A Modeling Study of the Precipitation Features of the Rainfall Event on 1-3 June 2008 (IOP 4) during the SoWMEX/TiMREX

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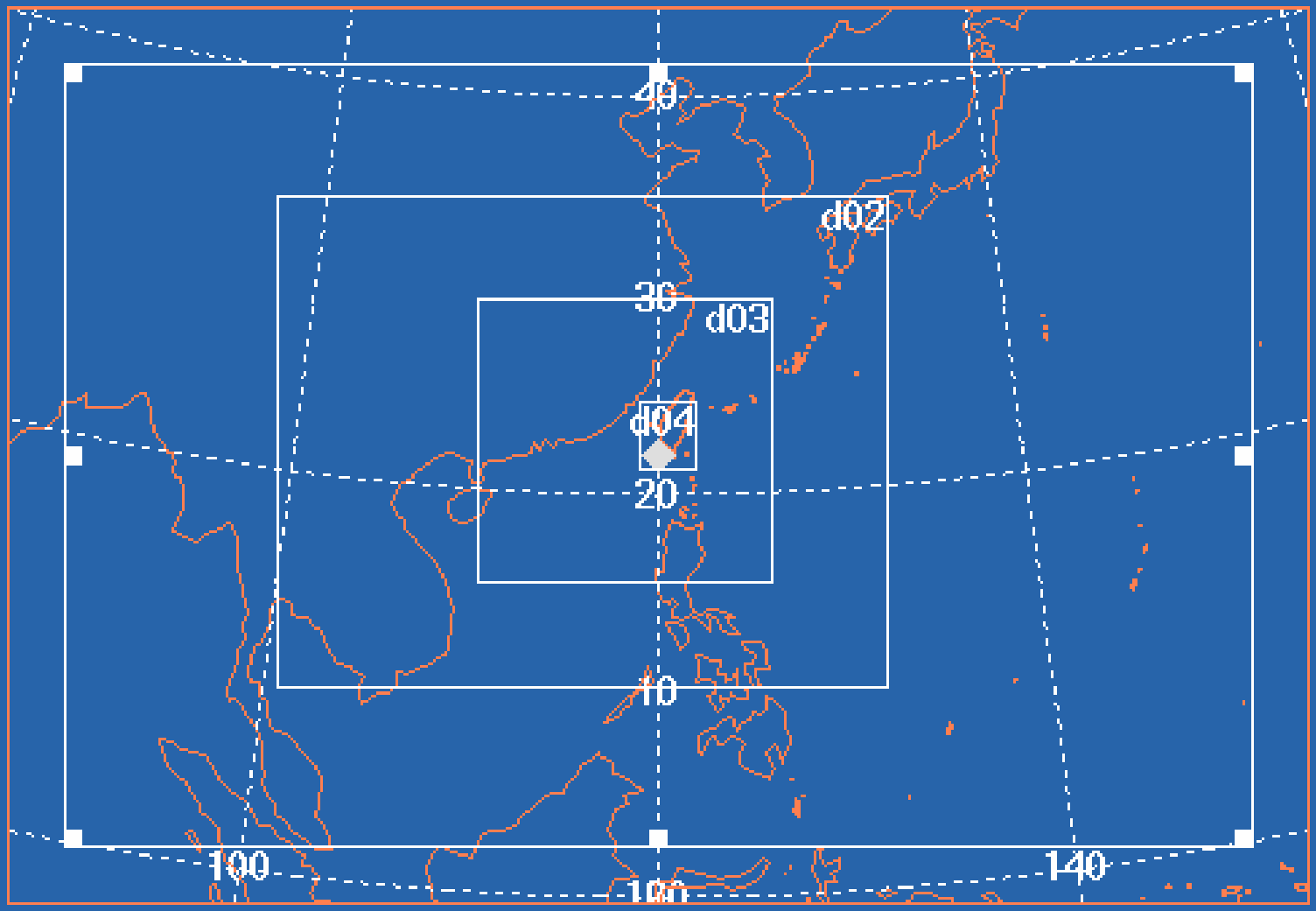
20-22 October 2009

Objectives

- To investigate the capability of WRF model to simulate the synoptic, kinematic and precipitation features associated with the Mei-Yu frontal system on 1-3 June 2008 (IOP 4).
- To understand the evolution from frontal precipitation to orographic precipitation for this case.

WRF Configuration



Two-way interactive

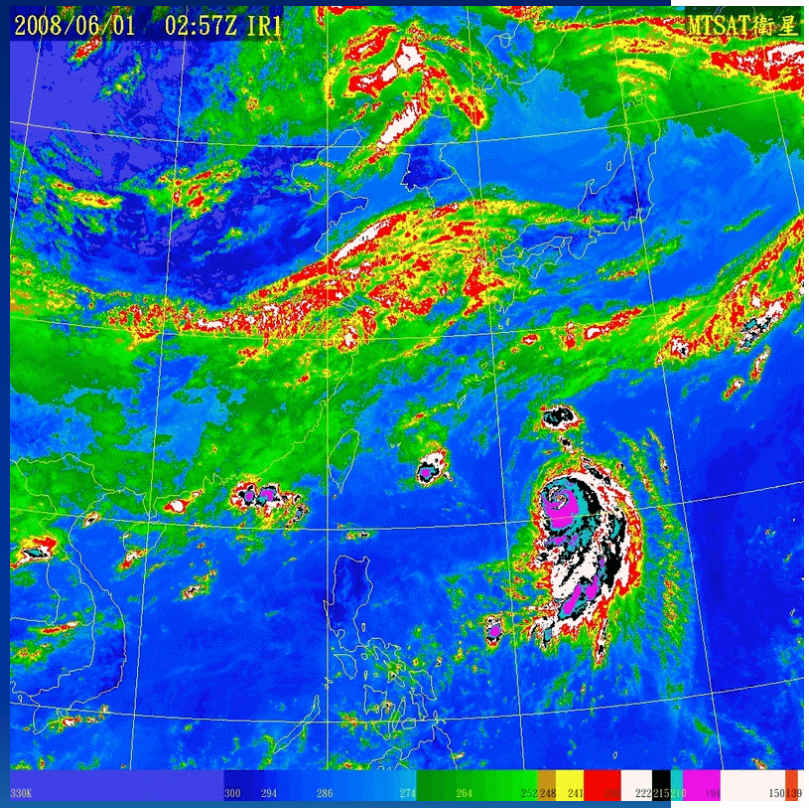
D1: 45 km
D2: 15 km
D3: 5 km
D4: 1.67 km

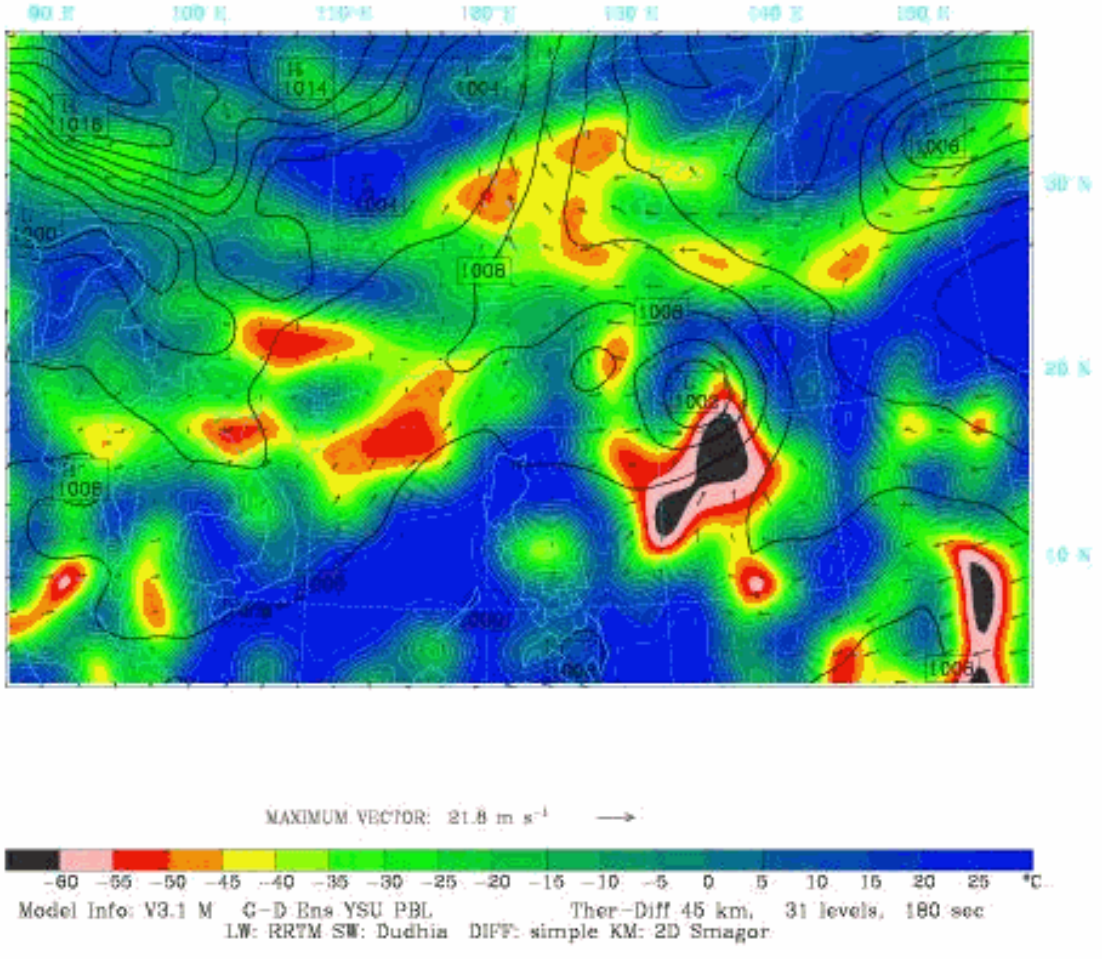
32 levels
In vertical

WRF model setup

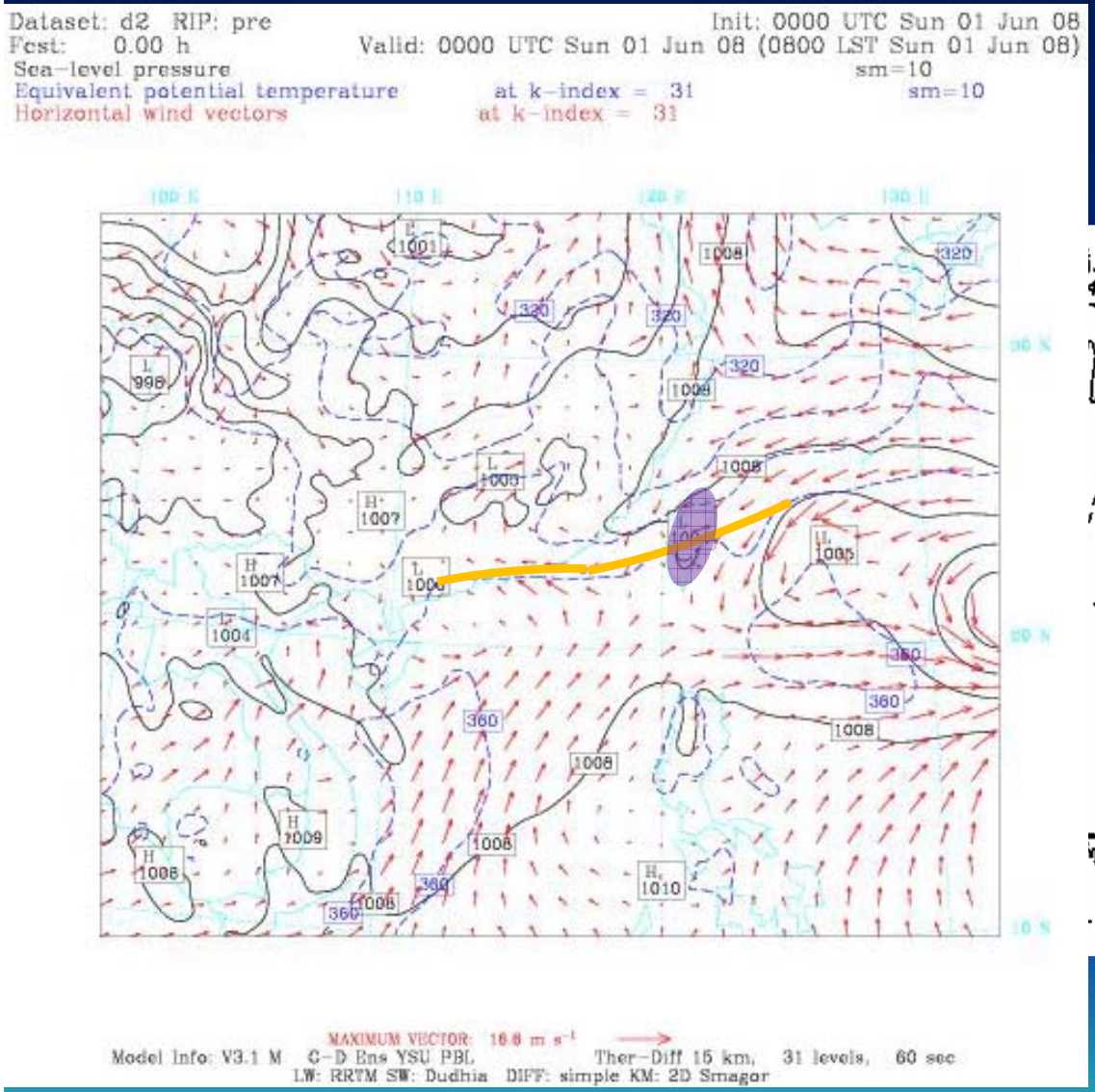
Version	V 3.1.1
Fcst Period	72 h
Cumulus	Grell-Devenyi (2002)
Microphysics	WSM6/WDM6
PBL	YSU
Radiation	RRTM for shortwave Dudhia (1989) for longwave
I.C.	NCEP/FNL analysis (2008/06/01 0000 UTC)
B.C.	NCEP/FNL analysis

