Revisiting the Climatic Impacts of Strong and Weak ENSO using High-Resolution Atmospheric Model

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Abstract

To evaluate the performance of a high-resolution atmospheric model (HiRAM) and to improve our understanding of the climatic impacts of ENSO teleconnection, we analyzed AMIP style HiRAM simulations conducted effectively at 25 km grid spacing. To better assess HiRAM response to ENSO teleconnection; we categorized it into strong and weak El Niño/La Niña episodes. HiRAM model reproduced the impacts of strong ENSO over global scale very well, however, it underestimated ENSO teleconnection patterns and associated changes over regional scale (e.g., MENA and South Asia), especially following weak ENSO that could be attributed to model weak response to circulation changes such as Pacific North American (PNA) and North Atlantic Oscillation (NAO). Moreover, our results emphasize that ENSO impacts are relatively stronger over the Inter-Tropical Convergence Zone (ITCZ) compared to extra-tropics and high-latitude regions. The positive phase of ENSO causes a weakening in rainfall over the African tropical rain-belt, parts of South and Southeast Asia. Both the reanalysis and HiRAM results reveal that ENSO-induced negative (positive) NAO-like response and associated changes over Southern Europe and North Africa vary significantly following the increased intensity of El Niño (La Niña). We further found that ENSO magnitude significantly impacts the Hadley and Walker circulations. The El Niño phase of ENSO overall strengthens Hadley Cell, and the reverse is true for the La Niña phase. This ENSO-induced strengthening and weakening of Hadley Cell induce significant impact over South Asian and African convective regions through modification in the ITCZ circulation system.

Keywords: ENSO, El Nino/La Nina, NAO, MENA, Hadley Circulation, ITCZ, Monsoon System

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