Similar Storms – Different Results

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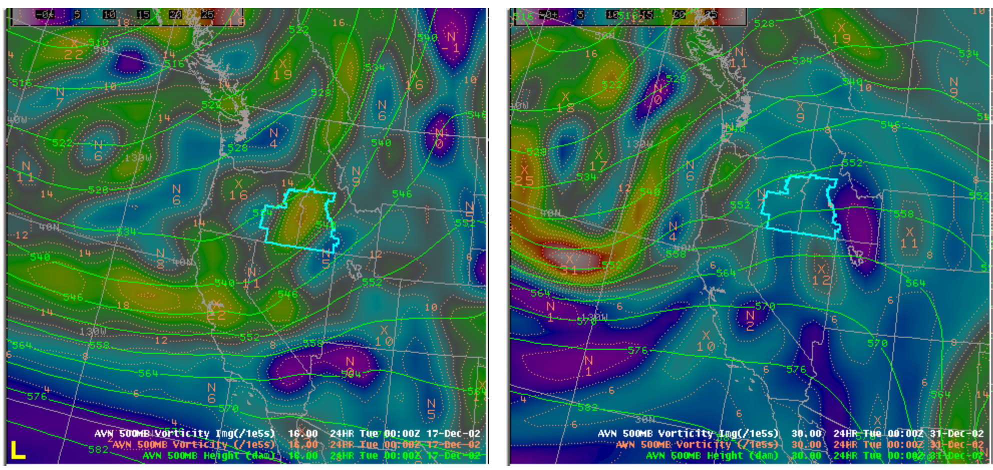
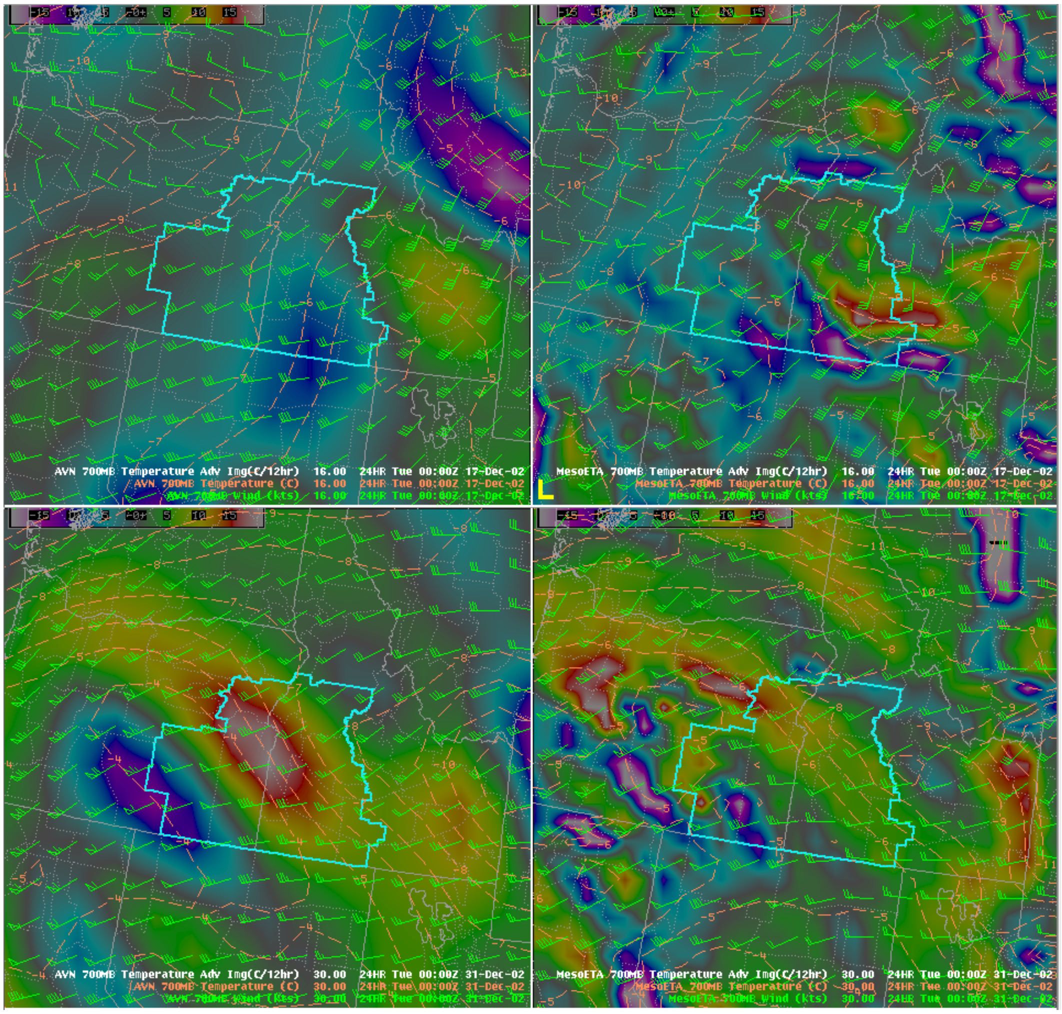
In December 2002 the Boise forecast area received several interesting storms with very different weather impacts. Here, we examine two cases where the forecasts were somewhat similar, but the final results were quite different. The first case is from 00Z December 16, 2002, forecasting for the 12-hour period ending at 00Z December 17th (a 12-24 hour forecast). The second case is from 00Z December 30, 2002, forecasting for the 12-hour period ending 00Z December 31st (a 12-24 hour forecast).

