ProfileDisplay User's Guide

Version 6

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1.0   Introduction

This document provides a description for the use of ProfileDisplay (PDISP). ProfileDisplay was developed under contract to the Operational Products Development Branch (OPDB) of the Satellite Meteorology and Climatology Division (SMCD) of the Center for Satellite Applications and Research (STAR) of the National Environmental Satellite, Data and Information Service (NESDIS) of the National Oceanic and Atmospheric Administration (NOAA).

PDISP was originally developed to support the display of collocated profiles from the Tiros-N Operational Vertical Sounder (TOVS) and the Defense Meteorological Satellite Program (DMSP) satellite systems. The original version was written in BASIC and ran under DOS. The DOS version was eventually replaced with a version written in Java that runs on multiple operating systems. The new version was capable of displaying data from a variety of satellite systems including the Advanced Tiros-N Operational Vertical Sounder (ATOVS).

ProfileDisplay evolved over the years to include greatly enhanced functionality. While the primary focus of the current version is still the display of collocated radiosonde and satellite profiles, the program can now do much more including the calculation and display of vertical accuracy statistics and scatter plots.

With the development of the NPOESS Product Validation Summary System (NPROVS), ProfileDisplay was updated further and included as part of the NPROVS graphics software. As part of NPROVS the program was modified to provide the ability to display data from all satellite systems that are processed by NPROVS including GOES, Aqua-AIRS, IASI, MIRS and COSMIC.

2.0   Overview

ProfileDisplay performs five overall functions: profile display, sub-selection, raw data display, vertical statistic display and scatter plot display. Switching between these five functions can be done by selecting one of the tabs that appear near the top of the window. The location of the tabs varies depending on the operating system being used but it is usually location underneath the toolbar (figure XX).
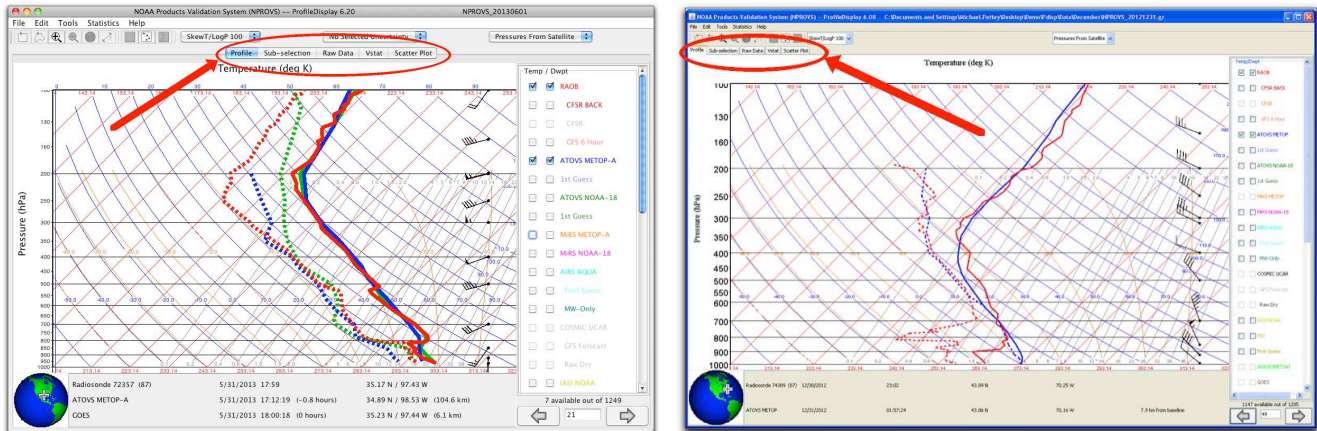

Figure XX — Location of tabs that switch between major program functions
(Macintosh on the left, Windows XP on the right)

2.1   Profile Tab

When selected, the profile tab displays temperature and moisture profiles from a variety of satellite systems as well as other sources including forecast analysis data. Temperature profiles appear as solid lines while moisture (dewpoint temperature) data appear as dashed lines.

Along the right side of the window are checkboxes that correspond to every available temperature and moisture profile. These can be selected and unselected to turn the display of each profile on or off.
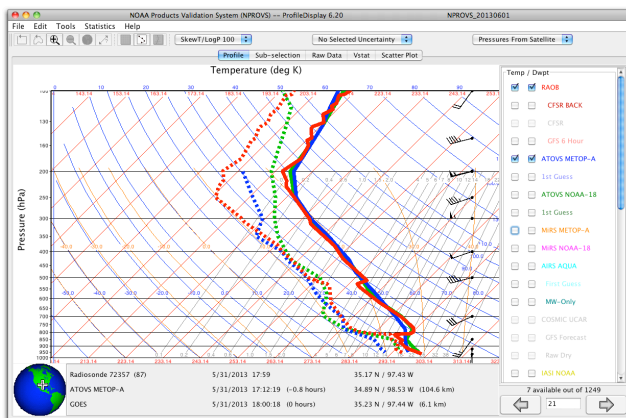
Beneath the checkboxes in the lower right corner of the window are arrow buttons. The files read by ProfileDisplay contain many records each of which contains data from multiple satellites collocated with a ground truth observation. The graph in the Profile tab displays one such collocation at a time. The left and right arrow buttons are used to switch to different collocation. Additionally, a specific collocation/record number can be entered in the text box between the arrow buttons.

2.2 Sub-selection Tab

The sub-selection tab contains many controls that allow for the sub-selection of available collocations. The controls can be combined to quickly focus on a specific subset of collections that match the selected criteria. The settings from the sub-selection tab affect the profiles that are available for display within the profile and raw data tabs. The settings also are used when calculating the statistics that are display in the vertical statistic and scatter plot tabs.

The upper right part of the sub-selection tab contains a global map showing the locations of every collocation that matches the currently selected criteria. The locations are color coded based on terrain type of the ground truth system and whether or not the ground truth is a ship or a dropsonde.

The upper left corner of the window contains controls that apply each collocation. The date and time of the collocation can be selected by adjusting the slider controls. Controls are also available that will show collocations that are inside of or outside of selected time and distance windows.

At the bottom of the sub-selection tab is a series of sub-tabs that correspond to the ground truth system and every other system (satellite, forecast, etc.) that has been collocated with the ground truth. Selecting one of the sub-tabs will show additional sub-selection controls that are specific to each system.
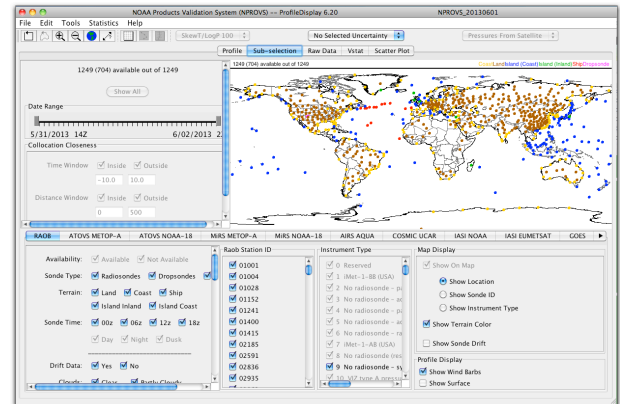
2.3 Raw Data Tab

All of the systems available to ProfileDisplay contain more data that are displayed graphically. This ancillary data can be viewed using the Raw Data tab. In the lower left corner of the tab is a drop-down list that contains entries for every available system as well as an entry for a table that shows all temperature and moisture values within a table.
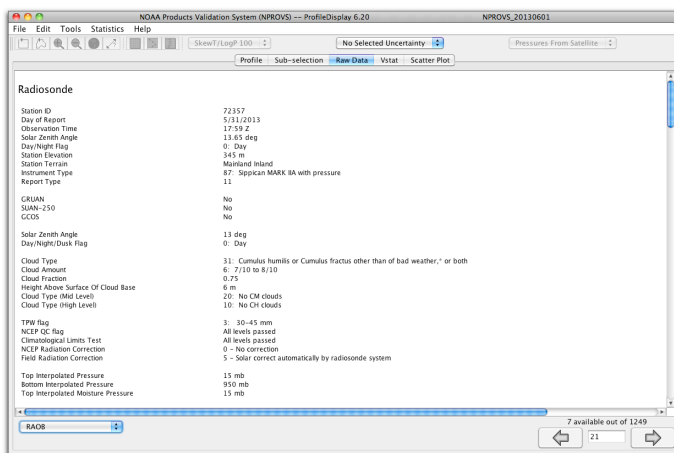
When a particular system is chosen, all data from that system is displayed as text. The data is from the currently selected collocation. In the lower right corner of the window are the same left and right arrow buttons that appear within the Profile tab. These are used to switch between collocations.

