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Pacific Northwest National Laboratory
Operated by Battelle for the
U.S. Department of Energy

User's Guide for MetView: A Meteorological Display and Assessment Tool

Clifford S. Glantz
Mitchell A. Pelton
K. Jerry Allwine
Kenneth W. Burk

September 2000

Prepared for
The U.S. Department of Energy
Under Contract DE-AC06-76RLO 1830

Pacific Northwest National Laboratory
Richland, Washington 99352

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Summary

MetView Version 2.0 is an easy-to-use computer program for accessing, viewing, and analyzing meteorological data. *MetView* provides both graphical and numerical displays of data. It can accommodate data from an extensive meteorological monitoring network that includes near-surface monitoring locations, instrumented towers, sodars, and meteorologist observations.

MetView is used operationally for both routine, emergency response, and research applications at the U.S. Department of Energy's Hanford Site. At the Site's Emergency Operations Center, *MetView* aids in the access, visualization, and interpretation of real-time meteorological data. Historical data can also be accessed and displayed. Emergency response personnel at the Emergency Operations Center use *MetView* products in the formulation of protective action recommendations and other decisions. Emergency response personnel at on- and off-site command centers also use model products in formulating their action plans. To be an effective tool for such applications, the model must operate quickly, be very simple to use, and have easily interpreted output products.

In the initial stage of an emergency, *MetView* can be operated using a very simple, five-step procedure. This first-responder procedure allows non-technical staff to rapidly generate meteorological products and disseminate key information. After first-responder information products are produced, the Emergency Operations Center's technical staff can conduct more sophisticated analyses using the model. This may include examining the vertical variation in winds, assessing recent changes in atmospheric conditions, evaluating atmospheric mixing rates, and forecasting changes in meteorological conditions.

This user's guide provides easy-to-follow instructions for both first-responder and routine operation of the model. Step-by-step explanations are provided for each component of *MetView* operation. Every screen, icon, and user-controlled function is described. Examples, with explanations, are provided for each type of MetView output display. The directory structure and key files required for MetView operation are described. Information is provided on the naming convention, format, and contents of each type of meteorological data file used by the model area. This user's guide serves as a ready reference for experienced *MetView* users and a training manual for new users.

Acknowledgements

The authors wish to acknowledge the support of a number of Hanford Site staff members who have greatly contributed to our work in developing and implementing the ***MetView*** model. Our principal clients have been Larry Campbell, Gayla Aldridge, and Ted Morales with Flour Daniel Hanford. We appreciate their insight, patience, and dedication in working with our ***MetView*** development team. We would also like to acknowledge the technical support provided by Russ Bechtol and Rudy Prosser, the administrative support provided by Sheila Woody, and the management support provided by Dan Connell and Mary Brown.

The authors greatly appreciate the technical assistance and constructive suggestions provided by Dana Hoitink (Project Manager of the Meteorological and Clincatological Services Project) and the meteorologists at the Hanford Meteorology Station. In particular, Perry Perrault, Gary Reinecke, and Dave Keller provided timely comments.

Finally, the authors would like to thank Jo Lynn Draper for editing the document, Jennifer Kirk for providing text-processing services, and Phyllis Parker for general administrative support in publishing this document.

Contents

Figures

Tables

1.0 Introduction

1.1 Overview of *MetView 2.0*

Welcome to ***MetView 2.0***! ***MetView*** is an easy-to-use computer program for accessing, viewing, and analyzing meteorological data. ***MetView*** can provide both graphical and numerical displays of data from an extensive meteorological monitoring network. It can accommodate real-time and historical data from near-surface monitoring locations, instrumented towers, sodars, and meteorologist observations.

At the U.S. Department of Energy's Hanford Site, ***MetView*** is used operationally at the Emergency Operations Center (EOC), the Hanford Meteorology Station (HMS), and at other Site locations. ***MetView*** presents data collected by the Hanford Meteorology Monitoring Network. Currently, the network has 30 monitoring stations that are located on the Hanford Site and in neighboring areas. These stations provide measurements of the near-surface wind, temperature, precipitation, and atmospheric pressure. Four of the monitoring stations are equipped with tall towers and Doppler acoustic sodars. The tall towers provide data on winds and temperatures at multiple heights above the ground. Atmospheric pressure, moisture, precipitation, and other parameters are also measured near the base of the tall towers. The sodars use acoustic signals to measure winds at heights up to several hundred meters above ground level. Selected observations made by the meteorologist at the HMS are also available for display.

MetView was initially developed to serve the emergency response needs of the Hanford Site. At the EOC, ***MetView*** aids in the access, visualization, and interpretation of the real-time meteorological data. The model is operated by "first-responders"[1], meteorologists, and hazard evaluators. Site decision makers use ***MetView*** products in the formulation of protective action recommendations and other decisions. State and county representatives, field team managers, safety and security personnel, and other EOC staff members use model products in their planning. Emergency response personnel at other on-site and offsite command centers also use model products in formulating their action plans. To be an effective tool for such a diverse audience, the model must operate quickly, be very simple to use, and have easily interpreted output products.

At the HMS, ***MetView*** provides meteorologists and support staff with timely, straightforward, and meaningful presentations of meteorological data. The model is used to display and assess current meteorological conditions across the Site. It is also used to display recent data that can be used to evaluate past conditions and to forecast short-term trends in meteorological conditions. The model can also used to display historical data. Examining data from past days, weeks, months, or years can assist meteorologists in

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[1] First-responders are the first staff members to arrive at the EOC during an emergency event. The first-responders may not be meteorologists, health physicists, or engineers. They may instead be administrative support personnel, safety and security specialists, communications staff, or computer systems specialists.

recognizing characteristic circulation patterns and the way they evolve under different circumstances.

At other Site locations, ***MetView*** is used for a variety of operational and research applications. The model can be used to assess meteorological conditions for dispersion modeling, develop scenario packages for emergency response training exercises, or evaluate meteorological conditions for onsite field experiments.

In the remainder of this section, we will describe the Hanford Site and its meteorological monitoring program. In Section 2, we present a brief set of instructions for operating ***MetView*** in the first-responder mode. In Section 3, we present the step-by-step procedure for running ***MetView***. This includes a description of each menu screen, user option, and display product. Section 4 presents the ***MetView*** directory structure and describes some key files. Section 5 presents a detailed description of the format and contents of the meteorological input files.

1.2 Description of the Hanford Site

The Hanford Site lies within the semi-arid Pasco Basin of the Columbia Plateau in southeastern Washington State (Figure 1.1). The Hanford Site occupies an area of about 1,450 km^2 (about 560 mi^2). The Columbia River flows through the northern part of the Hanford Site and, turning south, forms part of the Site's eastern boundary. The Yakima River runs along a portion of the southern boundary of the Hanford Site. Rattlesnake Mountain, Yakima Ridge, and Umtanum Ridge form the southwestern and western boundaries. The Saddle Mountains form the northern boundary of the Hanford Site. Two small east-west ridges, Gable Butte and Gable Mountain, rise above the plateau of the central part of the Hanford Site. Adjoining lands to the west, north, and east are principally range and agricultural land. The cities of Kennewick, Pasco, and Richland (the Tri-Cities) constitute the nearest population centers and are located southeast of the Hanford Site.

Beginning in the 1940's (with the creation of the site as part of the Manhattan Project), Hanford played a pivotal role in the nation's defense as a plutonium production complex. Currently, Hanford is engaged in the world's largest environmental cleanup project, with many challenges to be resolved in the face of overlapping technical, political, regulatory, and cultural interests. Hanford also has a mission to develop and deploy science and technology. The large size of the Hanford Site, coupled with restricted public access, provides a buffer for the smaller operational areas that are currently used for storage of nuclear materials, waste processing, waste disposal, and scientific research (Dirkes et al. 1999). Hanford's four major operational areas, which occupy only about 6% of the Site, are the 100, 200, 300, and 400 Areas.

- The 100 Areas. This consists of the 100-B/C, 100-D, 100-F, 100H, 100-K, and 100-N Areas. These areas lie along the south shore of the Columbia River in the northern portion of the Hanford Site. These areas contain former plutonium production reactors and associated facilities. Spent nuclear fuel is currently

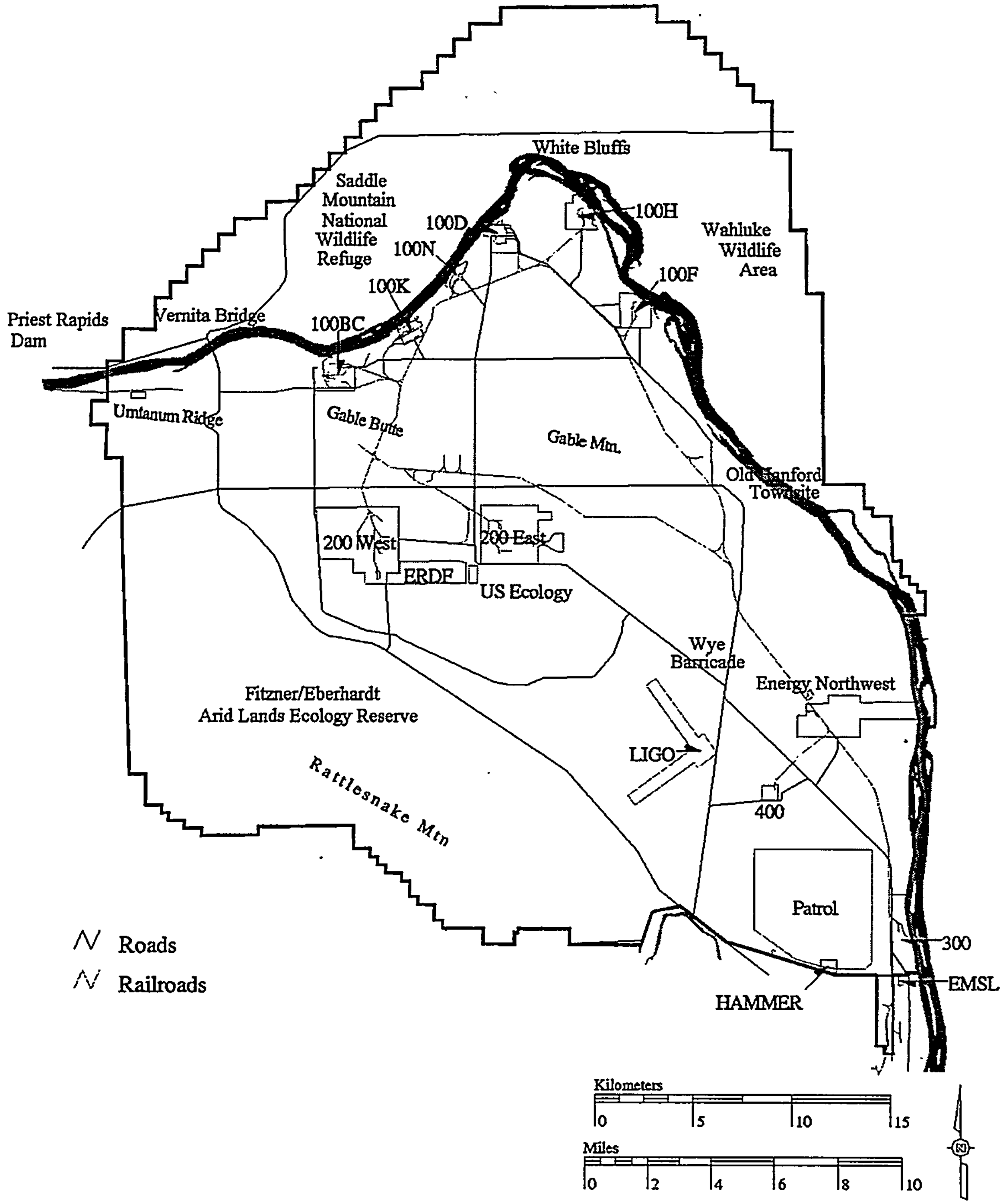

Figure 1.1 The Hanford Site.

stored underwater in 100-K Area basins. The removal of this fuel and its transition to dry storage in the 200 Area is one of the Site's highest priorities.

- The 200 Areas. The 200 East and 200 West Areas are in the center of the Hanford Site on the Central Plateau. Facilities in these areas were used for extracting plutonium from spent reactor fuel and processing the plutonium. Massive quantities of radioactive wastes are currently stored in these areas. The stabilization of plutonium-bearing materials, the retrieval and stabilization of wastes stored in underground storage tanks, and the safe storage and disposal of solid waste materials are some of the major clean-up activities being conducted in the 200 Areas.

- The 300 Area. This area is located near the southern border of the Hanford Site. It contains laboratories, support facilities, and former reactor fuel manufacturing facilities.

- The 400 Area. This area is located between the 200 and 300 Areas and contains the Fast Flux Test Facility (FFTF) and associated facilities.

On June 9, 2000, more than half of the original Hanford Site (~ 790 km^2 [305 mi^2]) was set aside as the Hanford Reach National Monument. The monument includes the 51-mile long "Hanford Reach" (the last free-flowing, non-tidal stretch of the Columbia River in the United States), Fitzner/Eberhardt Arid Land Ecology Reserve, Saddle Mountain Wildlife Refuge, Wahluke Slope Wildlife Area, and Hanford Dune Field. The monument is intended to preserve the unique ecological, scientific, historical, and cultural resources of the Hanford Site.

1.3 Meteorological Monitoring at the Hanford Site

The climate of the Hanford Site and the surrounding region is greatly influenced by the Pacific Ocean and Cascade Mountain Range to the west and the Rocky Mountains located to the north and east. The Pacific Ocean moderates temperatures throughout the Pacific Northwest and the Cascade Range generates a "rain shadow" that limits rain and snowfall in the eastern half of Washington State. The Cascade Range also serves as a source of cool air drainage, which has a considerable effect on the wind regime on the Hanford Site. Mountain ranges to the north and east of the region shield the area from the severe winter storms and frigid air masses that move southward across Canada (Hoitink et al. 2000).

Meteorological data for the Hanford Site are collected and archived at the HMS. The HMS is located near the center of the Site, just outside the northeast corner of the 200 West Area. Meteorological measurements have been made at the HMS since late 1944. Prior to the establishment of the HMS, local meteorological observations were made at the old Hanford townsite (1912 - late 1943) and in Richland (1943-1944). A climatological summary for Hanford is provided in Hoitink et al. (2000)[2].

The large size of the Site and its complex topography can give rise to substantial spatial variations in wind, precipitation, temperature, and other meteorological parameters. To accurately characterize meteorological differences across the Site, the HMS operates a network of automated monitoring stations. These stations, which currently number 30, are located throughout the Hanford Site and in neighboring areas (Figure1.2). A 122-m (400-ft)[3] instrumented tower operates at the HMS. A 60-m (200-ft) instrumented tower operates at each of the 100-N, 300 Area, and 400 Area (FFTF) monitoring sites. Most of the other network stations utilize short, instrumented towers with heights of about 9-m (30-ft). Instrumentation on each of the towers is summarized in Table 1.1

Data are collected and processed at each monitoring site and key information is transmitted to the HMS every 15 minutes. The HMS begins acquiring data from its monitoring station at the top of the hour, a quarter after-the-hour, at the half-hour, and at a quarter to the hour. The station uses radio telemetry to sequentially poll each of its automated monitoring stations. Most data are provided in the form of 15-minute average values (precipitation is a notable exception – it is provided in the form of a 15-minute total accumulation) based on measurements made at 5-second intervals throughout the averaging period. The data are processed at the HMS and formatted into meteorology files that can be read by ***MetView***. Five meteorological data files, one each for near-surface telemetry, 200-ft tower, 400-ft tower, surface observations at the HMS, and sodar data are prepared for each 15-minute period. The naming convention and format of these files is described in detail in Section 4.

Once the data is processed at the HMS and posted on its server, the data is transmitted to other servers. This includes the server at the EOC and a server at Pacific Northwest National Laboratory (PNNL). At the EOC and PNNL server, data for a given time period is usually available within about ten minutes of the end of the data averaging period. At the HMS, some files are available within a couple of minutes of the end of the averaging period while other files take a few minutes longer.

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[2] Hanford climatological data summaries have been updated annually since 1995. Earlier climatological reports that have been extensively cited include Glantz et al. (1990) and Stone et al. (1983). A detailed report on Hanford's meteorological monitoring instrumentation is provided in Glantz and Islam (1988).

[3] The "400-ft" tower is actually 125-m (410-ft) tall. The highest instrument measurement level on the tower is at 122 m (400 ft) above ground level.