In both cases, the 24-hour 500mb forecast of heights and vorticity is somewhat benign, with the main large-scale trough remaining off the coast (Fig 1).



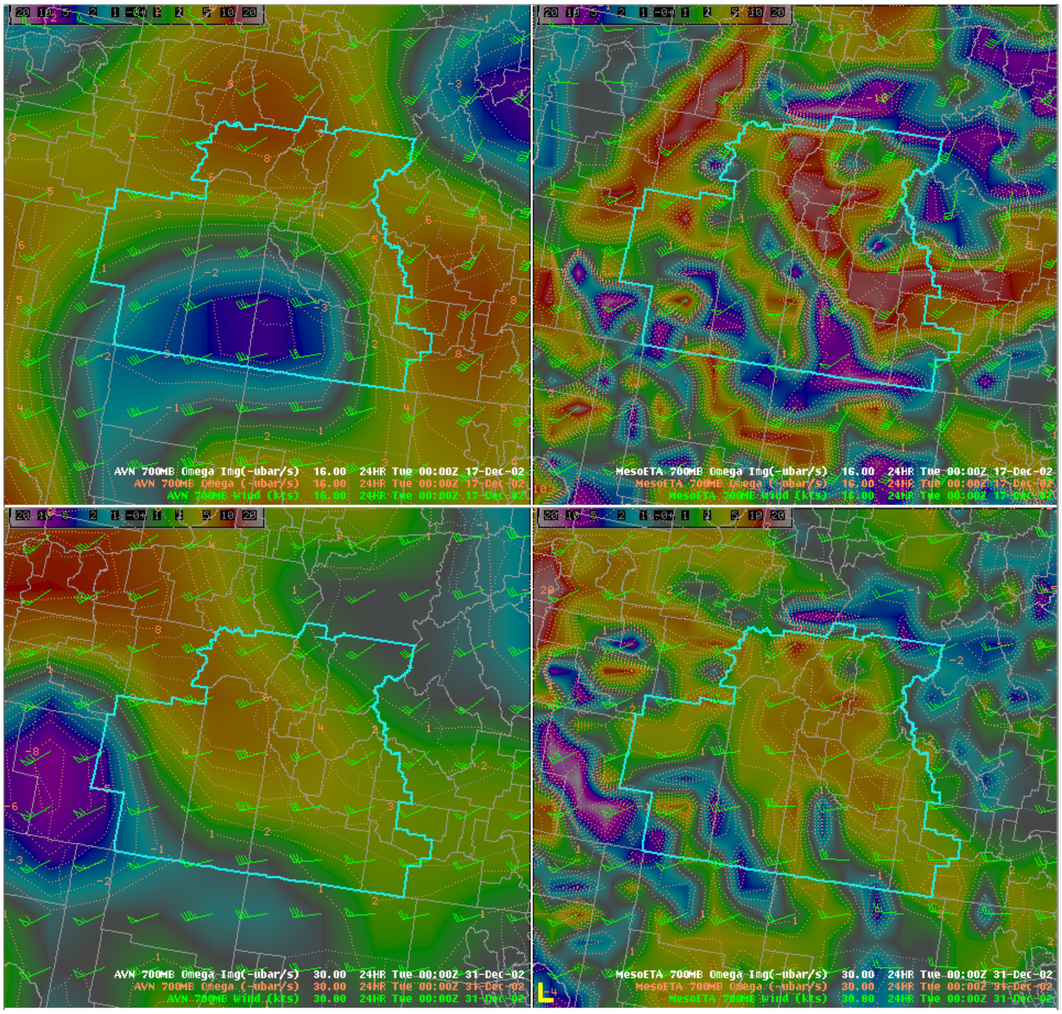
The Dec. 16th case has a bit stronger vorticity approaching the forecast area, but the feature was weakening as it moved inland and another system was intensifying further off the Pacific coast.

