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講員:楊世楷

指導教授:鍾高陞老師

Dynamics of the Intense Coastal Rainfall Event during TAHOPE-IOP3 : Radar Wind Retrieval, Ensemble Sensitivity Analysis, and k-Means Clustering

Abstract

This study investigated the features and mechanisms of coastal heavy rainfall with the Mei-Yu front using observational data and numerical simulations during 7 June 2022, and identified whether the favorable environments corresponded with similar precipitation in ensemble simulations, exploring the relationship between the primary factors resulted in precipitation. The 1-km resolution 3D synthetic wind field from the Wind Synthesis System using Doppler Measurements (WISSDOM) were used to analyze the evolution of dynamic field. Ensemble Sensitivity Analysis (ESA) illustrated the relationship between dynamic, thermodynamic field and precipitation, and K-means Clustering classified the ensemble members with similarities on precipitation or model variables.

The synthetic wind showed the southwesterly wind along the terrain during the rainfall period, the coastal strong low-level convergence between westerly and southerly caused by terrain. In ensemble simulations, the large-scale environment controlled by wind and water vapor according to ESA, which were important on producing heavy rainfall near the coast. The clustering results separated members with better rainfall performance and favorable rainfall conditions effectively. Both the large-scale frontal system and mesoscale dynamic process contributed to the formation of coastal heavy rainfall.

Keywords

Mei-Yu front

Ensemble simulation

Cluster analysis