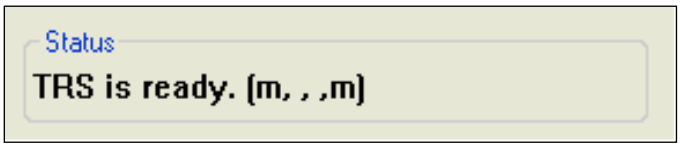


Exhibit 4-4 TRS Display Status: TRS Ready

Status Messages Display

Date	UTC Time	Flight Status Message
03-02-2009	11:05:49.98	Flight was initiated: Date 03-02-2009; Ascension 123; Release 1.
03-02-2009	11:06:05.88	Status Code: 0 - UPS has been turned off.
03-02-2009	11:06:24.86	Status Code: 16 - UPS is now running on battery.
03-02-2009	11:06:30.17	Status Code: 8 - UPS is now running on on-line power supply.
03-02-2009	11:06:34.11	TRS busy with motor warm-up operations.
03-02-2009	11:14:09.01	TRS completed initialization successfully.
03-02-2009	11:14:09.01	TRS is ready.

Exhibit 4-5a Status Messages of TRS warm-up and initialization

8. Once the TRS completes warm-up/initialization, the Hardware Status display will indicate a green check mark for the TRS (Exhibit 4-5b)

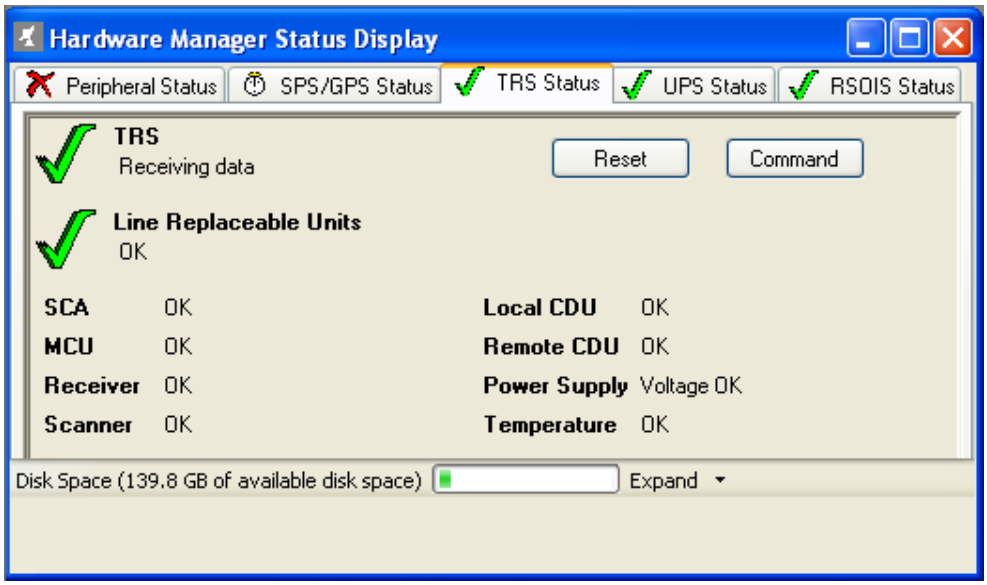


Exhibit 4-5b TRS Display Status: Motor Warm-Up

NOTE: The TRS equipment should be turned on at least 30 minutes before baseline. This time allows for the longer motor-up necessary in colder temperatures. In some cases, the motor warm-up operations and the initialization can take longer than 20 minutes to complete. The warm-up begins after the UPS is turned on.

NOTE: During TRS motor warm-up is a convenient time for the observer to prepare the balloon and flight train.

4.2 Preparing Balloon and Flight Train during TRS warm-up

Prepare balloon and flight train in accordance with NWS Manual 10-1401 Appendix D: Pre-Observation Preparations

4.3 Preparing the Radiosonde

Prepare radiosonde and battery in accordance with Appendix F: Radiosonde Preparation Instructions.

4.4 Completing the Preflight Information

The preflight information includes administrative information, flight equipment information and surface weather.

1. Once the TRS Display indicates the TRS is ready (Exhibit 4-4), move the antenna to the radiosonde baseline position using the TRS Display in both the azimuth and elevation before

filling in the Administrative Data Display (Exhibit 4-6 and 4-7). This verifies the TRS did successfully complete initialization.

NOTE: If the TRS will not move in either the Azimuth and/or Elevation, reset the TRS in the Hardware Status Window. Then reattempt moving the TRS after it completes initialization.

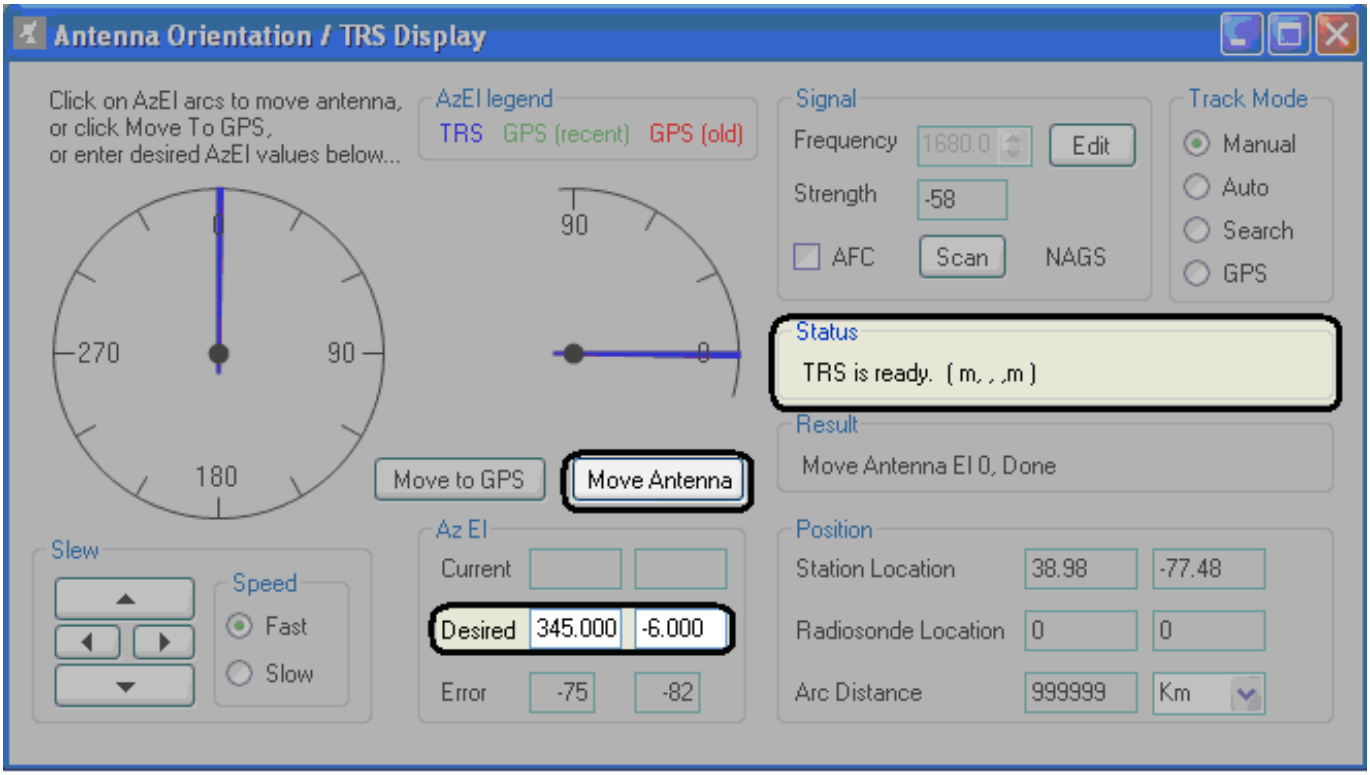


Exhibit 4-6 TRS Display

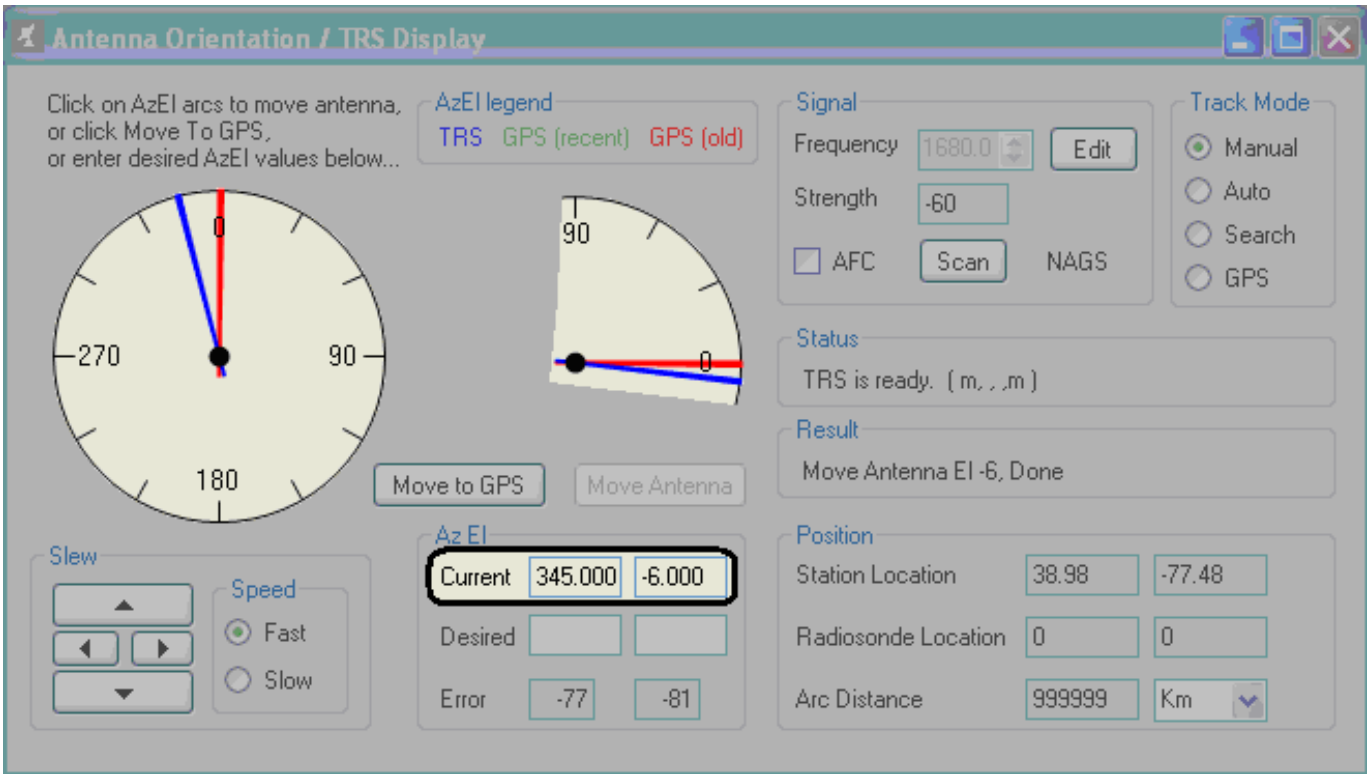


Exhibit 4-7 TRS pointed for baseline

NOTE: The TRS does not require a preflight antenna alignment. The equipment should start with the antenna pointing North and at 0 degrees elevation. If it does not, review Appendix D and advise maintenance staff.

NOTE: The Desired Azimuth and Desired Elevation fields are grayed out until the TRS has initialized. The Status on the TRS display will indicate the current step in the startup process.

2. The Administrative Data Display cells for Date and Time are set automatically from the workstation date and time (Exhibit 4-8). This time is updated automatically by Windows.

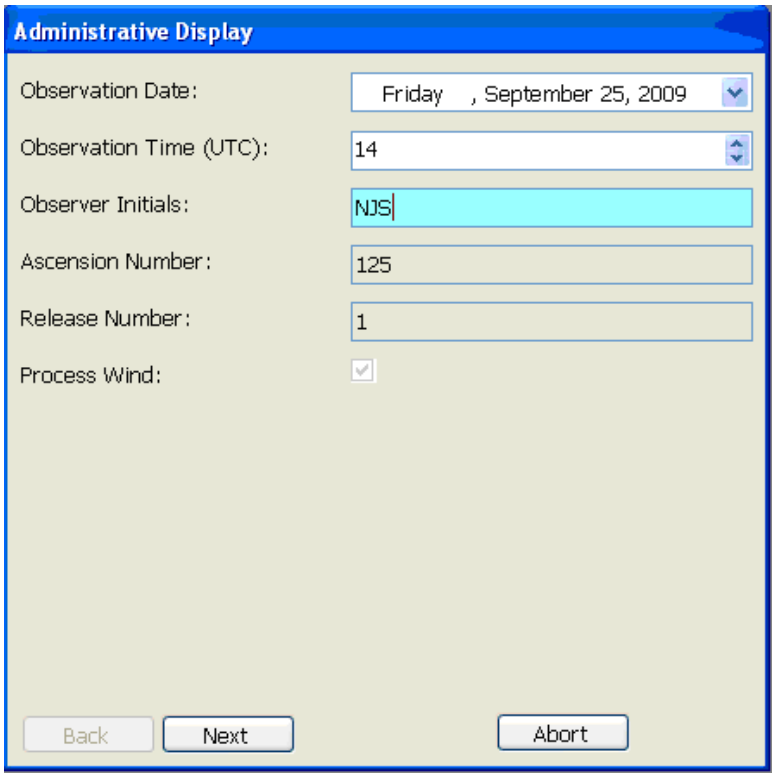


Exhibit 4-8 Administrative Display

3. If necessary, click on the up or down arrows in the Obsevation Time (UTC) cell to alter the entry provided by the software.
4. When entering your initials, RWS requires a minimum of 2 and up to a maximum of 4 letters. It will not allow numbers or any other deviations.
5. The Ascension Number is automatically entered by RWS and cannot be altered. The release number is triggered by the software and will update if a flight terminates early and the observer elects to do another release. The software will allow a maximum of 3 releases with the same ascension number.
6. The Process Wind default is check marked (Yes). After clicking the **Next** button, the Equipment Display appears (Exhibit 4-9).

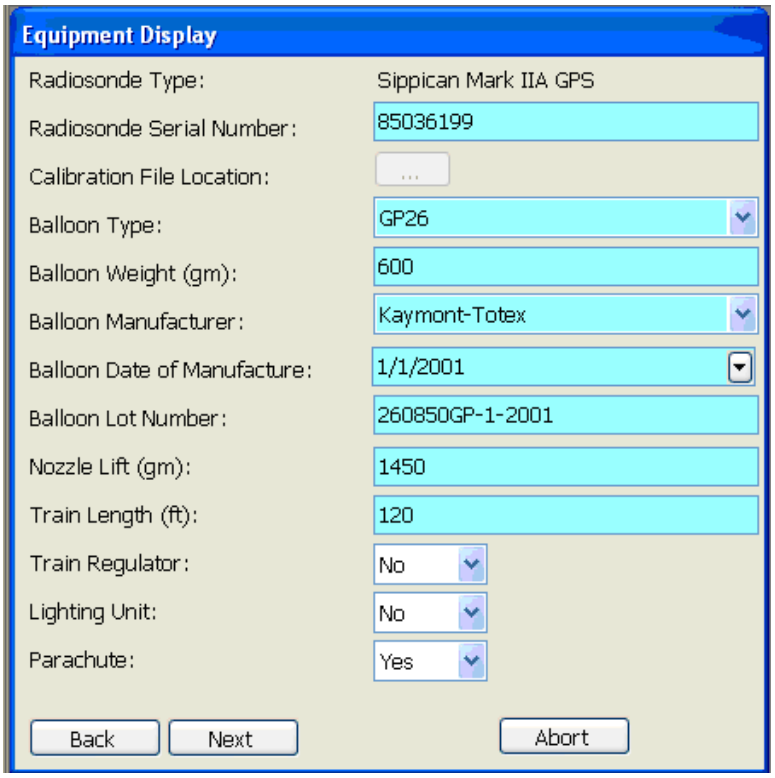


Exhibit 4-9 Equipment Display

7. The Equipment Display provides detailed information of the radiosonde, balloon, amount of gas, and the flight train. All this information is useful when analyzing the flight data.
8. The Radiosonde Type cell is predefined from the Station Data file entry and is not editable in preflight.
9. The Radiosonde Serial Number cell should be filled with the appropriate number on the radiosonde.
10. The Calibration File Location cell does not need to be filled. The radiosonde transmits the calibration data during the baseline process.
11. Select Balloon Type from the clickable drop-down. (Exhibit 4-10)

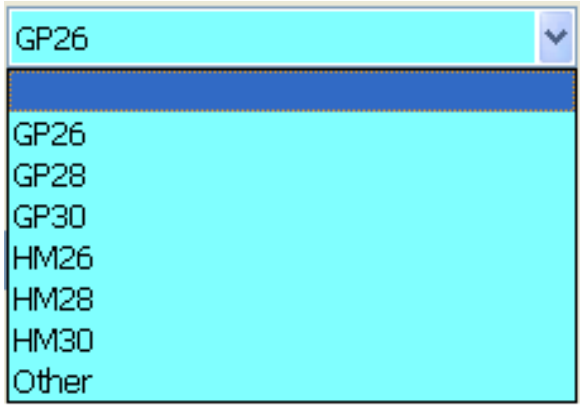


Exhibit 4-10 Balloon Type Dropdown

12. The Balloon Weight cell requires an entry of 300 to 2500 grams. When the Balloon Type is entered, the appropriate weight is automatically entered. The entry may be edited. Any entries outside this range will generate an error message and are not accepted.
13. The Balloon Manufacturer cell allows the operator to choose from a drop-down list (Exhibit 4-11).

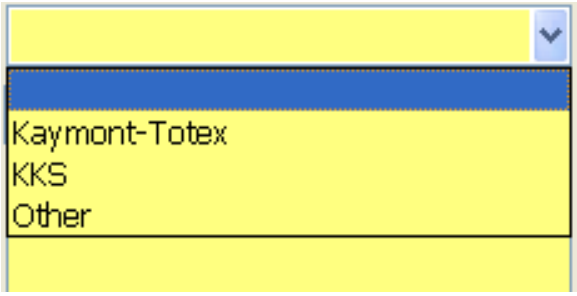


Exhibit 4-11 Balloon Manufacturer Options

14. The Date of Manufacture cell has a down arrow to open a calendar for selecting the Date (Exhibit 4-12). The date can also be entered in the mm/dd/yy format. RWS will not accept a date before 1/1/2000.

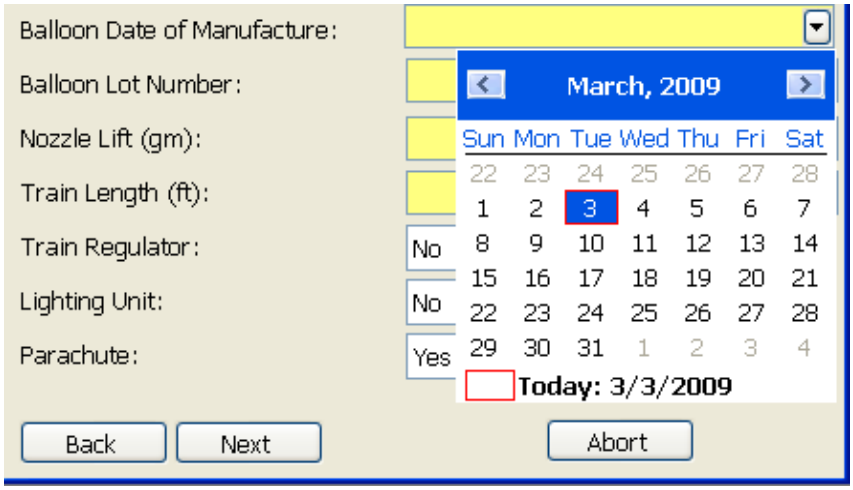


Exhibit 4-12 Date of Manufacture

15. The Balloon Lot Number cell allows text entry of the balloon lot number. The balloon lot number is located on the outside of the individually packaged balloons or on material within the packaging. **If a balloon lot number is not available enter N/A into the cell.**

    Examples of the balloon lot numbers:

    - 260801GP-01-2010
    - GP26-801-01-2010
    - 801-01-2010

16. The Gas Amount block is the grams of **Nozzle Lift** placed in the balloon. Acceptable values are 300 to 5000; anything else will generate an error message.

Nozzle Lift: Is the total amount of gas placed in the balloon minus the gas required to lift the balloon by itself. Typically this value will be 1300 to 2000 depending on the weather conditions and type of radiosonde used.

17. Train Length block - Values entered can range from 70 and 260 feet; anything else will result in an error message.
18. Train Regulator, Lighting Unit, and Parachute are all entries that require either a **Yes** or **No**.

NOTE: All sites are required to use a parachute unless a special waiver has been granted by WSH. Sites granted waivers are remote sites in the Alaskan and Pacific Regions

19. Click **Next** at the bottom of the Equipment Display
20. The Surface Observation Display appears. If it is initially blank, it may be populated by manually entering data or clicking the **Refresh** button to have the values from RSOIS and the PDB entered into the cells (Exhibit 4-13). RRS Sites without an RSOIS should enter the data from the local ASOS. For calm winds, enter the wind direction as "360" with a wind speed of "0".

NOTE: When the RSOIS is not available, observers need only to enter the Winds, Dry-bulb Temperature and one of the following parameters: Dewpoint Temperature, Wet-bulb Temperature or Relative Humidity. RWS will calculate the other two parameters.

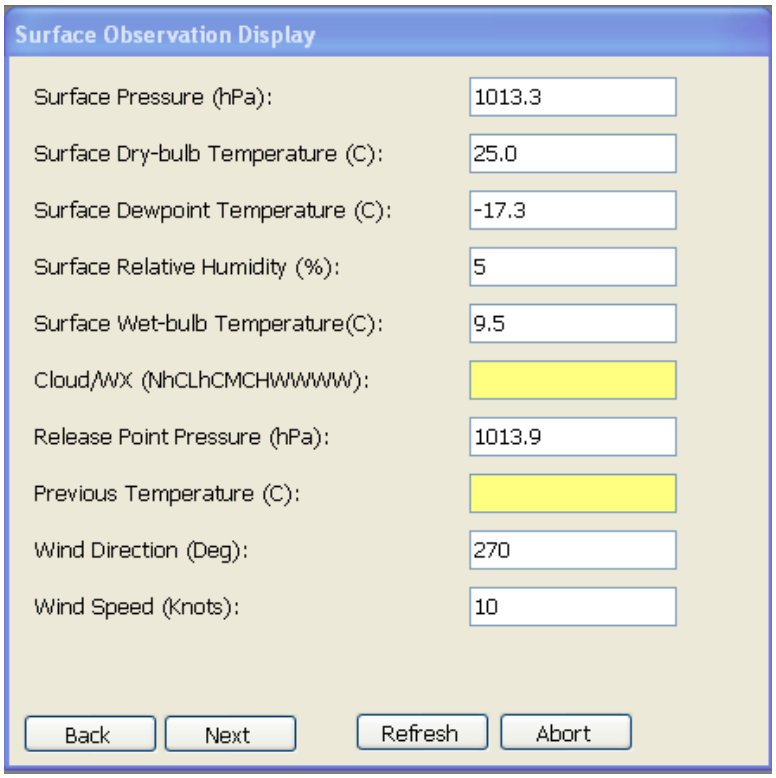


Exhibit 4-13 Refreshed SFC Observation Display

21. Entering the blocks manually provides the observer with feedback and error messages if the entries are outside the acceptable range.

Acceptable Ranges	
Surface Pressure :	750 to 1070 hPa
Surface Drybulb Temperature:	-55 to 45 C
Surface Dewpoint Temperature:	-135 to 35 C
Surface Relative Humidity:	0.5 to 100 %
Surface Wetbulb Temperature:	-55 to 45 C
Previous Temperature:	-55 to 45 C
Surface Wind Speed:	0 to 50 knots
Surface Wind Direction:	1 to 360 degrees

22. The Cloud/WX (NhCLhCMCHWWWW) Cell – Enter the 9 digits cloud/wx code. This can be left blank during preflight, but must be entered following release (Section 4.8 Step 3). The same present weather code may be entered twice if the weather is unchanging. The Cloud/WX Cell accepts only **numbers** or "**/**" and must comply with the instructions in Appendix B.

IMPORTANT: It is essential that the cloud group be entered accurately. RWS applies a temperature radiation correction algorithm based on the cloud group entered.

23. The Release Point Pressure Cell - This value is automatically calculated from the Station Data height difference between the baseline point and the release point height.
24. Previous Temperature Cell is required when the Surface Pressure is less than 1000 hPa. Enter the temperature 12 hours ago. The Previous Temperature is automatically entered for synoptic flights if a synoptic flight was conducted. Acceptable values are -55 to 45 C. If the data has to be manually entered, use RSOIS temperature records, or other local records (e.g., nearby ASOS).
25. Wind Speed Cell - Accepts values from 0 to 50 knots.
26. Wind Direction Cell - Accepts values from 1 to 360 degrees. For calm winds, enter the wind direction as 360.

NOTE: Before clicking the Next button in the Surface Observation, prepare the radiosonde according to Appendix F and point the TRS toward the radiosonde and set the TRS frequency.

27. After preparing the battery and waiting for the battery activation time (wet batteries only), connect the battery to the radiosonde and wait a minimum of five minutes before clicking the **Next** button on the Surface Observation Display. These five minutes allow the radiosonde time to acquire GPS from the GPS repeater.

28. The next step is to set the TRS frequency to the radiosonde frequency. The TRS default frequency is 1680 MHz and needs to be set to the radiosonde frequency.

NOTE: Chapter 15 describes how RWS can be set to automatically change the TRS frequency to a predefined frequency.

29. To change the TRS frequency, click the **Edit** button in the Antenna Orientation/TRS Display to enable editing of the TRS frequency (Exhibit 4-14).
30. In the Frequency cell, type the desired frequency, and then click the **Set** button (Exhibit 4-15). **If you do not click the Set button, the new frequency will not be applied. Once the frequency is set, ensure the AFC box is checked (Exhibit 4-16).**
31. The radiosonde signal strength is displayed below the Frequency cell in the TRS Display. In RWS version 2.0, RWS displays the signal strength in the same units as the TRS CDU. The signal strength values range from 0 to -130 dB. The strongest signal being 0 and the weakest being -130. Section 22.3 depicts the expected signal strength ranges for baseline, release & flight, as well as a conversion chart from RWS ver. 1.2 signal strength to RWS ver. 2.0.

NOTE: Occasionally the radiosonde frequency will change slightly during flight up to 100 kHz or 0.01 MHz. Turn AFC On at baseline; this will lock the TRS on to the precise radiosonde frequency for maximum signal.

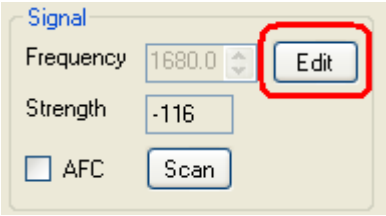


Exhibit 4-14 Edit Frequency

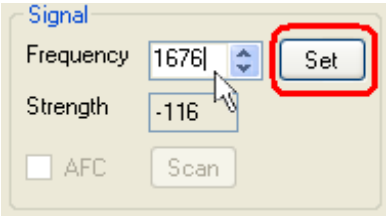


Exhibit 4-15 Entering Frequency

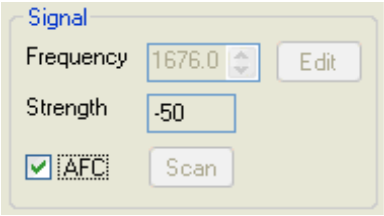


Exhibit 4-16 Frequency Set

NOTE: Do not use the Scan button if doing a second or third release. The receiver may lock-on to the previous radiosonde causing the invalid calibration data to be used at baseline. During second and third release, manually set the TRS frequency.

32. After the five minutes for GPS acquisition, click the **Refresh** button to ensure Surface Observations are current.

NOTE: Clicking the Refesh button will reset the Clouds/Wx cell to an empty cell.

33. Click **Next**. The Baseline process will begin.

4.5 Radiosonde Baseline Process

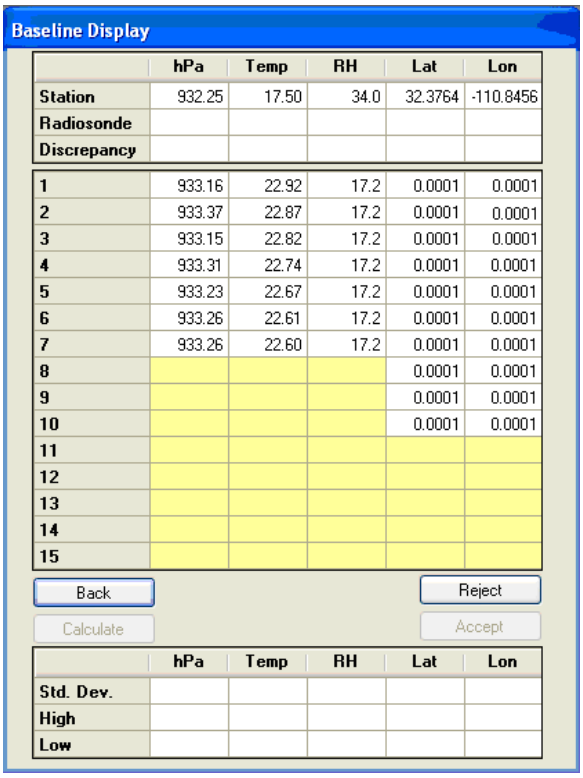
1. The SPS must initialize prior to beginning the baseline process. After the SPS initializes, it will start processing the radiosonde signal and then send data to RWS. This process typically takes less than a minute.
2. Once the SPS sends data to RWS, the Baseline Display will begin to be populated with data (Exhibit 4-17a).
3. Pressure, Temperature and Humidity (PTU) data will come in before Latitude and Longitude (GPS). It can take up to 5 minutes before GPS data is displayed. Do not click the Calculate button before making sure that PTU and GPS data is realistic and relatively stable.

NOTE: It may take up to 5 minutes from the time PTU data is received for the Radiosonde Pressure Sensor to stabilize.

4. After receiving PTU data, wait 5 minutes. Waiting this time allows the radiosonde pressure sensor to stabilize and the radiosonde to acquire GPS.
5. Once the PTU & GPS data is stable and the radiosonde has baselined for at least 5 min, click on the **Calculate** button (Exhibit 4-17b).
6. Exhibit 4-18a shows the Vaisala RS92 SPS/GPS status window. A “1” indicates that there is a satellite being tracked. A “0” means that satellite is not being tracked. Exhibit 4-18b shows the LMS-6 GPS status window. For satellites being tracked, the signal to noise ratio (1 to 60) is displayed. Satellities not being tracked are shown as zero.

NOTE: If the Baseline process cannot be completed because the SPS has not initialized or GPS has not acquired lock within 5 minutes, follow procedures in Appendix D (Section D.2.4).

NOTE: Calculating the baseline discrepancy should be delayed until just prior to release. This will ensure the pressure discrepancy applied is as accurate as possible to the actual conditions at release. RWS requires the surface pressure re-entered, if the PDB is not connected and the surface observation pressure is more than 2 minutes old.



Baseline Display

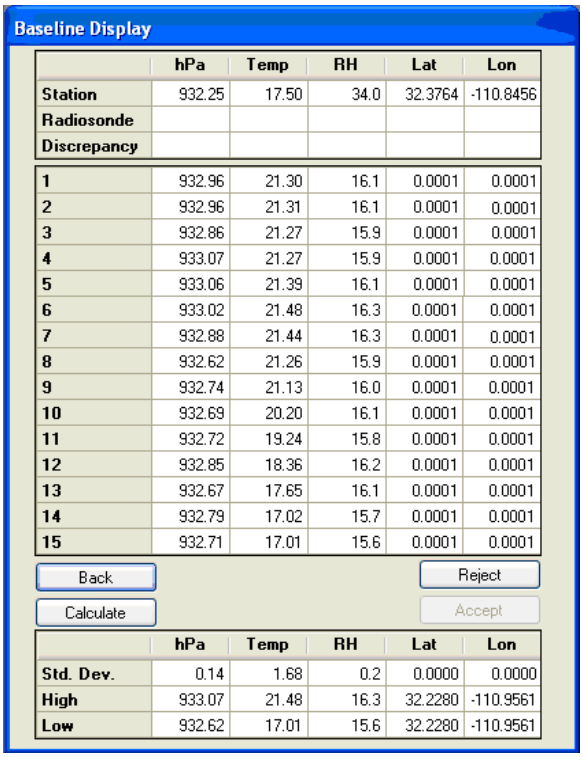
	hPa	Temp	RH	Lat	Lon
Station	932.25	17.50	34.0	32.3764	-110.8456
Radiosonde					
Discrepancy					
1	933.16	22.92	17.2	0.0001	0.0001
2	933.37	22.87	17.2	0.0001	0.0001
3	933.15	22.82	17.2	0.0001	0.0001
4	933.31	22.74	17.2	0.0001	0.0001
5	933.23	22.67	17.2	0.0001	0.0001
6	933.26	22.61	17.2	0.0001	0.0001
7	933.26	22.60	17.2	0.0001	0.0001
8				0.0001	0.0001
9				0.0001	0.0001
10				0.0001	0.0001
11					
12					
13					
14					
15					

Back Reject

Calculate Accept

	hPa	Temp	RH	Lat	Lon
Std. Dev.					
High					
Low					

Exhibit 4-17a Baseline in Progress



Baseline Display

	hPa	Temp	RH	Lat	Lon
Station	932.25	17.50	34.0	32.3764	-110.8456
Radiosonde					
Discrepancy					
1	932.96	21.30	16.1	0.0001	0.0001
2	932.96	21.31	16.1	0.0001	0.0001
3	932.86	21.27	15.9	0.0001	0.0001
4	933.07	21.27	15.9	0.0001	0.0001
5	933.06	21.39	16.1	0.0001	0.0001
6	933.02	21.48	16.3	0.0001	0.0001
7	932.88	21.44	16.3	0.0001	0.0001
8	932.62	21.26	15.9	0.0001	0.0001
9	932.74	21.13	16.0	0.0001	0.0001
10	932.69	20.20	16.1	0.0001	0.0001
11	932.72	19.24	15.8	0.0001	0.0001
12	932.85	18.36	16.2	0.0001	0.0001
13	932.67	17.65	16.1	0.0001	0.0001
14	932.79	17.02	15.7	0.0001	0.0001
15	932.71	17.01	15.6	0.0001	0.0001

Back Reject

Calculate Accept

	hPa	Temp	RH	Lat	Lon
Std. Dev.	0.14	1.68	0.2	0.0000	0.0000
High	933.07	21.48	16.3	32.2280	-110.9561
Low	932.62	17.01	15.6	32.2280	-110.9561

Exhibit 4-17b Baseline Ready to Run Calculate

7. After clicking the **Calculate** button, statistics on the radiosonde pressure, temperature, RH and latitude/longitude are shown (Exhibit 4-19).
8. The Pressure discrepancy is the difference between the pressure reported from the PDB and radiosonde and is shown in Table 4-1. It is critical that the Pressure discrepancy is accurate and within the constraints listed in the table below for each radiosonde type. If the radiosonde is found to have a discrepancy greater than the limit, baseline will fail. Verify that the station pressure is correct and baseline the radiosonde again. If it fails, reject the instrument.

Radiosonde Type	Pressure Discrepancy Constraints
Lockheed Martin Sippican LMS-6	± 5 hPa
Vaisala RS92-NGP	± 3 hPa

Table 4-1 Pressure discrepancy thresholds

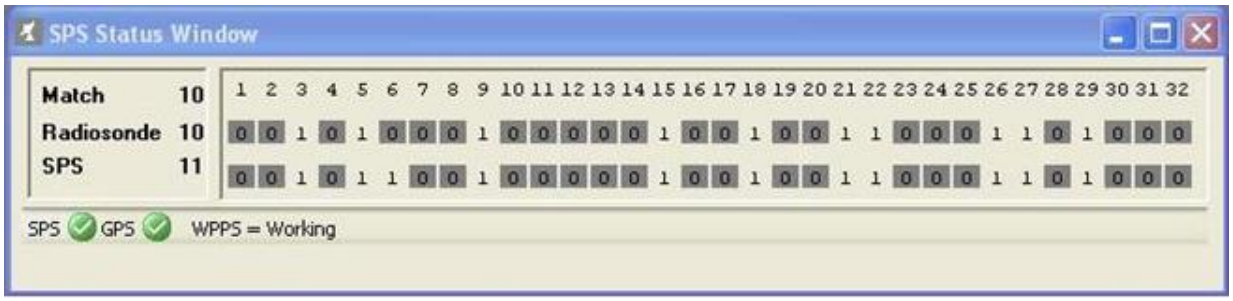


Exhibit 4-18a RS-92 SPS/GPS status display

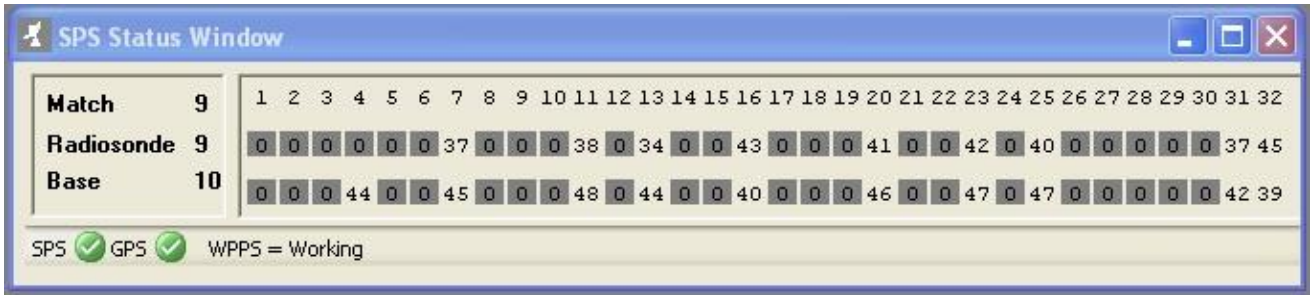
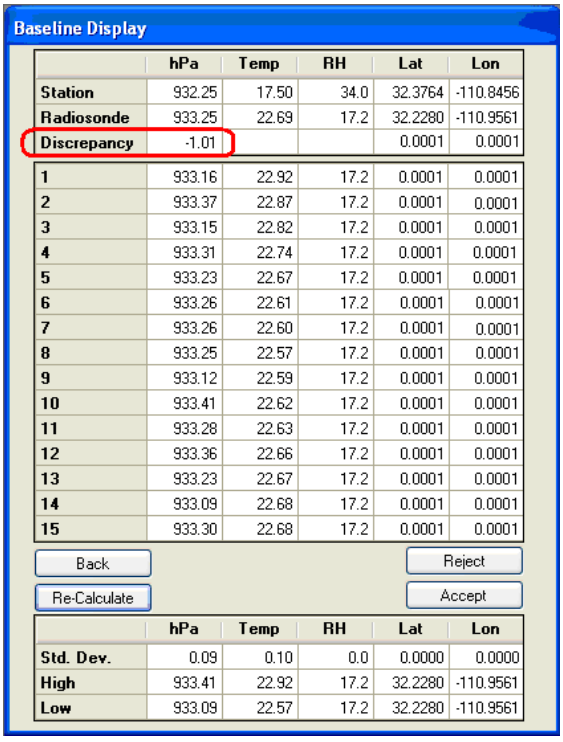


Exhibit 4-18b LMS-6 SPS/GPS status display

9. Radiosonde temperature and RH values must be representative of the radiosonde baseline area. If the radiosonde data is noisy (i.e., high standard deviation) or differ from the baseline location conditions by more than 3C or 30% RH, reject the instrument.
10. The Latitude and Longitude discrepancies are the differences between the Latitude and Longitude reported by the radiosonde and the station location. They are typically less than ±0.005. If values routinely exceed ±0.1, have an electronics technician check the SPS equipment and/or RRS Station Data.
11. If the pressure discrepancy is within the limit and other data is acceptable, click the **Accept** button. A window asking, "Do you wish to continue?" will appear (Exhibit 4-20).



	hPa	Temp	RH	Lat	Lon
Station	932.25	17.50	34.0	32.3764	-110.8456
Radiosonde	933.25	22.69	17.2	32.2280	-110.9561
Discrepancy	-1.01			0.0001	0.0001
1	933.16	22.92	17.2	0.0001	0.0001
2	933.37	22.87	17.2	0.0001	0.0001
3	933.15	22.82	17.2	0.0001	0.0001
4	933.31	22.74	17.2	0.0001	0.0001
5	933.23	22.67	17.2	0.0001	0.0001
6	933.26	22.61	17.2	0.0001	0.0001
7	933.26	22.60	17.2	0.0001	0.0001
8	933.25	22.57	17.2	0.0001	0.0001
9	933.12	22.59	17.2	0.0001	0.0001
10	933.41	22.62	17.2	0.0001	0.0001
11	933.28	22.63	17.2	0.0001	0.0001
12	933.36	22.66	17.2	0.0001	0.0001
13	933.23	22.67	17.2	0.0001	0.0001
14	933.09	22.68	17.2	0.0001	0.0001
15	933.30	22.68	17.2	0.0001	0.0001

	hPa	Temp	RH	Lat	Lon
Std. Dev.	0.09	0.10	0.0	0.0000	0.0000
High	933.41	22.92	17.2	32.2280	-110.9561
Low	933.09	22.57	17.2	32.2280	-110.9561

Exhibit 4-19 Accept Baseline

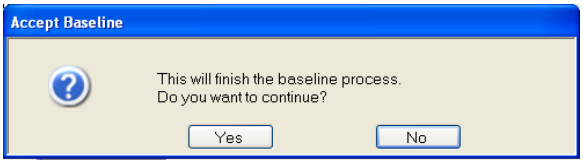


Exhibit 4-20 Continue Flight

12. Click the **Yes** button in the Accept Baseline window. The Waiting For Balloon Release Display will appear (Exhibit 4-20).

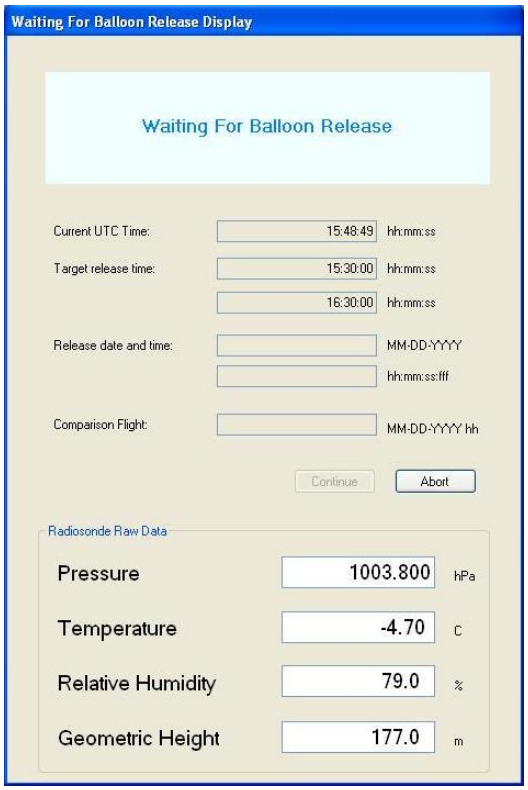


Exhibit 4-20 Waiting for Balloon Release

NOTE: Prior to leaving the office to go to the inflation building, check the radiosonde raw data at the bottom of the Waiting For Balloon Release Display (Exhibit 4-20) or along the bottom of the screen to ensure the instrument is transmitting realistic pressure, temperature and relative humidity values. If the data looks unrealistic or is bad, abort the observations and reject the radiosonde.

4.6 Launching the Balloon

1. Prior to leaving the office, the antenna should be moved to point in the direction the radiosonde will travel after release.
    a. Using the TRS Display, put the TRS in **Manual** Track Mode
    b. Ensure AFC is ON
    c. Point the antenna in the direction the wind is expected to take the balloon and leave the antenna in the Manual Track Mode.
        - In the TRS Display, enter the desired azimuth and elevation into the TRS Display. Click the **Move Antenna** button.
    d. At the release shelter, if possible keep the radiosonde in near full view of the sky. This will reduce the chance of missing GPS data near the surface.

e. Using the CDU, verify the signal strength and antenna position. The signal strength should be above -60. If the signal strength is below -60, double check the frequency is the same as at baseline. If it has changed more than 0.01 MHz, set the frequency back to what it was at baseline and turn AFC ON.

NOTE: It is vital that the frequency and signal strength be checked prior to and immediately after release. This should be done using the CDU at the release site. It is also important to ensure the antenna is operational and tracking properly by using the CDU. Appendix E (Section E2.2) and Chapter 3 of NWS Manual 10-1401 have additional details.

2. Launch the radiosonde in accordance with NWS Manual 10-1401. Leave the TRS in Manual Track Mode and lock onto the radiosonde using the RWS TRS Display.

   a. Point the TRS toward the direction of the balloon.

      - In the TRS Display, enter the desired azimuth and elevation into the TRS Display. Click the **Move Antenna** button.

      OR

      - Click **Move to GPS** button (GPS Dependent).

   b. In the TRS Display, put the TRS in **Search** Track Mode. The TRS will search for the radiosonde and will automatically switch to Auto Track Mode to track the strongest signal.

IMPORTANT: Never release a radiosonde into a thunderstorm. Wait until the storm has passed. A thunderstorm is defined as ending when at least 15 minutes have passed since the last clap of thunder was heard. If the storm persists during the entire release time window, then the observation will be logged as missed. **See NWS Manual 1401 and Chapter 13 of this guide for more information.**

3. Chapter 22 contains a quick start guide for locking on the radiosonde using RWS and expected signal strengths.

4.7 Controlling the TRS with RWS

1. The TRS Display in RWS has a few features to assist in locking onto the radiosonde. There are three main methods to move the TRS when it is in Manual Track Mode.

   a. The first method is to enter the desired azimuth and elevation into the TRS Display and click the **Move Antenna** button (Exhibit 4-21).

   b. The second method is to click in the area inside Azimuth and/or Elevation display (highlighted in Exhibit 4-22).

c. The third method is dependent on having GPS data from the radiosonde. The Azimuth and Elevation display indicates the GPS calculated azimuth and elevation to the radiosonde in green (Exhibit 4-23). To move the TRS to the GPS calculated azimuth and elevation, click the **Move to GPS** button.

NOTE: If the GPS calculated azimuth and elevation is red, then GPS data is not available and this function may not point the antenna toward the radiosonde.

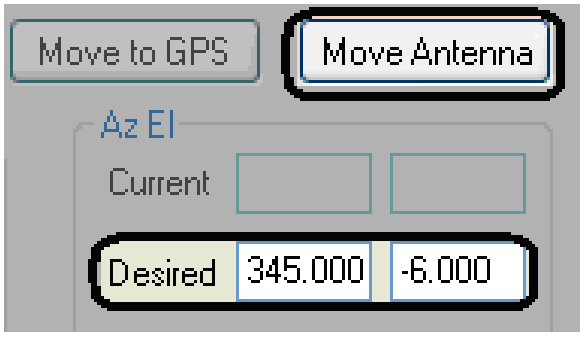


Exhibit 4-21 Move Antenna

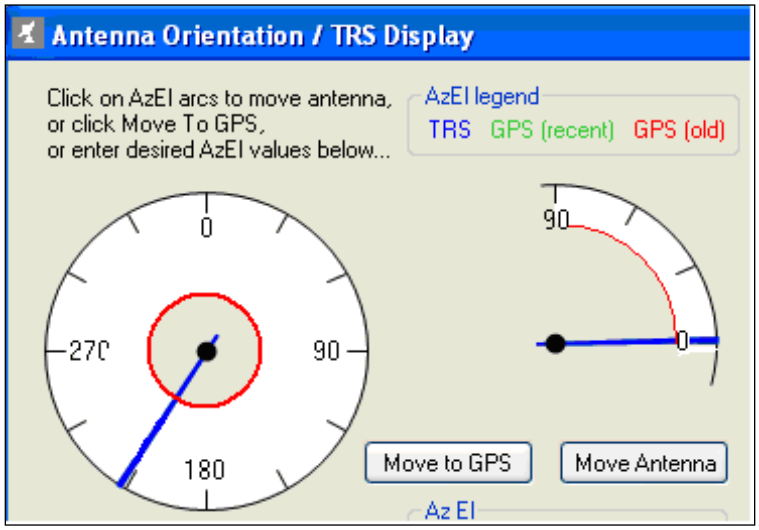


Exhibit 4-22 Point Antenna

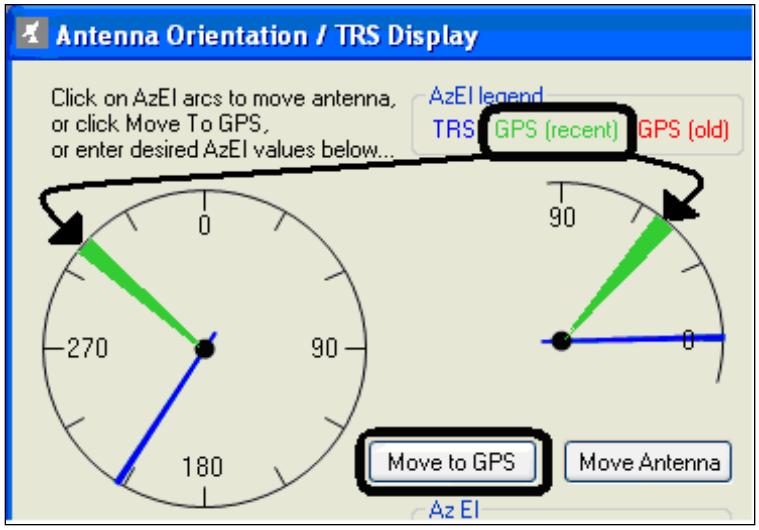


Exhibit 4-23 Move to GPS

2. There are four different selectable TRS Track Modes

   a. In Manual Track Mode, the observer can manually move the TRS. While data can be received in this mode, the TRS will not track the radiosonde.

   b. In Auto Track Mode, the TRS will automatically follow the strongest signal radiosonde (Exhibit 4-24). After release, point the TRS in the direction of the radiosonde and select Auto Track Mode. The TRS will then automatically track the radiosonde.

   c. In Search Track Mode, the TRS will begin an RWS Limited Search (Exhibit 4-25). An RWS Limited Search has two different operating methods that are automatically selected. Both methods will find the strongest signal and then switch to Auto Track Mode. The first method will be selected if GPS data is available.

      i. If GPS data is available, selecting Search Track Mode will first point the TRS to the GPS Calculated Azimuth and Elevation and begin a conical Limited Search.

      ii. If GPS data is not available, selecting Search Track Mode will begin a conical Limited Search starting in the direction the TRS is currently pointing.

NOTE: If Limited Search Mode fails to find a strong enough signal, the TRS will switch to Full Search Mode. If this occurs, put the TRS back into Manual Track Mode, reposition the TRS and reattempt to find the radiosonde. Full Search Mode can take an extended amount of time to locate the radiosonde, which could exceed the RWS threshold for missing data.

   d. In GPS Track Mode, RWS will repeatedly point the TRS to GPS calculated Azimuth and Elevation angles. GPS Track Mode is designed to be used as a temporary work-around for a TRS scanner failure, which prevents the TRS from tracking while in Auto

Track Mode. While in GPS Track Mode, the TRS is actually in Manual and RWS is pointing the TRS every five seconds to GPS calculated Azimuth and Elevation angles. **GPS Track Mode is dependent on GPS data and <u>will not</u> function if GPS data is missing for more than one minute.** While in GPS Track Mode, the observer should actively monitor RWS in the event of missing GPS data (Exhibit 4-26).

NOTE: Using GPS Track Mode requires the observer to actively monitor RWS to ensure GPS data is not missing for more than one minute.

NOTE: See NWS MANUAL 10-1401, for more information on Limited Search.

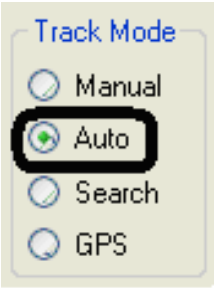


Exhibit 4-24 Auto

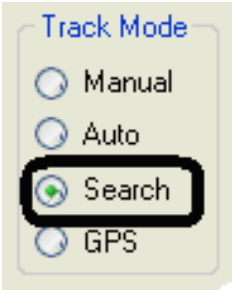


Exhibit 4-25 Search

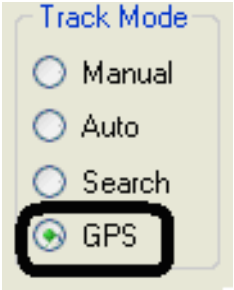


Exhibit 4-26 GPS

CAUTION: If GPS data is not being received, be sure to point the TRS in the general direction of the radiosonde before using Search Track Mode. It is vital to know what the wind directions are above your location. Check the upper level charts and the VAD wind profile from WSR-88D or wind profiler (if available) prior to launch. You may need to manually position the antenna if signal is lost due to a tracking problem.

3. The TRS Display also shows the azimuth and elevation tracking errors (Exhibit 4-27). These tracking errors are unit-less indications of how close the TRS is to pointing directly at the radiosonde. The smaller the errors, the closer to the radiosonde. The tracking errors are most useful when the TRS is using the NAGS (Narrow Angle Gathering Sensor). When pointed at the radiosonde while in NAGS, the tracking errors will typically range between +10 or -10.

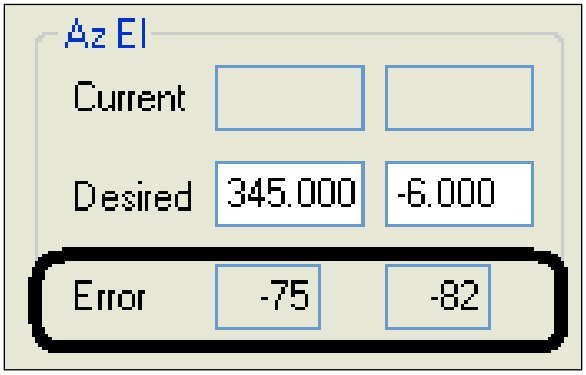


Exhibit 4-27 TRS Tracking Errors

4.8 Release Detection and Release Surface Observation

1. The software automatically detects launch by the decrease in pressure. If this function should fail to detect release do the following.
    a. Click on the "Yellow Balloon" icon at the top of the RWS Main window to activate the launch (Exhibit 4-28).
    b. Verify the signal strength. If the signal strength is low (< -70 within a few minutes after launch) make sure the frequency has not changed from the frequency at baseline. If the frequency has changed, turn AFC OFF set the frequency and turn AFC ON. Then make sure the TRS is tracking the radiosonde. Refer to Section 22.3 for expected signal strength.
    c. Verify the correct release point time has been selected (Chapter 5, Section 5.1.2).

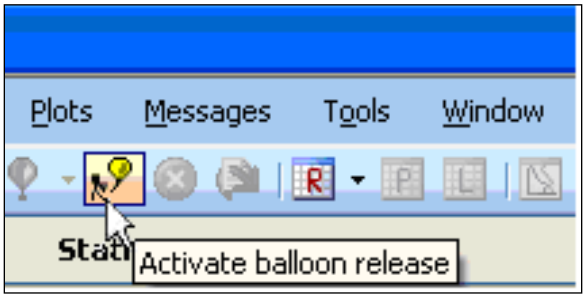


Exhibit 4-28 Manual or Simulated Balloon Release

2. After the launch, the Waiting for Balloon Release Display indicates Release detected (Exhibit 4-29). Click the **Continue** button to proceed to the Release Surface Observation.

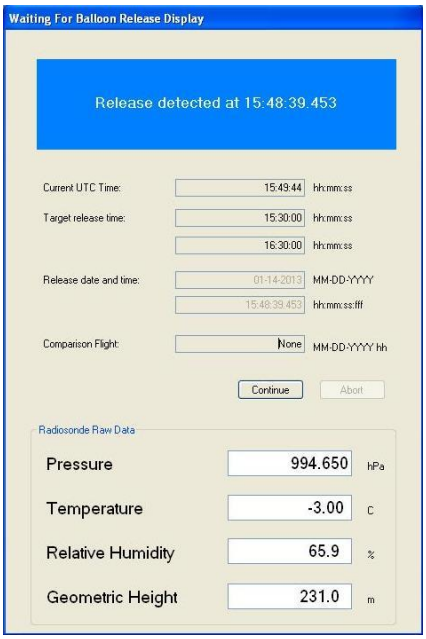


Exhibit 4-29 Balloon Release Detected

3. The Release Surface Observation Display contains the surface observation (RSOIS/PDB data) captured at the time of release. RWS uses the release surface observation data as the first data point of the sounding. The operator may edit any cell of the release surface observation, or hit the **Refresh** button to undo any changes (Exhibit 4-30). Click **OK** to accept the Release Surface Observation. The Release Surface Observation will become the data at 0.0 minutes elapsed time in the Processed Tabular Display.

NOTE: RWS requires that any surface observation parameters deferred during preflight observation be entered in the Release Surface Observation Display.

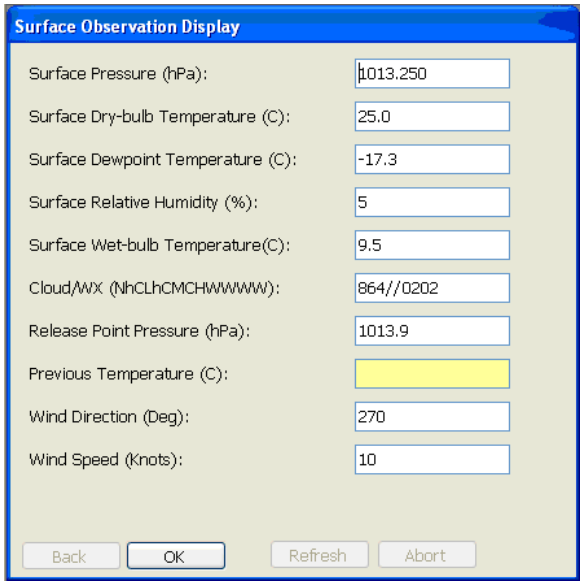


Exhibit 4-30 Surface Observation Display

5 RRS Observation- Checking and Editing Data

This chapter describes the procedures for Marking erroneous flight data and how to check sounding data during a typical RRS observation. **After reading this chapter, the observer should read Chapter 13 on handling significant, but less common, data problems.**

IMPORTANT: The RWS software doesn't delete all erroneous data and will not alert the observer to all questionable/erroneous data. The observer needs to periodically review the sounding data for erroneous data that needs to be Marked. If the sounding data is not edited as required, erroneous data will appear in the coded messages and be transmitted to data users. <u>Observer quality control of the data must be done prior to data transmission</u>.

5.1 Data Editing

Once the radiosonde has been launched, in-flight data editing can be divided into three main areas:

- Post-release Surface Observation
- Release Detection
- Marked sounding data

5.1.1 Post-Release Surface Observation

Follow these steps to check the Surface Observations:

1. After the Balloon Release is detected appears, click **Continue** to move forward into the Post-Release Surface Observation.
2. Re-validating the Surface Observation is the first task performed after release. The Post-Release Surface Observation Display follows the release detection screen. This displays the surface observation from the RSOIS/PDB.
    a. Update the Cloud/WX with conditions at release.
    b. If erroneous, edit the surface observation data. Clicking the **Undo** button will undo any changes.
    c. When finished, click the **OK** button to save the changes to the surface observation. RWS will use the surface observation data as the first data point of the sounding. Exhibit 5-1 is an example of the Post-Release Surface Observation Display.

NOTE: The Cloud/WX data at release time needs to be rechecked to ensure it is accurate. The temperature data radiation correction is derived from the cloud data and significantly impacts the RADAT and Coded Messages.

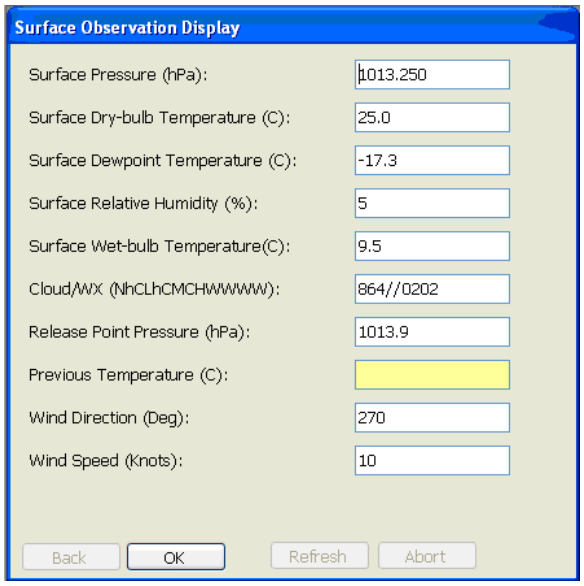


Exhibit 5-1 Surface Observation

NOTE: If the surface weather observation has any errors, it may be changed by the observer anytime during or after the flight as well as in Rework. However, any flight data edits will be lost if the surface observation is changed. Thus, it is important to verify the surface weather observation immediately after release.

5.1.2 Flight Release Detection

Validating the release point time accuracy should be performed after the post-release surface observation. The RRS software automatically detects the time of release from the decrease in pressure. In some cases, the selected release time may be inaccurate. It is important that the observer verify that the release was accurately detected and if necessary, adjust the release time. If the release is not detected correctly, the resulting sounding data may be erroneous.

To determine if the release time was selected correctly, use the Raw PTU Tabular Display, Processed Tabular Display, and Pressure Plot (Exhibit 5-2). In the Raw PTU Tabular Display, the release detection is indicated by a green line at time 0.00. The pressure data above the green line should be relatively stable (preflight) and the pressure data below the line should show decreasing pressure (in-flight). In the Processed Tabular Display, the Geopotential Height above Elapsed Time 0.00 should increase at approximately 3 to 6 meters per second.

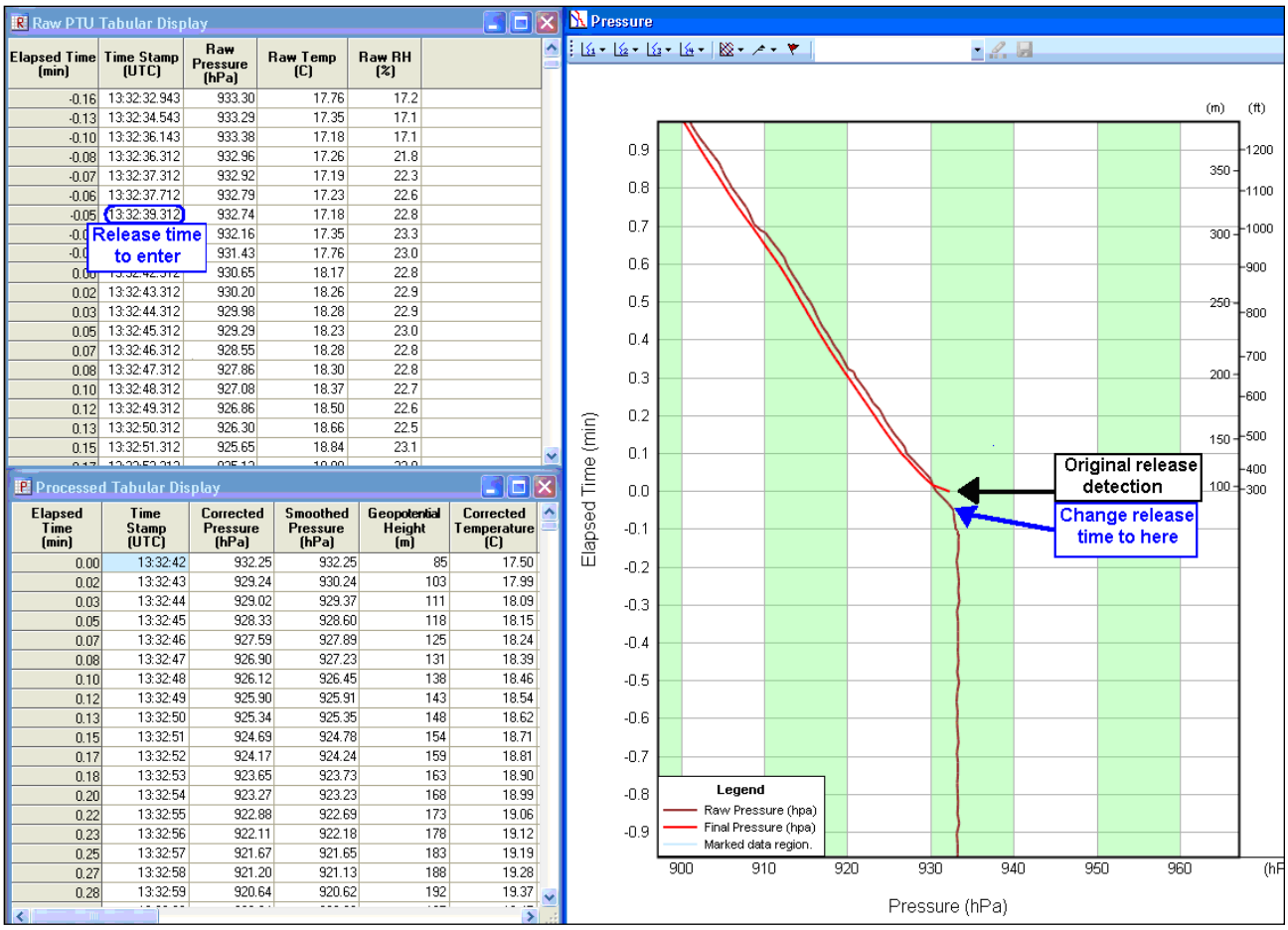


Exhibit 5-2: Verifying the accuracy of the Release Detection

Sometimes the release time will not be accurately detected (see Exhibit 5-2). To change the release time to the correct value, follow these steps:

1. Using the Raw PTU Tabular Display and Pressure Plot, determine the point at which release actually occurred. Note the raw PTU time stamp.
2. Select **Release Time** from the Tools pull-down menu.

NOTE: It is best to enter the exact release time stamp from the Raw PTU Table (e.g. 13:32:39.312 UTC from Exhibit 5-2).

3. Enter the correct release time in the Release window. (The date may need to be modified if the release time crosses 00 UTC.)
4. Click **OK**. The surface observation screen will appear, populated with the surface weather data nearest the selected release time.
5. Review the surface observation and make any edits necessary and click **Accept**.
6. RWS will begin to reprocess the flight data using the changed release time.

7. Once the release time has been changed (see Exhibit 5-3), re-verify in the Raw PTU Tabular Display that the release time was changed correctly. Additionally, the Geopotential Height in the Processed Tabular Display can be checked to verify release was changed correctly. The Geopotential Height should have increasing heights from elapsed time 0.00 (surface) at about 3 to 6 meters a second.

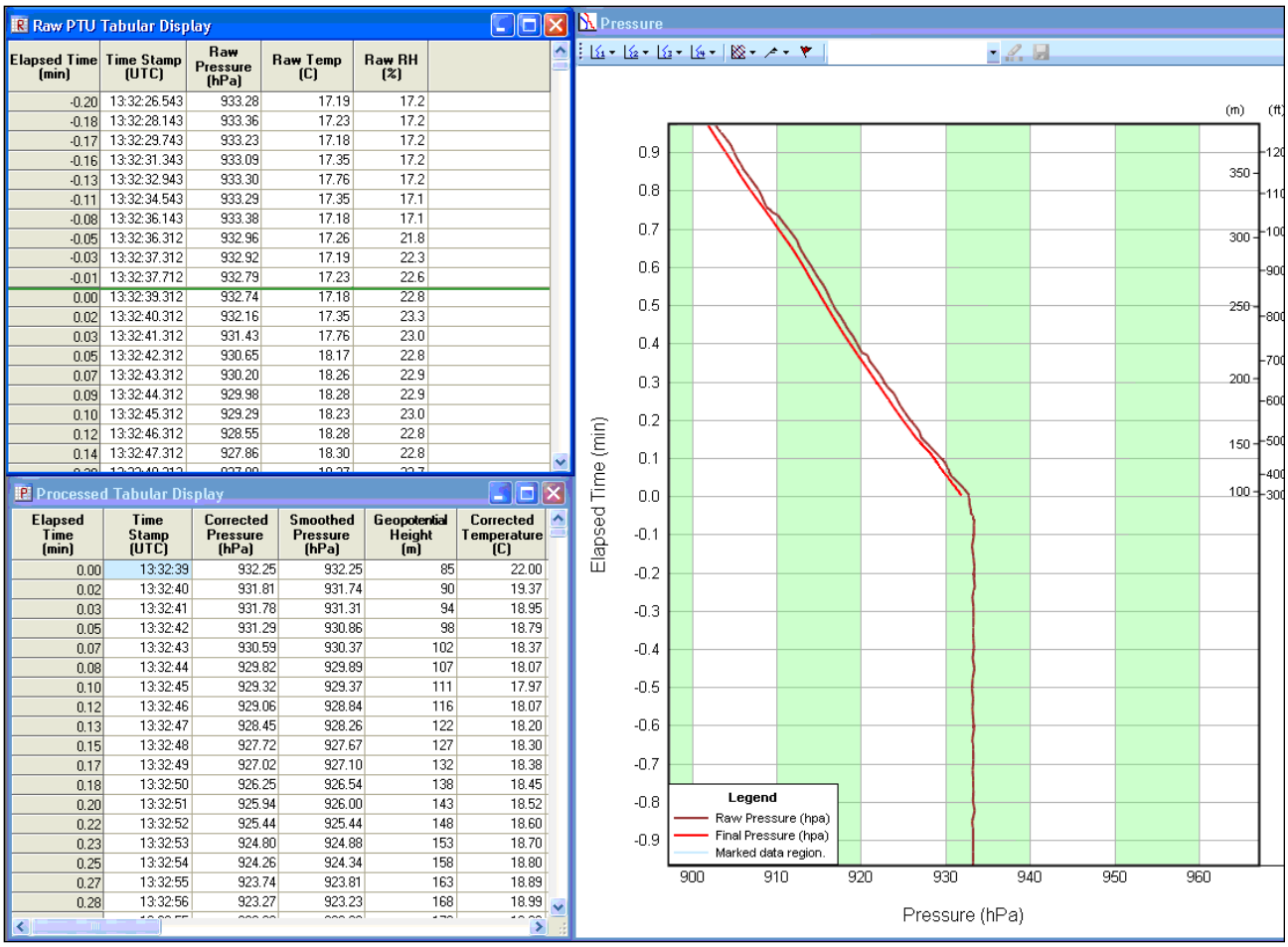


Exhibit 5-3: Release Time correctly changed

5.1.3 Marking / Unmarking Data

Erroneous data shall be marked for interpolation or rejection by the observer. The data listed in Table 5-1 can be Marked in either the Processed Tabular Display or specific RWS plots. Whether using the Processed Tabular Display or RWS Plots, the process of Marking/UnMarking can be broken down into four main steps.

1. Highlighting data to be Marked / Unmarked.
2. Applying User Edits.
3. Reviewing data to ensure Marking / Unmarking was appropriate.
4. Repeat as necessary

Markable Data	Processed Tabular Display	Markable RWS plots
Smoothed Pressure	√	• Flight Monitor • Pressure
Corrected Temperature	√	• Flight Monitor • Temperature
Relative Humidity	√	• Flight Monitor • Humidity
Wind components u and v	√ (Not recommended)	• Wind Profile
Radiosonde Latitude and Longitude	√ (Not recommended)	Not Available

Table 5-1: Table and Plots for Marking Data

NOTE: Although wind components and radiosonde location are editable, observers are discouraged from Marking this data. GPS Wind data has been found to be highly accurate and in only very rare situations requires Marking.

Marking data should be done after verifying the surface weather observation and release time. Otherwise all data marking will be lost if the surface observation or release time is changed after Marking data.

There are several things to keep in mind when Marking data. The first row of data in the Processed Tabular Display (surface data) cannot be Marked. Data Marked for less than a minute will be interpolated. If a minute or more of Temperature or RH data is Marked, the data will Marked rejected and not used. When more than 1 minute is Marked, the plotted and tabular data will be missing. However, the missing data will not be reflected in the coded messages until the missing data is > 20 hPa thick of PTU or > 1500 meters thick of winds data.

Only one plot or tabular display can be used to Mark data at a time. In order to Mark data in another display, exit Edit Mode in the display. Exiting Edit Mode will require the User Edits to be applied or canceled.

NOTE: In the Processed Tabular Display, data can only be Marked when the table is set to a 1 second interval.

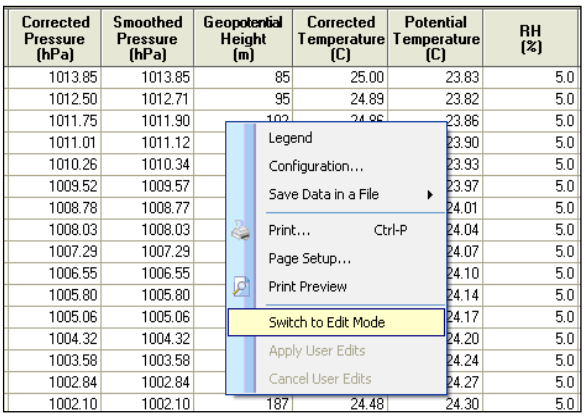
5.1.3.1 To Mark data in the Processed Tabular Display, follow these steps:

1. Marking data requires the Processed Tabular Display to be switched to Edit Mode. To switch to Edit Mode, right click in the Processed Tabular Display and select **Switch to Edit Mode** from the menu (Exhibit 5-4). The Processed Tabular Display will indicate edit mode by changing the color of the column header titles to red.

2. To Mark data, left click and drag over the data cells in which changes are desired. The Marked cells background color will change to blue (Exhibit 5-5).

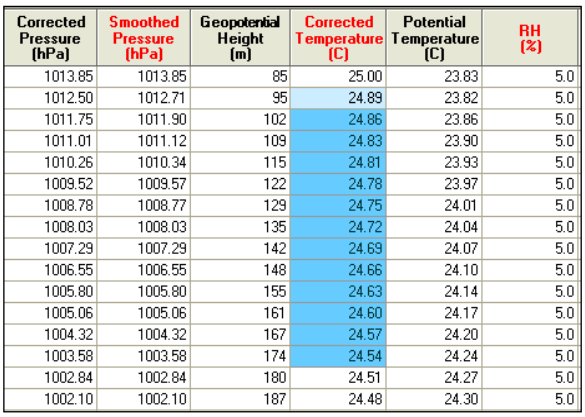
3. To finalize these changes, right click in the Processed Tabular Display and select **Apply User Edits** (Exhibit 5-6). Once the User Edits are applied, the Marked cells will have a blue background (Exhibit 5-7).

NOTE: Data marked for less than a minute will be interpolated. If a minute or more of Temperature or RH data is marked, the data will be Marked rejected (red background in the Processed Tabular Display) and not used.



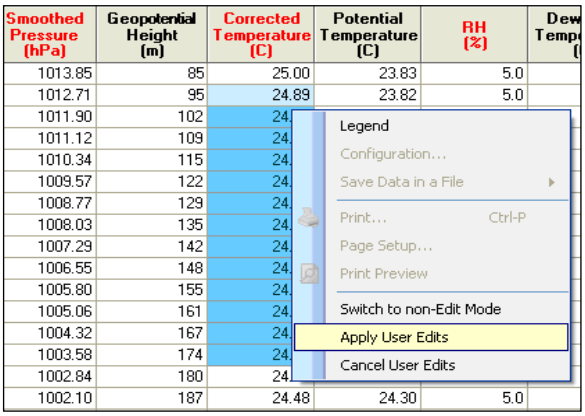
Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)
1013.85	1013.85	85	25.00	23.83	5.0
1012.50	1012.71	95	24.89	23.82	5.0
1011.75	1011.90	102	24.86	23.86	5.0
1011.01	1011.12	109	24.83	23.90	5.0
1010.26	1010.34	115	24.81	23.93	5.0
1009.52	1009.57	122	24.78	23.97	5.0
1008.78	1008.77	129	24.75	24.01	5.0
1008.03	1008.03	135	24.72	24.04	5.0
1007.29	1007.29	142	24.69	24.07	5.0
1006.55	1006.55	148	24.66	24.10	5.0
1005.80	1005.80	155	24.63	24.14	5.0
1005.06	1005.06	161	24.60	24.17	5.0
1004.32	1004.32	167	24.57	24.20	5.0
1003.58	1003.58	174	24.54	24.24	5.0
1002.84	1002.84	180	24.51	24.27	5.0
1002.10	1002.10	187	24.48	24.30	5.0

Exhibit 5-4 Switch to Edit Mode



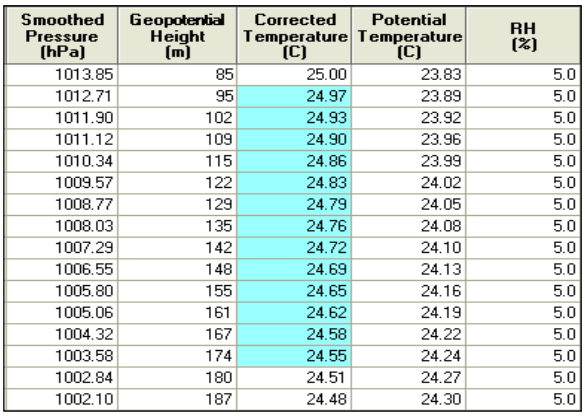
Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)
1013.85	1013.85	85	25.00	23.83	5.0
1012.50	1012.71	95	24.89	23.82	5.0
1011.75	1011.90	102	24.86	23.86	5.0
1011.01	1011.12	109	24.83	23.90	5.0
1010.26	1010.34	115	24.81	23.93	5.0
1009.52	1009.57	122	24.78	23.97	5.0
1008.78	1008.77	129	24.75	24.01	5.0
1008.03	1008.03	135	24.72	24.04	5.0
1007.29	1007.29	142	24.69	24.07	5.0
1006.55	1006.55	148	24.66	24.10	5.0
1005.80	1005.80	155	24.63	24.14	5.0
1005.06	1005.06	161	24.60	24.17	5.0
1004.32	1004.32	167	24.57	24.20	5.0
1003.58	1003.58	174	24.54	24.24	5.0
1002.84	1002.84	180	24.51	24.27	5.0
1002.10	1002.10	187	24.48	24.30	5.0

Exhibit 5-5 Highlighting cells



Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)	Dew Tempe (
1013.85	85	25.00	23.83	5.0	
1012.71	95	24.89	23.82	5.0	
1011.90	102	24.			
1011.12	109	24.			
1010.34	115	24.			
1009.57	122	24.			
1008.77	129	24.			
1008.03	135	24.			
1007.29	142	24.			
1006.55	148	24.			
1005.80	155	24.			
1005.06	161	24.			
1004.32	167	24.			
1003.58	174	24.			
1002.84	180	24.			
1002.10	187	24.48	24.30	5.0	

Exhibit 5-6 Applying User Edits



Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)
1013.85	85	25.00	23.83	5.0
1012.71	95	24.97	23.89	5.0
1011.90	102	24.93	23.92	5.0
1011.12	109	24.90	23.96	5.0
1010.34	115	24.86	23.99	5.0
1009.57	122	24.83	24.02	5.0
1008.77	129	24.79	24.05	5.0
1008.03	135	24.76	24.08	5.0
1007.29	142	24.72	24.10	5.0
1006.55	148	24.69	24.13	5.0
1005.80	155	24.65	24.16	5.0
1005.06	161	24.62	24.19	5.0
1004.32	167	24.58	24.22	5.0
1003.58	174	24.55	24.24	5.0
1002.84	180	24.51	24.27	5.0
1002.10	187	24.48	24.30	5.0

Exhibit 5-7 Marked Data

5.1.3.2 To UnMark data in the Processed Tabular Display, follow these steps:

1. UnMarking data requires the Processed Tabular Display to be switched to Edit Mode. To switch to Edit Mode, right click in the Processed Tabular Display and select **Switch to Edit Mode** from the menu (Exhibit 5-4). The Processed Tabular Display will indicate edit mode by changing the color of the column header titles to red.

2. To UnMark data, left click and drag over the data cells in which changes are desired. The

UnMarked cells background color will change to white.

3. To finalize these changes, right click in the Processed Tabular Display and select **Apply User Edits** (Exhibit 5-6). Once the User Edits are applied, the UnMarked cells will have a white background. Chapters 5 and 11 contain more details on marking data.

4. Sometimes it may be necessary to Mark **all** the sounding data (including winds) in the erroneous layer. This can be done by clicking and holding the cursor on the Elapsed Time data column and dragging down the cursor to highlight and mark all erroneous data cells (Exhibit 5-8). See step 3 to Apply User Edits.

Processed Tabular Display

Elapsed Time (Minutes)	Time Stamp (UTC)	Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)	Dewpoint Temperature (C)
5.98	02:45:31	837.43	837.45	1663	14.10	29.03	60.1	6.49
6.00	02:45:32	837.23	837.05	1667	14.07	29.03	60.9	6.64
6.02	02:45:33	836.69	836.66	1671	14.04	29.04	61.9	6.85
6.03	02:45:34	836.39	836.29	1675	14.01	29.06	62.2	6.90
6.05	02:45:35	835.82	835.90	1679	14.00	29.09	63.8	7.26
6.07	02:45:36	835.43	835.53	1683	13.99	29.11	63.7	7.23
6.08	02:45:37	834.93	835.17	1686	14.00	29.16	64.3	7.37
6.10	02:45:38	834.73	834.78	1690	14.01	29.21	64.1	7.34
6.12	02:45:39	834.35	834.40	1694	14.01	29.25	64.3	7.39
6.13	02:45:40	834.04	834.02	1698	14.00	29.28	64.7	7.47
6.15	02:45:41	833.81	833.68	1701	13.95	29.27	64.7	7.42
6.17	02:45:42	833.40	833.33	1705	13.88	29.22	65.3	7.49
6.18	02:45:43	832.97	832.99	1708	13.80	29.18	65.8	7.52
6.20	02:45:44	832.56	832.64	1712	13.75	29.15	66.6	7.65
6.22	02:45:45	832.16	832.28	1715	13.73	29.17	66.3	7.56
6.23	02:45:46	832.04	831.92	1719	13.71	29.20	66.5	7.60
6.25	02:45:47	831.66	831.54	1723	13.69	29.21	66.4	7.55
6.27	02:45:48	831.17	831.16	1727	13.66	29.22	66.6	7.57
6.28	02:45:49	830.82	830.78	1731	13.63	29.23	66.8	7.58
6.30	02:45:50	830.48	830.41	1735	13.64	29.27	66.6	7.54
6.32	02:45:51	830.03	830.04	1738	13.66	29.33	66.6	7.57
6.33	02:45:52	829.64	829.63	1742	13.68	29.39	66.7	7.60
6.35	02:45:53	829.18	829.23	1747	13.65	29.41	66.8	7.60
6.37	02:45:54	828.80	828.82	1751	13.63	29.42	67.4	7.71
6.38	02:45:55	828.49	828.41	1755	13.60	29.44	67.8	7.77
6.40	02:45:56	828.08	827.99	1759	13.58	29.46	67.9	7.77
6.42	02:45:57	827.55	827.57	1763	13.50	29.42	68.0	7.72
6.43	02:45:58	827.24	827.15	1768	13.43	29.39	68.0	7.65
6.45	02:45:59	826.75	826.75	1772	13.37	29.37	68.6	7.73
6.47	02:46:00	826.29	826.34	1776	13.30	29.34	68.6	7.66
6.48	02:46:01	825.84	825.94	1780	13.22	29.30	68.5	7.56

Exhibit 5-8: Marking all sounding data in a layer.

5.1.3.3 To Mark data in the RWS Plots, follow these steps:

1. Marking data requires the plot to be switch into Edit Mode. To switch to Edit Mode, right click in the Plot and select **Switch to Edit Mode** from the menu or the keyboard shortcut **Ctrl E** (Exhibit 5-9).

2. RWS will indicate Edit Mode in the bottom left of the Plot and by a highlighted eraser in the toolbar (Exhibit 5-10A and B).

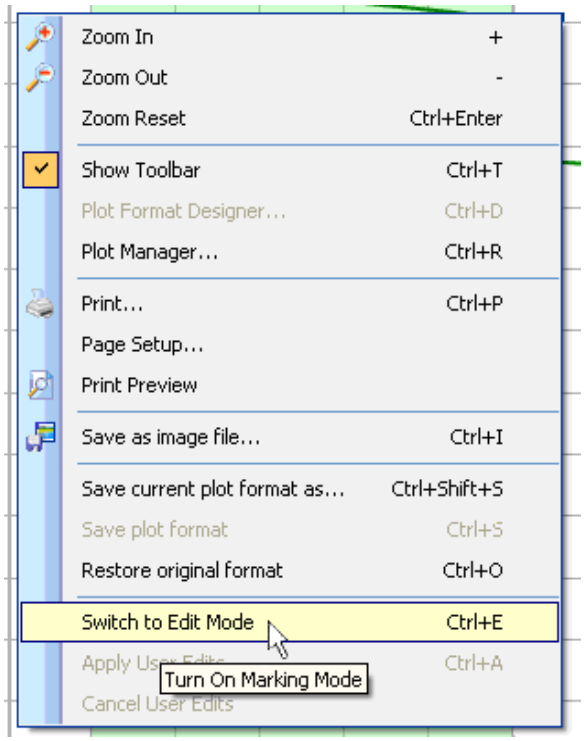


Exhibit 5-9: Switch to Edit Mode

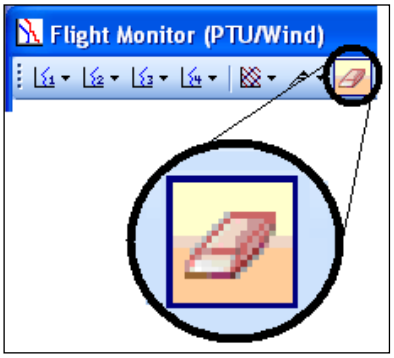


Exhibit 5-10 A: Edit Mode Indicator (Toolbar)

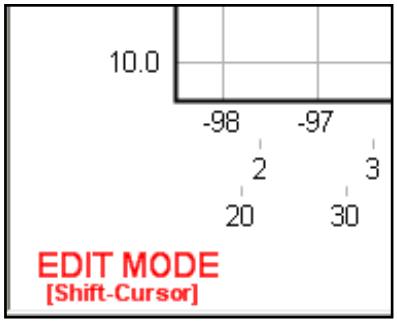


Exhibit 5-10 B: Edit Mode Indicator (Plot)

3. To Mark/UnMark data, press and hold the **Shift** key. Then, click and hold the left mouse button, while dragging a box over the data lines to be Marked (Exhibit 5-11).

4. When the box is over the data lines to be Marked, release the left mouse button and Shift key. The area will change color to indicate it has been selected to be Marked (Exhibit 5-12). A line drawn between the surrounding unmarked points will appear if the selected data amount is less than 1 minute.

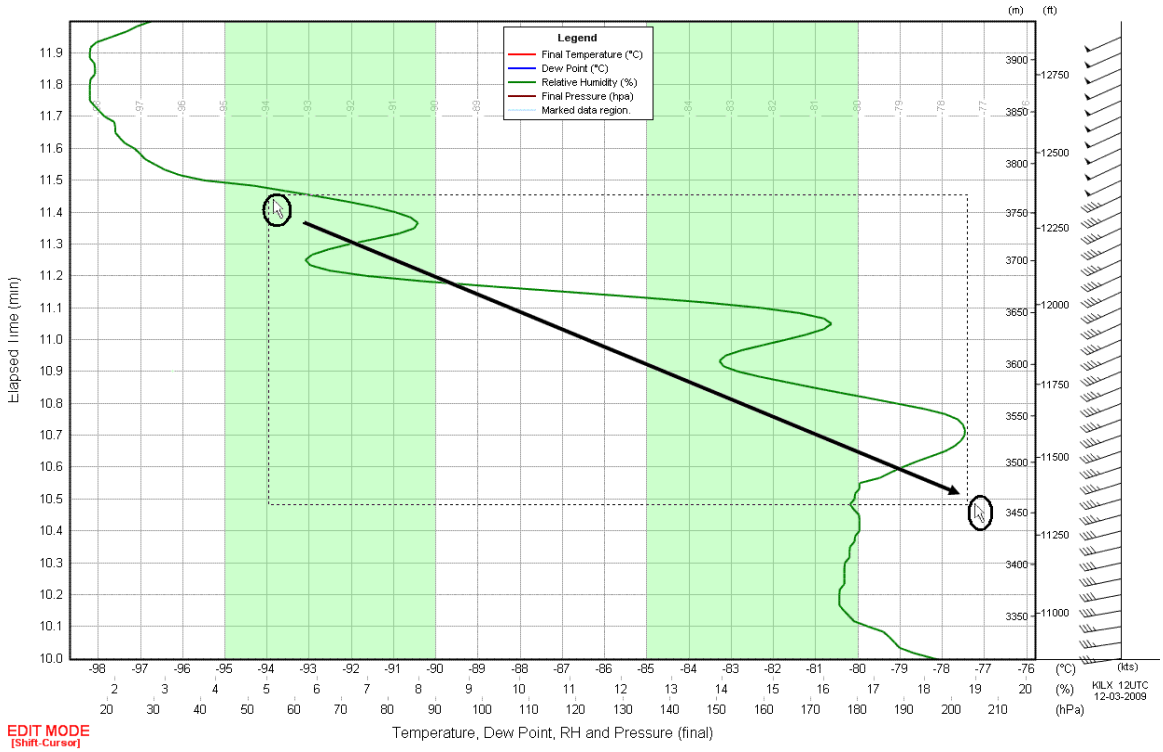


Exhibit 5-11: Highlighting plot data to be Marked.

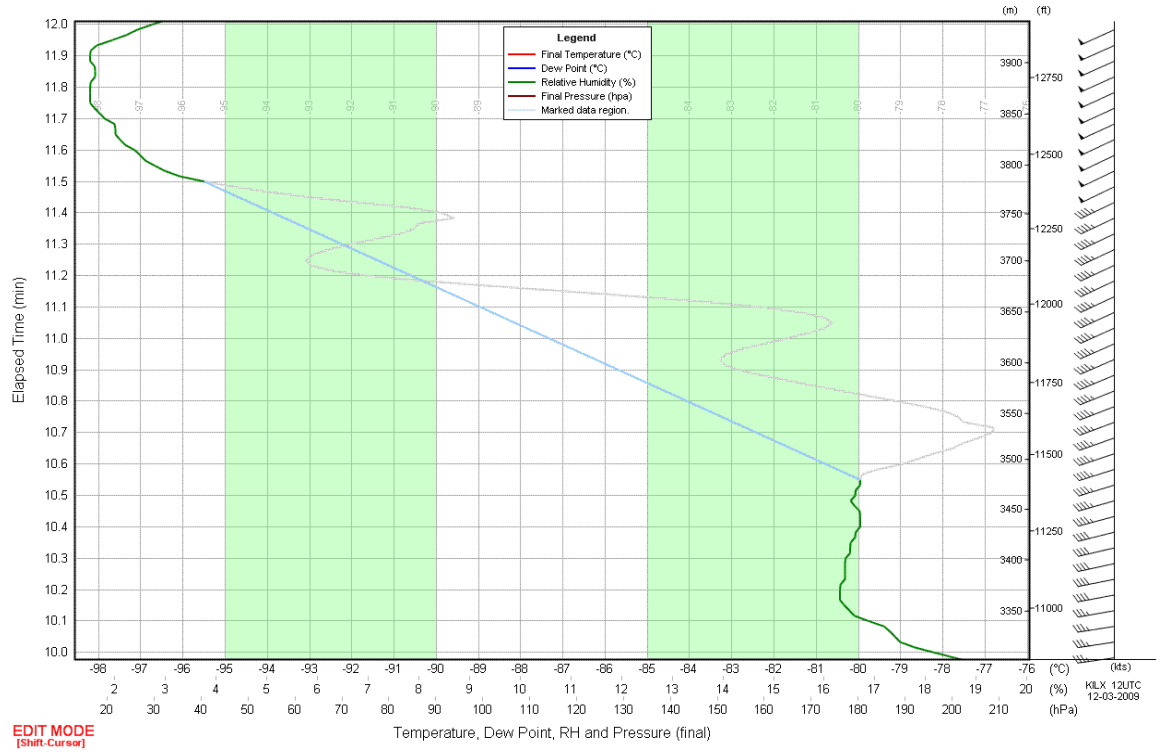


Exhibit 5-12: Highlighting plot data and Interpolated data.

5. To finalize these changes, right mouse click in the Plot and select **Apply User Edits** (Exhibit 5-13). Once the User Edits are applied, an interpolated data line will replace the original data (Exhibit 5-14).