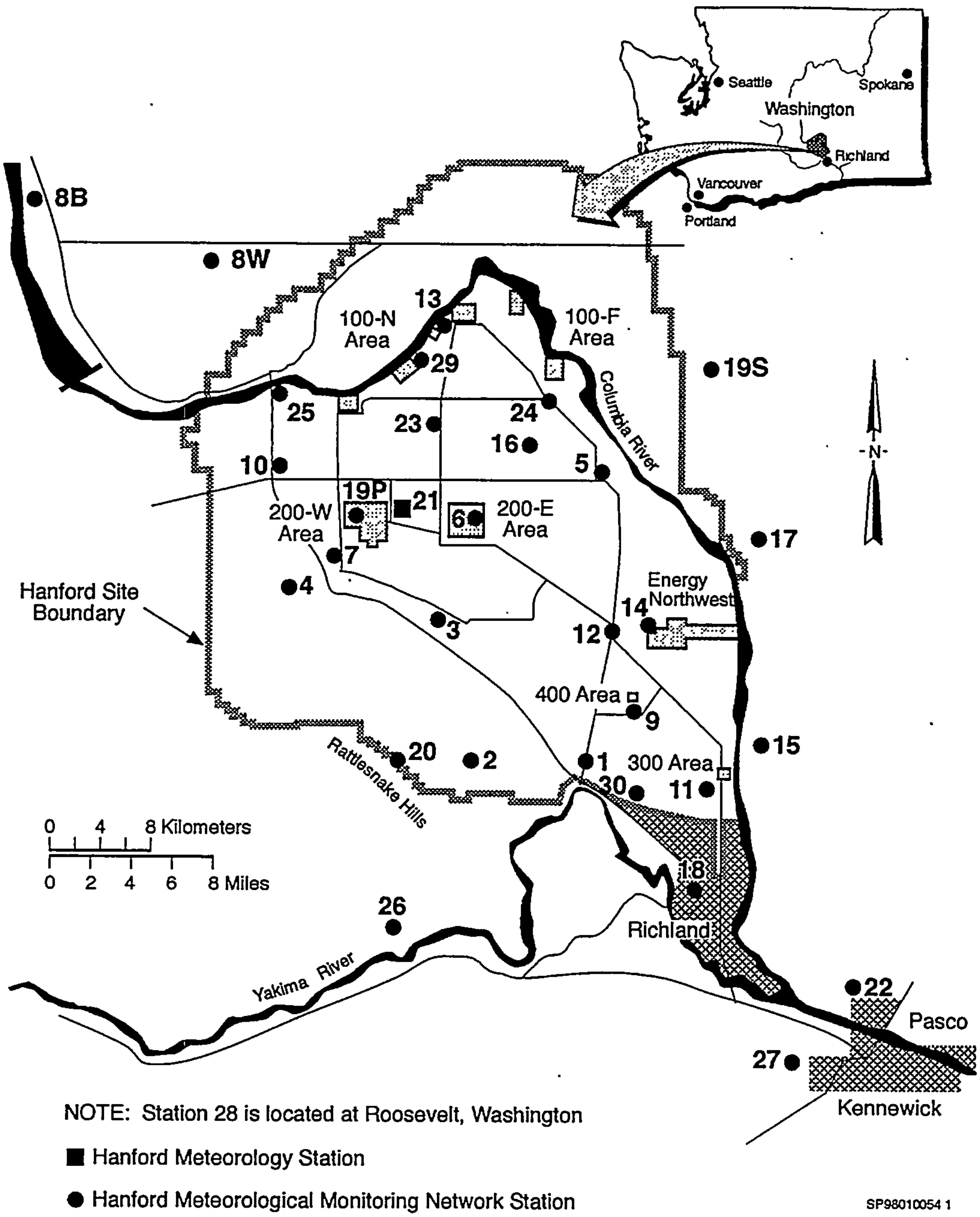


Figure 1.2 The Hanford Meteorology Monitoring Network.

Table 1.1. Station Numbers, Names, and Instrumentation for each Hanford Meteorological Monitoring Network Site.

Site Number	Site Name	Instrumentation
1	Prosser Barricade	WS, WD, T, P
2	EOC	WS, WD, T, P
3	Army Loop Road	WS, WD, T, P
4	Rattlesnake Springs	WS, WD, T, P
5	Edna	WS, WD, T
6	200 East Area	WS, WD, T, P, AP
7	200 West Area	WS, WD, T, P
8B	Beverly	WS, WD, T, P
8W[a]	Wahluke Slope	WS, WD, T, P
9	FFTF (60 m)	WD, T, TD, DP, P, AP
10	Yakima Barricade	WS, WD, T, P, AP
11	300 Area (60 m)	WS, WD, T, TD, DP, P, AP
12	Wye Barricade	WS, WD, T, P
13	100-N Area (60 m)	WS, WD, T, TD, DP, P, AP
14	Energy Northwest (Supply System)	WS, WD, T, P
15	Franklin County	WS, WD, T
16	Gable Mountain	WS, WD, T
17	Ringold	WS, WD, T, P
18	Richland Airport	WS, WD, T, AP
19P	Plutonium Finishing Plant	WS, WD, T, AP
19S[b]	Sagehill	WS, WD, T
20	Rattlesnake Mountain	WS, WD, T, P
21	HMS (125 m)	WS, WD, T, P, AP
22	Tri-Cities Airport	WS, WD, T, P
23	Gable West	WS, WD, T
24	100-F Area	WS, WD, T, P
25	Vernita Bridge	WS, WD, T
26	Benton City	WS, WD, T, P
27	Vista	WS, WD, T, P
28[c]	Roosevelt, Washington	WS, WD, T, P, AP
29	100-K Area	WS, WD, T, P, AP
30	HAMMER	WS, WD, T

(a) Key: WS = wind speed, WD = wind direction, T = temperature, P = precipitation, AP= atmospheric pressure, DP = dew point (atmospheric moisture)

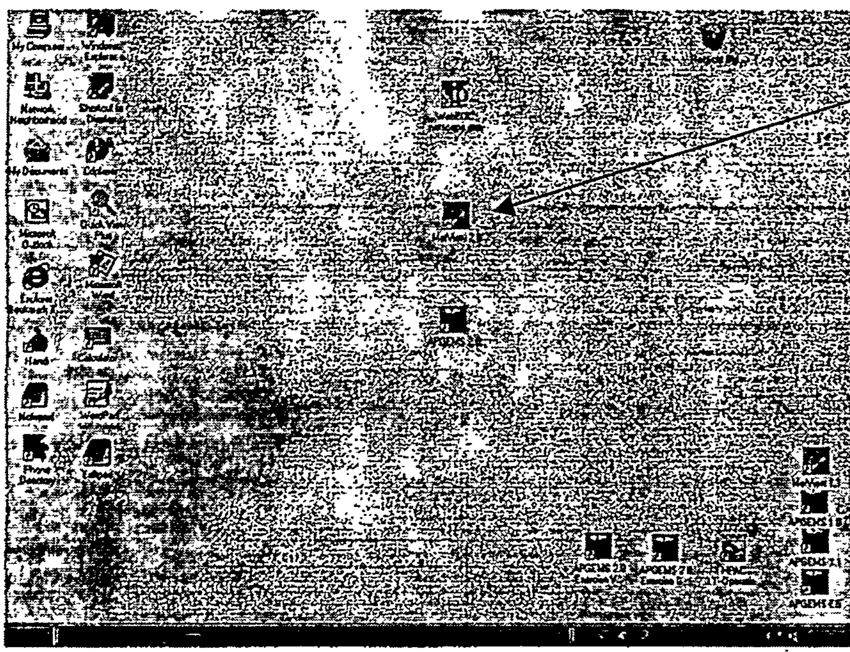
(b) Station no longer active.

(c) Roosevelt is located on the Columbia River west/southwest of the Site.

2.0 Instructions for the First Responder

If the Hanford Site's Emergency Operations Center is activated (for an exercise or a real event), the first staff members to arrive at the facility are responsible for performing "first responder" activities. These include using ***MetView*** to display and disseminate information on current wind conditions across the Site. This ***MetView*** assignment can be accomplished in a few easy steps.

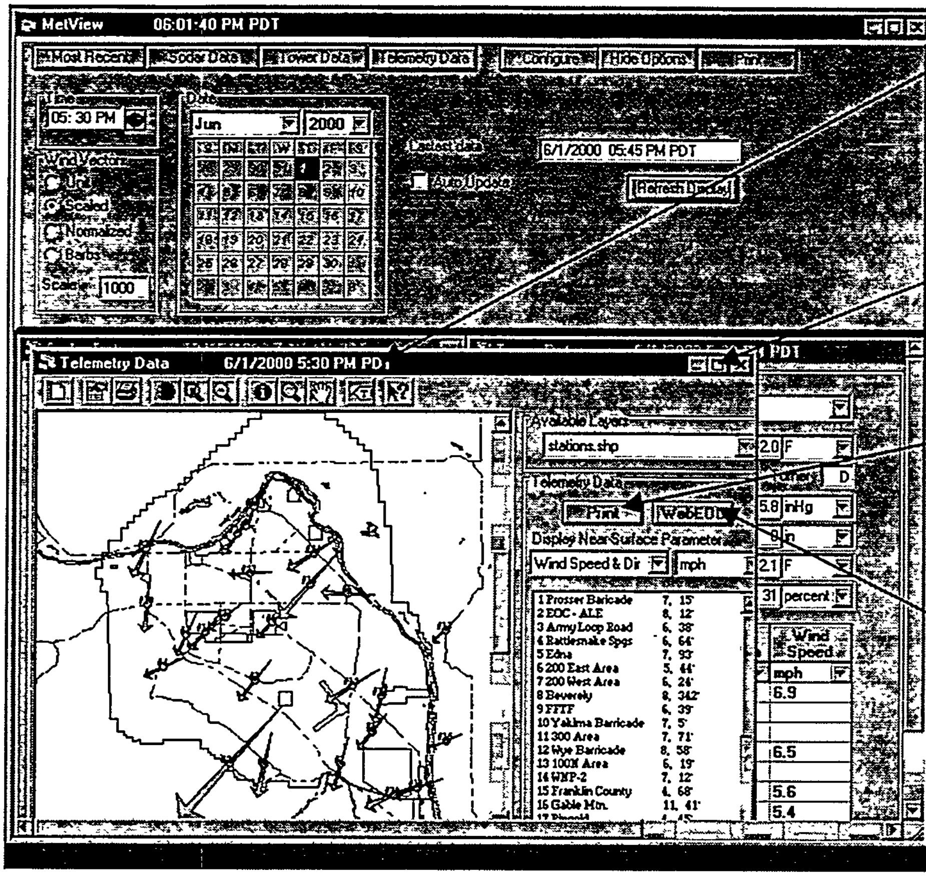
Step 1. **Double-click the *MetView* icon on one of the meteorology workstations.** The standard location for the MetView icon on the Meteorologist's UDAC workstation is near the center of the screen.



Step 1.
Run ***MetView***.
(double-click the ***MetView*** icon).

After double-clicking the icon, the **MetView** screen should appear and automatically display the most recent meteorological data available for the Hanford Site (see the screen display on the next page).

Step 2. **Check the Date and Time.** Examine the date and time displayed in the top line of the Telemetry Data display. You don't want to display the wind field from last year! Data are updated at the HMS every quarter hour. It generally takes the new data about another 10 minutes to arrive at the EOC (the time it takes to collect, process, and transmit the data to the workstation). If you think the data being displayed is no longer the most recent data, follow the instructions for "Refreshing the Data" (presented on the next page).



Step 2.
Check the date and time of the Telemetry Data.

Step 3.
Maximize the Telemetry Data window.

Step 4.
Click *Print*.

Step 5.
Click *WebEOC*.

Step 3. **Maximize the Display.** Make the wind field plot in the Telemetry Data window a little bigger by clicking the "maximize" button in the upper right hand corner of the window.

Step 4. **Print the Wind Field.** Click ***Print*** to generate a hardcopy of the wind field plot. The plot should emerge from the workstation's printer in a few seconds.

Step 5. **Copy the Wind Field Display to the WebEOC.** Click ***WebEOC*** to transfer a copy of the Telemetry Data image to the WebEOC system. This makes the data available for display at other workstations.

You have now completed your initial first responder responsibilities using ***MetView***.

Refreshing the Data...

To determine if new meteorological data are available for display, click ***Most Recent*** and repeat Steps 2-5. The ***MetView*** display will be refreshed with the most recent data. New data are made available for display at about 10, 25, 40, and 55 minutes after each hour.

If you are asked to provide data from an earlier time period, you can reset the calendar and clock counter to the desired date and time (see Section 3.2 for additional instructions). After resetting the date and time to the desired setting - click ***Refresh Display*** and the requested data will be displayed.

Click ***Most Recent*** to display the most recent HMS met data.

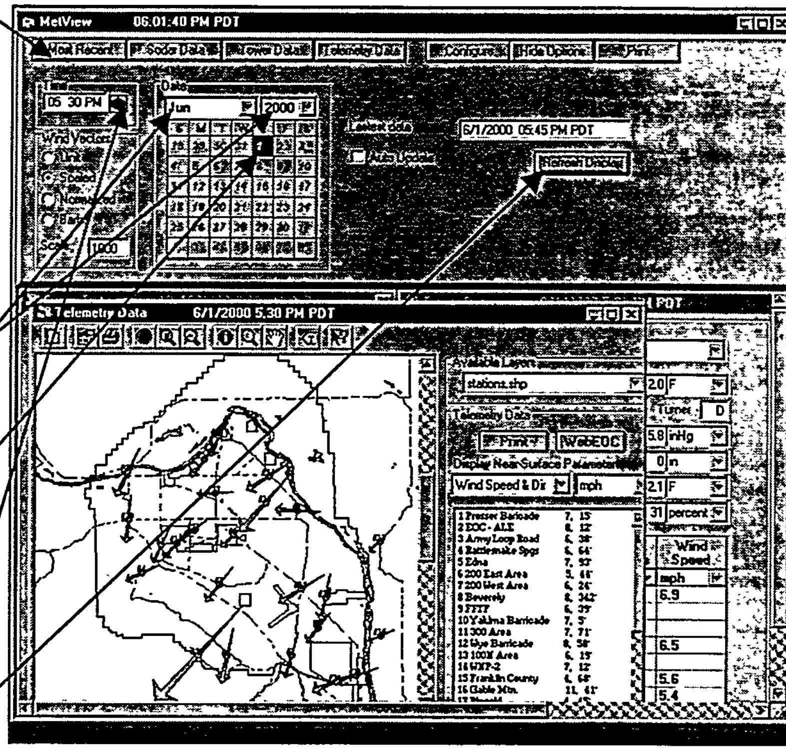
To examine data from a different date and time:

1) Click the *year* text box and click your selection from the drop down list box. Repeat for *month* -------------

2) Click the date on the calendar to select the day of the month ------------

3) Click the time spinner forward or backward to select the time of day ---

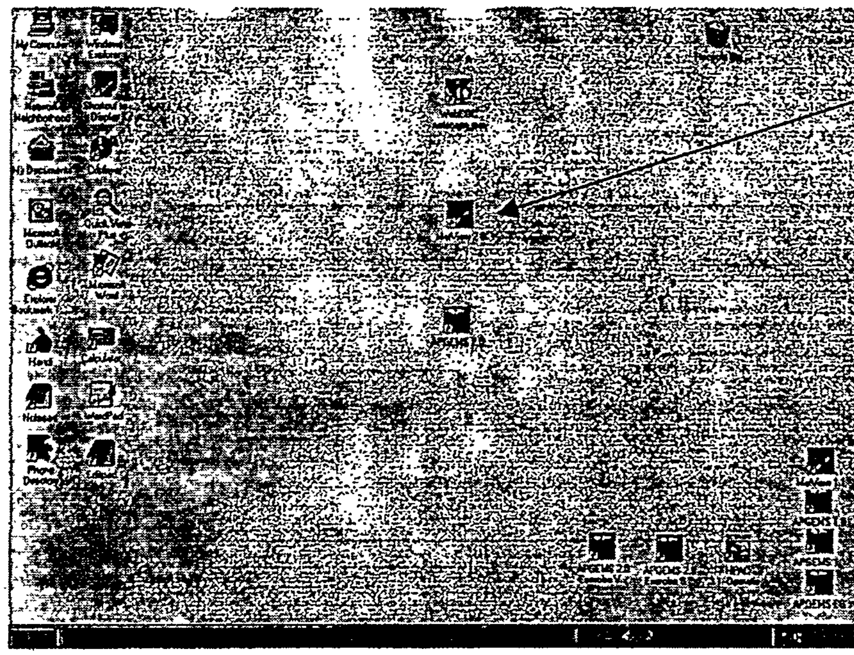
Click ***Refresh Display*** to display output for the requested date and time.



3.0 General Procedure for Running MetView – Menu and Display

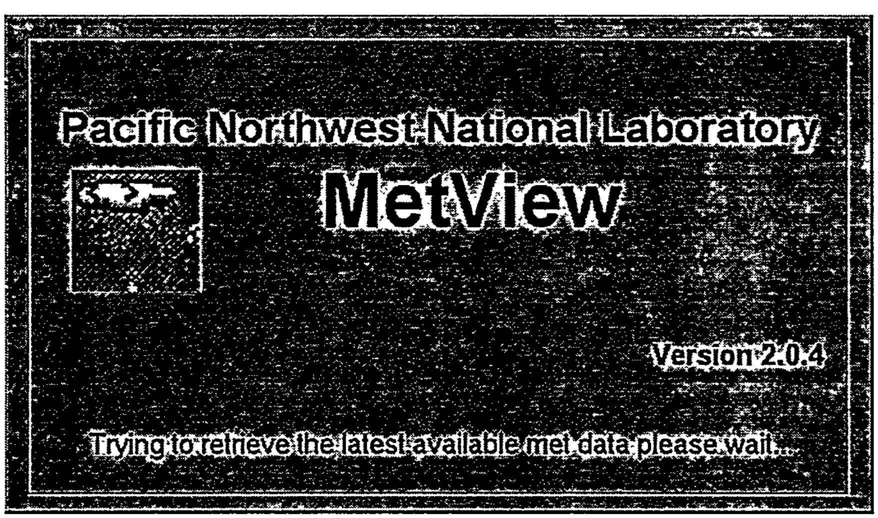
3.1 Starting *MetView*

To run the *MetView* model, the first step is to double-click the *MetView* icon. The standard location for the *MetView* icon on the Meteorologist's EOC workstation is near the center of the screen.

