# August 29th, 2007 Supercell Event over Northwest California

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**ABSTRACT**

A supercell thunderstorm occurred over Trinity County in northwest California during the afternoon of August 29, 2007. Supercells are a rare event over northwest California, and this particular supercell was weak compared to Great Plains storms. However, these events do occur and forecasters at the Eureka, CA WFO (EKA) must be aware of the environmental parameters that are favorable for the formation of supercells in this region, in addition to the possibility of severe weather. Based on Doppler radar data, EKA issued a severe thunderstorm warning for west- central Trinity County at 2223 UTC. Small hail, heavy rainfall, and brief gusty winds were forecast to occur with this slow-moving cell.

## Synoptic Situation

A broad upper level high pressure ridge was building over the Great Basin during the day of 29Aug07. As a result, 850 – 500mb winds were generally out of the south across most of California and the eastern Pacific. At the surface, a thermal trough was deepening over northeastern California and southern Oregon with high pressure to the west of the EKA coastal waters. This resulted in onshore flow along the coast turning to a more southerly fetch inland. As a result of clear skies and abundant daytime insolation, interior high temperatures were forecast to be near 100° F and coastal high temperatures were expected to be in the lower 70s. Convective mid-level moisture was present over the Sacramento Valley in the morning and was moving to the north-northwest toward the Trinity Alps and Yolla Bolly Mountains. This trajectory is especially favorable for development of convection over this area as the moist air mass is forced upslope as it approaches the high terrain of the California coastal mountain ranges.

## Forecast

Both NAM and RUC models forecasted a weak upper level short wave moving over northern California by late afternoon of 29Aug07. NAM12 vorticity associated with the short wave can be seen in Fig. 1. CAPE and LI forecasts from the NAM (Figs. 2 and 3) show an unstable environment preceding the event. LI's of about -6° C were forecast over the area. Even after adjusting for the known negative model bias in LI during unstable conditions, an unstable environment favorable for convection was depicted. NAM also forecasted CAPE of near 2200 J/kg over the Trinity Alps during the afternoon hours.

Water vapor imagery from the afternoon showed a plume of mid-level moisture moving north over the area with a coupled dry intrusion situated just south of the EKA county warning area (CWA) (see Fig. 4 taken at 2000 UTC). With the northward trajectory of the shortwave, this dry slot was forecast to be over the area by late in the afternoon with the potential to further destabilize the atmosphere.

The 1200 UTC sounding from KMFR (Fig. 5) shows steep lapse rates above the low level inversion (from sfc to 850 mb) giving a general idea that the elevated environment in northern California was unstable. The KMFR sounding also shows reasonable shear in the low levels, with an easterly component to the wind at the surface and southwesterly flow aloft. This sounding indicates there was a relatively moist layer between 600 and 700 millibars, with dry air prevalent to the surface. Precipitable water measurements were near an inch, indicating that there was indeed some moisture in the pre-storm environment.

Looking at severe weather parameters from KMFR, the Bulk Richardson Number of 20.0 indicates there was a potential for supercells to occur. A storm relative helicity of $44 m^2/s^2$ is below tornado potential, but within the realm of supercells. The SWEAT and Total Totals indices were not indicative of a threat for severe thunderstorms. Therefore the overall consensus of severe weather parameters indicated a marginal threat for severe weather, with hail and wind being the greatest threat.

# Observations

Visible satellite imagery from the morning and early afternoon of 29Aug07 showed altocumulus castellanus (ACCAS) clouds from the previous day's convection moving west-northwest into the EKA CWA (not shown). This was a clear indication that moist, easterly flow from the central valley was in place prior to storm initiation. This flow pattern is climatologically favorable for the formation of severe convection in the Trinity Alps and Yolla Bolly Mountains.

The first towering cumulus (TCU) formed in the Yolla Bolly Mountains in southeast Trinity County around 1900 UTC. By 2000 UTC, visible imagery showed widespread TCU throughout Trinity and northeast Mendocino Counties. The first echoes for the storm of interest could be seen on base reflectivity from KBHX WSR-88D radar at 2204 UTC forming on the ridges near Hayfork Bally. These echoes rapidly intensified to 62 dBZ by 2216 UTC with composite reflectivity showing a similar transformation during this time period (Fig. 6). The storm remained quasi-stationary as the upslope flow continually generated the updraft over the ridge top. The severe thunderstorm warning was issued at 2223 UTC as the environment seemed favorable for marginally severe hail.

8-bit SRM velocity data indicated broad rotation in the storm, starting at about 2222 UTC (Fig. 7). The rotation was persistent, lasting throughout the storm's lifetime (shown again in Fig. 8). Although the rotation was weak, the length of time which the storm exhibited rotation likely allowed enough time for hail growth. Storm top divergence was also evident in the upper tilts of the SRM velocity data, in particular at 6.0° (not shown) indicative of a strong to severe thunderstorm.

Visible satellite imagery taken at 2315 UTC showed the growing thunderstorm over Hayfork Bally displaying characteristics of a rapidly intensifying storm with a well defined anvil structure and an overshooting dome (Fig. 9). Infrared satellite imagery at this time showed cloud-top temperatures near -42° C in the overshooting dome (Fig. 10). At 2319 UTC, a 65 to 70 dBZ core (Fig. 11) was seen on composite reflectivity over the Hayfork Creek Valley just southwest of Hayfork Bally Mountain. Vertically integrated liquid (VIL) water content during this time showed values of 45 to 50 $kg/m^2$, and the Layer 2 Maximum Reflectivity (layer is between 24-33 kft) product showed >57 dBZ from 2307 UTC through 2319 UTC in the general hail growth region of the storm suggesting a potential for marginally severe hail (Fig. 12).

Also at 2319 UTC, a weak BWER could be seen at the 4.3° elevation slice (Fig. 13). Although there were no strong reflectivities to cap this BWER at 6.0°, there was a difference of up to 8000 ft between the two levels, and it is possible that the radar beam did not sample the overlying reflectivities at the storm top very well. The BWER is a clear signal that the storm had a strong updraft at that time.

Subsequent radar images showed an apparent collapse in reflectivity in the upper elevations and by 2330 UTC an increase to 62 dBZ reflectivity at 0.5° was evident. The storm began to dissipate rapidly after this time.