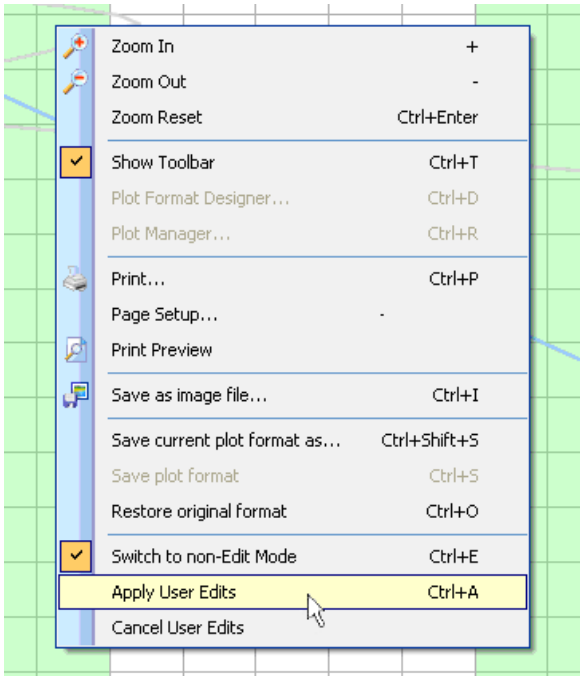


Exhibit 5-13: Apply User Edits

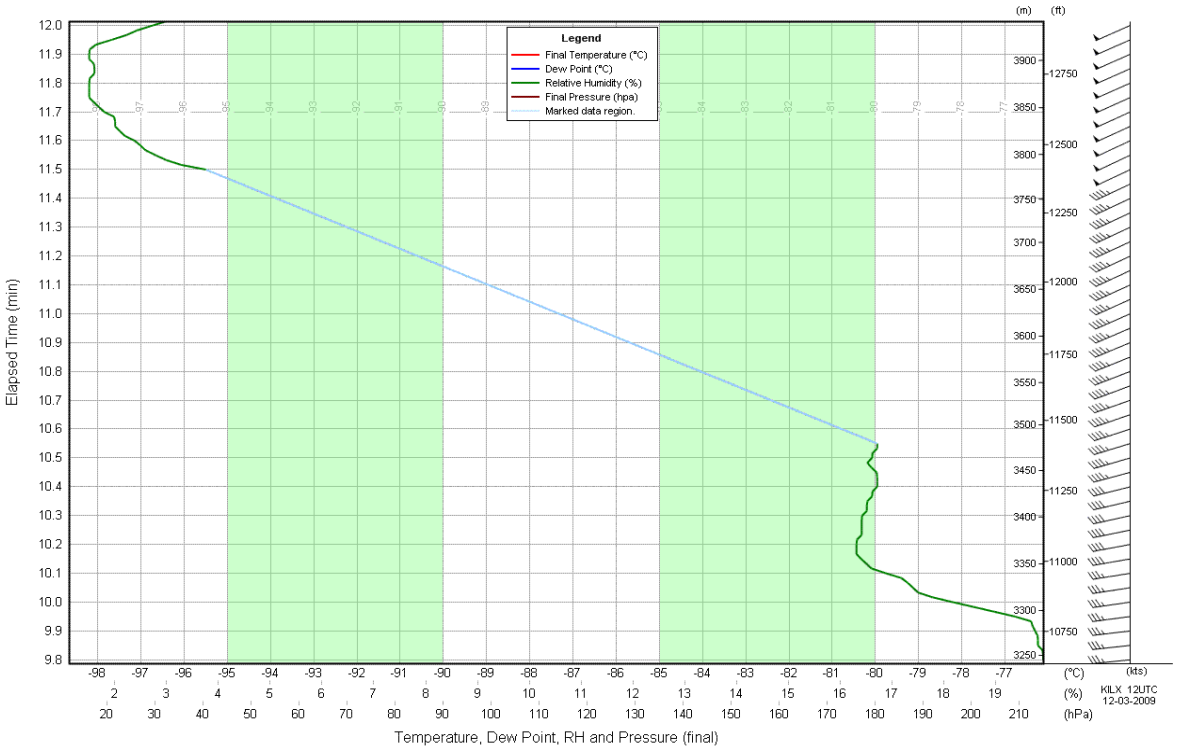


Exhibit 5-14: Plot with User edits applied.

5.1.3.4 To UnMark/Restore data in the RWS Plots, follow these steps:

1. Marking data requires the plot to be switched into Edit Mode. To switch to Edit Mode by right clicking in the Plot and select **Switch to Edit Mode** from the menu or the keyboard shortcut **Ctrl E** (Exhibit 5-15).

2. RWS will indicate Edit Mode in the bottom left of the Plot and by a highlighted eraser in the toolbar (Exhibit 5-16A and B).

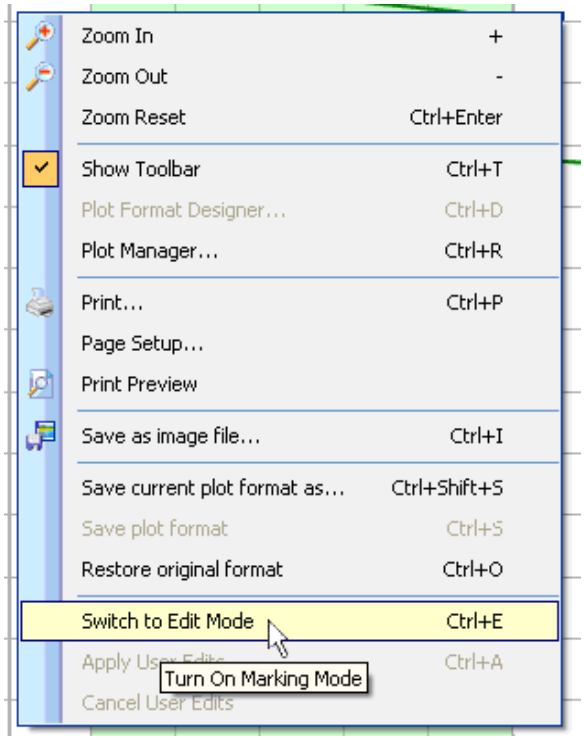


Exhibit 5-15: Switch to Edit Mode

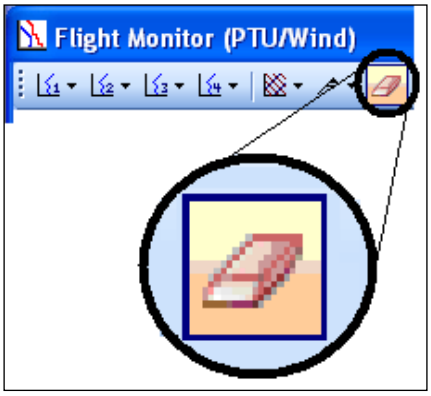


Exhibit 5-16 A: Edit Mode Indicator (Toolbar)

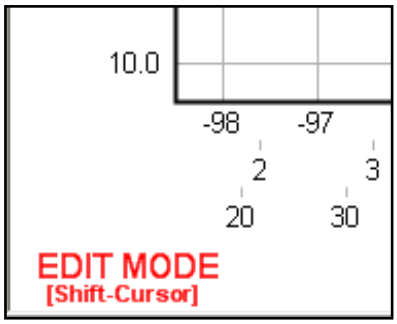


Exhibit 5-16 B: Edit Mode Indicator (Plot)

3. To UnMark data, press and hold the **Shift** key. Then, click and hold the left mouse button, while dragging a box over the data lines to be Marked (Exhibit 5-17).

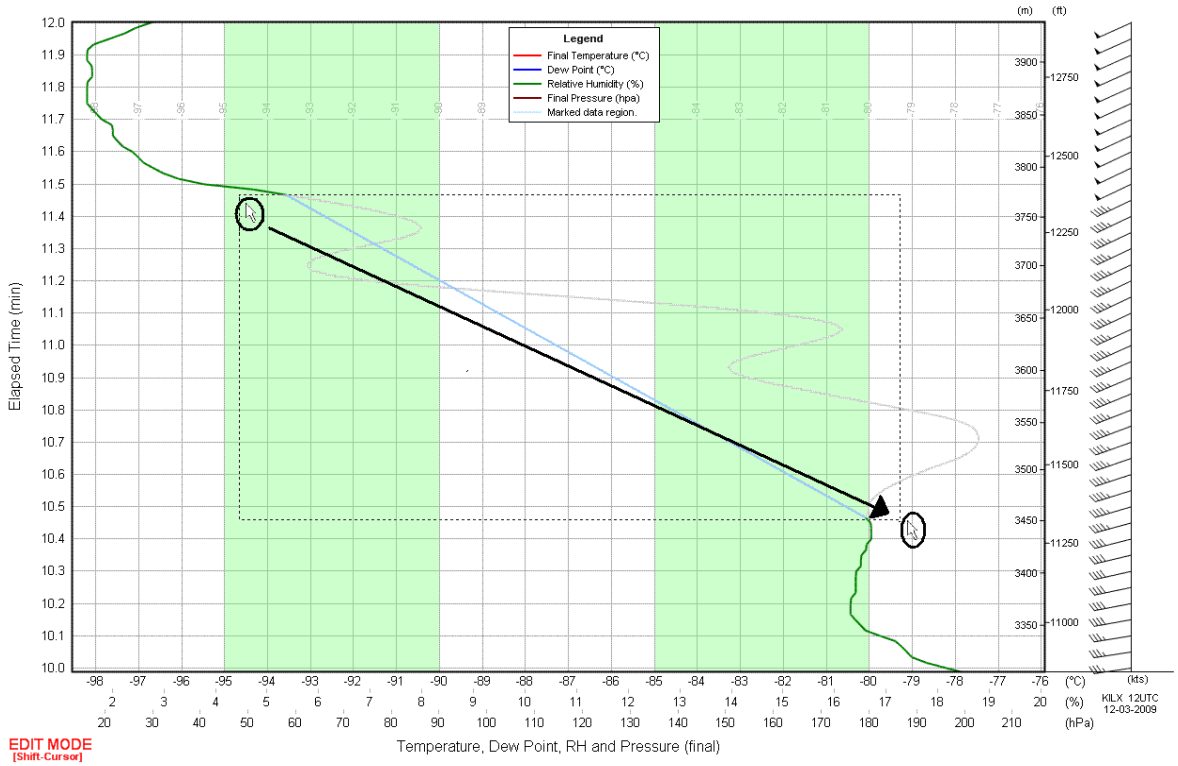


Exhibit 5-17: Highlighting plot data to be UnMarked.

4. When the box includes the data lines to be unmark, release the left mouse button and Shift key. A Data Marking Options display will appear when the user's intentions are ambiguous (both unmarked and marked data is included in the box, or multiple parameters are included). This allows the user to enclose the area to unmark without hitting the exact boundary points (Exhibit 5-18).

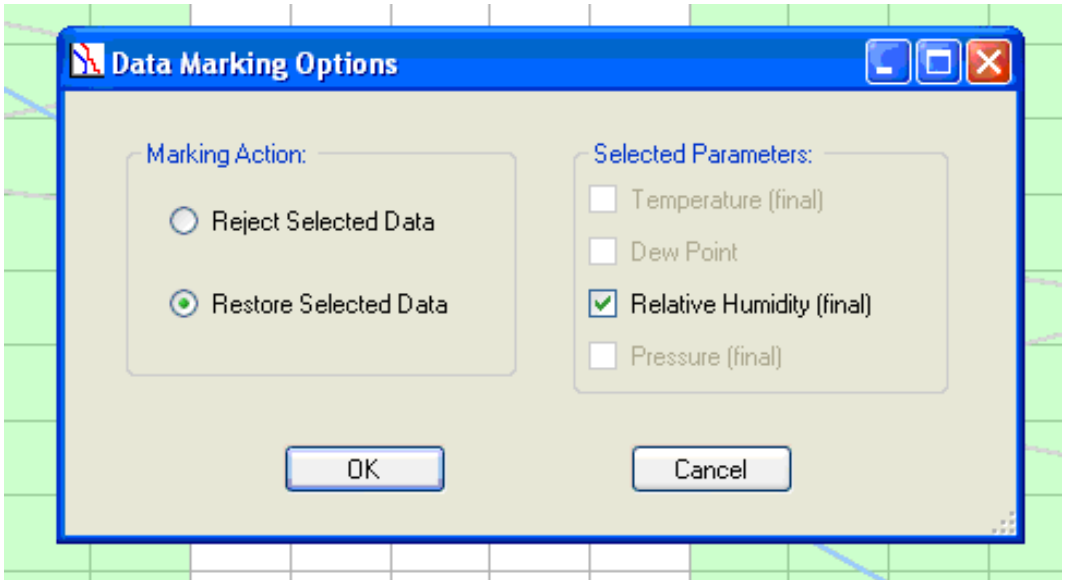


Exhibit 5-18: Highlighting plot data and Interpolated data.

5. Select the **Restore Selected Data** under *Marking Action* section. Select the appropriate parameter (e.g. Temperature, RH, ect..) under the *Selected Parameters* section. The Plot will restore the original data.

NOTE: Selecting Reject Selected Data in the Data Marking Options display will extend the Marking of data to any unmarked data within the box.

6. To finalize these changes, right mouse click in the plot and select **Apply User Edits** (Exhibit 5-19). Once the User Edits are applied, the plot will refresh (Exhibit 5-20).

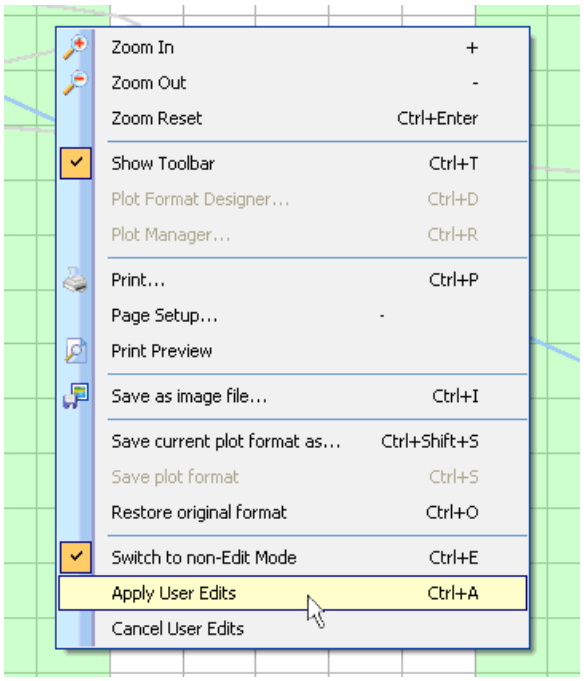


Exhibit 5-19: Apply User Edits

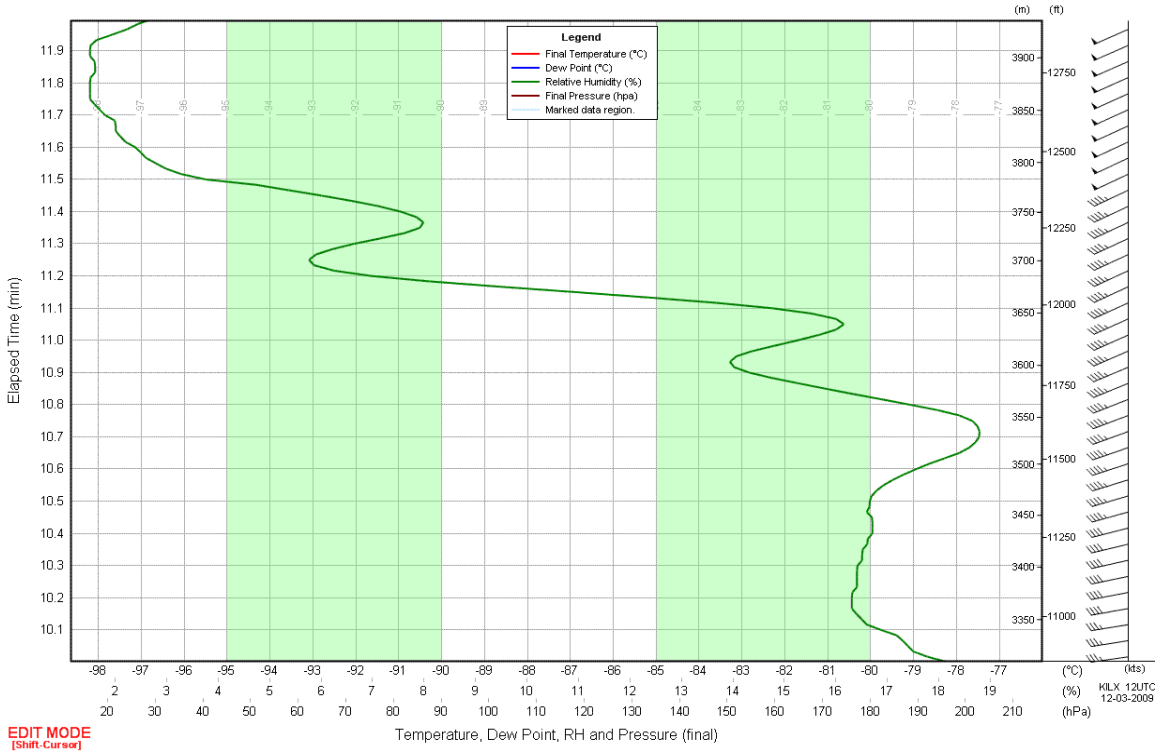


Exhibit 5-20: Plot with User edits applied.

5.2 Checking Sounding Data Quality

It is very important to start reviewing the sounding data shortly after release and thereafter to ensure that the radiosonde is working correctly. While reviewing the tabular data is helpful, examining each data plot is a quick way to check sounding data quality

IMPORTANT: Make sure to read Chapter 13 to understand significant data problems that can occur and how to handle them.

5.2.1 Pressure Data

Follow these steps to check the pressure profile:

1. Review the pressure profile for the first ten minutes of the flight. It should be a smooth curve with a slightly concave shape. Exhibit 5-21 shows an example of this profile.

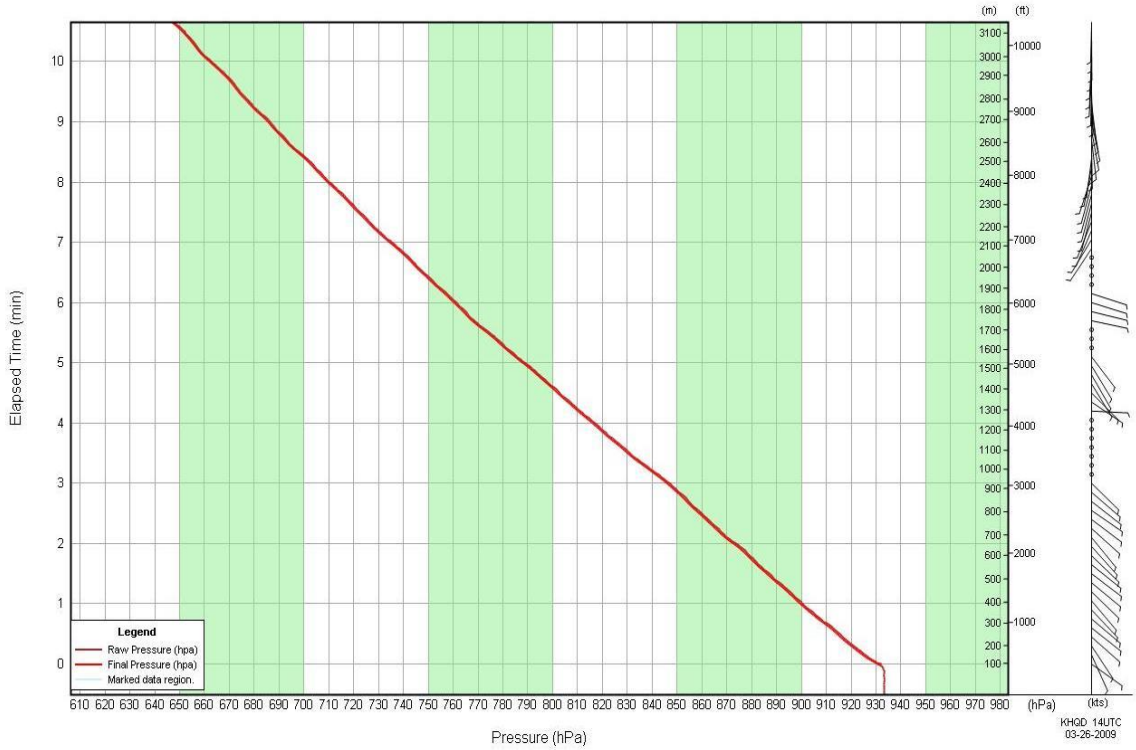


Exhibit 5-21: Pressure data plot for the first 10 minutes of the sounding

2. As the sounding proceeds to balloon burst, continue to monitor the pressure data. At balloon burst, the complete pressure profile will have taken on a smooth, logarithmic curve. Exhibit 5-22A shows a typical example.

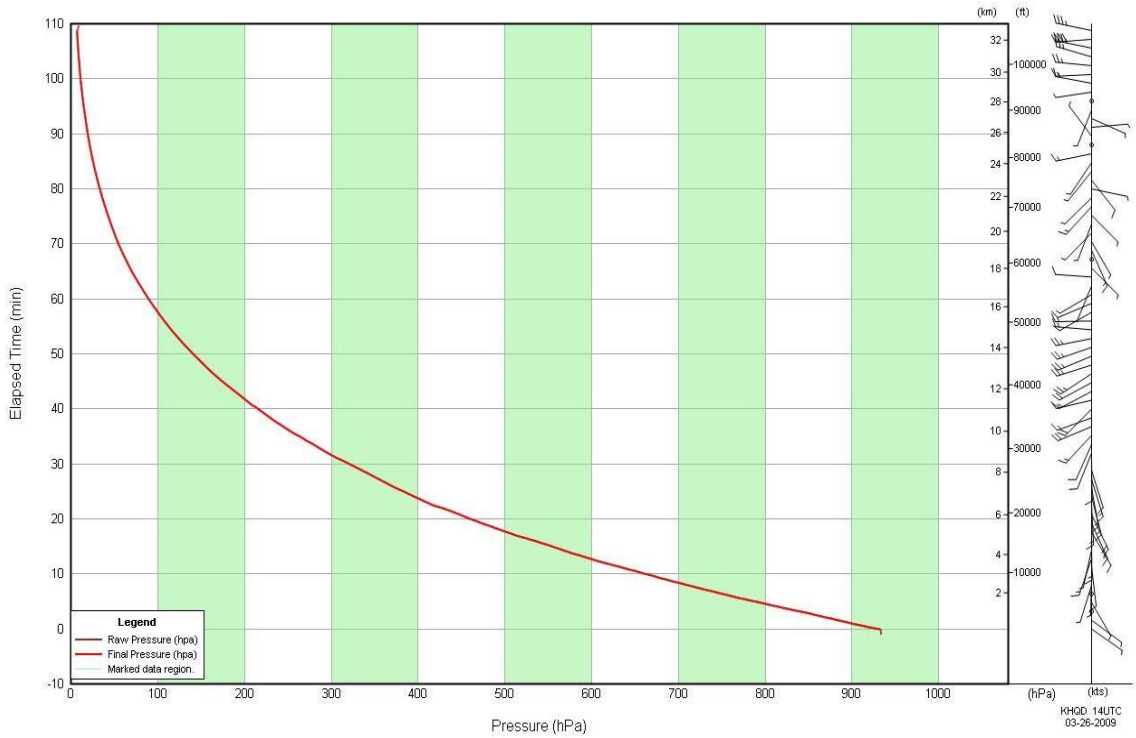


Exhibit 5-22 A: Pressure data plot for an entire sounding

3. The Pressure, Ascension Rate , Height Plot and Check Messages can be used to identify erroneous pressure data. The Pressure Plot can be useful in identifying some situations, such as abrupt pressure jumps off surface, wavy pressure, or pressure spikes.
4. The Check Messages will indicate unusual ascent rates and height changes from the previous sounding.

The Ascension Rate or Height Plot can be used to identify a leaking pressure cell, leaking balloon or other atmospheric phenomena. Ascent Rate Plots typically have gradual oscillations near 5 m/s (Exhibit 5-22 B). Large oscillations in ascent rate can be indications of turbulence or gravity waves (Exhibit 5-22 C), while deviations between the Ascension Rate and GPS Ascension Rate can indicate a leaking pressure sensor. See Chapter 13 for more information on pressure data and ascent rates. It is worthy to note that the ascent rate plot has shown promise in identifying layers of turbulence that affect commercial aircraft (Ref: http://www.nwas.org/jom/articles/2014/2014-JOM5/2014-JOM5.pdf

IMPORTANT: The heights derived from the pressure and GPS sensor have allowable errors and their data will often not match exactly. This can become noticeable above 50 hPa. Only terminate a sounding owing to a leaking pressure sensor if the criteria noted in Chapter 13 are met.

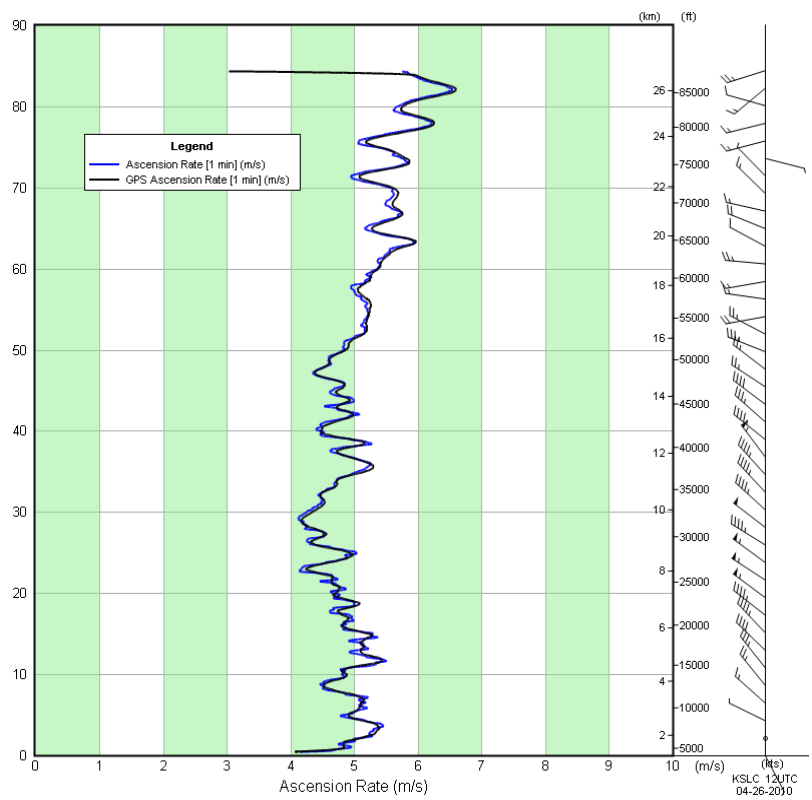


Exhibit 5-22 B: Typical Ascent Rate Plot

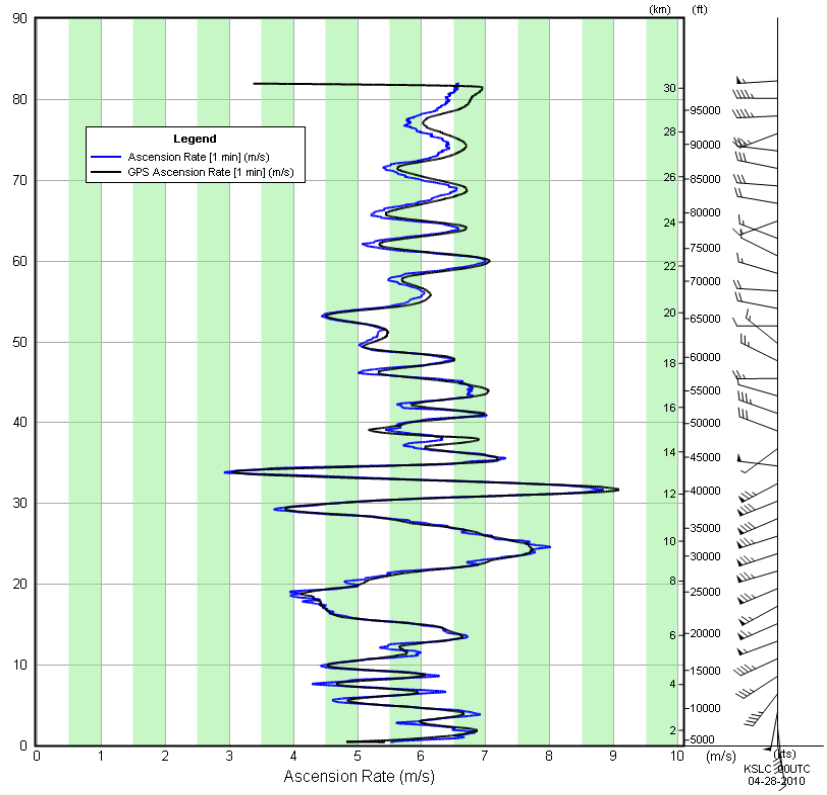


Exhibit 5-22 C: Ascent Rate on a flight with turbulence

IMPORTANT: GPS data from the Vaisala RS-92 radiosonde can be noisy on occasion and results in layers of erratic GPS data in the GPS Geometric heights and ascent rate plots. See Section 13.10 for more information.

5.2.1.1 Typical Features in Pressure Data Profiles

Balloon Burst**:** Balloon burst is automatically detected by the software when the ascent rate changes from ascending to rapidly descending. The Pressure Plot will show the balloon burst level as the point where the smoothed pressure is no longer plotted and the raw pressure is rapidly increasing with time of height. Exhibit 5-23 shows a Pressure Data Plot with the balloon burst occurring at 108.7 minutes and at a pressure of 7 hPa. Chapter 11 describes other possible flight termination reasons.

Wavy pressure profile: If the radiosonde encounters atmospheric turbulence, waves or bumps may appear anywhere in the pressure data profile. In most cases no action needs to be taken. See Chapter 13 for more information on how to handle such data.

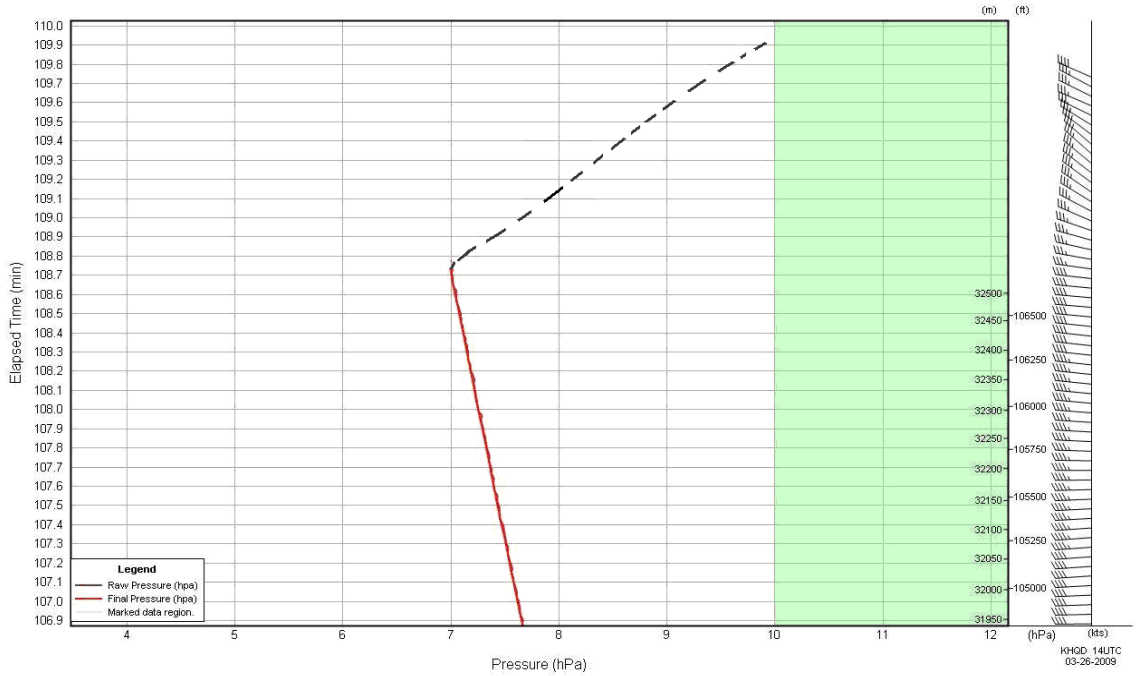


Exhibit 5-23: Typical balloon burst profile as shown in the Pressure Data Plot

5.2.2 Temperature Data

The radiosonde temperature sensor is very sensitive with a fast response time. **Only edit the temperature data if there are data check messages for excessive temperature lapse rates or other related data check messages. See Chapter 13 for more information.**

Follow these steps to check the temperature data:

1. Review the Temperature Data Plot for the first ten minutes of the flight. It may show inversions or decrease at a rate greater than 9.8C/km. This happens routinely with superadiabatic lapse rates off surface. Exhibit 5-24 shows an example of a typical profile for a morning sounding.

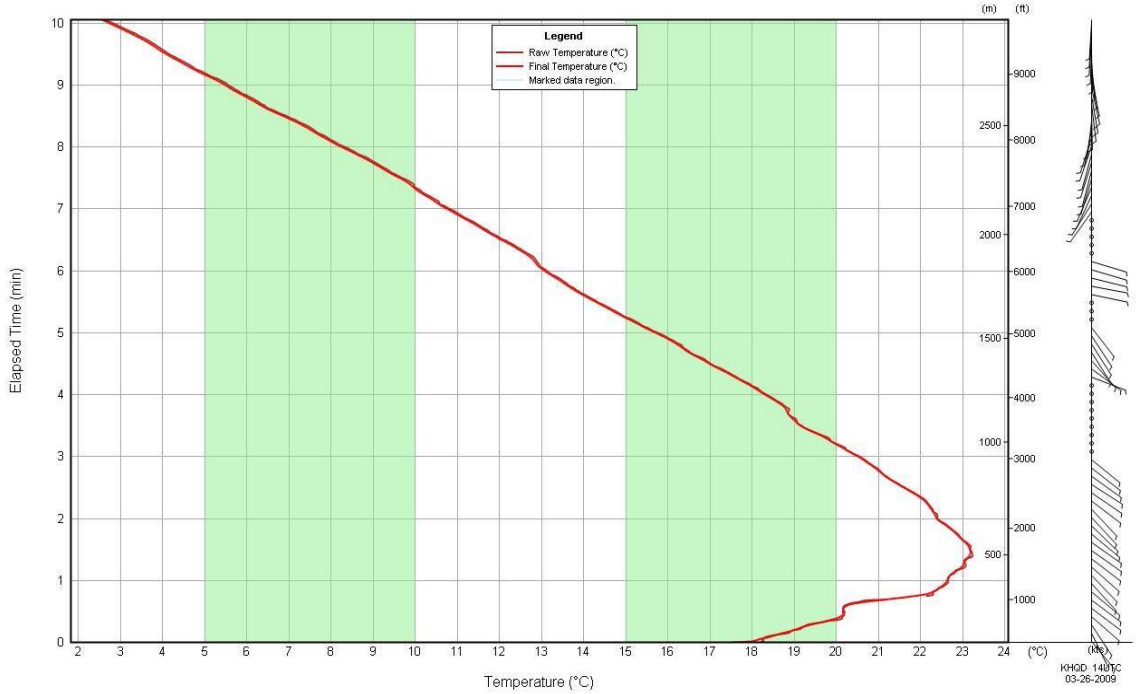


Exhibit 5-24: Typical temperature profile for the first 10 minutes of a sounding

2. As the sounding proceeds, continue to monitor the temperature data. Exhibit 5-25 shows a typical temperature profile from surface to balloon burst

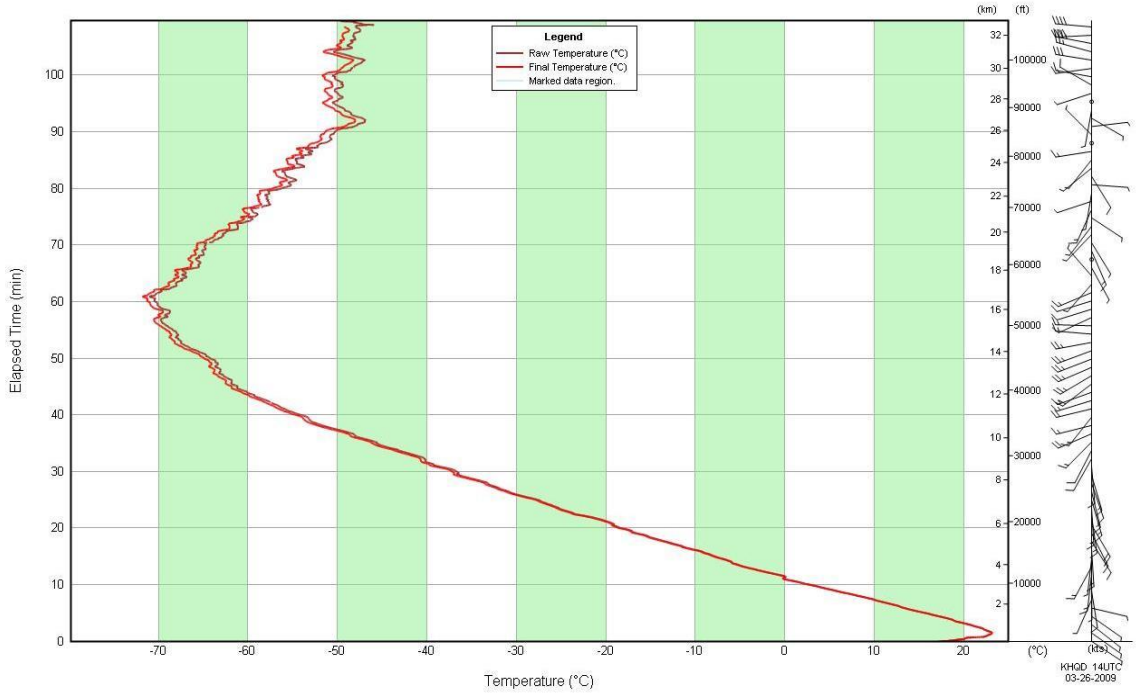


Exhibit 5-25: Typical temperature data profile for entire sounding

3. In some situations, the temperature lapse rate in portions of the sounding will be excessive and Check Messages for these lapse rates will appear. Review the sounding data and Mark the data as necessary. See Chapter 13 for more information.

5.2.2.1 Typical Features in Temperature Data Profiles

Inversions: These are layers where the temperature warms with height. It is not uncommon to see layers aloft where the temperature warmed several degrees or more in only a few seconds. In most cases such inversions are real, but the temperatures in the Raw PTU display may be marked as rejected (see Section 5.2.5 below).

Freezing levels: These are levels where the temperature crosses the 0°C. Exhibit 5-25 shows the freezing level at 11 minutes. During the summer, there is typically just one crossing of the freezing level. In the winter months, it is not uncommon to see 3 or more crossings of the freezing level. Freezing levels selected above 20,000 feet or 7 km are very rare and probably indicate a failure of the temperature sensor. RRS software automatically records the freezing level(s) in the WMO levels table and codes these data in the freezing level or RADAT message.

Tropopause: The tropopause is the level in the atmosphere where troposphere ends and the rate of temperature decrease with height slows or stops. The average height of the tropopause is about 10 km. The height will vary with latitude and time of year. The tropopause is a feature of almost all upper air soundings, although sometimes it is not clearly defined. There will also be cases where 2 or more tropopause levels are identified. Exhibit 5-25 shows the tropopause at about 60 minutes. The software automatically detects and records the tropopause.

Stratosphere: Above the tropopause is the stratosphere where temperatures remain nearly constant or begins increasing with height. It is not uncommon to see the temperature warm to near -40C as the radiosonde reaches 30 km and higher. You will also see more structure or oscillations in the temperature profile compared to that in the troposphere.

NOTE: During daytime soundings, even when the sun is low on the horizon, the *raw* temperature data are often erratic or noisy in appearance starting at about 12 km and higher. This is especially apparent with the Vaisala RS92 radiosonde. If there are no data check messages for lapse rates or other related data check messages, then theses data are acceptable and must not be deleted.

5.2.3 RH data

IMPORTANT: In nearly all cases the RH data should be left as is and not edited. DO NOT EXCESSIVELY DELETE RH DATA. RH is used to calculate heights and excessive, unnessary editing can introduce height errors. See Chapter 13 for more information.

Follow these steps for checking the RH data:

1. Review the RH Plot for the first ten minutes of the flight. Exhibit 5-26 shows an example of a typical RH profile. The profile may show the RH falling or rising with height. If the radiosonde enters a cloud in the lower troposphere the RH will likely exceed 90%.

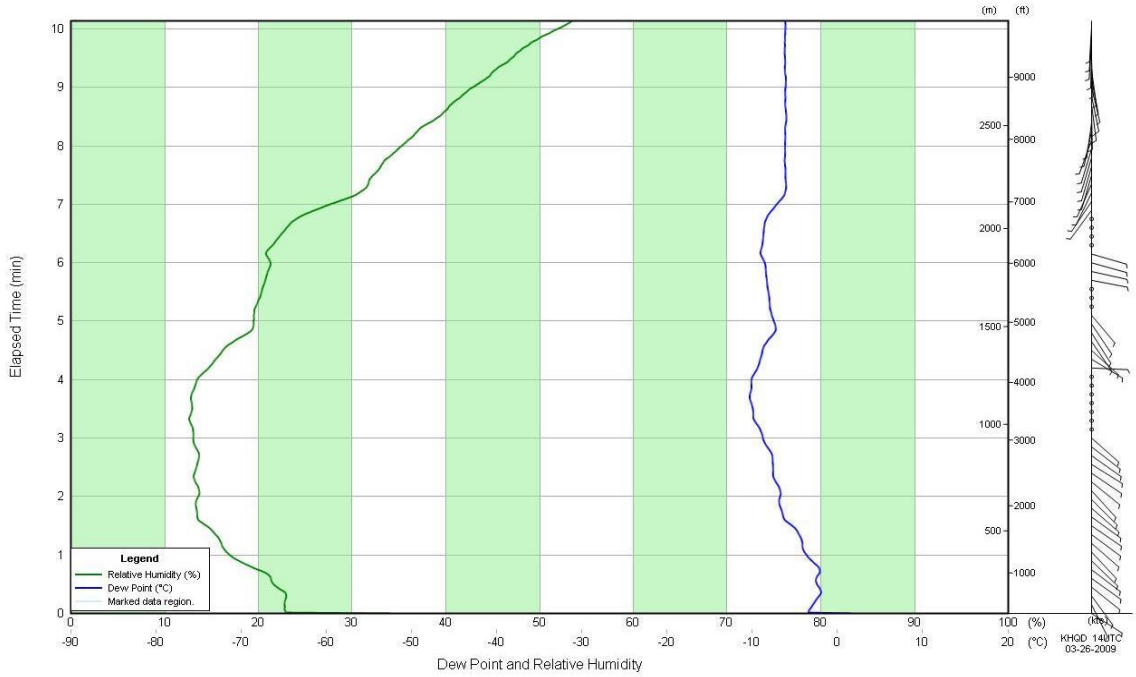


Exhibit 5-26: RH Plot for the first 10 minute of a sounding

2. As the sounding proceeds, continue to monitor the RH data. Exhibit 5-27 shows a typical RH profile from surface to balloon burst.

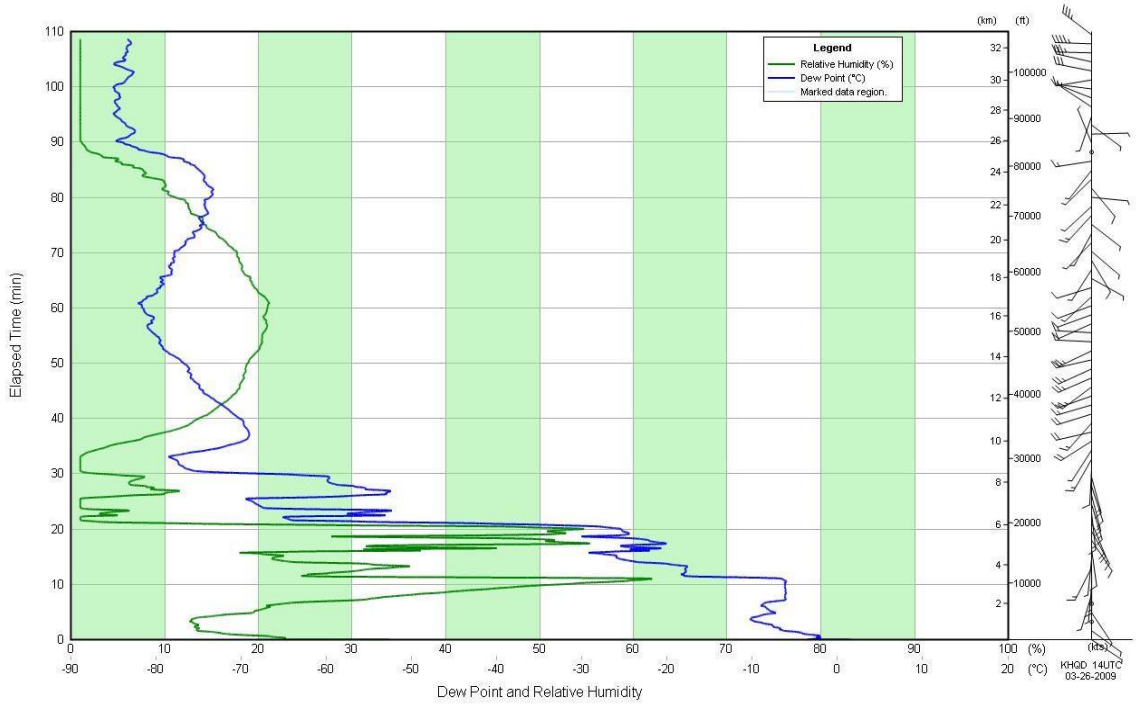


Exhibit 5-27: Example of a RH data profile from surface to flight termination

3. In some situations, the RH will fall by more than 5% just off surface, or is too moist in the stratosphere. You will need to take action on such data problems and review Chapter 13 for more information.

5.2.3.1 Typical Features in Humidity Data Profiles

Relative humidity profiles can change rapidly with height and from one sounding to the next. Inside a cloud the actual RH is not always 100% . In the stratosphere, the air becomes very dry with RH values close to 1%.

IMPORTANT: In nearly all cases the RH data should be left as is and not edited. DO NOT EXCESSIVELY DELETE RH DATA. See Chapter 13 for more information.

Other features that may be seen include:

Abrupt RH change off surface: Occasionally, the transition from the surface RH to the radiosonde RH data is not smooth. Exhibit 5-28 is an example of the temporary dry bias near the surface. A dry bias can occur when the radiosonde humidity sensor is not adequately ventilated during the first few seconds after release. Typically, the dry bias gradually disappears within the first minute after release. The RH data near the surface should be marked if a dry bias is more than 5% just off surface. See Chapter 13 for more information. Other times the RH will abruptly increase off the surface . Review Chapter 13 on how to handle the data if the change in RH exceeds 5%.

Rapid changes in RH aloft: Sometimes the RH will change rapidly with height in the atmosphere. The Vaisala RS92 radiosonde uses a very sensitive RH sensor that can detect very shallow layers of moist or dry air. Exhibit 5-29 shows a RH plot from a Vaisala RS92 radiosonde with rapidly changing RH data with altitude. These data are acceptable. Also note in Exhibit 5-29 that the RH is near 1% above 13,000 meters. RH typically falls to near 1% above 200 hPa and such data should be left as is.

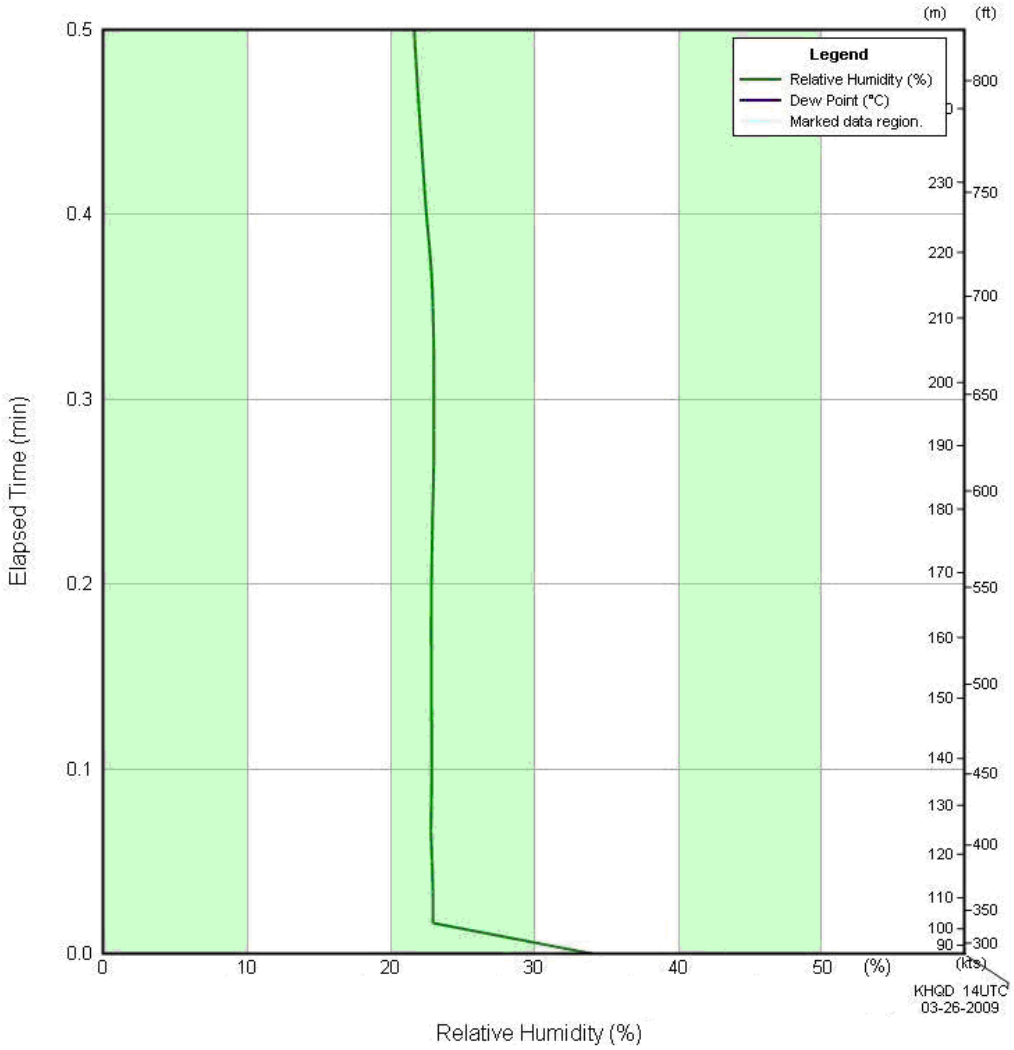


Exhibit 5-28 RH Dry Bias near surface

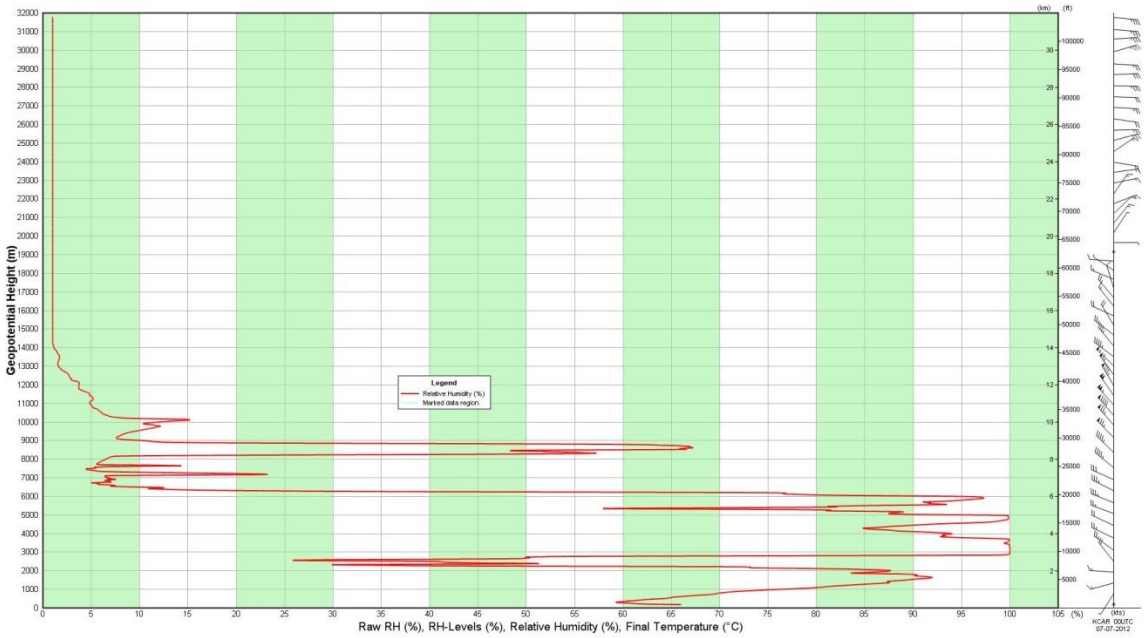


Exhibit 5-29: Rapidly changing RH data aloft. These data are acceptable.

5.2.4 Wind Data

Winds derived from GPS are typically very accurate and it is rare that there will be problems with the data.

<u>IMPORTANT:</u> In nearly all cases the wind data should be left as is and not edited. DO NOT EXCESSIVELY DELETE WIND DATA. See Chapter 13 for more information.

Follow these steps for checking the wind data:

1. For the most part the accuracy of the winds is rarely a problem and edits to the data should not be done.. Review the Wind Data Plot for the first ten minutes of the flight. Exhibit 5-29 shows an example of a typical wind profile near the surface.

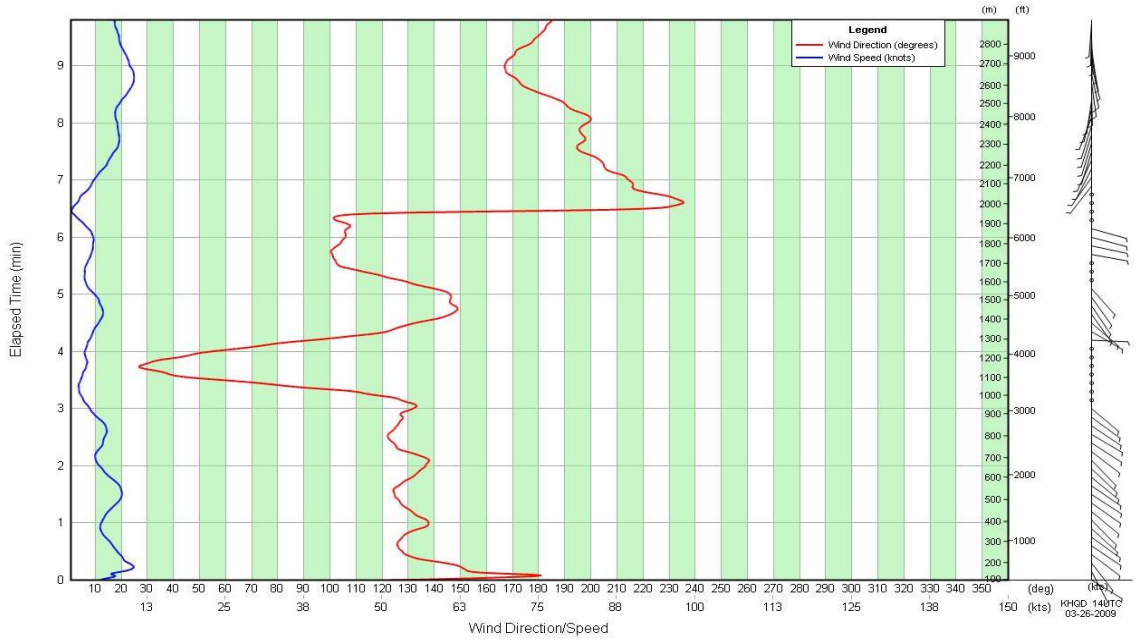


Exhibit 5-29: Example of a wind data profile from surface to 10 minutes

2. As the sounding proceeds, continue to monitor the wind data. Exhibit 5-30 shows a typical wind profile during the winter months from surface to balloon burst.

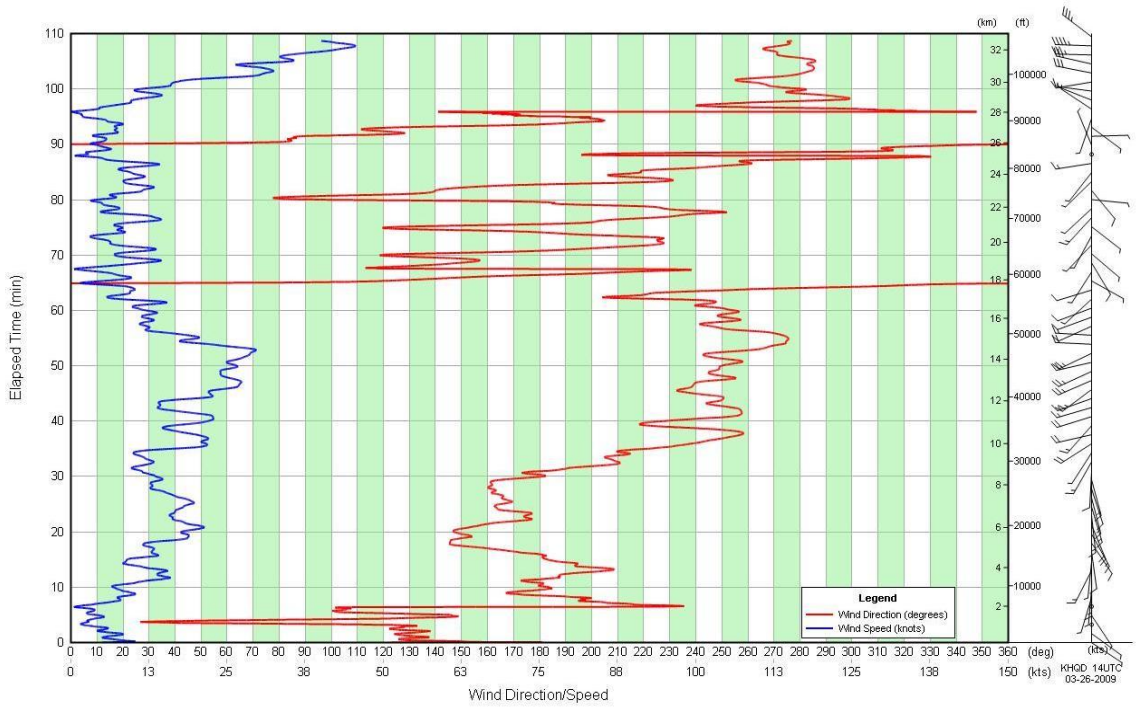


Exhibit 5-30: Example of a wind data profile from surface to balloon burst

NOTE: If the winds are missing for more than 5 minutes or look suspicious review Chapter 13 for more information.

5.2.4.1 Typical Features in Wind Data profiles

Jet Stream Winds: Jet streams are narrow bands of high speed winds that meander around the Earth at altitudes ranging from 10 to 15 km. These high speed winds are generally 2 to 3 km thick and can be hundreds of km wide. While not common, maximum wind speeds within jet streams can exceed 225 knots and are strongest during the winter and spring months. The RRS software records the highest winds and will generate a Check Message if wind speeds exceed 180 knots.

Stratospheric winds: In the stratosphere, winds speeds and directions can vary significantly from what was measured in the troposphere.

5.2.5 Missing Data

5.2.5.1 Missing and Rejected Raw PTU Data

In the Raw PTU Tabular Display, yellow cells indicate that no data was received by the radiosonde (Exhibit 5-31). The PTU data from the radiosonde may become missing during the flight for a variety of reasons. If the (pressure and/or temperature) data from the radiosonde becomes missing continuously for a minute, an audible alarm will sound and a pop-up message will appear. The flight will terminate if missing temperature data reaches 3 consecutive minutes and 10 consecutive minutes for missing pressure. If you hear an alarm or you see significant missing data, see Chapter 13 - Troubleshooting on how to handle this situation.

Received PTU Tabular Display

Elapsed Time (min)	Time Stamp (UTC)	Raw Pressure (hPa)	Pressure QI	Raw Temp (C)	Temp QI	Raw RH (%)	RH QI
80.45	19:06:35.430	36.38	100.00	-54.12	100.00	8.1	100.00
80.47	19:06:36.531	36.34	100.00	-54.19	100.00	8.1	100.00
80.48	19:06:37.531	36.32	100.00	-54.18	100.00	8.0	100.00
80.50	19:06:38.531	36.29	100.00	-54.20	100.00	8.0	100.00
80.55	19:06:41.531		0.00		0.00		0.00
80.60	19:06:44.531		0.00		0.00		0.00
80.65	19:06:47.530		0.00		0.00		0.00
80.68	19:06:49.531	36.02	100.00	-53.78	100.00	8.8	100.00
80.70	19:06:50.531	35.99	100.00	-53.78	100.00	8.8	100.00
80.72	19:06:51.530	35.93	100.00	-53.74	100.00	7.8	100.00
80.73	19:06:52.531	35.89	100.00	-53.55	100.00	7.6	100.00
80.78	19:06:55.531		0.00		0.00		0.00
80.83	19:06:58.530		0.00		0.00		0.00
80.88	19:07:01.531		0.00		0.00		0.00
80.93	19:07:04.430	35.57	100.00	-53.99	100.00	8.9	100.00
80.95	19:07:05.531	35.50	100.00	-53.96	100.00	8.9	100.00
81.00	19:07:08.531		0.00		0.00		0.00
81.05	19:07:11.531		0.00		0.00		0.00
81.10	19:07:14.530		0.00		0.00		0.00
81.15	19:07:17.530		0.00		0.00		0.00
81.20	19:07:20.531		0.00		0.00		0.00
81.25	19:07:23.531		0.00		0.00		0.00
81.30	19:07:26.531		0.00		0.00		0.00

Exhibit 5-31: Missing data in the Raw PTU Tabular Display

Data cells highlighted in red in the Raw PTU indicate that the data were rejected by a software outlier removal algorithm. These data will not be used in the Processed Tabular data and can not be restored by the observer. Rejected data (and missing data) cells are often seen just prior to release and after balloon burst. Exhibit 5-32 shows typical Raw PTU data at Balloon Burst. Rejected temperature data cells may also occur if the temperature cools or warms abruptly with time or height.

NOTE: Upon receiving the one minute of missing data warning, the observer should first check the frequency in the TRS Display. If it has changed by more than 0.02 MHz, turn the AFC OFF, set the frequency back to the baseline frequency and turn AFC ON. If the missing data continues, ensure the TRS is tracking the radiosonde.

Received PTU Tabular Display

Elapsed Time (min)	Time Stamp (UTC)	Raw Pressure (hPa)	Pressure QI	Raw Temp (C)	Temp QI	Raw RH (%)	RH QI
100.34	19:16:59.653	7.24	100.00	-29.22	100.00	0.0	100.00
100.36	19:17:00.653	7.27	100.00	-29.16	100.00	0.0	100.00
100.38	19:17:01.653	7.28	100.00	-29.22	100.00	0.0	100.00
100.39	19:17:02.653	7.29	100.00	-29.34	100.00	0.0	100.00
100.40	19:17:03.053	7.34	100.00	-29.44	100.00	0.0	100.00
100.43	19:17:04.652	7.34	100.00	-29.54	100.00	0.0	100.00
100.44	19:17:05.653	7.37	100.00	-29.63	100.00	0.0	100.00
100.46	19:17:06.552	7.44	100.00	-29.59	100.00	0.0	100.00
100.47	19:17:07.552	7.54	100.00	-29.61	100.00	0.0	100.00
100.49	19:17:08.652	7.60	100.00	-29.86	100.00	0.0	100.00
100.51	19:17:09.653	7.63	100.00	-30.18	100.00	0.0	100.00
100.53	19:17:10.653	7.73	100.00	-30.36	100.00	0.0	100.00
100.54	19:17:11.552	7.77	100.00	-30.51	100.00	0.0	100.00
100.56	19:17:12.653	7.88	100.00	-30.46	100.00	0.0	100.00
100.58	19:17:13.653	7.95	100.00	-30.39	100.00	0.0	100.00
100.59	19:17:14.653	8.13	100.00	-30.31	100.00	0.0	100.00
100.61	19:17:15.653	8.18	100.00	-30.42	100.00	0.0	100.00
100.63	19:17:16.653	8.29	100.00	-30.54	100.00	0.0	100.00
100.64	19:17:17.653	8.35	100.00	-31.14	100.00	0.0	100.00
100.66	19:17:18.653	8.48	100.00	-31.90	100.00	0.0	100.00
100.68	19:17:19.653	8.61	100.00	-32.57	100.00	0.0	100.00
100.69	19:17:20.653	8.67	100.00	-33.24	100.00	0.0	100.00
100.71	19:17:21.653	8.76	100.00	-34.16	100.00	0.0	100.00

Exhibit 5-32: Rejected data in the Raw PTU Tabular Display at balloon burst

5.2.5.2 Missing/Rejected PTU Processed Data

More than one minute of missing data in the Raw PTU tabular display will result in a corresponding layer of missing data (and associated derived data) in the Processed Tabular data (colored red). The Smoothed Pressure will continue to display interpolated values through the strata of the missing data.

NOTE: In the Processed Tabular Display, the ascension rate and temperature lapse rate data will be missing for a short time after release. The ascent rate and temperature lapse rate columns will be populated once enough flight data has been collected to calculate these parameters.

The wind direction, speed data and u & v wind components will be interpolated if there is less than one minute of missing GPS data. If there is more than one minute of missing GPS data, the wind direction, speed and u & v wind components will be displayed as missing. The latitude, longitude, geometric height and arc distance data might not be affected depending on the extent of the missing GPS data.

5.2.5.3 Missing Data Appearing in Plots

If the temperature, RH or winds data is missing (or observer deleted) for more than 1 minute the associated data plot will show gaps where the missing data occurred. Exhibit 5-33 is an example of a data gap in the temperature and RH Data Plot.

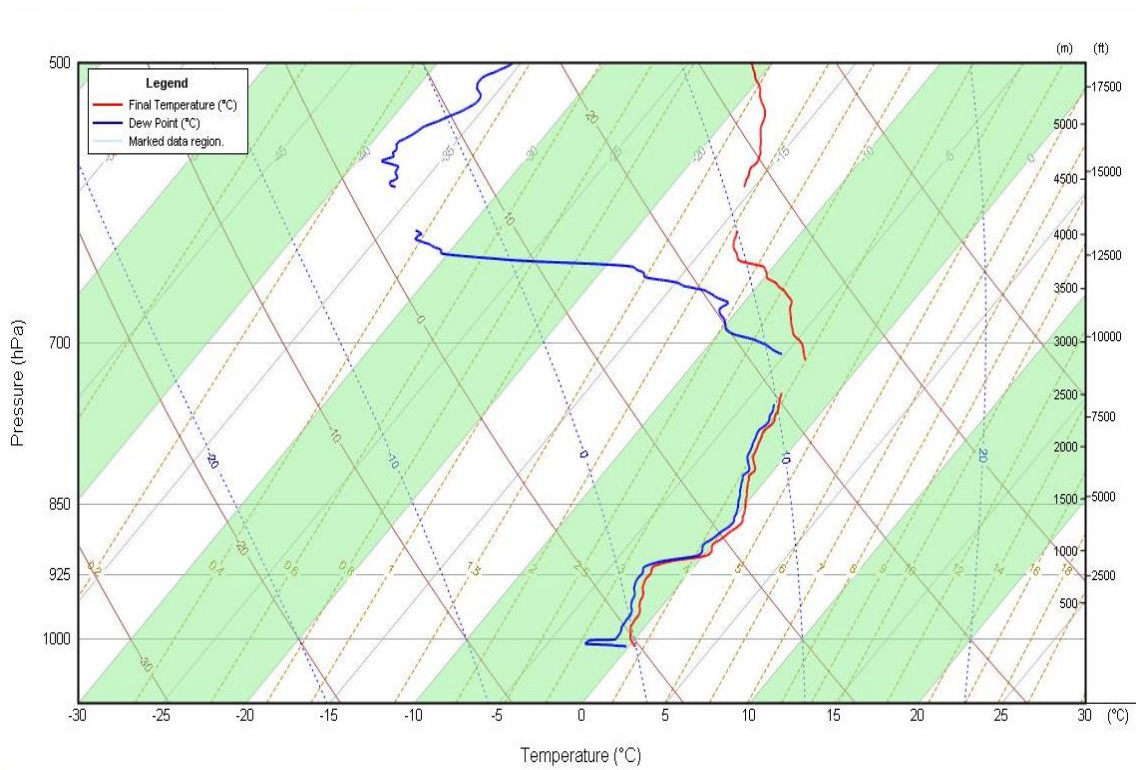


Exhibit 5-33: Missing data in the temperature and RH Plot

5.2.5.4 Missing Data and the WMO Levels Table

WMO levels noting the beginning and ending of missing (or observer deleted) data will not be shown in the WMO Levels table (and Coded Messages) unless the missing (or deleted) temperature or RH data is at least 20 hPa thick. Levels noting the beginning and ending of missing wind data will only be shown in the WMO Levels table (and coded message) if the layer is at least 1,500 meters thick.

5.2.6 Height Data

Figure 5-34 shows a typical plot of the geopotential height (derived from the pressure sensor) and geometric height (derived from the GPS receiver) versus time. Near 90 minutes; note that the two plots begin to diverge. Differences become apparent starting at about 16 km or 100 hPa and are caused by allowable accuracy errors in the pressure sensor and GPS receiver. However, height differences exceeding 750 meters and occurring earlier in the sounding may indicate a leaking pressure sensor cell. See Chapter 13 for more information on pressure data anomalies..

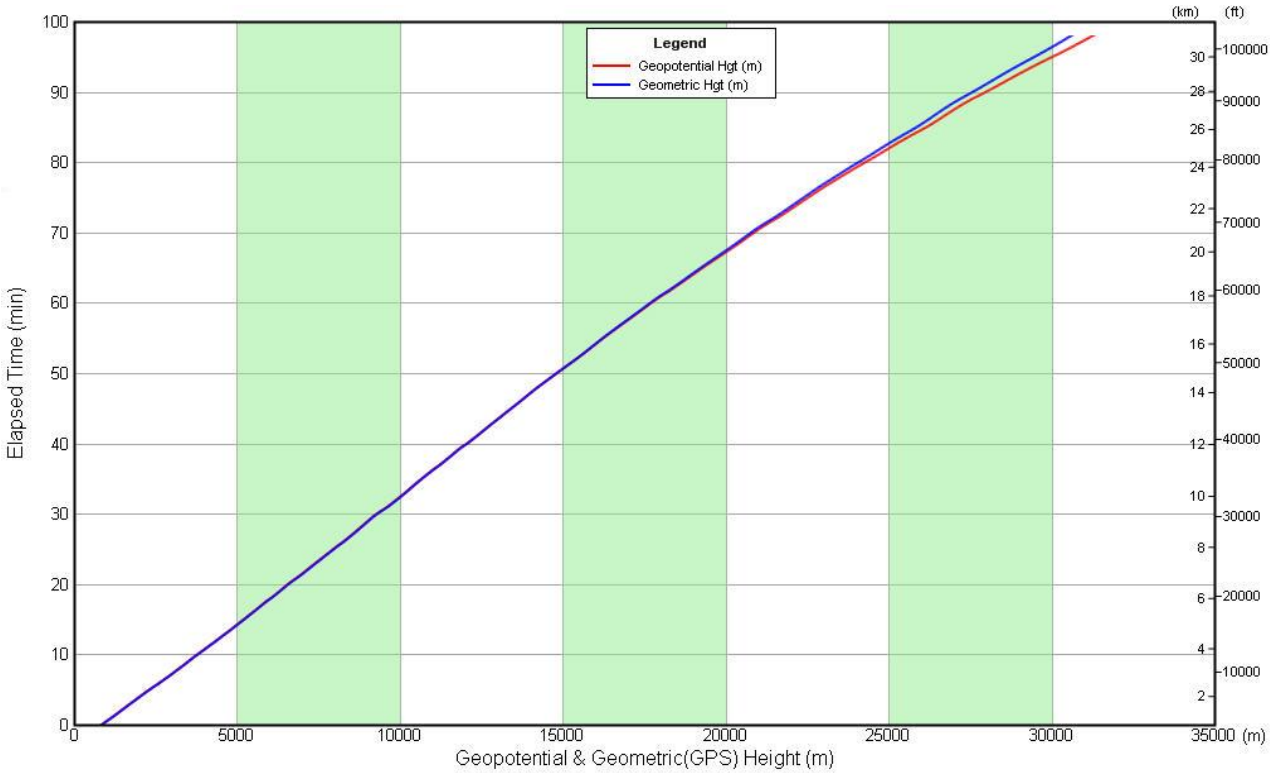


Exhibit 5-34 Typical Height Plot showing geopotential and geometric heights

IMPORTANT: GPS data from the Vaisala RS-92 radiosonde can be noisy on occasion and results in layers of erratic GPS data in the GPS Geometric heights and ascent rate plots. See Section 13.10 for more information.

5.3 Workspaces

RWS allows observers to save the arrangement of various plots and tabular displays as a Workspace. Observers create a Workspace by placing plots and or tabular displays in a convenient arrangement. The Workspace can then be saved by selecting the **Save Workspace As**.. option from the **Flight** pull-down menu. Workspaces are unique for each Observer account. RWS comes with a preinstalled recommended Workspace (Exhibit 5-35).

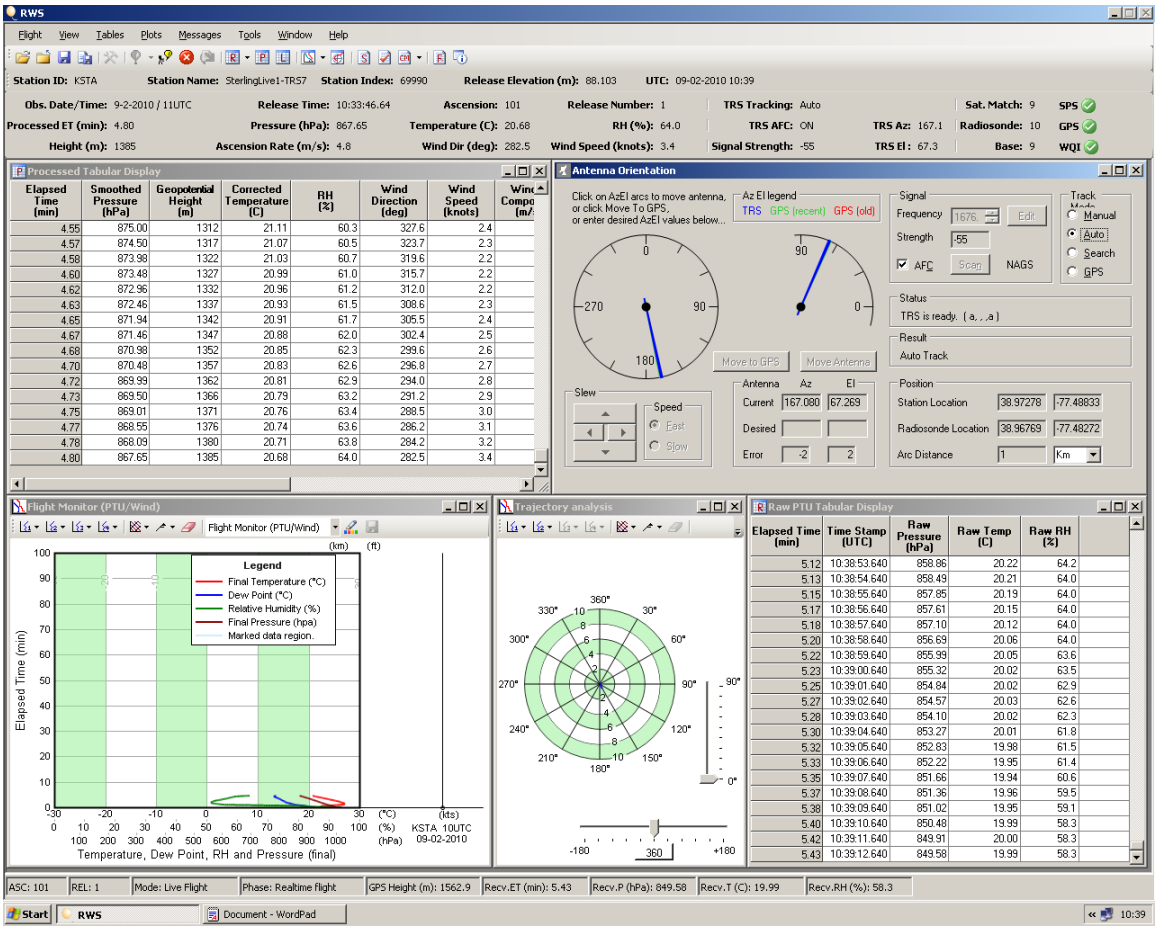


Exhibit 5-35: RWS Default Workspace; Flight Monitor

6 RRS Observation - Check and Status Messages

The RWS software will automatically identify meteorological and flight/system conditions that may require the observer's attention. These conditions are logged in the Check and Status Messages. These messages can provide assistance in finding areas of the flight that have questionable or erroneous data; however they do not identify all flight problems. The operator must use these alerts in conjunction with the plots and other tools to determine data quality. Refer to Chapter 13 for more information on sounding data quality control

6.1 Check Messages

The Check Messages are designed to alert the operator of unusual or abnormal meteorological conditions. The Check Messages are not continually updated; they are only generated when one of the following occur:

- The flight passes 400 or 70hPa
- The observer runs **Code, Update Levels** or **Apply User Edits** commands
- Flight termination

Messages displayed may indicate problems with the data that require your attention. Typically, these messages point out data that is inconsistent with the rest of the sounding data or with data from the previous flight. Examine each message and corresponding data to determine if any intervention is required. Exhibit 6-1 shows Check Messages with some stratums that have large temperature lapse rates.

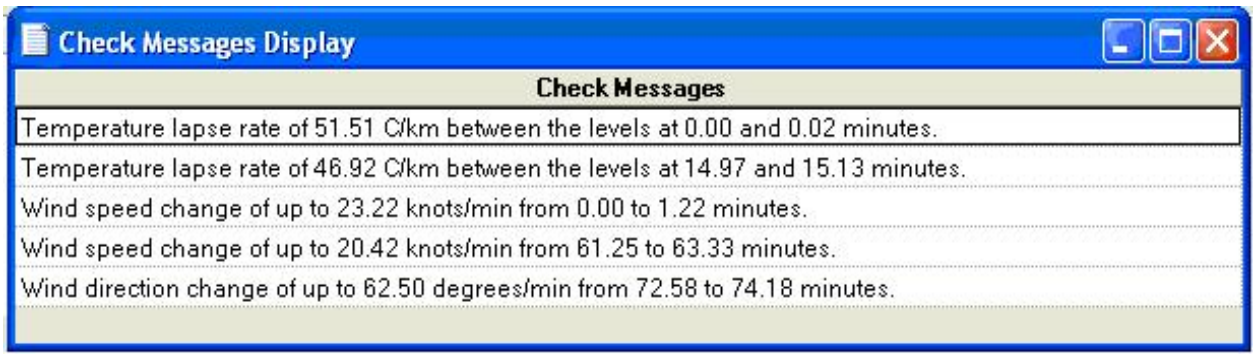


Exhibit 6-1 Temperature Lapse Rate Check Messages

Check Messages
No previous flight data available for comparison.
Data missing near possible Tropopause. Check Tropopause.
There was a height change of ***<height change (meters)>*** meters from previous flight at time ***<elapsed time (minutes)>.***
There was a temperature change of ***<temperature change (degrees Celsius)>*** degrees from previous flight at time ***<elapsed time (minutes)>.***
Missing mandatory pressure level at ***<pressure (hPa)>*** millibars
Multiple levels with same pressure at times ***<elapsed time (minutes)>*** and ***<elapsed time (minutes)>***
No tropopause found at 500 mb or above. Tropopause found at ***<pressure (mbs)>*** will be used.
Ascent Rate of ***<ascent rate>*** m/min detected from 12.48 to 14.61 minutes.
There is a temperature lapse rate of ***<value>*** degrees per kilometer between the levels at ***<elapsed time (minutes)>*** and ***<elapsed time (minutes)>*** minutes.
Wind direction change of up to ***<angle (degrees)>*** degrees/min from ***<elapsed time (minutes)>*** to ***<elapsed time (minutes)>*** minutes**.**
Wind speed change of up to ***<wind speed change (knots)>*** knots/min from ***<elapsed time (minutes)>*** to ***<elapsed time (minutes)>*** minutes.
Wind speed exceeds 180 knots from minute ***<elapsed time (minutes)>*** to minute ***<elapsed time (minutes)>.***
Temperature Lapse Rate of ***<value>*** C/Km between the levels at ***<elapsed time (minutes)>*** to ***<elapsed time (minutes)>*** minutes

Table 6-1 List of Possible Check Messages

6.2 Status Messages

Status Messages provide information on (mostly non-meteorological) flight events. Unlike the Check Messages, the Status Message update automatically throughout the flight. Many of the Status Messages are routine, indicating that a part of the flight has been successful (i.e. Radiosonde has been baselined successfully). Other non-routine Status Messages alert the observer to take a closer look and determine if intervention is required.

The Status Message also allows the observer to add comments to any Status Message by clicking in the Comment column. Additionally, an observer can add another Status Message and comment by right clicking and selecting the **Add Status Message**. Adding a message is a good method for the observer to document anything out of the ordinary or any actions taken. Exhibit 6-2 shows an example of a Status Message Display with an observer added message. Exhibit 6-3 is a list of Status Message descriptions.

Status Messages Display

Date	UTC Time	Flight Status Message	Comment
12-03-2009	10:35:46.34	TRS initialization in progress.	
12-03-2009	10:35:51.25	Status Code: 16 - UPS is now running on battery.	
12-03-2009	10:35:56.55	Status Code: 8 - UPS is now running on on-line power supply.	
12-03-2009	10:36:01.22	TRS busy with motor warm-up operations.	
12-03-2009	10:38:16.11	TRS completed initialization successfully.	
12-03-2009	10:38:16.11	TRS is ready.	
12-03-2009	10:42:06.25	Status Code: 8 - UPS is now running on on-line power supply.	
12-03-2009	10:56:14.20	User added message	battery connected

Exhibit 6-2 User Added Message

6.2.1 Status Messages Explanations

Status Messages

Flight was initiated: Date *<yyyymmdd>*; **Ascension** *<###>*; **Release** *<#>*. Date, Release and Ascension number for the flight.
Comparison flight is Ascension *<#>*, **Date** *<yyyymmdd>*, **Time** *<hh>* **UTC.** Ascension number of flight used as a comparison.
No appropriate flight found for comparison. Previous synoptic flight more than 24 hours prior.
Comparison flight is more than 12 hours before current flight. A synoptic flight was not found within the past 24 hours to use as a comparison.
Observer has backed out of baseline and reentered preflight information entry. This message appears when the **Back** or **Reject** button is clicked in the baseline screen.
UPS Status: code ***<## (##)>,*** *<Power source>*, *<Battery life %>*, *<additional alert>* This is the format for the UPS Status messages. After powering the UPS on, three UPS status messages appear. • The first message indicates that the UPS was off. • The second message indicates that the UPS is on battery power. • The third message indicates that the UPS is on AC line power. Additional UPS status messages can appear anytime during a flight, indicating a change in the UPS status. Typically, additional UPS status messages occur when the AC line power to the UPS is intermittent, requiring the UPS to power the system via backup battery power. **NOTE:** Occasionally, the status will report conflicting statuses, "Battery 100%, Low Battery". If this condition occurs, inform the system technician. This status can be caused by one of the following conditions. • Battery is reaching the end of its useful life. • The capacitors are aging. • The UPS has been off for hours. • The UPS has not had time to warm up (less than 15 minutes). • Occasional glitch

TRS initialization in progress. The TRS has started its initialization. This occurs when the TRS is powered on or reset.
TRS busy with motor warm-up operation. The TRS must run motor warm-up prior to initialization. This usually occurs when ambient temperatures are below 50 degrees.
TRS completed initialization successfully. The TRS completed initialization without problem.
TRS completed initialization unsuccessfully. The TRS had a problem and is not initialized.
TRS frequency as of radiosonde baseline is: #### MHz This status message records the frequency during baseline.
TRS is ready. The TRS has completed initialization and is ready for use.
TRS Reset done. (See HW view) The TRS has completed a reset.
TRS Reset requested by operator... to be followed by a Limited Search. The TRS was reset by the operator (during a sounding). When the TRS has finished resetting, RWS will attempt to reacquire the radiosonde.
SPS Reset requested by entering Baseline --> Init. The SPS is reset when entering the baseline display.
SPS initialized successfully. (Receiving data) The SPS initialized and is sending radiosonde data.
SPS Reset requested by operator. The SPS reset selected by the operator.
SPS reset successfully. (Receiving data) The SPS reset successfully and is receiving data.
Radiosonde has been baselined successfully. The radiosonde completed baseline with a pressure discrepancy within tolerance.
Pressure discrepancy of <###> hPa was found during baseline, within the <*##*> **to <*##*> hPa limits.** The baseline pressure discrepancy is recorded for reference.
Successful release. The flight was released and 5 minutes of processed data has been received. This does **<u>not</u>** indicate the release is officially successful (aka. 400 hPa).
Unsuccessful release. The flight was terminated and data was not received
Balloon release auto-detected at <*time*> **UTC.** The time RWS detected release at the indicated time.
Balloon release initiated by operator at <*time*> **UTC.** The time flight release was initiated by the operator at the indicated time.

Balloon released *<EARLY / LATE>* **outside of synoptic window. Observation re- categorized as a** *<time>* **UTC special observation.** The flight was originally identified as a synoptic flight, but was released outside a synoptic window and thus is a special observation.
Balloon released *<EARLY / LATE>* **within a synoptic window. Observation re- categorized as a** *<time>***UTC synoptic observation.** The flight was originally identified as a special flight, but was released inside a synoptic window and thus is a synoptic observation.
Release time changed to *<time>* **UTC.** New release time. This message appears after the observer changes the release time.
Reascending balloon detected --<time> RWS detected a reascending balloon. Data during the reascending will not appear in the levels table or coded message.
Descending balloon detected --<time> RWS detected a descending balloon. Data during the descending will not appear in the levels table or coded message.
Event marker received from SPS Indicates a manual release button was clicked.
External Backup Device has been removed. Switching to alternate backup folder (C:\RWSBackup). The external hard drive has been disconnected or has failed. RWS will begin backing flights to C:\RWSBackup.
External Backup Device has been restored. RWS will backup files to external folder The external hard drive is working or has been connected. RWS will begin backing flights to the external hard drive.
Coded Messages were generated. RWS has selected levels data and coded the data into Coded Messages. Occurs automatically at 400 hPa, 70 hPa, and termination. Messages also occurs when the observer runs the following commands Code, Apply User Edits, Update Levels, Change Release Time, Change Surface Observation and Change Termination Time.
PDS data edited. The observer marked and applied user edits in the Processed Tabular Display.
The RADAT message has been generated. The flight has reached 400 hPa and the Coded messages have been generated or the observer has manually run code prior to reaching 400 after a freezing level was reached allowing the RADAT to be generated.
Part *<FZL , MAN, SIG, ABV>* **transmission SUCCESSFUL, using** *<LAN, Phone 1,2 or 3>, try <##>* The coded message was successfully transmitted via the indicated route and on the indicated number of attempts. Doesn't indicate if the message was successfully received.
Part *<FZL , MAN, SIG, ABV>* **transmission UNSUCCESSFUL** The coded message was not successfully transmitted.

Missing *<type>* **data for more than one minute beginning at** *<elapsed time>* **minutes.** Records the start time of the missing data.
Operator elected to shut UPS power Off at termination. Records the UPS being turned off at the flight termination
<Termination Reason> **detected at** *<time>* **minutes.** The termination reason and the elapsed time for termination.
Flight terminated: *<Termination Reason>*. The termination reason selected by RWS
Flight Levels termination is set to *<elapsed time>* **minutes** The elapsed time flight terminated as selected by RWS
Termination reason changed to *<reason>*. The observer changed the termination reason.
Successful observation. The flight terminated at a pressure higher in altitude than 400 hPa. The flight is officially successful.
Unsuccessful observation. The flight terminated at a pressure lower in altitude than 400 hPa. The flight is officially unsuccessful.
User added message. The observer clicked the **Add Message** button in the Status Messages.
TRS Critical HW: LRU: *<status bit>***, SCA:** *<status bit>***, MCU:** *<status bit>***, Receiver:** *<status bit>***, Scanner:** *<status bit>***, Power Supply:** *<Status>* Notify maintenance personnel if TRS error causes problems continuing the flight to normal termination.
TRS Critical HW: <*number***> MCU 000800 - Az over-current** A TRS azimuth motor over-current was detected. After four azimuth motor over-currents have been detected within rapid succession, RWS will switch the TRS to Manual Track Mode.
TRS Critical HW: RWS detected continuous MCU over-currents. The TRS may be in motor lock-out, which may require a TRS RESET and attempting to lock-on to the radiosonde to prevent missing data. In rare instances, more than four azimuth motor over-currents can occur in rapid succession such that the TRS will place the motor in lock-out. See section 21.2.5 for more information on recovering from this mode.
TRS Critical HW: *<component abbreviation><status bit> - <decoded status bit>* Critical hardware status bit was detected. The TRS component status bit is displayed and briefly decoded. Notify maintenance personnel of the TRS Critical HW status.
Surface Observation data was successfully modified. The observer modified the surface observation after release.
Flight Levels termination is set to <elapsed time> minutes. The observer changed the termination time.

Exhibit 6-3: Status Message descriptions

7 RRS Observation - Plot Selection & Management

RWS has the ability to display the flight data through a variety of standard plots and user created plots. All plots fall into one of two categories: shared or private. Shared plots are those formats accessible by all users of the computer. Changes to these plots require administrative rights. Private plots are those formats only accessible by individual users, based on their Windows user accounts. In addition, RWS allows the users to create and save new plots using up to four data parameters.

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7.1 Plot Selection

A list of standard plots can be displayed by clicking on the Plots pull-down menu. To open a plot just click on the plot name under the **Plots** pull-down menu (Exhibit 7-1). Additionally, lists of user created and private plots can be displayed by clicking the **Select Plot**… option under the Plots pull-down menu. The plot selection form will open (Exhibit 7-2). This form contains tabs for both the shared and private plot lists. An option is also provided to control whether the newly displayed plot is to appear in a new plot window, or in place of an existing plot window (if currently highlighted as the active window). Once a selection is made, the plot will appear in the program workspace.

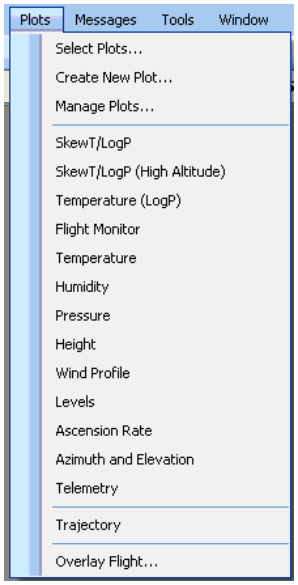


Exhibit 7-1 Plots Pull-down Menu

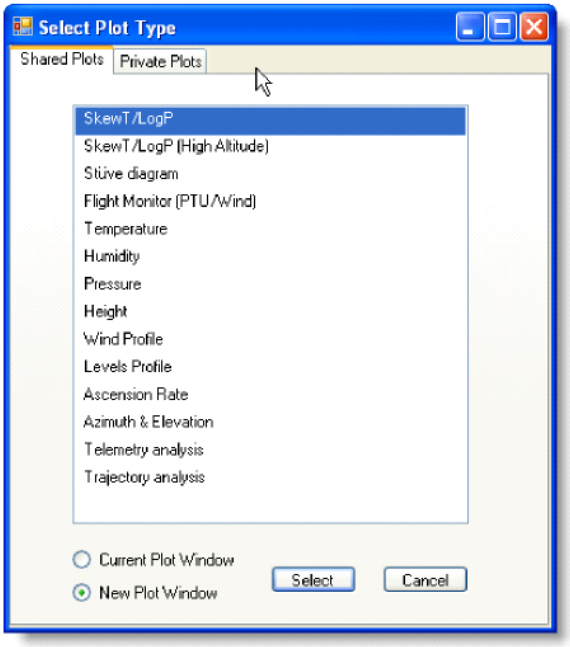


Exhibit 7-2 Plot Selection Form

Default Plots descriptions

Skew-T/Log-P – This plot is a thermodynamic diagram of Temperature, Dewpoint and Winds with respect to Pressure from 1070 to 100 hPa.

Skew-T/Log-P (High Altitude) – This plot is a thermodynamic diagram of Temperature, Dewpoint and Winds with respect to Pressure from 100 to 10 hPa.

Temperature (Log-P) – This plot is a vertical profile of Temperature, Dewpoint and Winds with respect to Pressure scale from 1070 to 10 hPa.

Flight Monitor (PTU/Wind) – This plot is a vertical profile of Temperature, Dewpoint, Relative Humidity, Pressure and Winds with respect to flight time. This plot displays the main meteorological parameters for easy viewing all on one chart.

Temperature – This plot is a vertical profile of raw Temperature, final Temperature and Winds with respect to flight time. The final Temperature incorporates the RWS smoothing routine and solar correction. This plot can be used to identify and Mark areas of erroneous temperature data.

Humidity – This plot is a vertical profile of Dewpoint, Relative Humidity and Winds with respect to flight time. This plot can be used to identify and Mark areas of erroneous humidity data.

Pressure – This plot is a vertical profile of raw Pressure, final Pressure and Winds with respect to flight time. This plot can be used to identify and Mark areas of erroneous humidity data. This plot can also be used to determine the termination reason (e.g. floating balloon, descending/reascending)

Height – This plot is a vertical profile of Geopotential height, Geometric height and winds with respect to flight time.

Wind Profile – This plot is a vertical profile of Wind direction and Wind speed with respect to flight time. While not automatically displayed, the Wind u & v Components are also available as the 3rd and 4th parameters.

Levels Profile – This plot is a vertical profile of final Temperature, Dewpoint, Temperature-levels, Dewpoint-levels and Winds with respect to Pressure from 1070 to 100 hPa.

Ascension Rate – This is a plot of the balloon ascent rate with respect to flight time. It displays three calculated ascent rates. The first two rates (1-second Ascension Rate and 1-minute Ascension Rate) are calculated from the Geopotential Height. The third rate (GPS Ascension Rate) is calculated from the GPS Geometric Height. These ascent rates can be used to identify a leaking pressure cell or balloon by comparing the 1-minute Ascension Rate(s) to the GPS Ascension Rate. <u>This is the only plot that does not automatically update.</u> Section 13.3.1 provides more information on leaking pressure cells.

Azimuth & Elevation – This is a plot of the Antenna Azimuth/Elevation, GPS Calculated Azimuth/Elevation (Radiosonde Position) and Winds with respect to flight time. This plot can be used in conjunction with the Telemetry Analysis plot to evaluate TRS tracking performance.

Telemetry Analysis – This is a plot of the TRS signal strength, TRS frequency, Slant Range and Winds with respect to flight time. This plot can be used in conjunction with the Azimuth & Elevation plot to evaluate TRS / Radiosonde performance (e.g. radiosonde failure). These values are also displayed in the Antenna Orientation/TRS Display.

Trajectory Analysis – This plot is a polar plot of the Radiosonde Position in reference to the release point. The center of plot represents the release point. This is the only plot in RWS that can be manipulated to view the trajectory in three dimensions.

7.2 Adding a New Plot

New plot configurations can be easily defined using the **Plots** pull-down menu and selecting **Create New Plot**... menu item. A form appears as shown in Exhibit 7-3. First, assign a name for the plot. The name must be unique to the other plot names being used. Then select whether the plot will be **Shared** or **Private** (described below). Finally, select an existing plot format to serve as the template for the new plot from the pull-down list. After pressing the **Next** button, the plot will appear. Further editing and customization can then be performed using the Plot Designer in Chapter 8.

