The Impact Of Ocean/Atmosphere Coupling on North Pacific Atmospheric Variability in a "Pacemaker" Experiment: Sensitivity to Convection in the Tropical Northwest Pacific

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We examine the influence of ocean/atmosphere coupling on the winter North Pacific atmospheric circulation during the 1996-1999 period, and in particular during the 1997/98 El Niño event, using "super-ensembles" (>100) of regionally-coupled and uncoupled GCM simulations with the GFDL-R30 model. In all model simulations, observed sea surface temperatures (SST) are prescribed in the tropical eastern Pacific east of 172˚E. In the control simulations, climatological SSTs are specified elsewhere, whereas in the "pacemaker" simulations a bulk mixed layer model is coupled to the atmosphere in the tropical Indo-Pacific ocean or in the entire ocean.

Our results suggest that, in this model, most of the impact of global air/sea interactions on the winter circulation in the North Pacific can be attributed to coupling in the Tropics. Furthermore, we find that coupling in the tropical northwest Pacific (TNWP) exerts the strongest impact, with local oceanic warming (cooling) leading to enhanced (suppressed) convection in this region, which in turn excites Rossby waves that propagate into the North Pacific/North American (PNA) sector. During the 1997/98 NIÑO event, in particular, warm remotely-forced SSTs west of the dateline lead to an enhanced ENSO teleconnection in early winter, with both the forcing and the response being reminiscent of the observed signals. Further analysis shows that the sensitivity of the circulation in the PNA sector to convection in TNWP region is generally present throughout the winter, but is suppressed in the core of winter of a NIÑO year, when the Pacific midlatitude jet is strongest and subtropically traps Rossby waves generated in the TNWP region. Thus, the feedback from coupling on the NIÑO teleconnection is limited to fall and early winter, when the Rossby wavetrain emanating from the TNWP interferes constructively with the main ENSO wavetrain emanating from the central equatorial Pacific.

Observational evidence supports the existence of a preferred region in the tropical northwest Pacific for forcing circulation anomalies in the PNA sector in early winter. Thus, how convection in that region is affected by interactions with the ocean may well play an important role in driving observed atmospheric teleconnections.