Geophysical Research Abstracts, Vol. 9, 02451, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-02451

Large Scale Dynamics and MJO Forcing of ENSO Variability

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Year-to-year variability associated with the El Niño/Southern Oscillation (ENSO) is governed by large-scale ocean dynamics and coupled ocean-atmosphere interactions. However, the cycle between warm and cold phase ENSO conditions exhibits considerable irregularity in terms of amplitude, duration, and spatial and temporal patterns of development. One factor contributing to this irregularity is stochastic forcing in the form of weather noise, a prominent source of which is the Madden-Julian Oscillation (MJO). A simple two-predictor regression model is developed to estimate the relative influence of large-scale low frequency deterministic ocean-atmosphere dynamics and stochastic forcing on peak sea surface temperature (SST) anomalies associated with ENSO for the period 1980-2005. One predictor is equatorial warm water volume, which is an index for the role that upper ocean heat content plays in regulating ENSO variability. The other predictor characterizes stochastic forcing in the western Pacific in the form of an MJO activity index. The two-predictor model accounts for about 65% of peak Nino3.4 SST anomaly variance at 2-3 season lead times and suggests about equal influence (on average) of stochastic and deterministic processes affecting peak ENSO SST anomalies over the past 25 years. The implications of these results for ENSO prediction are discussed.