Evaluation of high-resolution numerical model simulations of atmospheric river events during HMT-2006

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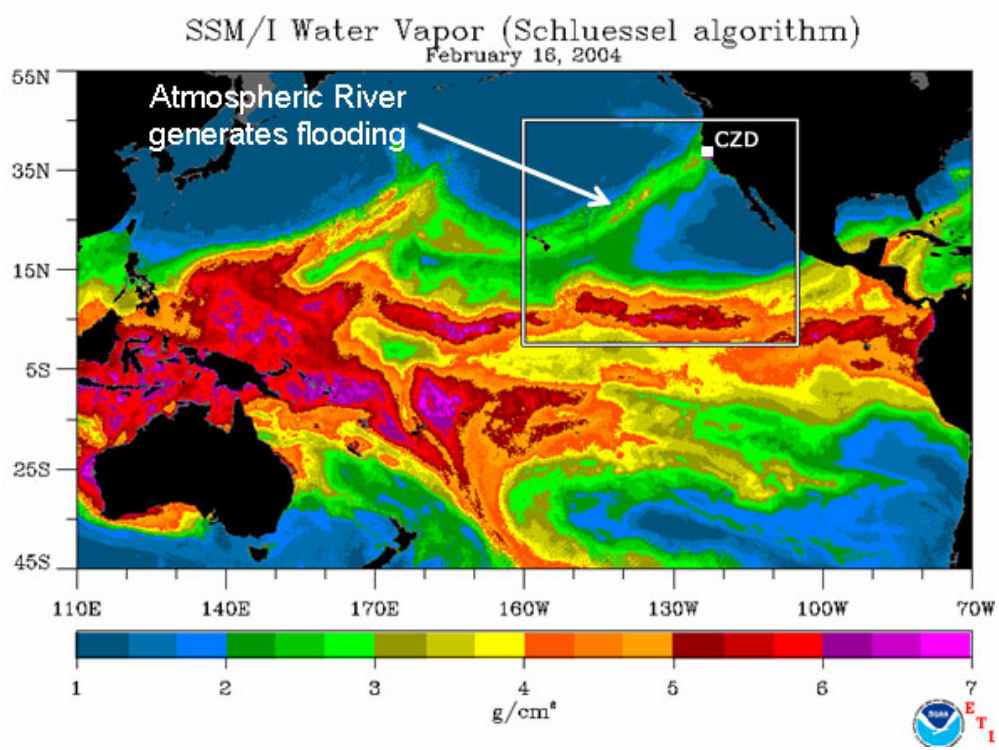
INTRODUCTION

• During the winter season significant precipitation events in California are often caused by land-falling “atmospheric rivers” associated with extra tropical cyclones in the Pacific.

• Atmospheric rivers are elongated regions of high values of vertically integrated water vapor over the Pacific and Atlantic oceans that extend from the tropics and subtropics into the extratropics (Neiman et al. 2007, Bao et al. 2006, Ralph et al. 2004) and are readily identifiable using SSM/I.

• Due to the terrain steepness and soil characteristics in the area, a high risk of flooding and landslides is often associated with these events.

