Examining the Dry Lightning Event of 23 August 1999 for Northwest California

Ross Van Til, WFO Eureka, CA

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INTRODUCTION

Several short-lived elevated thunderstorms developed across interior portions of Northwest California late in the afternoon of August 23rd 1999. These storms sparked several large fires near the Humboldt-Trinity County border. Based on radar data, and their efficiency as fire starters, these storms are believed to have been very low-precipitation producers, if not completely dry. Critical elements associated with this event are fairly subtle, and require careful investigation to determine the cause of this dangerous fire weather situation.

SYNOPTIC AND MESOSCALE FEATURES

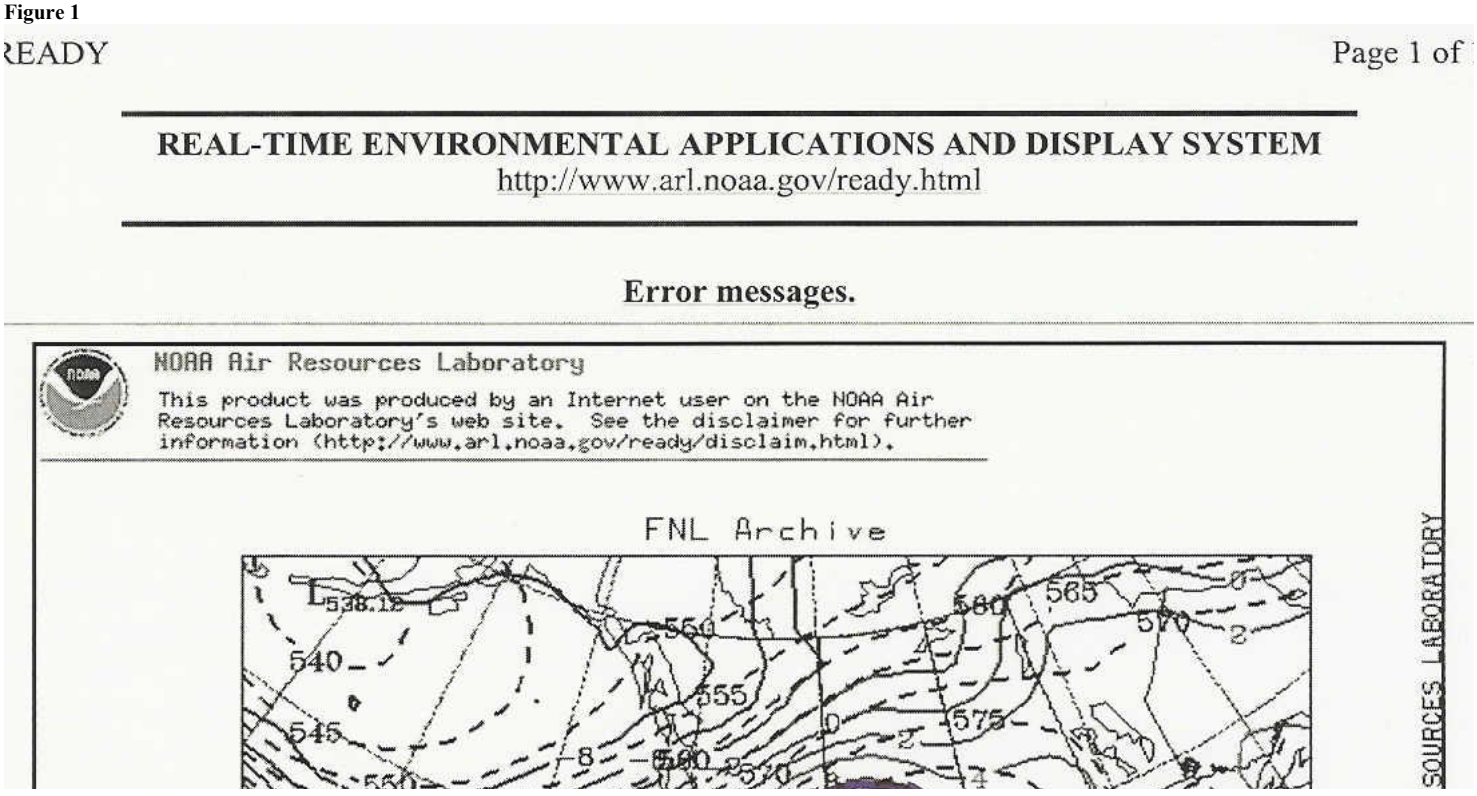
On August 20th, three days before the event, the WFO Eureka County Warning Area (CWA) sat between a broad 500mb ridge across much of the western US, centered over the Rocky Mountain States, and a trough in the Eastern Pacific. Through the morning of the 23rd, the upper ridge was in the process of retrograding into the Pacific Northwest, allowing for moist south-southeast flow to develop across the eastern portions of the CWA. On the afternoon of the 23rd, the Eureka CWA lay in the transition zone between the air mass associated with the ridge over the western US, and that associated with the trough over the Eastern Pacific (fig.1). An approaching weak upper-level disturbance rotating around the base of the East Pacific trough would add the final piece of the puzzle for this event on the synoptic scale (fig. 2).

