

A STUDY OF MICROPHYSICAL PROCESSES OCCURRING IN CONVECTION DURING TIMREX

Angela K. Rowe, Steven. A. Rutledge, and Ben Jong-Dao
Jou

SoWMEX/TiMREX workshop

3 November 2010

Motivation

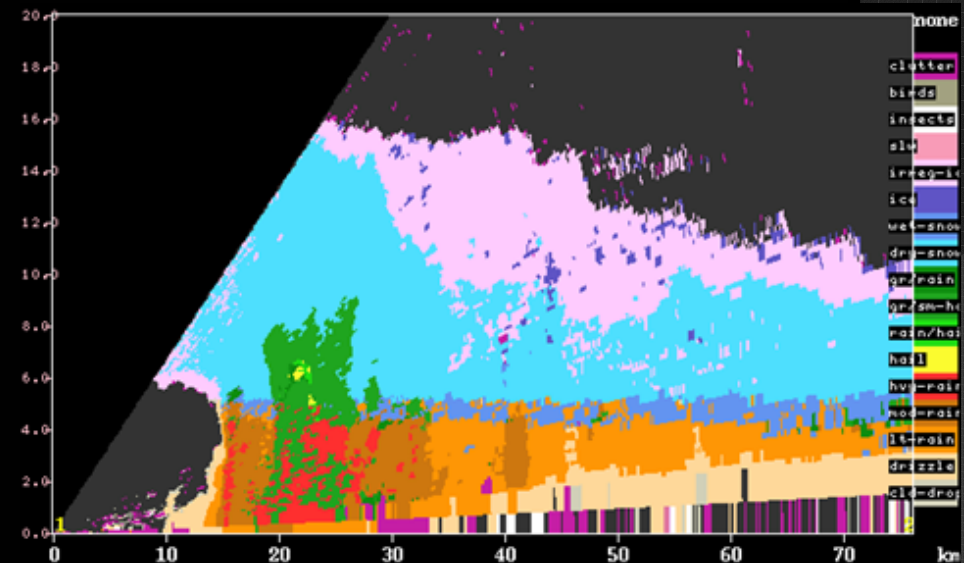
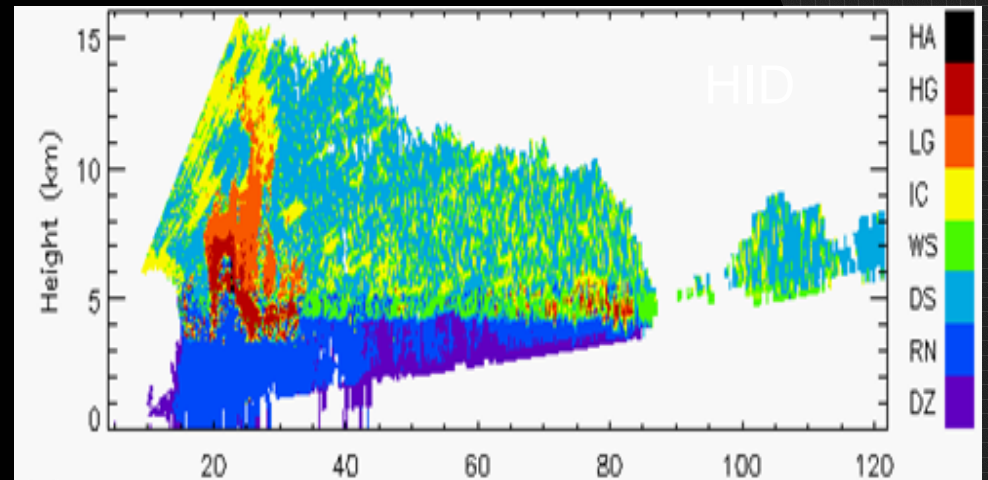
- ◎ TiMREX goal: “To improve understanding of the physical processes associated with the terrain-influenced heavy precipitation systems...”
- ◎ Low skill for warm season QPF estimation attributed to inadequate representation of microphysical processes and lack of knowledge of cloud structures in numerical models
 - Retrieve microphysical properties using polarimetric capabilities of the radars
 - Determine relative contributions of ice and warm-rain processes to heavy convective rainfall
 - Develop framework coupling dynamics and microphysics in orographic precipitation

Objectives

- 1) To classify hydrometeor types in intense convective cells relative to topography
 - 2) To determine the dominant microphysical processes leading to intense convective rainfall
 - 3) To compare with convective cells from other locations characterized by terrain-influenced heavy rainfall (e.g., NAME)
- Although warm-rain processes likely dominant, hypothesize that mixed-phase processes become more important along slopes

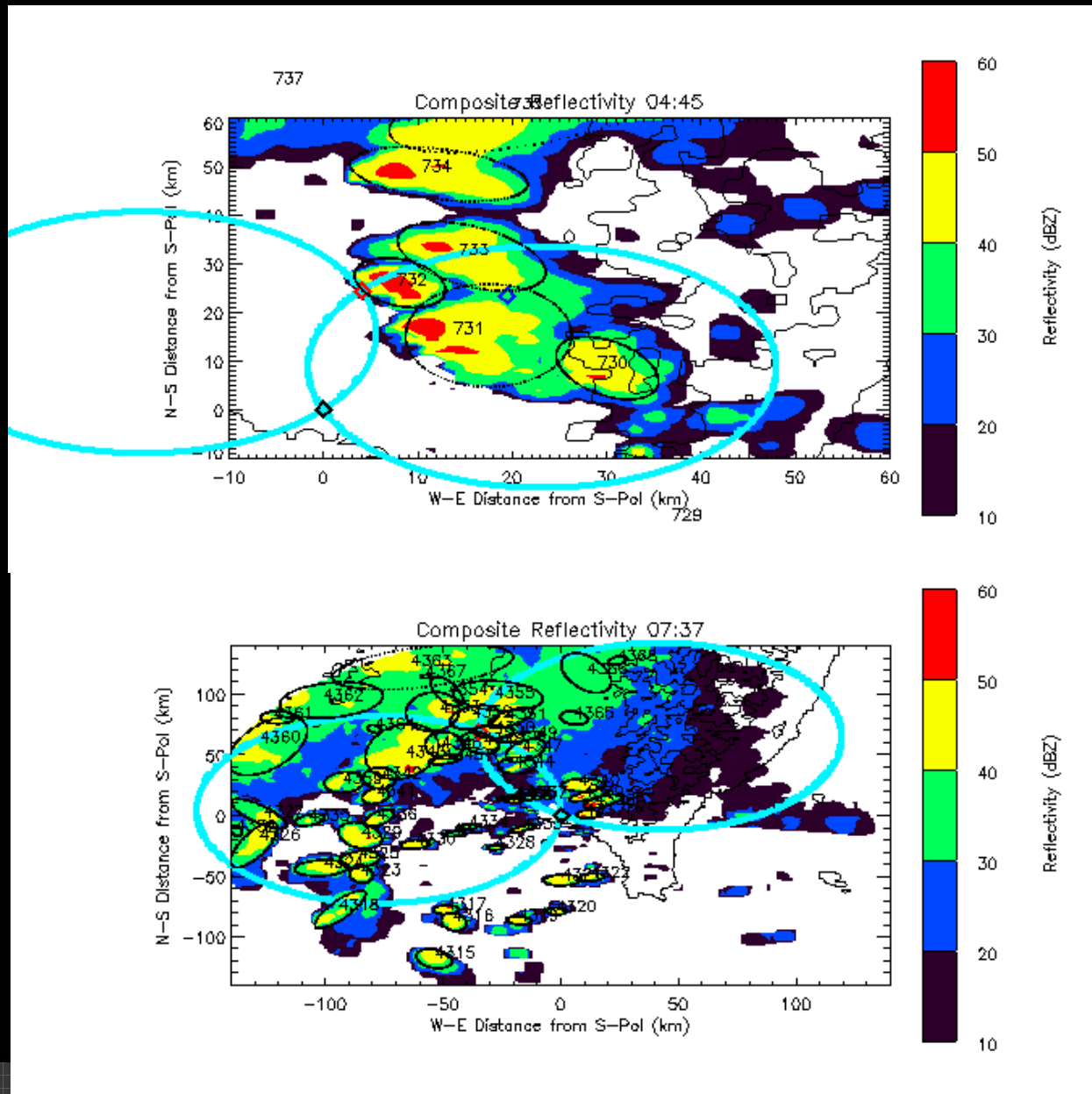
Methodology

- Case selection
 - 30 May, 31 May, 1 June, 14 June
- QC S-Pol data based on thresholds used in NAME (Lang et al. 2007, 2009)
- Filtered differential phase (Hubbert and Bringi 1995) and calculated KDP
- Gridding (REORDER)
 - 1-km horizontal, 0.5-km vertical resolution
- HID
 - Fuzzy logic, based on Liu and Chandrasekar (2000)
 - Includes drizzle, rain, dry snow, wet snow, ice, low-density graupel, high-density graupel, and hail
- Tracking algorithm



green: graupel/small hail, yellow: hail, red: heavy rain

Cell tracking



- Variation of TITAN (Dixon and Wiener 1993)

- Centroid identification scheme

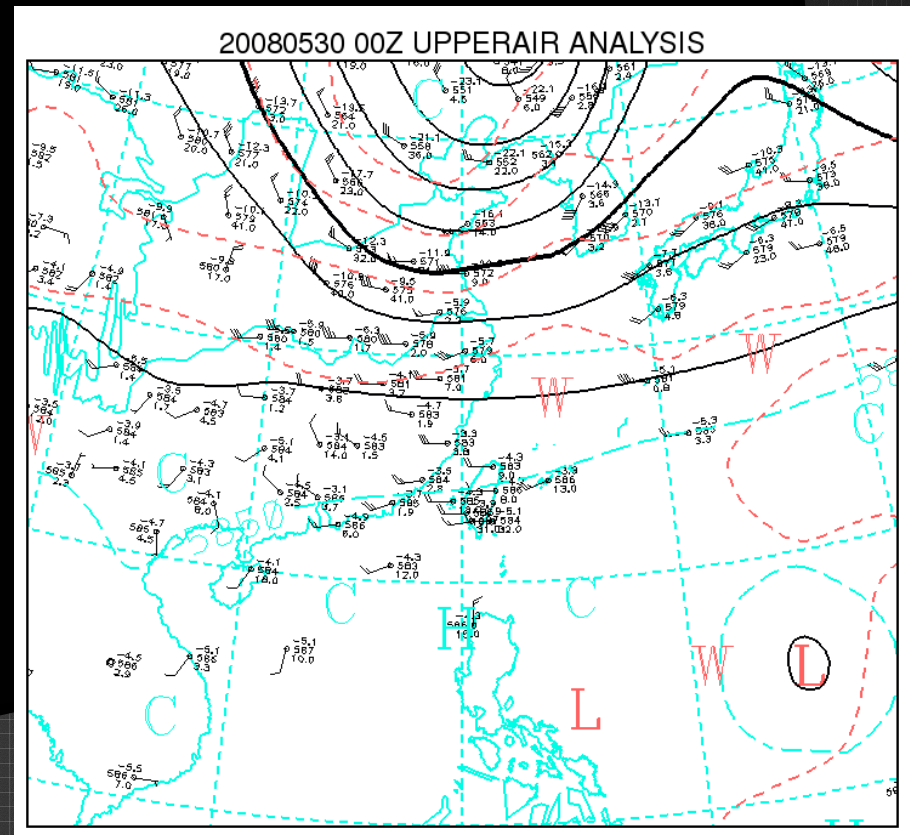
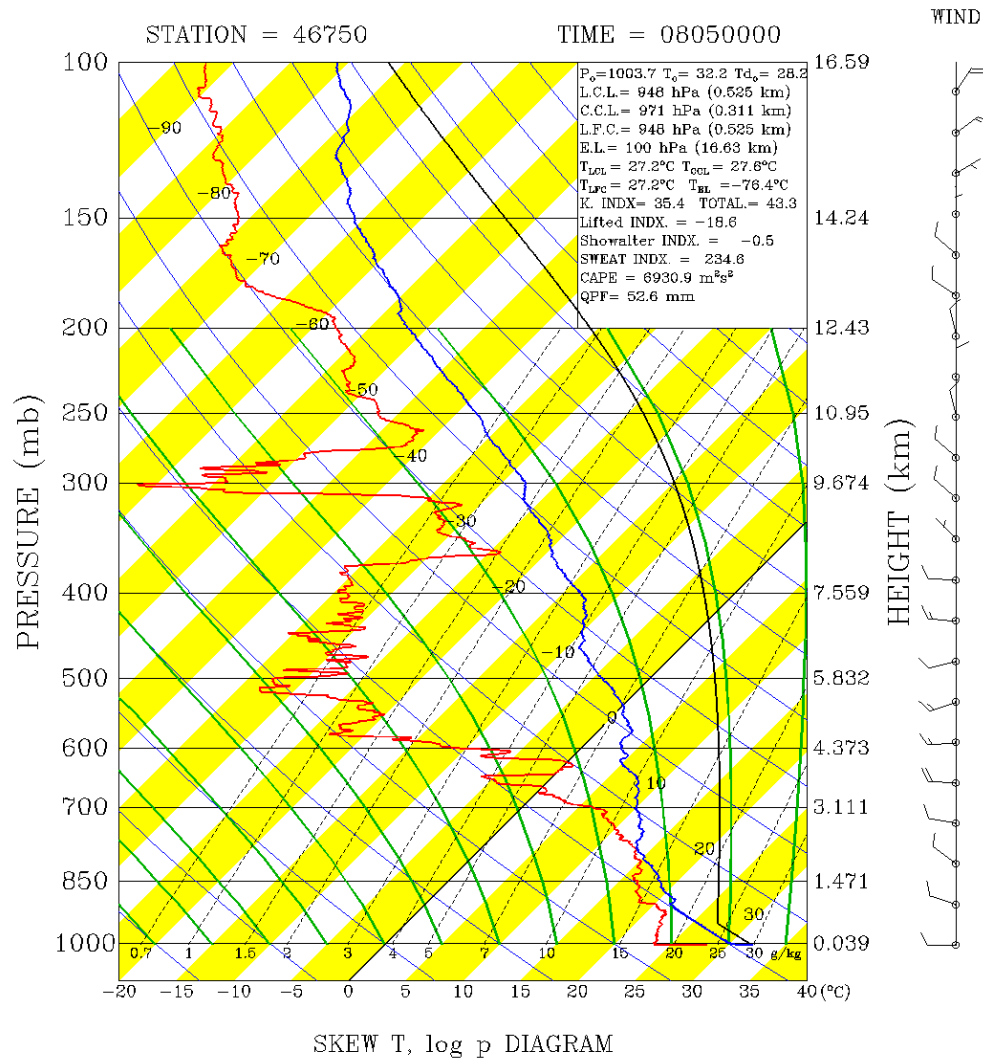
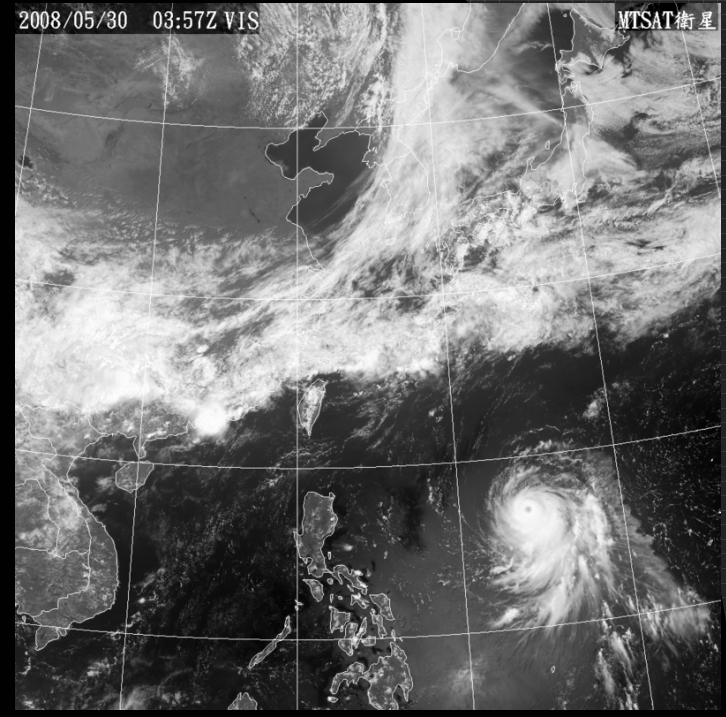
- Apply thresholds based on reflectivity (35 or 45 dBZ) and area (10 km² and 2 km², respectively)