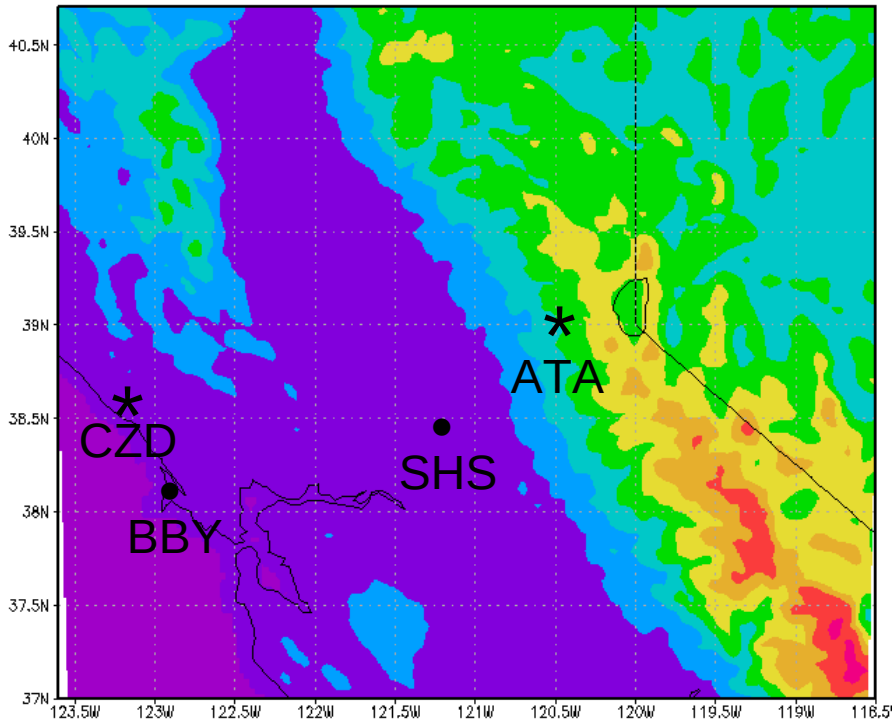
• The main goal of the present study was to evaluate performance of the Weather Research and Forecasting (WRF) ARW model in the case of events characterized by atmospheric river settings.



DATA AND METHODOLOGY

SIMULATIONS

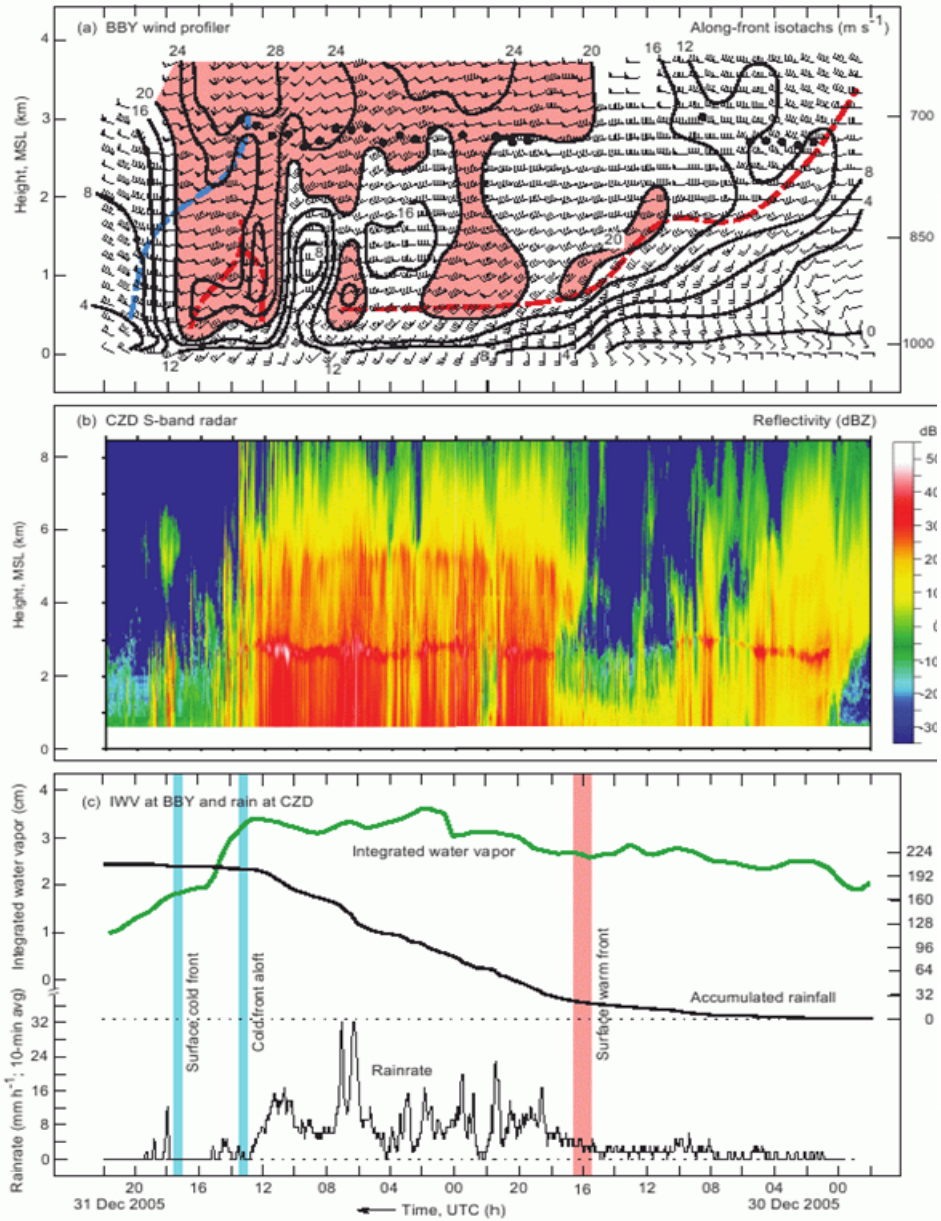
- 5 “atmospheric river” events
- 3km WRF-ARW
- 4 different Microphysics
  (Lin, WSM6, Thompson & Schultz)
- YSU PBL
- LAPS initialization
- 40km Eta LBC