2.4 Vertical Statistics Tab

The Vertical Statistics tab displays a graph that shows vertical accuracy statistics for either temperature or moisture. The main portion of the window shows a graph and the statistics for the selected systems.

Displayed beneath the graph are the statistical values at specific pressure levels. The values change as the cursor is moved up and down the graph.

Along the right side of the window are controls that affect the manner in which the statistics are displayed. At the top are left and right arrow buttons that allow for switching between different sets of vertical stastistics.

The "Data Type" section of the controls is used to switch between temperature and moisture statistics.
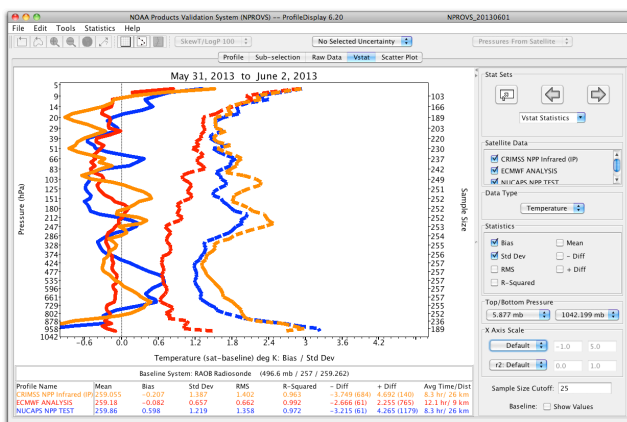
2.5   Scatter Plot Tab

The Scatter Plot tab displays scatter plots that show a comparison between chosen systems and a baseline system. The value of the baseline system is along the X-axis while the values of the matched systems are displayed along the Y-axis. The graph shows data points for every collocation that fits the current sub-selection criteria. A slider on the right side of the window switches the graph between different pressure levels.
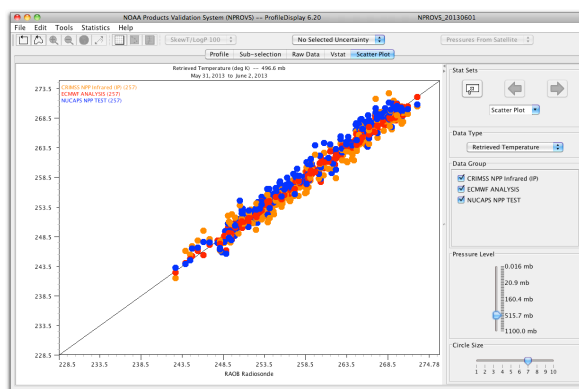
3.0   Installing/Running PDISP

ProfileDisplay is a Java application. As such, it can be run on any platform (Macintosh, Windows, Linux, etc.) on which Java has been installed. The entire program is contained within the file ProfileDisplay.jar. This is a Java archive file, which is a file compressed using the standard ZIP format that contains all of the code, file data and images used by the program.

In order to install PDISP, all that is necessary is to copy the ProfileDisplay.jar file to any location on a computer. The actual location does not matter, but for the sake of consistency it is probably a good idea to place it in the same location as other programs. For Windows users this may be the "Program Files" directory if the user has the proper permissions. For Macintosh users it can be placed within the "Applications" directory.

3.1

Using ProfileDisplay With Additional Memory

Running PDISP from the command line with the java command or by double-clicking the application will execute the program with a default amount of memory. The amount of memory varies and is usually determined by the installed Java runtime environment. Typically, the amount of default memory is adequate. But if additional memory is desired, PDISP can be given extra memory using one of two methods:

1) From the command line, use the command: java –mx512m –jar ProfileDisplay.jar
2) A batch file or run script can be created that contains the above command. The batch file or script can then be double-clicked.

The –mx512m part of the command will reserve 512 megabytes of memory for the program. This number can be set to any desired value. It should be noted, however, that increasing the amount of memory for PDISP will decrease the amount of system memory available for other programs.

Running The Program

There are two methods available for running ProfileDisplay. The first method is to go to the command line, switch to the directory that contains ProfileDisplay.jar, and type the command:

        java –jar ProfileDisplay.jar

The second way to run PDISP will usually be the easiest. On most operating systems all you need to do is double-click the ProfileDisplay.jar icon just like you would if you were running any other program. This will kick off Java and start running PDISP.

4.0   Using PDISP

ProfileDisplay reads data from files that use the NOAA Products Validation System (NPROVS) Data File Format. This includes daily files produced by NPROVS, weekly and monthly NPROVS files, and Unified Radiosonde Report files.

Each file is comprised of a group of records, each of which contains data from a single collocation. A collocation is defined as a single data point from a baseline system, typically a radiosonde, to which data from zero or more satellites are matched. In most files, including those produced by NPROVS, a radiosonde is collocated with multiple satellites.

4.0.1   Tabbed Panels

ProfileDisplay is divided into five primary functions: display of profiles, sub-selection, raw data display, vertical statistic display and scatter plot display. The program window contains tabbed panels that allow for the quick switching between program functions (figure XX).


Figure XX — Tabs for tabbed panels on a Macintosh (top) and Windows (bottom).

The profile panel is used to view sounding profiles for each collocation that is available in a selected file. The sub-selection panel shows the location of all available collocations in the file and provides a variety of controls that allow for the sub-selection of collocations. The raw data panel displays all available raw data from sondes and satellites. The Vstat panel shows the results of vertical accuracy statistic generation. The scatter plot panel shows a scatter plot that compares each satellite to a baseline system.

4.0.2   Toolbar

The ProfileDisplay window contains a toolbar near the top of the window. This toolbar contains icons that provide quick access to commonly used functions. Every toolbar function can also be accessed by using the menus.
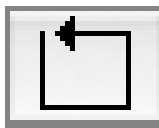
 Used to draw a rubber-band box to select an area on the sub-selection and the scatter plot graph.

  Used to draw a polygon around points on the scatter plot graph.

Turns on the "zoom in" function. After clicking this button the cursor will turn into a magnifying glass with a plus sign. Used in the profile graph panel and the sub-selection.

This icon turns on the "zoom out" function. Clicking this button will cause the cursor to change to a magnifying glass with a minus sign. Used in the profile graph panel and the sub-selection.
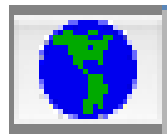
Clicking this icon will cause the geographic map to zoom out and show the entire Earth centered on 0 degrees longitude.

This icon turns on the option to display the distance between two points on the geographic map.
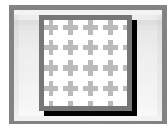
Toggles grid lines on the profile graph, vertical statistics graph and scatter plot graph.

Toggles data points on the profile graph.

4.1   Profile Panel

The profile panel displays individual profile data for each collocation. The main part of the panel contains a graph on which temperature and dewpoint temperature profiles are plotted (figure XX).

To the right of the graph is a list of all available profiles for the current collocation. If a profile is available, it will be displayed in a specific color. When a profile is not available, the profile name will be grayed out and the checkbox will be disabled. The two columns of checkboxes to the left of the profile name are used to turn the corresponding profiles on or off. The left-most column contains the checkboxes for temperature profiles. The second column is for dewpoint temperature profiles. If uncertainty K profiles are available, two additional columns of checkboxes will appear. In such a case the order of the checkboxes will be temperature, dewpoint temperature, temperature K profile and moisture K profile.