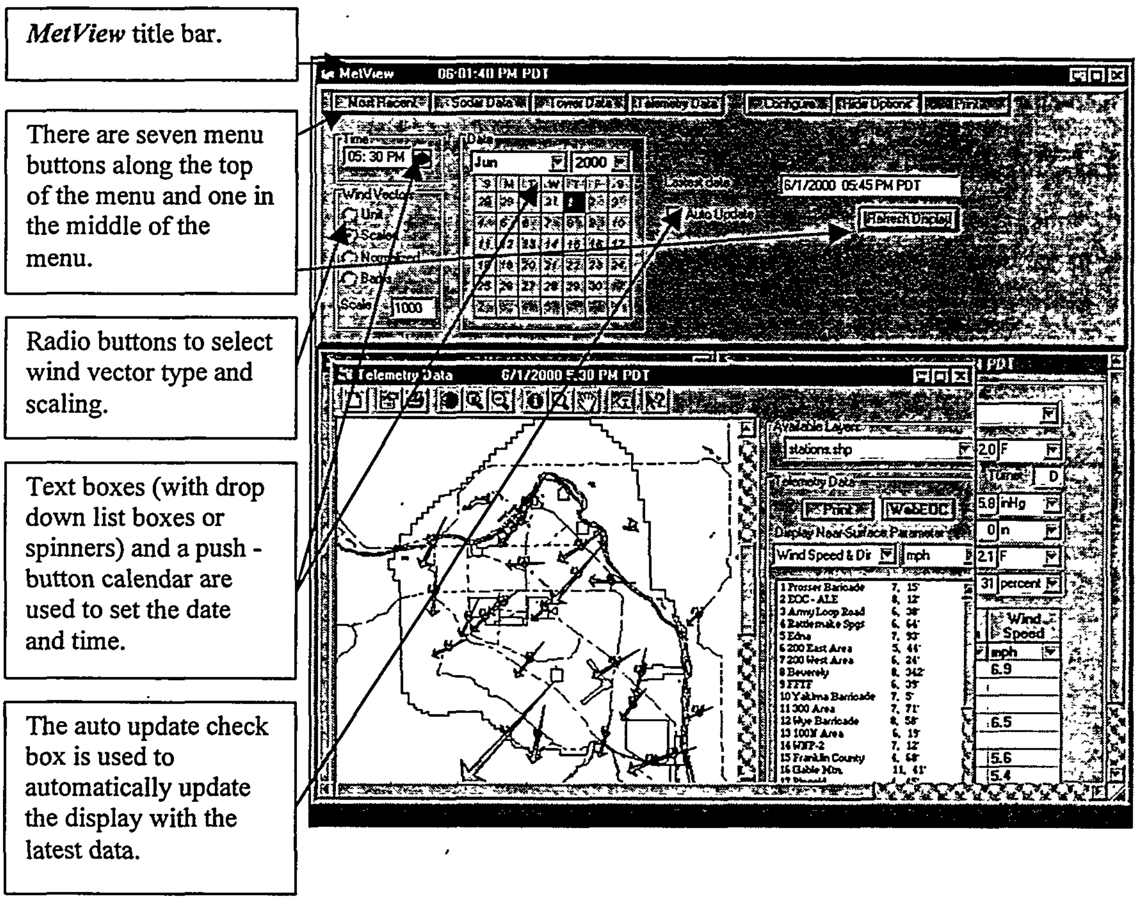


Run *MetView*. by double-clicking the *MetView* icon.

When this is accomplished, a message should briefly appear on the screen indicating that the *MetView* model is initiating.

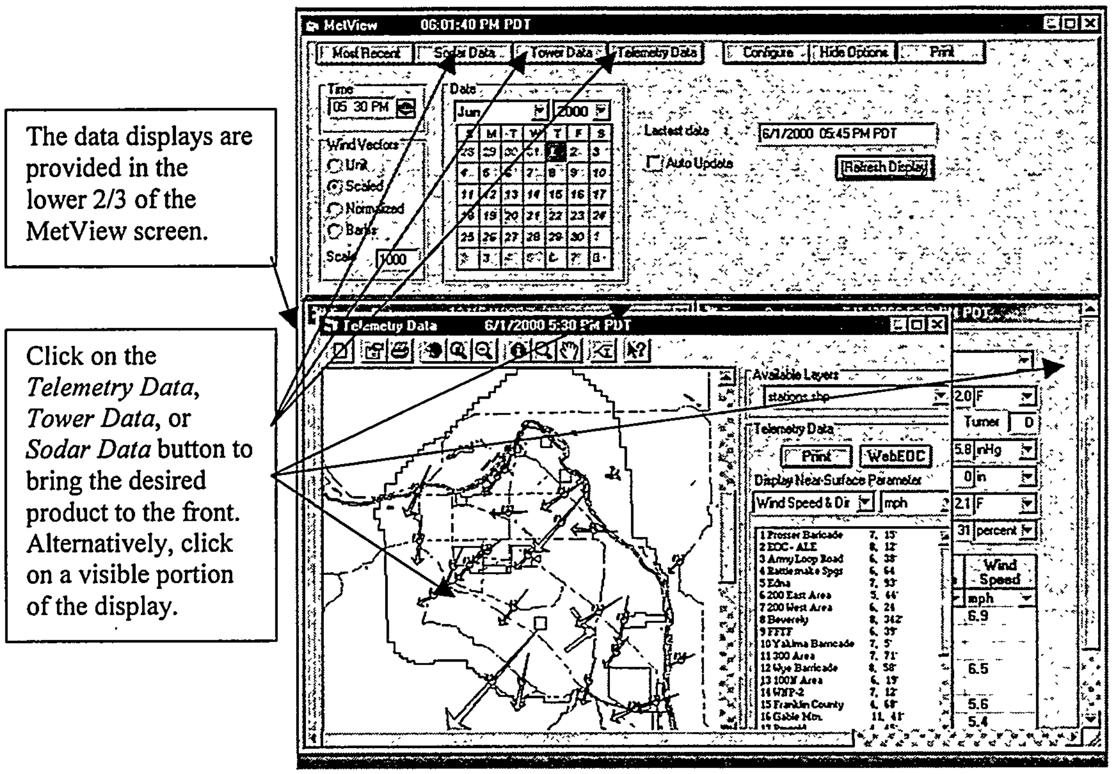


After a few seconds, the ***MetView*** screen should appear. At the very top of ***MetView*** is the title bar with the name of the program and the time of day. Just below the title bar, taking up about a third of the screen, is the "Main Menu". At the top of the Main Menu are a series of menu buttons. These buttons are used to access and display the most recent data, switch products in the display window, adjust the directory configuration, hide the Main Menu, and the print display products. Below the menu buttons are a series of text boxes (with drop down list boxes), radio buttons, and a check button designed to select the date and time of data to be displayed, choose the type of wind vectors presented, and turn the automatic update of meteorological data on and off. A *Refresh Display* button is used to update the data display. Each component of the Main Menu activity will be discussed in detail in Section 3.2 and 3.3.



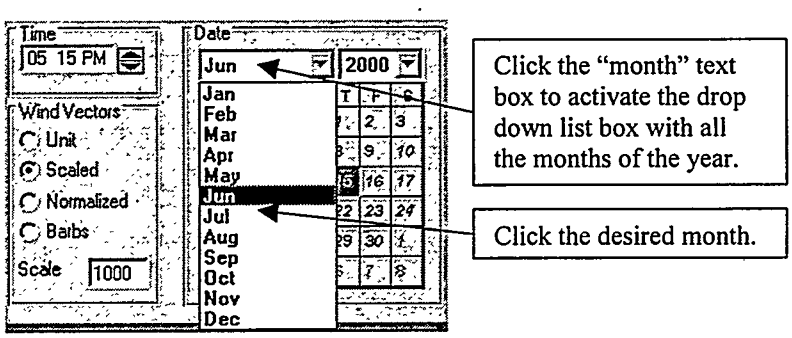
Below the Main Menu is the display window. On initial startup, data are presented for the most recent meteorological data available to the program. Three products are provided in the display window: the *Telemetry Data*, *Tower Data*, and *Sodar Data*. The *Telemetry Data* product provides a graphical display of near-surface meteorological parameters. It is prominently positioned as the top-layer in the display window. *Tower Data* provides numerical information from the Site's tall towers. This product is partially hidden behind the *Telemetry Data* on the right side of the display window. *Sodar Data* provides numerical information from the Site's Doppler acoustic sounders. This product is almost fully hidden behind the *Telemetry Data* in the left side of the display window.

A product can be brought to the front of the display window by clicking on the appropriate menu button at the top of the MetView screen. A product can also be brought to the front of the display window by clicking on a portion of the product that is visible from behind another display product.



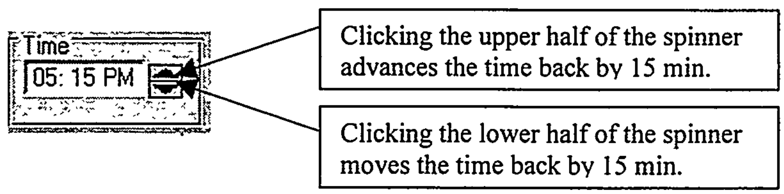
3.2 Main Menu – Adjusting the Date/Time and Refreshing the Display

To examine data from a different date and time, change the date and time settings and click the *Refresh Display* button. You can change the year by clicking on the appropriate text box. A drop down list box will appear displaying five years. Click the desired year from this list or use the scroll bar to view other candidate years (the years 1900 – 2100 are available in the list box). Change the month by clicking on the appropriate text box. A drop down list box will appear displaying all twelve months of the year. Click on the desired month

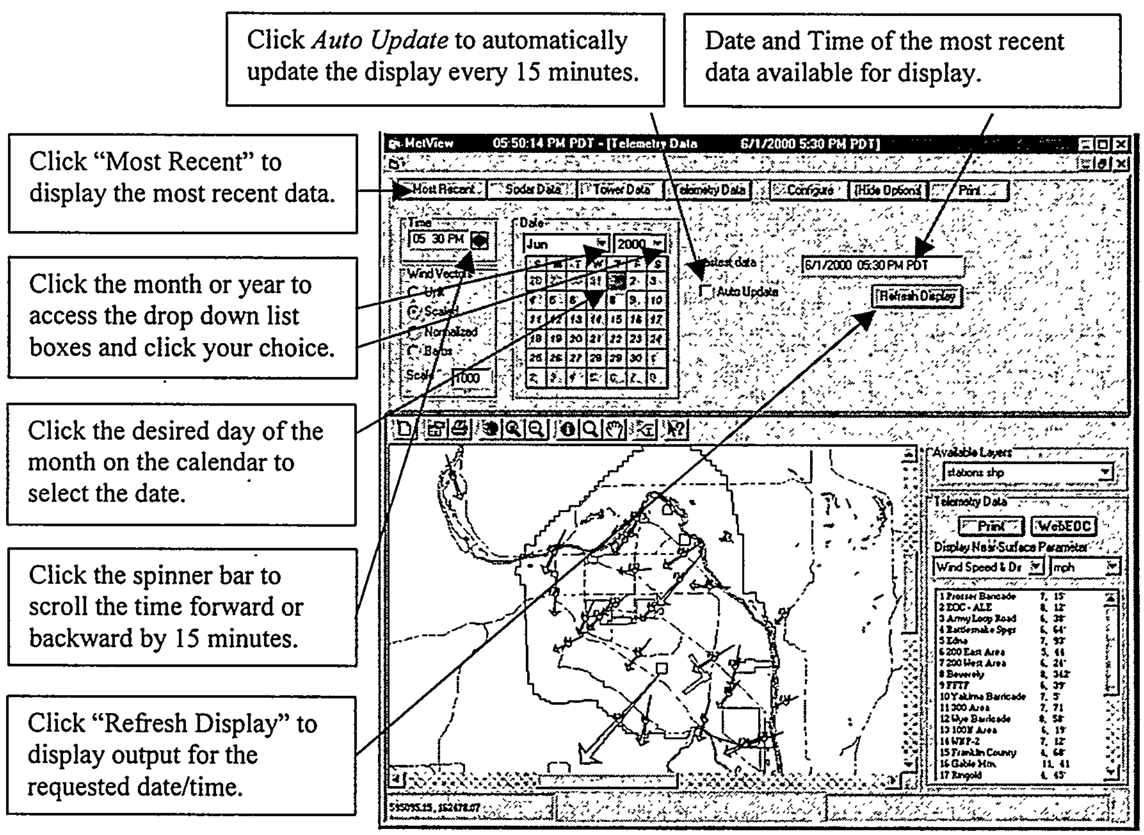


If the month is changed, the calendar display will change to present the calendar for the indicated month and year. Change the day of the month by clicking on the desired date box on the calendar. The selected day will appear as if it were "pushed in" from the rest of the calendar days.

To reset the time, click on the spinner located immediately to the right of the time display. Each click on the upper half of the spinner advances the time by 15 min; each click on the lower half of the spinner moves the time back in 15 min increments. Clicking and holding the spinner quickly advances or retreats the time. If the time display passes through midnight, the date on the calendar will automatically move ahead or back one day to account for passing into a different day. The time display can only change through the use of the spinner; the time display cannot be manually edited.



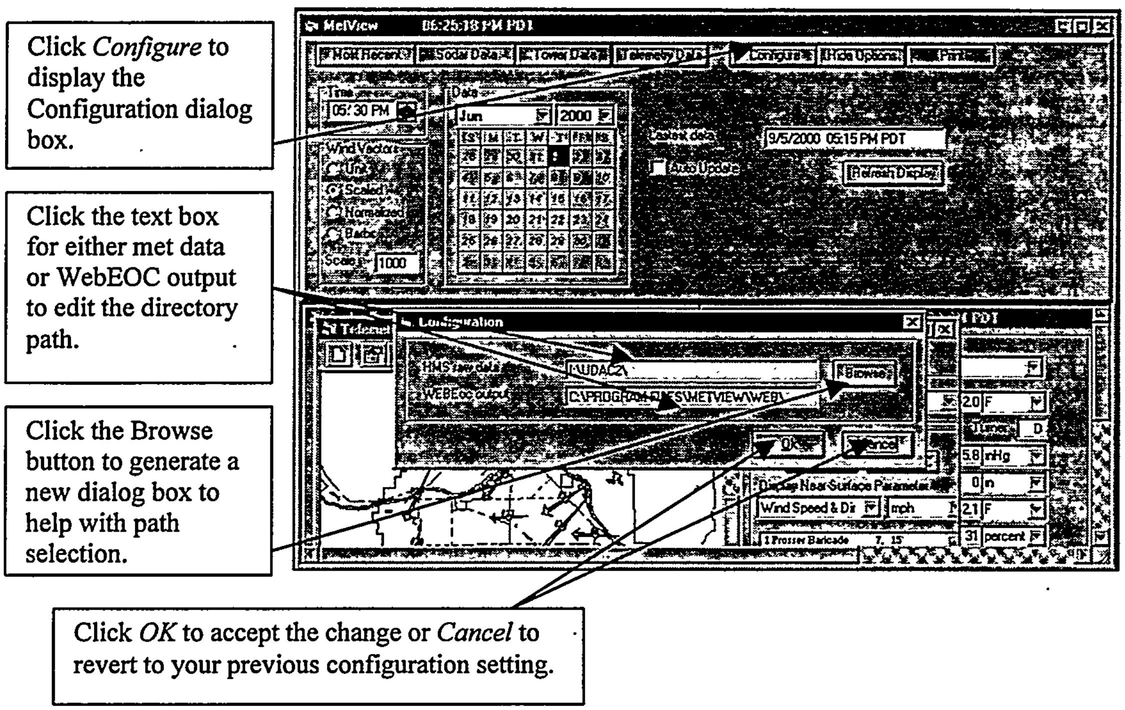
To immediately view the most recent available meteorological data, click the *Most Recent* button. The program will search for the most recent data and immediately display it. The date and time of the most recent data are displayed in the "Latest Data" text box. To automatically update the display every 15 minutes click the *Auto Update* check box. This feature searches for new data at 10, 25, 40, and 55 minutes after the hour (this factors in the 10-minute delay in the arrival of data from the quarter hour).



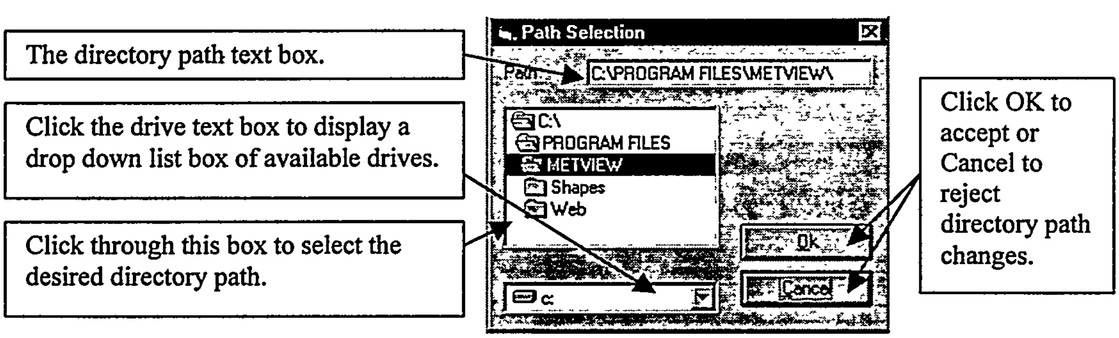
3.3 Main Menu – Configure

The *Configure* button is used to assign the directory for accessing meteorological data and outputting WebEOC products. At the EOC, recent meteorological data is found on the EOC web server at: *//apeoc01/metdata/.* At PNNL, it is found on the public server at: *//pnl05/udac/.* At the weather station, meteorological data are found on the HMS server at: *c:\data.* The WebEOC output function is only used at the EOC (the default address for this destination is *c:\program files\metview\web*).

To change the directory configuration, click the *Configure* button. The Configuration dialog box will appear on the screen. Click the text box of the directory you want to change and edit the address. After setting a new directory location, click OK to return to the main menu.

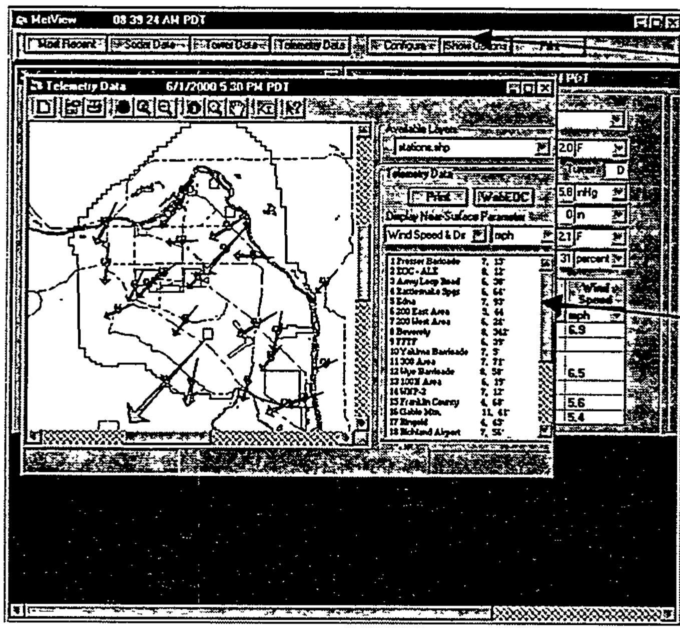


Alternatively, you can click the *Browse* button on the Configuration dialog box to do path selection. Click on the desired drive and directory and click *OK* to accept the new path (or *Cancel* to reject the changes) and return to the Configuration dialog box.



