

## High-resolution, ensemble simulations of intense tropical cyclones and their stochasticity during the El Niños of 1997 and 2015

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Extreme El Niño events affect the number of intense tropical cyclones (ITCs) over the western North Pacific (e.g., Camargo and Sobel, 2005; Chan 2007). Extreme El Niño events were observed in 1997 and 2015. In the both years, the number of ITC were above normal in the western North Pacific. In order to clarify how, and to what extent, sea surface temperature (SST) anomaly distributions control the ITCs genesis, we conducted 50-member ensemble simulations for boreal summer in 1997 and 2015 using a global nonhydrostatic model called NICAM (Satoh et al. 2014) with a horizontal grid interval of 14 km. Clouds were explicitly calculated using a single-moment bulk microphysics scheme without cumulus convection scheme. The sea surface temperature was nudged toward observed SST data using a slab ocean model.

We found no robust control of ITCs by a prescribed SST distribution. These simulations showed that, even if the same SST was used as the boundary condition for each ensemble simulation, the number of ITCs varied substantially among members. This means that uncertainty remains large for seasonal forecasts of ITC activity. However, the ensemble simulations showed a clear relationship between the number of ITCs and their genesis locations in the western North Pacific. We compared environmental conditions between ensemble members. We found that the simulated numbers of ITCs in the western North Pacific were also closely related to the strength of the monsoon trough, which stochastically varies under given SST conditions. This indicates that reliable seasonal forecasting of ITCs depends on our ability to accurately reproduce the monsoon trough, whose strength is modulated mainly by internal atmospheric variability as well as SST.

Keywords: intense tropical cyclone, monsoon trough, El Niño, high resolution global nonhydrostatic model, ensemble simulation