A Cold Spring Storm Producing Severe Weather and Heavy Snowfall in Northern California

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INTRODUCTION

May 20, 2002 was an unseasonably active weather day in Northern California. Five tornado warnings, nine severe thunderstorm warnings, seventeen severe weather statements, seven urban and small stream flood statements, two winter storm warnings, and three snow advisories were all issued for the daytime period by WFO Sacramento. The heavy snow products continued into the night. While the time of year may not be considered by many to be winter, two-day precipitation totals spanning late on the 19th to early on the 21st of one to three inches suggest otherwise as do measurable snow accumulations down to elevations of 3500 feet. It was this unique combination of winter and severe convective weather that suggested this case to be useful for the training and education of the WFO Sacramento forecast staff.

EVENT SYNOPSIS

For the three days preceding May 20, an unseasonably cold pattern had developed in the eastern Pacific, with heights of the 500 mb isobaric surface just off the west coast around 5400m, roughly 300m lower than 1948-2000 climatological normals for May. Temperatures at 500mb associated with this cold cyclone were measured as low as -25 to -30 C (Fig. 1). The flow over the Pacific Northwest had been south to southwest and cyclonic, producing favorable conditions for upslope-enhanced precipitation over the Southern Cascades since the 17th, but as the pattern was indicative of an ‘omega'-type block, Northern California had only begun to see precipitation during the day on the 19th as the closed low slowly propagated east-southeast.

By early Monday, May 20th, lines of showers with isolated embedded thunderstorms were occurring over the Northern California coastal range and advecting into the Sacramento Valley (Fig 2). Meanwhile, a Winter Storm Warning had been issued for the Northern Sierra and Lassen Park area as snow was already falling below 5000 feet. Model forecasts indicating the low tracking more easterly and less southerly during the day suggested increased upslope enhancement over the Sierra, and increased instability producing favorable conditions for locally very heavy snowfall.

As the morning progressed, the area of organized showers had moved across the valley and into the Sierra Nevada with heavy snow now affecting the heavily traveled Interstate 80 corridor and some snow falling as low as 3500 feet. Observed and model soundings indicated CAPE over Northern California in the range of 800 - 1200 J/kg (Fig 3). This instability was only expected to increase with continued cold advection expected in the 700-400mb layer (Fig 4). and visible satellite imagery indicating significant breaks in the cloud cover in the valley for increased low level diabatic heating (Fig 5). This instability would support the formation of some funnel clouds and locally strong thunderstorms, but even with south to southeasterly low level winds, shear and helicity were not expected to become significant enough to support rotating thunderstorms. The main threat would be hail, with a deep layer of subfreezing air above the valley coinciding with potentially strong updrafts, as well as locally heavy rain.

Rapid development from showers to strong thunderstorms was observed in satellite and radar data between 1100 and 1200 PDT over the Sacramento Valley and portions of the Sacramento Delta and Northern San Joaquin Valley. Spotter reports of hail began shortly before noon and escalated to a report of a tornado on the ground just after noon in Sutter County north of Marysville (Fig 6). Cell movement was primarily to the northeast, with those cells showing strong tenancies of propagation to the east usually ending up producing the most severe weather. Storm persistence was variable, with most storms lasting less than 30 minutes and development of the strongest storms usually occurring on the southernmost flanks of the lines.

