

A brief Summary of

Southwest Monsoon Experiment (SoWMEX) 2010

Southwest Monsoon Experiment 2010 is to be hold during the period of May 27 to June 30, 2010 at Nan-tsi-hsian creek of southwestern Taiwan. The goal of the field observation campaign is to verify and improve the capability of quantitative precipitation estimation and forecasting (QPE/QPF) at valley region under the prevailing southwest monsoon.

1. Introduction

Typhoon Morakot accompanying with the southwest monsoonal flow produced extreme precipitation on the southwestern Taiwan. The average of accumulated precipitation exceeded 1000mm during 36hrs on the mountain area and resulted in several severe landslides and hundreds people died. The radar estimated rainfall represents the local extreme precipitation taking place at the slender valley (Fig 1a). Yu and Cheng (2010) show the high occurrence frequency of large reflectivity occurred on the vicinity of the slender valley (Fig 1b). The mechanism of heavy rainfall in the southwest monsoonal flow regime over the slender valley is not clear.

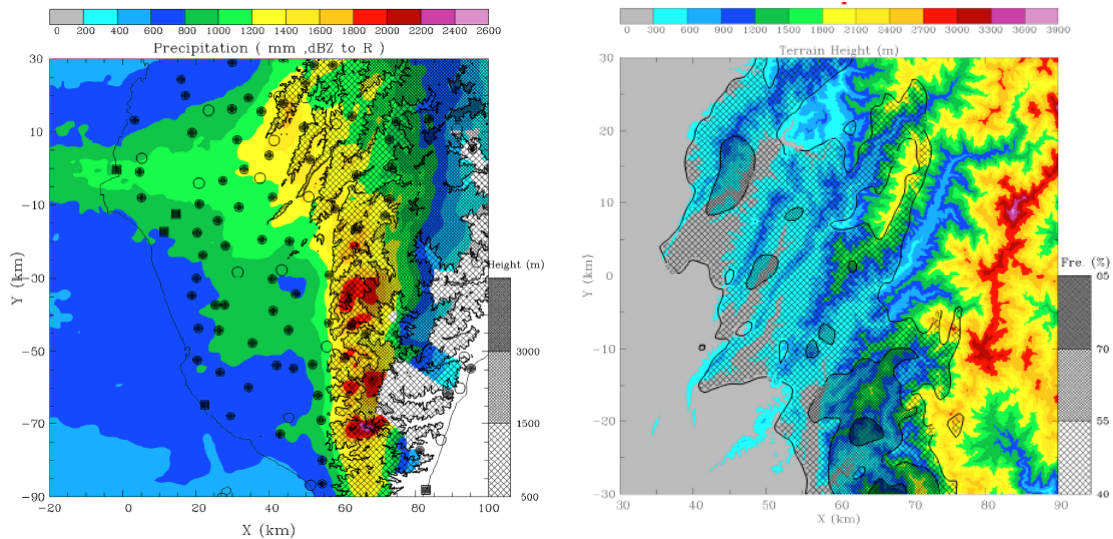


Fig 1 (a) Distribution of 36hrs accumulated precipitation. (b) Distribution of occurrence frequency.

The observations from rain gauge contrast sharply with QPF of the numerical simulations over south Taiwan during SoWMEX-2008 (Lai et al. 2010, Fig. 2). The observations from rain gauge exhibited the principle precipitation occurring over the

costal area and the secondary precipitation occurring over the mountain area. The QPF of the numerical simulations capture the similar pattern, however the volume distributions are opposite and much weaker.

