

Responses of the subseasonal to seasonal atmospheric variability to the recent Pacific SST anomaly

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Warm sea surface temperature anomalies (SSTA) is pronounced in the Pacific in recent years. Sensitivity simulations revealed that the warm SST anomaly (SSTA), especially in the subtropics, is responsible for the abnormally active tropical cyclones (TCs) in the Pacific during boreal summer 2018 (Qian et al. 2019). We further examine the SSTA impacts on the TC precursors (e.g., easterly waves) and intraseasonal oscillation (ISO), which are closely related to the TC activity in the western North Pacific (WNP). Simulation dataset using 14-km mesh Nonhydrostatic Icosahedral Atmospheric Model (NICAM) is analyzed. The dataset consists of control experiments (i.e., forced by full SSTA in 2018) and sensitivity experiments without SSTA in a local domain (e.g., tropical Pacific, subtropical Pacific, etc.), and those forced by regional SSTA in 2018 with other areas restored to the climatological SST. The simulations were forced by the 12 member SST time series for each setup, which were calculated using a coupled general circulation model, the GFDL Low Ocean Resolution (FLOR) model.

The seasonal mean large-scale atmospheric responses and lower tropospheric high-frequency kinetic energy (KE), as a proxy of TC precursor activity, are compared. In the control simulations (with full SSTA in 2018), eastward extension of westerly anomalies in the tropics manifest as the enhanced Asian summer monsoon, which is consistent with the observations. A marked zonal convergence and cross-equatorial flow collocate with high KE anomalies, suggesting the enhancement of the TC precursor activity by accumulation of moisture and large-scale upward motion in the central tropical Pacific. In the WNP, large-scale cyclonic circulation reaches mid-latitude, with positive KE anomalies there. This indicates that the atmospheric response to the SSTA in 2018 provide favorable conditions for the development of TC precursors, leading to the abnormal TC activity in the Pacific (Qian et al. 2019). In the simulations without the SSTA in the subtropics, tropical westerly anomalies in the tropical Pacific and cyclonic circulation in the WNP disappear, with negative KE anomalies over the broad Pacific domain. In the case without the SSTA in the tropics, dominant impacts appear in the WNP with negative KE anomalies and weakening of lower tropospheric westerly anomalies, despite the secondary importance in the central to eastern Pacific. These are closely associated with the different responses of local Hadley and Walker circulations to the regional SSTA, and possibly responsible for complicated responses of ISO in the WNP.

Keywords: Pacific SST anomaly, intraseasonal oscillation, TC precursor, global nonhydrostatic model