Model View of Inversion Evolution

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The evolution of low clouds and fog trapped under winter valley inversions can be a challenging forecast problem. Typically, model guidance struggles simply to forecast the inversion itself – and has very little to add in terms of forecasting where low clouds and fog will form. However, current GFE SmartInit schemes use low-level model soundings in deriving various surface parameters, and can pick up on some moisture features that otherwise might go unnoticed.

Figures 1 through 5 show the DGEX PoP forecasts for December 15, 2004 through December 17, 2004. At 12Z on Wednesday, December 15th, there is precipitation exiting the Magic Valley of southcentral Idaho, moving south and east.

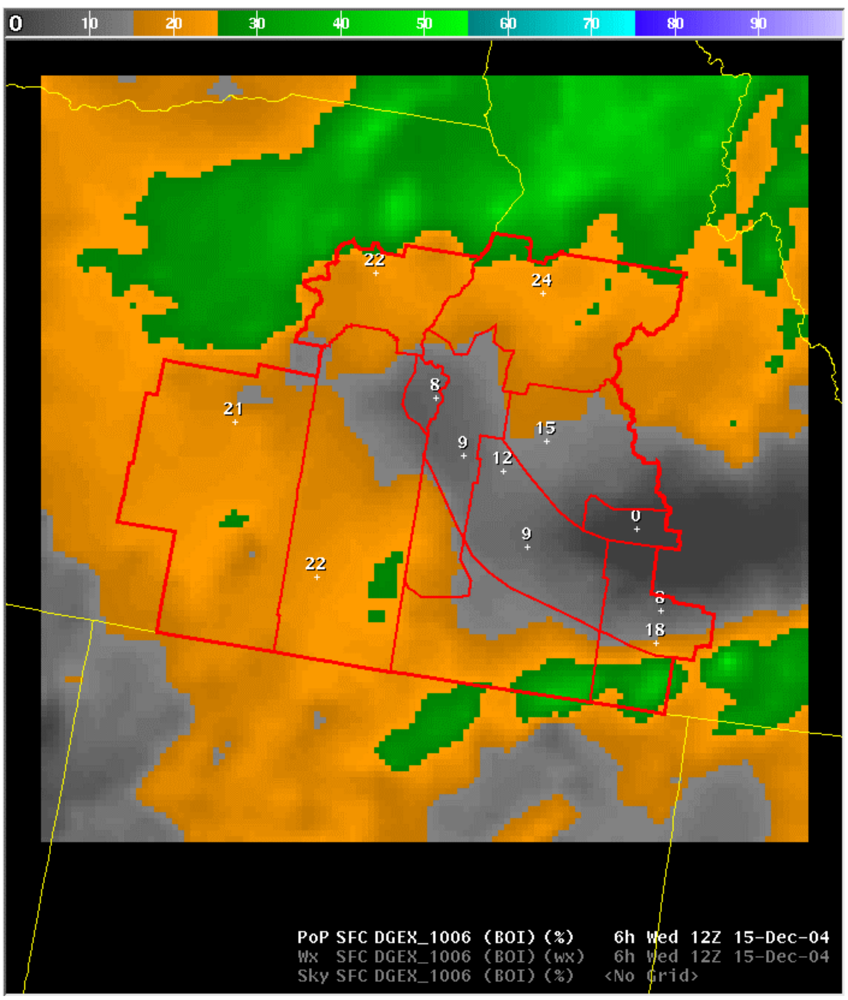

Figure 1: DGEX PoP ending at 12Z December 15, 2004.

By Wednesday afternoon (figure 2), the PoPs have dropped, as precipitation moves out of the area:

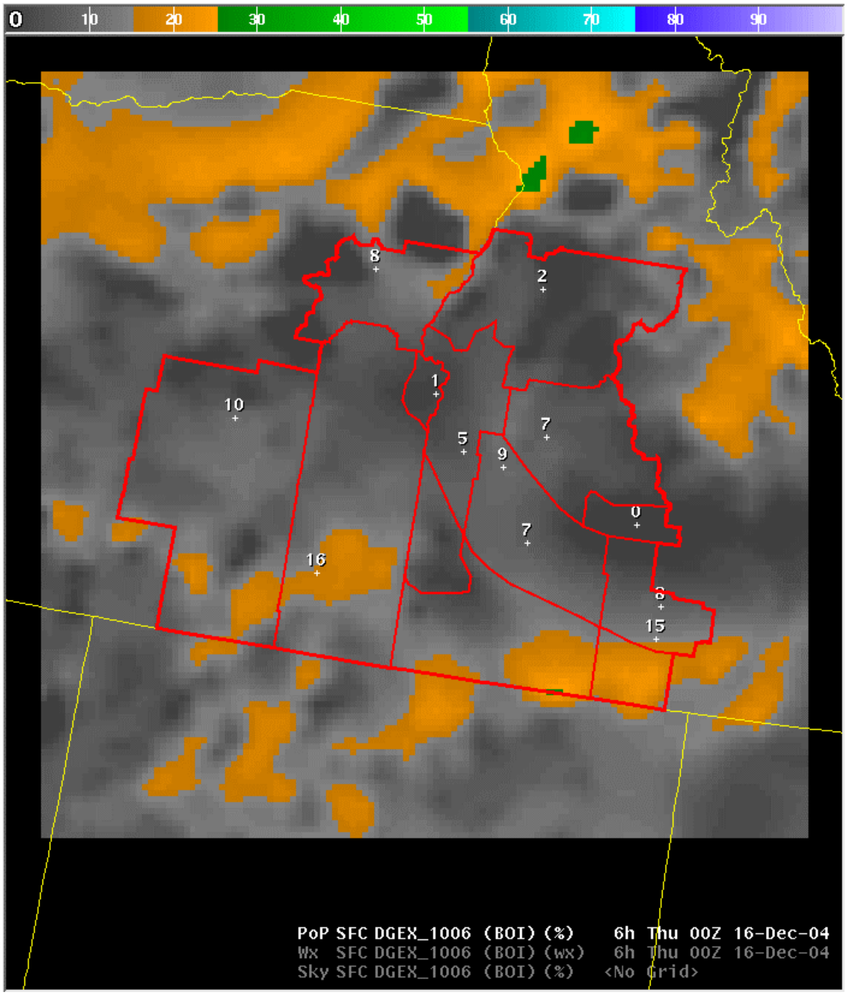

Figure 2: DGEX PoP ending at 00Z December 16, 2004.

By Thursday morning (12Z on the 16th) , the QPF is long gone, but low PoPs remain, especially in the Magic Valley of south-central Idaho.