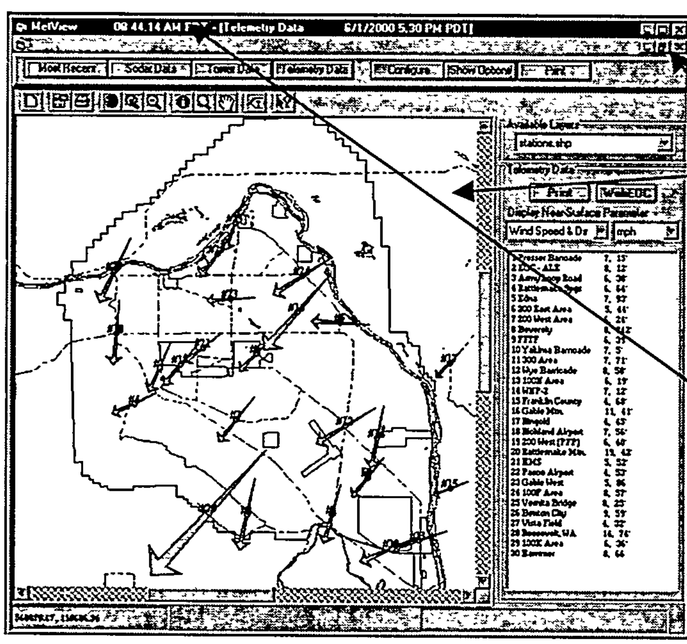
3.4 Main Menu – Hide Options/Show Options

Click the *Hide Options* button to expand the output display window to cover most of the Main Menu. Only the title bar and menu bar will remain visible above the output display window. The *Hide Options* button will also turn into a *Show Options* button. If *Hide Options* is selected and the display product is maximized in its window, the title bar of the display product will be merged with the main title bar. Click the *Show Options* button to restore the main menu, reduce the size of the display window, and restore the *Hide Options* button.



Click the *Hide Options* button to hide most of the Main Menu and turn the *Hide Options* button into *a Show Options* button.

The size of the display window is increased as most of the Main Menu is hidden.

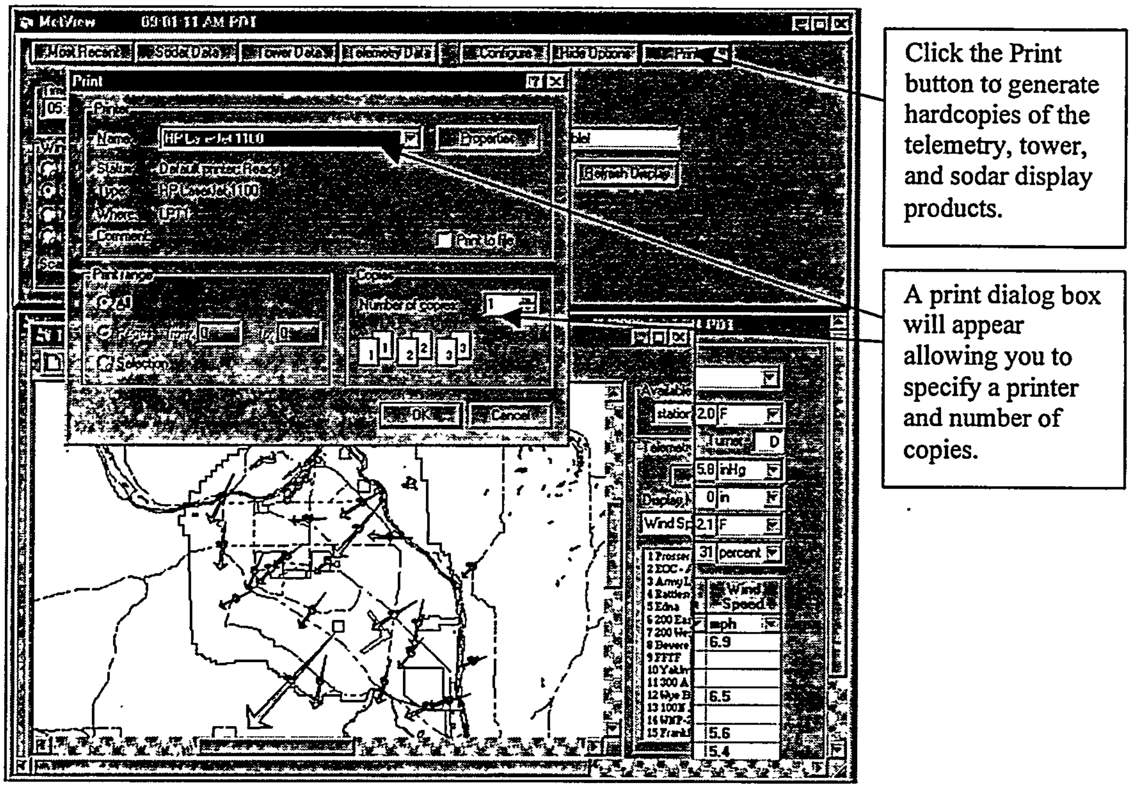


Click the Windows maximize button in the upper left-hand corner of the product to maximize its presentation in the display window.

Information from the display product's title bar is now merged into the main title bar.

3.5 Main Menu – Print

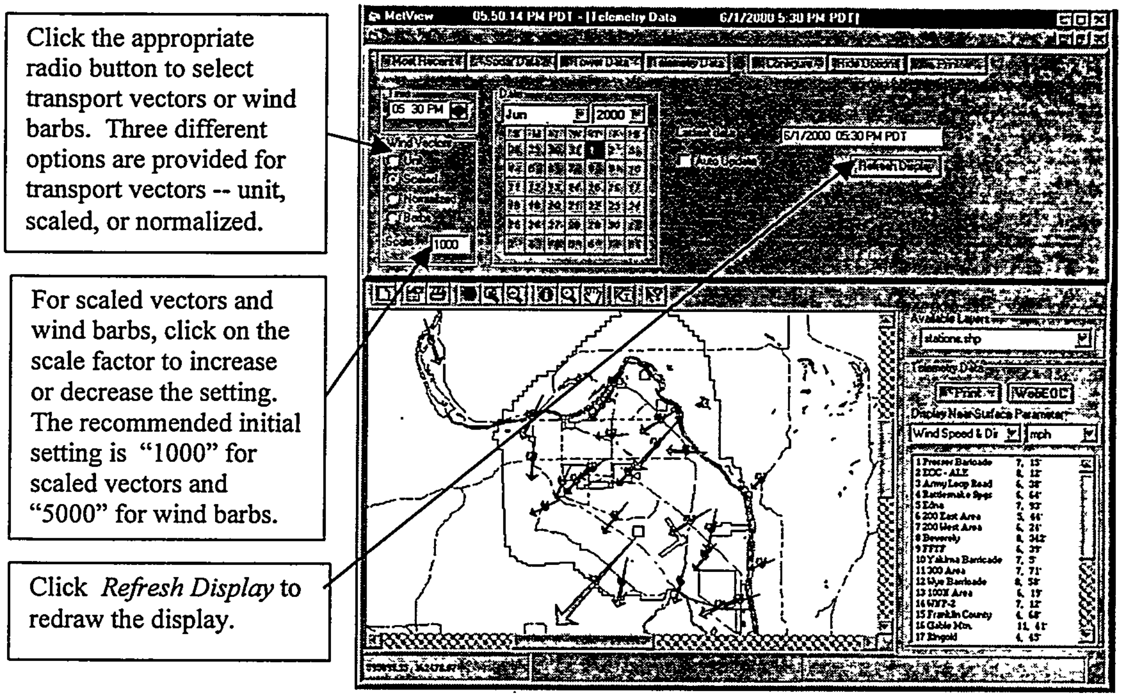
The Print button on the Main Menu is used to generate a hardcopies of the telemetry, tower, and sodar products for the indicated time period.



Output will include a hardcopy of the currently displayed telemetry plot, the "400 ft" tower data (including surface observations), all of the "200 ft" tower data, and all of the sodar data. An example of the output generated from this print option is presented in the Appendix. Operationally, this print option is only used occasionally because it generates at least five pages of output products. More typically, the print button within the display product is used (see Section 3.7).

3.6 Main Menu – Selecting the Graphical Display of Wind Data

On the left side of the Main Menu is a box for selecting the method to graphically display wind data. Winds can be displayed as transport vectors or wind barbs. Transport vectors are arrows that show the direction the wind is blowing. These vectors can be drawn as "unit" vectors with a constant size or as "scaled" or "normalized" vectors with the length of the transport arrow being proportionate to the wind speed. In the scaled mode, a fixed ratio is set between the length of the transport vector and wind speed. This ratio can only be altered by manually adjusting the scaling factor. In the normalized mode, the ratio between the length of the transport vector and wind speed is computed by the model and is based on the highest wind speed at any monitoring station. Transport vectors are used to display wind data for all EOC applications.



Wind barbs are a graphical display method often employed in meteorological products to analyze winds. The wind barb indicates the direction from which the wind is blowing and the number of barbs on its tail indicates the wind speed. Section 3.7 presents instructions on how to estimate the wind speed using wind barbs.

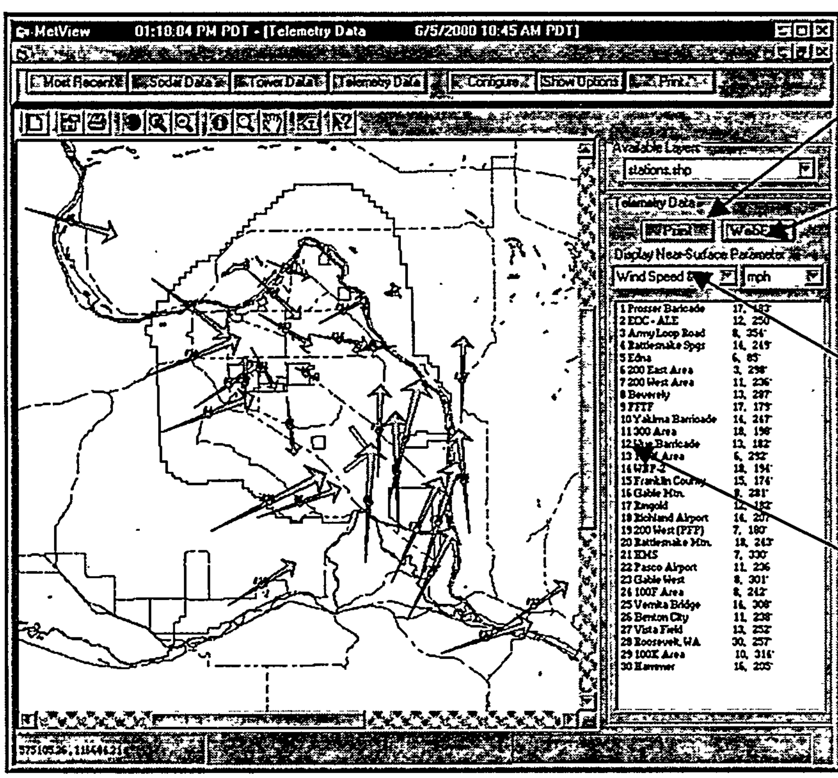
Wind vectors are almost exclusively used to display wind data at the EOC while wind barbs are generally used at the HMS. For both scaled vectors and wind barbs, the user can adjust the scaling factor that determines the mean size of the wind vector or barb. The recommended initial setting for scaled wind vectors is "1000". This setting works for the most commonly occurring ranges in wind speeds. Increasing this value increases the average size of the wind vectors (this may be employed when wind speeds are generally low). Similarly, decreasing this value decreases the average size of the wind vectors (this may improve the readability of the wind display when wind speeds are high across the site). The recommended initial setting for wind barbs is "5000". To adjust the scaling factor, click on the "Scale" text box and edit the scaling factor (the "Scale" text box is not used and is not displayed when the "unit" or "normalized" wind vectors are selected). Click *Refresh Display* and the wind vectors or barbs will be redrawn using the new scaling factor.

3.7 Telemetry Data Window – General Properties and Display of Wind Data

The Telemetry Data product can graphically and numerically present the wind direction and wind speed at each of the near-surface monitoring stations. The date and time of the data presented are provided on the title bar of the display. All the wind data presented in this product are based on measurements made at 9-m (30-ft) above ground level. The graphical product presents a background map of the Hanford Site and the surrounding area. The Site boundary, major operating areas, roads, rivers, and other major bodies of water are displayed on the background map. The location of each monitoring station is displayed as a small circle. Each station's identification number is plotted near its location. Wind vectors are drawn with the location of the monitoring site at the mid-point of the vector. Wind barbs are drawn with the location of the monitoring site at the head of the wind barb.

Numerical information is provided to the right of the graphical display. The station identification number, name, wind speed (mph), and direction (° from N) are provided. If the text box containing the numerical data is too small to allow all of the stations' data to appear at once, a vertical scroll bar will be provided.

Click the *Print* button in the upper right portion of the product to generate a hardcopy of the telemetry data plot. A "Print" dialog box will be displayed to allow the user to select a printer and customize the print job. Click *OK* in the Print dialog box to continue with the designated print job. Unlike the *Print* button on the Main Menu, this print function will only generate a hardcopy of the displayed telemetry data product.



Click *Print* to generate a hardcopy of the display.

Click *WebEOC* to transfer output data for display.

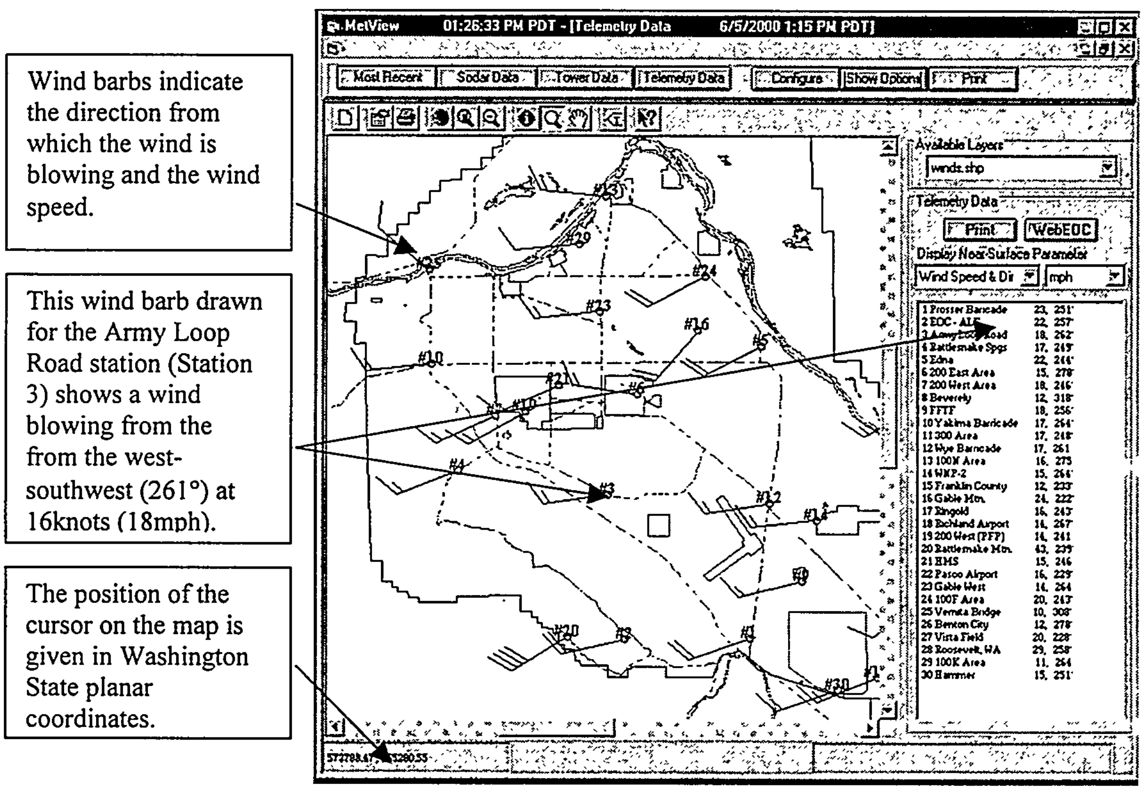
The "Display Near-Surface Parameter" option indicates that wind speed and direction are being presented.

Each line in the numerical presentation of data presents the station id #, name, wind speed (mph), and the direction from which the wind is blowing.