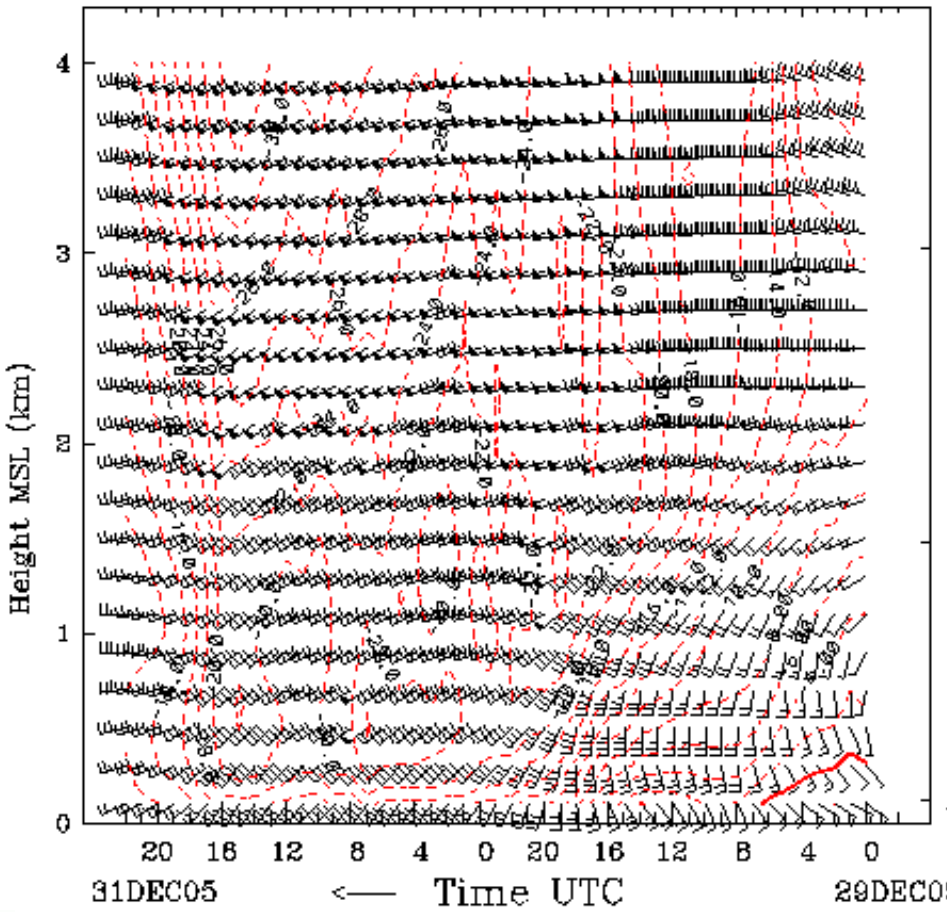
OBSERVATIONS

- Tipping-bucket rain gauges at Cazadero and Alta (CZD ~475m MSL and ATA ~1085m MSL)
- S-band vertically pointing radar (CZD and ATA)
- 915-MHz wind profiler at Bodega Bay and Sloughhouse (BBY ~12m MSL and SHS ~50m MSL)

