



NOAA to Provide Enhanced Frost Forecast Information to Improve Russian River Water Management

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Sonoma County water resource managers and area farmers need high-resolution frost forecasts to better manage flows in the Russian River and its tributaries. Improved monitoring and prediction of frost conditions will help the agricultural community and the Sonoma County Water Agency (SCWA) better determine the need for crop protection and help manage water resources more effectively. Last spring the National Oceanic and Atmospheric Administration's Earth Systems Research Lab, in partnership with the National Weather Service (NWS), began developing a prototype high-resolution digital forecast utilizing real-time vineyard temperature data contributed by a number of growers. The stations provided by FarmEcology Labs to NOAA along with those supplied from the Sonoma County Wine Grape Commission weather station network operated by Western Weather Group are shown in Figure 1. This prototype system is currently focused on the Alexander Valley.

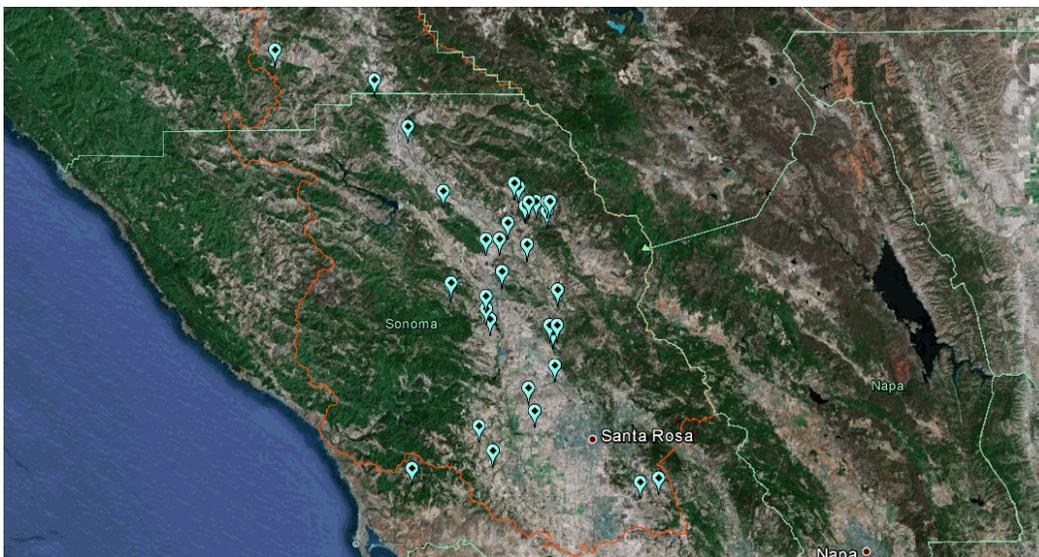


Figure 1 Vineyard data available hourly used to bias correct the numerical model guidance to account for microclimates do to terrain. The orange outline is the Russian River Basin.

The frost forecast system is built around these real-time observations combined with a number of different forecast models run at NOAA's National Center for Environmental Prediction (NCEP) in Washington D.C. These forecasts are not sufficient to resolve the important microclimates associated with individual vineyards. In order to compensate for this, a scheme that was developed by the NWS as part of their National Digital Forecast Database process was implemented. This scheme uses high-resolution digital terrain information along with as many surface real-time observations as can be obtained, to educate the models as to the microclimates based on the vineyard temperature observations. Figure 2a and 2b are examples of how the bias correction adjusts the models.

