

HMT-West 2008
Summary of IOP 4
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IOP4 Start 3 Jan 21UTC
IOP4 End 7 Jan 12UTC

Non-autonomous Instrument Operations Summary:

- ESRL HYDROX Radar began operations 3Jan/22UTC and shut down 4Jan/21UTC. The forecast for a heavy rain event with freezing levels 6000-7000ft descending to 3000ft after frontal passage. Rain began at 3Jan/23UTC and continued into the afternoon of 4Jan. At 4/21UTC winds were gusting to 63kts at BLU and the radar dish became uncontrollable. A decision was made to lock down the radar and abandon the site, owing to both observations becoming impossible and impending heavy snow. The radar crew noted a transition from rain to sleet as they were departing at 4Jan/2230UTC. Product flow was intermittent owing to power outages through the 4th.
- Slough House sondes and special RAOBS from OAK and RNO began at 3Jan/20UTC at four-hour intervals. Power failure most likely due to high winds at SHS eliminated launches 4 Jan 18-23UTC missing the 20UTC launch and delayed the launch at 5 Jan/00UTC

Autonomous Instrument Operations Summary:

- Chico surface and profiler site went down 4 Jan 15UTC owing to power outage related to high wind. Was down for the duration of IOP4
- Cazadero went out 4 Jan 11UTC, came back up 5 Jan 00UTC to 6 Jan 10UTC then went out as battery backup ran out.
- BLU surface site went down 4 Jan 15UTC for the duration of IOP4.
- SHS power failure at 4 Jan 18-23UTC took the surface station observations down
- Lee Vining site stayed up, despite the indication that site was out on HMT web page.
- All other sites appeared to remain up and operative during the event.

Weather Overview

IOP4 was generated by a massive trough development in the eastern Pacific. Jetstream speeds at 12km estimated by cloud tags on the back side of this developing trough and some aircraft reports had speeds of over 200kts with a peak observation of 235kts ...unprecedented speeds. The surface low had a central pressure of less than 960 mb. An IPW plume or river was evident offshore and moving down the coast with the storm. There was a good warm advection period through from initiation on 3 Jan through 4 Jan

22UTC. This event was well handled by the GFS many days out. On the forecast shift on Dec 27 the GFS was pointing at Thursday 3 Jan and this certainly came to pass. Subsequent forecasts never wavered significantly on the event timing or intensity. NWP, HPC, NWSWFO, CNRFC, and ESRL forecasts were outstanding. Crews deployed in a timely manner and repairs were made to critical instrumentation prior to the event. Little did we realize that the weather itself would take some of these systems out by the end of the event.

080105/0000V006 GFS 200 MB HEIGHTS, ISOTACHS AND WIND (KTS)