- Ellipse-fitting method

30 May

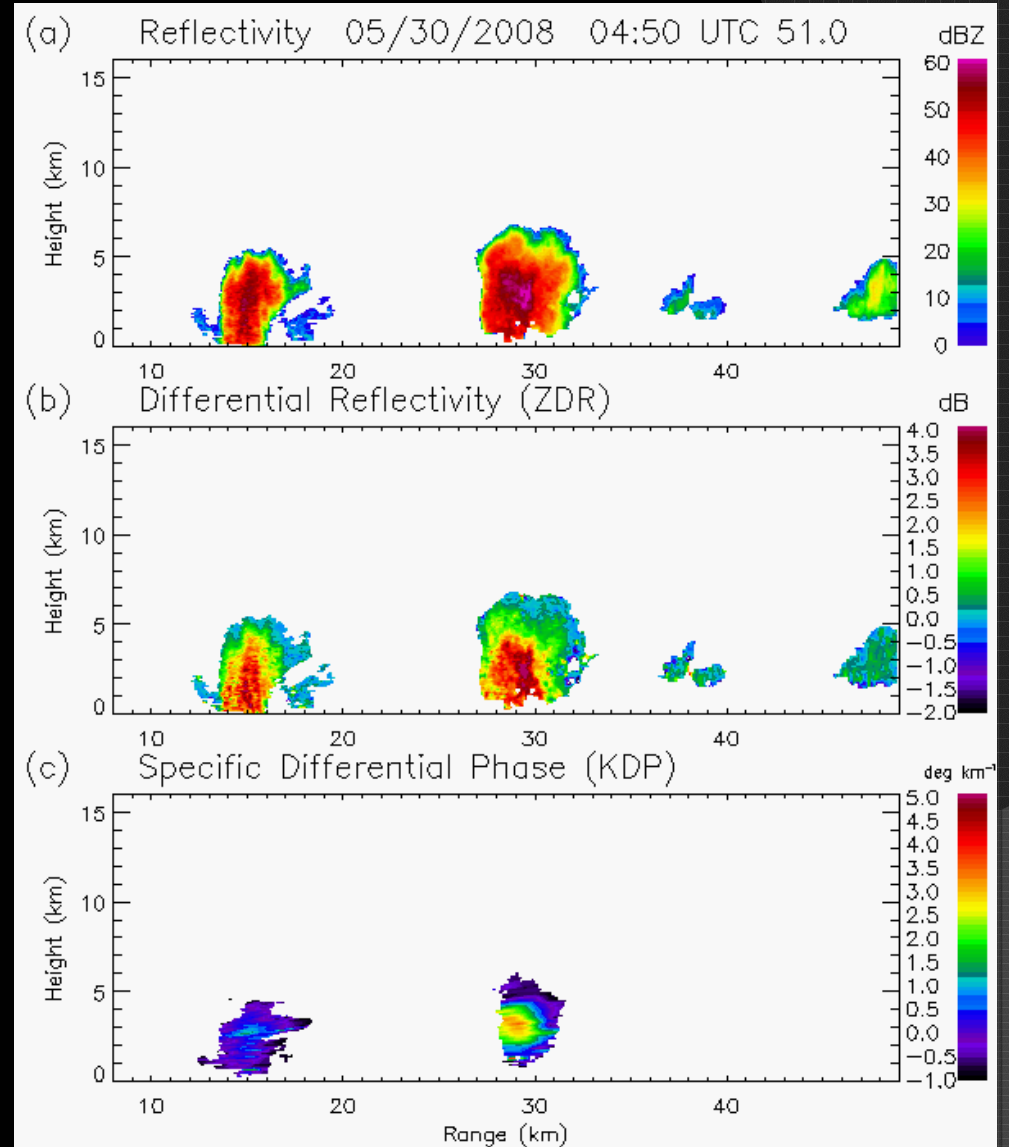
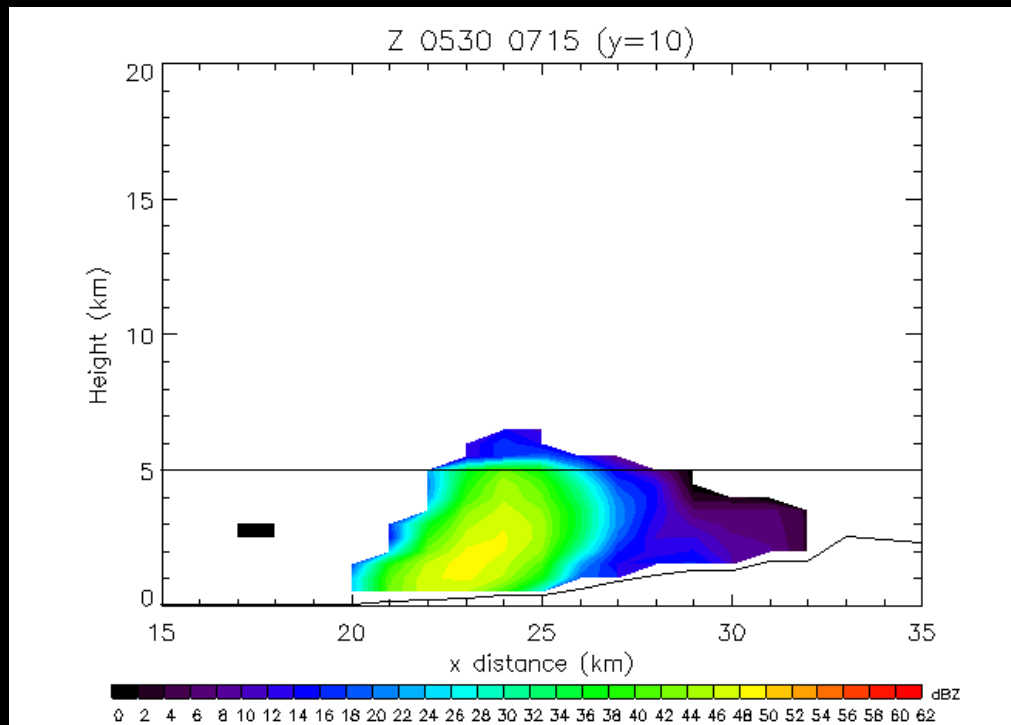
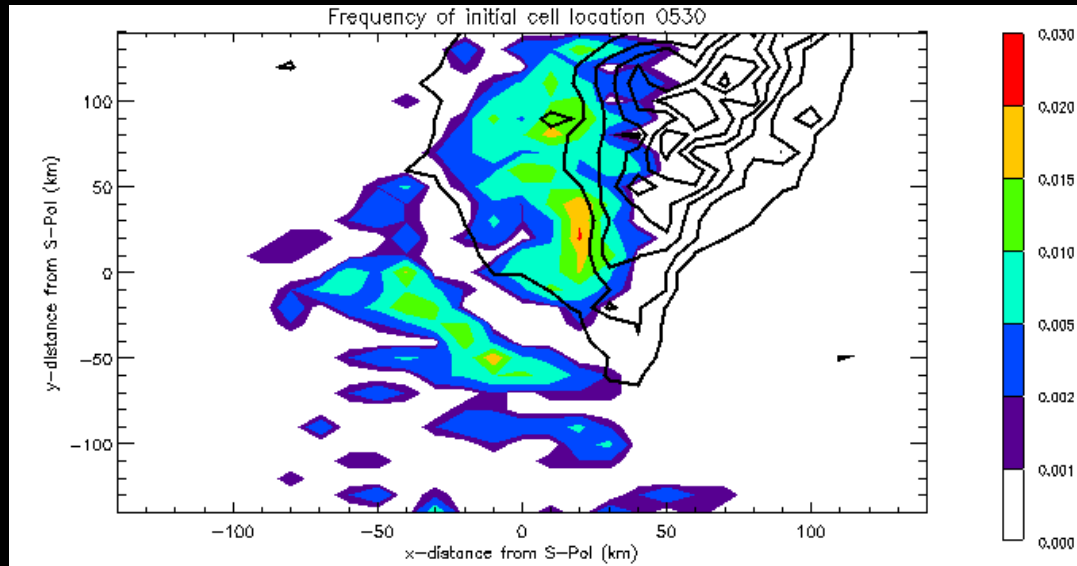
2008/05/30 03:57Z VIS

