Precipitation Estimates at Long Range
A Western Region WES TA-Lite

By

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A heavy precipitation case in eastern Baker County, Oregon occurred on the evening of June 3rd 2004. This area is closer to the Pendleton radar (KPDT), but is blocked at the lowest elevation angles by mountains north of Baker County. The Boise radar (KCBX) has a clear view in that direction – but due to several factors, the Pendleton radar precipitation estimates were more representative for this day.

The 00Z June 04, 2004 sounding at Boise showed only a moderate amount of moisture, with 0.66 inches of precipitable water:

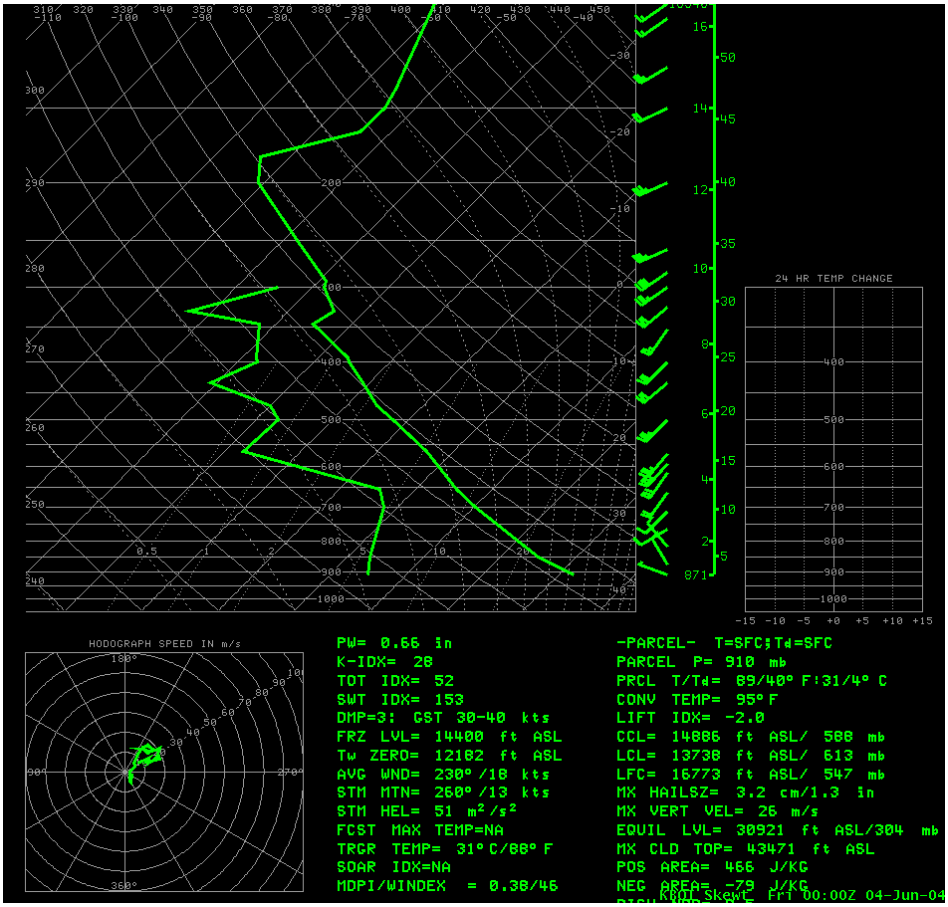

Fig 1. KBOI sounding at 00Z 04 June 2004

However, on GOES sounder satellite imagery, there is considerably more moisture evident earlier in the day near convective clouds developing over north central Oregon, with precipitable water values over one inch:

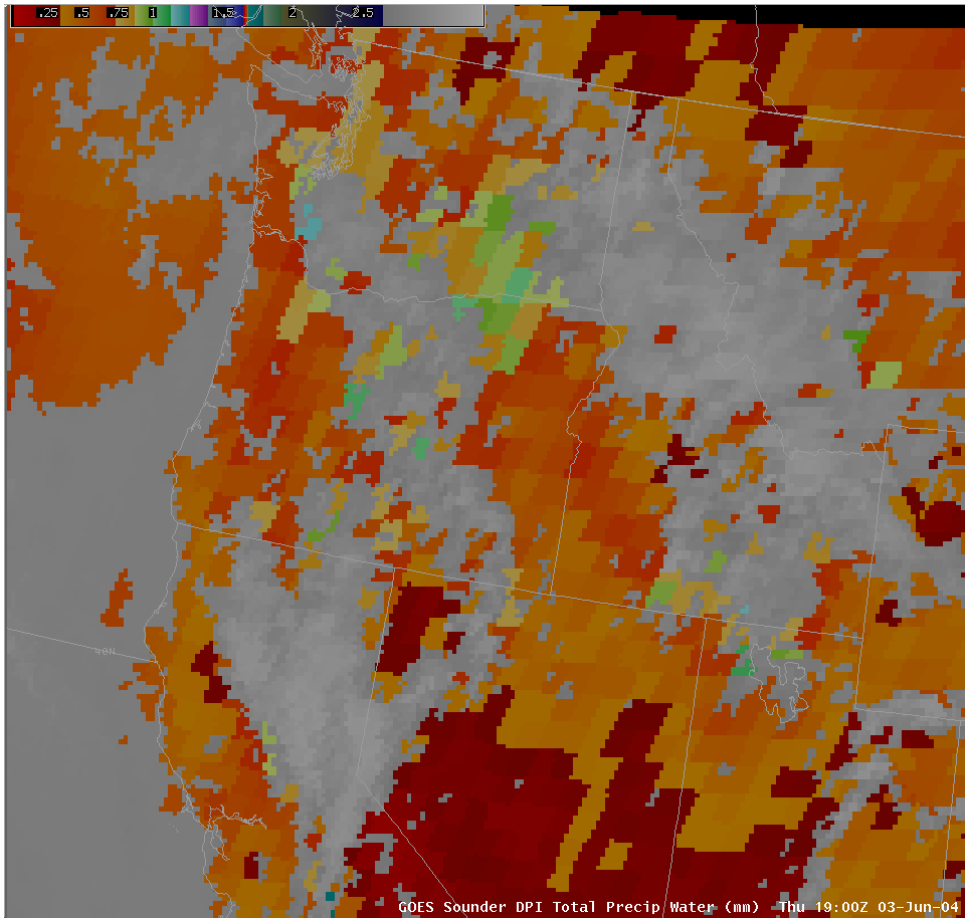

Fig 2. GOES sounder precipitable water image at 19 Z 03 June 2004

These storms continued to develop and move eastward across Baker County Oregon, with several convective cells passing over the same areas in western Baker County over and over.

An Eta model BUFR soundings at 00Z 04 June 2004, showed a very good analysis of the moisture structure over Boise. The freezing level is 14,600 feet versus the 14,400 feet observed on the actual sounding. In addition, the model has a precipitable water value of 0.69 versus the 0.66 observed on the actual sounding:

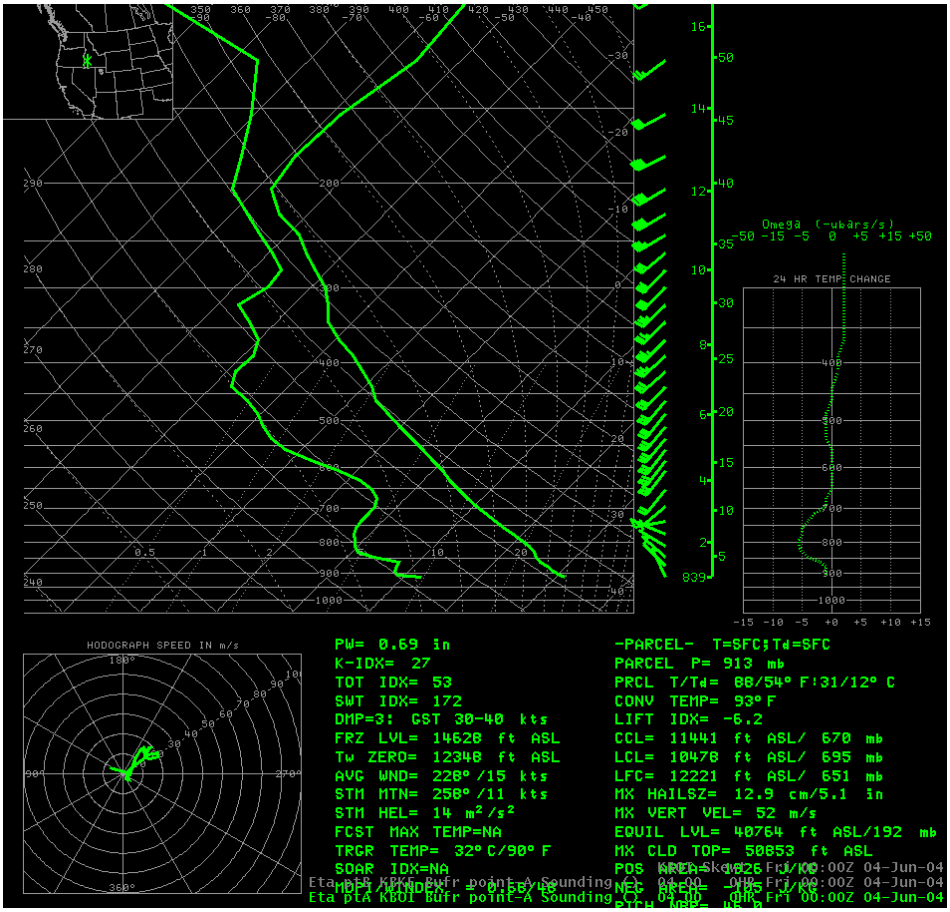

Fig 3. Eta BUFR sounding for KBOI at 00Z 04 June 2004.

The model also has a good handle on the different amount of moisture available in Baker County than over the Boise area. The Eta BUFR sounding over Baker at the same time showed a freezing level of nearly 13000 feet and a precipitable water value of 0.82:

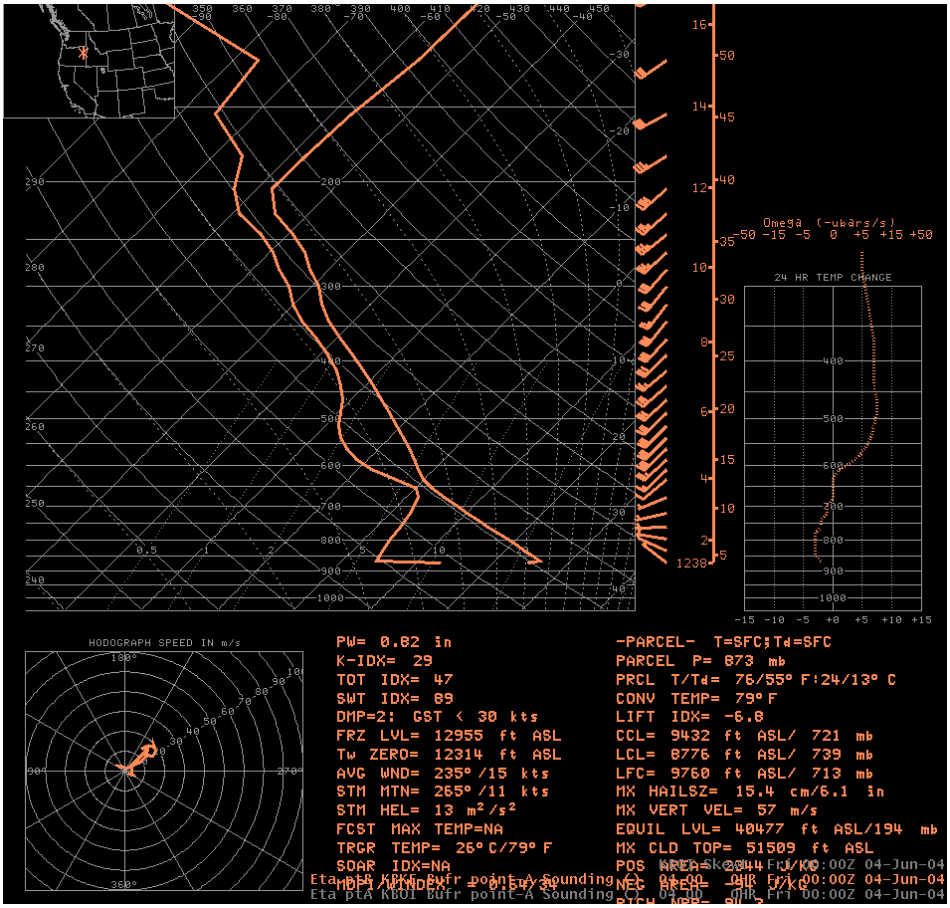

Fig 3. Eta BUFR sounding for KBKE at 00Z 04 June 2004

When both Eta BUFR soundings are overlaid, the differences in moisture are quite obvious. The Baker sounding has much more moisture available in the mid-levels, and is slightly cooler and more unstable. The most moisture is found just slightly below the freezing level, at about 12000 feet.:

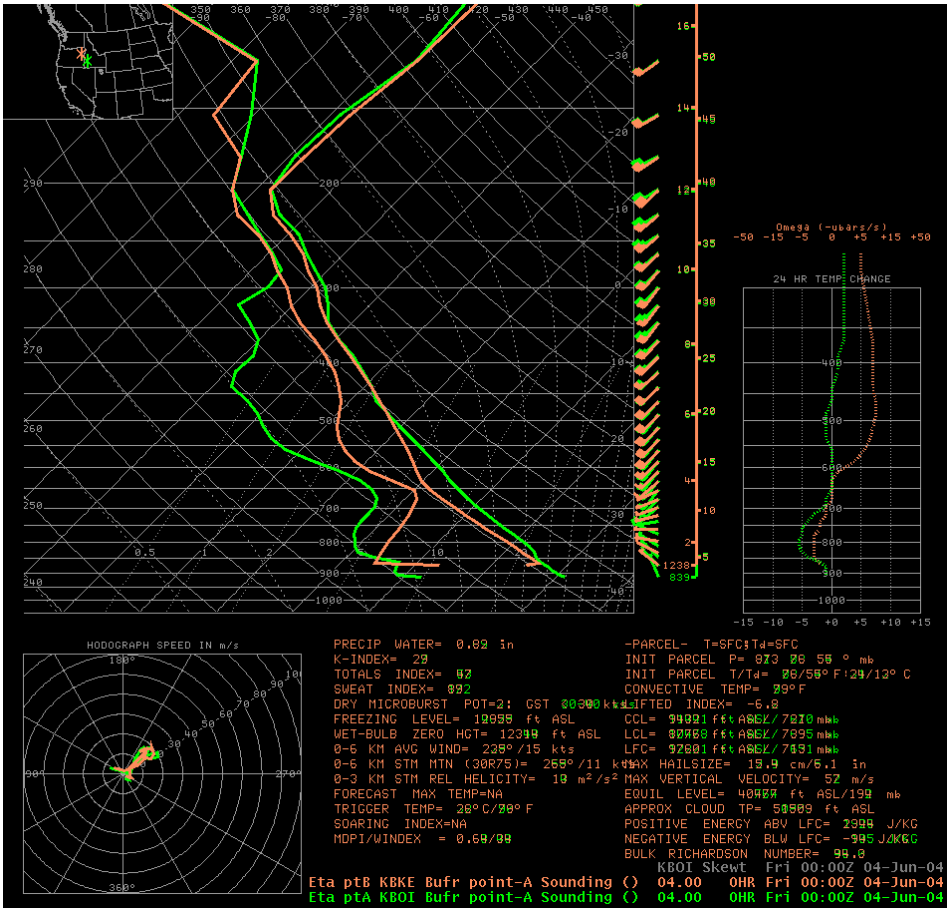

Fig 4. Eta BUFR sounding for KBOI and KBKE at 00Z 04 June 2004

With this difference in moisture in mind, forecasters should be worried about the potential heavy rain with the convective storms over Baker County, especially in areas where several storms have passed over the same area.

The Storm Total Precipitation product from the Boise radar (KCBX) show some huge precipitations totals of 3 to 4 inches just north of Sumpter, Oregon:

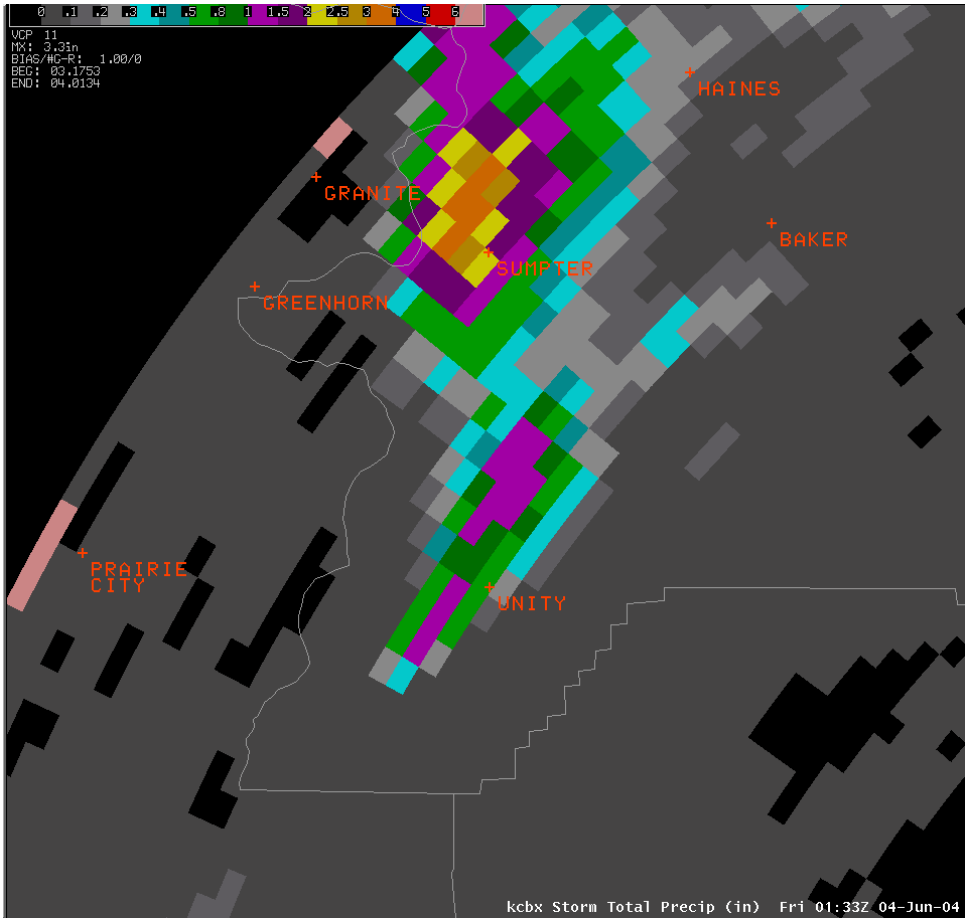

Fig 5. KCBX Storm Total Precip product at 0132Z 00Z 04 June 2004

However, forecasters need to be aware that this storm is very far from the KCBX radar. Though not blocked by topography, the lowest elevation angle from the KCBX radar is over 17,000 feet over Sumpter. In this case, where the freezing level is around 13,000 feet and lots of moisture is available below and near the freezing level, it is likely that the lowest elevation angle radar data is hitting hail in the upper parts of the storm. The radar precipitation processing algorithms assume that this reflectivity data from over 17,000 feet is what is valid near the surface. In this case, where the model soundings indicate drier air below the cloud base, it is likely that the hail is melting or sublimating below cloud base.