EVALUATION OF SIMULATED MESOSCALE FEATURES

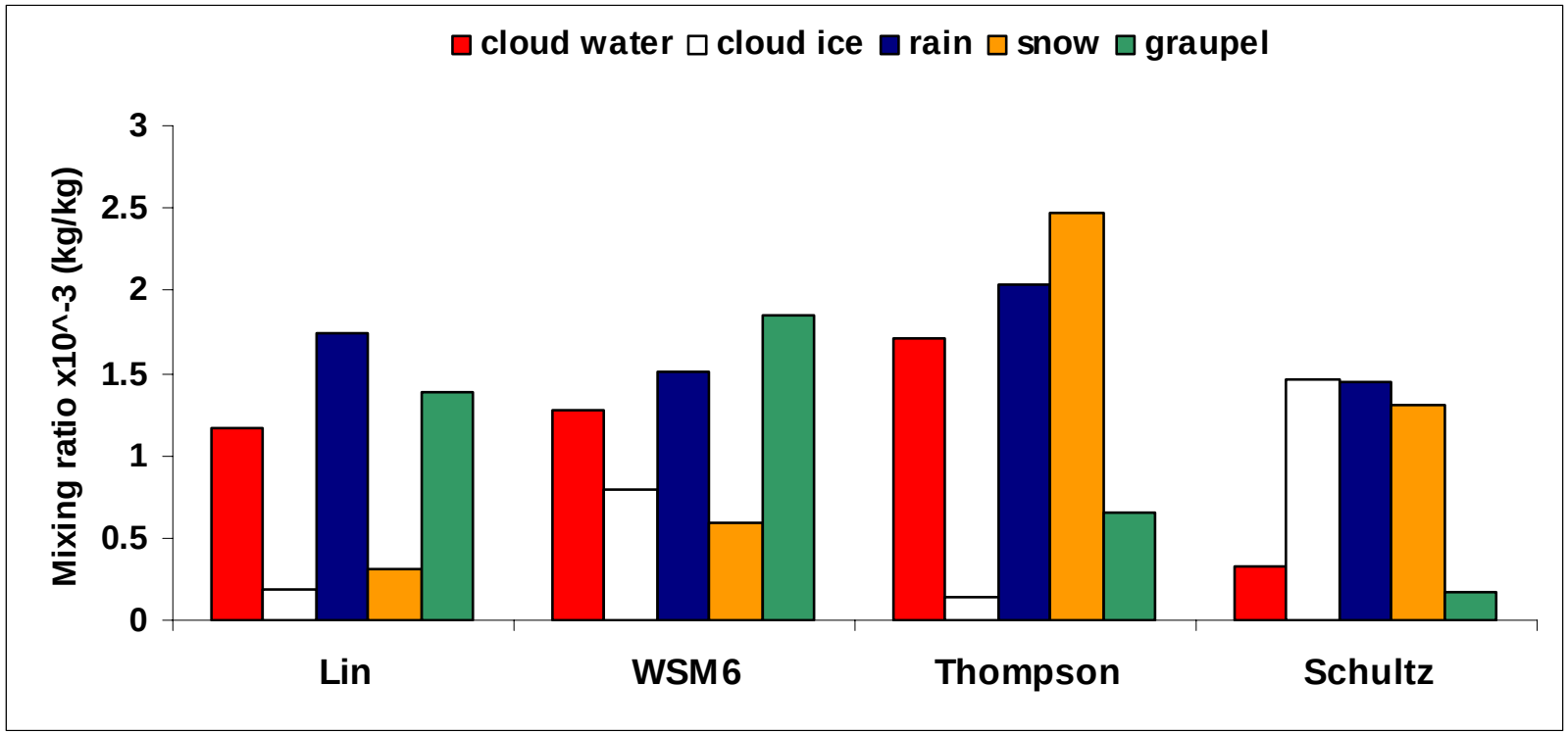


12302005 CZD
Wind profile simulation



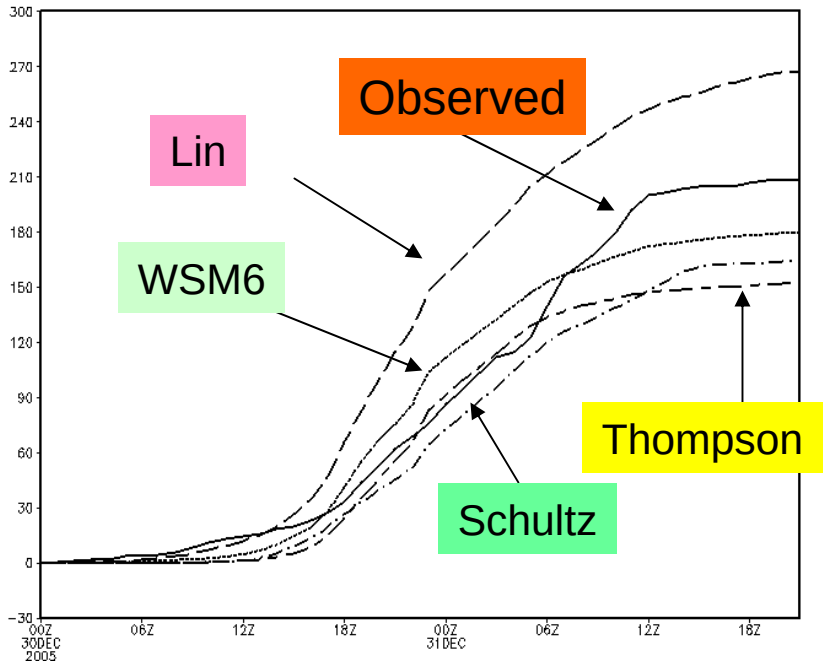
MICROPHYSICAL ASSPECTS: WATER SUBSTANCE PARTITION

6-hourly domain averages of water substance partitions for all 5 events