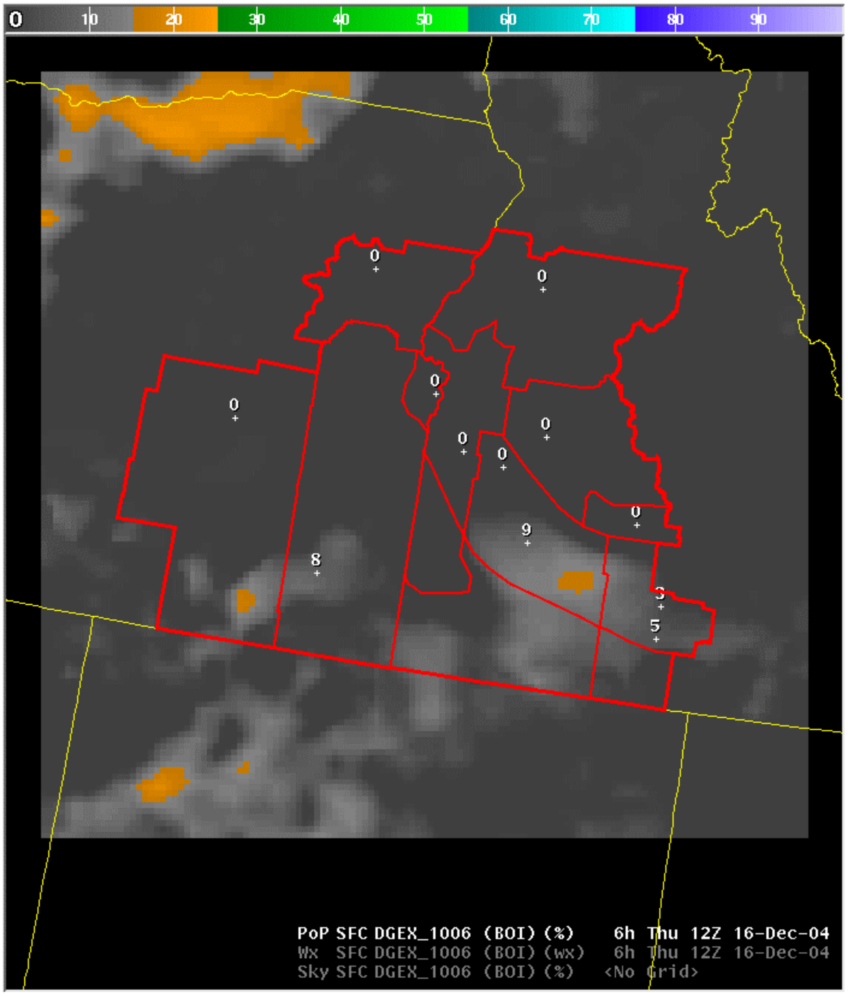

Figure 3: DGEX PoP ending at 12Z December 16, 2004.

The DGEX PoP SmartInit considers "low-level" moisture (in addition to QPF), so it is picking up on remaining low-level moisture in the Magic Valley.

By Thursday afternoon (00Z on the 17th), the area of slightly higher PoPs appears to be moving northwest toward the Treasure Valley of western Idaho.

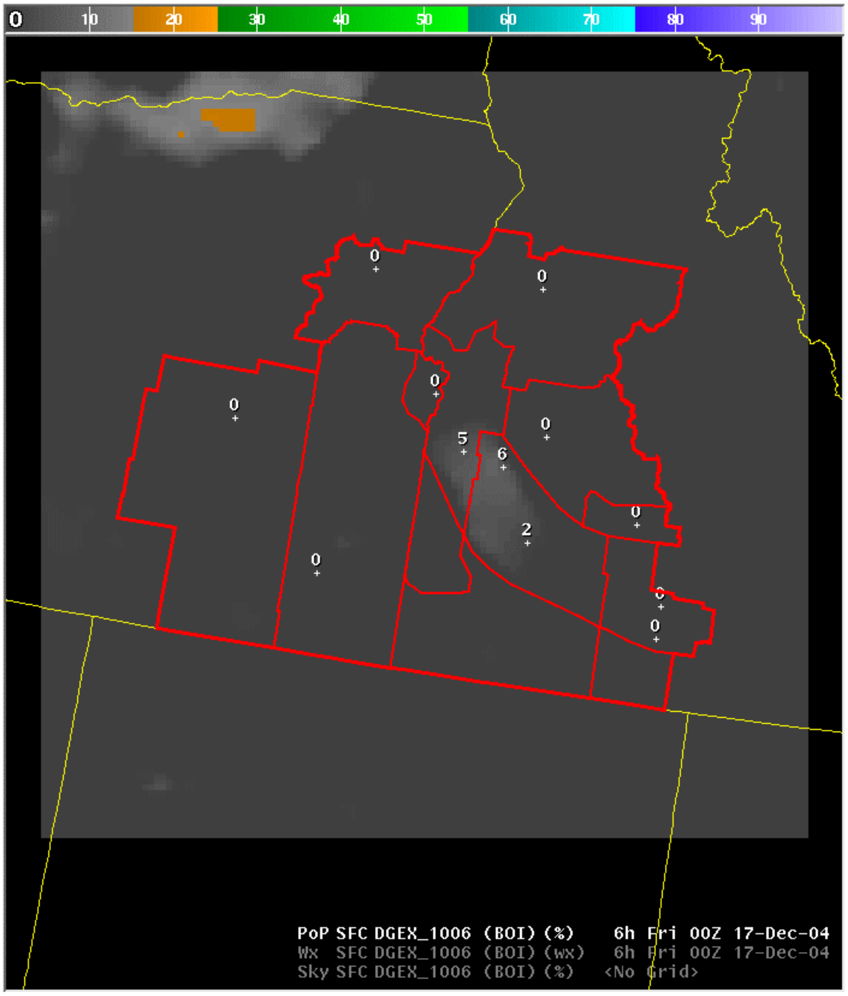

Figure 4: DGEX PoP ending at 00Z December 17, 2004.