Beneath the graph is an area containing basic information about each displayed satellite. The first line contains time and location information for the baseline system. Additional systems are displayed beneath the baseline and also contain time and location information. For the additional systems the time distance and distance difference between the system and the baseline are also displayed.
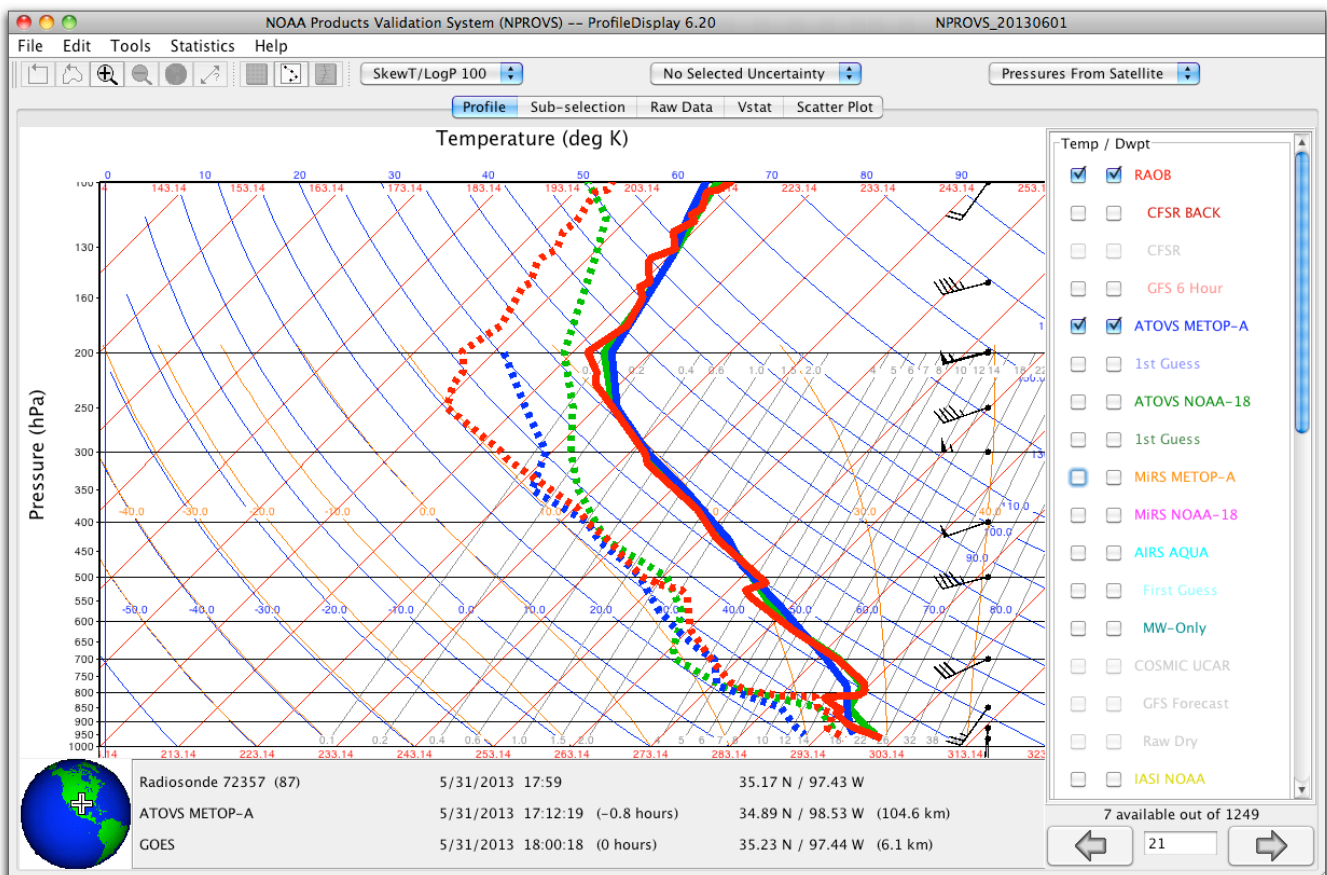

Figure XX — PDISP window showing the profile panel. Temperature (solid) and dewpoint temperature (dashed) profiles for several satellites are displayed.

The lower right corner of the profile panel contains controls that provide the ability to switch between collocations. The left and right arrow buttons are used to switch to the previous and next collocation respectively. The text field between the arrow buttons can be used to enter a specific collocation number. In addition to these controls, the keyboard arrow keys can be used. The left and right keyboard arrow keys function in the same way as the corresponding arrow buttons. The up arrow key can be used to advance ten collocations at a time. The down arrow key will move backwards ten collocations at a time.

Above the arrow buttons is a label that shows the number of available collocations and the total number of collocations in the file. When a sub-selection of collocations is made, the number of available collocations will change to reflect the number the match the sub-selection options.

4.1.1   Zooming and Scrolling

By default, the profile graph displays each profile from the bottom of the atmosphere to the top. Although this provides a good overview of the matchup, it is sometimes difficult to see the exact difference between the profiles. In this case, zooming in on a portion of the graph can be helpful.

The zoom in function can be selected from the Tools menu or by clicking the icon in the toolbar. The program will then enlarge the graph. Additional zooming can be done be selecting "Zoom In" again. Zooming in can be done up to three times.

To return to a larger view of the graph, go to the Tools menu and select "Zoom Out".

When zooming is enabled, only a portion of the graph will be visible. To view a different part of the graph it will be necessary to scroll or pan. Scroll bars appear on the right side and bottom of the graph when zooming is on. These can be used to scroll around the graph.

In addition to scrolling, it is possible to use panning to move around the graph. To do this, move the mouse pointer over the graph. Then press the mouse button. With the button still held down, move the mouse pointer around the graph.

4.1.2   Changing The Plot Type

When PDISP is first started, the default plot type will be a Skew-Temperature Log-Pressure plot with the pressure range from 1000 mb up to 100 mb. The plot type can be changed by choosing a pressure scale from the drop-down list in the toolbar or by selecting "Change Plot Type" from the Tools menu in the menu bar. When the menu is used, a dialog will appear that shows the different graph options (figure XX).

There are eight types of pre-defined plots. To change the plot type, click on the image of the desired plot type. This will immediately cause the profile graph to change to the new plot type. Selecting the OK button will get rid of the dialog will keeping the new selection. Selecting the Cancel button will get rid of the dialog and cause the graph to revert back to the previous setting.
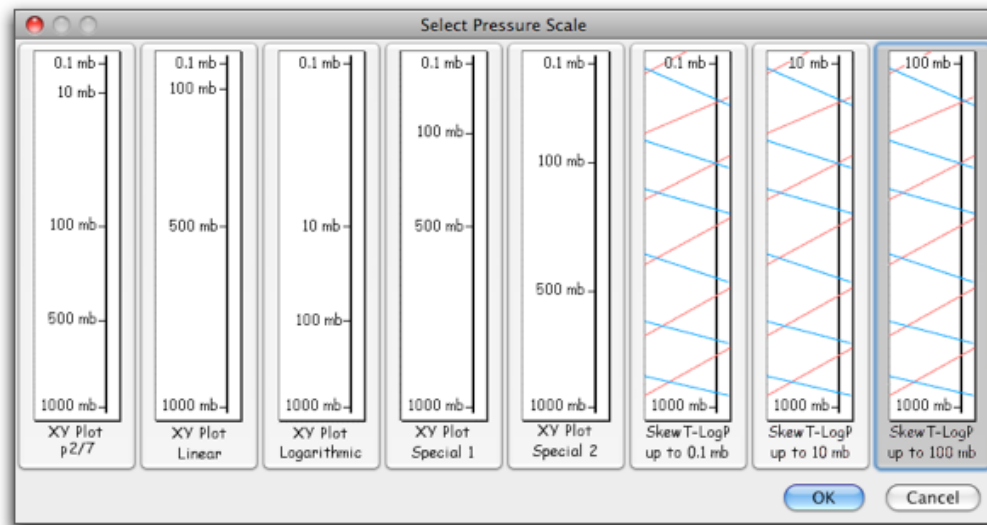
Figure XX — Pressure scale selection dialog

The eight pre-defined plot types are divided into two groups. One group, which are the five shown on the left side of the dialog, are standard XY plots. The other group, on the right side of the dialog, are Skew-Temperature Log-Pressure plots.

$P^{2/7}$ — This plot was selected because it does a reasonably good job of showing the profiles from the surface to the top of the atmosphere. With this scale, 100 mb is plotted approximately in the middle of the Y-axis.

Linear — The linear plot uses the pressure values themselves to determine where to plot each pressure. This plot type overemphasizes the lower atmosphere while squeezing the upper atmosphere into a small area.

Logarithmic — This plot type plots the pressure values on a strictly logarithmic scale. This is essentially the opposite of the linear scale since the upper atmosphere is highlighted at the expense of the lower atmosphere.

Special 1 — This is a scale that was created to provide a better balance between the upper and lower atmosphere. It is a modified linear scale. The pressures are plotted as three separate linear scales: 0.1 mb to 100 mb, 100 mb to 500 mb, and 500 mb to 1000 mb. The 100 mb pressure is plotted so that it is 1/4 of the way down the axis while the 500 mb pressure is plotted 1/2 way down the axis.

Special 2 — The Special 2 scale is the same as the Special 1 scale. The difference is the location of the 100 mb and 500 mb pressures. The 100 mb pressure is 1/3 of the way down the axis. The 500 mb pressure is 2/3 of the way down the axis.

Skew-T Plots — The three Skew-T Log-P plots are essentially the same. The only difference between them is the upper pressure limit.

4.1.3 Displaying Grid Lines And Data Points

The graph can be modified to turn grid lines on and off. The display of individual data points for each profile can also be toggled.