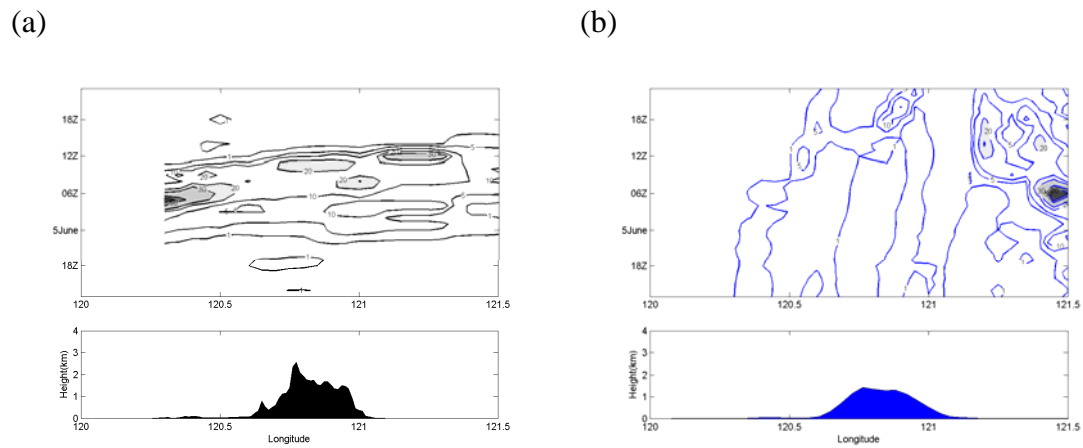


Fig 2 Hourly precipitation time-space diagram. (a) rain gauge, (b) model.

However, comparing with the rain gauge observations, QPESUMS demonstrates the radar reflectivity derived rainfall was severely under-estimated, especially over the mountain area (Fig. 3). Modification of the currently QPE using QPESUMS is important. The under-estimation of radar derived rainfall in this region might result from 1) the enhanced precipitation near surface level due to the prevailing flow lifting on the terrain, and 2) pronounced beam blockage of the operational radars in the environment of slender valley.

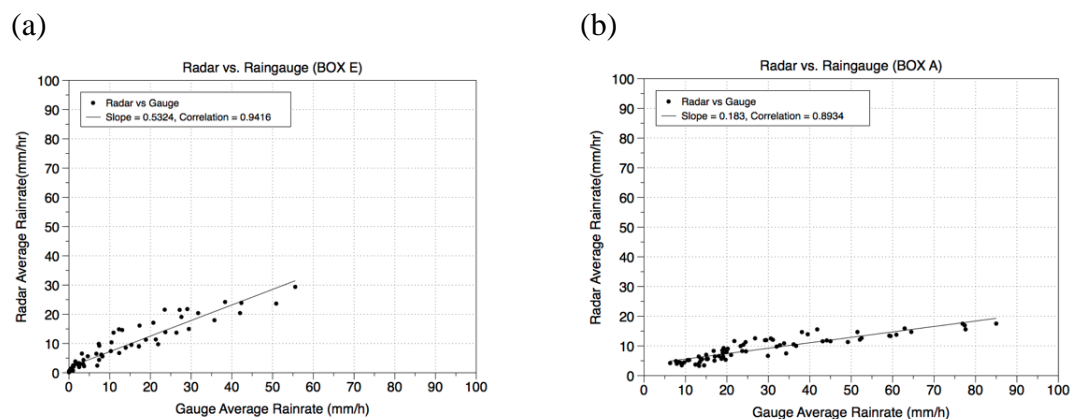


Fig 3 The correlation of radar reflectivity derived rainfall and rain gauge at (a) plain (b) mountain.

White et al. (2003, Fig. 12) demonstrated that with similar hourly rainfall, the reflectivity and vertical velocity profiles both are significantly different between the stratiform precipitation systems with/without bright band during California Jets

Experiment (CALJET). A lack of the information of the precipitation structure at lower troposphere results in severe estimation error. The very devil is that the radar site at hill is difficult in observing nobrightband rain, otherwise the radar site at costal plan or at valley meets beam occulted problems (Fig. 18 of White et al. 2003).