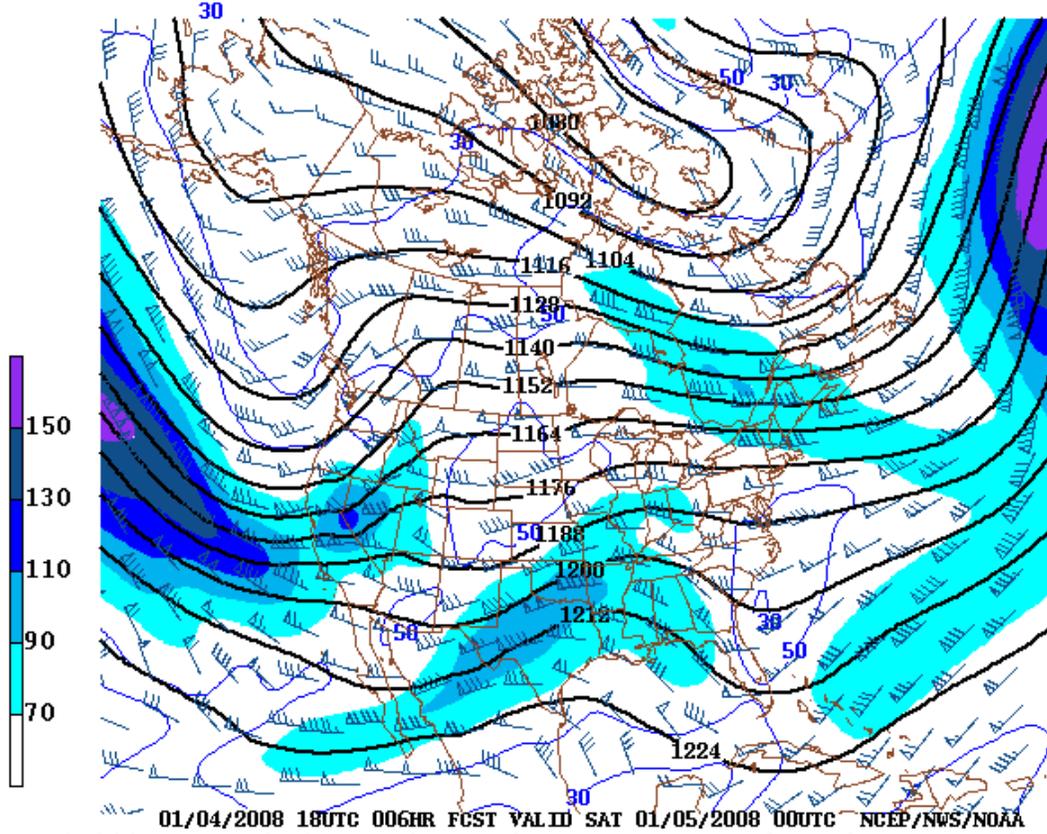


Fig 1: 200MB trough about mid event showing intense wind speeds on west side. Note that ARB is in left exit region of main jet.

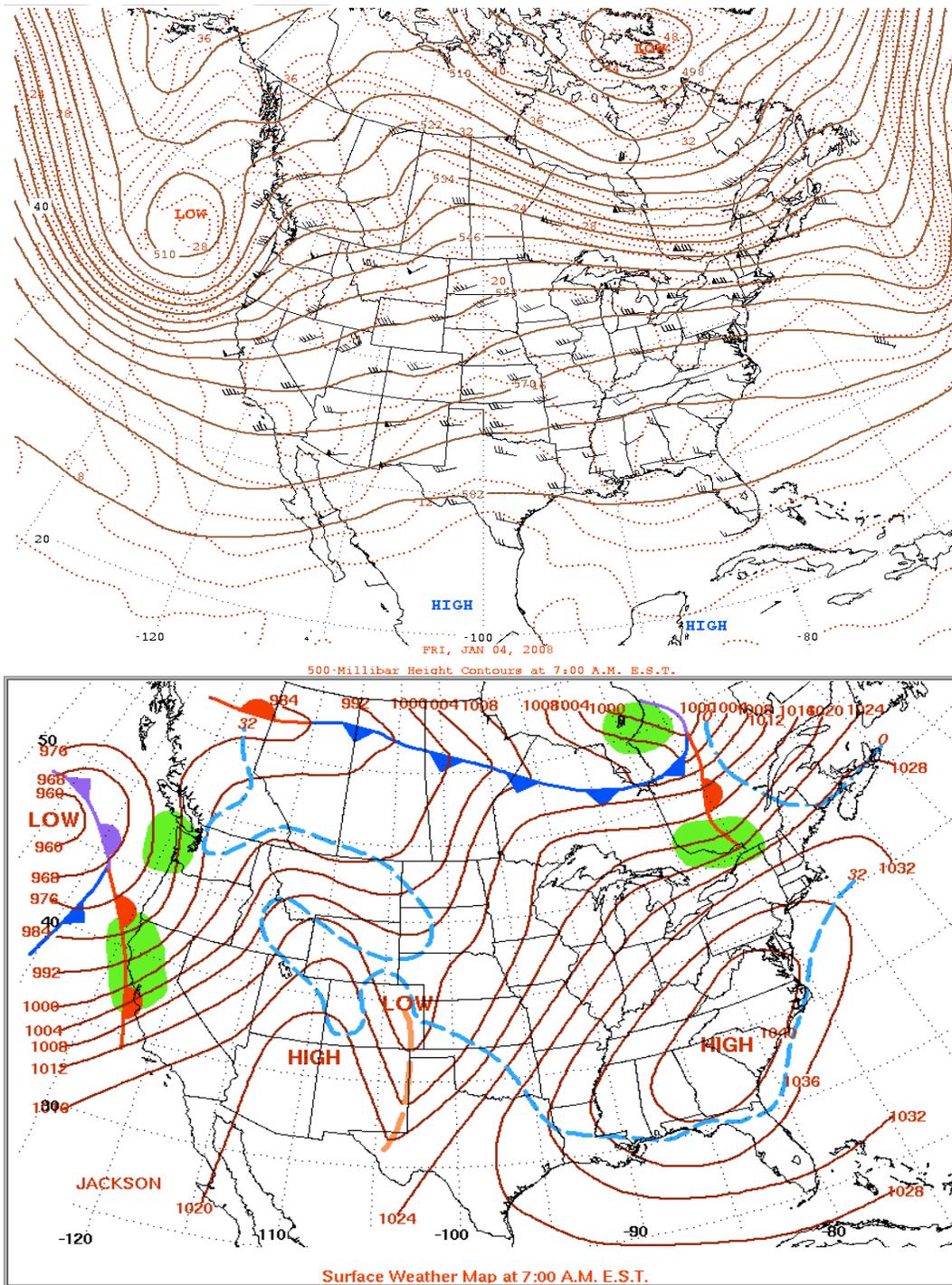


Fig 2a,b. 500MB (top) and Surface (bottom) maps for 4 Jan 12UTC showing intense upper level trough and very deep sfc low off the coast of OR.

