13-14 March 2003 High Wind Event With Embedded Severe Convection

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Introduction

The leading upper level short wave trough embedded in a broad long wave trough extending over most of the northern Pacific Ocean was rapidly approaching the coast of northern California on the afternoon of March 13th, 2003 (fig. 1). Ahead of this leading shortwave, relatively warm subtropical air was being advected northward into northern California raising daytime highs into the 60s. Strong gradient level winds were evident both ahead and behind the system. Higher elevation sites in the Coast Range gusted in excess of gale force while sustained winds at lower elevations and in the northern California coastal waters blew 20 to 30 knots for a period of about 24 hours from about 06Z on the 13th through 06Z on the 14th. Between the warm air mass ahead of the system and the cold air behind it, a strong line of showers and thunderstorms formed. It was only within about two hours on either side of the passage of this convective boundary, which occurred between 22Z and 02Z, during which the maximum wind thresholds for this storm system were reached. Thus, while long fused wind advisories are necessary to cover the widespread nature of the gradient wind in events of this type, special marine and severe thunderstorm warnings should be used to most accurately convey to the public the duration and intensity of the winds associated with the embedded severe thunderstorms.

Synoptic and Mesoscale Features

At 00Z on the 14th of March 2003, the GFS model analysis showed that northern California was in the right rear quadrant of one polar front jet stream maximum as the left front quadrant of another jet maximum quickly approached from the west (fig. 2, lower left). At 00Z on the 14th, surface convergence was also present on the initialization panel of the GFS model just west of the northern California Coast (fig. 2, upper right). At the same time, strong diffluent flow and a maximum of 300mb wind divergence was sweeping up the coastline from the southwest (fig. 2, upper left). On the radar, the strong line of showers and thunderstorms were coincident with the intersection of these two features (figs.3 & 4). Since the National Lightning Detection Network was consistently indicating numerous lightning strikes just offshore, and the features discussed above were forecast to persist as they passed over the forecast area, it was very evident that the convective line off of the coast would maintain its strength as it moved inland.

The VAD wind profiler showed winds in excess of 50 knots just 3,500 feet above sea level as the line approached (fig. 5). The forward momentum of the approaching line and these winds exceeding 50 knots just above the surface were clear indications that convective enhancement of the gradient level surface winds throughout the area would be a major concern. The wind profiler as well as forecast soundings indicated fairly uniform flow with respect to both wind speed and direction as the convective line passed over the RDA, indicating that, due to insufficient shear in the lowest 5 km of the atmosphere, straight line wind damage was the main severe threat with this line as it continued onto the coast.

When the convective line moved inland, isolated gusts in excess of severe limits were observed. This is supported by the wind velocity data from the KBHX radar (fig. 6). On this velocity scan, just prior to the arrival of the maximum wind gusts recorded at and near the coast, one can see a wind maximum aloft near Trinidad. Trinidad gusted to 58 knots as this convective line moved through. Additionally, wind gusts in excess of 65 knots (and up to 83 knots) occurred along the peaks of the Coast Range. Lightning was also observed along the coast. No tornadoes were reported.

