

An Examination of a Lightning Event in the San Francisco Bay Region Using the Weather Event Simulator

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Introduction

Beginning approximately 0530Z 26 August 2003 (10:30 pm PDT 25 August), isolated lightning strikes were detected along the border between San Benito and Monterey counties in the southern portion of the Monterey National Weather Service Office (WFO) County Warning Area (CWA). An infrared satellite image for 0530Z ([Fig. 1](#)) shows the incipient convective development propagating northward through the border between San Benito and Santa Clara counties, with just 2 associated NLDN-detected cloud-to-ground lightning strikes having occurred in the preceding 15 minutes. During the subsequent 1.5 hours, the associated area of convection significantly intensified and expanded as it propagated northward into Santa Clara and then Alameda and Contra Costa counties ([Fig. 2](#)); between 0645Z and 0700Z there were 81 NLDN-detected lightning strikes.

Lightning strikes in the rural interior of Santa Clara County resulted in several wildfire starts, which ultimately grew into the 31,000 acre Santa Clara Complex Fire. The largest emergency fire shelter deployment in California history took place in this fire complex on 29 August when 55 firefighters were forced to deploy their shelters. Unlike across most of the rest of the U.S., warm season thunderstorm and lightning events are relatively rare in the WFO Monterey CWA.

This WES case, then, was intended to provide our forecasters with the opportunity to examine in detail a significant local convective outbreak, especially with respect to fire weather considerations. Also, unlike most previous WES exercises done at WFO Monterey, this case was suitable for taking advantage of the displaced real time (DRT) capabilities of WES and thus of simulating the sort of critical situational awareness issues that do, at least on infrequent occasion, locally arise.

Overview of WES Exercise

The forecasters started this WES case as if it were 10:45 pm (0545Z 26 August) on August 25, and let it run forward in displaced real time mode for one hour, until 11:45 pm (0645Z 26 August). The overnight shift at WFO Monterey starts at 11:00 pm, so this more-or-less simulates the situation as confronted by the then newly-arriving duty forecaster. During the 1-hour DRT-mode playback, the forecasters were asked to decide in real time what short-fused products (if any) they would issue and when. Although this exercise was primarily motivated by fire weather considerations, the forecasters were not told this. So, during the DRT-mode playback, they had to consider the possible need for issuance of any of the full range of short-fused public, aviation and marine products. Quick development of the appropriate situational awareness, then, is thus an additional facet of this exercise. Here are the actual questions the forecasters were asked to consider as the playback unfolded (note that some spotter-type reports are also included at the appropriate times):

- 1) At or before 06:10z, would you consider issuing a Flash Flood Watch? Yes/No and Why? If yes, list the specific zones.
- 2) At or before 06:10z, Select NCEP/Hydro-> Fire Weather -> Day1. You remember the SPC fire weather forecaster starts the overnight Planet12 chat around this time. Would you consider a chat with him to discuss the Day 1 dry lightning outlook only being over Montana?
- 3) At 06:15z the CDF office in Santa Clara County calls to report small lightning caused fire starts in southern areas of their county. They also ask for lat/lon info of lightning data. Consider any actions you would take?
- 4) At 06:17z the Harbormaster at Moss Landing calls to report frequent lightning and hail. He asks you to consider issuing a Special Marine Warning. What do you do?
- 5) At any point during the hour would you issue a Red Flag Warning for dry lightning? A Flash Flood Warning? A Severe Thunderstorm Warning? A Tornado Warning? A High Wind Warning? or a Wind Advisory? If yes, use WarnGen to issue the short-term warnings (excluding red flags).
- 6) At any point during the hour would you Planet12 chat or call the SPC mesoscale/convective forecaster?
- 7) Would a Rapid Scan request be useful? Why or why not?
- 8) What was the meteorological trigger for this convective event?
- 9) List any other specific products you would issue and or update as well as significant actions you would take to best handle the situation.

Background Information

The summer of 2003 was unusual for the Monterey CWA in that there were at least four distinct lightning outbreaks in association with surges of monsoonal moisture. In contrast, it is not uncommon to go the entire summer season without local lightning events, with perhaps one or two being the "average." In the summer of 2003, the first two of these lightning events occurred in rapid succession in late July. This WES case considers the third of these outbreaks in late August 2003 (which was shortly followed by another lightning event in early September.) Partly as a result of this above-normal lightning activity, renewed debate ensued within the fire weather community (including the Geographic Area Coordination Centers, GACCs, in Redding and Riverside) over the exact criteria for issuance of Red Flag Warnings for dry lightning. With this debate then continuing through the off-season, it's important to ensure all of our forecasters are aware of the current operational protocols regarding dry lightning -- thus providing additional motivation for the selection of this case as a WES exercise.