MTSAT衛星

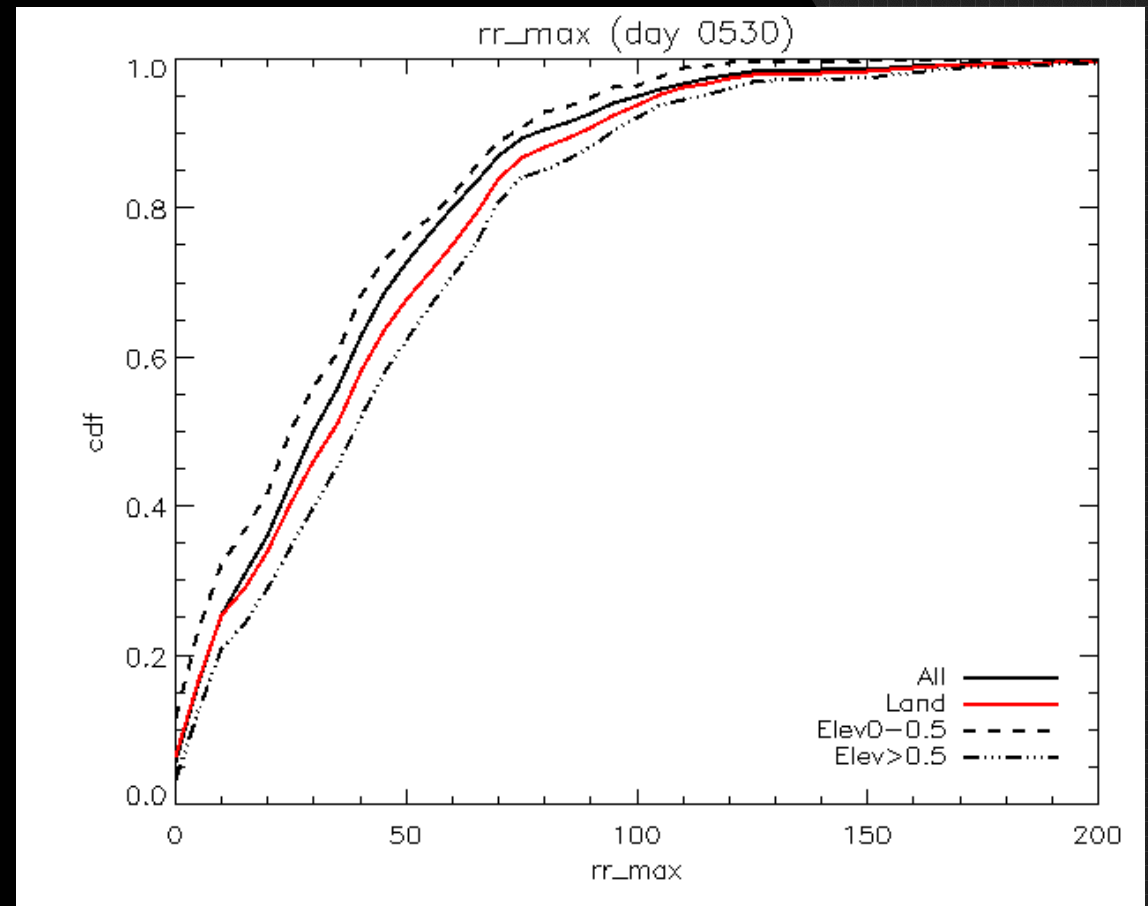
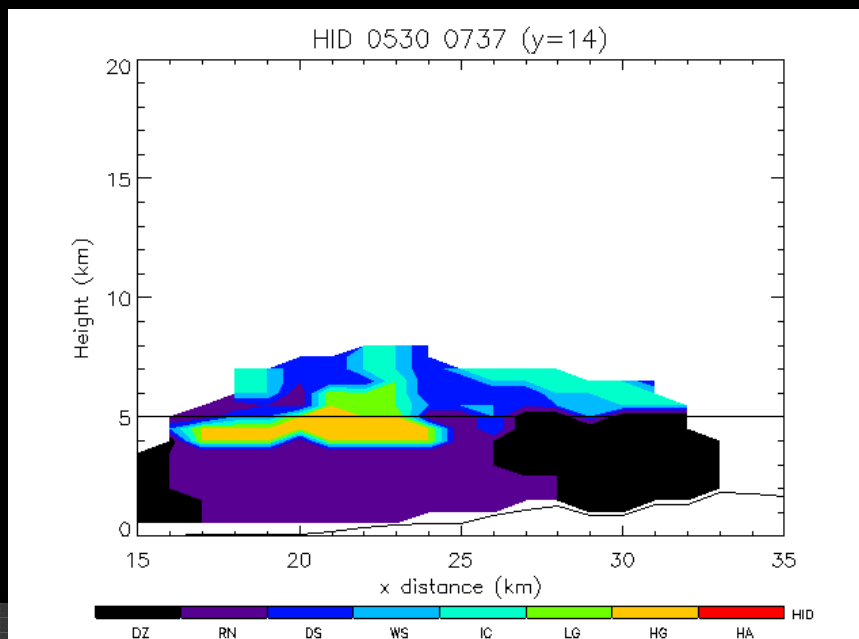
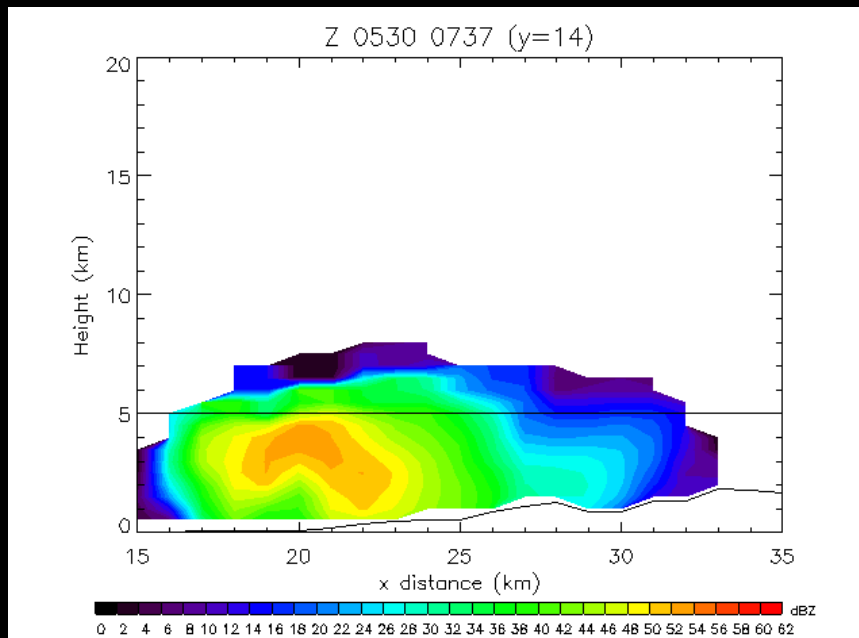


Dry mid-levels, lack of synoptic scale systems

30 May



30 May

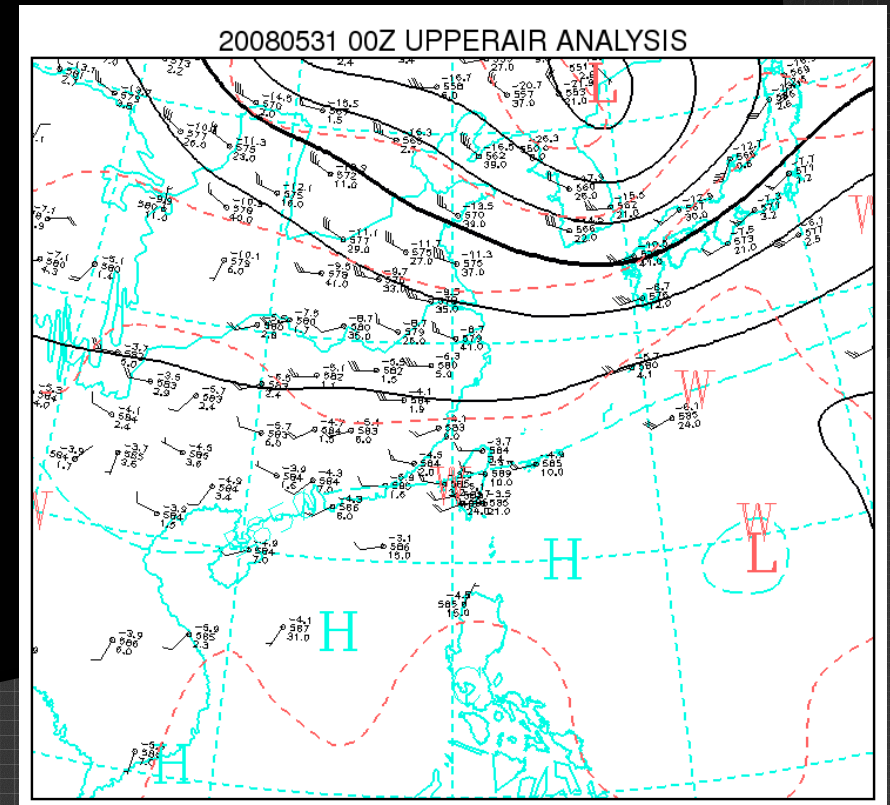
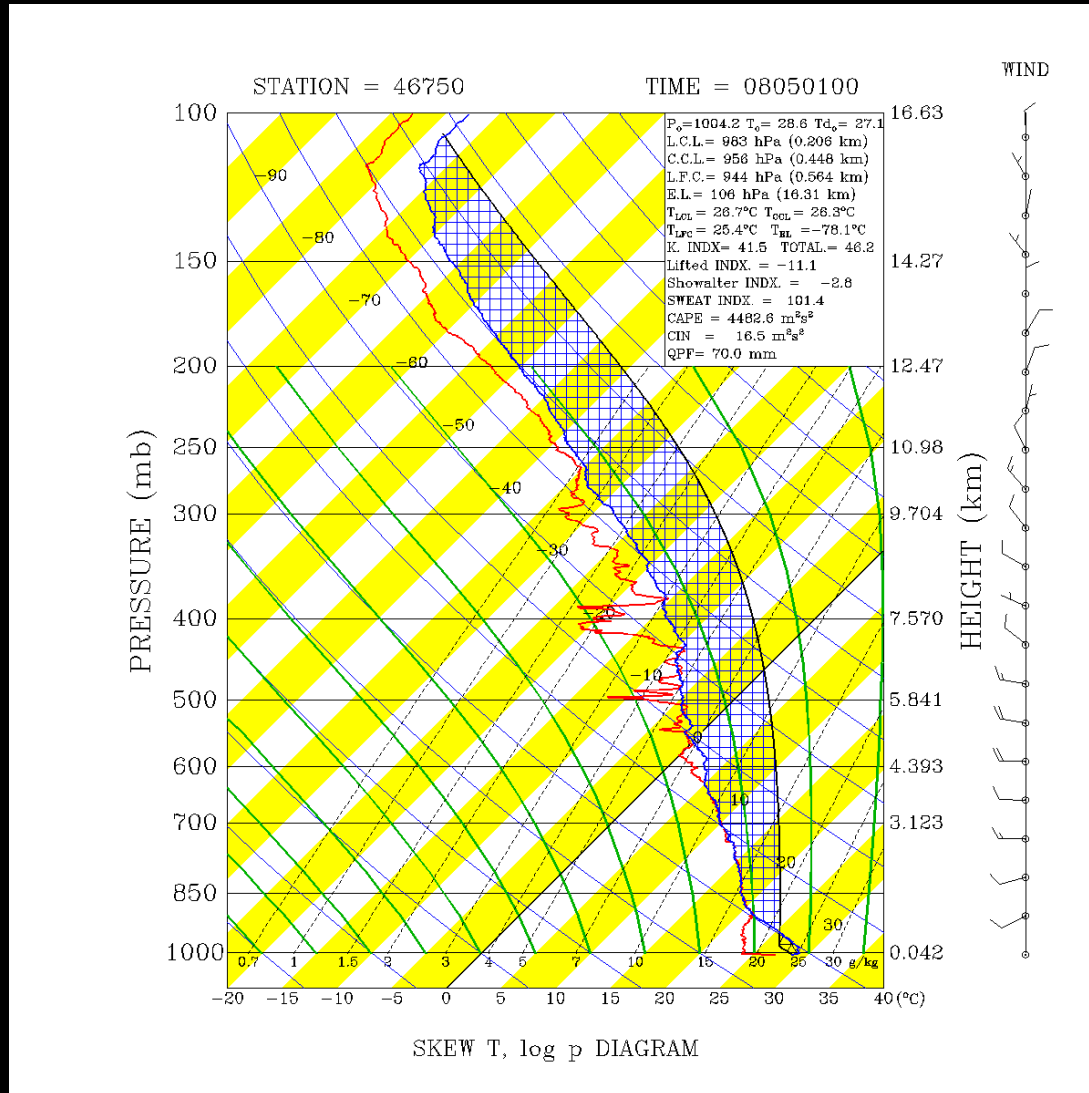
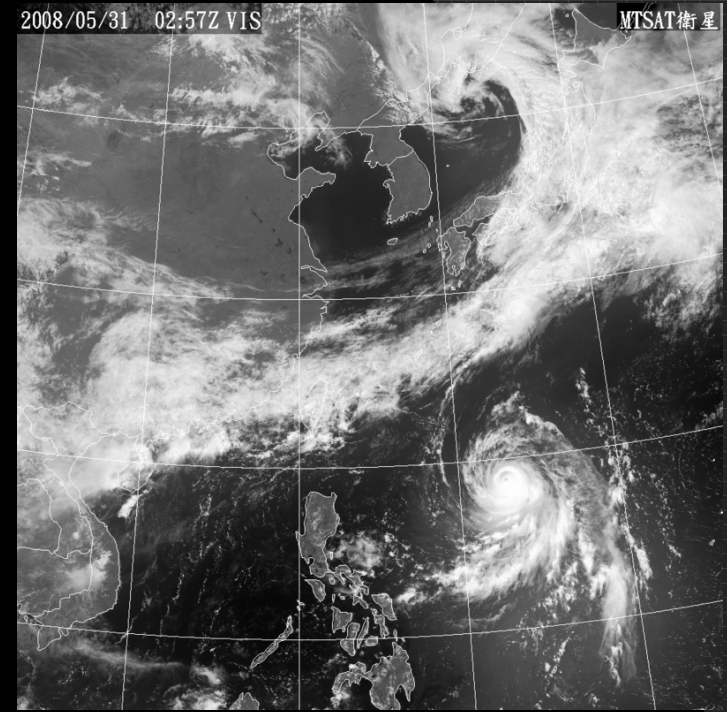


- Limited vertical growth
- Melting ice signature
- Tilted slope
- Increased rain rate along slopes
- Topography as lifting mechanism