As is often the case for the Boise forecast area, both cases have warm advection processes dominating the forcing vertical motion and precipitation. In figure 2, we show the GFS and Eta 24-hour 700mb temperature forecasts with the image showing temperature advection. The top panels are for the Dec 16th case, while the bottom panels are for the Dec 30th case.



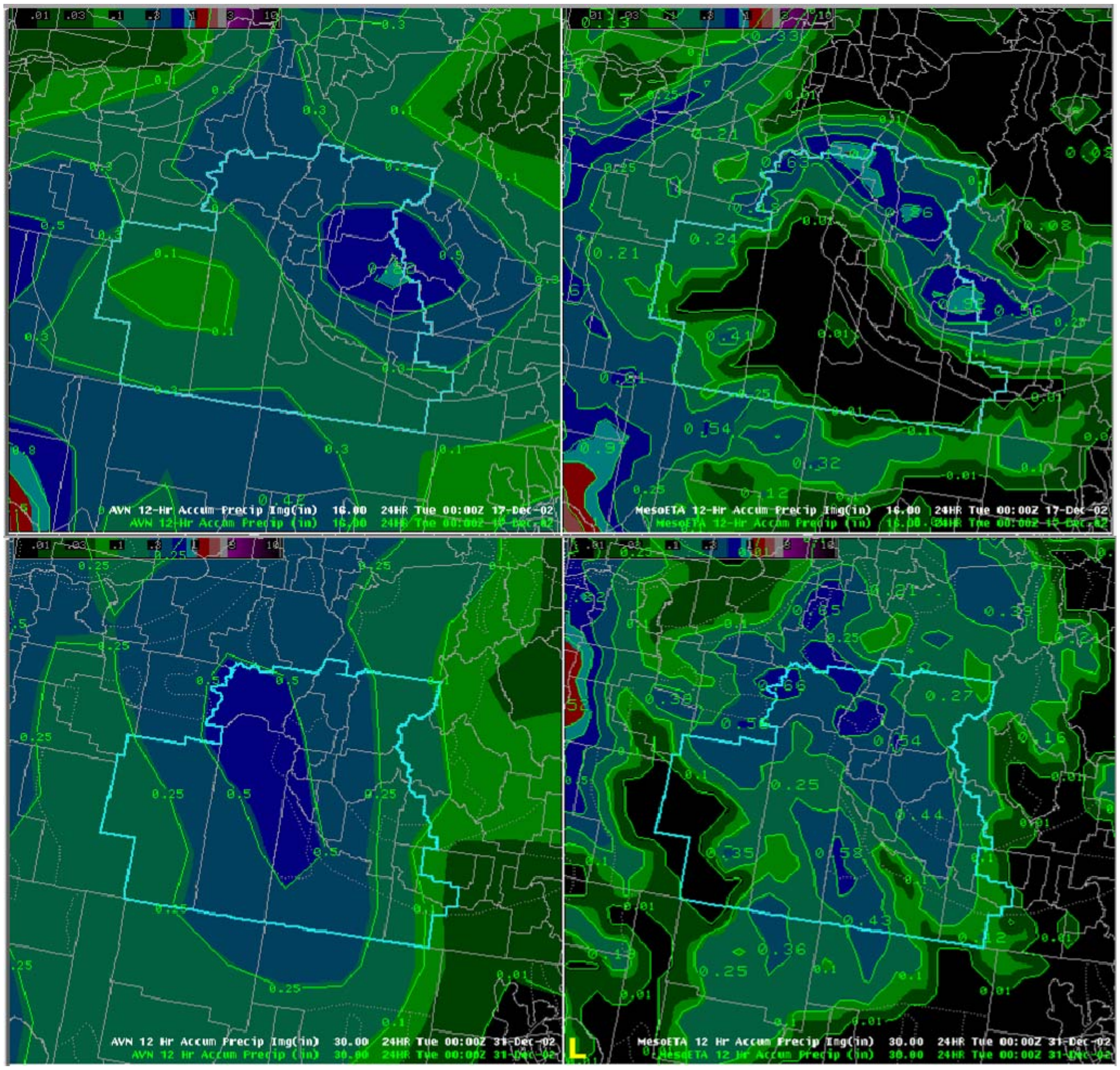
For the Dec 16th case, the area of warm advection has moved just to the northeast of the forecast area by the end of our forecast period, but it was stronger as it passed over the forecast area in the previous 12 hours. For the Dec 30th case, the large band of warm advection stretches from northwest to southeast directly across the forecast area.