To simply forecast lightning, regardless of whether it's best characterized as "wet" or "dry," remains a daunting challenge. Furthermore, the criteria for issuance of a Red Flag Warning for dry lightning are among the most subjective of those for all NWS short-fused products. In the latest California Fire Weather Annual Operating Plan, "dry lightning" is defined as:

A lightning event that is not accompanied by enough precipitation to significantly wet fuels that have been identified as critically dry. Significant precipitation is defined as ranging from .05 inches for grass or brush fuels to .15 inches for closed-canopy timber/heavy fuels.

Therefore, one of the key questions to consider during this WES case was whether or not to issue a Red Flag Warning for dry lightning.

Meteorological and Fire Weather Discussion

Water vapor imagery from 0600Z 26 August ([Fig. 3](#)) indicates a short-wave trough moving northeastward into coastal central California. Superimposed Eta model initialized 500 mb heights include this feature, but the model representation appears to be both too weak and displaced too far to the southwest. As this shortwave trough subsequently moved northeastward towards the San Francisco Bay Region, it interacted with monsoonal moisture advecting into the region from the southwest. As is usually the case with dry lightning events, there was no clear-cut right or wrong answer as to whether or not the lightning was "dry." The main area of thunderstorms passed over a data sparse region of Santa Clara County, so ground-based rainfall reports were limited. The 0000Z 26 August Oakland sounding ([Fig. 4](#)) indicated a deep and dry sub-cloud layer, more suggestive of dry rather than wet thunderstorms. Thus, despite significant 88D base reflectivities ([Fig. 5a](#)) and radar-estimated 1-hr QPF ([Fig. 5b](#)), it was certainly quite possible a little rain was actually reaching the ground - which, in fact, was later substantiated by the limited number of surface precipitation reports received from within the region traversed by these thunderstorms.

In this exercise, then, if the forecasters gave valid scientific reasoning for not issuing a Red Flag Warning for dry lightning, that was considered an acceptable decision. However, at the very least, during the exercise all forecasters should have decided to update the Fire Weather Forecast and "headline" for the increased lightning activity as well as the possibility for dry lightning. In the end, this event sparked a 31,000 acre wildfire that cost over \$10 million to suppress, so the rapid issuance of a Red Flag Warning for dry lightning was the most appropriate action to take.