31 May

2008/05/31 02:57Z VIS

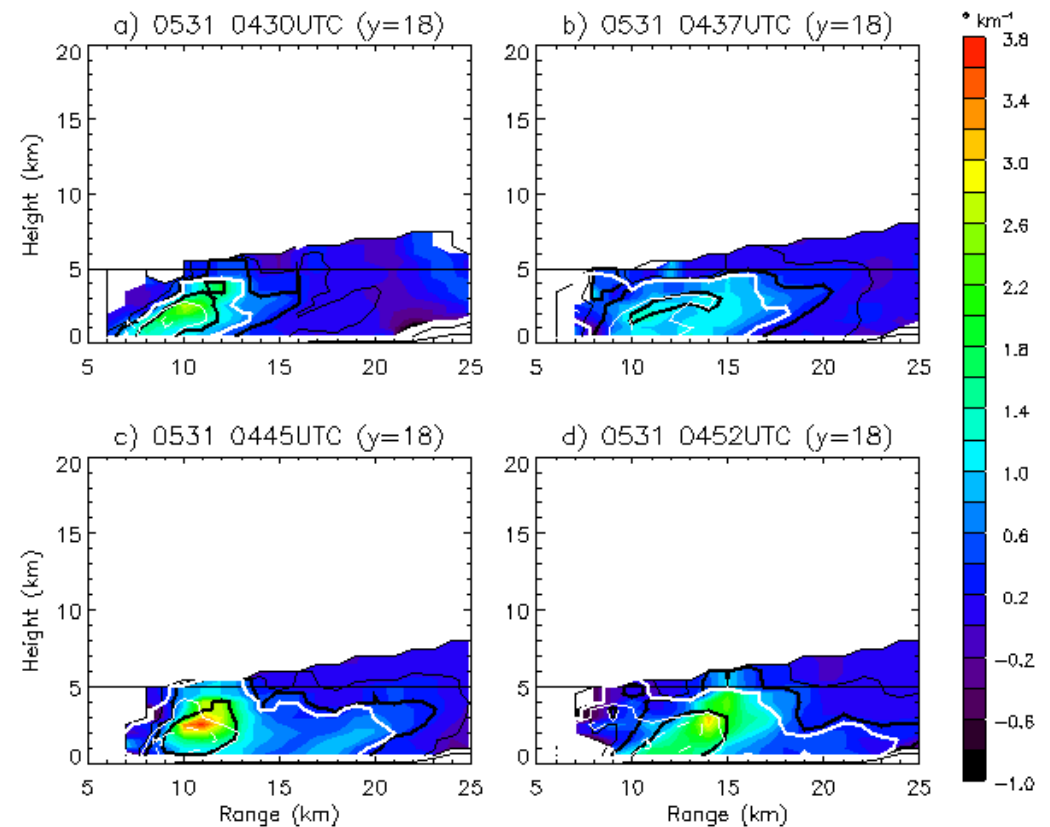
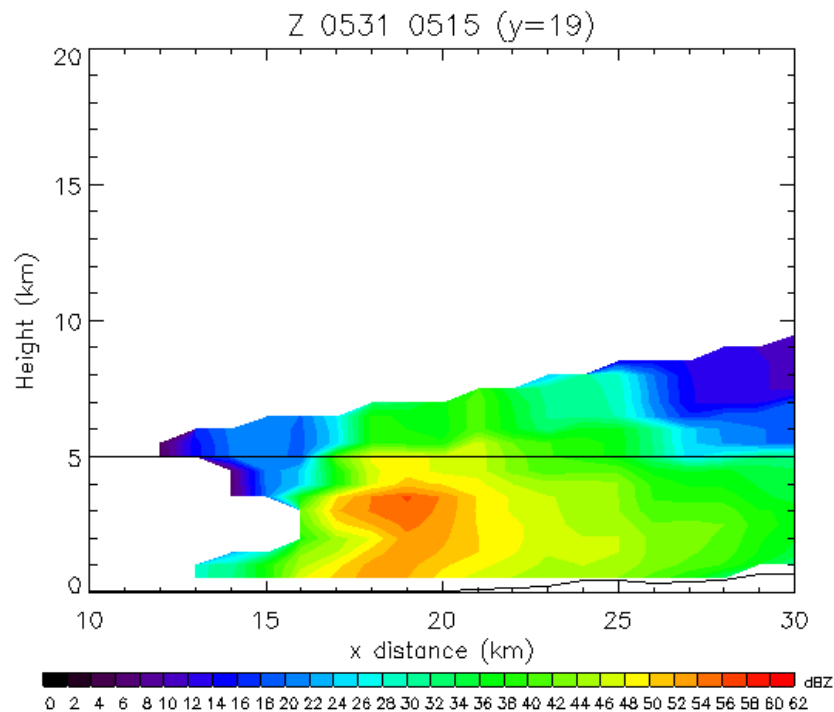
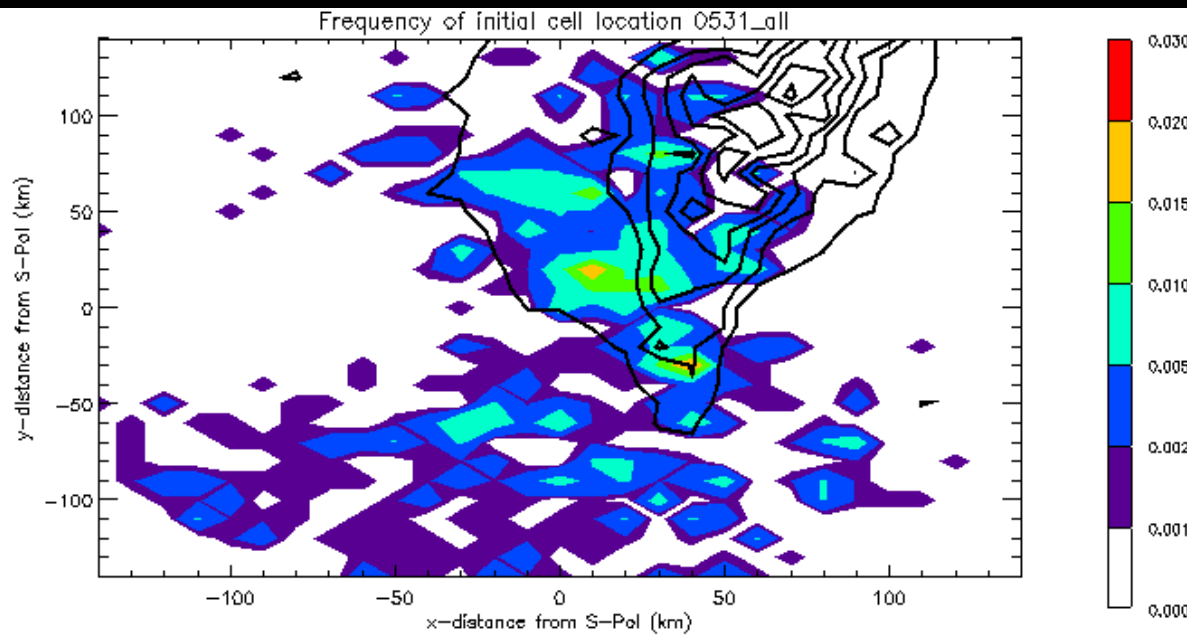
MTSAT 衛星



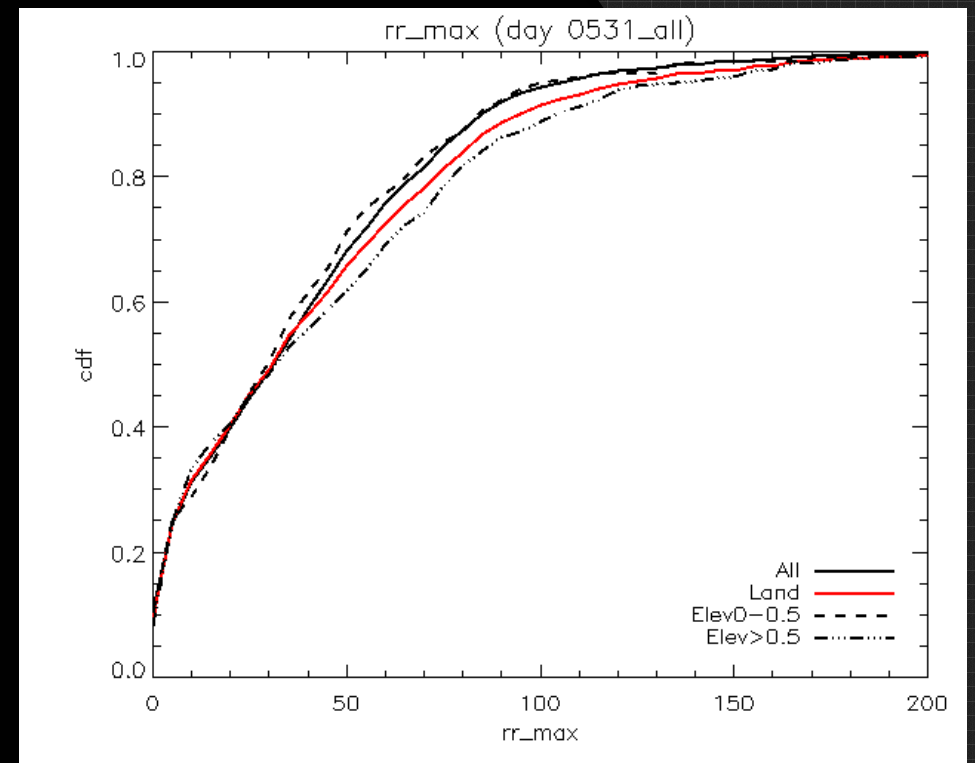
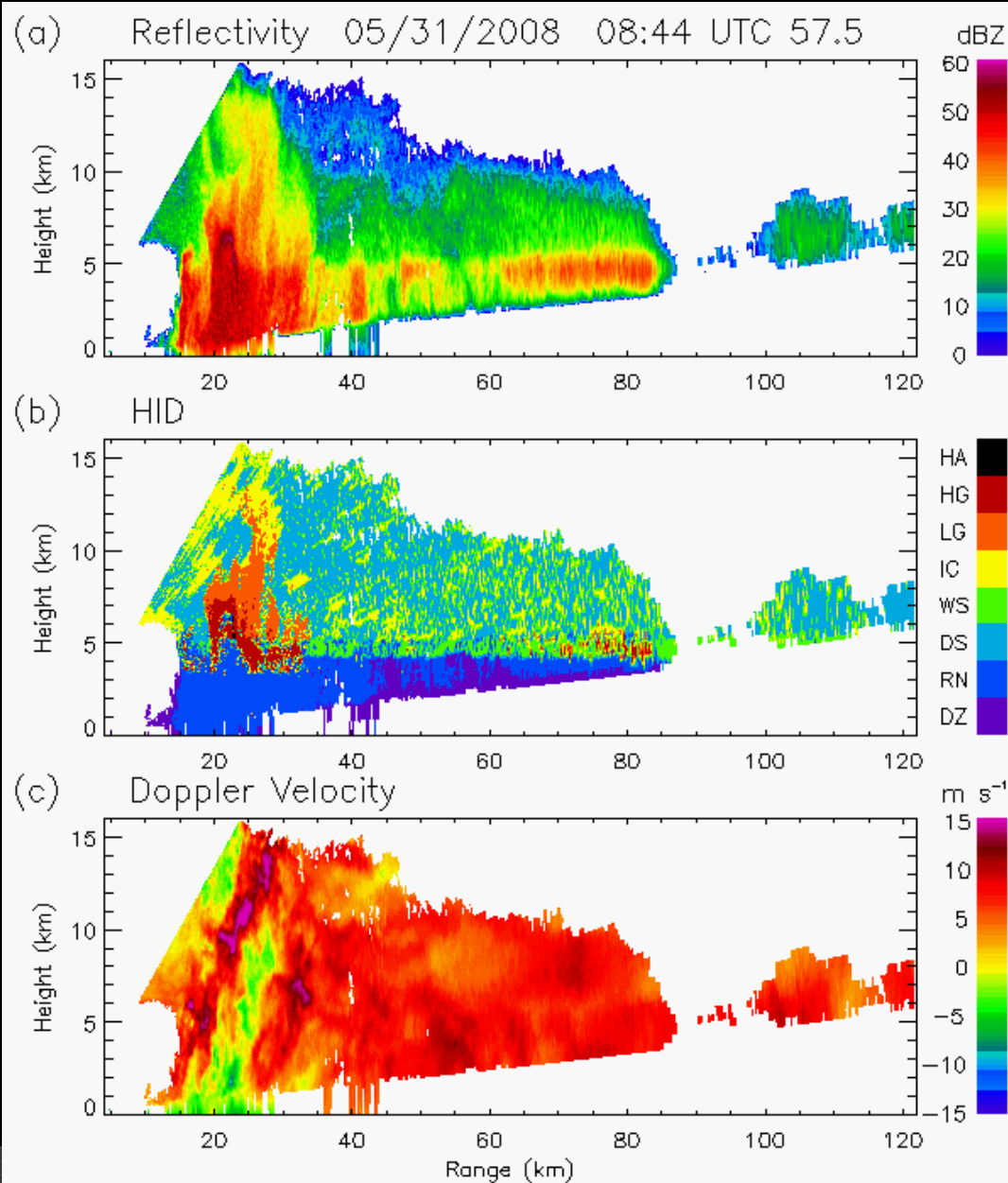
Moister environment, lack of upper-level system, Mei-Yu front over northern Taiwan

