Title

Assessment of Intraseasonal Variations in California Rainfall and the Role of the Madden and Julian Oscillation

Author
Jones, Charles

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TITLE: Assessment of Intraseasonal Variations in California Rainfall and the Role of the Madden and Julian Oscillation

Principal Investigator: **Dr. Charles Jones**

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FINAL TECHNICAL REPORT

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Summary

California receives most of its annual precipitation during the winter season, with large spatial contrasts and temporal variations being observed in the total rainfall amounts. Currently there is widespread understanding of the implications of large atmospheric and oceanic anomalies to the economy and society of the state of California. Typical of this awareness, is the high level of public and government concern at the onset of El Niño conditions in 1997. Therefore, thorough documentation and understanding of the spatial and temporal variability of precipitation in California is a key element in developing efficient and successful programs of water resources management and emergency awareness.

Observational evidence of California rainfall shows important variations on interannual and intraseasonal time scales. While the relationships between El Niño events and California rainfall have been investigated in previous studies and is indeed the present focus of several research activities, the mechanisms associated with intraseasonal changes have received much less attention. In the tropical region, the Madden and Julian Oscillation (MJO) (30-60 days variations) is the primary mode of intraseasonal variability. During this research project, we have investigated the occurrence of extreme precipitation events in California and a possible modulation by the MJO. The research accomplishments have been reported in a refereed journal article and several professional meetings.

During the second year of this project, it became clear that a better understanding of local circulations (i.e. mesoscale circulations) are necessary in order to understand the problem of heavy precipitation events in southern California. Local circulations and their interaction with the complex topography play a key role in generating heavy rainfall. In this context, the funding support from the Water Resources Center has truly served as "seed money" to enlarge the current project. Collaboration with the National Weather Service Office in Los Angeles/Oxnard has been established in order to investigate local circulations and extreme events. A project supported by the Cooperative Program for Operational Meteorology, Education and Training (COMET) has been awarded: "Investigation of Mesoscale Wind Patterns in the California Bight: Influence on Extreme Precipitation Events". Among other activities, real-time forecasts based on the Pennsylvania State University/National Center for Atmospheric Research (PSU/NCAR) Mesoscale Model (MM5-V3) has been fully operational at the Institute of Computational Earth System Science (ICESS), University of California, Santa Barbara. The real-time forecasts proved quite helpful for the forecasters at the NWS Los Angeles/Oxnard Office during the last winter, given the much finer resolution of the PSU/NCAR MM5-V3 forecasts compared to other operational weather forecast models. MM5 forecasts can be seen in at: www.icess.ucsb.edu/asr/mm5_forecasts.htm.

In another refereed journal publication, we have performed a detailed assessment of the MM5 forecast skill as it is used in real-time operation. The selected case study is the storm of 23-24 February 1998, which was one of the most intense rainfall events to hit southern California during the strongest El Niño event on record (peak rainfall exceeded 355 mm in 30 hours). The model performance, validated against rainfall data, indicates a similar frequency distribution of observed accumulated rainfall data. Specific comparison of accumulated rain between station data and model estimates show a wide spectrum of accuracy with errors as low as 10-15% to more than 100%. Additionally, the comparison of hourly rain from station data and the MM5 shows that the model forecast lags the observed rain by about three to four hours. Despite the above shortcomings, high-resolution forecasts from the real-time MM5 have been routinely used

in wintertime and proven quite useful. For instance, hourly rainfall averaged in specific locations can be used in real-time as significant tool to forecast extreme rainfall in Southern California.

The two-year research funding from the Water Resources Center, University of California, Riverside, has played a key role as seed-money to continue the study of heavy precipitation events in California. The PI (C. Jones) has been recently awarded by the Climate Variability and Predictability Program (CLIVAR) Pacific Program, NOAA, to develop statistical forecasts of intraseasonal and seasonal variations of precipitation and temperature over the western United States. The two-year support from the WRC is greatly appreciated.

Further information about publications, presentations in professional meetings and reprints are attached.

PUBLICATIONS AND PROFESSIONAL PRESENTATIONS

The research accomplished in the two years is described in the following publications.

1) Jones, C., L. M. V. de Carvalho, B. Bower, and D. Danielson, 2000: Forecast skill of the Penn State/NCAR MM5 mesoscale model during the heavy precipitation event of 23-24 February 1998 in Southern California. Submitted to Weather and Forecasting.

2) Jones, C. 2000: Occurrence of extreme precipitation events in California and relationships with the Madden-Julian Oscillation. *J. Climate*, 13, 3576-3587.

3) Jones, C., L. M. V. de Carvalho, D. Danielson and B. Bower, 2000: Mesoscale simulations of heavy precipitation events in Southern California during the 1997-98 El Niño. *Proceedings of the Symposium on Precipitation Extremes: Prediction, Impacts, and Responses, 81th Annual Meeting of the American Meteorological Society, Albuquerque, NM.*

4) Jones, C., D. Danielson, D. Gomberg, B. Bower, 2000: Mesoscale simulations of heavy precipitation in southern California during the 1997-98 El Niño. Proceedings of the 10th PSU/NCAR Mesoscale Modeling System Users' Workshop, National Center for Atmospheric Research, Boulder, CO, June 21 - 23, 2000, 107-109 pp.

5) Jones, C., D. Danielson, D. Gomberg, B. Bower, 2000: Mesoscale simulations of heavy precipitation in southern California during the 1997-98 El Niño. Proceedings of the 13th International Commission on Clouds and Precipitation, Reno, Nevada, 405-409 pp.

6) Jones, C. 2000: Occurrence of extreme precipitation events in California and relationships with the Madden-Julian Oscillation. Presented at the *11th Symposium on Global Change Studies*, 80th Annual Meeting of the American Meteorological Society, Long Beach, 9-14 January 2000.

7) Jones, C. 1999: Occurrence of extreme precipitation events in California and relationships with the Madden-Julian Oscillation. Proceedings of the *24th Annual Climate Diagnostic and Prediction Workshop*, Tucson, Arizona, 5-9 November, 1999, 363-366.

TRAINING ACCOMPLISHEMENTS

Undergraduate	Master's Degree	Ph.D. Degree	Post-Ph.D.

Ms Valerie Olson, Ph. D. Student at the UCSB Geography Department and originally involved in this project, has left the graduate program for personal reasons.