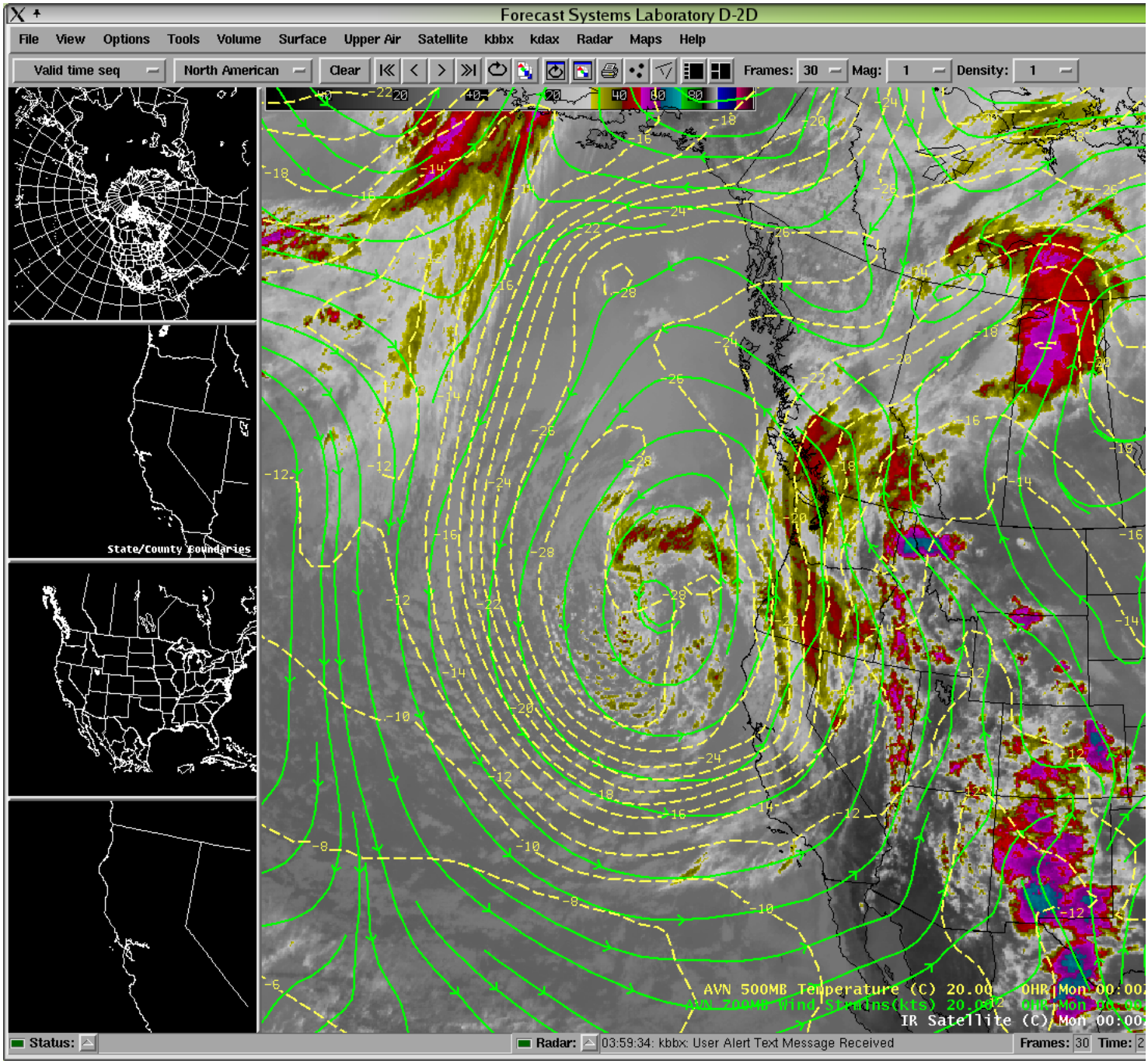
As the afternoon progressed, reports of severe hail associated with the storms continued, with the focus shifting from the Southern Sacramento Valley and Delta southeastward into the Northern San Joaquin Valley and adjacent Motherlode (Sierra Foothills) as the low moved toward the North Coast. Toward evening, funnel cloud reports continued and one last severe storm produced penny sized hail just south of Sacramento around 1830 PDT.

Documented severe weather from this event included one confirmed and one unconfirmed tornado and seven large hail reports. Damage itself was minimal.

CONCLUSIONS

This very anomalous event produced quite anomalous weather. While spring storms can bring snow to the Northern California mountains as late as June, to have measurable snow accumulate at 3500 foot elevations is remarkable. In addition, a day of numerous severe thunderstorms in the Central Valley is a relatively infrequent event to begin with, much less to have this day occur at what would be considered the tail end of the season in which sufficient low level moisture would be present. Fortunately, the forecasters on duty during this unusual event recognized it as such and responded with the appropriate level of awareness and readiness. This case lent itself to be used as an exercise in either a heavy snow event or a severe weather event. It is envisioned that both will be utilized in the future for enhanced forecaster training in situational awareness, perhaps in combination with each other.