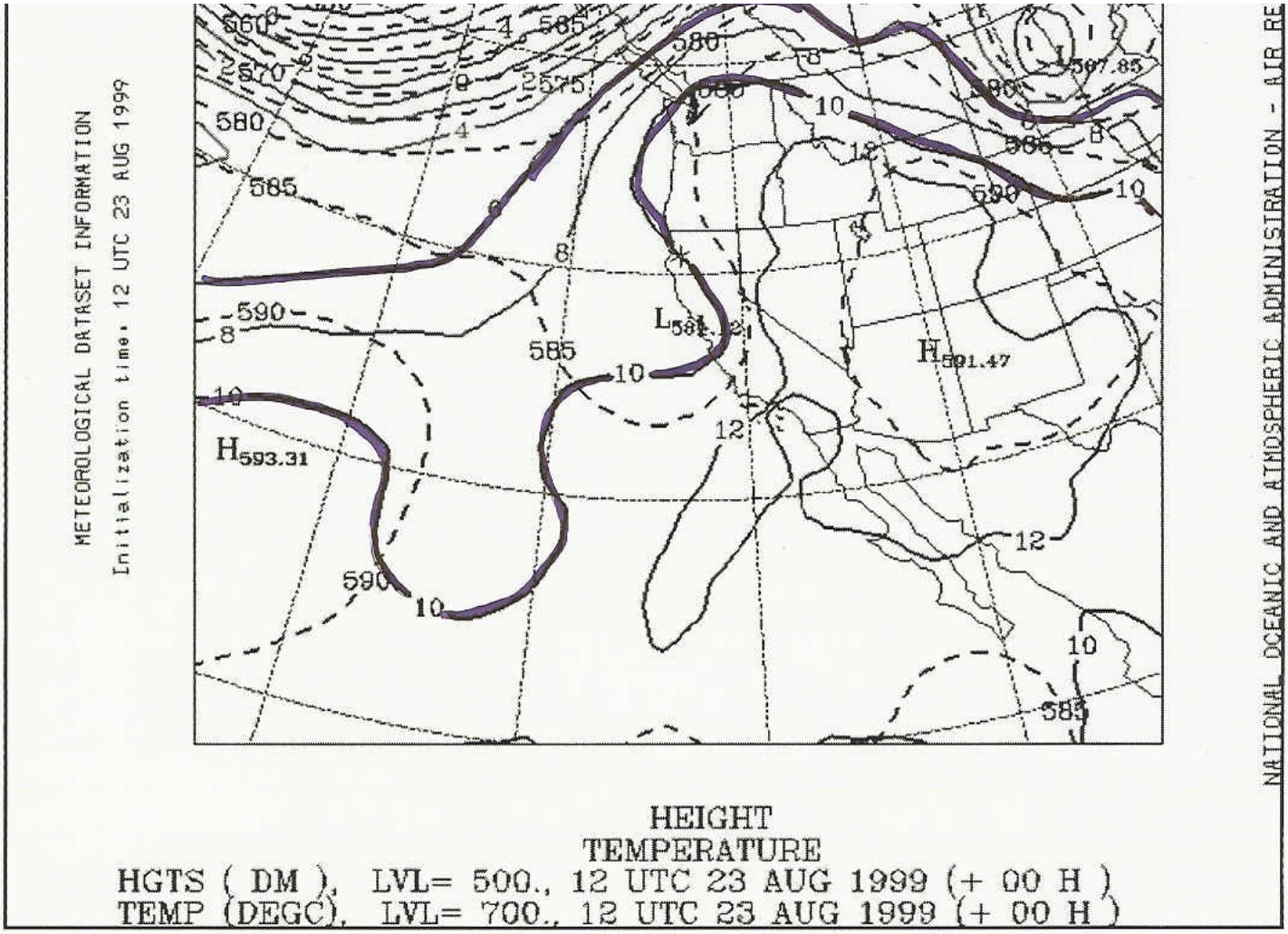
Some important smaller scale features are also critical to discuss in association with this event. An investigation of archived radar data shows that thunderstorms initially fired slightly east of the CWA just prior to 21Z (fig. 3). This initial area of convection formed as moist south-southeast flow aloft interacted with the mountain slopes on the western side of the Sacramento Valley. This area of convection intensified as it moved northeastward into Trinity County, however, no fires were started by these storms, as they were likely heavy rain producers. This is supported by the radar data, as well as by the synoptic situation, with deeper monsoonal moisture in place over the eastern portion the CWA. Shortly after 21Z, other storms then began to initiate along a southwest to northeast line in northwestern Trinity County. These storms had less low-level moisture to work with, yet sufficient mid-level moisture to produce 55-60 DBZ elevated cores. Lightning data (fig 3a - copyrighted - not to be reproduced or redistributed) confirms that these storms produced a brief period of frequent cloud to ground lightning strikes. Radar data indicates that the high reflectivity mid-level cores did not translate all the way to the surface during the downdraft phase of these storm's lifecycles (fig. 4). Therefore, the main effect of the relatively dry downdrafts associated with these storms was likely to fan the flames of the recently sparked fires. This is obviously a very dangerous fire weather situation, and several fires quickly spread out of control.