Both functions can be turned on or off by selecting the appropriate option from the Tools menu. The grid line option, which is only available an XY plot is selected, will draw grid lines behind the graph to make it easier to match a point on a profile with corresponding temperatures and pressures. With the option turned off (figure XX) the grid lines will not be displayed.
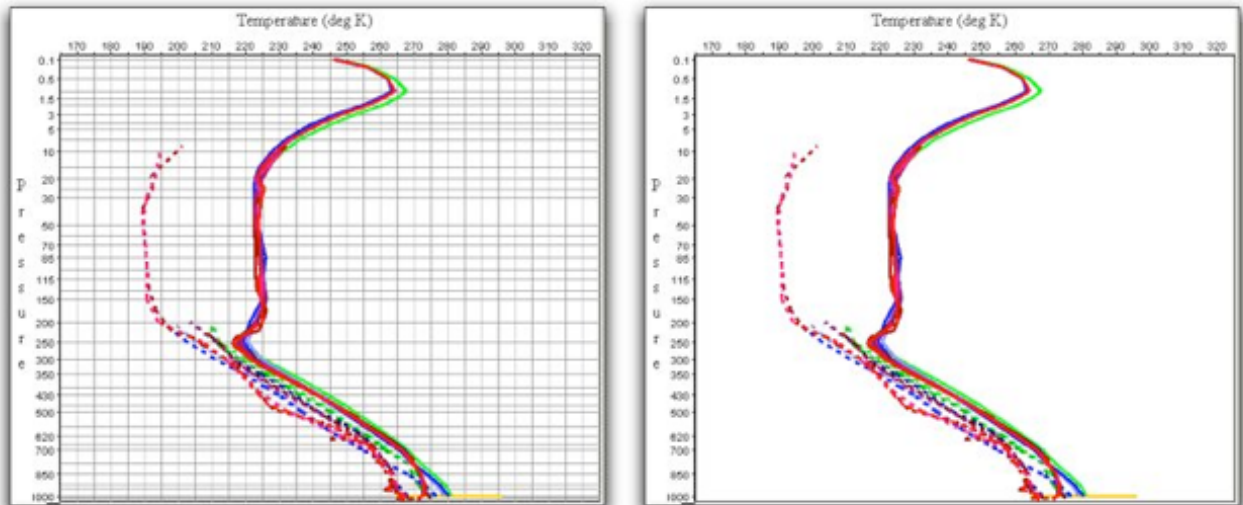

Figure XX — Profiles with grid line option turned off (left) and on (right)

The option to display data points will draw a circle on top of each profile at the location of each actual data point (Figure XX).
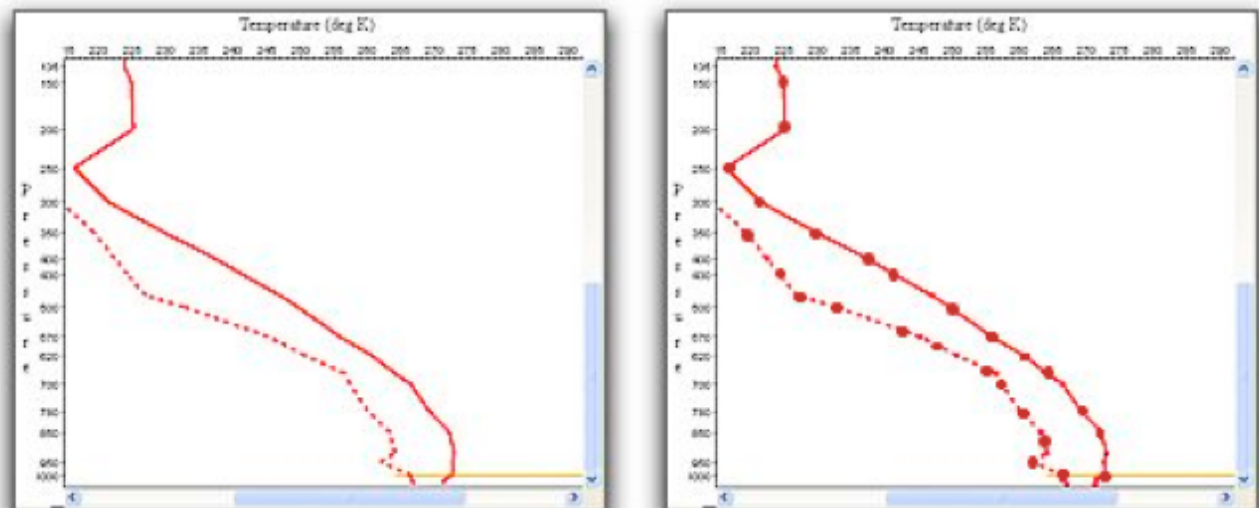

Figure XX — Profile data with data point option turned off (left) and on (right)

4.2   Raw Data Panel

While the profile panel provides a good overview of each collocation, it is sometimes desirable to view the data more closely. The raw data panel accomplishes this by displaying all available data for each group of data in a collocation.

The raw data is divided into several sections. The first section lists the dates and times of the groups of data. The second section contains a table of the specific temperature and moisture values. The rows of the table represent each pressure level. The columns contain the temperature and moisture data. The remaining sections contain the raw data from each satellite. Each section can be viewed by using the list in the lower left corner of the panel to select one of the sections.

4.3   Sub-selection Panel

The sub-selection panel (
Figure XX) has two functions. The first function is the display of the location of each collocation. The second function is to allow for the sub-selection of collocations. The sub-selection panel accomplishes both functions with a map along with a variety of sub-selection controls.
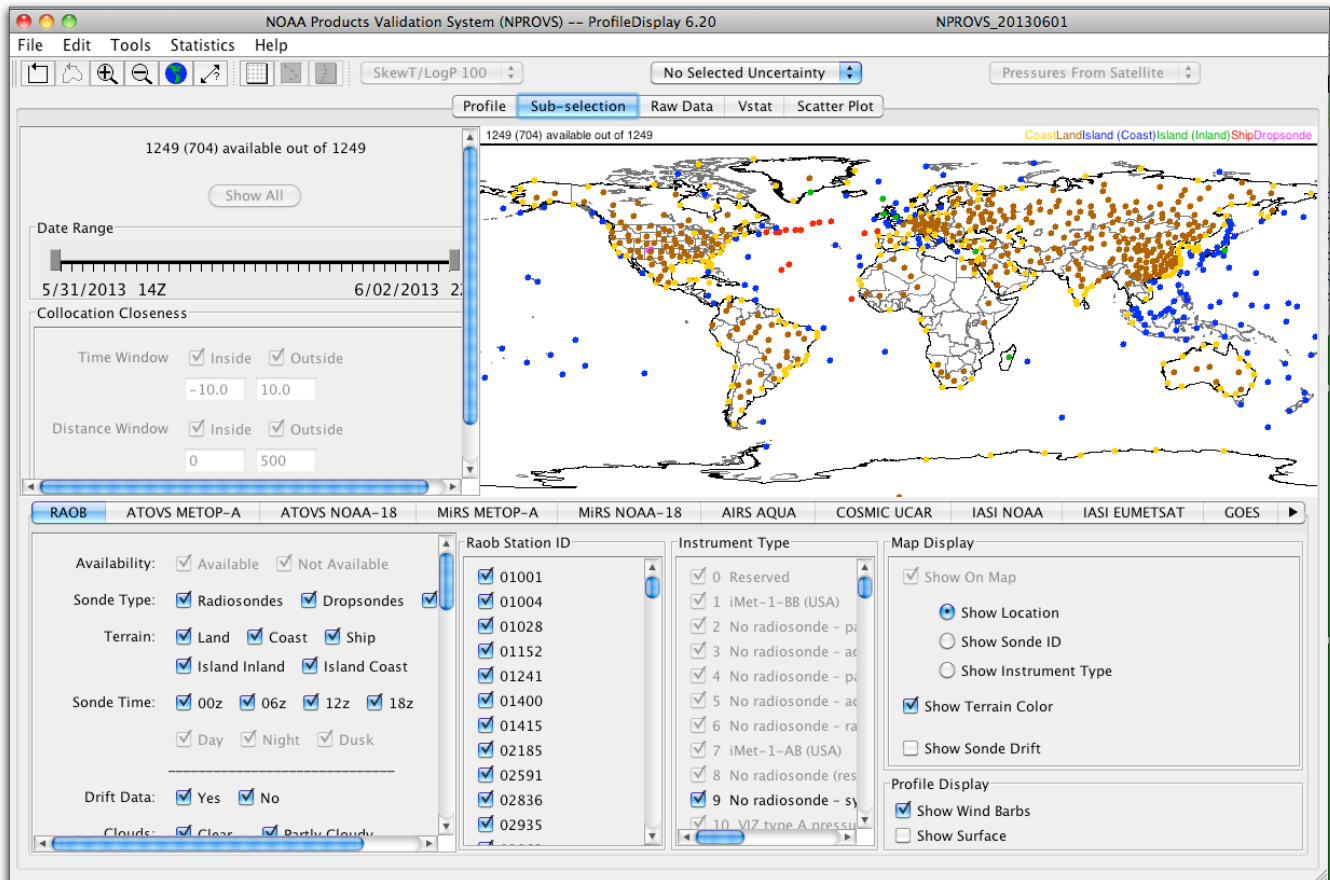

Figure XX — Sub-selection panel with sub-selection controls.