31 May

- Tilted updraft
- Initial warm-rain processes
- Melting signature

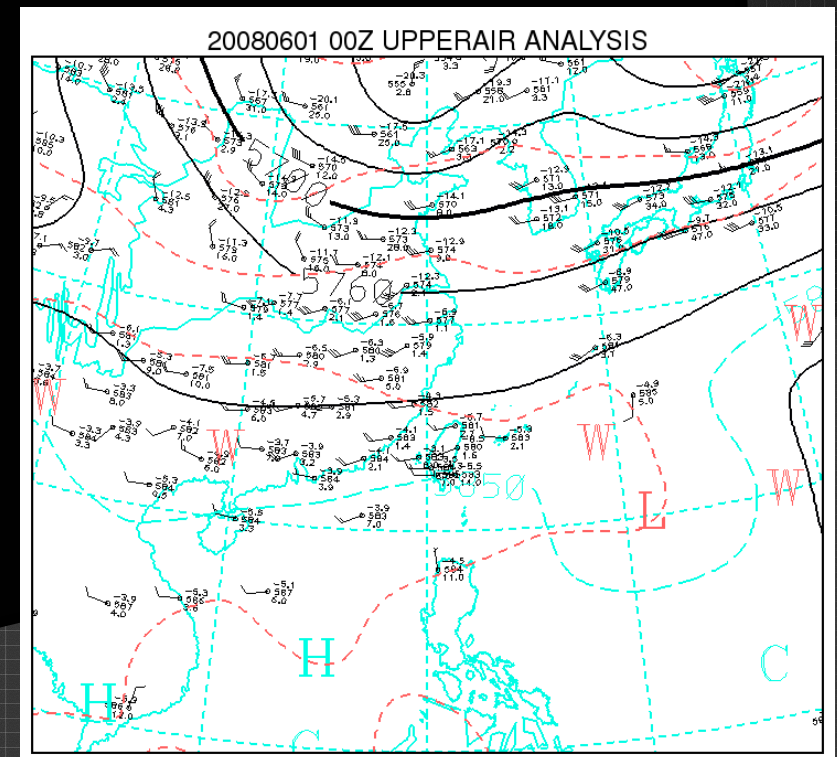
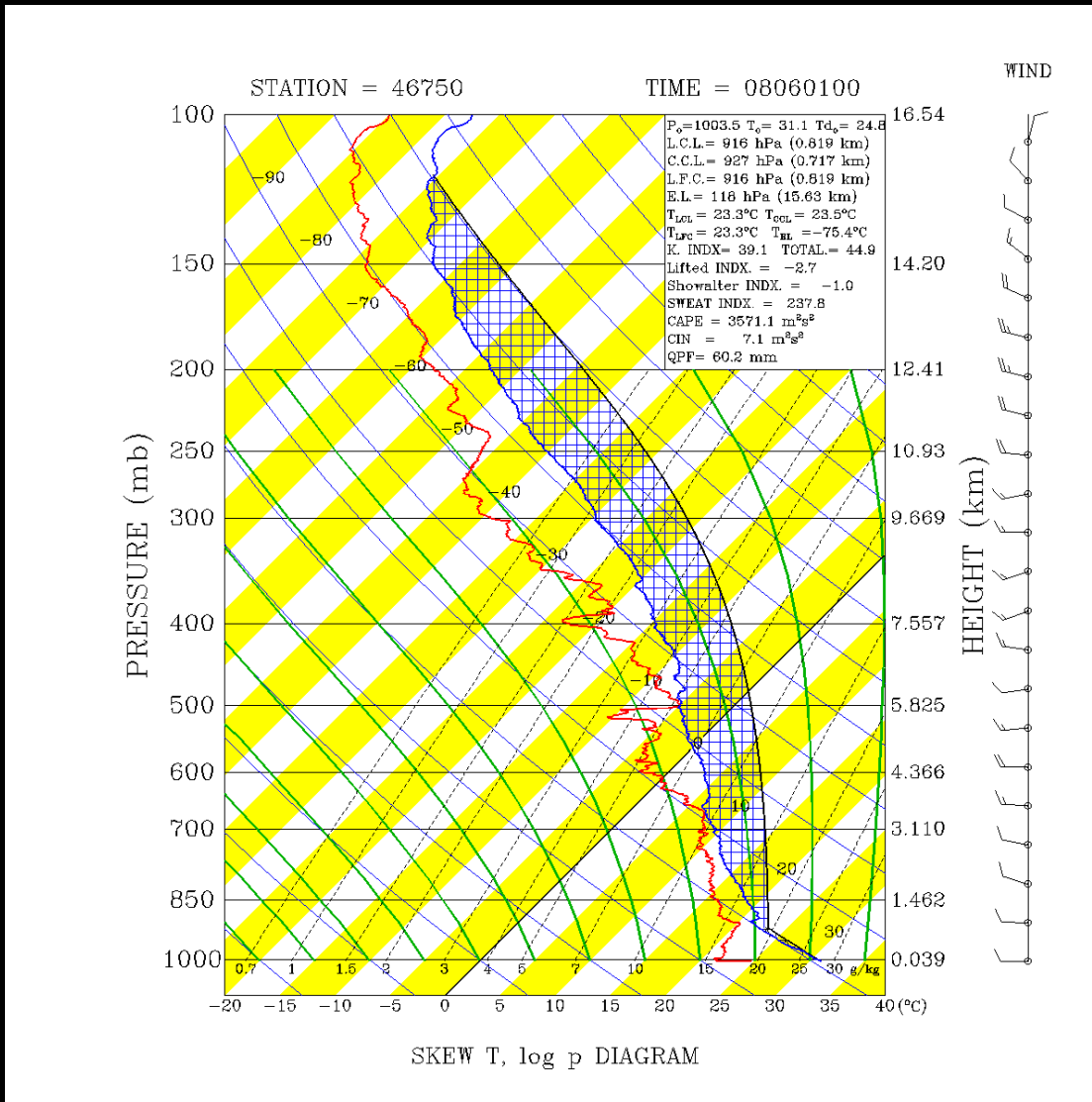
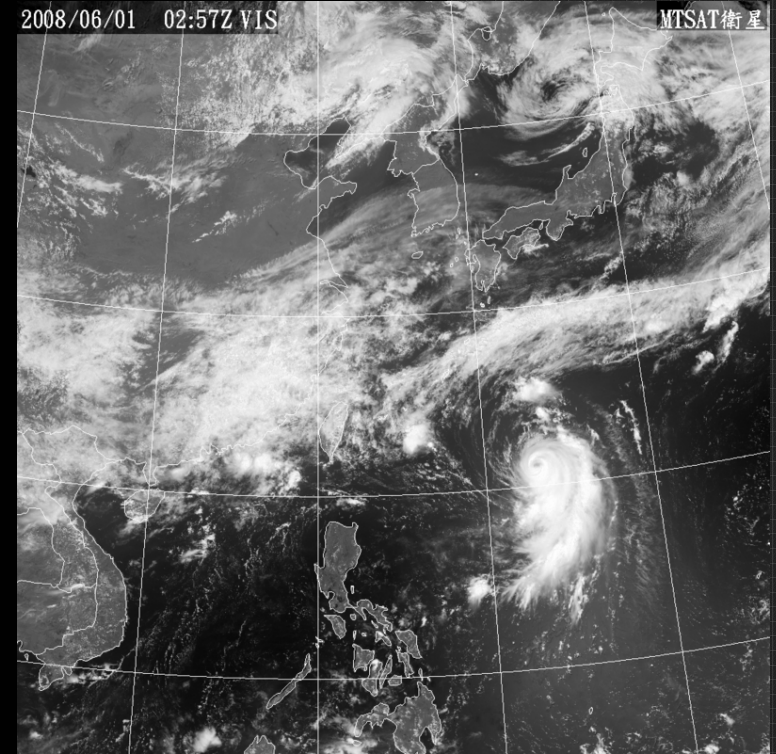


31 May

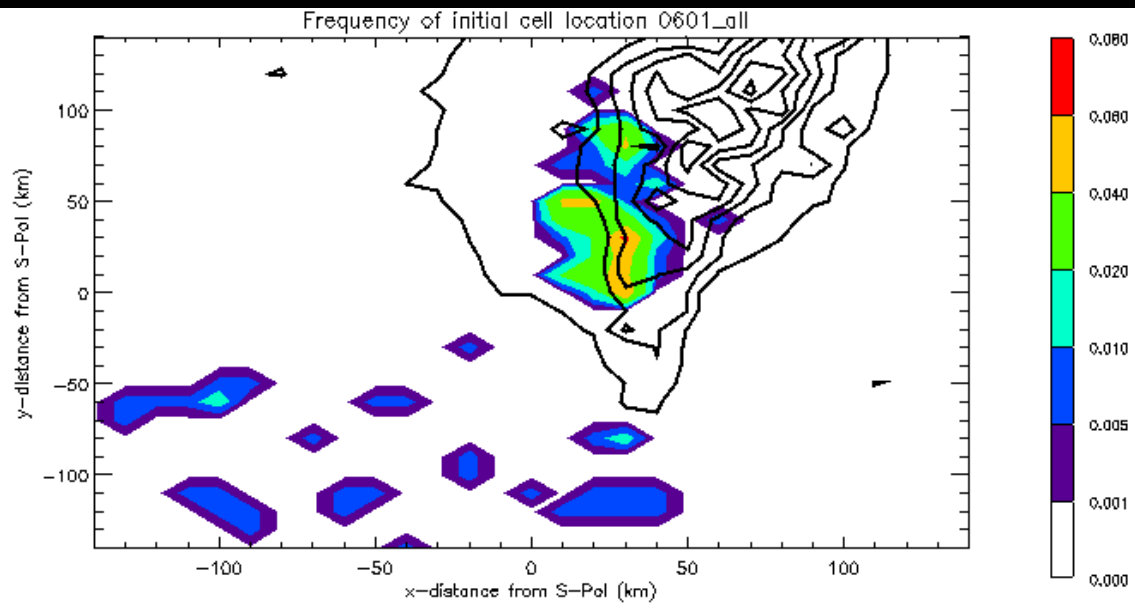


- Enhanced rain rates over slopes
- Deep echo extending above 15 km
- 40-dBZ echo several km above melting level
- Storm-top divergence
- Melting ice/contribution from mixed-phase processes

1 June

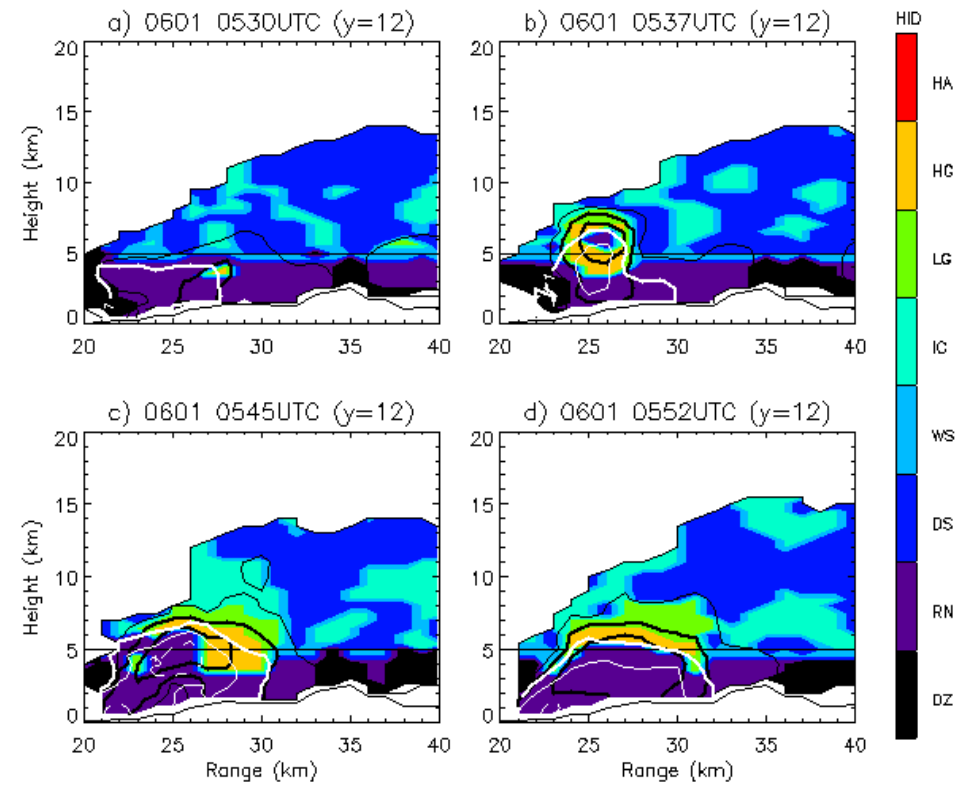
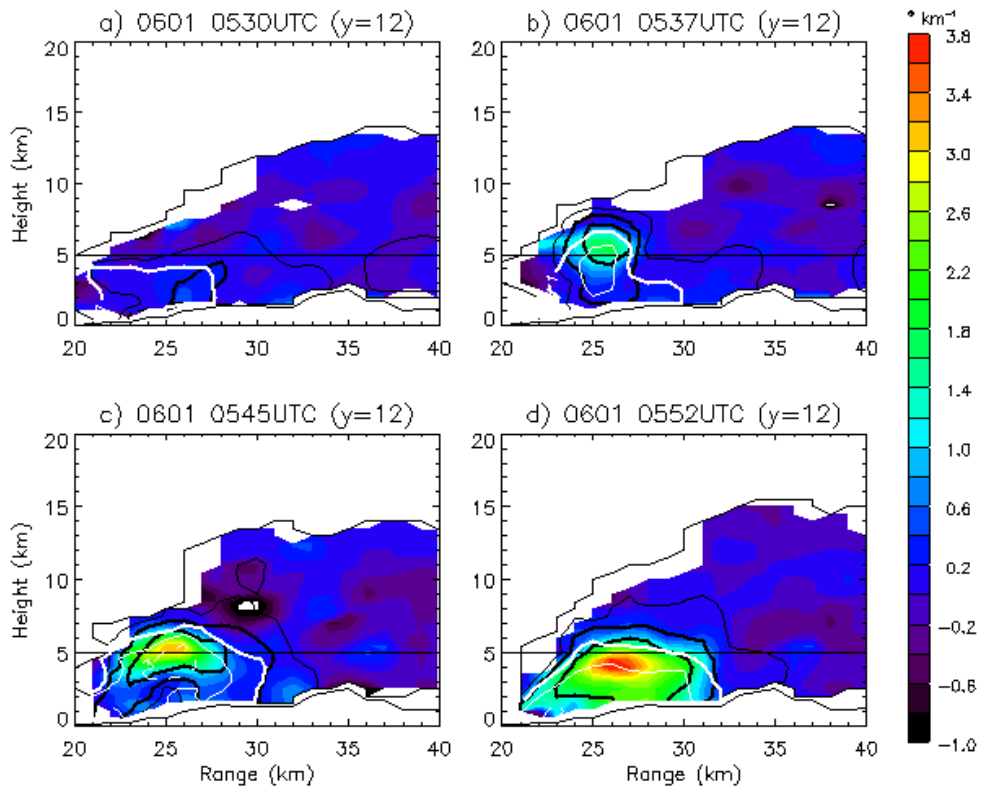


