Geophysical Research Abstracts
Vol. 15, EGU2013-1704, 2013
EGU General Assembly 2013

Space-time variation of the Typhoon Morkat (2009) rainband structure over Taiwan's complex terrain observed by weather radars and rain gauge measurements

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This research studies the structure of precipitation systems over Taiwan as Typhoon Morakot (2009) impinged on the island on 8 August 2009 using data observed by weather radars and rain gauges. A newly-designed multiple-Doppler radar synthesis technique particularly designed for dealing with non-flat surfaces is applied to analyze the three-dimensional wind fields over the ocean and terrain. In the northern and southern portion of the analysis domain where the mountain slope is relatively gentle and steep, respectively, the radar reflectivity measurements indicate that the precipitation systems exhibit horizontal translation in the north and abrupt intensification in the south. Far from the southern mountainous region, a north-south oscillation of an east-west-oriented band of strong radar reflectivity (>40 dBZ) with a horizontal span of 20 km is observed. Along the mountain slopes, the region of strong radar reflectivity expands to a much wider north-south-oriented area. The major precipitation is confined to the windward side of the mountains. Further analysis reveals that the upstream atmosphere is statically unstable, which implies that the lifting of the incoming convective cells by the topography will easily trigger precipitation. Thus, most of the moisture will be consumed before the air reaches the leeward side of the mountains. The long duration and the wide range of heavy precipitation in the mountainous regions resulted in a record-breaking rainfall amount of 2,000 mm over four days.

A noticeable feature of the prevailing westerly flow is a wind speed maximum ($\sim$ 40 m s-1) above the mountain crest, which can be explained by a simplified shallow water model.

The capability of applying the weather radar to provide a reliable quantitative estimate of the rainfall over a large area with high temporal and spatial resolution is shown using dual-polarimetric radar data. Our results demonstrate the potential applications of the knowledge of the wind and precipitation characteristics in hydrology and other related fields.