4.3.1   Geographic Map

The geographic map displays all collocations that meet the current sub-selection settings. Each collocation is plotted on the map at the location of the baseline system (typically the radiosonde). The color of the circle represents the terrain type of the baseline using terrain values defined by the NOAA Products Validation System (NPROVS).

Several additional options are available when plotting each collocation location. Depending on the available systems, the name and location of each system can be plotted on the map. For most sondes, the station ID or the instrument type can be plotted along with the location (figure XX).

At the bottom of the sub-selection panels are controls for every system. To display the location of a system on the map begin by selecting the tab for the desired system. On the right side of the system

controls will be map display controls. These can be selected/deselected to control what is plotted on the geographic map.
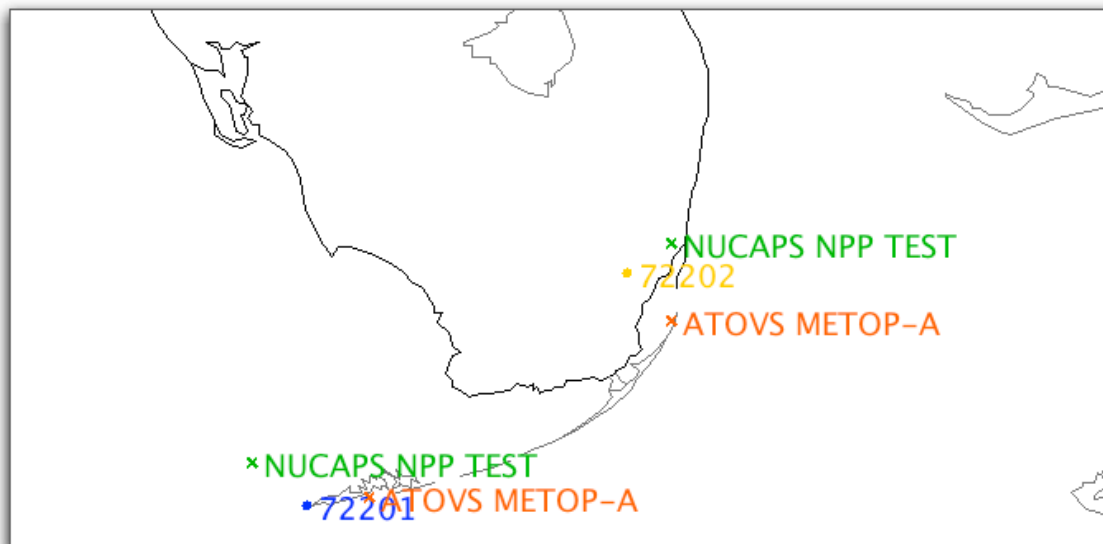

Figure XX — Locations of collocated satellites in relation to radiosondes (72202 and 72201).

The radiosonde balloon drift is another display option on the geographic map. The course of the balloon as it ascended is plotted in a magenta line beginning at the location of the radiosonde (figure XX).
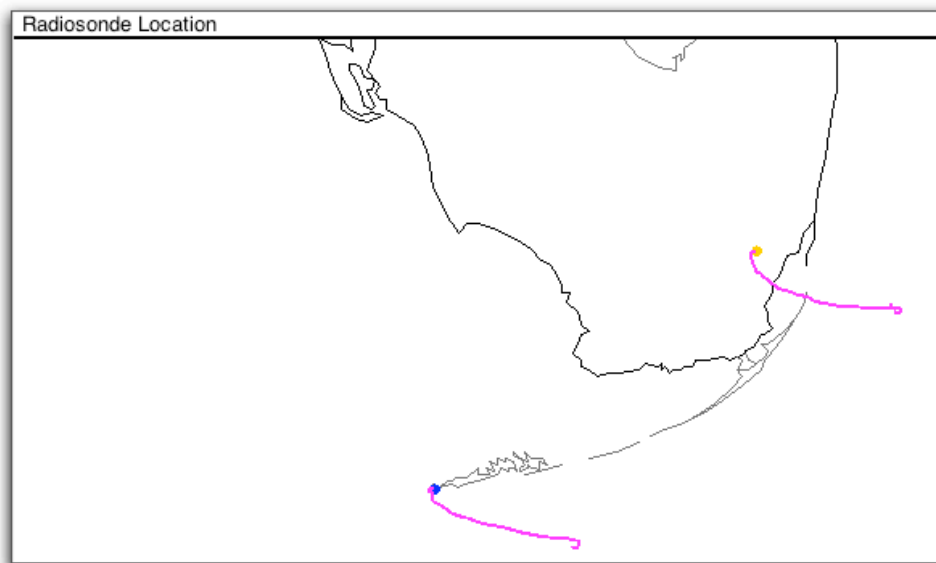

Figure XX — Radiosonde balloon drift. The purple line shows the location of the balloons as they ascended.

The "Show Distance Between Points" menu and toolbar icon can be selected to show the distance between any two points on the map. Pressing the mouse button and dragging the mouse will draw a line on the map and display the distance from the beginning of the line to the end of the line (figure XX).
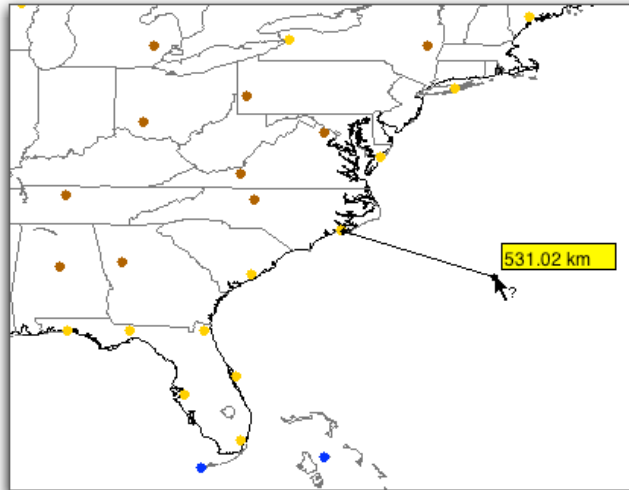
Figure XX — Displaying the distance between two points. The distance updates as the mouse pointer is moved.

4.3.2   Sub-selection

The sub-selection controls provide a highly flexible way to choose which collocations to display. When one or more of the controls is set, only collocations that match the settings will be displayed on the geographic map, in the profile panel, and in the raw data panel. The sub-selection settings are also used when generating vertical accuracy statistics and scatter plots.

The geographic map can be used to quickly select specific collocations or areas. When the "Subselect Using Rectangles" option is chosen from the Tools menu or from the toolbar, a rubber-band box can be draw on the map (figure XX). When the mouse is released after drawing the box, most of the map will turn gray while the selected area will be white with a red outline. Additional areas may be selected by holding down the Shift key while drawing another box. Collocations within the boxes will be available.
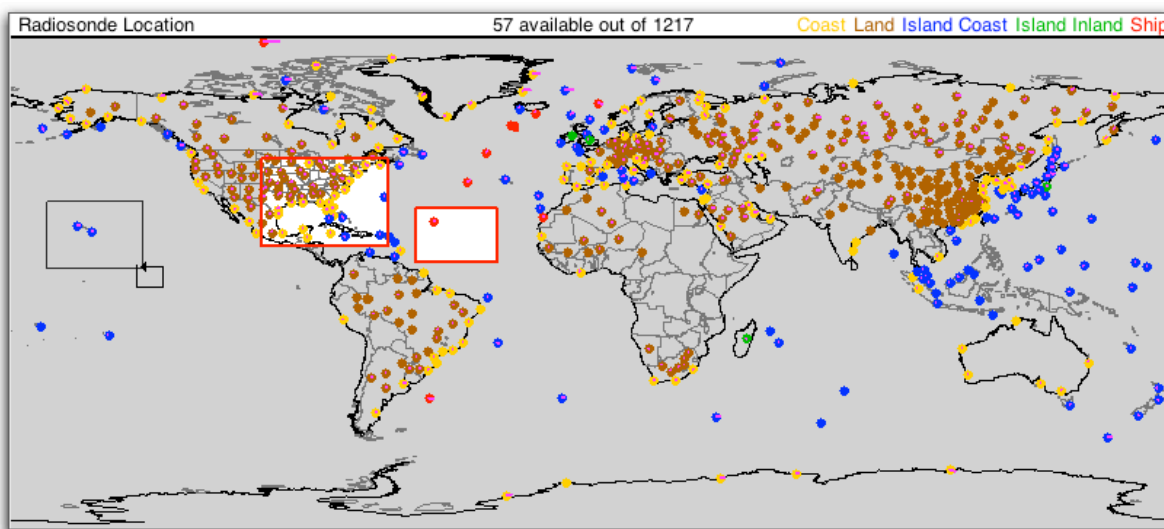
Figure XX — Sub-selection using geographic areas.
Two areas have already been selected (Eastern United States and Atlantic Ocean).
A third area is being drawn around Hawaii.

