system depends in large measure on the underlying NWP model rather than on the subsequent application of analogs.

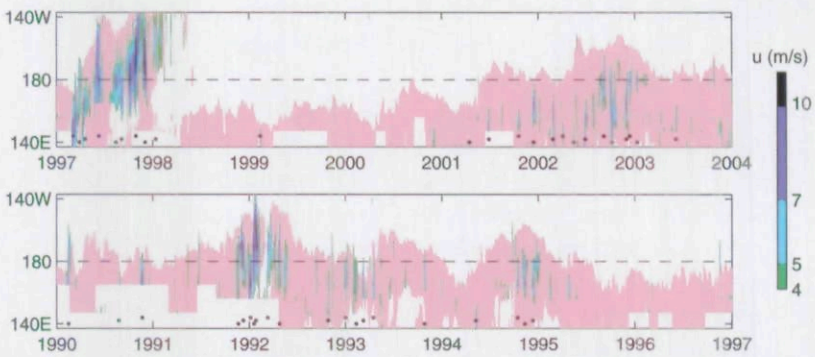
Pattern-recognition and forecast analogs show promise for discerning the patterns associated with major weather events. Future work requires regular updating of the events database as well as the associated fingerprints.—Paul Knight (The Pennsylvania State University), B. Root, G. Young, S. Greybush, R. Grumm, R. Holmes, and J. Ross. *"A Fingerprinting Technique for Major Weather Events," in the July* Journal of Applied Meteorology and Climatology.

Could Ocean-Modulated Wind Bursts Lead to Better El Niño Forecasts?

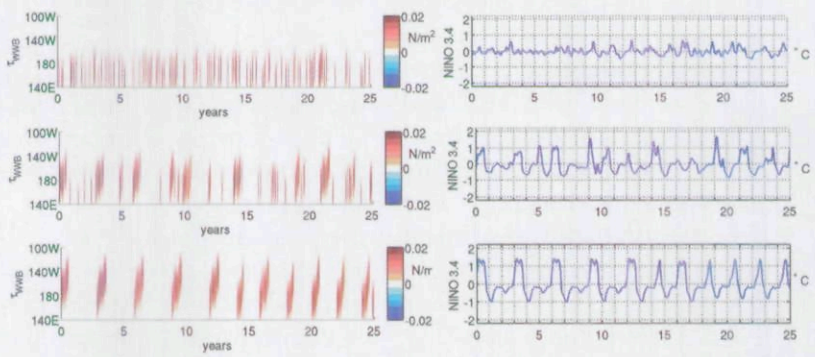
Episodes of strong westerly winds over the tropical Pacific, known as westerly wind bursts (WWBs), have accompanied every significant El Niño event of the past 25 years. In many models, WWBs are treated as a purely stochastic (i.e., random) forcing, consistent with the description of ENSO as a damped oscillatory system driven by external noise. Recent observations, however, show that while the precise timing of a specific WWB event is unpredictable, the characteristics of WWBs, such as the location and likelihood of occurrence, depend upon the large-scale sea surface temperature (SST) field. The WWB characteristics are therefore "modulated" by the SST and should not be considered as purely stochastic or external to the coupled ENSO system. We find that when the feedback between WWBs and SST is included in a numerical model, the amplitude of ENSO variability is twice as large as from a model with purely stochastic WWBs. A new picture of ENSO seems to emerge: a possibly self-sustained oscillating system maintained by the effects of the modulated WWBs.

We examined the consequences of WWB modulation by the ocean using an ocean general circulation model coupled to a statistical atmosphere model with the inclusion of a novel semistochastic WWB parameterization. The parameterization was constructed such that the likelihood of WWB occurrence increases as the western Pacific warm pool extends: a semistochastic formulation that has both the deterministic and stochastic elements of WWBs seen in observations.

We found that modulation of WWBs by SST strongly affects the characteristics of ENSO. In particular, coupled feedbacks between SST and WWBs may be sufficient to transfer the system from a damped regime to one with self-sustained oscillations. Modulated WWBs also play a



Evidence for westerly wind burst modulation. **Equatorial zonal wind anomalies in the TAO buoy data greater than 4 m s^{-1} (blue) are superimposed on the western Pacific warm pool extent (pink) as measured by the 29°C SST isotherm. These data imply that WWBs are 2.8 times more likely to occur when the warm pool extends past the date line. (Gebbie et al.)**



Diverse dynamical regimes in an ENSO model. **The response of model ENSO variability to different westerly wind-burst formulations. The left panels show a time–longitude section of WWB zonal wind-stress anomaly (τ) averaged between 5°N and 5°S. The right panels show the resulting Nino 3.4 index for three model experiments. The top row is from a purely stochastic WWB representation, the middle from a semistochastic representation in which the statistics of WWBs depend upon the SST, and the bottom row is from a deterministic WWB parameterization where the precise WWB timing is completely determined by the SST. Observed WWB characteristics seem to be close to the semistochastic formulation. (Gebbie et al.)**

ECHOES

"With population growth and the decline in the water, there are the elements in the equation which you could call 'the perfect drought.'"

