How well do Global Climate Models detect tropical cyclones considering cyclone phase?

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The center of a tropical cyclone (TC) is searched and tracked by determining whether the model data or the gridded parameters show static or thermodynamic characteristics. Similar to existing studies (Oouchi et al. 2006; Bengtsson et al. 2007; Walsh et al. 2007; Murakami and Wang, 2010) on searching and tracking TCs using gridded simulation data, the searching and tracking of the TCs in this study was divided into tracking process, which searches for the center of the cyclone, and structure process, which explores the vertical structure at the center (Suzuki and Parker, 2012). Moreover, Hart (2003)'s a cyclone phase (CP) technique was also considered during the TC tracking to identify cyclones such as extratropical cyclones. The modified tracking method is possible to figure out the formation, movement, and dissipation of candidate TCs, which is a life of the cyclones. All candidate TCs detected in this study passed through the modified tracking method.

To verify the modified tracking method, GFS (Global Forecast System) analysis field data were collected to define the TCs that occurred in the Western North Pacific (WNP) during 2009–2014. In addition, the best-track data in the RSMC (Regional Specialized Meteorological Center) Tokyo Typhoon Center was prepared to compare with the result used the GFS data every 6 hours. The modified tracking method was applied in the current climate simulation, which was generated using AGCM GME climate data, which are high-resolution model data for application and evaluation of current climate predictions. The GME is an operational global numerical weather prediction model of German Weather Service. This model is distinguishable from other general circulation models (GCMs) by a uniform icosahedral–hexagonal grid. A major advantage of the geodesic grid is the avoidance of the pole problem in the GCM unlike conventional latitude-longitude grids (Majewski et al., 2002). The experiments used GFS data for verifying the existing tracking method showed that 146 TCs occurred in the WNP over 6 years, which is 23 more than the observed number, and they showed monthly/seasonal characteristics similar to those of the observation. However, when the cyclonic phase was considered for the identified TCs,

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14 other cyclones were found. Therefore, even when the other cyclones were excluded, the correlation coefficient was maintained at 0.9 or higher. Furthermore, this method was applied to the simulations of current climate from 1980 to 2009. As in the analysis field research, the results showed that the correlation coefficient of the seasonal variation between the model and observation increased from 0.6 to 0.8, particularly when the cyclone phase was considered.

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