

Linear or Nonlinear Modeling for ENSO Dynamics?

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The observed ENSO statistics exhibits a non-Gaussian behavior, which is indicative of the presence of nonlinear processes. In this paper, we use the Recharge Oscillator Model (ROM), a largely used Low-Order Model (LOM) of ENSO, as well as methodologies borrowed from the field of statistical mechanics to identify which aspects of the system may give rise to non-linearities that are consistent with the observed ENSO statistics. In particular, we are interested in understanding whether the non-linearities reside in the system dynamics or in the fast atmospheric forcing. Our results indicate that one important dynamical nonlinearity often introduced in the ROM cannot justify a non-Gaussian system behavior, while the nonlinearity in the atmospheric forcing can instead produce a statistics similar to the observed. The implications of the non-Gaussian character of ENSO statistics for the frequency of extreme El Niño events is then examined.