Figure 1

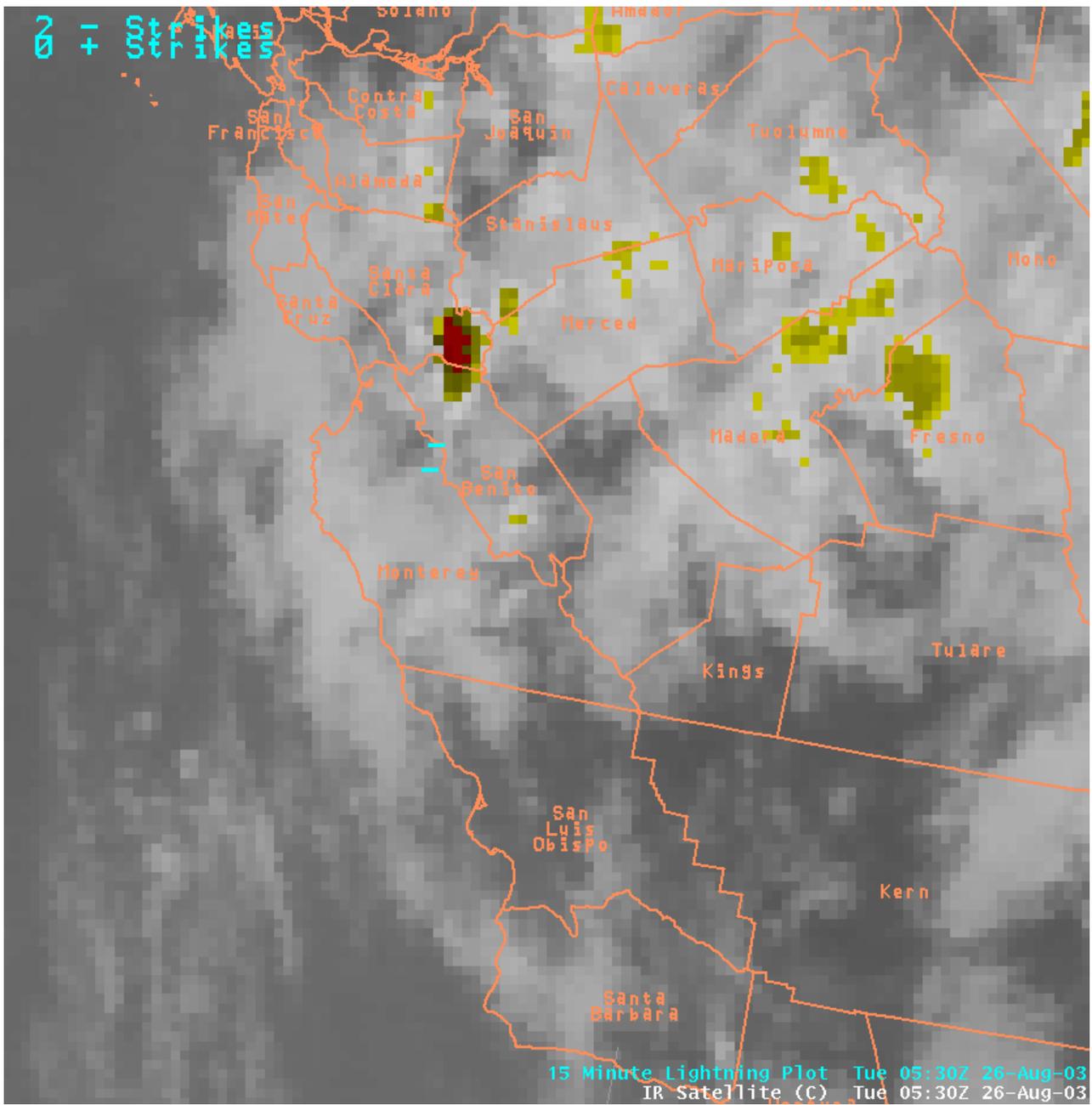


Figure 2