Spotters in the Hayfork Bally Lookout reported pea-sized hail, gusty winds, and cloud-to-ground lightning with the storm between 2200 UTC and 2230 UTC. Other spotters in the region reported light rain, dark clouds with a flat base near the updraft, and lightning from 2200 UTC through 0000 UTC.

## Conclusion

Based on these observations it is concluded that a weak supercell impacted the Hayfork Creek Valley just east of Hyampon. Cloud-to-ground lightning, gusty winds, heavy rainfall, and small hail were observed and reported in the vicinity of where the severe thunderstorm warning was in effect. No severe weather was officially reported with this storm, but this is likely due to a lack of observers in the sparsely populated upper elevations of Trinity County where the significant weather occurred. Though there were no ground based reports of severe hail, observations of both radar and satellite imagery support the notion that marginally severe hail fell in this region.

# Figures

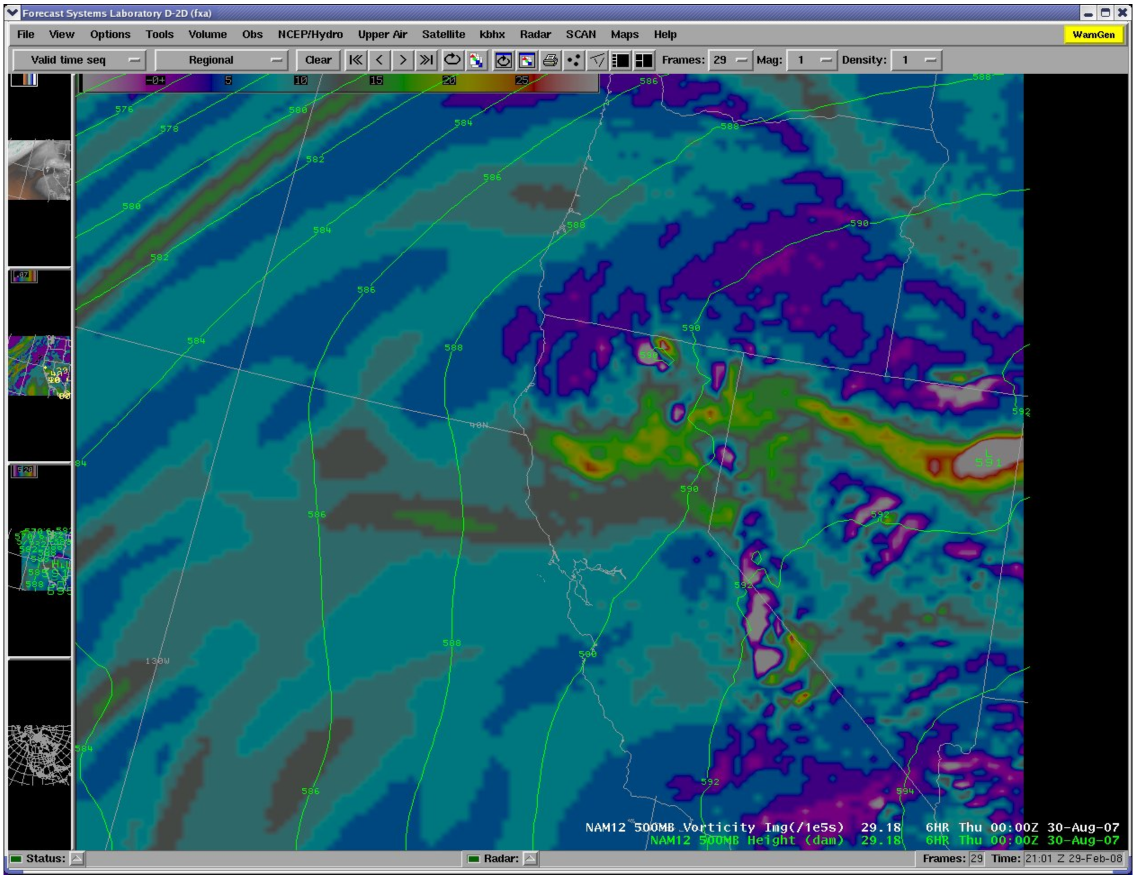