The subtropical moisture band was well defined and impinging on the West Coast and Sierras. Predicted IPW values were 35-40mm off shore and 30-32mm on shore.

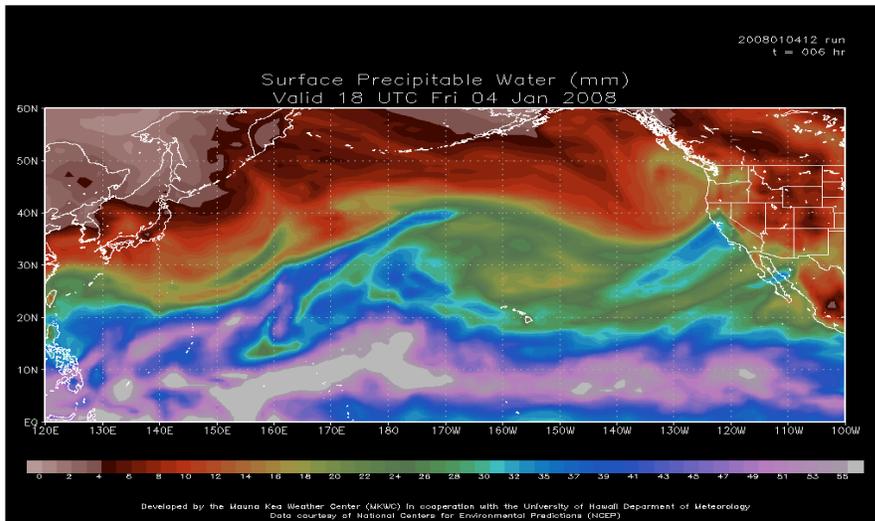


Fig. 3: Six hour forecast of IPW for 18UTC 4 Jan...probably as good as an analysis to characterize the IPW river associated with the trough development.

GPS IPW plots for the event show big increases over land from 3 Jan-4 Jan. Plots illustrate how rapidly moisture moved into the ARB region

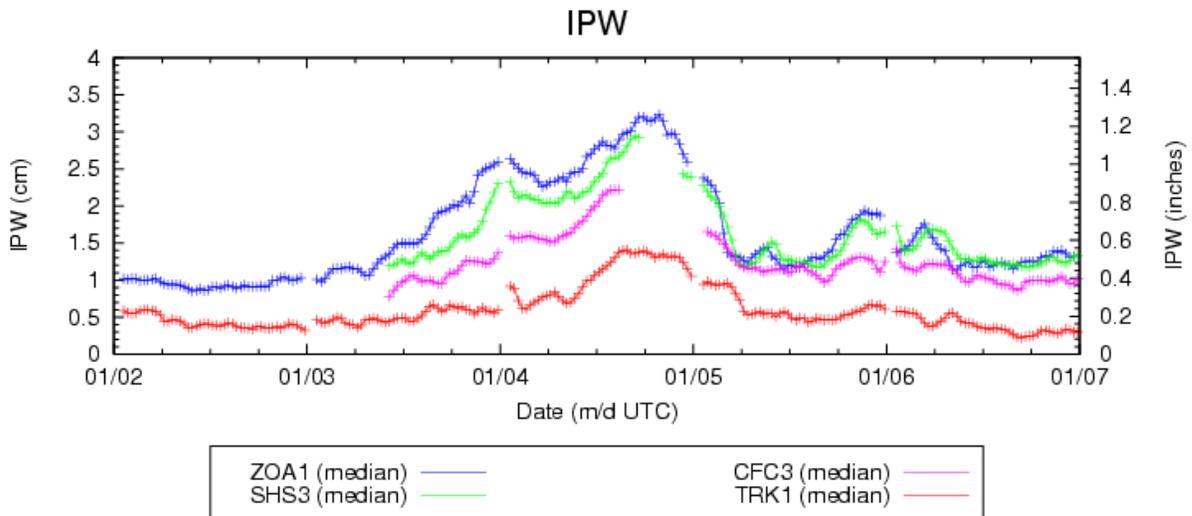


Fig 4. IPW timeseries from Fremont, CA (ZOA1) near Oakland, CA and three sites to the Northeast of Fremont. From West to East, these sites are Sloughouse, CA (SHS3), Colfax, CA(CFC3), and Truckee, CA (TRK1).

Winds in the moist layer were 50-70kts as seen on the SHS profiler plot. Freezing level was 6000-7000 ft descending to 5000 ft with frontal passage. Before its power failure SHS was showing a classic barrier jet profile.

