Evaluation of the Pacific Decadal Oscillation in the HighResMIP-PRIMAVERA model simulations

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The Pacific Decadal Oscillation (PDO) exercises an enormous impact on both global and regional climate. While stochastic atmospheric forcing has long been believed to cause PDO-related sea surface temperature (SST) anomalies, oceanic dynamical response to the atmospheric forcing is key to understand how the ocean-to-atmosphere feedback plays a role in the PDO cycle. However, such oceanic roles remain uncertain due to short observations and low-resolution coupled models that cannot resolve a rich structure of the extratropical oceanic fronts. Here we show that the HighResMIP-PRIMAVERA coupled models have an improved performance in simulating the ocean-atmosphere variability associated with PDO. After the mature phase of positive PDO, a zonally-elongated dipole pattern of surface turbulent heat flux anomalies appears along the Kuroshio extension SST front and lasts for 3 to 4 years, a feature indicative of the ocean-to-atmosphere feedback. Sea level pressure anomalies reverse a sign in response to the surface heating pattern, contributing to a phase shift of PDO. The HighResMIP models also tend to improve the reproducibility of the PDO pattern even without the tropical Pacific SST forcing, suggesting an important role of the frontal-scale ocean-atmosphere interaction.

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