**Figure 1 NAM12 Vorticity forecast for 00 UTC on 30Aug07.**

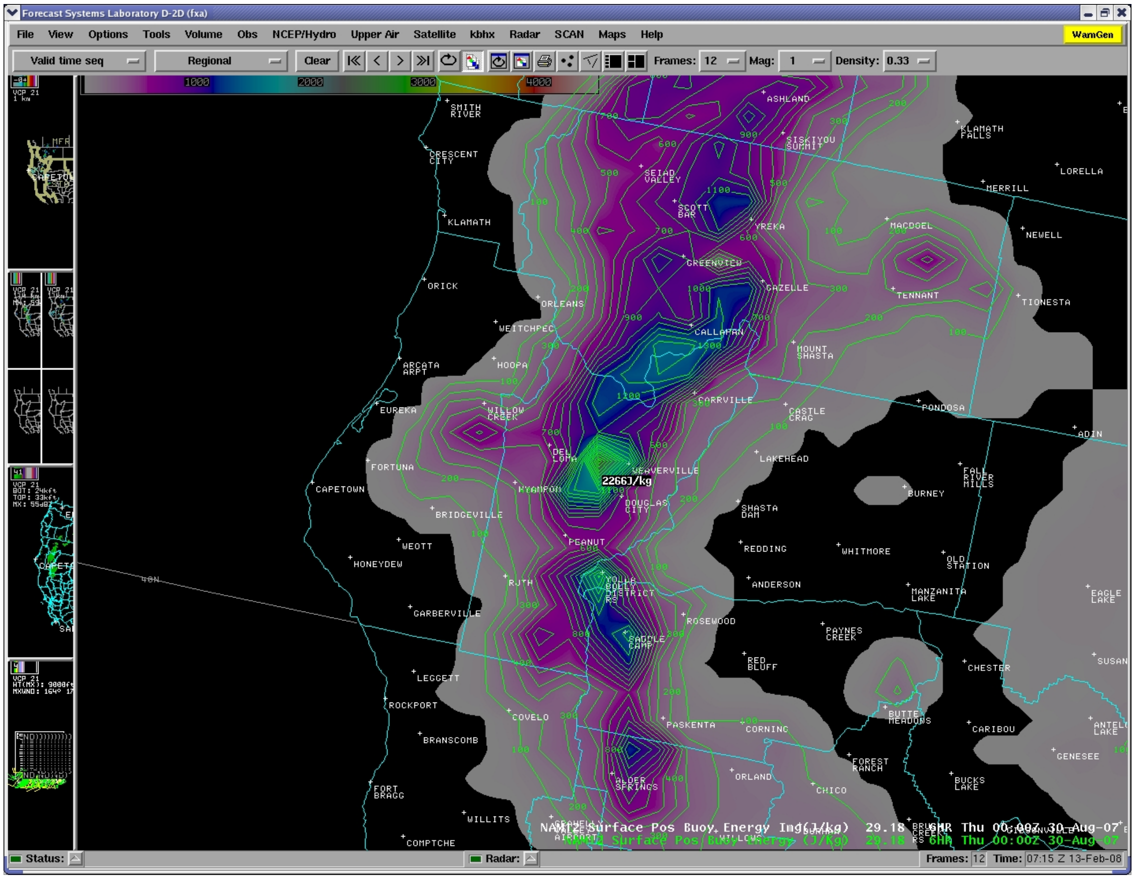


**Figure 2. NAM12 Cape (J/kg) forecast for 0000 UTC on 30Aug07.**

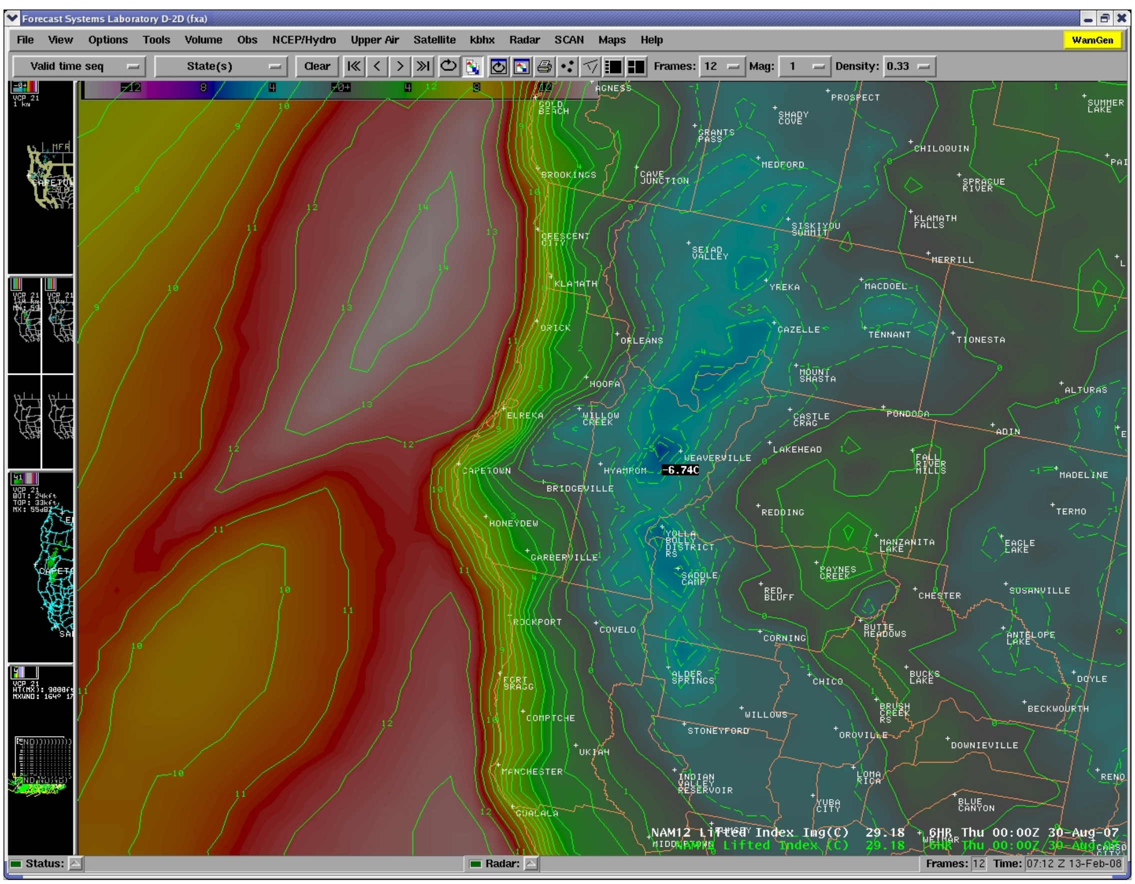


**Figure 3. NAM12 LI (ºC) forecast for 0000 UTC on 30Aug07.**

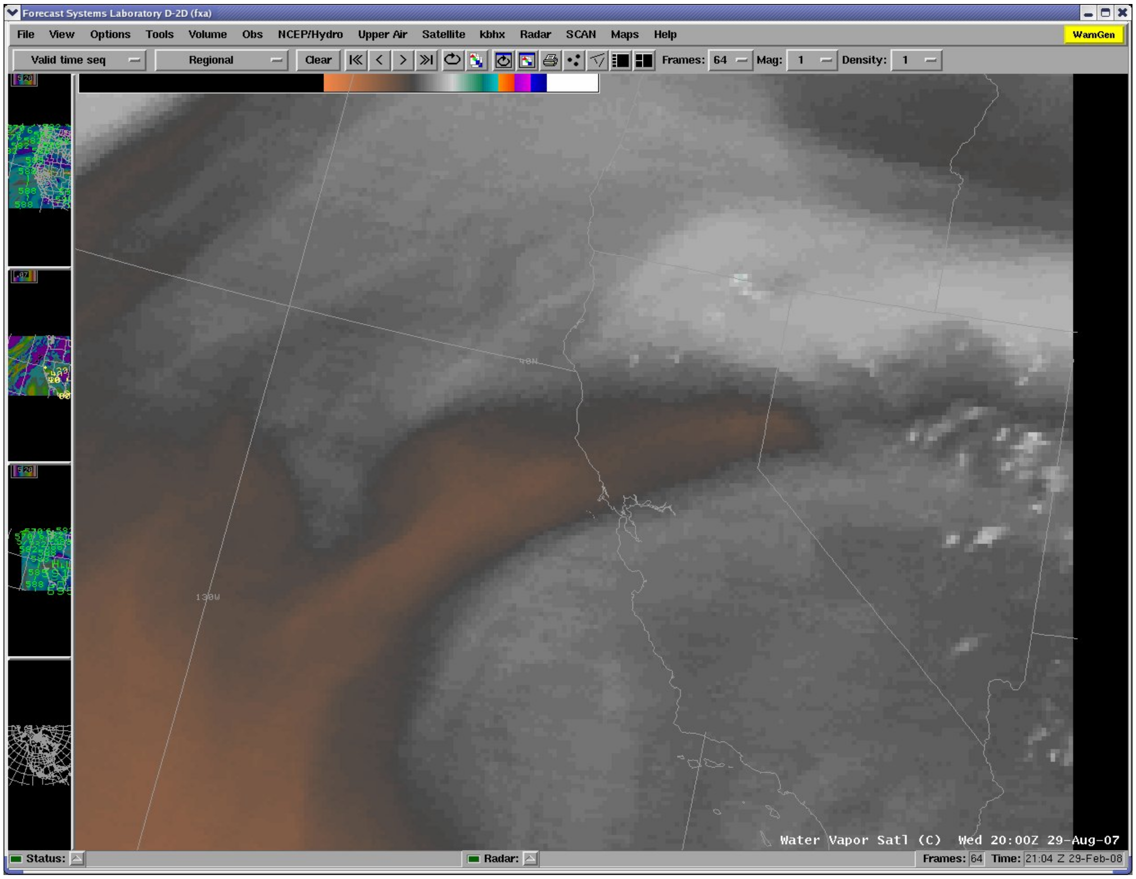