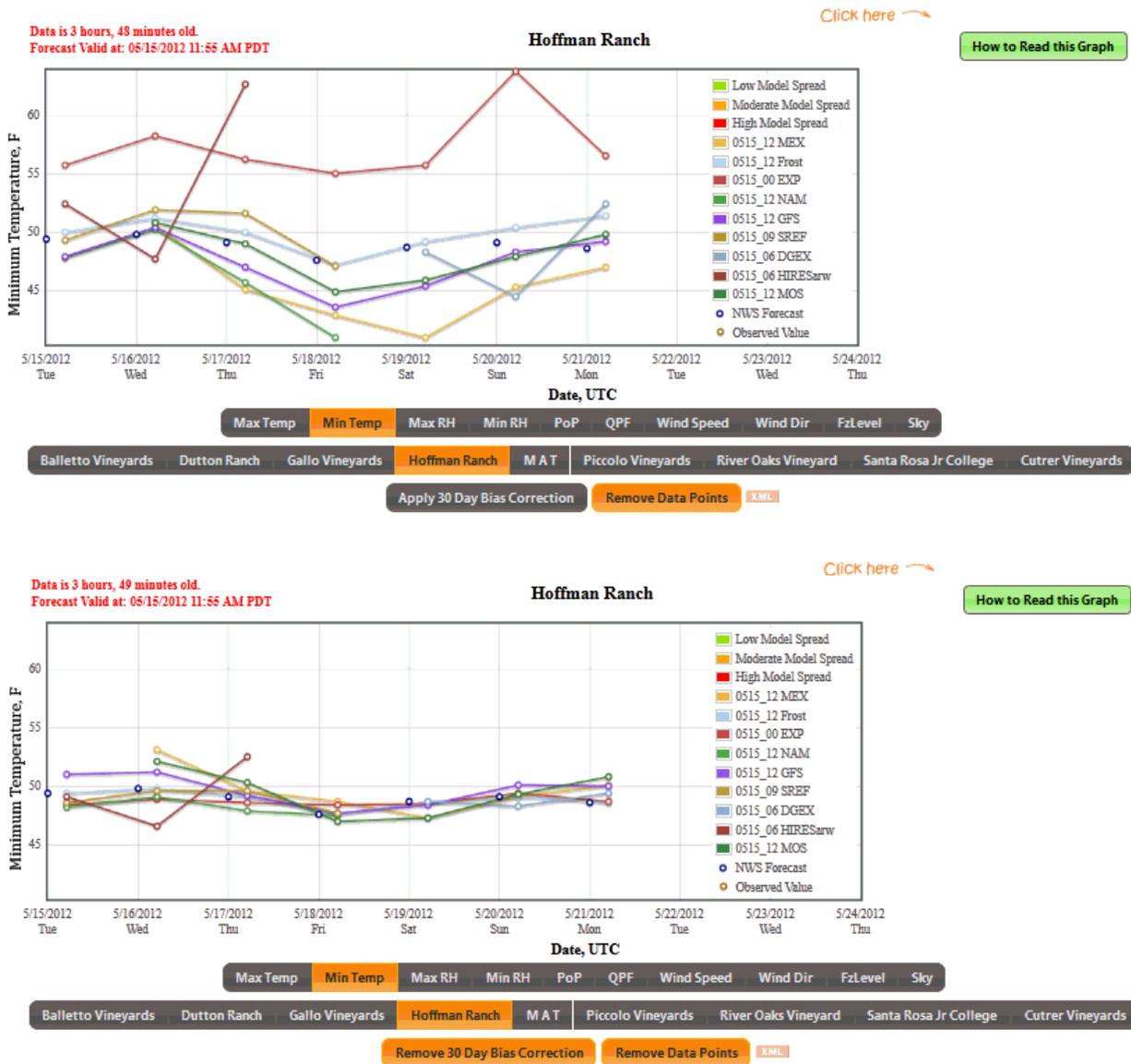


Figure 2 (a) uncorrected raw minimum temperature forecasts for a selected vineyard station (Hoffmann Ranch). The color coding identifies the dynamic or statistical model used as listed on the right. 2(b) bottom panel is the corrected forecast applying the 30 day running bias correction produced by comparing raw model forecasts to observed temperatures. The spread in forecasts now represents the level of forecast uncertainty. Users can use this spread to help make decisions on frost potential.

Figure 2a(upper) shows the raw model minimum temperature forecast (MinT) for the Hoffman Ranch vineyard temperature location. The colors used can be mapped to the different models available for this particular forecast. There

is a wide spread in the model guidance as most do not account for terrain influences. Figure 2b (bottom) shows the bias corrected forecast using a 30 day weighted average bias correction value as computed for each model from the observed minimums observed at Hoffman Ranch. There is still model spread in the forecast but greatly reduced. This spread provides the user some measure of confidence in the forecast. A small spread means higher confidence and large spread lower confidence in the forecast. The blue circles denote the official NWS forecast. These charts can be viewed daily at http://www.esrl.noaa.gov/psd/data/obs/nwspqr/ms/model_spectrum_v2_2.php

Figure 3 shows the location of 22 sites used to verify daily maximum and minimum temperatures plotted over the 250m terrain used for this frost forecast system.