In both cases, the models generate impressive vertical motion. Figure 3 shows the side-by-side GFS/Eta comparison of 700mb Omega for both these cases.



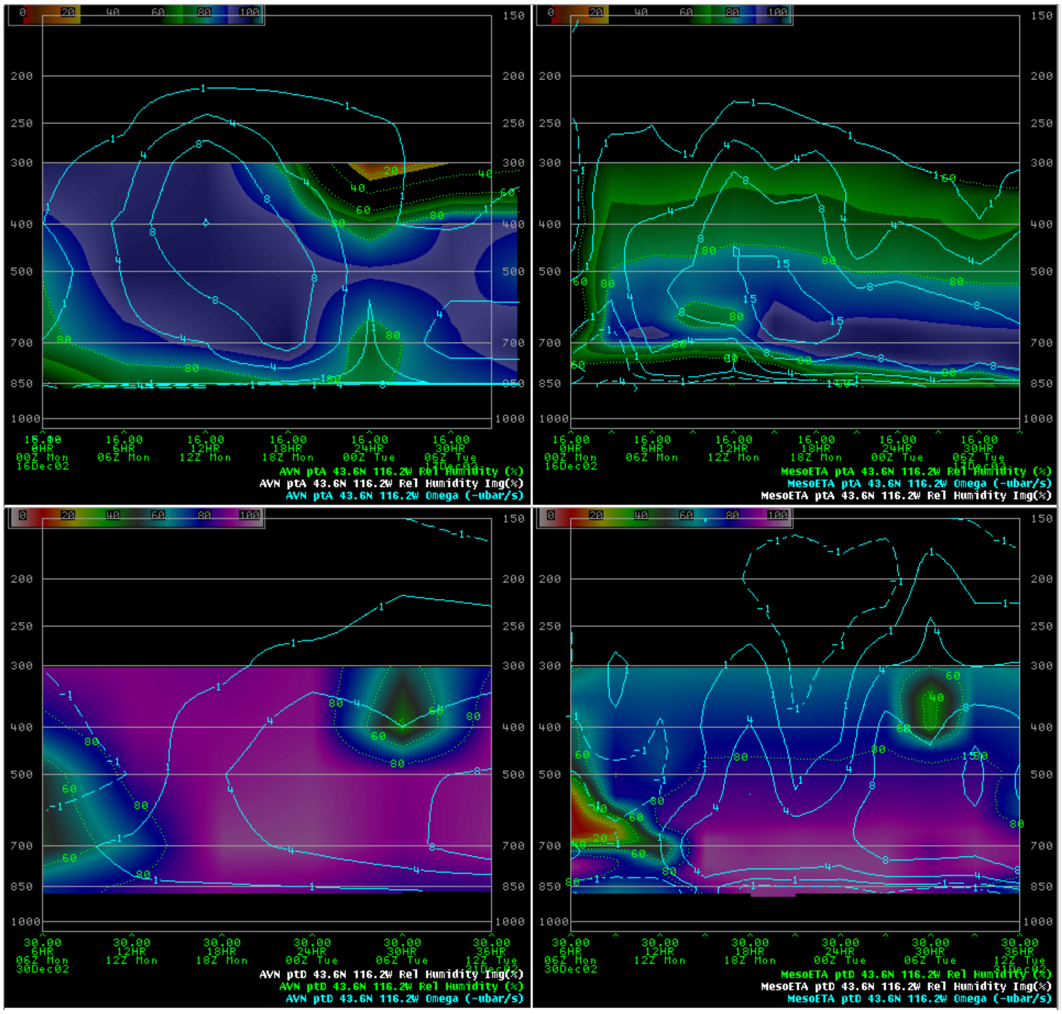
In both cases, a band of upward vertical motion (warm colors on the image) stretches from northwest to southeast across the forecast area, with the Eta forecast capturing more detailed structure (due to the higher grid resolution displayable in AWIPS). The vertical motion appears to be a bit more intense in the Dec. 16th case, but covering a bit broader area in the Dec. 30th case.

