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Seasonal march of tropical cyclogenesis simulated in eight climate models from WCRP CMIP3 multimodel dataset

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This study examines the tropical cyclogenesis over the western Pacific region (Eq.-40N, 100E-180) simulated in coupled general circulation models (CGCMs) participating in the third phase of the World Climate Research Programme Coupled Model Intercomparison Project (WCRP CMIP3). Eight CGCMs are selected that have the horizontal resolution of atmospheric components finer than or equal to T63 and have daily three-dimensional atmospheric data archived. The genesis number is validated against the best track dataset issued by the Japan Meteorological Agency. Five of the eight CGCMs reproduce realistic distributions of annual tropical cyclogenesis with a large fraction over the “key region” of (10-20N, 110-150E). These five CGCMs also simulate the summer-winter contrast of TC genesis realistically. However, all models overestimate TC numbers in early summer (May-June) and underestimate them in mature summer (July-September).

Analyses of a genesis potential (GP) index proposed by Emanuel and Nolan (2002) suggest the importance of realistic seasonal march of the monsoon trough. Simulated GP has consistent seasonal biases with that of TC genesis number; namely, the CGCMs overestimate the GP in early summer and underestimate it in mature summer. For all of the five CGCMs, these seasonal biases in the GP reside in biases of absolute vorticity and shear, associated with the seasonal march of the monsoon trough.

In the 40-yr ECMWF reanalysis dataset, the trough migrates northward to reach the key region in mature summer and contributes to maximum in TC genesis number. On the other hand, the trough in all of these five CGCMs migrates northward earlier and reaches the key region in early summer, leading to the overestimation of TC genesis number in this season. In mature summer, the simulated trough reaches as far as 15-25N. Strong northeasterly vertical shear south of the trough dominates in the key region, and provides an unfavorable condition for TC genesis.