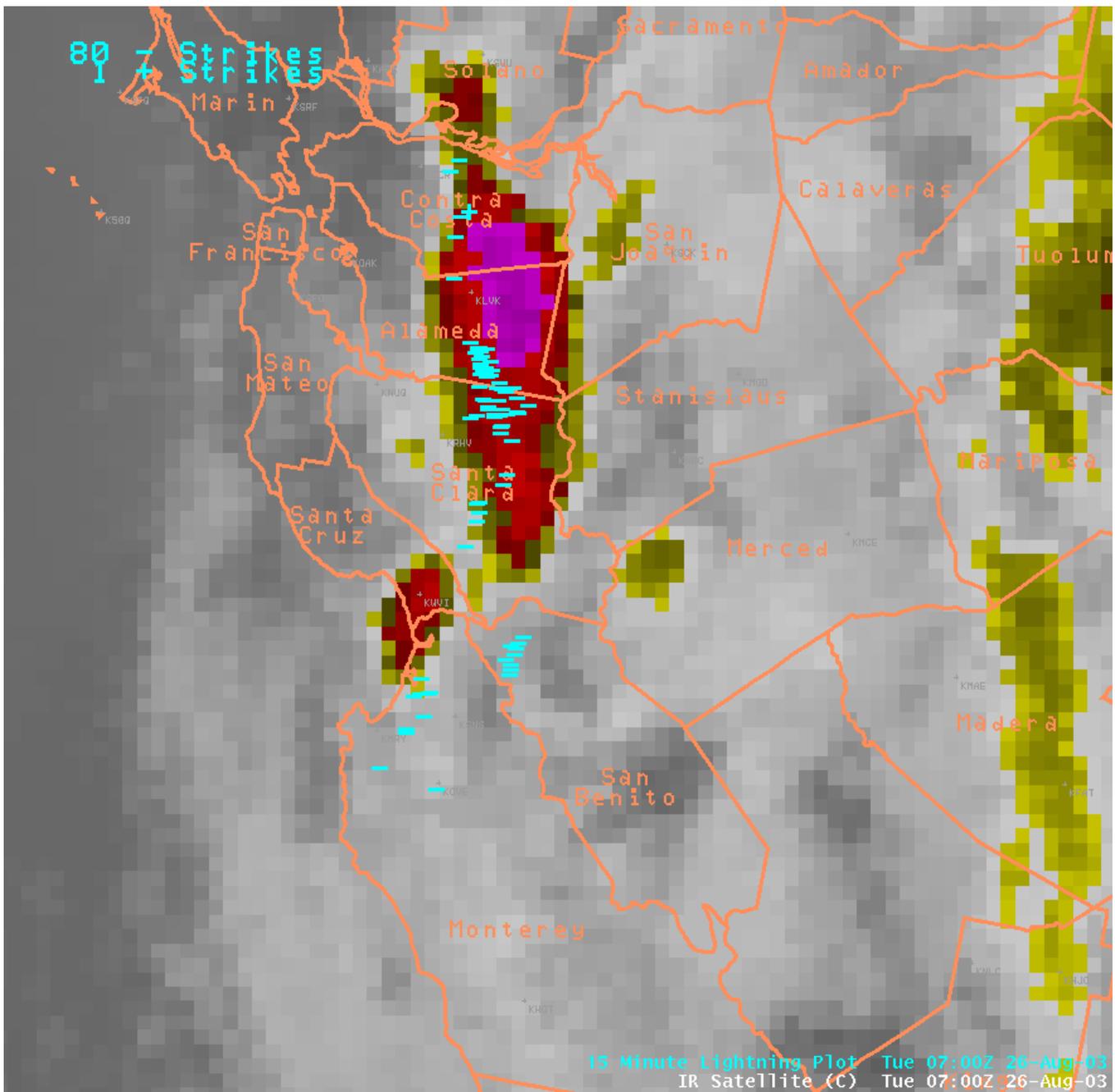


Figure 3

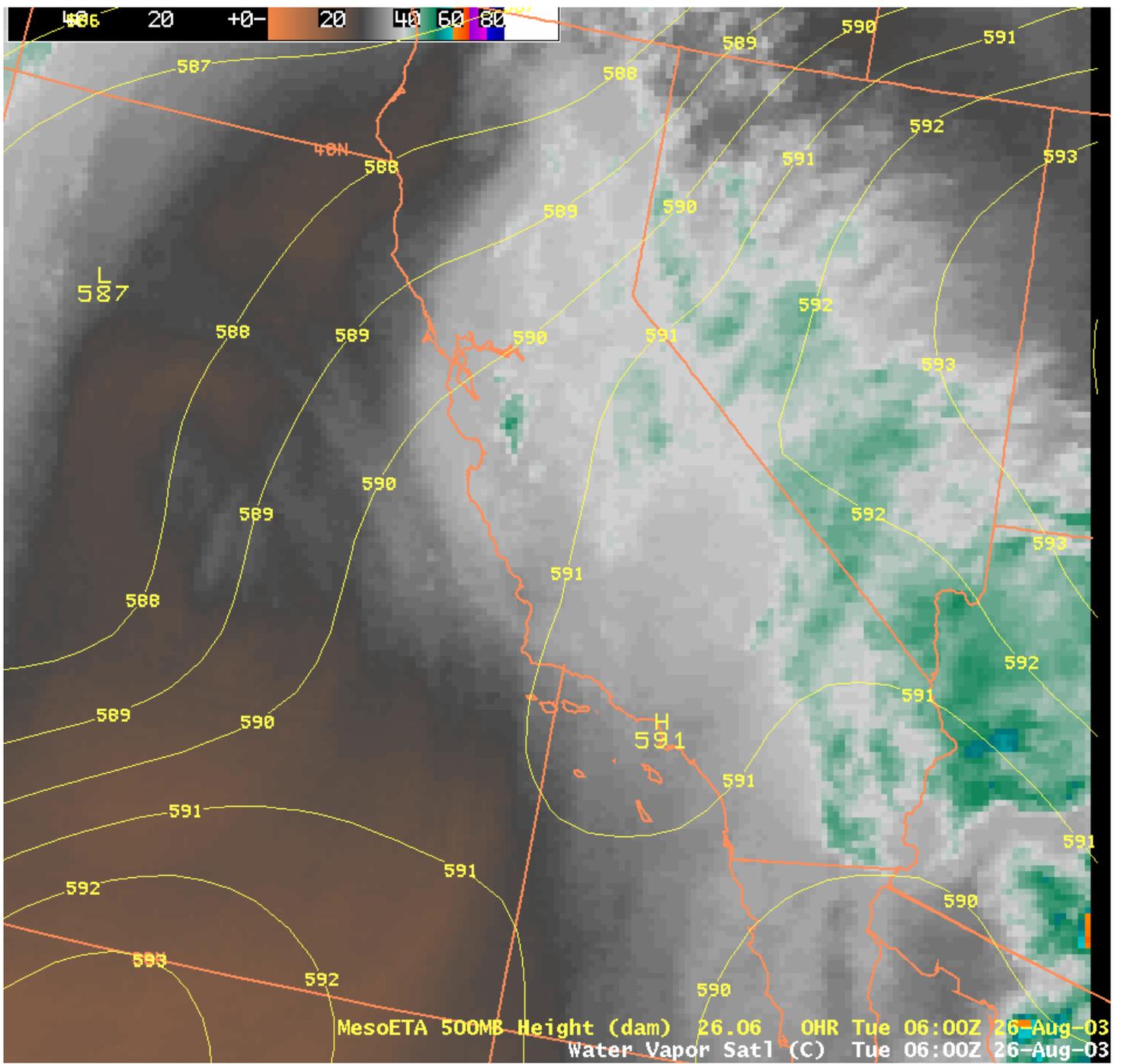


