Remote response of a developing tropical cyclone over the western North Pacific to large-scale vapor transport from the Kuroshio in boreal fall

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A remote linkage between the development of tropical cyclone (TC) over the western North Pacific and moisture transport from the Kuroshio Current due to environmental flow toward TC was examined by using regional cloud resolving model and Lagrangian diagnostics. In this study, we specially highlighted a prototypical TC (Typhoon Chaba 2010), which developed and migrated northward over the Philippines Sea in boreal fall, and conducted sensitivity experiments that modified surface turbulent latent heat flux (LHF) over the Kuroshio. The large-scale environment was characterized by a combination of two synoptic systems, eastward-migrating anticyclone from the Asian continent and TC approaching Japan, bringing low-level northeasterly flows over the Kuroshio through an enhanced meridional pressure gradient in that region. Trajectory analyses suggested that air parcels along the northeasterlies modified by receiving abundant water vapor from the underlying Kuroshio may contribute to latent heating within Chaba’s inner core region as a remote effect, leading to TC development.

When LHF was removed or reduced over the Kuroshio under the dominance of the northwesterly flow, TC intensity attenuated during its developing stage even though TC was fairly far away from the Kuroshio. Since no or little modification of dry air parcels occurred in the atmospheric boundary layer over the Kuroshio, contribution of those parcels to latent heat release around Chaba’s eyewall become small. Furthermore, dry air penetration into TC’s inner core region may act as an inhibitor of convection within that region, resulting in deceleration of the TC development. These findings were consistent with another TC (Typhoon Toakge 2004) with a similar synoptic environment, increasing reliability of remote impact of moisture import from the Kuroshio on TC development.

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