- **Shared Plots** are custom plots which all users can use to view flight data. These plots can only be created or modified by a RWS Site Administrator. Shared Plots allow sites to create unique standard plots (configured for their site) that all users can view.
- **Private Plots** are custom plots which can only be viewed by a single user. Private Plots allow each user to create their own configured plots.

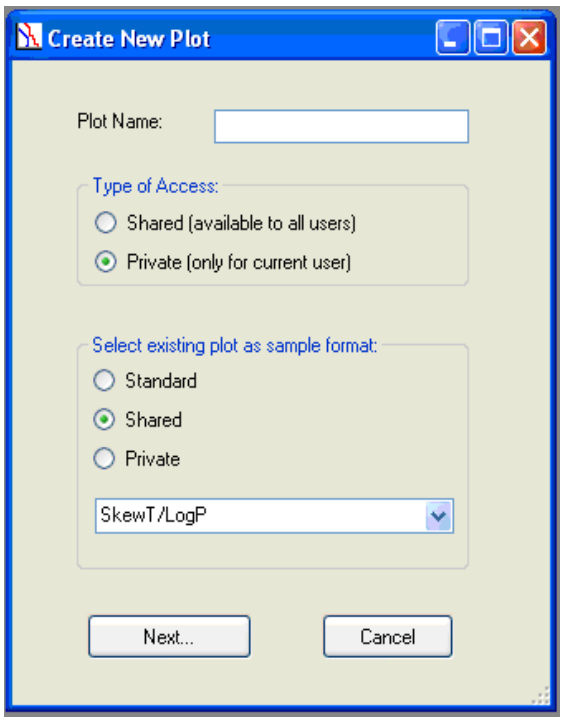


Exhibit 7-3 New Plot Form

7.3 Managing Plot Collections

The plot manager form (Exhibit 7-4) can be selected from the **Plots** pull-down menu. The plot manager provides the capability to rename, delete or reorder plots contained in your private list (or also the shared list if you are a system administrator). To perform any of the functions, select the desired plot and press the **Rename**, **Delete**, or arrow button. The arrow buttons move the selected plot up or down in the list.

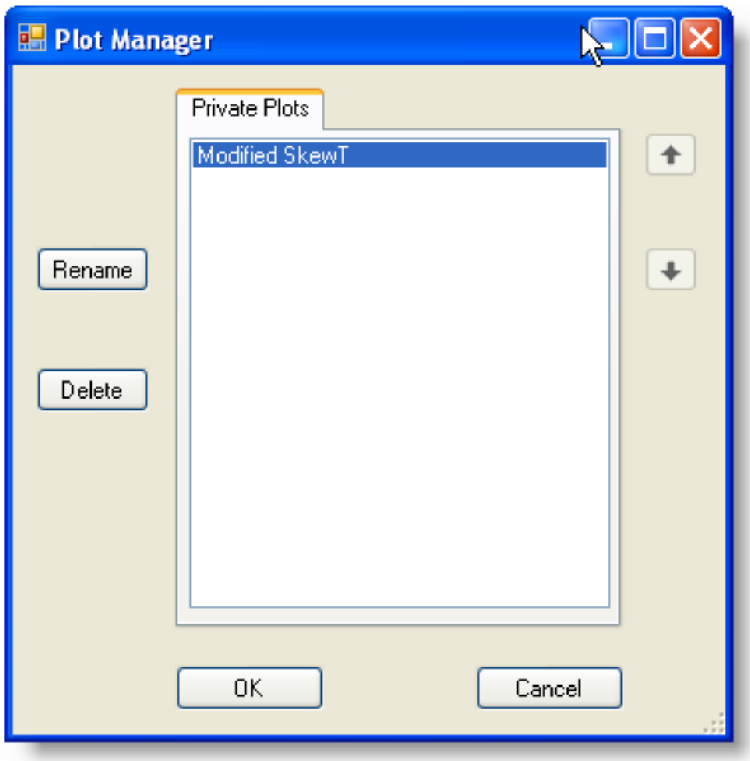


Exhibit 7-4 Plot Manager Form

8 RRS Observation - Plot Format Designer

The Plot Format Designer is the primary tool for customizing plot formats (Exhibit 8-1). It is displayed using the icon on the toolbar of the plot to be customized or via the right click menu. The Plot Format Designer has six tabbed panels, enabling the user to modify various components of the plot.

Only the shared and private plots (accessible through the **Select Plots…** option of the **Plots** pull-down menu) can be customized with the designer tool. Any user can use the Plot Format Designer to change private plots, but only RWS Site Administrators can use it to modify shared plots. The Plot Format Designer option is disabled for standard plots (those listed in the **Plots** pull-down menu). The changes made to the shared or private plots are applied after clicking the **Apply** button. Refer to Section 8.7 on saving the Plot.

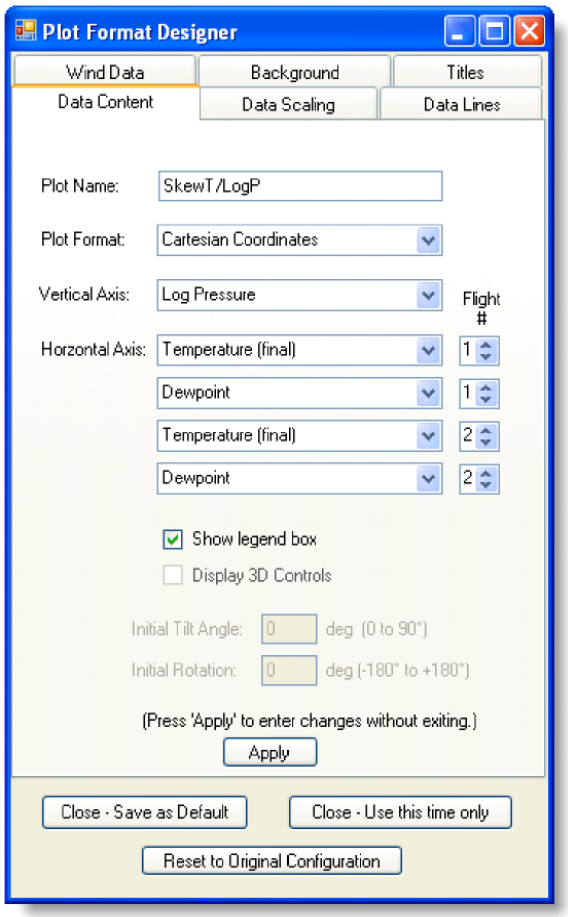


Exhibit 8-1 Plot Format Designer: Data Content Panel

8.1 Data Content

The Data Content tab (Exhibit 8-1) is used to edit the plot name and select the general plot format (Cartesian or Polar coordinates). Only the trajectory plot uses polar coordinates. The selection of data parameters for the vertical and horizontal axes can also be made on this screen.

8.1.1 Vertical Axis

RRS Plot only supports one of three parameters as the vertical axis value, as listed in Table 8-1. Select the desired vertical axis parameter from the drop down list.

- Log Pressure
- Geopotential Height
- Time (elapsed)

Table 8-1 Vertical Axis Parameters

8.1.2 Horizontal Axis

You can select up to four parameters to be plotted using the drop down lists. For each horizontal axis parameter, the flight # (1 for primary, 2 for overlay) must also be selected. The parameters listed include raw and/or final (corrected and/or smoothed) and WMO levels values for each of the basic measured parameters are selectable. Additional system parameters are selectable for evaluating system performance. Table 8-2 is a list of the 33 horizontal axis parameters.

Meteorological Parameters		RRS System Parameters
• Pressure (raw)	• Wind U	1. Signal Strength
• Pressure (final)	• Wind V	2. Frequency
• Temperature (raw)	• Wind Speed	3. Antenna Azimuth
• Temperature (final)	• Wind Direction	4. Antenna Elevation
• Temperature (levels)	• Wind Speed (levels)	5. Radiosonde Psn Azimuth
• Relative Humidity (raw)	• Wind Direction (levels)	6. Radiosonde Psn Elevation
• Relative Humidity (final)	• Ascension Rate (1 sec)	7. Slant Range
• Relative Humidity (levels)	• Ascension Rate (1 min)	8. Antenna / Receiver Status
• Dew Point	• GPS Ascension Rate (1 sec)	9. Azimuth Error
• Dew Point (levels)	• GPS Ascension Rate (1 min)	10. Elevation Error
• Geopotential Height		11. Frequency Error
• Geometric Height		

Table 8-2 Horizontal Axis Parameters

8.2 Data Scaling

The Data Scaling tab in the Plot Format Designer allows control of the vertical and horizontal axes scales. By default, the plot axes scales will auto expand automatically to adapt to out of range values. The minimum and maximum limits are expanded if necessary to accommodate the actual range of data. The limits are never decreased. To disable this function, deselect the Auto Expand check box for each axis.

8.2.1 Vertical Scaling

The vertical axis scaling allows for selecting the minimum and maximum values. If Auto Expand is selected the minimum and maximum will automatically expand to the data (Exhibit 8-2).

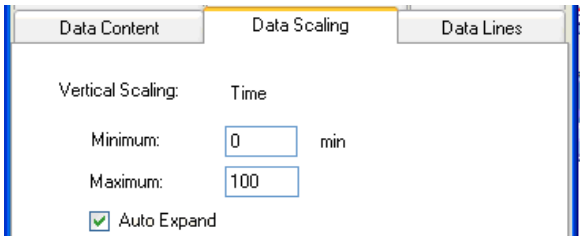


Exhibit 8-2 Plot Format Designer: Vertical Axis Scaling

8.2.2 Horizontal Scaling

Each horizontal parameter has an individual scale. The scale values apply to the parameter currently selected in the list of axis parameters (Exhibit 8-3). When a different horizontal parameter is selected, all of the changes to that point are automatically applied to the plotted image. Also note that changes to the scaling of horizontal parameters automatically apply to all of the other horizontal parameters that share the same scale. For example, changing the range of temperature to be displayed will also apply to how the dewpoint temperature is scaled, since the dewpoint temperature uses the temperature scale.

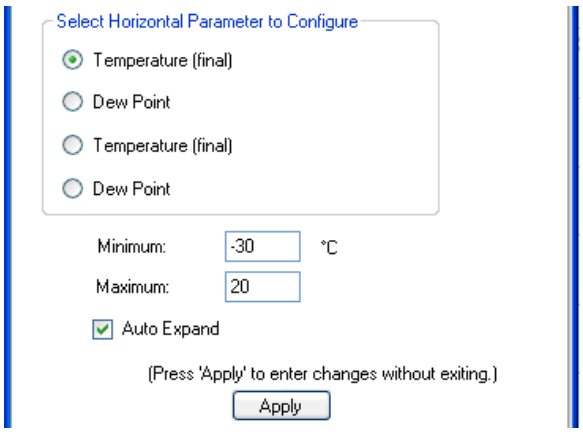


Exhibit 8-3 Plot Format Designer: Horizontal Axis Scaling

8.3 Data Lines

The Data Lines tab of the Plot Format Designer (Exhibit 8-4) is used to control the characteristics of the various data lines to be plotted (horizontal axis parameters). This includes the style of the lines, thickness, and color. The controls provided in this tab apply to the parameter selected at the top of the tab. Each parameter is individually controlled. All of the data line controls in this panel result in immediate changes to the plot displayed in the main RRS Plot window.

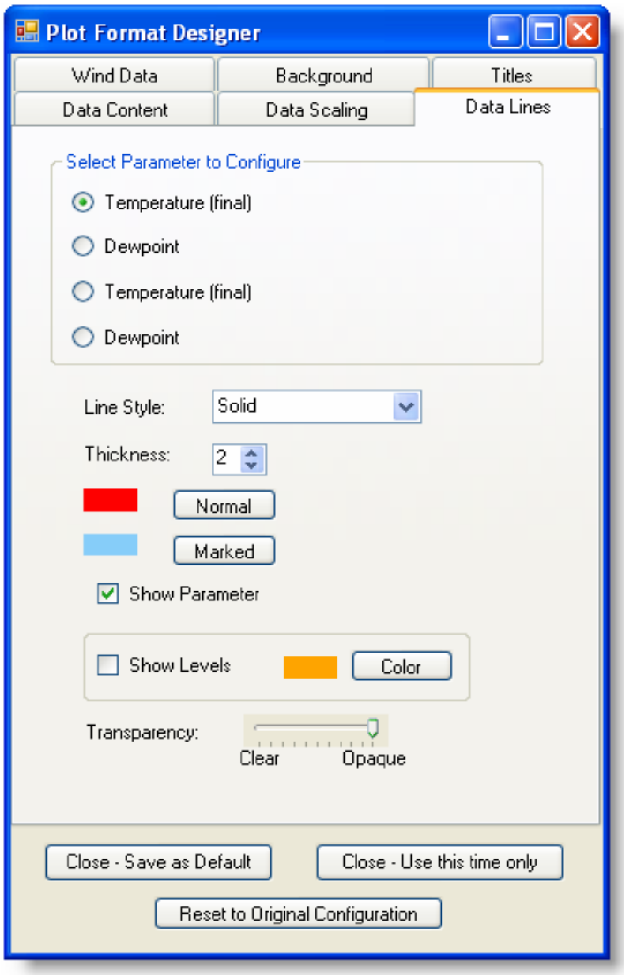


Exhibit 8-4 Plot Format Designer: Data Lines Panel

8.3.1 Changing the Line Style

The style of the line can be selected from the drop down control labeled Line Style, as listed in Exhibit 8-5.

Exhibit 8-5 Line Style Control

8.3.2 Changing the Line Colors

The line color can be changed for the normal or marked data lines. The current color selected for each parameter is shown in the middle of the display. Normal refers to the unmarked data. Marked refers to the marked data. To change the color, click either the **Normal** button for data lines or the **Marked** button for marked data lines. A color dialog box will appear as shown in Exhibit 8-6. Once the color has been selected, click **OK**. For clarity, it is a good idea to choose dissimilar colors for the data and the marked data lines.

Exhibit 8-6 Color Dialog Box

8.3.3 Show Parameter

Individual data lines can be temporarily turned off by deselecting the Show Parameter check box (Exhibit 8-7).

8.3.4 Line Transparency

The line transparency can be changed for any of the parameter lines allowing data beneath the line to show through. The transparency can be changed by sliding the indicator along the bar to attain the desired effect (Exhibit 8-7).

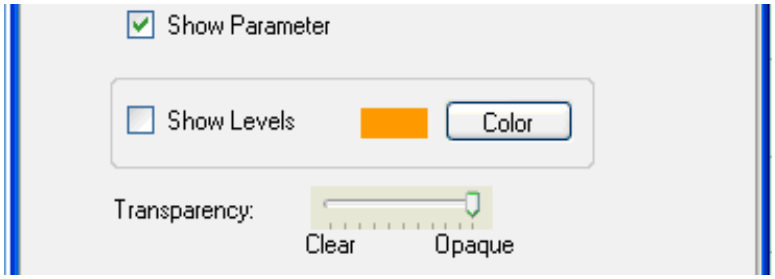


Exhibit 8-7 Show Parameter, Levels and Transparency

8.3.5 Displaying Levels Markers

Users can display WMO Level markers by selecting the check box in the Data Lines panel. It is also possible to change the color of these markers for each parameter. The WMO Level markers only appear on related parameters, (for example: Significant temperatures only with temperature, significant winds only with winds, and significant RH only with moisture fields). An "X" is drawn at the location of each significant level. Other levels are indicated with a short horizontal bar (Exhibit 8-8).

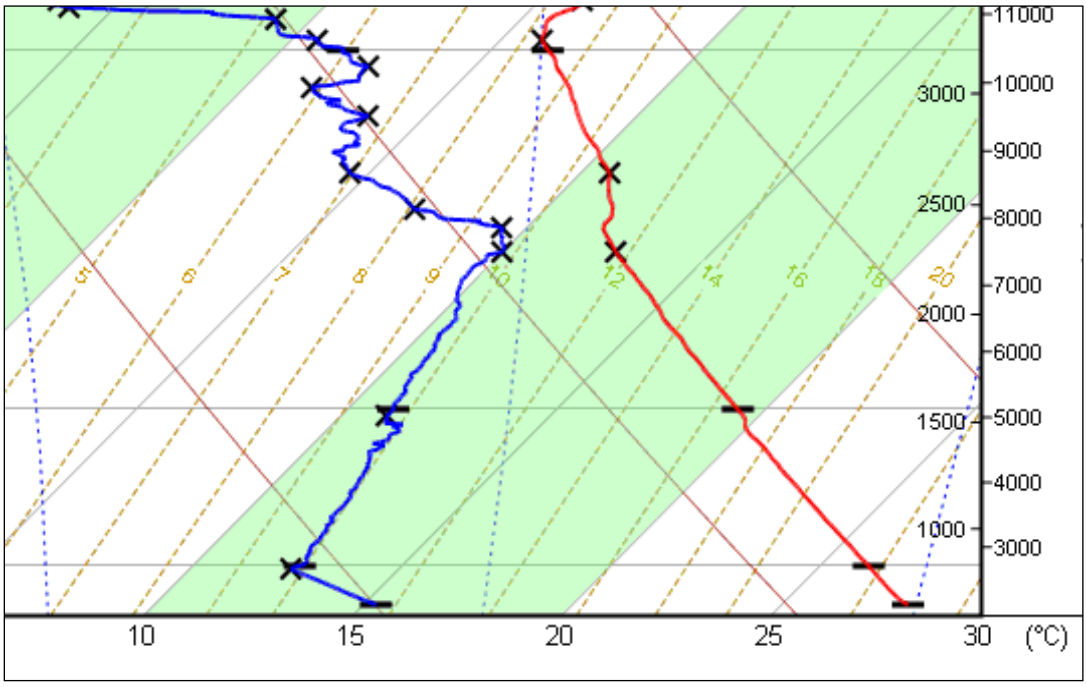


Exhibit 8-8 Skew-T with Level Markers

8.4 Wind Data

The Wind Data Panel of the Plot Format Control controls the display of the height values and wind data on the right side of the plot (Exhibit 8-9). If wind from the primary and overlay flights are both selected to be shown, two columns of wind barbs are displayed.

The wind panel source allows for selecting the data source for the wind panel (Exhibit 8-9). The **Processed Dataset** displays high resolution winds; the **Levels Table** displays only the wind levels data, and **Both** displays both the high resolution and wind level data. The levels data will be much less dense than the one second winds. To make the high resolution data readable, the data is filtered depending on the level of zoom in effect.

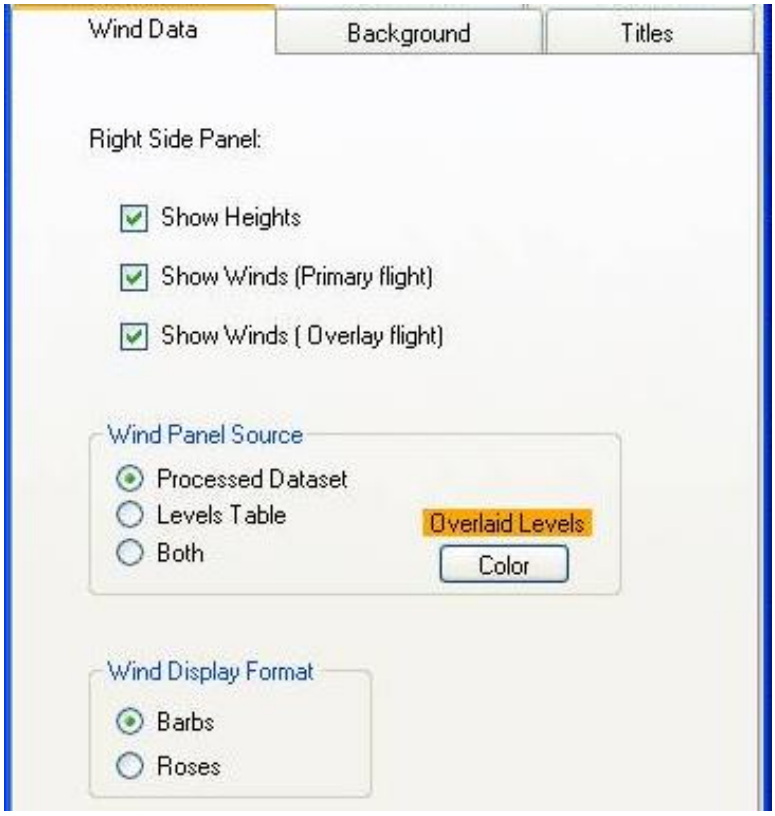


Exhibit 8-9 Show Parameter, Levels and Transparency

8.4.1 Wind Display Formats

RWS can display graphically displaying wind vectors (wind direction and speed) in two formats. These are either conventional wind barbs (Exhibit 8-10) or wind roses (Exhibit 8-11).

The wind rose depicts wind direction the same as wind barbs (line points in direction wind is coming from), but depicts the wind speed by varying the length of the line (proportional to the speed). A scale marker for 50 kts is shown along the base of the side panel to interpret the wind speeds.

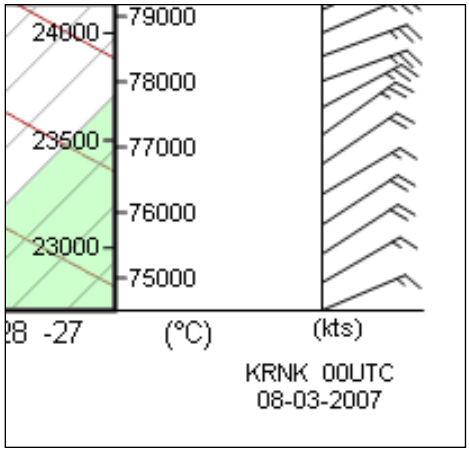


Exhibit 8-10 Wind Barb Display

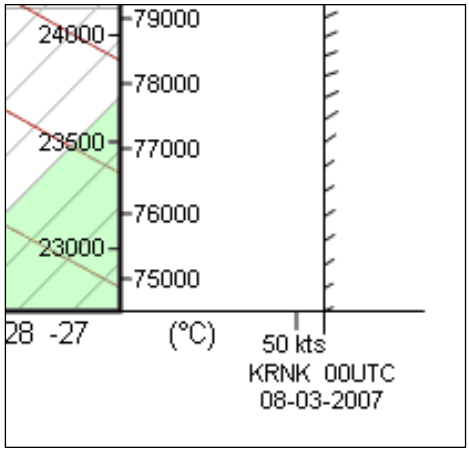


Exhibit 8-11 Wind Rose Display

8.5 Background

The Plot Designer Background Tab controls all of the scale lines and shading associated with the plotting diagram. Parameters such as line style, thickness, color, in-line labeling, and transparency can be controlled for the specific parameter selected at the top of the panel (Exhibit 8-12). To turn a particular object on or off, use the Show Parameter check box. Users can activate in-line value labels (at fixed positions determined within the program) by selecting the Show In-Line Labels check box. Otherwise, this tab provides the same options for changing the line style and color as described for the Data Lines tab.

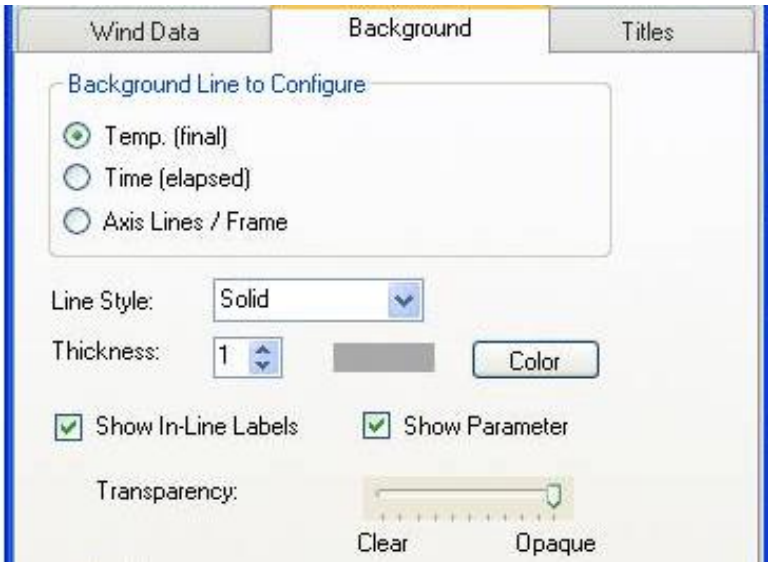


Exhibit 8-12 Background Line Configuration

In addition, the Background tab can activate and control the color and transparency of the shade bars that are associated with the first horizontal parameter scale. Normally, this would be temperature. When this function is activated by selecting the Show Shading check box, alternating bands of the

selected shade color and white are displayed for predetermined increments of the parameter (e.g., every 10 degree increment of temperature).

At the bottom of the tab is a slider bar for controlling the Skew Angle (0 to 45 degrees). This only applies when a skewable parameter is selected as the first horizontal parameter (Temperature (final), and the vertical scale is log Pressure. The plotted display immediately changes as you change the values in any of these controls.

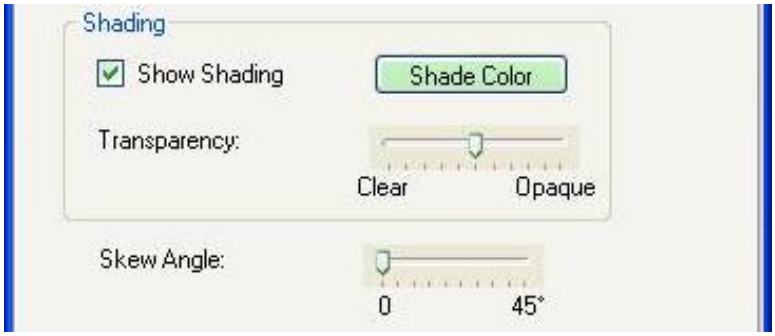


Exhibit 8-13 Background Shading

8.6 Titles

Plot Designer Titles tab controls the titles displayed (Exhibit 8-14). The exact title(s) can be entered for the main plot title, overlay flight title (for overlaid flight data) and the horizontal and vertical axis titles. Plot Titles can be set to be determined dynamically based on information from the flight data used such as date, station, or time. Table 8-3 lists the text codes to be entered in the Plot or Overlay title fields. The text codes are uppercase words surrounded by exclamation point symbols. Any text outside the exclamation points is displayed as entered. By default, the text codes relate to the first flight. To access values from the comparison flight, append a “2” to the text codes (e.g., !STATIONNAME2!).

The font style and size can be modified for each title by clicking the **Font** button. The horizontal and vertical axis font style and size can be modified by selecting the **Axis Data Labels Font** button.

- Selecting **Show plot title(s) on screen** will display the plot titles on the screen.
- Selecting **Show plot title(s) on printouts** will display the plot titles on printouts.
- Selecting **Show horizontal** or **vertical title on screen** will display the horizontal or vertical title on the screen.
- Selecting **Compress margins on screen display**.will minimize the plot margins and show more of the plot.

The **Apply** button must be pressed to modify the plot in the main plotting window.

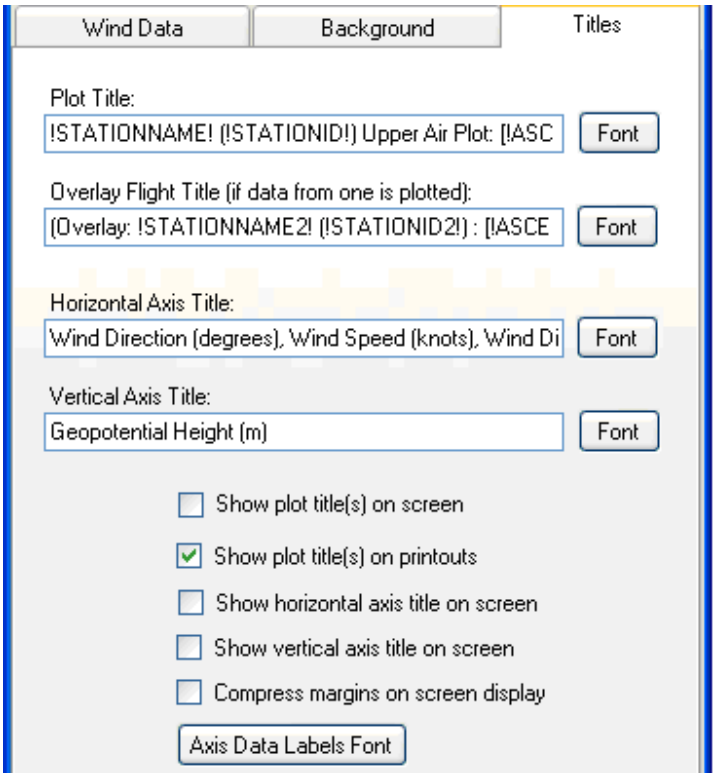


Exhibit 8-14 Plot Designer Titles

First Flight Text Code	Comparison Flight Text Code	Flight Information Used
!STATIONNAME!	!STATIONNAME2!	Full text name of the station
!STATIONID!	!STATIONID2!	Station identified (call letters)
!WBANNO!	!WBANNO2!	WBAN number for the station
!WMONO!	!WMONO2!	WMO number for the station
!TIME!	!TIME2!	Time of the observation
!DATE!	!DATE2!	Date of the observation
!ASCENSIONNO!	!ASCENSIONNO2!	Ascension number for the observation
!RELEASENO!	!RELEASENO2!	Release number for the observation
!FILENAME!	!FILENAME2!	File name of the flight data file
!RWSVERS!	!RWSVERS2!	RWS software version number
!SONDENAME!	!SONDENAME2!	Radiosonde model used for the flight
!LAT!	!LAT2!	Station latitude
!LONG!	!LONG2!	Station longitude

Table 8-3 Dynamic Title Text Codes

8.7 Closing/Saving the Format Designer

The designer form has a set of six tabbed screens control various aspects of the plotting format. On the Data Content, Data Scaling, and Titles pages, an **Apply** button is included. The **Apply** button

must be pressed in order to have the current plot reflect the new format. Changes made on the other pages will appear instantly on the plot displayed.

The designer form must be closed before any other user interface actions with the program can be accomplished. The two **Close** buttons at the bottom of the form designate whether the format is to become the new default for the plot, or only to be used for this display only (Exhibit 8-15). Closing the form using the close icon "X" in the upper right corner of the form is equivalent to the **Close – Use this time only** button. The **Reset to Original Configuraton** button restores all settings to the original configuration prior to opening the designer.

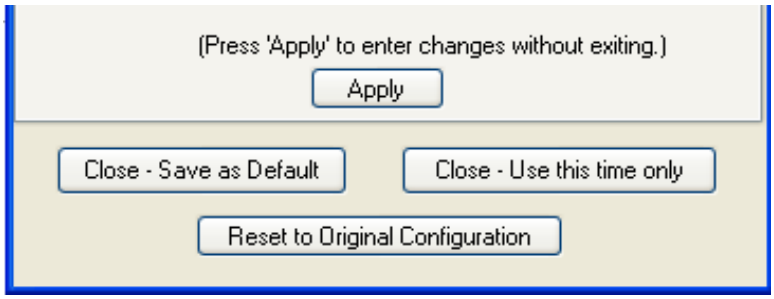


Exhibit 8-15 Plot Format Designer: Close Buttons

NOTE: When RWS Site Administrators attempt to save changes to shared plots, a confirmation message will appear (Exhibit 8-16). This is to prevent accidental modification of the format being used for all users. To avoid this notification, administrators should use the system as a non-administrator for routine use, only logging in as an administrator when necessary to configure the program.

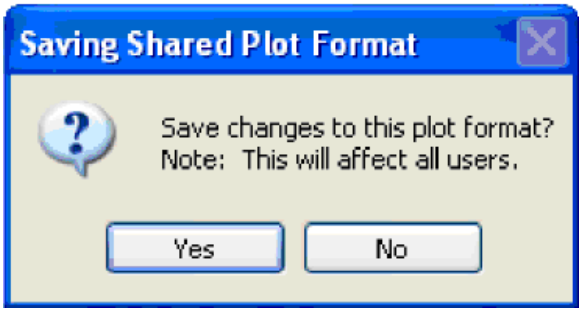


Exhibit 8-16 Confirmation Message when Saving Shared Plot Formats

9 RRS Observation – Manipulating Plot Displays

Control over the plot display options can be accomplished from either the tool strip at the top of the plot and/or the right-click menu.

9.1 Zooming

A user can zoom in or out (change in magnification level of the plot), or pan (change position of the viewed portion of the plot without changing the zoom level) using a variety of mechanisms (mouse and keyboard). These control functions relate to one plot at a time.

NOTE: When using the keyboard to zoom or pan, the desired plot form must be the active window (window frame has a bolder color). When using the Plot Format Designer, the focus shifts to that window. To move the focus back to the plot form, perform a mouse click on the plot image or its window frame.

9.1.1 Banding a Region with the Mouse

Users can zoom into a particular area of the plot simply by selecting an area with the mouse (hold down left button and drag to form a box around the area to be displayed). The plot will redisplay covering the area you selected, expanding in height or width as necessary to match the aspect ratio (width vs. height) of the plot (Exhibit 9-1).

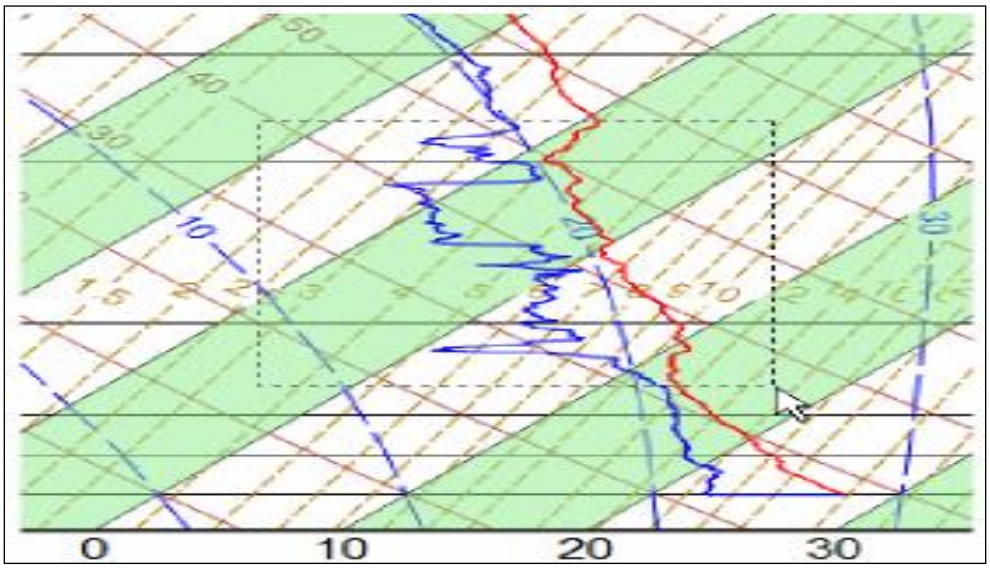


Exhibit 9-1 Selecting an Area with the Mouse

9.1.2 Incremental Zooming

The following keyboard commands force the plot display to zoom in or out in stepped increments:

Keystroke	Resulting Action
Add (+) Key	Zoom In
Subtract (-) Key	Zoom Out
CTRL Enter	Zoom Reset (to full scale)

It is also possible to zoom in or out in using the context menu (by right-clicking with the mouse on the plotted image). The portion of the context menu related to this is shown in Exhibit 9-2.

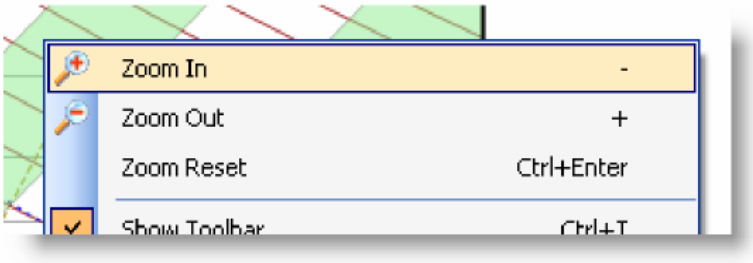


Exhibit 9-2 Zoom Items in Context Menu

9.2 Panning

Users can pan (change position of the viewed portion of the plot without changing the zoom level) using the arrow keys on the keyboard. When you press the left arrow, the display will be centered to the left of the current position, and the right arrow moving the center of the display to the right. It is similar with the up and down arrow keys. The program will not pan below the surface or initial time point.

9.3 Plots Form Toolbars

Each plot form has a tool strip providing quick access to a sub-set of the display options provided by the Plot Format Designer. However, any changes made with the tool strip are temporary in nature. The plot will return to the original configuration after it is closed and redisplayed, unless the format is specifically saved (one of the tool strip buttons discussed in Section 9.3.7).

9.3.1 Data Parameters

The four buttons on the left side of the tool strip are related to each of the possible four parameters. Hover the mouse over the button to identify the parameter (Exhibit 9-3).

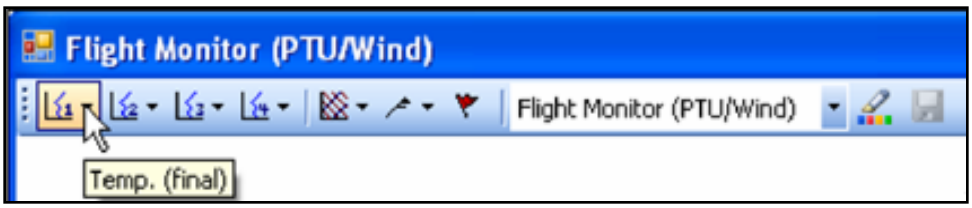


Exhibit 9-3 Plot Form Tool Strip

When a parameter button on the tool strip is selected, a menu drops down as shown in Exhibit 9-4. It allows the user to control whether the parameter is to be shown on the plot, and whether tick marks for the WMO levels are to be shown. The type of line style (solid, short dash, medium dash, dotted, or dash-dot) can be modified, as well as the transparency level of the line drawn for the parameter's data.

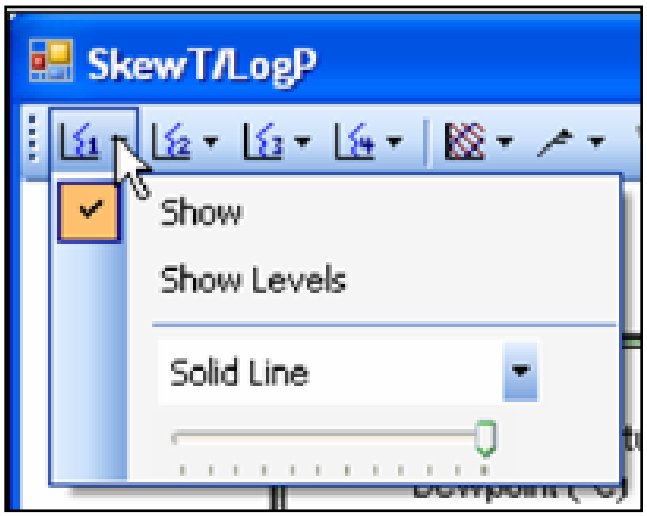


Exhibit 9-4 Tool Strip Parameter Menu

9.3.2 Background Options

The drop down menu associated with the Background Options menu (Exhibit 9-5) allows the user to control whether various lines on the plot background are displayed or not. The Legend Box can be selected or disabled, as well as the shading between parameter intervals.

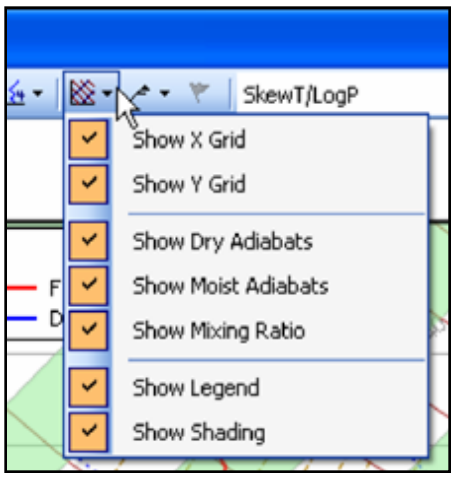


Exhibit 9-5 Tool Strip Background Options Menu

9.3.3 Wind Data Panel Options

The drop down menu associated with the Side Panel Options item on the tool strip controls (Exhibit 9-6). Changes in the wind display are made through this menu, as well as turning the height scale on and off.

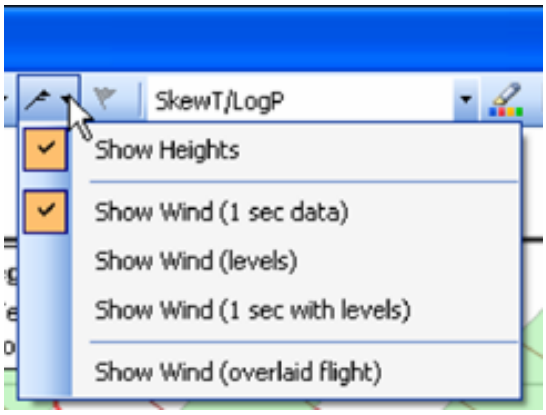


Exhibit 9-6 Tool Strip Side Panel Options Menu

9.3.4 Marking Mode

When a plot is displayed with markable parameter values from the RRS Processed Tabular Display, the marking button on the tool strip is enabled (Exhibit 9-7B). Otherwise, it is disabled as it appears in Exhibit 9-7A. Selecting this button (Exhibit 9-8) turns the marking (editing) mode on or off, depending on the current state of the mode. The data marking capabilities are discussed in a later section.

Exhibit 9-7A Marking Mode Disabled

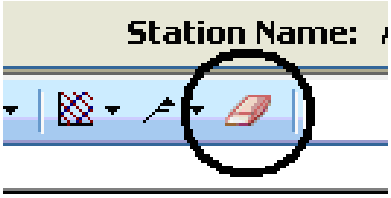


Exhibit 9-7B Marking Mode Enabled

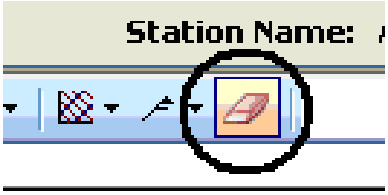


Exhibit 9-8 Marking Mode Button ON

9.3.5 Plot Type Selection

Quick changes between plot types can be made using the plot form tool strip's drop down list of available plot formats. This list contains both the shared and private plots. Private plots are preceded with a "My:" label. The drop down list is shown in Exhibit 9-10. Once a selection is made, the plot form will immediately change to the new plot format.

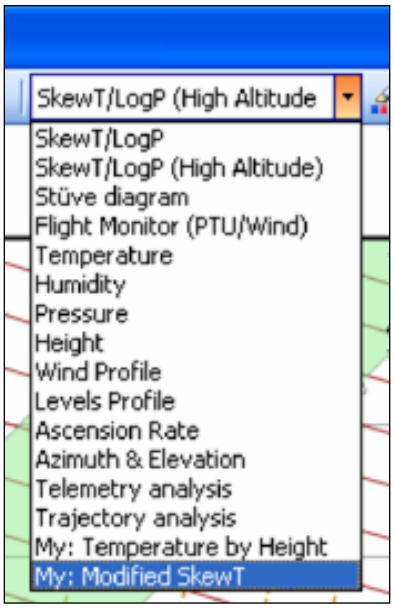


Exhibit 9-10 Tool Strip Plot Selection List

9.3.6 Plot Format Designer Button

A button is provided on the plot form tool strip for quick access to the Plot Format Designer tool. The Plot Format Designer tool is discussed in an earlier section.

Exhibit 9-12 Tool Strip Plot Format Designer Button

9.3.7 Save Plot Format Button

A button is provided on the right side of the plot form tool strip to immediately save the displayed format of a plot. This button is only enabled for private plots. Shared plots are enabled only for system administrators.

Exhibit 9-11 Tool Strip Save Plot Format Button

9.4 Context Menu

A context menu is displayed when a right-click is made with the mouse on a particular plot display (Exhibit 9-12).

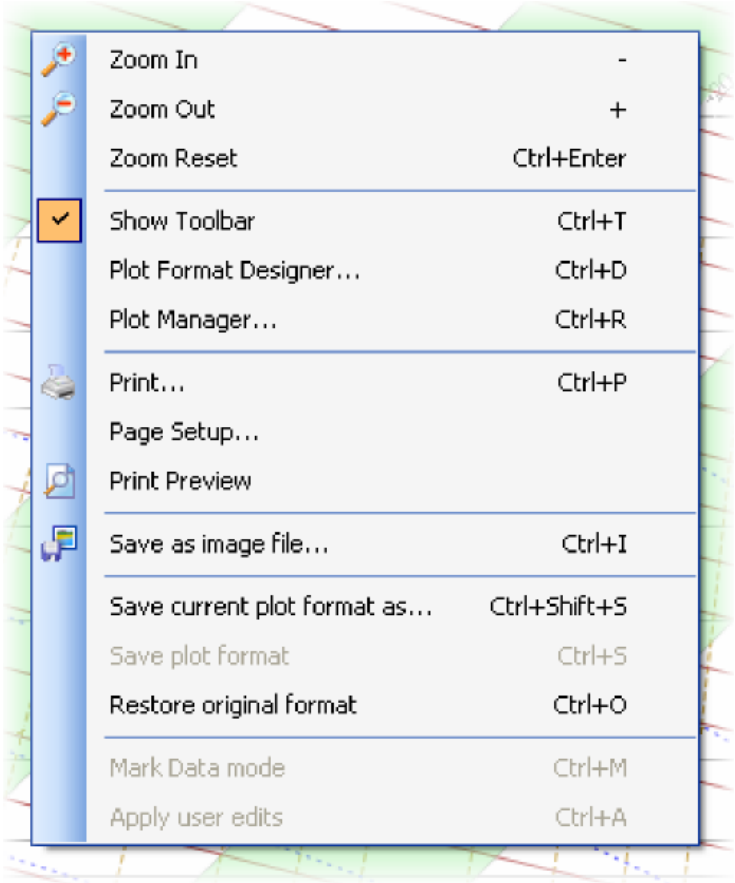


Exhibit 9-12 Plot Image Context Menu

9.4.1 Zoom Functions

The zoom in and zoom out menu items provide incremental zoom changes as described in Section 9.1 on zooming. The zoom reset item returns the display to full coverage (no zoom).

9.4.2 Show Toolbar

This menu item controls whether the tool strip on the plot form is displayed.

9.4.3 Plot Format Designer

This menu item will activate the Plot Format Designer window. The designer window must be closed before control returns to any of the other program items.

9.4.4 Plot Manager

This menu item displays the Plot Manager form, described earlier, to rename and delete plot format names.

9.4.5 Printing Functions

The “Print...” item displays the standard windows print dialog box in order to print a copy of the plot. Page orientation and margins can be modified using the “Page Setup...” menu item. Finally, a preview of the printed copy can be viewed using the “Print Preview” menu item.

9.4.6 Save as Image File

Plotted images can be saved on the hard drive as standard graphic files using the “Save Image File As...” menu item. A dialog box will appear to select the filename and graphic format to be used (**Exhibit 9-13**).

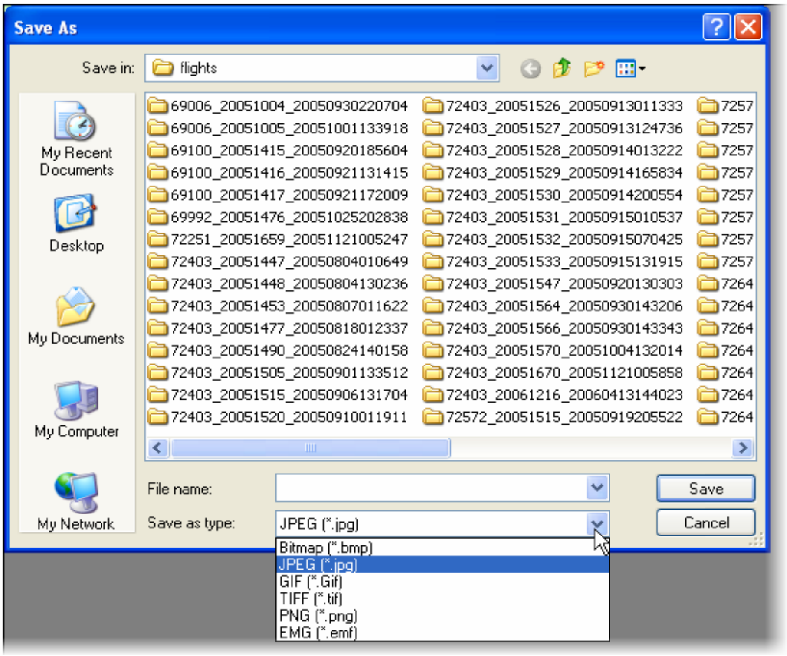


Exhibit 9-13 Save As Image File

9.4.7 Save or Restore Plot Format

Menu items are provided to save the currently displayed plot format as a new type (limited to creating new private plots for non-administrators), updating the format if previously saved, or restoring the displayed plot format to that previously saved.

9.5 Legend Box

The Legend Box appearing on the plot can be placed at any location by dragging with the mouse. When you move the mouse over the Legend Box, the cursor becomes a finger pointing style. Left clicking on the box aligns the cursor with the upper left corner of the Legend, which can then be dragged to the desired location (in or outside of the plotting area). Release the mouse button when you get to the desired location.

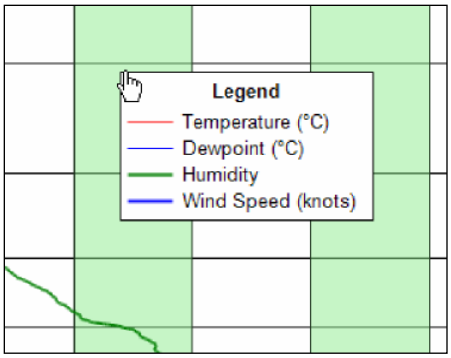


Exhibit 9-14 Dragging the Legend Box

9.6 Three-Dimensional Controls

The Trajectory Plot use the polar coordinate plotting system, first appearing looking straight down on the plot giving the traditional view (Exhibit 9-15).

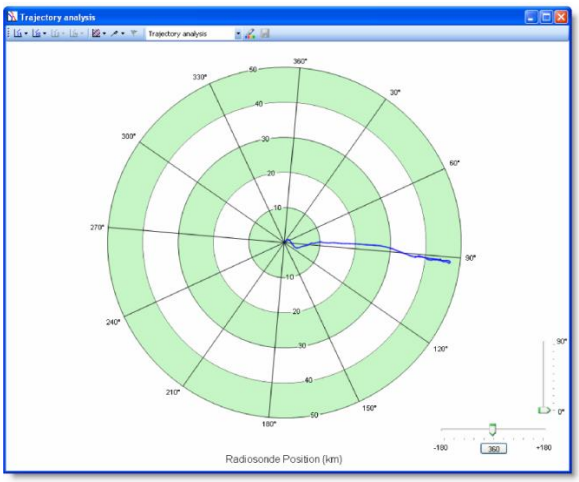


Exhibit 9-15 Trajectory Plot

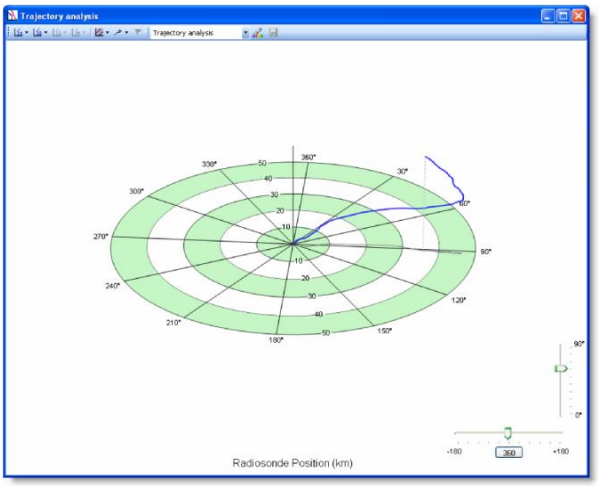


Exhibit 9-16 Tilted Trajectory Plot

However, using the slider bars in the lower right corner of the plot window, you can tilt and rotate the plot resulting in a three-dimensional type display (Exhibit 9-17). The trajectory line is shadowed at the surface to improve the visualization. Pressing the **360** button restores the plot to the starting point with the 360 degree point at the top.

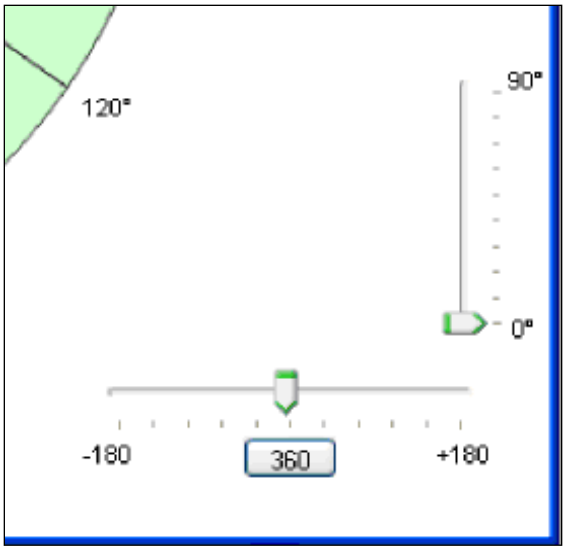


Exhibit 9-17 Tilted Trajectory Plot

When the plot is rotated (e.g. 360º not at the top), a vertical bar appears to better visualize the trajectory. This bar is left dimensionless due to the viewing angle. However, when the plot is fully tilted back 90º, the view is from the side, and height units are now displayed along the vertical bar. Users may find it more useful to move the tilt and rotation slightly to give a better appearance of the 3-D drawing.

Hovering the cursor over the plot line in the trajectory display will provide a popup data window the same as the two dimensional plots. This feature is useful in locating the exact position of the radiosonde, and key observed data values.

9.7 Data Value Display

There are several ways to obtain the precise values for data points along the plotted line, or for any point on the plot background. In either case, the data values appear in a popup window next to the cursor location.

To obtain the value for a point along the data line, simply position the mouse cursor over the point of interest and hold it there for a second. The popup data window will automatically appear (Exhibit 9-17). The data will always include the elapsed time and the parameter pointed to on the plot, as well as a standard set of parameters.

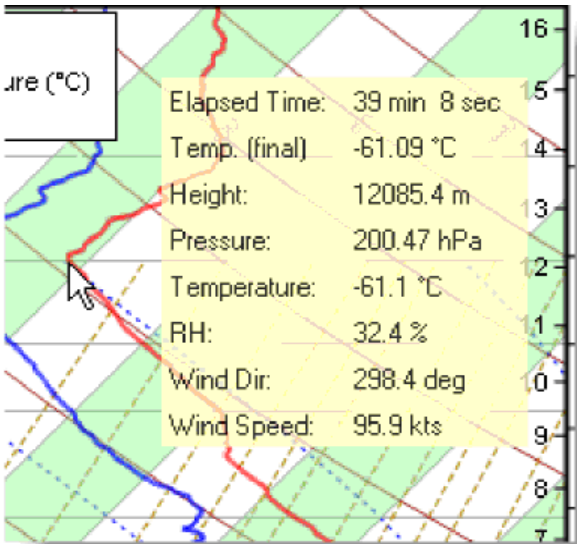


Exhibit 9-17 Data Popup

To obtain a value for any location on the plot area background, hold down the **CTRL** key and select the left button on the mouse to activate a large cross-hair cursor. This cursor will span the entire height and width of the plot area. Values are displayed for all currently selected vertical and horizontal axis parameters. If there are multiple horizontal axes, the cursor extends into this area for easier reference (Exhibit 9-18).

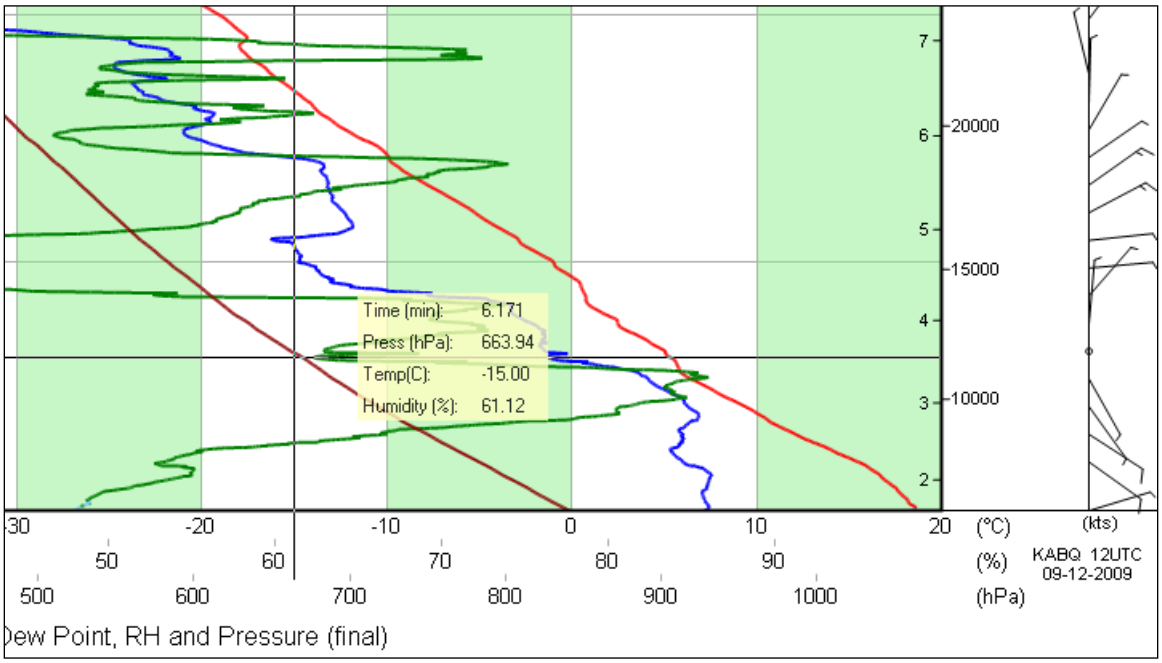


Exhibit 9-18 Crosshair cursor with multiple axis

10 RRS Observation – Transmitting Messages

This chapter discusses the procedure for transmitting WMO Coded Messages to host computers. The following section describes general procedures for transmission.

10.1 General Procedures

RWS automatically generates WMO Coded Messages at specific levels during the flight. They may also be manually generated anytime during or after the flight. Once the WMO Coded Messages are generated, the observer should review the plots, Check Messages, and Tabular Data prior to transmitting. If changes are made to the flight data the WMO Coded Messages will need to be re-coded. After data has been checked for quality and any re-coding has taken place, select the appropriate message(s) and click the **Transmit** button.

10.2 Coded Messages

The WMO Coded messages include the RADAT (FZL), Mandatory Levels (MAN), Significant Levels (SGL), and Above 100 hPa Levels (ABV). RWS will **Code**/generate and display the WMO coded messages whenever the **Code** option is selected from the Messages pull-down menu. During a flight, RWS automatically issues the **Code** command when the flight reaches 400 hPa, 70 hPa, and at termination. When the WMO Coded Messages are generated, RWS also regenerates and displays the Check and Status messages. The Check messages alert the observer to unusual or abnormal meteorological conditions.

IMPORTANT: The WMO Coded Message window allows the edits to the coded message. The observer must not edit the messages in anyway unless there are obvious errors or the action is approved by WSH. To edit upper air data, the observer will review and edit the flight data by Marking data in the Processed Tabular Display and then re-Code the WMO Coded Messages. The RRS software has been designed to automatically include required 101 groups to cover most situations. Because of this, the program does not present a prompt asking for 101 groups. Any edits made to the WMO Coded Message will not be reflected in the Processed Tabular Display.

The transmission of WMO Coded Messages can take place anytime during a flight and up to 6 hours after flight termination in Rework. A message may be transmitted by clicking on the desired message in the upper left box. A check mark indicates the message will be transmitted. Clicking the **Transmit** button will transmit the coded messages selected. While not usually necessary, the entire Coded Message can be transmitted at any time during the flight. In some instances, such as multiple or late releases, it may be necessary to transmit the Coded Messages early in the flight to ensure the data makes it into the weather prediction models. Table 10-1 indicates which required portions of the Coded Messages must be transmitted when the flight reaches set levels.

Flight Level Reached	Coded Message to be Transmitted
400 hPa	RADAT
70 hPa	MAN and SGL
Termination	ABV

Table 10-1 WMO Coded Message Transmission Requirements

The WMO Coded Messages are transmitted through one primary connection route with three backup connections. If the primary connection fails, RWS will automatically attempt to connect to each backup connection (in succession) three times. If all connections are unsuccessful it is recorded in the Status Messages. With remote upper air locations as the exception, the typical setup for the primary and backup connections is listed below.

- Primary connection for most sites is the LAN connection to local LDAD.
- First backup connection is a dial-in connection to the local LDAD.
- Second backup connection is a dial-in connection to the Regional Headquarters LDAD.
- Third backup connection is a dial-in connection to another Regional Headquarters LDAD.

On occasion, it may be necessary to only use certain transmission routes for the Coded Messages. For instance, if the local Phone 1 backup is temporarily down, the Phone 1 route can be deselected and the Coded Messages sent via the remaining routes (Exhibit 10-1). More than one route can be deselected. The deselecting route(s) is temporary and does not affect future transmissions.

NOTE: The LAN connection is automatically tested at the beginning of the flight. RWS will automatically deselect the LAN if connection cannot be established. Additionally, if a phone number is not entered for a backup phone connection in the Station Data LDAD Info, the Phone route will not be available for selection.

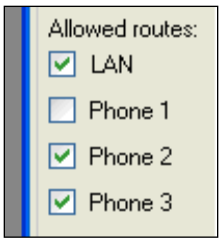


Exhibit 10-1 Coded Message Transmission Routes

NOTE: The RRS software does not compute fallout winds.

10.2.1 Manually Coded No Data Messages

If a flight fails at release and no data above surface is available or a flight will not be taken, the observer must send a No Data Message. To create a No Data Message, select **No Data** from the Messages pull-down menu. The No Data Message window will appear. Select the appropriate reason from the drop-down menu for the flight being missed (Exhibit 10-2). The WMO Coded and

RADAT Message window will open with TTAA Message in the bottom right window. The (TTAA), (TTBB), and (TTDD) messages must all be sent with the appropriate 101 groups when a flight was missed or no data is available above the surface.

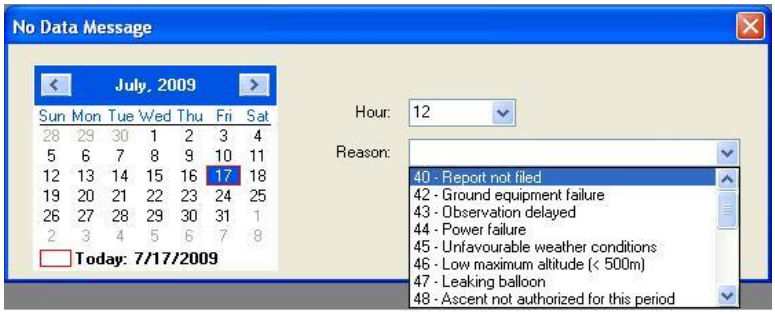


Exhibit 10-2 No Data Message with Options

AWIPS Message: USUS97 KQHC 270000
MANHQC
72403 TTAA 7700/ 72403 51515 10142=

NOTE: There are two different procedures that should be followed when a flight is missed.

1. When a flight is not possible for any reason, the observer must use the No Data option and add the proper 101 groups for the reason for no data.
2. When a flight is missed and another was possible, but not allowed - The observer must add a 10148 group after the 51515 message in the TTAA, TTBB and TTDD messages. The 10148 group signifies that an ascent was not authorized.

The 10148 group should only be used when a second release is possible, but not allowed by NCEP or other approving authorities

10.2.2 Using the Code Option

The WMO Coded Messages can be opened manually by selecting **Code** in the Messages pull-down menu. From the WMO Message Display select the part of the message to view. When the MAN message is selected, the screen showing the TTAA coded message appears (Exhibit 10-3).

NOTE: The group following the 10164 is the stability index and the two groups following the 10194 group are the mean level winds from surface to 5,000 feet and from 5,000 feet to 10,000 feet.

```
69003 TTAA  70001 69003 99021 24056 01002 00258 22458 12503
92930 16439 12007 85645 12458 10004 70244 05699 01014 50591
11577 05523 40758 24778 06029 30960 41387 05525 25081 51383
06525 20224 57782 17003 15404 59781 26501 10658 61581 30513
88179 60381 05024 77999 51515 10164 00007 10194 11005 01008=
```

Exhibit 10-3 Mandatory Levels to 100 hPa

Clicking on the SIG message will display the TTBB and PPBB messages. (Exhibit 10-4)

```
69003 TTBB  70000 69003 00021 24056 11018 23861 22974 20050
33918 15631 44860 13058 55859 13058 66838 11457 77831 11057
88823 10444 99799 08428 11797 08225 22791 08656 33777 08059
44776 07859 55753 05659 66734 03656 77733 03456 88728 03460
99722 04471 11715 05071 22712 05489 33711 05695 44709 05699
55701 05699 66674 04099 77659 02676 88653 02276 99643 02499
11640 02699 22634 02099 33605 00576 44598 01176 55567 04774
31313 58708 80003 41414 00900 51515 10159=

PPBB  70000 69003 90012 01002 12003 10006 90346 12007 11007
08005 90789 00507 35011 36012 91246 35517 05518 04021=
```

Exhibit 10-4 Significant Levels and Winds to 100 hPa

The group immediately after the 31313 group tells the user if a solar correction is used, the radiosonde type and the ground equipment used. The second group following the 31313 group always begins with an eight. This group provides actual time of release in UTC.

IMPORTANT: NEVER delete or change the data in the 31313 group unless authorized by WSH.

31313 $s_r r_a r_a s_a s_a$ 8GGgg - (Example : 31313 **58708 80003**)

s_r	Solar and infrared radiation correction
$r_a r_a$	Radiosonde/sounding system used
$s_a s_a$	Tracking technique/status of system used

8	Indicator for time
GGgg	Time of observation in hours and minutes UTC is the actual time of radiosonde release.

Examples of the 31313 code group

58708

5 = Data corrected for solar radiation. (0 = No solar correction)

87 = LM Sippican MKIIA GPS radiosonde

08 = GPS tracking system

80003

8 = Is a designator to indicate that the release time follows

0003 = Is the actual time of release in UTC in hours and minutes (00:03 UTC)

The group immediately after the 41414 is the cloud code group. Appendix B covers the coding and decoding of the cloud group and weather group that are entered during pre-flight.

41414 $N_hC_LhC_MC_H$ - (Example 41414 81571)

N_h Cloud amount in eights of the sky of low or middle clouds.
NOTE: Only the amount of the low clouds if present. If no low clouds are present, then the amount of middle clouds. Never include high clouds.

C_L Type of low cloud.

h Height of lowest cloud layer

C_M Type of middle cloud

C_H Type of high cloud

The group or groups immediately after the 51515 group tells the user additional information about the flight or reason for termination. 101 groups are groups strictly for U.S. stations. The 101 code breakdown is found in section 3 of this chapter.

Selecting the ABV message will display the TTCC, TTDD, and PPDD messages (Exhibit 10-5).

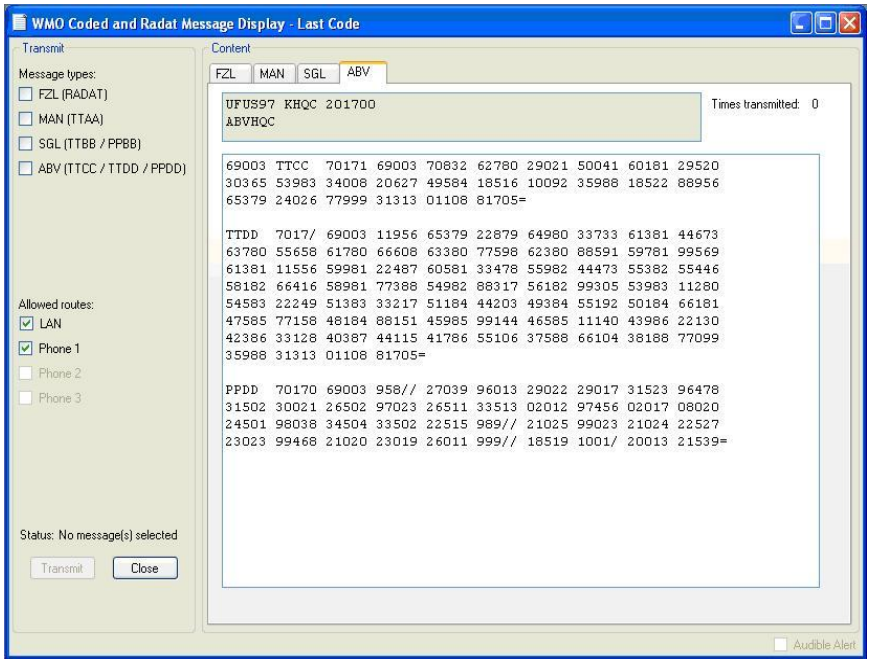


Exhibit 10-5 MAN and SIG Messages Above 100 hPa

10.2.3 The RADAT Message

The RADAT message indicates the height of the freezing level(s) in hundreds of feet based on pressure altitude, along with the highest relative humidity observer at a freezing level. This data is important to meteorologists and aviation interests. The RRS software will automatically code the RADAT message and alarm after achieving 400 hPa.

The RADAT message can be manually generated by selecting **Code** in the Message pull-down menu (Exhibit 10-6). To view the RADAT, select the FZL option in the WMO Coded Message (Exhibit 10-7) and the RADAT message is displayed. Prior to transmitting the RADAT message, ensure the flight is above 400 hPa so that all freezing levels are measured. Also review the Check Messages and flight data and Mark data that needs editing. Transmitting the RADAT may be necessary, even if the flight terminates below 400 hPa and another flight is not authorized.

Exhibit 10-6 The Code option in the Messages pull-down

IMPORTANT: <u>Do NOT edit or change the data in the RADAT message.</u> Pressure altitudes are used to generate heights and this data is not available to the observer. If the RADAT is erroneous you may code it as missing.

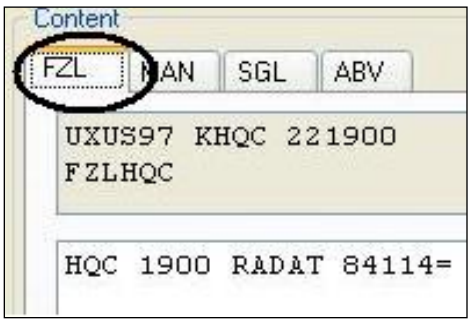


Exhibit 10-7 Message Options

10.2.3.1 Automatically Coded Groups of the RADAT message

The following is a breakdown of the RADAT message showing the elements the RRS software automatically codes.

CCC GGGG RADAT UU (D) (hphphp) (hphphp) (hphphp) (/n) RAICG HHMSL SNW

CCC 3 Letter Station ID

GGGG Observation time to the nearest hour (UTC)

RADAT A contraction to indicate that freezing level data follows.

UU Relative humidity to the nearest percent. Use highest RH of any of the coded crossings of the 0° isotherm. Code 00 when the RH is 100 percent. Enter "ZERO" when the entire sounding is below 0° Celsius. Code "MISG" when the surface temperature is warmer than 0° Celsius and the sounding is terminated before the 0° Celsius isotherm is reached. Coded // when RH is missing.

(D) A letter designator identifying the 0° Celsius isotherm crossing to which the coded value of UU corresponds; L for lowest, M for middle, H for highest. When only one height value is coded, this figure is omitted.

(hphphp) A geopotential height coded in hundreds of feet above MSL at which the sounding crosses the 0° Celsius isotherm. A maximum of 3 levels are selected and displayed as follows:

A. The first crossing of the 0° Celsius isotherm after release

B. The uppermost crossing of the 0° Celsius isotherm.

C. The intermediate cross of the 0° Celsius isotherm. When there are two or more intermediate levels, the level with the highest RH is selected. If these levels have the same RH, the lowest level is selected.

D. After the levels are selected they are encoded in ascending order of height.

(/n) Indicator group to show the number of crossings of the 0° Celsius isotherm other than those whose heights are coded. If all crossings are coded, the /n group is omitted.

Manually Added Groups:

(RAICG) A contraction to indicate that icing data follows (Only when icing is present).

Note: As a general rule RAICG should be appended if the dew point depressions at the 0° Celsius crossings are 3 degrees or less and persist for several hundred meters.

(HH) The altitude of icing in hundreds of feet MSL as determined from the sounding. Include the indicator "MSL" following the height; e.g., RAICG 12 MSL indicating "icing above 1200 feet mean sea level."

(SNW) Include the contraction SNW if snow is apparently causing a slow ascension rate; e.g., RAICG 13 MSL SNW.

Examples of Coded Freezing Level Data

	RH (%)	CROSSING ALTITUDE (FT)			CODED AS:
		Lowest	Middle	Upper	
Example 1:	63	3500			RADAT 63L035
Example 2:	89	2300	Missing	4200	RADAT 89H023///042

After the RADAT message is displayed, click on RADAT in the upper left box until a Red Check appears. After checking the RADAT message block, click on the Transmit button to send the message. Once the RADAT message is transmitted the display will update the Times transmitted.

NOTE: The transmit button is not enabled until a message is selected.

10.3 Coded Message Breakdown

The observer must understand how to properly code and decode upper-air messages. The messages for the sites in the continental United States, Alaska, the Bahamas, and the Caribbean are in WMO Region IV. The sites in the Pacific Region are in WMO Region V. The coding practices in Region IV and V differ slightly, the difference being the stability index and mean low level winds are not computed for sites in Region V.

CODED MESSAGE BREAKDOWN

91285 TTAA 56001 91285 99011 28060 01009 00107 24856 01007
92787 20456 33502 85514 18265 22504 70145 07413 27011 50586
04170 33025 40758 17367 32025 30966 32764 30537 25092 40762
30545 20241 52560 30541 15421 67158 30024 10657 79756 32024
88999 77999 51515 10164 00011 10194 32003 23507=

IIiii TTAA YYGGI_d IIiii 99PPP TTTDD ddfff 00hhh TTTDD ddfff
92hhh TTTDD ddfff 85hhh TTTDD ddfff 70hhh TTTDD ddfff 50hhh
TTTDD ddfff 40hhh TTTDD ddfff 30hhh TTTDD ddfff 25hhh TTTDD
ddfff 20hhh TTTDD ddfff 15hhh TTTDD ddfff 10hhh TTTDD ddfff
88PPP 77PPP 51515 10164 000I_sI_s 10194 ddfff ddfff=

IIiii - Block number and station number

TTAA - Indicator of mandatory levels up to 100 hPa.

YYGGI_d -

YY - Day of the month, (When winds are given in knots 50 will be added to YY)

GG - Actual time of observation, to the nearest whole hour UTC

I_d - Indicator used to specify the pressure relative to the last standard isobaric surface for which a wind is reported. Reported to the nearest hundreds of hectopascals. (Used in TTAA and TTCC)

PPhhh - Mandatory pressure levels

PP - Starts with 99 - indicating surface 00 -1000 hPa 92- 925 hPa 85 - 850 hPa on until 10 - 100 hPa.

hhh - Height in geopotential meters (gpm)

Sfc to 500 hPa - Reported in whole gpm (thousands not reported) 3204 gpm reported 204
500 hPa to Term - Reported in tens of gpm 6053 gpm reported 605

TTTDD - Temperature and Dewpoint Depression Values

TTT - Dry bulb Temperature in degrees Celsius. Last digit indicates if the temperature is negative or positive. Negative temperatures will have an odd number for the 3rd digit. Positive temperatures will have an even number for the last digit.

DD – Dewpoint Depression. This number is subtracted from the dry bulb temperature. Numbers of less than 55, are degrees and tenths. (i.e.) 49 is 4.9 degree dewpoint depression. Numbers of 56 or greater are dewpoint depressions in whole degrees. To obtain the proper dewpoint depression value subtract 50 from any value 56 or greater. (i.e.) 72 would be a dewpoint depression of 22 degrees.

ddfff - Wind Direction and Speed

dd - True Wind Direction to the nearest 10 degrees. Wind directions of 500 degrees or greater indicate winds with speeds greater than 100 knots. When reading the direction in this case, one should subtract 500 from the direction and remember to add 100 to the wind speed value.

fff - Wind Speed in knots. Wind directions are actually rounded to the nearest 5 degrees. The unit digit of the wind direction is added to the hundreds digit of the wind speed. (i.e., 27520 is winds from 275 degrees at 20 knots.)

88hhh - TTTDD 88 - indicates tropopause

77hhh - ddfff 77 - indicates max wind group

51515 - Regional Code Groups Follow

10164 - Indicator that the stability index follows

10194 - Indicator that the mean low level wind groups follow

ddfff ddfff - First group mean winds sfc - 5000 feet
Second group mean winds 5000 - 10000 feet

= (End of message symbol) It is a telecommunications character and is not part of the code.

91285 TTBB 56000 91285 00011 28060 11008 26057 22000 24856
33905 19057 44850 18265 55795 13257 66768 12260 77764 12039
88700 07413 99679 05817 11675 06259 22670 06661 33652 06061
44644 05666 55627 03462 66606 02068 77567 01163 88548 01271

99478 05769 11339 28364 22281 34763 33137 71358 44100 79756
31313 01102 82307 41414 59571=

IIiii TTBB YYGGa_4 IIiii 00PPP TTTDD 11PPP TTTDD 22PPP TTTDD
33PPP TTTDD 44PPP TTTDD 55PPP TTTDD 66PPP TTTDD 77PPP TTTDD
88PPP TTTDD 99PPP TTTDD 11PPP TTTDD 22PPP TTTDD 33PPP TTTDD
44PPP TTTDD 55PPP TTTDD 66PPP TTTDD 77PPP TTTDD 88PPP TTTDD
99PPP TTTDD 11PPP TTTDD 22PPP TTTDD 33PPP TTTDD 44PPP TTTDD
31313 s_r r_ar_a s_as_a 8GGgg 41414 $N_hC_LhC_MC_H$=

a_4 - Type of measuring equipment used. (Used only in TTBB and TTDD.)

0 - Pressure instrument associated with wind-measuring equipment
1 - Optical Theodolite
2 - Radiotheodolite
3 - Radar
4 - Pressure instrument associated with wind-measuring equipment but pressure element failed during ascent
5 - VLF-Omega
6 - Loran-C
7 - Wind profiler
8 - Satellite navigation
9 - Reserved

NOTE: a_4 is not fully implemented into the RRS software - RRS codes “0" in TTBB & TTDD.

PPP - Pressure of Significant Levels Selected

SFC to 100 hPa - Levels selected to nearest whole hPa

Above 100 hPa - Levels selected to nearest 0.1 hPa

31313 - Data on Sea Surface Temp & Sounding System Used

s_r - Solar and infrared radiation correction.

0 - No correction
1 - Correction Made
4 - No Correction Made
5 - Correction Made

r_ar_a - Radiosonde Used

87 – Lockheed Martin Sippican GPS MarkIIA (USA)
51 - Lockheed Martin Sippican type B-2 time commutated (USA)
52 - Vaisala GPS RS92-NGP (Finland)

s_as_a -Tracking Technique/Status Used

00 - No windfinding
01 - Automatic with auxiliary optical direction finding
02 - Automatic with auxiliary radio direction finding
03 - Automatic with auxiliary ranging
05 - Automatic with multiple VLF-Omega frequencies
06 - Automatic cross chain Loran-C
07 - Automatic with auxiliary wind profiler
08 - Automatic satellite navigation

8 - Indicator
GG - Hour UTC of release
gg - Minute of release

41414 - Cloud Data $N_hC_LhC_MC_H$

N_h - Amount in eighths of all the C_L present or, if no C_L is present, the amount of all the C_M present.
C_L - Type of low cloud present
h - Height above surface of lowest cloud seen
C_M - Type of middle cloud present
C_H - Type of high cloud present

PPBB 56000 91285 90012 01009 01003 00502 90346 32002 26003
20502 90789 21005 23508 27013 91245 26512 27016 26514 9169/
31013 33026 9205/ 32523 32025 93013 31034 31538 29542 935//
30547 949// 30024 9504/ 30025 32037=

PPBB YYGGa_4 Iiiii 9$t_n$uuu ddfff ddfff ddfff 9tnuuu ddfff ddfff ddfff=

YYGGa_4 Iiiii ddfff - Previously described

9 - Indicator to show winds in units or 300 meters or 1,000 foot increments
t_n - Indicates tens digit of altitude - 0 = less than 10,000 feet 1 - 10,000 - 19,000 feet
u - Indicates the unit value of altitude of winds

91285 TTCC 56002 91285 70858 76757 05508 50059 63959 11005
30378 54160 06009 20638 51161 07512 88922 82356 33014 77999=

TTDD 5600/ 91285 11922 82356 22700 76757 33517 64359 44472
64959 55364 57560 66130 47162=

PPDD 56000 91285 9556/ 32522 33015 970// 13004 98047 08012
09512 07012 99015 08012 08011 05005=

Breakdown for $101A_{df}A_{df}$ - Miscellaneous Regional Data

Code Figure	Definition
40 - 59	Reason for no report or an incomplete report
40	Report not filed
41	Incomplete report; full report to follow
42	Ground equipment failure
43	Observation delayed
44	Power failure
45	Unfavorable weather conditions
46	Low maximum altitude (less than 1500 feet above ground)
47	Leaking balloon
48	Ascent not authorized for this period
49	Alert
50	Ascent did not extend above 400 hPa level
51	Balloon forced down by icing conditions
53	Atmospheric interference
54	Local interference
55	Fading signal*
56	Weak signal*
57	Preventive maintenance
58	Flight equipment failure (transmitter, balloon, attachments, etc.)
59	Any reason not listed above

* Fading signals differ from weak signals in that "fading signals" are first received satisfactorily, then become increasingly weaker, and finally become too weak for reception, while "weak signals" are weak from the beginning of the ascent.

60 - 64: Miscellaneous

62	Radiosonde report precedes
64	Stability index follows: $000I_sI_s$

65 - 69: Doubtful Data

65	Geopotential and temperature data is doubtful between following levels: $0P_nP_nP'_nP'_n$
66	Geopotential data is doubtful between the following levels: $0P_nP_nP'_nP'_n$
67	Temperature data is doubtful between the following levels: $0P_nP_nP'_nP'_n$

68	Dew point depression is missing between the following levels: $0P_nP_nP'_nP'_n$ (not used when T_nT_n is also missing)
70 - 74	Not allocated

Breakdown for $101A_{df}A_{df}$ - Miscellaneous Regional Data (Continued)

75 - 89	Corrected Data
78	Corrected tropopause data section follows
79	Corrected maximum wind section follows
80	Corrected report for the entire report (*first** and *second** transmissions) follows
81	Corrected report of the entire PART A and/or PART B precedes
82	Corrected report of the entire PART C and/or PART D precedes
83	Corrected data for *mandatory levels*** follow
84	Corrected data for *significant levels*** follow
85	Minor error(s) in this report; correction follows
86	*Significant level(s)* not included in original report follow: $//P_nP_nP_n$ $T_nT_nT_{an}D_nD_n$ or $P_nP_nP_nT_nT_n$
87	Corrected data for *surface* follow
88	Corrected *additional data* groups follow: $101A_{df}A_{df}$ .... etc.
90 - 99	
90	Extrapolated geopotential data follow: $P_nP_nh_nh_nh_n$ $(d_nd_nd_nf_nf_n)$
94	Averaged wind for the surface to 5000 foot MSL layer and the 5000 to 10000 foot MSL layer follows: ddfff ddfff (can be used in the PART A message)

NOTE: Numbers not shown have no assigned meaning or do not pertain to NWS upper-air sites.

Unless both the stability index and the mean winds are missing, the Part A message always contains two special 101 groups as follows:

10164 Group that identifies stability index.

10194 Group that identifies the mean winds.

A 5-character group $000I_sI_s$ follows the 10164 which contains the encoded stability index. The I_sI_s value that appears in the coded message for the stability index is interpreted as follows:

Stability Index Table

Code Value	Meaning
00 to 40	Stability index is 0 to 40
51 to 90	Stability index is -1 to -40
91	RH < 20% at either base or 500 mb level or calculation failed.
92	RH is missing at the base level.

The 10194 group for mean winds from the surface to 5000 feet MSL and from 5000 to 10000 feet MSL are encoded in two code groups using the format $d_m d_m f_m f_m f_m$, where $d_m d_m$ is the mean direction and $f_m f_m f_m$ is the mean wind speed. If the mean wind is missing, it is reported as /////. If winds for both layers (i.e. Sfc. - 5K and 5K to 10K feet MSL) are missing, the 10194 is not sent.

Additional 101 groups as shown in the Table can be entered after the 51515 as long as the last two digits are in ascending order with the other groups. For example, if the report has been corrected, this section would appear as follows:

51515 10164 00092 10181 10194 ///// 26516=

11 RRS Observation – Flight Termination

RRS flights may terminate in one of four ways:

1. Automatic termination by the system
2. Manual termination by the observer
3. Predetermined termination at a certain pressure level.
4. Sudden unexpected failure such as hardware or power failure.

The following sections discuss each type of termination.

11.1 Automatic Flight Termination

RWS terminates a flight automatically when the radiosonde data indicates the observation has ended. Automatic termination can occur for a number of reasons, but the three most common are balloon burst, floating balloon, and excessive missing data. Even though RWS can automatically detect flight termination the flight data should be reviewed to verify the termination time and reason. If necessary the termination point/time and reason can be changed to accurately depict the flight.

When flight termination occurs, the UPS Status Window will appear indicating the software has terminated the flight. If an additional release is not necessary, click the **Yes** button to turn OFF the UPS and TRS (Exhibit 11-1). Otherwise, leave the UPS ON for the next release of the ascension.

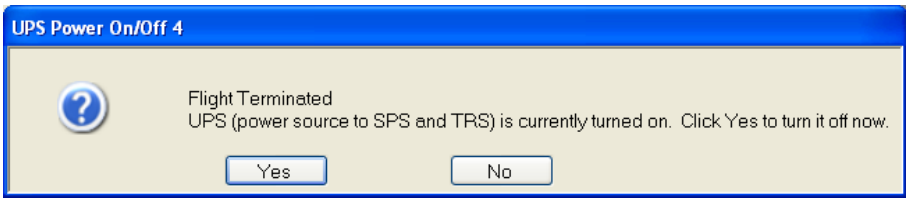


Exhibit 11-1 UPS Status Change Window

1. After clicking **Yes** in the UPS Power window, a Validation window appears (Exhibit 11-2) Click **Yes** to confirm the shutdown of the UPS.

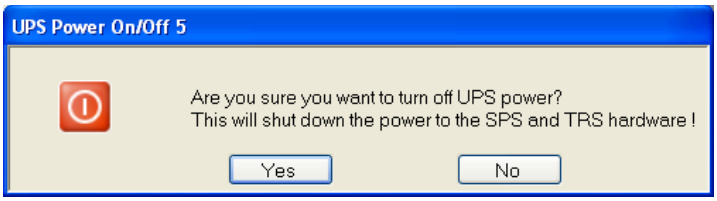


Exhibit 11-2 Validation Window

2. The window shown in Exhibit 11-3 will appear alerting the observer that this release has been saved to the database. Click **OK.**

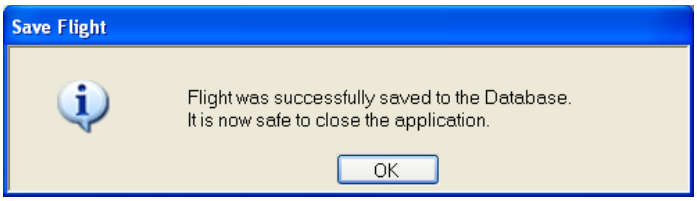


Exhibit 11-3 Flight Saved to Database

NOTE: An Active Release is the most successful release of an Ascension Number. When there is more than one release for an Ascension Number, RWS will prompt the observer to select the Active Release.

3. After the UPS prompt, the **Code** command is automatically executed and the Check, Status, and Coded Messages will appear. Transmit the Coded Messages ONLY after reviewing the flight data and termination time and reason for accuracy (See Chapters 5 and 13).
4. To change the termination time or reason, select **Termination Time** or **Termination Reason** from the **Tools** pull-down menu. Validating the Termination Time and Reason is the final major operator task that should normally be performed.

NOTE: The observer may not change the termination time later than the time determined by the software.

NOTE: Data Marked within 3 minutes of the termination point is lost if the Termination Time is changed.

11.1.1 Balloon Burst

The most common reason for flight termination is balloon burst. RWS will terminate a flight based on a decrease of radiosonde geopotential height over a two minute interval. The burst detection process is delayed an additional three minutes to allow for potential floating balloon detection (Section 11.1.2).

The pressure profile is the best verification that the flight has terminated for balloon burst. Exhibit 11-4 illustrates a typical pressure profile that results when a balloon bursts. The Raw Pressure profile extends past the termination point and shows the part of the balloon's descent. The Corrected and Smoothed Pressure profiles end at the point of balloon burst.

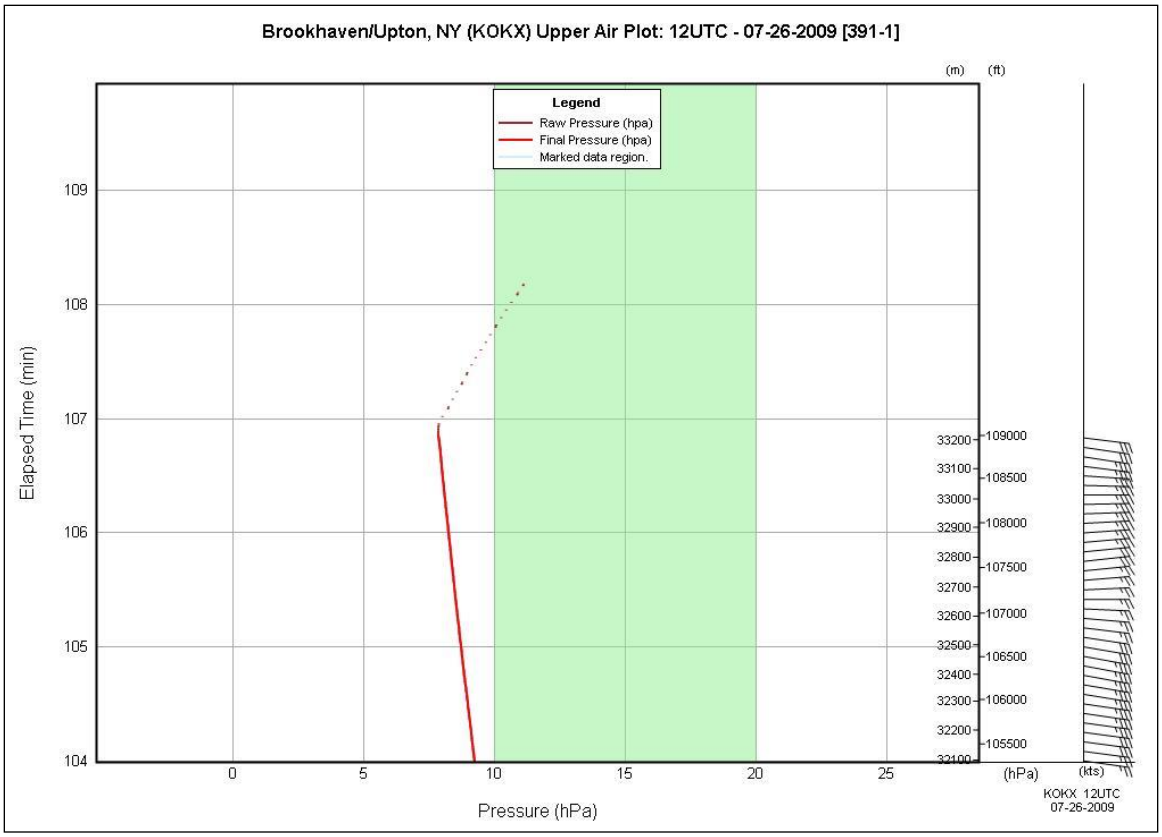


Exhibit 11-4 Termination for Balloon Burst

11.1.2 Leaking or Floating Balloon

Occasionally a flight terminates because the balloon stops rising and begins floating at a nearly constant altitude, or rises so slowly that there is no point in continuing the flight. A float can occur because of a leaking or icing balloon. RWS will terminate the flight if the balloon fails to change height over time. If the Geopotential Height over 5 minutes does not increase at least 300 meters, and if the balloon does not rise at least 1 meter per second then the flight is terminated as a floating balloon. The termination point will be set to the starting point of the float.

11.1.3 Excessive Missing Data

Excessive Missing Data (EMD) occurs when there is a significant amount of missing raw PTU data. Many things can cause the flight to automatically terminate for EMD, such as radiosonde failure, tracking problems and hardware failure. Thus, when a flight terminates for EMD it is important to review the flight data and change the termination reason appropriately. Section 11.4 describes the user selectable termination reasons.

RWS will terminate for EMD when the flight has three minutes of consecutive missing data or when the amount of cumulative (non-consecutive) missing data is reached (Table 11-1). The missing raw data does not include data automatically marked as an outlier.

Flight Length	Cumulative Missing	
	Pressure Data	Temperature Data
Surface to 10 minutes	4 minutes	4 minutes
Surface to 25 minutes	10 minutes	6 minutes
Surface to 60 minutes	24 minutes	12 minutes
Entire flight	40 minutes	16 minutes

Table 11-1 Cumulative Missing Data Limits

11.1.4 Radiosonde Failure

RWS will terminate the flight owing to radiosonde failure if it appears that the temperature sensor has failed. The temperature sensor is considered broken if:

1. Over any 5 minutes period the difference between highest and lowest temperature in that period is less than 0.2 degrees Celsius.
2. Over any 2 minute period the average raw temperature difference (temperature of a given point minus temperature of previous point) is greater than 0.5 degrees Celsius

11.1.5 RWS unknown failure – Recovery

In the event the RWS software exits abruptly or the workstation abruptly turns off, the RWS software sets the termination reason to "RWS unknown failure – Recovery". When RWS software is restarted the flight is automatically reopened in Rework. If the flight ended before reaching 400 hPa, the observer should review the flight data and determine if another release is necessary before sending the Coded Messages. See Section 11.5 for more information on flight recovery.

11.2 Manual Termination

In the event RWS has not terminated the flight or the temperature or pressure data is too erroneous, the observer can manually terminate the flight. Perform the following steps to manually terminate a flight.