IR satellite map vs. WRF cloud-top temperature

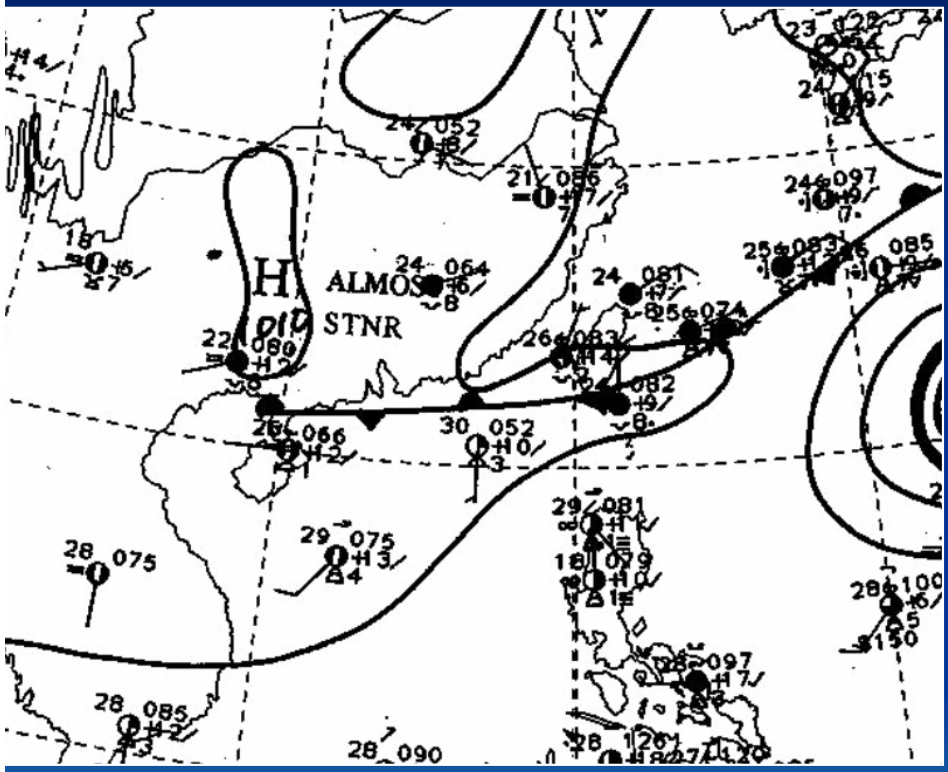




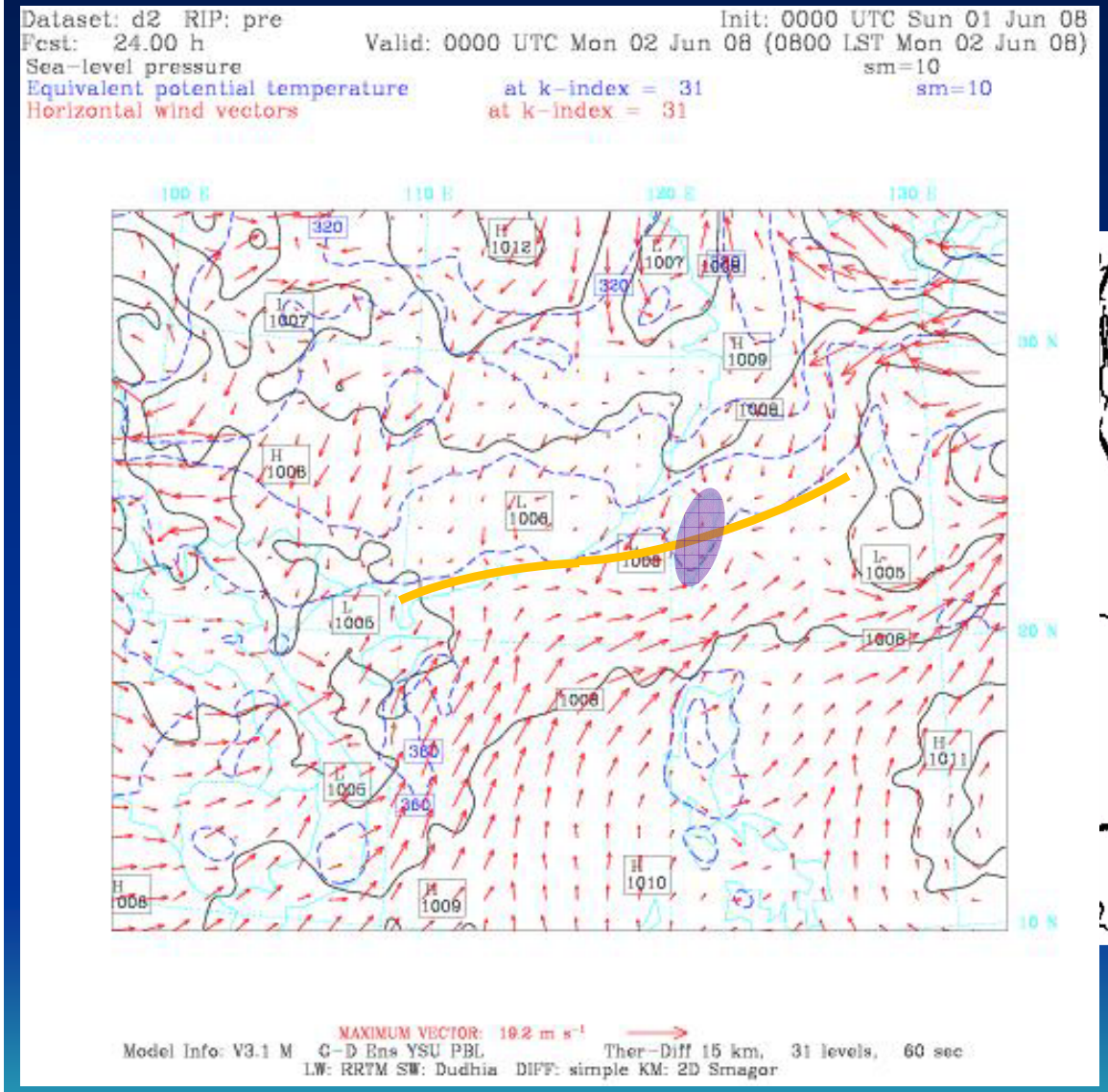
Frontal Position on Domain 2



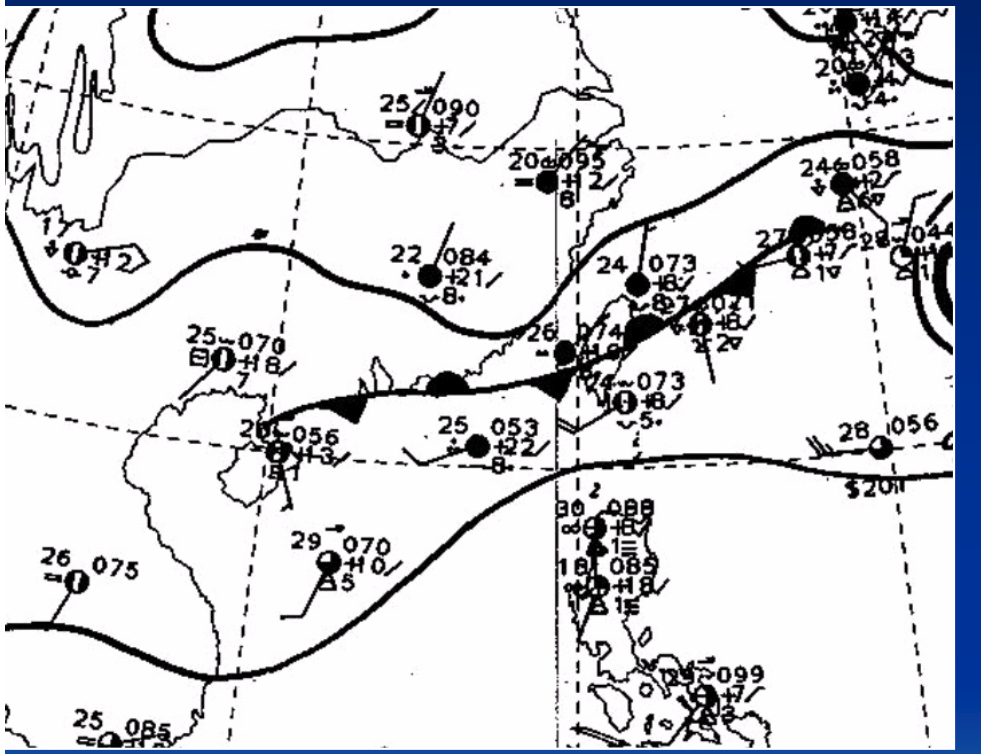
t = 0 h
(00 UTC 1 June 2008)



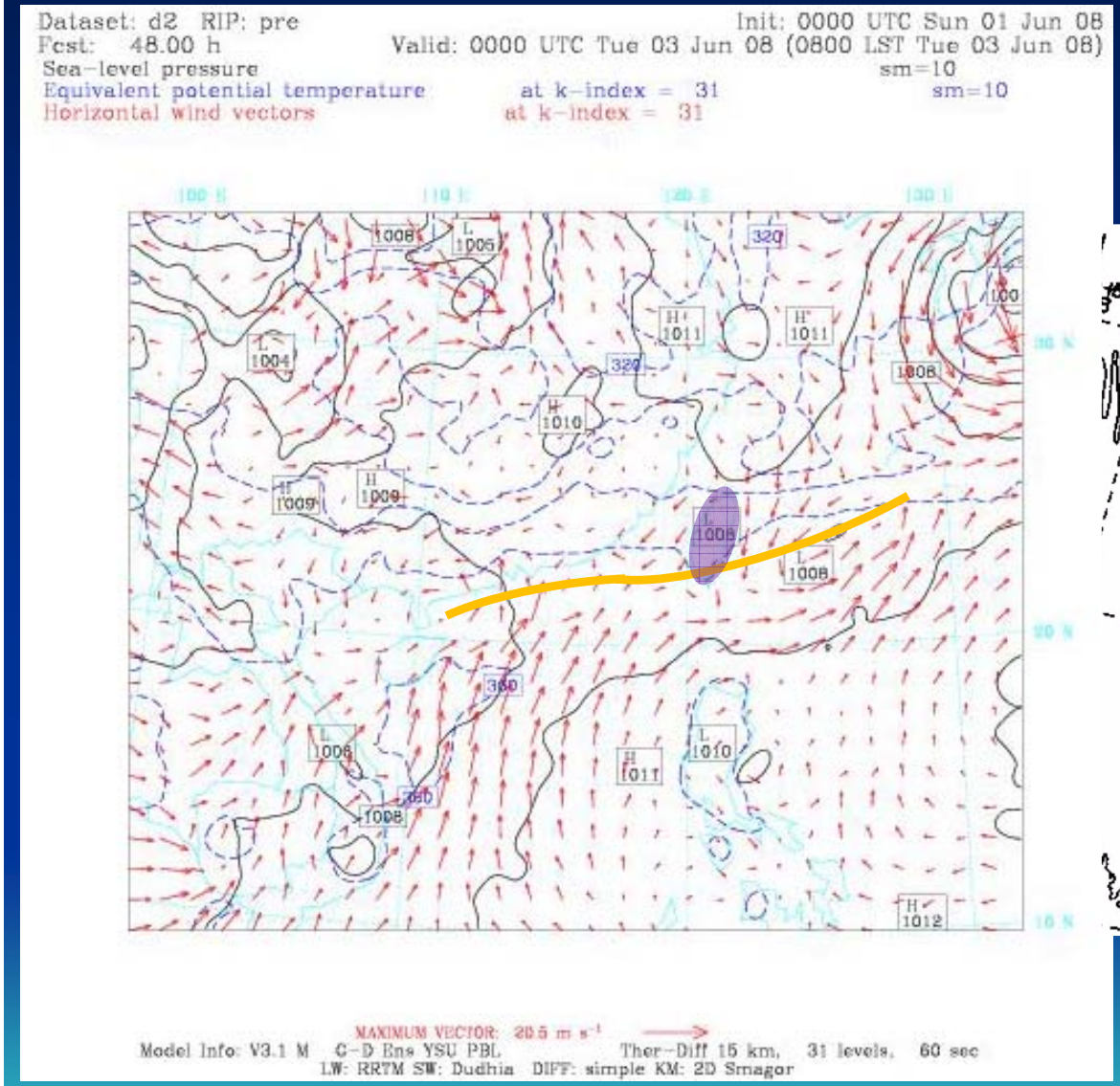
Frontal Position on Domain 2



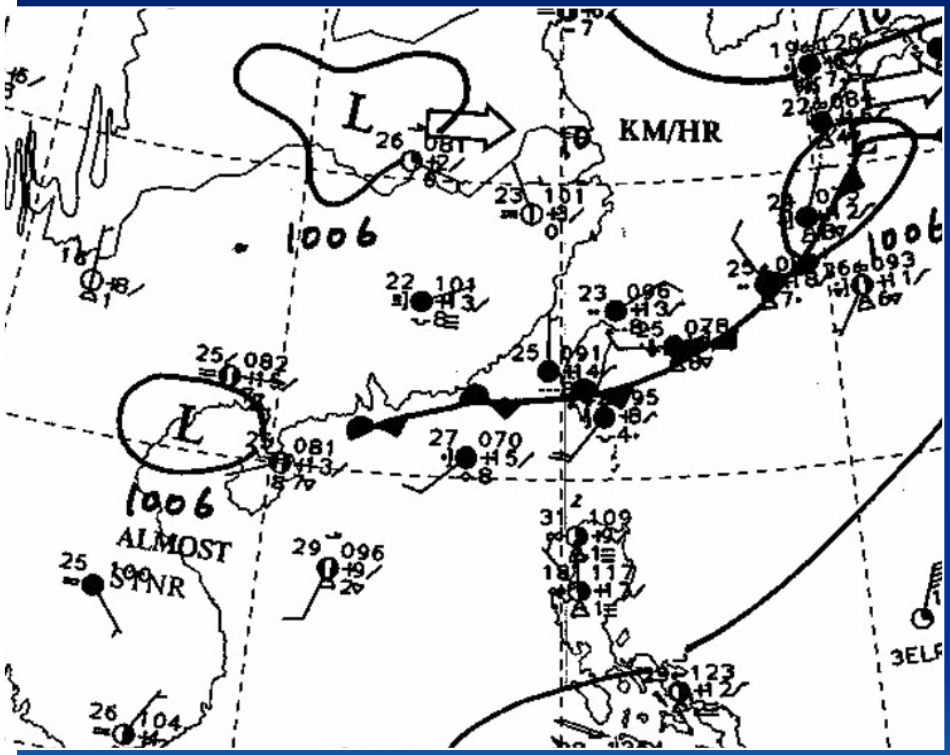
t = 24 h
(00 UTC 2 June 2008)



