# 9.14 MODEL INTERPRETATION USING SLIDER BARS IN INTERACTIVE FORECAST PREPARATION


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## 1. INTRODUCTION

The Techniques Development Laboratory (TDL) has been developing and testing techniques that support Interactive Forecast Preparation (IFP) for many years. The concept of IFP is key to achieving modernized forecast operations at National Weather Service (NWS) field offices with the Advanced Weather Interactive Processing System (AWIPS). With IFP, forecasters employ a family of techniques to prepare digital forecasts of weather elements (Ruth et al. 1998). Many public, aviation, and other specialized NWS products are automatically composed and formatted from the forecaster-prepared database (Peroutka et al. 1998). The significance of these techniques is that they allow forecasters to concentrate on the meteorology of the situation by relieving them of the need to type products in different formats. The common database used to generate these products also allows for more consistent forecasts over time and among products, and easier monitoring and maintenance of those forecasts.

One of the first IFP systems was the Interactive Computer Worded Forecast (Ruth and Peroutka 1993). Since the time this system was introduced into field operations a decade ago, the NWS has realized a steady improvement in the quality of its model forecast guidance (Kalnay et al. 1996). Meteorological details previously unseen, including local effects due to mountains, valleys, and coastlines, are now readily apparent in high-resolution model output. With AWIPS, this improved guidance is beginning to flow to field offices. IFP will enable NWS Weather Forecast Offices (WFOs) to share the new wealth of detailed information with its users. Using the latest IFP grid interpretation and editing techniques, WFO forecasters will apply their expertise by adding value to high-resolution guidance. Detailed grid-based products (LeFebvre et al. 1996) as well as new text and tabular products will be produced.

Most grid modification techniques require that forecasters physically draw graphical depictions of predicted weather on spatial or time-series displays with a mouse (Ruth 1993, Paterson et al. 1993, LeFebvre 1995). Using these tools to prepare a set of grids for all required forecast elements at every hour without degrading model resolution is a daunting task. Model interpretation techniques developed at TDL provide an alternative to drawing forecasts. Initially, the forecaster chooses a model or interactively blends models which provide a reasonable first-guess forecast. The forecaster then adjusts slider bars which control the timing, location, type, and intensity of weather on grids. The resulting interpretation uses the original model guidance to maintain spatial and temporal details which are consistent with the adjusted forecast.

The concept of model interpretation with slider bars was introduced by Ruth and Du (1997). The paper presented here describes model interpretation from a user's perspective. Slider bars do not afford the forecaster the same control that is available by editing weather directly. However, they can be used to prepare high-resolution forecast products in a time effective manner--an important consideration for efficient use of NWS staff. The power, flexibility, and scope of model interpretation is shown in the sets of slider bars the forecaster can choose to adjust.

## 2. CATEGORICAL SLIDER BARS

Model interpretation techniques do not change gridfields directly, but instead enable forecasters to set threshold values relevant to the interpretation of model grids. These values may be thresholds used in the initialization of categorical weather forecasts from model probabilities (e.g., frozen or freezing precipitation). They may be significant categories used in NWS operations (e.g., "likely" precipitation). Or they may be defined for the purpose of adjusting continuous model fields (e.g., "light wind") by using categorical slider bars. Forecasters make adjustments by moving slider bars while viewing a color image of the resulting forecast on the screen (Fig. 1). Adjustments are made at selected forecast projections, interpolated in time, and then applied to the original model fields at their full-resolution in time and space.

Categorical slider bars used in the interpretation of thunderstorms are seen on the left of Fig. 1. One slider bar is provided to adjust threshold probabilities for each of six categories based on model guidance for both severe and non-severe thunderstorms. For example, to increase the area where thunderstorms are considered likely, a forecasters would move the likely slider bar to the right while viewing the color-coded likely area enlarge on the screen. In effect, this action lowers the threshold probability required in model guidance for the likely category of thunderstorms which in turn allows more gridpoints to enter the likely category at the displayed forecast projection.