1. Select **Terminate** from the Flight Pull-down menu or click the Red Circle on the RWS tool bar (Exhibit 11-5). Click **Yes** in the Terminate Flight window to terminate the flight (Exhibit 11-6).

Exhibit 11-5 Manually Terminate

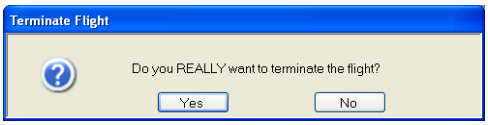


Exhibit 11-6 Validation window

2. After clicking **Yes** in the validation window, the UPS Status Window will appear indicating the flight has been terminated. If an additional release is not necessary, click the **Yes** button to turn OFF the UPS and TRS (Exhibit 11-7). Otherwise, leave the UPS ON for the next release of the ascension.

NOTE: Turning off the UPS enables the proper shutdown of the TRS and tracking equipment.

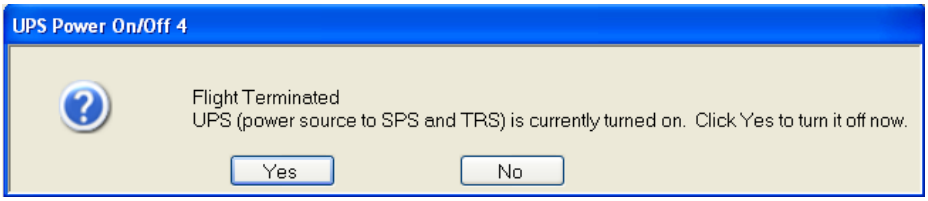


Exhibit 11-7 UPS Power Window

3. After clicking **Yes** in the UPS Power window, a Validation window appears (Exhibit 11-8) Click **Yes** to confirm you wish to shutdown the UPS.

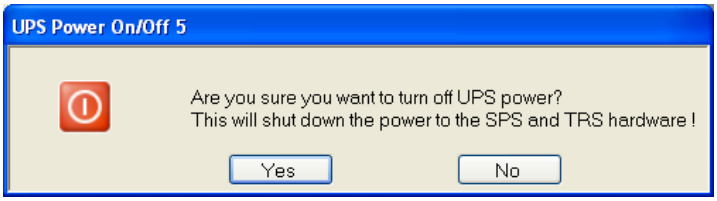


Exhibit 11-8 Validation Window

4. The window shown in Exhibit 11-9 will appear alerting the observer that this release has been saved to the database.

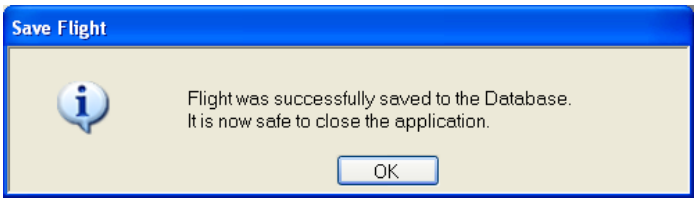


Exhibit 11-9 Flight Saved to Database

5. After the UPS prompt, the Code command is automatically executed and the Check, Status, and Coded Messages will appear. Do not transmit the Coded Messages until the flight data and termination reason is reviewed for accuracy. (See Chapters 5 and 13)

6. After transmitting the messages, open the Flight Summary display and copy or print the data required in WS Form B-29. If a problem or abnormal condition occurred, save and print whatever messages or plots that may be of help to determine the cause of the problem. When finished reviewing and transmitting the flight data, close RWS from the Flight pull-down menu. (Exhibit 11-17)

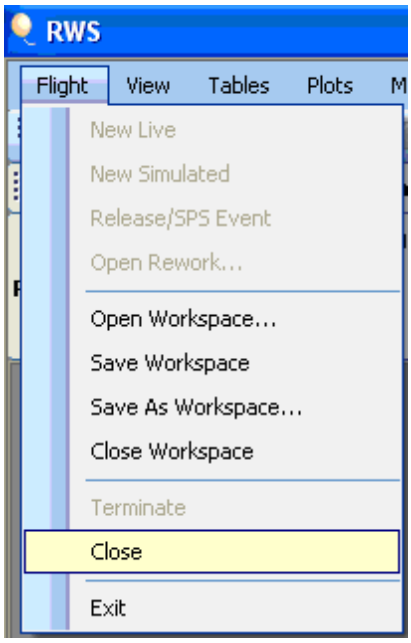


Exhibit 11-17 Close Flight

7. Click **Yes** in the Validation window (Exhibit 11-18).

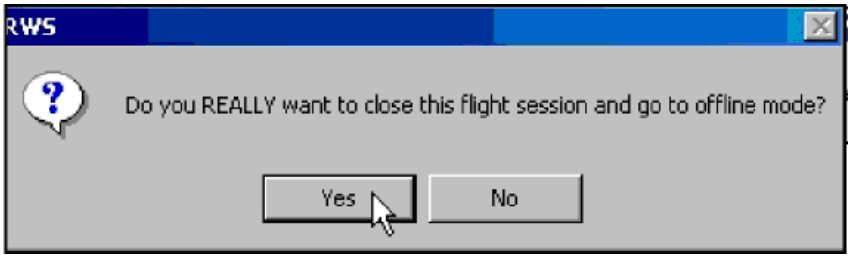


Exhibit 11-18 Validation Window

8. A final window appears stating that the flight was saved to the database and that to Archive the flight go into Utility option. Click **OK**. (Exhibit 11-19)

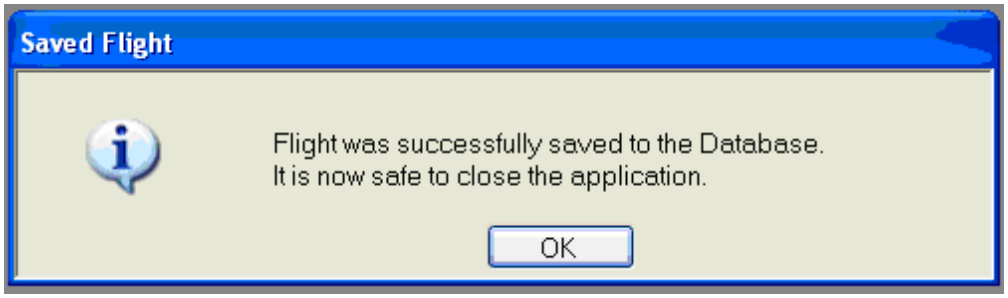


Exhibit 11-19 Close Application

NOTE: If the software crashes, the software will automatically go to Rework. In Rework, the flight may be transmitted up to 6 hours after flight termination, but RRS does not allow the flight to be continued after a crash or power failure.

11.3 Early Termination Prior to 400 hPa and Second Release

There will be occasions when the flight will either automatically terminate or have to be terminated by the observer prior to reaching 400 hPa. When this occurs, first determine if an additional release is authorized. The following window will automatically be displayed (Exhibit 11-20).

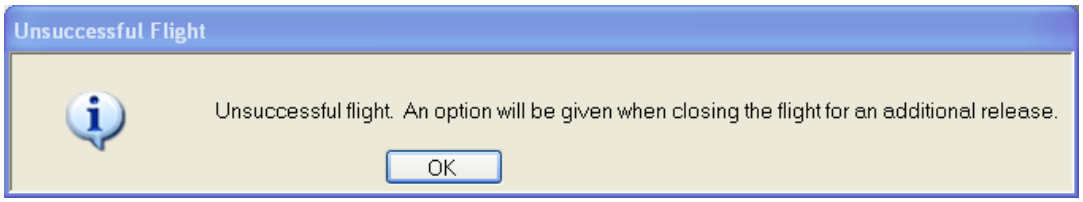


Exhibit 11-20 Unsuccessful Flight Popup

If an additional release is authorized, do the following steps:

1. Click **Close** under Flight pull-down menu.
2. A window will appear asking, "Would you like to run a new release of this ascension?" Click **Yes**. (Exhibit 11-21).

Exhibit 11-21 New Release Prompt

3. The preflight displays will open for the next release. The preflight can be continued as described in Chapter 4;.

NOTE: Make sure to use a different frequency on the new radiosonde. Prior to baseline, a pop-up window will appear as a reminder to change frequency. Additionally, set the TRS to Manual, realign it to the baseline azimuth and elevation and set it to the new radiosonde frequency.

4. After completing the Administrative, Equipment and Surface Observation displays, click the **Next** button. A reminder pop-up window will appear to change frequency (Exhibit 11-22).

Exhibit 11-22 Change Frequency Reminder Message

5. When closing the flight after completing additional releases a window will prompt the observer to select the Active Release for the Ascension (Exhibit 11-23). The Active Release is usually the most successful release with the best quality data and will be the release that is archived and sent to NCDC.

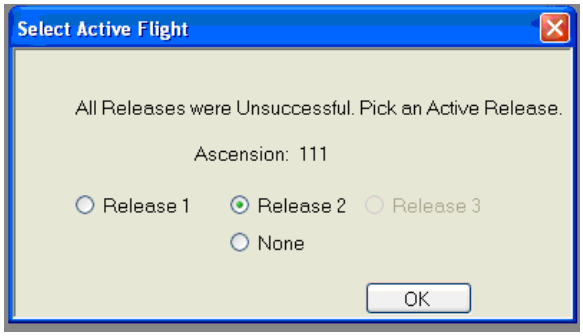


Exhibit 11-23 Select the Active Release

11.4 Manually Selectable Termination Reasons

After termination, the termination reason should be reviewed for accuracy. When the termination reason does not accurately describe the termination, the observer should manually change the reason. Below is a procedure to change the termination reason and descriptions of termination reasons.

1. To change the flight termination reason, select **Change Termination Reason…** from the **Tools** pull-down menu.

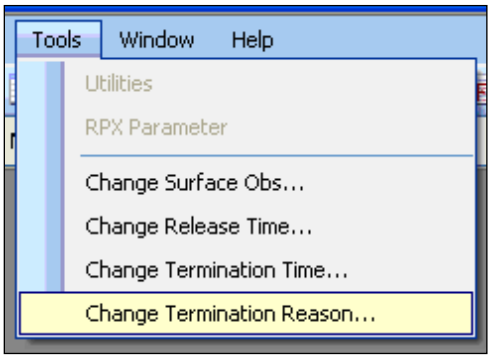


Exhibit 11-24 Tools Pull-Down Menu

2. Select the termination reason from the pull-down list and click **OK** (Exhibit 11-25).

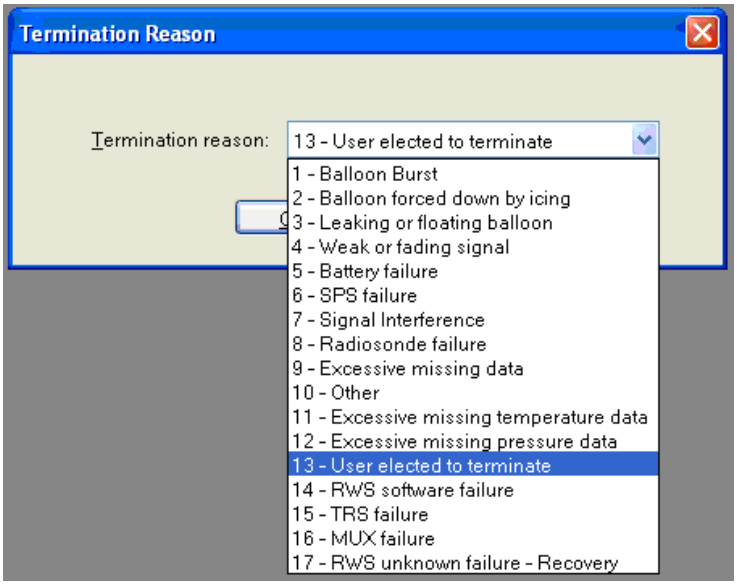


Exhibit 11-25 Termination Reason Selection

3. The Status Messages will reflect the change to the Termination Reason (Exhibit 11-26).

12-04-2009	20:11:48.75	Flight terminated: 13 - User elected to terminate.
12-04-2009	20:11:49.72	Flight Levels termination is set to 15.10 minutes.
12-04-2009	20:11:50.06	Coded Messages were generated.
12-04-2009	20:11:56.16	Termination reason changed to 1 - Balloon Burst.

Exhibit 11-26 Status Message for a Termination Reason change

Termination Reason Descriptions

1. **Balloon Burst **** – RWS will terminate for a Balloon Burst when the Geopotential Height decreases over a two minute interval.
2. **Balloon forced down by icing** – If RWS automatically terminated for a Leaking or Floating Balloon and the flight data shows that the balloon began to float after crossing through a high humidity layer with temperatures below freezing.
3. **Leaking or Floating Balloon **** – RWS will terminate for a Floating Balloon when the balloon fails to increase at least 300 meters over 5 minutes.
4. **Weak or fading signal** – If RWS automatically terminated the flight for Excessive Missing Data and the TRS signal strength was fading near the time the PTU data became missing.
5. **Battery failure** – If RWS automatically terminated the flight for Excessive Missing Data and there was a sudden TRS signal strength drop at the time the PTU data became missing.
6. **SPS failure** – If RWS automatically terminated the flight for Excessive Missing Data and either the TRS signal strength was strong while the PTU data became missing or the

Hardware Status indicates no communication with the SPS (This assumes the DCE/MUX alarm light is not illuminated).

7. **Signal Interference** – If RWS automatically terminated the flight for Excessive Missing Data and a change was noted in the TRS frequency greater than .5 MHz.
8. **Radiosonde Failure** – If the raw pressure and/or temperature data was continuously unrealistic for an extended amount of time. Note the Termination Time should also be adjusted as necessary.
9. **Excessive Missing Data (EMD) **** – RWS will terminate for EMD when the flight has either 3 minutes of continuous missing raw PTU data or has exceeded the cumulative missing raw pressure and/or missing raw temperature data thresholds. The missing raw data used to determine termination does not include data marked as outlier.
10. **Other** – The termination reason cannot be determined.
11. **Excessive missing temperature data **** – RWS will terminate for EMD when the flight has either 3 minutes of continuous missing raw temperature data or has exceeded the cumulative missing raw temperature data thresholds. The missing raw data used to determine termination does not include data marked as outlier.
12. **Excessive missing pressure data**** – RWS will terminate for EMD when the flight has either 10 minutes of continuous missing raw pressure data or has exceeded the cumulative missing raw pressure data thresholds. The missing raw data used to determine termination does not include data marked as outlier.
13. **User Elected to Terminate **** – The observer manually terminated the flight.
14. **RWS software failure** – If RWS automatically terminated for RWS Unknown Failure and the RWS software had frozen or had an exception that caused it to close.
15. **TRS failure** – If RWS automatically terminated for EMD and the observer or technician identifies the missing data was actually due to a TRS component failure(s).
16. **MUX failur**e – If RWS automatically terminated for EMD and the observer or technician identifies the missing data was actually due to a problem with the MUX.
17. **RWS Unknown Failure – Recovery **** – RWS will terminate for RWS Unknown Failure when the RWS Software or workstation is halted during a flight and is restarted. RWS will Rework any flight closed abruptly and assign a termination reason of RWS Unknown Failure.

NOTE: The termination reasons listed with a ** indicate the only termination reasons RWS can select automatically. All other reasons are manually selected by the observer. The observer should review the flight data to identify the actual termination reason.

11.5 Hardware or Software Failures

There may be occurrences where the hardware or software may fail in the middle of the flight. While these situations are expected to be rare the observer must understand what to do when these

situations arise. Should RWS software close suddenly due to a software or hardware failure, perform the following steps:

1. Restart the RWS software. If the workstation lost power temporarily it may be necessary to turn the workstation back on.
2. Once RWS is restarted the software will alert the user that a flight did not terminate cleanly and RWS will open the flight in Rework.
3. Once in Rework, the observer should;

    - Review the flight information to determine if the data is valid.
    - Mark Data as necessary.
    - Transmit the coded Messages.
    - Determine if an additional release is necessary and authorized.

4. When exiting the Rework an option is provided to run a new release of this ascension.
5. If a new release is authorized, see Section 11.3 Step 1 for additional information.

12 Transferring Archive Files

After completion of each flight, the data will be archived and sent to the National Climatic Data Center (NCDC) electronically using the RRS workstation. The observer can build and send the archive files to NCDC by using one simple RWS utility.

NOTE: Maintain at least the last 3 month's worth of flight database files on CDs or backup hard drive. Flights can be exported to external media (e.g. CD) utilizing the Flight Export Utility (Chapter 16 contains more information on Export and Deleting flight database files).

NOTE: Unless authorized by WSH, the archive will not be sent to NCDC on hard media, such as a CDROM.

Steps to Build and Transfer the Archive Files

1. On the RRS workstation, in the Offline Mode select the Tools Option and click on Utilities (Exhibit 12-1). When the Utilities window opens, select the NCDC Archive Utility.

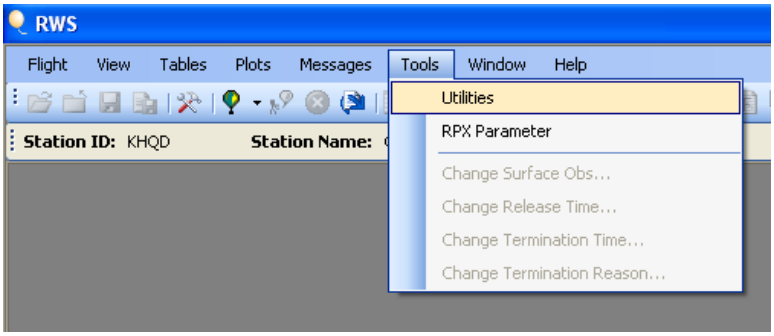


Exhibit 12-1 Utilities

2. In the NCDC Archive Utility (Exhibit 12-2), highlight the row of the flight to be archived (Exhibit 12-3).

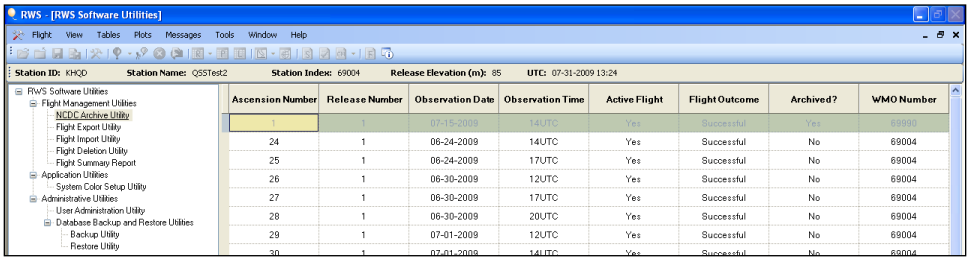
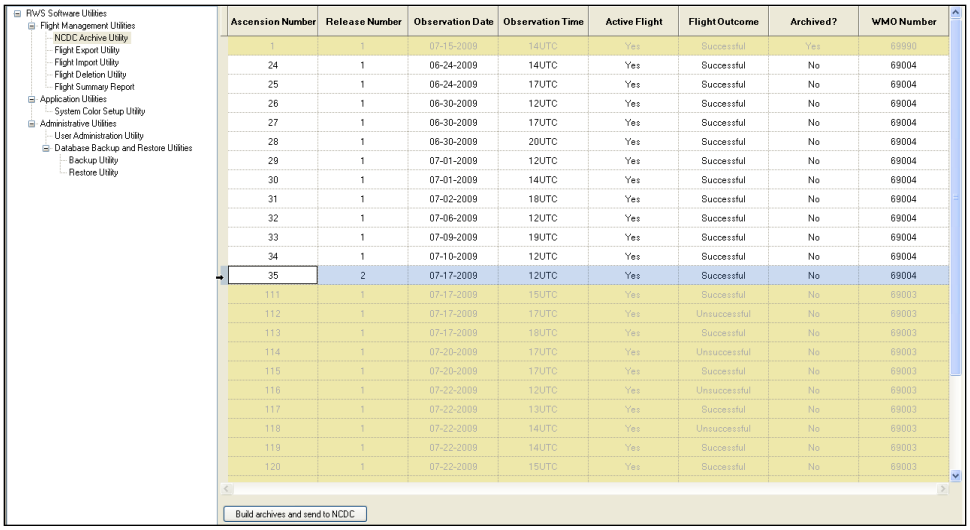


Exhibit 12-2 NCDC Archive Utility



Ascension Number	Release Number	Observation Date	Observation Time	Active Flight	Flight Outcome	Archived?	WMO Number
1	1	07-15-2009	14UTC	Yes	Successful	Yes	69990
24	1	06-24-2009	14UTC	Yes	Successful	No	69004
25	1	06-24-2009	17UTC	Yes	Successful	No	69004
26	1	06-30-2009	12UTC	Yes	Successful	No	69004
27	1	06-30-2009	17UTC	Yes	Successful	No	69004
28	1	06-30-2009	20UTC	Yes	Successful	No	69004
29	1	07-01-2009	12UTC	Yes	Successful	No	69004
30	1	07-01-2009	14UTC	Yes	Successful	No	69004
31	1	07-02-2009	18UTC	Yes	Successful	No	69004
32	1	07-06-2009	12UTC	Yes	Successful	No	69004
33	1	07-09-2009	19UTC	Yes	Successful	No	69004
34	1	07-10-2009	12UTC	Yes	Successful	No	69004
35	2	07-17-2009	12UTC	Yes	Successful	No	69004
111	1	07-17-2009	15UTC	Yes	Successful	No	69003
112	1	07-17-2009	17UTC	Yes	Unsuccessful	No	69003
113	1	07-17-2009	18UTC	Yes	Successful	No	69003
114	1	07-20-2009	17UTC	Yes	Unsuccessful	No	69003
115	1	07-20-2009	17UTC	Yes	Successful	No	69003
116	1	07-22-2009	12UTC	Yes	Unsuccessful	No	69003
117	1	07-22-2009	13UTC	Yes	Successful	No	69003
118	1	07-22-2009	14UTC	Yes	Unsuccessful	No	69003
119	1	07-22-2009	14UTC	Yes	Successful	No	69003
120	1	07-22-2009	15UTC	Yes	Successful	No	69003

Exhibit 12-3 Select Ascension to Archive

3. Click the **Build archives and send to NCDC** button.
4. The Status below the button will show the Ascension number and percentage complete (Exhibit 12-4).

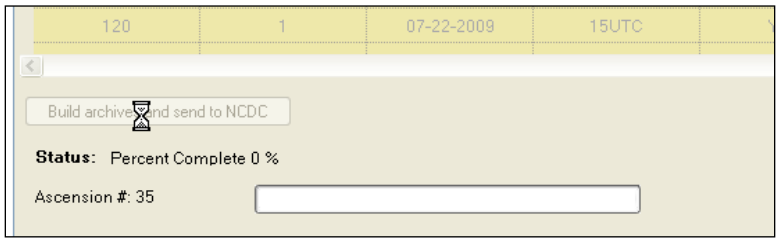


Exhibit 12-4 Building archives and sending

5. After the archiving is complete an Archive Utility Results pop-up message will appear (Exhibit 12-5).

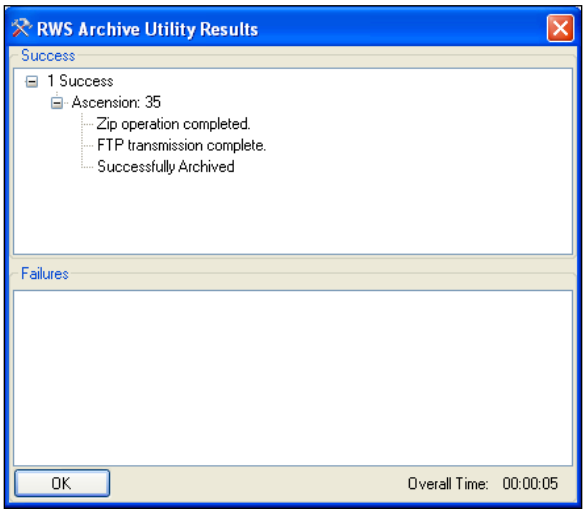


Exhibit 12-5 RWS Archive Utility Results

6. Verify the flight was archived by going back and viewing the Archive Table. The row will have a green background and the "Archived?" column will have a "Yes" (Exhibit 12-6)

Ascension Number	Release Number	Observation Date	Observation Time	Active Flight	Flight Outcome	Archived?	WMO Number
1	1	07-15-2009	14UTC	Yes	Successful	Yes	69990
24	1	06-24-2009	14UTC	Yes	Successful	No	69004
25	1	06-24-2009	17UTC	Yes	Successful	No	69004
26	1	06-30-2009	12UTC	Yes	Successful	No	69004
27	1	06-30-2009	17UTC	Yes	Successful	No	69004
28	1	06-30-2009	20UTC	Yes	Successful	No	69004
29	1	07-01-2009	12UTC	Yes	Successful	No	69004
30	1	07-01-2009	14UTC	Yes	Successful	No	69004
31	1	07-02-2009	18UTC	Yes	Successful	No	69004
32	1	07-06-2009	12UTC	Yes	Successful	No	69004
33	1	07-09-2009	19UTC	Yes	Successful	No	69004
34	1	07-10-2009	12UTC	Yes	Successful	No	69004
35	2	07-17-2009	12UTC	Yes	Successful	Yes	69004

Exhibit 12-6 Verify Flight Archived

7. After archiving the flight, to exit RWS software select **Close** and then select **Exit** from the Flight pull-down menu. (Exhibit 12-7) The RWS software will close.

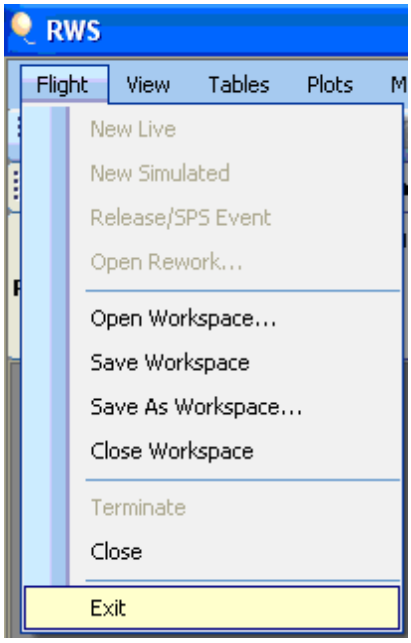


Exhibit 12-7 Exit Flight

NOTE: The archive files sent to NCDC contain a compressed file containing the flights H, T, and B files.

- **"H" file (Archive header file)**
- **"T" file (Archive thermal file)**
- **"B" file (Archive BUFR file)**

NOTE: One way to verify the reception of archived data to the NCDC ftp site is to visit `www1.ncdc.noaa.gov/pub/data/ua/RRS/YYYY` (where `YYYY` is the current year). Once at the website find the log file representing the site by identifying the station ID and the year and month the data was transmitted. For example klwx_0801_log.txt would contain the upload history for LWX for January of 2008.

13 In-flight Data Problems

Accurate upper-air soundings are essential for weather forecasting. Yet there will be times where the sounding has data problems that require action by the observer as the software does not automatically remove all erroneous data. This chapter will cover problems seen in radiosonde data. It is assumed that the reader can identify and understand typical sounding data features and how to mark and delete data (see Chapter 5).

If the observer has a sounding with data problems not covered in this chapter, an attempt must be made to verify that the data is accurate. If there are numerous data Check messages for ascent rates, super adiabatic temperature lapse rates and height/temperature changes, the temperature or pressure data is likely excessively bad and the sounding should be terminated at the point where the data problems began. If there are problems with RH or wind data, delete the data for either winds or RH from the point where it went bad to the end of the flight, but let the sounding proceed to flight termination (i.e. balloon burst).

It is essential to quality control the sounding data prior to disseminating the data to users. Never disseminate poor quality soundings with the assumption that NCEP or other data users will correct or edit the bad data on their end.

IMPORTANT: When editing pressure, temperature, RH or winds data, delete ALL the data in the erroneous layer. If more than 1 minute of data needs to be deleted, do not randomly keep a data point in the layer so that the RRS software backfills the layer with interpolated values. This does nothing more than generate an unrealistic sounding.

13.1 Balloon Release Made Too Early or Late

Observers should strive to launch the radiosonde during established release time windows. See Chapter 4 for more information.

If an observer mistakenly releases a balloon even a second before 11:00 or 23:00 UTC, RWS will log the observation time as 11:00 or 23:00 UTC. Likewise, equipment problems or weather (e.g., thunderstorms) may result in a balloon release being made late. If it release occurs late, even a second beyond the release time window, RWS will log the flight as a 13:00 UTC or 01:00 UTC observation.

If the radiosonde is released outside the release time window, then under no circumstances will the observer modify the release time or observation time in the coded messages or elsewhere to make it a 12:00Z or 00:00Z observation.

Let the software log the times correctly and disseminate the observation to NCEP and NCDC as is normally done. In NWS form B-29 log, record the flight in the Flight Summary section and note in the remarks that the release was made too early or late. Do not log the flight as missed or as a special sounding.

A similar situation may occur with special or non-synoptic soundings. Again, if the release is made outside the non-synoptic release time window, do not modify the release time or observation time.

IMPORTANT: On rare occasions severe weather (thunderstorms or high winds) are expected to occur during the entire 90 minute release time window (see Chapter 4) and a sounding can't be taken during that time. Yet an upper air observation is critically needed for forecasts and warnings. In such a case, the office Lead Forecaster or NCEP SDM will be contacted about releasing the radiosonde before 11:00 or 23:00 UTC to avoid the severe weather that is expected to occur at the office. If permission for an early release is approved, it will be handled and disseminated as a special observation. The early radiosonde release will be done as close to 11:00 or 23:00 UTC as possible. Since there will be no 12:00 or 00:00 UTC observation, issue a "No data message (101xx) after the Special is completed. In the NWS upper air B-29 and B-85 forms, log the sounding as a special. The associated 12:00 or 11:00 UTC sounding will be logged in forms as missed. The same rules apply if it is decided by the Lead Forecaster or SDM to launch the radiosonde after 12:29 or 01:29 UTC to avoid severe weather.

13.2 Pressure Data Anomalies and Problems

If a Pressure Plot is seen that does not show a smooth curve to flight termination one may conclude that the pressure sensor is faulty. However, this section will show that in most cases the questionable data is being caused by real atmospheric events rather than failure of the pressure sensor.

IMPORTANT: RWS will interpolate the pressure data no matter how thick a layer is Marked by the observer. Never overly smooth the pressure data as this will likely create an erroneous sounding. If more than 10 consecutive minutes of pressure data needs to be Marked, then too much data has been lost and the sounding needs to be terminated at the beginning of the bad pressure data.

The geometric height (GPS height) data in the Processed Tabular Display is an excellent tool for verifying the accuracy of the geopotential height (and pressure) data. Change the table configuration so that the two heights are side by side. When comparing the two heights, the difference in height from second to second will typically be within a meter or two of each other. In Exhibit 13-1, the Processed Tabular Display has been configured to show the two heights side by side. The geometric and geopotential heights change 4 to 6 meters each second and are in good agreement with each other. An easy way to compare the geometric and geopotential heights can be done by reviewing Height and Ascension Rate Plots. Examples of both are shown in Exhibit 13-2 and 13-3. The heights and ascent rates for both heights in these examples are in very close agreement.

NOTE: Owing to allowable errors in the pressure sensor and GPS chip, there will almost always be differences in geopotential and geometric heights during portions of the sounding. For a particular level the difference is typically less than 50 meters early in the sounding. Above about 16 km or 100 hPa the differences can gradually increase up to 750 meters near 30 km or 10 hPa. If they exceed 750 meters at this height, follow the instructions in Section 13-4.

IMPORTANT: GPS data, especially from the Vaisala RS-92 radiosonde can be noisy on occasion and results in layers of erratic data in the Height and Ascent Rate plots. See Section 13.10 for more information.

Flight View Tables Plots Messages Tools Window Help

Station ID: KIAD **Station Name:** Sterling, VA **Station Index:** 72403 **Release Elevation (m):** 88.435

Elapsed Time (min)	Time Stamp (UTC)	Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Geometric Height (m)	Arc Distance (m)
6.72	23:13:32	778.55	778.49	2130	2132	2596.20
6.73	23:13:33	777.94	777.97	2136	2138	2611.61
6.75	23:13:34	777.44	777.46	2141	2143	2626.98
6.77	23:13:35	776.88	776.95	2146	2148	2641.89
6.78	23:13:36	776.32	776.47	2151	2153	2657.29
6.80	23:13:37	775.95	775.97	2156	2158	2673.54
6.82	23:13:38	775.42	775.47	2161	2163	2688.72
6.83	23:13:39	774.99	774.97	2166	2168	2703.86
6.85	23:13:40	774.44	774.46	2171	2173	2719.07
6.87	23:13:41	774.14	773.96	2177	2179	2734.83
6.88	23:13:42	773.57	773.48	2181	2184	2750.54
6.90	23:13:43	773.08	772.97	2187	2189	2765.55
6.92	23:13:44	772.42	772.46	2192	2194	2781.04
6.93	23:13:45	771.82	771.94	2197	2199	2797.09
6.95	23:13:46	771.37	771.44	2202	2204	2813.38
6.97	23:13:47	771.03	770.94	2207	2209	2828.91
6.98	23:13:48	770.36	770.45	2212	2214	2844.67
7.00	23:13:49	769.83	769.98	2217	2219	2860.21
7.02	23:13:50	769.29	769.52	2222	2224	2875.99
7.03	23:13:51	768.95	769.07	2227	2229	2891.55
7.05	23:13:52	768.58	768.63	2231	2235	2908.14
7.07	23:13:53	768.24	768.17	2236	2240	2924.17
7.08	23:13:54	767.88	767.72	2240	2245	2939.76
7.10	23:13:55	767.35	767.29	2245	2250	2955.81

Exhibit 13-1: Processed Tabular Display showing the geopotential and geometric heights side.

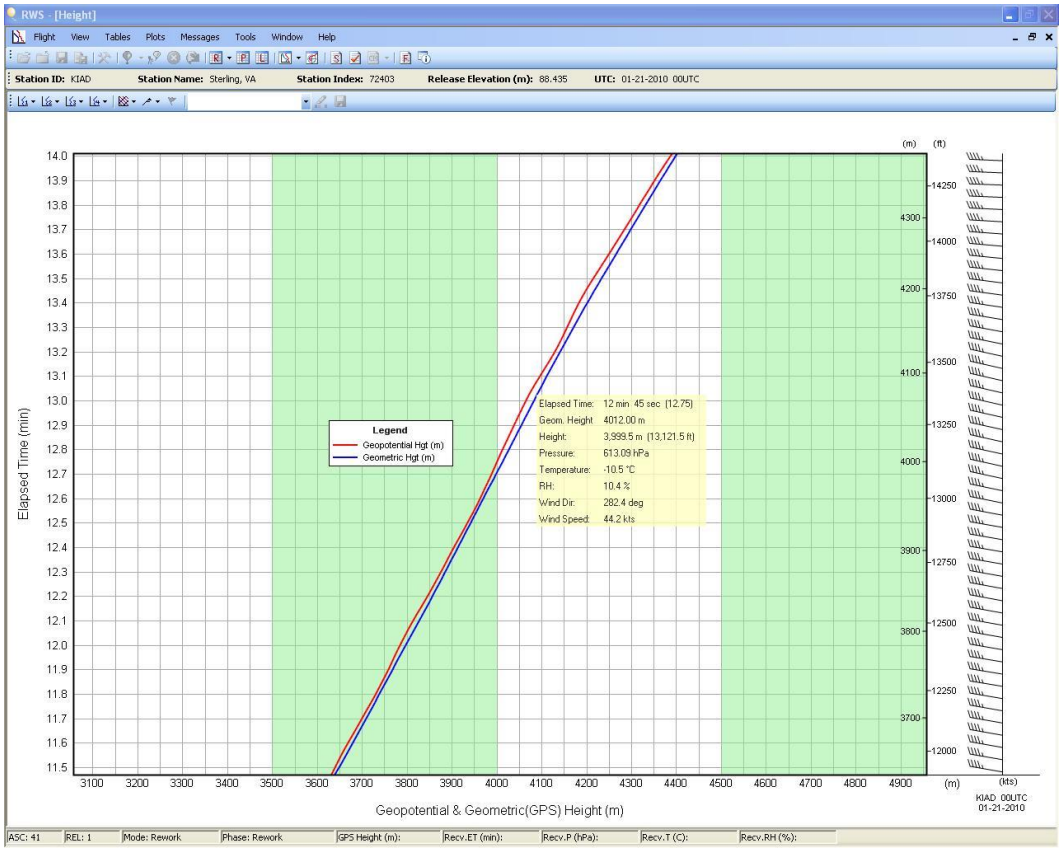


Exhibit 13-2: Height Plot showing the geopotential and geometric heights.

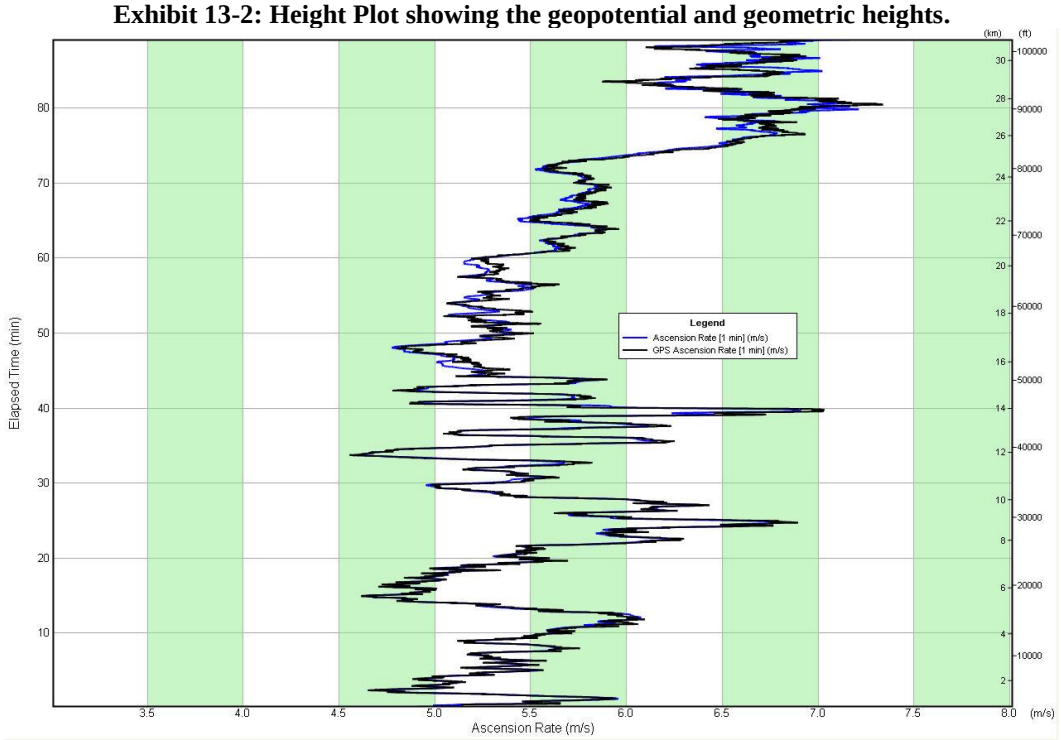


Exhibit 13-3: Ascension Rate Plot showing the ascent rates based on geopotential and geometric heights.

13.2.1 Wavy Pressure Profile

Sometimes if there is turbulence, atmospheric gravity waves, or balloon icing aloft, the Pressure Plot will show undulations or a “wavy” profile. With such a profile the balloon ascent rate speeds up and slows down or vice versa. A faulty pressure sensor may also cause this kind of problem, but this is not common. With a wavy pressure profile, Data Check Messages may appear for:

- Ascent rates exceeding 500 meters/minute
- Changes in heights and temperature from the previous sounding

Exhibit 13-4 shows a Pressure Data Plot with a wavy profile between 6 and 20 minutes. If such a profile in seen, follow these steps:

1. Verify that the pressure data is accurate in the wavy pressure layer by examining the Height Plot. Note the difference in geometric and geopotential heights from one second to the next. They should overlay closely with each other and the differences should be mostly 100 meters or less. Above about 16 km or 100 hPa the allowable differences can gradually increase to near 750 meters at 30 km or 10 hPa. If they agree, then **do not edit** the pressure data. Doing so can generate height errors. Exhibit 13-5 is the Height Plot from the same observation shown in Exhibit 13-4. Note the very good agreement between the two heights.
2. If they do not agree, the pressure sensor is likely at fault (See Section 13-4 and 13-5 as possibilities) and Marking of all the pressure data in the layer is required. If the erroneous data persist for more than 10 consecutive minutes, the pressure sensor has likely failed and the flight needs to be terminated at the point where the sensor failure occurred.

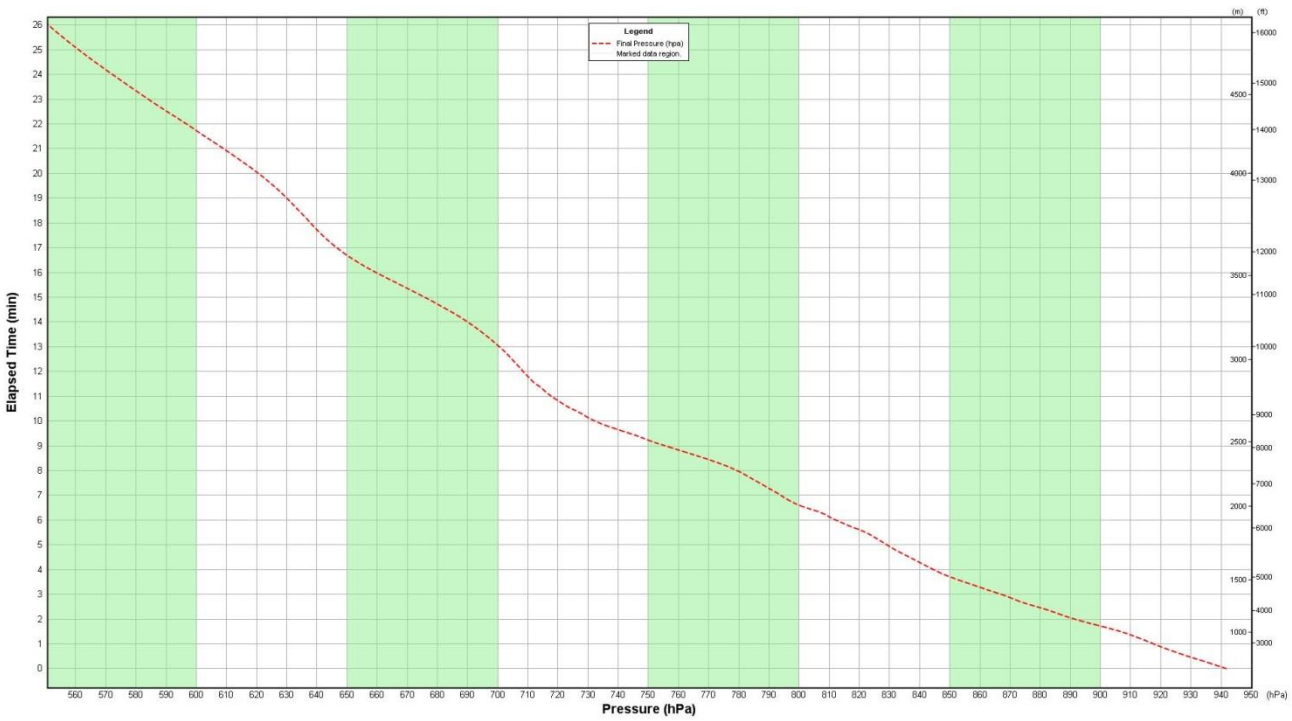


Exhibit 13-4: Pressure data profile showing fluctuations

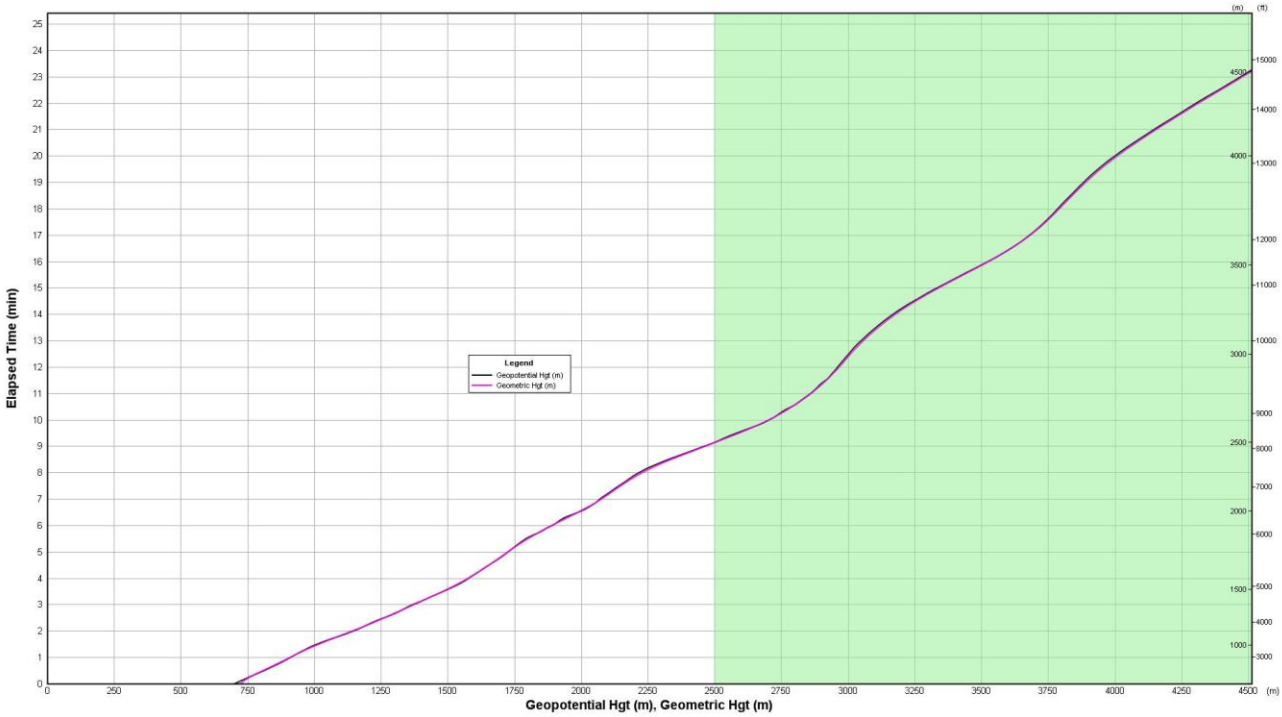


Exhibit 13-5: Same observation as Exhibit 13-4, but Height Plot showing geometric and geopotential Heights

13.2.2 Descending and Re-ascending Balloon

The descending/re-ascending balloon situation also causes a wavy pressure data profile, but it is more severe in that the balloon actually descends for a period of time and then re-ascends. It typically occurs below 10 km and may be caused by temporary balloon icing, severe turbulence, or strong atmospheric gravity waves. It may also result from a faulty pressure sensor, but this is not common. RRS will not select levels during this event to avoid coding duplicate pressure levels. Exhibit 13-6 shows descending/re-ascending layers between 12.5 and 14 minutes into the sounding.

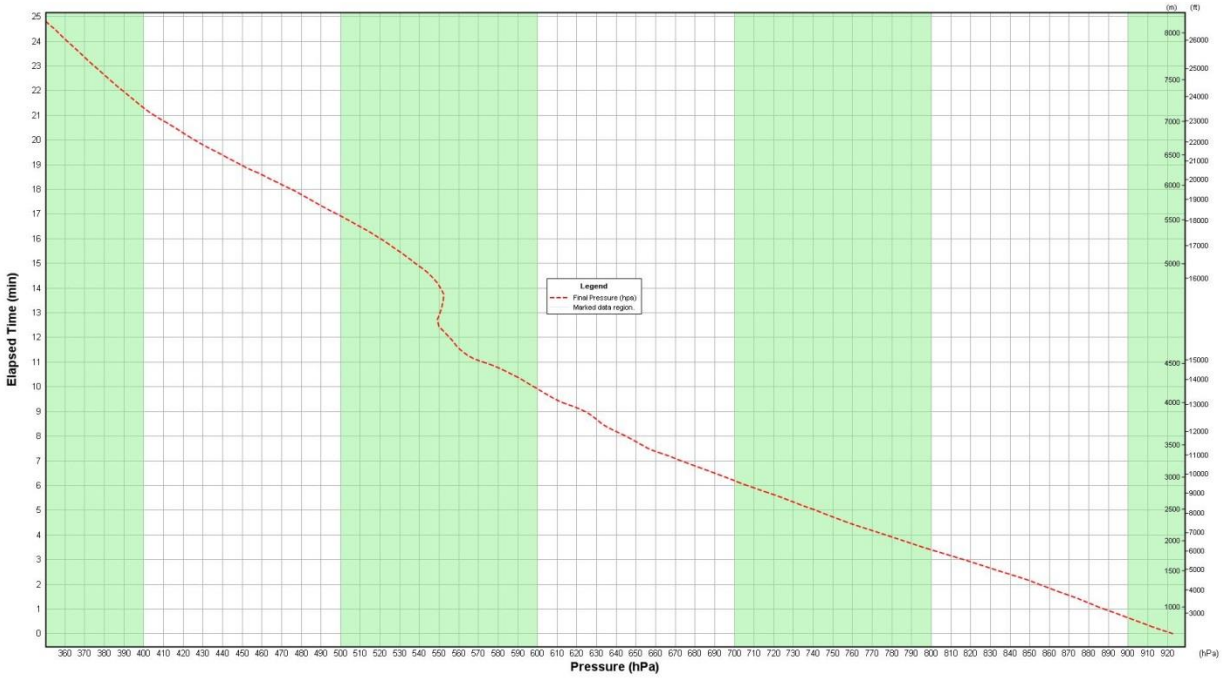


Exhibit 13-6: Pressure profile showing descending/reascending layers between 40 and 55 minutes

If there is a descending/reascending balloon detected by the software that persists for 30 or more seconds it will log the event in the Status Messages Display. Exhibit 13-7 shows an example.

Status Messages Display

Date	UTC Time	Flight Status Message	Comment
03-05-2010	20:29:23.97	Balloon release auto-detected at 20:29:10.896 UTC.	
03-05-2010	20:29:24.53	No appropriate flight found for comparison.	
03-05-2010	20:35:44.31	Successful release.	
03-05-2010	20:56:14.08	The RADAT message has been generated.	
03-05-2010	20:56:14.44	Coded Messages were generated.	
03-05-2010	21:16:06.16	Descending balloon detected at 44.08 minutes.	
03-05-2010	21:16:06.17	Reascending balloon detected at 45.30 minutes.	
03-05-2010	21:23:29.98	Descending balloon detected at 50.87 minutes.	
03-05-2010	21:23:30.00	Reascending balloon detected at 52.70 minutes.	
03-05-2010	21:35:55.63	Coded Messages were generated.	

Exhibit 13-7: Status Messages with descending and reascending messages

If descending/reascending pressure profile and Status Message are seen, the following Check Messages may also appear:

- Ascent rates
- Changes in heights and temperature from the previous sounding
- Super-adiabatic lapse rates

If the sounding indicates a descending/reascending balloon, follow these steps:

1. Verify that the pressure data are accurate in the wavy pressure layer by examining the Height Plot. Note the difference in geometric and geopotential heights from one second to the next. They should overlay closely with each other and the differences should be mostly 100 meters or less. Above about 16 km or 100 hPa the allowable differences can increase to near 750 meters at 30 km or 10 hPa. If they agree, then **do not edit** the pressure data. Doing so can generate height errors. Exhibit 13-8 is the Height Plot from the same observation shown in Exhibit 13-6. Note the very good agreement between the two heights.
2. If they do not agree, the pressure sensor is likely at fault (See Section 13-4 and 13-5 as possibilities) and Marking of all the pressure data in the layer is required. If the erroneous data persist for more than 10 consecutive minutes, the pressure sensor has likely failed and the sounding needs to be terminated at the point where the sensor failure occurred.

NOTE: If GPS data is missing, the geometric heights will not be available to compare with the geopotential height data. If this occurs, assume that in most cases the pressure sensor is working correctly and so the pressure data does not require any action. Continue to monitor all the flight data and compare it the previous sounding from 12 hours ago. If the data do not compare well *and* there are numerous data check messages for ascent rates, super-adiabats and/or height/temperature changes, terminate the sounding at the point where the data problems began.

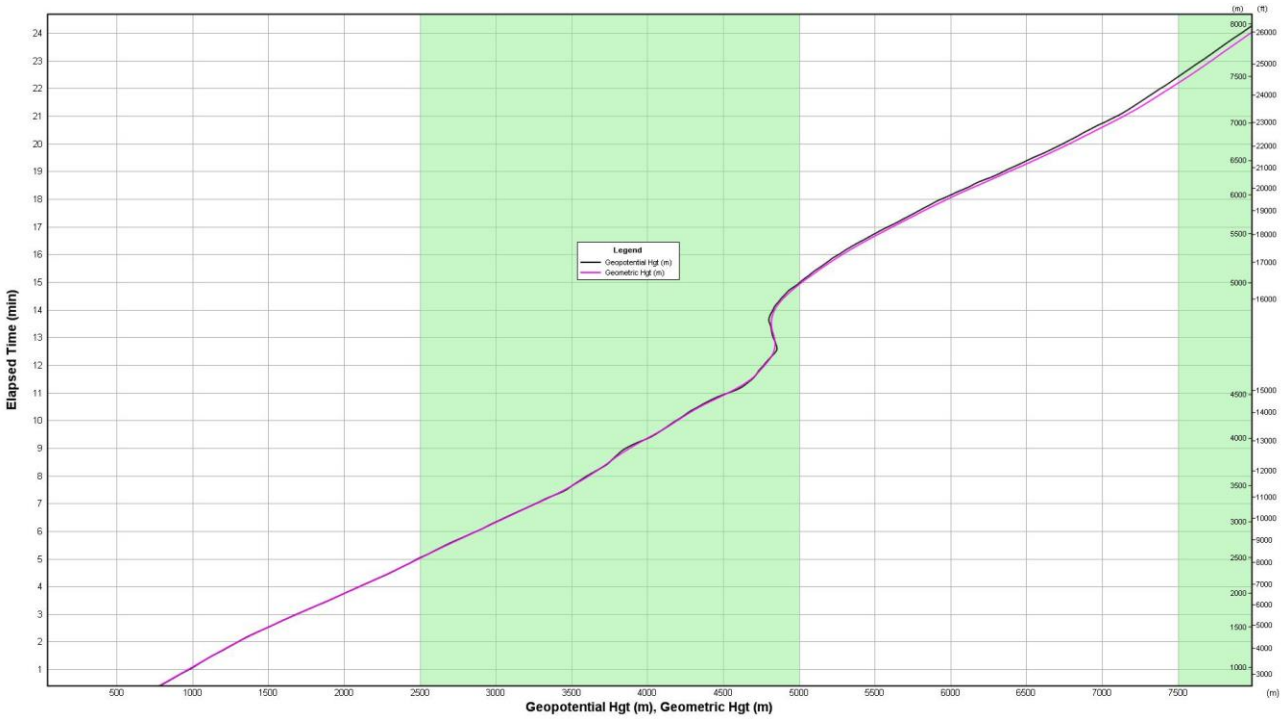


Exhibit 13-8: Same observation as Exhibit 13-6, but Height Plot showing Geometric and Geopotential Heights

13.3 Soundings inside Severe Turbulence

Sometimes severe turbulence (e.g., strong atmospheric gravity waves or rotor cloud) can cause the balloon to descend or ascend very quickly or fly nearly horizontal for several kilometers. This anomaly is more common in winter and spring and at upper-air stations located in mountainous regions. When the balloon finally starts rising again downwind from the release point, it can be very abrupt. Downdrafts can cause portions of the sounding to warm significantly when compared to the sounding taken 12 hours earlier.

Exhibit 13-9 shows the pressure profile of a sounding that passed through a severe atmospheric gravity wave or rotor cloud between 5 and 10 minutes and Exhibit 13-10 shows a close up of the pressure profile inside this event. The balloon in this example flew nearly horizontal for more than 4 km and once the balloon exited the wave, the ascent rate jumped to over 750 meters/minute. Exhibit 13-11 shows the check messages for this flight.

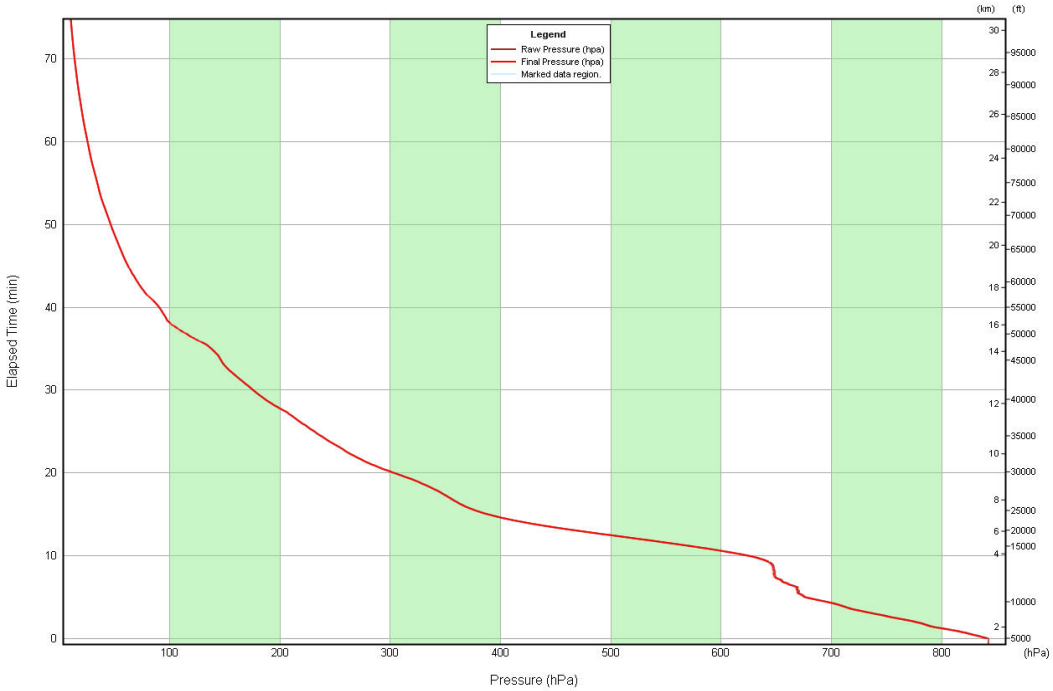


Exhibit 13-9: Pressure Plot showing a balloon passing through a mountain wave between about 5 and 10 minutes

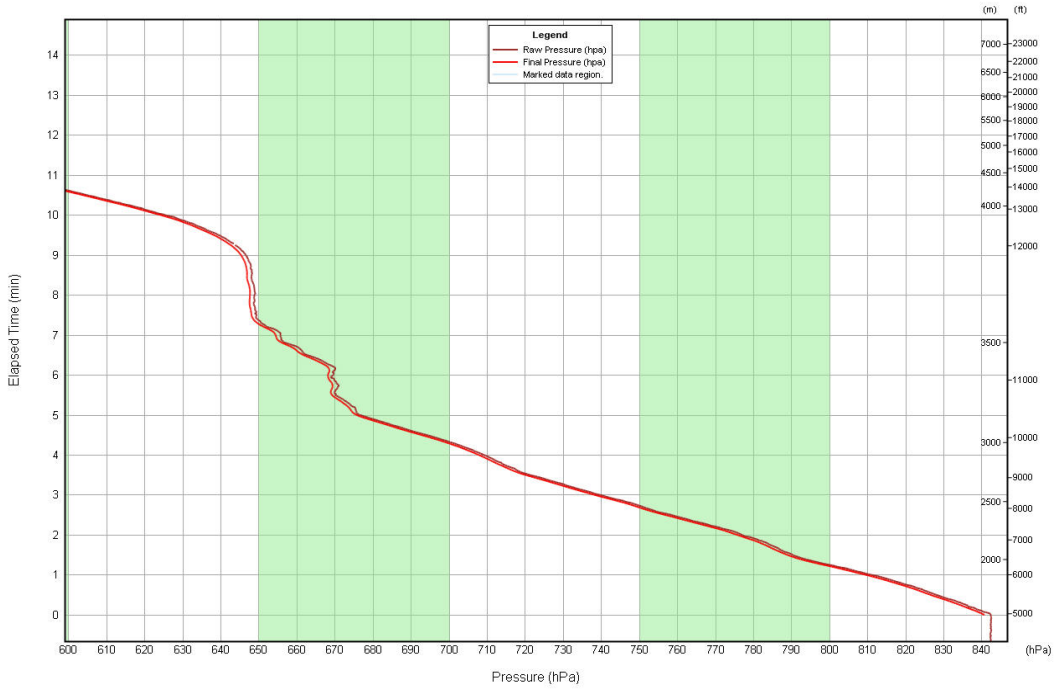


Exhibit 13-10: Same as Exhibit 13-7, but showing a close up of the pressure anomaly

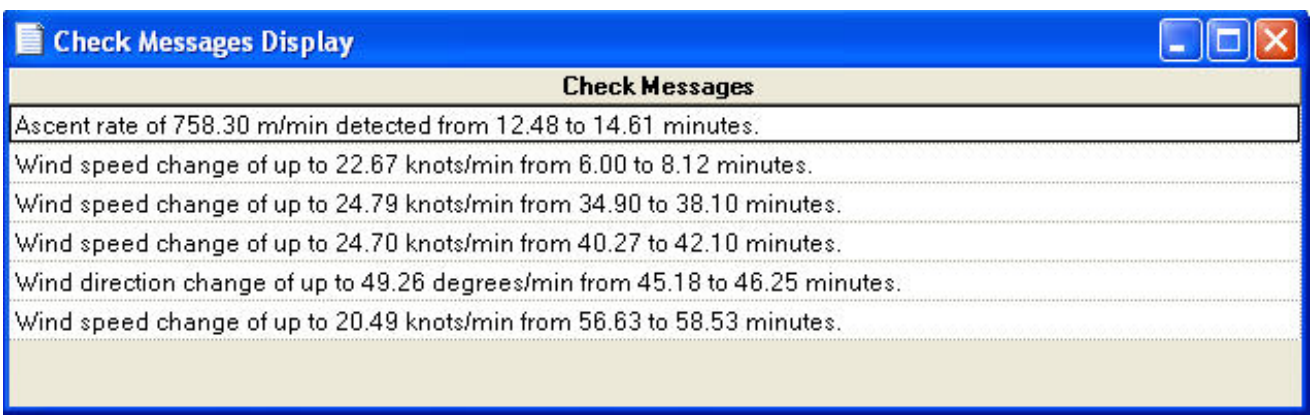


Exhibit 13-11: Check Messages when radiosonde enters the severe turbulence.

In such situations, Check Messages may also be seen for,

- Changes in heights and temperature from the previous sounding
- Superadiabatic lapse rates

While soundings into severe atmospheric turbulence are not common, they can create soundings that are not representative of the synoptic-scale environment and action needs to be taken. If the sounding has encountered severe turbulence and the pressure data profile is very erratic, follow these steps:

1. Verify that the pressure data are accurate in the wavy pressure layer by examining the Height Plot. Note the difference in geometric and geopotential heights from one second to the next. They should overlay closely with each other and the differences should be mostly 100 meters or less. Above about 16 km or 100 hPa the allowable differences can increase to 750 meters at 30 km or 10 hPa. If they agree, then **do not edit** the pressure data (doing so can generate height errors). The pressure sensor is correctly measuring the ups and downs of the radiosonde as it passes through the turbulence. See Exhibit 13-12 as an example. Both heights are in good agreement with each other and this indicates the pressure sensor is working correctly. If the two heights are not close to one another, the pressure sensor has failed. Terminate the sounding at the point where the pressure data first went bad.
2. If the wavy pressure profile is real, review the Temperature Plot and overlay the Temperature Plot from the sounding taken 12 hours ago. Notify the WFO lead forecaster and the NCEP SDM if any of the following are seen:

   - The Temperature Plot with an overlay of the previous sounding shows warming or cooling by more than 5C within or near the erratic pressure layer.
   - 4 or more check messages for height and temperature changes, deleted pressure levels, fast/slow ascension rates, and superadiabatic lapse rates.

If it is decided that data will be deleted inside the turbulent layer, then **delete <u>all</u> the data in that layer (including winds). Do not arbitrarily save a few data points in the layer so that the RWS backfills the deleted data layer with interpolated values.**

If terminating the sounding early, select a termination time at the point the radiosonde entered the turbulence or wave.

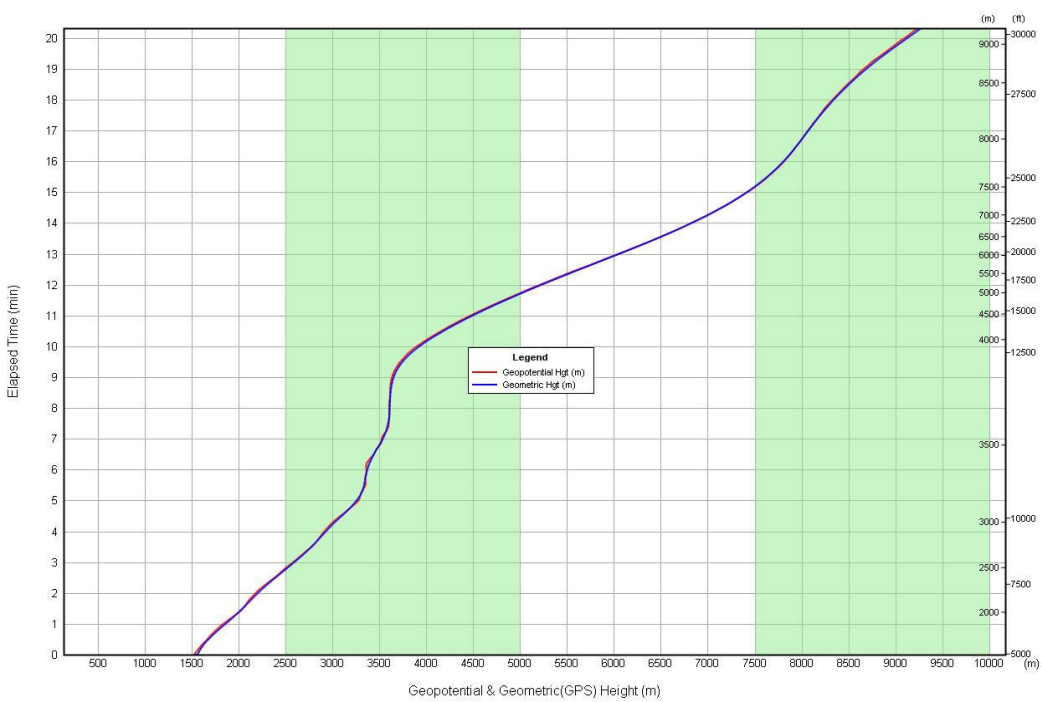


Exhibit 13-12: Geopotential and Geometric Height Plot when a radiosonde enters the severe turbulence.

13.4 Very High Termination Altitude (Leaking Pressure Cell)

On rare occasions, the pressure sensor cell will begin to leak or fail in some other way while the radiosonde is aloft. The problem typically becomes noticeable above about 100 hPa or 16 km. The result will likely be a very high, unrealistic termination altitude and pressure. The ascent rates in portions of the sounding will also likely exceed 500 meters/minute. Any sounding that ascends above 5 hPa needs to be examined for this problem. If a leaking pressure cell has occurred, RRS may show Check Messages for,

- High ascent rates exceeding 500 meters/minute
- Height changes from the previous sounding

Exhibit 13-13 shows an extreme example of a leaking pressure cell as seen in the Pressure Plot The Flight Summary showed a termination altitude of 56,154 meters and termination pressure of 0.05 hPa. The radiosonde reached this altitude in just over 100 minutes, resulting in an average ascent rate of more than 550 meters/minute. Exhibit 13-14 shows the Processed Tabular Display near the end of the flight and indicates significant differences between the geometric and geopotential heights. Exhibit 13-15 shows the Height Plot for this observation and the discrepancy in the geopotential and geometric heights is quite apparent. It is likely that the pressure cell failed about 12 minutes after the radiosonde was released.

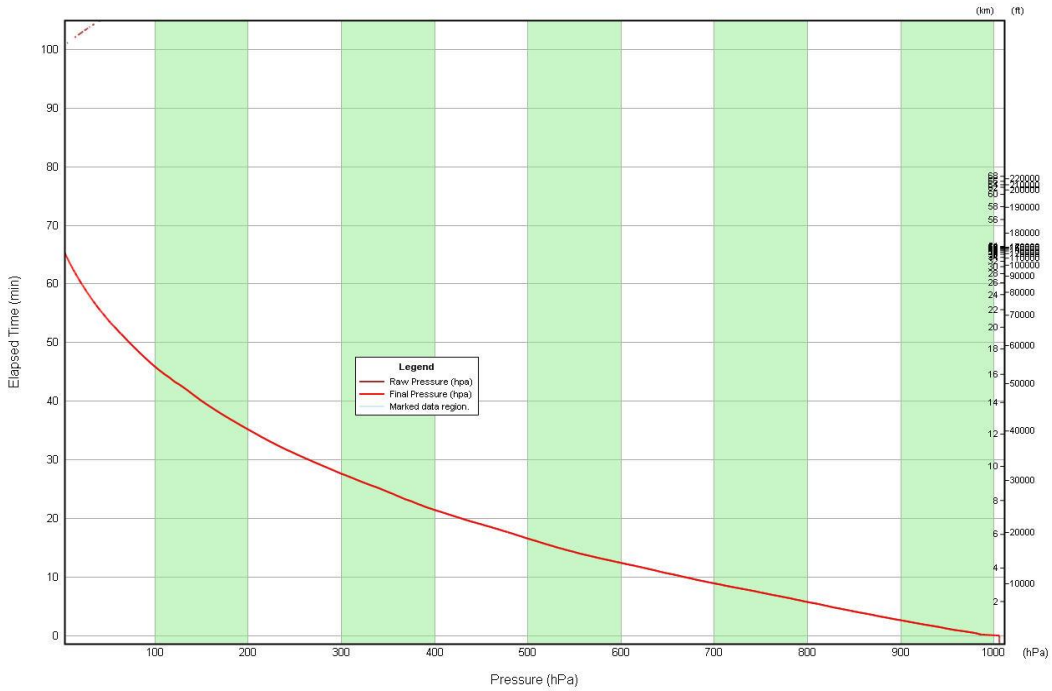


Exhibit 13-13: Leaking pressure cell causing unrealistic pressure values

Processed Tabular Display

Elapsed Time (min)	Time Stamp (UTC)	Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Ascension Rate (m/s)	Geometric Height (m)
65.82	18:38:43	1.76	1.75	41156	250.8	21423
65.83	18:38:44	1.70	1.69	41371	255.6	21429
65.85	18:38:45	1.63	1.63	41598	259.8	21435
65.87	18:38:46	1.57	1.57	41830	263.0	21441
65.88	18:38:47	1.50	1.51	42059	265.3	21447
65.90	18:38:48	1.45	1.46	42285	266.8	21454
65.92	18:38:49	1.40	1.41	42506	267.4	21460
65.93	18:38:50	1.35	1.36	42720	267.0	21466
65.95	18:38:51	1.30	1.31	42933	265.7	21473
65.97	18:38:52	1.26	1.27	43149	264.1	21480
65.98	18:38:53	1.23	1.22	43367	262.4	21485
66.00	18:38:54	1.19	1.18	43590	260.7	21490
66.02	18:38:55	1.16	1.14	43827	258.9	21497
66.03	18:38:56	1.12	1.09	44084	257.0	21503
66.05	18:38:57	1.07	1.04	44361	254.9	21508
66.07	18:38:58	1.02	1.00	44661	252.8	21515
66.08	18:38:59	0.98	0.94	44999	250.5	21521
66.10	18:39:00	0.92	0.89	45383	248.3	21527
66.12	18:39:01	0.86	0.83	45812	246.2	21533
66.13	18:39:02	0.80	0.77	46279	244.1	21539
66.15	18:39:03	0.74	0.71	46776	242.0	21545
66.17	18:39:04	0.68	0.65	47297	240.0	21552
66.18	18:39:05	0.61	0.60	47842	238.0	21559
66.20	18:39:06	0.55	0.55	48403	235.9	21564
66.22	18:39:07	0.49	0.50	48978	233.7	21569
66.23	18:39:08	0.45	0.45	49569	231.5	21576
66.25	18:39:09	0.41	0.41	50177	229.1	21582
66.27	18:39:10	0.37	0.37	50790	226.6	21588
66.28	18:39:11	0.34	0.34	51365	223.8	21595
66.30	18:39:12	0.31	0.31	51881	220.7	21601
66.32	18:39:13	0.28	0.29	52336	217.3	21606

Exhibit 13-14: Leaking pressure cell causing significant differences in the geopotential and geometric heights

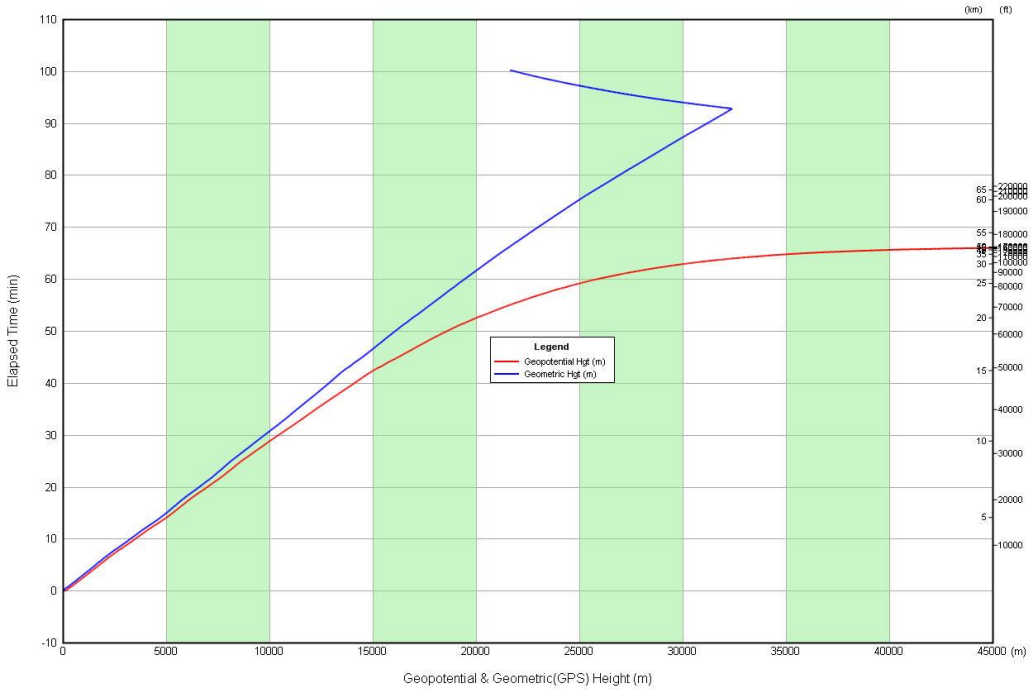


Exhibit 13-15: Geopotential and Geometric Height Plot indicating a leaking pressure cell

Do to design limitations, it is uncommon for typical NWS balloons when properly inflated, to rise above 5 hPa and observations above 3.0 hPa or 40,000 meters are nearly impossible. Moreover, NWS balloons often rise at less than 375 meters/minute on average from surface to flight termination and it takes around 90 minutes or more to reach an altitude of 30,000 meters.

Exhibit 13-16 shows a Pressure Data Plot of a leaking pressure cell that is more commonly seen.

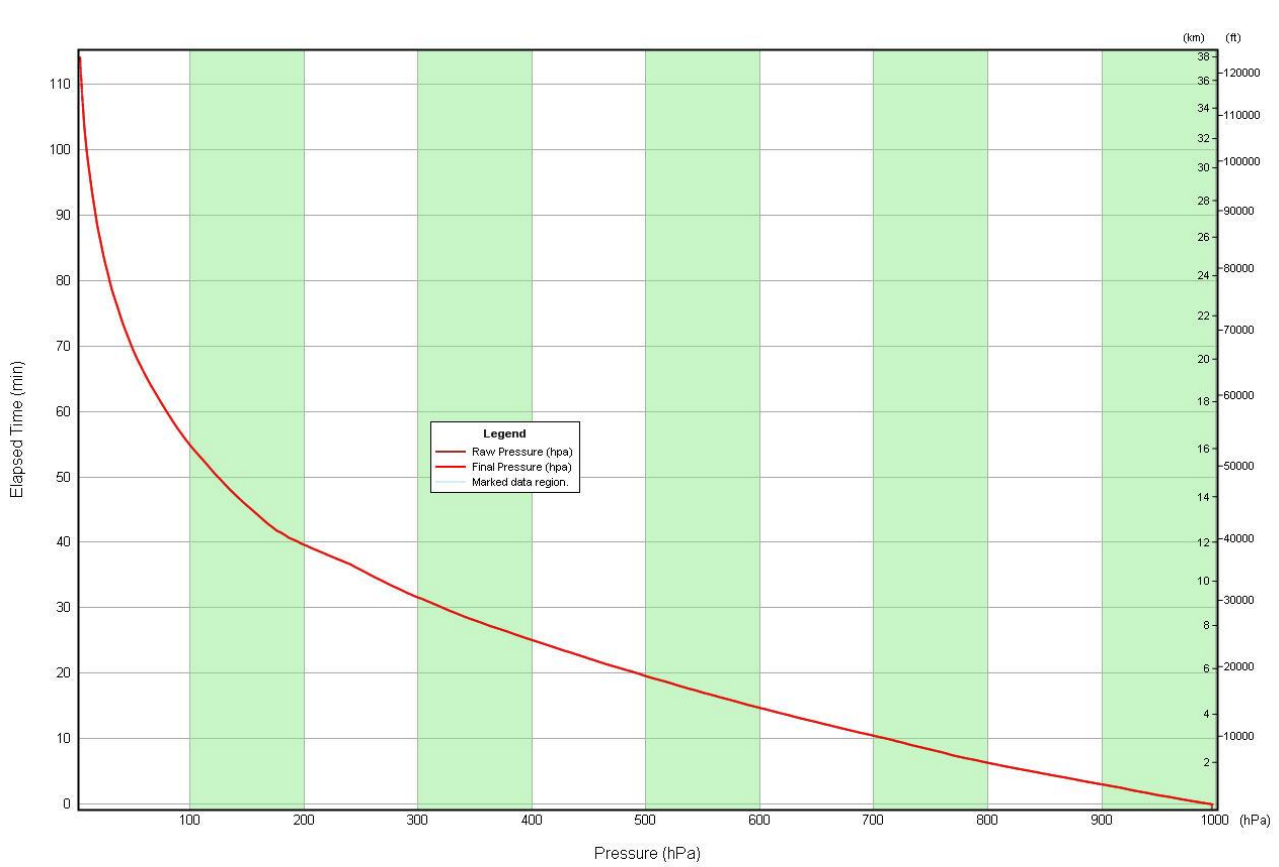


Exhibit 13-16: Typical Pressure Plot of a leaking pressure cell

At first glance, the pressure data look reasonable. Yet, the Flight Summary showed the following information:

- An average ascent rate from 100 hPa to balloon burst of 368 meters/minute
- Balloon burst altitude at 38,000 meters
- Termination pressure at 3.4 hPa.

There were also Check Messages for ascent rates exceeding 500 meters/minute at 110 minutes and a height change of 109 meters at 7.0 hPa. Moreover, the difference in height between the GPS geometric height and geopotential height in the Processed Tabular Display exceeded 1 km at 7.0 hPa. At 5.0 hPa it exceeded 1,700 meters (See Exhibit 13-17.) Near balloon burst the difference

was over 2,500 meters. Exhibit 13-18 shows the Height Plot and significant differences can be seen in the geopotential and geometric heights near the end of the observation. Similar differences are seen in the Ascension Rate Plot (only smoothed 1 minute data is displayed) shown in Exhibit 13-19. This information indicates a problem with the pressure sensor and it failed around 95 minutes into the observation.

Processed Tabular Display

Elapsed Time (min)	Time Stamp (UTC)	Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Ascension Rate (m/s)	Geometric Height (m)
108.88	12:52:00	5.04	5.05	35237	7.2	33525
108.90	12:52:01	5.04	5.04	35245	7.2	33529
108.92	12:52:02	5.04	5.04	35251	7.2	33535
108.93	12:52:03	5.04	5.03	35257	7.2	33541
108.95	12:52:04	5.03	5.03	35265	7.2	33544
108.97	12:52:05	5.02	5.02	35271	7.2	33547
108.98	12:52:06	5.01	5.02	35277	7.1	33551
109.00	12:52:07	5.01	5.01	35284	7.1	33559
109.02	12:52:08	5.02	5.01	35292	7.1	33567
109.03	12:52:09	5.01	5.00	35299	7.1	33574
109.05	12:52:10	5.00	5.00	35307	7.1	33578
109.07	12:52:11	4.99	4.99	35314	7.1	33582
109.08	12:52:12	4.99	4.99	35322	7.1	33588
109.10	12:52:13	4.98	4.98	35331	7.1	33596
109.12	12:52:14	4.98	4.97	35338	7.1	33603
109.13	12:52:15	4.97	4.97	35347	7.1	33607
109.15	12:52:16	4.96	4.96	35356	7.1	33610
109.17	12:52:17	4.95	4.96	35364	7.2	33616
109.18	12:52:18	4.95	4.95	35371	7.2	33623
109.20	12:52:19	4.95	4.95	35379	7.2	33630
109.22	12:52:20	4.94	4.94	35387	7.2	33636
109.23	12:52:21	4.93	4.93	35395	7.2	33640
109.25	12:52:22	4.93	4.93	35403	7.3	33646

Exhibit 13-17: Processed Tabular Display data showing geometric and geopotential height differences caused by a leaking pressure cell

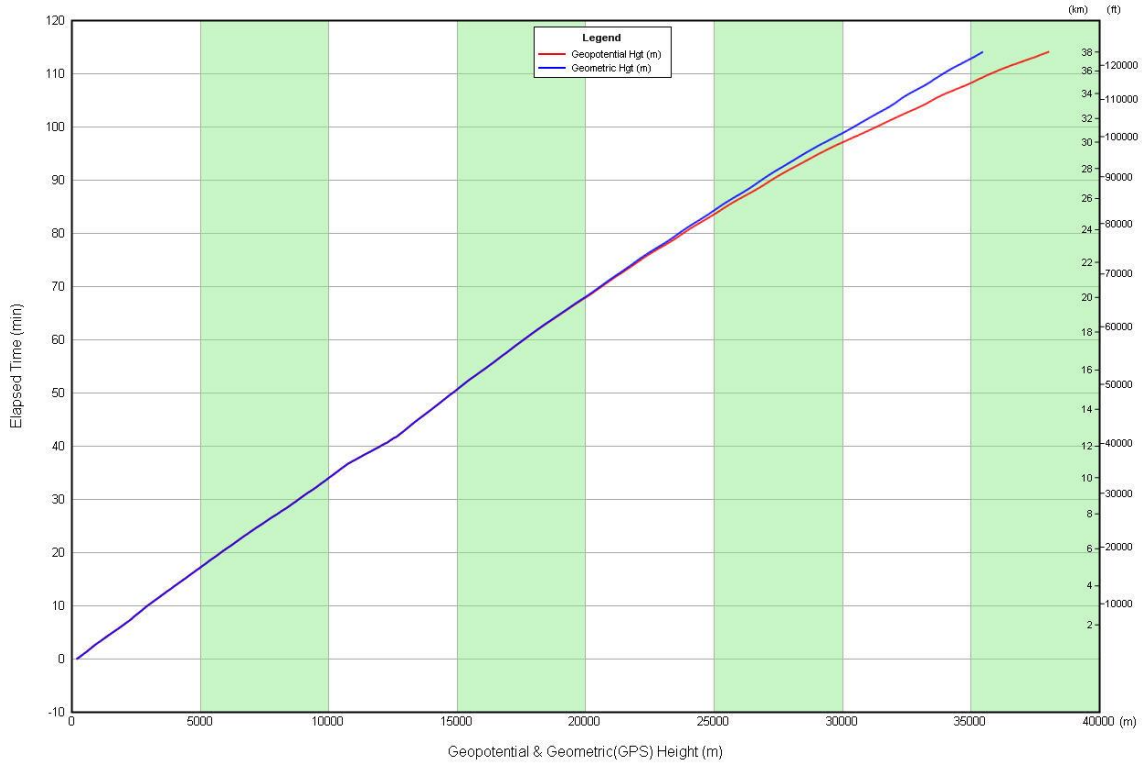


Exhibit 13-18: Height Plot showing the pressure cell failing at about 95 minutes

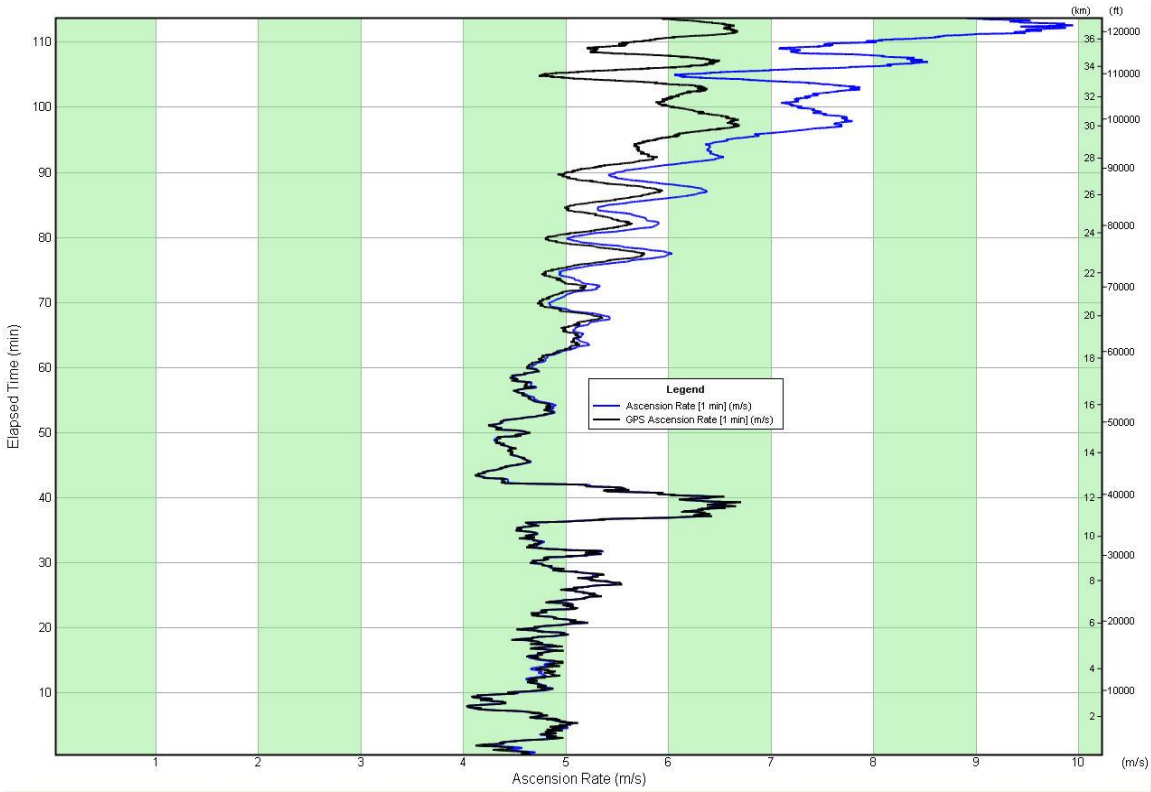


Exhibit 13-19: Ascension Rate Plot of smoothed geometric and geopotential ascent rates

If the sounding terminates at or above 5.0hPa (about 35,000 meters), follow these steps:

1. Carefully review the Flight Summary data. Average ascent rates from surface to flight termination exceeding 350 meters/minute should be looked upon with suspicion.
2. Using the Processed Tabular Display and Height Plot, compare the GPS Geometric height and Geopotential Height at 7.0 hPa. They should be within 750 meters of each other. If the difference exceeds 750 meters **AND** there are Check Messages for fast ascent rates and height changes from the previous sounding, a pressure cell failure has likely occurred. Terminate the sounding at the point where the height differences are no more than 500 meters. This should eliminate the Check Messages related to this problem.

IMPORTANT: The heights derived from the pressure and GPS sensor have allowable errors and their data will often not match exactly. This can become noticeable above 15 km or about 100 hPa. Only terminate a sounding owing to a leaking pressure sensor if the above criteria are met.

If the GPS data (i.e., geometric heights) are missing, but there are several Check Messages for fast ascent rates and height changes for data above 15 km, terminate the sounding at the level where the Check Messages first indicate questionable data.

13.5 Erratic Pressure Data

Radiosonde circuitry or other problems can cause spikes or noise in the pressure data. Exhibit 13-20 shows an example where the pressure sensor provided erratic pressure data from about minute 3.6 to 5.0. The problem can be verified by examining the Height Plot, shown in Exhibit 13-21. Note how the geopotential heights (derived from the pressure sensor) differ significantly from the geometric (GPS) heights between about 3.6 and 5.0 minutes.

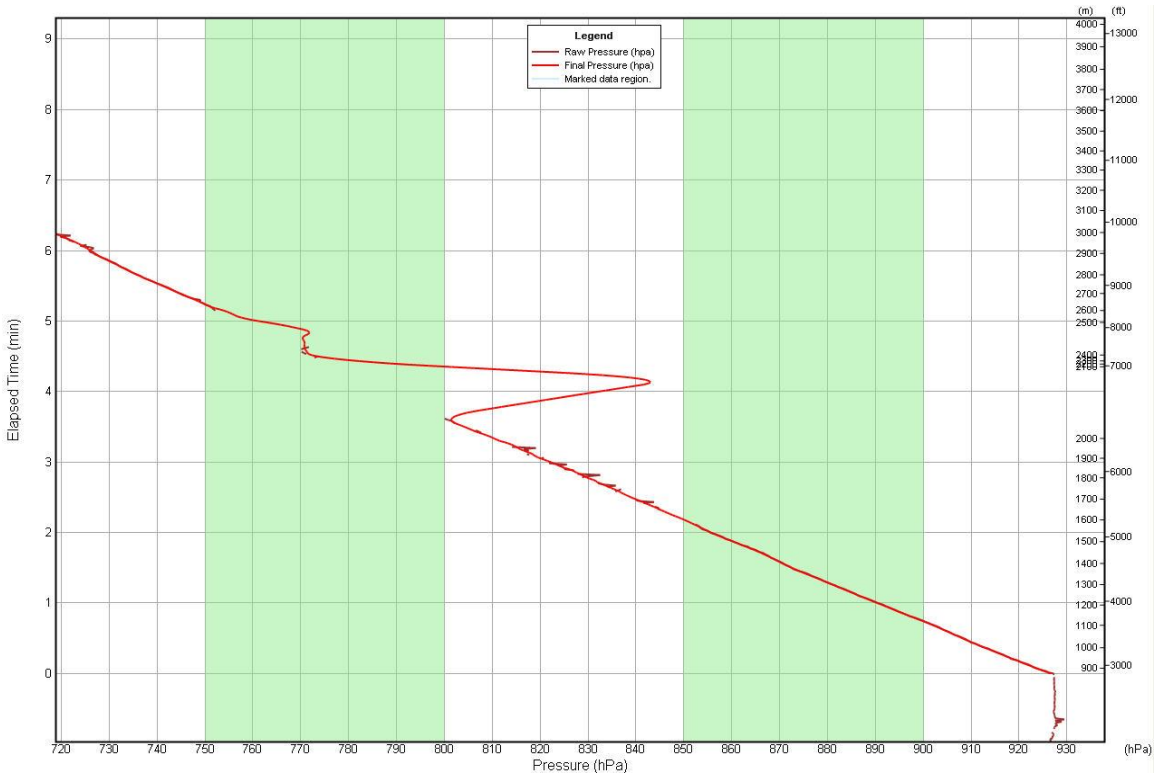


Exhibit 13-20: Pressure Plot showing erratic data from about 3.6 to 5 minutes.

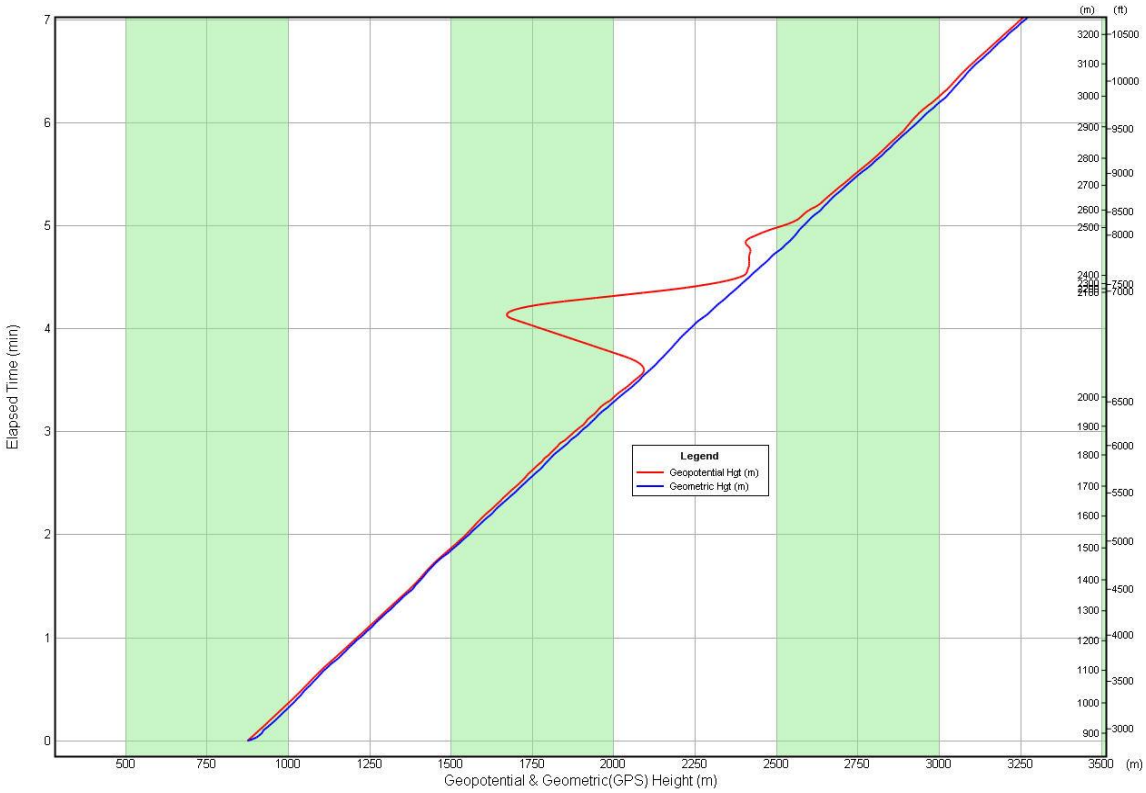


Exhibit 13-21: Height Plot showing the geopotential heights differing from the geometric heights

If the sounding shows erratic pressure data, follow these steps:

3. Expand or zoom into the data plot to help better find beginning and end points of the erratic data.
4. Delete the erroneous data. If the amount deleted exceeds more than 10 consecutive minutes, the pressure sensor has likely failed and the flight needs to be terminated at the point where the sensor failure occurred

13.6 Pressure Increase after Balloon Release

Sometimes the Pressure Plot or Processed Tabular Display shows that the smoothed pressure increased just after release and then decreased. As an example, see Exhibit 13-22. The "raw pressure" is decreasing with height, but the smoothed pressure increases just off surface and then decreases. This anomaly is likely caused by the station pressure changing from the time it was first entered into the workstation to when the radiosonde was baselined. An incorrect pressure correction is then applied to the corrected pressure data, which is used to generate the smoothed pressure data. The same problem can also cause the smoothed pressure off surface to rapidly decrease after release, but it will not be as noticeable in the data plot.