Typically, the cold air of the inversion along with the low-clouds and fog, drain downhill from the slightly higher elevations of the Magic Valley into the Treasure Valley.

By Friday morning (12Z on the 17^{th}), the slightly higher PoPs have moved all the way down through the Treasure Valley:

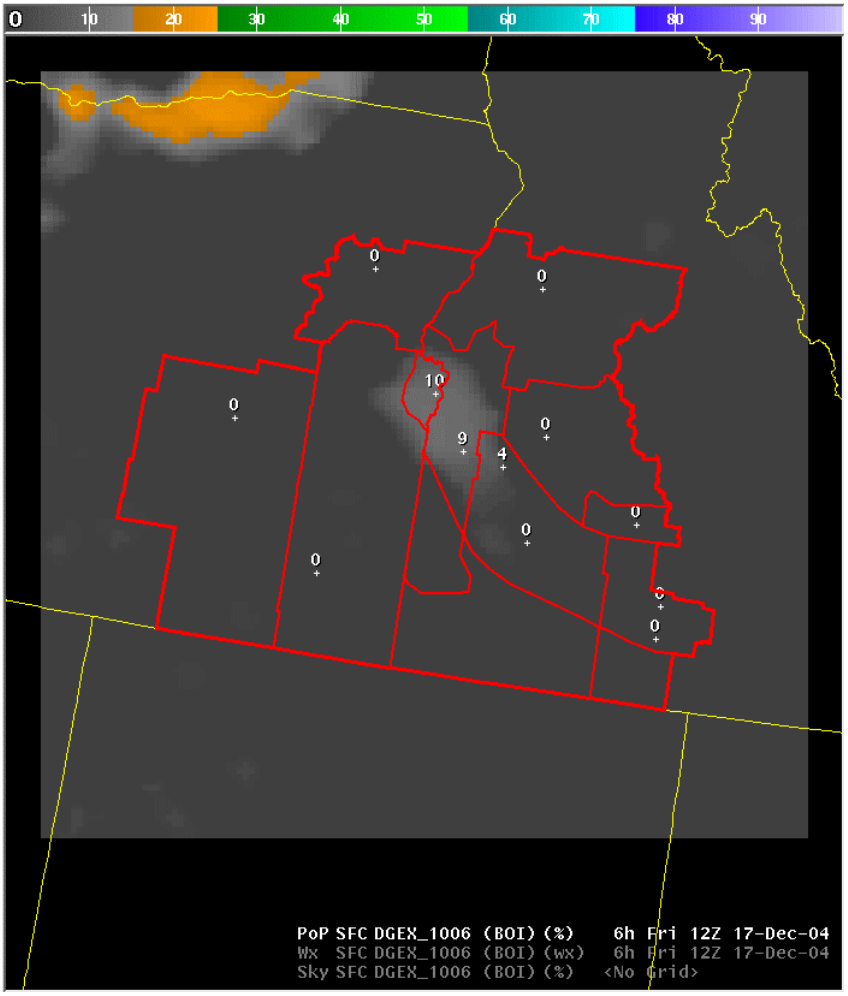

Figure 5: DGEX PoP ending at 12Z December 17, 2004.

It appears that the model is indicating the low-level moisture starts in the Magic Valley and drains toward the bottom part of the Treasure Valley. We don't have soundings from the DGEX available in AWIPS, but soundings from the regular GFS run for the same period showed very subtle, and similar, features.

Figure 6 shows the soundings from the GFS model for 12Z on the 16th for Twin Falls in the Magic Valley (in white) and Ontario in the Treasure Valley (in green).