Animation controls in the lower left corner of the screen (Fig. 1) allow the forecaster to display images of categorical weather at 3-h intervals for all available model forecast projections. The forecaster can stop the loop and adjust thresholds for as many hours as desired. Threshold settings are linearly interpolated for intermedi-

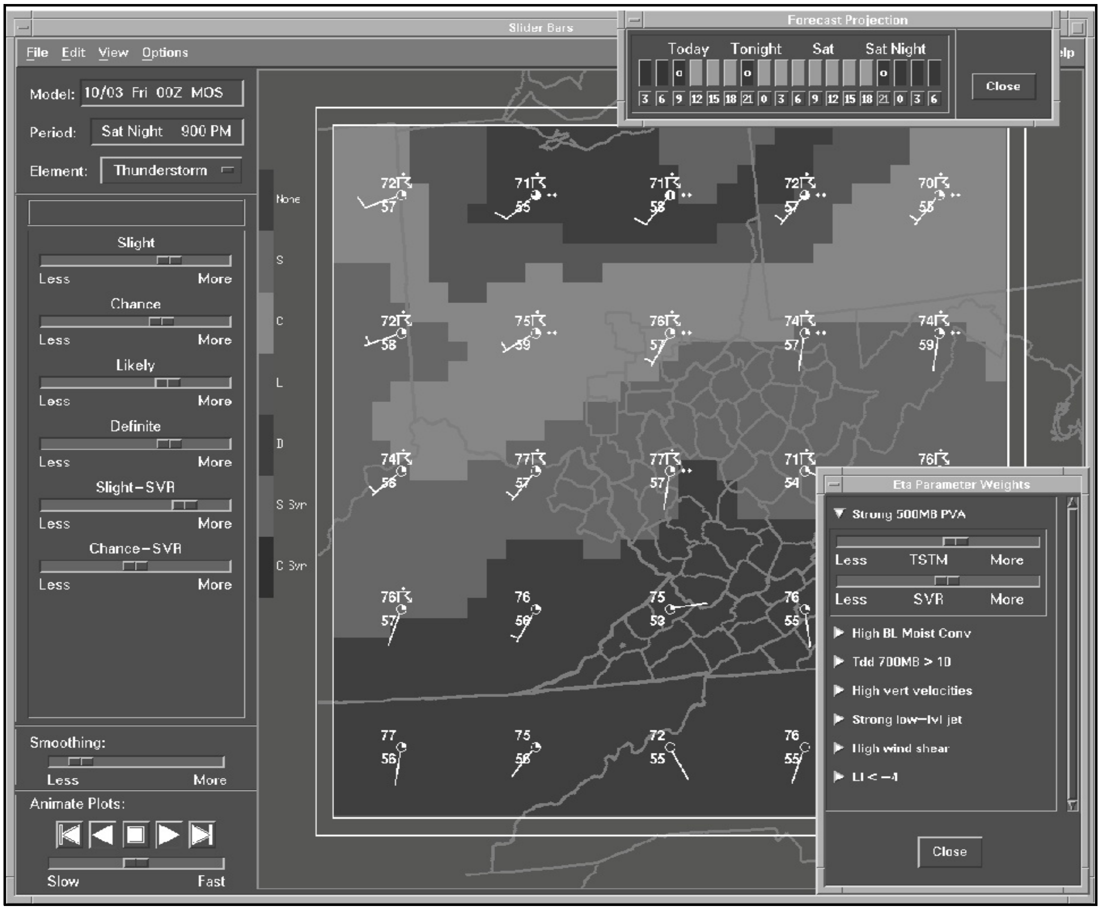


Figure 1: Slider bar interface.

ate hours. This means that if a forecaster lowers model thresholds to achieve more thunderstorms in the morning and then raises model thresholds to decrease thunderstorm activity in the evening, model guidance for thunderstorms that afternoon would be interpreted with near default threshold values. A time line window positioned near the top of the screen indicates hours for which the forecaster has adjusted thresholds. This window can also be used to select forecast projections directly and to copy sets of thresholds from one hour to another.