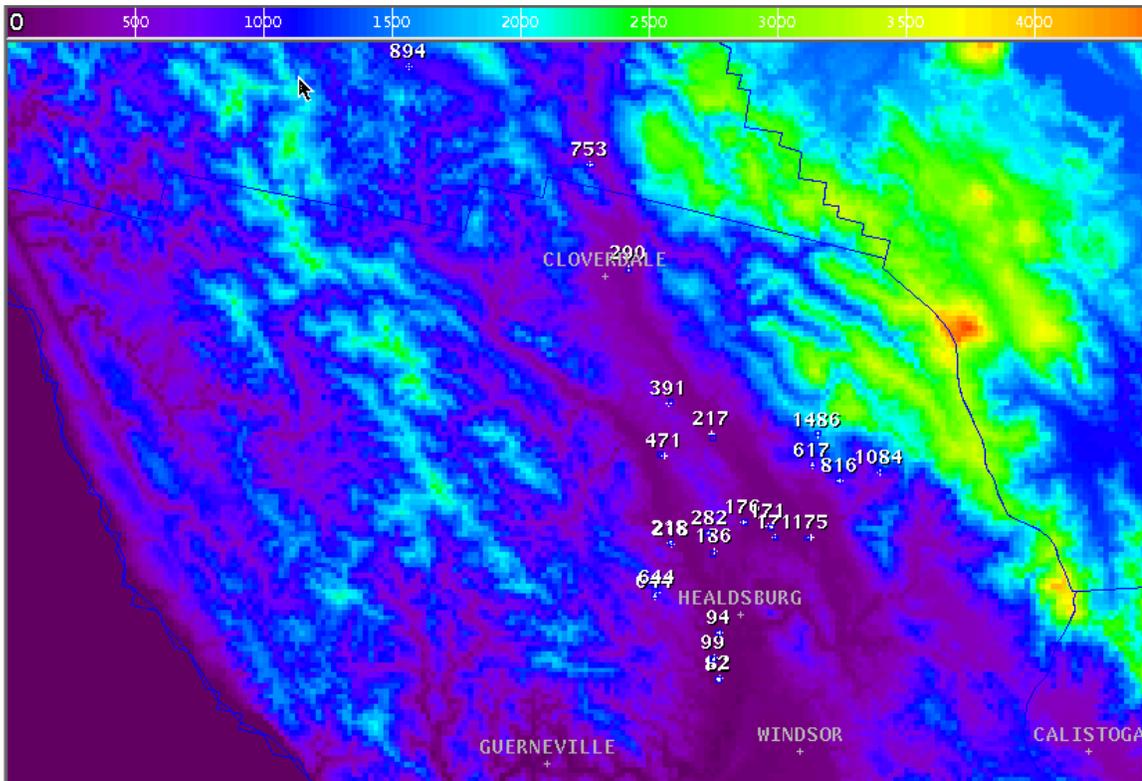


Figure 3 250 m terrain used for the frost forecast system along with the locations of 22 vineyard sites used to verify daily max and min temperatures. The site elevation in feet is shown. The color bar at the top provides the elevation color relationship.

Not only is it important to forecast the minimum or maximum temperatures, but also to know how long the temperature may stay below freezing and when will it begin. To do this requires correctly forecasting the daily trends in temperature. Daily plots of forecast versus observed trends are generated to determine how well the forecast is tracking hourly temperature changes. Figure 4 provides an example of this.