Figure 4

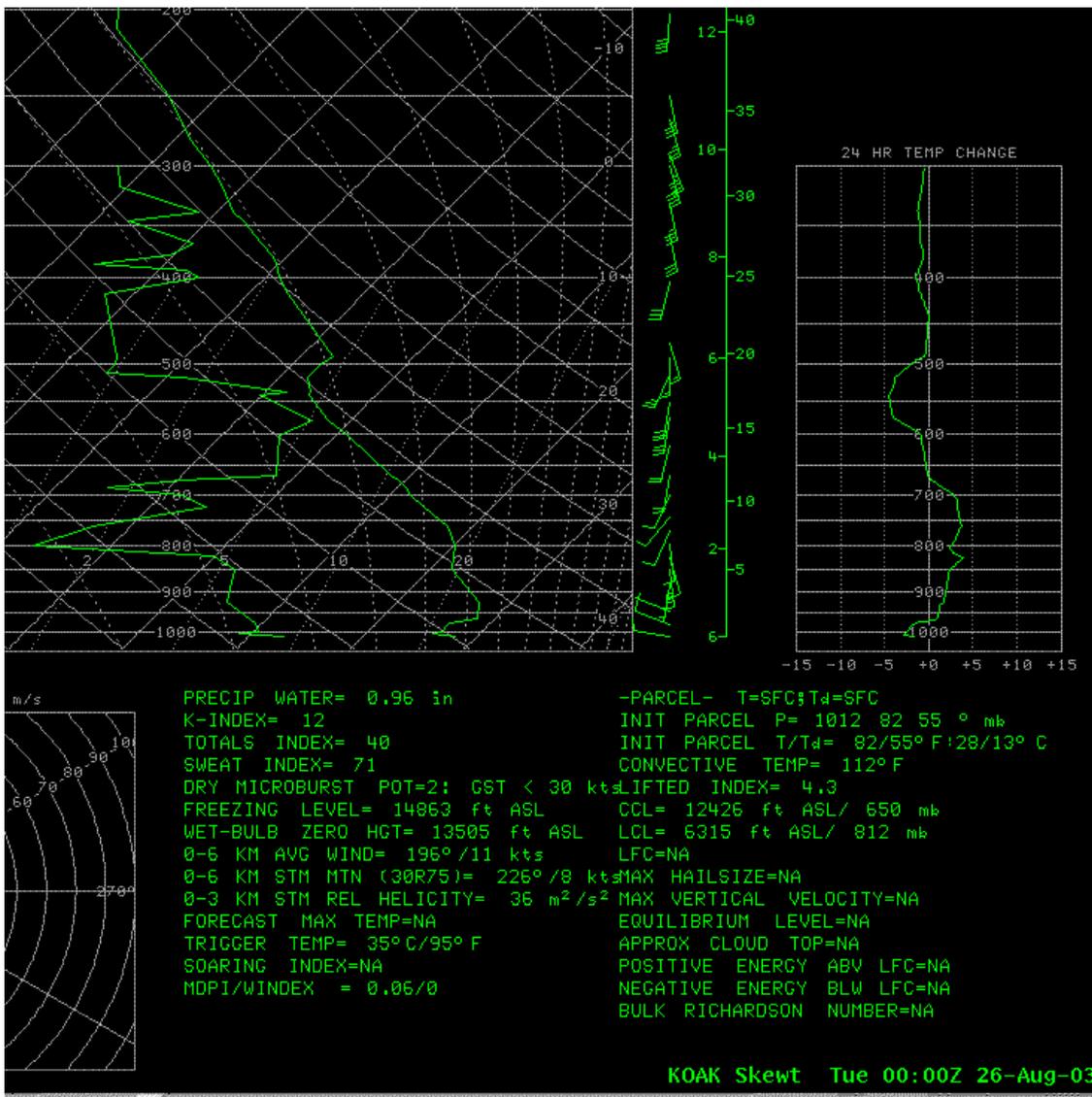