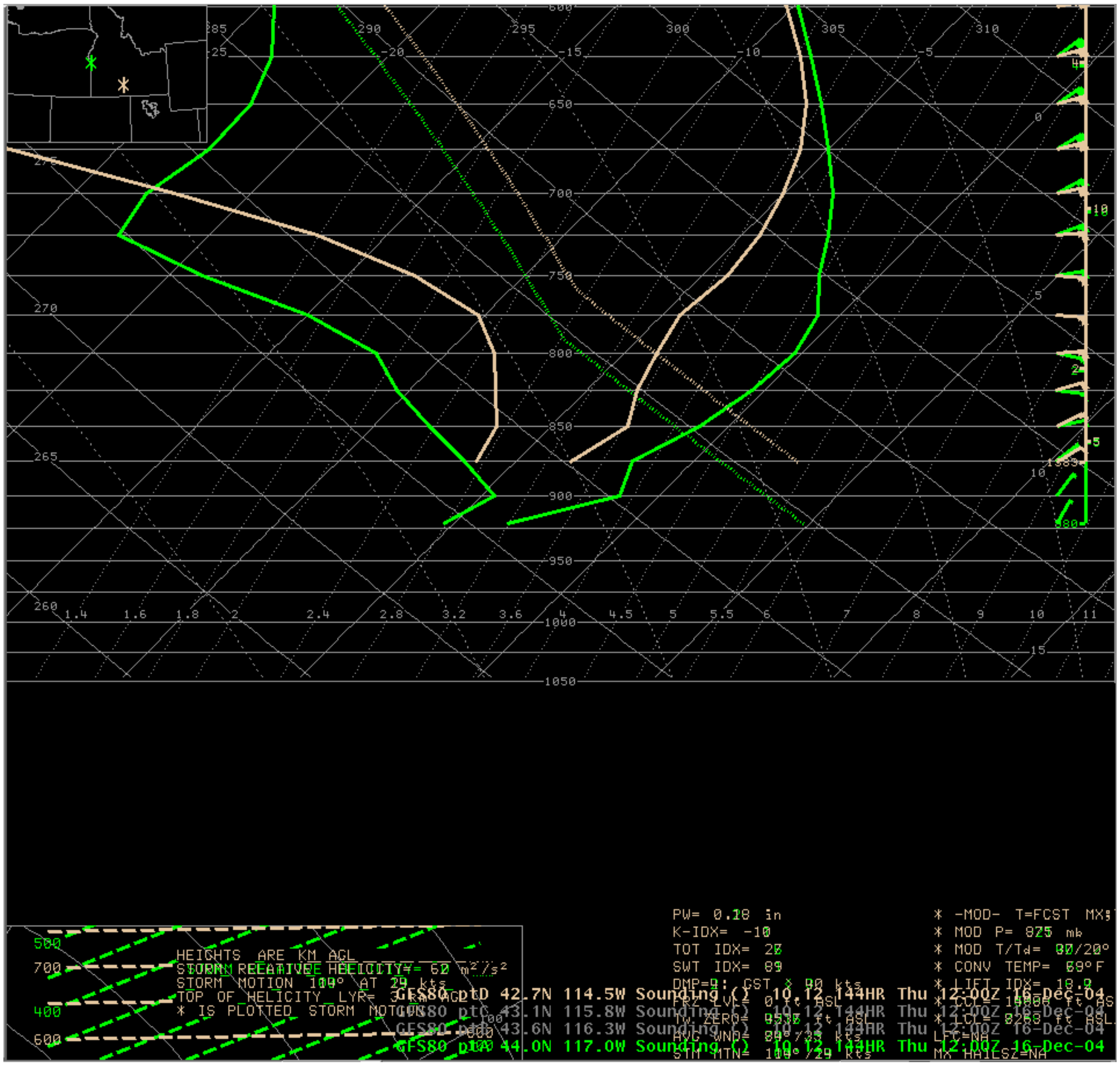

Figure 6: GFS forecast sounding for Twin Falls (white) and Ontario (Green) for 12Z December 16, 2004.

While not nearly saturated, the model is certainly showing a much deeper and extensive area of low-level moisture near Twin Falls, compared to Ontario. If you compare moisture content at similar levels (say, 850 mb), Twin Falls has quite a bit more moisture available than at Ontario.

By Friday morning (12Z on the 17th) , the moisture values are much more similar.