Figure 1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Radar:
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Frames: 30
Time:

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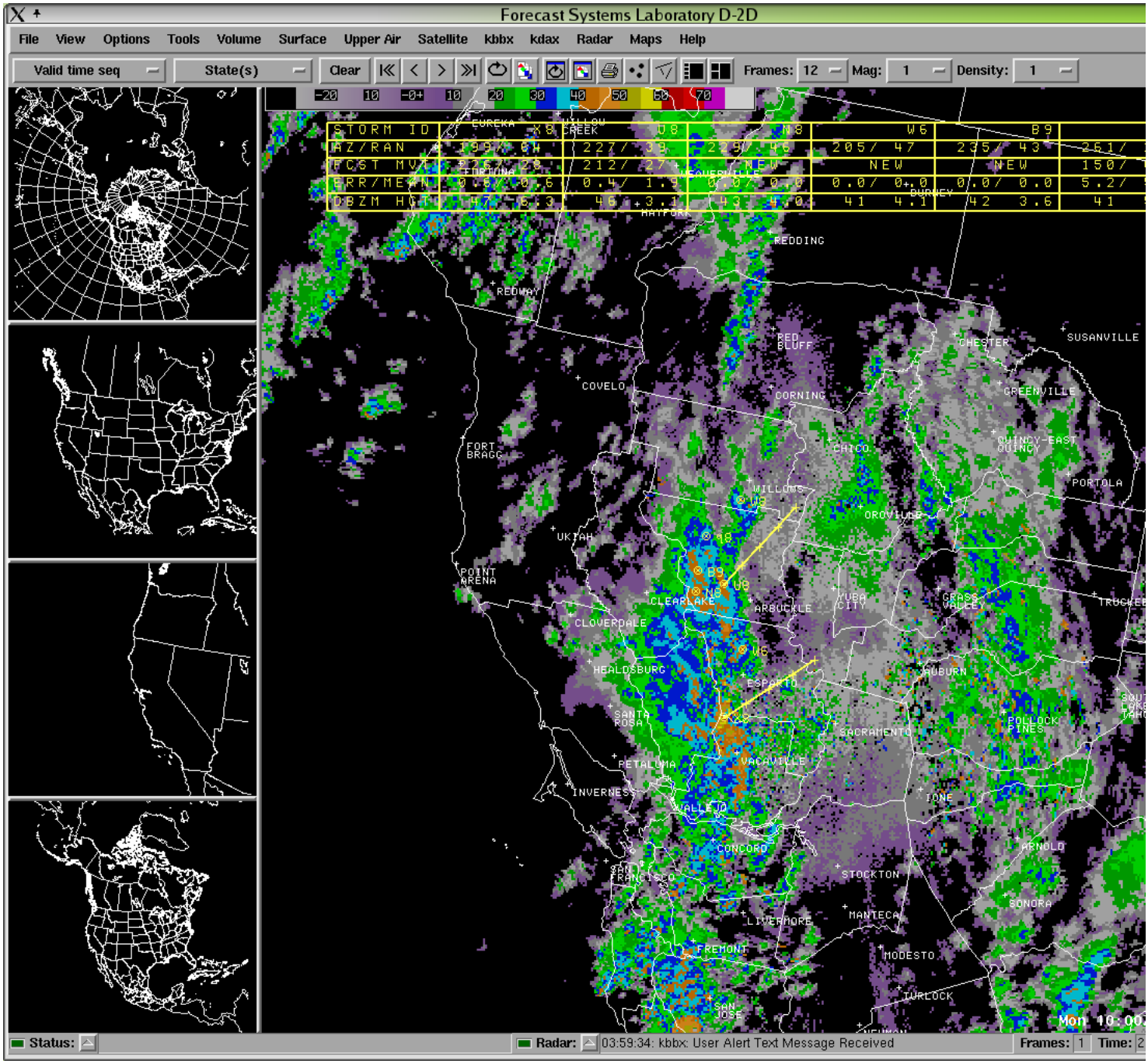
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ERR/MEAN
OBZM HGT
EUREKA
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REDDING
REDWAY
RED BLUFF
CHESTER
SUSANVILLE
COVELO
CORNING
GREENVILLE
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QUINCY-EAST QUINCY
PORTOLA
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POINT ARENA