Figure 5a

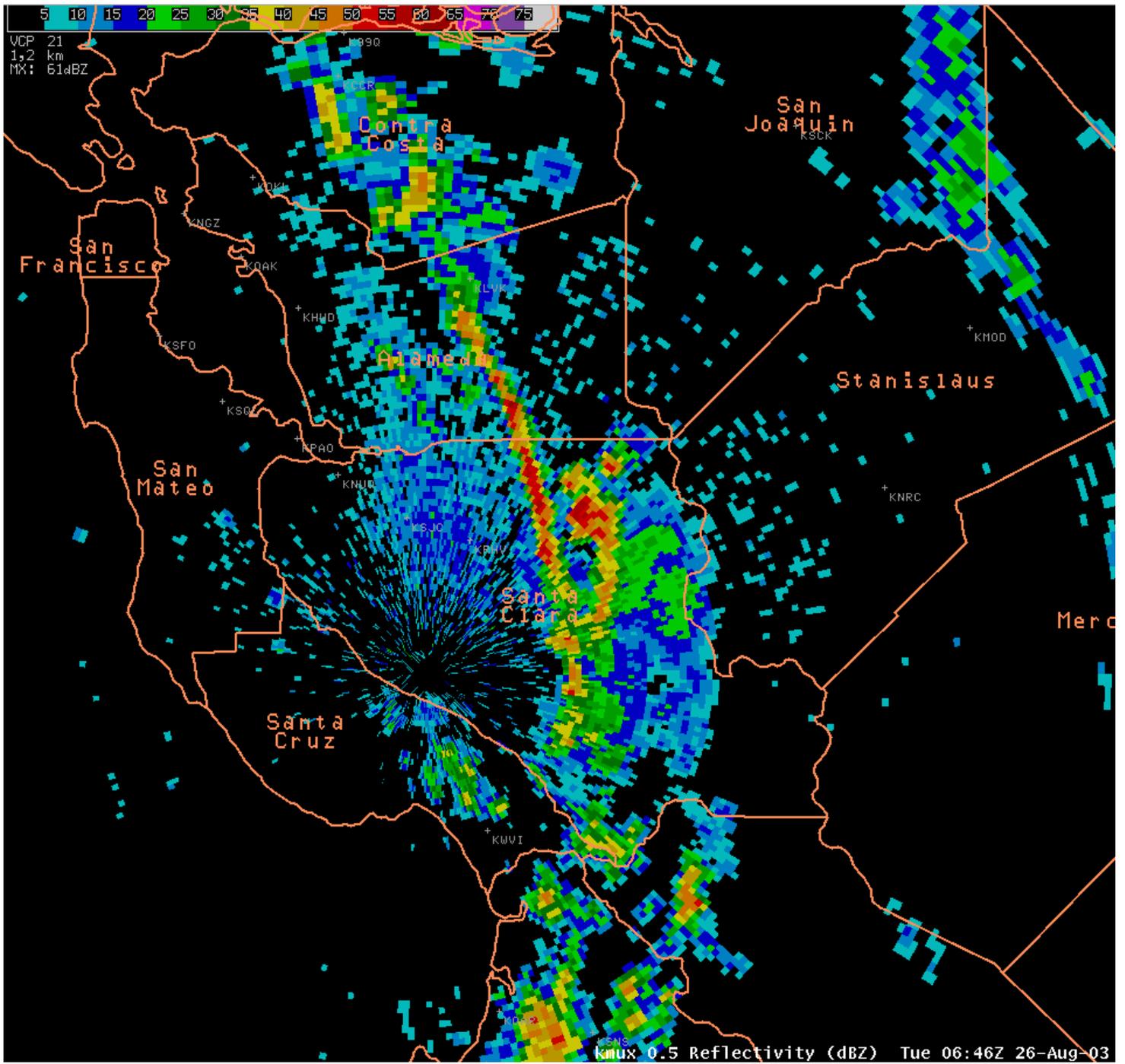


Figure 5b

