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Abstract

The PSU/NCAR MM5 was used to investigate the orographic effects on the characteristics of mesoscale precipitation systems over Taiwan. For the particular shape of Central Mountain Range (CMR) which located with NNE-SSW direction along the island and with maximum height over 3000m, the passage of environment flow will be modified by CMR tremendously. It is also found that the rainfall was concentrated on some special locations during the Mei-Yu season and winter. The most interesting point on this study is to discuss the terrain effect on the special precipitation pattern using simulation results.

A Mei-Yu front penetrated over Taiwan on 7-8 June 1987 (TAMEX IOP8) was presented. The observation indicated that before the front passage (20 hour earlier, 7 June) there were heavier rainfall accumulations occurred in the slope of CMR, and concentrated on northern, central and southern of Taiwan (Fig. 1a). While rainfall amount exceeded over 150mm during only few hours in the afternoon and there were 2 or 3 peaks found on the rainfall time-series record. However, the precipitation pattern was

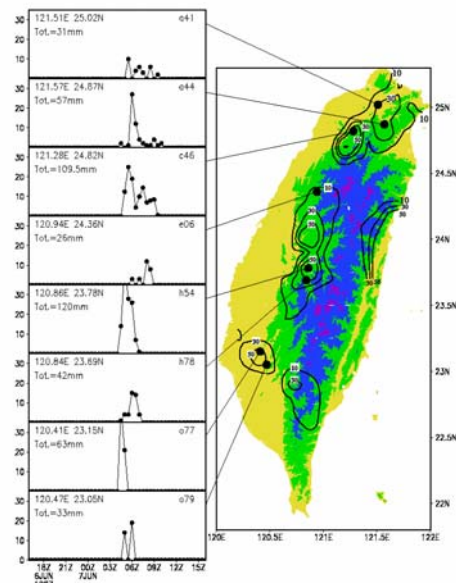
quite different before and during the front passage. Rainfall spread from coast to mountain area associated the passing front indicated the convection systems were moved from the Taiwan Strait (Fig. 1b), and just prior the front the interaction between southwesterly and topography will trigger precipitation over southern Taiwan.

On 7 June, the environment was suitable for the development of convection systems with the unstable atmosphere of high CAPE value (~ 2000) and low Froude number (Fr , ~ 0.3) synoptic flow from south (southwest). Flow was split around the CMR while interacted with the diurnal thermal circulations during the daytime, there were three convergent area formed on the northern, central, and southern parts of the western slope of CMR. These convergence areas triggered the convective system and made abundant rainfall. Modeling studies (Fig. 2) shown the evidence of convection is at first triggered on the slope of Central Mountain Range (CMR) by the local convergence which formed by the synoptic flow with the thermal induced circulation (Fig. 3). The sensitivity tests also indicate that the land-sea breeze, latent heat releasing and the surface fluxes support the dominant lifting part on the generation of the convection systems.

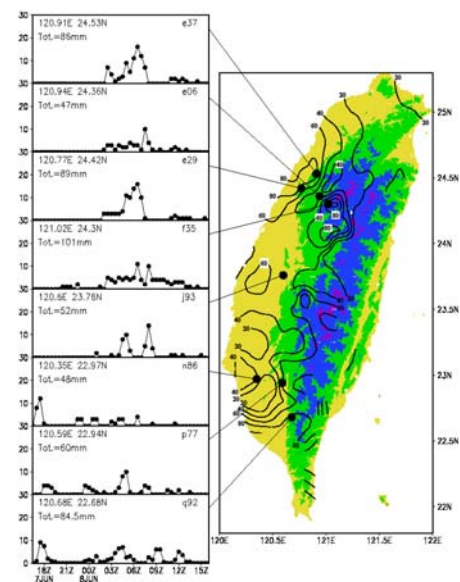
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A shallow cold front passed through Taiwan after 20 hours; there were two types of precipitation systems found during the passage (Fig. 4). One of them was formed prior the front on the southern area of Taiwan Strait, from the simulation experiment the prefrontal southwesterly near the island will decelerate by the topography of Taiwan then turn its direction. While confluent with the continuously southwesterly, a confluence zone just located offshore which triggered deep convection and moved into Taiwan Island. Another type of precipitation was embedded in the front zone; the retarding of CMR when the front arrived in the north tip of Taiwan enhanced temperature and moisture gradient, convective systems then be triggered and move to northeast by the prefrontal southwesterly. The modeling results showed the shallow front separated to two parts when penetrated in Taiwan, east part moved fast and west part slowed down. By the intending of low convergence in the west part of front zone, deep convection associated with front passage made heavy rainfall observed in the inland area of Taiwan (central), with the friction of land surface the convection weaken for a while but enhanced again by the lifting of CMR.