The Blue Mountains just north of western Baker County typically block the lowest angle of the Pendleton radar (KPDT). Mountain elevations in the Blue Mountains reach nearly 9000 feet, with the theoretical height of the lowest elevation angle over Sumpter of only 7000 feet.

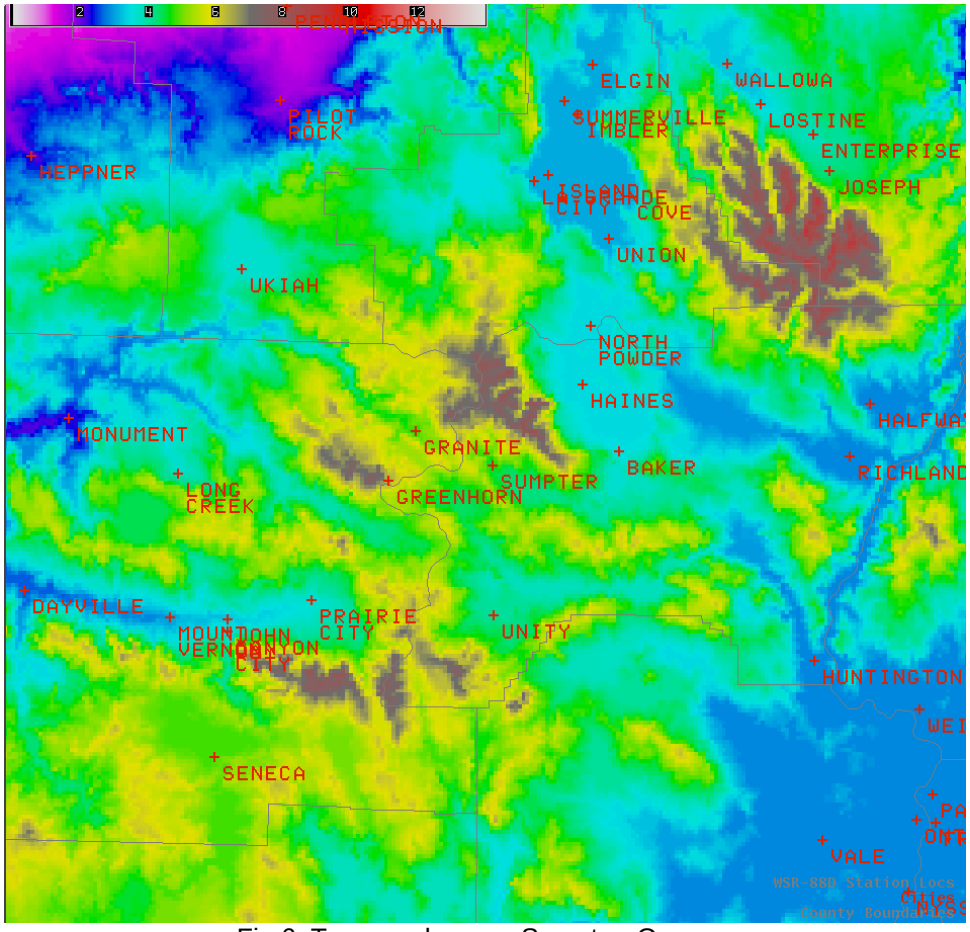

Fig 6. Topography near Sumpter, Oregon.

