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The Impact of Radiative Interactions on Tropical Cyclone Development in a General Circulation Model

Bosong Zhang[1], Brian Soden[1], Gabriel Vecchi[2,3], and Wenchang Yang[2]
[1]RSMAS, University of Miami, Miami, FL, United States of America
[2]Department of Geosciences, Princeton University, Princeton, NJ, United States of America
[3]Princeton Environmental Institute, Princeton University, Princeton, NJ, United States of America

The impact of radiative interactions on tropical cyclone (TC) climatology is investigated using a global, TC-permitting general circulation model (GCM) with realistic boundary conditions. In this model, synoptic-scale radiative interactions are suppressed by overwriting the model-generated atmospheric radiative cooling rates with its monthly-varying climatological values. When radiative interactions are suppressed, the global TC frequency is significantly reduced, indicating that radiative interactions are a critical component of TC development even in the presence of spatially varying boundary conditions. The reduced TC activity is primarily due to a decrease in the frequency of pre-TC synoptic disturbances (“seeds”), whereas the likelihood that the seeds undergo cyclogenesis is less affected. When radiative interactions are suppressed, TC genesis shifts toward coastal regions, whereas TC lysis locations stay almost unchanged; together the distance between genesis and lysis is shortened, reducing TC duration. In a warmer climate, the magnitude of TC reduction from suppressing radiative interactions is diminished due to the larger contribution from latent heat release with increased sea surface temperatures. These results highlight the importance of radiative interactions in modulating the frequency and duration of TCs.