To the left of the geographic map are collocation sub-selection controls. The "Show All" button, when pressed, will reset all sub-selection settings to their default values. As a result, all collocations in the file will become available again.

The date range slider is a dual slider that limits that date and time of the collocation. Collocations will be available if the baseline system date and time is within the date range specified by the two slider tabs.

The time and distance windows are enabled when one or more satellite system is set to "available". The time window (in hours) and distance window (in kilometers) are set in the text fields. For each window, if the inside box is not checked then collocations where the satellite differs from the baseline system by less than the values will not be displayed. If the outside box is not checked then collocations where the satellite differs by more than the values will not be displayed.

At the bottom of the sub-selection panel are tabs for every available system. The location of the tabs is constant across operating systems but the appearance varies (figure XX). Under some Windows systems all of the satellite tabs are visible at the same time and are stacked in one or more rows. On a Macintosh only one row of tabs is visible. If there is not enough space for all of the tabs to fit then arrows will appear on the left and right ends of the row. Clicking the arrow will advance to the next tab. Clicking and holding down the arrow will bring up a list of tabs that can be selected.
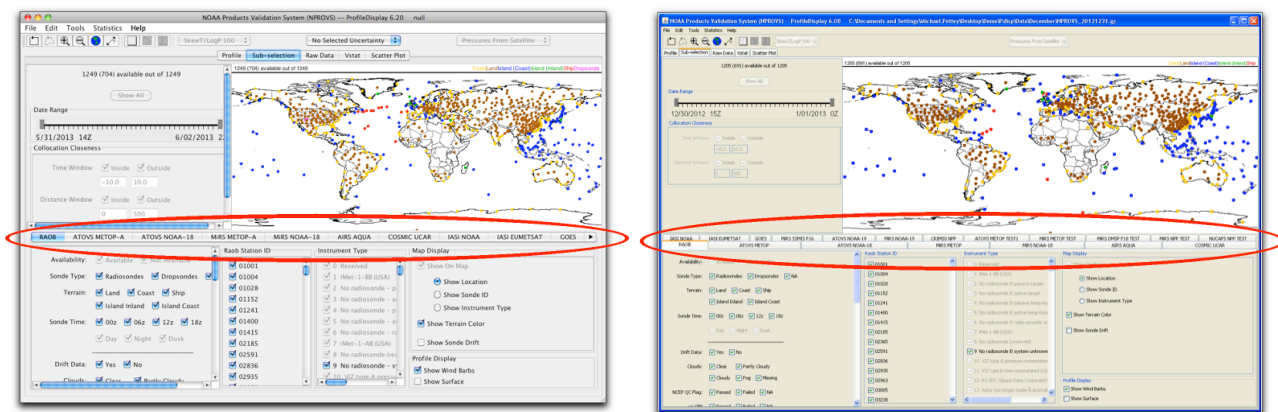

Figure XX — Location and appearance of sub-selection tabs on a Macintosh (left) and Windows XP (right)

The sub-selection controls vary for each satellite system but they work in the same manner. In general, if a checkbox is unselected then collocations that match the unselected box will become unavailable for display and statistics. For example, figure XX shows some of the controls that are available for sondes. The terrain group of checkboxes contain "land", "coast", "ship", "island inland" and "island coast". If the "land" checkbox is unselected, then all collocations with a sonde terrain type value that is land will be marked as unavailable. If the "coast" box is also unselected then collocations with sonde terrain values equal to coast will also be marked as unavailable.
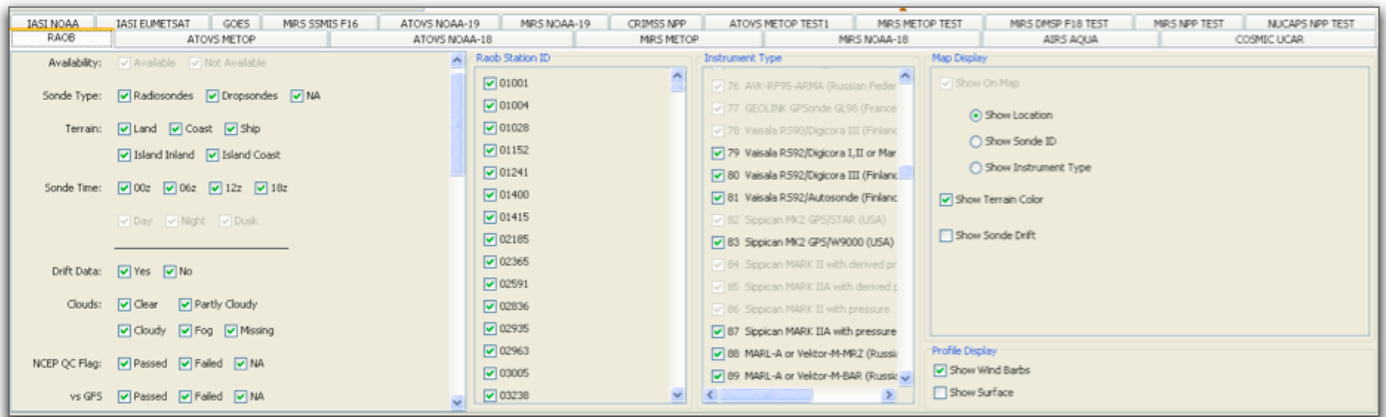
Figure XX — Sonde sub-selection controls

Every system has sub-selection controls for availability. If both the "available" and "not available" checkboxes are selected then it does not matter whether or not a particular collocation contains data for the system in question. If the "available" box is selected and the "not available" box is unselected, then collocations that do not contain data for the system will not be available. This is useful when concentrating on one system or a group of systems since it ensures that collocations that do not contain data for the desired systems are ignored in both the display of profiles and the calculation of statistics.

4.4   Vertical Statistics Panel

While it is useful to view data from individual collocations, it is often helpful to view a summary of the data over a selected period of time. This is most easily done by computing vertical accuracy statistics.

The process of computing vertical statistics is begun by selecting "Compute Vstats" from the Statistics menu. A dialog will appear (figure XX) that provides several options. The right side of the dialog contains checkboxes for every available profile. Statistics will be generated for all selected profiles.

At the top of the left side of the dialog is a text field that can be used to enter a description of the generated statistics. This feature is not used in the current version of ProfileDisplay but will be enabled in a future version.