CLEARLAKE
ARBUCKLE
YUBA CITY
GRASS VALLEY
TRUCKEE
CLOVERDALE
HEALDSBURG
AUBURN
ESPARTO
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POLLOCK PINES
SACRAMENTO
PETALUMA
VACAVILLE
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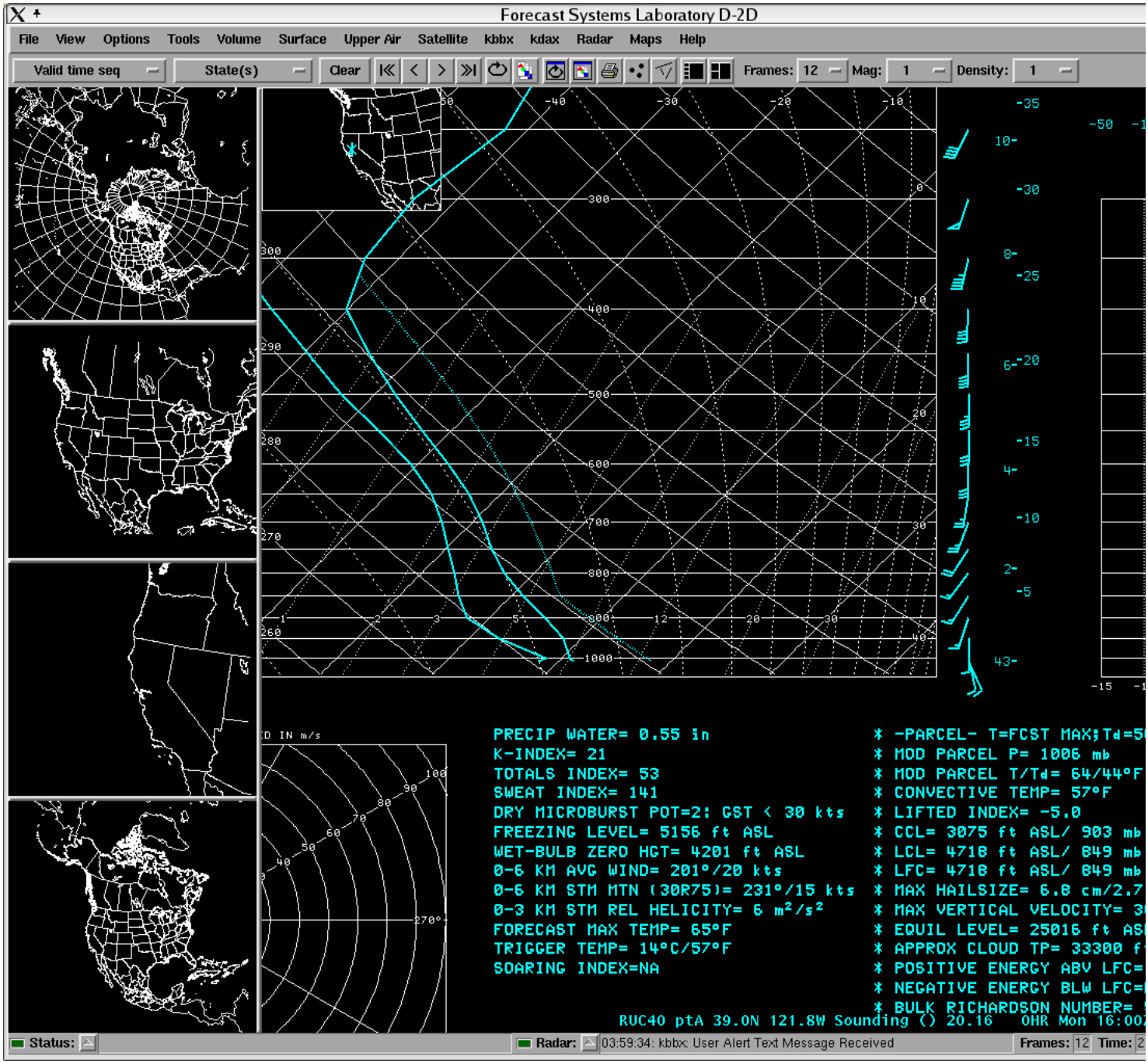
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K-INDEX= 21
TOTALS INDEX= 53
SWEAT INDEX= 141
DRY MICROBURST POT=2: GST < 30 kts
FREEZING LEVEL= 5156 ft ASL
WET-BULB ZERO HGT= 4201 ft ASL
0-6 KM AVG WIND= 201°/20 kts
0-6 KM STM MTN (30R75)= 231°/15 kts
0-3 KM STM REL HELICITY= 6 m²/s²