Finally, it is important to review the skill of the forecasts. It should be remembered that Western Weather Group currently provides written forecasts to growers and will continue to do so. Access to the high-resolution digital forecasts is provided via web site displays. A current set of what they can view is listed below:

<http://www.esrl.noaa.gov/psd/data/obs/nwspqr/anim/MaxT.php> - MaxT forecast animation

<http://www.esrl.noaa.gov/psd/data/obs/nwspqr/anim/MinT.php> - MinT forecast animation

http://www.esrl.noaa.gov/psd/data/obs/nwspqr/dst/ms/model_nws.php - Interactive hourly forecast display with and without bias correction for a select number of vineyards.

http://www.esrl.noaa.gov/psd/data/obs/nwspqr/ms/model_spectrum_v2_2.php - Interactive forecast display with and without bias correction for a select number of vineyards

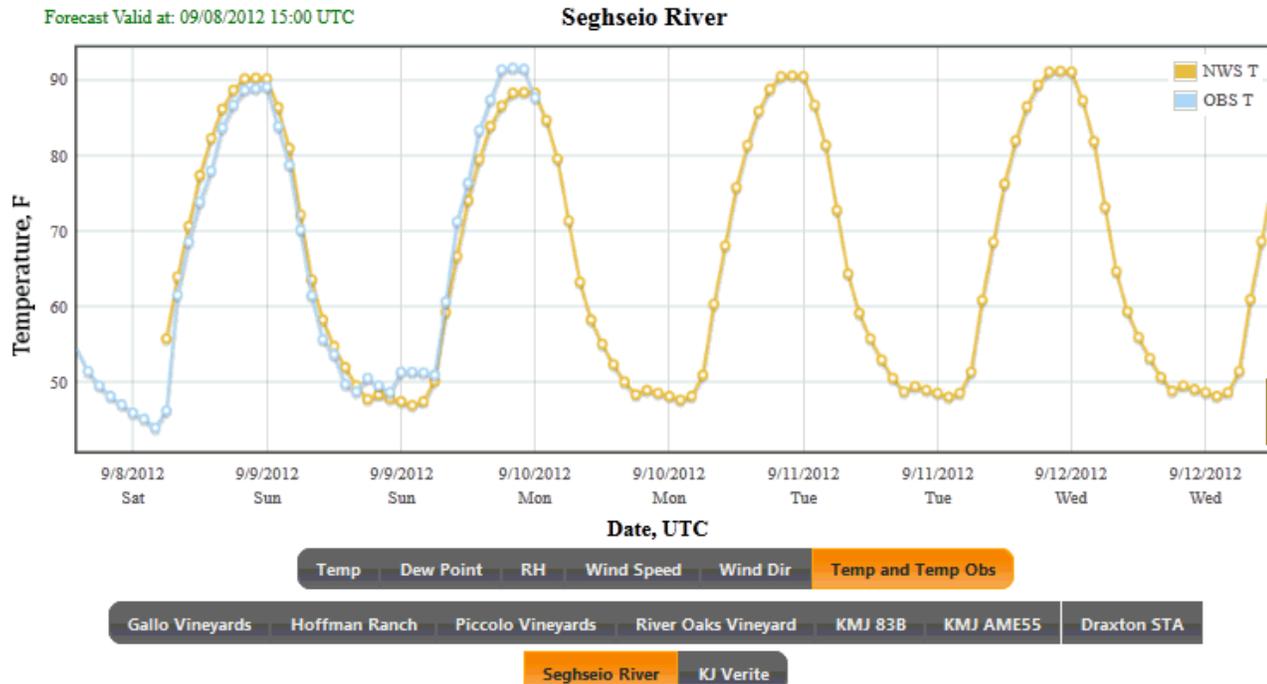


Figure 4 Diurnal temperature trends with yellow denoting official forecast and blue denoting the hourly observations for Seghseio River station.

Figure 5 shows an error histogram of MaxT forecasts for the official forecast downscaled to 250m (NWS) and a few sample statistical and dynamic models used as guidance by the NWS. Note there are several data points with large errors of up to 14 degrees although the majority of the forecast errors are +/- 4 degrees. This histogram uses 22 ADCON sites where hourly data are available. Figure 6 is a comparable chart to Figure 5 but for MinT.