ESRL Physical Sciences Division
Wind Profiling Radar

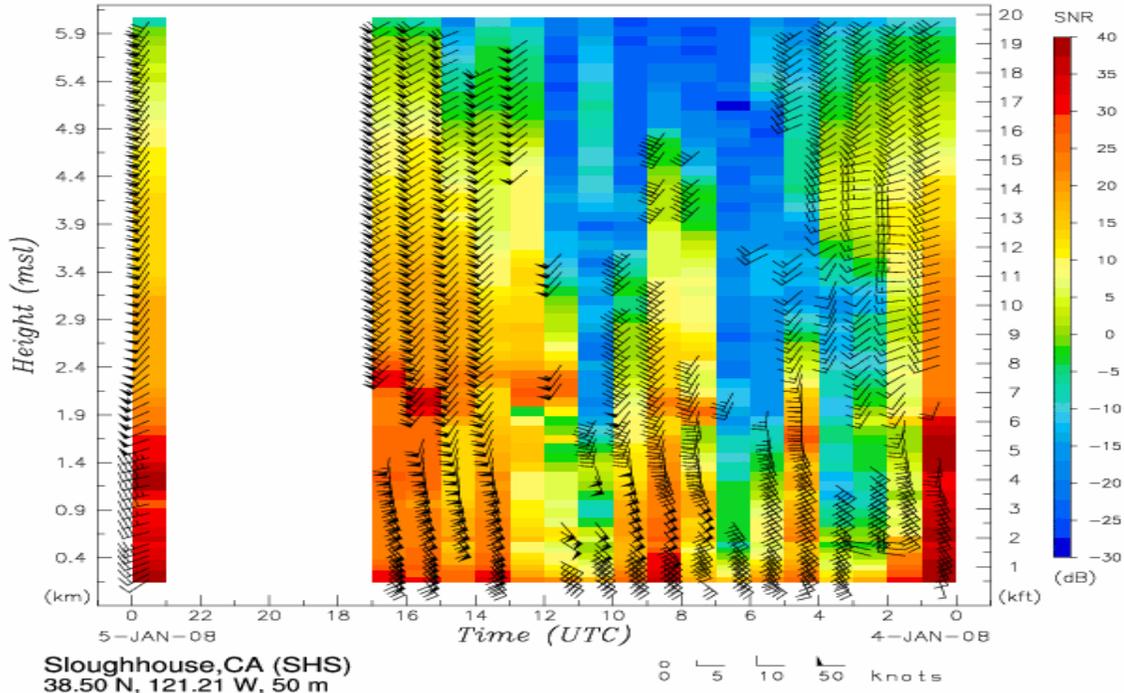


Fig 5. Time series of SHS wind profile and reflectivity. Freezing level (at gradient in reflectivity) looks to be increasing from 6200ft at 4 Jan 00UTC to 7500ft at 16UTC. There was a power failure at 17UTC. When system came back freezing level was about 5500ft.

Surface plot at 4 Jan 23UTC just about the time the radar site had been abandoned, showed heavy rain at low levels and heavy snow at BLU. Just a few hours before BLU had recorded a gust to 63kts at the airport. Radar dish became uncontrollable necessitating a shutdown. On this plot it appears that the first of many minor upper level troughs or fronts was passing BLU. Winds at lower elevation had shifted more southwesterly while strong SE winds continued to the south. Heavy rain was occurring along and south of this frontal boundary, likely in the warm prefrontal moisture plume.