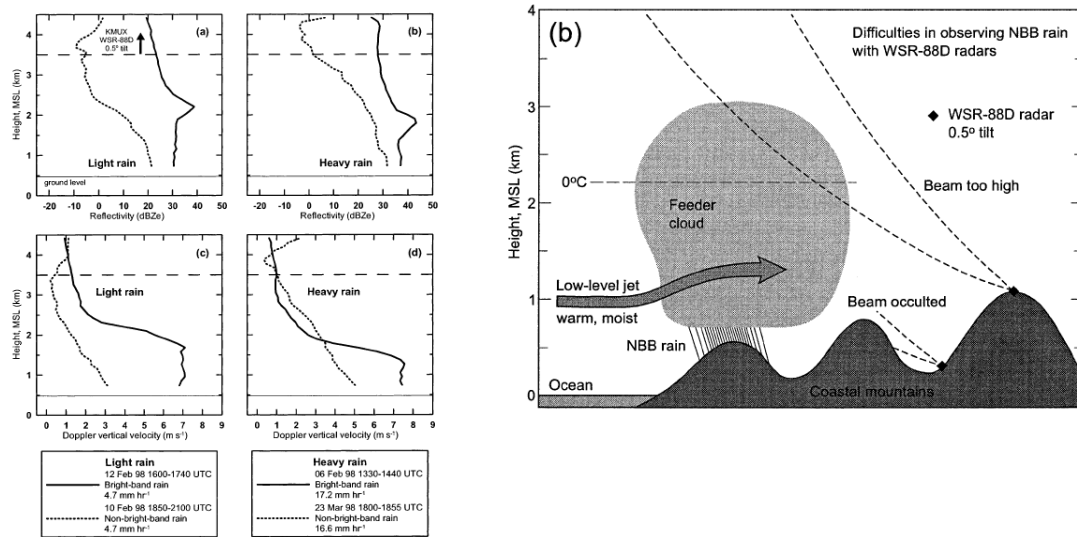


Fig. 12 and Fig. 18 of White et al. (2003)

Berne et al. (2005, Fig.2) propose a methodology of recovering the reflectivity profile in radar beam blockage by complex terrain, this is, adding an X-band vertically pointing radar at valley. The analyses of vertically pointing radar data during SoWMEX2008 show the difference features of reflectivity and vertical velocity between convective precipitation and stratiform precipitation.

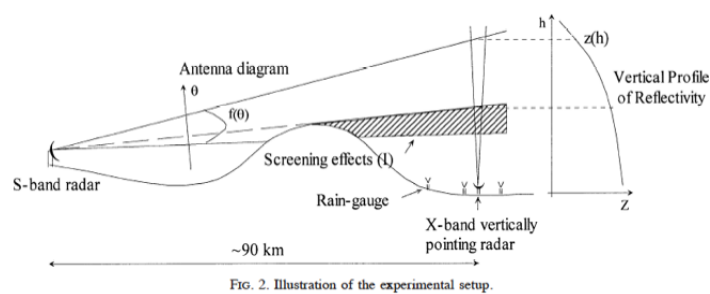


Fig. 2 of Berne et al. (2005)

The drop size distributions (DSDs) observed by the disdrometer setting on the surface can aid the presumption of the precipitation processes. The polarimetric radar provides more parameters than traditional Doppler radar and has the capability of hydrometeor classification and DSDs inversion which are important information for a better understanding of possible precipitation processes.

The environmental stability and prevailing flow structure affect not only the location of occurrence (ex. plain, foothill or mountain), but also the vertical velocity of the precipitation systems and the resultant rainfall characteristic. Thus, the vertical thermodynamic and kinematic structure providing by soundings are essential.

2. Scientific objectives

- 1) Understanding of orographic precipitation processes under the influence of Southwest Monsoon.
- 2) Evaluate the extent of under-estimation of rainfall by using QPESUMS in the mountainous area.
- 3) Provide the reference and the strategy of QPE/QPF modification and the instrument category.

3. Instrument deployment

- 1) Regional stations

The main region of the field campaign is Nan-tsi-hsian creek of southwestern Taiwan. The surface station is designed as a cross shape. Three stations are along the valley (one of them is Chia-hsian automatic weather surface station of CWB). Two stations are located at western slop and eastern slop, respectively. The center one is supersite (SS), the instruments includes 1) Japan X-band Doppler radar, 2) mobile sounding (GPS), 3) Korea Parsivel disdrometer and 4) Microwave rain radar (MRR), 5) Joss-Waldogiel disdrometer(JWD) and 6) Integrated Sounding System (ISS). The rain measurement site R1 sets an automatic weather surface station (MAWS); R2 and R3 both include a MAWS and a JWD.