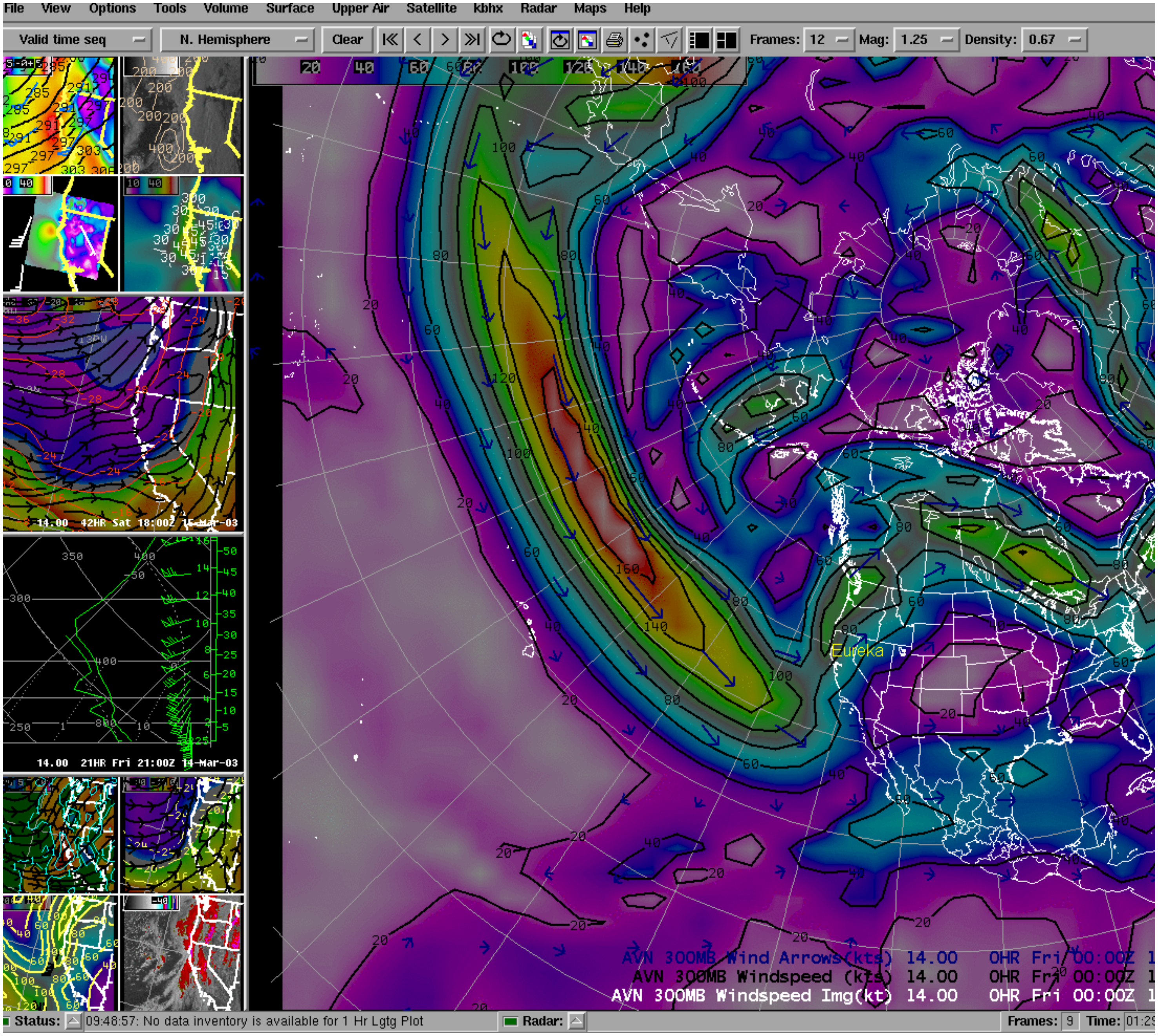
It should be noted that, while this was a March event, temperatures in the low and mid levels were quite warm since this was the first shortwave on the upwind side of the long wave trough. Thus, winter storm warnings and snow advisories were not needed for this event. As the colder air that was fueling the convective instability from aloft moved inland and built lower into the atmosphere, however, snow levels did lower rapidly. Snow levels lowered to about 3500 feet by the 15th of March.

Summary

The purpose of this paper is to help the forecaster distinguish between strong gradient induced winds and convectively induced winds. Prior to the event, model solutions indicated that the forecast area had a good potential for convection. During the event it became clear that the models were running a little slow. The colder air aloft, and corresponding instability, supporting the line of convection began to out run those that the GFS model was depicting. The forecast problem of the day involved answering the following two questions; 1) Would the existing long fused products cover the widespread non-convective gradient winds?, and 2) Would convectively forced winds exceed severe thunderstorm warning levels? In facing this challenge, the forecasters had to determine what was the right message to convey to the public. Based on surface observations, LAPs surface analysis charts, radar data, and model initialization, there was good justification for a shorter duration severe thunderstorm warning along areas of the coast. In the end, this system did produce strong gradient level winds with embedded convective gusts well into severe thunderstorm warning criteria, thus, illustrating the important and challenging decision a forecaster must make in this kind of situation.