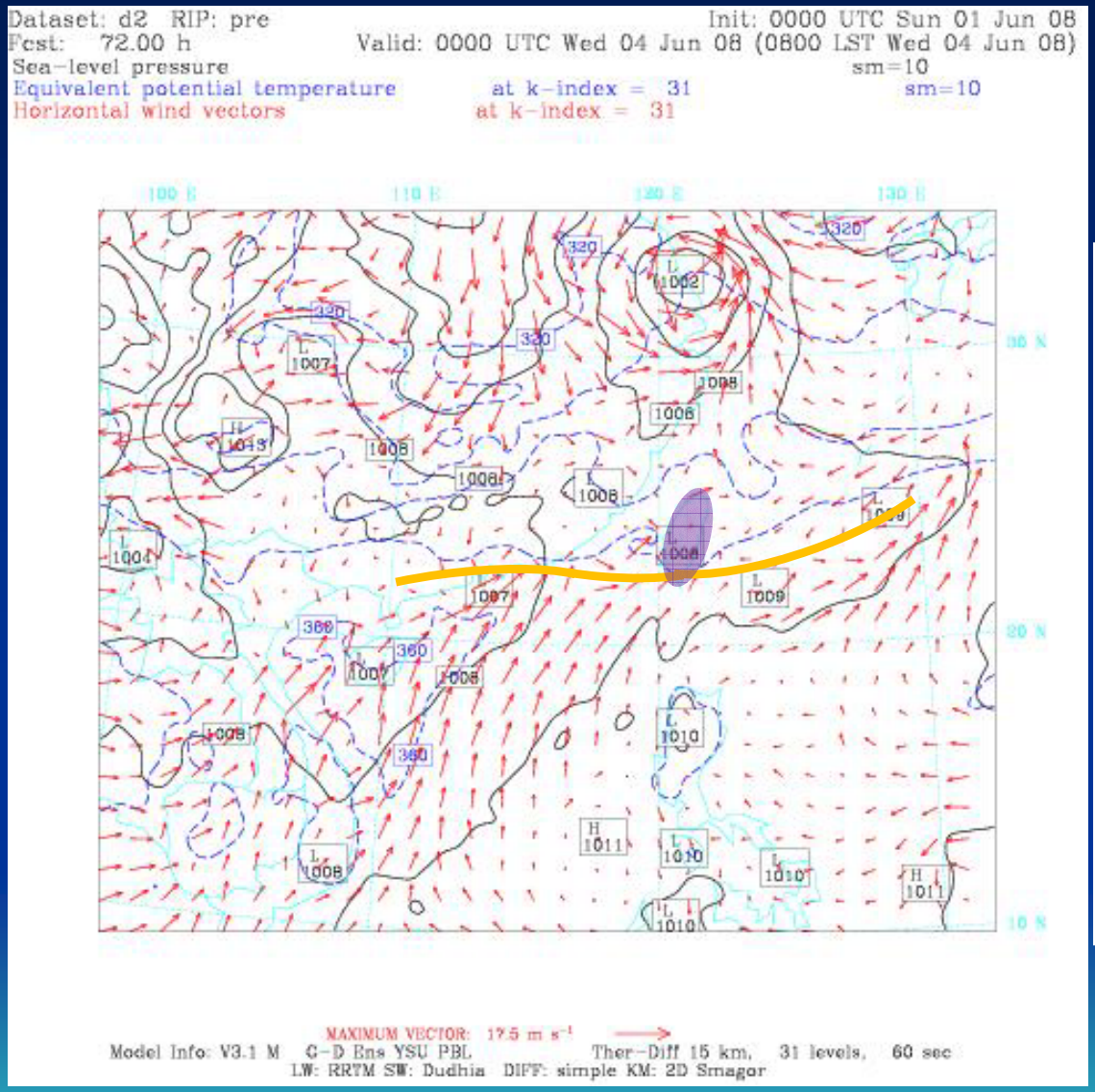
Frontal Position on Domain 2



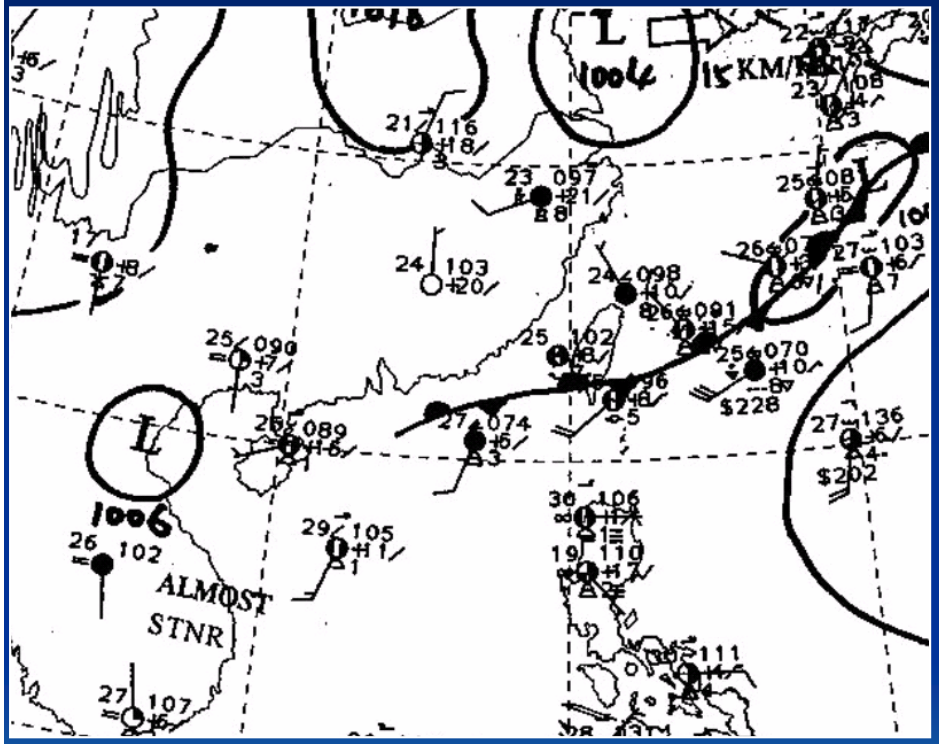
t = 48 h
(00 UTC 3 June 2008)



Frontal Position on Domain 2

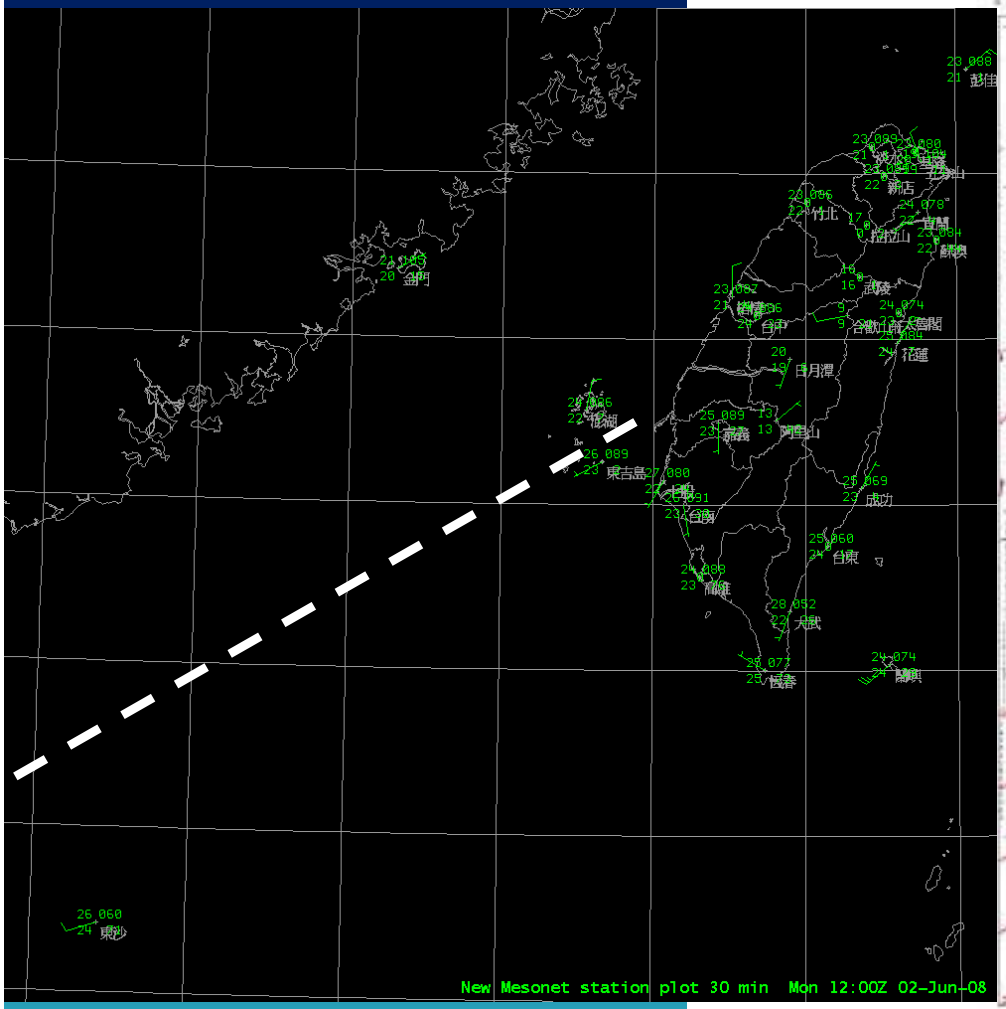


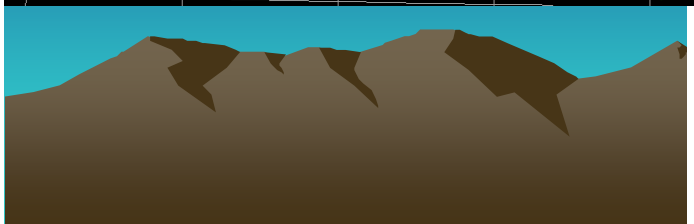
t = 72 h
(00 UTC 4 June 2008)

