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Different coupled atmosphere-recharge oscillator Low Order Models for ENSO: a projection approach.

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El Ninõ-Southern Oscillation (ENSO) is a large scale geophysical phenomenon where, according to the celebrated recharge oscillator model (ROM), the Ocean slow variables given by the East Pacific Sea Surface Temperature (SST) and the average thermocline depth (h), interact with some fast "irrelevant" ones, representing mostly the atmosphere (the westerly wind burst and the Madden-Julian Oscillation). The fast variables are usually inserted in the model as an external stochastic forcing. In a recent work (M. Bianucci, "Analytical probability density function for the statistics of the ENSO phenomenon: asymmetry and power law tail" Geophysical Research Letters, under press) the author, using a projection approach applied to general deterministic coupled systems, gives a physically reasonable explanation for the use of stochastic models for mimicking the apparent random features of the ENSO phenomenon. Moreover, in the same paper, assuming that the interaction between the ROM and the fast atmosphere is of multiplicative type, i.e., it depends on the SST variable, an analytical expression for the equilibrium density function of the anomaly SST is obtained. This expression fits well the data from observations, reproducing the asymmetry and the power law tail of the histograms of the NINÕ3 index. Here, using the same theoretical approach, we consider and discuss different kind of interactions between the ROM and the other perturbing variables, and we take into account also non linear ROM as a low order model for ENSO. The theoretical and numerical results are then compared with data from observations.