Additional Figure: Fig. 7

Figure 1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Eureka
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AVN 300MB Windspeed (kts) 14.00 0HR Fri 00:00Z
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14.00 42HR Sat 18:00Z 15-Mar-03
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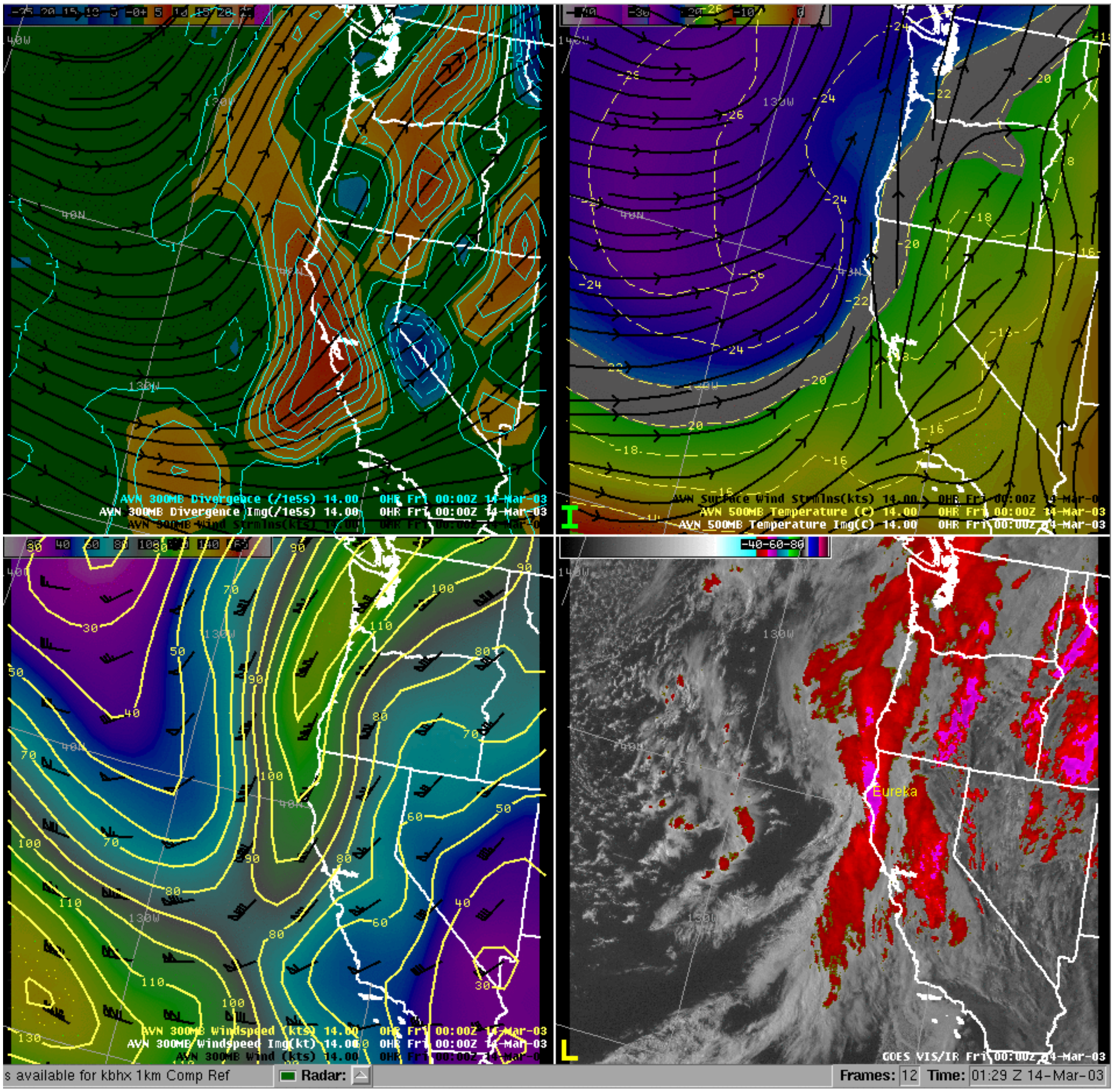
Time:

Figure 2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GOES VIS/IR Fri 00:00Z 14-Mar-03
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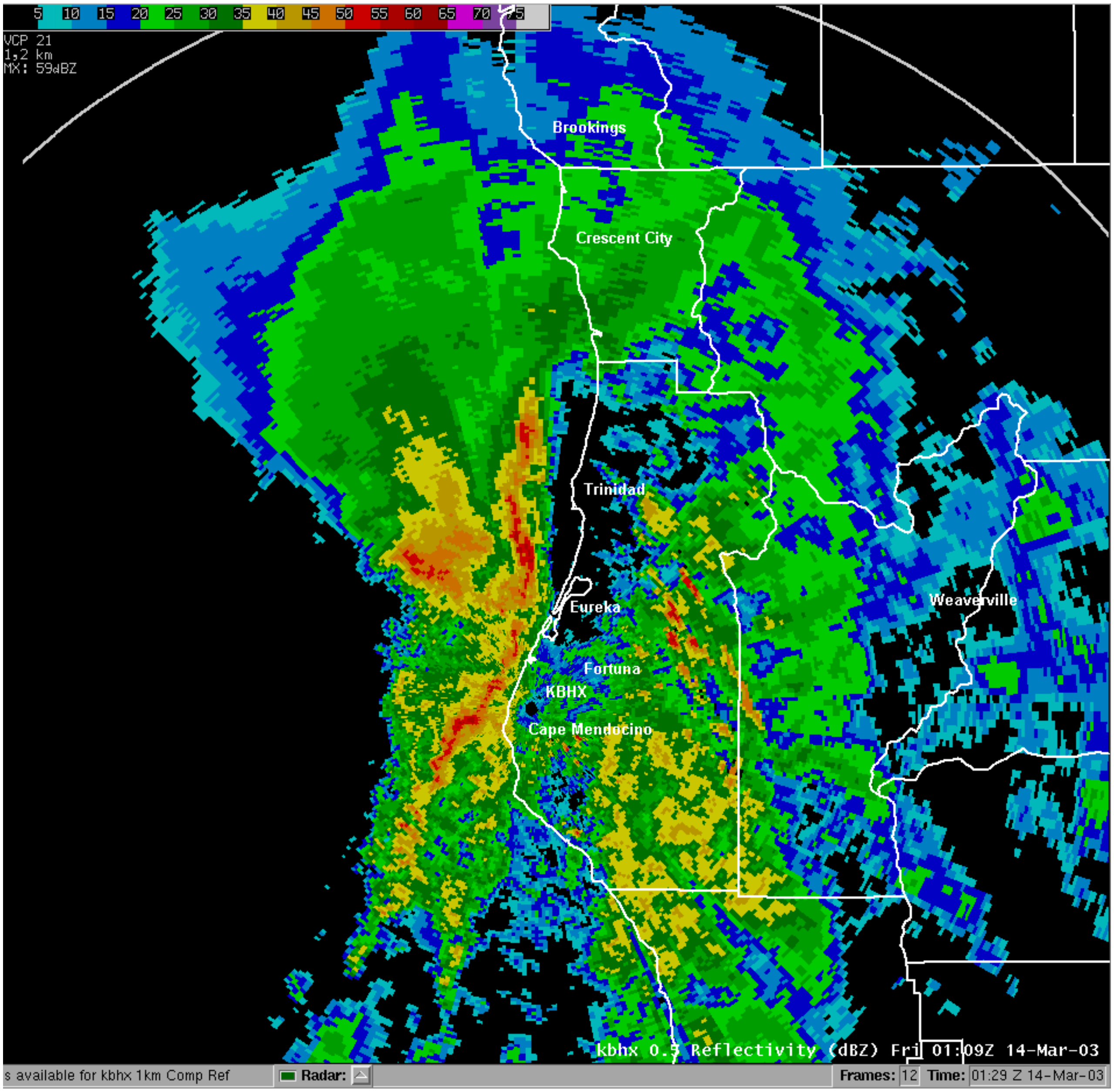
Figure 3



