The South Pacific Meridional Mode: A Mechanism for ENSO-like variability

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Abstract The impacts of atmospheric variability in the mid- to high- latitude South Pacific on the climate of the tropical Pacific are investigated in models of different degrees of coupling between the atmosphere and ocean. A robust thermodynamically coupled mode of variability, defined as the South Pacific Meridional Mode (SPMM), has been identified in multiple Atmospheric General Circulation Models coupled to a slab ocean. The physical interpretation of the SPMM is nearly identical to the North Pacific Meridional Mode (NPMM, Chiang and Vimont, 2004) with off-equatorial southeast trade wind variability originating from South Pacific mid-high latitudes altering the latent heat flux and sea surface temperature (SST) and the wind-evaporation-SST (WES) feedback. We also show that a positive cloud feedback plays a role in the development of this mode, but this effect is model-dependent. While physically analogous to the NPMM, a key difference for the SPMM is that it has a stronger expression in the equatorial Pacific and leads to the ENSO-like variability in the absence of ocean-atmosphere dynamical coupling, thus acting as a more effective conduit through which mid- to high- latitude intrinsic variability affects the tropical Pacific variability. Preliminary analysis shows that the SPMM is active in fully coupled climate models as well as observations. This study highlights the important role of the southern hemisphere in the tropical climate variability, and suggests that including observations from the data-poor South Pacific could improve the ENSO predictability.