Another day characterized by diurnal convection

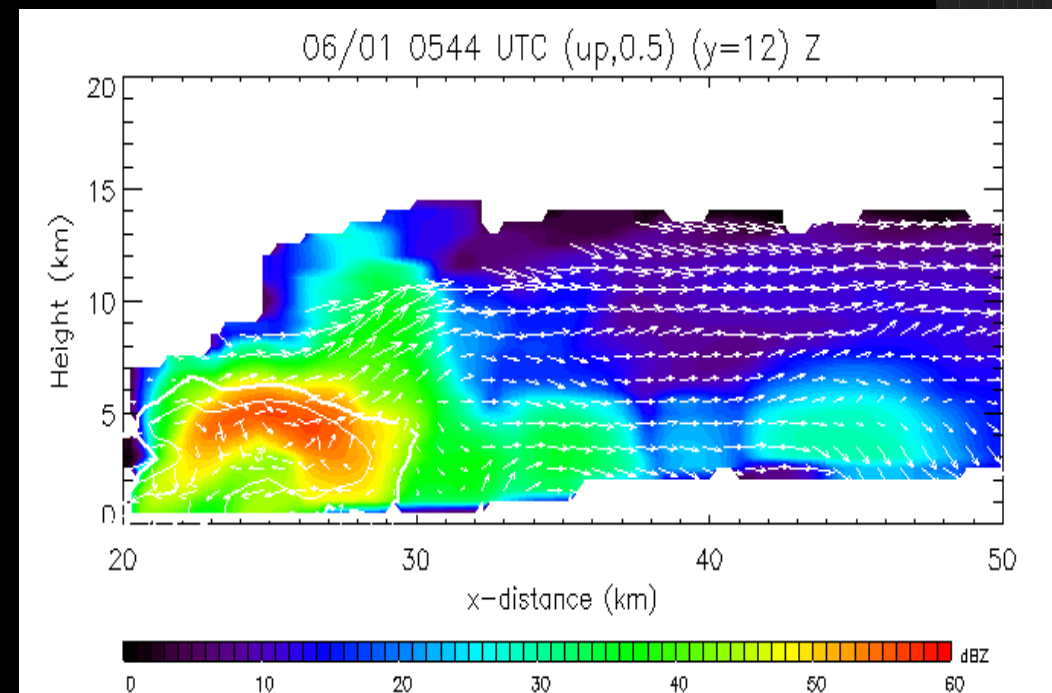
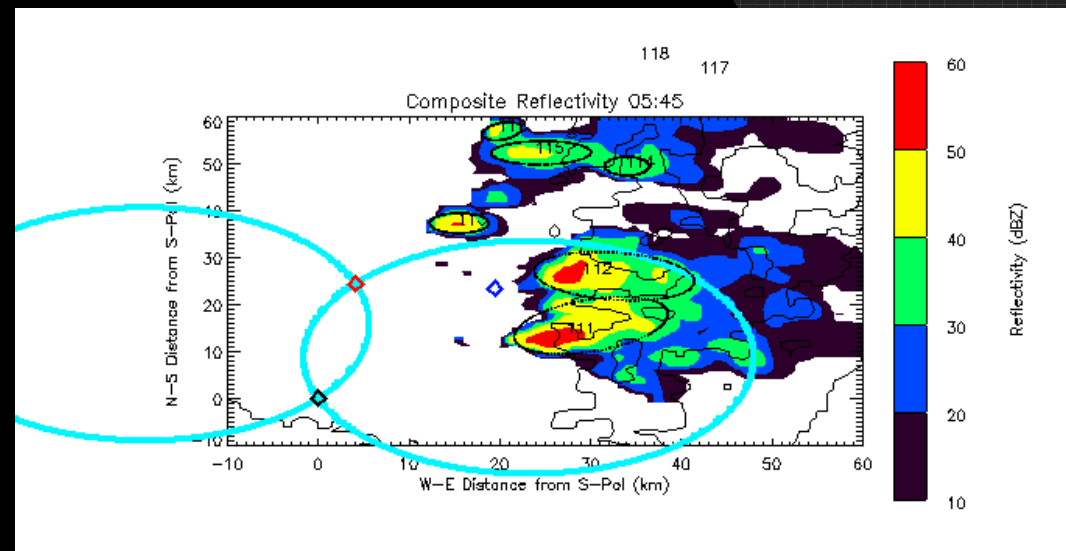
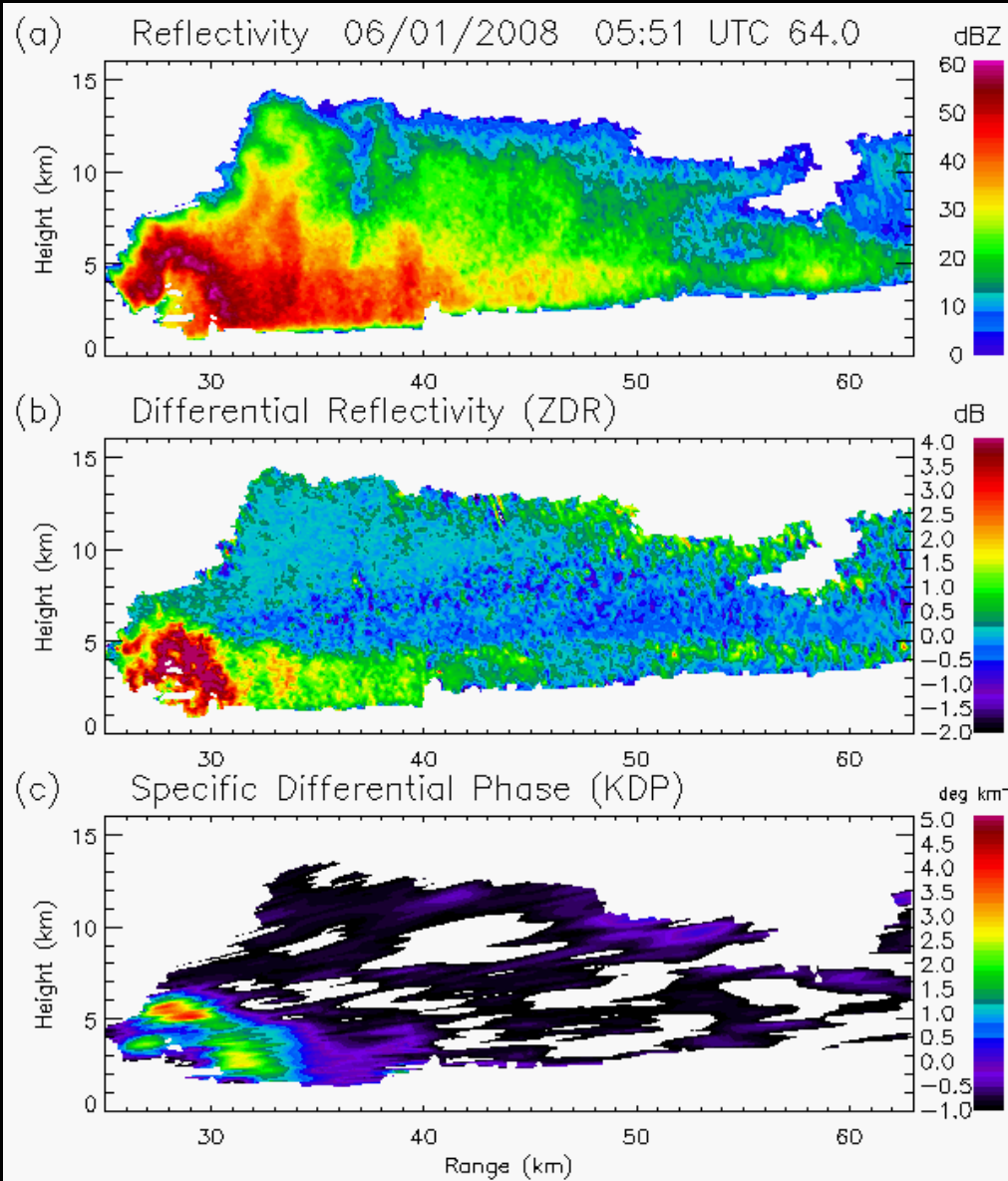


1 June

Melting of large ice hydrometeors



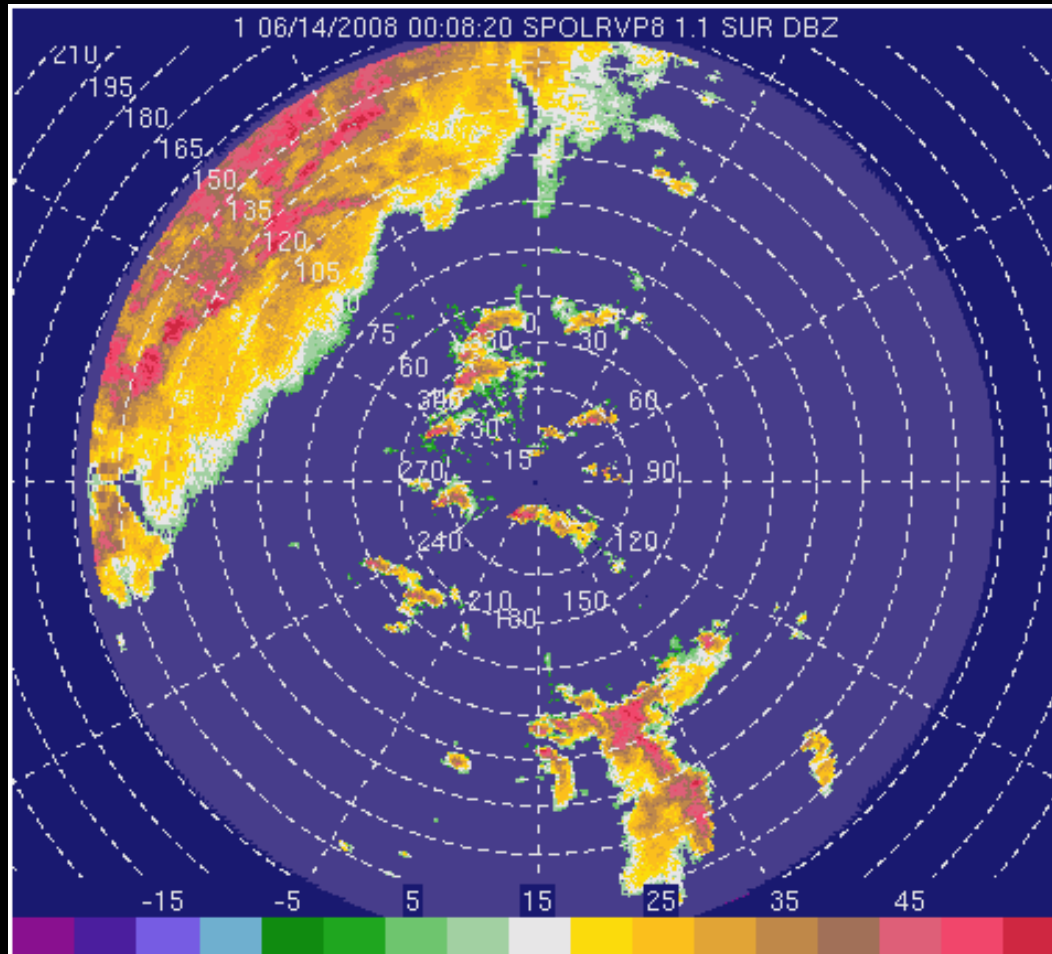
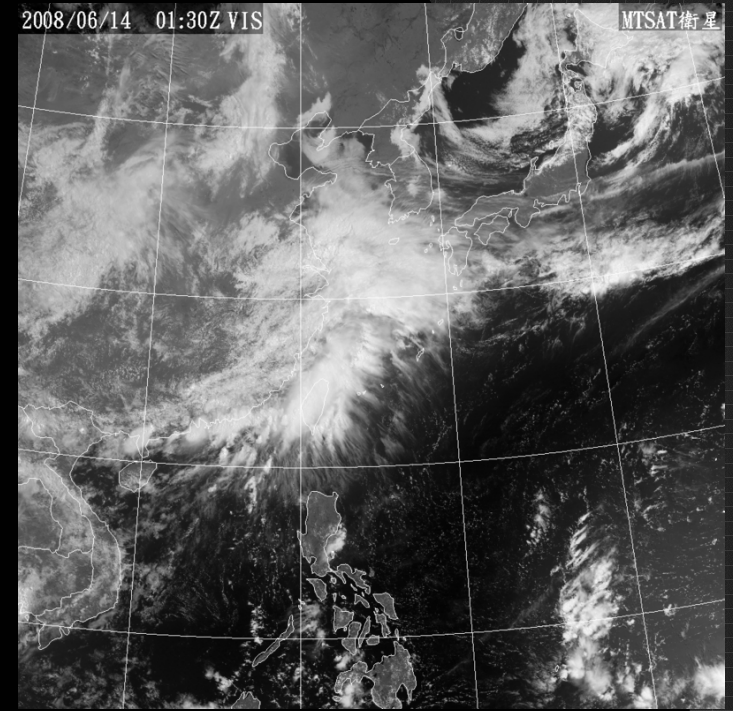
1 June