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1,2 km
MX: 59dBZ
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Trinidad
Eureka
Fortuna
KBHX
Cape Mendocino
Weaverville
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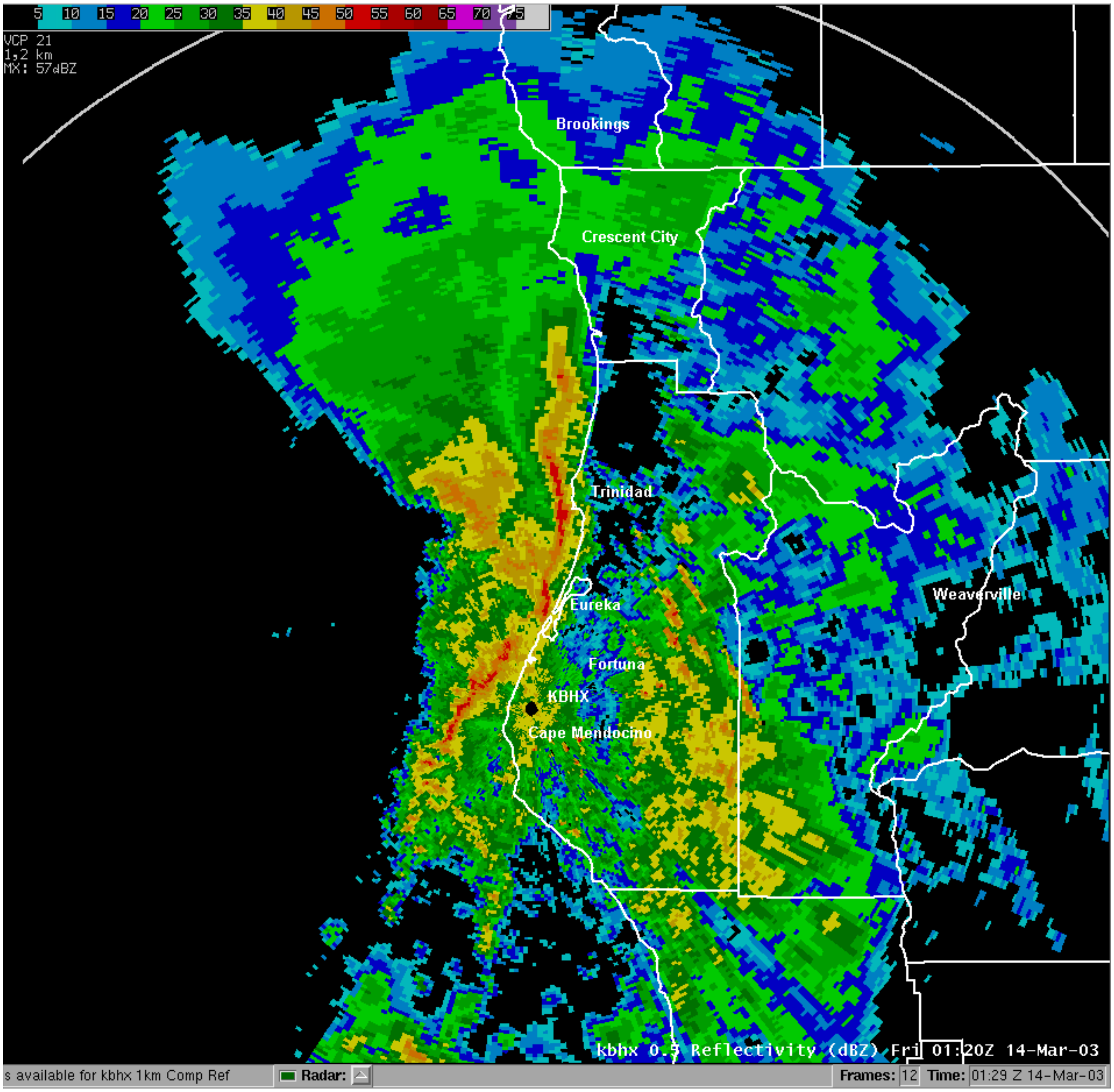
Figure 4



5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
VCP 21
1,2 km
MX: 57dBZ
Brookings
Crescent City
Trinidad
Eureka
Fortuna
KBHX
Cape Mendocino
Weaverville
kbhx 0.5 Reflectivity (dBZ) Fri 01:20Z 14-Mar-03
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Figure 5