DISCUSSION

The general synoptic pattern associated with this hazardous fire weather situation is one that forecasters in the region should be aware of. The threat of thunderstorms across the Eureka CWA was fairly straightforward given this pattern. However, the short-lived, generally dry nature of some of these storms, and the associated critical fire weather situation, was a less obvious result. The boundary between the two air masses in the region is the key in situations such as August 23rd 1999. To the east sits the moisture rich air mass, associated with the south-southeast monsoonal flow. To the west is the generally drier air mass associated with the Pacific trough. Where the two air masses meet, mid-level moisture has been advected over drier air at low levels. In this boundary corridor, dry thunderstorms are likely. The presence of an approaching upper-level disturbance greatly enhances this possibility.

Figure 1




METEOROLOGICAL DATASET INFORMATION
Initialization time: 12 UTC 23 AUG 1999
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION - AIR RE
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565
570
575
580
585
590
$H_{593.31}$
$L_{581.21}$
$H_{591.47}$
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TEMPERATURE
HGTS (DM), LVL= 500., 12 UTC 23 AUG 1999 (+ 00 H)
TEMP (DEGC), LVL= 700., 12 UTC 23 AUG 1999 (+ 00 H)

Figure 2

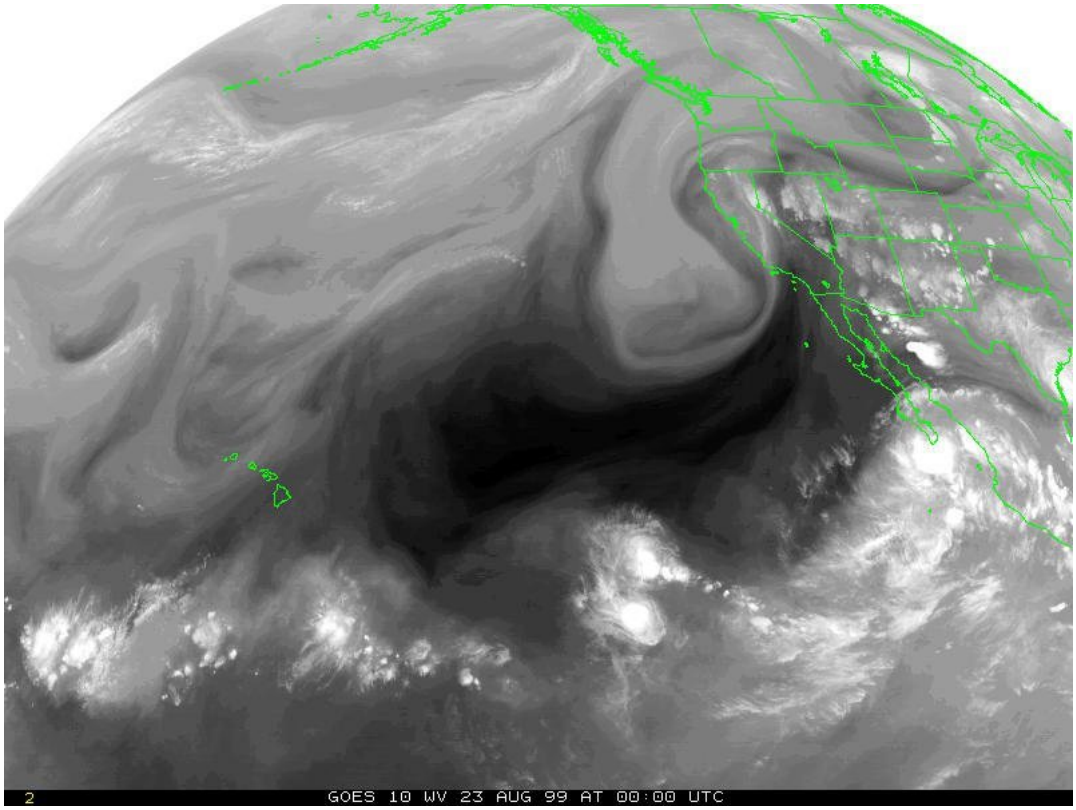
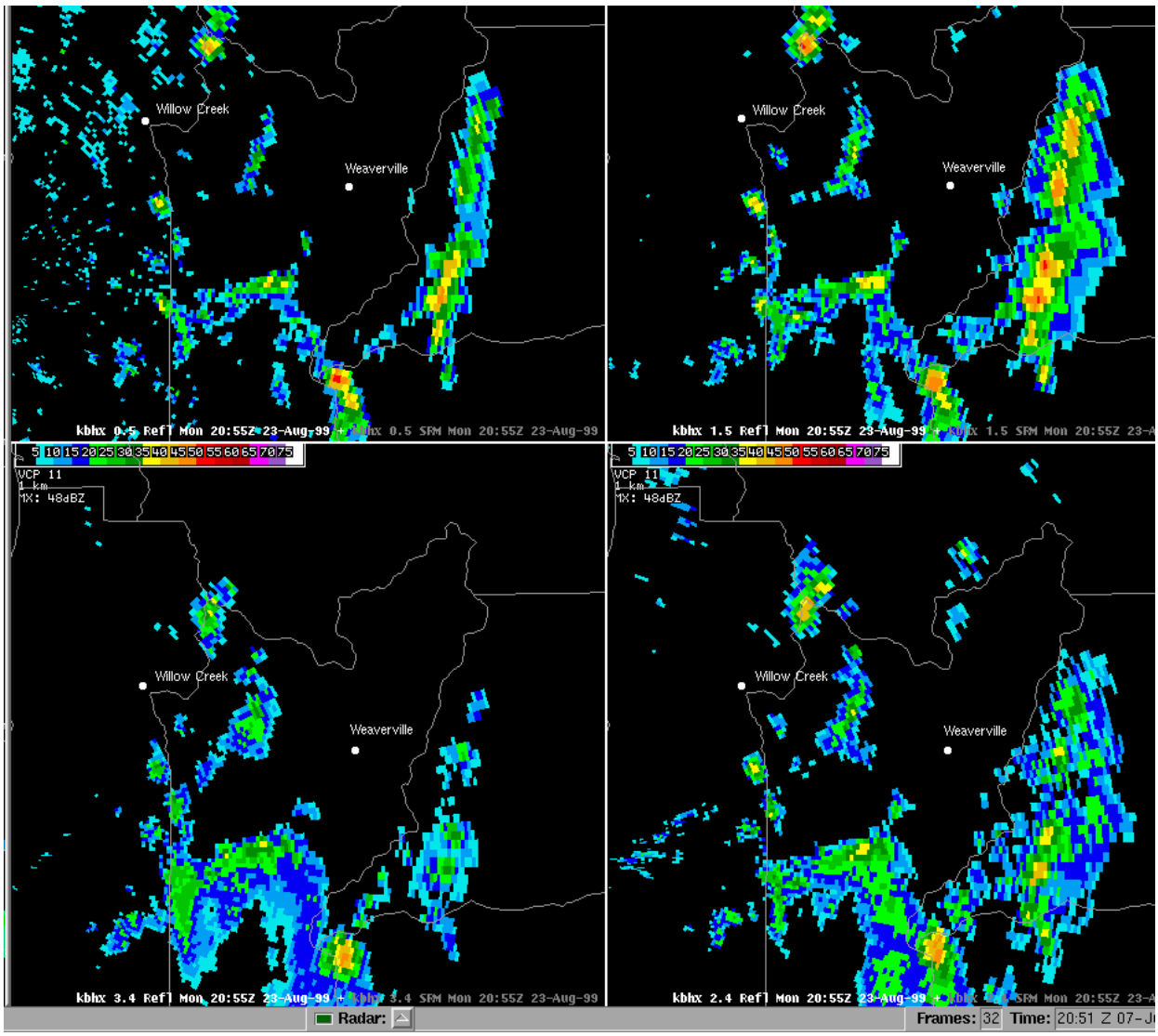


