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Effects of sea surface characteristics on typhoon evolution using multi-satellite data

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To explore the effects of sea surface characteristics on the violent typhoon evolution, this study uses some data, including the best track of Japan Meteorological Agency (JMA), cloud top temperature of Moderate Resolution Imaging Spectroradiometer(MODIS), sea surface temperature of Tropical Rainfall Measuring Mission Microwave Image (TRMM), mixed layer depth of Hybird Coordinate Ocean Model (HYCOM), and sea surface height anomaly of Envisat and Jason-1. From the best track data of typhoon occurring during 1981 to 2009, it is known that the majority of typhoons occur during July to October. To cooperate with the satellite data, this study would select the violent typhoons as specimens, which occurred during 2006 to 2009 and whose life periods were all over five days. Moreover, two aspects, the maximum wind speed near the typhoon core and cumulonimbus development are applied to understanding how the sea surface characteristics affect the development of typhoon. The results are found that there are 60% of the violent typhoons with a positive correlation coefficient (more than 0.53) between their maximum wind speeds and the sea surface height anomaly. On the other hand, there are 70% of the violent typhoons with a negative correlation coefficient (less than -0.6) between sea surface height anomaly and cloud top temperature. In addition, this study also classifies all the data of sea surface temperature, sea surface height anomaly, the maximum wind speed near the typhoon core, cloud top temperature, and heat content index in the unsupervised classification method. The results show that different classes represent distinct stages of the typhoon development with their respective sea surface characteristics. When typhoons pass through warm eddies, the sea surface heat may offer more energy to enhance the vertical convection and deepen the cumulonimbus, whereas the maximum wind speed near the center may be affected. On the contrary, when typhoons pass through cold eddies, the energy from the ocean is too little to increase the convection, so the cumulonimbus will be lower. Therefore, the variation of cloud top temperature depends on the intensity of convection, which may indicate whether the potential heat is enough to affect the intensity of typhoon. Obviously, understanding the effects of cold and warm eddies on convections will improve the prediction of typhoon intensity.