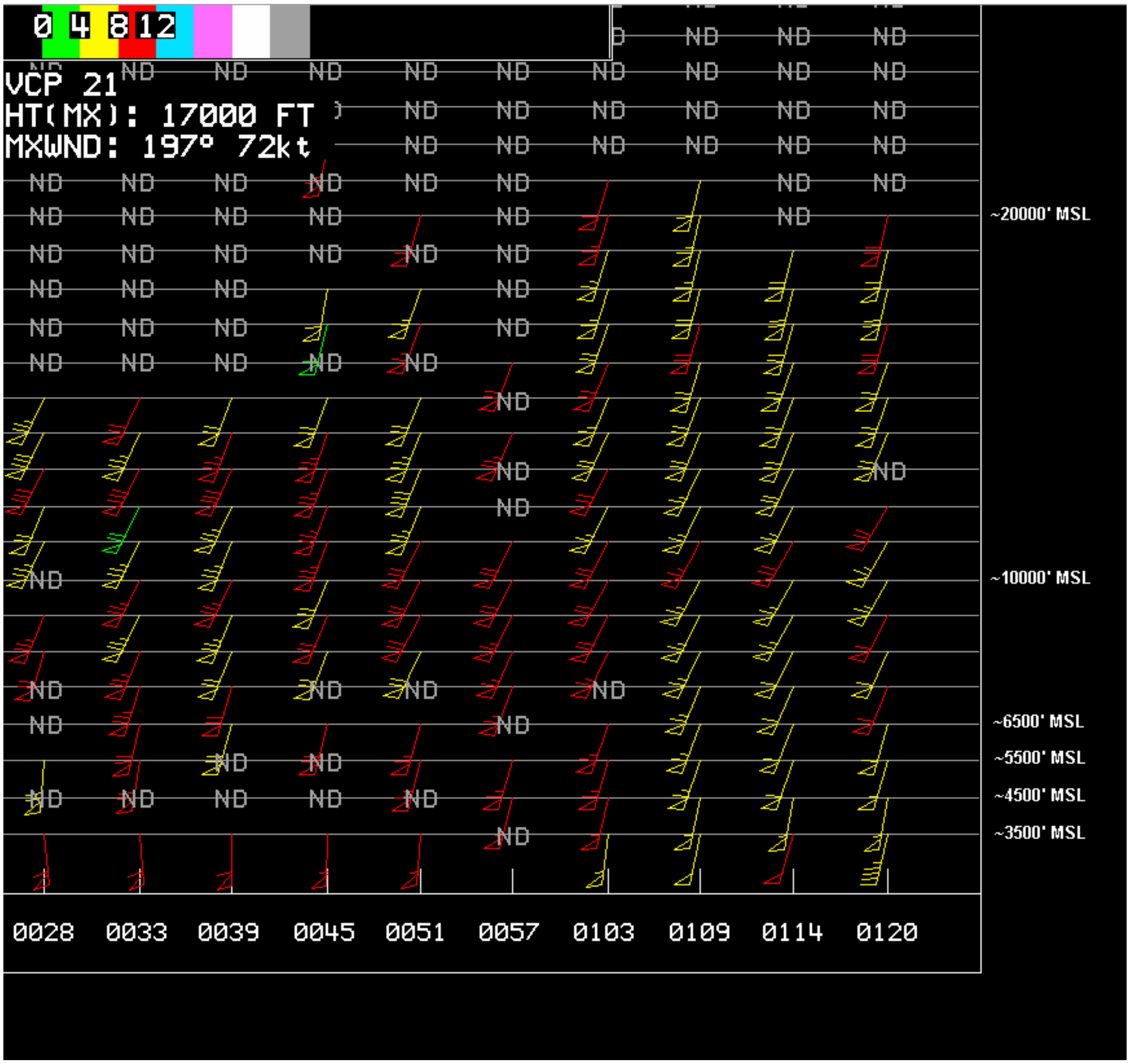
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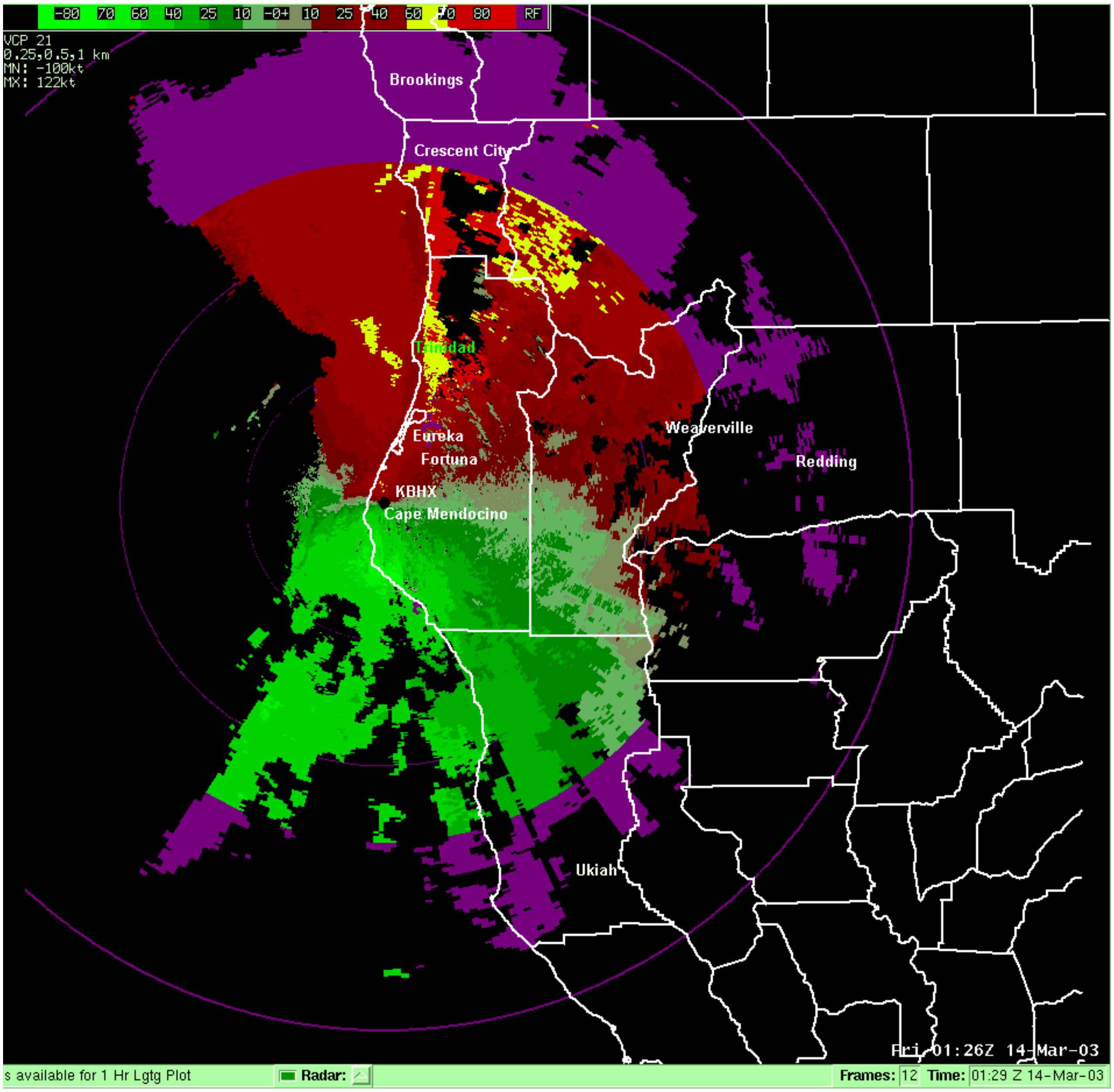
Figure 6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Cape Mendocino
Weaverville
