



East Asian summer monsoon changes under RCP4.5 Scenario Projected by 33 CMIP5 models: Why do the models show such a large spread?

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Abstract

Analysis of East Asian summer monsoon changes under RCP4.5 Scenario projected by 33 CMIP5 models reveals a large spread among the models. While some models do show significantly enhanced trend of summer monsoon circulation, some other models even show significantly weakened trend. This study aims to understand the underlying mechanisms that dominate the projection of East Asian summer monsoon changes. The authors highlight that the East Asian summer climate is dominated by the Western North Pacific Subtropical High (WNPSH). Responses of the WNPSH to global warming are analyzed using the outputs of 33 coupled models participated in the Coupled Model Intercomparison Project 5 (CMIP5). Changes of the WNPSH during the period of 2050-2099 (21C) in the RCP4.5 experiment with respect to that during 1950-1999 (20C) in the historical experiment are studied. A large spread is seen in the projections. Among the 33 models, 5 (4) models project significant increases (decreases) of the WNPSH intensity in the 21C, while the remaining models and Multi-Model Ensemble (MME) show no significant change. Changes of the WNPSH are dominated by the zonal SST gradient between the tropical Indian Ocean (TIO) and the tropical western Pacific (TWP). A stronger warming in the TIO than the TWP favors increased rainfall over the TIO and a warm Kelvin wave emanating from the TIO to the TWP, which further triggers a low level anticyclone over the western North Pacific (WNP) through Ekman divergence. The projected change of the WNPSH would modulate the change in precipitation and circulation over East Asia. All the models with a significantly increased (decreased) WNPSH intensity are associated with a significant increase in the precipitation over the northern (southern) part of East Asian continent, and an enhanced (weakened) southerly summer monsoon.

Keywords: Western North Pacific Subtropical High, global warming, Zonal SST gradient, CMIP5