However, the 1.5 degree elevation angle from the KPDT radar is about 13,000 feet over Sumpter, easily clearing the Blue Mountains. While this is still very high, and likely contaminated by hail, it is lower than the data from lowest elevation angle from the Boise radar. Indeed, the storm total precipitation estimates from the KPDT radar at nearly the same time are much less, around 2 to 2.5 inches in the area around Sumpter:

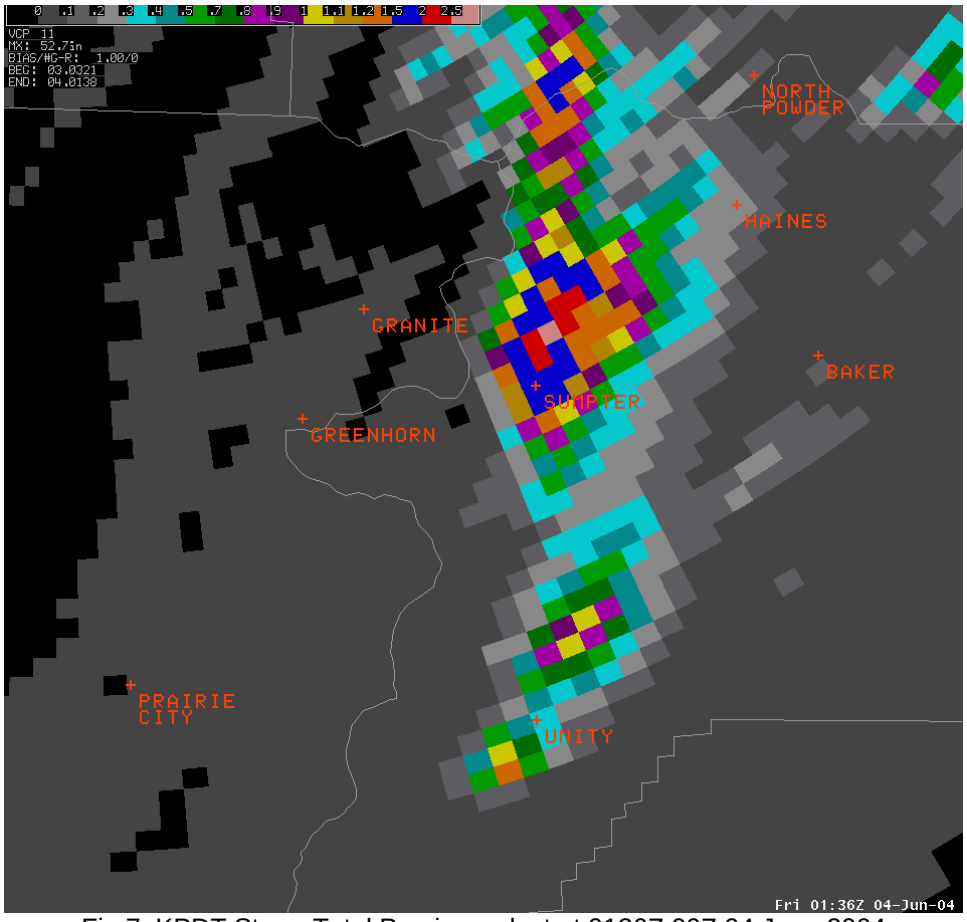

Fig 7. KPDT Storm Total Precip product at 0136Z 00Z 04 June 2004

Spotter reports from near Sumpter at 0130Z said that nearly 2 inches of rain had fallen in the past couple of hours.

Conclusion

This case shows that even though terrain blockage may reduce the effectiveness of precipitation estimates from a neighboring radar, sometimes data from a more distant radar is reaching upper parts of the storm and contaminated by hail. Thus, forecasters must carefully consider beam geometry and vertical temperature and moisture structure to decide if precipitation estimates are accurate. In areas where estimates from two radars are available, careful consideration can also help forecasters decide which estimate is more accurate in different situations and different areas.