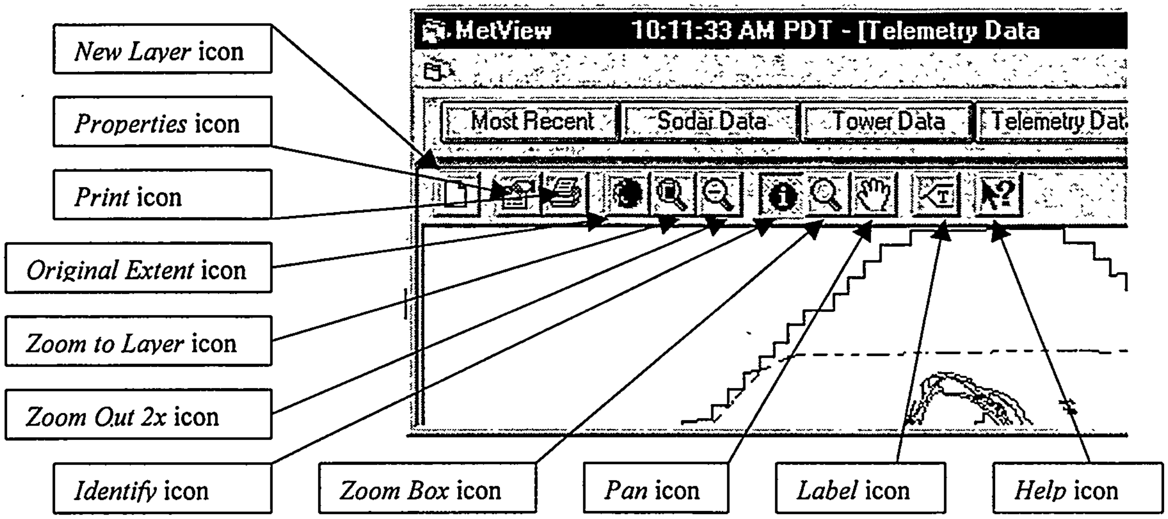
Click *WebEOC* to transfer a copy of the Telemetry Data image to the WebEOC system-making it available for display in the EOC.

A presentation of the near-surface wind data using wind barbs has a different appearance from the presentation of the wind vectors. In the wind barb mode, the wind direction is indicated by the orientation of the line that ends at the monitoring station location. The line points out from the station toward the direction from which the wind is blowing. At the other end of the wind barb are small lines that are almost perpendicular to the main direction line. These "barbs" indicate the wind speed. Each half-sized barb indicates a wind speed of 3 - 7 knots (3 - 8 mph) and each full-sized barb indicates a wind speed of 8 - 12 knots (9 - 14 mph). A triangle indicates a wind speed 48 - 50 knots (55 - 60 mph). Lines and triangles are added together at the end of the wind barb to indicate the actual speed. For example, a wind speed of 65 knots (75 mph) would be represented by one triangle, one full-sized line, and one half-sized line coming off the end of the wind barb.

In all display products, the position of the cursor on the map is indicated in Washington State planar coordinates (m) in the lower left corner of the display. This information is useful when determining positions and for estimating the distance between two locations.



Above the display are a series of icons that can be used to alter the display of telemetry data. The first icon is *New Layer*. This is used to find data on a new layer of background information to plot (e.g., as topography, buildings, railroad lines).

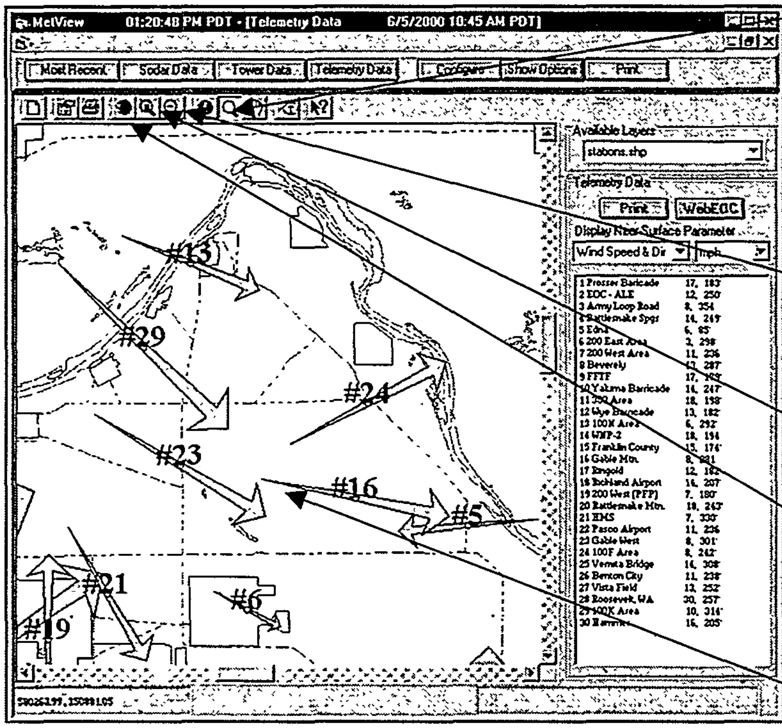


The next icon is *Properties.* Clicking this icon brings up a window that allows the user to adjust the properties of the shape files displayed on the background map. The user can use this to do such things as turn-off a map item (e.g., make roads disappear), change the color of any map background feature, change the shape of any map line or its fill style (e.g., turn solid lines into dashed line, or change circles into triangles), or change the size of text material to display (e.g., increase the size of the station numbers). The third icon is *Print.* This has the same function as the large *Print* button on the right side of the display.

The graphical display of near-surface wind data and other near-surface parameters can be adjusted by using the zoom buttons at the top of the telemetry display window. To zoom in click the *Zoom Box* button, move the cursor into the display window, click and drag the cursor to form a box around the area you want to zoom in on, and release the mouse button. The display will zoom in on the boxed area. Once the *Zoom Box* button is clicked it stays on until another button is clicked. This allows the user to repeatedly click and drag within the display window to zoom in for an increasingly detailed look at an area of interest.

To zoom out, click the *Zoom Out 2x* button. This will expand both the east-west and north-south extent of the displayed window by a factor of two, thereby, increasing the area displayed by a factor of four.

The *Zoom to Layer* and *Original Extent* buttons also adjust the display. The *Zoom to Layer* provides a display that includes all of the Hanford Monitoring Network's monitoring stations, including the Roosevelt station (located on the Columbia River ~ 100 km (60 mi) southwest of the southernmost point on the Hanford Site. This display is centered near the Benton City monitoring station and covers a very large area. Clicking *Original Extent* re-centers the display on the geographic center of the Hanford Site and covers the monitoring stations within the vicinity of the Hanford Site, leaving out the remote Roosevelt station.



Click *Zoom Box* to zoom in on any area of interest. Click and drag the cursor to highlight an area. Release the mouse button and the display will be redrawn.

Click *Zoom Out 2x* to expand the area displayed.

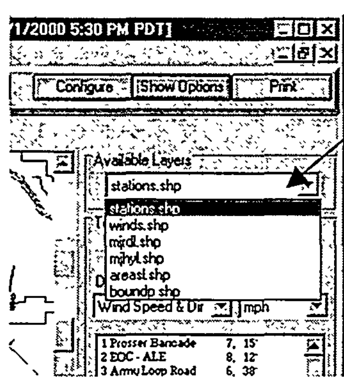
Click *Zoom to Layer* to adjust the display to show all of the monitoring stations.

Click *Original Extent* to adjust the display to show all of the monitoring stations in the vicinity of the Hanford Site (excludes Roosevelt).

Zoomed-in display

Within any display product, the user can use the *Pan* icon or the horizontal and vertical scroll bars to move the displayed image and examine any location in the covered domain. Click *Pan* and position the cursor within the display. Click on the image while keeping the left mouse key depressed. Drag the image across the screen to reposition the display. When you release the mouse key the image will be fully redrawn in its new position.

The *Identify* icon is used in conjunction with the "Available Layers" text box. To get additional information about a feature of the display, click within the Available Layers text box. A drop down list box will appear presenting a list of all the layers plotted in the display.



Click the Available Layers text box and a drop down list of display layers. Click the layer for which you want additional information.

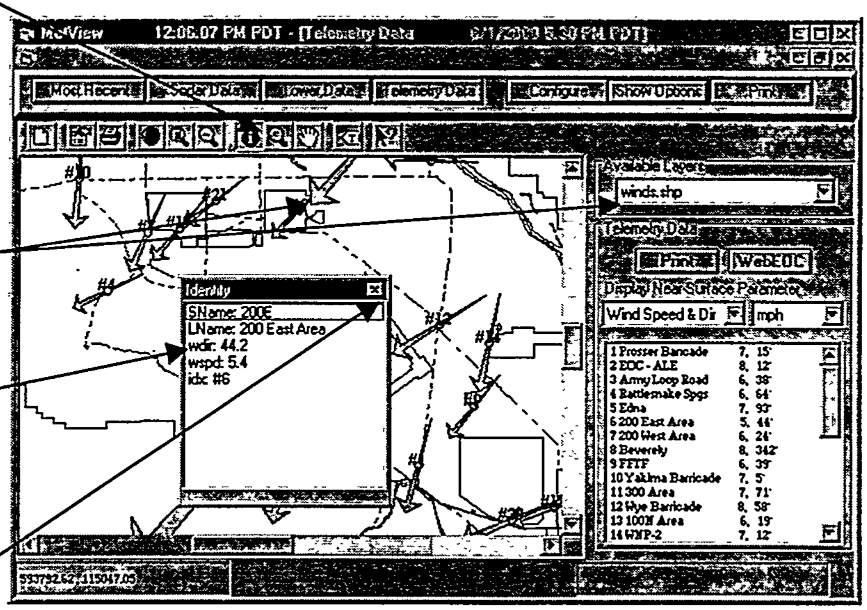
Among the standard set of available layers are monitoring stations, wind data, major roads, major hydrological features, and area boundaries. After selecting the layer, click the *Identify* icon and then click on the map feature for which you want additional information. Information will be displayed in a text box.

Click *Identify*.

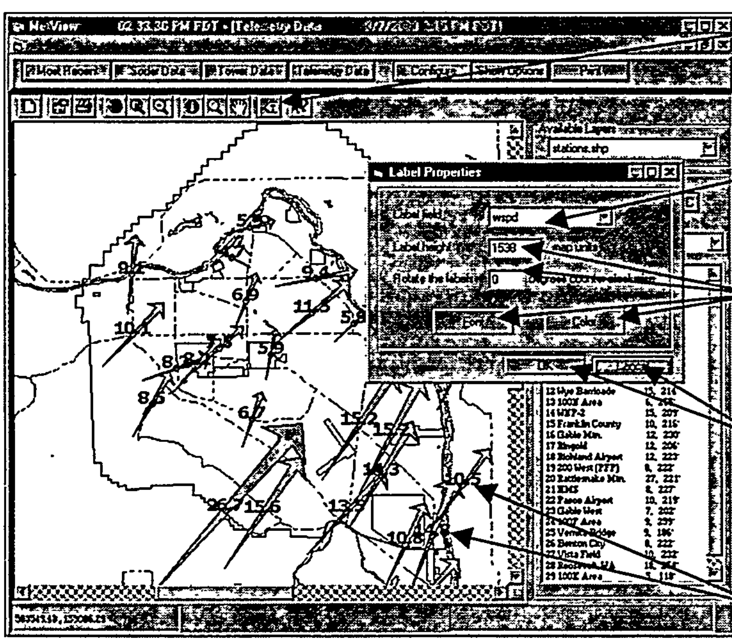
Click the map feature that is linked to the selected layer. In this example, it's the wind data layer from 200 East.

An "Identify" text box displays information on the station (e.g., position, met data).

Click to close the Identify box.



The *Label* icon is designed to set display parameters (e.g., font style, color, size) and then plot key labels (e.g., station id, wind direction, wind speed, station coordinates) on the graph. The *Help* icon is designed to activate the model's help feature. At this point in time, the Help feature is not fully operational.



Click the *Label* icon to generate the Label Properties dialog box.

Click the Label field text box to select a label parameter.

The label height, rotation, font, & color can be adjusted.

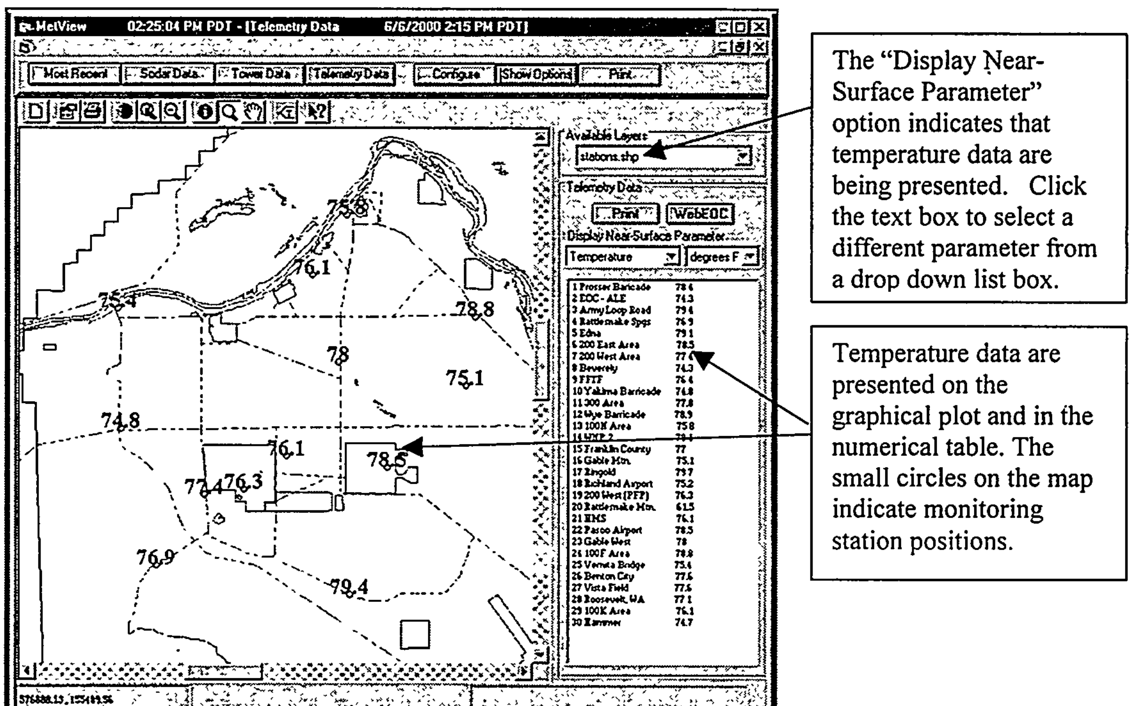
Click *OK* or *Cancel* to implement or cancel labeling changes.

In this example, wind speed data is displayed as a label on the plot.

3.8 Telemetry Data Window – Display of Temperature, Precipitation, Atmospheric Pressure, and Elevation Data

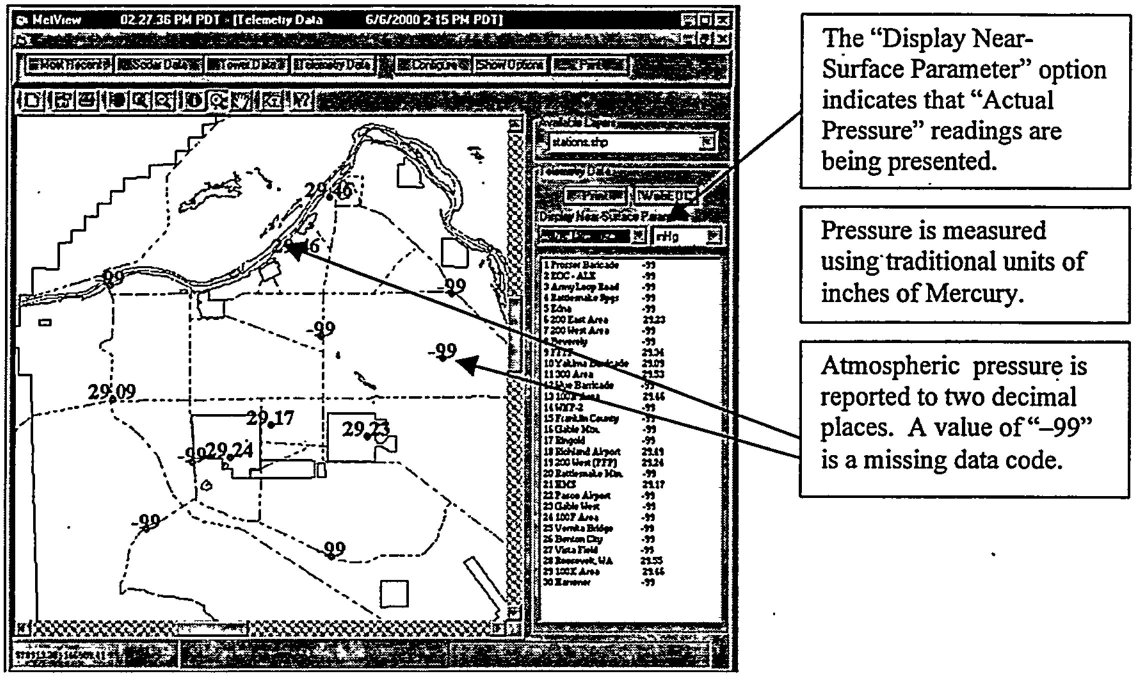
The Telemetry Data display can graphically and numerically present temperature (°F), precipitation (in/15 min), atmospheric pressure (in Hg), and elevation (m) at each of the near-surface monitoring stations. Temperature and atmospheric pressure measurements are made at ~ 1.7 m (5.5 ft) above ground level. Precipitation and station elevation data are measured at ground level.

To display values for one of these meteorology parameters, click on the list box under the "Display Near-Surface Parameter" heading (on the right side of the Telemetry data display). A drop down list box will appear. Click on the desired parameter and the Telemetry data product will automatically change to display that parameter. The graphical display will show the numerical value of the parameter at each monitoring location. To avoid the clutter of too many numbers on the display, station identification numbers are not plotted as they are for wind vectors. A numerical presentation of the data is also provided.



Click *Print* to generate a hardcopy of the parameter plot. Click *WebEOC* to transfer a copy of the plot to the WebEOC system.

While winds and temperatures are measured at each station, atmospheric pressure and precipitation are only measured at selected stations. Missing data is indicated by a missing data code (e.g., "–99" or "–99.99"). The parameter name used for atmospheric pressure is "Actual Pressure." This name indicates that this is an actual pressure measurement as opposed to a pressure measurement that has been corrected to sea level.