**Figure 4. Water vapor imagery at 2000 UTC on 29Aug07.**

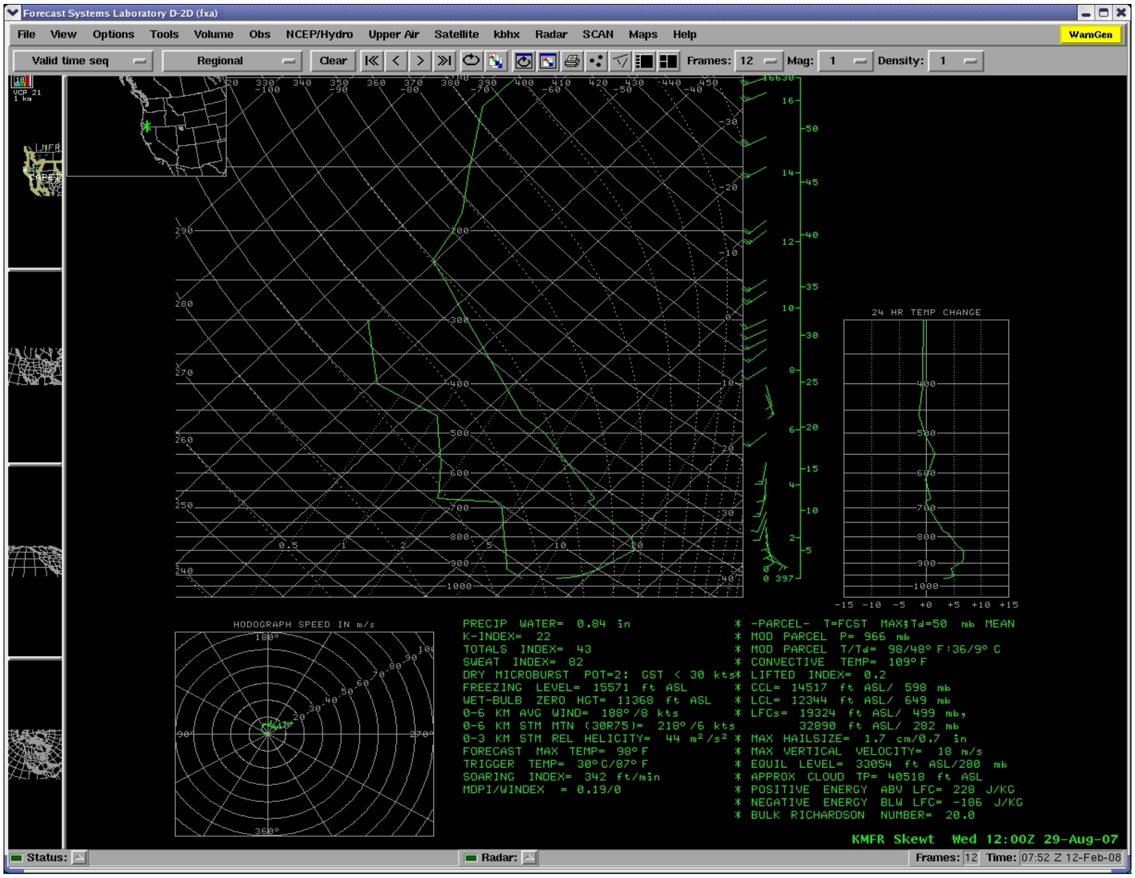


**Figure 5. KMFR RAOB at 12 UTC on 29Aug07.**

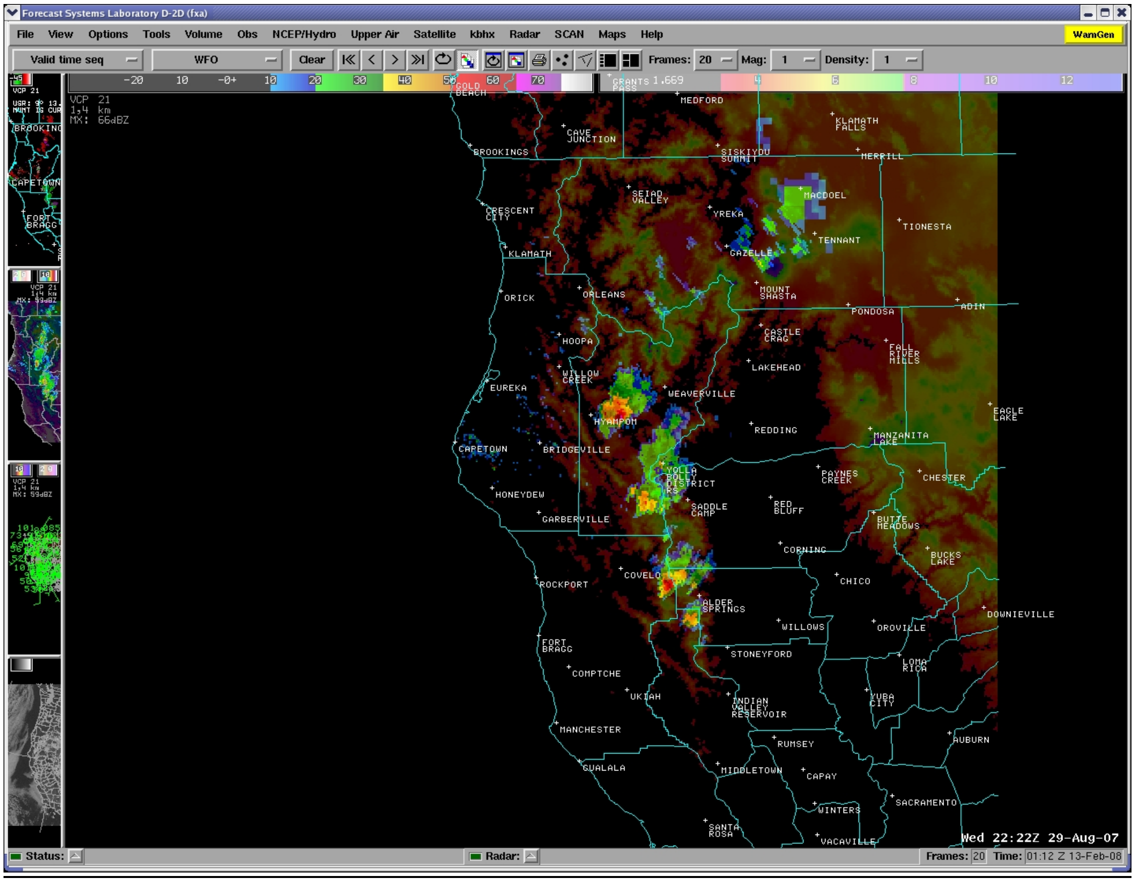

**Figure 6. KBHX Composite Reflectivity superimposed on terrain > 3 kft at 2222 UTC on 29Aug07.**

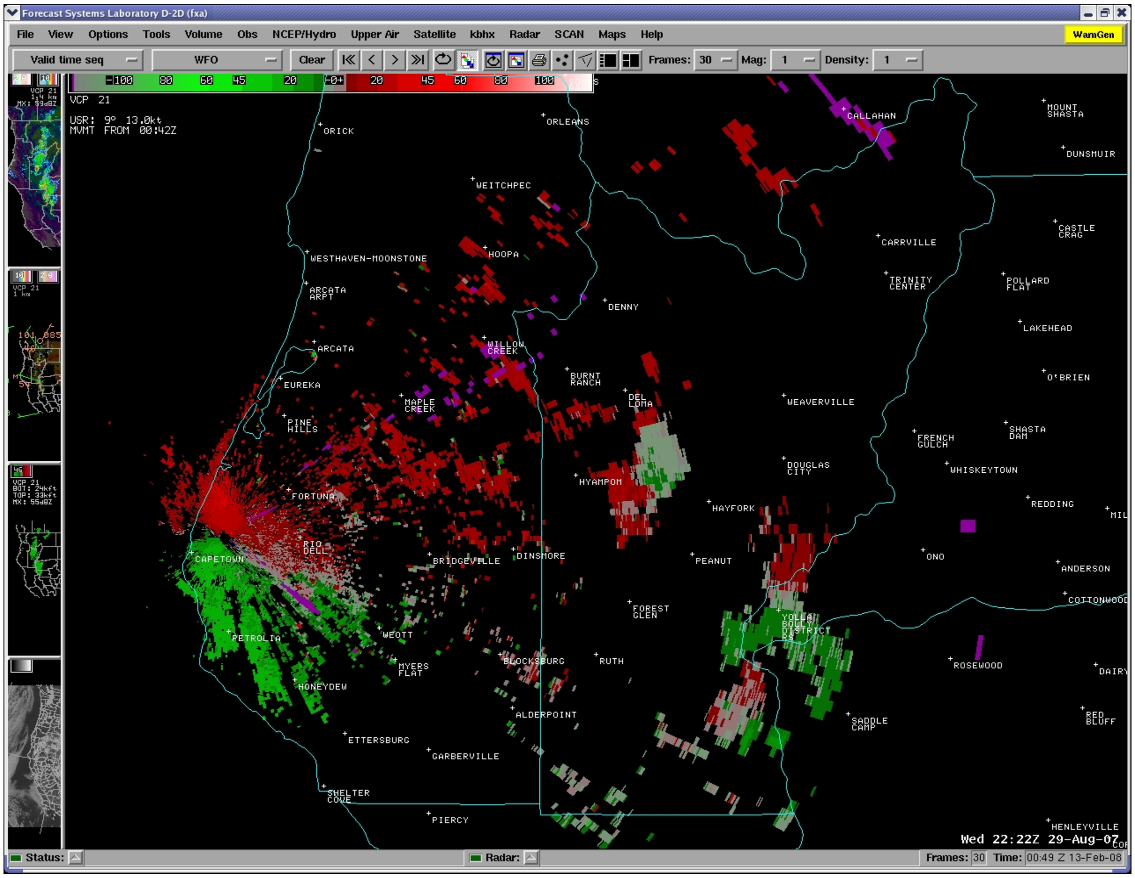