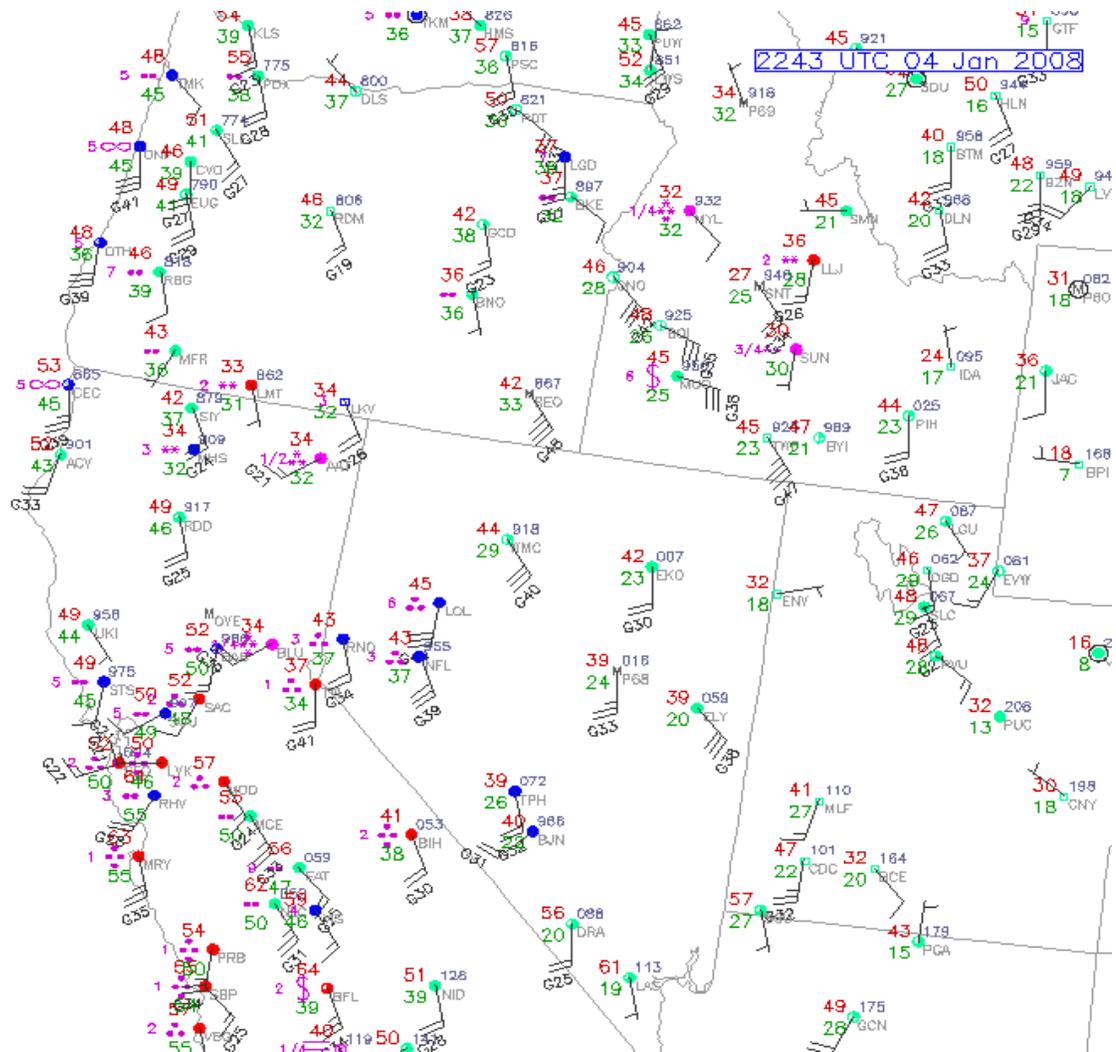


Fig 6. Surface observations at 4 Jan 2243UTC showing heavy rain and strong valley winds and barrier jet. BLU had just changed over to snow. Likely this was time of upper level frontal passage.

HYDROX radar documented the rain event beginning on 3 Jan 21UTC until the radar was shutdown. The figures below show the onset of the precipitation on January 3rd. The first figure shows the DAX reflectivity as the band approached BLU, and the second figure shows the HYDROX reflectivity