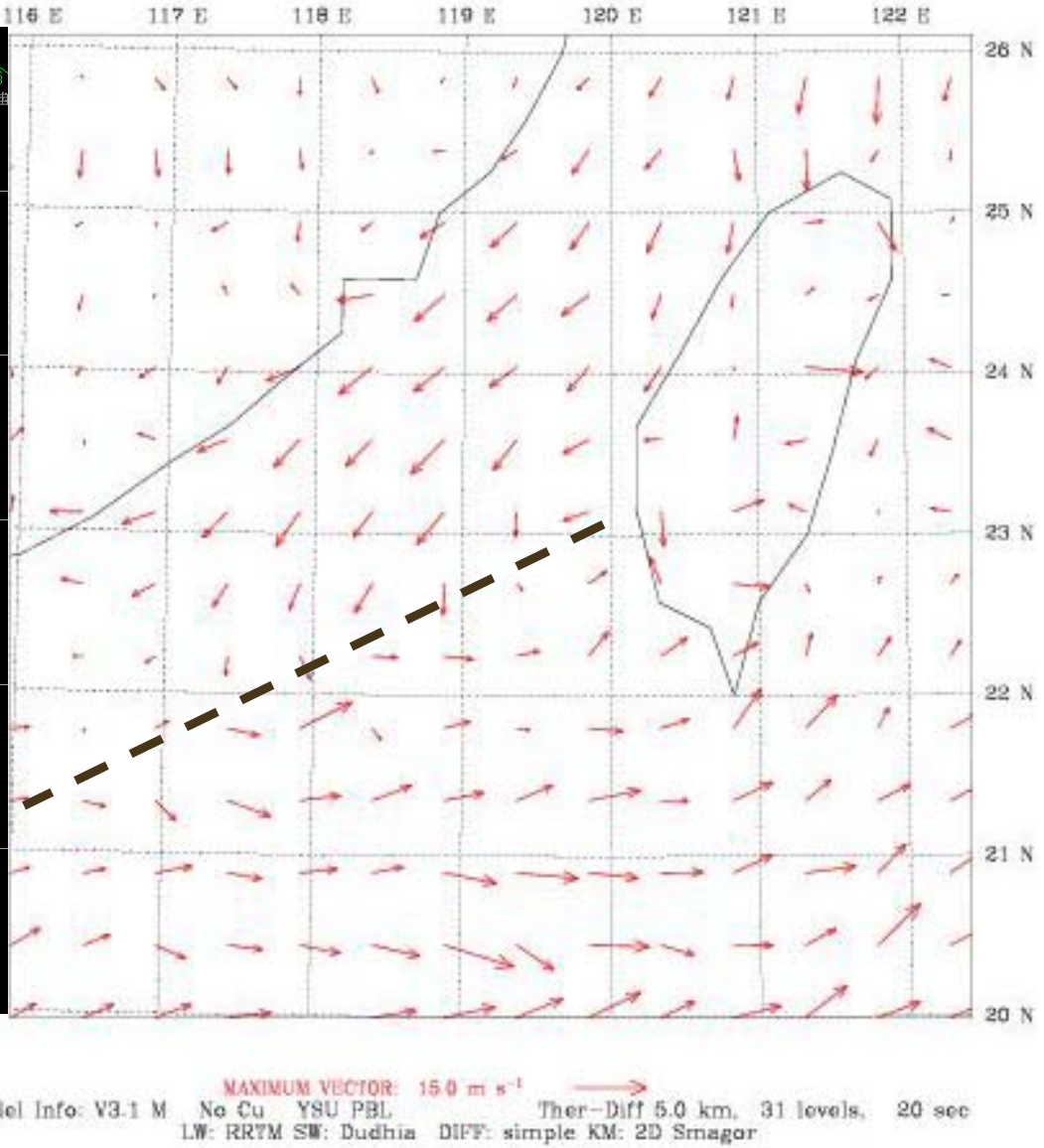


Simulated Surface Wind on Domain 3

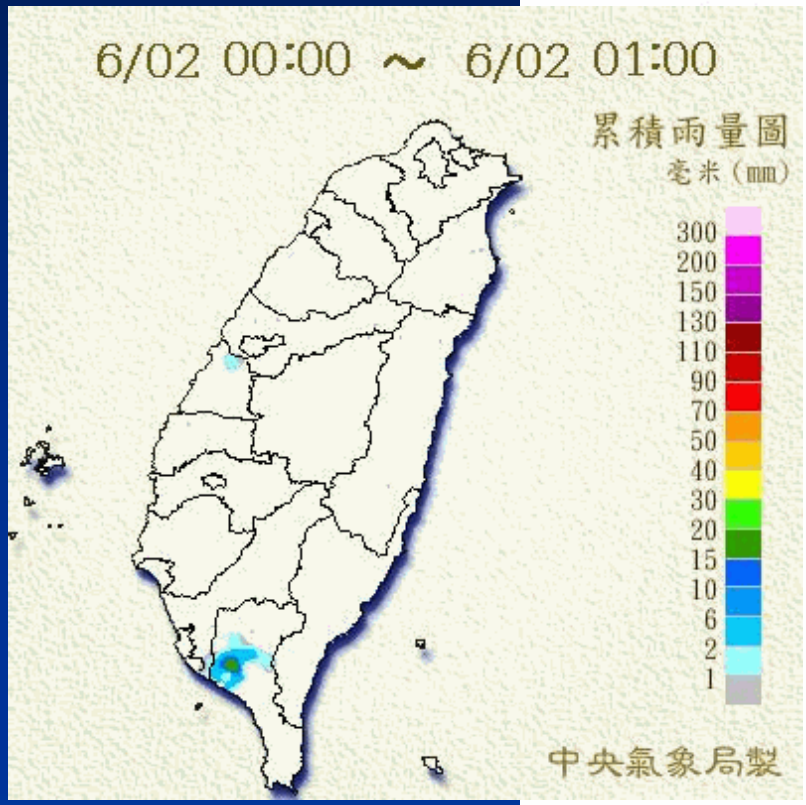
Observed Surface Wind

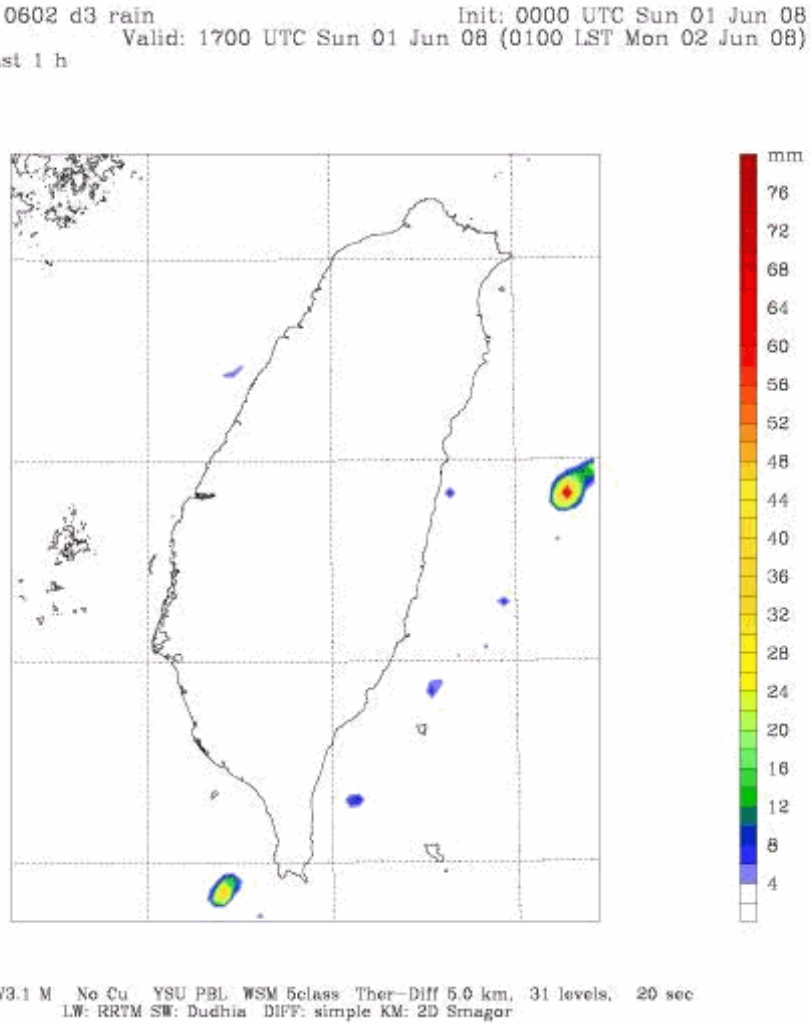




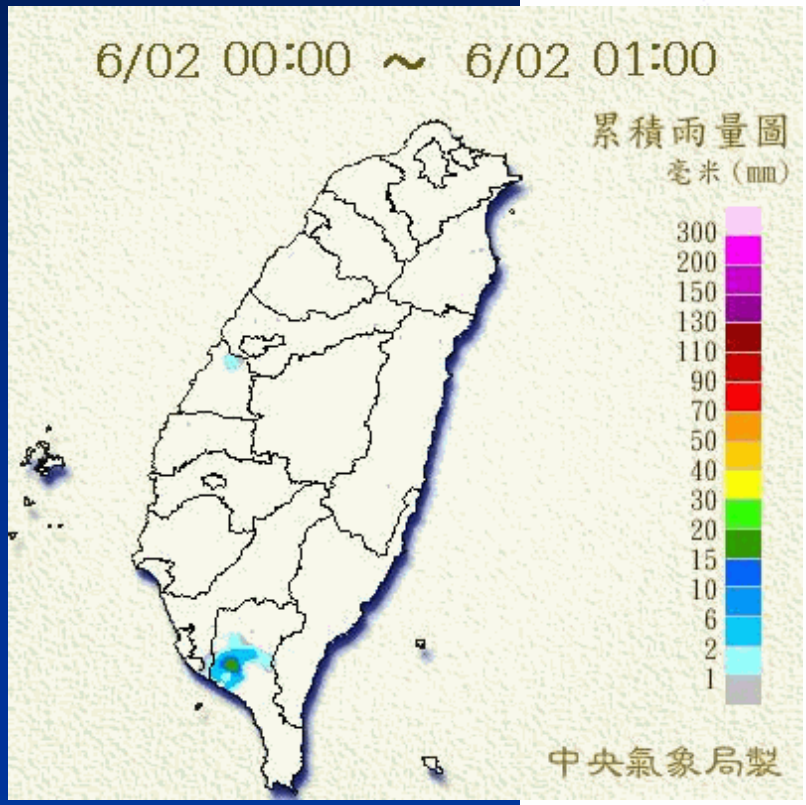


Observed vs. WRF Accumulated Rainfall on 2 June

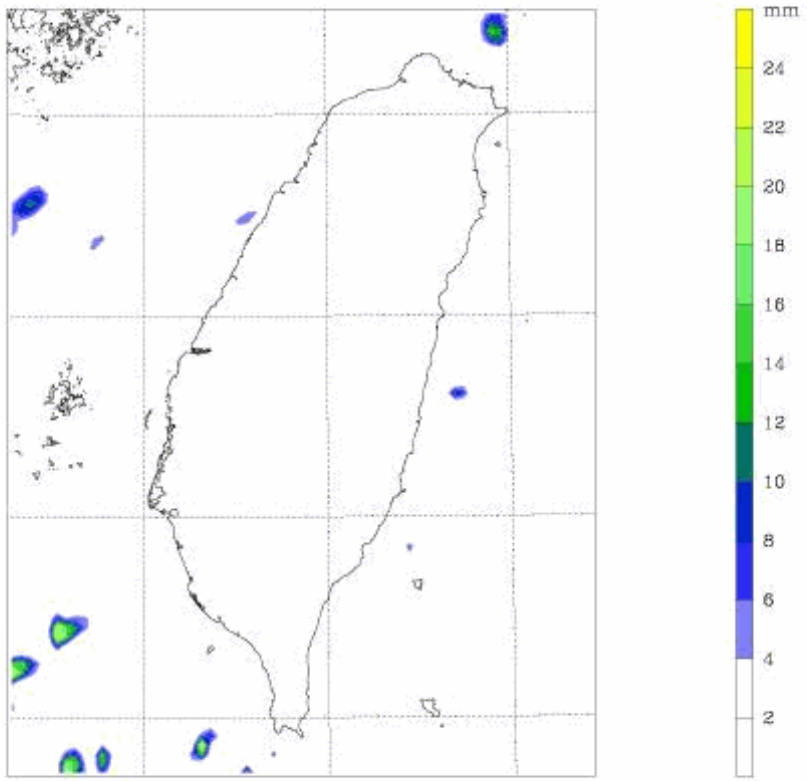