## 3. MODEL BLENDING

The end result of threshold adjustments with slider bars is a user-specified interpretation of one or more forecast models. If model guidance does not provide a reasonable first guess, model interpretation becomes impractical. Model initializations of surface weather are available from Model Output Statistics (MOS) or can be derived from numerical models directly. MOS forecast guidance (Glahn and Lowry 1972, Carter et al. 1989) is currently available from the Nested Grid Model (NGM) for over 700 stations in the United States. MOS forecasts will soon be available from the Eta and Aviation (AVN) models. In AWIPS, the Local AWIPS MOS Program (LAMP) updates MOS forecasts based on the latest hourly observations (Glahn 1980, Unger et al. 1989). MOS and LAMP station forecasts are mapped to a grid by using WFO-specified assignment schemes for each forecast element. TDL is currently funding a cooperative research project with the Pennsylvania State University to develop statistical methods which will produce hourly forecast guidance on high-resolution grids.

At present, the initialization of surface weather elements from numerical model output is available only from the Eta model. These fields are created at the National Centers for Environmental Prediction (NCEP) and distributed to WFOs via satellite broadcast. The Eta surface weather algorithms were originally developed by NCEP in support of the Olympic Games in Atlanta. This year, software which derives probabilities and values for surface weather elements from AVN, Eta, NGM, and Rapid Update Cycle (RUC) model output will be distributed to WFOs with the IFP system (Wier 1998). This should enhance the utility of model interpretation in the field. In the future, it may be possible to use model ensemble output to provide additional initialization options.

Upon start-up of the slider bar interface, the forecaster chooses a model for interpretation. Forecasts from that model are initially displayed with default or previous threshold settings. The model name is shown in the upper left of the screen (Fig. 1). A slider bar dialog box (Fig. 2) can be used to blend the initial model forecast with guidance from other models. As the forecaster moves a slider bar to the right, guidance for that model is proportionately "added in." The resulting blend is displayed on the screen immediately. It is incumbent upon the forecaster to ensure that any particular blend makes meteorological sense. As with categorical slider bars, model blends are set by the forecaster for selected projection times. Settings for intermediate hours are derived by linear interpolation.

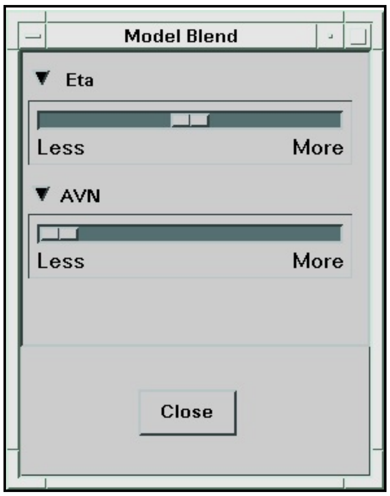


Figure 2: Model blend dialog box.

## 4. TIME AND SPACE ADJUSTMENTS

A common modification WFO forecasters make to guidance is to adjust the model timing. The dialog box shown in Fig. 3 interactively "speeds up" or "slows down" model guidance by looking forward or backward in time, respectively. The time slider bar controls this offset in hours. The magnitude slider bar controls the degree of influence on the current grid.

Similarly, space adjustment slider bars shift model guidance north, south, east, or west. This particular adjustment is not recommended at WFOs with mountains or coastlines since model details describing those areas would be lost. Settings for time and space adjustments are linearly interpolated and applied to intermediate grids in the same manner as model thresholds.

