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Extra-tropical influence on the formation of tropical cyclone in the western North Pacific: A case study of Peipah (2007)

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While the most tropical cyclone (TC) formations are initiated from lower-to-mid tropospheric vortex spin up, the vorticity of pre-Peipah (2007) in the western North Pacific originated in the upper troposphere. Deep convection around this pre-TC vorticity became significant (the maximum convective area reached over 1.5 $\times$ 104 km2) only one day before TC formation, making genesis prediction quite difficult. This uncommon TC formation process was explained in terms of tropical-extratropical interactions, which is known as one of TC formation pathway called tropical transition over the North Atlantic. As there have not been many recent case studies of tropical transition over the western North Pacific, this study explores the formation pathway of Peipah into details.
The formation of Peipah can be explained in three steps regarding their deep convective activities. The first deep convection is attributed to the quasi-geostrophic (QG) forcing for ascent induce by upper-tropospheric potential vorticity (PV) intrusion from the extratropics. This results in the initiation of surface low-height anomaly as well as the presence of a vorticity maximum in the upper troposphere several days before TC formation. Within the pre-TC disturbance, the negative temperature anomaly is identified due to the cold air transported from the extra-tropics. As the PV trough in the upper troposphere breaks anti-cyclonically and forms a cut-off low, the second deep convection promotes associated with another QG-forcing for ascent. After this episode of deep convection, the cold-cored pre-TC disturbance is transformed into a warm-cored disturbance. Lastly, the lower-tropospheric vorticity grows via barotropic energy conversion in the tropics, the eddy kinetic energy of pre-TC vorticity in-creases. Increased lower-tropospheric vorticity of pre-TC is followed by the surface convergence of moisture over warm ocean surfaces, which further favors continual deep convection. The subsequent accumulation of latent heat diabatically redistributes PV in the troposphere and led to the eventual formation of Peipah.