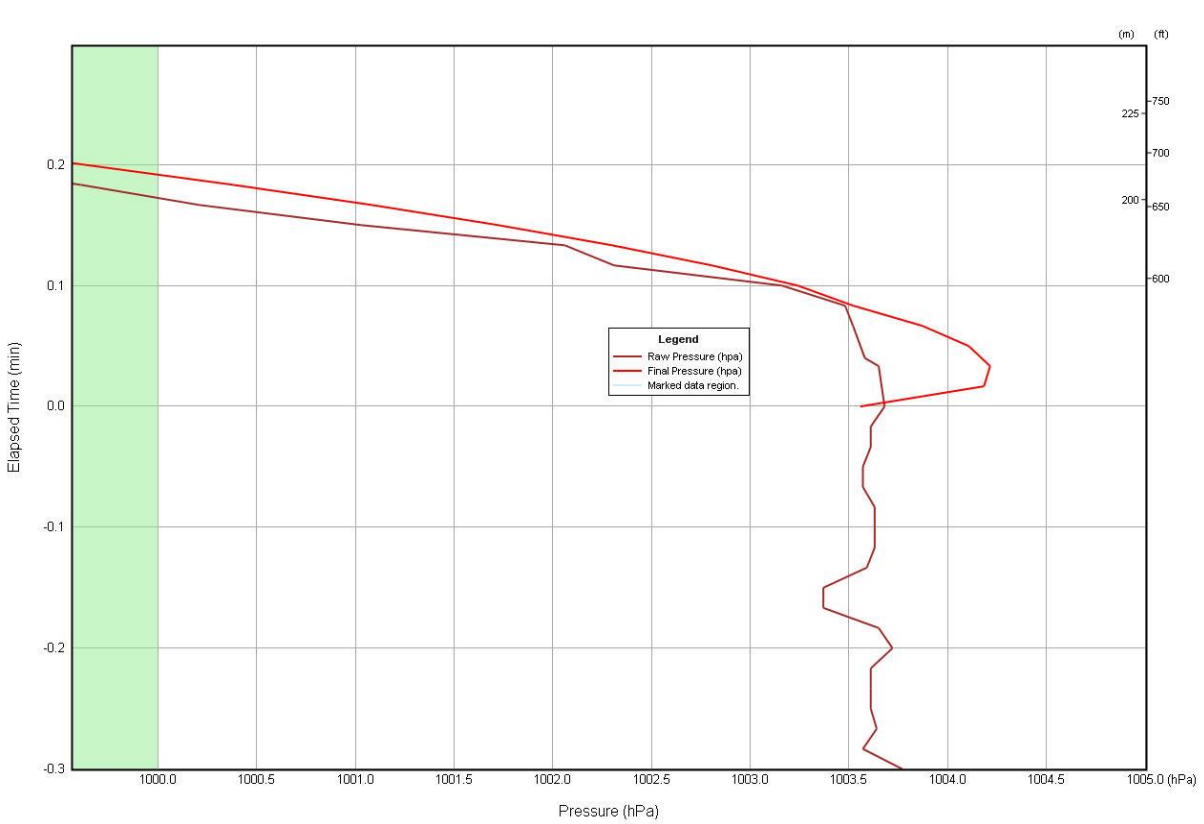


Exhibit 13-22: Corrected and smoothed pressure increase off surface

If a pressure increase off surface in seen in the plot and the difference between the surface pressure and the first pressure data point from the released radiosonde exceeds 0.5 hPa, follow these steps:

1. First review the release point in the Raw PTU Table. If the release time was selected correctly, do not edit the pressure data. Let the sounding proceed, but monitor the sounding data. If there are frequent check messages for height changes and the Geometric Height and geopotential height differences exceed 750 meters, terminate the sounding at the start of the flight.
2. Also review the Processed Tabular Display. If the pressure difference (increase or decrease) between the surface station pressure and the first point (3 to 6 meters above the surface) from the released radiosonde exceeds 5 hPa, the pressure sensor clearly failed and the flight needs to be terminated at the start of the flight.
3. For future soundings, refresh the complete surface observation just prior to radiosonde baseline and then check again at release time. This will ensure that the station pressure used for baseline is accurate.

13.6.1 Significant Error in Release Detection Time

The RRS software automatically recognizes balloon release by detecting a decrease in pressure. There are certain conditions that may cause the release detection to be significantly too early or late. These include:

- Missing data near release time
- High surface wind releases
- Rapid change in station pressure
- Erratic radiosonde motion at launch
- Change in radiosonde frequency
- Radiosonde or ground equipment failure

A rapid change in station pressure (approaching storm) may cause the software to detect an early or late release. This may also occur during transport to the inflation building if it is far from the radiosonde baseline location. A change in frequency of only .2 MHz may cause the signal to be lost and release may not be detected. Lastly, temporary radiosonde or equipment problems are also 0possible points of failure.

The key to minimizing this problem is:

1. Verify the frequency and sensor readings during baseline, after baseline, and prior to going to the inflation building.

NOTE: The observer may not be able to validate the sensor performance at the inflation building, but a check of the frequency, signal strength, and the operation of the equipment can be done by viewing the CDU display.

2. It is critical that the frequency and signal strength be verified at the release point prior to and immediately after release.

Exhibit 13-23 shows the Processed Tabular Display data from a sounding where the release was not detected until 3.5 minutes after actual release. The surface station pressure was 980.75 hPa, but the release was not detected until the radiosonde was at 877.5 hPa The TRS receiver shifted off frequency by only .4 MHz and lost the radiosonde signal just after release. The observer in this example noticed the problem and locked back on the frequency. Once the receiver locked back onto the correct frequency, the release was detected. The software interpolated the Processed Tabular Display data from surface to the first good data point and a Surface Pressure Threshold message was generated noting a discrepancy in the pressure off surface (see Exhibit 13-23). Interpolation of the data occurred because less than 1-minute of missing data was recognized by the software. Because there was a 3.5 minute gap in the data after release, the Pressure Plot in Exhibit 13-24 shows a rapid decline in pressure off surface. Check Messages (see Exhibit 13-24) for a high ascent rate exceeding 1,100 meters/minute and an off surface pressure discrepancy over 100 hPa also resulted.

Processed Tabular Display

Elapsed Time (min)	Time Stamp (UTC)	Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)	Dewpoint Temperature (C)
0.00	19:11:08	980.75	980.75	85	12.40	13.99	21.0	-9.31
0.02	19:11:09	975.70	975.73	128	12.03	14.03	20.1	-10.16
0.03	19:11:10	970.76	970.78	170	11.81	14.23	19.3	-10.90
0.05	19:11:11	965.85	965.86	213	11.59	14.43	18.4	-11.67
0.07	19:11:12	960.96	960.97	255	11.37	14.63	17.5	-12.45
0.08	19:11:13	956.10	956.11	297	11.15	14.82	16.6	-13.26
0.10	19:11:14	951.26	951.26	340	10.93	15.02	15.8	-14.10
0.12	19:11:15	946.45	946.45	382	10.72	15.21	14.9	-14.97
0.13	19:11:16	941.66	941.66	424	10.50	15.41	14.0	-15.88
0.15	19:11:17	936.90	936.90	466	10.28	15.61	13.1	-16.82
0.17	19:11:18	932.16	932.16	508	10.06	15.80	12.3	-17.81
0.18	19:11:19	927.45	927.45	550	9.84	16.00	11.4	-18.85
0.20	19:11:20	922.75	922.75	592	9.62	16.19	10.5	-19.95
0.22	19:11:21	918.09	918.09	634	9.41	16.39	9.7	-21.12
0.23	19:11:22	913.44	913.44	676	9.19	16.58	8.8	-22.38
0.25	19:11:23	908.82	908.82	718	8.97	16.78	7.9	-23.73
0.27	19:11:24	904.22	904.22	760	8.75	16.97	7.0	-25.20
0.28	19:11:25	899.65	899.65	802	8.53	17.17	6.2	-26.82
0.30	19:11:26	895.10	895.10	844	8.31	17.36	5.4	-28.36
0.32	19:11:27	890.57	890.57	885	8.09	17.56	4.7	-30.07
0.33	19:11:28	886.07	886.07	927	7.90	17.78	4.3	-31.15
0.35	19:11:29	881.58	881.93	966	7.73	17.99	4.1	-31.76
0.37	19:11:30	877.12	878.14	1001	7.58	18.19	4.0	-32.08

Surface Pressure Threshold

The difference between the surface and radiosonde pressures at release exceeds 1 hPa.
(Surface pressure: 980.748 hPa, Corrected sonde pressure: 877.487 hPa)
Verify the release point and surface data are correct.

OK

Exhibit 13-23: Processed Data and Threshold Message for a sounding with late release detection

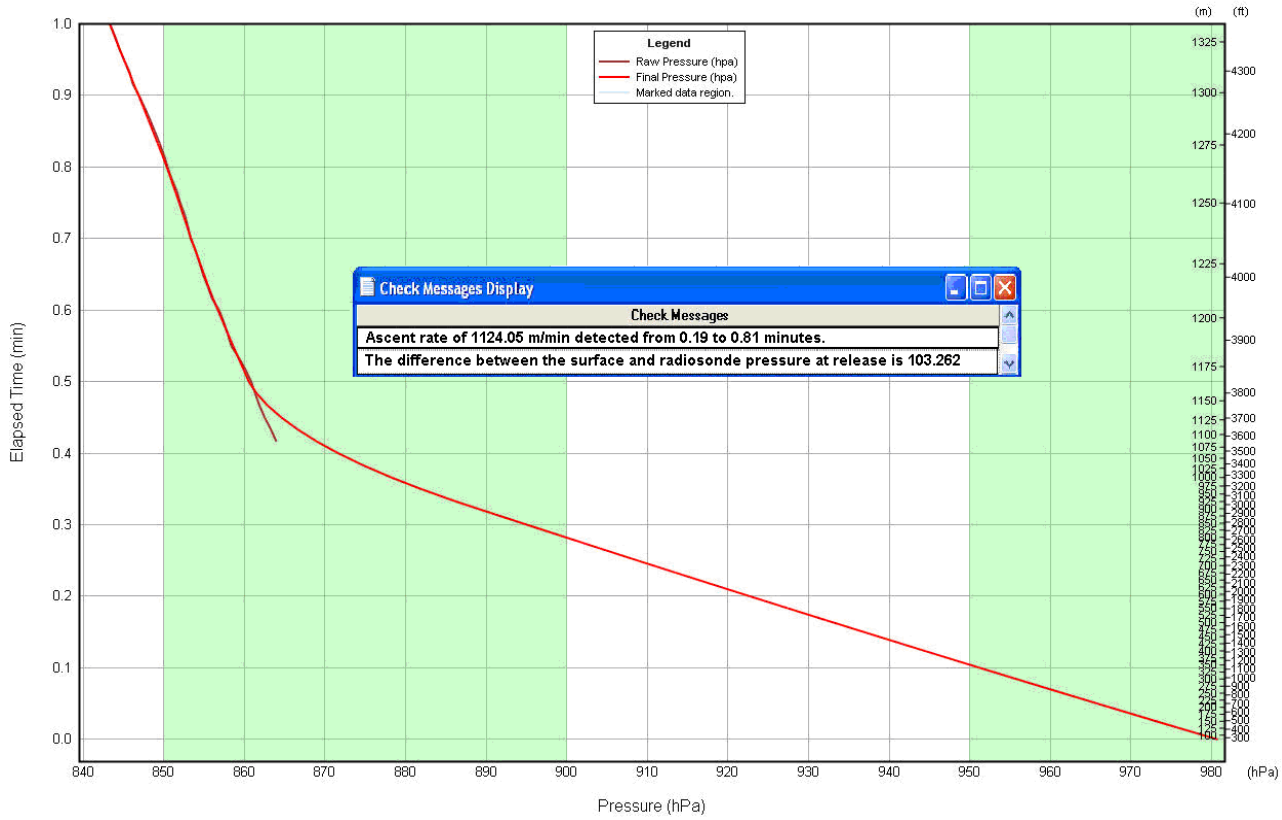


Exhibit 13-24: Pressure Plot for a sounding with late release detection minutes

In this example, the release was detected late and no data was available. In this example, the flight needs to be terminated because more than 3 consecutive minutes of data were missing.

If balloon release was detected too early or late, follow these steps:

1. If a release is detected too early or too late review the Raw PTU display to find the point where the pressure shows a continual decrease. It should be close to the station pressure recorded at baseline. This point is the correct release time. Record the time and select **Change Release Time** from the **Tools** pull-down menu. Enter the correct date and release time and click **OK**.
2. Sometimes, if a release is not detected automatically, the "Waiting for Balloon Release" window will still be flashing. Select the yellow "Manual Release" icon on the toolbar at the top left of the screen display (Exhibit 13-25). The blinking blue screen will then show a release time. Select **Continue** and verify the surface observation information, then select **OK**. Next, review the Raw PTU Table to find the point where the pressure shows a continual decrease. It should be close to the station pressure recorded at baseline. This point is the correct release time. Record the time and then select **Change Release Time** from the **Tools** pull-down menu. Enter the correct date and release time and click **OK**.
3. If the amount of missing data after release exceeds 3 minutes, terminate the sounding. Too much data has been lost.

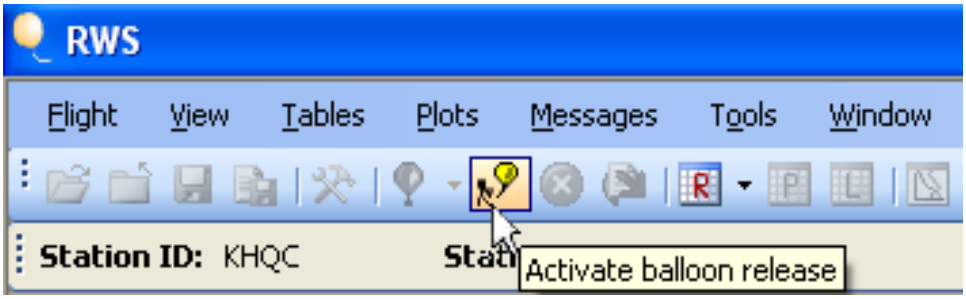


Exhibit 13-25: Manual Release Icon

13.7 Temperature Data Problems

Problems with the temperature data typically result from precipitation on the temperature sensor evaporating or freezing, radiosonde sensor defects, or incorrect radiosonde preparation by the observer.

NOTE: The radiosonde temperature sensor is very sensitive and can measure small temperature changes every second. In nearly all cases deletion of the temperature data only needs to be done if data Check Messages for lapse rates are generated.

13.7.1 Superadiabatic Lapse Rate

The dry adiabatic temperature lapse rate in the atmosphere is close to 9.8 C/km. Occasionally, the rate of cooling with altitude is higher than this value and the lapse rate is known as superadiabatic. Superadiabatic lapse rates do occur naturally in the environment. Yet, lapse rates exceeding 34C/km off surface and 15C/km aloft are very likely caused by problems with the radiosonde or surface weather equipment and corrective action is required by the observer.

RRS will generate temperature lapse rate Check Messages if the superadiabatic lapse rate is erroneous and exceeds the following values:

- Surface to 1 km: Lapse rate is 34 C/km or more
- Above 1 km to sounding termination: Lapse rate is 15 C/km or more

IMPORTANT: Do not delete temperature data aloft if the lapse rate seen in the PDS data is between 9.8 and 15C/km.

13.7.1.1 Strong Superadiabatic Lapse Rate Off Surface

Superadiabatic lapse rates occur frequently within 20 hPa of the surface. Most are legitimate meteorological events that result from solar heating of the ground. However, if the lapse rate exceeds 34 C per kilometer within 1 km of the surface, it is considered to be erroneous data and RRS will generate a Check Message. As an example, Exhibit 13-26 shows a Temperature Plot with the temperature cooling rapidly off surface. The resulting Check Message is also shown and shows an

unrealistic lapse rate of nearly 113 C/km. The cause for this super was a faulty RSOIS surface temperature sensor.

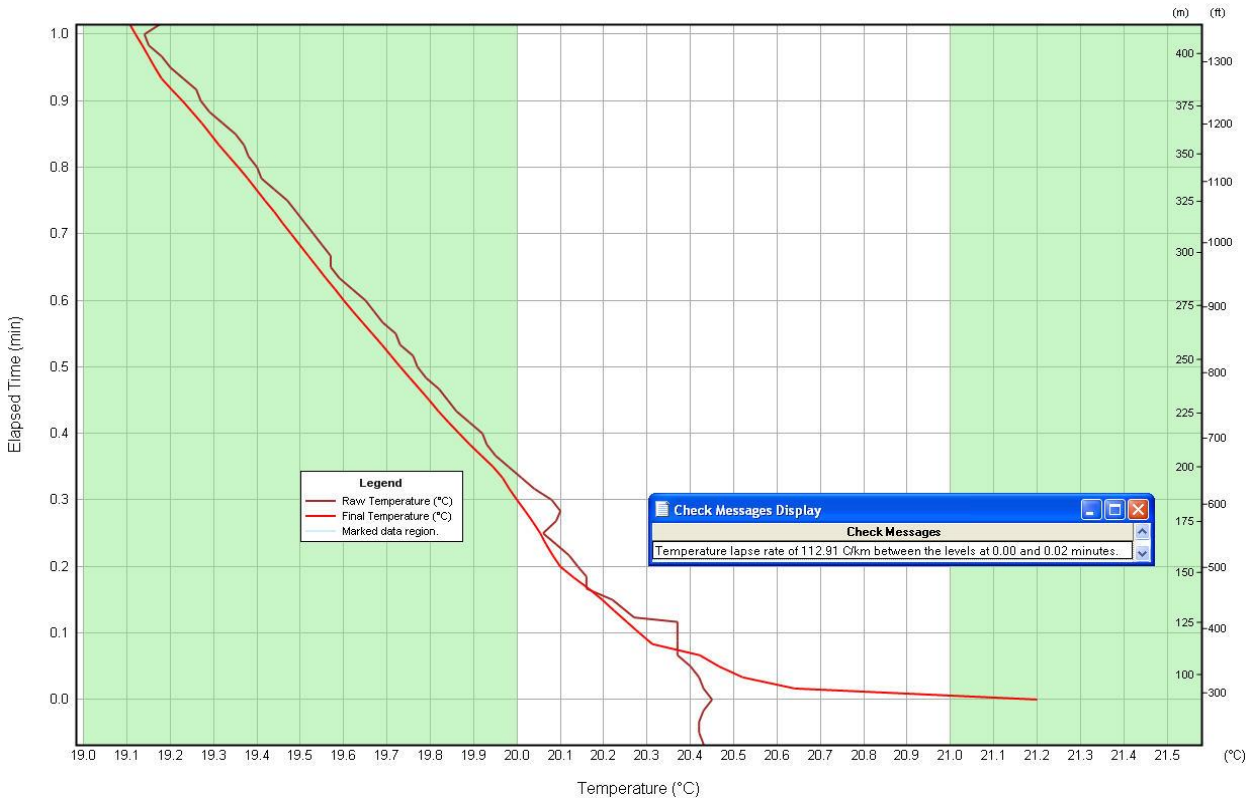


Exhibit 13-26: Superadiabatic lapse rate near surface and resulting Check Message

If RRS generates a superadiabatic lapse rate off surface exceeding 34 C/km a Data Check Message results. Follow these steps:

1. Verify that the surface temperature observation at the time of balloon release is correct. If it is not, change the observation. This may eliminate the Check Message.

IMPORTANT: <u>Never</u> apply an arbitrary correction to an accurate surface temperature value to eliminate the off-surface superadiabatic lapse rate. Never use surface temperature or RH observations taken more than 200 meters from the balloon release point.

2. If the surface temperature observation is correct, use the Temperature Plot to help identify the thickness of the erroneous layer. Delete up to 30 seconds of temperature data off surface. If this does not eliminate the Check Message, delete up to 1 minute of temperature data. Do not delete more than 1 minute of data to eliminate the superadiabatic lapse rate.
3. If the Check Message persists even after deletion of up to 1 minute of temperature data, continue to monitor the sounding data and Check Messages as there may be a calibration problem with the radiosonde and much or all of the temperature data erroneous.

4. If the strong surface super is occurring at night or early morning hours or occurs frequently, notify the electronics technician of the problem. The surface weather observation equipment may be out of calibration or is poorly located and needs to be checked. If the ET finds no fault with the surface weather equipment and the problem persists, then notify the Regional Office Upper air Program Manager as soon as possible.

13.7.1.2 Evaporative Cooling on the Temperature Sensor ("Wet bulb Effect")

The temperature sensor in the GPS radiosonde is very small and responds quickly to temperature changes. However, the small size of the sensor allows it to get easily wet when it is inside a cloud or exposed to precipitation. Once the sensor exits the cloud and is exposed to drier air, evaporative cooling or the "wet-bulb effect" occurs, causing an abrupt and unrealistic decrease in temperature with height. The wet-bulb effect typically occurs from near surface to about 8 km and may occur in one or more layers in the atmosphere, especially if the radiosonde enters a thick precipitating cloud.

Exhibit 13-27 shows a typical example of the wet-bulb effect. At about 5.5 minutes, into the sounding, the dewpoint decreases quickly (i.e., radiosonde is exiting the cloud) and the temperature cools off rapidly creating a layer of superadiabatic lapse rates. Exhibit 13-27 also shows the Check Messages for this sounding. Two lapse rates, one exceeding 50C/km, were generated.

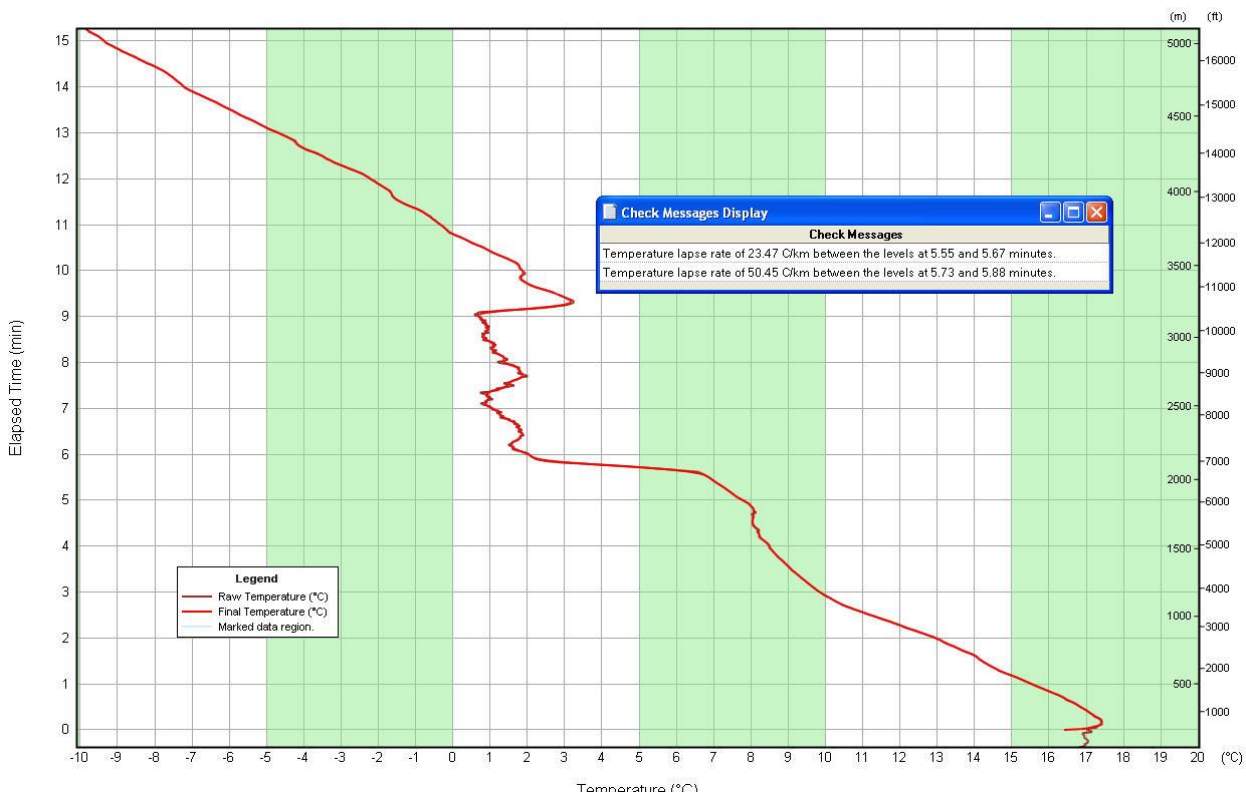


Exhibit 13-27: Temperature Plot showing the wet-bulb effect starting at about 5.5 minutes

If the wet-bulb effect is observed in the sounding, follow these steps:

1. Examine the Temperature Data Plot and lapse rate Check Messages to determine the thickness of the erroneous layer(s).
2. Review the Check Messages to determine the beginning and end times of the erroneous layer. Go to the Processed Tabular Display and delete **all** the temperature data in the erroneous layer. If the first round of editing does not eliminate the super-adiabatic lapse rates in the Check Messages, expand the deleted layer in small increments on both sides of the layer until the messages no longer appear. In the example shown in Exhibit 13-27, all the temperature data from 5.5 to 7.0 minutes was deleted
3. Sometimes the wet-bulb effect is severe and may be caused by excessive wetting of the temperature sensor. Water may also freeze on the sensor making the problem worse. The temperature sensor in such a case may take several minutes or more to dry out and recover. If steps 1 and 2 do not eliminate the Check Message, continue deleting temperature data in small increments until the Check Message no longer appears**.** If the layer of deleted data is more than 3 consecutive minutes, terminate the sounding at the point where the wet-bulb effect began.
4. If there are more than 3 layers showing the wet-bulb effect, and more than one minute of data will have to be deleted to correct each layer, terminate the sounding at the point where the wet-bulb effect began.

13.7.1.3 Superadiabatic Lapse Rates Above 8 km.

Superadiabatic lapse rates exceeding 15C/km above 8 km are very rare and are not likely being caused by the wet-bulb effect. They may be a result of a radiosonde defect, a very short flight train, or the temperature sensor boom was not positioned correctly during radiosonde preparation.

If Check Messages for superadiabatic lapse rates are seen above 8 km, follow these steps:

1. Using the Temperature Data Plot and Check Messages as a guide, delete **all** the erroneous temperature data. If the first round of editing does not eliminate the super-adiabatic lapse rates in the Check Messages expand the deleted layer in increments until the messages no longer appear. If the layer of deleted data is more than 3 consecutive minutes, terminate the sounding at the point where the superadiabatic lapse rates began.
2. If RRS generates four or more Check Messages for superadiabatic lapse rates above 8 km (see Exhibit 13-28), the temperature sensor has likely failed and the sounding needs to be terminated at the point where the bad lapse rates began.
3. In the future, make sure the temperature sensor boom is positioned in accordance with the radiosonde preparation instructions. In addition, always make the flight train no less than 25 meters long to ensure that heat from the balloon does not contaminate the temperature data.

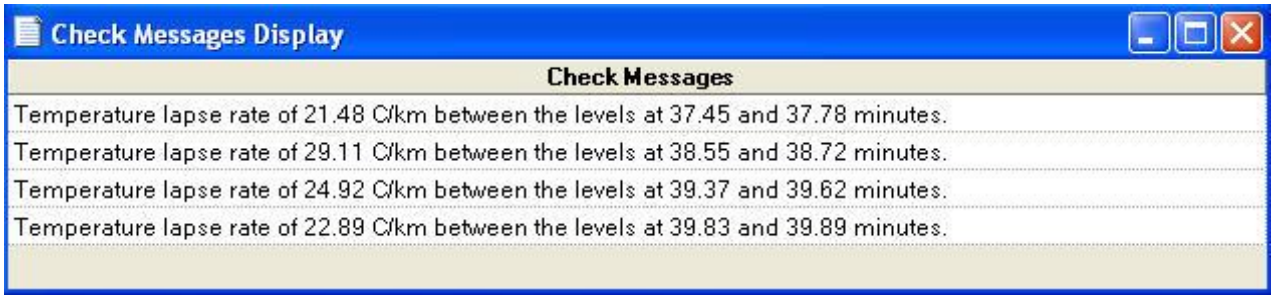


Exhibit 13-28: Superadiabatic lapse rate Check Messages appearing for data above 8 km.

13.7.1.4 Sounding Inside or Near a Thunderstorm

RELEASING A RADIOSONDE WHILE A THUNDERSTORM IS OCCURRING IS STRICTLY PROHIBITED!

The observer risks being struck by lightning and the sounding data collected are unusable and do not represent the synoptic scale environment. Calculated indices such as the Lifted Index will be erroneous and NCEP will not use such soundings for their numerical weather prediction models. See NWS Upper air Manual 10-1401 for more information on radiosonde releases during thunderstorm activity.

Exhibit 13-29 shows a typical temperature and dewpoint temperature profile from a radiosonde that was released into a thunderstorm. Note the very erratic temperatures from near surface to about 18 minutes. Erratic temperatures can also been with the Skew-T Plot, shown in Exhibit 13-30. Exhibit 13-31 shows numerous Check Messages for superadiabatic lapse rates.

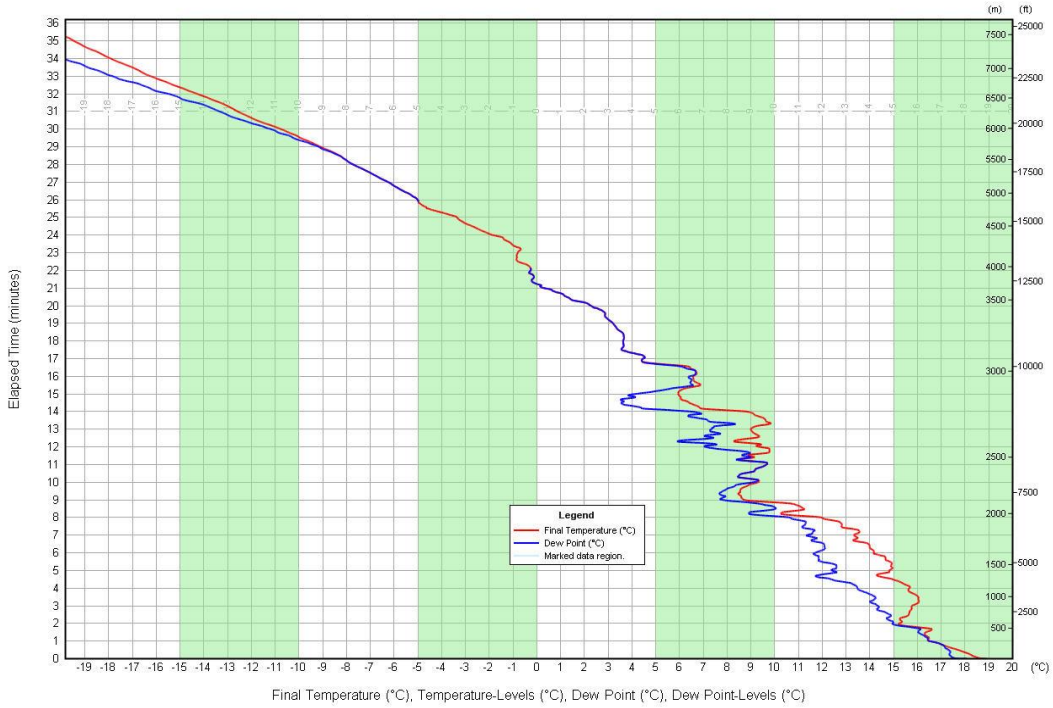


Exhibit 13-29: Typical Temperature and Dewpoint Plot inside a thunderstorm

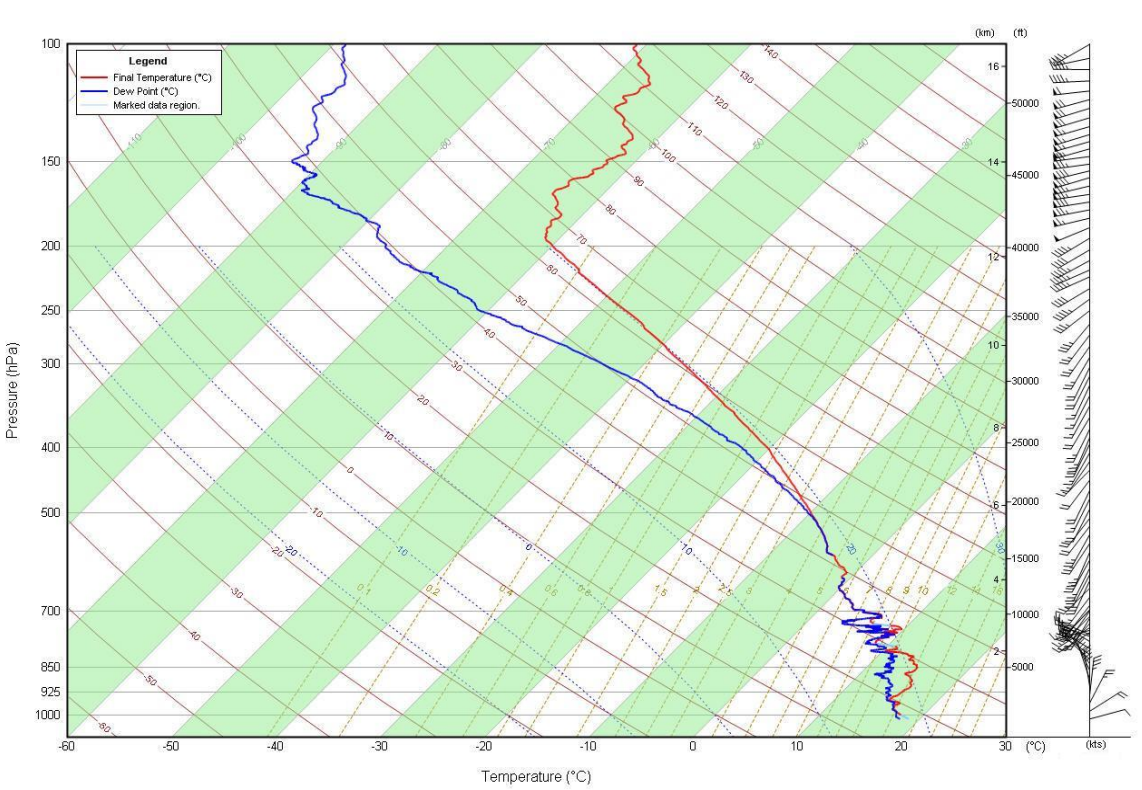
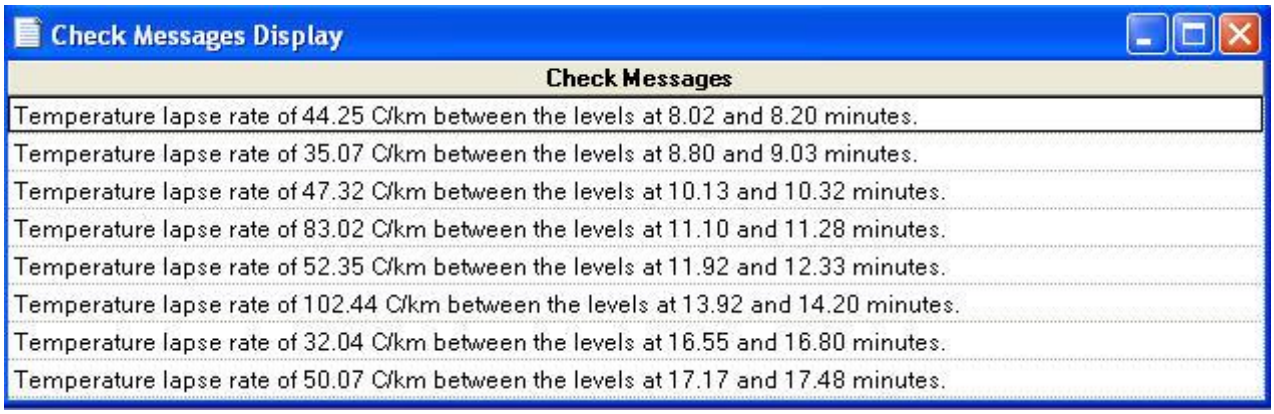


Exhibit 13-30: Skew-T Plot of a sounding taken inside a thunderstorm



Check Messages Display

Check Messages
Temperature lapse rate of 44.25 C/km between the levels at 8.02 and 8.20 minutes.
Temperature lapse rate of 35.07 C/km between the levels at 8.80 and 9.03 minutes.
Temperature lapse rate of 47.32 C/km between the levels at 10.13 and 10.32 minutes.
Temperature lapse rate of 83.02 C/km between the levels at 11.10 and 11.28 minutes.
Temperature lapse rate of 52.35 C/km between the levels at 11.92 and 12.33 minutes.
Temperature lapse rate of 102.44 C/km between the levels at 13.92 and 14.20 minutes.
Temperature lapse rate of 32.04 C/km between the levels at 16.55 and 16.80 minutes.
Temperature lapse rate of 50.07 C/km between the levels at 17.17 and 17.48 minutes.

Exhibit 13-31: Check Messages from a sounding inside a thunderstorm

Other data problems encountered when a radiosonde enters a thunderstorm include very erratic wind directions and speeds, moist-biased RH data, and erratic ascent rates.

Sometimes there will be no thunderstorm at release time, but there is convective activity in the area some distance away from the release point. After release, the radiosonde will enter or go near a thunderstorm or a developing one. An example of such a sounding is shown in Exhibit 13-32. The sounding looks acceptable until about 16 minutes into the sounding when the temperature and dewpoint become very erratic. 19 Check Messages for superadiabatic lapse rates were generated and are shown in Exhibit 13-33.

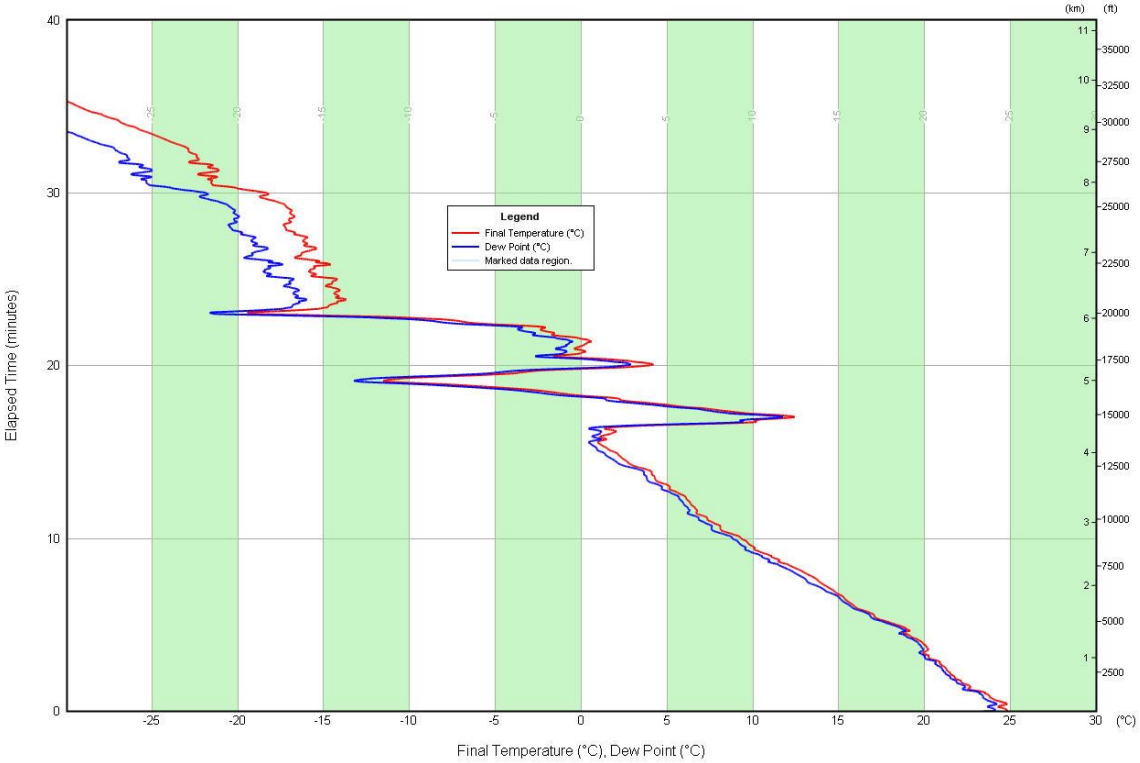
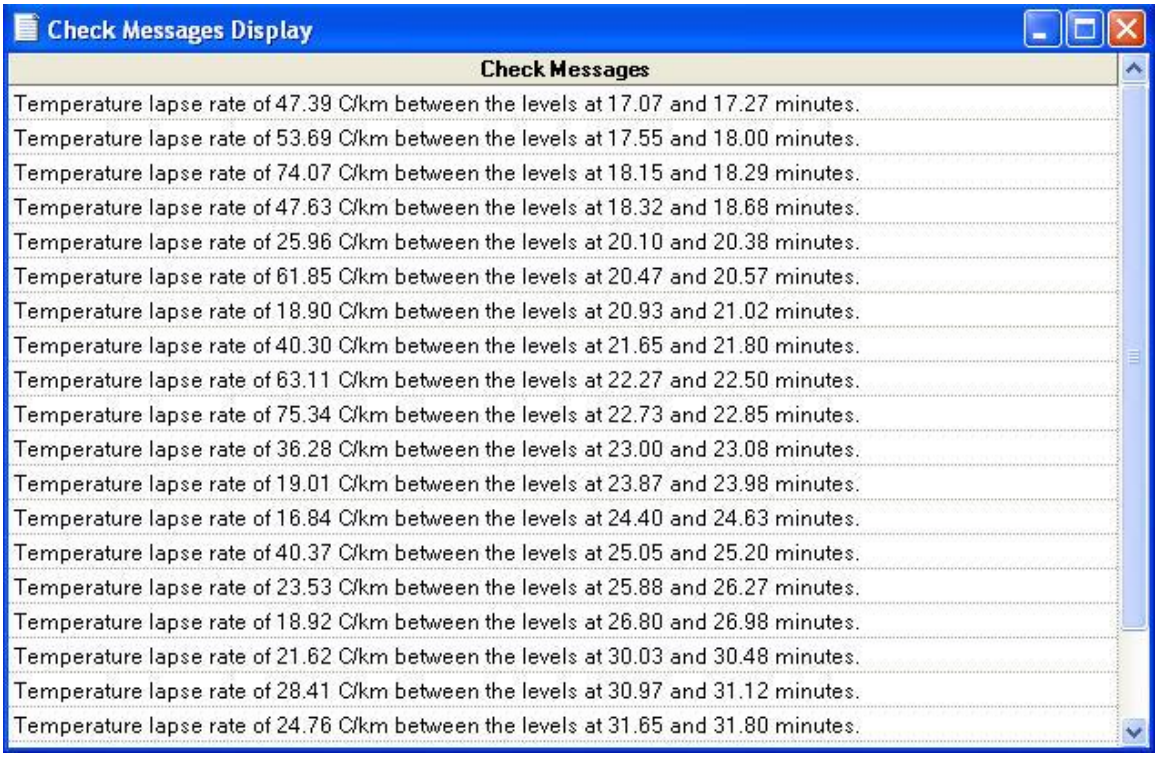


Exhibit 13-32: Temperature and Dewpoint Plot from a sounding that entered a thunderstorm about 16 minutes after release.



Check Messages Display

Check Messages
Temperature lapse rate of 47.39 C/km between the levels at 17.07 and 17.27 minutes.
Temperature lapse rate of 53.69 C/km between the levels at 17.55 and 18.00 minutes.
Temperature lapse rate of 74.07 C/km between the levels at 18.15 and 18.29 minutes.
Temperature lapse rate of 47.63 C/km between the levels at 18.32 and 18.68 minutes.
Temperature lapse rate of 25.96 C/km between the levels at 20.10 and 20.38 minutes.
Temperature lapse rate of 61.85 C/km between the levels at 20.47 and 20.57 minutes.
Temperature lapse rate of 18.90 C/km between the levels at 20.93 and 21.02 minutes.
Temperature lapse rate of 40.30 C/km between the levels at 21.65 and 21.80 minutes.
Temperature lapse rate of 63.11 C/km between the levels at 22.27 and 22.50 minutes.
Temperature lapse rate of 75.34 C/km between the levels at 22.73 and 22.85 minutes.
Temperature lapse rate of 36.28 C/km between the levels at 23.00 and 23.08 minutes.
Temperature lapse rate of 19.01 C/km between the levels at 23.87 and 23.98 minutes.
Temperature lapse rate of 16.84 C/km between the levels at 24.40 and 24.63 minutes.
Temperature lapse rate of 40.37 C/km between the levels at 25.05 and 25.20 minutes.
Temperature lapse rate of 23.53 C/km between the levels at 25.88 and 26.27 minutes.
Temperature lapse rate of 18.92 C/km between the levels at 26.80 and 26.98 minutes.
Temperature lapse rate of 21.62 C/km between the levels at 30.03 and 30.48 minutes.
Temperature lapse rate of 28.41 C/km between the levels at 30.97 and 31.12 minutes.
Temperature lapse rate of 24.76 C/km between the levels at 31.65 and 31.80 minutes.

Exhibit 13-33: Check Messages from a sounding inside a thunderstorm

If there is convective activity occurring in the area at release time, monitor the sounding data and Check Messages closely. If the radiosonde enters or goes near a thunderstorm, follows these steps:

1. Examine the data plots and Check Messages.
2. If the temperature data looks very erratic and there are numerous Check Messages for superadiabatic lapse rates, terminate the sounding at the point where the temperature data first became erratic. As an example, the sounding shown in Exhibit 13-32 should have been terminated at 16 minutes.

13.8 Relative Humidity (RH) Data Problems

Of all the data provided by radiosondes, verifying the accuracy of the Relative Humidity data profile can be very difficult, since moisture in the atmosphere can vary significantly with height and distance and over a short period of time. Many RH data problems are caused by limitations of the sensor technology. The allowable error in the RH data accuracy can be as high as +/- 10%. This section covers common problems that need to be handled by the observer. In nearly all other cases the RH data should be left as is and not edited.

IMPORTANT: RRS does not provide Check Messages for erroneous RH data and careful monitoring of the RH profile needs to be done. Edit the RH only if problems noted in this section are seen or if it is certain the RH data are erroneous. In all other cases, leave the RH data as they are reported. <u>DO NOT OVER DELETE RH DATA</u> . RH is used to calculate heights and excessive, unnecessary editing can introduce height errors in the sounding.

13.8.1 Rapid Change in RH off Surface

The RH sensor at times may indicate significantly lower or higher readings immediately off surface because the surface weather observation (from RSOIS or ASOS) of RH does not agree with the first RH data reported from the radiosonde after release. Significant drying off surface is common and is possibly caused by the RH sensor not being properly ventilated after release. Exhibit 13-34 shows an example where the Surface RH was 77.5% but the first RH data reported from the radiosonde was 71.3%.

If the difference between the surface weather RH observation and the first RH data point aloft exceeds 10%, follow these steps:

1. Using the RH Plot and Processed Tabular Display, determine the time it took for the RH sensor to recover (i.e., RH data increases) and provide RH measurements more in line with the surface RH observation from RSOIS.
2. Delete **<u>all</u>** the RH in the erroneous layer.

3. Correcting this RH anomaly should not require the deletion of more than 1 minute of data. If it appears that it took more than 1 minute for the sensor to recover (see Exhibit 13-35), do not delete more than 1 minute of RH data. Let the sounding proceed, but continue to monitor the RH data for any further problems that require action from the observer
4. Significant discrepancies in RH just off surface may also be caused by the surface weather equipment being out of calibration or poorly sited. If RH discrepancies off surface occur often, the equipment needs to be checked by an electronics technician to make sure it is operating correctly. Routine maintenance of the equipment is essential. Relocation of the RSOIS may also be necessary.

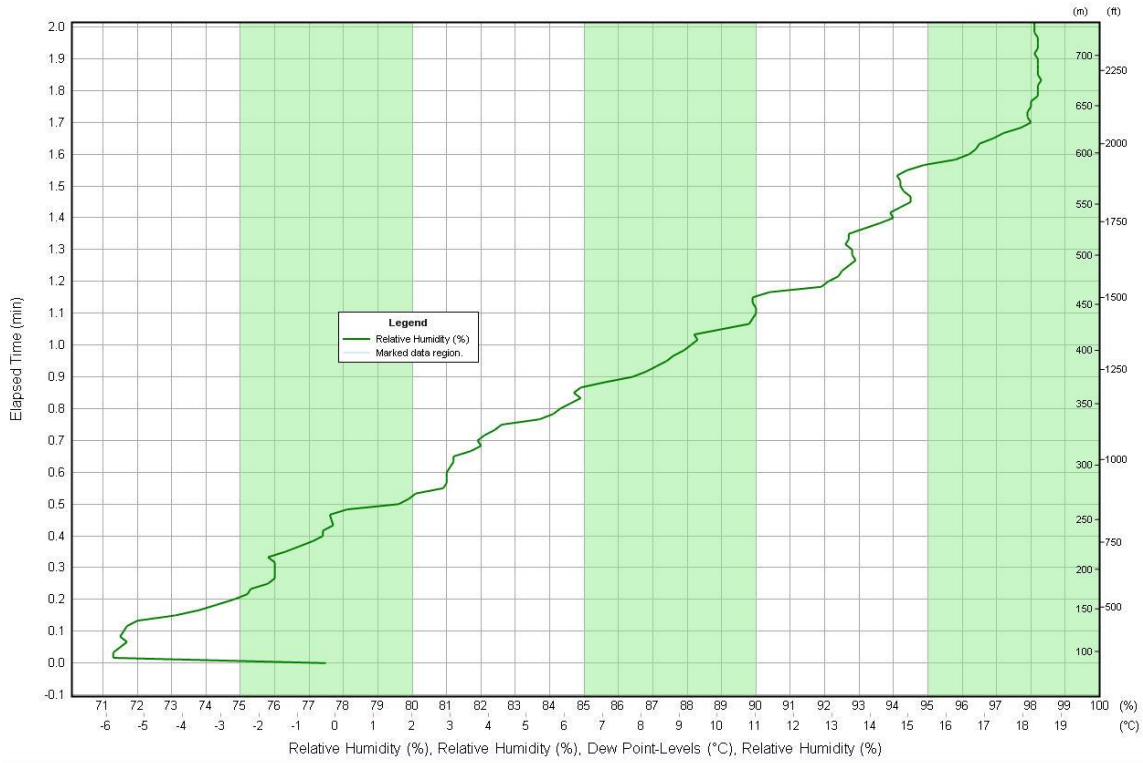


Exhibit 13-34: Relative Humidity Plot showing rapid drying off surface. The sensor recovered near 0.9 minutes

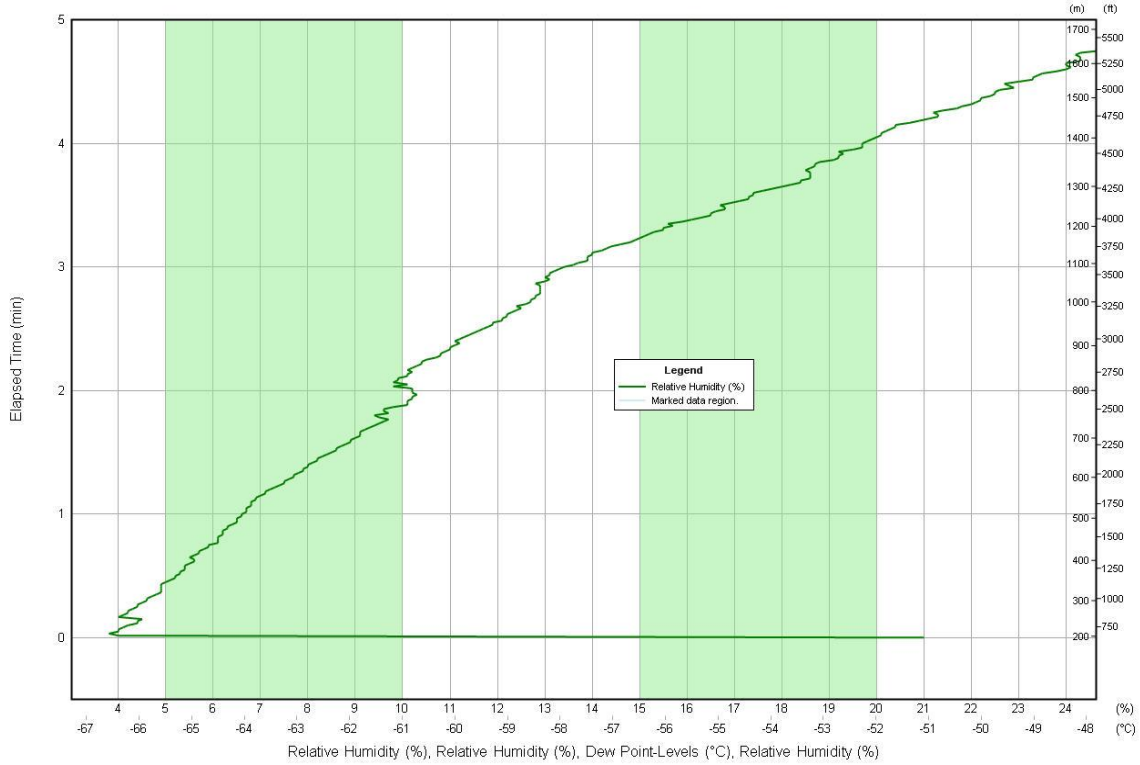


Exhibit 13-35: Relative Humidity Plot showing sensor recovery taking more than one minute

13.8.2 Layers of Constant 1% RH Values

Occasionally, the RH data may show prolonged periods of constant 1% RH values between surface and 200 hPa. These dry layers are often real, but sometimes they indicate a problem with the RH sensor If prolonged periods of constant 1% RH data occur in the sounding, follow these steps:

1. If layer of constant 1% RH values persist for less than 15 minutes, leave the RH data as is**.** **Do not delete the data**. Exhibit 13-36 shows an example of such a RH profile.

2. If the constant 1% RH values persist for more than 15 **consecutive** minutes anywhere **between surface and 200 hPa**, the sensor has likely failed completely and **all** the RH data from the start of the 1% values to flight termination needs to be deleted. Exhibit 13-37 is an example of such a RH data profile. The RH sensor failed at about 12 minutes into the sounding. **Above 200 hPa the RH is typically near 1% and such values should not be deleted**.

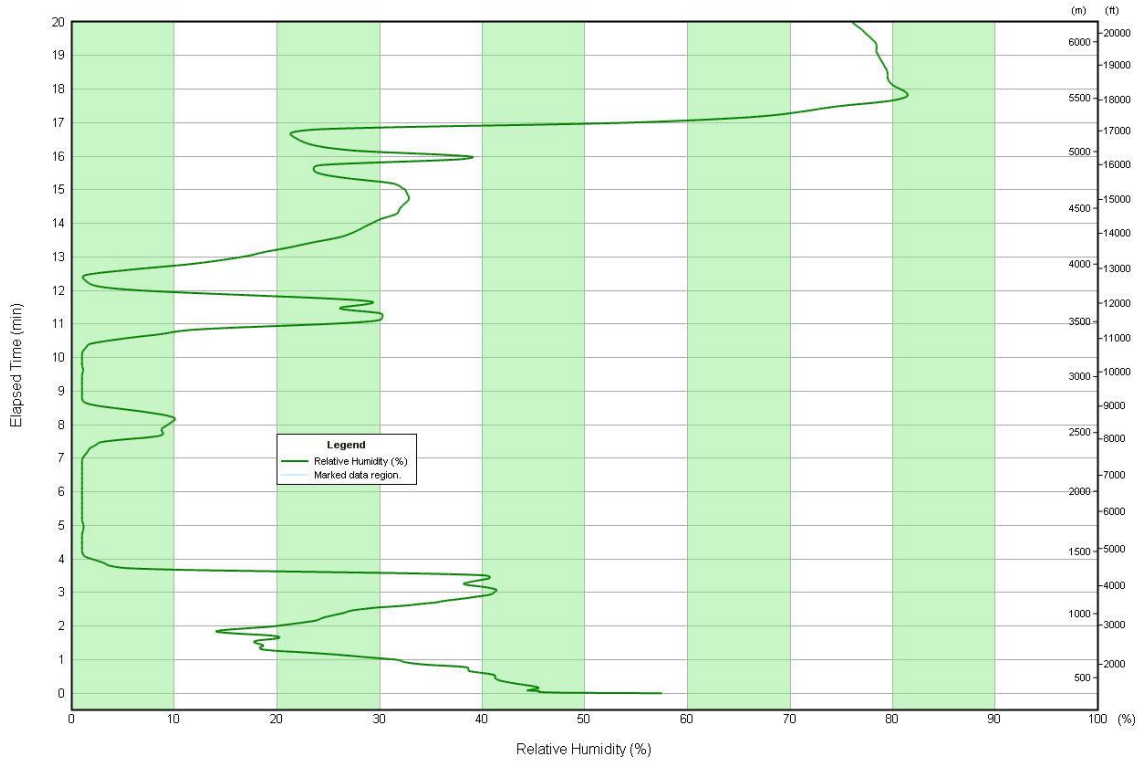


Exhibit 13-36: RH Plot showing layers of 1% RH values lasting less than 15 minutes. These data are acceptable.

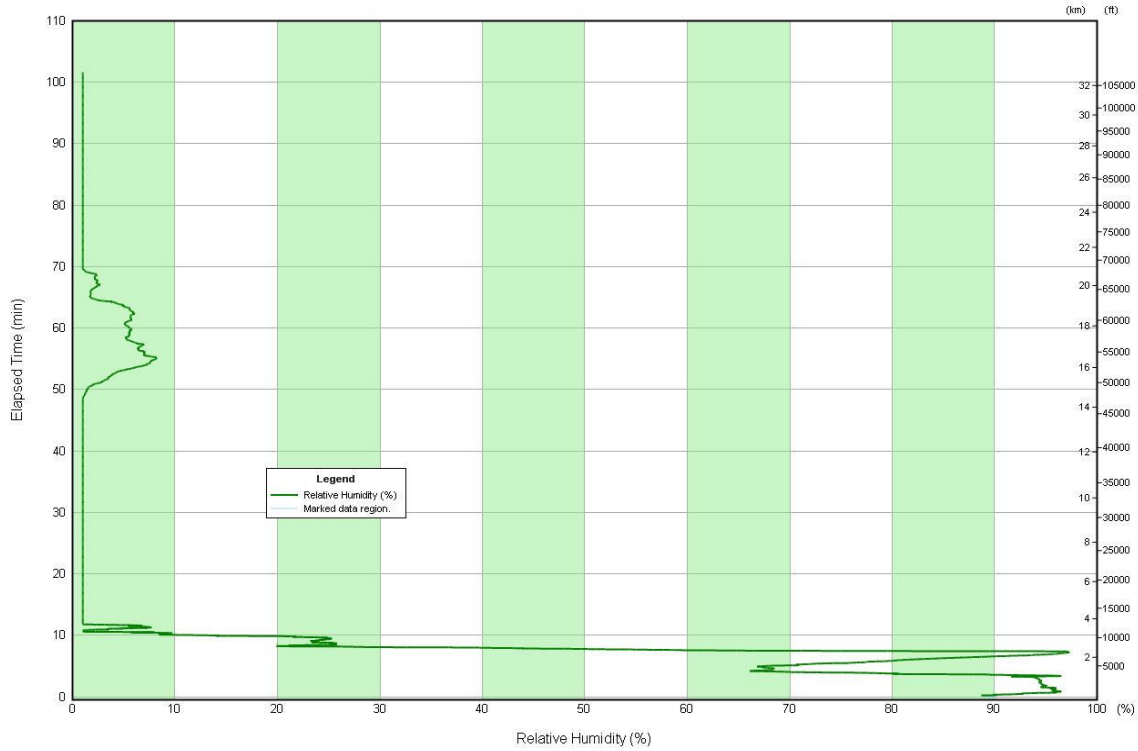


Exhibit 13-37: RH data showing sensor failure at about 12 minutes.

13.8.3 High RH above 200 hPa

Above about 12 km or 200 hPa, the RH in the atmosphere decreases to well below 30% and typically falls to near 1%. On occasion, the radiosonde will pass through a thick cloud or precipitation layer and the RH sensor absorbs excessive moisture or becomes ice covered. The radiosonde later enters drier air, but the RH sensor never dries out and RH values remain biased too high for the remainder of the sounding. This will be readily apparent by examining the RH Plot above 200 hPa.

If the RH Plot shows 30% or higher RH values persisting or appearing periodically from above 200 hPa to sounding termination, follow these steps.

1. After flight termination, delete **all** the RH data from 200 hPa to the end of the sounding.
2. If the TTAA and TTBB coded messages were transmitted earlier without the RH data edits as noted in step 1, retransmit them with the RH data edits applied.

13.9 Wind Data

Unlike the wind data obtained from the old MicroART system, GPS winds from RRS are very accurate and it is rare there will be problems. Wind speeds well over 200 knots have been accurately measured from GPS radiosondes. Likewise, light and variable winds are also accurately measured. Yet, it is common to see Check Messages for wind speed and direction changes and Exhibit 13-40 shows a typical example.

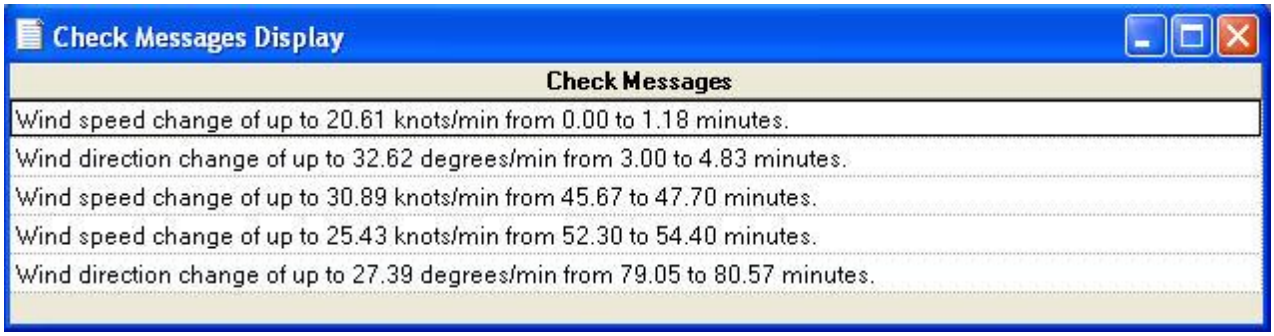


Exhibit 13-38: Typical wind speed and direction Check Messages

If there are Check Messages for wind speed and direction changes they can be mostly ignored and no action to edit the data needs to be taken. **Don't delete wind data unless it is certain they are in error.** If the sounding shows wind data Check Messages numbering 12 or more you should verify the wind data accuracy. Follow these steps:

1. Using the previous sounding, aircraft data, WSR-88D winds, and/or wind profilers verify the accuracy of the radiosonde winds. If the wind data compare reasonably well, no further action needs to be taken.
2. If the observer is **certain** the winds are bad and has no doubts, then **all** the wind data in the erroneous layer need to be deleted.

13.9.1 Missing Winds

While the accuracy of the GPS winds are very good, there will be times when there is GPS loss and the wind data is missing for several minutes or more off surface or in thick layers elsewhere in the sounding. Sometimes all the winds are missing in the sounding.

If there are significant amounts (3 minutes or more) of missing winds during the sounding notify the WFO lead forecaster and NCEP SDM immediately. A second release may be required if the wind data is deemed essential. If there are frequent soundings with missing winds, notify the office electronics technician and the Regional Office Upper air Program Manager. There may be a ground equipment problem or a problem with the radiosondes.

13.10 Erratic GPS Geometric Data

On occasion, the GPS derived geometric height data will be erratic. It is more common with the Vaisala RS-92 radiosonde and results in erratic geometric data appearing in the Height or Ascent Rate plots. Exhibit 13-39 shows the Height Plot of a sounding with noisy GPS data occurring mostly between 40 and 80 minutes. Exhibit 13-40 shows the Ascent Rate plot from the same sounding. In both cases note that the height and ascent rate data derived from the pressure sensor (geopontential) are smoother and far less erratic.

If erratic GPS data are seen, there is little to no impact on the calculated GPS winds or the data appearing in the coded messages. DO NOT DELETE the GPS data unless the wind data have been deemed erroneous. See Section 13.9 for more information.

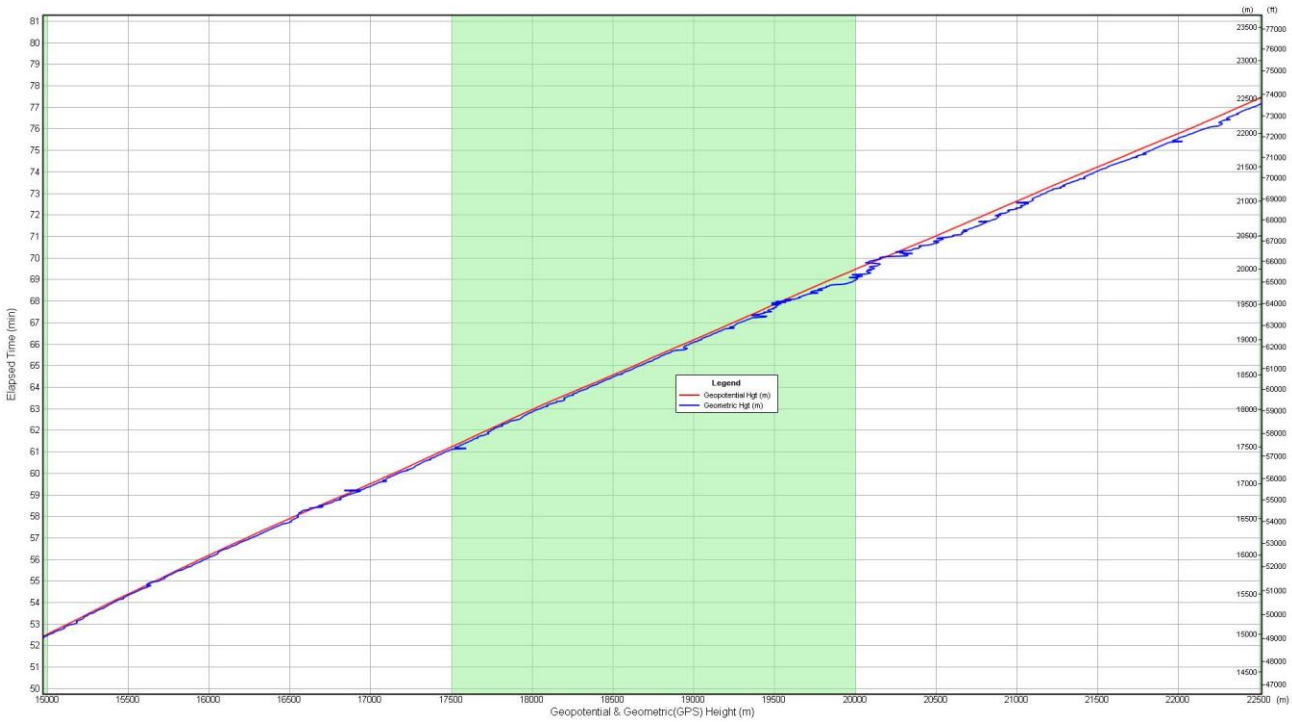


Exhibit 13-39: Erratic GPS geomertric heights (plotted in blue).

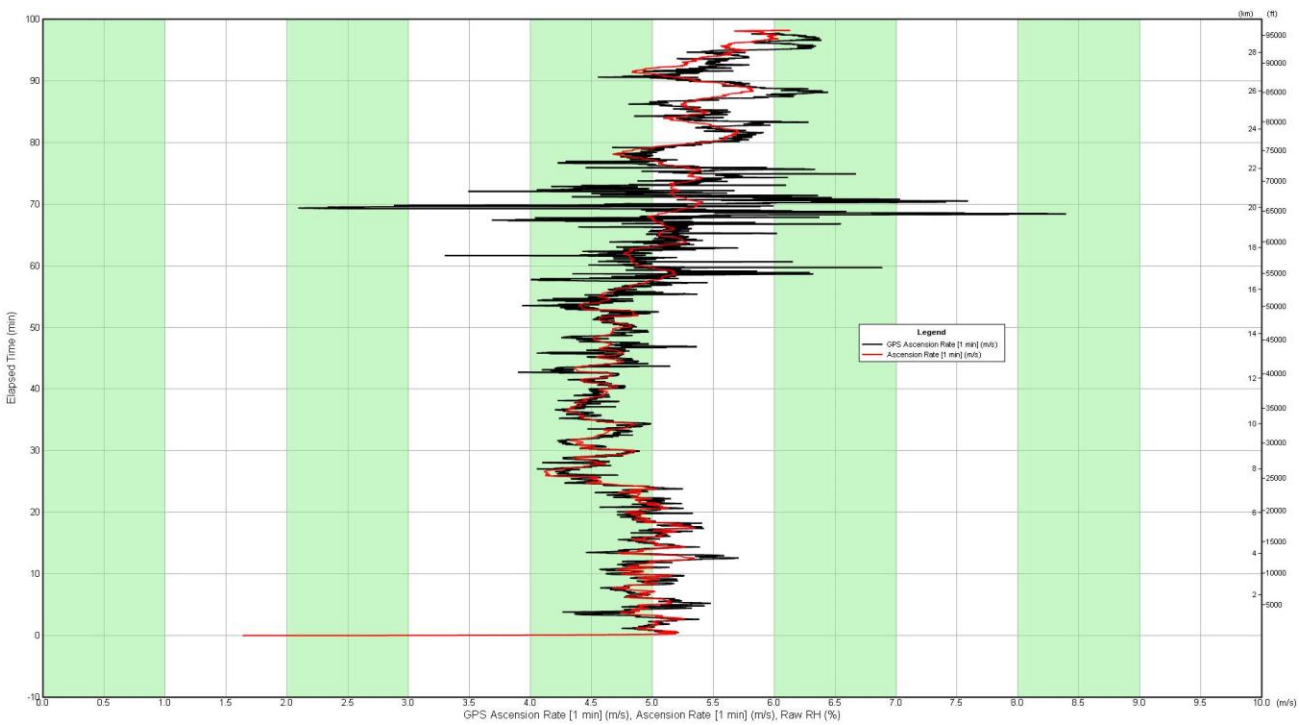


Exhibit 13-40: Erratic ascent rates derived from the GPS geometric data (plotted in black).

13.11 Data Spikes

Data spikes in the plots may be seen with any of the radiosonde data, but they will be more common with the RH data. This is because the RRS software only smoothes the RH data and a data spike or outlier removal algorithm is not applied. Data outlier removal is applied to the pressure and temperature data.

When data spikes occur, the data plots will show 1 or 2 data points (1 to 2 seconds) that are extreme departures from data on either side of the spike. Exhibit 13-41 shows a data spike in the RH Plot. The raw data show a spike at about 4.5 minutes lastly only 2 seconds. Note that the smoothed RH data (dashed blue line) only partially removed the spike.

IMPORTANT: Rapid changes in RH with height are common in the atmosphere and radiosonde RH sensors can detect these changes. <u>DO NOT OVER DELETE RH DATA</u>. RH is used to calculate heights and excessive, unnecessary editing can introduce height errors in the sounding.

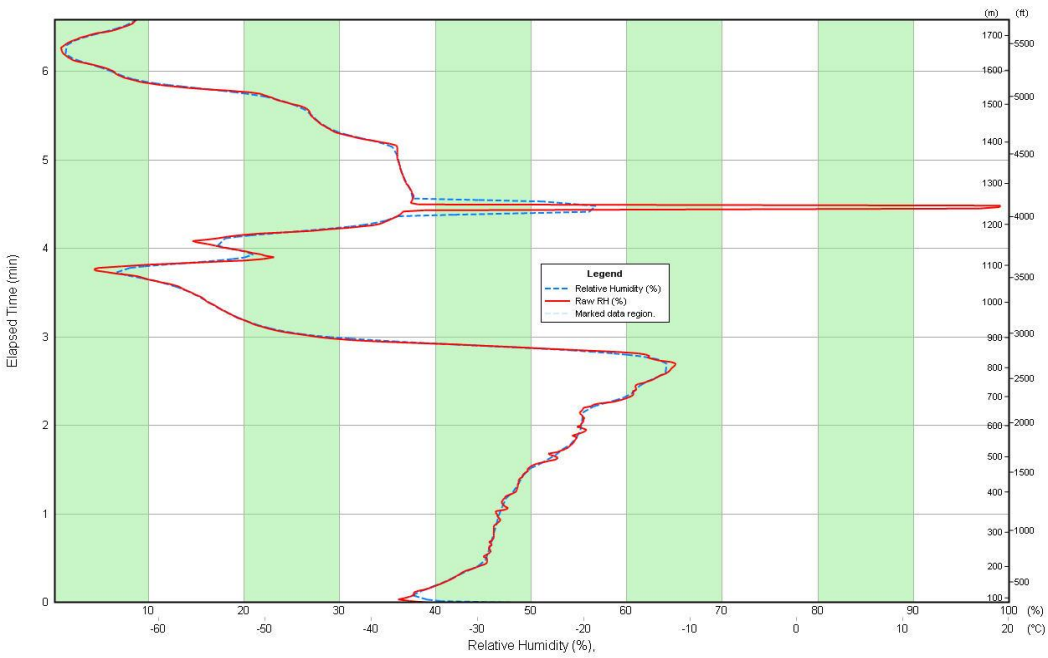


Exhibit 13-41: Data spike in the Relative Humidity Plot at about 4.5 minutes.

If there is a spike in the temperature data, sometimes the software does not remove all the erroneous raw data and a spike will still appear in the final or processed temperature (and dew point) data. Exhibit 13-42 shows a temperature data spike at 11 minutes. The spike in temperature also caused Check Messages for lapse rates exceeding 65 C/km to appear.

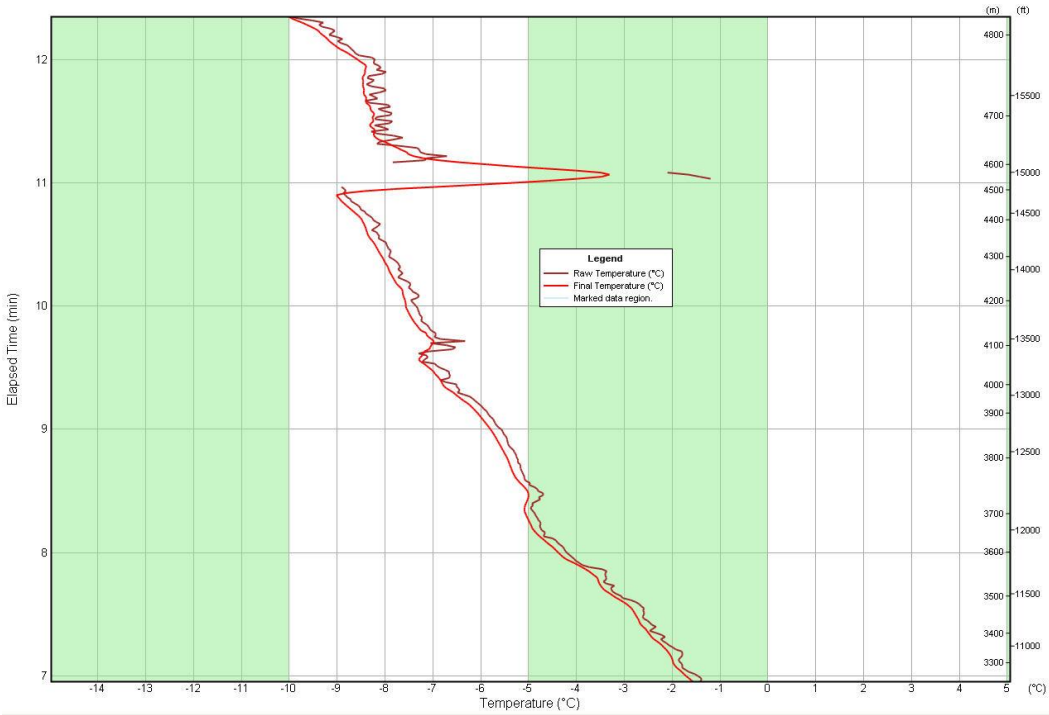


Exhibit 13-42: Temperature and dewpoint spike at 11 minutes

After identifying a possible data spike in the plotted data, follow these steps.

(1) Expand or zoom into the data plot to help better identify the beginning and ending points of the data spike.

(2) If there is a temperature data spike that requires observer action, Data Check Messages will be generated and they can help find the bad data. Delete the temperature data following the instructions in Section 13.7.

(3) If there is a RH data spike, only delete it if it is 2 or less data points thick and exceeds 50% RH from values on either side of it. In all other cases, the RH data spikes can be left as is. In Exhibit 13-41, the RH spiked to nearly 100% for 1 second in a layer where the RH averaged about 37% on either side of the spike.

13.12 Radiosonde Sensor Failure

NWS uses over 75,000 radiosondes across a network of 92 upper air stations each year. A small percentage of them will have very serious defects or calibration problems. Sometimes these problems will not be detected by the observer or the software during radiosonde preparation and baseline. It's only when the radiosonde is aloft that significant data problems become apparent. There will be other times when the radiosonde strikes an object during release and gets damaged. This too can cause pressure, temperature and RH data problems. When a radiosonde is not working correctly, is damaged during release, or is poorly calibrated at the factory one or more of the following may occur during the sounding:

- Abrupt rise or unrealistic drop in pressure exceeding 5 hPa just off surface or aloft.
- Numerous check messages for superadiabatic lapse rates, fast ascent rates, increasing pressure levels, and/or changes in heights and temperatures from the previous sounding.
- Thick layers (1 km or more thick) of erratic pressure, temperature, or RH data
- Frequent data drop-outs or spikes
- Freezing levels occurring at 6,000 meters or higher
- Early flight termination owing to battery or radiosonde failure
- All GPS winds are missing

Thus, it is important to monitor all flight data just prior to balloon release and periodically during the sounding. If the temperature and/or pressure data are bad it may be necessary to terminate the sounding early. Never assume that the software will detect all bad data and terminate the sounding correctly. If problems with radiosonde data appear to be occurring often with a particular radiosonde shipment, promptly notify the Regional Office Upper Air Program Manager.

Examples:

In some cases the software will detect problems and correctly terminate the sounding early. Many times it does not. Exhibit 13-43 shows an example of a pressure sensor failure clearly occurring at 26.6 minutes. While a Check Messages was generated for an ascension rate exceeding 2,500 meters/minute from this erroneous data, the rapid fall in pressure data was not deleted by the software. The flight was not automatically terminated until 27.8 minutes. Over one minute of very erroneous data remained and appeared in the coded messages.

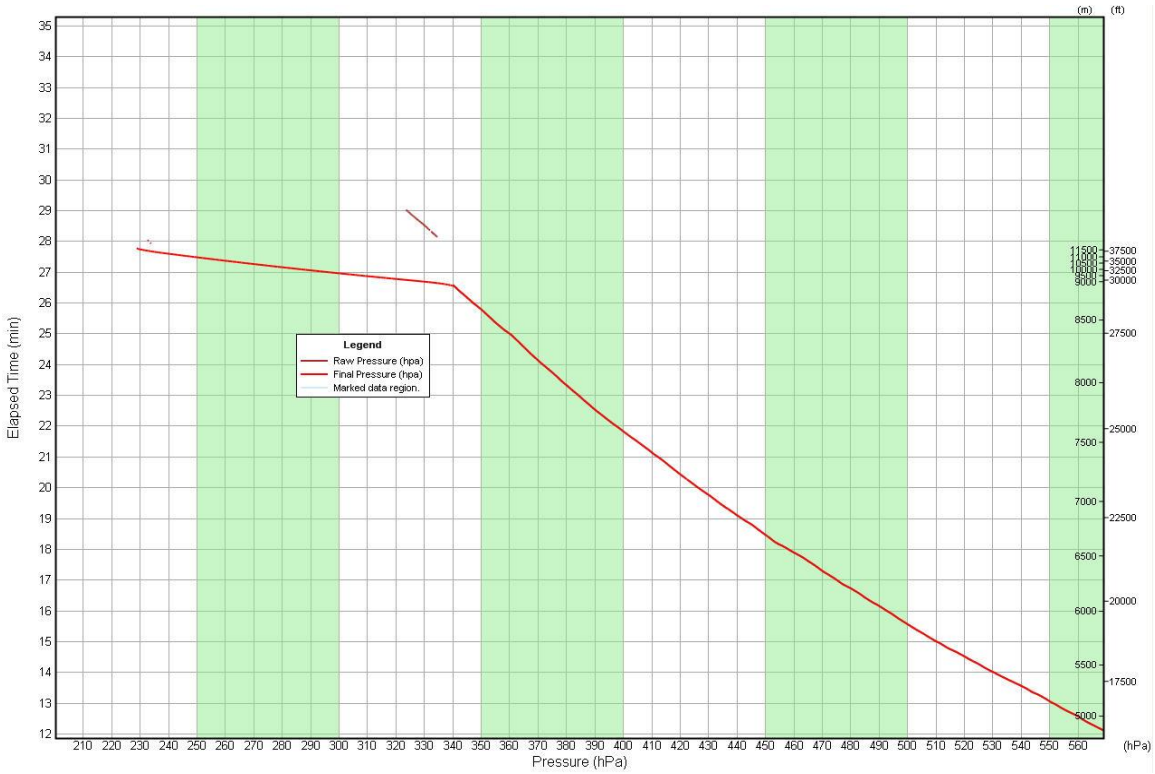


Exhibit 13-42: Pressure sensor failure at 26.6 minutes

Exhibit 13-44 shows what can happen to the pressure data if the radiosonde hits an object during release. In this case, the instrument hit the ground and the pressure sensor was damaged. This resulted in a jump in pressure near 15 hPa just off the surface. If the radiosonde hits an object at release and the pressure data shifts abruptly off surface, the sounding must be terminated and none of the data should be transmitted or archived.

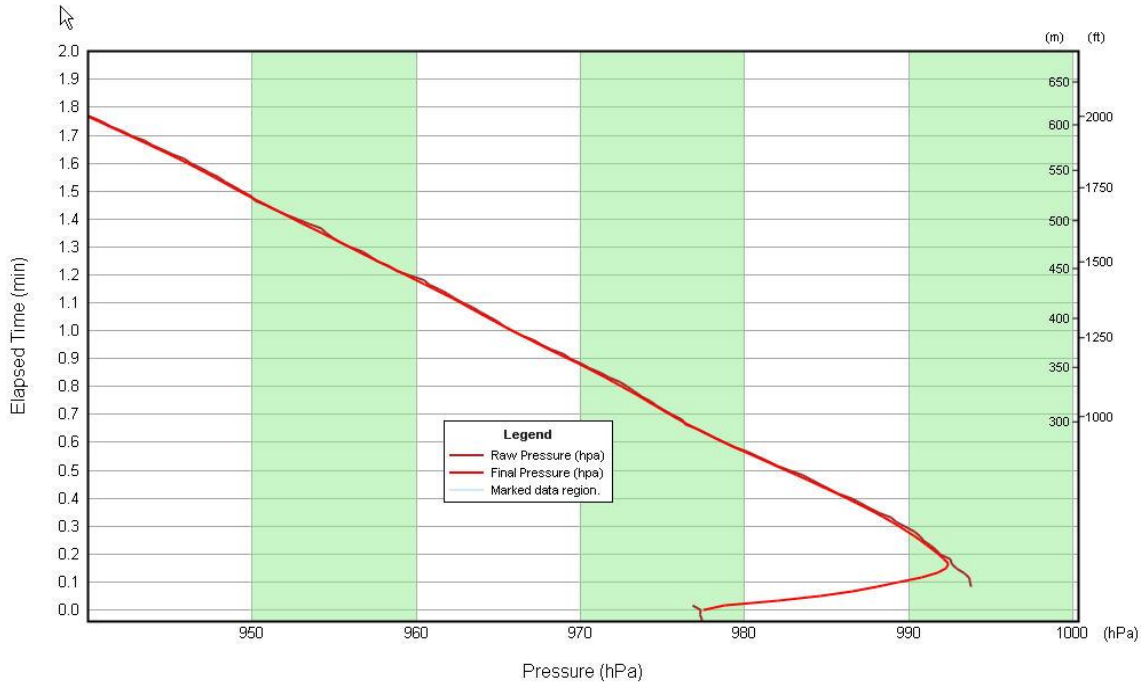


Exhibit 13-43: Pressure sensor failure caused by the radiosonde hitting the ground

Sometimes the radiosonde is transmitting bad temperature data during baseline inside the office that are not even close to what is common for room temperature conditions. Exhibit 13-43 shows the raw temperature (red plot) from a Vaisala RS92 before and after release. The radiosonde was baselined in the office, but the raw temperature from the radiosonde was well below 0C and decreased to -26C at 0.0 minutes. The observer did not pay close attention to the erroneous data during baseline, accepted the data, and released the radiosonde. With a surface temperature near +3.0C, a very strong discontinuity can be seen off surface and a check message for a super-adiabatic lapse rate near 9,000C/km was generated. Temperatures from the radiosonde continued to be way too cold after release as there were also numerous Data Check Messages for height changes from the previous sounding. In this example the observation should have been terminated with none of the data transmitted.

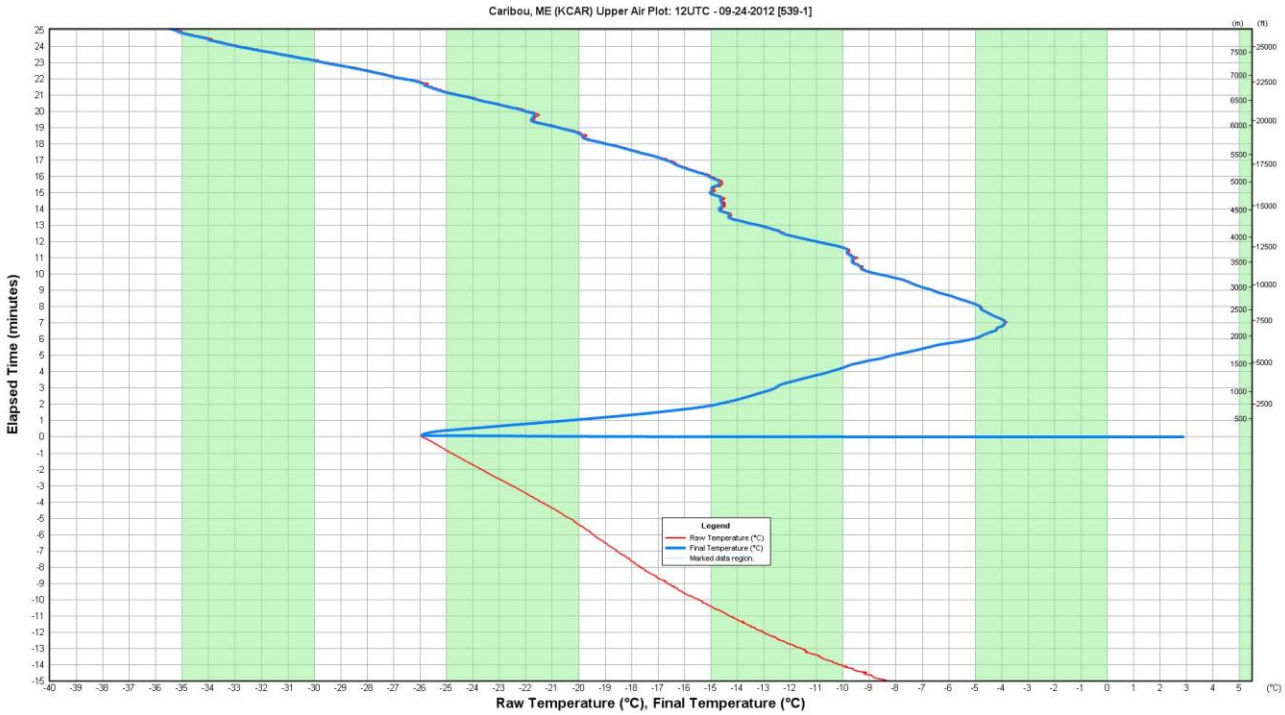


Exhibit 13-44: Temperature sensor failure from a Vaisala RS92 radiosonde

14 Rework – Reprocessing Flights

This chapter covers Rework mode and its use in reprocessing flights. Rework is used for several reasons. The most common reasons are:

1. To correct data after a flight has been completed for re-transmission to NCEP.
2. Quality control observations and assess operator performance.
3. Provide operator training.
4. Review past storm or meteorological events on station and with other sites by importing data files of the event(s).

NOTE: In Rework, the WMO Coded messages can be retransmitted to NCEP up to six hours after the observation's time of termination.

Rework mode allows the observer to open a previous flight and review and edit the flight data. Rework contains most of the capabilities available in the Live Flight mode. Observers should become familiar with Reworking flights, since it is a useful tool for reviewing flight data and the only means of transmitting data in the event of a software crash.

14.1 Rework Functions

Rework mode has the same functions available as the post-termination portion of a Live Flight, with the exception of anything to do with monitoring and controlling RRS hardware. The observer can review, Mark, Code and transmit flight data the same as in Live Flight mode.

The transmitting of the WMO Coded Messages is partially restricted in Rework. The WMO Coded Messages can only be transmitted within 6 hours of the observation termination time. Chapter 10 describes in detail the Coding and transmission of the WMO Coded Messages.

NOTE: For more information on reviewing or marking flight review Chapters 5 through 7

14.2 Starting Rework

Follow these steps:

1. Select the **Perform rework of a previous flight** from the Main menu (Exhibit 14-1). Alternatively, select the **Open Rework** option from the *Flight* pull-down menu.

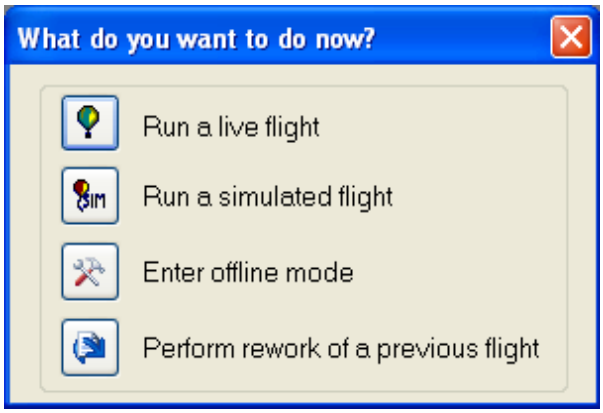


Exhibit 14-1 Flight Options

2. Select the flight to Rework from the *Previous Flight* window (Exhibit 14-2) and click **OK** button.

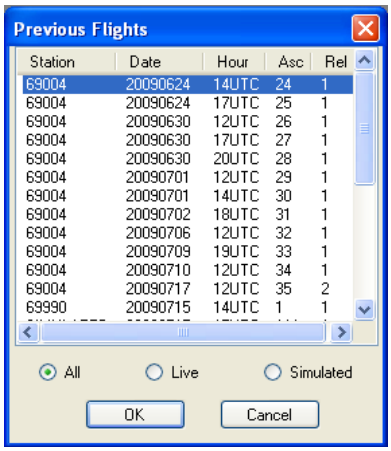


Exhibit 14-2 Previous Flight Window

NOTE: The flights are listed in chronological order including flights that were imported from other sites. They can be sorted by Live and Simulated flights.

3. In the Select Station Data window, select the **Use flight Station Data** option. Then click the **OK** button (Exhibit 14-3).

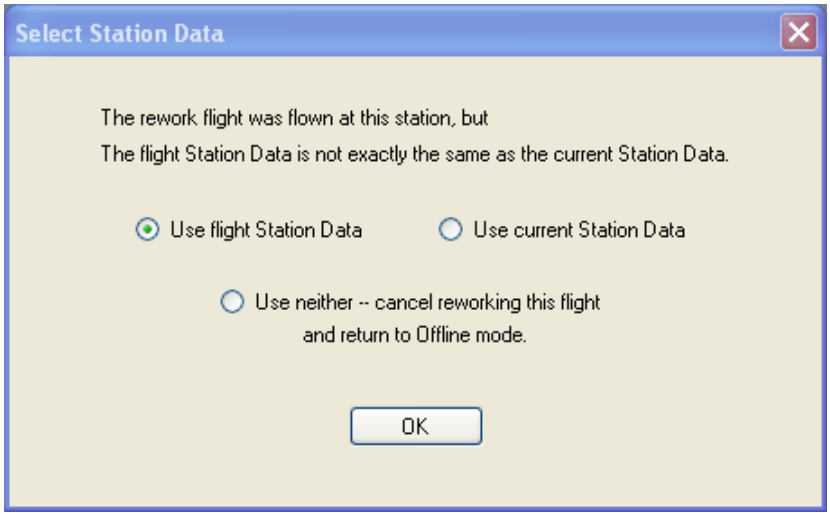


Exhibit 14-3 Select Station Data

NOTE: Rework uses flight Station Data for flights with a radiosonde different than the current Station Data. Reworking flights using Current Station Data is not typical.

