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The Influence of Eastern Indian Ocean Convection on Wintertime Asian Precipitation

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We investigate the regional influence of tropical convection in the eastern Indian Ocean during the boreal cold season, both in terms of the mean response and in the context of the seasonally-evolving background flow. Wintertime tropical convection in the Indian Ocean has been linked to large changes in precipitation over Southwest Asia, including both multi-year drought and MJO-driven short-term flooding episodes. We analyze the regional influence with both observational analysis and modeling experiments. The modeling experiments utilize a modified version of the NCAR CAM 3.1, where we modify the calculation of diabatic heating in the model to create an enhanced area of tropical convection, with all other aspects of the model left to freely evolve. This is similar to linear modeling experiments with specific diabatic heating forcing, but allows the response to evolve in a fully nonlinear fashion, with direct simulation of moist processes and precipitation.

The analysis shows that enhanced tropical oceanic convection forces strong subsidence over SW Asia by generating a Gill-type Rossby wave response that intersects with the jet – the resulting temperature advection is balanced by subsidence. The reverse occurs with suppressed tropical convection. There is considerable similarity between the patterns of interannual variability and intraseasonal (MJO) variability, but with some significant differences in extent and latitudinal position of the ocean convection, which we examine with both an idealized Gill-type model and a series of modified GCM experiments. Month-by-month analysis suggests some limitations of the GCM, apparently due to an imperfect representation of the jet in some months, which we further analyze in GCM runs with diabatic heating specified over the whole globe. Finally, we relate our analysis to Jan-Apr 2008, which was another severe drought period for Southwest Asia.