In figure 4, the side-by-side GFS/Eta 12-hour precipitation accumulation is shown for both cases.



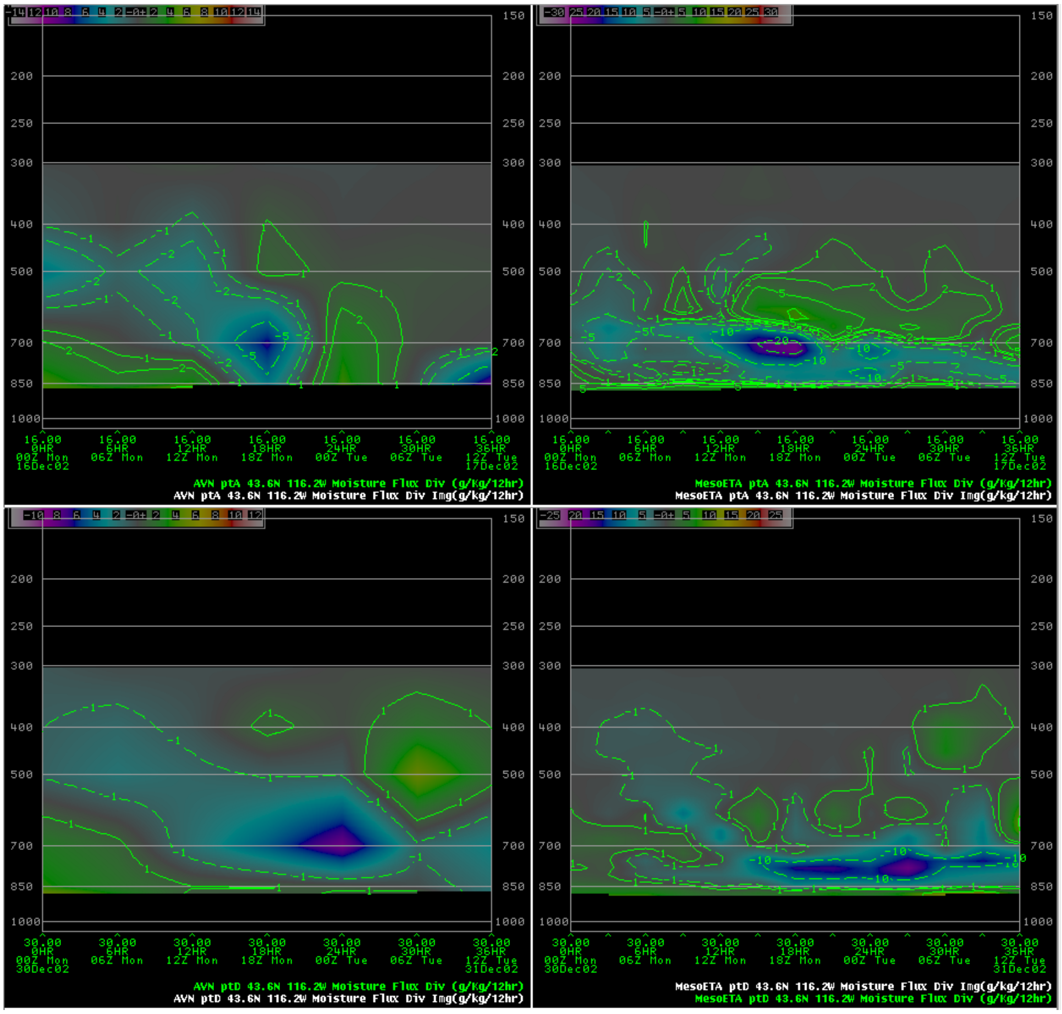
In both cases, the model is forecasting large areas of precipitation more than 0.3 with significant areas above 0.5 inch. Interestingly the Dec 16th case has higher precipitation amounts, but the area of precipitation is more focussed over the mountains over the northeast part of the forecast area, while the Dec 30th case has more widespread precipitation with locally higher amounts over all the mountainous areas.