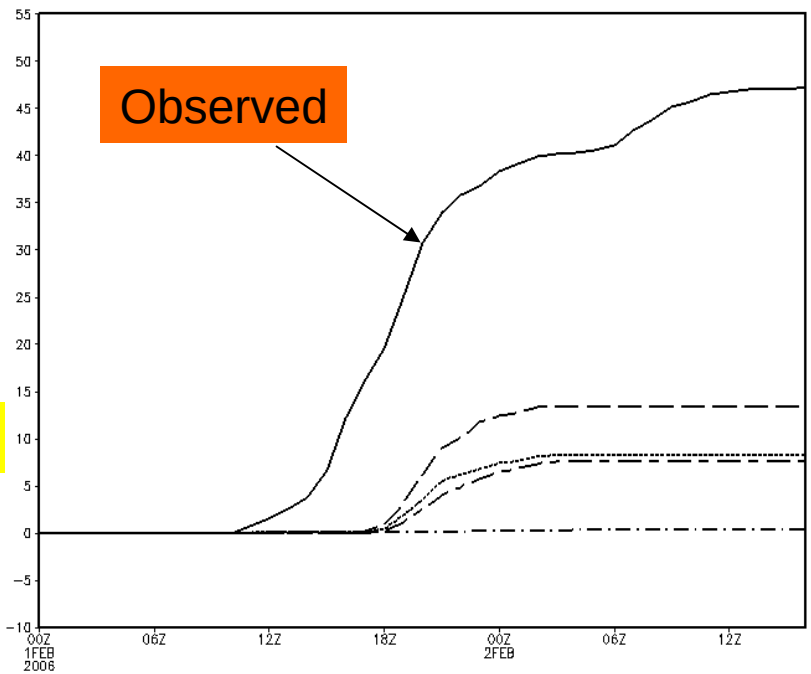
CZD BRIGHT BAND AND NONBRIGHT BAND PRECIPITATION ACCUMULATIONS

BRIGHT BAND



12302005

NONBRIGHT BAND



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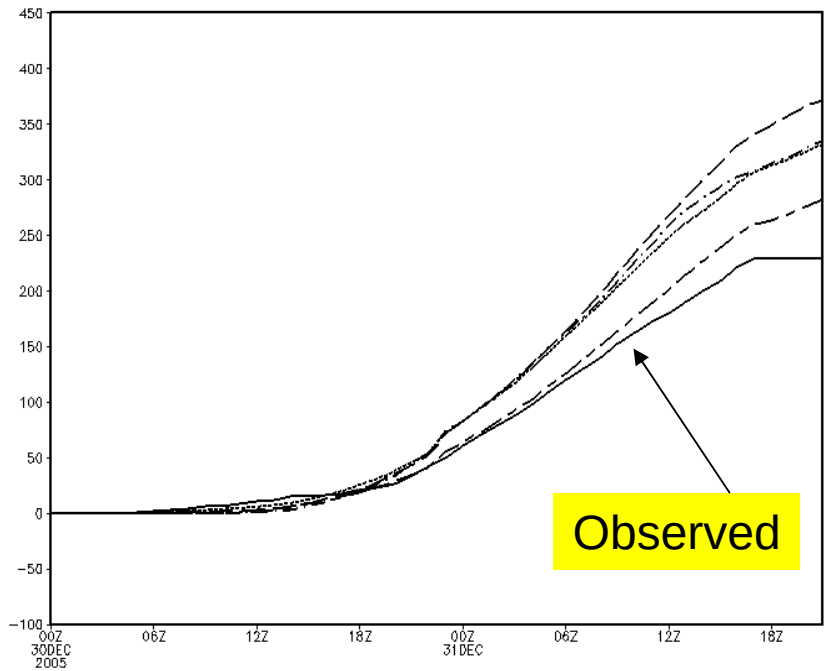