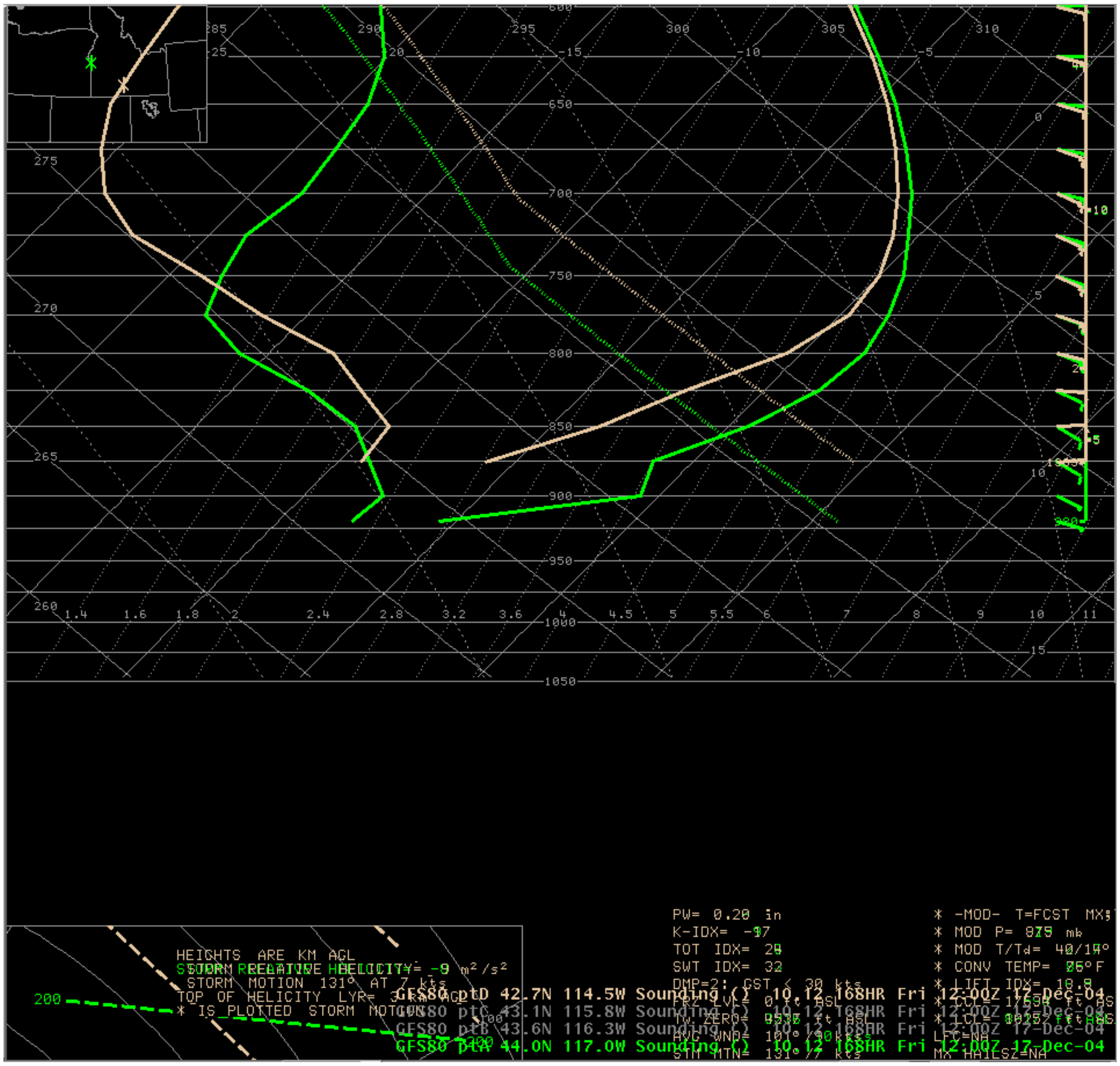

Figure 7: GFS forecast sounding for Twin Falls (white) and Ontario (Green) for 12Z December 17, 2004.

And by Saturday morning (figure 8), the moisture values are nearly identical, so that the depth of the high RH air is now a little deeper at Ontario than it is at Twin Falls:

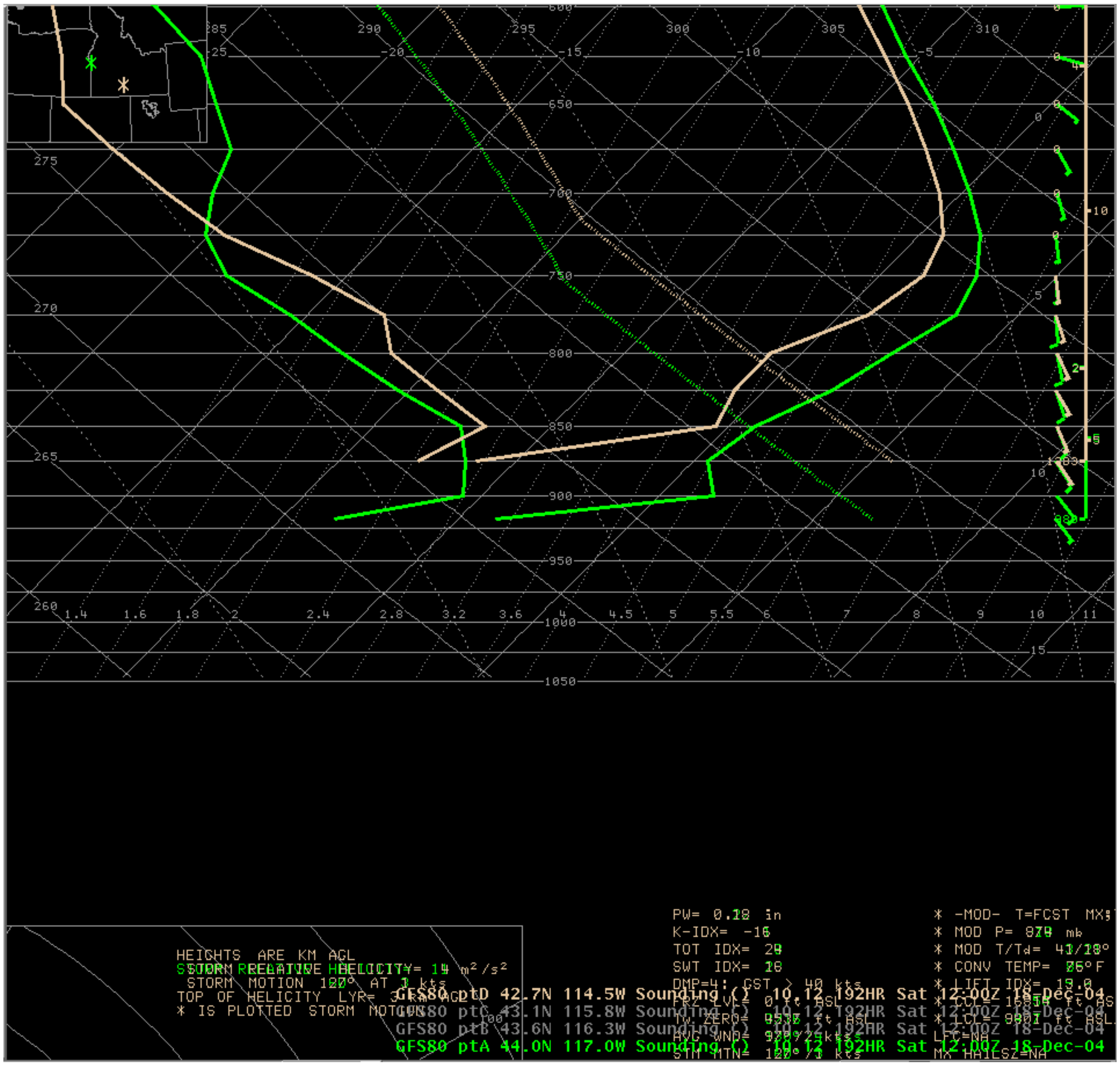

Figure 8: GFS forecast sounding for Twin Falls (white) and Ontario (Green) for 12Z December 18, 2004.

If you look at the wind barbs in the soundings you can see why this transfer of moisture might be taking place. There is easterly flow at the low and mid levels bringing the moist air down toward the lower part of the valley

Figure 9 shows the DGEX 500mb and Surface Pressure pattern on Thursday, December 16th at 12Z. You can see how the ridge building into Washington and Oregon is bringing northeasterly flow aloft across southern Idaho.