## 5. GEOGRAPHIC WEIGHTS

Adjustments to element categories, model blending, and shifts in time or space apply evenly to every point on the grid. It is through the use of geographic weights, parameter weights, and element weights that a forecaster targets adjustments toward specific regions. The dialog box in Fig. 4 shows the geographic slider bars used for model interpretation at the NWS forecast office in Boise, Idaho. Weighting schemes are created at a WFO by assigning gridpoints values from 0 to 100 for each geo-

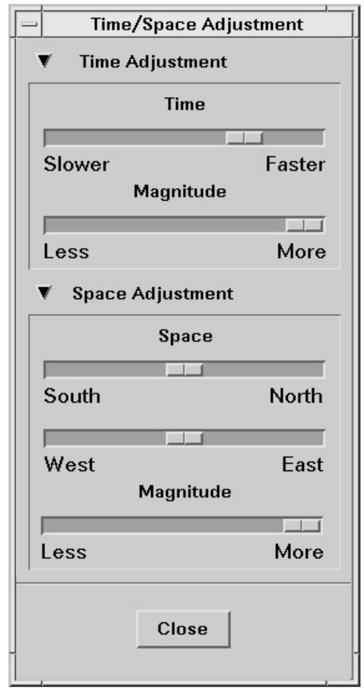


Figure 3: Time/space dialog box.

graphic feature. Geographic slider bars are then used to induce categorical forecasts from model guidance such as snow in the Central Mountains, thunderstorms in the Lower Snake River Valley, or fog near Ontario. This is accomplished by selectively raising or lowering model threholds at each gridpoint in proportion to its geographic weight for that feature.

For example, if the WFO forecaster feels that the model is "under doing" the chance of snow showers in the


Figure 4: Geographic weight dialog box.

Owyhee mountains, the forecaster could use the Owyhee mountains slider bar to lower the model probability required for precipitation in that area of the grid only. The forecaster could reposition the rain/snow line in that area by adjusting the threshold for probability of frozen precipitation with the Owyhee slider bar. By moving slider bars, the forecaster does not actually create snow showers in the forecast database, but instead makes it progressively "easier" for the forecast model to initialize snow showers in that region of the grid. Diurnal effects and the shapes of mountains are reflected in the forecast to the extent that these influences are handled in the original model guidance.

## 6. MODEL PARAMETER AND ELEMENT WEIGHTS

A significant feature of model interpretation is the ability to adjust surface weather grids based on numerical model parameters. For instance, forecasters could choose to lower thunderstorm thresholds at gridpoints where they judge the model has underestimated convection based on strong 500 mb positive vorticity advection or high boundary level moisture convergence. The resulting increase in thunderstorm activity would match in time the movement of the selected model feature across the forecast area.

The forecaster names and sets weighting schemes for model parameters with a weight editor (Fig. 5). Each function is defined by drawing or redrawing a line on a graph. That function is used to derive weights, from 0 to 100, for every gridpoint based on the matching model forecast at that point. One slider bar appears in the dialog box for each weighting scheme. It may be desirable to create more than one scheme per model parameter. For example, forecasters could increase or decrease cloud cover based on vorticity advection with a different weighting function. Figure 6 shows a slider bar dialog box for Eta model parameters.

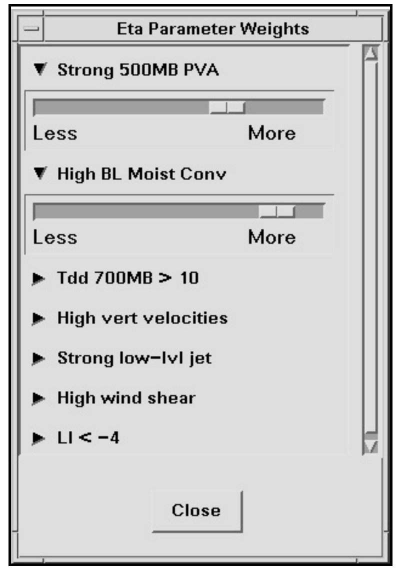


Figure 6: Parameter weight dialog box.

