Abstract

A climatological study of 100 mm or greater days in northern California

Norman W. Junker
National Weather Service
HPC/NCEP
Camp Springs MD 20746
Email: norman.junker@noaa.gov

Richard H. Grumm
National Weather Service
State College, PA
Email: richard.grumm@noaa.gov

Robert Hart
Florida State University
Department of Meteorology
404 Love Building
Tallahassee

Lance F. Bosart
The University of Albany/SUNY
Dept. of Earth and Atmospheric Sciences
1400 Washington Avenue
Albany, NY 12222
Email:bosart@atmos.albany.edu

Introduction:

A 10-year climatology of 100 mm (4 inch) and greater rainfall events was constructed from Official NCEP Hydrometeorological Prediction Center precipitation analyses as described in Junker et al. (2002), Cases were observed from mid-October until mid-May. However, the bulk of the cases occurred from late November-March with a distinct maximum occurring during the winter months.

However, significant season-to-season variation in frequency was observed. For each case, the mean-sea level pressure and 500 hPa height analysis at 0000 UTC and 1200 UTC were examined to establish which time was most likely closest to the beginning of the event. Gridded fields for these times were then compared to the daily climatological means from the 30-year period from 1961-1990 as described by Grumm et al. (2000). GRADS(http://grads.iges.org/grads/) was used to compute and plot deviations from normal of selected parameters and diagnostic fields at standard levels from the 30-year normal for each event. Composites were constructed of various parameters for 18 of the 100-mm or greater event that had almost identical locations (39^o to 40^oN and 120.5^o to121^oW) of their maximum precipitation in the Sierra Nevada range of northern California. Monthly mean charts of 500 hPa heights, 850 hPa winds and precipitable water were constructed for the 2 months with the most observed 100 mm events and the 2 months with the fewest observed events.

The two “dry” months were associated with above normal 500 hPa heights across the Pacific Northwest and central and northern Rocky mountain states while also having a below normal u-component of the 850 hPa winds over northern California.

The two “wet” months had an axis of stronger than normal u-component 850 hPa winds extending into California. The composite mean 500 hPa of each "wet" month exhibited a negative anomaly centered near 30°N 160°W that extended to the west or southwest past the dateline while having a positive anomaly to its east or southeast.

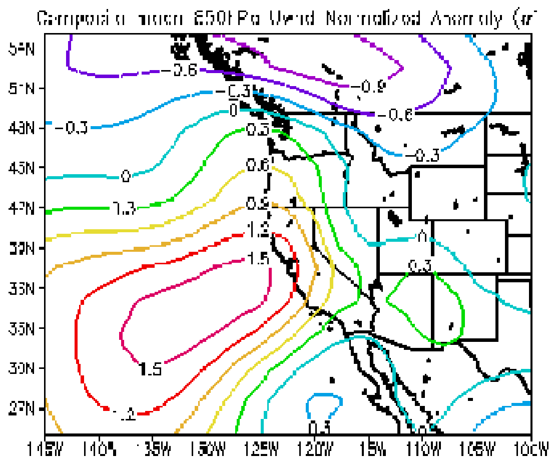

Figure 1. Composite mean normalized 850 hPa u-wind component anomaly. The plot shows the number of standard deviations that the composite mean varied from normal (interval=0.3 standard deviations)

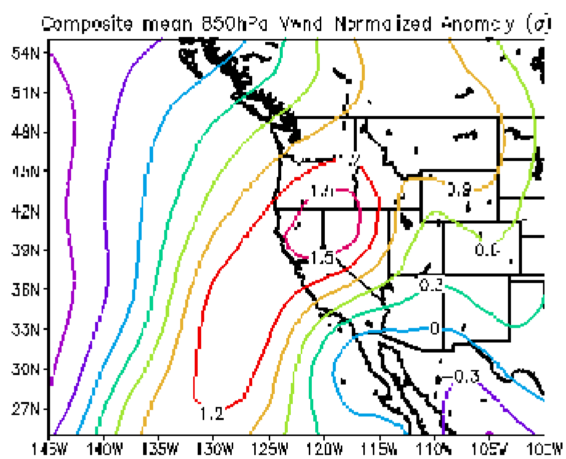

Figure 2. Composite mean normalized 850 hPa v-wind component anomaly. The plot shows the number of standard deviations that the composite mean varied from normal (interval=0.3 standard deviations)

The eighteen case 100 mm or greater event composites displayed a synoptic pattern with below normal heights at 850 and 700 hPa off the Pacific Northwest coast and above normal heights over Baja California, a pattern very similar to the one found by Pandey et al (1999). Southwesterly winds were present at 850 and 700 hPa with stronger than normal u and v components of the 850 wind (Fig. 1 and 2).

The composites also displayed anomalously high precipitable water (Fig. 3) and strong 850 hPA and 1000-700 hPa moisture transport in a band extending from 30°N 135°W north-eastward into northern California. A composite of the 250 hPa wind field suggested the presence of the entrance region of a jet streak over northern California.