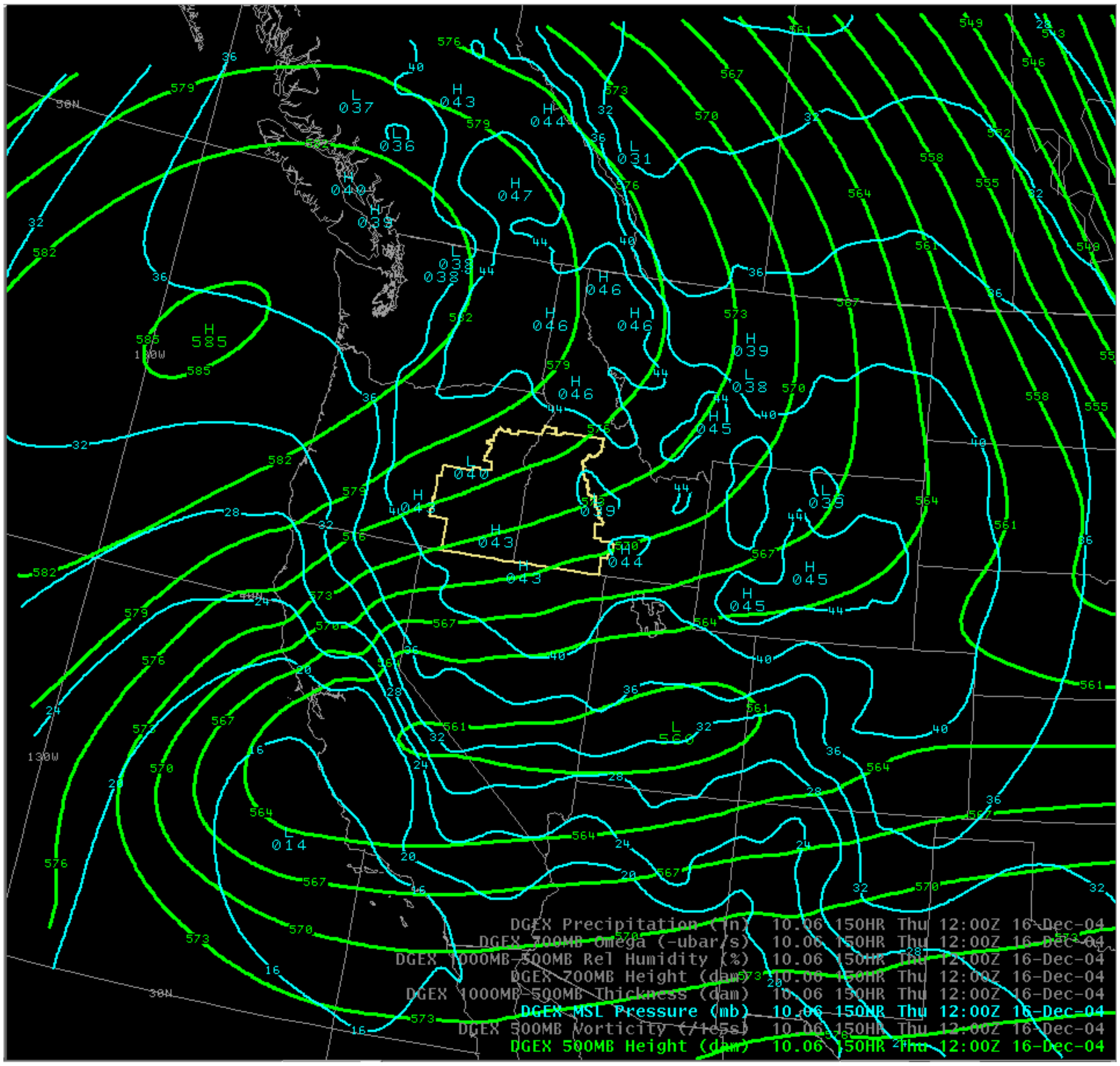

Figure 9: DGEX forecasts of 500mb Heights (green) and Sea Level Pressure (blue) for 12Z December 16, 2004.

The point is NOT that the models handle forecasting these fog/stratus cases well. The major driving factors in these fog/stratus events are very-small-scale surface and boundary-layer conditions that are not observed well – nor well simulated by the models. Our major difficulty in forecasting these events is getting an accurate forecast of mid- and upper-level clouds – which allows the surface temperatures to fall fast enough to reach saturation and initiate the event.

However, the model data shown here points out that sometimes synoptic or mesoscale features (in this case, the location of low-level moisture) may also have an impact on the evolution of the fog and stratus event – and the models might have some important information to offer for these features. Squeezing all the data you can out of either model BUFR soundings or grid point soundings, can help improve the forecast in difficult situations.