This digital forecast system will remain in a prototype mode through the frost season of 2013 to evaluate its utility in improving water management for the Russian River. Additionally discussions are underway to install a device called a SODAR, Sound Detection And Ranging, that will provide detailed measurements of the height of the temperature inversion during frost conditions. If the inversion is shallow, using fans to mix the warmer air aloft with the surface cold air can be effective in mitigating frost impacts and eliminate the use of water. Geyserville is the preliminary site that has been chosen for this equipment. Figure 7 shows an example from a Utah SODAR site of the type of information one can obtain.

NOAA would like to acknowledge Sonoma County Water Agency who is funding this study and specifically Jay Jasperse who initiated discussion on this subject. We would also acknowledge Western Weather Group and specifically Don Schukraft for valuable feedback on the products being generated and access to six weather stations. Finally we would like to acknowledge Nick Fry from the Winegrape Commission and Terry Rosetti of FarmEcology who very much helped facilitate obtaining additional vineyard weather data.

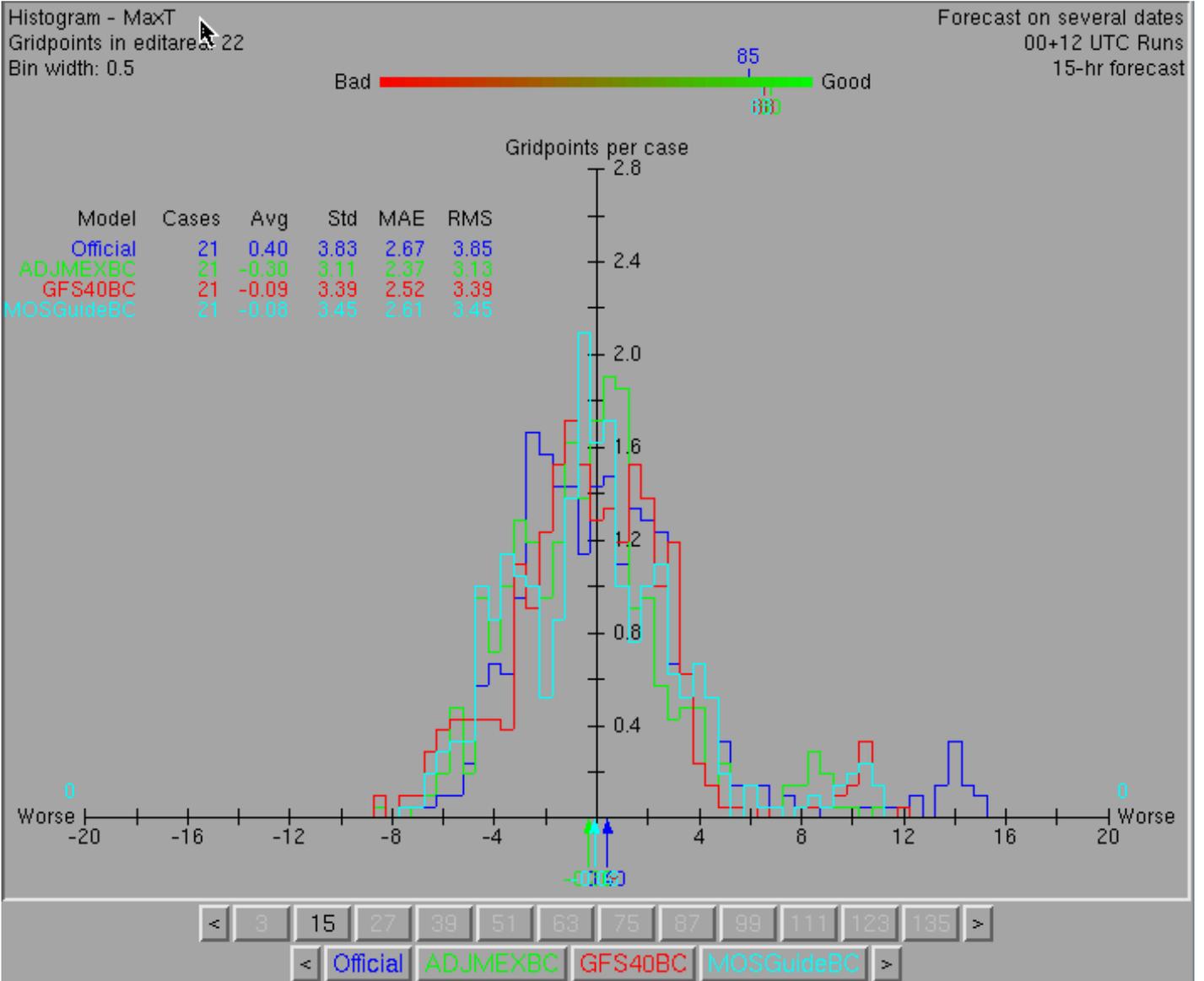


Figure 5 Error histogram for MaxT for the official NWS 15 hr forecast and various model guidance for the first 23 days of September 2012.