Observed vs. WRF Accumulated Rainfall on 2 June

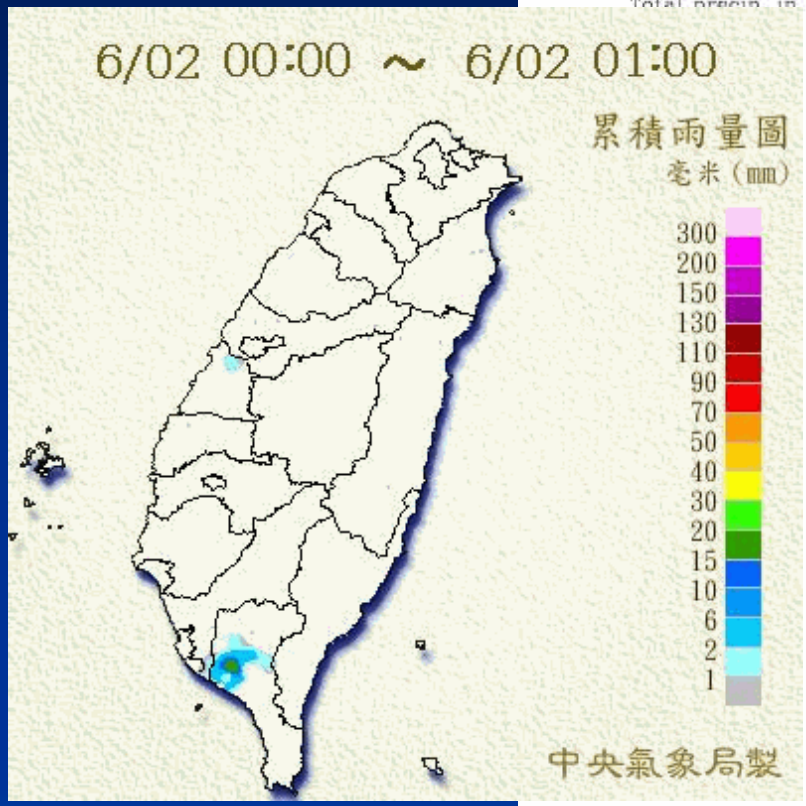


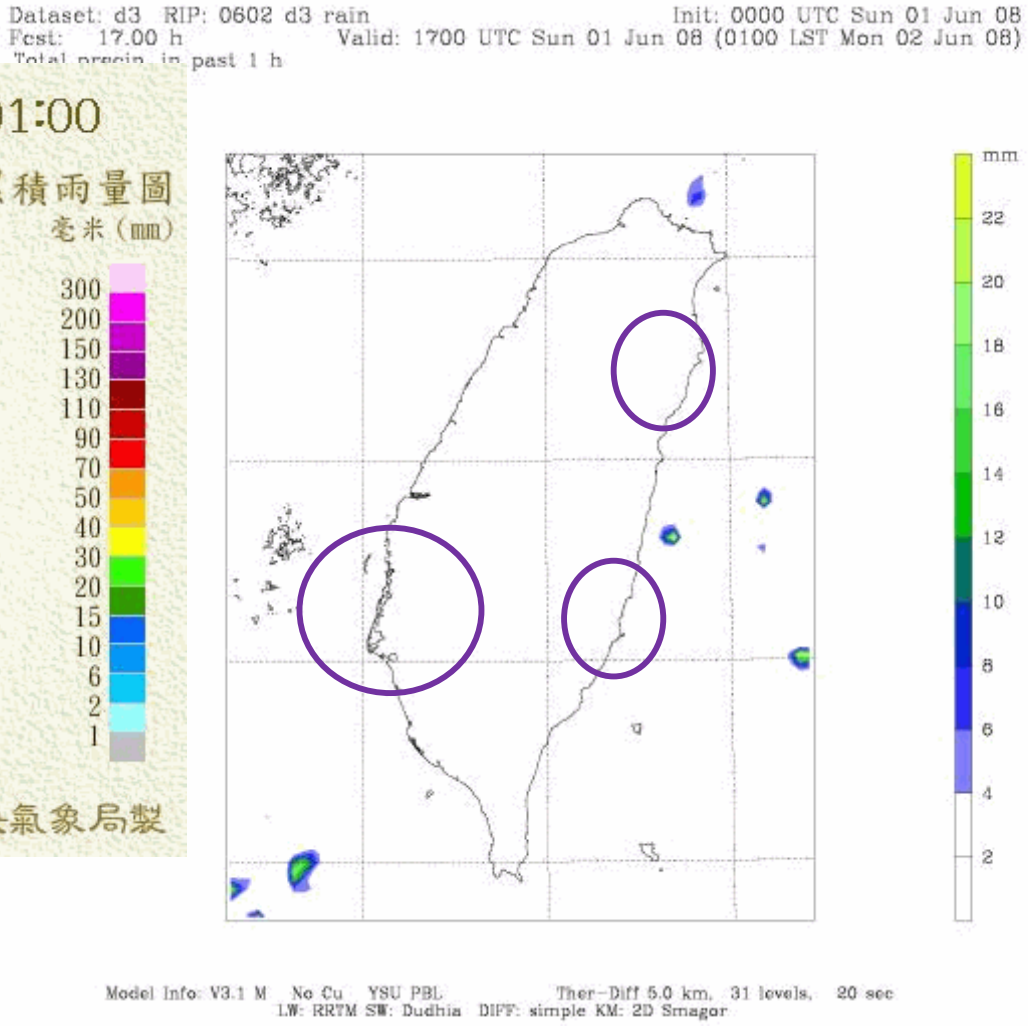
WSM6



WRF Accumulated Rainfall on 2 June

WDM6

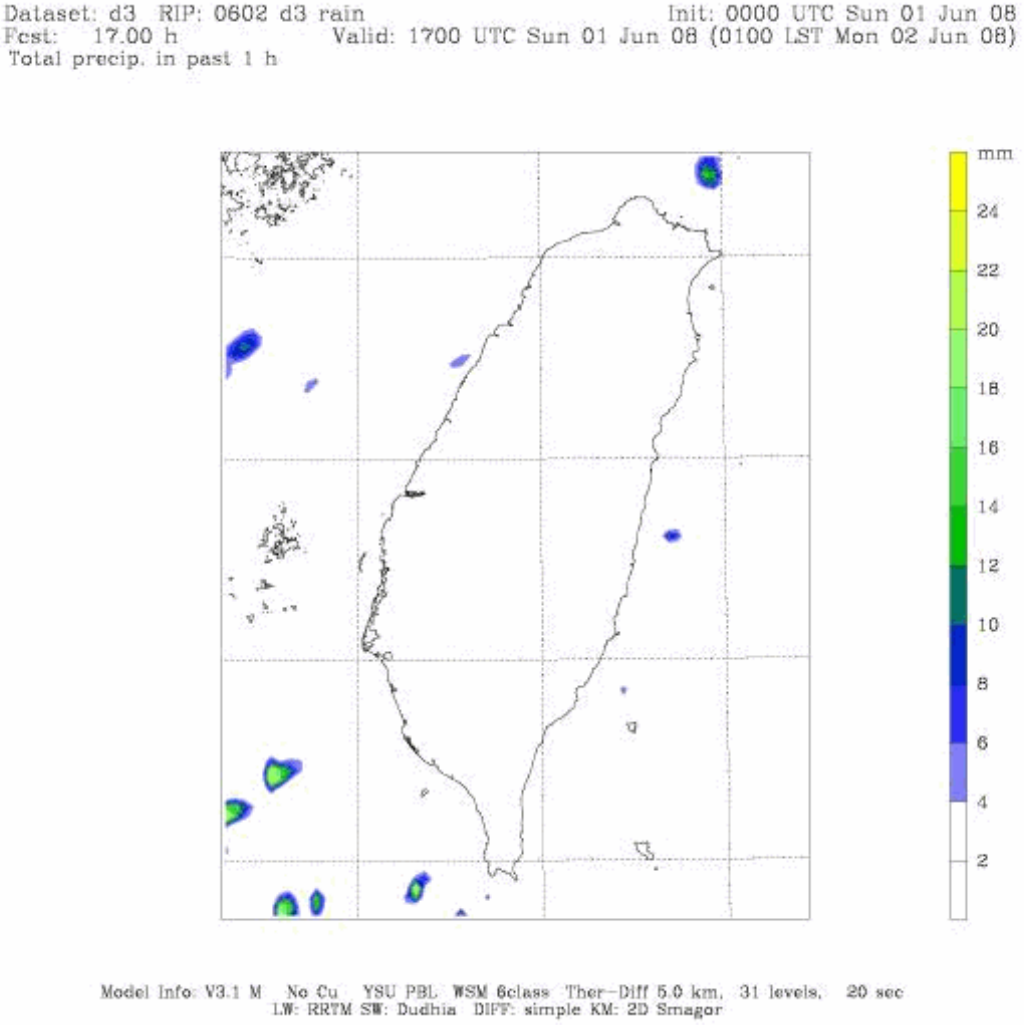




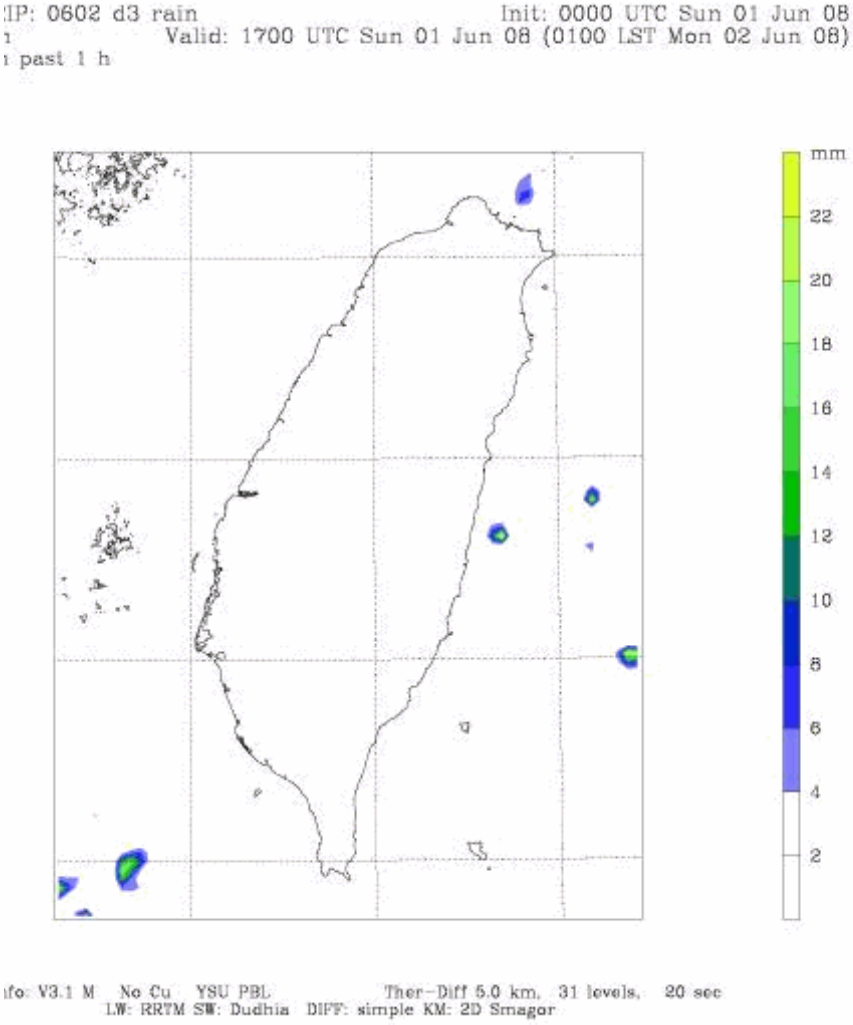
WDM6 in better agreement with observed rainfall !