Similar fields were examined for three multi-

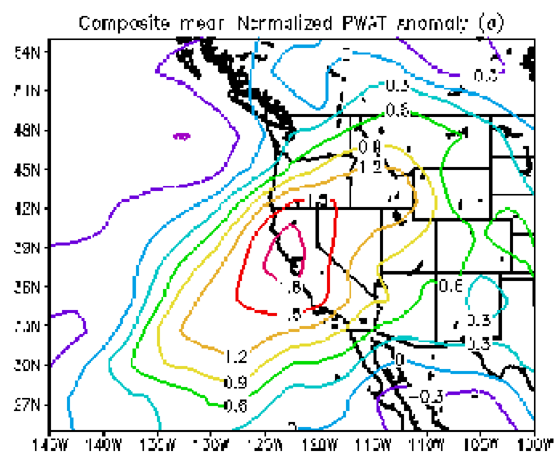

Figure 3. 18-case composite mean normalized precipitation anomaly. The plot shows the number of standard deviations that the composite mean varied from normal (interval=0.3 standard deviations

day, extreme rainfall events that produced major flooding or flash flooding in Northern California (each was associated with a federal disaster declaration) were then compared to the 100 mm or greater composites. The width of the axis of above normal moisture transport was significantly wider for each day of these three more extreme events than was found for the 18-case composite. The magnitude of the departures from normal were also greater, especially for the moisture transport and precipitable water (not shown).

Conclusions:

The 18-case composites identified anomaly patterns for several parameters that appear to have utility in forecasting major precipitation events in the northern parts of the Sierra Nevada range of California. Anomaly fields from three multi-day heavy rainfall events that led to serious flooding or flash flooding were significantly stronger than those of the 18-case composite. Anomalies of the v-component of the 850 wind and precipitable water were two to four standard deviations from the norm.

A case when 100 mm verified 12 UTC 27 Dec. 2002 was also investigated using model forecasts from the NCEP Eta (12-36 h forecasts) and NCEP GFS (60-84 h) of precipitable water and the 850-hPA v-components of the wind. Each of these fields displayed anomalies of greater than 3 standard deviations from the norm (Figures 5 and 6) suggesting that the models can be used to identify days when there is a high threat of extreme rainfall.

The strength of the height, wind, moisture flux and precipitable water anomalies during these major events suggests that anomalies of these fields could be used to identify cases that have the potential to produce major flooding or flash flooding in Northern

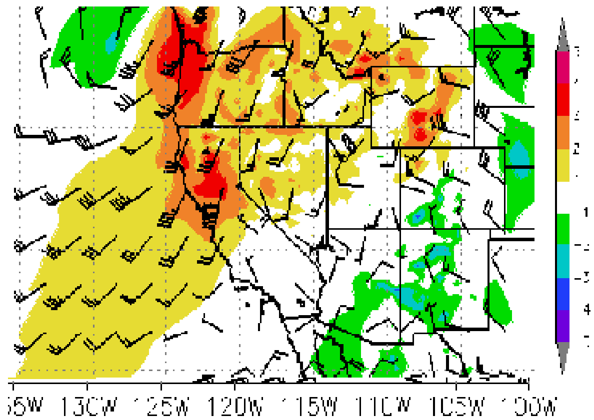

Figure 4. GFS 72-h forecast V. T. 00 UTC 27 Dec 2002 of 850 hPa wind (barbs) and the normalized v-component of the wind, The bar on the right-hand side of figure color code the strength of the anomaly. The dark orange-red indicates a greater than 3 standard deviation from the norm.

California from model forecast fields even if the models' explicit forecasts of precipitation prove to be relatively poor. However, 120-h GFS forecast that had poor mass and wind field forecasts also had poor forecasts of the anomaly patterns suggesting that an ensemble approach might be needed to better capture

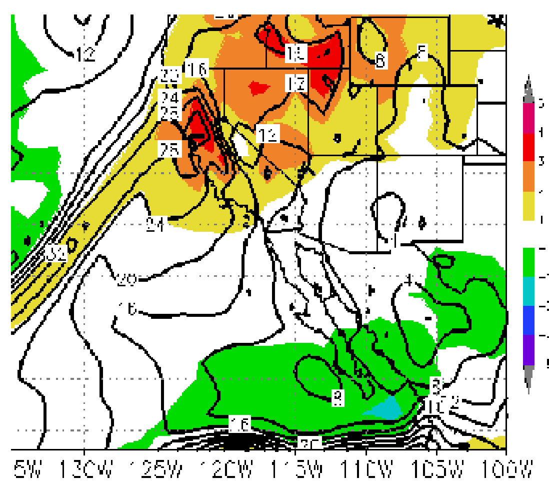

Figure 5. Same as Fig. 5 except for precipitable water. Precipitable water interval=4 mm. The bar at right indicates color coding of strength of the anomaly, the dark orange represents a departure of greater than 3 standard deviations.

the probability of extreme rainfall.

References

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