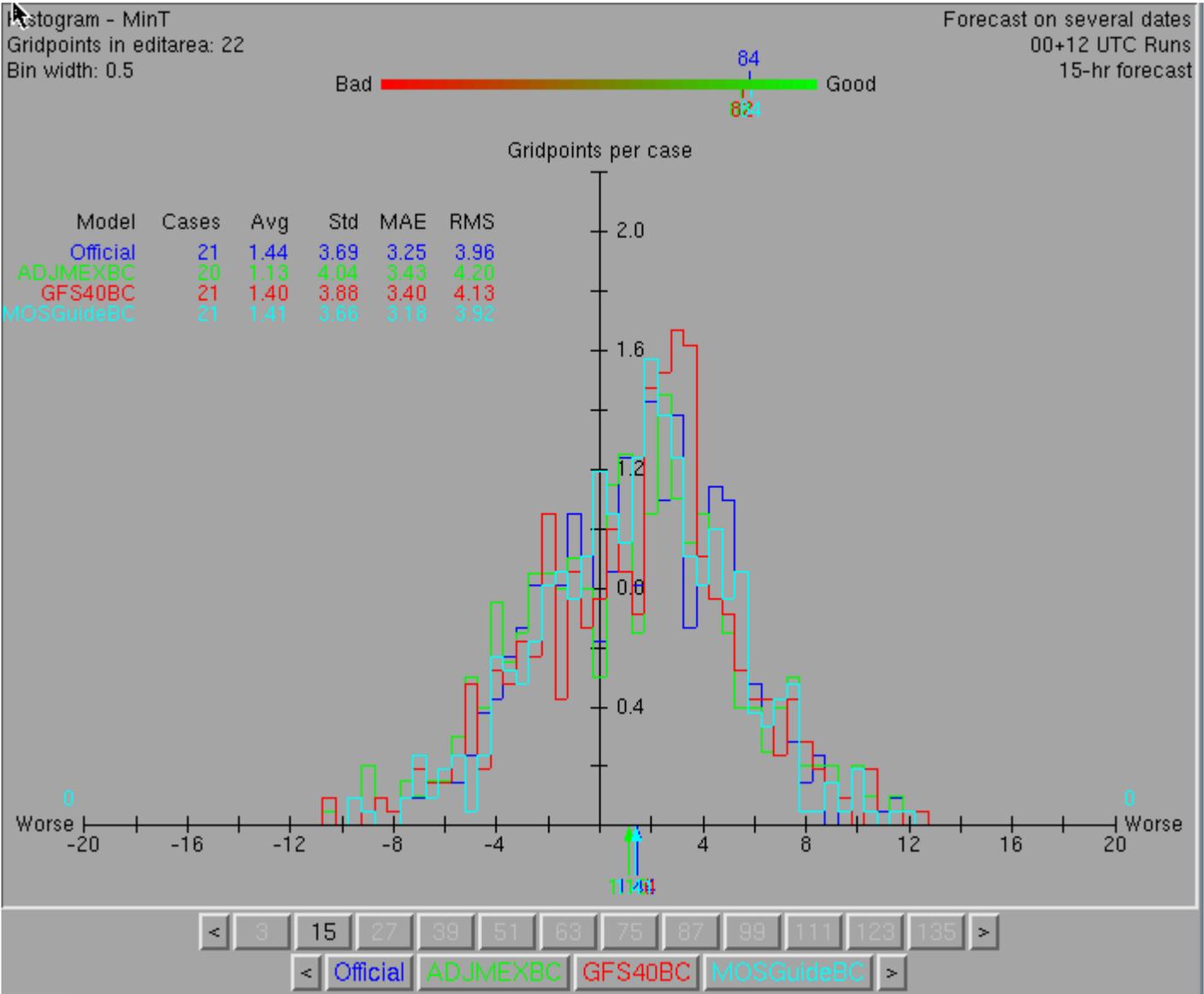


Figure 6 Same as Figure 5 but for MinT.