—Bill Patzert, a climatologist at NASA's Jet Propulsion Laboratory in Pasadena, California, on conditions in Southern California. Through late June, Los Angeles was suffering through its driest year since record keeping began in 1877, with only 3.21 inches of rainfall over the previous 12 months and no rain in the forecast before September. Average rainfall during its July–June rainy season is 15.14 inches. Additionally, the Sierra Nevada mountains had delivered only 20% of their normal rain production to the region. Combining these conditions with regional population growth over the past 50 years of 2–4 times the national average, Southern California is facing a portentous water situation where, as Patzert points out, "Mother Nature is converging with human nature." (Source: *The Guardian*)

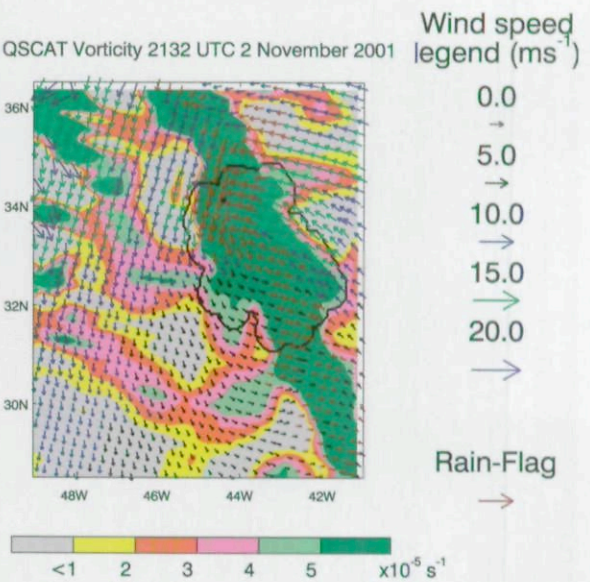
role in the irregular timing of warm episodes and the asymmetry in the size of warm and cold events in this ENSO model. Parameterizing the modulation of WWBs by an increase of the linear air–sea coupling coefficient seems to miss important dynamical processes, and a purely stochastic representation of WWBs elicits only a weak ocean response.

The new view of wind bursts may have implications for the predictability of El Niño. The modulation of WWBs by the ocean suggests that ENSO's predictability limit may be longer than would be anticipated if the WWBs were purely stochastic. If the observation that WWBs are modulated by the SST can be translated into a practical WWB prediction scheme, there is hope for enhanced skill in ENSO forecasts.—Geoffrey Gebbie (Harvard University), I. Eisenman, A. Wittenberg, and E. Tziperman. "*Modulation of Westerly Wind Bursts by Sea Surface Temperature: A Semi-Stochastic Feedback for ENSO,*" *in the September* Journal of the Atmospheric Sciences.

Vorticity-based Detection of Tropical Cyclogenesis

Although tropical cyclogenesis (TCG) is a very active area of research, it remains a highly debatable and unresolved topic. While considerable attention has been paid to tropical cyclone formation, little attention has focused on observational studies of the very early stages of TCG, otherwise referred to as the genesis stage. In the past, the early stages of TCG were unverifiable in surface observations, due to the paucity of meteorological data over the tropical oceans. Using satellites, we developed a robust technique for locating and monitoring tropical disturbances from the early genesis stage to the tropical depression stage in the Atlantic Basin. Overall, the detection technique proved very effective, identifying such tropical disturbances approximately 19 to 101 h before classification as tropical cyclones by the National Hurricane Center.

This new approach used a combination of *QuikSCAT* observations of surface vorticity and GOES imagery of cloud-top temperatures to track systems (those that did develop into tropical cyclones) backward through their development. Our technique is based on identification of surface vorticity and wind-speed signatures that exceed certain threshold



An example of the early stages of TCG identified by the vorticity-based detection technique shows Tropical Cyclone Noel (2001) 26 h before classification as a subtropical storm. The background color represents *QuikSCAT*-derived relative vorticity, with dark green representing all vorticity values greater than 5.0×10^{-5} s^{-1}. The black, solid lines signify the locations where the detection technique's criteria are met within 75 km from the cloud-cluster center in the associated GOES infrared image. This vorticity signature is associated with the nontropical occluded low that spawned Noel, and illustrates an apparent surface circulation. Noel eventually grew into a weak hurricane. (Gierach et al.)