4. The RWS opens in Rework mode, and the observer can now review the flight data (Exhibit 14-4).

Exhibit 14-4 Rework Mode

14.3 Rework as a Flight Recovery Tool

In the event of a software crash, RWS will automatically open the flight data in Rework once RWS software is restarted. This will allow the observer to review, mark, Code and transmit the flight data.

On very rare occasions, RWS will not automatically reopen the flight data in Rework. Check the Rework list of flights for the current ascension number (Exhibit 14-2). If the flight is not listed in the Rework list flights, it cannot be Reworked and an additional flight may be necessary.

14.4 Rework as Analysis and Training Tool

RWS can also import and Rework previous flights from other RRS sites. Once a flight database has been imported into RWS, the flight will be listed in the Rework menu. Reworking flights with various atmospheric characteristics can be a useful for storm analysis, quality analysis and training tool. Chapter 16 contains more information on importing flight databases and other RWS software utilities.

14.5 Exiting Rework

1. To close Rework mode, select the **Close** option from the Flight pull-down menu.
2. A pop-up window will appear asking if the changes made to the flight data should be committed (saved) (Exhibit 14-6). Select **Commit changes** to save changes to the flight data or **Discard changes** not to save changes to the flight data. Then click **Close Flight Session** button.

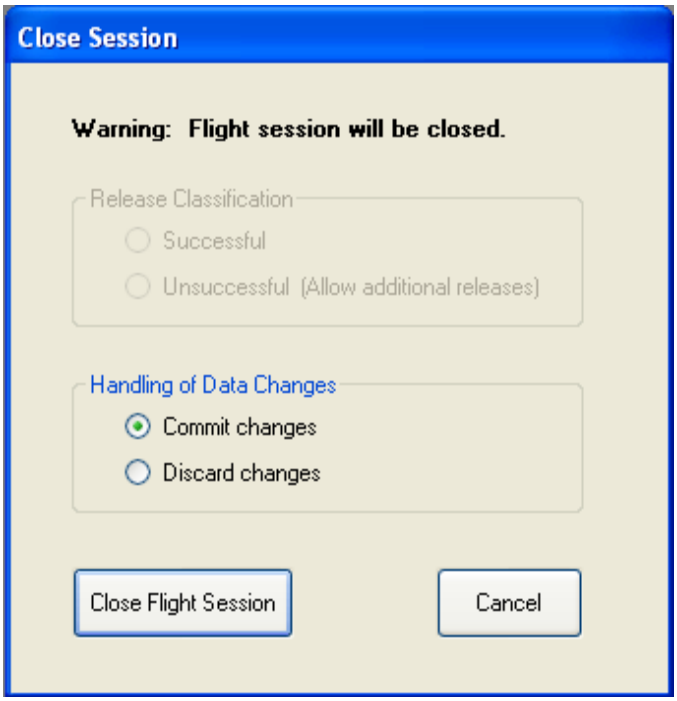


Exhibit 14-6 Commit/Save Changes to Flight

3. If the flight was recovered from a software crash, a pop-up window may appear as a reminder that Rework mode does not have access to the Hardware. The UPS will have to be powered off the manually using the Offline Maintenance Suite (OMS) (Exhibit 14-7, 14-8 and 14-9).

NOTE: In the event of a software crash, use the Offline Maintenance Suite to turn the UPS off (Exhibit 14-8 and 14-9).

Exhibit 14-7 Rework cannot access the Hardware

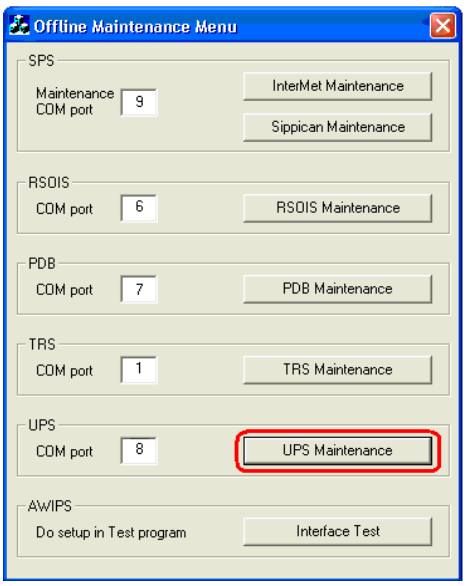


Exhibit 14-8 Offline Maintenance Suite

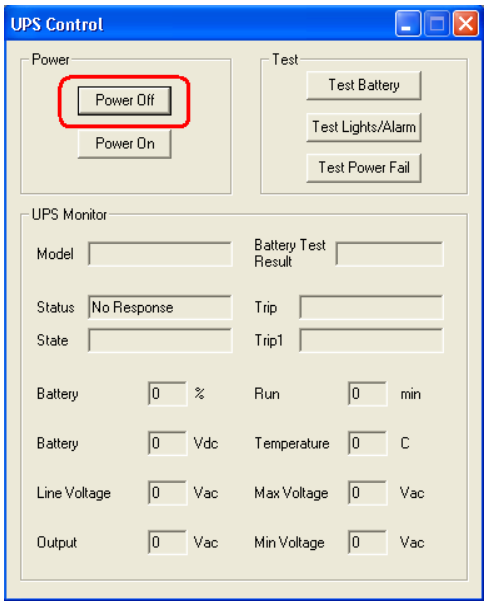


Exhibit 14-9 UPS Maintenance

4. If the flight was marked unsuccessful, a pop-up message will appear asking if the observer wants to run another release of the same ascension (Exhibit 14-10). Section 11.3 describes the multiple releases. If another release is necessary, click **Yes**.

Exhibit 14-10 New Release Prompt

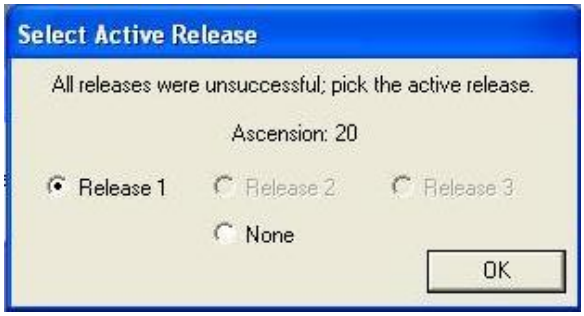


Exhibit 14-11 Active Release Prompt

5. Finally, the *Select an Active Release* pop-up window will appear (Exhibit 14-11). Select the appropriate release for the current ascension number. This is usually the flight that reached the highest altitude with good data. Then click **OK**.

15 Station Data

The station data contains site specific information including system location and configuration. The station data is used by the RWS software to ensure that data transmitted reflects the proper station data, radiosonde type, tracking method and equipment, along with communication header information.

15.1 Station Data Display

The station data consists of two sections. The top portion of the display (known as the Master Station Data) is maintained by WSH. **No changes may be made by the site to this screen display unless authorized by WSH.** The bottom portion side of the screen display (known as the Local Station Data) may be entered by the RWS Site Administrator (Exhibit 15-1). All modifications to the cataloged station data must be coordinated through NWSHQ to ensure the NWSHQ website remains current.

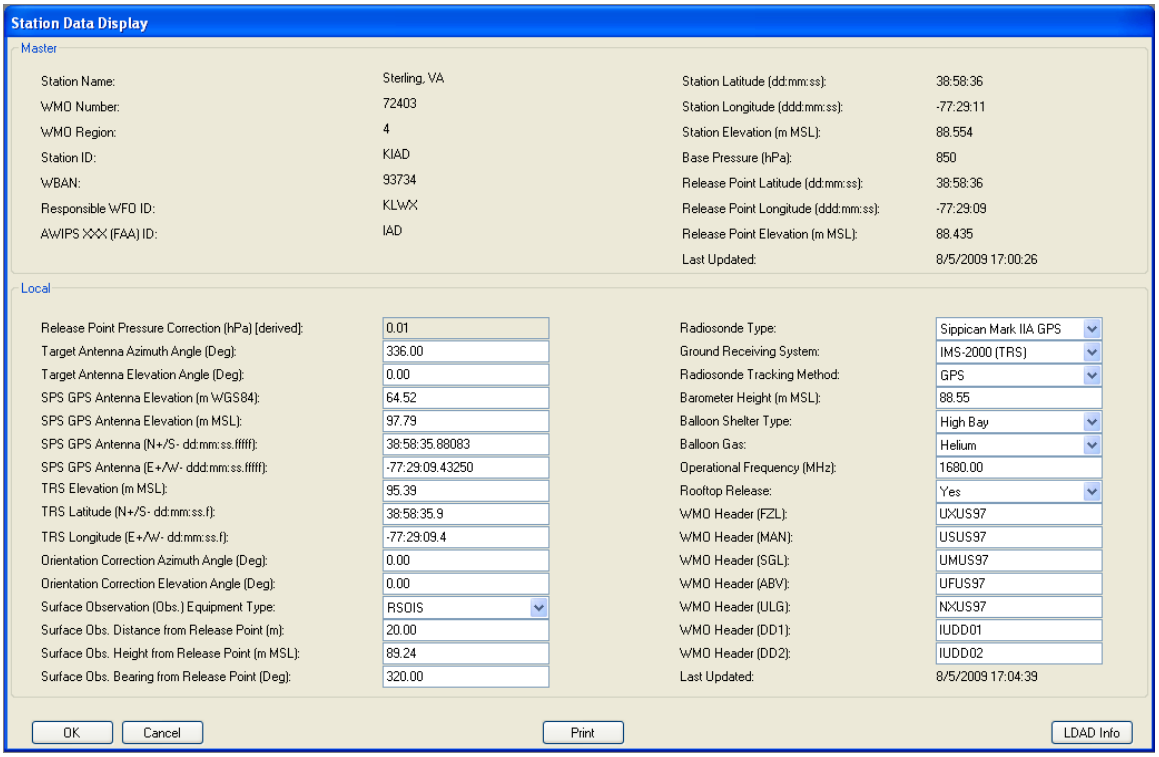
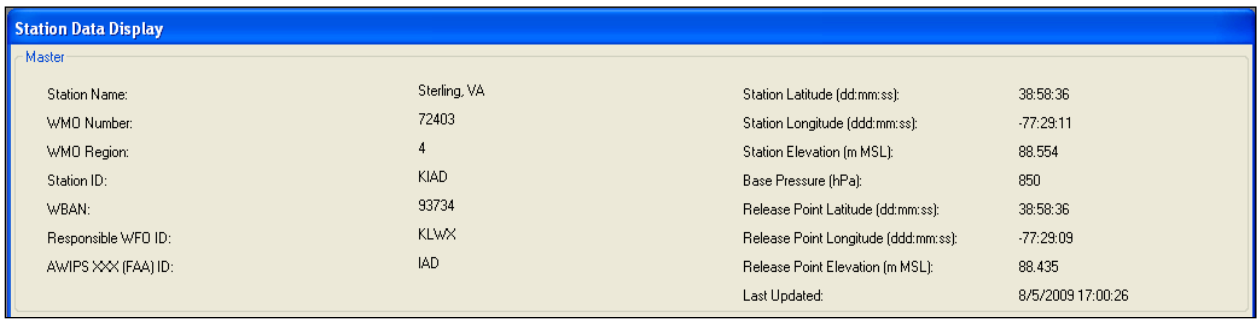


Exhibit 15-1 Station Data Display

15.1.1 National Weather Service Headquarters Maintained Data

The Master Station Data contains basic information about the station that changes infrequently. This section is locked and should only be updated in coordination with WSH. The blocks include the Station Name, WMO Number, WMO Region, Station ID, WBAN, Latitude, Longitude, Elevation, etc. During installation, a site need only enter the proper WMO Number to populate the Master Station Data (Exhibit 15-2).



Station Data Display

Master

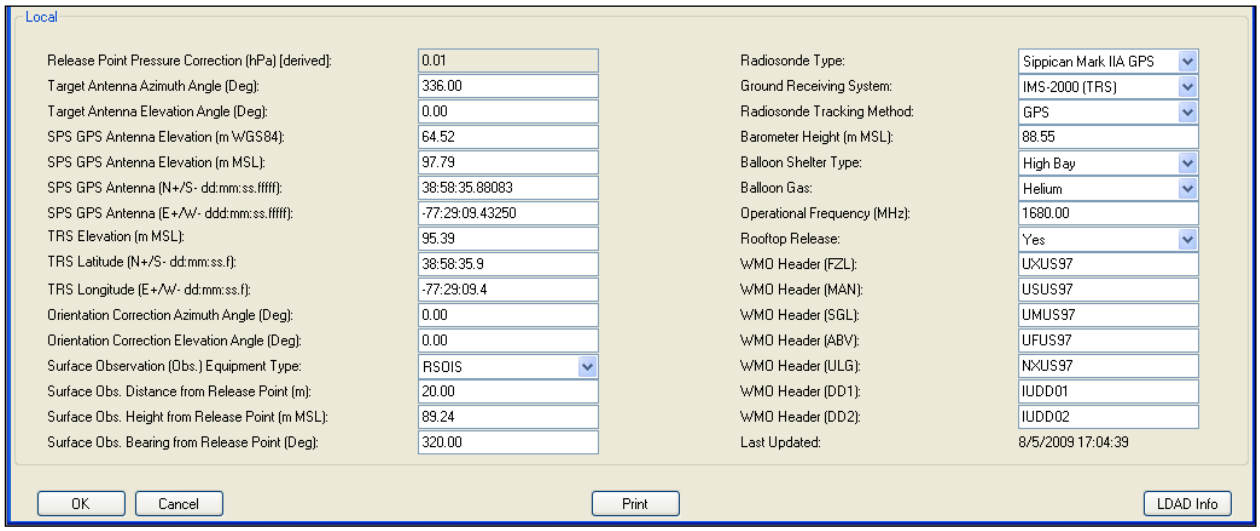
Station Name:	Sterling, VA	Station Latitude (dd:mm:ss):	38:58:36
WMO Number:	72403	Station Longitude (ddd:mm:ss):	-77:29:11
WMO Region:	4	Station Elevation (m MSL):	88.554
Station ID:	KIAD	Base Pressure (hPa):	850
WBAN:	93734	Release Point Latitude (dd:mm:ss):	38:58:36
Responsible WFO ID:	KLWX	Release Point Longitude (ddd:mm:ss):	-77:29:09
AWIPS XXX (FAA) ID:	IAD	Release Point Elevation (m MSL):	88.435
		Last Updated:	8/5/2009 17:00:26

Exhibit 15-2 WSH Maintained Data

NOTE: During RRS installation, a survey is done to ensure the Lat/Long and Elevation for the Release Point, Baseline Point and TRS are correct. Any corrections or updates made to these data or any other entries, must be sent to the WSH to update the Master Station Database.

15.1.2 Data Entered and Maintained by Station

The Local Station Data can be entered and maintained by the Site Manager/Administrator (Exhibit 15-3). Accuracy of the information entered is essential and changes other than gas type, radiosonde type, and surface observation equipment must be coordinated with NWSHQ and Region prior to implementation.



Local

Release Point Pressure Correction (hPa) [derived]:	0.01	Radiosonde Type:	Sippican Mark IIA GPS
Target Antenna Azimuth Angle (Deg):	336.00	Ground Receiving System:	IMS-2000 (TRS)
Target Antenna Elevation Angle (Deg):	0.00	Radiosonde Tracking Method:	GPS
SPS GPS Antenna Elevation (m WGS84):	64.52	Barometer Height (m MSL):	88.55
SPS GPS Antenna Elevation (m MSL):	97.79	Balloon Shelter Type:	High Bay
SPS GPS Antenna (N+/S- dd:mm:ss.fffff):	38:58:35.88083	Balloon Gas:	Helium
SPS GPS Antenna (E+/W- ddd:mm:ss.fffff):	-77:29:09.43250	Operational Frequency (MHz):	1680.00
TRS Elevation (m MSL):	95.39	Rooftop Release:	Yes
TRS Latitude (N+/S- dd:mm:ss.f):	38:58:35.9	WMO Header (FZL):	UXUS97
TRS Longitude (E+/W- dd:mm:ss.f):	-77:29:09.4	WMO Header (MAN):	USUS97
Orientation Correction Azimuth Angle (Deg):	0.00	WMO Header (SGL):	UMUS97
Orientation Correction Elevation Angle (Deg):	0.00	WMO Header (ABV):	UFUS97
Surface Observation (Obs.) Equipment Type:	RSOIS	WMO Header (ULG):	NXUS97
Surface Obs. Distance from Release Point (m):	20.00	WMO Header (DD1):	IUDD01
Surface Obs. Height from Release Point (m MSL):	89.24	WMO Header (DD2):	IUDD02
Surface Obs. Bearing from Release Point (Deg):	320.00	Last Updated:	8/5/2009 17:04:39

OK Cancel Print LDAD Info

Exhibit 15-3 Station Maintained Data

15.2 Viewing Station Data

To enter the station data:

1. Start RWS.

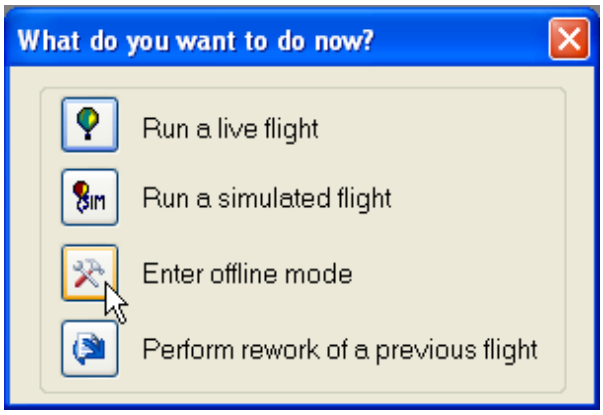


Exhibit 15-4 Options Window

2. In the main menu, select **Enter offline mode** (Exhibit 15-4).

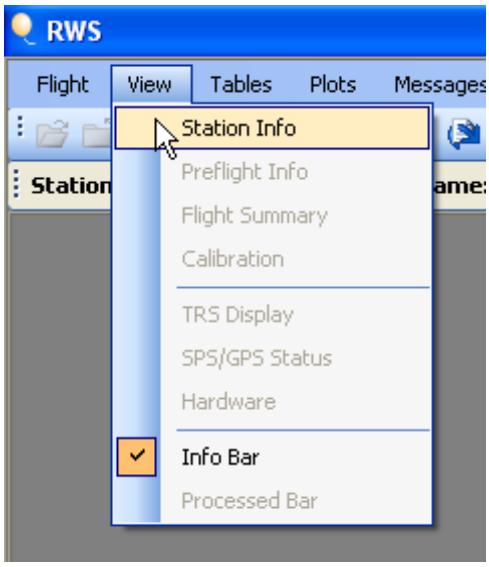


Exhibit 15-5 View Options

3. Select **Station Info** from the **View** pull-down menu (Exhibit 15-5). The Station Data appears.

15.2.1 Entering Individual Data Blocks

The Master and Local Station Data was collected during the RRS deployment. The Station Data for each RRS site has been cataloged on a NWSHQ website https://ops13web.nws.noaa.gov/rrsupload/ . The station data from this website shall be user entered as a part of the RWS software installation.

NOTE: The entries in the Local Station Data may be entered by the Site Administrator. It is important to remember changes in Latitude, Longitude, Elevation, Tracking System, Radiosonde Type, and others parameters must be coordinated with NWSHQ and Region ahead of time to allow users to make the adjustments in their databases.

Local Station Data

- **Release Point Pressure Correction (hPa) (derived)**
  This calculated value is the difference in hectopascals between the Station Elevation (baseline location) and Release Point Elevation. RWS automatically calculates this value using the elevations provided in the Master Station Data. This value is applied to the PDB reading (Surface Pressure Observation) to correct the reading for the Release Point Elevation. The correction will be positive if the release point height is lower than the baseline height. The correction will be negative if the release point height is higher than the baseline height. **The release point height is the height of the inflation building's floor in meters + 1.2 meters (Approximates the point where the instrument is typically released).**

- **Target Antenna Azimuth Angle (Deg)**
  Enter to the nearest .01 of a degree. Azimuth relative to True North. (RDF only)

- **Target Antenna Elevation Angle (Deg)**
  Enter to the nearest .01 of a degree. (RDF only)

- **SPS GPS Elevation (m WGS84)**
  Enter to the nearest 0.01 of a meter above MSL.

- **SPS GPS Elevation (m MSL)**
  Enter to the nearest 0.01 of a meter above MSL.

- **SPS GPS Latitude (N+S- dd:mm:ss.fffff)**
  Enter to the nearest 0.00001 of a second.

- **SPS GPS Longitude (E+W- dd:mm:ss.fffff)**
  Enter to the nearest 0.00001 of a second.

- **TRS Elevation (msl)**
  Enter to the nearest 0.01 of a meter above MSL.

- **TRS Latitude (N+/S- dd:mm:ss.f)**
  Enter to the nearest 0.1 of a second.

- **TRS Longitude (E+/W- dd:mm:ss.f)**
  Enter to the nearest 0.1 of a second.

- **Orientation Correction Azimuth Angle (Deg)**
  Enter to 0.01 degrees with RDF only

- **Orientation Correction Elevation Angle(Deg)**
  Enter to 0.01 degrees with RDF only

- **Surface Observation (Obs.) Equipment Type**
  Toggle Options (RSOIS, ASOS and Other). If RSOIS or ASOS is not installed or inoperative, use Other.

- **Surface Obs. Distance from Release Point (m)**
  To the nearest 0.01 of a meter.

- **Surface Obs. Height (m MSL)**
  Elevation of the Temp/RH unit to the nearest 0.01 of a meter.

- **Surface Observation Equipment Bearing (Deg)**
  Enter to the nearest 0.01 relative to True North.

- **Radiosonde Type**
  Toggle Options
    - LMS-6 Lockheed Martin Sippican GPS
    - Vaisala RS92-NGP GPS

- **Ground Receiving System**
  Toggle Options - IMS-2000 (TRS), IMS-1500C, and Other

- **Radiosonde Tracking Method**
  Toggle Options (GPS and RDF)

- **Barometer Height (m MSL)**
  Enter the baseline height to the nearest 0.01 meters. The Station Elevation and Barometer Height (baseline point) should be the same.

- **Balloon Shelter Type**
  Toggle Options (High Bay, Low Bay, BILS, Roof-Top BILS, and Not Specified)

- **Balloon Gas**
  Toggle Options (Hydrogen, Helium, and Natural Gas)

- **Operational Frequency (MHz)**
  The Operational Frequency is the default frequency that RWS software will set the TRS antenna to at the beginning of a flight. This allows TRS to have a default frequency other than 1680 MHz. Coordinate this frequency with the Regional Upper Air Manager. Allowable Values (1676 to 1682 MHz).

- **Rooftop Release**
  Toggle Options (YES and NO)

- **WMO Header (FZL)**
  Header for RADAT or Freezing Level Header information

- **WMO Header (MAN)**
  Header for Mandatory Levels SFC - 100 hPa

- **WMO Header (SGL)**
  Header for Significant Levels SFC - 100 hPa

- **WMO Header (ABV)**
  Header for Levels Above 100 hPa

- **WMO Header (ULG)**
  Header for Upper Air Logistics Information

- **WMO Header (DD1)**
  Header for DD1

- **WMO Header (DD2)**
  Header for DD2

- **LDAD Information**
  This information is required to ensure the coded messages are transmitted. The communication parameters allow the site to send the messages via the LAN or phone lines.

1. Clicking on the **LDAD Info** button at the bottom of the Station Data Display allows the observer to view the communication routes (Exhibit 15-6).

Exhibit 15-6 LDAD Information

2. The LDAD Data Display window appears. The LDAD Data Display window lists the available RWS connections to the LDAD for transmitting the WMO Coded Messages (Exhibit 15-7).

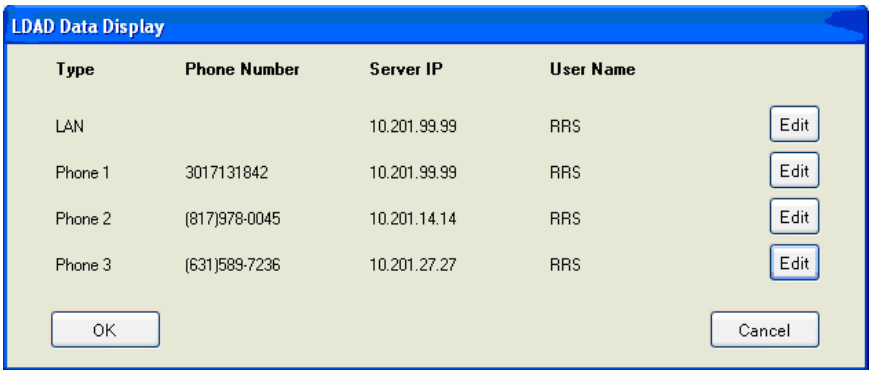


Exhibit 15-7 Example LAN and Phone Line Options

3. To edit a connection, click the connection **Edit** button.
4. The edit window appears for the communication line selected (Exhibit 15-8).
5. Click in the cell(s) to enter or edit the information. Click the **Test** button to validate the connection. After entering and testing the connection information, click **OK** in the edit window, LDAD Data Display window and the Station Data window to save the edits.

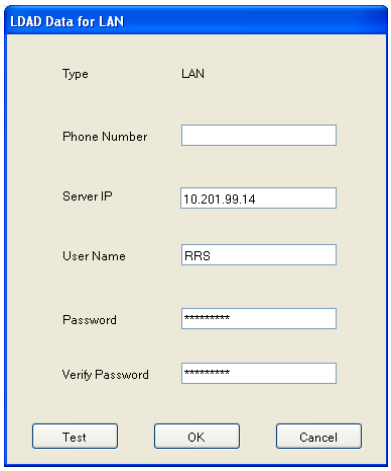


Exhibit 15-8 Edit windows for the communication lines

NOTE: If the LAN is down, the software will try each dial-up line 3 times prior to going to the next each additional backup line.

16 RWS Software Utilities

The RWS software incorporates utilities to manage RWS and flight databases. The RWS utilities are accessible in the Offline mode of RWS. To open the utilities, click on **Tools** pull–down menu and select **Utilities** (Exhibit 16-1).

Utilities are used to accomplish numerous tasks and functions, such as system setup, flight archiving, and flight summary reports. The RWS Software Utilities has three major subsets.

- Flight Management Utilities
- Application Utilities
- Administrative Utilities

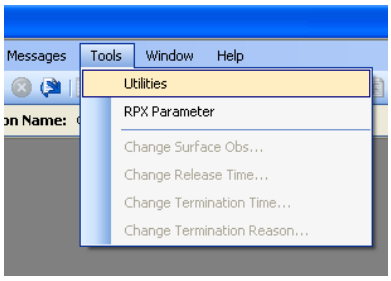


Exhibit 16-1 Opening RWS Software Utilities

16.1 Flight Management Utilities

The Flight Management Utilities are used to manage the flight files. There are a total of five flight management utilities (Exhibit 16-2).

Exhibit 16-2 Flight Management Utilities

The NCDC Archive, Flight Export and Summary Report can be accessed by all RWS users. The Flight Import and Deletion Utilities can only be accessed by a user that is an RWS Site Administrator.

16.1.1 NCDC Archive Utility

The NCDC Archive Utility builds and sends the flight data to the National Climatic Data Center (NCDC) electronically. This utility lists all the flights and makes it easy to see which flights have been Archived. Using this utility, an observer can build and send the archive flights to NCDC with two mouse clicks. The listed flights can be re-sorted by clicking on one of the column headers.

From the list flights, only Active Flights can be archived. Active Flights are typically the most successful release of each ascension number. A release is designated as an Active Flight by the observer when closing a flight. In addition, flights from other sites cannot be archived and are grayed out.

The process to Archive and Send the flight to NCDC is described below.

1. In the NCDC Archive Utility (Exhibit 16-3), select the row of the flight to be archived (Exhibit 16-3).

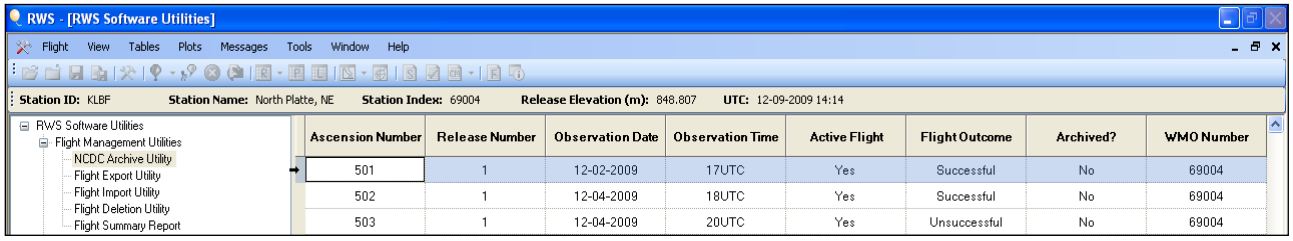


Exhibit 16-3 NCDC Archive Utility

2. Click the **Build archives and send to NCDC** button.
3. The Status below the button will show the Ascension number and percentage complete (Exhibit 16-4).

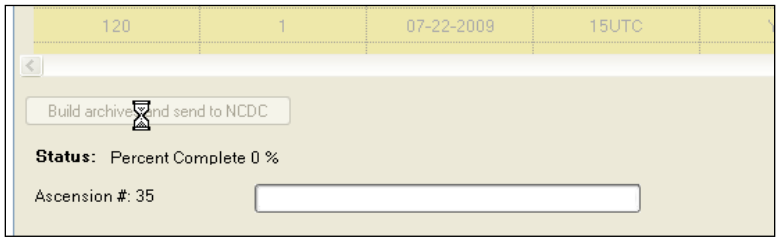


Exhibit 16-4 Building archives and sending

4. After the archiving is complete an Archive Utility Results pop-up message will appear (Exhibit 16-5). Click **OK**.

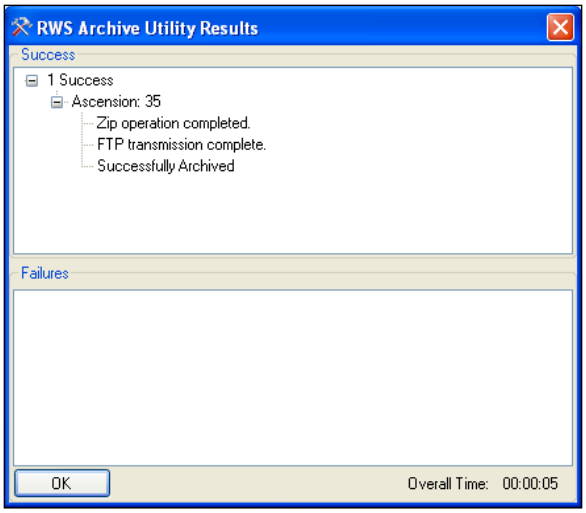
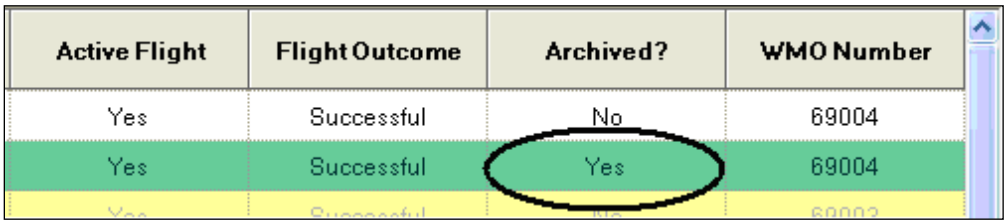


Exhibit 16-5 RWS Archive Utility Results

5. Verify the flight was archived by going back and viewing the Archive Table. The row will have a green background and the "Archived?" column will have a "Yes" (Exhibit 16-6).



Active Flight	Flight Outcome	Archived?	WMO Number
Yes	Successful	No	69004
Yes	Successful	Yes	69004

Exhibit 16-6 Verify Flight Archived

NOTE: The archive files sent to NCDC contain a compressed file containing the flights H, T, and B files.

- **"H" file (Archive header file)**
- **"T" file (Archive thermal file)**
- **"B" file (Archive BUFR file)**

NOTE: One way to verify the reception of archived data to the NCDC ftp site is to visit `www1.ncdc.noaa.gov/pub/data/ua/RRS/YYYY` (where `YYYY` is the current year). Once at the website find the log file representing the site by identifying the station ID and the year and month the data was transmitted. For example klwx_0801_log.txt would contain the upload history for LWX for January of 2008.

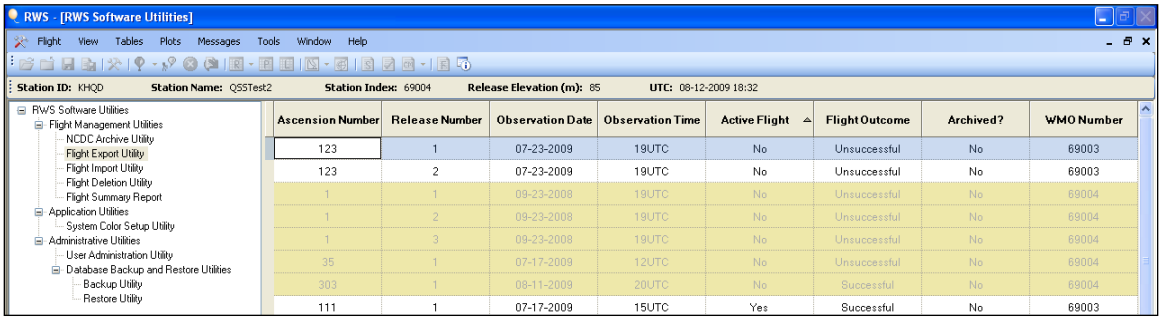
16.1.2 Flight Export Utility

The Flight Export Utility creates files that can be used as a RWS backup or can be imported into RWS using the Flight Import Utility. This utility exports the selected flight(s) file(s) to a location on the RRS Workstation. One or more flights can be exported at a time. Flights exported are not deleted from the RWS.

NOTE: The Flight Export Utility makes it easier for sites to share flight files with other RWS sites.

The process to Export a flight is described below.

1. In the Flight Export Utility, highlight the row(s) of the flight(s) to be exported (Exhibit 16-8). The listed flights can be re-sorted by clicking on one of the column headers.



Ascension Number	Release Number	Observation Date	Observation Time	Active Flight	Flight Outcome	Archived?	WMO Number
123	1	07-23-2009	19UTC	No	Unsuccessful	No	69003
123	2	07-23-2009	19UTC	No	Unsuccessful	No	69003
1	1	09-23-2008	19UTC	No	Unsuccessful	No	69004
1	2	09-23-2008	19UTC	No	Unsuccessful	No	69004
1	3	09-23-2008	19UTC	No	Unsuccessful	No	69004
35	1	07-17-2009	12UTC	No	Unsuccessful	No	69004
303	1	08-11-2009	20UTC	No	Successful	No	69004
111	1	07-17-2009	15UTC	Yes	Successful	No	69003

Exhibit 16-8 Select Ascension to Export

2. Click the **Export** button.
3. The **Browse for Folder** window will appear (Exhibit 16-9). Browse to the desired location for exporting the flight(s).

NOTE: To export flights to a CD, first export flights to a local folder. Then use Windows to write the flight files onto a CD.

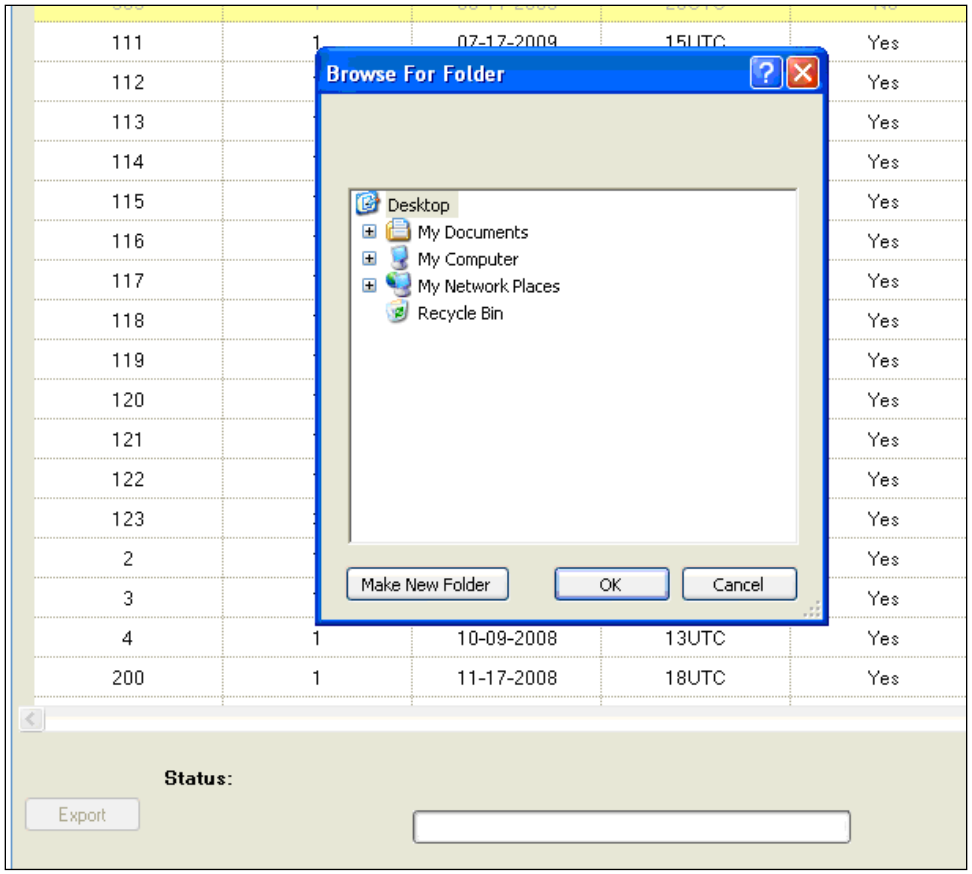


Exhibit 16-9 Browse to the location for export.

4. Click **OK.** The selected flights will begin exporting and the status will be displayed at the bottom of the window (Exhibit 16-10).

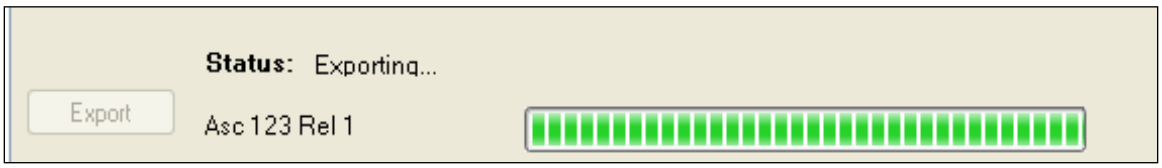


Exhibit 16-10 Exporting Status

5. Once the flight(s) have been exported, the Export Utility Results window will appear (Exhibit 16-11). Any flight(s) not exported successfully will be listed in the Failure portion of the Export Utility Results window. Click **OK** to close the results window.

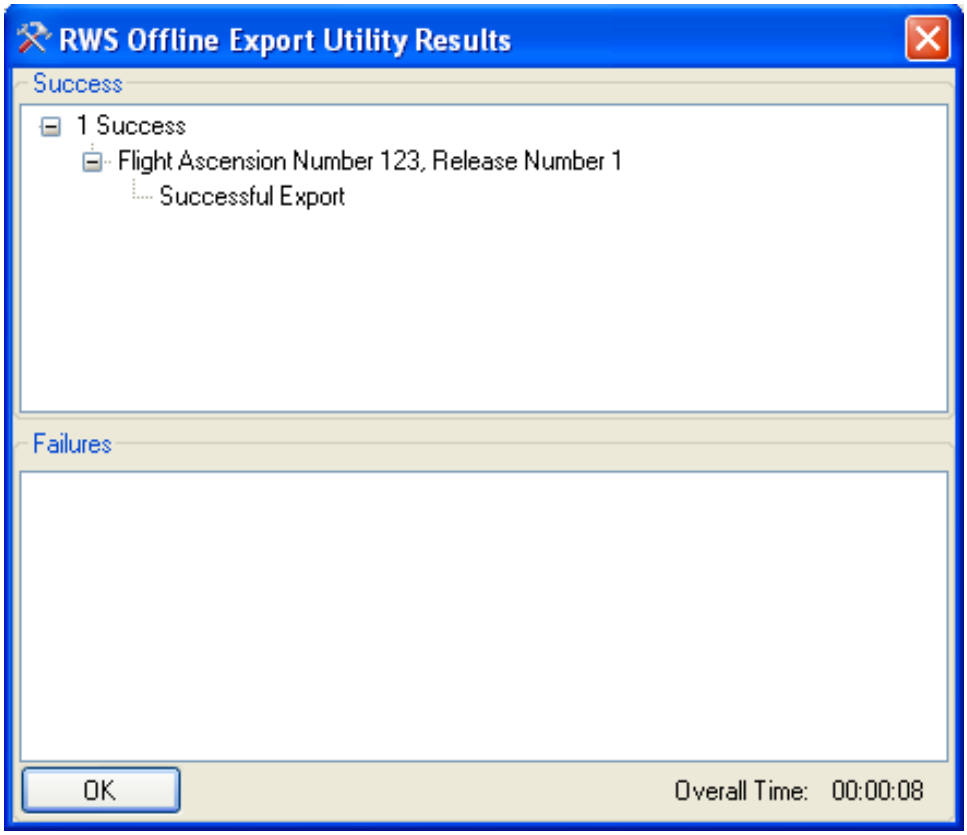


Exhibit 16-11 RWS Export Utility Results

16.1.3 Flight Import Utility

The Flight Import Utility can import flight files previously exported into RWS. One or more flights can be imported at a time. Flights imported are not deleted from the import location.

The process to Import a flight is described below.

1. In the Flight Import Utility, click the **Select File(s)…** button.
2. The **RWS Offline Import** window will appear (Exhibit 16-12). Browse to the desired flight file.

NOTE: RWS 2 files have .mdf file extensions and RWS 1.2 files have .mdb file extensions. By default "RWS Flights" shows RWS 2 flights. Change the "Files of Types" to view RWS 1.2 flights.

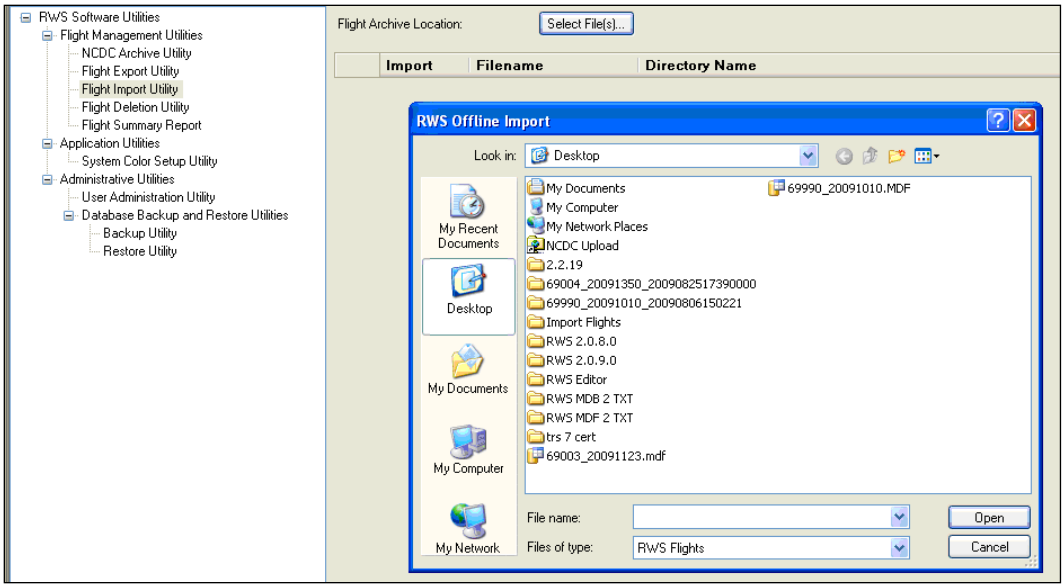


Exhibit 16-12 Browse to the file(s) to import

3. Select the desired flight file(s) and click **Open**. The selected flights will be listed in the Flight Import Utility (Exhibit 16-13). To select multiple files hold the CTRL key down while selecting files.

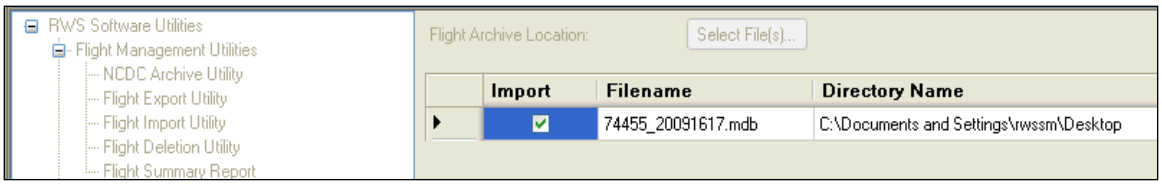


Exhibit 16-13 Flights to be imported

4. Click the **Import** button at the bottom of the display. The flight files will begin importing and the status will be displayed at the bottom of the window (Exhibit 16-14).

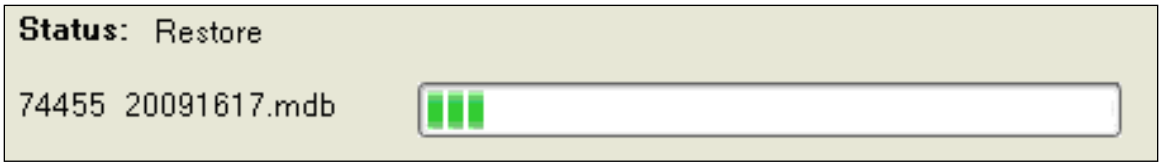


Exhibit 16-14 Importing Status

5. Once the flight(s) have been imported, the Import Utility Results window will appear (Exhibit 16-15). Any flight(s) not imported successfully will be listed in the Failure portion of the Import Utility Results window. Click **OK** to close the results window.

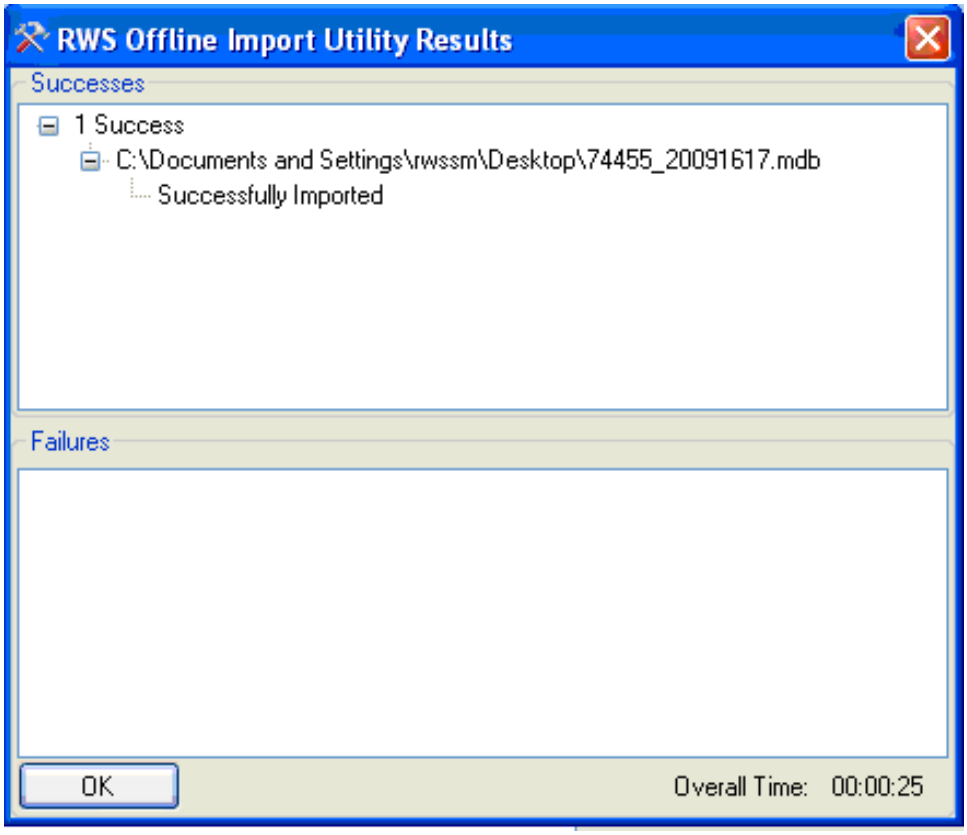


Exhibit 16-15 RWS Import Utility Results

16.1.4 Flight Deletion Utility

The Flight Deletion Utility deletes the selected flight(s) files from RWS. This utility can delete local flights and those imported from other sites. Local flights can only be deleted if they are older than 32 days and have been archived using the NCDC Archive Utility. One or more flights can be deleted at a time. Flights deleted are permanently deleted from RWS.

NOTE: Maintain at least the last 3 month's flight database files on CDs or backup hard drive. Flights can be exported to external media (e.g. CD) utilizing the Flight Export Utility.

The process to delete a flight is described below.

1. From the list of flights in the Flight Deletion Utility, select the flight(s) to be deleted. To select multiple flights hold the CTRL key down while selecting flights. Click the **Delete** button at the bottom of the display.

NOTE: Only the flights with a white background can be selected for deletion. The listed flights can be re-sorted by clicking on one of the column headers.

2. A Deletion Confirmation message will appear (Exhibit 16-16). Click **Yes** to continue the deletion process.

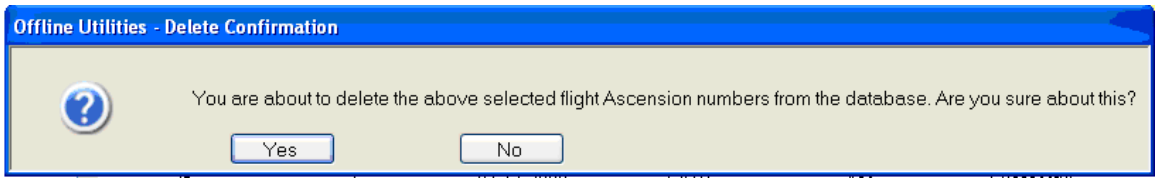


Exhibit 16-16 Deletion Confirmation message

3. The flight files will begin to be deleted and the status will be displayed at the bottom of the window (Exhibit 16-17).

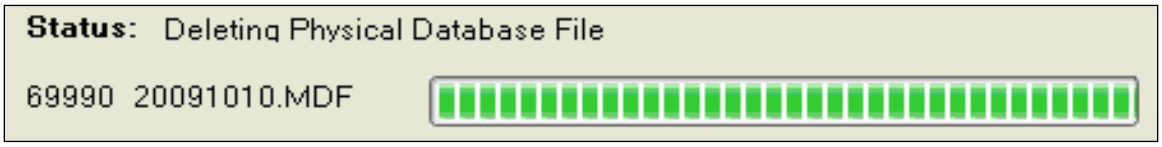


Exhibit 16-17 Deletion Status

4. Once the flight(s) have been deleted, the Deletion Utility Results window will appear (Exhibit 16-18). Any flight(s) not imported successfully will be listed in the Failure portion of the Import Utility Results window. Click **OK** to close the results window.

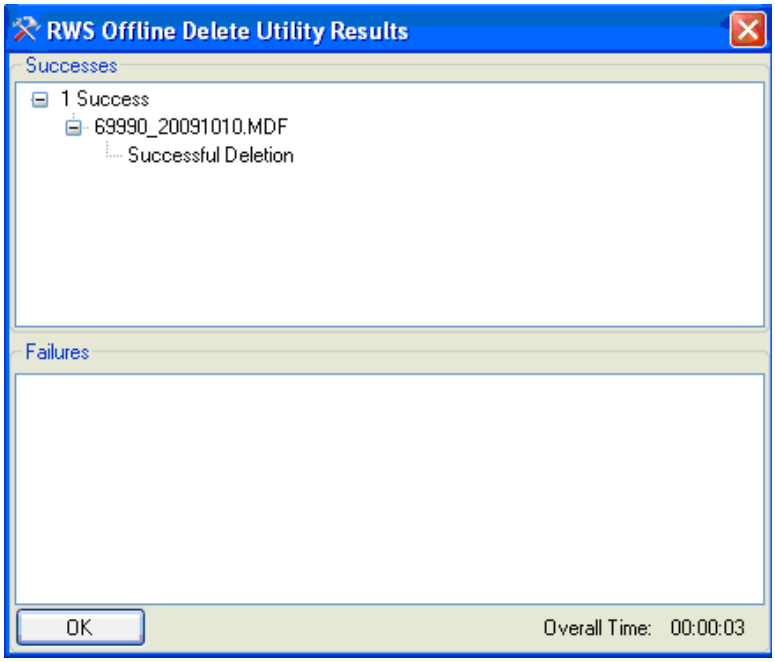


Exhibit 16-18 Deletion Results Window

16.1.5 Flight Summary Utility

The Flight Summary Utility allows the operator to view/print the Flight Summary from any of the flights. When several flights are selected the average of the flight stats are displayed at top of the Flight Summary Report (Exhibit 16-19). This utility is an excellent tool for determining flight statistics, flight performance or just reviewing flight summaries without running Rework for each flight. To open the Flight Summary Utility, click on Flight Summary Report under Flight Management Utilities.

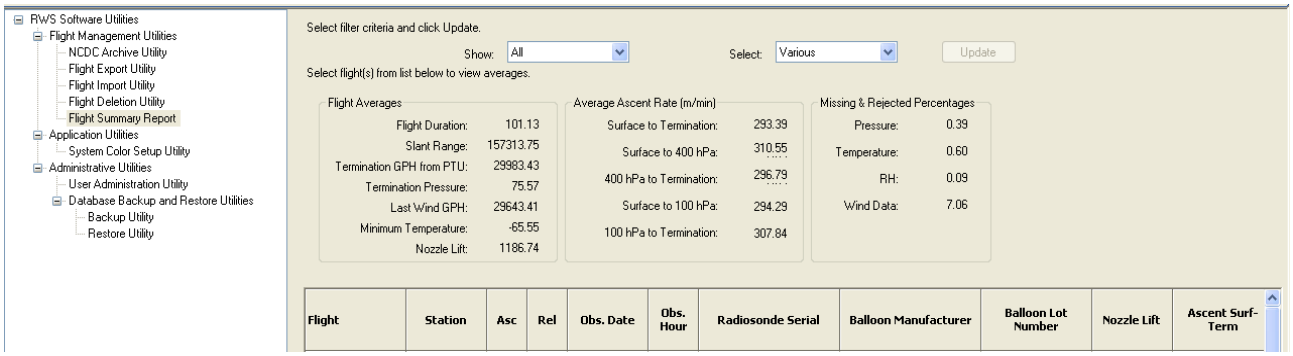


Exhibit 16-19 Flight Summary Selection Windows

16.1.5.1 Flight Summary Options

At the top of Flight Summary Selection Window, two different options may be used to select the type of flights to review (Exhibit 16-20) or the month the flight was flown (Exhibit 16-21). After selecting the type of flights and the months, click on the **Update** button to list the flights meeting the selected criteria.

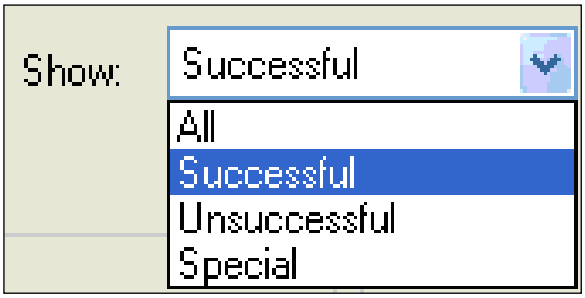


Exhibit 16-20 Types of Flights

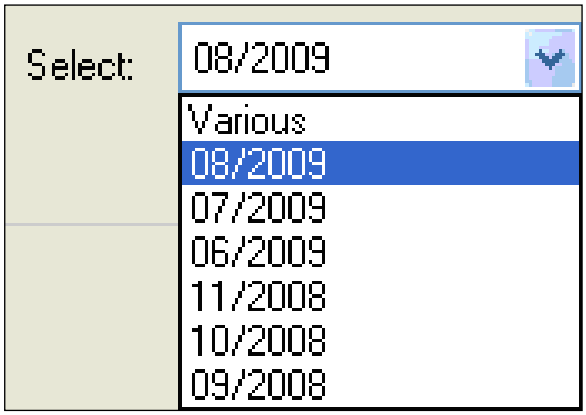


Exhibit 16-21 Month of Flight

16.1.5.2 Individual Flight Summary Display

The individual Flight Summary Report shows critical flight performance data. Select a flight, and then click on the **View** button. A Flight Summary display similar to Exhibit 16-22 will appear. Alternatively, clicking **Save As File** will create a comma delimited text file containing the flight summary data for each flight selected.

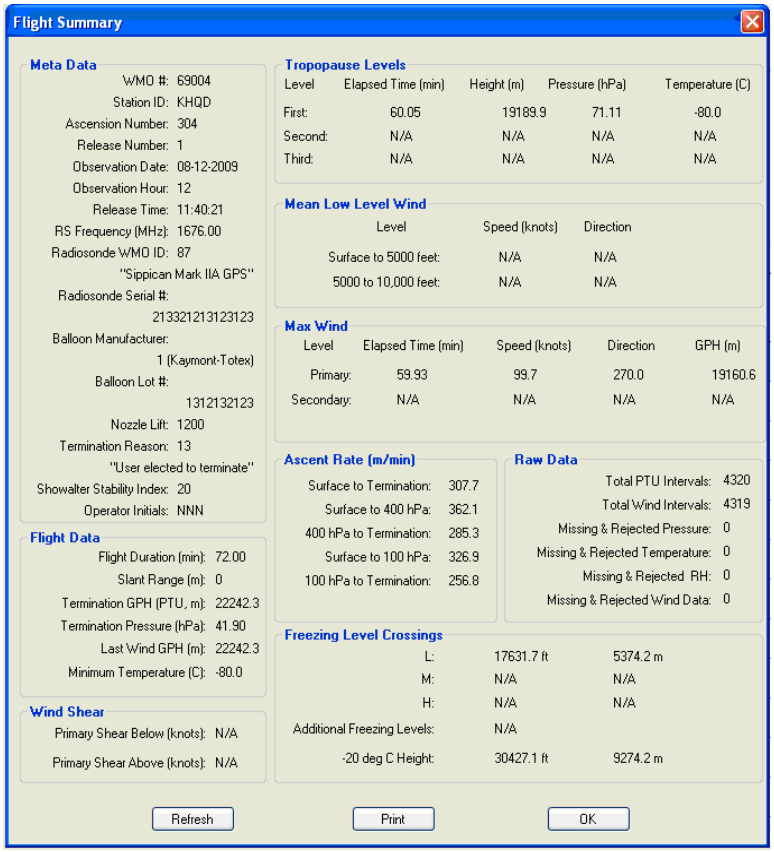


Exhibit 16-22 Flight Summary Displays

16.2 Application Utilities

The Application Utilities allows each user to configure the system color used with the tabular data. Alternate character representation of data status in grids can be selected through the System Color Setup Utility (Exhibit 16-23). To changing colors left click on the desired color; a color selection window will appear. Select the desired color and click **OK** (Exhibits 16-24). Once the color(s) have been selected, click the **Update** button on the bottom of the window. The **Restore Defaults** button will set the colors back to the original configuration.

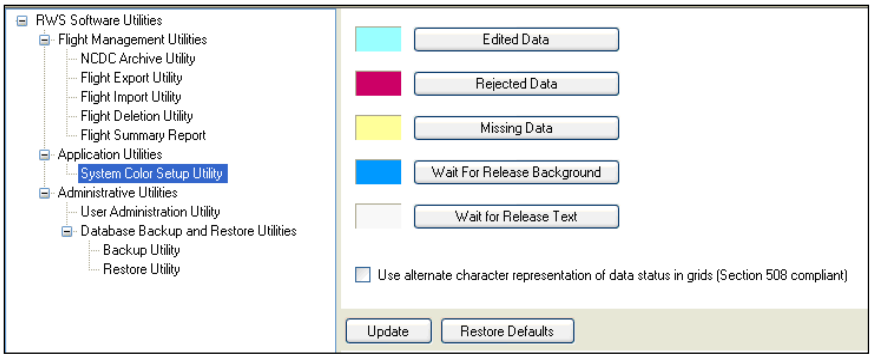


Exhibit 16-23 System Color Setup

NOTE: Each observer may change the system and plot colors. The change will not affect other users

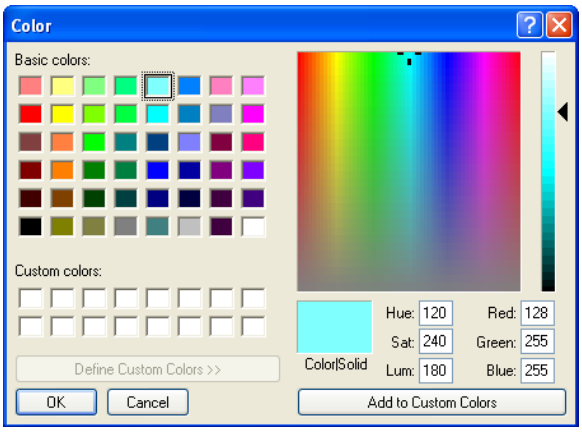


Exhibit 16-24 Color Selection Window

To select an alternate character representation of data status, select the check box in the System Color Setup Utility (Exhibit 16-25). This feature applies alternate character representation in the RWS displays in addition to the selected colors.

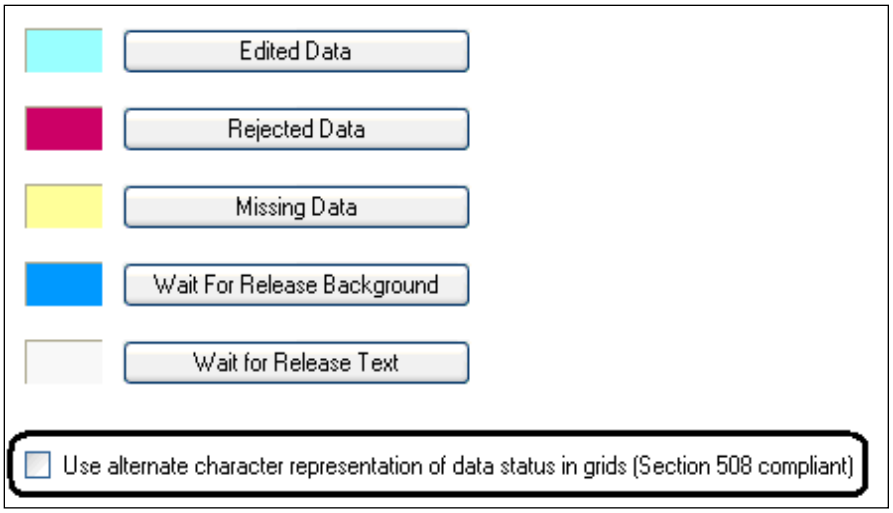


Exhibit 16-25 Alternate Character Representation

16.3 Administrative Utilities

The Administrative Utilities is only available to the RWS Site Administrator(s). There are three Administrative Utilities; User Administration Utility, Backup Utility and Restore Utility.

16.3.1 User Administration Utility

The User Administration Utility can only be accessed by RWS Site Administrators with Windows Administrator privileges. The User Administration Utility can be used to create new Windows users and assign them one of the three different levels of RWS access privileges to system or network users. Only users with RWS access privileges have access to the RWS program (Exhibit 16-26). There are three levels of RWS access privileges:

- RWS Site Administrator
  - Has complete access to the RWS software, Offline Maintenance Suite (OMS) and associated utilities. The User Admin Utility can only be used if the RWS Site Administrator has Windows Administrator privileges.
- RWS Observer
  - Can conduct live flights, transmit coded messages and run a few offline utilities.
- RWS Trainee
  - Can only run a simulated flight.

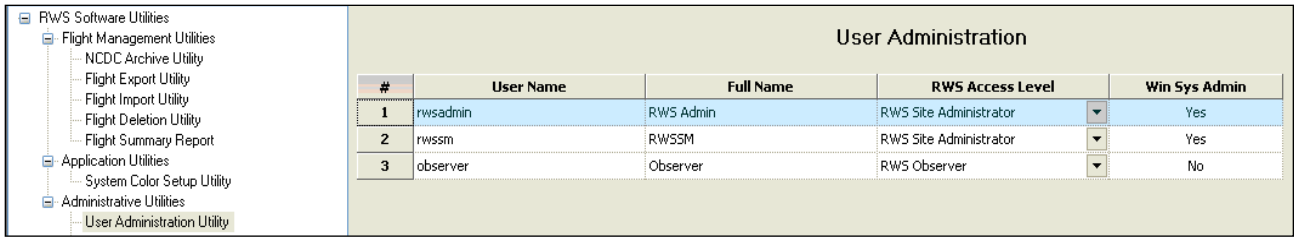


Exhibit 16-26 User Administration Utility

NOTE: The Win Sys Admin column indicates whether the user has Windows Administration Privileges.

NOTE: RWS cannot grant users Windows System Administrators privileges. RWS automatically assigns new users to the Windows Users group.

NOTE: Changing the RWS Access Level for a user (with Windows System Administrators privileges) from RWS Site Administrator to RWS Observer will revoke the Windows System Administrators privileges.

16.3.1.1 Adding a User to RWS

In order for users to access RWS, they first must be added to the user list in the RWS User Administration Utility.

1. To add a user account, click the **Add** button in the User Administration Utility. The Add User window will appear (Exhibit 16-27).
2. If the user account already exists in Windows select the desired user from the **Current User** tab.
3. If the user account does not already exist in Windows select the **New Local Account** tab.
4. From the pull-down list, select the desired RWS access level.

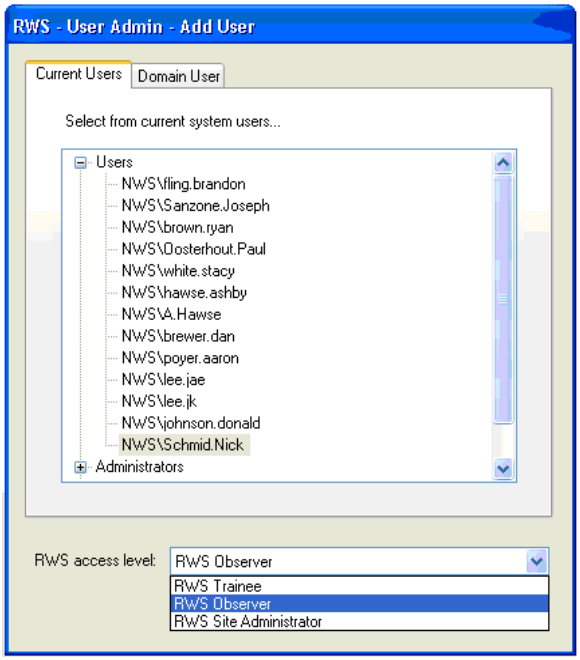


Exhibit 16-27A Active Directory: Add User window

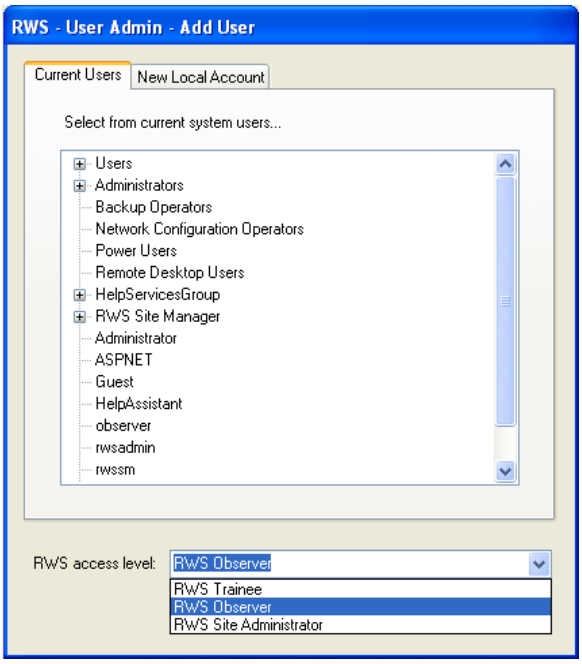


Exhibit 16-27B Non-Active Directory: Add User window

5. In the Add User window, click **OK.** The upper right progress bar will indicate the process of adding the user to the RWS User Administration Utility.
6. Once the user has been added, the user will be listed in the User Administration Utility.

NOTE: RWS does provide the ability to create a new user in Windows and RWS simultaneously, but this is only allowed for non-NOAANet systems.

16.3.1.2 Changing the RWS Access Level

To change a user's RWS Access Level, select the appropriate level from the pull-down list (e.g. RWS Trainee to RWS Observer).

16.3.1.3 Removing a User in RWS

RWS has the ability to remove users from RWS and Windows or from only RWS.

1. To remove a user, select the user from the RWS User Administration Utility.
2. Click the Remove button at the bottom of the window. A Remove User window will appear (Exhibit 16-28).

Exhibit 16-28 RWS User Removal Utility

3. Select either; **Remove user from RWS** or **Remove user from RWS and Windows.**
   - Users removed from RWS will not be able to run the RWS software.
   - Users removed from RWS and Windows will not be able to log onto the RWS Workstation.
4. In the Remove User window, click the **OK** button. A window asking, "Are you sure you want to restrict <username> from accessing the RWS application?" will appear.
5. Click **OK** in the "Are you sure…" window. Another window asking, "Are you sure you want to delete the local user Windows account for <username>?" will appear.
6. Click **OK** in the "Are you sure…" window. The upper right progress bar will indicate the process of removing the user.

16.3.2 Backup and Restore Utilities

RWS includes utilities to backup and restore the RWS flight database files on the external drive or RRS workstation. The Backup Utility is different from the Flight Export Utility, because it copies the RWS database files and flight files to a designated location. This Backup Utility shall be run monthly to backup flight database files on the external hard drive or other designated location.

16.3.2.1 Backup Utility

Once in the Backup Utility follow these steps to back up the RWS database.

1. Click the **Select Folder** button at the top of the display. Browse to the desired backup location: the location the files will be backed up to (e.g. the external hard drive). Then click **OK**.
2. Select the flight(s) to be backed up by clicking on the name of the file. The filenames for the flights are labeled as follows;

WWWWW_YYYYRAAA.mdf

- ***WWWWW*** = WMO Number
- ***YYYY*** = Year

- ***R*** = Release Number
- ***AAA*** = Ascension Number
- **mdf** is the file extension

3. In addition to any flights selected for backup, it is recommended to also select the ***HQStation_2005.MDF*** and ***RRSDB_2005.MDF*** files. These files are the main database files for RWS.
4. Lastly, click the **Backup** button at the bottom of the screen. The files will begin copying to the backup location selected in step 1. A progress bar will indicate when the backup of each file is complete. A Results window will appear once the backup has finished.

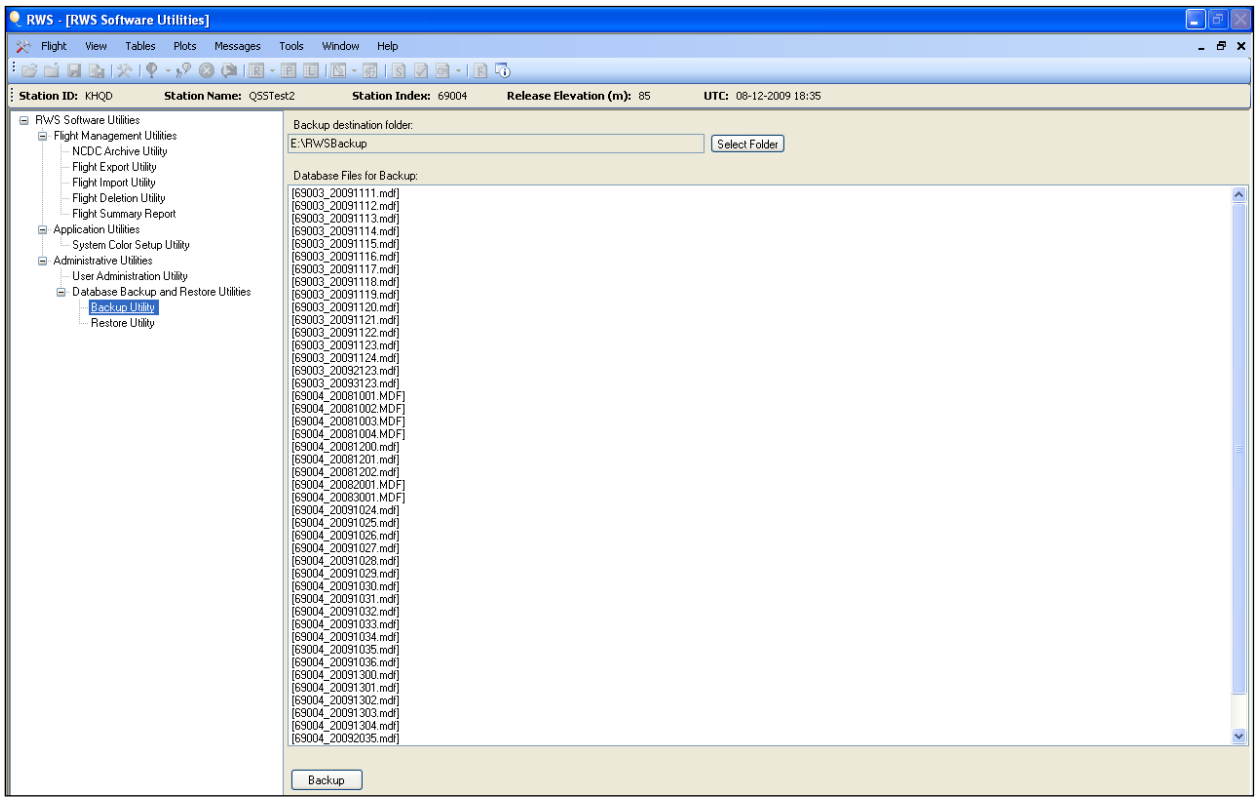


Exhibit 16-29 RWS Backup Utility

16.3.2.2 Restore Utility

The Restore Utility copies RWS database files and flight files from a backup location to C:\RWS\RWS. After the RWS software is reinstalled, the Restore Utility can be used to restore the previous flight files from the backup location. In addition, if flight files are accidentally deleted from RWS, the Restore Utility can be used to restore the deleted flight files.

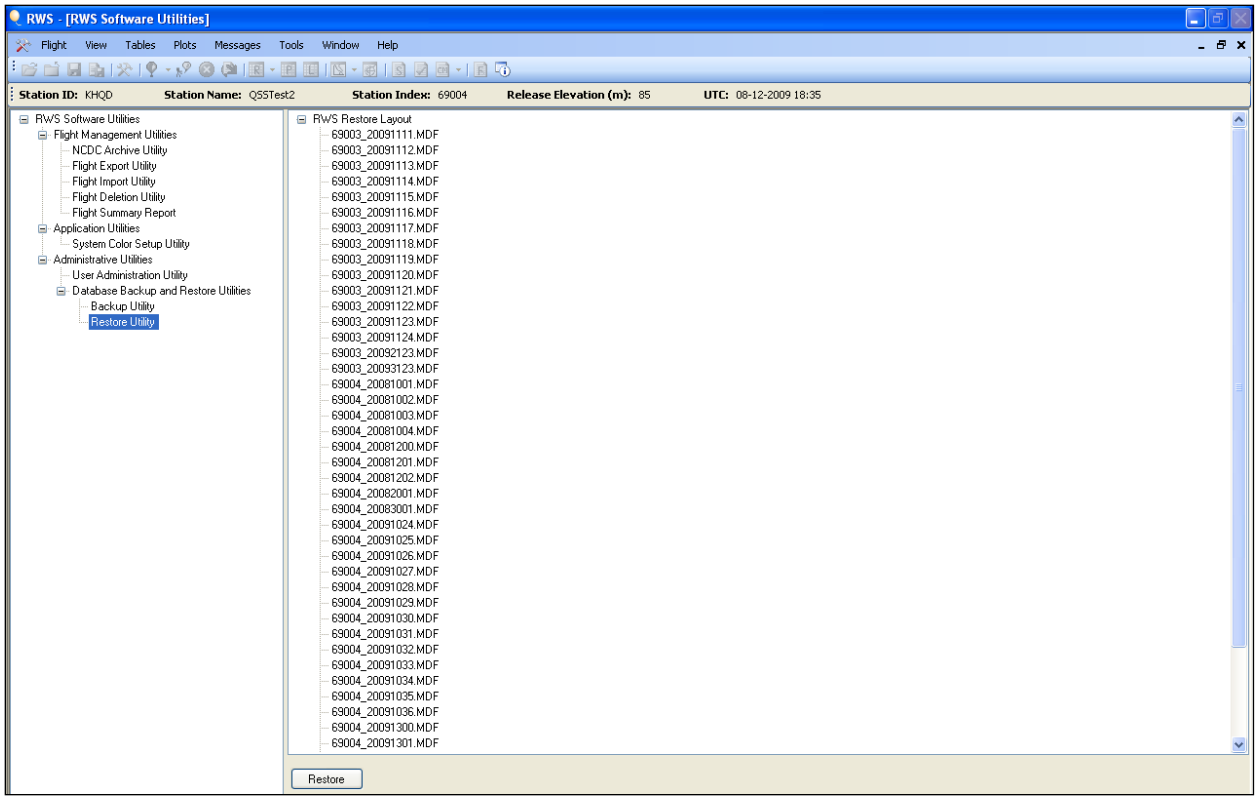


Exhibit 16-30 RWS Restore Utility

17 Checking the System Status

This chapter describes the hardware status checks. These checks must be performed before every flight. The checks may not be necessary for second and third releases if the known reason for the flight failure was other than hardware.. The hardware checks ensure the Signal Processing System (SPS), Global Positioning System (GPS), Telemetry Receiver System (TRS), the Radiosonde Surface Observing Instrumentation System (RSOIS), the Precision Digital Barometer (PDB), the printer, the Local Area Network (LAN), and the modem are functioning properly. The operator may check the Hardware Status and SPS Status displays at anytime during or after a flight, or when working in the offline mode.

17.1 Getting Started

To start the Hardware Status Check, follow these steps:

1. Log in with an assigned User Name and Password.
2. Double click the RWS icon on the desktop. RWS will start and the Security Warning window appears. Read and click the **OK** button. (Exhibit 17-1)

Exhibit 17-1 RWS Window with Security Warning Message

NOTE: Ensure the TRS and SPS equipment are on and have been allowed a minimum of 30 minutes to warm-up prior to starting the Baseline Check.

3. If it has been more than 12 hours since the last observation, the following window will appear. (Exhibit 17-2) Clicking “No” will bring the software to Exhibit 17-4. If the operator clicks “Yes” Exhibit 17-3 appears allowing a “No Data Message” to be generated by selecting the proper 101 groups from the drop-down list.

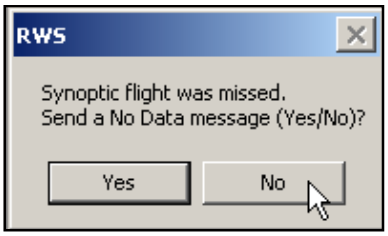


Exhibit 17-2 Missed Flight Window

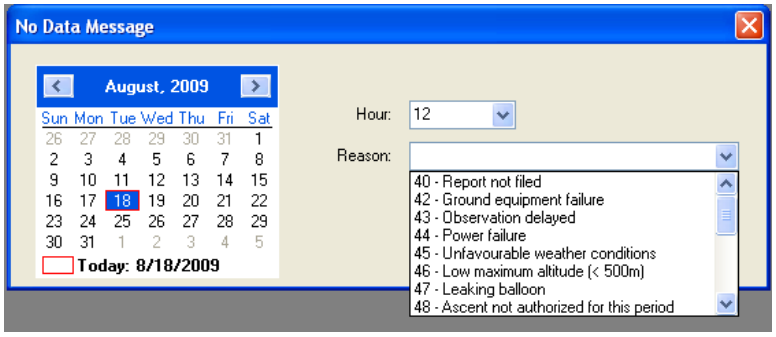


Exhibit 17-3 No Data Message with 101 Group Drop-down List

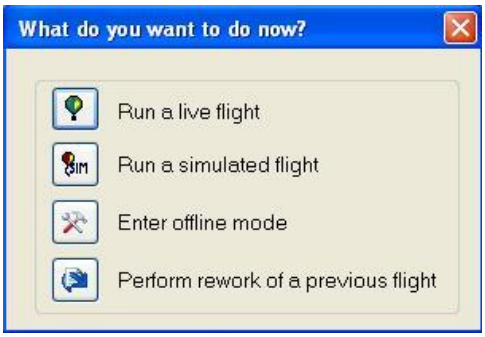


Exhibit 17-4 Flight Option Window

4. The Flight Option Window will appear and the Live Flight Option should be selected (Exhibit 17-4).
5. The Hardware Status window appears (Exhibits 17-5 through 17-9).
6. A prompt will appear to turn on the UPS which powers the TRS and SPS equipment. Once the observer has powered on the UPS the TRS will begin to initialize.
7. Prior to the initialization a warm-up period may be required for the TRS depending on temperature. In colder temperatures (approximately below 50 F), a wait up to 30 minutes may be necessary for the TRS checks to turn green.
8. If any of the equipment status checks fail, close / reopen the Hardware Manager. If the equipment continues to fail, click the **PrintScrn** key to print the Hardware Status display, and contact the electronics technician.

NOTE: The SPS/GPS Status tab will have a clock icon until the baseline. The PDB will also show Beyond Tolerance when the pressure is changing rapidly ("Burst Mode On").

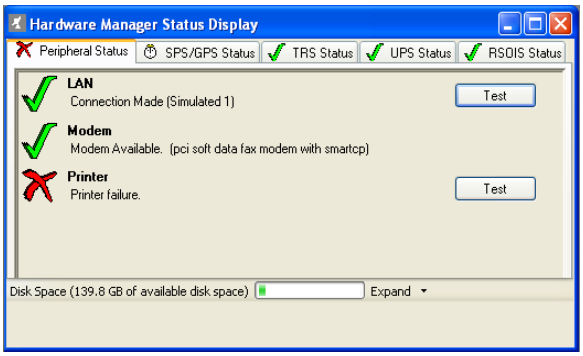


Exhibit 17-5 Hardware Manager: Peripheral Status

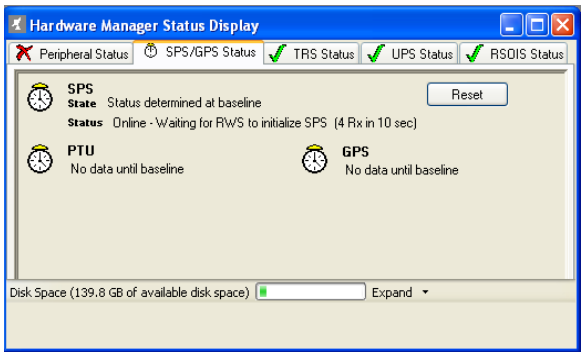


Exhibit 17-6 Hardware Manager: SPS/GPS Status

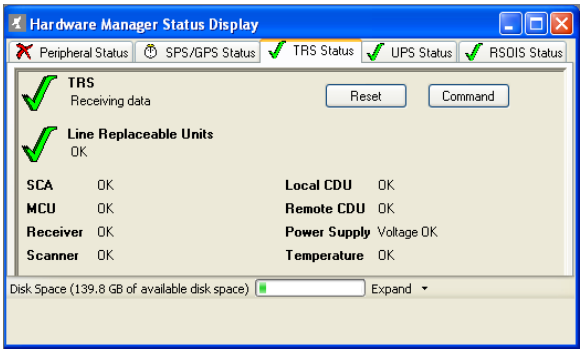


Exhibit 17-7 Hardware Manager: TRS Status

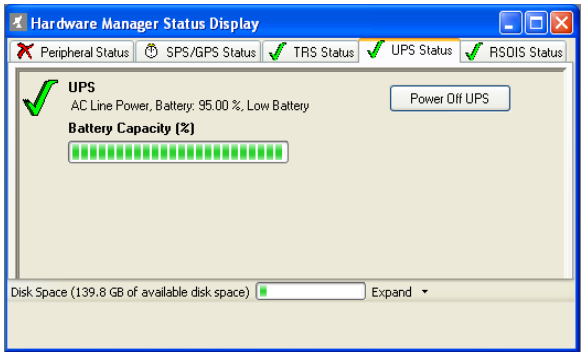


Exhibit 17-8 Hardware Manager: UPS Status

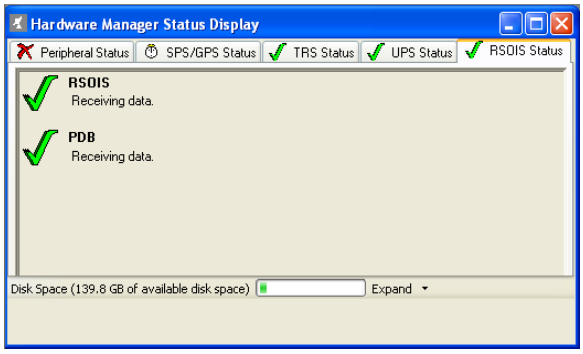
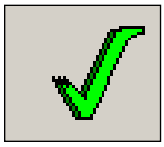
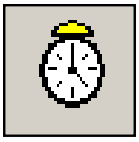
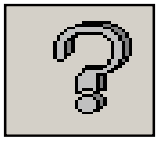
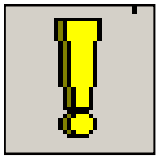
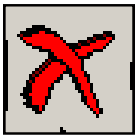


Exhibit 17-9 Hardware Manager: RSOIS Status

Hardware Status Icons:

 **Passed**	 **Waiting**	 **Unknown**	 **Beyond Tolerance**	 **Failed**
Hardware is working	**Waiting for communications from hardware**	**Hardware status not known.**	**Possible error with hardware. Does not always indicate a problem.**	**Hardware is not functioning or has not be initiated.**

The Hardware Status display indicates the status of the following hardware items:

- **UPS**
- **SPS**
- **PTU**
- **GPS**
- **RSOIS**
- **PDB**
- **TRS**
- **Line Replaceable Units**
- **LAN**
- **MODEM**
- **PRINTER**

Uninterruptible Power Supply (UPS) - Located in the Radome with the TRS. The UPS ensures reliable power is supplied to the system in case of a power failure or fluctuation. The UPS provides at least 10 minutes of backup power to operate the entire TRS and launch area components. The battery capacity (0 - 100%) will be indicated to the right of the UPS Status Icon.

When starting a flight the user is prompted to power on the UPS. Once the UPS is powered on the Hardware Manager Status Display will show the status as the UPS powers on from Offline to Battery to AC Line power (Exhibit 17-8). The Status Messages logs the changes in the UPS Status. At flight termination a prompt window will appear asking if the UPS should be turned off.

Signal Processing System (SPS) - The TRS is designed to receive telemetry from any radiosonde that meets the RRS requirements. The TRS delivers the radiosonde telemetry signal as a 10.7 MHz IF to the SPS. Each radiosonde requires a compatible SPS that will convert its unique signal into a standard format required by the workstation. SPS is checked at baseline. This indicates the SPS is communicating with the workstation.

Pressure, Temperature and Humidity (PTU) – This indicates whether pressure, temperature and humidity data is being received by the SPS. This status does not update until baseline.

Global Positioning System (GPS) – This indicates whether the GPS ground receiver (a subcomponent of the SPS) is processing radiosonde GPS data. It will change to a green checkmark once the radiosonde and SPS both have 4 or more common satellites in view.

Radiosonde Surface Observing Instrumentation System (RSOIS) - Automated sensors located within 200 meters of the release point. Sensors include Temperature, RH, Wind Speed and Direction. If an RSOIS is not connected or inoperative the Hardware Manager display will indicate a red X.

Precision Digital Barometer (PDB) - Located within 15 feet of the RRS workstation and at the same height as the baseline height. The PDB provides pressure measurements for comparison to the radiosondes pressure sensor during the baseline.

Telemetry Receiver System (TRS) - The TRS consists several subcomponents, these are listed in the TRS Status tab of the Hardware Status. The Hardware Status will indicate the TRS Status throughout the flight. If a fault or problem exists a Hardware Status Icon other than a green check mark is shown along with text briefly describing the failure. Remember a warm-up period is temperature dependent. Extended warm-up times may be expected at sites with colder temperatures. The TRS motor warm-up operations should not exceed 30 minutes. If motor warm-up operations exceed 30 minutes follow trouble shooting procedures in Appendix D.

Besides noting the overall status of the TRS, the Hardware Status provides a status for each Line Replaceable Unit (LRU) (Exhibit 17-10) If a problem exists with any of the LRUs, the status will change to something other than OK. Print or capture the Hardware Status display and contact the electronics technician.

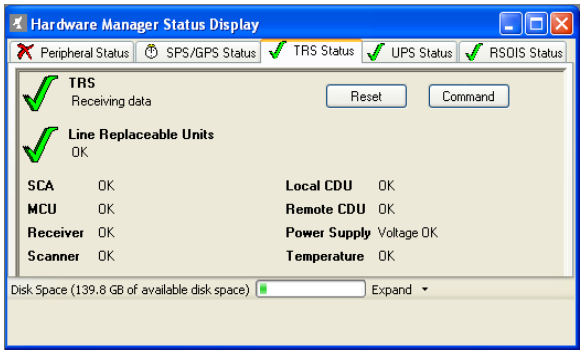


Exhibit 17-10 Line Replaceable Units within the TRS

Local Area Network (LAN) - Hardware Status Check will validate the connection to the LAN is operational.

MODEM - Hardware Status Check will validate the connection if a modem is available.

17.2 Printer Test

The printer test normally takes no more than a few seconds. If the **Test** button is pressed the Printer Status indicator should indicate a green check mark and within a few seconds print a test page. If the printer is non-functional a red "X" will appear. If the printer is not ready for use, a question mark or red "X" will appear.

17.3 SPS Status Window

This window shows the number of satellites being received by the GPS receiver and the radiosonde. (Exhibit 17-8) A minimum of 4 matches are required to process winds and gather height information. The circles to the right of the SPS and GPS letters must be green for GPS lock to receive positional data. If the circles do not turn green and the Match number does not reach 4 or more within 200 seconds of beginning baseline, reinitialize the SPS and wait a minimum of 2 minutes.

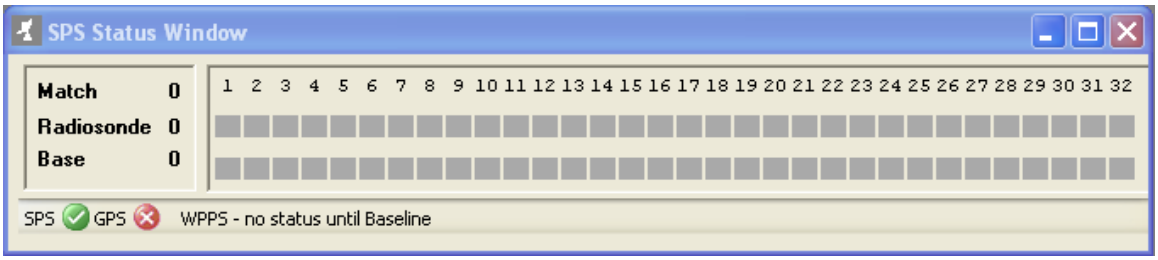


Exhibit 17-8 SPS Status Window

NOTE: This window will show no meaningful information prior to baseline.

17.4 Gathering Specific Data for Fault Isolation

NOTE: Prior to gathering data, if the Hardware Status window continues to indicate a problem reset the SPS, TRS or UPS.

If resetting the equipment does not work, print or capture the Hardware Status display, notify the electronics technician, and enter a problem report into the Engineering Management Reporting System (EMRS). If the problem does not prevent the flight continue the preflight process.

17.5 Windows and McAfee Updates

By default, the RWS Workstation automatically checks for Windows and McAfee Updates during non-synoptic times. Some of the Updates may require the RWS Workstation to be restarted after

downloading. The following process will prevent Windows Update from requesting a restart in the middle of a flight.

- Log onto the RWS workstation at least 10 minutes before running the RWS Software. This process allows Windows Startup and Updates to stabilize before flight.

17.5.1 Manual Microsoft Windows Updates for Windows Administrators

A yellow shield icon in the lower right task bar (Exhibit 17-9) indicates a Windows Update is pending. Only users with Administrator rights can download and install Windows Updates. To manually download and install Windows Updates, click on the icon. The Automatic Updates window will appear (Exhibit 17-10).

Exhibit 17-9 Windows Update Icon

- Select the **Express Install** option and click the **Install** button (Exhibit 17-10). The Updates will begin downloading and installing.

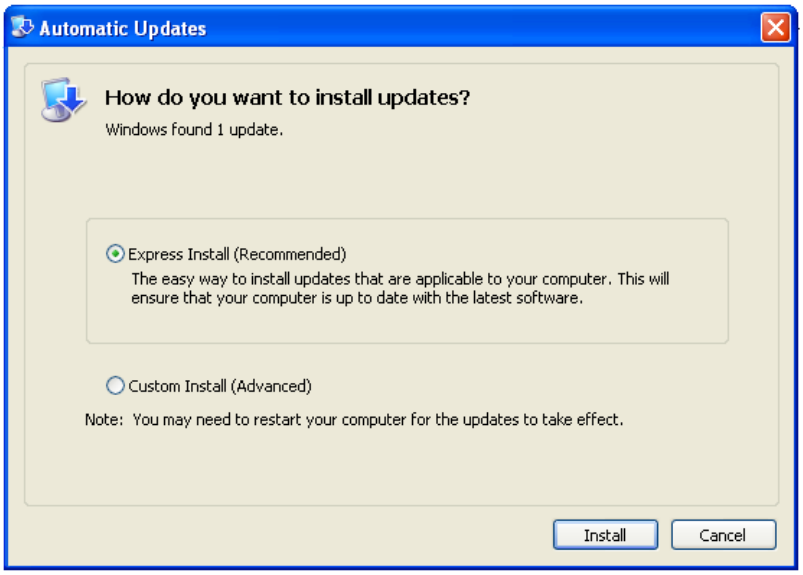


Exhibit 17-10 Automatic Updates Window

- Once the Updates have been installed Installation complete window will appear. Click the **Restart Now** button (Exhibit 17-11).

