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A Dynamical Stochastic Skeleton Model for the MJO and ENSO

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A simple dynamical stochastic model for the tropical ocean-atmosphere is proposed for major intraseasonal to interannual processes including the El Niño Southern Oscillation (ENSO) as well as the Madden-Julian Oscillation (MJO) and associated wind bursts. As compared to usual simple to intermediate models for the ENSO, the MJO and wind bursts are here solved dynamically instead of being prescribed or parameterized which provides their upscale contribution to the interannual flow as well as their modulation in return in a more explicit way. Such a model serves as a prototype "skeleton" for General Circulation Models (GCMs) that solve similar dynamical interactions across several spatio-temporal scales but usually show common and systematic biases in representing tropical variability as a whole. The most salient features of the ENSO, the wind bursts and the MJO are captured altogether including their overall structure, evolution and fundamental interactions in addition to their intermittency, diversity and energy distribution across scales. This includes a realistic onset of El Niño events with increased wind bursts and MJO activity starting in the Indian ocean to western Pacific and expanding eastward towards the central Pacific, as well as significant interannual modulation of the characteristics of intraseasonal variability. The model developed here also should be useful to diagnose, analyze and help eliminate the strong tropical biases which exist in current operational models.