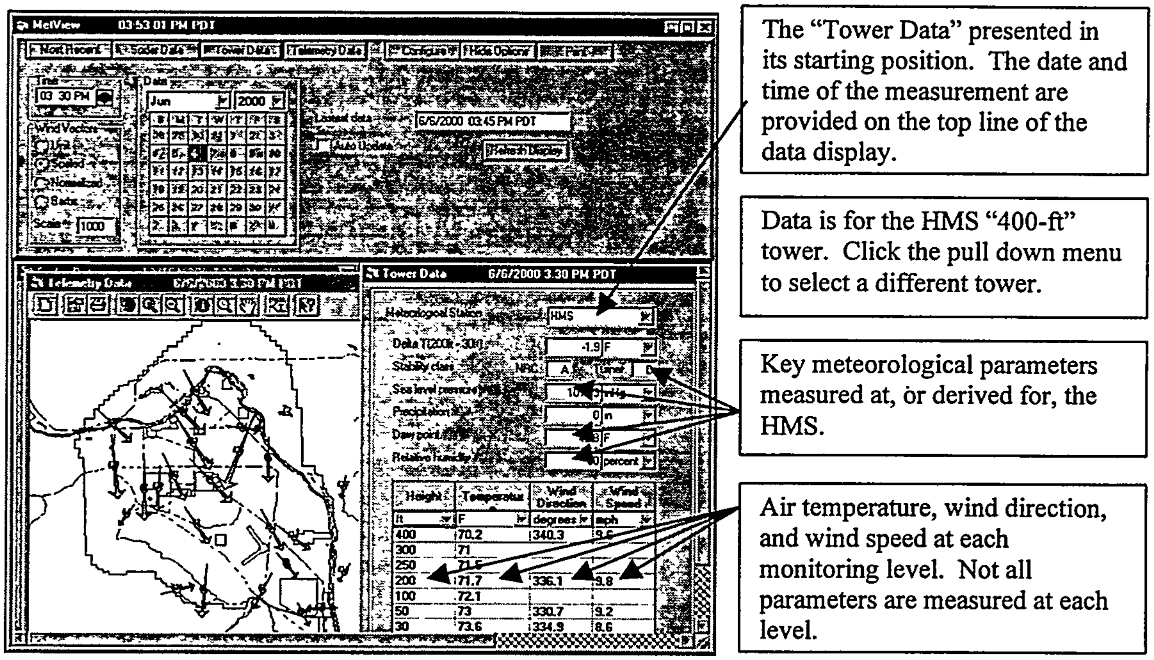
3.9 Tower Data Window –Tower Data and Surface Observations

The Tower Data display provides numerical data on the winds, temperatures, and other parameters measured on the Site's "400-ft" and "200-ft" instrumented towers and surface observations made at the HMS. The Tower Data can be accessed by clicking the *Tower Data* button or by clicking on any visible portion of the *Tower Data* display. Clicking the *Tower Data* button only reveals about half of the Tower Data display for the HMS monitoring site. To view the entire product, click on the top line of the Tower Data and drag the display to the left. If HMS is selected, surface observations, as well as tower data, will be provided.

Data from the HMS is presented as the default selection. To view data from another tower, click on the pull down menu to the right of the meteorology station name, and then click on the name of the station whose tower data you wish to view. For each tower, the data provided in the upper half of the display includes:

- Delta T (°F); this is the difference in the temperatures measured at the 60-m (200-ft) and 9 m (30-ft) monitoring levels on the tower. This value is the average of the differences measured at five-second intervals over the 15-minute monitoring period. It may be a slightly different value than the difference in the 15-minute average temperature at the two heights

- atmospheric stability category determined using the U.S. Nuclear Regulatory Commission (NRC) method at all of the towers and also with the Turner method at the HMS (Section 5.1 provides a more detailed discussion of atmospheric stability).
- station pressure corrected to sea level (millibars)
- precipitation (inches/15 minutes) (this value is also presented in the Telemetry Data display of precipitation)
- dew point temperature (°F)
- relative humidity (%)



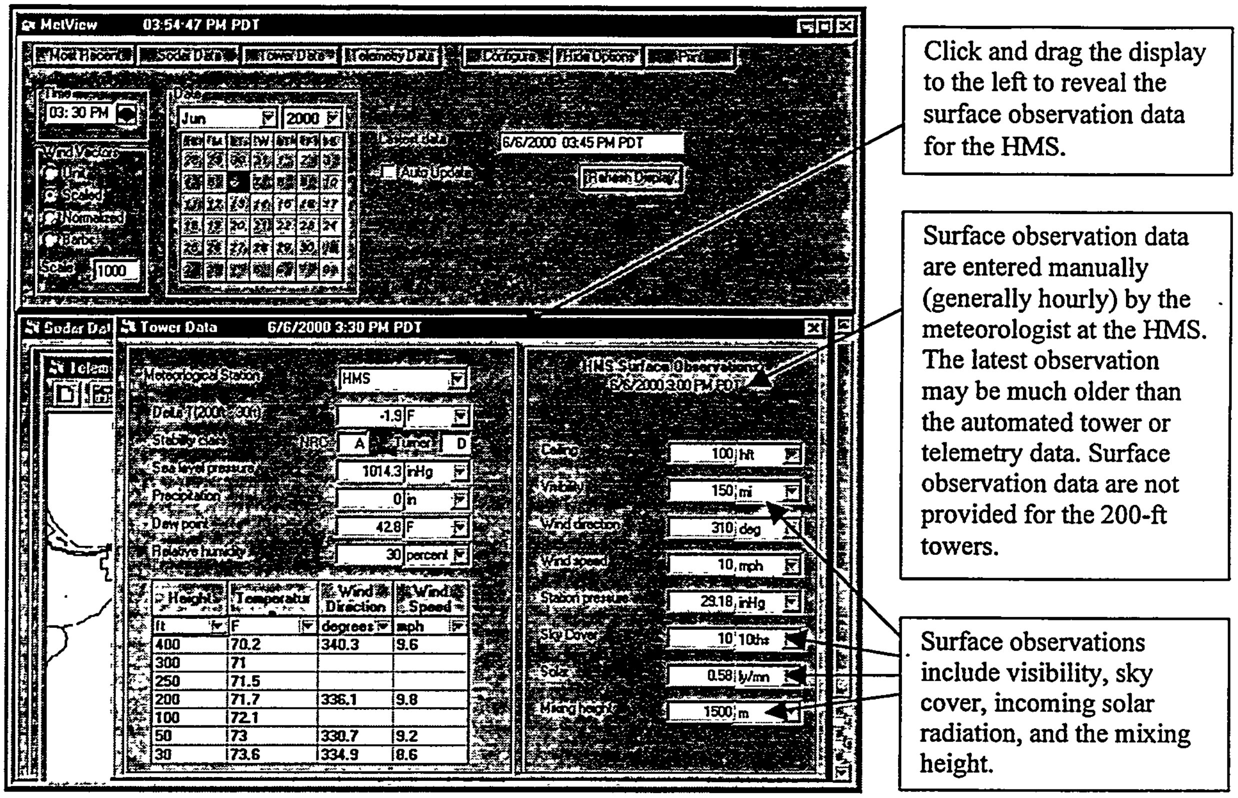
In the lower half of the display, the temperature (°F), wind direction (° from North), and wind speed (mph) are presented at multiple monitoring levels (meters above ground level). Note that not all of these parameters are measured at every level.

For the HMS, selected surface observations are also provided. These include:

- the cloud ceiling (the height in hundreds of feet to the lower base of the clouds)
- horizontal visibility (in miles)
- wind direction (° from North) at 50 ft above ground level
- wind speed (mph) at 50 ft above ground level
- atmospheric pressure (Hg)
- observed sky cover (tenths); the amount of sky obscured by clouds
- incoming solar radiation (in langleys/min)[4]
- mixing height (m); the distance from the surface to the top of the atmosphere's lower mixed layer. Pollutants are readily dispersed through the mixed layer by atmospheric turbulence.

[4] A langely is 1 gram calorie per square centimeter.

Additional information on all meteorological parameters are provided in Section 5.

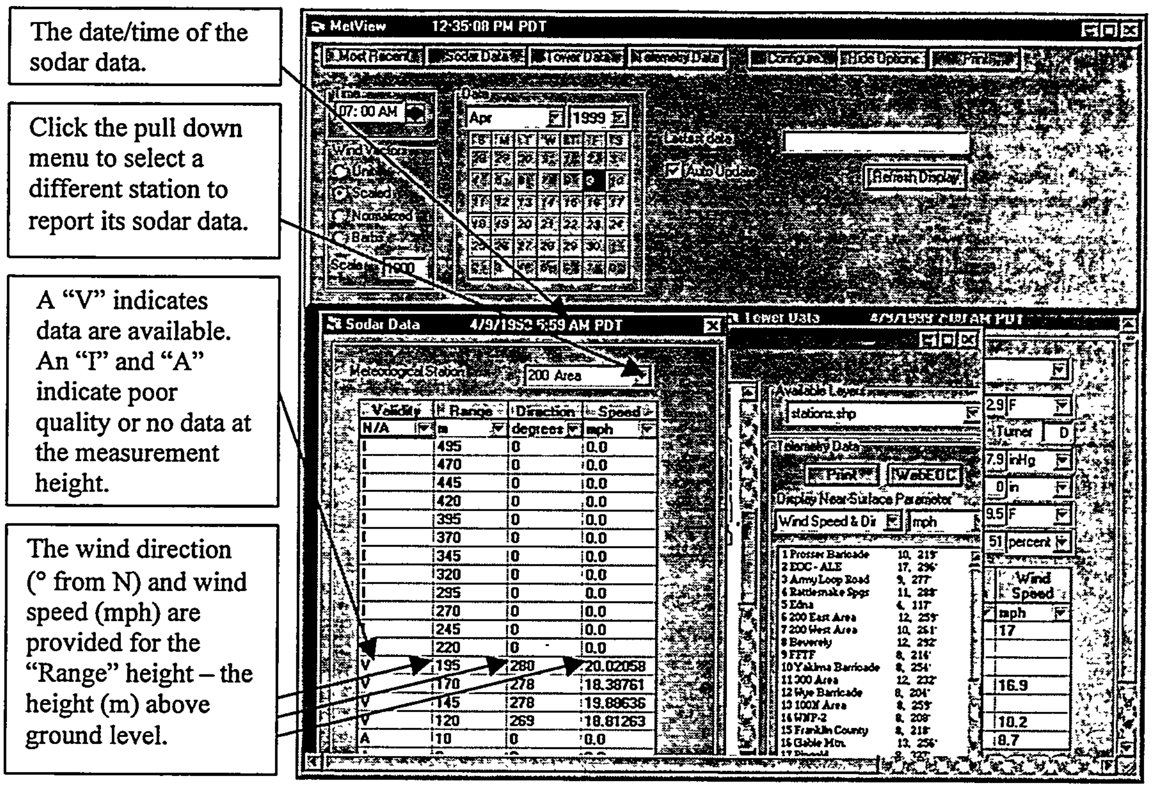


3.10 Sodar Data Window

The Sodar Data product provides numerical data on the remote measurement of winds aloft. The Sodar data can be accessed by clicking the *Sodar Data* button or by clicking on any visible portion of the *Sodar Data* display.

Data from the 200 Area (the HMS) is presented as the default selection. To view data from another sodar site, click on the "Meteorological Station" text box and a drop down text box will appear. Click on the location of the sodar whose data you wish to view. The date and time of the sodar data are presented on the top line of the Sodar Data display. Please check this date and time against the date and time of the period of interest. The sodar systems are often down for extended periods of time; the most recently available data may be weeks or months old.

Below the station name are the data returned for the measurement period. The sodar reports data at a number of heights above ground level – this height is indicated in the column labeled "Range." Wind direction (° from North) and wind speed (mph) are provided for each measurement range at which a signal is echoed back to the sodar receiver. The first column of information presents a "validity" flag for the data. A "V" indicates a valid reading – a signal was sent and received for that height and the wind direction and speed are computed. An "I" indicates an invalid reading – wind directions and speed could not be computed for the indicated height. An "A" generally indicates that the measurement height is too low for a returning signal to be processed.



4.0 Directory Structure and Support Files

The *MetView* directory contains several files and a couple of data subdirectories (see Figure 4.1). The most important file in the *MetView* directory is the *MetView* executable. This is the file accessed by the *MetView* shortcut. The CONVERT.CSV file provides unit conversion information. There are almost 1,400 unit conversions in this file (e.g., to convert from miles/sec to kilometers/sec multiply by 1.609). While only a few are used in *MetView*, it is important to have this file to ensure that all data are provided in meaningful units. METVIEW.DEP is an optional dependency file. The ST5UNST.LOG is a log file that is used to record information about model installation (it is needed to de-install the program). This file needs to be kept in the directory to ensure that the program can be upgraded or deinstalled in the future.

Name	Size	Type	Modified	Attributes
Shapes		File Folder	7/31/00 5:48 PM	
Web		File Folder	7/31/00 5:48 PM	
CONVERT.CSV	37KB	Microsof...	3/30/99 4:18 PM	A
METVIEW.DEP	13KB	DEP File	4/2/99 4:23 PM	A
METVIEW.exe	325KB	Applicati...	11/23/99 9:27 AM	A
METView.INI	1KB	Configur...	7/31/00 4:55 PM	A
ST5UNST.LOG	10KB	LOG File	4/12/99 2:42 PM	A

Figure 4.1 The Contents of the *MetView* Directory.

The METVIEW.INI file contains model initialization information that is required to run the model. This included the file location for raw meteorological data, Web output, an initial scaling factor used to display wind vectors, and a flag to identify the type of wind vector the user last displayed. A sample METVIEW.INI file is presented in Figure 4.2.

```
8,"I:\UDAC\","                                HMS raw data"
29,"C:\PROGRAM FILES\METVIEW\WEB\","          WEBEoc output"
"scale",1000
"option",2
"autoupdate",0
```

Figure 4.2 Contents of a Sample METVIEW.INI file.

The first line in METVIEW.INI presents information on where to find the directory that contains the raw meteorological data. The first item in that line is the size of the forthcoming character string. The second item, the character string, contains the address of the meteorological data directory. Next, a field is provided for a description of the data in the directory. The second line follows the same format and presents the string that contains the address of the directory to which web output products are to be copied.

The third line begins with the descriptive string "scale" and is followed by the scaling initial factor to be used when displaying wind vectors. A scaling factor of "1000" is the recommended value for most wind vector plots. A scaling factor of "5000" is the preferred factor to use when displaying wind barbs. The fourth line contains the label "option" and presents a number that indicates the default presentation of wind vector type. A "1" indicates that unit vectors will be displayed, "2" indicates scaled vectors, "3" indicates normalized vectors, and "4" indicated wind barbs (see Section 3.5 for more information). The last line in the file contains the label "autoupdate." A "1" indicates that the auto update feature (i.e., to automatically update the data displayed at regular intervals) will be enabled at program start-up and a "0" indicates that automatic data updates will not be enabled.

The SHAPES directory contains a series of files that are used for generating maps and other graphical background products (e.g., roads, rivers, facility boundaries). Figure 4.3 presents a listing of the contents of the SHAPES file. The ".DBF" files are the database files that hold the information about the shapes or contours contained in the like named ".SHP" file. The ".SHP" files are shape files that hold the collection of points that make up the different shapes or contours. The ".SHX" files are shape index files.

Name	Size	Type	Modified	Attributes
AREASL.DBF	3KB	DBF File	2/12/98 8:31 AM	
AREASL.SHP	22KB	SHP File	2/12/98 8:31 AM	
AREASL.SHX	1KB	SHX File	2/12/98 8:31 AM	
BOUNDP.DBF	1KB	DBF File	11/20/97 3:29 PM	
BOUNDP.SHP	4KB	SHP File	11/20/97 3:29 PM	
BOUNDP.SHX	1KB	SHX File	11/20/97 3:29 PM	
MJHYL.DBF	117KB	DBF File	12/5/97 11:17 AM	
MJHYL.SHP	882KB	SHP File	12/5/97 11:17 AM	
MJHYL.SHX	12KB	SHX File	12/5/97 11:17 AM	
MJRDL.DBF	1,668KB	DBF File	12/5/97 11:18 AM	
MJRDL.SHP	672KB	SHP File	12/5/97 11:18 AM	
MJRDL.SHX	52KB	SHX File	12/5/97 11:18 AM	
stations.dbf	5KB	DBF File	7/31/00 6:29 PM	A
stations.shp	1KB	SHP File	7/31/00 6:29 PM	A
stations.shx	1KB	SHX File	7/31/00 6:29 PM	A
winds.dbf	3KB	DBF File	7/31/00 6:29 PM	A
winds.shp	6KB	SHP File	7/31/00 6:29 PM	A
winds.shx	1KB	SHX File	7/31/00 6:29 PM	A

Figure 4.3 Contents of the SHAPE directory.

5.0 Meteorological Data Files

There are five types of meteorological data files that are used by ***MetView***.

1. Telemetry file - contains near-surface data from each of the monitoring network's stations. This file has a "TE" designation in its name.

2. Surface observation file - contains observations entered by the duty meteorologist. This includes data such as cloud ceiling, solar radiation, mixing depth, and visibility. This file has an "OB" designation in its name.

3. 200-ft tower data file - contains data from all heights on the "200-ft" towers. This file has a "2F" designation in its name.

4. 400-ft tower data file - contains data from all heights on the HMS's "400-ft" tower. This file has a "2F" designation in its name.

5. Sodar data file - contains data from the Doppler acoustic sodars. This file has a "SO" designation in its name.

In the following sections we present the naming convention for the meteorological data files and describe in detail each type of file.