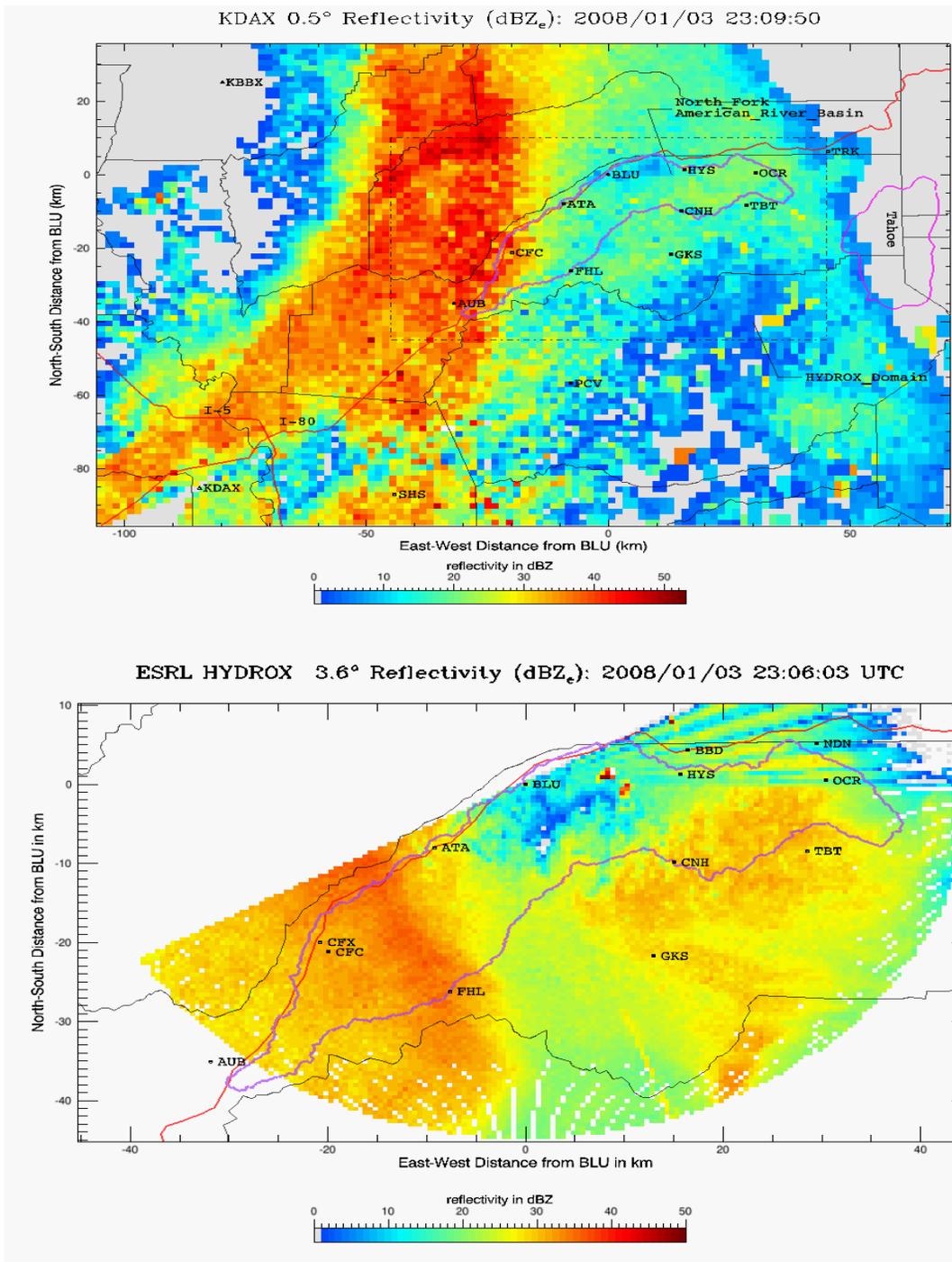
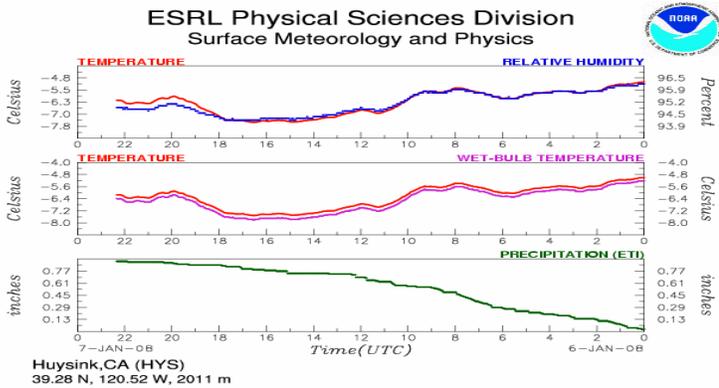
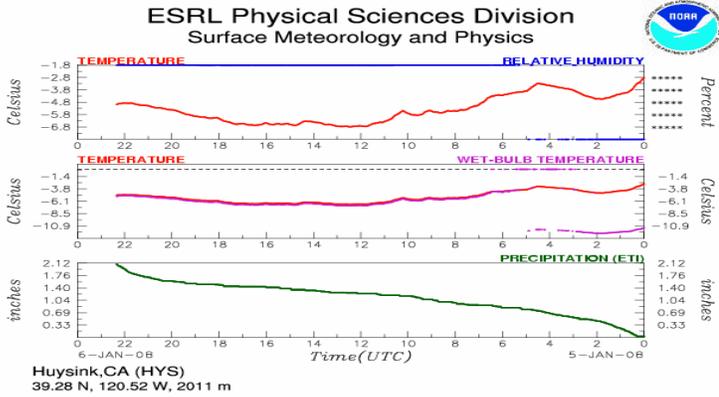
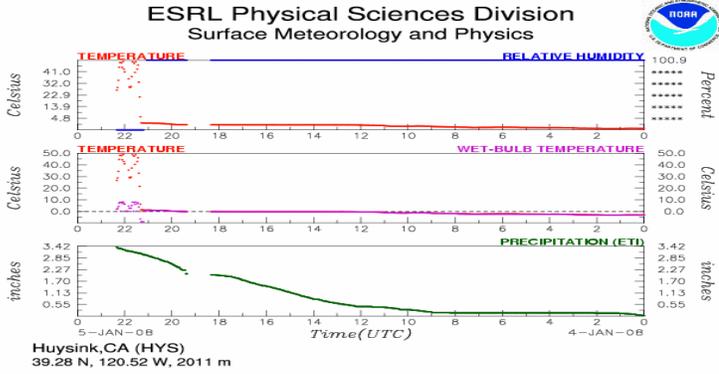


Fig 7: DAX (top) and HYDROX (bottom) reflectivity near the ARB just after 3 Jan 23UTC. Both show the approach of heavy precipitation from the first significant rain band of IOP4.

Liquid precipitation for this event totaled 6 to 7 inches in the ARB with snow as much as 10 ft in the eastern parts of the drainage area. At BLU snow totaled about 3 ft. Since the power was lost at BLU we present the time series from Huysink just to the east and at the upper part of the ARB.



