

2025年熱帶低壓TD02和2024年熱帶低壓TD19引發的 暴洪災害多重情境分析與預警

Analysis on the Multiscale Situations of Flood Disaster Involved in the Tropical Depressions of 2025 TD02 & 2024 TD19 for Early Warning

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Abstract

The heavy rainfall events on 12-13 June 2025 (TD02, Case 1) and 21-22 September 2024 (TD19, Case 2) due to the influence of tropical depressions brought severe flash floods with landslides, damage of roads, houses and crops in Taiwan areas. The objective of this research is to realize the large-scale dynamic conditions, and furthermore, the physical mechanisms from the mesoscale point of views to find out the approximate approaches for disaster prevention and early warning.

The primary findings for Case 1 suggest that under the influence of Pacific High and TS Wutip (蝴蝶), a convergent effect of southeasterly steering flow was located off the east and northeast area of Taiwan in an intensely unstable environment, and this weather pattern made TD02 propagate northwestward in moving speed~15 m/s. Furthermore, just before the landfall at Fengbin, Hualien (花蓮豐濱), its vertical structure was in a tilt form and a secondary vortex was obvious at the south-southwest flank of the primary one, probably organized by the Taiwan complex terrain and mountains. The low-pressure belt was formed and shifted northward near the south coast of Taiwan, and, combining the circulation flow of Pacific High, the southwesterly flow with moist and warm air resulted in the heavy rainfall over the south part of Taiwan with maximum hourly rainfall rate of 89 mm (高雄大寮) and daily rainfall rate of 239 mm (屏東春日), respectively. Also, in Case 2, the vigorous water vapor was delivered from the South China Sea to Taiwan, Japan and Korea areas, and the positive vorticity in low level and negative vorticity in high level off the northeast coast of Taiwan brought an unstable environment for maintenance of TD. Again, the coupling effect of Taiwan terrain and circulation of TD19 as well as the intrusion of a cold moist tongue from the east coast of China to the north coast of Taiwan triggered the initiation and development of deep convection between TD19 and Taiwan topography. Based on the radar observations, the cloud top of the well-defined deep convection could reach more than 10km in altitude, and it resulted in the maximum hourly and daily rainfall rates were 102mm (新北三貂嶺) and 369mm (新北平溪), respectively.

The forecasts of TD track, duration of stay, amount of accumulated rainfall and intensity of wind field are the key factors for disaster preparation, and more information input for nowcasting is quite significant for well preparation, including intensive satellite and radar observations. Hopefully, the preliminary concept models combined from these two catastrophic flooding cases could offer a multiscale weather scenario for the early warning of disaster.

Key words : tropical depression, flash flood, disaster prevention

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