Time height sections of Relative Humidity and Omega at Boise are shown in figure 5 from both the GFS and Eta. Boise is located in the valley in the center of the forecast area, southwest of the large area of mountains that covers the northeast part of the forecast area.



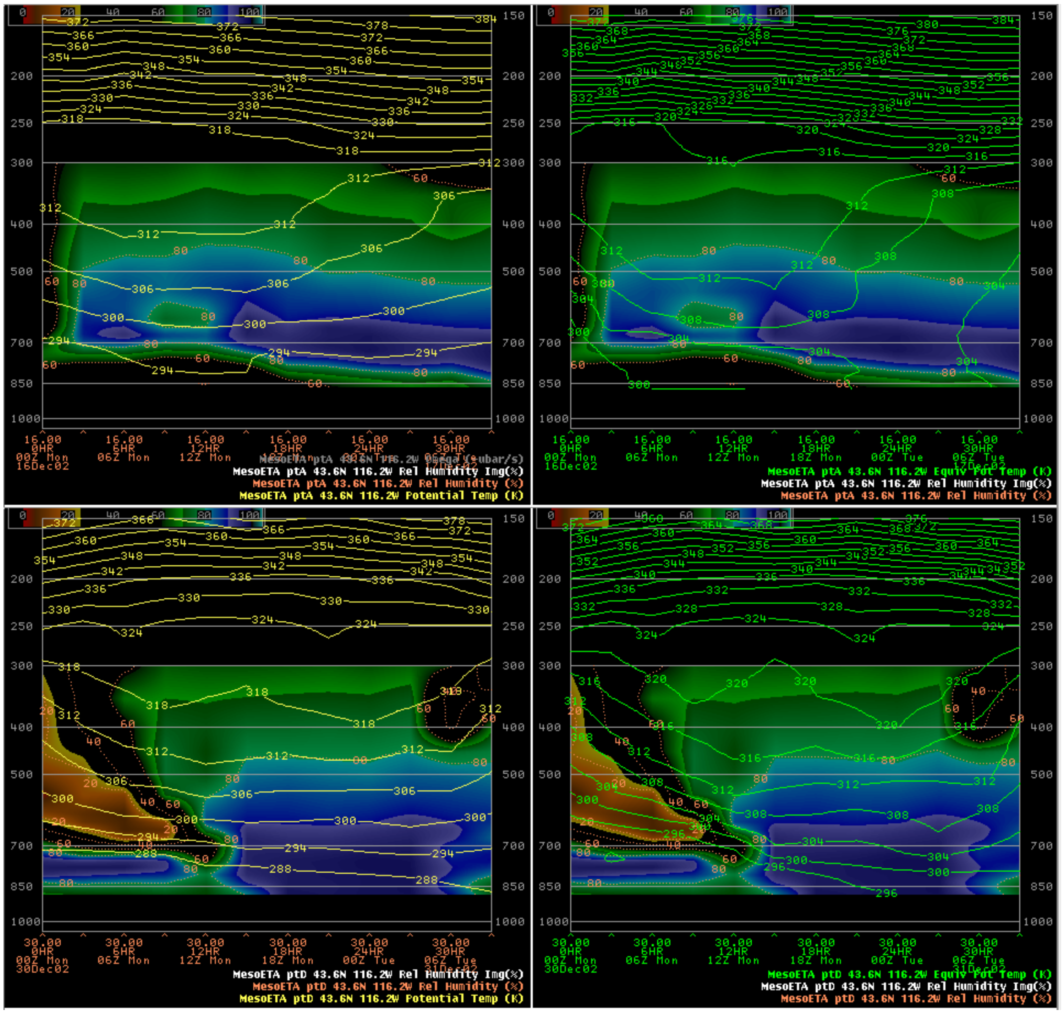
The airmass is nearly saturated in both cases, but the vertical motions are much stronger in the Dec. 16th case than the Dec 30th case. As expected, the finer resolution grid data of the Eta shows stronger vertical motion, with finer structures.