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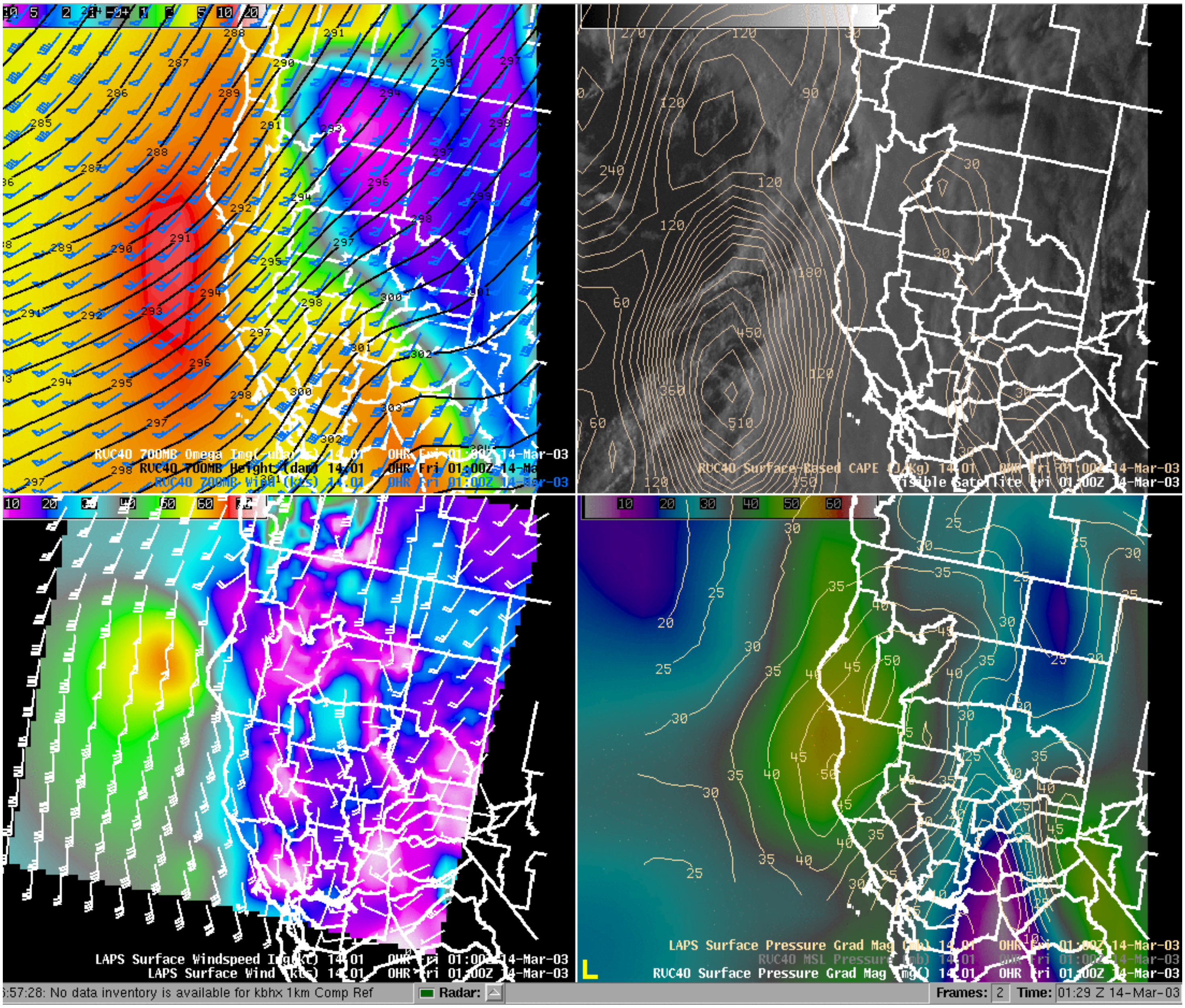
Figure 7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RUC40 700MB Wind (kts) 14.01 OHR Fri 01:00Z 14-Mar-03
RUC40 Surface-Based CAPE (J/kg) 14.01 OHR Fri 01:00Z 14-Mar-03
Visible Satellite Fri 01:00Z 14-Mar-03
LAPS Surface Windspeed Img(kt) 14.01 OHR Fri 01:00Z 14-Mar-03
LAPS Surface Wind (kts) 14.01 OHR Fri 01:00Z 14-Mar-03
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