WRF Accumulated Rainfall on 2 June

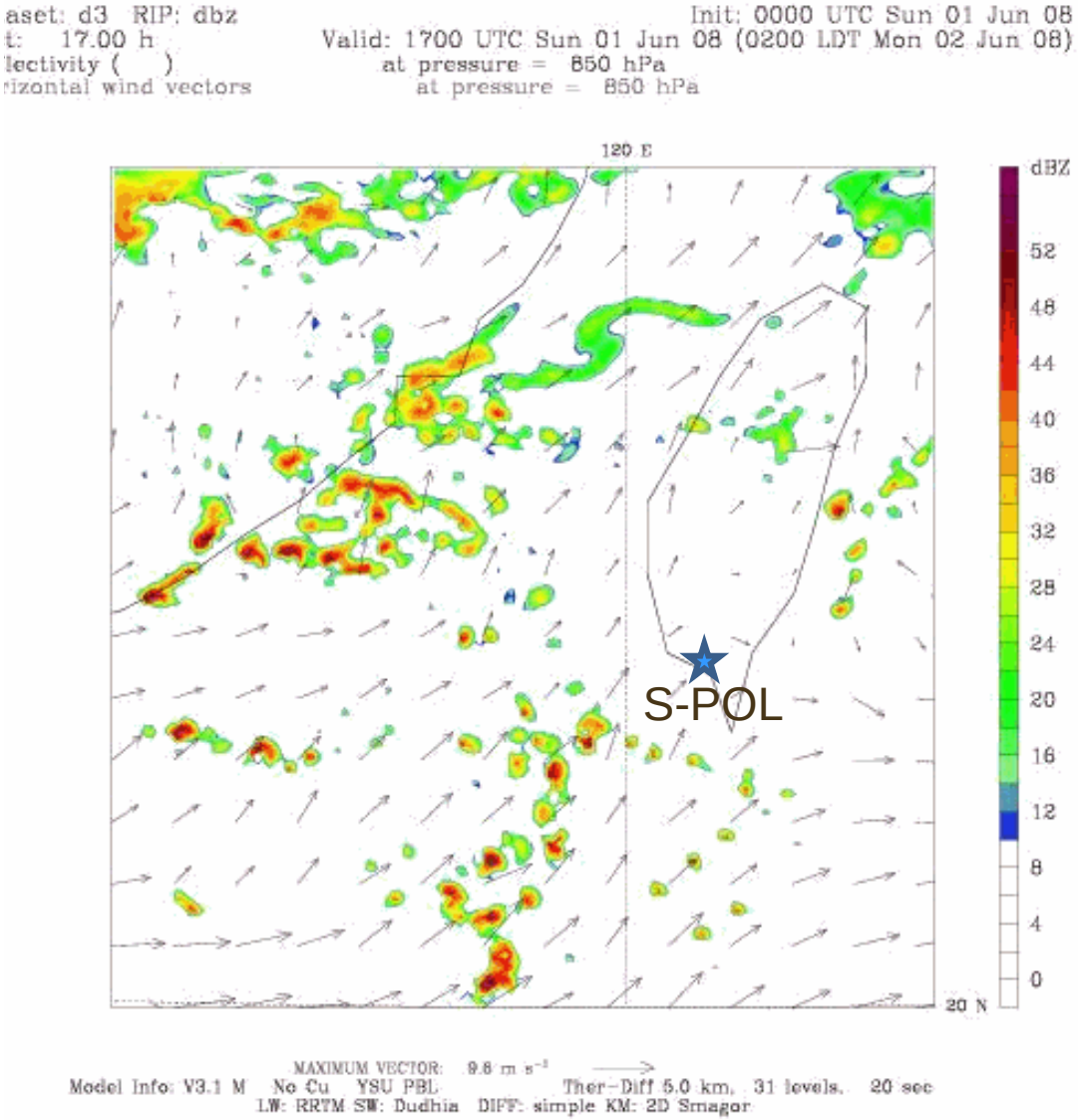
WSM6



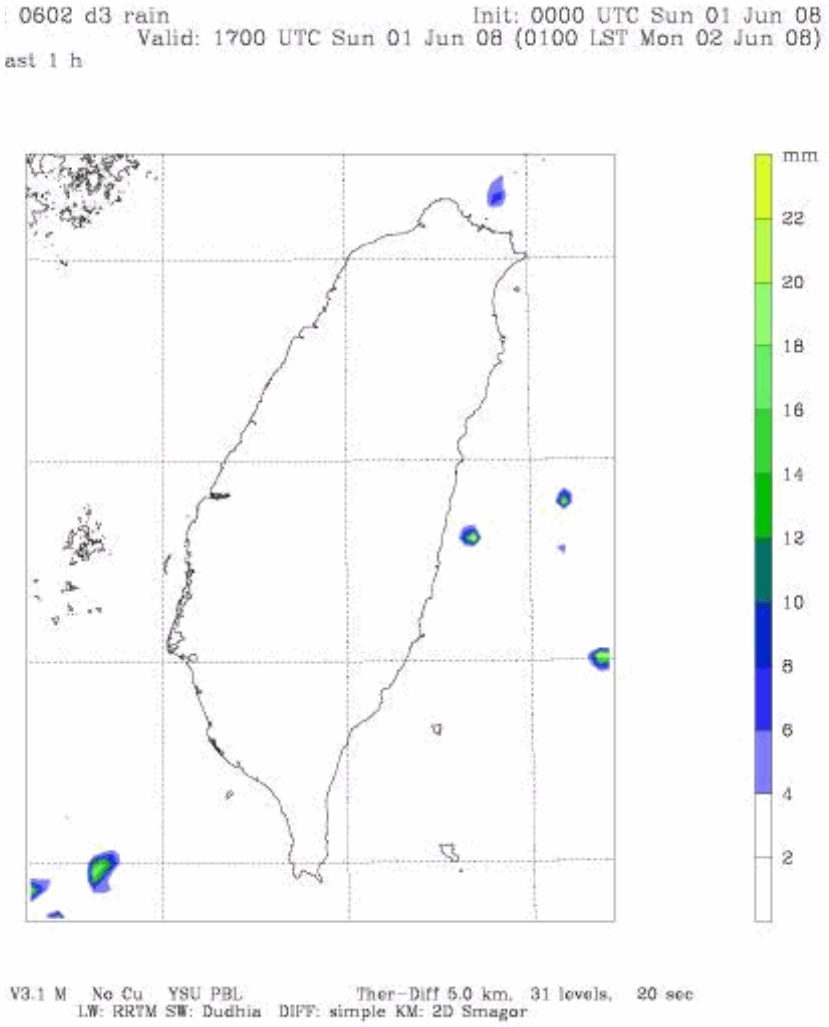
WDM6



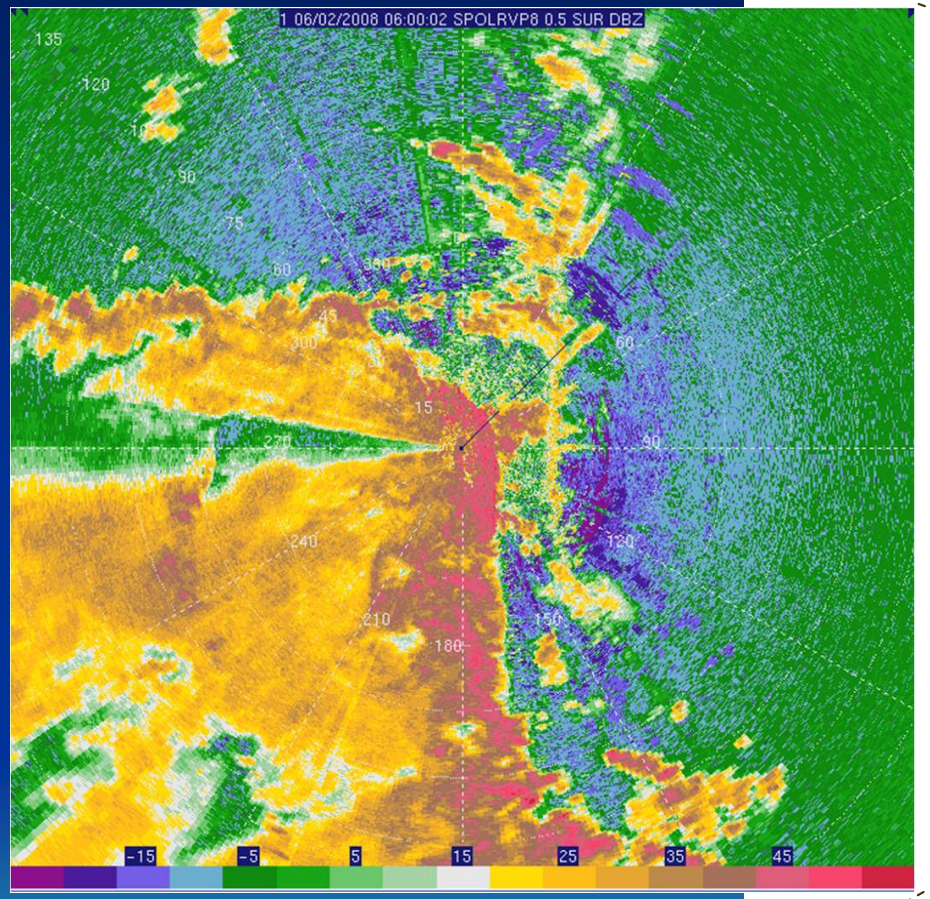
Hourly Radar Reflectivity at 850 hPa



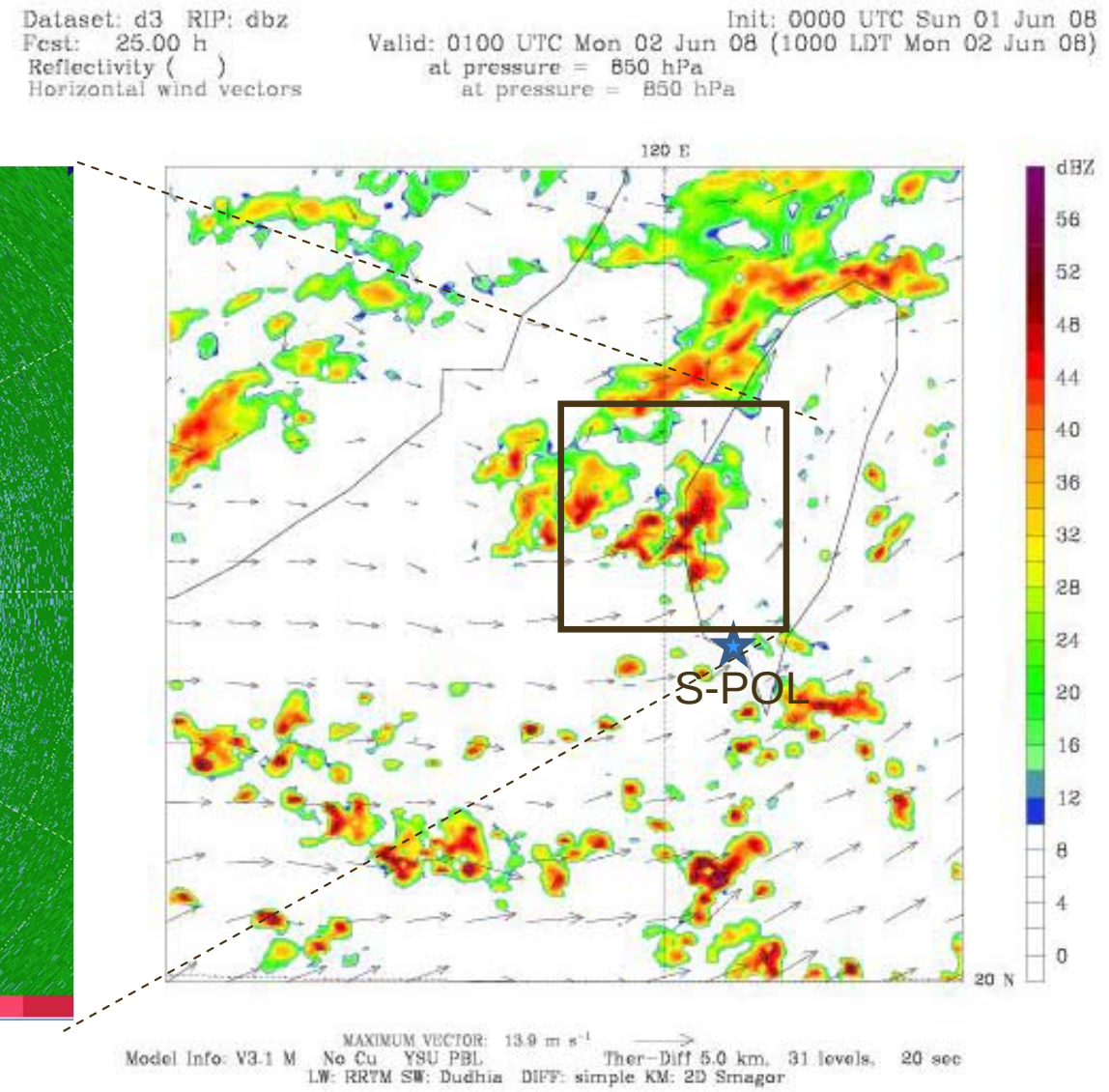
Accumulated Rainfall on 2 June



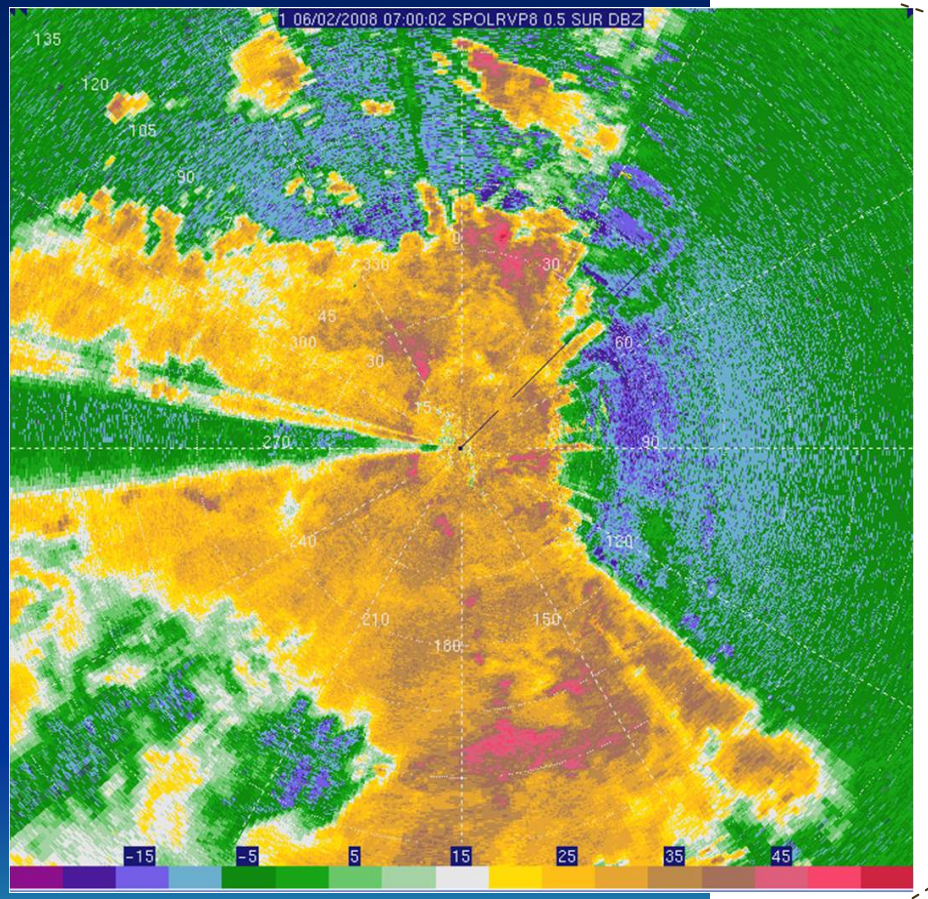
S-POL Radar Reflectivity



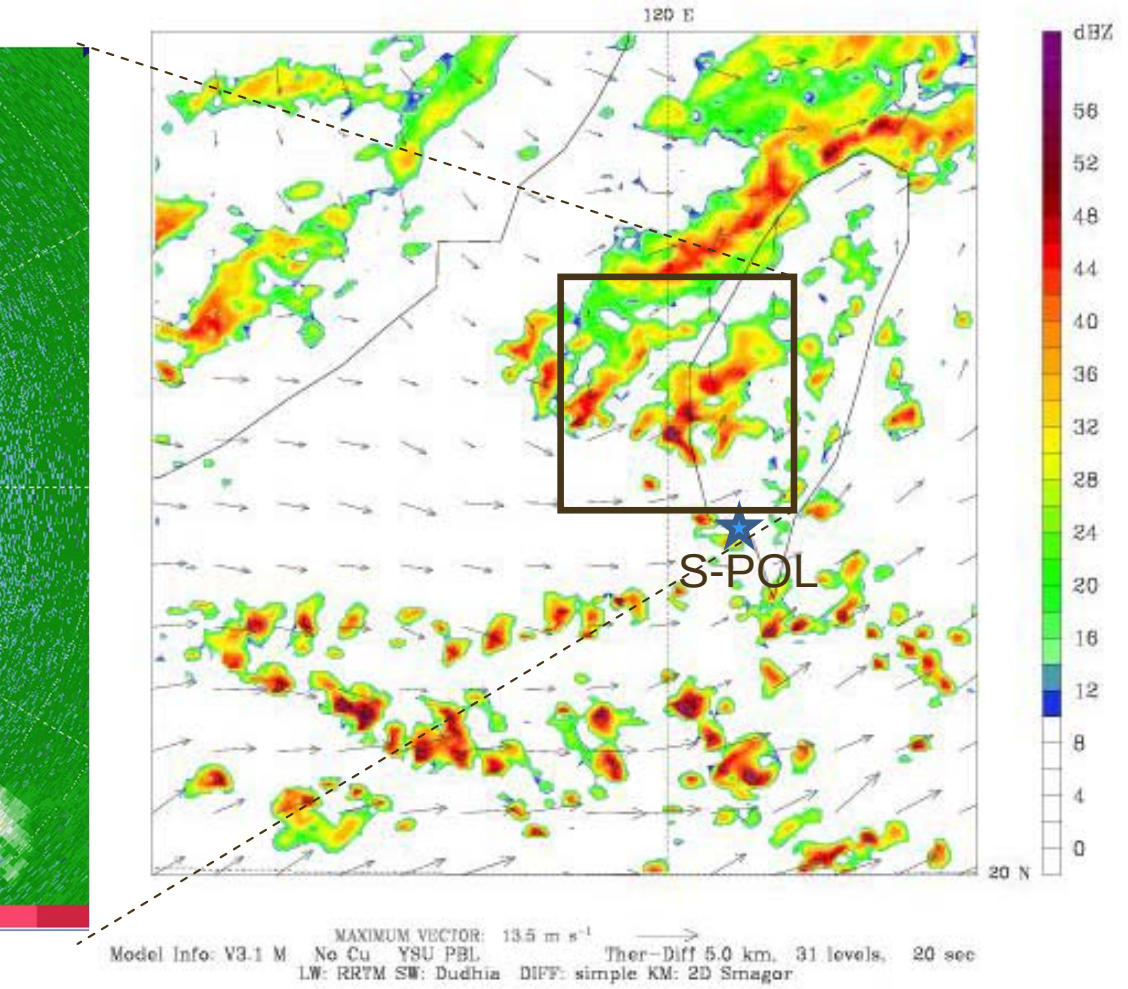
Simulated Radar Reflectivity



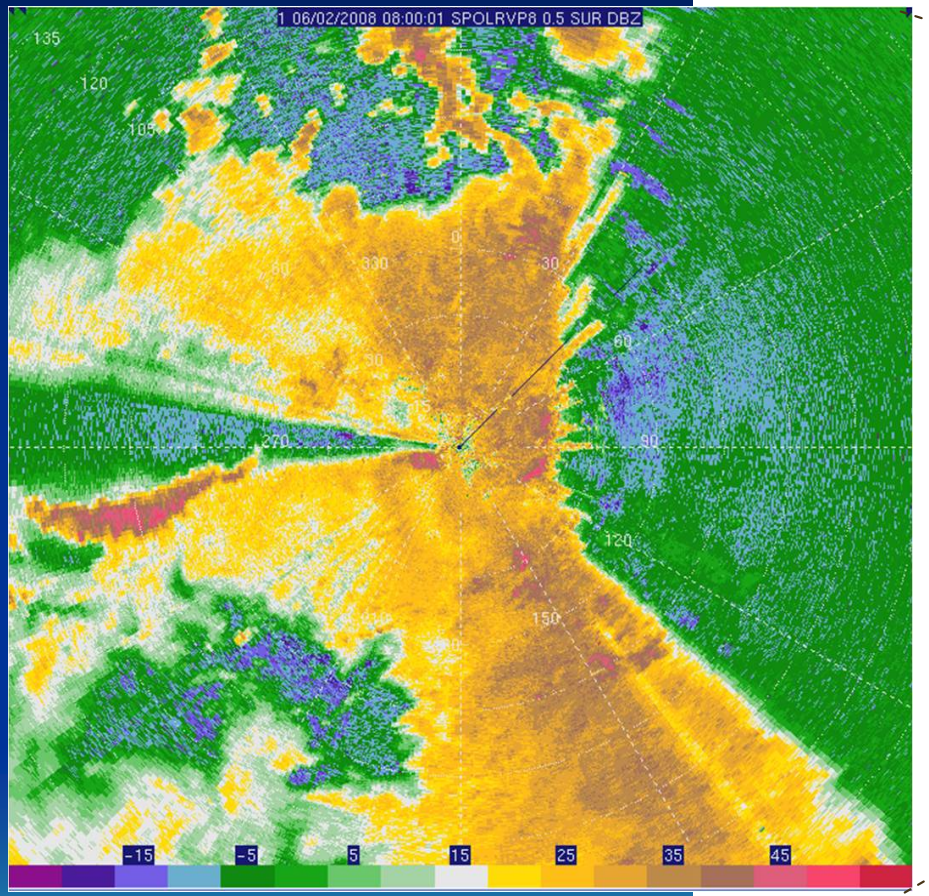
S-POL Radar Reflectivity



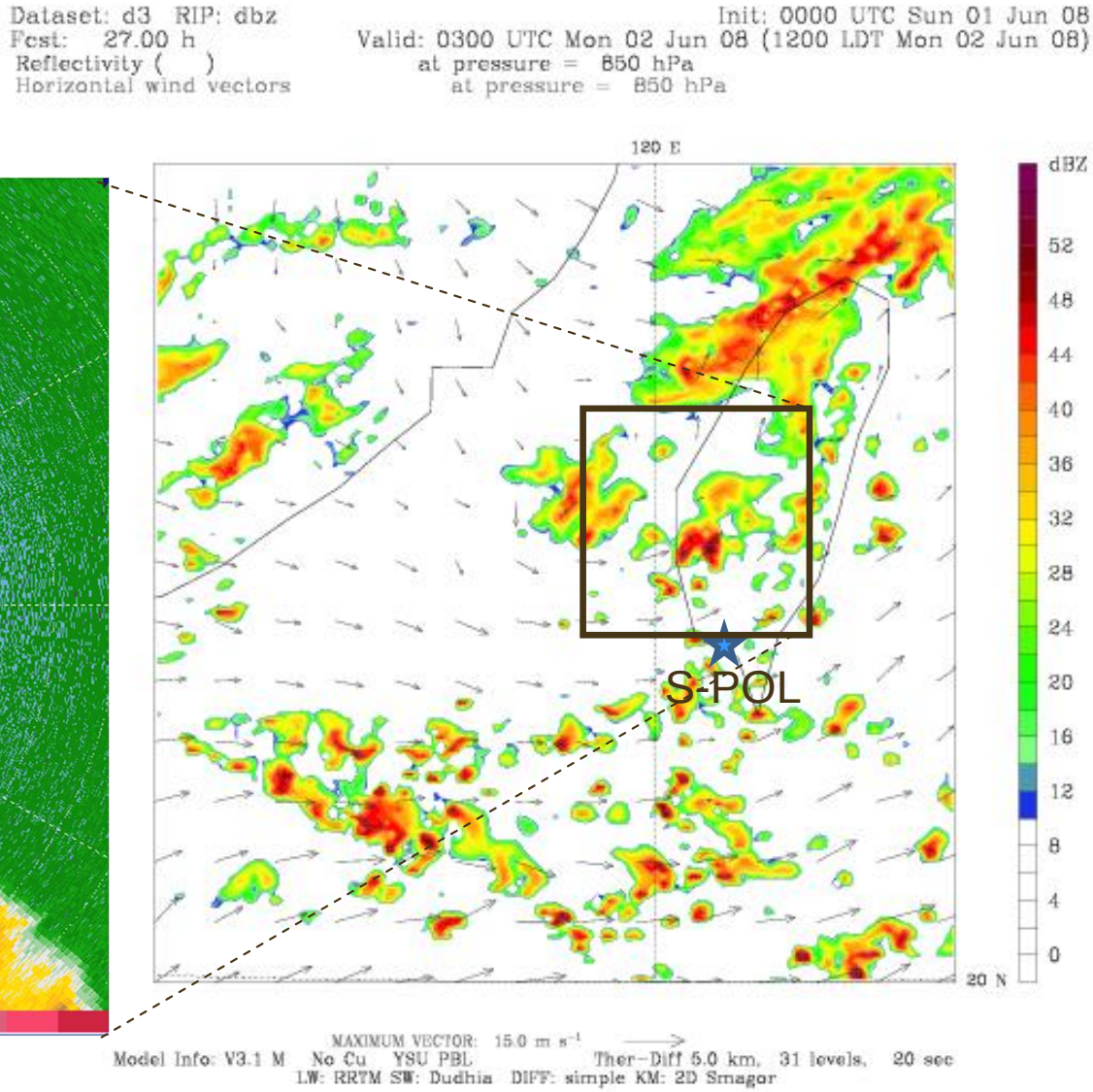
Simulated Radar Reflectivity



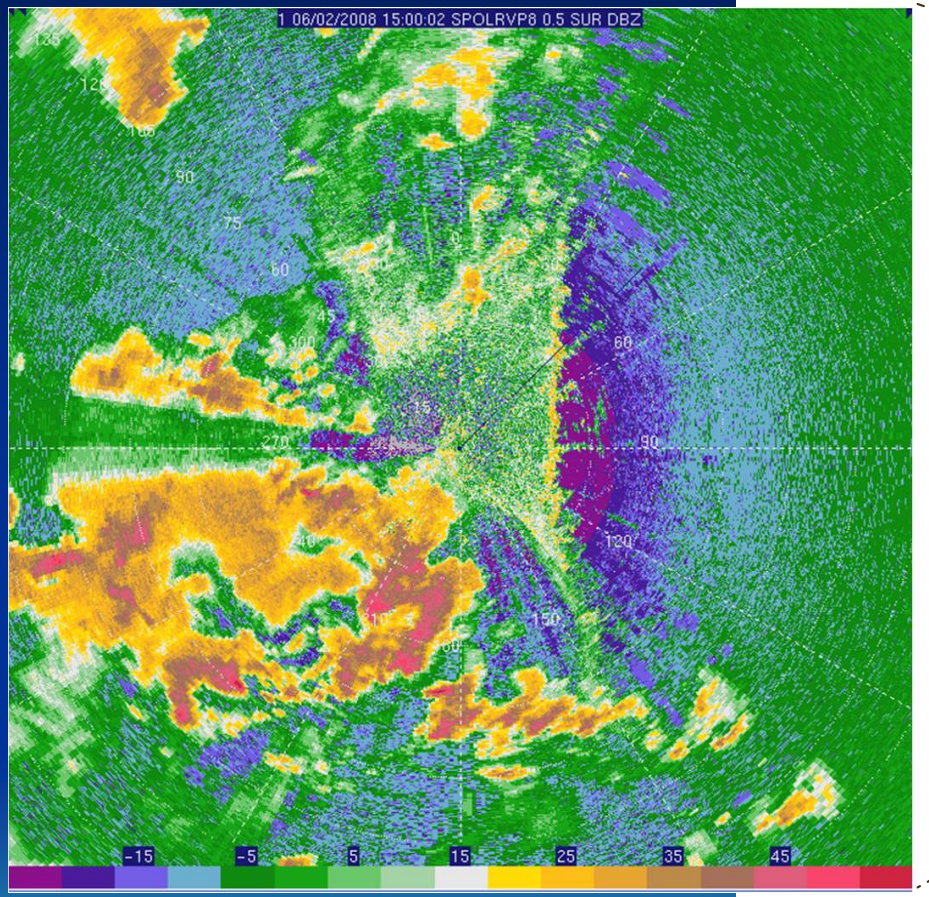
S-POL Radar Reflectivity



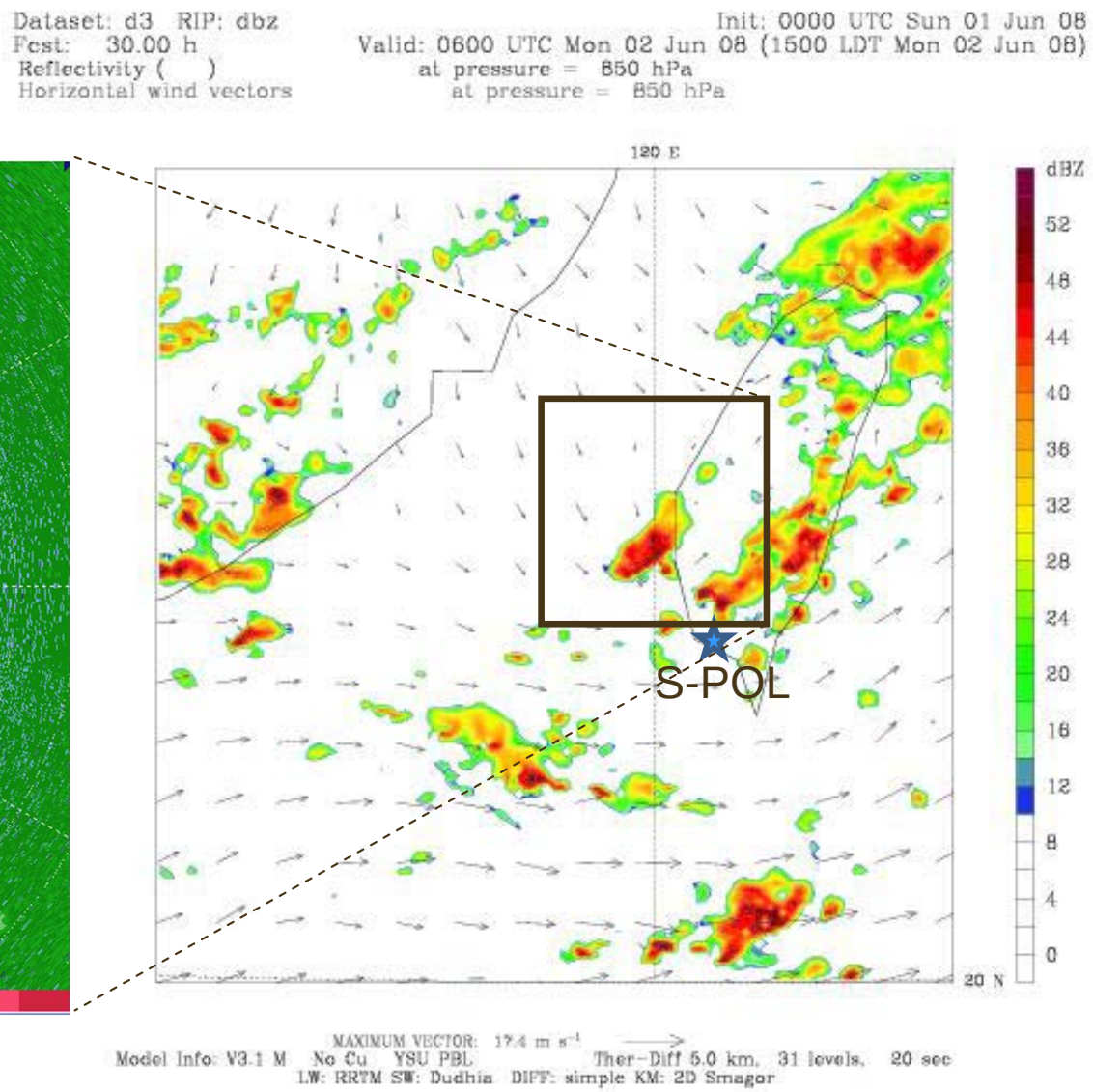
Simulated Radar Reflectivity



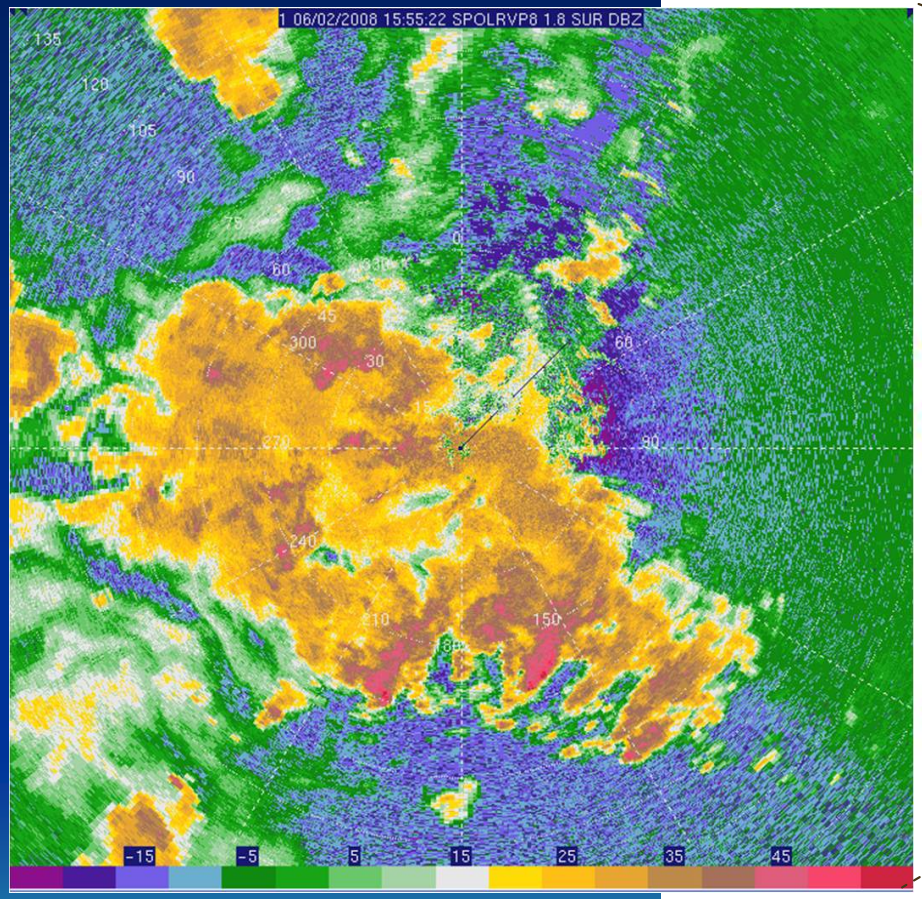
S-POL Radar Reflectivity



