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Oceanic Internal Variability, Tropical Instability Waves and the El Nino-Southern Oscillation

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Tropical instability waves (TIWs) are a major source of internally-generated oceanic variability in the central and eastern equatorial Pacific Ocean. These non-linear processes play an important role in the heat and momentum budgets and influence the sea surface temperature (SST) in a region critical for low-frequency coupled modes of variability such as the El Nino-Southern Oscillation (ENSO). However, their direct contribution to this type of interannual variability has received little attention. Previous studies using ocean- or atmosphere-only models suggest that TIW rectification may drive low-frequency SST and wind stress variability in the eastern Pacific that is comparable in magnitude to that driven by the Madden-Julian Oscillation (MJO) in the western Pacific. Other work suggests that TIWs can interact with equatorial Kelvin waves, limiting the magnitude of the associated thermocline depth and SST anomalies. In this study, we investigate the influence of TIWs on coupled variability using a 1/4-degree ocean model of the equatorial Pacific coupled to a simple atmosphere. The use of a simple atmosphere, in which a large portion of complex intrinsic atmospheric variability is absent, is intended to facilitate an examination of the first-order TIW effect on coupled variability. This setup allows the dominant mode of air-sea coupling, represented as a statistical relationship between SST and wind stress anomalies, while also permitting the effects of TIW-rectification on the variability of thermodynamic fields near the air-sea interface. Using this model setup, we perform two ensembles of idealised coupled model forecast experiments which are initiated with either downwelling or upwelling Kelvin waves in the western Pacific. By examining the results of these ensemble experiments, which only differ due to internal oceanic variability, we quantify the impact of TIWs on the characteristics of subsequent coupled events. The results have implications for our understanding of ENSO irregularity and predictability, and its representation in low-resolution coupled general circulation models.