Figure 3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Weaverville
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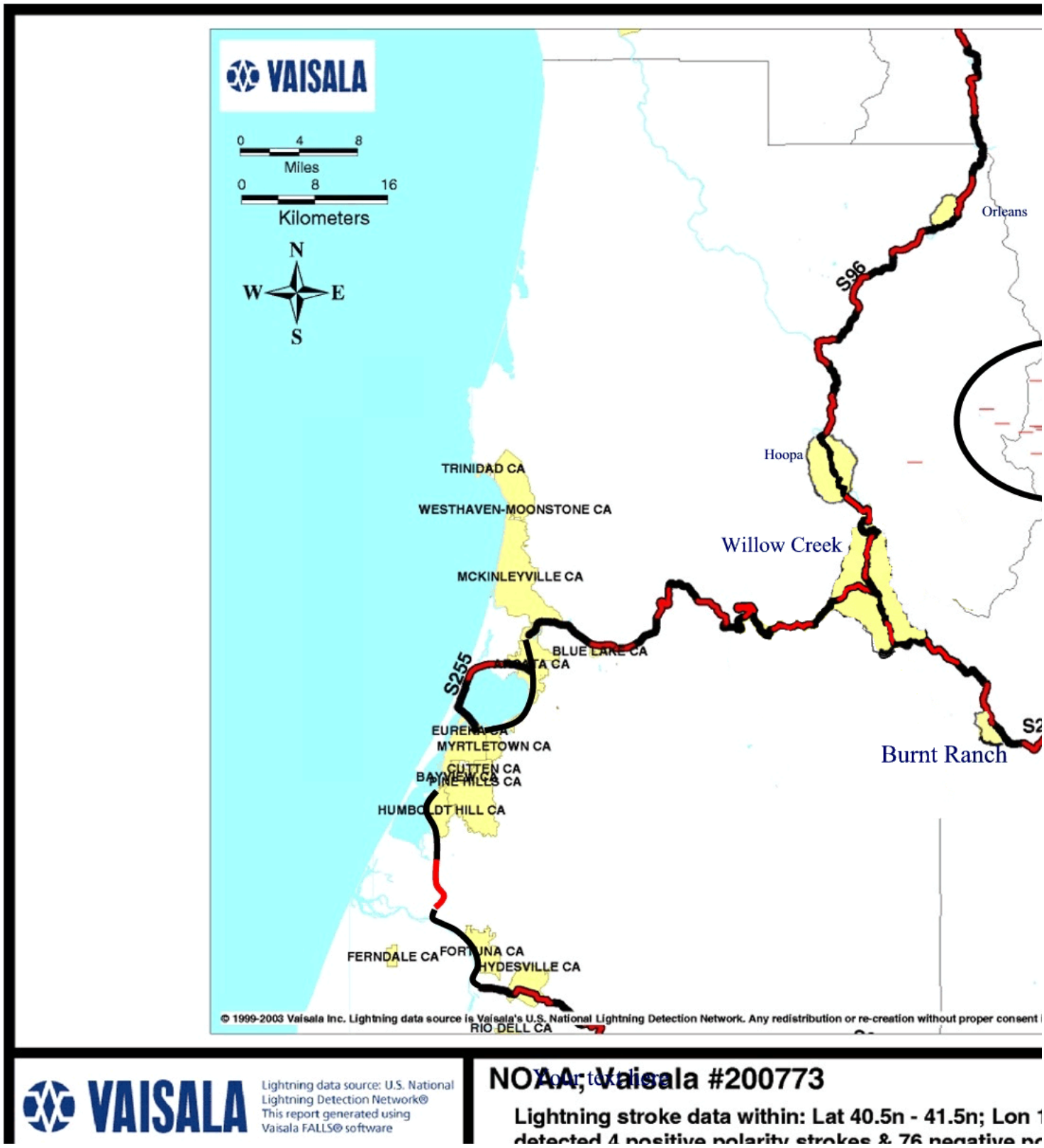
kbhx 1.5 Refl Mon 20:55Z 23-Aug-99
5 10 15 20 25 30 35 40 45 50 55 60 65 70 75
VCP 11
1 km
MX: 48dBZ
kbhx 3.4 Refl Mon 20:55Z 23-Aug-99
kbhx 2.4 Refl Mon 20:55Z 23-Aug-99
Radar:
Frames: 32
Time: 20:51 Z 07-J