FORECAST MAX TEMP= 65°F
TRIGGER TEMP= 14°C/57°F
SOARING INDEX=NA
* -PARCEL- T=FCST MAX;Td=5
* MOD PARCEL P= 1006 mb
* MOD PARCEL T/Td= 64/44°F
* CONVECTIVE TEMP= 57°F
* LIFTED INDEX= -5.0
* CCL= 3075 ft ASL/ 903 mb
* LCL= 4718 ft ASL/ 849 mb
* LFC= 4718 ft ASL/ 849 mb
* MAX HAILSIZE= 6.8 cm/2.7
* MAX VERTICAL VELOCITY= 3
* EQUIL LEVEL= 25016 ft AS
* APPROX CLOUD TP= 33300 f
* POSITIVE ENERGY ABV LFC=
* NEGATIVE ENERGY BLW LFC=
* BULK RICHARDSON NUMBER=
RUC40 ptA 39.0N 121.8W Sounding () 20.16 0HR Mon 16:00
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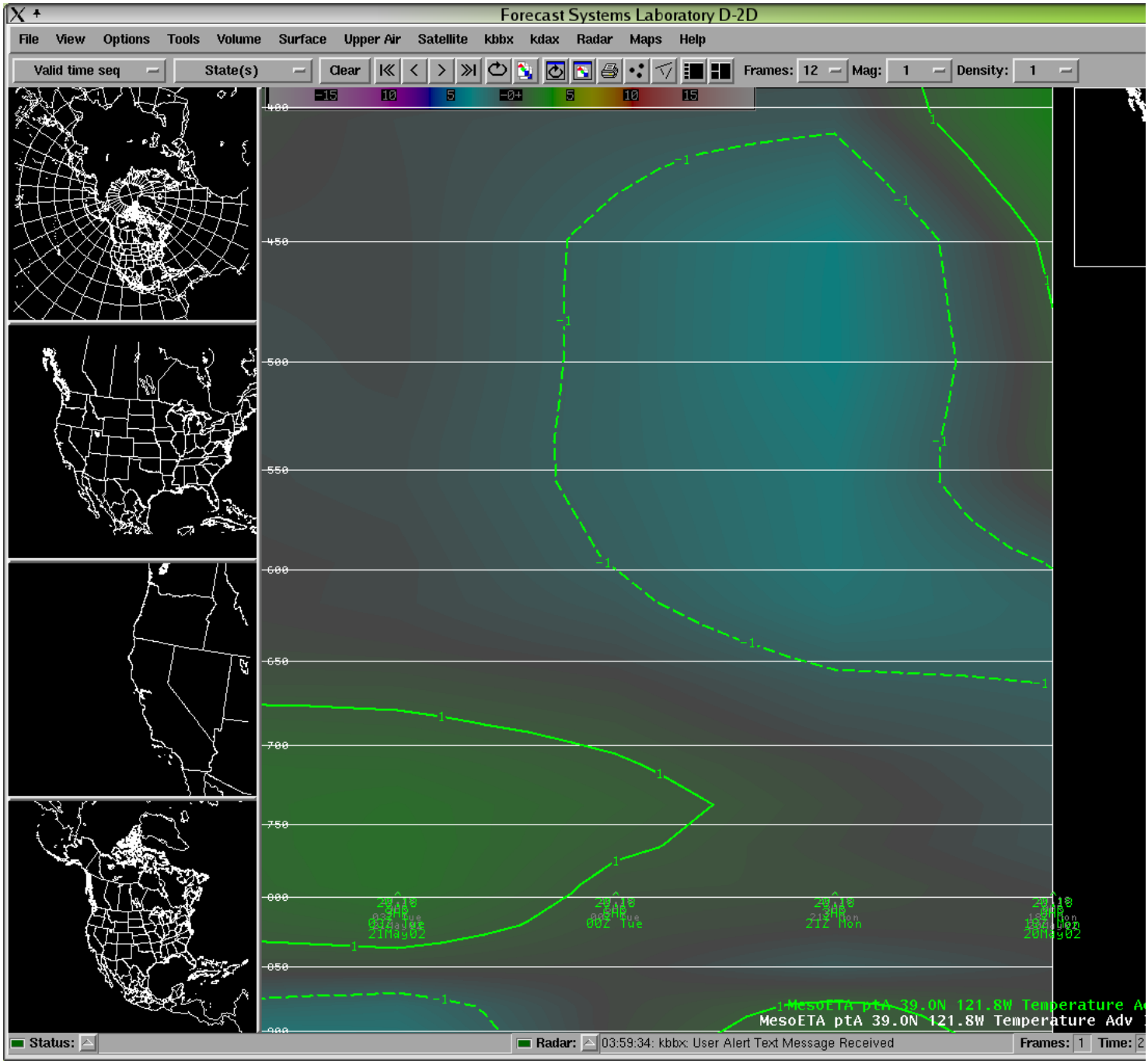