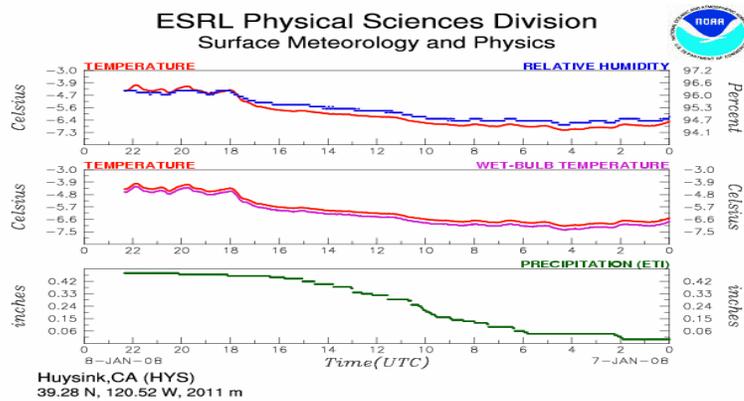


Fig 8. Series of time plots for Huysink observing site from 4 Jan 00 to 8 Jan 00UTC: Total amount of precipitation for the event at Huysink is 6.86 inches of liquid. This typified observations in the central Sierras.

HMT Ensemble model products generally performed well. Shown is the 24 hr ensemble mean (multimodel and time-phased) forecast from 4 Jan 00UTC to 5 Jan 00UTC. It shows precipitation amounts 4-5 inches over the area and covers most of the rain event prior to the conversion to snow. During this period Huysink had 3.42 inches...the forecast at Huysink on the graphic product was between 3 and 4 inches. Between 5 Jan 00UTC and 6 Jan 00UTC model predicted between 2-3 inches at HUY (not shown)...observed: 2.12. At BLU the forecast was for exactly 4 inches. Unfortunately no continuous observations were recovered at BLU.

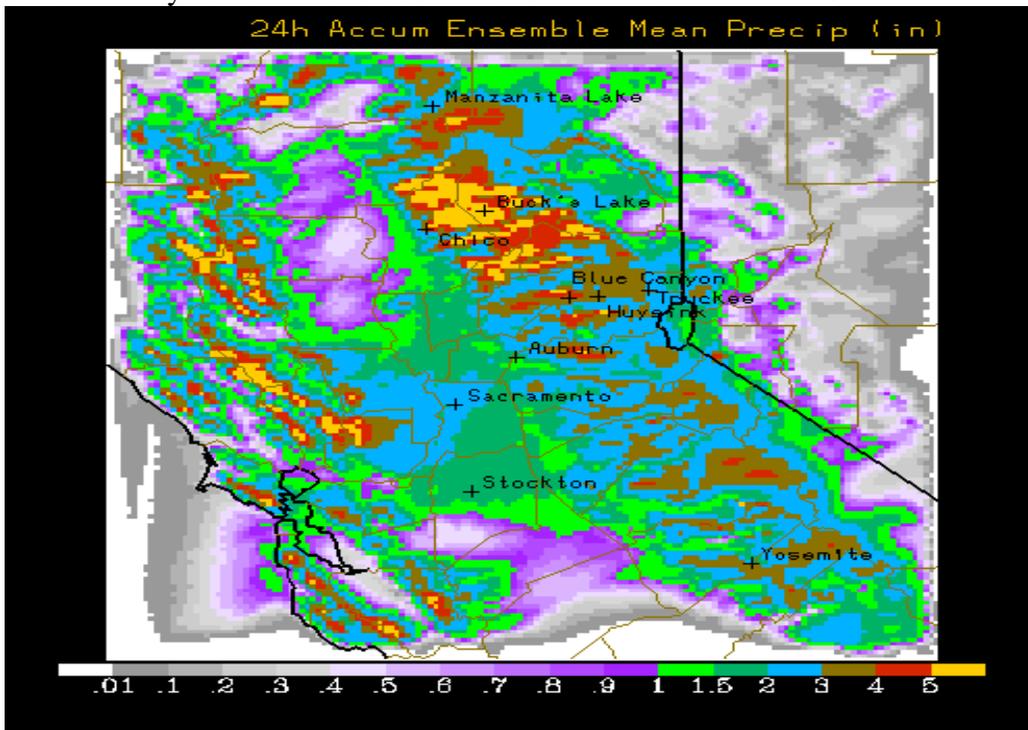


Fig.8.HMT 3-km ensemble mean total liquid precipitation for central California for 24 hours ending at 5 Jan 00UTC.

Another use of the high resolution ensemble was to predict the freezing level and the transition of precipitation from rain to snow. The figure below shows a WRF-NMM cross-section for 4 Jan 18UTC through the ARB with BLU located at 1.6km. This cross-section shows the warm advection period (just prior to frontal passage) with rain and snow mixed for the BLU area. Freezing level predicted to be at 2300m during this period. Ice cloud tops out at 11km. melting layer is clearly seen and compares well with SHS (observed freezing level at 17UTC (just prior to power outage) was 2400m.

