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Impact of interactive westerly wind bursts in CCSM3

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Westerly wind bursts (WWBs) events are commonly viewed as completely stochastic processes, independent of any oceanic forcing. Some recent work and observations have suggested that these events also contain a deterministic component, modulated by the SST. This potentially affects the problem of El Niño Southern Oscillation (ENSO) predictability and prediction. In this study, we examine the impact of parameterized WWBs on ENSO variability in the Community Climate System Model version 3.0 (CCSM3). The WWB parameterization is derived based on 50 years atmospheric reanalysis data and observed estimates of tropical Pacific SST. To study the impact of WWBs three experiments are performed. In the first experiment, the model is integrated for several hundred years with no prescribed WWB events (i.e., the control). In the second case, fully stochastic WWB events are introduced. In other words, the occurrence, location, duration, and scale of the WWBs are determined (within bounds) randomly. These wind anomalies are always positive (eastward) without a westward counterpart and are totally independent of the state variables (e.g. SST), and can be thought of as additive noise. For the third case, the WWB are introduced but as multiplicative noise or semistochastic forcing, modulated by the SST. The first three statistical moments for the NiÒo 3.4 index shows that the semistochastic case produced larger ENSO events and the bias towards the cold phase is reduced as compared to the control and the fully stochastic runs. There is very little significant statistical difference between the control and the fully stochastic WWB simulations suggesting that the deterministic component of the burst is responsible for reshaping ENSO events. Lag-lead correlation of ocean variables with Niño 3.4 index suggests much larger predictability for the semistochastic simulation. It also shows a shift toward self sustain delayed or recharge type of oscillator as the experiments progress from the control to the fully-stochastic to the semistochastic runs. A gradual increase in the period of oscillation is also observed in that same order. Overall, the parameterized WWB has the capability to modify the ENSO regime (i.e., damped and forced by weather noise or self sustained) in the CGCM, demonstrating the effects of sub-seasonal events on interannual time scales.