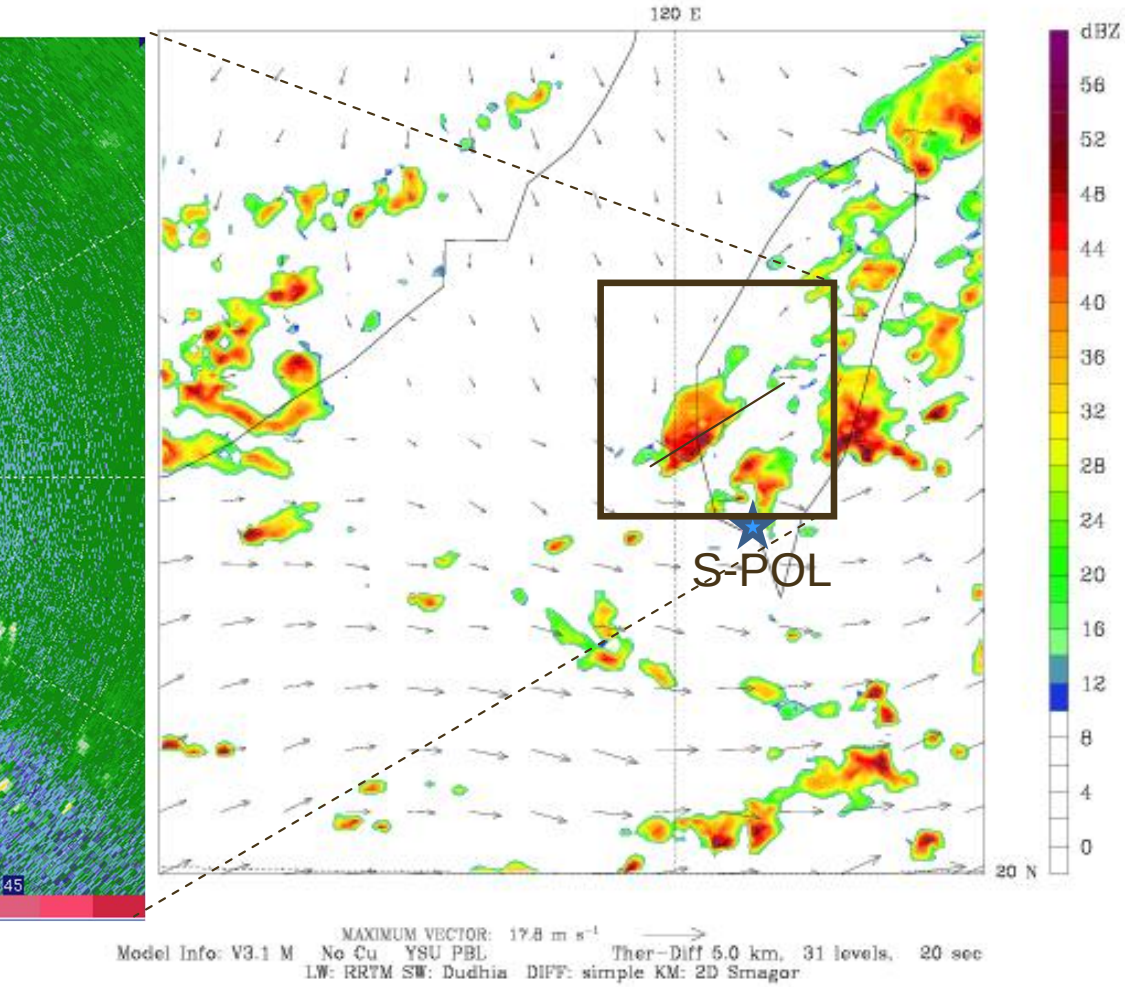
Simulated Radar Reflectivity



S-POL Radar Reflectivity

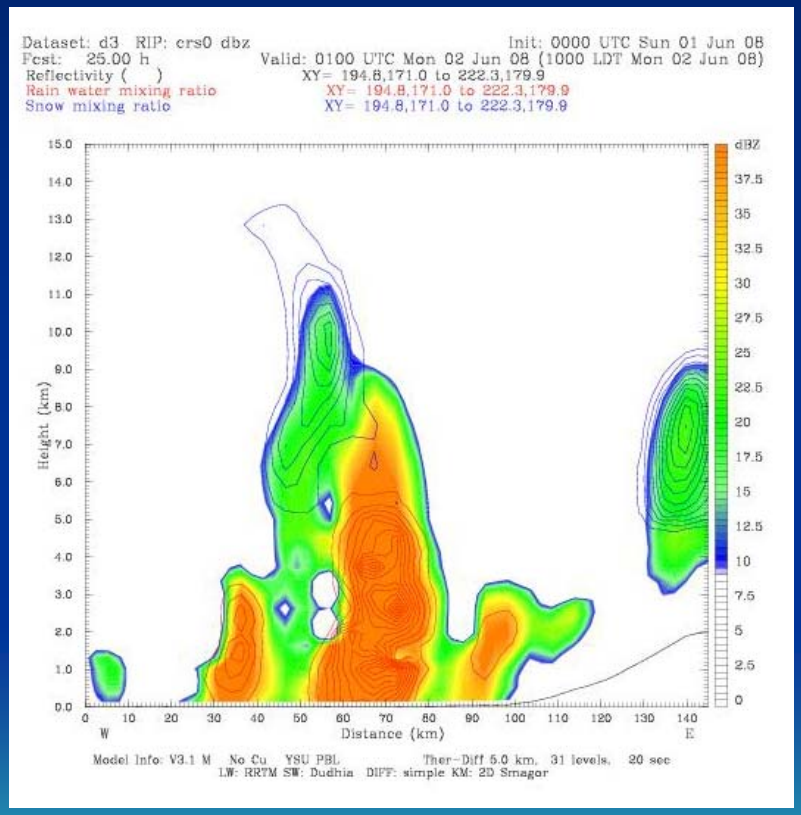


Simulated Radar Reflectivity

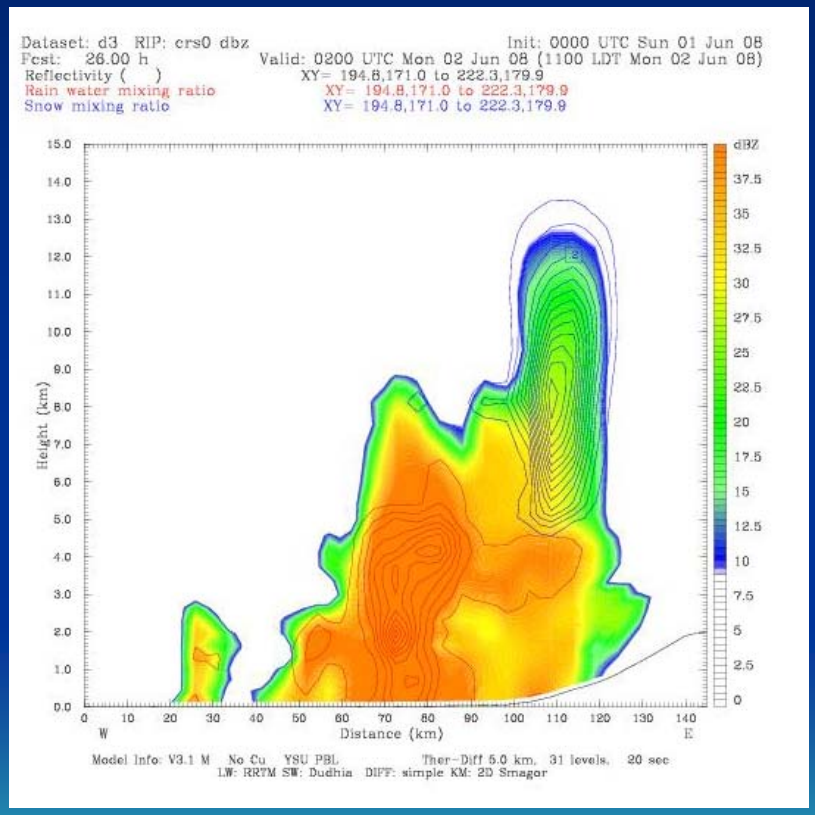


Vertical Cross Sections of Z, Qr, and Qs

t = 25 h

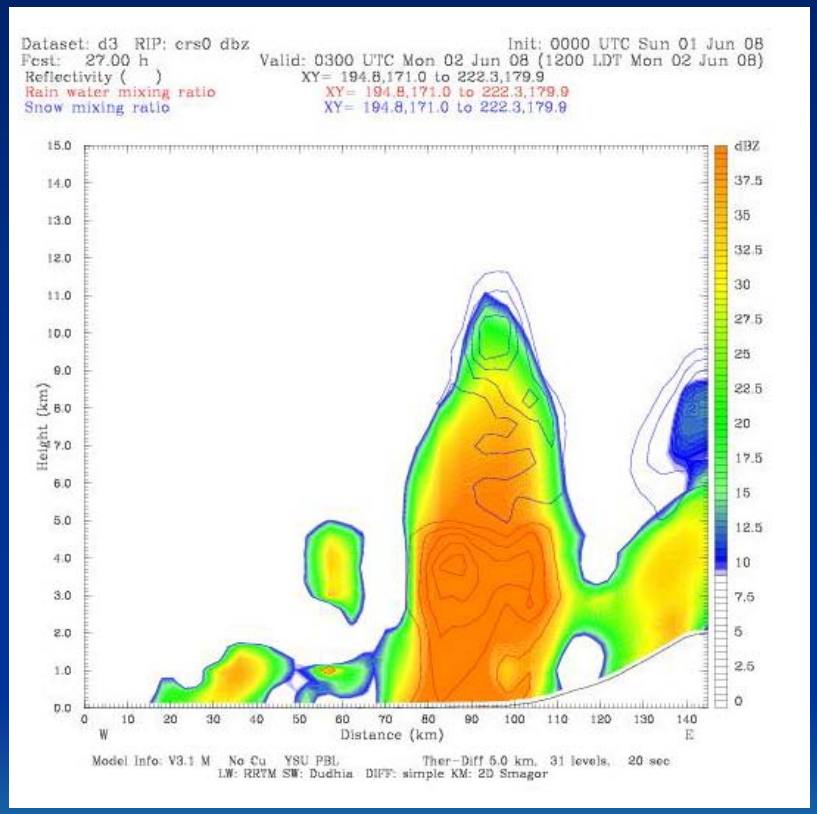


t = 26 h

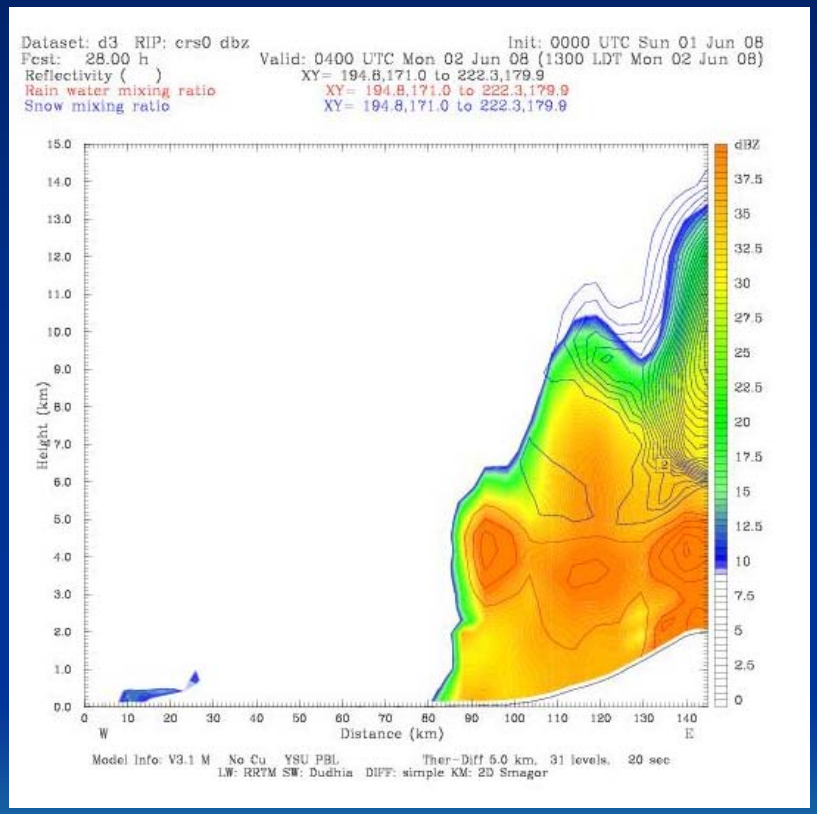


Vertical Cross Sections of Z, Qr, and Qs

t = 27 h

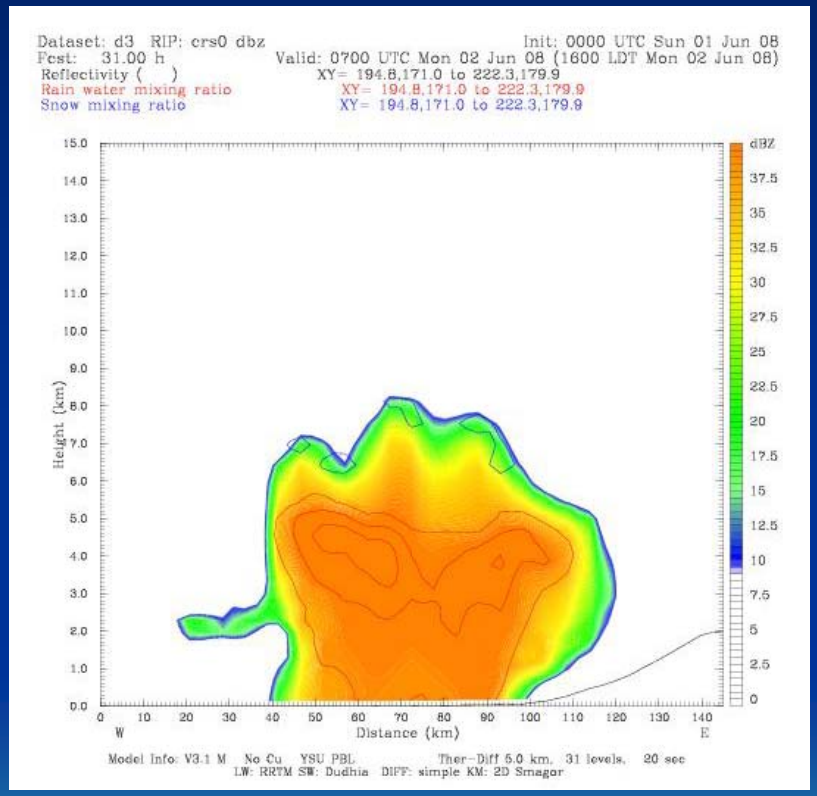


t = 28 h

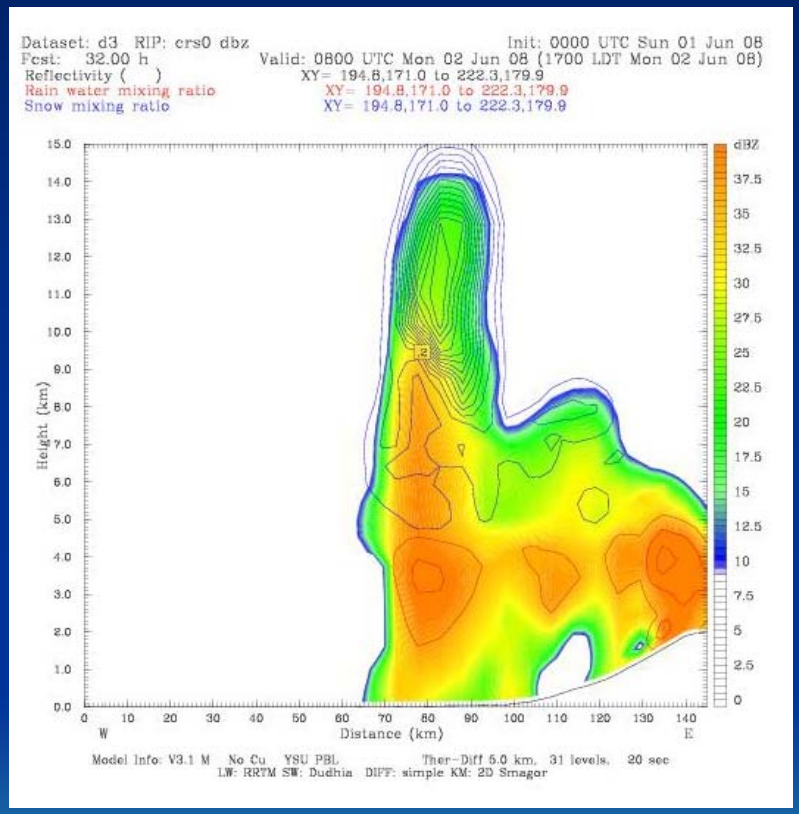


Vertical Cross Sections of Z, Qr, and Qs

t = 31 h



t = 32 h



Summary

- Several MCSs were embedded with the quasi-stationary Mei-Yu front on 1-3 June 2008, resulting in heavy rainfall and local flooding.
- A quadruply nested-grid WRF model with the finest grid size of 1.67 km is used to simulate the synoptic environment, kinematic and precipitation structures in this frontal convective systems.
- Preliminary comparisons with the S-POL observation show that the WRF model reproduces reasonably well the movement of Mei-Yu frontal system, wind shift, and the embedded precipitation structures, although the simulated frontal position is slightly to the north of the observed.

Summary

- Evident differences in precipitation structures are found in simulations using the 6-category single-moment (WSM6) and double-moment (WDM6) microphysics schemes.
- More work will be conducted to further investigate the hydrometeor calibration with S-POL PID products and microphysical evolution of the MCSs embedded in this quasi-stationary Mei-Yu front.