5.1 Meteorological Data File Naming Convention

Every 15 minutes new meteorological data are received at the HMS and processed into data files that are automatically copied to ***MetView*** servers (including the EOC server). File names contain the date and time for which the files contain data. The following naming convention is observed for all files:

YyMmDdHh.NnT

where: Yy = the two digit year code (e.g., 99 = 1999, 00 = 2000)
Mn = the two digit month code (e.g., 01 = January, 02 = February)
Dd = the day of the month (e.g., 01 = the 1st, 02 = 2nd, 31 = 31st)
Hh = hour of the day (01 = 1 AM, 13 = 1 PM, 23 = 11 PM)
Nn = the name of type of data file (i.e., TE, OB, 2F, 4F, or SO)
T = the first digit in the minutes after the hour, where "0" indicates the data for the top of the hour, "1" for 15 min after the hour, "3" for 30 min after the hour, and "4" for 45 min after the hour.

All date/time combinations are in Pacific Standard Time (PST) throughout the year. Because Pacific Daylight Time (PDT) is one hour ahead of PST, the file "00061923.TE3" provides data for June 20, 2000, at 12:30 PDT (June 19, 2000 at 23:30 PST). The decision to keep files date/time in PST was made because the meteorology station operates on PST throughout the year. In addition, if we allowed the date/times in the file name to transition between PST and PDT, we would have a missing hour of data during the spring transition to PDT and two hours of data with the exact same file names during the fall transition.

5.2 Description of the Telemetry Data File

The telemetry data file presents near-surface meteorological data. For Hanford, this means meteorological measurements made at each of 30 monitoring stations. A sample telemetry data file is provided in Figure 5.1. The first three lines of the file present introductory information. This includes a label (i.e., "HMS Telemetry Data"), the date and time at the end of the 15-minute monitoring period, and the number of active monitoring stations. The next two lines present the parameter name and unit of measure for each column of data to be presented in the file. Following this introduction, meteorological data and station information are presented with one line of data for each station. Each line of station data presents the:

- ID number for the station
- 4-character name of the station.
- wind direction – this is the average direction of the wind (in degrees from North) at approximately 9 m (30 ft) above ground level. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-min averaging period and then dividing by the number of observations.
- wind speed – this is the average speed of the wind (in mph) at approximately 9 m (30 ft) above ground level. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-min averaging period and then dividing by the number of observations.
- air temperature – this is the average temperature (°F) during the 15-min averaging period at approximately 1.7 m (5.5 ft) above ground level. It is computed by averaging all the temperature observations reported at 5-second intervals during the 15-min averaging period.
- precipitation amount during the15-min measurement period (inches per 15 min). It is measured using a tipping rain gage. Precipitation values represent the liquid water content of the precipitation. Stations that are not measuring precipitation present a missing data code "-99.00".

```
HMS Telemetry Data
 11/09/1999 13:45 PST
 30 stations
num,name, wdir , wspd , temp , precp, pres , elev , LONGITUDE, LATITUDE, ELEV,  UTM E,  UTM N , WA-S E, WA-S N
          (deg), (mph),(degF), (in.),(inHg), (ft.),   (deg)   ,   (deg) ,  (m),   (m) ,   (m)  ,  (m) ,   (m)
  1,PROS, 330.7,   5.2,  50.3,   .00,-99.00, 480.0, 119.41214, 46.39181,  146, 314542, 5140191, 583663, 118226
  2,EOC , 123.4,   2.1,  49.6,   .00,-99.00,1240.0, 119.53703, 46.39225,  378, 304942, 5140540, 574058, 118150
  3,ARMY, 294.5,   2.7,  50.9,   .00,-99.00, 565.0, 119.55122, 46.48933,  172, 304199, 5151362, 572837, 128927
  4,RSPG,   4.7,   3.8,  49.8,   .00,-99.00, 680.0, 119.70006, 46.50597,  207, 292840, 5153591, 561393, 130650
  5,EDNA, 317.8,   6.2,  51.2,-99.00,-99.00, 410.0, 119.39747, 46.58714,  125, 316329, 5161860, 584488, 139951
  6,200E, 309.6,   4.8,  50.5,   .00, 29.11, 680.0, 119.52147, 46.55614,  207, 306719, 5158712, 575029, 136380
  7,200W, 339.0,   4.2,  50.3,   .00,-99.00, 650.0, 119.66264, 46.54272,  198, 295848, 5157577, 564221, 134764
  8,BVLY, 309.2,   1.9,  49.8,   .00,-99.00, 555.0, 119.94364, 46.75236,  169, 275175, 5181635, 542506, 157875
  9,FFTF, 320.2,   4.8,  49.7,   .00, 29.22, 570.0, 119.35986, 46.42953,  174, 318687, 5144261, 587623, 122475
 10,YAKB, 334.6,   2.7,  49.4,   .00, 28.97, 795.0, 119.72622, 46.57806,  242, 291109, 5161670, 559306, 138641
 11,300A, 330.9,   6.6,  50.5,   .00, 29.40, 390.0, 119.28617, 46.36425,  119, 324139, 5136841, 593398, 115304
 12,WYEB, 302.3,   4.7,  50.3,   .00,-99.00, 550.0, 119.39119, 46.48211,  168, 316456, 5150175, 585133, 128285
 13,100N, 240.7,   3.7,  51.8,   .00, 29.33, 460.0, 119.55083, 46.68886,  140, 304947, 5173531, 572600, 151104
 14,WPPS, 315.1,   5.0,  50.9,   .00,-99.00, 450.0, 119.34481, 46.47014,  137, 319977, 5148739, 588714, 127005
 15,FRNK, 320.8,   4.3,  48.6,-99.00,-99.00, 875.0, 119.23792, 46.41733,  267, 328017, 5142633, 597016, 121262
 16,GABL, 311.5,   5.1,  47.9,-99.00,-99.00,1085.0, 119.46011, 46.59844,  331, 311569, 5163263, 579671, 141142
 17,RING, 248.8,   5.0,  51.3,   .00,-99.00, 620.0, 119.23761, 46.54494,  189, 328443, 5156811, 596812, 135444
 18,RICH, 306.4,   6.3,  49.5,   .00, 29.37, 390.0, 119.30103, 46.30072,  119, 322790, 5129816, 592362, 108227
 19,PFP ,   1.3,   4.2,  49.5,-99.00, 29.11, 675.0, 119.63258, 46.54539,  206, 298163, 5157796, 566523, 135085
 20,RMTN, 209.1,  20.9,  44.2,   .00,-99.00,3560.0, 119.59292, 46.39431, 1085, 300652, 5140909, 569758, 118328
 21,HMS , 349.0,   3.1,  49.8,   .00, 29.06, 733.0, 119.59917, 46.56278,  220, 300788, 5159643, 569063, 137047
 22,PASC, 289.3,   6.0,  52.4,   .00,-99.00, 410.0, 119.11425, 46.25714,  125, 337045, 5124573, 606834, 103619
 23,GABW, 286.1,   4.1,  50.7,-99.00,-99.00, 490.0, 119.55792, 46.61181,  149, 304126, 5164988, 572161, 142533
 24,100F, 307.8,   3.2,  51.5,   .00,-99.00, 410.0, 119.45231, 46.63458,  125, 312292, 5167260, 580216, 145167
 25,VERN, 257.7,   6.9,  50.2,-99.00,-99.00, 430.0, 119.72750, 46.64111,  131, 291254, 5168679, 559140, 145649
 26,BENT,  48.0,   5.1,  48.8,   .00,-99.00,1055.0, 119.60767, 46.29003,  322, 299137, 5129360, 568755, 106725
 27,VSTA, 310.2,   6.0,  51.1,   .00,-99.00, 503.0, 119.20122, 46.21833,  153, 330223, 5120443, 600200,  99192
 28,SURF, 231.8,   3.5,  48.2,   .00, 29.44, 275.0, 120.19861, 45.72500,  107, 251096, 5068253, 523463,  43579
 29,100K, 249.3,   5.3,  51.0,   .00, 29.34, 450.0, 119.57750, 46.65733,  137, 302792, 5170094, 570601, 147575
 30,HAMR, 337.4,   5.6,  50.1,-99.00,-99.00, 450.0, 119.32583, 46.35639,  137, 321062, 5136057, 590359, 114385
```

Figure 5.1. A Sample Telemetry Data file. This file is named 99110913.TE4, indicating that it is the telemetry file for November, 19, 1999 at 1:45 PM PST.

- atmospheric pressure – this is the average atmospheric pressure (inches of Mercury) during the 15-minute averaging period. Atmospheric pressure is measured at ~ 1.7 m (5.5 ft) above ground level. It is computed by averaging all the temperature observations reported at 5-second intervals during the 15-minute averaging period. Stations that are not measuring pressure present a missing data code "-99.00".

- station elevation[5] (feet above sea level)

- station longitude (degrees West)

- station latitude (degrees North)

- station elevation[4] (meters above sea level)

- local UTM east/west coordinate (meters East)

- local UTM north/south coordinate (meters North)

- Washington State planar east/west coordinate (meters East)

- Washington State planar north/south coordinate (meters North)

5.2 Description of the Surface Observation Data File

The surface observation data file presents hourly meteorologist observations and a summary of key instrument readings. The data in this file are not automatically updated; instead, new data must be input by the meteorologist. If new data are not available, the surface observation data file will still be generated every 15 minutes using the most recent data available (even if the data are old). A sample surface observation data file is provided in Figure 5.2. The first two lines of the file present introductory information. This includes a label (i.e., "HMS Surface Observation") and the date and time at which the data were observed. The next two lines present the parameter names and units of measure for the data presented in the file. Following this introduction, a line of surface observation data is presented. This line provides:

- cloud ceiling height (hundreds of feet above the surface) – this is the height of the cloud base. At night, the ceiling height is measured using a cloud ceiling light projector and a clinometer. During the day, ceiling height is estimated from aviation reports and other sources of information.

[5] Station elevation is provided twice in each line of data (using two different units of measure). This allows the telemetry data file to meet the requirements of different software products that access these data.

```
HMS Surface Observation
 11/09/1999 13:00 PST
 ceil,   vis, slpr , dewpt,  dir,  spd, stapr, dry,wetb,  rh,   sc  ,precp,  solar, mix
(hft),(mi.), (mbs),  (F) ,(deg),(mph),(inHg), (F), (F), (%),(10ths),(in./hr),(ly/mn), (m)
   60,  150,1010.6,   45,  80,   4, 29.06,  50,  47,  82,    10,  .00,    .18, 500,  0
```

Figure 5.2. A Sample Surface Observation file. This file is named 99110913.OB4, indicating that it is the surface observation file for November, 19, 1999, at 1:45 p.m. PST.

- visibility (miles) – subjectively determined by the duty meteorologist based on ability to discern landmarks at known distances.

- atmospheric pressure corrected to sea level (millibars) – the station pressure measured near the top of the hour is multiplied by the appropriate factors to obtain the pressure that would be observed if the station were located at sea level instead of its actual elevation of 220 m (772 ft) above sea level.

- wind direction (°F) – this is based on an observation made near the top of the hour using the instrument mounted at the 30-m (50-ft) level on the "400-ft" tower.

- wind speed (mph) – this is based on an observation made near the top of the hour using the instrument mounted at the 30-m (50-ft) level on the "400-ft" tower

- station atmospheric pressure (inches of Mercury) – this is based on a measurement of atmospheric pressure made near the top of the hour.

- dry bulb temperature (°F) – this is another name for the air temperature. It is based on an observation made near the top of the hour using a temperature sensor mounted at 1.5 m (5 ft) above ground level.

- wet bulb temperature (°F) – the temperature to which a parcel of air is cooled by evaporating water into it until the air is saturated. This is a measure of atmospheric moisture. It is based on an observation made near the top of the hour using a sensor mounted at 1.7 m (5.5 ft) above ground level.

- relative humidity (%) – is the ratio of amount of moisture the air is holding to the maximum amount it can hold at its current temperature. It is computed based on measurements made by temperature and atmospheric moisture sensors.

- sky cover (tenths) – this is the amount of the visible sky that is obscured by cloud cover. This observation by the meteorologist is made near the top of each hour.

- precipitation (inches per hour) – this is the cumulative amount of precipitation collected during the past hour. It is measured using an automatic tipping rain gage. When temperatures are at or below freezing, the collected precipitation is melted to estimate its liquid water content.

- solar radiation (langelys/minute) – this is an average of the incoming solar radiation measured by sensors over the past hour.

- mixing depth (meters) – this is the height above the surface through which the atmospheric is well mixed via the action of thermal and/or mechanical turbulence.

Mixing depth estimates are based on data collected by sodars and other instruments.

- frozen precipitation flag – if there is no precipitation or the precipitation is in a liquid state, this flag will be "0". If frozen precipitation is reported, the value of this flag will be set to "1" or another non-zero value.

5.3 Description of the 200-ft Tower Data File

The "200-ft" tower data file presents data measured on the instrumented 60-m (200-ft) instrumented towers that are located in the 100-, 300-, and 400-Areas (FFTF). A sample "200-ft" tower data file is provided in Figure 5.3. Data are provided for each of the Site's "200-ft" towers in this one file. Data for the 400 Area's tower is provided first, followed by data for the 300 Area, and then data for the 100 Area tower. The first three lines of the file present introductory information. This includes a label (i.e., "HMS 60-m Towers"), the date and time at the end of the 15-min monitoring period, and the number of active "200-ft" towers. The next line contains the name of the first tower for which data are presented. The following two lines present the name and units of measure for each column of data to be presented for this tower. Following this introduction, meteorological data are presented for each monitoring height on the tower. Each line of data presents observations of:

- the height above ground (ft) that the winds and temperature are monitored.

- wind direction – this is the average direction of the wind (in degrees from North) at the measurement height. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-minute averaging period and then dividing by the number of observations.

- wind speed – this is the average speed of the wind (in mph) at the measurement height. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-min averaging period and then dividing by the number of observations.

- air temperature – this is the average temperature (°F) during the 15-minute averaging period at the measurement height. It is computed by averaging all the temperature observations reported at 5-second intervals during the 15-min averaging period.

```
HMS 60m Towers
                    11/09/1999 13:45 PST
                    3 stations
                   FFTF
                   level, wdir , wspd , temp
                    (ft),(deg.), (mph),(deg.F)
                    197., 319.4,   5.1,  48.6
                     82., 321.0,   5.1,-999.9
                     33., 320.2,   4.8,  49.4
                          dewpt,    rh , temp , delta
                      6.,  40.3,  70.0,  49.7,    -.8
                   300A
                   level, wdir , wspd , temp
                    (ft),(deg.), (mph),(deg.F)
                    197., 326.0,   6.9,  49.3
                     82., 327.2,   6.8,-999.9
                     33., 330.9,   6.6,  50.1
                          dewpt,    rh , temp , delta
                      6.,  44.6,  80.1,  50.5,    -.9
                   100N
                   level, wdir , wspd , temp
                    (ft),(deg.), (mph),(deg.F)
                    197., 236.9,   3.8,  50.3
                     82., 239.4,   3.8,-999.9
                     33., 240.7,   3.7,  51.3
                          dewpt,    rh , temp , delta
                      6.,  42.5,  70.3,  51.8,    -.9
```

Figure 5.3. A Sample 200-ft Tower Data File. This file is named 99110913.2F4, indicating that it is the 200-ft tower data file for November, 19, 1999, at 1:45 p.m. PST.

The next line of data provides the name of another set of parameters and is followed by a line of data. This line of data presents:

- the height above ground (ft) that the parameters are monitored
- dew point temperature (°F) – the temperature to which a parcel of air is cooled to reach 100% saturation (dew formation). This is a measure of atmospheric moisture.
- relative humidity (%) – is the ratio of amount of moisture the air is holding to the amount it can hold at its current temperature.
- air temperature – this is the average temperature (°F) during the 15-minute averaging period at the measurement height.

- Delta T (°F) – this is an estimate of the average difference in temperature between the 60-m (200 ft) and 9-m (30 ft) levels on the tower ($T_{60\,m} - T_{9m}$). The Delta T value represents the average of the difference in temperatures measured at 5-second intervals during the 15-minute averaging period. This parameter may vary from the difference in the 15-minute averages of the temperatures at 60-m (200-ft) and 9-m (30-ft). Delta T can be used to estimate atmospheric stability via a method employed by the U.S. Nuclear Regulatory Commission (NRC) (Table 5.1).

Table 5.1 The NRC Delta T Method for Determining Atmospheric Stability.

Atmospheric Stability	Vertical Temp. Difference (°C/100m)
A or 1 - very unstable	$\Delta T/\Delta Z \leq -1.9$
B or 2 - moderately unstable	$-1.9 < \Delta T/\Delta Z \leq -1.7$
C or 3 - slightly unstable	$-1.7 < \Delta T/\Delta Z \leq -1.5$
D or 4 - neutral	$-1.5 < \Delta T/\Delta Z \leq -0.5$
E or 5 - slightly stable	$-0.5 < \Delta T/\Delta Z \leq 1.5$
F or 6 - stable	$1.5 < \Delta T/\Delta Z \leq 4.0$
G or 7 - extremely stable	$4.0 < \Delta T/\Delta Z$

At the end of this data line, data from the first station is completed. The information format now repeats itself for the next "200-ft" tower and so on until all the "200-ft" stations have reported their data (i.e., the next line of data contains the name of the second tower for which data are presented).

5.4 Description of the 400-ft Tower Data File

The "400-ft" tower data file presents data measured on the instrumented 125-m (410-ft) instrumented tower that is located at the Hanford Meteorology Station. A sample "400-ft" tower data file is provided in Figure 5.4. The first two lines of the file present introductory information. This includes a label (i.e., "HMS 400ft Tower") and the date and time at the end of the 15-minute monitoring period. The next two lines present the parameter name and unit of measure for each column of data to be presented for this tower. Following this introduction, meteorological data are presented for each monitoring height on the tower. Each line of data presents observations of:

- the height above ground (ft) that the winds and temperature are monitored

- wind direction – this is the average direction of the wind (in degrees from North) at the measurement height. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-minute averaging period and then dividing by the number of observations.

- wind speed – this is the average speed of the wind (in mph) at the measurement height. It is computed by performing a vector addition of all the wind observations reported at 5-second intervals during the 15-minute averaging period and then dividing by the number of observations.