**Figure 7. KBHX SRM8 Velocity at 2222 UTC on 29Aug07.**

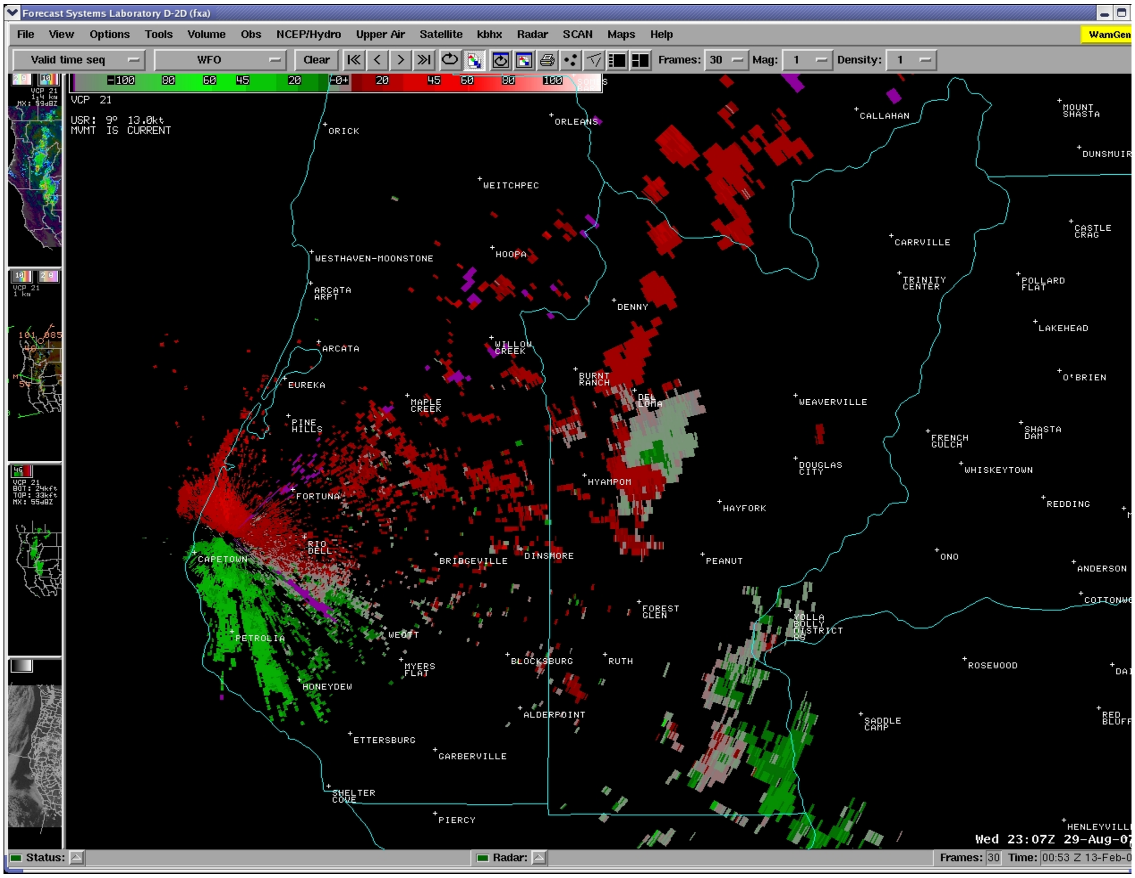


**Figure 8. KBHX SRM8 Velocity at 2307 UTC on 29Aug07.**

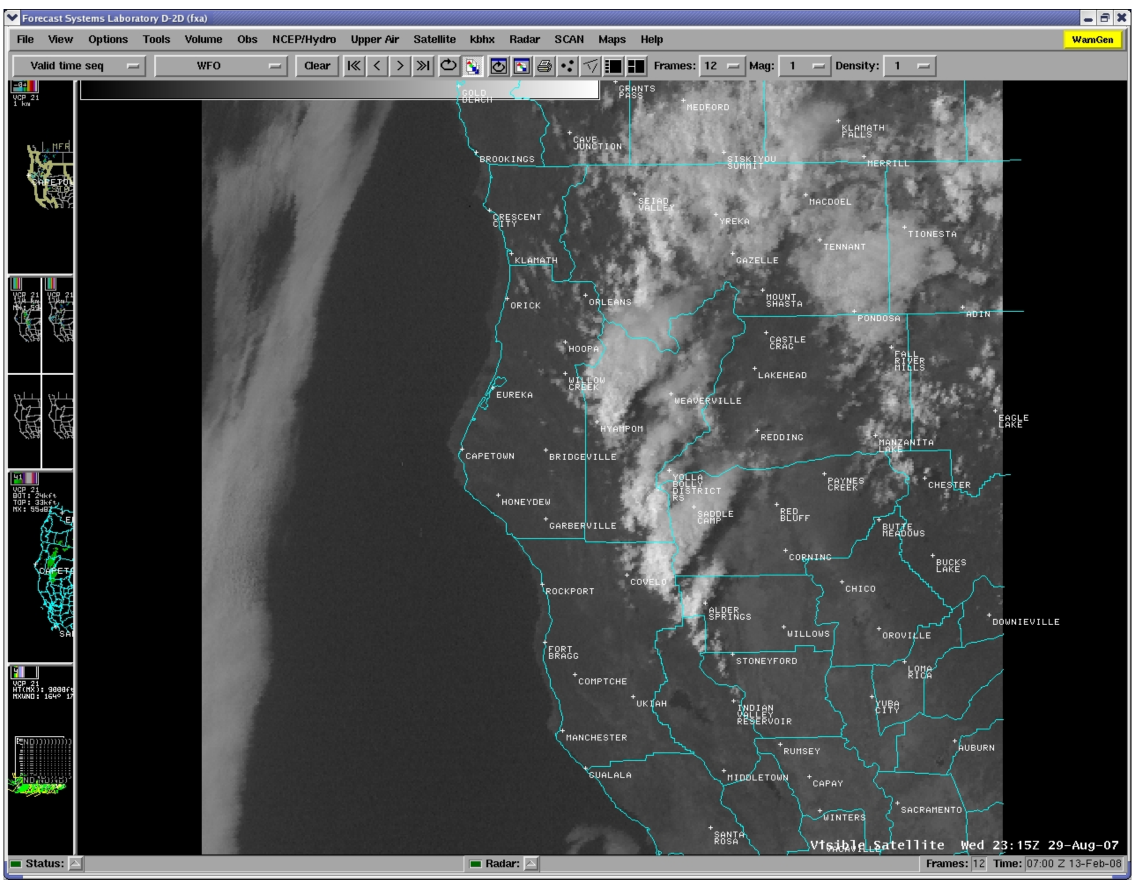


**Figure 9. GOES-10 Visible Satellite at 2315 UTC on 29Aug07.**

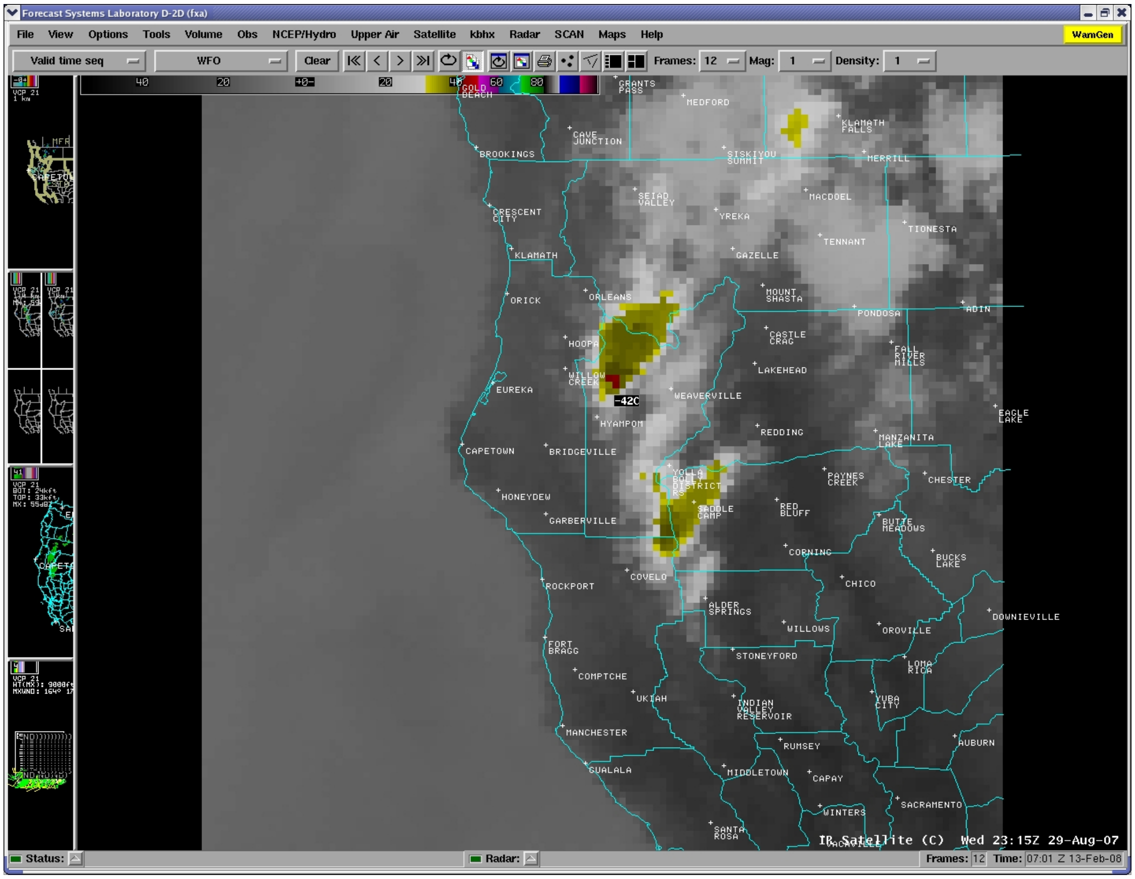


**Figure 10. GOES-10 Infrared Satellite at 2315 UTC on 29Aug07.**

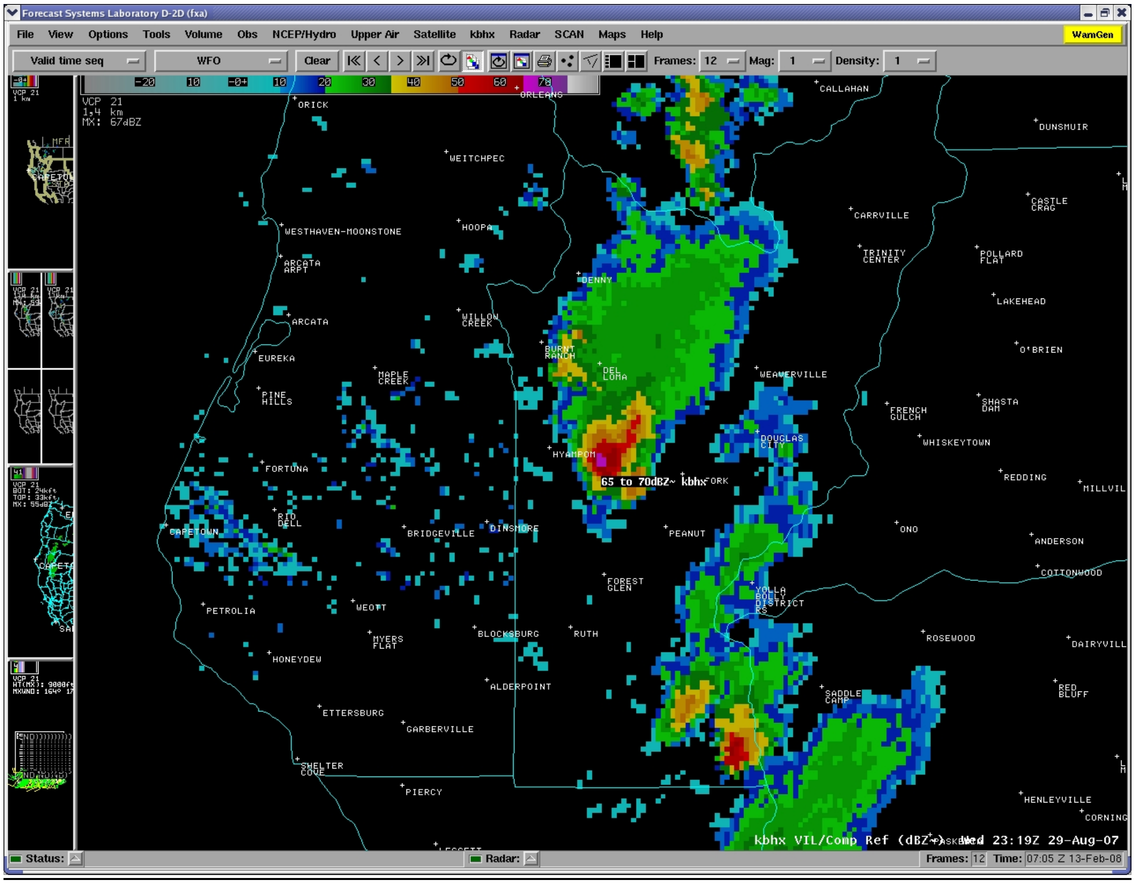