Figure 6 shows side-by-side GFS/Eta time-height sections of moisture convergence at Boise.



In both cases, areas of low-level moisture convergence are evident. In the Dec. 16th case, the moisture convergence is more focused in time (around 18Z on Dec 16th) and a little higher (centerred on 700mb), while in the Dec 30th case, the moisture convergence lasts much longer and is lower (centerred on 800mb).

Figure 7 shows Eta time-height sections of potential temperature (Theta) and equivalent potential temperature (Theta-e) at Boise (Note the GFS time-height images are not shown) Relative humidity is shown as an image in both panels.



Here there are large differences, with the Dec 16th case having much greater vertical spacing of theta and theta-e lines – indicating low static stability. In fact, there is some indication of theta-e decreasing with height between 18Z on Dec 16th and 00Z on Dec 17th, which would indicate the possibility of convective instability in the presence of lifting. On the other hand, the Dec. 30th case has much stronger stability – especially at low levels.

To summarize, these two cases are somewhat similar in that upper-level vorticity advection is weak, and low-level warm advection is occurring in both cases. The models predict similar amounts of precipitation in each case – with similar values of moisture convergence. However, in the case with low static stability, the model forecasts the precipitation to be more concentrated in the mountains, with little precipitation in the valleys – while the high static stability case has a broader area of precipitation.

Results:

For the Dec 16th case, Boise received only a Trace of precip during the 12-hour period ending at 00Z Dec. 17th. A few valley locations received over 0.25 inch, but precipitation amounts of 0.33 to 0.65 were common in the mountains northeast of Boise. Of much more interest were the winds generated by convection that developed during the morning of the 16th. Wind gusts to 39 knots were recorded at the Boise airport, with gusts to 64 miles per hour reported at other valley locations around Boise.

For the Dec 30th case, Boise received 0.24 inches of precip during the 12-hour period ending at 00Z Dec 31st. (another 0.50 fell during the evening hours after 00Z). Mountain sites received similar precipitation amounts of about 0.5 to 1.00 inches, which accumulated as 4 to 12 inches of snow.

Once again, this shows the significant influence stability has on the response of the atmosphere to forcing for vertical motion. The less-stable case had stronger vertical motions – but they were concentrated more along the mountains. Precipitation was not the main issue – but rather the winds associated with convection. On the other hand, in the more stable case, vertical motions were weaker, but they lasted longer and were located further away from the mountains. The precipitation was the main forecast issue, with large snow accumulations occurring across large areas of the forecast area.