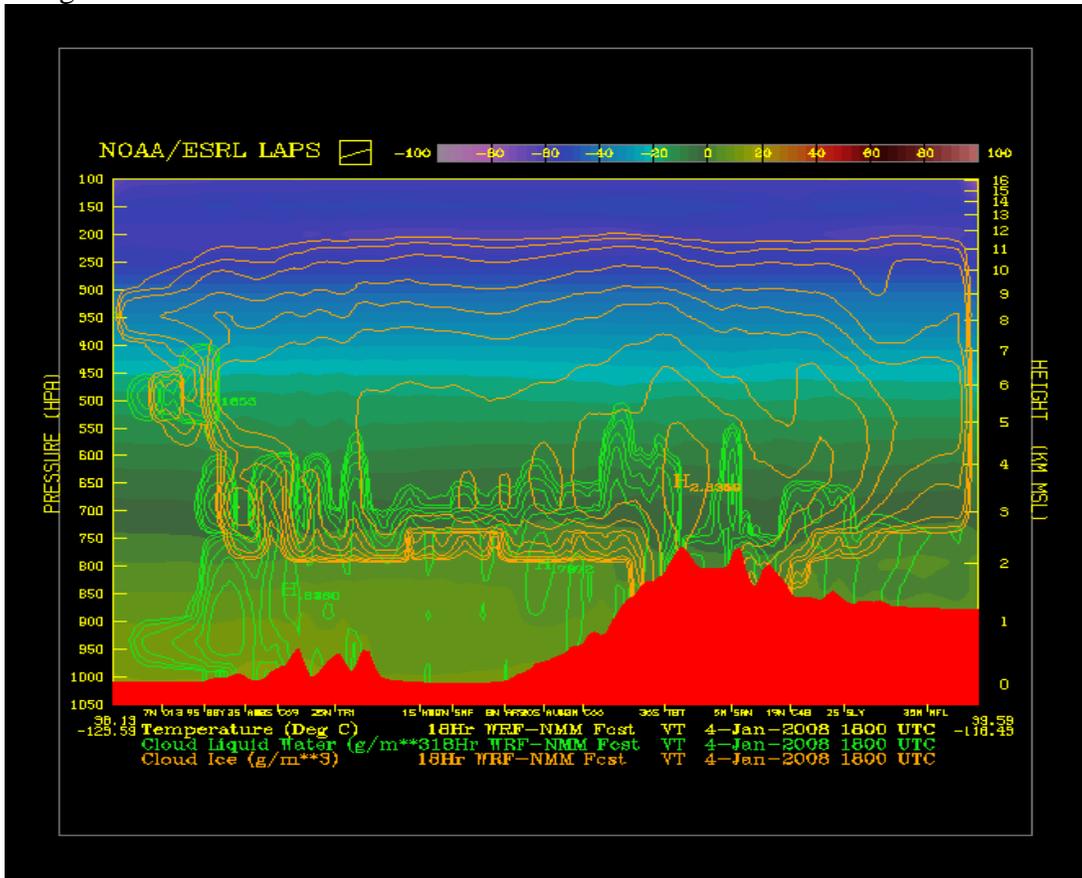


Fig. 9. Cross-section through 18-hour prediction (valid at 4 Jan 18UTC) from the WRF-NMM (3km resolution) of cloud liquid water and cloud ice fields at along ARB axis. Bottom of dark green band is 0C isotherm. Melting layer is clearly seen.

Observed total precipitation could be seen from the AHPS national product. Analyses over California shows the 4-day event had 5-8 inches of liquid. Note that some locations on the coast had over 10 inches. This event cumulatively, was one of the heaviest precipitation events in years.

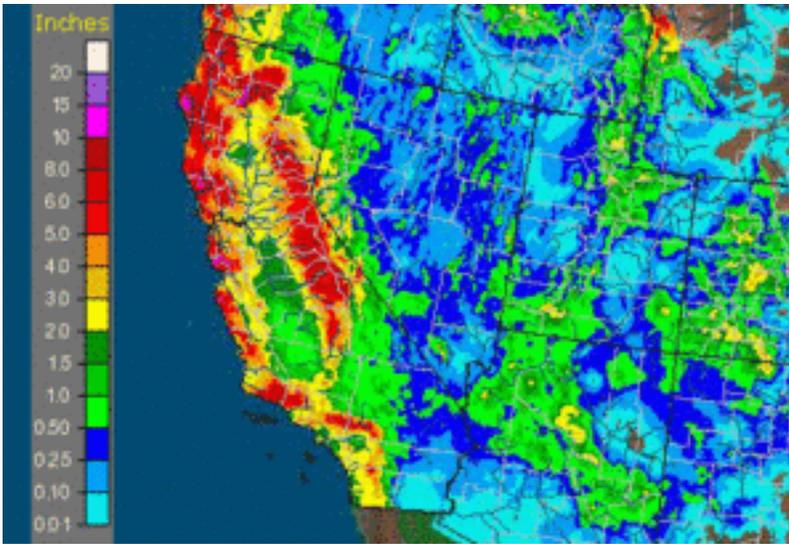


Figure 10: Total precipitation for IOP4 3-7 Jan 2008