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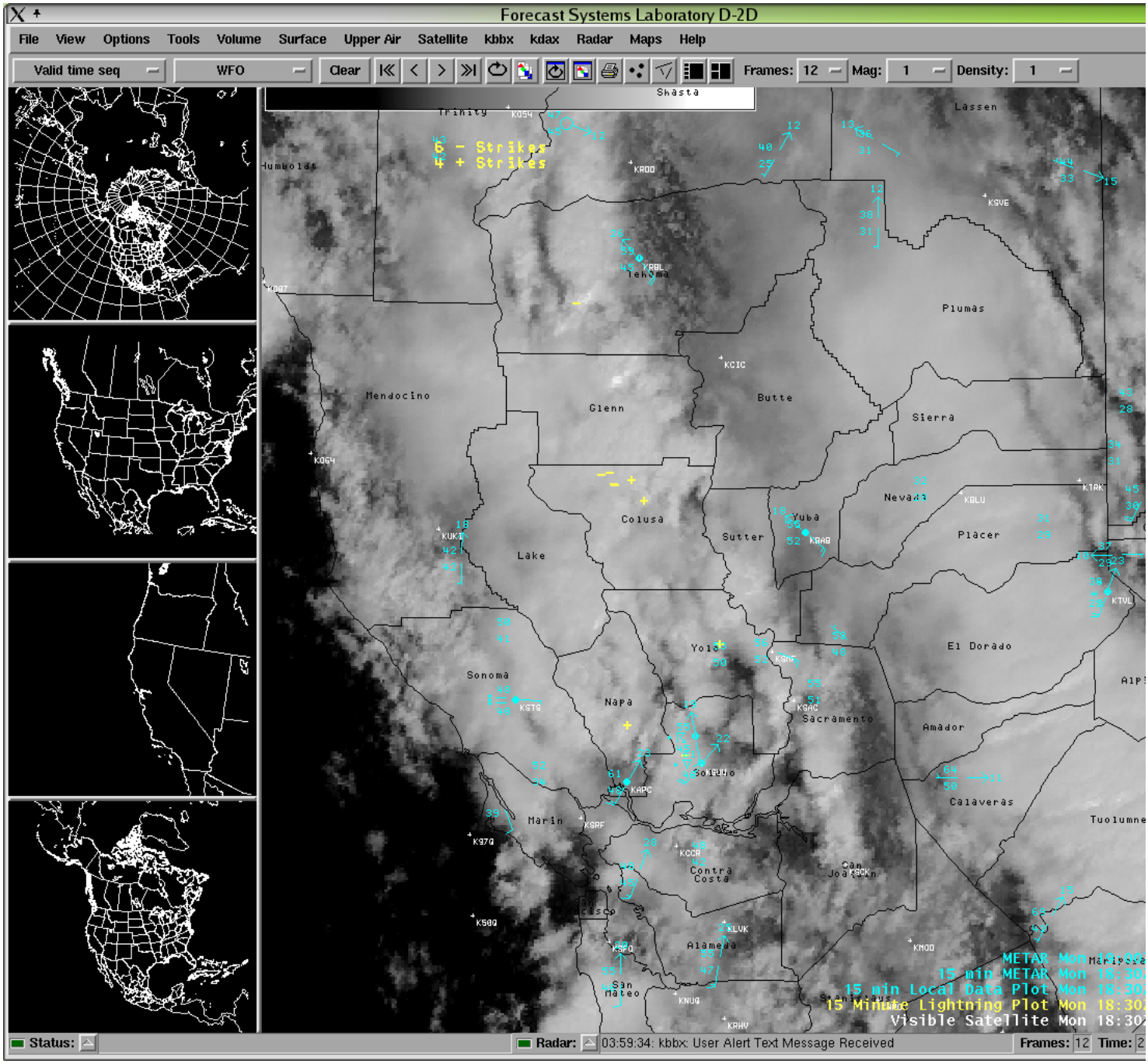
Figure 5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Trinity
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Mendocino
Glenn
Butte
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Colusa
Sutter
Yuba
Nevada
Placer
Lake
Yolo
El Dorado
Sonoma
Napa
Sacramento
Amador
Calaveras
Tuolumne
Marin
Contra Costa
Alameda
San Mateo
15 min METAR Mon
15 min Local Data Plot Mon
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Visible Satellite Mon