On 13 January 2012, from 0759-0829 MST data shows a surface-based nocturnal inversion modulated by waves aloft transitioning to a capped convective boundary layer
Courtesy of Dr. Clark King (NOAA/PSD)

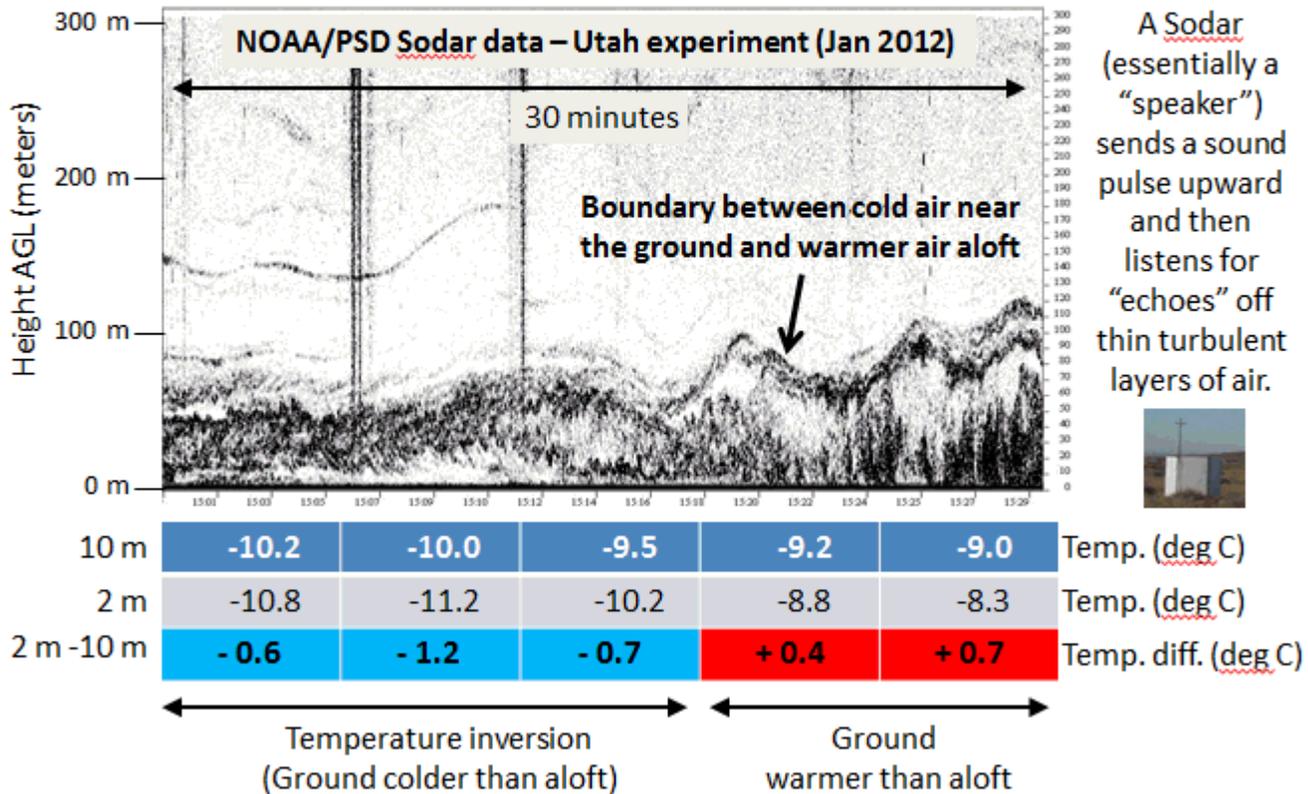


Figure 7 Example of the SODAR's capability to measure the height of a shallow temperature inversion and how it breaks down through surface heating.