Not only the precipitation systems in Mei-Yu season, but also the winter precipitation over Taiwan show the special geographic distribution characteristics. The present study simulated the event in 10~12 December 1998, most of the rainfall observed in the northeast part of Taiwan Island (I-Lan plain) within strong northeasterly. From the simulation study (Fig. 5), it is found that the flow retarded by the CMR and blocked on the windward slope, upstream



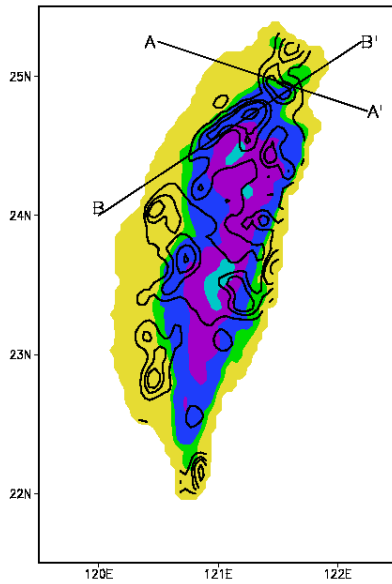
influence with the supplying of surface fluxes



triggered the convection system.

FIG. 1. 24 hours accumulated rainfall pattern for (a) 7 June 1987 (b) 8 June 1987. Right panel indicates the isohyets of accumulated rainfall for the day, Contour interval is 10mm, 30mm, 50mm, 80mm, and 100mm. The 30 minutes time series of rainfall records on the sampling observation stations where locate in the local maximum areas are shown in the left panel.

24Hour Accumulated Rainfall (mm)
07June1987 CN



24hr Accumulated Rainfall
08Jun1987 MM5 OUTPUT (cm)

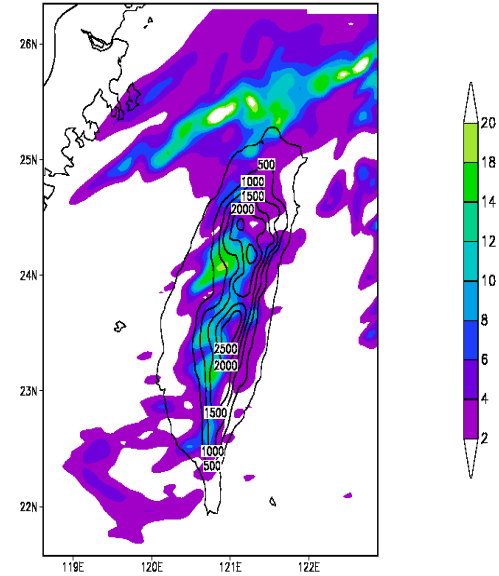


Fig. 2. Simulation results of 24 hours accumulated rainfall pattern for (a) 7 June 1987 (b) 8 June 1987 in Control Run experiment. Contour interval is 10mm, 30mm, 50mm, 80mm, and 100mm. A-A' line shown in (a) will be used as the cross-section analysis in Fig. 3.