- air temperature – this is the average temperature (°F) during the 15-minute averaging period at the measurement height. It is computed by averaging all the temperature observations reported at 5-second intervals during the 15-minute averaging period.

The next two lines of data provide the name and units of measure for the set of parameters and that is presented in the next line of data. The following line of data presents:

- the height above ground (ft) that the parameters are monitored

- solar radiation (langelys/min)-this is a measurement of the average incoming solar radiation during the 15-min averaging period.

- relative humidity (%)-is the ratio of amount of moisture the air is holding to the amount it can hold at its current temperature

- dew point temperature (°F)-the temperature to which a parcel of air is cooled to reach 100% saturation (dew formation). This is a measure of atmospheric moisture.

- atmospheric stability class (see Table 5.1 for information on stability).

```
HMS 400ft Tower
 11/09/1999 13:45 PST
level, wdir , wspd , temp
 (ft),(deg.), (mph),(deg.F)
 400., 336.2,    3.0,  46.8
 300.,-999.9,-999.9,  47.4
 250.,-999.9,-999.9,  47.8
 200., 342.6,    3.3,  48.0
 100.,-999.9,-999.9,  48.5
  50., 343.4,    3.2,  49.0
  30., 349.0,    3.1,  49.1
   3.,-999.9,-999.9,  49.8
       solar, dewpt, stab
    (ly/min),(degF), (A-G)
   0.,  .120,  45.1, 4
```

Figure 5.4. A Sample 400-ft Tower Data File. This file is named 99110913.4F4, indicating that it is the "400-ft" tower data file for November 19, 1999, at 1:45 p.m. PST.

5.5 Description of the Sodar Data File

The Sodar data file presents data measured by the Doppler acoustic sodars. The sodars use sound waves to measure three-dimensional winds and turbulence parameters at multiple heights from near the surface up to 600 m (2000 ft) above the ground (the ***MetView*** program only reads and displays a portion of the data generated by the sodars). The Sodar data file is provided in Figures 5.5 and 5.6. The Sodar data file is the most difficult of the five meteorological files to read and understand. The method of processing and formatting sodar data is much more complicated than those from other instruments. Formatting errors and other problems are also more common in the sodar file than the other types of meteorological data files. The first line of the file presents an identification number for the sodar station, the date and time for the observation, and other information. This includes:

- "DM" which indicates the beginning of data from a sodar station
- identification number for the sodar station – "101" is 100N, "102" is 200 Area (HMS), "103" is the 300 Area, and "104" is the 400 Area (FFTF).
- date and time – information is presented using two-digit codes for the month, day of the month, year, hour, and minutes after the hour.
- additional instrument information that is not used by ***MetView.***

For example, "DM 101 11 09 99 13 41 ...," means data are presented for the 100N station on November 9, 1999, at 01:41 p.m. The second line of the file is generally blank. The next line, provides data labels for each column of data that will be presented. These include the height of the measurement ("range"), "Echo" and "S Echo" (raw sound echo readings), wind speed ("speed"), wind direction ("theta"), sigma theta ("S TETA"), vertical velocity (W), sigma W ("S W"), and others. The next line is generally blank and is followed by multiple lines of data from the sodar (beginning with the upper most measurement height and working downward towards the surface). Each data line presents:

- a data validity code – "A" indicates an invalid reading (only found below the lowest valid height, "V" is a valid reading (data was received for this height), and "I" is invalid (a valid reading was not obtained for this height).
- height above ground for which the readings are made (m)
- two data elements of echo information[6]

---

[6] Not reported by ***MetView***

- wind speed (cm/sec) at the measurement height
- wind direction (° from North) at the measurement height
- standard deviation of wind direction (°)[5]
- vertical wind speed (cm/sec)[5]
- standard deviation of vertical wind speed (cm/sec)[5]

Missing data are indicated by "-9999,"are simply omitted or indicated with "0." A "$" may follow the last line of data for a station (the last line of data generally presents readings for 2 m above ground level). After a sodar site's data is completed, a line beginning with "DM" indicates the start of data for the next sodar site.

```
DM 101    11      09      99       13      26      18        0      61      23

 RANGE    ECHO S ECHO  SPEED    TETA S TETA      W      S W ETAM  STA  S U  S V

I  510  -9999  -9999
I  480  -9999  -9999
I  450  -9999  -9999
I  420  -9999  -9999
I  390  -9999  -9999
I  360  -9999  -9999
I  330  -9999  -9999
I  300  -9999  -9999
I  270  -9999  -9999
I  240     21     20
I  210     21     30
I  180  -9999  -9999
I  150  -9999  -9999
I  120  -9999  -9999
I   90  -9999  -9999
I   60  -9999  -9999
A   10      0      0      0      0      0      0      0    0    0    0    0
A    2      0      0      0      0      0      0      0    0    0    0    0
$
```

Figure 5.5. First Part of a Sample Sodar Data File. This figure presents the data from the first sodar site reported in this file (the data from the other three sodar sites are presented in Figure 5.6). This sodar data file is named 99110913.SD4, indicating that it is the sodar data file updated for November 9, 1999, at 1:45 p.m. PST.

```
DM 102   11       9      95         13       30        0         229     285      32

 RANGE    ECHO S ECHO  SPEED   TETA S TETA       W     S W ETAM  STA   S U   S V

I  420  -9999  -9999
I  400  -9999  -9999
I  380  -9999  -9999
I  360  -9999  -9999
I  340  -9999  -9999
V  320  -9999  -9999  -9999  -9999  -9999  -9999  -9999     0     0     0     0
V  300  -9999  -9999  -9999  -9999  -9999  -9999  -9999     0     0     0     0
V  280    149     14    220    141     18     -6     15     0     0     0     0
V  260  -9999  -9999  -9999  -9999  -9999  -9999  -9999     0     0     0     0
V  240    134     24    204    120  -9999     14      1     0     0     0     0
I  220  -9999  -9999
I  200  -9999  -9999
I  180  -9999  -9999
I  160  -9999  -9999
I  140  -9999  -9999
I  120  -9999  -9999
A   10      0      0      0      0      0      0      0     0     0     0     0
A    2      0      0      0      0      0      0      0     0     0     0     0
$
DM 103   11       9      99         13       30        1         262      33     193

 RANGE    ECHO S ECHO  SPEED   TETA S TETA       W     S W ETAM  STA   S U   S V

I  510  -9999  -9999
I  480  -9999  -9999
I  450     54     13
I  420  -9999  -9999
I  390     56     24
I  360     51     22
I  330     59     25
I  300     53     32
I  270     65     37
V  240    116     55    157     19  -9999      0      1     0     0     0     0
V  210     60     55  -9999  -9999  -9999     13      1     0     0     0     0
V  180     38     29  -9999  -9999  -9999      0      1     0     0     0     0
V  150     35     38  -9999  -9999  -9999     -7      1     0     0     0     0
V  120     32 -30431  -9999  -9999  -9999  -9999  -9999     0     0     0     0
V   90     46 -21536  -9999  -9999  -9999  -9999  -9999     0     0     0     0
V   60     39 -25045  -9999  -9999  -9999  -9999  -9999     0     0     0     0
A   10      0      0      0      0      0      0      0     0     0     0     0
A    2      0      0      0      0      0      0      0     0     0     0     0
$
DM 104   11       9      99         13       30        0         188      85     153

 RANGE    ECHO S ECHO  SPEED   TETA S TETA       W     S W ETAM  STA   S U   S V

I  420  -9999  -9999
I  390  -9999  -9999
I  360  -9999  -9999
V  330    123     32    638    158      1     73      1     0     0     0     0
V  300    184     58    521    146     23     53     12     0     0     0     0
V  270    122     43    340    130     34     55     10     0     0     0     0
V  240    163     39    225    123     44     28     12     0     0     0     0
V  210    127     54  -9999  -9999  -9999     27     12     0     0     0     0
V  180    111     30  -9999  -9999  -9999     19      7     0     0     0     0
V  150    193     27  -9999  -9999  -9999     15     10     0     0     0     0
V  120    249     39  -9999  -9999  -9999      2     14     0     0     0     0
V   90    114     51  -9999  -9999  -9999     10      9     0     0     0     0
V   60     78     45  -9999  -9999  -9999     14      1     0     0     0     0
A   10      0      0      0      0      0      0      0     0     0     0     0
A    2      0      0      0      0      0      0      0     0     0     0     0
```

Figure 5.6. The Remainder of the Sample Sodar Data File. This figure presents the data from the second through fourth sodar sites in the file named 99110913.SD4.

6. 0 References

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Appendix

Hardcopy Output Products

Appendix

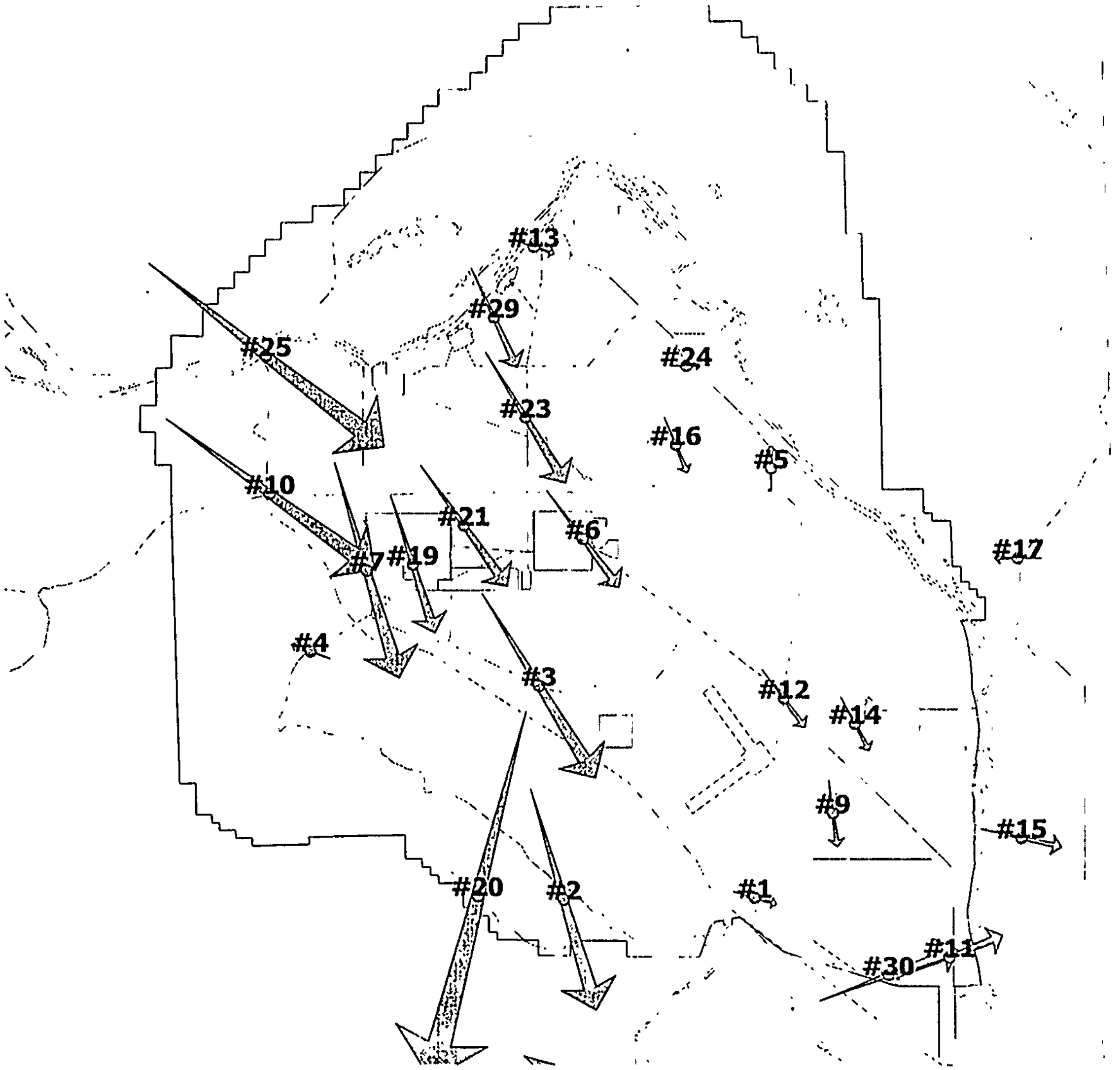
Hardcopy Output Products

This appendix presents a sample *MetView* hardcopy output product. This product includes:

- a wind vector plot displayed in the telemetry data product
- sodar data listings for all four sodars
- tower data listings for all four tall towers
- surface observation data.

Clicking the Print button on the Main Menu generates these hardcopy products.

Map of Hanford Site Meteorology Data for 9/5/2000 9:00 AM PDT



NRC Atmospheric Stability at HMS: B

Wind Speed & Dir (mph)

1 Prosser Baricade	2,	286°
2 EOC - ALE	12,	344°
3 Army Loop Road	11,	329°
4 Rattlesnake Spgs	2,	111°
5 Edna	2,	180°
6 200 East Area	6,	323°
7 200 West Area	11,	343°
8 Beverely	6,	320°
9 FFTF	3,	353°
10 Yakima Barricade	13,	306°
11 300 Area	6,	248°
12 Wye Barricade	4,	323°
13 100N Area	2,	288°
14 WNP-2	3,	332°
15 Franklin County	4,	282°
16 Gable Mtn.	3,	338°
17 Ringold	2,	90°
18 Richland Airport	5,	285°
19 200 West (PFP)	7,	342°
20 Rattlesnake Mtn.	19,	15°
21 HMS	8,	325°
22 Pasco Airport	2,	320°
23 Gable West	8,	329°
24 100F Area	1,	271°
25 Vernita Bridge	15,	308°
26 Benton City	12,	241°
27 Vista Field	2,	3°
28 Roosevelt, WA	17,	250°
29 100K Area	6,	335°
30 Hammer	7,	249°

Sodar Data Listing for 9/5/2000 9:00 AM PDT

Sodar station 100 Area

Flag	Height (m)	Direction (degrees)	Speed (mph)
I	510	0	0.0
I	480	0	0.0
I	450	0	0.0
I	420	0	0.0
I	390	0	0.0
I	360	0	0.0
I	330	0	0.0
I	300	0	0.0
I	270	0	0.0
I	240	0	0.0
I	210	0	0.0
I	180	0	0.0
I	150	0	0.0
I	120	0	0.0
I	90	0	0.0
I	60	0	0.0
A	10	0	0.0
A	2	0	0.0

Sodar station 200 Area

Flag	Height (m)	Direction (degrees)	Speed (mph)
I	420	0	0.0
I	400	0	0.0
I	380	0	0.0
I	360	0	0.0
I	340	0	0.0
I	320	0	0.0
I	300	0	0.0
I	280	0	0.0
I	260	0	0.0
I	240	0	0.0
I	220	0	0.0
I	200	0	0.0
I	180	0	0.0
I	160	0	0.0
I	140	0	0.0
I	120	0	0.0
A	10	0	0.0
A	2	0	0.0

Sodar station 300 Area

Flag	Height (m)	Direction (degrees)	Speed (mph)
I	510	0	0.0
I	480	0	0.0
I	450	0	0.0
I	420	0	0.0
I	390	0	0.0
I	360	0	0.0
I	330	0	0.0
I	300	0	0.0
I	270	0	0.0
I	240	0	0.0
I	210	0	0.0
I	180	0	0.0
I	150	0	0.0
I	120	0	0.0
I	90	0	0.0
I	60	0	0.0
A	10	0	0.0
A	2	0	0.0

Sodar station 400 Area

Flag	Height (m)	Direction (degrees)	Speed (mph)
I	510	0	0.0
I	480	0	0.0
I	450	0	0.0
I	420	0	0.0
I	390	0	0.0
I	360	0	0.0
I	330	0	0.0
I	300	0	0.0
I	270	0	0.0
I	240	0	0.0
I	210	0	0.0
I	180	0	0.0
I	150	0	0.0
I	120	0	0.0
I	90	0	0.0
I	60	0	0.0
A	10	0	0.0
A	2	0	0.0

Tower Data Listing for 9/5/2000 9:00 AM PDT

Tower station FFTF
Stability class: NRC->D Turner ->N/A
Dew point: 44
Relative humidity: 54.2

Height (ft)	Temperature (F°)	Direction (degrees)	Speed (mph)
197	58.8	329.9	4
82		340.1	3.9
33	59.9	352.6	3.4
6	60.6		

Tower station 300A
Stability class: NRC->D Turner ->N/A
Dew point: 44.1
Relative humidity: 51.2

Height (ft)	Temperature (F°)	Direction (degrees)	Speed (mph)
197	59.8	252.9	6.2
82		248.3	6
33	60.7	247.7	5.8
6	62.4		

Tower station 100N
Stability class: NRC->D Turner ->N/A
Dew point: 41.4
Relative humidity: 45.4

Height (ft)	Temperature (F°)	Direction (degrees)	Speed (mph)
197	60.5	289.8	3.3
82		292.7	2.3
33	61.5	288.2	2.2
6	62.8		

Tower station HMS
Stability class: NRC->B Turner ->D
Dew point: 42.9
Relative humidity: 53

Height (ft)	Temperature (F°)	Direction (degrees)	Speed (mph)
400	59.6	318.2	8.6
300	60.6		
250	60.9		
200	61.1	317.4	8.7
100	61.7		
50	62.3	318.8	8
30	62.8	324.7	7.5

HMS Suface Observations for 9/5/2000 9:00 AM PDT

Ceiling: 0 (hft)
Visibility: 150 (mi)
Sea level pressure: 1018.5 (mbs)
Dew point: 44 (degrees F)
Wind direction: 310 (deg)
Wind speed: 12 (mph)
Station pressure: 29.3 (inHg)
Dry bulb temperature: 61 (degrees F)
Wet bulb temperature: 52 (degrees F)
Relative humidity: 53 (%)
Sky cover: 4 (10ths)
Precipitation: 0 (in/15 min)
Incoming solar radiation: 0.16 (ly/mn)
Mixing height: 300 (m)

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