中央氣象署113年第三十八屆天氣分析與預報研討會
38th Conference on Weather Analysis and Forecasting

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Abstract

The influences of surface layer physics schemes on tropical cyclone (TC) intensity and structure are diagnosed using the WRF 4.5.1 modeling with high resolution to simulate Typhoon Rai (2021). Numerical experiments are designed with three surface layer physics schemes including Revised MM5 Scheme (MM5), Eta Similarity Scheme (CTL), and Mellor–Yamada Nakanishi Niino scheme (MYNN). The impact of surface layer physics schemes has been investigated through the characteristics of surface layer, planetary boundary layer, and typhoon circulation. The results show that surface layer physics schemes barely affected TC tracks but significantly affected TC intensity. At the surface layer, relatively higher surface wind speed, friction velocity, enthalpy exchange coefficients, surface fluxes of heat and moisture, and water vapor mixing ratio are found in CTL, followed by MM5 and MYNN, these variables vary with different surface layer parameterizations. The results also demonstrate that simulated structures, such as primary and secondary circulation, potential temperature, boundary layer heights, warm-core anomaly and height, and angular momentum are substantially impacted by surface layer physics schemes, and the CTL produces a larger magnitude than MM5 and MYNN. By using the Sawyer-Eliassen equation to analyze the contributing components, it is shown that diabatic heating plays a major role in secondary circulation.

Key words: Surface layer physics schemes