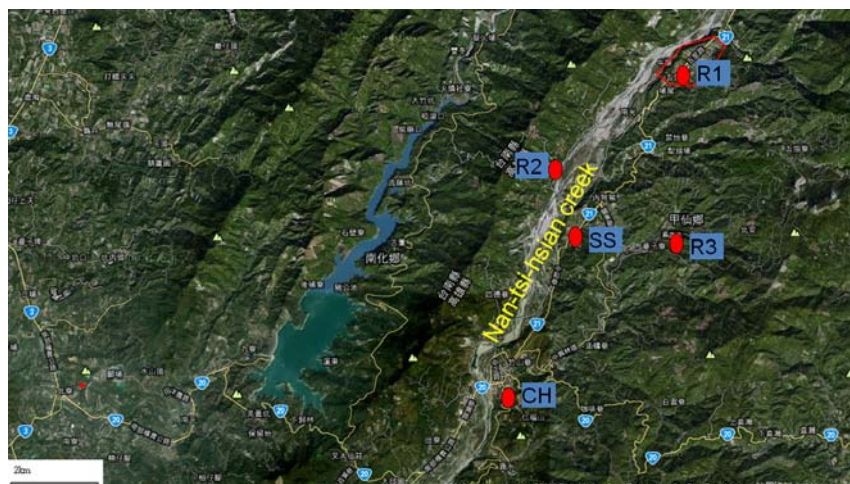


Fig4. Regional stations map.

2) Mobile stations

The mobile X-band polarimetric radar, TEAM-R will accompany with the MAWS and deploy at Ji-lai.

3) Upper air observation

Beside the operational rawinsonde network and mobile soundings, the dropsondes are deployed at each flight mission in event driven and to sample the upstream environmental characteristic. Dropsonde will supply the moisture, thermodynamic and kinematic properties and the mesoscale variability over the ocean. The synoptic observation region is illustrated in Fig 5. Total flight time is about 25 hrs. Each flight mission will lunch 15 dropsondes and take about 3 hrs.

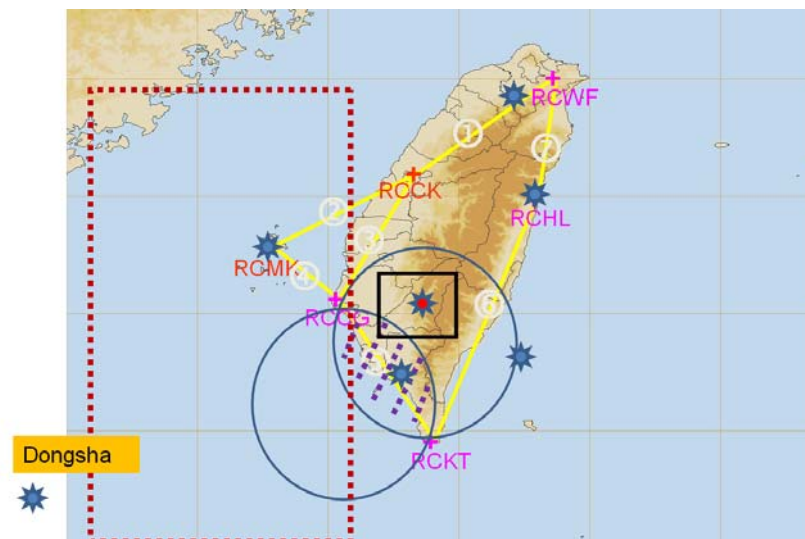


Fig5. Upstream dropsonde and dual-Doppler wind synthesis domain over Taiwan

4. Experimental design

1) Regular observation

The operational rawinsonde and radar network will operate in regular mode. During the experiment period, the rain measurement will be operated continuously. The TEAM-R will keep in surveillance mode and the Japan X-band Doppler radar will keep in RHI mode along the valley.

2) Intensive observing period (IOP)

When there is a possibly of heavy rain event during the experiment period, an IOP will be called by the scientific planning group (SPG). During the IOP period the flight mission of dropsondes and the additional GPS sounding at supersite will be launched.

5. Data Management

The experiment data will be collected and posted on the website: <http://sowmex.cwb.gov.tw/>

6. Acknowledgment

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7. Reference

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