Status:
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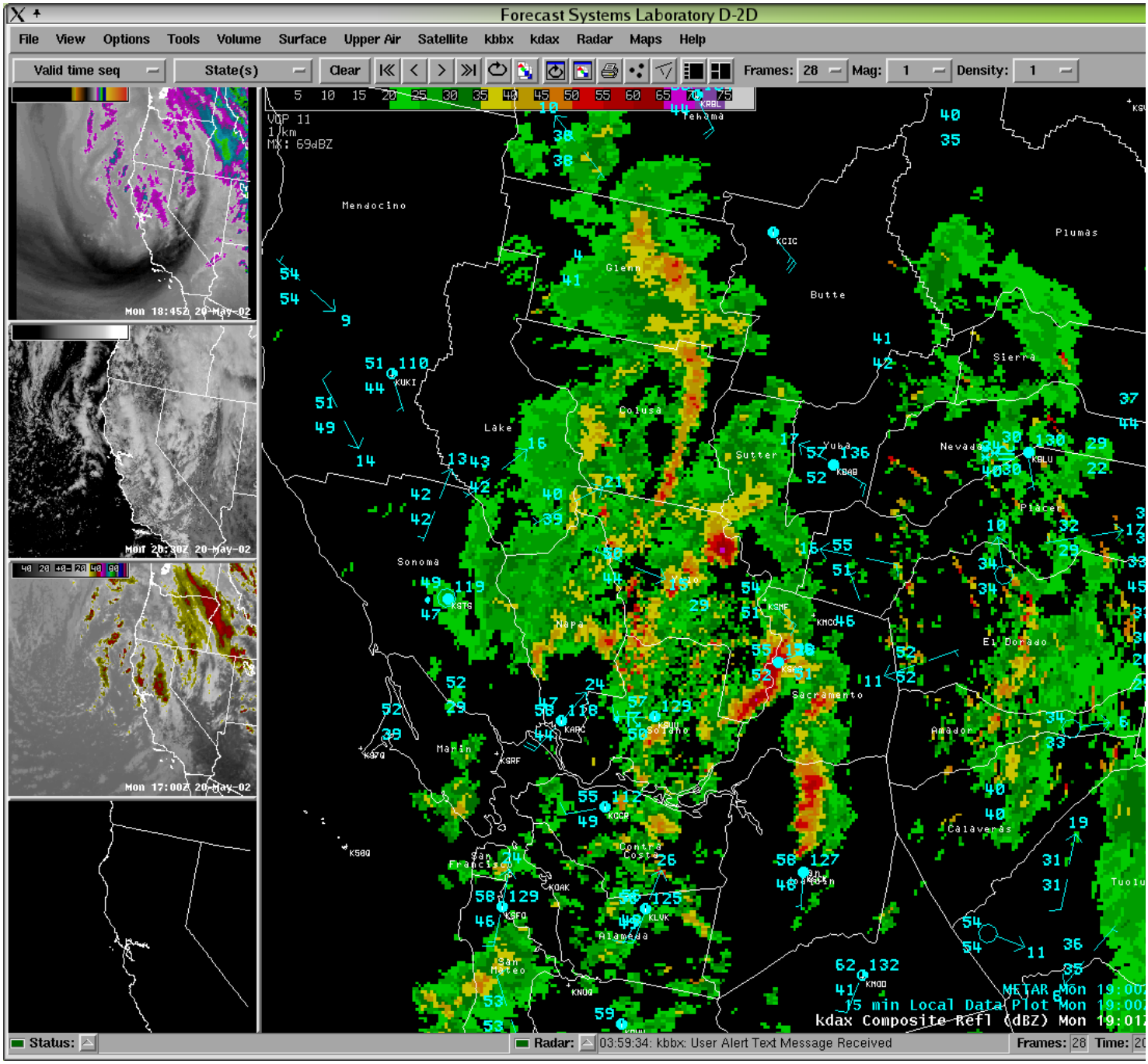
Figure 6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MX: 69dBZ
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Mon 17:00Z 20-May-02
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Glenn
Butte
Plumas
Tehama
Lake
Colusa
Sutter
Yuba
Sierra
Nevada
Placer
Sonoma
Napa
Yolo
Sacramento
El Dorado
Amador
Solano
Marin
Contra Costa
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KMOD
METAR Mon 19:00
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