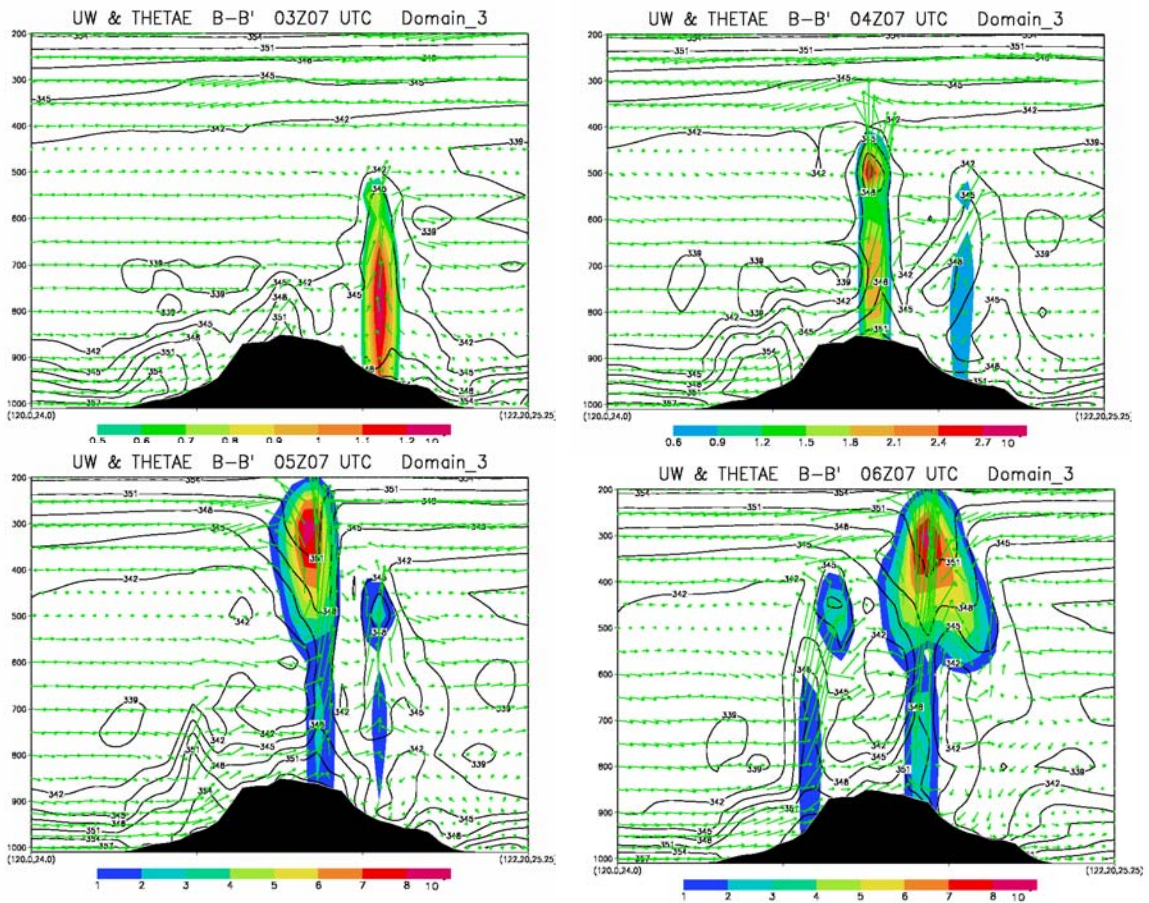


Fig. 3. B-B' cross-section analysis of the development of northwestern part of Taiwan. Winds shows in vector and the equivalent potential temperature in contour with 3 degree K interval. Shading area indicates the rain water in 0.1 g/kg. (a) 1100Z (b) 1200Z (c) 1300Z (d) 1400Z LST 7 June 1987.

6-hour accum. rain & sfc ThetaE 00Z08

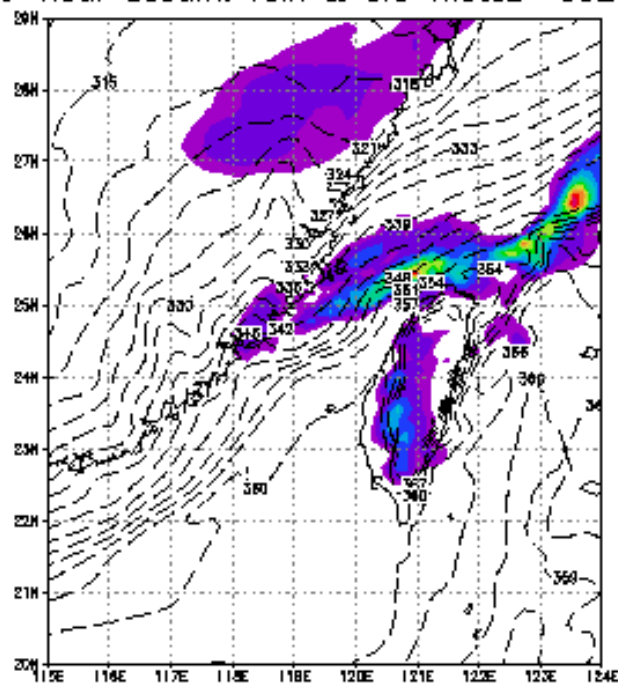


Fig. 4. Simulation results on the front passage. Shading area indicates the 3-hours accumulated rainfall from 10Z to 13Z LST 8 June 1987. Winds shows in vector and the equivalent potential temperature in contour with 3 degree K interval.

MM5 Output, Local Time 98121000-98121023 Z
Accumulative Rain (mm/day)

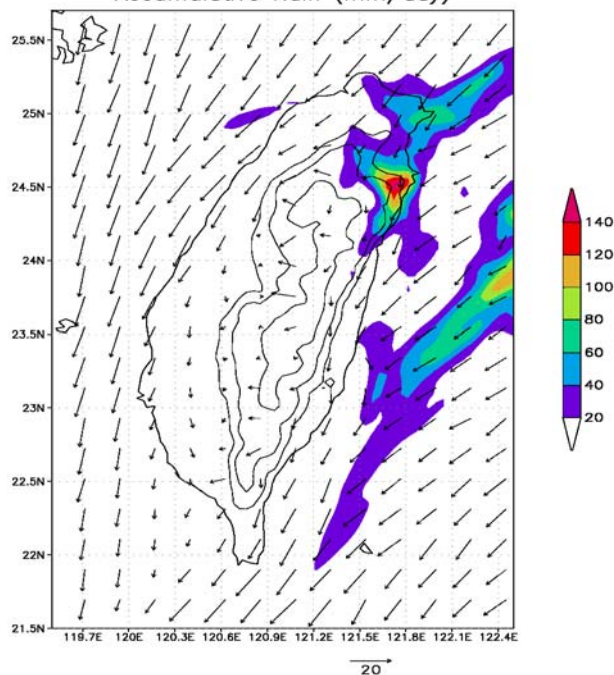


Fig. 5. Simulation results of 24 hours accumulated rainfall pattern for 10 December 1998. Contour interval is 10mm and winds shows in vector.