Element weights (Fig. 7) work in the same manner as model parameter weights. In this case, adjustments to one forecast element are based on a previously prepared forecast for another element. For example, using a cloud cover element weight, a forecaster could decrease maximum temperatures in those areas of the grid where overcast skies have been forecast.

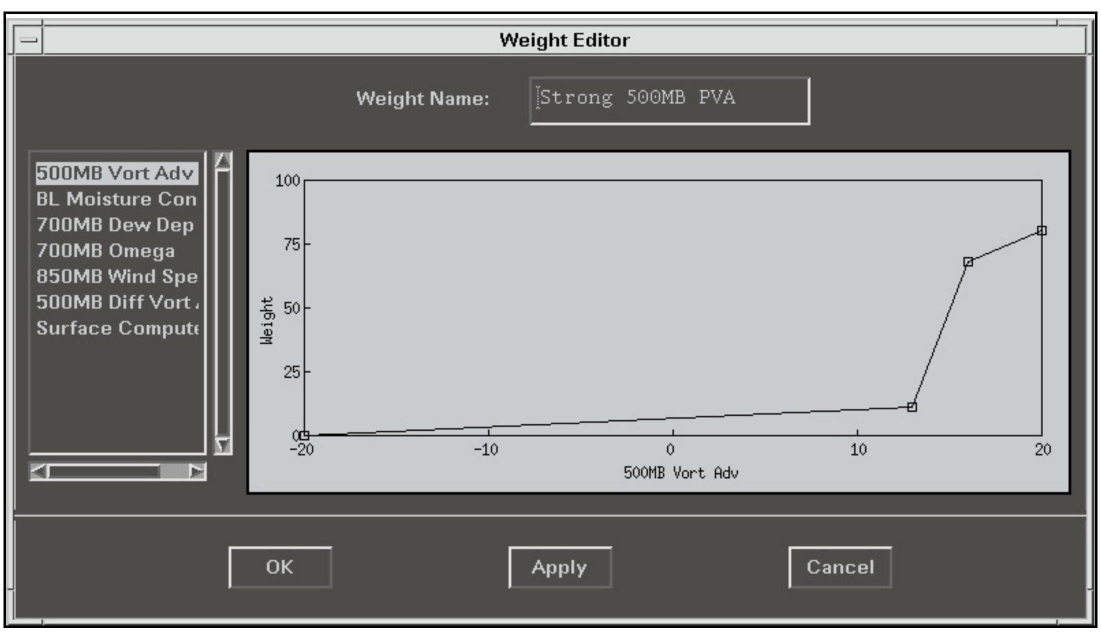


Figure 5: Weight editor.

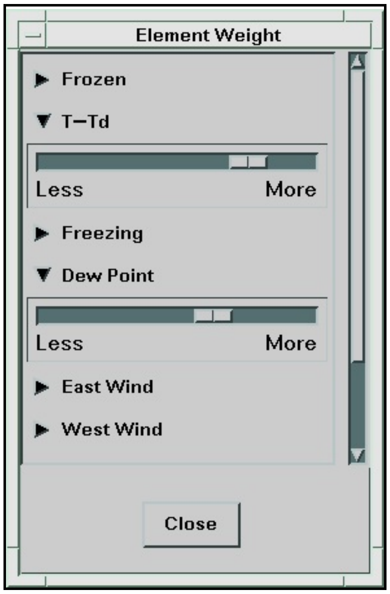

Figure 7: Element weight dialog box.

## 7. CONCLUSION

The NWS is currently preparing to implement IFP techniques at WFOs nationwide (Meiggs et al. 1998). The system will include both model interpretation and grid editing tools for all forecast elements. These tools are designed to work in tandem, with model interpretation used to reduce the frequency and extent of grid editing, especially beyond the first forecast periods. Forecaster acceptance of model interpretation techniques will depend on the availability of reasonable high-resolution model forecast guidance, the perceived importance of providing mesoscale detail in NWS forecasts, the diversity of terrain within the local area of forecast responsibility, and the amount of time a forecaster has on shift to edit grids.

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