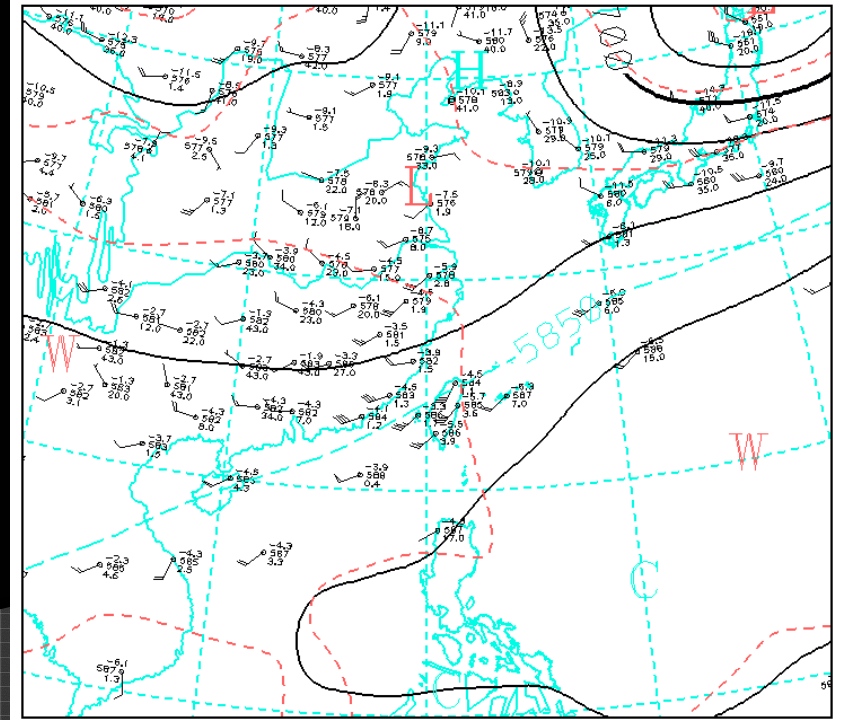
14 June

2008/06/14 01:30Z VIS

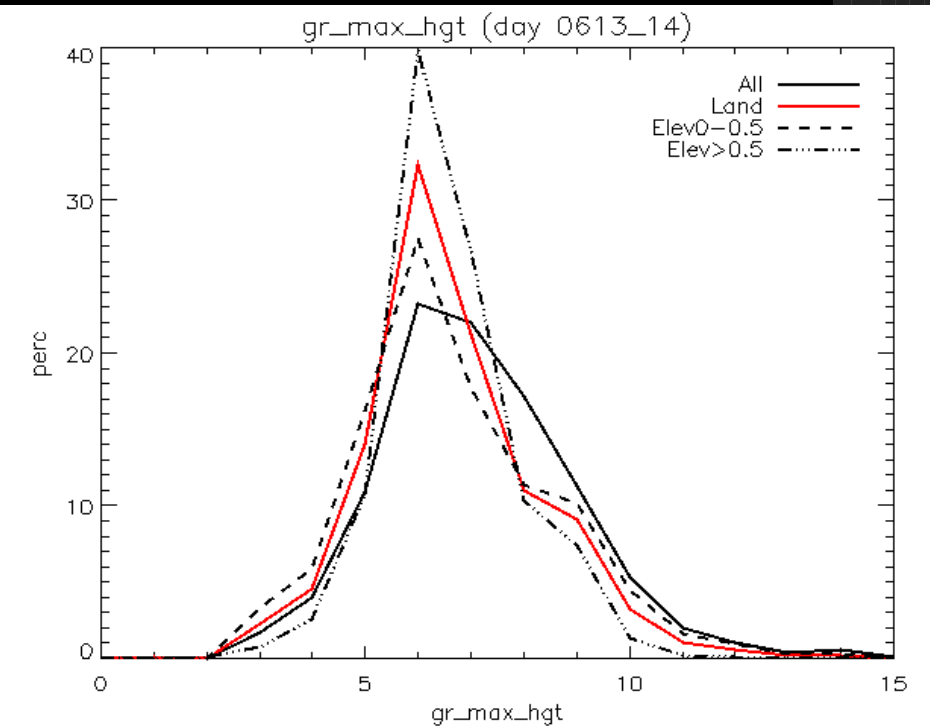
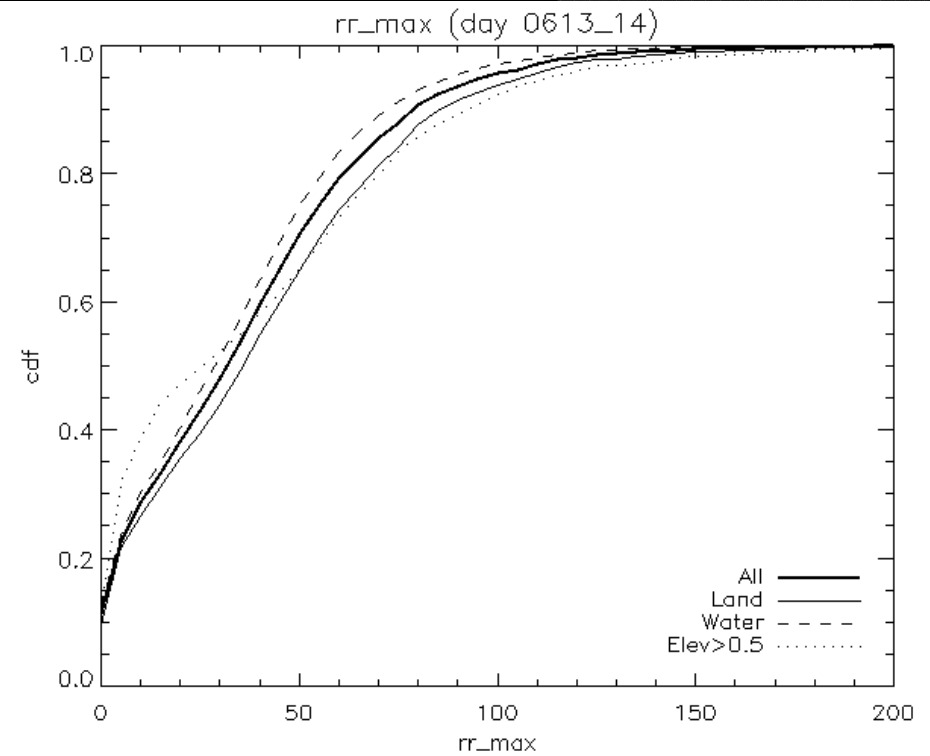
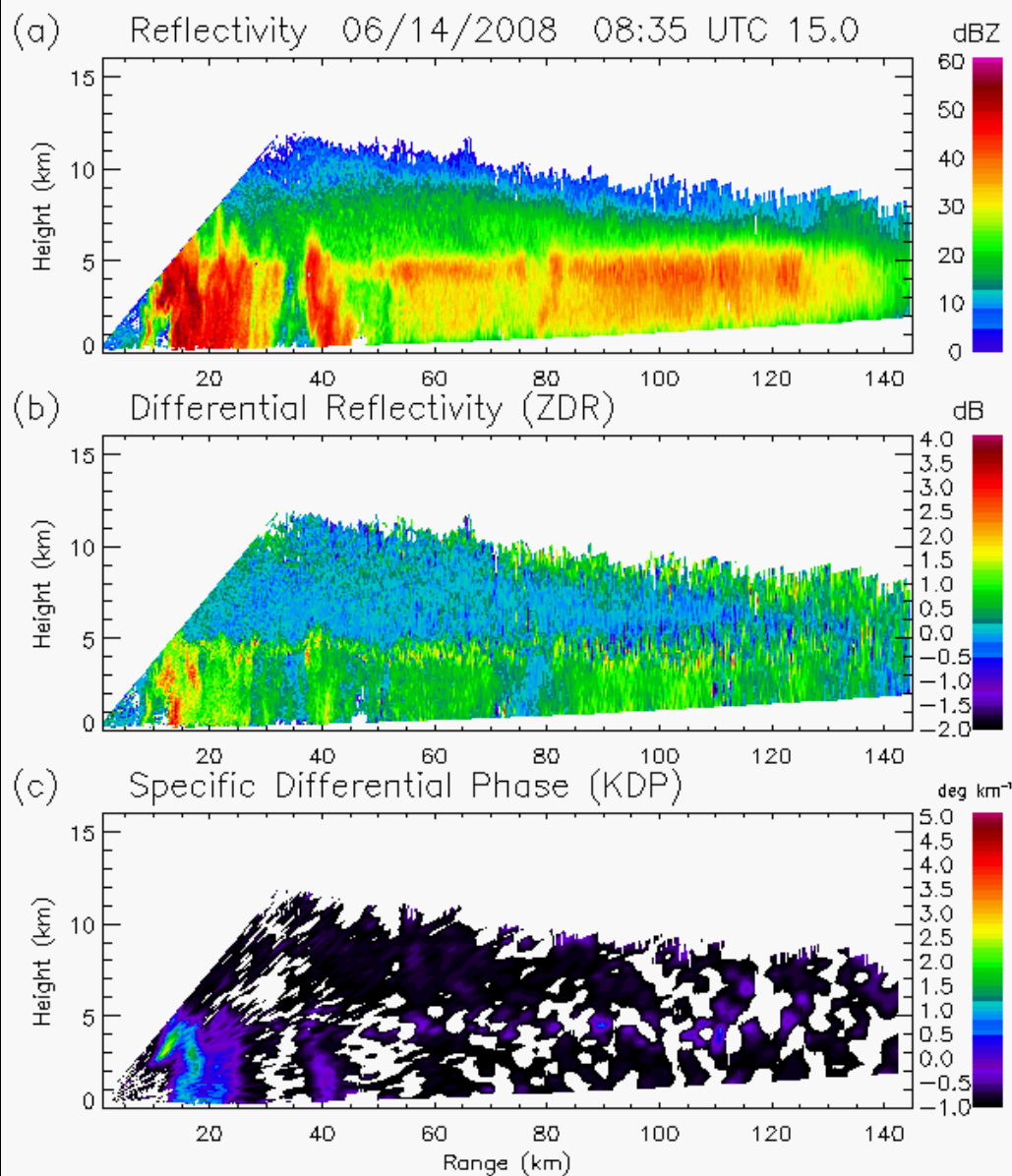
MTSAT衛星



20080614 00Z UPPERAIR ANALYSIS

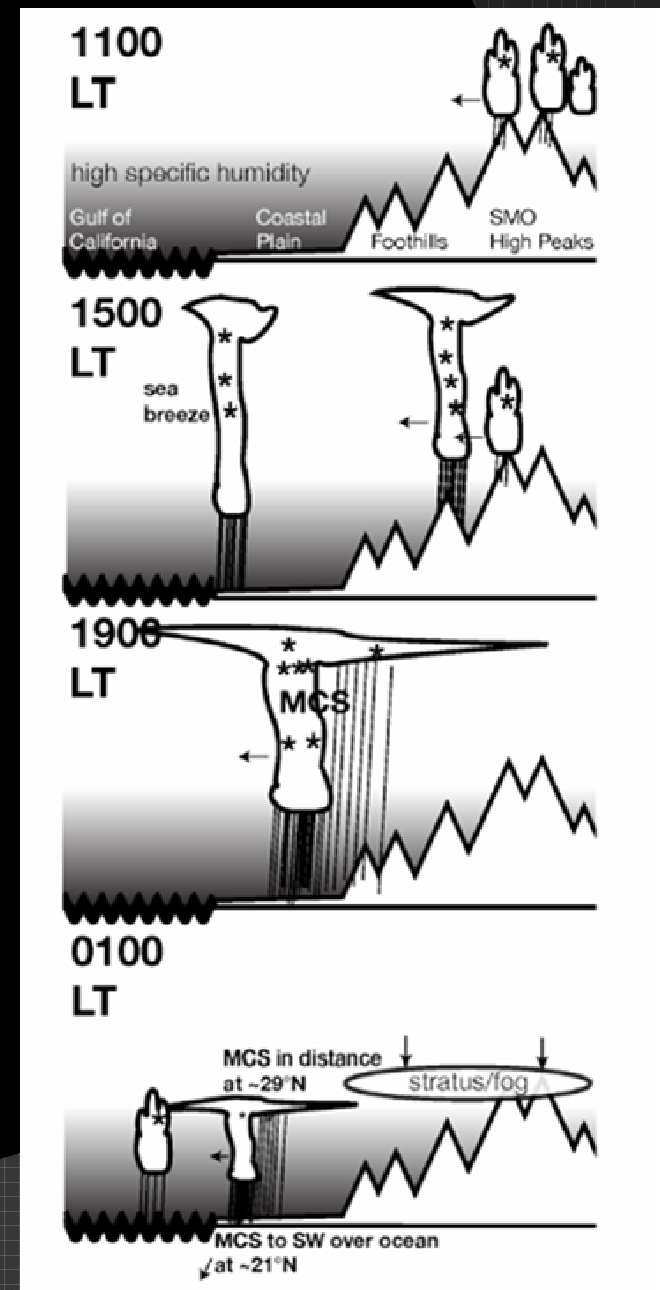
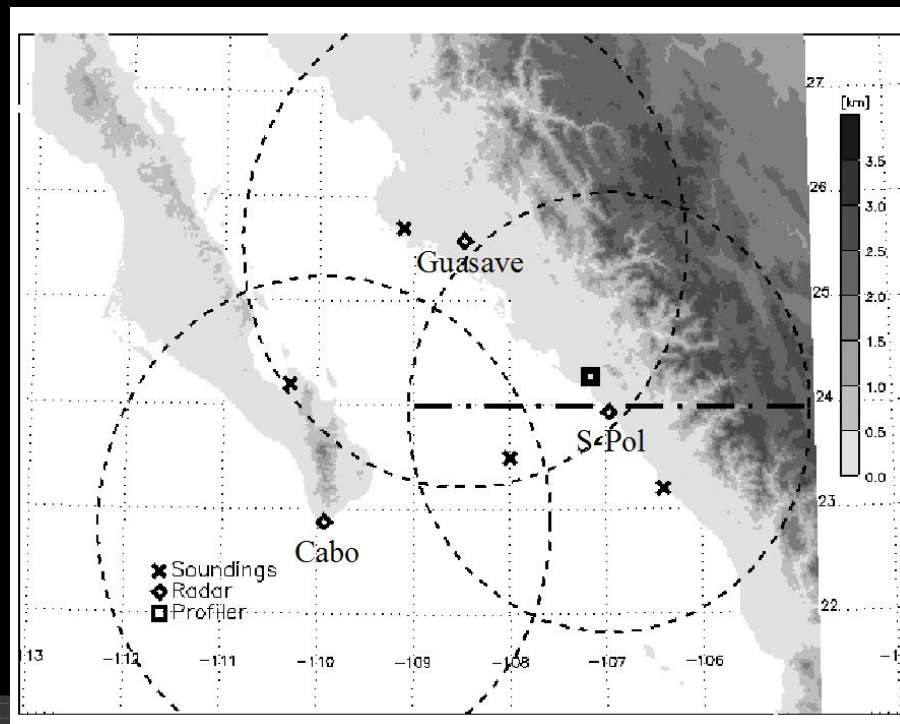