Beneath the description field is a list of all available profiles. One profile from this list can be selected as the baseline profile. By default, the baseline profile will be the radiosonde to which all satellites have been collocated. But this can be changed to any available profile. When the statistics are computed, the difference between each of the selected profiles and the baseline profile will be calculated.
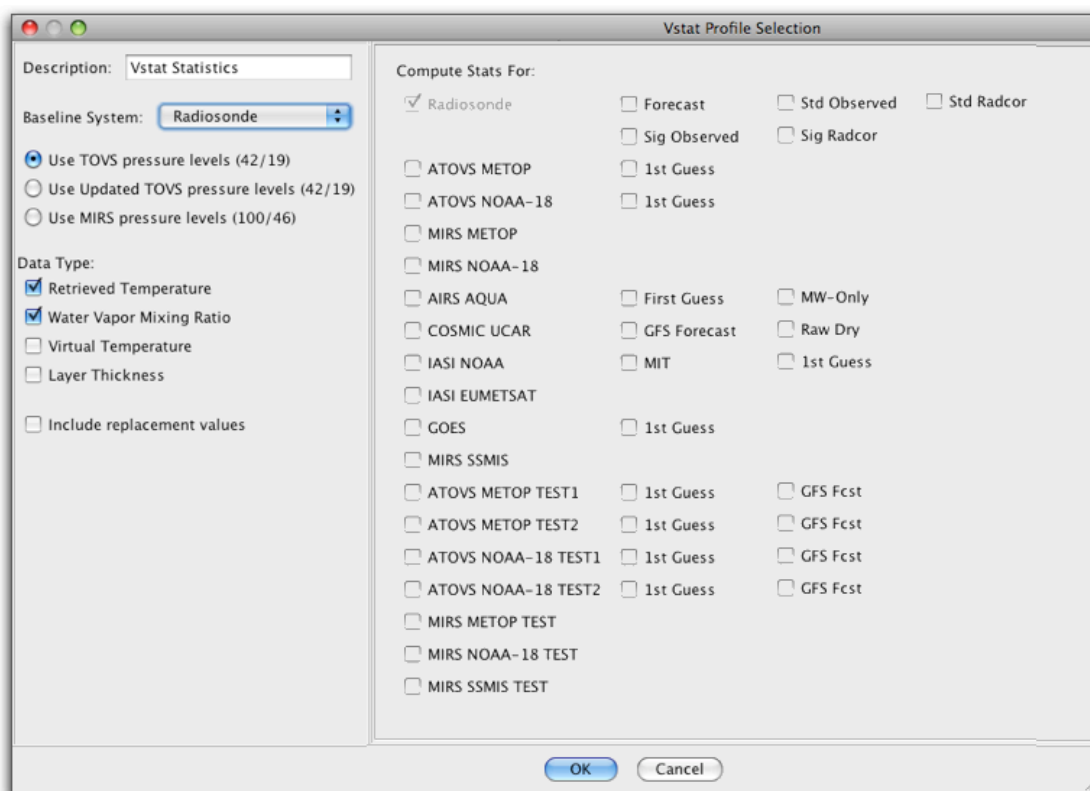

Figure XX — Vertical statistic selection dialog.

Several pressure level options are available: 42 ATOVS levels (older definition), 42 ATOVS levels (new definition), and 100 MIRS pressure levels. Data from each system will be interpolated, if necessary, to the chosen pressure levels.

After the selections are made, the program will begin generating the vertical accuracy statistics. The current sub-selection settings are used to determine which collocations to use. For each collocation,

temperature and moisture data are read for each profile. A running sum of the differences between each profile and the baseline profile is maintained at each pressure level.

When all of the collocations have been processed, a new vertical statistic graph will be available in the Vstat panel (figure XX). The left side of the graph shows the pressure level in black and the baseline mean in gray. Along the right side of the graph is the sample size at each level. As the mouse pointer is moved up and down on the graph, the data values corresponding to the nearest pressure level are displayed beneath the graph.

Various controls are positioned along the right side of the window. These controls allow for changes in the type of data being displayed and the manner in which the data are displayed. The data type, retrieved temperature or water vapor, can be selected from the drop-down list at the top. The type of statistic can be selected using the checkboxes beneath the data type. Beneath that are checkboxes for each profile that can be selected or unselected to toggle the display of data for the chosen profile.
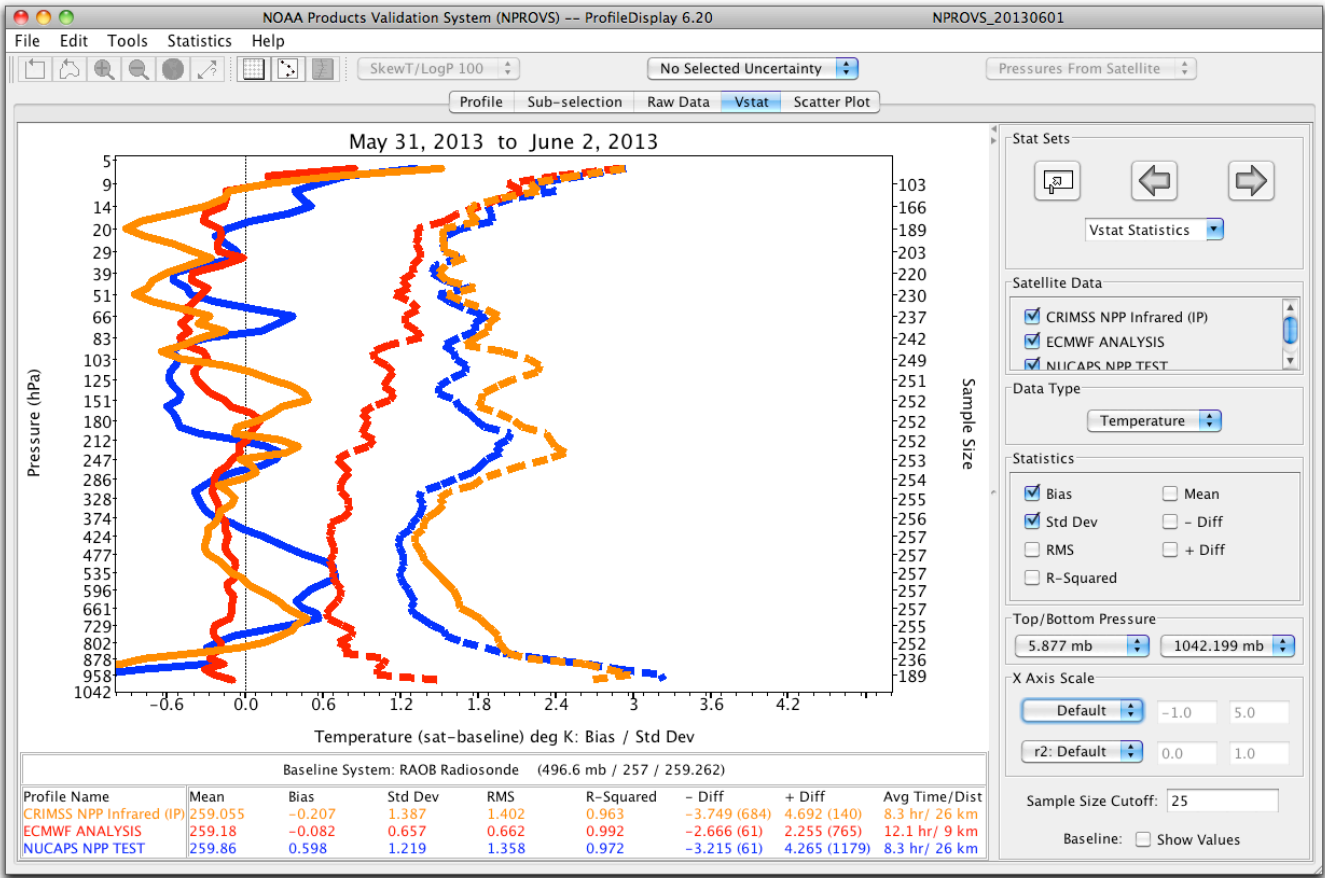
Figure XX — Vertical statistic window.

At the bottom is a control that modifies the x-axis scale. Two options are available: default and automatic. When the default scale is selected, the minimum and maximum values on the x-axis will be set to values that are pre-defined based on the current data type. When the automatic option is selected, the minimum and maximum values will be adjusted based on the actual minimum and maximum values of the displayed data.

4.5 Scatter Plot Panel

The scatter plot option in ProfileDisplay creates a basic scatter plot of selected data that compares data from satellites with data from a baseline system, typically a radiosonde. To generate a scatter plot, select "Compute Scatter Plot" from the Statistics menu. A dialog will appear that is similar to the one used when creating vertical accuracy statistics.