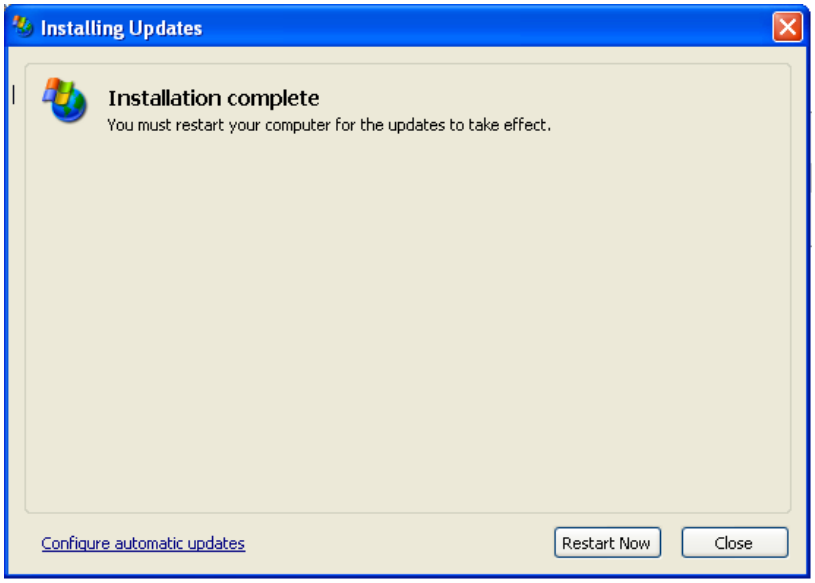


Exhibit 17-11 Installation Complete

17.5.2 Manual McAfee Updates for Windows Administrators

By default, McAfee is set to automatically download and install updates. To manually the McAfee, right-click on the icon in the lower right task bar (Exhibit 17-12).

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Exhibit 17-12 Windows Update Icon

- Click on the **Update Now…** option on menu (Exhibit 17-13). The McAfee AutoUpdate window will appear (Exhibit 17-14).

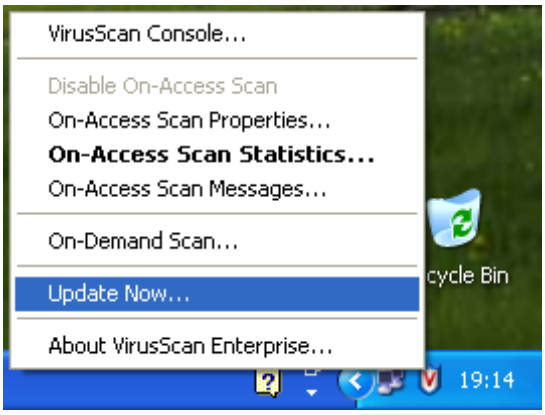


Exhibit 17-13 McAfee Update Now Menu

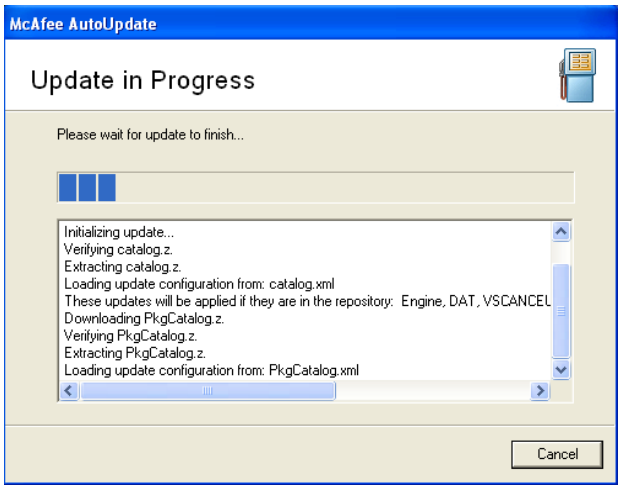


Exhibit 17-14 McAfee AutoUpdate

- Once the Updates have been completed, click the **Close** button (Exhibit 17-15).

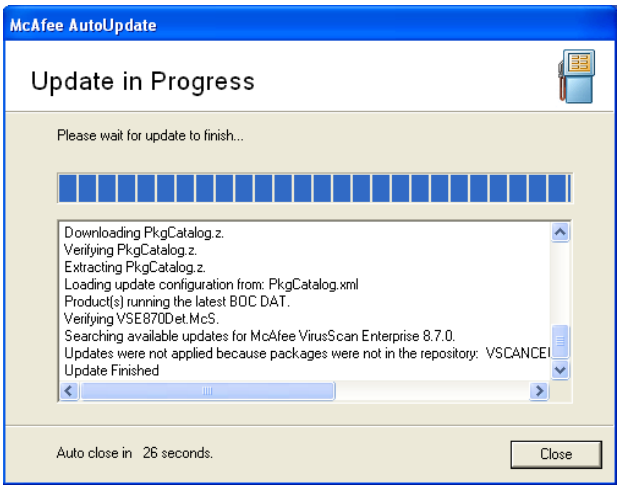


Exhibit 17-15 McAfee AutoUpdate Complete

18 Appendix A. Abbreviations and Acronyms

This appendix includes abbreviations, acronyms, and contractions; they are defined in accordance with their usage in this handbook.

ABV ..... Mandatory and Significant Levels Above 100 hPa
AC ..... Air Conditioner
AFC ..... Automatic Frequency Control
AGL ..... Above Ground Level
AWIPS ..... Advanced Weather Interactive Processing System
AZ ..... Azimuth

BILS ..... Balloon Inflation Launch Shelter
BMD ..... Begin Missing Data
BX ..... Box

C ..... Centigrade
CCB ..... Configuration Control Board
CCW ..... Counter-Clockwise
CD ..... Compact Disk
CDU ..... Control Display Unit
cm ..... centimeters
CM ..... Change Management
CONUS ..... Conterminous United States
CPU ..... Central Processing Unit
CW ..... Clockwise

db ..... Decibels
DCE ..... Digital Communication Equipment
Deg ..... Degree
DOC ..... Department of Commerce

EA ..... Each
EL ..... Elevation
EHB ..... Engineering Handbook
EMD ..... End Missing Data
EMRS ..... Engineering Management and Reporting System
ESA ..... Electronic Systems Analyst
ET ..... Electronics Technician

FAA ..... Federal Aviation Administration
FMH-3 ..... Federal Meteorological Handbook, Number 3
ft ..... Feet

FTM ..... Free Text Message
FTP ..... File Transfer Protocol
FZL ..... Freezing Level

Gb ..... Gigabyte
GDL ..... Greatest Departure from Linearity
gm ..... Gram
GPS ..... Global Positioning System

hPa ..... Hecto Pascals
HPC ..... Hydrometeorological Prediction Center

ICAO ..... International Civil Aviation Organization
IF ..... Intermediate Frequency
IP ..... Internet Protocol
IR ..... Infrared Radiation

KHz ..... Kilohertz
km ..... Kilometer
Kb ..... Kilobyte
kt ..... Knot (nautical miles per hour)

LAN ..... Local Area Network
Lat ..... Latitude
LCD ..... Liquid Crystal Display
LCDU ..... Local Control Display Unit
LDAD ..... Local Data Acquisition and Dissemination
LED ..... Light Emitting Diode
LNA ..... Low Noise Amplifier
Long ..... Longitude
LORAN ..... Long Range Navigation (system)
LOS ..... Loss of Signal
LRU ..... Line Replaceable Unit

m ..... Meters
MAN ..... Mandatory Levels to 100 hPa
mb ..... Millibar
Mb ..... Megabyte
MCU ..... Motion Control Unit
MDO ..... Meteorological (Met) Data Oscillator
MET ..... Meteorological
MHz ..... Megahertz
MIC ..... Meteorologist-in-Charge
Min ..... Minute
mph ..... Miles Per Hour

MSL .....Mean Sea Level

NAGS……..Narrow Angle Gathering Sensor
NAVAID…….....Navigation Aid (implied usage of radio based system)
NCDC……..……..……..National Climatic Data Center
NCEP…….. .....National Centers for Environmental Prediction, formerly NMC (e.g., AWC, NHC, MPC, SPC, and TPC)
NEC.....National Electrical Code
NLSC…… .....National Logistics Support Center
Nmi…… .....Nautical Mile (6076 feet)
NOAA .....National Oceanic and Atmospheric Administration
NOTAM…….....Notice to Airman
NWS……..... National Weather Service
NWSTC…….....National Weather Service Training Center
NWSTG…….....……National Weather Service Telecommunications Gateway
NWSM-10-1401……. .....National Weather Service Manual, Number 10

OAR .....Office of Oceanic and Atmospheric Research
OBIT……. ..... Offline Built-In Test
OCCWS .....Office of Climate Water and Weather Services
OFCM……. ..... Office of the Federal Coordinator for Meteorology
OMS…….. ..... Offline Maintenance Suite
OOS.....Office of Operational Services
OPS .....Office of Program Services
OQC……. ..... Operational Quality Control
OS ..... Observing Services
OS…… .....Operating System
OST…… .....Office of Systems Technology

PCM……. .....Pulse Code Modulation
PDB.....Precision Digital Barometer
PSA……. ..... Power Supply Assembly
PSI..... Pounds Per Square Inch
PTU…….. ..... Pressure, Temperature, Humidity

QC……. ..... Quality Control

R/ACU……..Receiver - Antenna Control Unit
RADAT……Freezing Level Data
RCDU……Remote Control Display Unit
RDF……Radio Direction Finding
RF…….. ……..…Radio Frequency
RH……. .....Relative Humidity
RMS .....Root Mean Square
RRS…….. .....Radiosonde Replacement System
RSMC ..... Regional Specialized Meteorological Centers
RSOIS .....Radiosonde Surface Observing Instrumentation System
RWS……...Radiosonde Replacement System Workstation

SDM……..... NCEP Senior Duty Meteorologist
SCA……..... System Communication System
SCSI .....Small Computer Systems Interface
Sec…….....Second
SGL ..... Significant Levels to 100 hPa
SID ..... Station Identifier
SIG ..... Significant Levels to 100 hPa
SIM…… .....System Integration Manager
Sonde…….....Radiosonde
SOO……..... Science and Operations Officer
SPC…… .....Storm Prediction Center
SPS……..... Signal Processing System

T-1…….....Connection capable of 1.544 million bits per second
TPC…….. .....Tropical Prediction Center (National Hurricane Center)
TPMS…….. ..... Transition Power Maintenance System
TRS……. ..... Telemetry Receiver System

UHF……...Ultra High Frequency (radio)
UPS…… ….Uninterruptible Power Supply
USB……..... Universal Serial Bus
UTC.....Universal Time Coordinated

VAD…….. ..... Velocity Azimuth Display

WAGS……..... Wide Angle Gathering Sensor
WBAN……. ..... Weather Bureau Army Navy
WBRT……...Weather Bureau Radio Theodolite
WCM…….....Warning Coordination Meteorologist
WFO…….....Weather Forecast Office
WMO……World Meteorological Organization
WS.....Weather Service
WSH…….....Weather Service Headquarters
WSOM…… ..... Weather Service Operations Manual
WWW…… ..... World Weather Watch
WWW…….. ..... World Wide Web

19 Appendix B. Clouds/WX Codes

This appendix provides the necessary tables and specific instructions to enter Clouds/Wx at the Surface Data screen. This guidance assumes no previous knowledge of synoptic code procedures. However, a basic understanding of clouds and weather is necessary.

For those already familiar with synoptic code, you will notice some departure from conventional WMO coding procedures. If you simply observe the elements requested and report them according to tables provided in this text, the intent of the Clouds/Wx entry will be fully met.

19.1 Getting Started

The Cloud/WX entry is a nine-digit, mandatory group. **All** nine digits must be entered, regardless of the presence **or** absence of clouds or significant weather conditions.

The WMO format for entry of clouds and weather has been modified in the RRS software to meet NCDC requirements. **All** stations using RRS software will follow this modified format, regardless of location; i.e., stations in either WMO Region IV or WMO Region V. A description of the nine-digit format follows:

1. Clouds/Wx group format: $\mathbf{N_hC_LhC_MC_HWWWW}$

   - $\mathbf{N_h}$ **=** Amount (in oktas) of the sky covered by <u>all</u> low clouds ($\mathbf{C_L}$) observed or the amount of sky covered by all the middle clouds ($\mathbf{C_M}$) observed. In no case will the amounts of the low and middle clouds be combined to report $\mathbf{N_h}$. Use **Table B-1** to report the amount of low or middle cloud coverage.

   - $\mathbf{C_L}$ **=** Type of low cloud, based on the priority given in **Table B-2**. A solidus (/) is reported if $\mathbf{C_L}$ clouds are not visible owing to fog or similar obscuring phenomena.

Note: Clouds are divided into three families, classified as low, middle, or high. The general height ranges for these are: surface to 6500 feet for low; 6500 feet to 20000 feet for middle; and above 20000 feet for high. Remember, these ranges are not absolute, but given as a guide only. More consideration may be given to the cloud form than the height in many cases. Each cloud family is coded with a single digit, 0 through 9. The code figure 0 is used to indicate that clouds are not present for a given family.

   - **h =** Height of the base of the lowest cloud observed. The height reported is with respect to the surface. The height is coded as a solidus (/) if there is a total surface-based obscuration that prevents an observation of the clouds. Use **Table B-3** for the cloud base height.

   - $\mathbf{C_M}$ = Type of middle cloud, based on priority given in **Table B-4**. A solidus (/) is reported if C_M clouds are not visible owing to fog or similar obscuring phenomena, or because of a continuous layer of lower clouds.

- **C_H** = Type of high cloud, based on priority given in **Table B-5**. A solidus (/) is reported if C_H clouds are not visible owing to fog or similar obscuring phenomena, or because of a continuous layer of lower clouds.
- **WWWW** = Present weather coded in two groups of **WW**. These code groups are found in **Table B-6**. The coding starts with 99 (the highest priority) and descends to 00 (the lowest priority). Note that code figure 17 is placed out of numerical sequence to highlight its relative coding priority. You should note that present weather codes for some weather phenomena are events that have occurred during the past hour, not at observation time. When entering **WWWW**, go down **Table B-6** and use the first and second applicable code figures. Note that two **WW** groups must always be coded, even if that means using the same code figure twice.

19.2 Table B-1 Amount of Low/Middle Cloud N_h

Code Figure	Cloud Amount in Oktas (eights)	Cloud Amount in Tenths
0	0	0
1	1 okta or less, but not zero	1/10 or less, but not zero
2	2 oktas	2/10 - 3/10
3	3 oktas	4/10
4	4 oktas	5/10
5	5 oktas	6/10
6	6 oktas	7/10 -8/10
7	7 oktas	9/10 or more, but not 10/10
8	8 oktas	10/10
9	Sky obscured by fog and/or other meteorological phenomena	
/	Cloud cover is indiscernible for reasons other than fog or other meteorological phenomena, or observation is not made	

Note: If there are any breaks in the sky at all, such as an overcast with a mackerel sky (altocumulus perlucidus or stratocumulus perlucidus), N_h would be encoded as 7. If there are only a few patches of low or middle cloud in the sky, N_h cannot be encoded as 0 but is encoded as 1. A partial obscuration does not affect the coding of N_h. A total

obscuration is coded as 9, not 8 (overcast sky).

19.3 Table B-2 Coding of Low Cloud, CL

This table presents the specifications for type of low cloud, $\mathbf{C_L}$, in order of priority. Go down the table and use the first applicable code figure.

Code Figure	Coding Criteria
	(a) Cumulonimbus present, with or without other C_L clouds
$\mathbf{C_L = 9}$	If the upper part of at least one of the cumulonimbus clouds present is clearly fibrous or striated, use $\mathbf{C_L = 9}$**.**
$\mathbf{C_L = 3}$	If the upper part of none of the cumulonimbus clouds present is clearly fibrous or striated, use $\mathbf{C_L = 3}$**.**
	(b) No cumulonimbus present
$\mathbf{C_L = 4}$	If stratocumulus formed by the spreading out of cumulus is present, use $\mathbf{C_L = 4}$**.**
$\mathbf{C_L = 8}$	If the $\mathbf{C_L}$ code figure 4 is not applicable and if cumulus and stratocumulus clouds with bases at different levels are present, use $\mathbf{C_L = 8}$**.**
$\mathbf{C_L = 2}$	If the $\mathbf{C_L}$ code figures 4 and 8 are not applicable and if cumulus clouds of moderate or strong vertical extent are present, use $\mathbf{C_L = 2}$**.**
$\mathbf{C_L = 1}$	If the $\mathbf{C_L}$ code figures 4, 8, and 2 are not applicable: use $\mathbf{C_L = 1}$**,** if the $\mathbf{C_L}$ clouds present are predominantly[1] cumulus with little vertical extent and seemingly flattened or ragged cumulus other than of bad weather[2], or both;
$\mathbf{C_L = 5}$	Use $\mathbf{C_L = 5}$**,** if among the $\mathbf{C_L}$ clouds present, stratocumulus other than that formed by the spreading out of cumulus is predominant;
$\mathbf{C_L = 6}$	Use $\mathbf{C_L = 6}$**,** if the $\mathbf{C_L}$ clouds present are predominantly stratus in a more or less continuous sheet or layer, or in ragged shreds (other than ragged stratus of bad weather), or both;
$\mathbf{C_L = 7}$	Use $\mathbf{C_L = 7}$**,** if the $\mathbf{C_L}$ clouds present are predominantly pannus (ragged shreds of stratus

	of bad weather or ragged cumulus of bad weather), or both.
0	No $\mathbf{C_L}$ Clouds -- No cumulus, cumulonimbus, stratocumulus, or stratus
/	$\mathbf{C_L}$ clouds not visible owing to fog or similar obscuring phenomena.

[1]Consideration of predominance is restricted to the clouds corresponding to $\mathbf{C_L}$ code figures 1, 5, 6 and 7, which have the same priority. Clouds of any one of these four specifications are said to be predominant when their sky cover is greater than that of the clouds of any of the other three specifications.

[2]'Bad weather' denotes the conditions which generally exist during precipitation and a short time before and after

19.4 Table B-3 Height of Cloud Base Above Ground, h

Code Figure	Reportable Heights (ft)
0	0 or 100
1	200 or 300
2	400 to 600*
3	700 to 900*
4	1000 to 1900*
5	2000 to 3200*
6	3300 to 4900*
7	5000 to 6500**
8	7000 to 8000**
9	8500 or higher or no clouds
/	unknown or base of clouds below surface of station

* reported in 100 foot increments

** reported in 500 foot increments

Note: This group is used to report the height of the base of the lowest cloud seen, regardless of cloud amount. The height reported is with respect to the surface.

The lowest cloud height is coded with a solidus (/) if there is a total surface-based obscuration that prevents an observation of the clouds.

19.5 Table B-4 Coding of Middle Clouds, C_M

This table presents the specifications for type of middle cloud, CM in order of priority. Go down the table and use the first applicable code figure.

Code Figure	Coding Criteria
(a) Altocumulus present	
C_M = 9	If the sky is chaotic, use **C_M = 9.**
C_M = 8	If the **C_M** code figure 9 is not applicable and if altocumulus with sprouting in the form of turrets or battlements or altocumulus having the appearance of small cumuliform tufts is present, use **C_M = 8.**
C_M = 7	If the **C_M** code figures 9 and 8 are not applicable and if altostratus or nimbostratus is present together with altocumulus, use **C_M = 7.**
C_M = 6	If the **C_M** code figures 9, 8, and 7 are not applicable and if altocumulus formed by the spreading out of cumulus or cumulonimbus is present, use **C_M = 6.**
C_M = 5	If the **C_M** code figures 9, 8, 7, and 6 are not applicable, and if the altocumulus present is progressively invading the sky, use **C_M** = 5.

*****There are several definitions of **C_M = 7** and each has a different priority; therefore **C_M = 7** appears several times in this code table.

C_M = 4	If the **C_M** code figures 9, 8, 7, 6, and 5 are not applicable, and if the altocumulus present is continually changing in appearance, use **C_M = 4.**
C_M = 7	If the **C_M** code figures 9, 8, 6, 5, and 4 are not applicable and if the altocumulus present occurs at two or more levels, use **C_M = 7.**
C_M = 7,3	If the **C_M** code figures 9, 8, 6, 5, and 4 are not applicable and if the altocumulus present occurs at one level, use **C_M = 7** or **3** depending on whether the greater part of the altocumulus is respectively opaque or semi-transparent.

(b) No altocumulus present

C_M = 2	If nimbostratus is present or if the greater part of the altostratus present is opaque, use **C_M = 2.**
C_M = 1	If there is no nimbostratus and if the greater part of the altostratus present is semi-transparent, use **C_M = 1.**
0	No **C_M** Clouds -- No altocumulus, altostratus, or nimbostratus.
/	**C_M** clouds not visible owing to fog or similar obscuring phenomena, or because of a continuous layer of lower clouds.

19.6 Table B-5 Coding of High Cloud C_H

This table presents the specifications for type of high cloud, **C_H**, in order of priority. Go down the table and use the first applicable code figure.

Code Figure	Coding Criteria
C_H = 9	If cirrocumulus is present alone or is more than the combined sky cover of any cirrus and cirrostratus present, use **C_H = 9.**
	(a) Cirrostratus present
C_H = 7	If the cirrostratus covers the whole sky, use **C_H = 7.**
C_H = 8	If the cirrostratus does not cover the whole sky and is not invading the celestial dome, use **C_H = 8.**
C_H = 6	If the cirrostratus is progressively invading the sky and if the continuous veil extends more than 45 degrees above the horizon but does not cover the whole sky, use **C_H = 6.**
C_H = 5	If the cirrostratus is progressively invading the sky but the continuous veil does not reach 45 degrees above the horizon, use **C_H = 5.**
	(b) C_H = 9 not applicable and no cirrostratus present
C_H = 4	If the cirrus clouds are invading the sky, use **C_H = 4.**

C_H = 3	If the **C_H** code figure 4 is not applicable and if dense cirrus which originated from cumulonimbus is present in the sky, use **C_H = 3.**
C_H = 2, 1	Use **C_H = 2,** if the combined sky cover of dense cirrus, of cirrus with sproutings in the form of small turrets or battlements and of cirrus in tufts is greater than the combined sky cover of cirrus in the form of filaments, strands or hooks; Use **C_H = 1,** if the combined sky cover of cirrus in the form of filaments, strands or hooks is greater than the combined sky cover of dense cirrus, of cirrus with sproutings in the form of small turrets or battlements and of cirrus in tufts.
0	No **C_H** Clouds -- No cirrus, cirrostratus, or cirrocumulus
/	**C_H** clouds not visible owing to fog or similar obscuring phenomena, or because of a continuous layer of lower clouds.

19.7 Table B-6 Coding of Present Weather, WW

This table presents the specifications for present weather, **WW**, in order of priority. Go down the table and use the first and second applicable code figures. The code figure with the higher priority is reported as the first **WW** group and the code with the lower priority is the second **WW** group. (This convention is followed even if the higher priority code decribes weather that occurred during the preceding hour but not at the time of observation.) Note that two **WW** groups must **always** be coded, even if that means using the same code figure twice. (the Example Observations page at the end of Appendix B.)

WW = 99-50 Used for precipitation at the station at the time of observation.

WW = 99-80 Used for showery precipitation or precipitation with current or recent thunderstorms.

NOTE: By U.S. definition, a thunderstorm is occurring at the station when thunder is first heard. The storm ends when 15 minutes has passed by without hearing thunder

IMPORTANT: Never release a radiosonde while a thunderstorm is occurring. See Chapter 13 for more information.

99 **Thunderstorm, severe, with hail, small hail, or snow pellets at time of observation.**

There may or may not also be rain or snow or a mixture of rain and snow of any intensity.

98 **Thunderstorm at time of observation combined with duststorm at time of observation.**

There must also be some sort of precipitation at the time of observation, but it may not be seen because of poor visibility. Judgment must be used.

97 **Thunderstorm, severe without hail, small hail, or snow pellets but with rain and/or snow at time of observation.**

The rain or snow may be of any intensity.

96 **Thunderstorm with hail, small hail, or snow pellets at time of observation.**

There may or may not be rain or snow or a mixture of rain and snow of any intensity.

95 **Thunderstorm without hail, small hail, or snow pellets, but with rain and/or snow at time of observation.**

WW = 94-91 Used if there was a thunderstorm during the past hour, and there is some sort of precipitation at the time of observation. In order to have this situation, the last thunder heard must have been more than 15 minutes before the observation, but less than 1 hour 15 minutes before the observation.

94 **Moderate or heavy snow or rain and snow mixed or hail, small hail, or snow pellets at time of observation. Thunderstorm during previous hour but not at time of observation.**

93 **Light snow or rain and snow mixed or hail, small hail, or snow pellets at time of observation. Thunderstorm during previous hour but not at time of observation.**

92 **Moderate or heavy rain at time of observation. Thunderstorm during previous hour but not at time of observation.**

No other forms of precipitation.

91 **Light rain at time of observation. Thunderstorm during previous hour but not at time of observation.**

No other forms of precipitation.

WW = 90-80 Used to report showery precipitation that is not associated with a thunderstorm. Showers fall from cumuliform clouds that are, by nature, isolated. Because of this, individual showers do not last very long. Code figure 89 is not reported under United States rules.

90 **Moderate or heavy shower(s) of hail, with or without rain or rain and snow mixed, not associated with thunder.**

88 **Moderate or heavy shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed.**

All of the precipitation must be moderate or heavy.

87 **Light shower(s) of snow pellets or small hail, with or without rain or rain and snow mixed.**

All of the precipitation must be light.

WW = 86-85 Used if only snow showers are observed at the station at the time of observation.

86 **Snow shower(s), moderate or heavy.**.

85 **Snow shower(s), light.**

WW = 84-83. Used if mixed rain showers and snow showers are observed at the station at the time of observation

84 **Moderate or heavy shower(s) of rain and snow mixed. Intensity of either may be moderate or heavy.**

83 **Light shower(s) of rain and snow mixed. Intensity of both must be light.**

WW = 82-80. Used to report rain showers at the time of observation.

82 **Violent rain shower(s).**

Report a rain shower as violent if the rate of fall is at least 1.0" per hour or 0.10" in 6 minutes

81 **Moderate or heavy rain shower(s).**

80 **Light rain shower(s).**

WW = 79-50 Use code figures 79-50 for precipitation that is not showery.

WW = 79-70 Use code figures 79-70 to report solid precipitation not in showers.

WW = 79-76 Use code figures 79-76 to report types of solid, non-showery precipitation.

79 **Ice Pellets.**

Use this code figure regardless of the intensity of the ice pellets and regardless of whether the ice pellets are mixed with another type of precipitation.

78 **Isolated star-like snow crystals with or without fog or ice fog.**

77 **Snow grains with or without fog or ice fog.**

Use this code figure regardless of intensity.

76 **Diamond dust (ice crystals) with or without fog or ice fog.**

WW = 75-70 Use code figures 75-70 to report snow that is not in the form of showers at the station at the time of the observation. The code figure selected depends on a combination of intensity and whether the snow is intermittent or continuous.

75 **Continuous fall of snowflakes, heavy at time of observation.**

74 **Intermittent fall of snowflakes, heavy at time of observation.**

73 **Continuous fall of snowflakes, moderate at time of observation.**

72 **Intermittent fall of snowflakes, moderate at time of observation.**

71 **Continuous fall of snowflakes, light at time of observation.**

70 **Intermittent fall of snowflakes, light at time of observation.**

WW = 69-60 Code figures 69-60 are generally used to report rain.

WW = 69-66 Use code figures 69-66 to report liquid precipitation that is mixed with snow or is freezing.

69 **Rain or drizzle and snow, moderate or heavy.**

68 **Rain or drizzle and snow, light.**

67 **Rain, freezing, moderate or heavy.**

66 **Rain, freezing, light.**

WW = 75-70 Use code figures 75-70 to report snow that is not in the form of showers at the station at the time of the observation. The code figure selected depends on a combination of intensity and whether the snow is intermittent or continuous.

65 **Rain, not freezing, continuous, heavy at time of observation.**

64 **Rain, not freezing, intermittent, heavy at time of observation.**

63 **Rain, not freezing, continuous, moderate at time of observation.**

62 **Rain, not freezing, intermittent, moderate at time of observation.**

61 **Rain, not freezing, continuous, light at time of observation.**

60 **Rain, not freezing, intermittent, light at time of observation.**

WW = 59-50 Use 59-50 to report drizzle.
WW = 59-56 Drizzle mixed with rain, or freezing drizzle.

59 **Drizzle and rain, moderate or heavy at time of observation.**

58 **Drizzle and rain, light at time of observation.**

57 **Drizzle, freezing, moderate or heavy at time of observation.**

56 **Drizzle, freezing, light at time of observation.**

WW = 55-50 Use code figures 55-50 to report drizzle (but not freezing drizzle or drizzle mixed with rain) at the station at the time of observation.

55 **Drizzle, not freezing, continuous, heavy at time of observation.**

54 **Drizzle, not freezing, intermittent, heavy at time of observation.**

53 **Drizzle, not freezing, continuous, moderate at time of observation.**

52 **Drizzle, not freezing, intermittent, moderate at time of observation.**

51 **Drizzle, not freezing, continuous, light at time of observation.**

50 **Drizzle, not freezing, intermittent, light at time of observation.**

WW = 49-00 Use code figure 49-00 when no precipitation is occurring at the station at the time of observation.

WW = 49-40 Use code figures 49-40 only if there is fog. The fog may be made of water droplets or ice crystals (ice fog). The visibility in fog or ice fog must be less than 5/8 mi. If the visibility is 5/8 mi or more, use code figure 10. The code figure used will depend on whether the fog has changed during the past hour and whether the sky can be seen (blue sky, stars or higher clouds).

49 **Fog depositing rime, sky invisible.**

Fog that deposits rime will be made up mostly of supercooled water droplets, not ice crystals.

48 **Fog, depositing rime, sky visible.**

47 **Fog or ice fog, sky invisible. Fog has begun or has become thicker during the preceding hour.**

46 **Fog or ice fog, sky visible. Fog has begun or has become thicker during the preceding hour.**

45 **Fog or ice fog, sky invisible. Fog has shown no appreciable change during the preceding hour.**

44 **Fog or ice fog, sky visible. Fog has shown no appreciable change during the preceding hour.**

43 **Fog or ice fog, sky invisible. Fog has become thinner during the preceding hour.**

42 **Fog or ice fog, sky visible. Fog has begun or has become thinner during the preceding hour.**

41 **Fog or ice fog in patches. Fog has begun or has become thicker during the preceding hour.**

40 **For or ice fog at a distance at the time of observation, but not at the station during the preceding hour, the fog or ice fog extending to a level above that of the observer.**

WW = 39-30 Use code figures 39-30 to report a duststorm, sandstorm, or drifting or blowing snow.

WW = 39-36 In deciding among code figures 39-36, the following must be considered: snow that is being moved by the wind may be generally low (below about 6 ft) or generally high (above 6 ft). If the snow is low, it is drifting snow; if high, it is blowing snow. Code figure 37 is not reported under United States rules.

39 **Heavy blowing snow, generally high (above eye level). Visibility less than 5/16 mi.**

38 **Light or moderate blowing snow, generally high (above eye level). Visibility 6 mi or less but not less than 5/16 mi.**

36 **Drifting snow, generally low (below eye level).**

WW = 35-30 In deciding among code figures 35-30 the following must be considered: if the visibility at the station at the time of observation is less than 5/16 mi, there is a severe duststorm or sandstorm; if the visibility is at least 5/16 mi but less than 5/8 mi, there is a light or moderate duststorm or sandstorm. The code figure used depends on the intensity of the duststorm or sandstorm and any change in its intensity during the preceding hour.

35 **Severe duststorm or sandstorm that has begun or has increased during the preceding hour.**

34 **Severe duststorm or sandstorm that has had no appreciable change during the preceding hour.**

33 **Severe duststorm or sandstorm that has decreased during the preceding hour.**

32 **Light or moderate duststorm or sandstorm that has begun or has increased during the preceding hour.**

31 **Light or moderate duststorm or sandstorm that has had no appreciable change during the preceding hour.**

30 **Light or moderate duststorm or sandstorm that has decreased during the preceding hour.**

WW = 29-20 Use code figures 29-20 to report precipitation, fog, ice fog, or thunderstorm at the station during the preceding hour but not at the station at the time of observation. Use code figures 29-25 if the precipitation was showery; otherwise use code figures 24-20.

IMPORTANT: Never release a radiosonde while a thunderstorm is occurring. See Chapter 13 for more information.

29 Thunderstorm (with or without precipitation).

Since by U.S. definition, a thunderstorm ends 15 minutes after the last thunder is heard, the last thunder or lightning must have happened at least 15 minutes before the time of the observation.

28 Fog or ice fog.

The visibility in the fog or ice fog must have been less than 5/8 mi.

27 Shower(s) of hail, small hail, or ice pellets, or of rain and hail, small hail, or ice pellets.

26 Shower(s) of snow, or of rain and snow.

25 Shower(s) of rain.

24 Freezing drizzle or freezing rain, not falling as shower(s).

23 Rain and snow or ice pellets, not falling as shower(s).

22 Snow not falling as shower(s).

21 Rain (not freezing), not falling as shower(s).

20 Drizzle (not freezing) or snow grains, not falling as shower(s).

WW = 19-00 Use code figures 19-00 to report certain hydrometeors, electrometeors, lithometeors or no precipitation at the station at the time of observation or during the preceding hour.

19 Funnel cloud(s), tornado, or waterspout at or within sight of the station during the preceding hour of the time of observation.

Since the highest code figure is reported (except code figure 17), code figure 19 cannot be used if WW can be encoded as some higher number.

18 Squalls. By U.S. definition, a sudden increase of at least 15 knots in average wind speed and sustained at 20 knots or more for at least 1 minute. This must occur at or within sight of the station during the preceding hour or at the time of observation.

If a squall without any precipitation is observed, either at the time of observation or during the past hour, use code figure 18. If there was any precipitation, or if there was a thunderstorm with the squall, use one of the other code figures, possibly code figure 29 or

one of the code figures 99-80. Select the one that best describes what happened.

WW = 17 Thunderstorm, but no precipitation at time of observation. Code figure 17 has priority over code figures 49-20 and 16-00.

17 Thunderstorm, but no precipitation at time of observation.

A thunderstorm is an electrical storm that may or may not be accompanied by precipitation. Since by U.S. definition, a thunderstorm does not end until 15 minutes after the last thunder is heard, code figure 17 would be used if the thunderstorm occurred within 15 minutes of the observation.

16 Precipitation within sight, reaching the ground or the surface of the sea, near to, but not at the station.

The precipitation must be 3 mi or less from the station, but not at the station to use code figure 16.

15 Precipitation within sight, reaching the ground or the surface of the sea, but distant; i.e., estimated to be more than 3 mi from the station.

14 Precipitation within sight, not reaching the ground or the surface of the sea.

Sometimes precipitation may fall from a cloud, but into air that is dry enough to evaporate it before it can reach the ground. This is fairly common in desert areas like some parts of the southwestern United States. This phenomena is called virga.

13 Lightning visible, no thunder heard.

There are two reasons you may see lightning but not hear thunder. The first is the lightning may be far enough away that the thunder doesn't reach the station. The other is that local sounds may muffle the thunder. Use code figure 13 to report distant lightning.

WW = 12-10 Use code figure 12 or 11 to report shallow fog. Continuous refers to covering half or more of the ground or sea; patchy refers to less than one-half coverage. The apparent visibility shall be less than 5/8 mi. Code figure 10 is used to report fog that is neither shallow nor has visibility less than 5/8 mi. (Code figures 49-40 are used to report fog that is not shallow but with visibility less than 5/8 mi.)

12 More or less continuous shallow fog or ice fog at the station; the fog or ice fog is not deeper than about 6 ft.

10 Mist

Code figure 10 refers only to water droplets and ice crystals. The visibility restriction shall be 5/8 mi or more but less than 7 mi. Use code figure 10 whether the mist is patchy

or more or less continuous.

WW = 09-04 Use code figures 09-04 to report lithometeors.

09 **Duststorm or sandstorm within sight at the time of observation, or at the station during the preceding hour.**

Visibility in dust or sand must be (or have been) 6 mi or less.

08 **Well-developed dust whirl(s) (devils) or sand whirl(s) seen at or near the station during the preceding hour or at the time of observation, but no duststorm or sandstorm.**

07 **Duststorm or sandstorm within sight at the time of observation, or at the station during the preceding hour.**

Visibility in dust or sand must be (or have been) 6 mi or less.

06 **Widespread dust in suspension in the air, not raised by wind at or near the station at the time of observation.**

This code figure may be used with any visibility, as long as there is dust in the air.

05 **Haze**

Code figure 05 is not restricted to the definition for reports of haze in the basic observation, but can be used if it is simply hazy, regardless of the visibility.

04 **Visibility reduced by smoke; e.g., veldt or forest fires, industrial smoke, or volcanic ash.**

If the smoke is coming from a great distance, it will be spread through a deep layer of the atmosphere. In this case, use code figure 04 regardless of how much the visibility is restricted. If the smoke is coming from somewhere fairly close, then it will be pretty much layered in the lower atmosphere. In this case, the visibility has to be 6 mi or less before code figure 04 is used.

WW = 03-00 Phenomena without significance.

03 **Clouds generally forming or developing.**

Used only if there are clouds at the time of the observation, no other weather

exists, and the clouds have increased or become more developed during the past hour.

02 **State of sky on the whole unchanged. This is the characteristic of the sky during the past hour.**

01 **Clouds generally dissolving or becoming less developed. This is the characteristic of the sky during the past hour.**

Used if the sky is clear at the time of observation, but there were clouds during the past hour. Also used when clouds have dissolved or become less developed during the past hour.

00 **Cloud development not observed or not observable. This is the characteristic of the past hour.**

Used if clouds were not observed during the past hour, whether the sky is clear or not at time of observation.

EXAMPLE OBSERVATIONS

Sky:	3/8 moderate cumulus at 2100 feet, 1/8 stratocumulus at 5000 feet, 2/8 altocumulus (one level, opaque) at 12000 feet. State of sky generally becoming less developed during past hour.
Weather:	Light rain shower ended 17 minutes before observation.
Code:	485702501
Sky:	Clear sky with few patches of semi-transparent altocumulus at 15000 feet. Altocumulus covered 4/8 of sky during past hour.
Weather:	None.
Code:	109300101
Sky:	Surface-based obscuration in fog with 300 feet vertical visibility.
Weather:	Fog with visibility 1/2 mile. Last hour had a partial obscuration (fog) and 8/8 stratus at 400 feet.
Code:	9////4747
Sky:	7/8 cumulonimbus (no anvil visible) at 1800 feet, 1/8 cirrus at 35000 feet, originating from cumulonimbus.
Weather:	Moderate showers of rain and small hail. Lightning seen in distance (on horizon), but no thunder heard.
Code:	734038813
Sky:	8/8 stratocumulus (with breaks) at 4500 feet. State of sky unchanged during past hour
Weather:	None.

Code:	756//0202
Sky:	8/8 nimbostratus at 2100 feet. State of sky unchanged during past hour.
Weather:	Light rain and drizzle. Patchy fog reducing visibility to 3 miles was present during past hour but not at time of observation. No other changes.
Code:	8052/5802

20 Appendix C. RRS Offline Maintenance

This appendix includes basic instructions for using the Offline Maintenance Suite (OMS). The OMS provides maintenance personnel additional information beyond what is shown in the Hardware Status Window. The information provided can isolate problems with the RRS hardware, communications links, or surface observation reporting equipment. The RRS Offline Maintenance software may only be used when the RWS software is not in use.

The Offline Maintenance Menu shown in Exhibit C-1 is the primary window which provides the user with possible options to choose for further analysis or fault isolation. Activation of the options requires only a simple click of the mouse over the desired option and test. The possible options that may be entered for refined fault isolation include:

- InterMet Maintenance
- Sippican Maintenance
- Vaisala Maintenance
- RSOIS Maintenance
- PDB Maintenance
- TRS Maintenance
- UPS Maintenance
- AWIPS Test

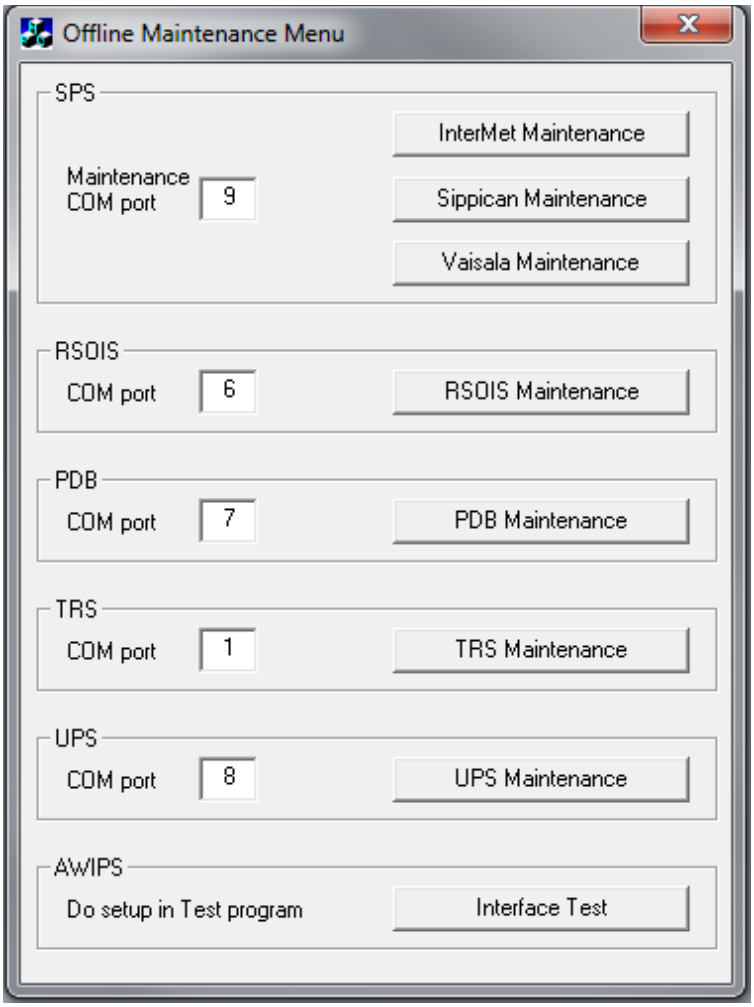


Exhibit C-1 Offline Maintenance Menu

20.1 InterMet Maintenance

Not Implemented.

20.2 Sippican Maintenance

The Sippican Maintenance Option when selected from the Offline Maintenance Menu provides the operator with detailed information on the Sippican SPS. Exhibit C-3A shows the Sippican SPSMaint Application main screen. Please refer to EHB 9-715 for more information on the Sippican SPSMaint Application.

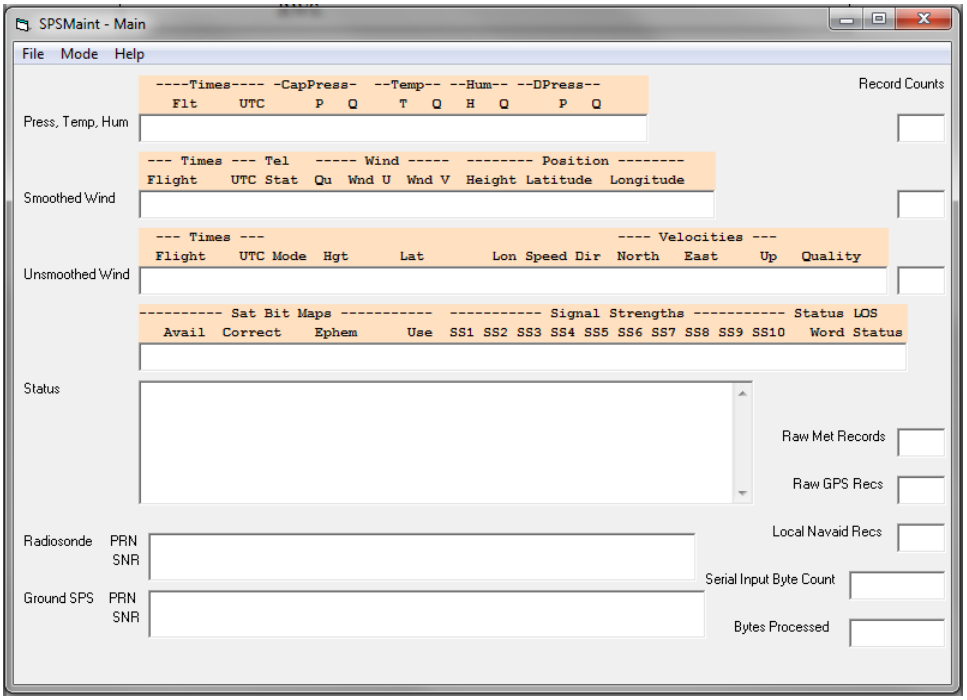


Exhibit C-2A Sippican SPS Maintenance Option

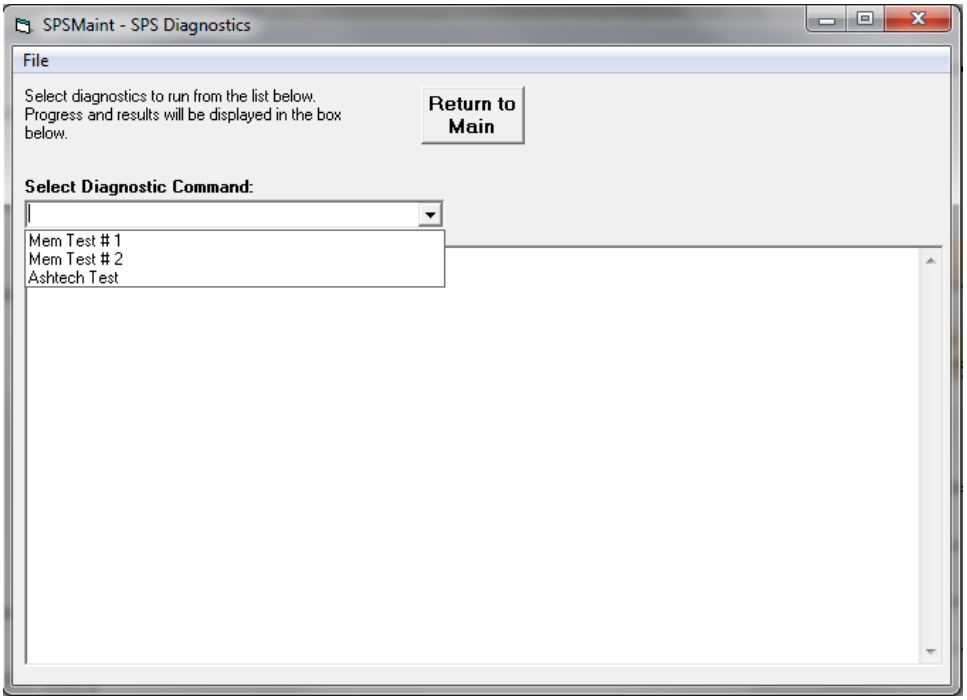


Exhibit C-2B Sippican SPS Ashtech Test

20.3 Vaisala Maintenance

The Vaisala Maintenance Option when selected from the Offline Maintenance Menu provides the operator with detailed information on the Vaisala SPS. Exhibit C-3A shows the Vaisala SPS Maintenance Application main screen. The Vaisala Maintenance Application is used to install SPS software updates, run hardware tests, and download diagnostic information. Please refer to EHB 9-715 for more information on the Vaisala Maintenance Application.

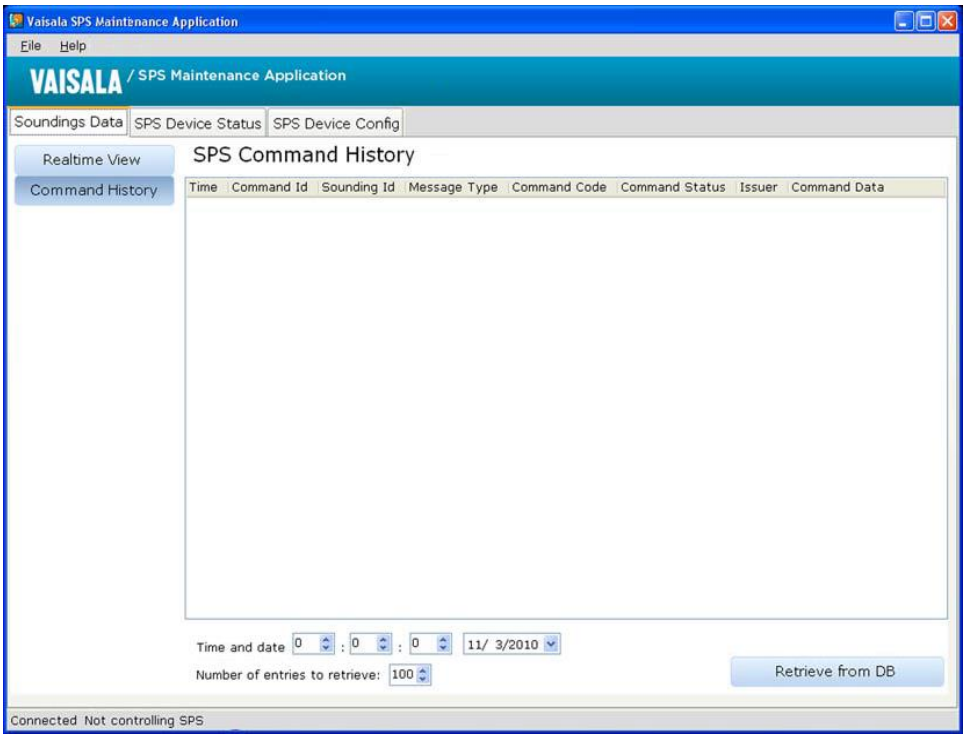


Exhibit C-3A Vaisala SPS Maintenance Software Main Screen

20.4 RSOIS Maintenance

The RSOIS Maintenance Option when selected from the Offline Maintenance Menu provides the operator with detailed information on the RSOIS. Exhibit C-3 provides an example of what information will be provided when this option is selected.

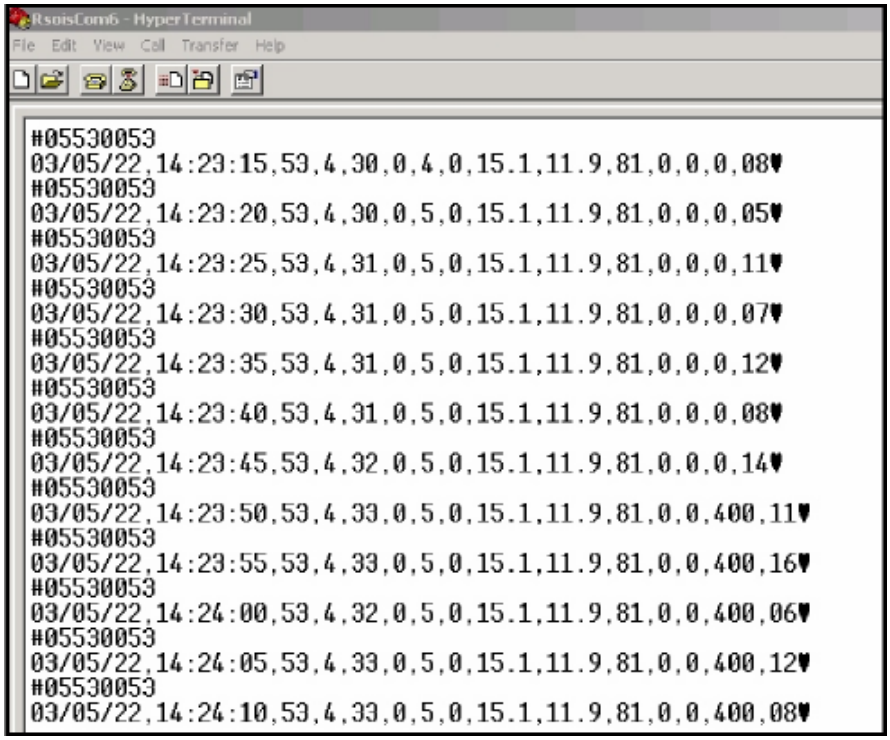


Exhibit C-3 RSOIS Maintenance

20.5 PDB Maintenance

The PDB Maintenance Option when selected from the Offline Maintenance Menu provides the operator with detailed information on the PDB. Exhibit C-4 provides an example of what information will be provided when this option is selected.

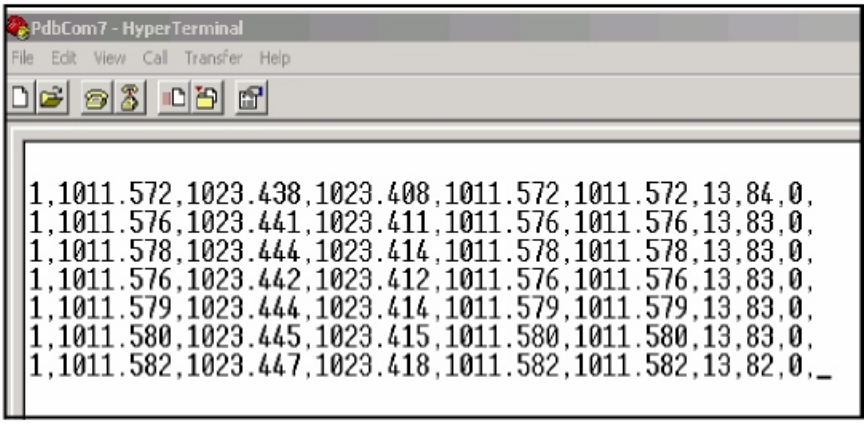


Exhibit C-4 PDB Maintenance

20.6 TRS Maintenance

The TRS Maintenance Option when selected from the Offline Maintenance Menu provides the operator with detailed information on the TRS. This option provides by far the most detailed information of the options that may be selected. Exhibit C-5 shows what options are available and C-5A provides an example of information when the SCA Test is initiated.

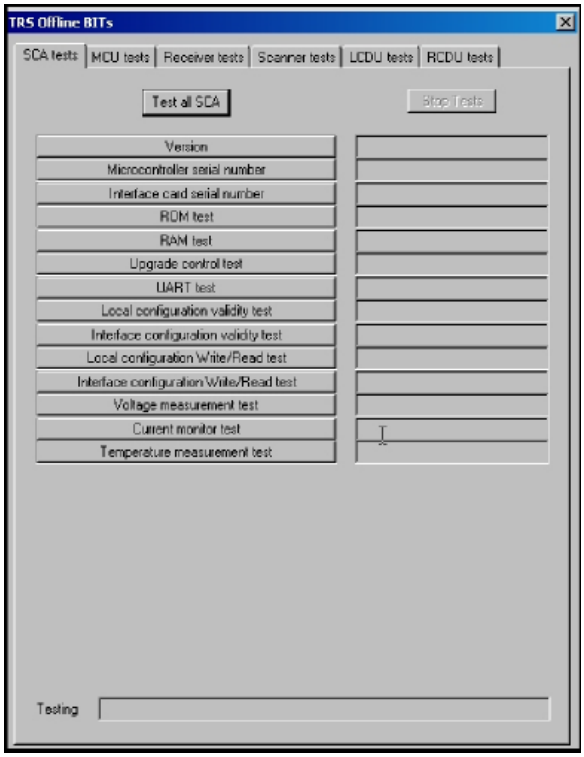


Exhibit C-5 TRS Menu

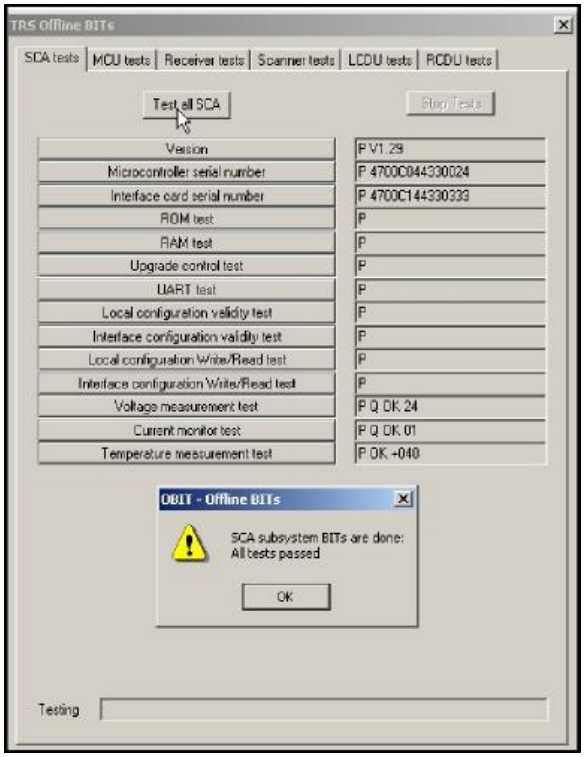


Exhibit C-5A SCA Tests

NOTE: When the TRS Offline Bits Menu is initially displayed the SCA Menu is displayed with the possible features that are tested.

20.6.1 MCU Tests

The MCU Tests is the second test series shown under the TRS Maintenance Option. When selected from the TRS Maintenance Window, it provides detailed information on the MCU. Exhibit C-5B provides an example of what information will be provided when this option is selected.

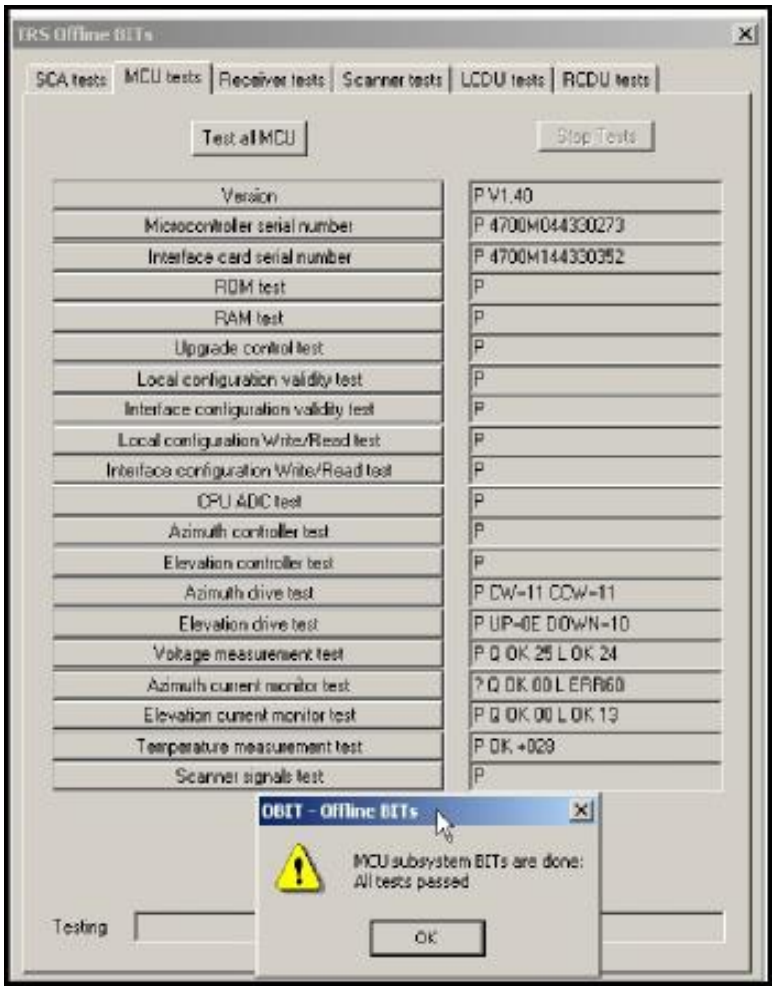


Exhibit C-5B MCU Tests

20.6.2 Receiver Tests

The Receiver Tests is the third test series shown under the TRS Maintenance Option. When selected from the TRS Maintenance Window, it provides detailed information on the receiver. Exhibit C-5C provides an example of what information will be provided when this option is selected.

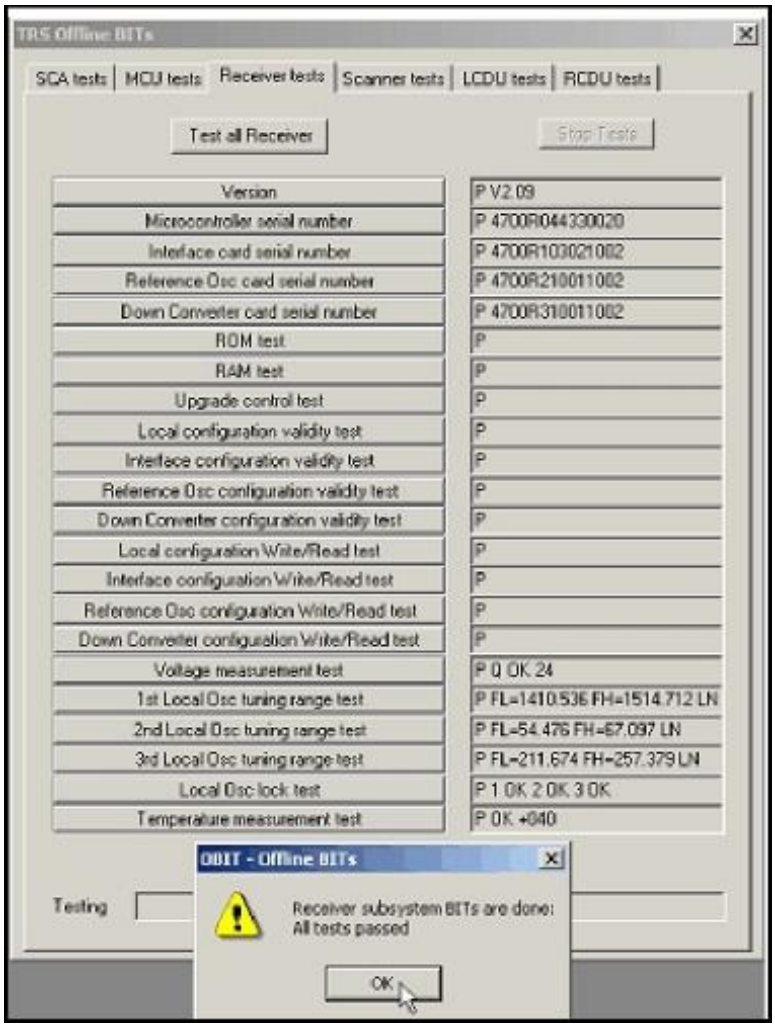


Exhibit C-5C Receiver Tests

20.6.3 Scanner Tests

The Scanner Tests is the fourth test series shown under the TRS Maintenance Option. It provides detailed information on the scanner. Exhibit C-5D shows the information provided.

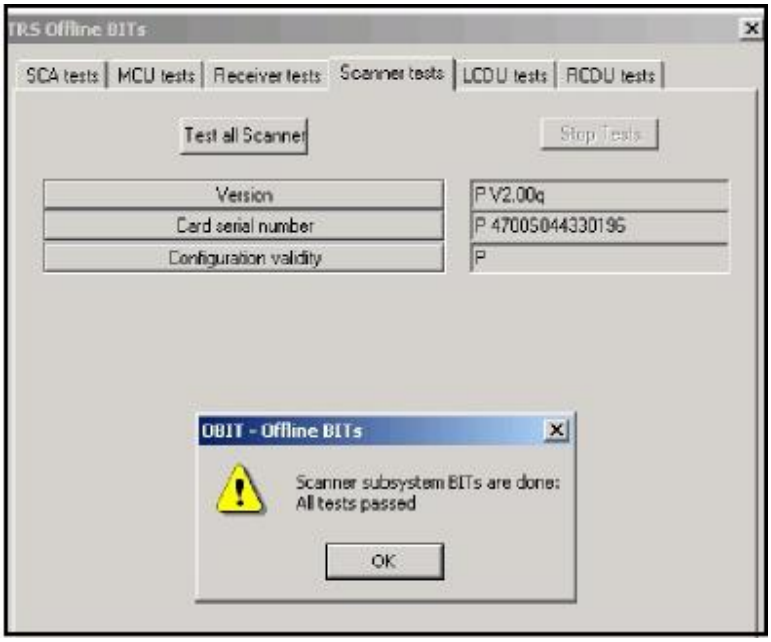


Exhibit C-5D Scanner Tests

20.6.4 LCDU Tests

The LCDU Tests is the fifth test series of the TRS Maintenance Option. It provides detailed information on the local control display unit in the radome. Exhibit C-5E shows the information provided. An RRS flight can be conducted without the use of the LCDU.

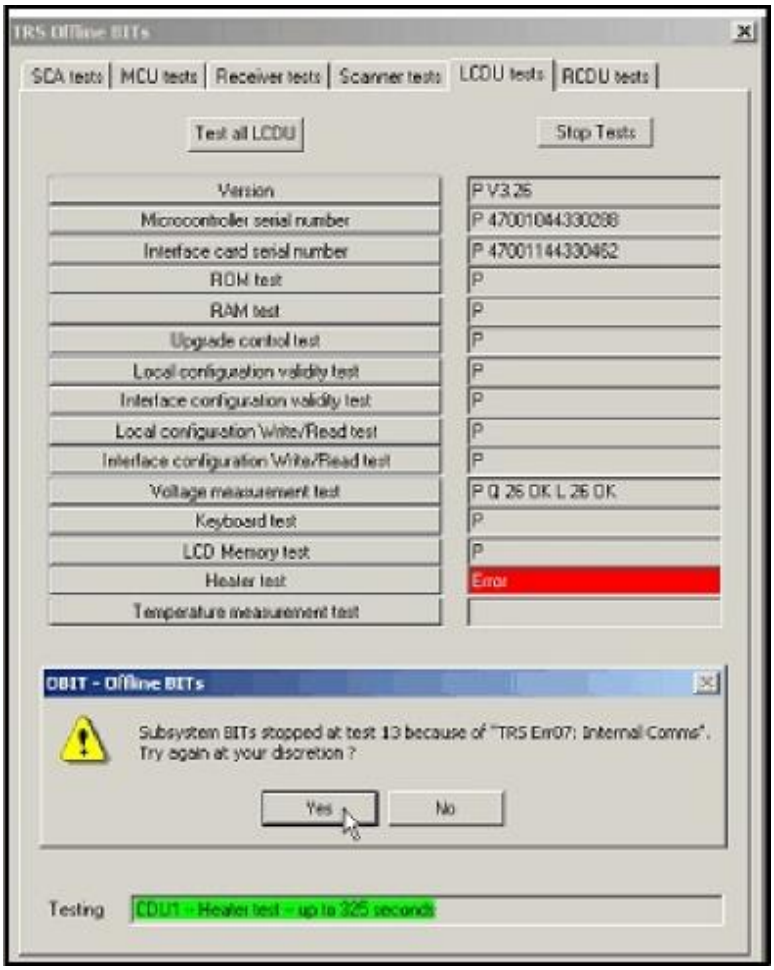


Exhibit C-5E LCDU Tests

20.6.5 RCDU Tests

The RCDU Tests is the final test series of the TRS Maintenance Option. It provides detailed information on the remote control display unit at the release point. Exhibit C-5F shows an “Error Message” requires maintenance notification and use of alternate release procedures until corrected. An RRS flight can be conducted without the use of the RCDU.

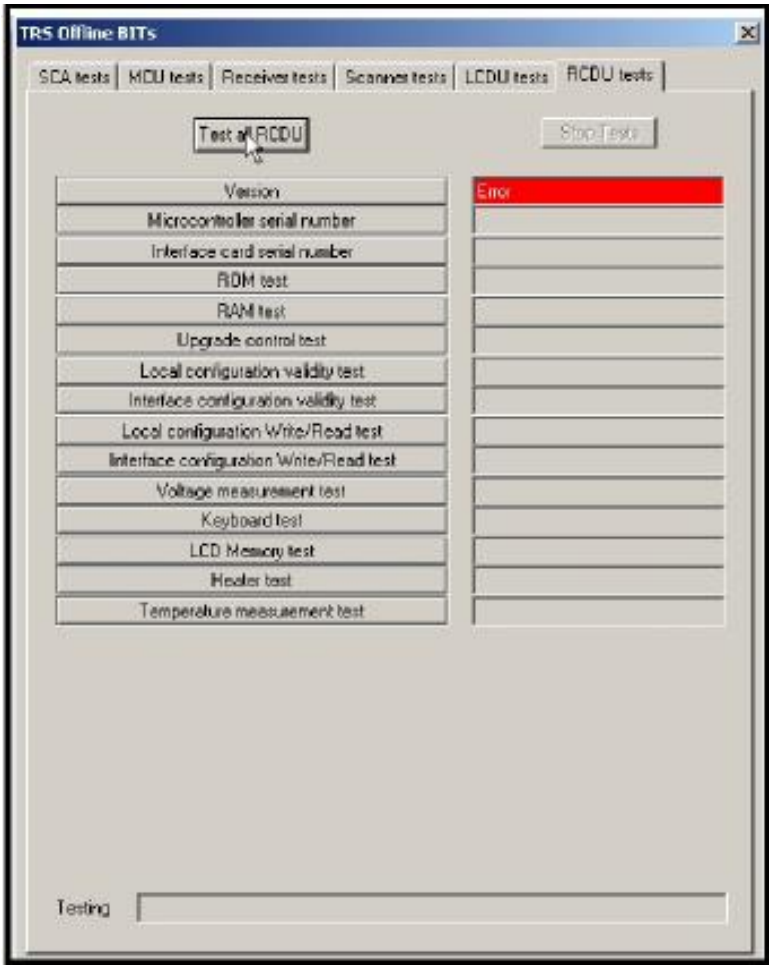


Exhibit C-5F RCDU Tests

20.6.6 TRS Advanced Commands

The OMS allows individual commands to be sent to the TRS. Sending individual commands allows technicians to view and set coefficients as required when replacing specific components (i.e MCU or Scanner). On the RWS Workstation, OMS restricts the sending of TRS commands to only RWS Site Administrators. On non-RWS Workstations, OMS restricts the sending of TRS commands to Windows Administrators.

NOTE: OMS does not allow all available TRS Commands to be sent to the TRS. Only TRS commands necessary as a part of TRS maintenance are permitted.

1. To begin sending individual commands to the TRS, select **TRS Advanced** from the **Tools** pull-down menu (Exhibit C-6).

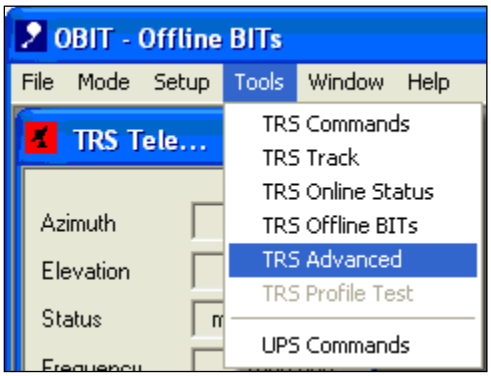


Exhibit C-6 Tools pull-down menu

2. The TRS Advanced Operations display will open (Exhibit C-7). This display has the ability to load firmware to each component of the TRS and send individual commands to the TRS.

NOTE: Firmware uploads is not implemented for use at RRS sites, unless specifically identified in a RRS Modification Note.

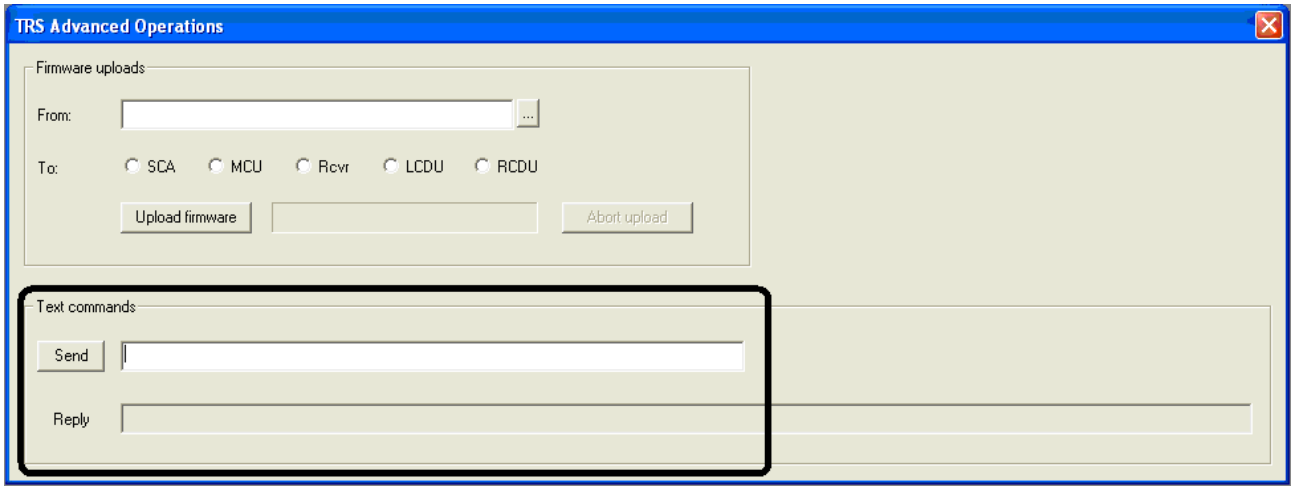


Exhibit C-7 TRS Advanced Operations Display

3. Enter the TRS Command in the Send text field. OMS will automatically preface the command with a "/" when the Send button is clicked (Exhibit C-8).

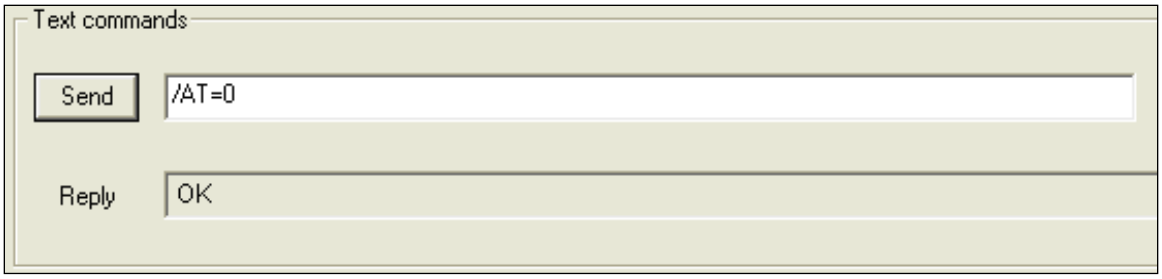


Exhibit C-8 TRS Text commands

4. The TRS response will display in the Reply field. To prevent unintentional coefficient editing, OMS doesn't allow all available TRS commands to be sent to the TRS.

20.7 UPS Maintenance

The UPS Maintenance Option from the Offline Maintenance Menu provides the operator with detailed information on the UPS. Exhibit C-9 shows the information provided.

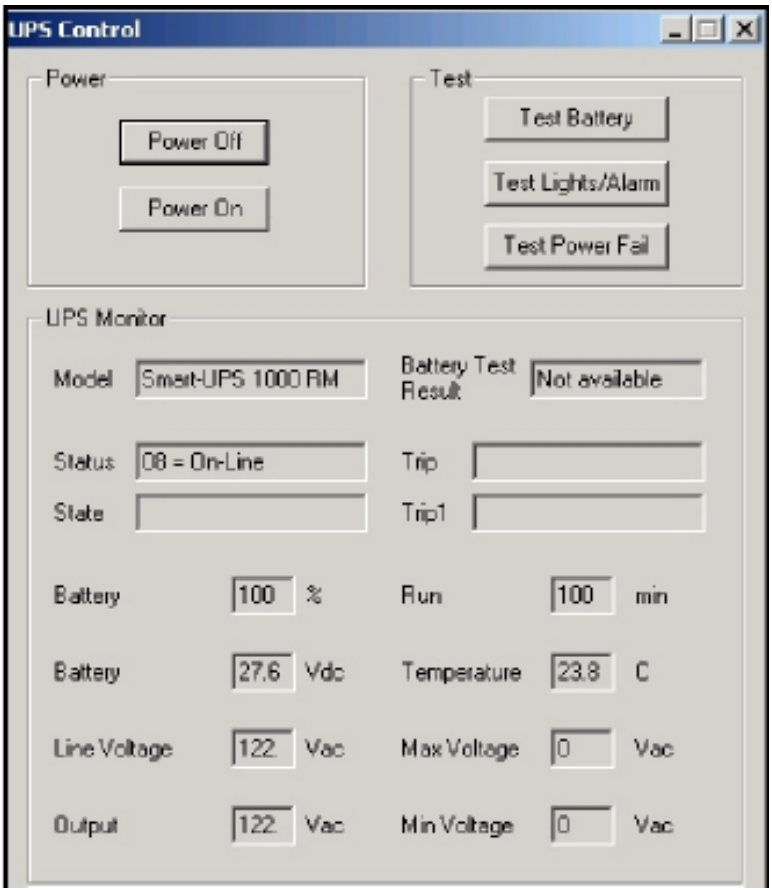


Exhibit C-9 UPS Tests

NOTE: The UPS Power options allow the operator to power on or off the power supply. The UPS control window can also be used to test the battery, lights, alarm and do a test power failure. The window also provides detailed information on the battery strength, voltage, temperature, and output. The initiation of the Battery Test is shown in Exhibit C-10.

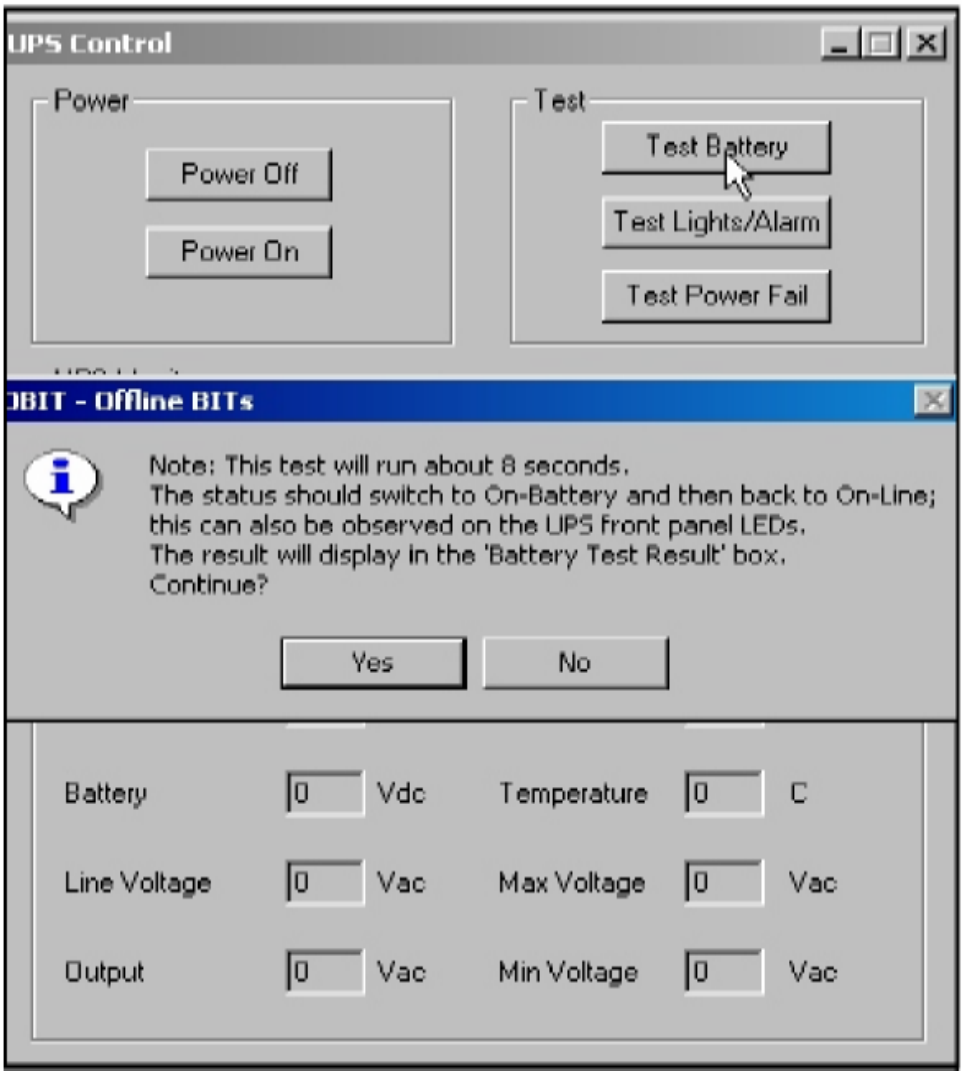


Exhibit C-10 Battery Test

21 Appendix D. Troubleshooting

This appendix discusses possible problems that can occur during a flight. It includes instructions to assist in resolving problems or recording diagnostic information for the electronics technician. It is up to the operator to try to diagnose the problem and take corrective action if possible. Even if the problem is beyond the operator's expertise, providing the electronics technician or others with what actually occurred before and after the event is vital to finding a solution.

21.1.1 Pre-flight Troubleshooting

During preflight, the most common areas problems occur are with the radiosonde, SPS and TRS. These problems usually are easily resolved in RWS by the operator.

21.1.1.1 No TRS Control or TRS Initialization Unsuccessful

When the TRS fails to complete warm up and/or initialization, RWS will indicate this failure in the Status Messages Display and the TRS tab of the Hardware Manager Status Display with message "TRS completed Initialization unsuccessfully". To resolve this problem follow the Corrective Action steps below.

1. Verify in the Hardware Manager that the UPS is On.
2. Click on the **Reset** button in the TRS Hardware Status (Exhibit D -1).
3. Allow up to 30 minutes in cold conditions (< 50 degrees F) for the TRS to complete warm-up and initialization.
4. If the TRS fails to complete the warm-up and/or initialization after resetting, turn the UPS Off, wait 30 seconds and then turn the UPS back on (Exhibit D -2).
5. If the TRS still fails to complete warm-up and/or initialization, contact your site electronics technician for additional trouble shooting.

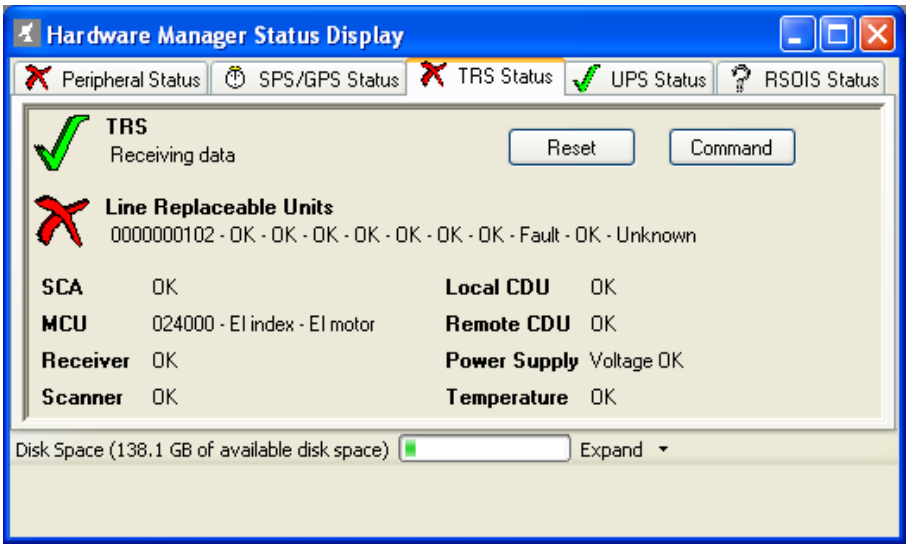


Exhibit D-1 Hardware Manager with a TRS Failure

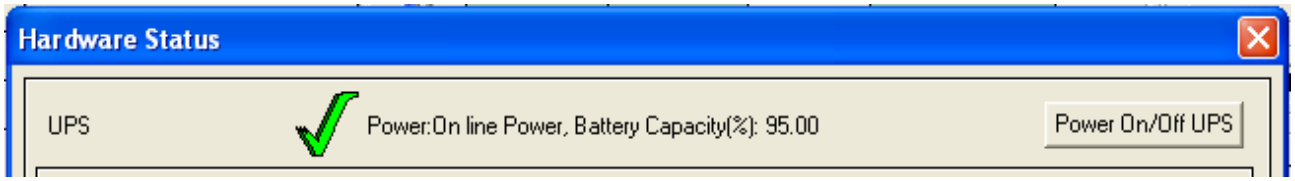


Exhibit D-2 UPS On/Off

21.1.1.2 SPS Failing to Initialize at Baseline

After clicking the Next button in the Surface Observation, RWS sends an Initialize command to the SPS. This typically initializes the flow of meteorological data from the SPS to the RWS. Occasionally the SPS will not initialize within two minutes. Use the Corrective Actions 1 – 3 (below) to resolve the SPS failing to Initialize. If none of the Corrective Actions 1-3 were successful, click the **Abort** button (Shown in Exhibit D-4). Set the instrument aside and try a new radiosonde.

NOTE: Clicking the Abort button closes the Pre-flight completely and takes you to Offline mode. This should not be exercised until trying the corrective actions.

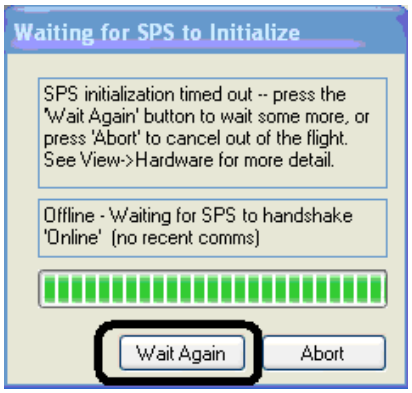


Exhibit D-3 Re-initializing the SPS

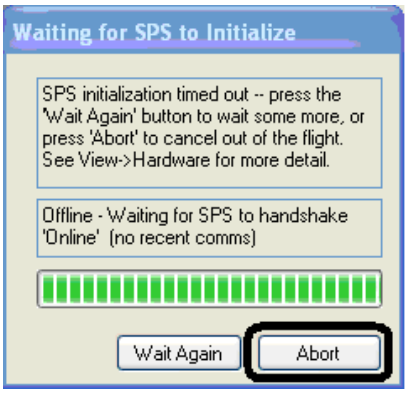


Exhibit D-4 Aborting Initialization

Corrective Action #1

- Ensure you have good signal strength and the receiver is locked on to the radiosonde (Ensure you have the TRS frequency set to match the radiosonde frequency). This includes verifying the TRS antenna is pointing to the baseline position.
- Verify there is no interference or noise in the area causing a degradation of the signal being received.
- Disconnect battery from the radiosonde and wait at least 30 seconds before reconnecting the battery to the radiosonde.

NOTE: For the Lockheed Martin Sippican Radiosondes. First, disconnect the Positive/ Red wire and then Ground or Black wire. Wait at least 30 seconds before reconnecting the Ground/Black wire first.

- Click the **Wait Again** button to re-run the initialization process for another two minutes (See Exhibit D-3). If no PTU data is displayed after two minutes, proceed to Corrective Action #2.

Corrective Action #2

- In the Hardware Status display, click the **SPS Reset** button. Wait 1 minute.
- Click the **Wait Again** button to re-run the initialization process for another two minutes (See Exhibit D-3). If no PTU data is displayed after two minutes, proceed to Corrective Action #3.

Corrective Action #3

- In the Hardware Status Display, click the **Power Off UPS** button. Wait 1 minute before clicking the **Power ON UPS** button (This is a hard reboot). It can take up to fifteen (15) minutes for the SPS GPS module to reacquire the GPS almanac.
- Disconnect the battery and wait 30 seconds, before re-connecting to the radiosonde.

NOTE: For the Lockheed Martin Sippican Radiosondes. Always disconnect the Red/Positive wire first and reconnect the Black/Ground wire first.

- Reorient TRS toward radiosonde and set TRS frequency to match the radiosonde.
- Click the **Wait Again** button to re-run the initialization process for another two minutes (See Exhibit D-3). If no PTU data is displayed after two minutes, click the Abort button (Shown in Exhibit D-4). Set the instrument aside and try a new radiosonde.

21.1.1.3 No GPS at Baseline – Corrective Actions

Once the SPS initializes, PTU and Lat/Long (GPS) data should begin filling the baseline display. If only GPS data is missing, ensure you have waited 5 minutes and then progressively try each of the following corrective actions.

NOTE: After taking each corrective action, it may take a few minutes for the GPS data to begin filling the baseline display.

Corrective Action #1

Verify Signal Strength (Exhibit D-7), it should be greater than -65 depending on the TRS azimuth angle and TRS frequency. Reorient TRS toward radiosonde and set TRS frequency to match the radiosonde. If GPS satellite matches (Exhibit D-8) aren't increasing after two minutes, proceed to Corrective Action #2.

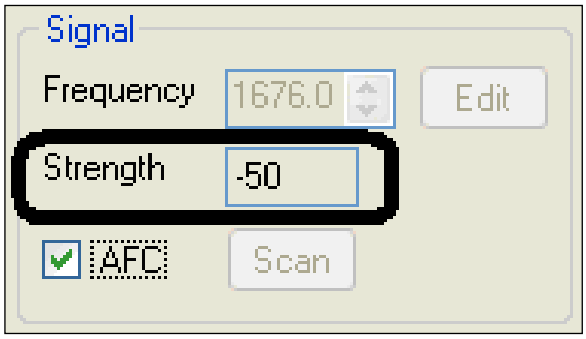


Exhibit D-7 – Check frequency and signal strength

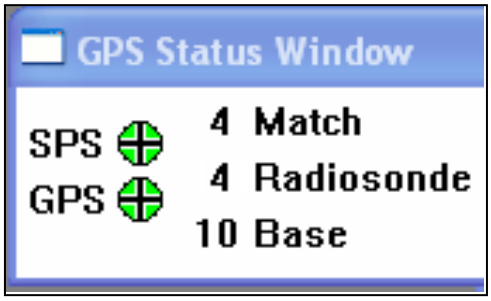


Exhibit D-8 – Satellite Matches

Corrective Action #2

Disconnect the battery and wait 30 seconds, before re-connecting to the radiosonde. If GPS satellite matches (Exhibit D-8) aren't increasing after two minutes, proceed to Corrective Action #3.

Corrective Action #3

Take radiosonde outside and suspend it such that it is at the same height as the baseline location inside the office and has a good view of the sky. Watch the SPS GPS Status bar for an increase in satellite matches. If GPS satellite matches (Exhibit D-8) aren't increasing after two minutes, proceed to Corrective Action #4.

NOTE: For the Lockheed Martin Sippican Radiosondes. Always disconnect the Red/Positive wire first and reconnect the Black/Ground wire first.

Corrective Action #4

In the Hardware Status display, click the **SPS Reset** button. Wait 1 minute. This re-initializes the SPS (This is a soft reboot). If GPS satellite matches (Exhibit D-8) aren't increasing after two minutes, proceed to Corrective Action #2.

Corrective Action #5

In the Hardware Status Display, click the **Power Off UPS** button. Wait 1 minute before clicking the **Power ON UPS** button (This is a hard reboot). It can take up to fifteen (15) minutes for the SPS GPS module to reacquire the GPS almanac. If GPS satellite matches (Exhibit D-8) aren't increasing after fifteen minutes, get another radiosonde

21.1.1.4 GPS during baseline, but no GPS Matches before release – Corrective Actions

After baseline, if the GPS satellite matches becomes zero while still at the baseline location, verify that bottom status (Exhibit D-9) bar displays height values that are near the station Release Elevation. If GPS Height appears reasonable (Based on the latest station data) to the Station Release Elevation then the RWS is experiencing a display issue. This condition should not affect your flight and GPS should be available at release.

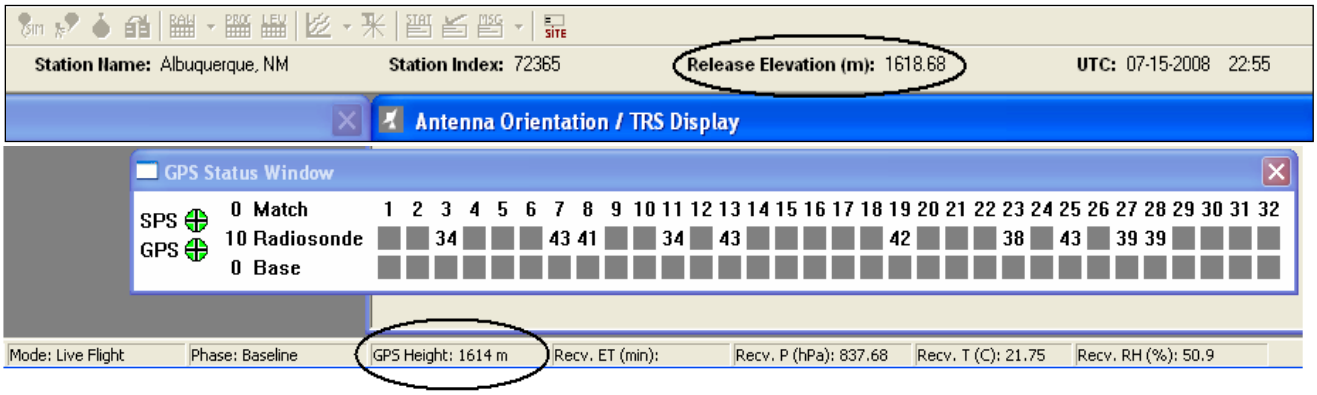


Exhibit D-9 - GPS Height available with 0 matches

21.1.2 In-flight Troubleshooting

There will be occasions during the flight when the operator must troubleshoot a problem before taking corrective action. A few problems that occur are:

- Signal Loss / Missing Data
- Antenna Not Tracking Properly GPS Loss
- RWS fails to detect release
- MCU Overload with Rapidly Changing Angles

21.1.2.1 Signal loss / Missing Data

1. Signal loss may occur because of numerous reasons: the receiver may have shifted frequency, the radiosonde may have failed, the antenna may not be locked-on to the radiosonde. **If the signal strength shown in the Antenna Orientation/TRS Display drops below -113/ dB, the antenna will no longer be able to track properly.** One of the pop-ups that will alert this operator is the "Missing PTU" popup. (Exhibit D-10)

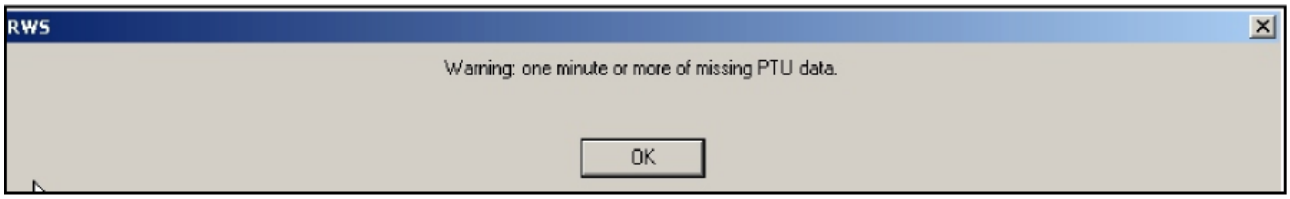


Exhibit D-10 1-Minute Missing PTU Popup

2. An audible alarm will accompany this popup. The popup will occur at 1 and 2 minutes. If the PTU is still missing after 3 consecutive minutes, a final popup comes up terminating the flight. (Exhibit D-11)

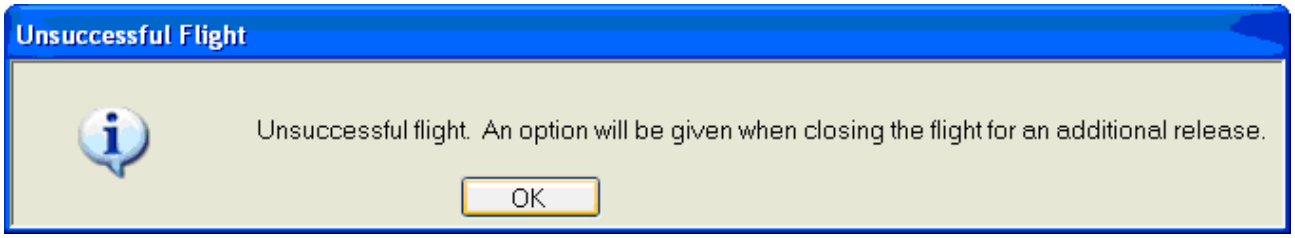


Exhibit D-11 Flight Terminated - UPS Turn Off Requested After 3 Minutes of Missing PTU

Missing Data – Corrective Actions

The operator must validate which problem exists when no signal is received. Missing data is the result of low or no signal strength. Use the following corrective action for Low or no signal strength.