14 June



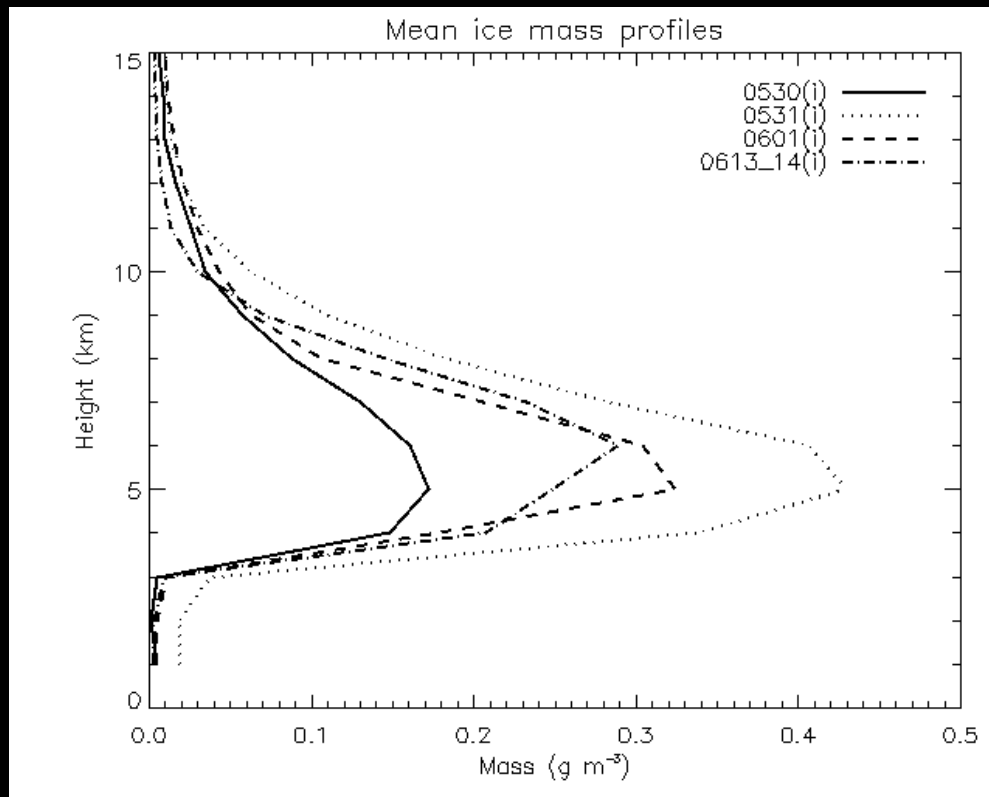
Comparison with NAME

- North American Monsoon Experiment: characterize and understand precipitation processes influenced by complex terrain
 - Strong influence of terrain on diurnal cycle of precipitation

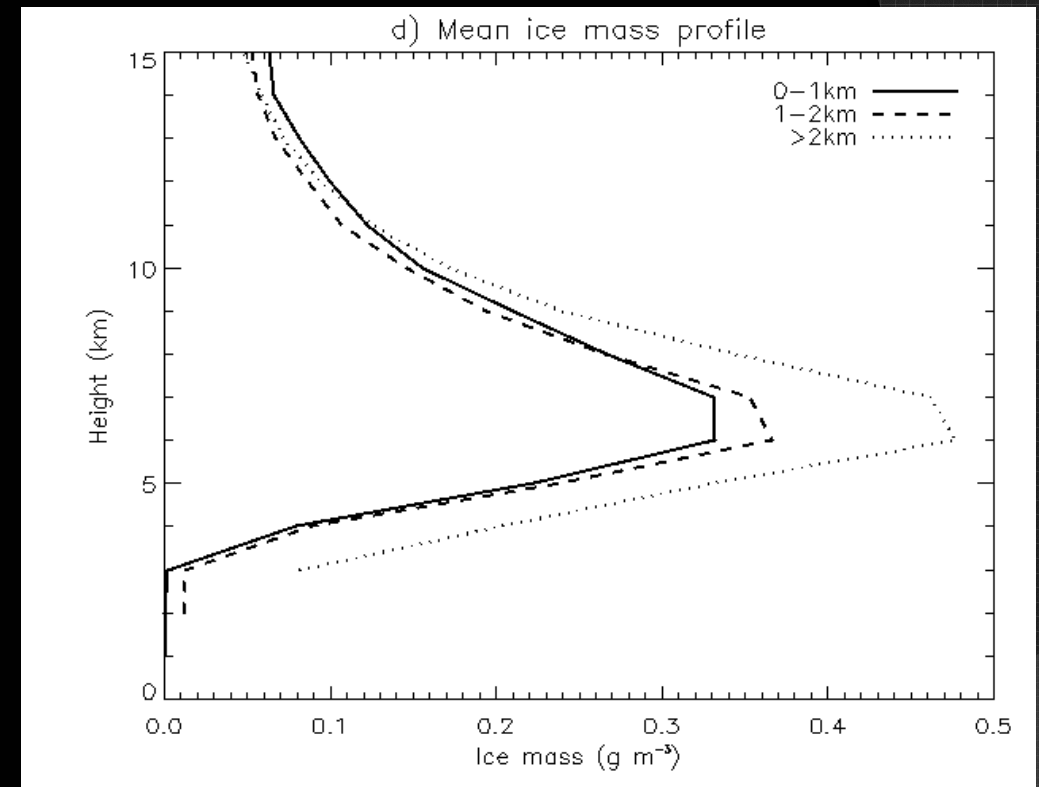


Comparison

TiMREX



NAME

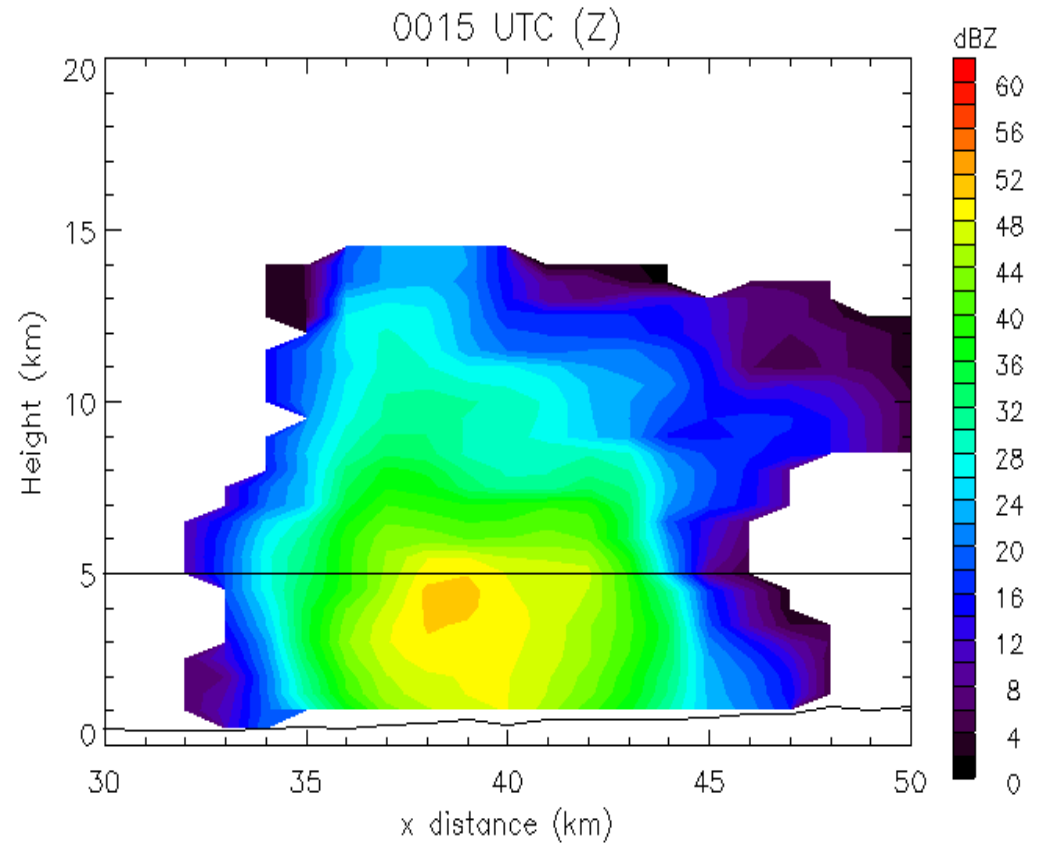
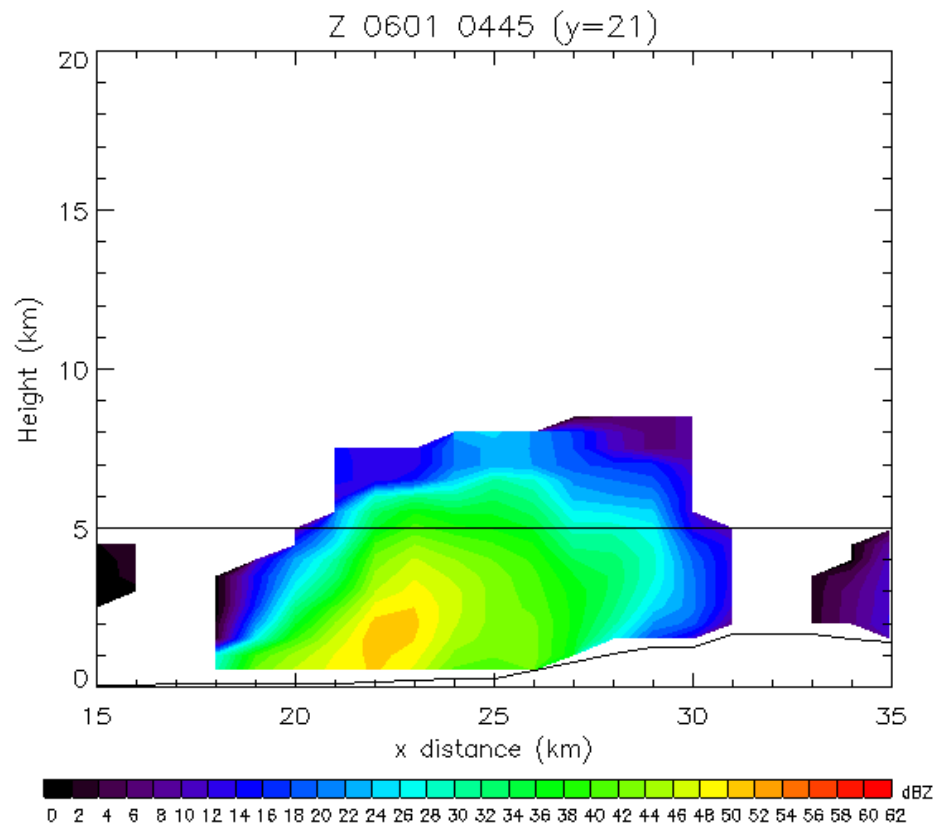


- Similar peak ice mass values near melting level
- Deeper extent of ice in NAME convection

Comparison

TiMREX

NAME



Tilted updrafts along topography during TiMREX compared to more upright convection in NAME

Summary and future work

- ◎ S-Pol polarimetric data suggest hypothesis that flow impinging on CMR lofts hydrometeors above melting level where they freeze
 - Subsequent melting contributes to intense rainfall rates near terrain
 - Need to correct dual-Doppler analysis to place in dynamical framework
- ◎ Comparison with NAME shows similar ice mass values, but shallower and more tilted updrafts
 - Further comparison with organized systems
- ◎ Analysis of 14 June case to look at evolution of organized system
 - Focus on comparisons between land and water and with previous studies

Thank you!
Questions? Suggestions?