THE EFFECT OF THE SEASONAL CYCLE ON ENSO IN A STOCHASTIC RECHARGE OSCILLATOR MODEL

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Abstract

A simple model of ENSO is developed to test the effect of the varying background state of the equatorial Pacific on ENSO dynamics. The model is based on the recharge oscillator, extended to include periodic variations of the two main model parameters, representing ENSO's growth/damping rate (γ) and angular frequency (ω). The model is forced stochastically to represent forcing by the atmosphere at fast time scales. Idealized experiments are performed to determine the effect of varying the γ, ω parameters on two of ENSO's prominent seasonal characteristics: the seasonal synchronization of ENSO event peaks and the "spring barrier" of persistence and predictability. It is found that the seasonal cycle of γ sets the seasonal cycle of ENSO variance, i.e. the timing of ENSO event peaks. ENSO's seasonal synchronization in this system is therefore independent of its natural frequency. The model's seasonal cycle of persistence is found to be due to the time variance of both γ and ω, and the interpretation of the "spring barrier" is consistent with that of *Torrence and Webster*, 1998. Statistical and dynamical fits of the model parameters to two general circulation models (GCMs) are performed. The dynamical fit, based on the so-called "Bjerknes indices" for ENSO, allows for the calculation of γ, ω from the seasonal fields of wind, temperature, currents, and heat fluxes. One model is a 50-year, eddy-resolving hindcast, used to test the robustness of the simple model in a system close to the observed equatorial Pacific. The second model produces a 20th century simulation with spurious ENSO characteristics, used to check the applicability of the simple model as a diagnostic tool for analyzing GCM output. It is found that in both cases, the statistical and dynamical estimates of γ agree well, and are able to reproduce the seasonal cycles of ENSO variance from the GCMs. However, substantial misfits are found in the estimates of ω. The results indicate that the linear paradigm of ENSO as a null hypothesis cannot be dismissed. Namely, ENSO can be well approximated by a damped, linear system forced stochastically by the atmosphere, where variations in the background state of the equatorial Pacific are sufficient to produce the observed seasonal cycle of variance. Additionally, the results highlight the potential utility of the combination of the simple model and Bjerknes indices for diagnosing the simulated seasonal cycles in GCMs and their effect on ENSO dynamics.