After the options are chosen, PDISP will read every collocation that matches the current sub-selection settings. The result will appear in the scatter plot panel (figure XX). The baseline system values are plotted along the x-axis while the data values for the comparison profiles are plotted along the y-axis.
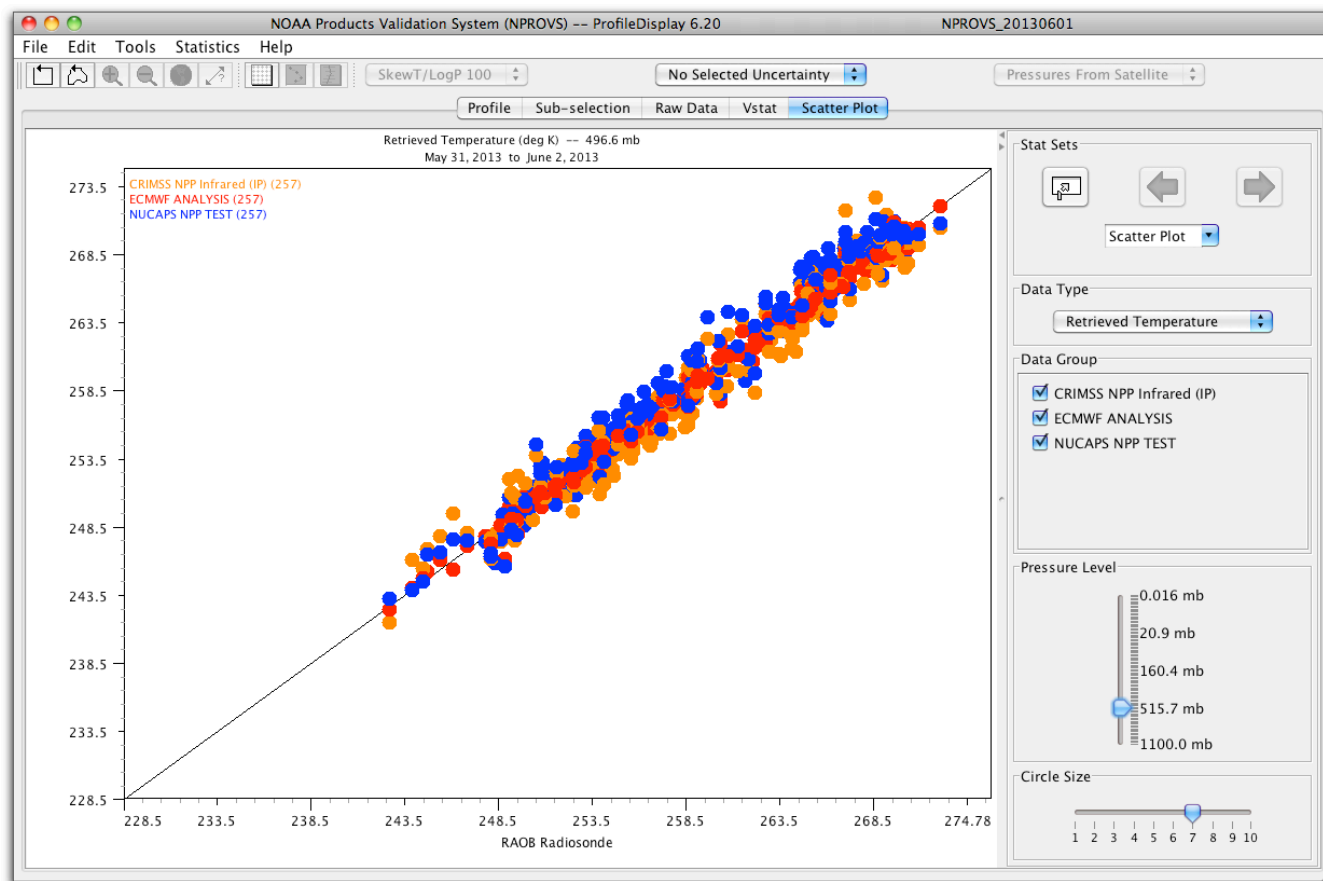

Figure XX — Scatter plot window showing retrieved temperatures at 500 mb.

When a scatter plot is generated, the scatter plot panel will contain one graph for each pressure level. The graph for a specific level can be viewed by adjusting the pressure level slider.

In the lower right portion of the scatter plot panel is a slider that controls the size of the circles on the graph. ProfileDisplay will, by default, choose a circle size that is generally appropriate based on the size of the window. There are times, however, when it may desirable to change the circle size. In some cases, an appropriate circle size can be difficult to accurately calculate. In other cases, changing the size of the circles can emphasize or deemphasize selected data.

4.5.1 Sub-selection From The Scatter Plot Panel

One of the advantages of generating a scatter plot graph is the ability to quickly view outlying data points. When such outliers are identified, a logical next step is to view the collocations that produced the outlying data. ProfileDisplay assists in this with a feature that allows a user to draw a rectangle or polygon around interesting points. To use this feature from within the scatter plot panel, choose "Subselect Using Rectangles" or "Subselect Using Polygons" in the Tools menu or by selecting one of the icons in the toolbar.

The rectangle option can be used to draw a rubber-band box anywhere on the graph. Pressing the mouse button will begin the drawing of the rectangle. When the mouse is moved while the mouse button remains pressed, a rectangle will be drawn.

The polygon option is used to draw an irregularly shaped polygon. After this option is turned on, the polygon is drawn by clicking various points on the graph. The first point in the polygon will be represented by a green square. Subsequent points are represented by orange squares. To complete the polygon, click on the first (green) square. To cancel a polygon, press the Escape key.
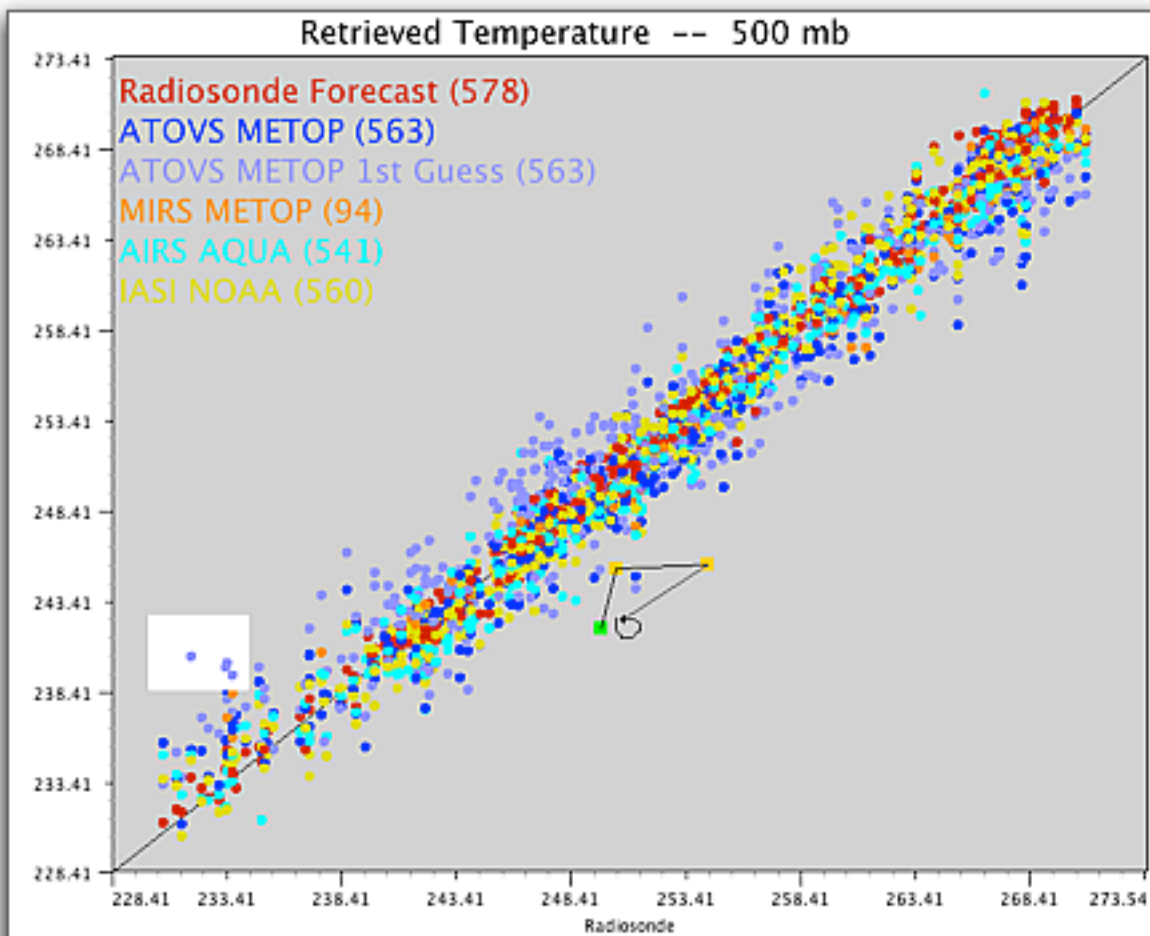

Figure XX — Sub-selecting data points on a scatter plot. A rectangle area has already been defined in the lower left of the graph. A second area, beneath the center of the plot, is in the process of being defined as a polygon.

When an area has been defined on the graph, the selected area will be white while everything outside of the selected area will be in gray (figure XX). Multiple areas can be defined by pressing and holding the shift key while beginning a new rectangle or polygon.

5.0   Other?