**Figure 11. KBHX Vertically Integrated Liquid at 2319 UTC on 29Aug07.**

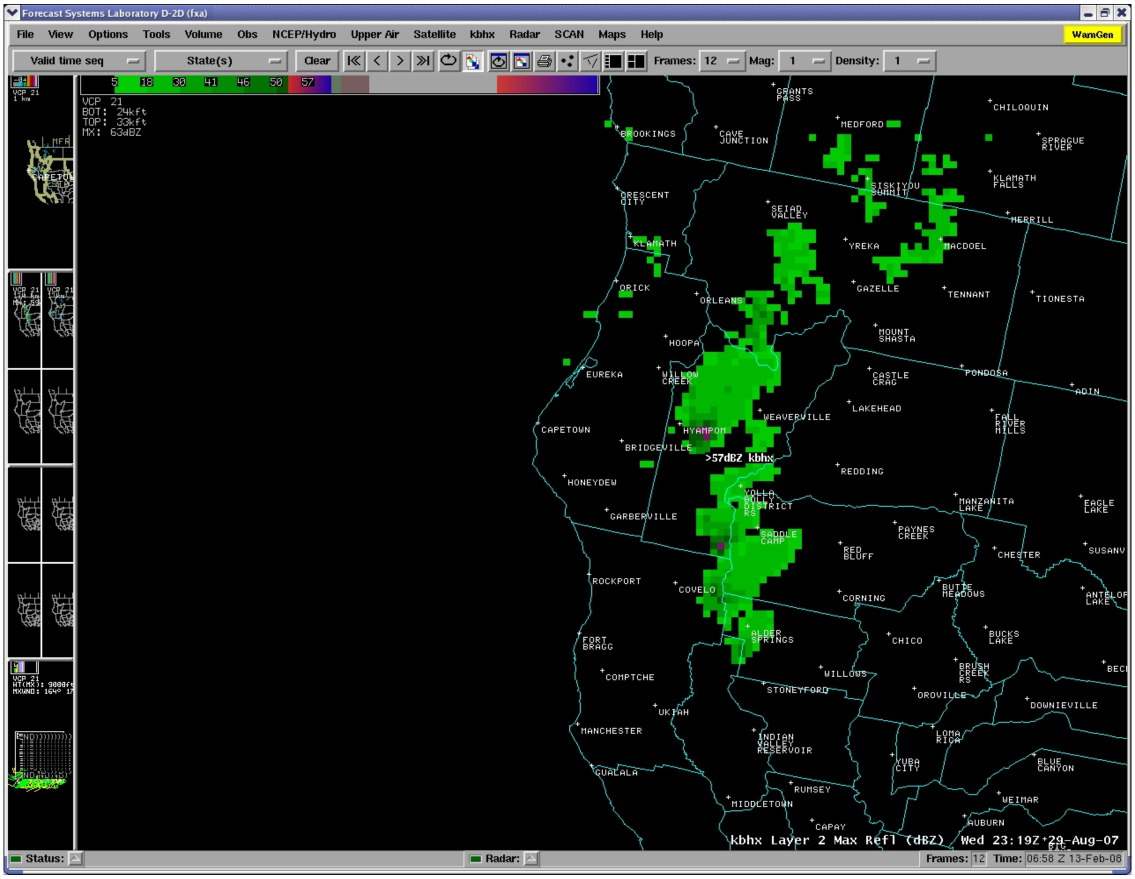


**Figure 12. KBHX Layer 2 Maximum Reflectivity at 2319 UTC on 29Aug07.**

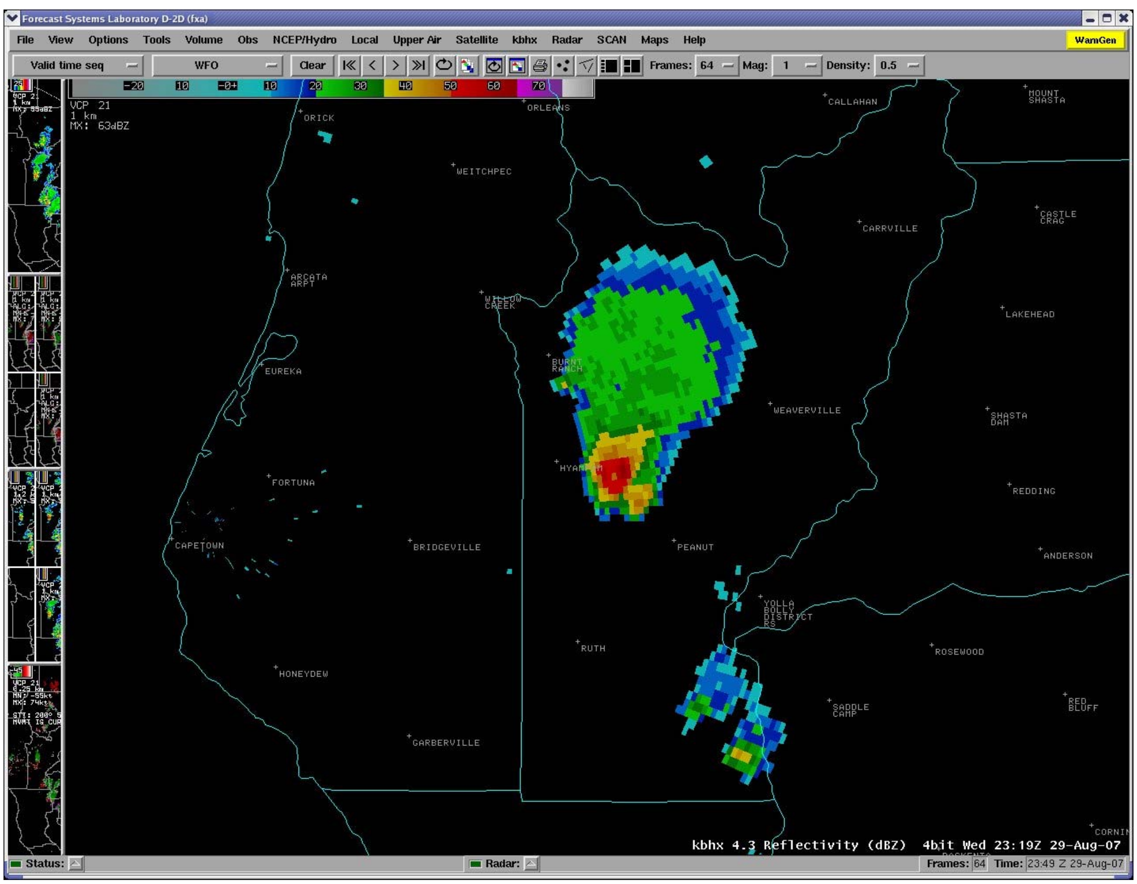


**Figure 13. KBHX 4.3º Base Reflectivity at 2319 UTC on 29Aug07 with BWER.**