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A study on the extratropical transition process of tropical cyclones using equivalent potential temperature

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Capturing the time of extratropical transition (ET) is very important for forecasters to determine expected weather pattern from changing tropical cyclones (TCs). In order to analyze and predict the dissipation of TC, a clear diagnosis of TC structure is needed. The purpose of this study is to investigate the structural changes of mean equivalent potential temperature and its asymmetry within TC by using 850hPa equivalent potential temperature which simulates well the thermodynamics of TC, and to provide an objective guidance for determining the timing of ET.
Hart (2003) proposed a guidance to determine the time of ET of TC by using a cyclone phase space derived from thermal wind and thermal asymmetry. This explains the structural changes of TC's warm core. The time of ET can be effectively diagnosed using the lower atmospheric warm core structure represented by 850hPa equivalent potential temperature.
In this study, using the analysis data of GDAPS (Global Data Assimilation and Prediction System N512 L70), change process and asymmetry of 850hPa equivalent potential temperature is analyzed for 11 TCs in 2015 which transferred into extratropical cyclones in the western North Pacific.
It is found that the equivalent potential temperature gradually declines as TC approaches dissipation stage and drops dramatically at the time of ET. The asymmetry of the equivalent potential temperature also increases greatly, and it tends to find symmetry again after some maximum value. This shows that lower atmospheric warm core of TC changes into cold core when a TC moves northward. This study shows how the time series of evolving equivalent potential temperature around the TC center effectively indicates the phase of changing TC structure. The same framework is expected to help forecasters produce improved operational TC analysis.