Figure 3a


VAISALA
0 4 8
Miles
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Kilometers
N
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Hoopa
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Willow Creek
MCKINLEYVILLE CA
BLUE LAKE CA
S255
EUREKA CA
MYRTLETOWN CA
CUTTEN CA
BAYVIEW CA
PINE HILLS CA
HUMBOLDT HILL CA
Burnt Ranch
FERNDALE CA
FORTUNA CA
HYDESVILLE CA
RIO DELL CA
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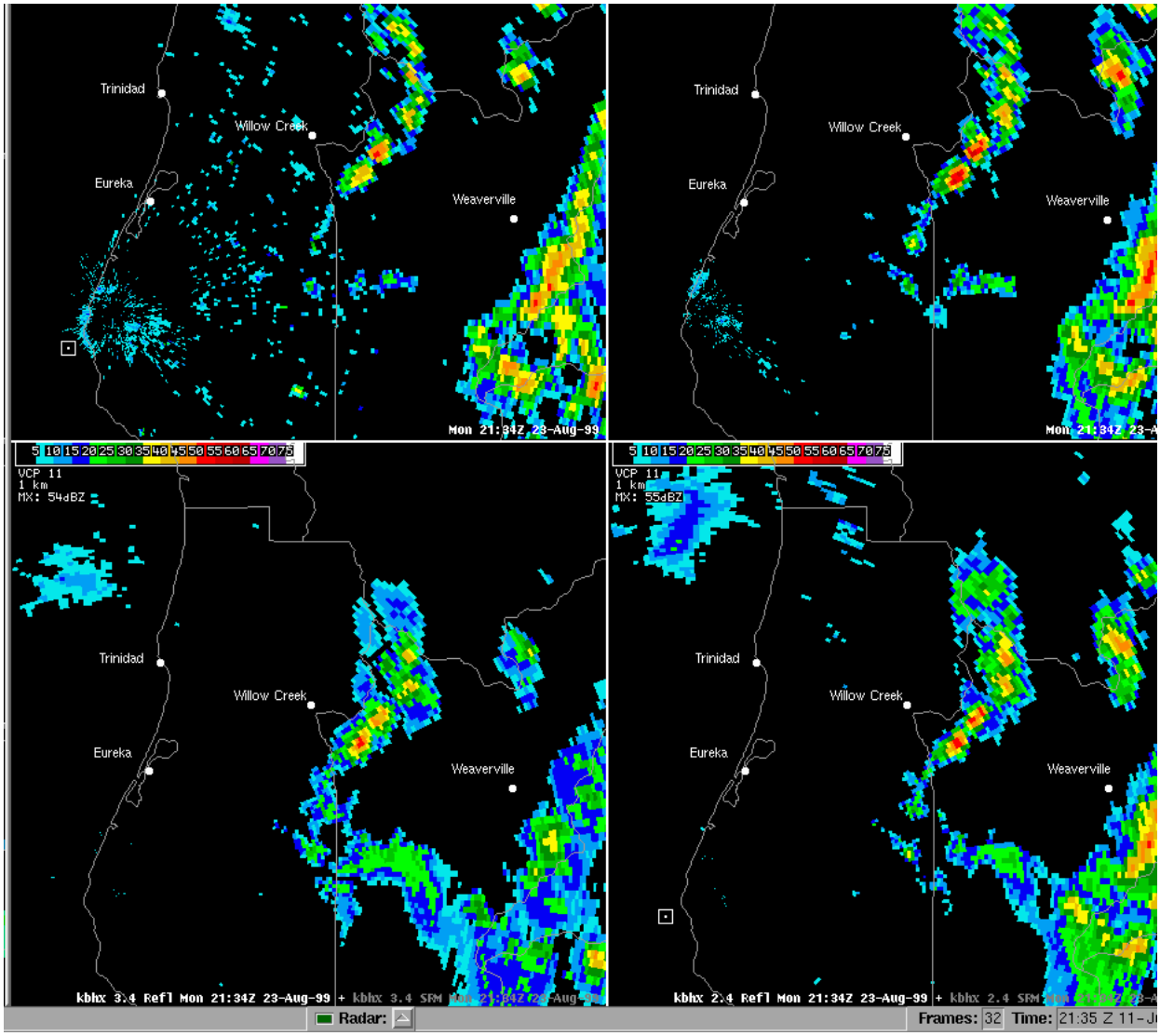
This report generated using Vaisala FALLS® software
NOAA; Vaisala #200773
Lightning stroke data within: Lat 40.5n - 41.5n; Lon

Figure 4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Willow Creek
Eureka
Weaverville
Mon 21:34Z 23-Aug-99
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VCP 11
1 km
MX: 54dBZ
MX: 55dBZ
kbhx 3.4 Refl Mon 21:34Z 23-Aug-99
kbhx 2.4 Refl Mon 21:34Z 23-Aug-99
Radar:
Frames: 32
Time: 21:35 Z 11-