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Interaction among Typhoon track, Asymmetrical Rainfall, and Taiwan Topography: A Case Study of Fanapi (2010)

C.-C. Wang and Y.-H. Chen

Department of Earth Sciences, National Taiwan Normal University, Taipei, Taiwan (cwang@ntnu.edu.tw)

Typhoon Fanapi (2010) was a westward-moving typhoon that made landfall and passed through Taiwan on 19 September 2010. With a peak 24-h rainfall of 1080 mm, it caused serious flooding over the coastal plains in southwestern Taiwan, including the city of Kaoshiung. Being a relatively small tropical cyclone (TC), Fanapi (2010) developed an asymmetrical rainfall pattern when and after it crossed the Central Mountain Range (CMR) of Taiwan, with most rain in the southern to southeastern quadrants. Meanwhile, upon leaving Taiwan, the TC showed a significant reduction in translation speed temporarily for 12 h, from about 22 km h^{-1} to 13 km h^{-1}.

Numerical experiments were carried out for Fanapi using the Cloud-Resolving Storm Simulator (CReSS) of Nagoya University at 3-km horizontal grid spacing and the National Centers of Environmental Prediction (NCEP) global analyses (at 1˚ latitude/longitude and 6-h resolution) as initial and boundary conditions (IC/BCs). Sensitivity tests starting at 0600 UTC 19 Sep, when the TC was crossing CMR, with varying water vapour amount and terrain height of Taiwan were performed. The results indicate that the asymmetrical latent heating (LH) effect, induced by the topography, also had significant impact on the track over a 9-h period and subsequent rainfall distribution: The model TCs with less moisture (and less asymmetry in LH) move faster (up to 24.3 km h^{-1}) and more toward the northwest (at 305˚) upon leaving Taiwan, while the TC in the control run (with full moisture and terrain) move at a slower speed (17.4 km h^{-1}) and more toward the west (at 280˚), both of which are closer to the observation.

The above simulation results of Fanapi are compared to those of Typhoon Morakot (2009), which was a much larger and slower-moving TC that also exhibited asymmetrical rainfall pattern. Morakot (2009) caused the most serious damages over Taiwan in the past 50 years.