- Point the TRS toward the last known position of the radiosonde. (Section 21.1.2.2)
- Check the frequency - Go to the Antenna Orientation/TRS Display (Exhibit D-12).

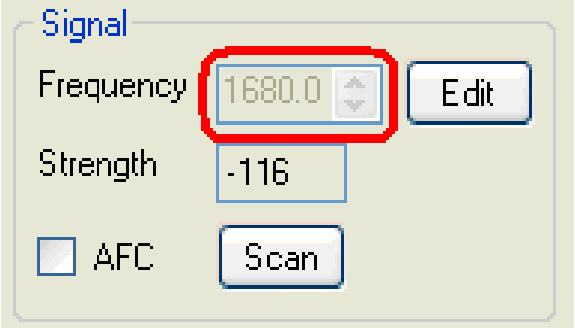


Exhibit D-12 Check frequency and signal strength

- If the frequency has changed, the operator should, click the **Edit** button and type in the frequency selected during Pre-flight.
- Click the **Set** button (Exhibit D-13).
- Make sure the **AFC** is on. The signal should increase and data should be restored.

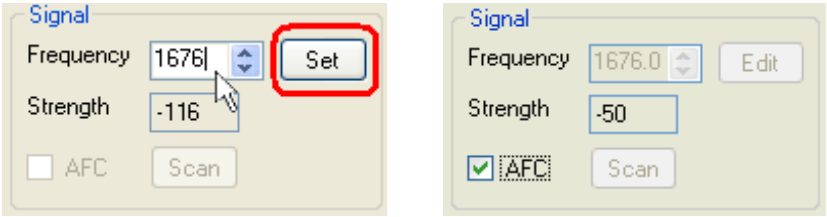


Exhibit D-13 Input desired frequency

21.1.2.2 Antenna Not Tracking Properly GPS Loss - Corrective Actions

Check the antenna tracking

1. Antenna Responds to Commands –
   - If GPS is still being received, select the **Search** button (See Exhibit D-14). The Search routine will move the antenna to the last known GPS location.

NOTE: If the elevation is above 60 degrees or the radiosonde is expected to change direction and track back close to the release point do not use the "Search" feature. Once this

condition no longer exists the search function may be used.

Exhibit D-14 Select Search track mode

- If the GPS signal is lost for more than 1 minute, the operator must look at the last usable position data and then manually move the antenna to that location.

NOTE: Under <u>Tables,</u> open <u>Processed;</u> the last azimuth and elevation data points are shown. If GPS was lost, scroll up to find the last data point.

2. Antenna Control is lost - (Signal Strength shown in Antenna Display < -113)

- If control of the antenna is lost during the flight, and no response is given to commands entered through the Antenna Orientation/TRS Display. Two different options are available.

NOTE: Place the Antenna in Manual Mode. Before resetting the TRS, determine in the Status Message Display window the time the TRS took for warm-up and initialization (prior to baseline). If the warm-up and initialization was longer than 3 minutes, the flight may terminate because of excessive missing data.

NOTE: Record the last azimuth/elevation and frequency.

- Press the TRS **Reset** button on the Hardware Status Display.

3. Once the TRS completes the reset, RWS will set the TRS frequency to the radiosonde frequency recorded during baseline.
   - If the last GPS calculated azimuth and elevation is available, RWS will then point the TRS to the last GPS calculated azimuth and elevation and perform a Limited Search for the radiosonde.
   - If the last GPS calculated azimuth and elevation is <u>not</u> available, RWS will point the TRS toward the release point and perform a Limited Search for the radiosonde.
4. In the event that the Limited Search is unsuccessful, the observer should verify the correct frequency and then manually move the TRS to the last known good position using the procedures listed in items 1 and 2. Remember, you must reacquire the signal within 3

minutes of the start of the missing data or the flight will automatically terminate due to "Excessive Missing Data".

21.1.2.3 RWS fails to detect release – Corrective action

1. After arriving back at the RWS, the observer notes that the RWS failed to detect release (See Exhibit D-15).
2. The observer should immediately click the yellow balloon icon above the flashing "Waiting for Target Release Time"

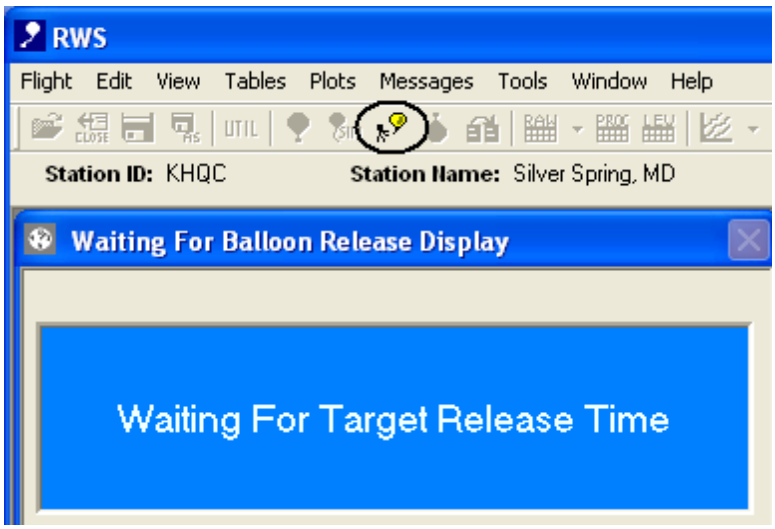


Exhibit D-15 Select yellow balloon icon to start flight

3. After the RWS completes its post release processing, the observer should open up the Raw PTU Tabular Display and located the pressure point where the pressure decreases uniformly.

IMPORTANT: To reduce the likelihood of release not being detected, observers must always check CDU for signal strength and frequency prior to release and immediately after release before returning to the office. Typically, TRS frequency shifts occur early in the flight .

NOTE: You should also verify the Geo-potential Height is increasing in the Processed Tabular Display. The first data above the surface should show at least a 2 meter increase from the station data at time 0.0.

21.1.2.4 MCU Overload with Rapidly Changing Angles – Corrective Actions

1. It is not unusual especially with light winds, or while tracking on a side-lobe, for the elevation and azimuth angles to change rapidly over a short period of time. If the RAW azimuth and elevation angles from the TRS are changing rapidly the antenna motor current will increase and generate a TRS Status message if the condition exists for more than four seconds. The tracking will be suspended for eight seconds. The Status Message that comes up for the TRS is the MCU: 0x0800 errors. (See Exhibit D-16a)

Date	UTC Time	Flight Status Message
02-16-2011	11:10:31.26	Successful release.
02-16-2011	11:11:35.30	TRS Critical HW: #1 MCU 000800 - Az over-current
02-16-2011	11:12:10.44	TRS Critical HW: #2 MCU 000800 - Az over-current
02-16-2011	11:12:41.39	TRS Critical HW: #3 MCU 000800 - Az over-current

Exhibit D-16A MCU 0x0800 Error Due to Difference in Raw and Processed Azimuth

2. If the Status Messages indicate a problem with the Motion Control Unit (MCU) the observer should take the antenna out of "Auto" track and place in "Manual" or "GPS" track mode until the azimuth and elevation angles are changing less rapidly. This condition is not unusual with high elevation angles or when a wind direction change occurs over a very short period of time. The inability for the TRS to drive the antenna over wide angular changes without exceeding the voltage again is the cause of the condition. ***If allowed to go unchecked, after five such Over-Currents the TRS will put the motor into "Over-Current Lock-out Mode" and the observer will no longer be able to control the TRS until the TRS is Reset.(See Exhibit D-16B)***

NOTE: RWS Build 2 has preventative feature that places RWS into "Manual" Track Mode if four (4) Motor Over-currents. RWS 2 will then visually and audibly alert the observer to the reattempt locking onto the radiosonde. While this feature will prevent most Over-Current Lock-outs, it is not perfect and Over-Current Lock-outs may still occur.

Date	UTC Time	Flight Status Message
02-16-2011	11:15:31.97	TRS Critical HW: RWS detected continuous MCU over-currents. The TRS may be in motor lock-out, which may require a TRS RESET and attempting to lock-on to the radiosonde to prevent missing data.

Exhibit D-16B TRS Over-Current Lock-out Mode Status Message

3. If this occurs, the TRS will have to be "Reset" from the Hardware Status Display (See Exhibit D-17A and D-17B).

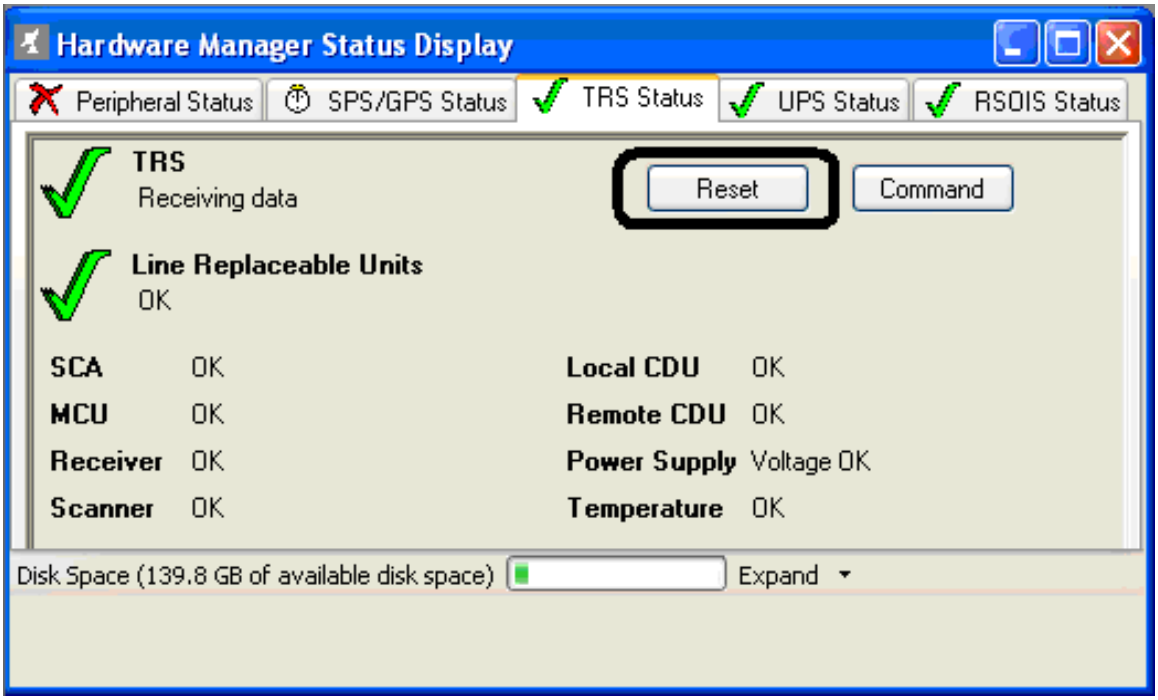


Exhibit D-17A TRS Reset button option

NOTE: If overhead conditions exist (elevation angles greater than 60 degrees), place the antenna into "Manual" track mode. The antenna should be kept in "Manual" and frequently pointed toward the radiosonde until the GPS derived elevation angles shown in the Processed Data Table decrease and show less erratic change. Alternatively, GPS Track Mode can be utilized until the radiosonde tracking movements are smaller.

Date	UTC Time	Flight Status Message
02-16-2011	11:15:31.97	TRS Critical HW: RWS detected continuous MCU over-currents. The TRS may be in motor lock-out, which may require a TRS RESET and attempting to lock-on to the radiosonde to prevent missing data.
02-16-2011	11:41:17.92	TRS Reset requested by operator... to be followed by a LimitedSearch.
02-16-2011	11:44:18.12	TRS Reset done. (See HW view)

Exhibit D-17B Operator requested TRS Reset Status Messages

21.1.2.5 Avoiding MCU Overload Errors through Launch Techniques

MCU 800 Error may be avoided by launching in “Manual” tracking and only placing the antenna into track after returning to the office. Upon returning to the office, follow the appropriate procedure below.

- If Radiosonde elevation is below 60 degrees and is expected to remain below 60 degrees elevation, the observer should point the TRS toward the radiosonde position and click on the **Search** button on the TRS display. The antenna will go into “Auto” track and “AFC” should be checked.
- If Elevation is above 60 degrees or is expected to go above 60 degrees, manually enter the azimuth and elevation angles from the Processed Tabular Display into the TRS display every 5 minutes until the elevation drops below 60 degrees and is expected to stay there. Once this occurs, place the antenna in “Search”. The antenna will go into “Auto” track and “AFC” should be checked.

NOTE: If the TRS has continuous problems tracking the radiosonde, contact the technician staff and use the GPS Track mode throughout the flight. The GPS Track mode is designed as a backup method to the standard tracking. If GPS data is missing, GPS Track Mode will not function and missing data will result.

21.1.3 Doing a Screen Capture

1. The first step in performing a “Screen Capture” is recognizing a problem. This may be by noticing a “Red X” on the “Hardware Status” display (See Exhibit D-18), seeing a Status Message, getting a Popup message, or just noticing incorrect data in the tabular display or plot.

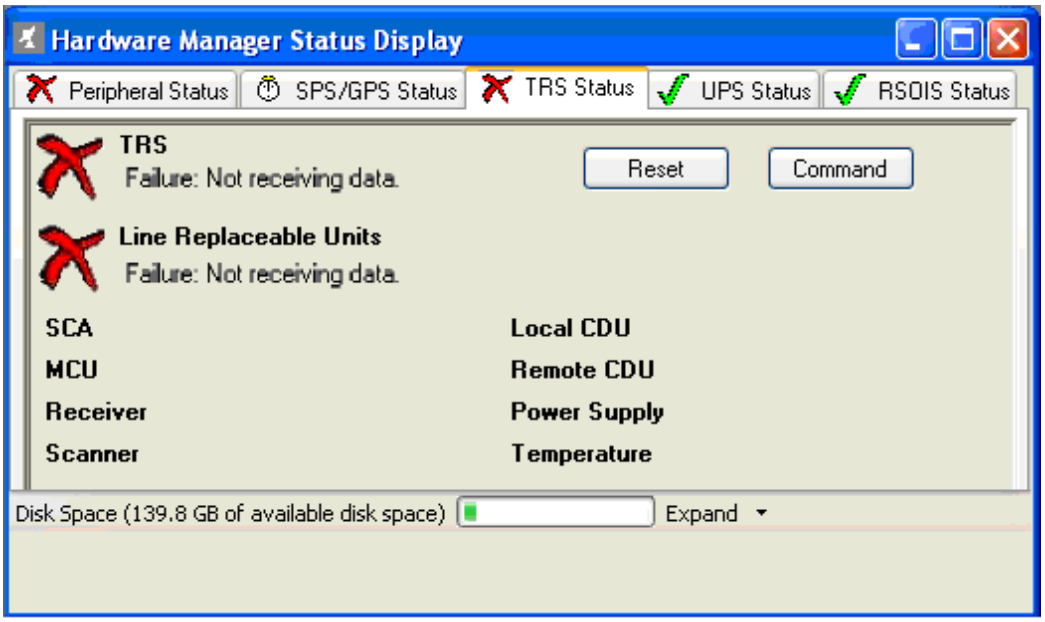


Exhibit D-18 TRS Reset button option

2. The second step to capturing the problem is after displaying the items you wish to capture is to hit the **Shift** key while pressing the **Print Screen** button. Minimize the RRS Program by clicking on the minimize icon. (See Exhibit D-19)

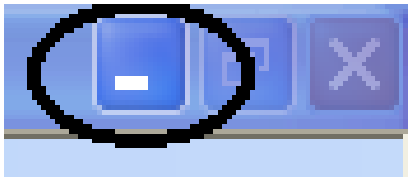


Exhibit D-19 Minimize Icon

3. The third step in capturing data or a display is to open WordPad. After opening WordPad do the following:

   - At the **File** Option, select **Page Setup** and select **Landscape** and click **OK**.
   - Click on the **Edit** Option and select **Paste**.
   - At the **File** Option, select **Save As**. Then, browse to the Desktop subdirectory and name the file and save it. Suggest using 3 letter Station ID and ascension number (See Exhibit D-21, i.e. ABQ388 – Albuquerque ascension number 388)

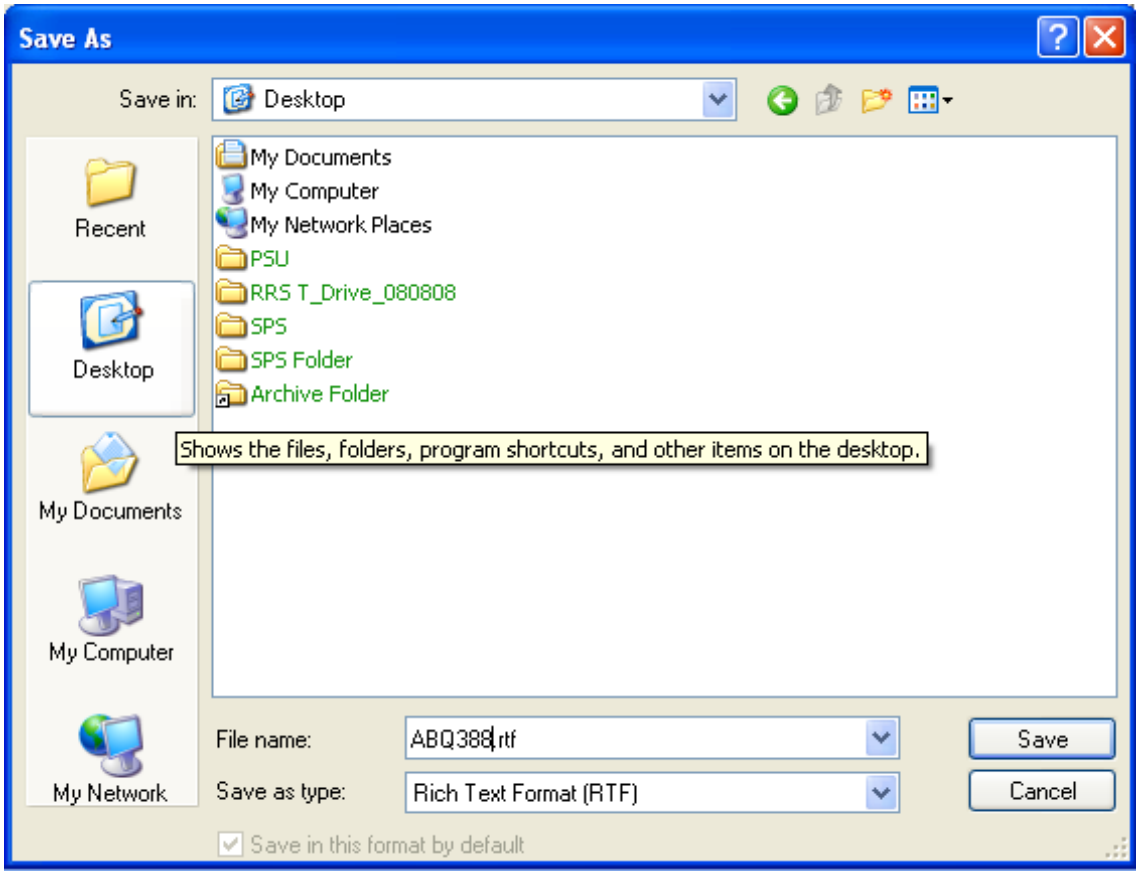


Exhibit D-20 Save screen capture on Desktop

21.1.4 Post-Flight Troubleshooting

If corrective action is taken to restore equipment operation and messages have not been transmitted. The observer may go into "Rework" and send the WMO Coded Messages up to 6 hours after flight termination.

Post-flight troubleshooting should also include going into the Offline Bit Utility (OBIT) and taking a closer look at equipment or Line Replaceable Unit indicating problems or failure. The data from the screen display after the diagnostics have run should be printed or captured for the electronics technician. An entry into the Engineering Management and Reporting System (EMRS) will be necessary.

21.1.5 Flight Capture Utility

The Flight Capture Utility is a program outside of RWS, that sends the RWS flight database file and associated log files to a FTP Server at NWSHQ. The Captured flights can then be review as a part of troubleshooting reported problems. The Flight Capture Utility can only be run when RWS Software is closed. Follow the steps below to Capture a flight.

1. Double click on the Capture Utility Icon (Exhibit D-21). The Capture Utility will start.

Exhibit D-21 Capture Icon

2. Select the flight to Capture from the pull-down list (Exhibit D-22).

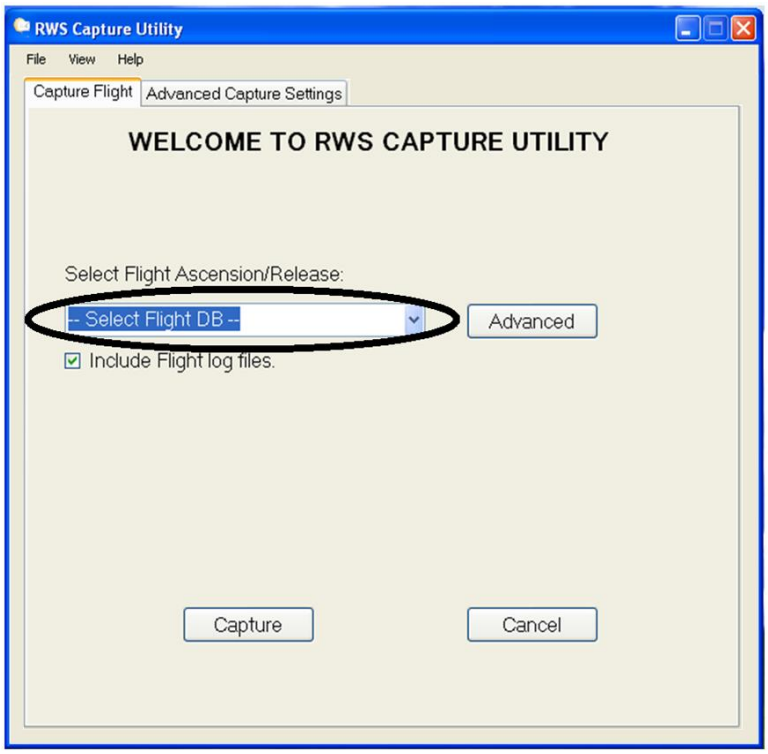


Exhibit D-22 Capture Utility

3. To include additional files in the Capture, select the **Advanced** button (Exhibit D-23). The Advanced Capture Settings will appear.

4. Click the **Browse** button to selected additional files (Exhibit D-24).

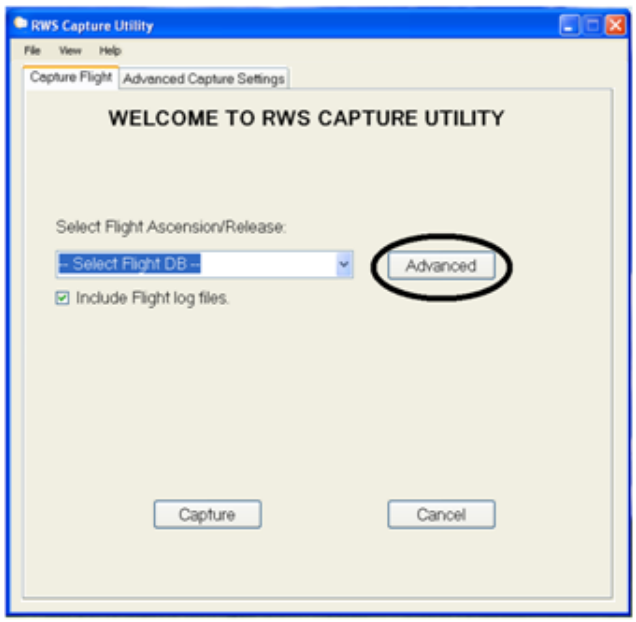


Exhibit D-23 Advanced Capture

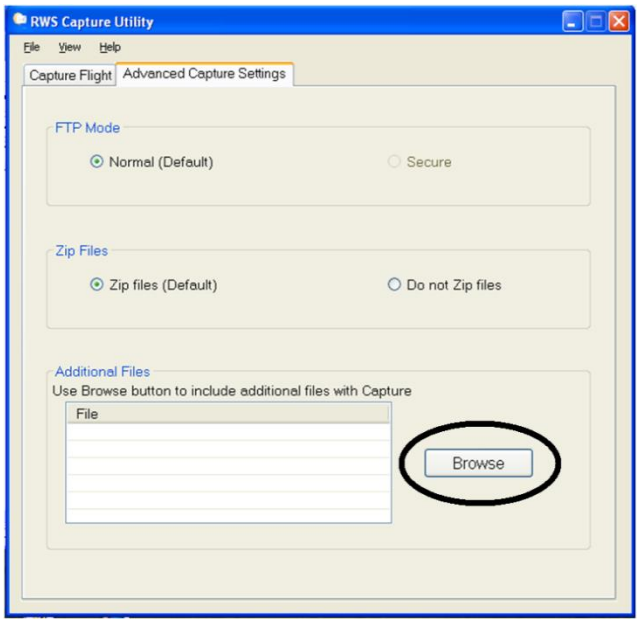


Exhibit D-24 Browsing for Additional Files

5. To Capture the flight database and associated files, click the Capture button (Exhibit D-24). The transfer may take several minutes depending on the connection speed. Once the transfer is complete the file name will appear on the screen (Exhibit D-25).

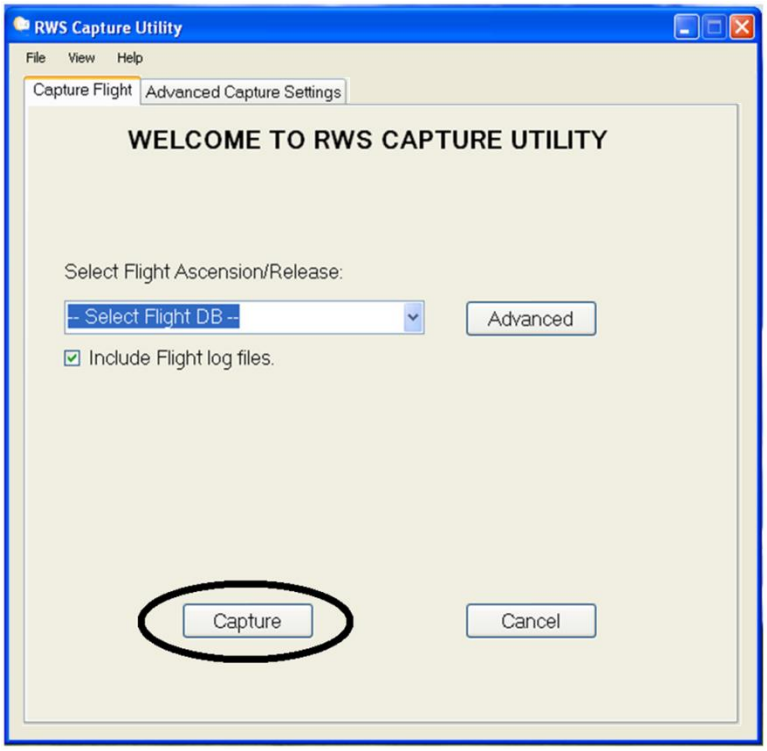


Exhibit D-24 Capturing Flight Files

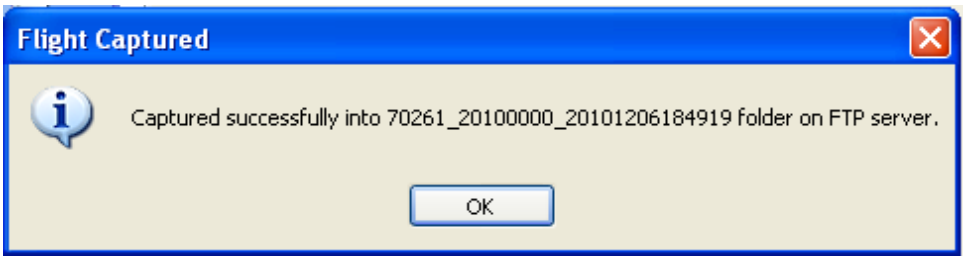


Exhibit D-25 Captured Filename

22 Appendix E – RWS Quick Guides

22.1 Overview

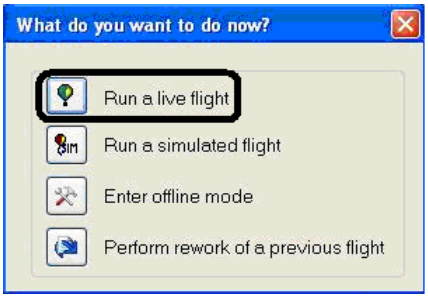
This appendix contains quick start guides as tools for observers. These guides do not contain all the details of the processes. For more information, refer to the sections referenced at the bottom of each Quick Start Guide.

22.2 QUICK GUIDE: Getting a flight started

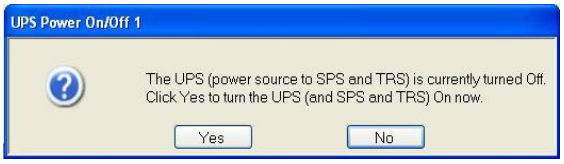
STEP 1 Double click the RWS Icon

STEP 2 Click **OK** in NOAA Warning Window

STEP 3 Select the icon next to **Run a Live Flight**



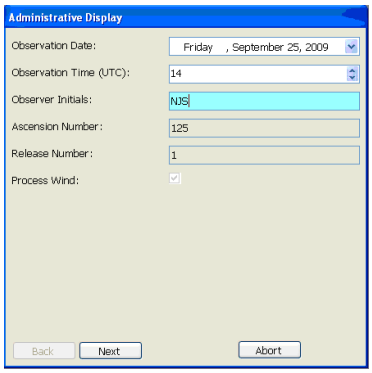
STEP 4 Click **YES** to Power UPS prompt



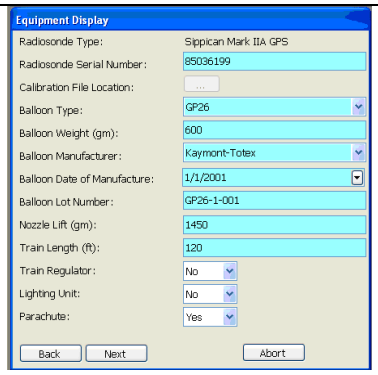
STEP 5 Prepare Balloon in accordance with NWSM10-1410

STEP 6 Prepare Radiosonde in accordance with NWSM10-1410

STEP 7 Complete Administrative Display. Then click **Next**.

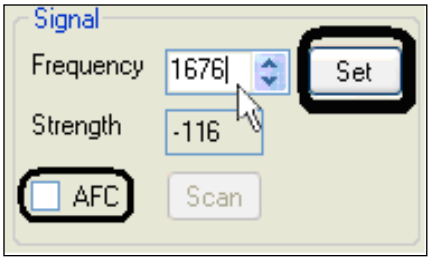


STEP 8 Complete Equipment Display.
Then click **Next**.



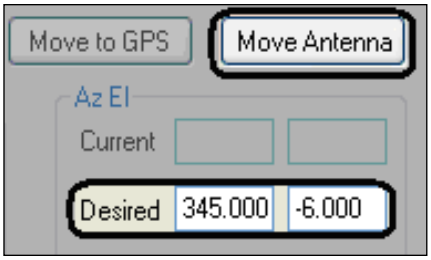
STEP 9 In the TRS Display, set the TRS to Radiosonde Frequency.

- Click the **Edit** button.
- Enter the radiosonde frequency
- Click the **Set** button
- Checkmark **AFC**

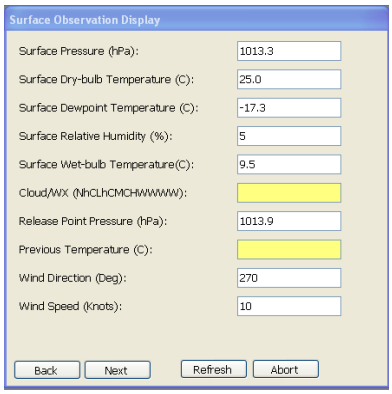


STEP 10 In the TRS Display, point the TRS toward baseline Az/EL

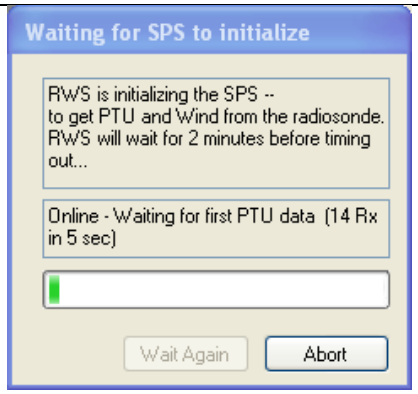
- Enter the baseline Az/El in the desired cells
- Click **Move Antenna.**



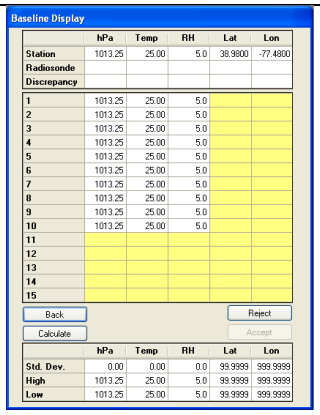
STEP 11 Complete Surface Observation Display. Then click **Next**.



STEP 12 Wait for SPS to Initialize and send data. If the SPS doesn't send data or initialize by the end of the progress bar, see Appendix D.



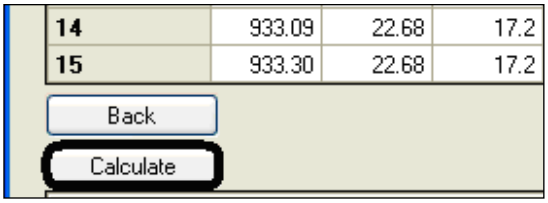
STEP 13 Once the SPS begins sending data, the Baseline Display will populate with data



	hPa	Temp	RH	Lat	Lon
Station	1013.25	25.00	5.0	38.9800	-77.4800
Radiosonde					
Discrepancy					
1	1013.25	25.00	5.0		
2	1013.25	25.00	5.0		
3	1013.25	25.00	5.0		
4	1013.25	25.00	5.0		
5	1013.25	25.00	5.0		
6	1013.25	25.00	5.0		
7	1013.25	25.00	5.0		
8	1013.25	25.00	5.0		
9	1013.25	25.00	5.0		
10	1013.25	25.00	5.0		
11					
12					
13					
14					
15					

	hPa	Temp	RH	Lat	Lon
Std. Dev.	0.00	0.00	0.0	99.9999	999.9999
High	1013.25	25.00	5.0	99.9999	999.9999
Low	1013.25	25.00	5.0	99.9999	999.9999

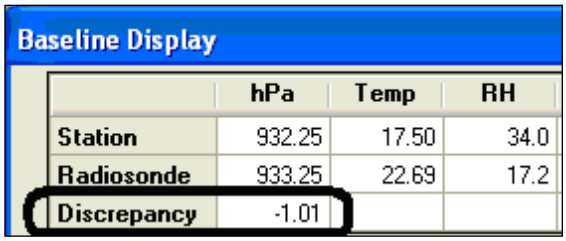
STEP 14 After receiving PTU, wait 5 minutes. This allows Pressure sensor to stabilize and GPS data to be acquired. Review PTU/GPS data for stability.
Then click **Calculate.**



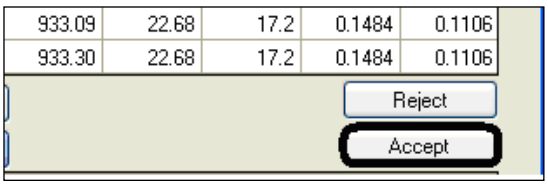
STEP 15 Pressure Discrepancy must be within,

+/-5 hPa for a LMS-6 sonde

+/-3 hpa for the RS92-NGP sonde



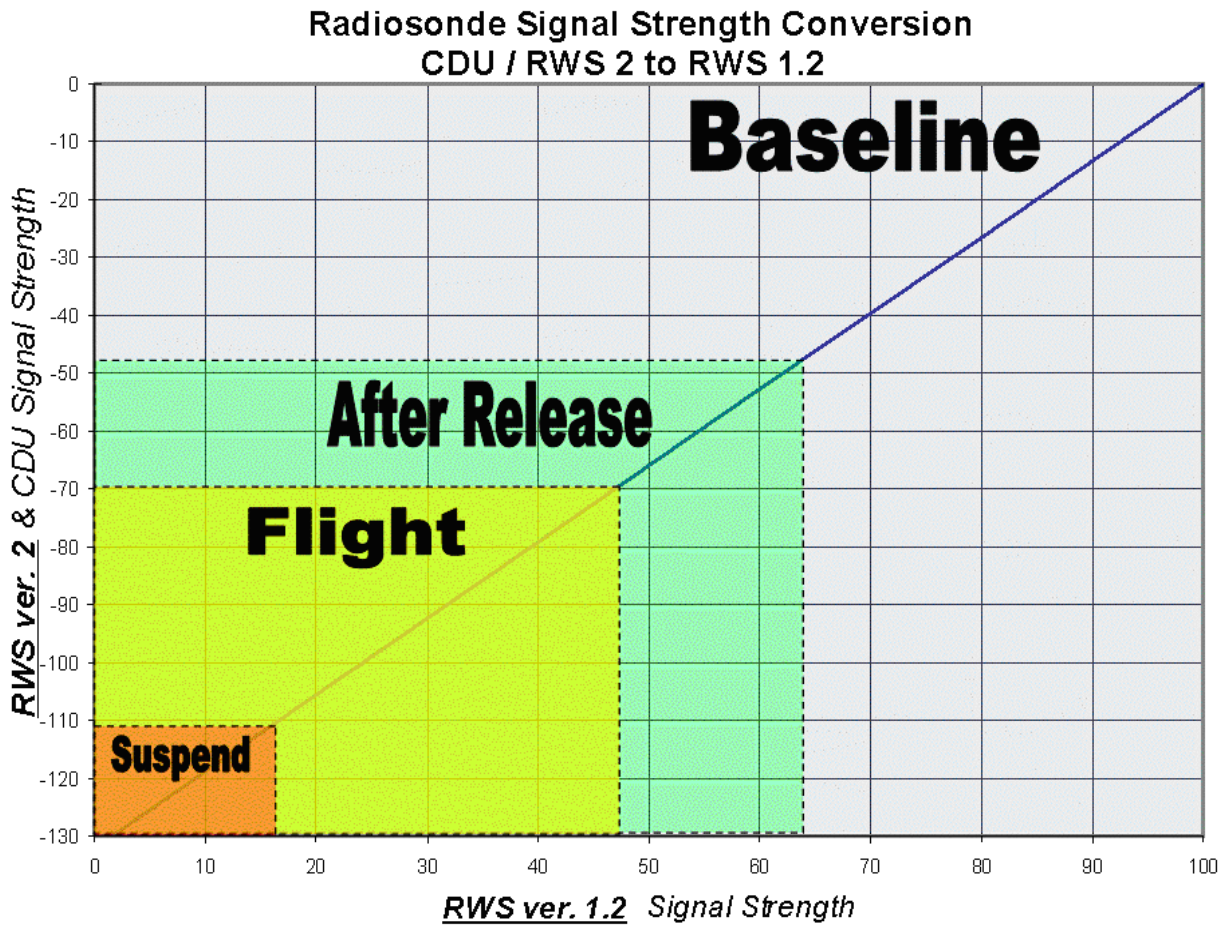
STEP 16 If the data looks acceptable, click the **Accept**.



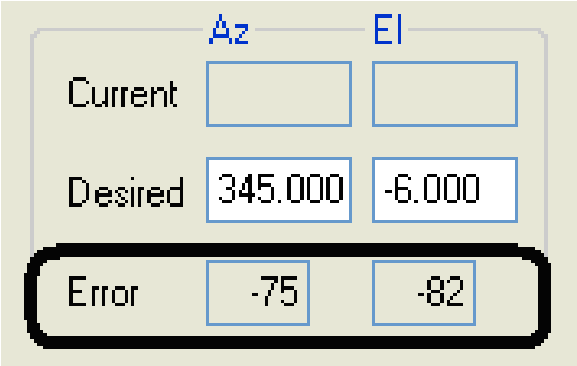
STEP 17 Launch the radiosonde in accordance with NWSM10-1410

22.3 QUICK GUIDE: Radiosonde Signal Strength

In RWS 1.2, the CDU and RWS used different Signal Strengths scales. In RWS 2, the CDU and RWS use the same Signal Strength scale. Below is a comparison plot



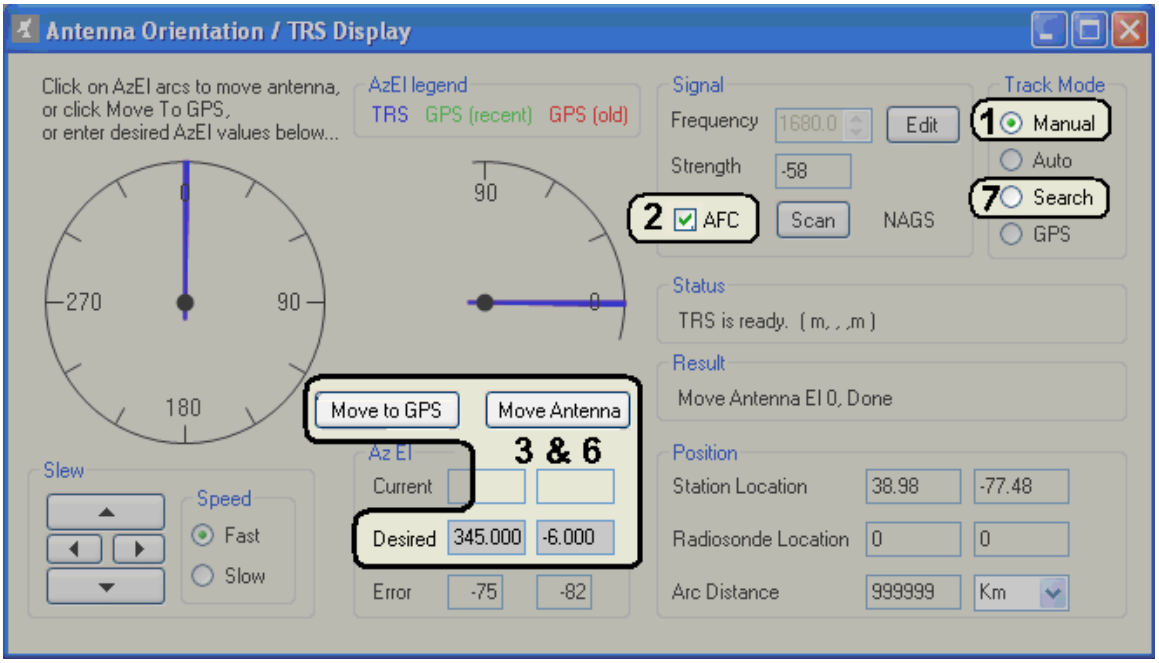
NOTE: The signal strength scale is representative only when the TRS Azimuth and Elevation Tracking errors are between +/- 20.



TRS Tracking Errors displayed in the TRS Display

22.4 QUICK GUIDE: Tracking the Radiosonde

Before launch	
STEP	**Description**
1	Before heading out the door check the raw data display on the bottom of the RWS data screen for accuracy. See Section 4.5 for more information.
2	In the TRS Display, put the TRS in **Manual** Track Mode.
3	Set the TRS to the Radiosonde Frequency. Turn AFC **ON**.
4	Point the TRS toward the direction the balloon is expected to travel. In the TRS Display, enter the desired azimuth and elevation into the TRS Display. Click the **Move Antenna** button.
5	If possible keep the radiosonde in near full view of the sky. This will reduce the chance of missing GPS data near the surface.
6	If possible, contact the office from the inflation building to have someone check the raw data display one more time for accuracy. Do not release the radiosonde if the data are bad.
7	Launch the radiosonde in accordance with NWSM10-1401.
After launch	
8	Point the TRS toward the direction of the balloon. In the TRS Display, enter the desired azimuth and elevation into the TRS Display. Click the **Move Antenna** button. OR Click **Move to GPS** (GPS Dependent) See Section 22.3 for expected signal strength.
9	In the TRS Display, put the TRS in **Search** Track Mode. The TRS will search for the radiosonde and will automatically switch to Auto Track Mode to track the strongest signal.

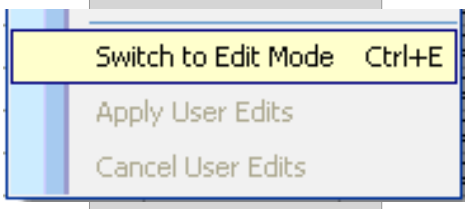


22.5 QUICK GUIDE: Marking Tabular Data

Marking Data: Processed Tabular Display

STEP 1: TO SWITCH TO EDIT MODE

Press **CTRL E** **OR** **Right Click**
Select **Switch to Edit Mode**



EDIT MODE INDICATOR

Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)
1013.85	85	25.00	23.83	5.0

Markable column header's change to Red

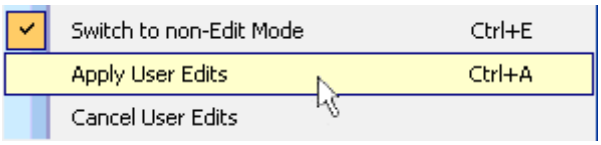
STEP 2: HIGHLIGHT DATA TO BE MARKED

Corrected Pressure (hPa)	Smoothed Pressure (hPa)	Geopotential Height (m)	Corrected Temperature (C)	Potential Temperature (C)	RH (%)
1013.85	1013.85	85	25.00	23.83	5.0
1012.50	1012.71	95	24.89	23.82	5.0
1011.75	1011.90	102	24.86	23.86	5.0
1011.01	1011.12	109	24.83	23.90	5.0
1010.26	1010.34	115	24.81	23.93	5.0
1009.52	1009.57	122	24.78	23.97	5.0
1008.78	1008.77	129	24.75	24.01	5.0
1008.03	1008.03	135	24.72	24.04	5.0
1007.29	1007.29	142	24.69	24.07	5.0
1006.55	1006.55	148	24.66	24.10	5.0
1005.80	1005.80	155	24.63	24.14	5.0
1005.06	1005.06	161	24.60	24.17	5.0
1004.32	1004.32	167	24.57	24.20	5.0
1003.58	1003.58	174	24.54	24.24	5.0
1002.84	1002.84	180	24.51	24.27	5.0
1002.10	1002.10	187	24.48	24.30	5.0

Click on cells to highlight cells

STEP 3: <u>APPLY USER EDITS</u>

Press **CTRL A** **OR** **Right Click**
Select **Apply User Edits**



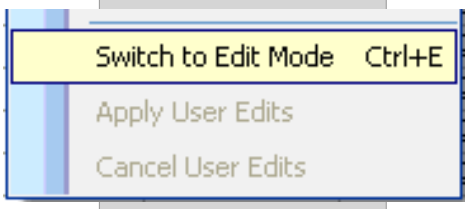
NOTE: < 1 minute Marked. Data will be interpolated.
> 1 minute Marked. Data will be rejected.

22.6 QUICK GUIDE: Marking Plot Data

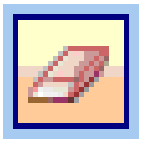
Marking Data: <u>Plots</u> (Pressure, Temperature & RH**)**

STEP 1: <u>TO SWITCH TO EDIT MODE</u>

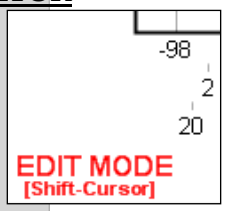
Press **CTRL E** **OR** **Right Click**
Select **Switch to Edit Mode**



<u>EDIT MODE INDICATOR</u>

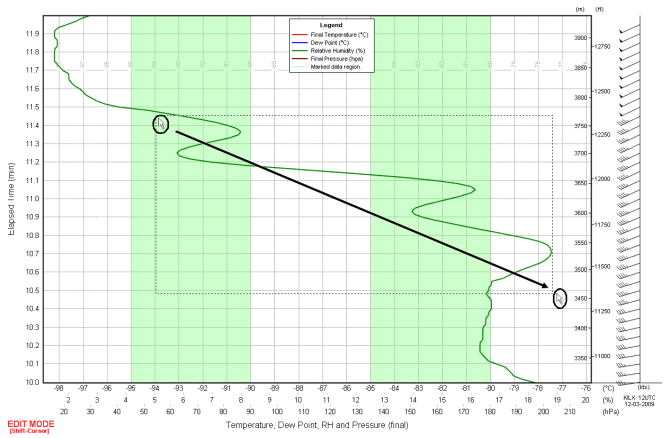


Icon is highlighted



Red Edit Mode Appears

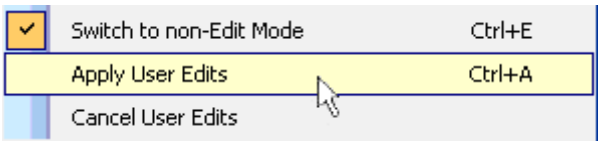
STEP 2: <u>HIGHLIGHT DATA TO BE MARKED</u>



Hold **Shift** key + **Left Click**
Drag a box around data to Mark.

STEP 3: <u>APPLY USER EDITS</u>

Press **CTRL A** **OR** **Right Click**
Select **Apply User Edits**

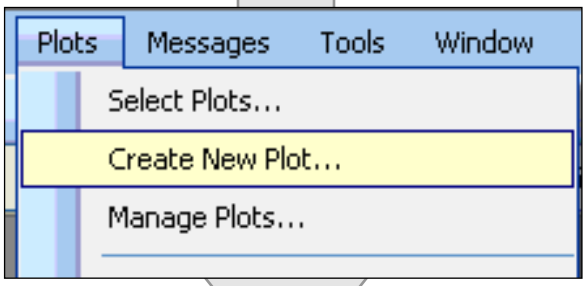


NOTE: < 1 minute Marked. Data will be interpolated.
> 1 minute Marked. Data will be rejected.

22.7 QUICK GUIDE: Creating a New Plot

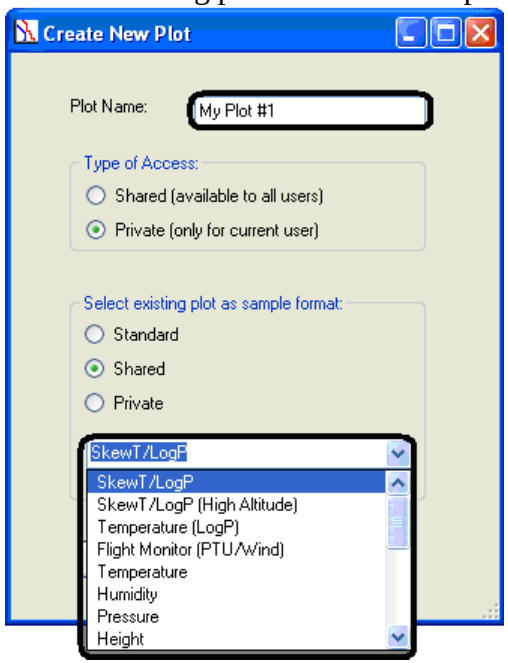
STEP 1:

Select **Create New Plot…** from the **Plots** pull-down menu



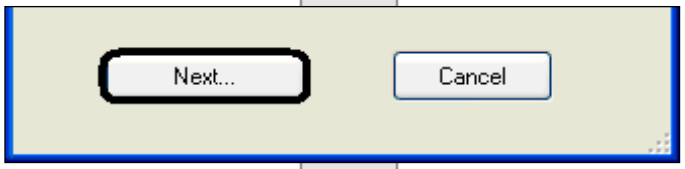
STEP 2:

Enter a unique ***Plot Name*** and
Select an existing plot to use as a template



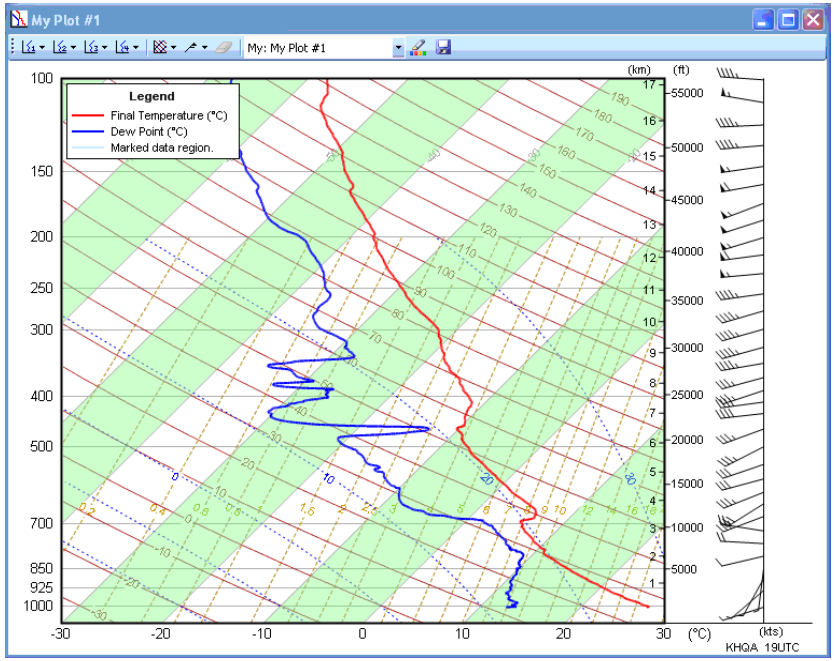
STEP 3:

Click **Next** in the Create New Plot window
The new plot will appear.



STEP 4:

Right click and select **Plot Format Designer** to customize the plot further



23 Appendix F – Radiosonde Preparation Instructions

It is essential that operators follow the instructions for preparing the radiosonde exactly as stated to help ensure an accurate and trouble-free observation.

23.1 Introduction to Vaisala Radiosonde RS92-NGP

The RS92-NGP radiosonde features a GPS receiver for wind finding. The robust code-correlating GPS offers a significant improvement to wind data availability. The radiosonde has a silicon pressure sensor, a heated twin humidity sensor, and a small, fast temperature sensor. The synthesizer-based transmitter is stable and uses a narrow bandwidth.

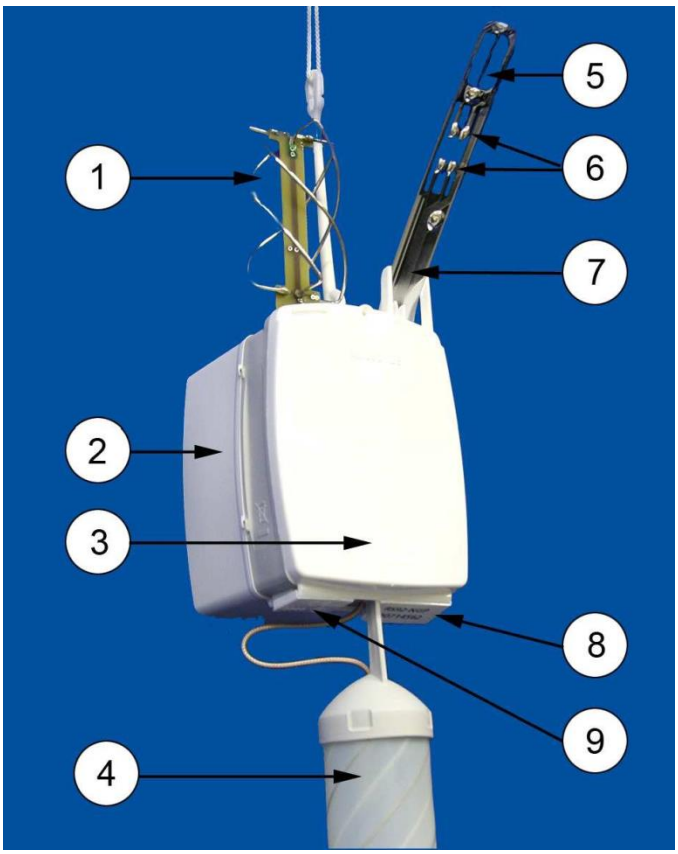


Exhibit F-1 Vaisala Radiosonde RS92-NGP

1	=	GPS antenna
2	=	Battery casing

3 = Vaisala radiosonde RS92-NGP
4 = Antenna, mailing bag inside
5 = Temperature sensor
6 = Humidity sensors
7 = Sensor boom
8 = GC25-FSD interface
9 = Additional sensor interface

1 Vaisala Frequency Setting Device GC25-FSD

Vaisala Frequency Setting Device GC25-FSD is used to recondition the humidity sensors and set the frequency of the radiosonde. The GC25-FSD is designed to be used exclusively with Vaisala Radiosonde RS92-NGP.

The Frequency Setting Device has a power supply and a communication connector for the radiosonde. It is also equipped with buttons that are used to set the frequency of the radiosonde.

Exhibit F-2 Vaisala Frequency Setting Device GC25-FSD

1 = Display
2 = Buttons
3 = Communication cable
4 = Radiosonde tray
5 = Power switch

2 Radiosonde Launch Preparation

This section contains information that is needed to operate RS92-NGP radiosonde.

It is essential that you carry out the preparation steps as instructed and always in the same way. Follow the instructions in the following sections for a successful sounding.

The general work order for a sounding is as follows:

a. Unpack the radiosonde.

b. Perform sounding preparations.

c. Connect the battery set.

d. Prepare the balloon.

e. Launch the radiosonde.

3 Unpacking the Radiosonde

Follow these steps to unpack the radiosonde.

CAUTION

Do not touch or hit the sensors on the sensor boom. Be careful not to bend the GPS antenna. By carefully handling the radiosonde, the sensor boom, and the antennas you ensure that the radiosonde functions properly during sounding.

Open the foil bag as indicated on the bag.

Exhibit F-3 Opening the foil bag

Lift the cardboard flap protecting the sensor boom. Be careful to avoid touching or hitting the sensors on the sensor boom. Remove the battery and radiosonde from the carton package.

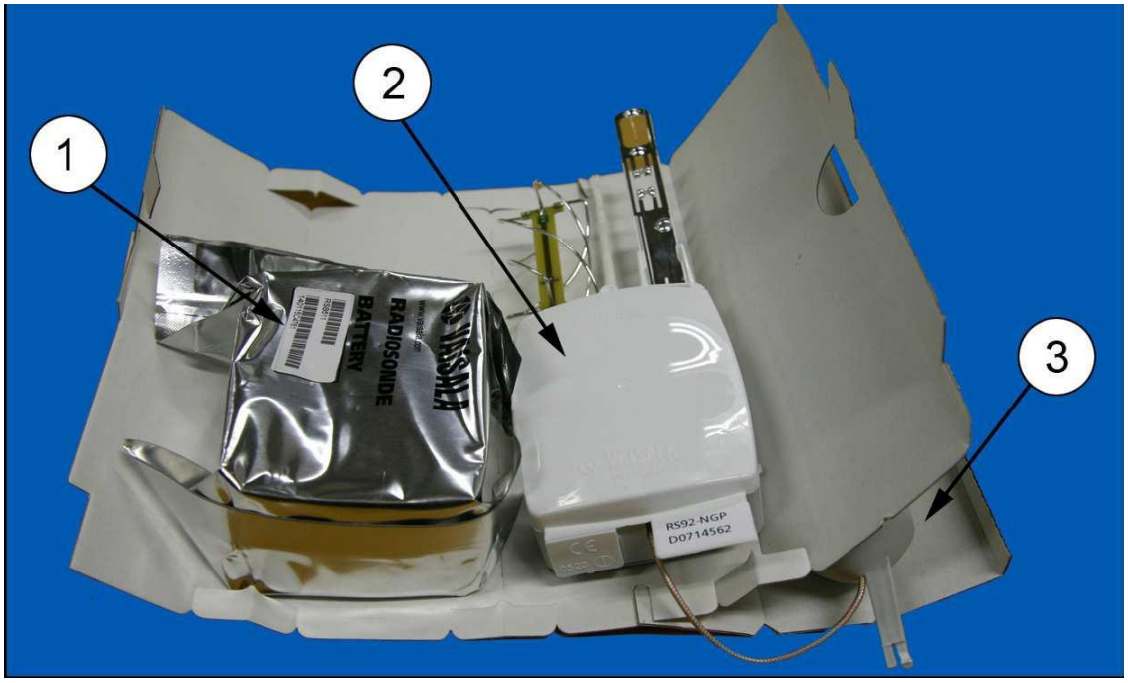


Exhibit F-4 Contents of the radiosonde package

The following numbers refer to Figure 77:

1 = Battery
2 = Radiosonde
3 = Antenna

4 Prepare the radiosonde for launch with Frequency Setting Device GC25- FSD

NOTE

Connect the radiosonde battery only after you have performed the sounding preparations as instructed in this section. Frequency setting is possible only when the battery is not connected.

Place the radiosonde on the radiosonde tray of the Frequency Setting Device by carefully sliding the lifting post to its place.

Exhibit F-5 Placing the radiosonde in the Frequency Setting Device

Exhibit F-6 Correct placement of the radiosonde in the Frequency Setting Device

Connect the communication cable to the GC25-FSD interface in the radiosonde. The text "UP" on the connector faces upwards.

Exhibit F-7 Connecting the communication cable

Switch on the Frequency Setting Device by pressing the power switch. The green LED in the power switch is lit.

The message "RS92-NGP detected" appears on the display. The Frequency Setting Device sets the default frequency of 1680 MHz automatically and starts to recondition the humidity sensor.

The reconditioning takes three minutes. The remaining time is shown on the display.

If you want to set another frequency, change the channel by pressing the buttons below the display at any time when the Frequency Setting Device is switched on and the radiosonde is connected to it.

Exhibit F-8 Channel selection buttons

Channel Frequency:

CH1 1676 MHz
CH2 1678 MHz
CH3 1680 MHz (default setting)
CH4 1682 MHz

When the Frequency Setting Device has finished the reconditoning, the message "Radiosonde is ready" appears on the display. Switch off the Frequency Setting Device, remove the radiosonde from the tray and disconnect the communication cable.

Open the right side lid. Attach the antenna and close the lid. Make sure it clicks into place.

> **CAUTION**
>
> **When handling the antenna, be careful not to bend or twist it. The antenna is flexible and resistant, but excessive force may cause damage to it.**

Exhibit F-9 Take a firm grip of the antenna's connection end

Exhibit F-10 Inserting the antenna clip into the opening

To ensure proper ventilation of temperature and humidity sensors during flight, the sensor boom must be placed into flight position.

Bend the sensor boom gently with your fingers so that it holds in angle position between the holders as shown in figure 9. You may have to spread the clips slightly. Do not touch the sensors.

CAUTION
Touch only the bottom of the boom. Do not touch or hit the sensors.

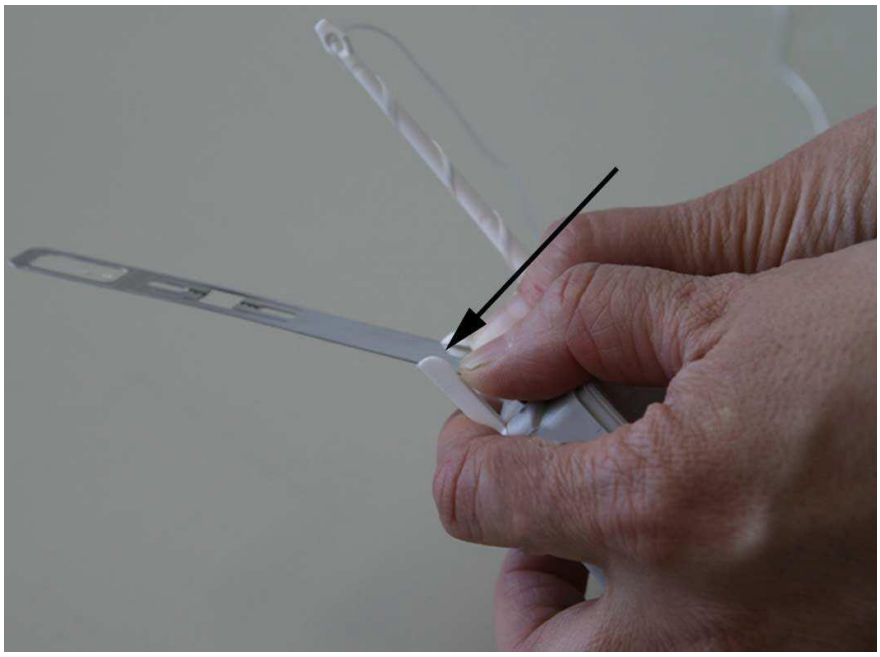


Exhibit F-11 Placing the sensor boom into flight position

The sensor boom is now in the flight position and remains so throughout the sounding.

5 Connecting the Battery Set

The radiosonde is powered by Dry-Cell Battery Set RSB531. Open the foil bag

as indicated in the bag.

Exhibit F-12 Battery package for RSB531

Take out the battery connector by pulling the wires gently. Connect the battery connector to the radiosonde.

Exhibit F-13 Connecting the battery connector to the radiosonde

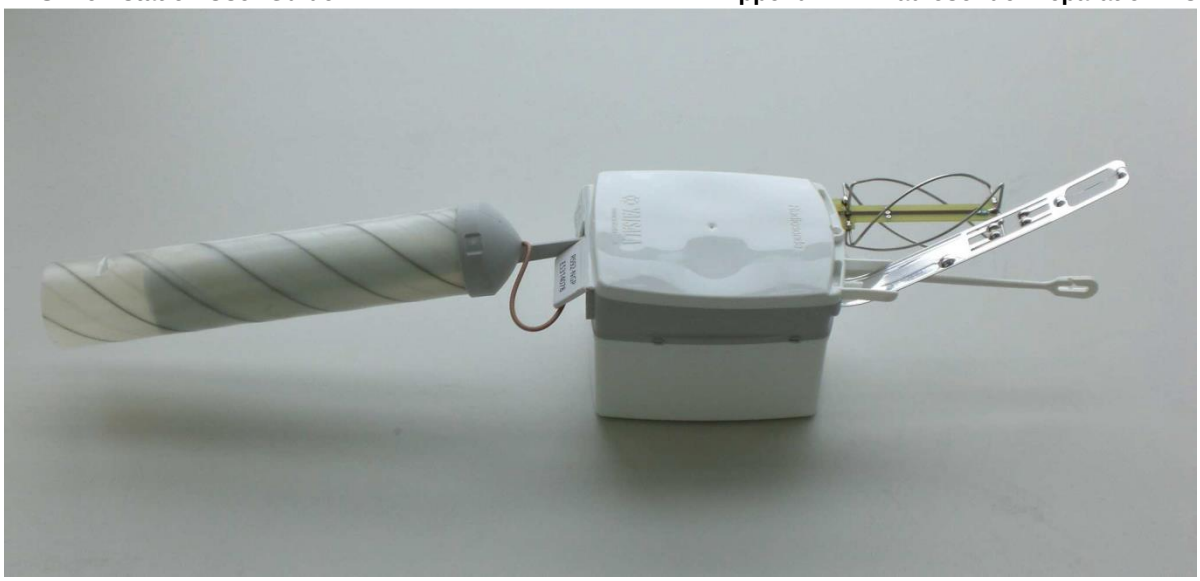


Exhibit F-14 The radiosonde is ready for attachment to the flight train

The radiosonde has now been activated. Close the battery casing firmly as it shown in Figure 12. In order to ensure 120 minutes of flight time, the radiosonde has to be launched within 30 minutes of battery connection.

6 Evaluating Baseline Radiosonde Performance

Evaluate the radiosonde baseline performance according to instructions issued by the National Weather Service.

If the radiosonde's pressure value is ± 3hPa off from the pressure reference, reject the radiosonde. The radiosonde should also be rejected if there is visible damage to the antennas or the sensor boom.

Carefully check the raw temperature and RH data for accuracy. Reject the instrument and start over with a new radiosonde if the values are erroneous.

The radiosonde is now prepared for launch. Place the radiosonde onto the radiosonde stand and proceed to the launch site to prepare the balloon.

7 Preparing the Balloon

Prepare the balloon according to instructions issued by the National Weather Service. Proceed to launch the radiosonde.

8 Launching the Radiosonde

You can now attach the balloon string to the radiosonde.

9 Using the Lifting Post

Follow these instructions to attach the balloon string to the radiosonde.

Make a loop with one end of the string and tie it with a knot.

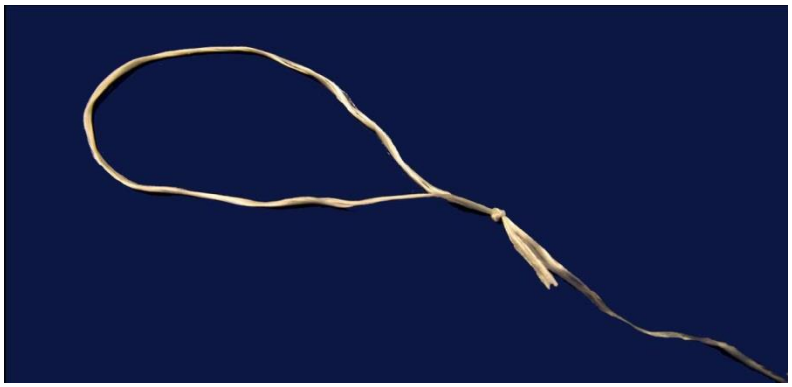


Exhibit F-15 Making a loop with the string.

Hold the loop with your thumb and index finger. Insert the string into the opening in the top part of the lifting post.

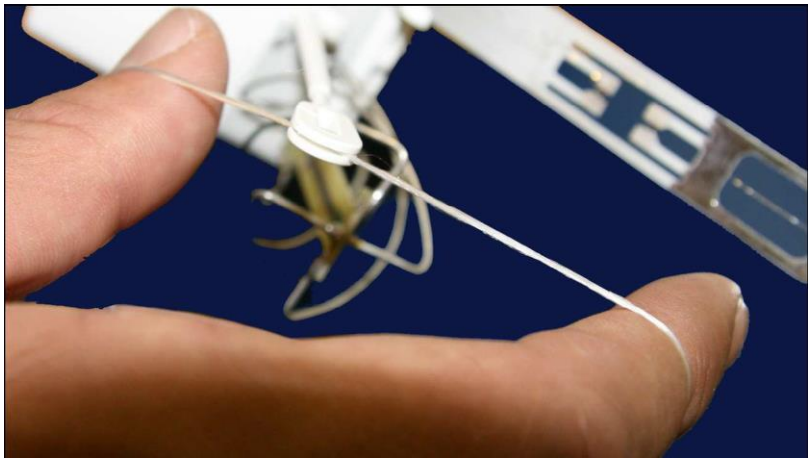


Exhibit F-16 Inserting the string into the opening of the lifting post

Slide the string through the opening to the gaps in the eyelet.

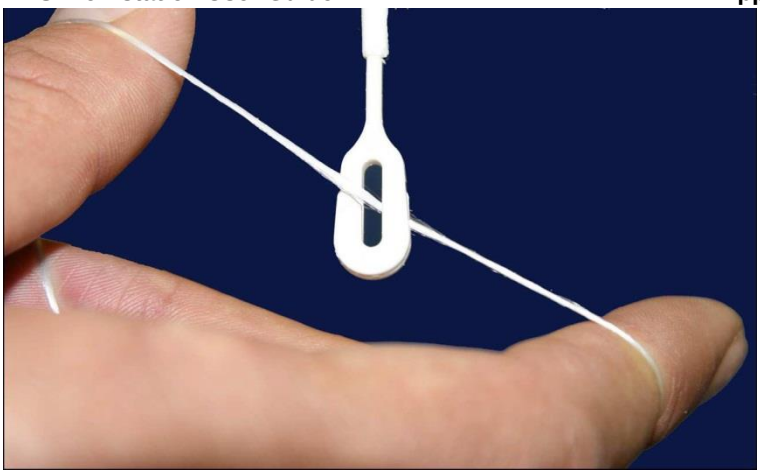


Exhibit F-17 Sliding the string through the opening

Turn the string slightly and guide it through the gaps on both sides of the eyelet. The string is now firmly attached to the lifting post.

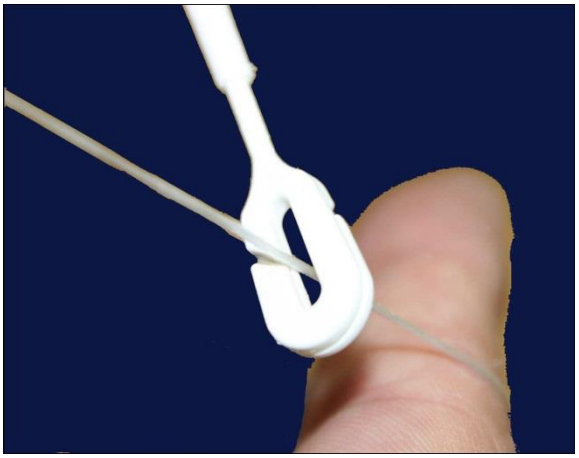


Exhibit F-18 Guiding the string through the gap

IMPORTANT
After attaching the string to the lifting post, cut off any excess string hanging from the loop knot to keep it from hitting the sensor boom and contaminating the temperature and RH data. Leave about an inch of string from the knot. See Exhibit F-15.

10 Releasing the Balloon

In order to ensure 120 minutes of flight time, the radiosonde must be launched within 30 minutes of battery connection. Follow these steps to release the balloon.

a. Make sure that the balloon string is not tangled.

b. Release the balloon and allow the radiosonde to lift from your hand. Do not release the instrument with it lying on the ground.

Immediately after the release, check the reception of the radiosonde frequency on the receiver. Proceed to monitor the sounding data on the RWS workstation.

23.2 The Lockheed Martin Sippican LMS-6 Radiosonde

Pre-Flight Preparation Instructions for the LMS6 RRS Radiosonde

1. Remove the radiosonde from the plastic bag and deploy the temperature sensor and RH sensor as seen in figure 1. Also remove the smaller plastic bags that cover the sensors themselves and discard.

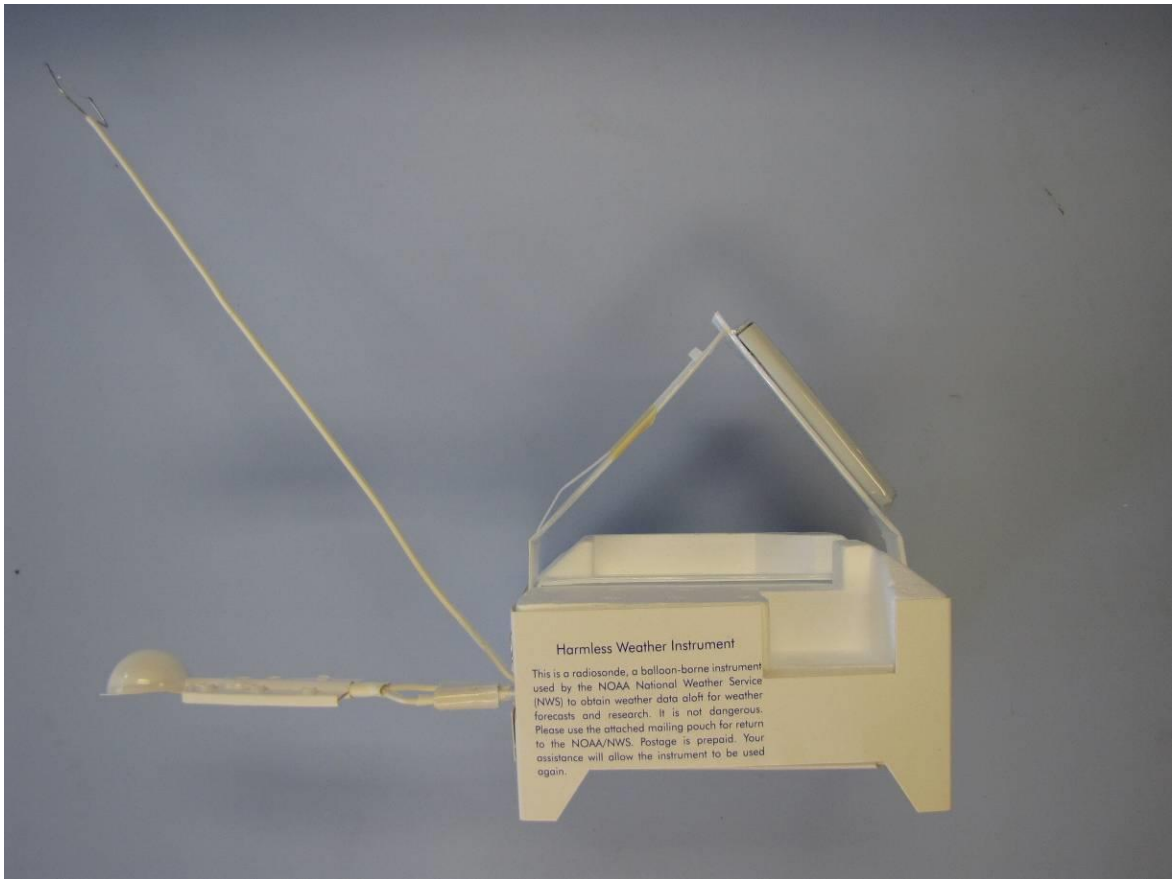


Figure 1 – Unpacked Radiosonde with Sensors Deployed

2. Selecting transmitter frequency

   2.1 Hold radiosonde in the orientation shown in figure 2.

   2.2 Lift "Set Frequency" flap to expose dip switch. The default frequency of the radiosonde is 1676 MHz (all switches pushed up).

   2.3 To change frequency, push the dipswitches into the positions as seen on the label in figure 3. A pen or pencil is a useful tool to push the dipswitches.

2.4 Remove paper backing from “Set Frequency” flap and close. Run finger across the flap to seal.

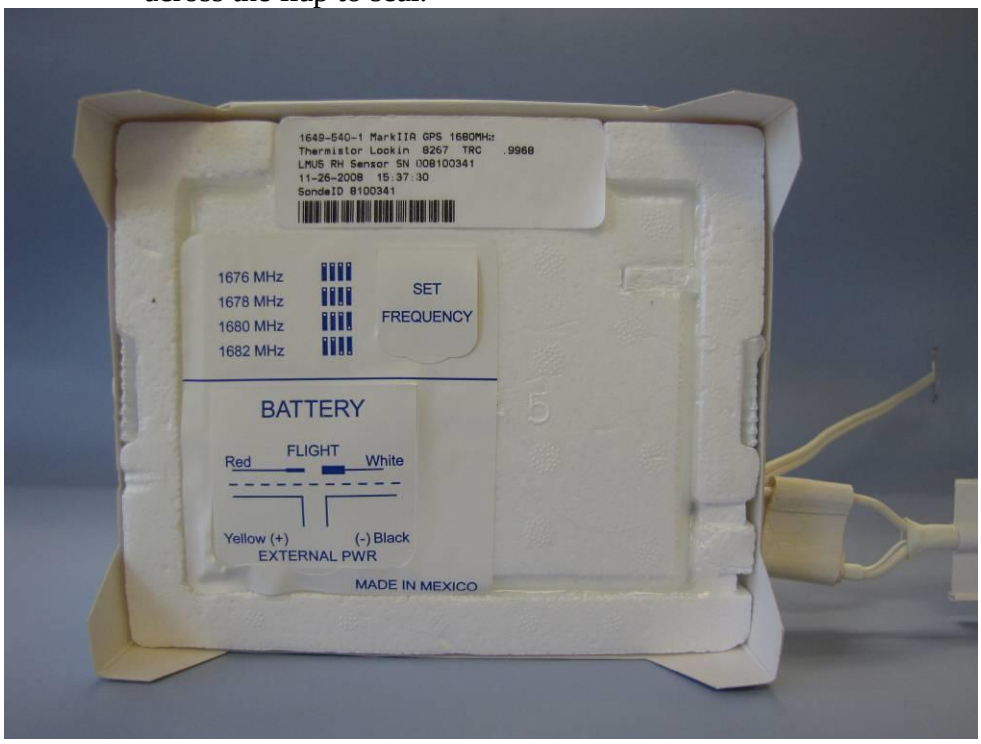
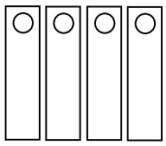
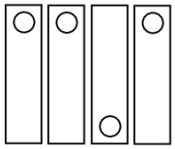
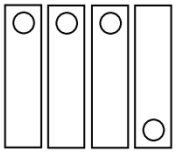
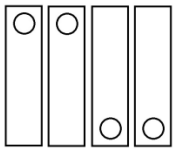


Figure 2 – Location of Frequency Switch and Power Plug

Figure 3 – Changing the Dipswitch

Frequency	Dip Switch Setting
1676 MHz	
1678 MHz	
1680 MHz	
1682 MHz	

3. Powering up the radiosonde

3.1 Hold radiosonde in orientation shown in figure 4 and lift “Battery” flap.

3.2 If powering the radiosonde for flight, connect the red and white wires. See figure 5.

3.3 The radiosonde can also be connected to an external power supply. This is achieved by taking the red (+) and black (-) wires and connecting them to the supplied LMS-6 power supply. When the sonde is ready to be flown, the power supply is disconnected and the red and white wires connected as in step 3.2.

3.4 Tuck all of the wires into the sonde. Remove the paper backing from the back of the “Battery” flap and close. Run finger across the flap to seal. See figure 5.

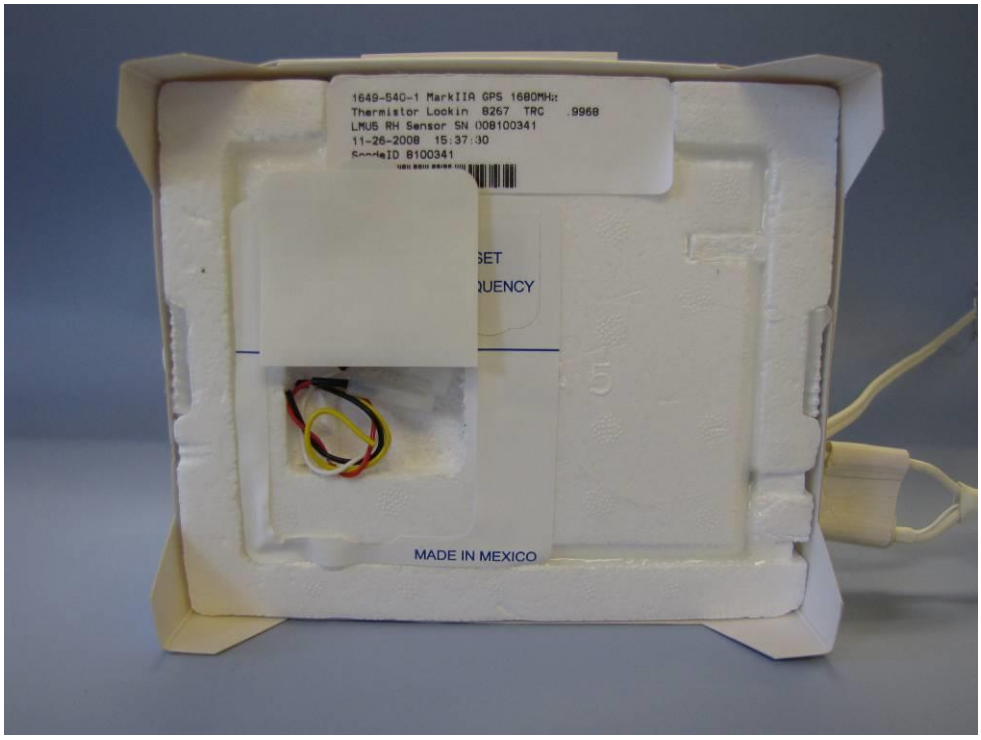


Figure 4 – Location of Battery Wires

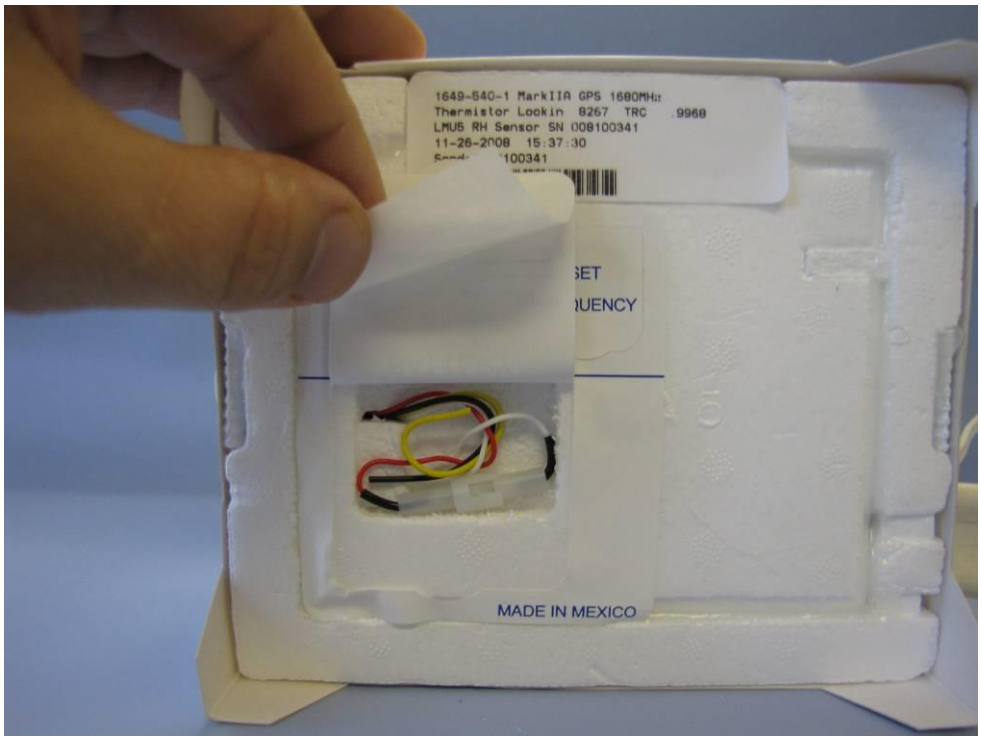


Figure 5 – Preparing the wires for flight

4. Establishing GPS lockup

4.1 Place the radiosonde in an area with a clear view of the sky in order to be able to receive the signals from the GPS satellites. Alternatively, the radiosonde can be placed under a GPS repeater if one is available. The radiosonde should attain GPS lock up in about 90 seconds.

5. Preparing for launch

5.1 Remove the adhesive backing from the bottom panel of the sleeve. See figure 6.

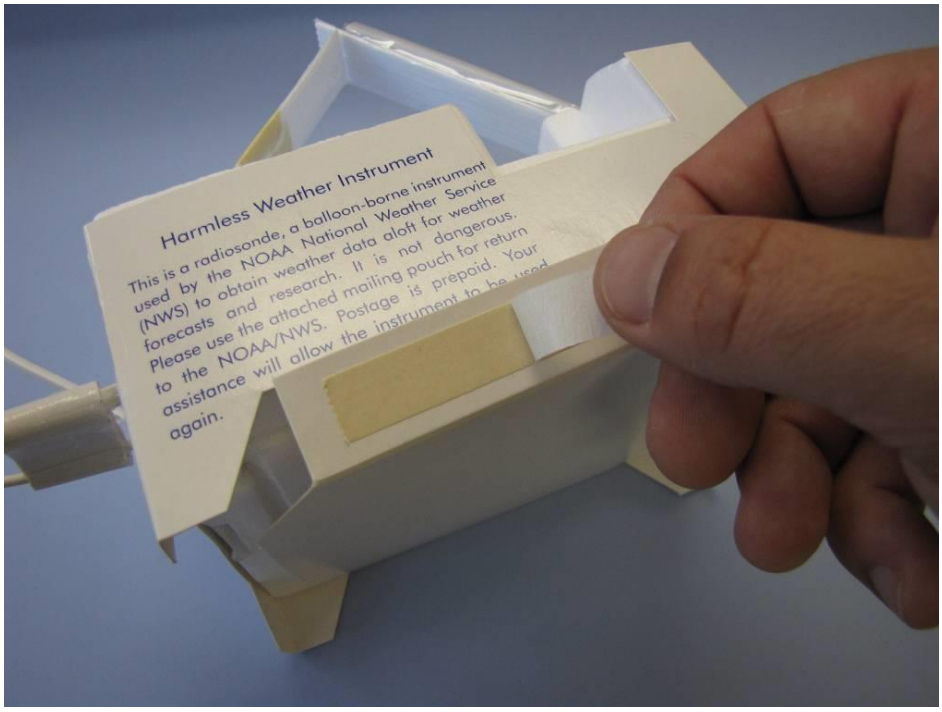


Figure 6 - Removing the Adhesive Backing.

5.2 Tuck the flap under the sleeve and run finger across to seal. See figure 7.

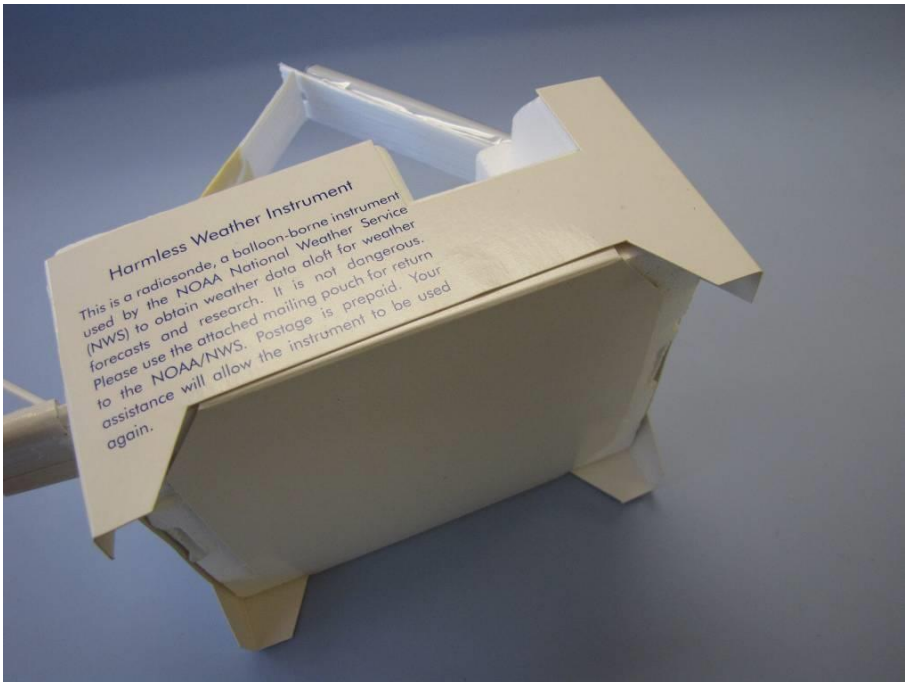


Figure 7 - Sealing the bottom of the sleeve.

5.3 Use the supplied cable tie to connect the corroplast lifting arms. Leave a loop so the string from the balloon train can be attached. See figure 8.

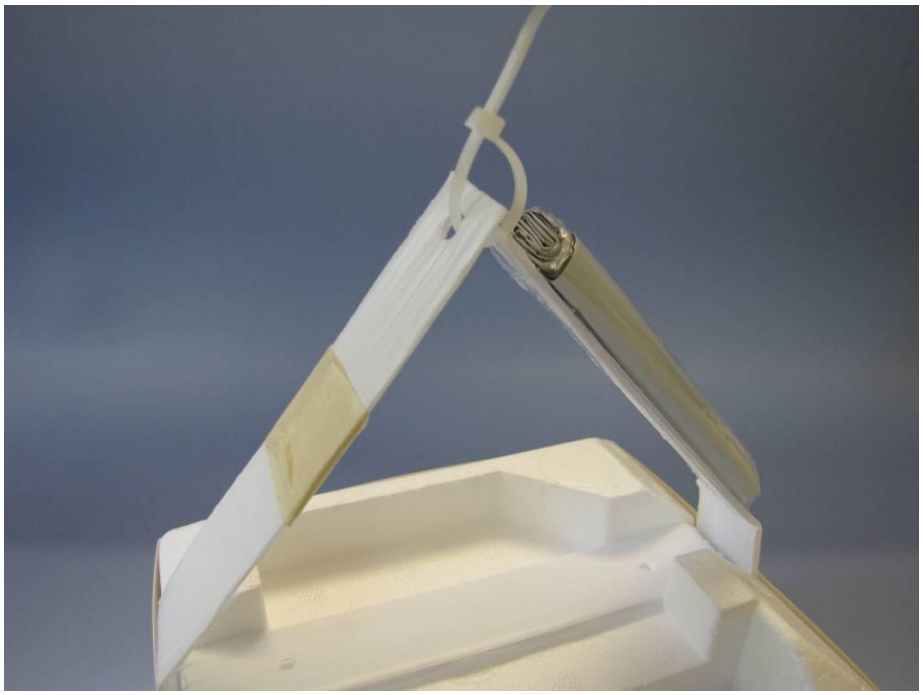


Figure 8 – Preparing the lifting arms

5.4 Attach the radiosonde to the balloon train and launch.