BRIGHT BAND AND NON-BRIGHT BAND ACCUMULATIONS AT ATA

BRIGHTBAND



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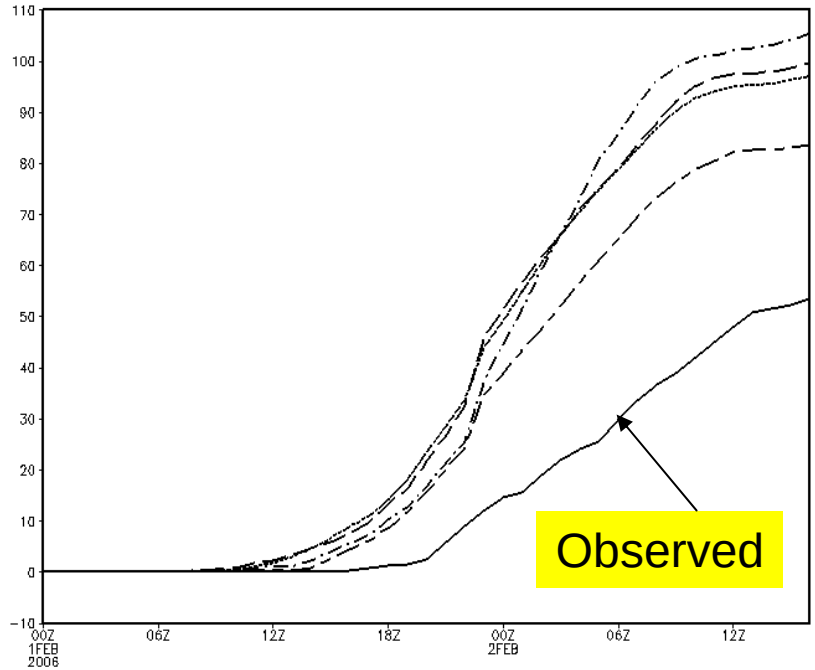
NONBRIGHTBAND



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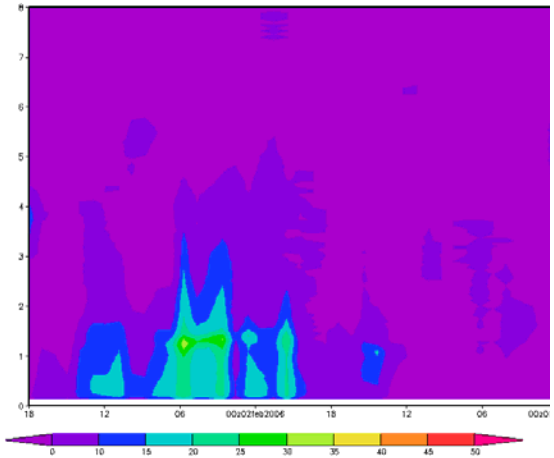
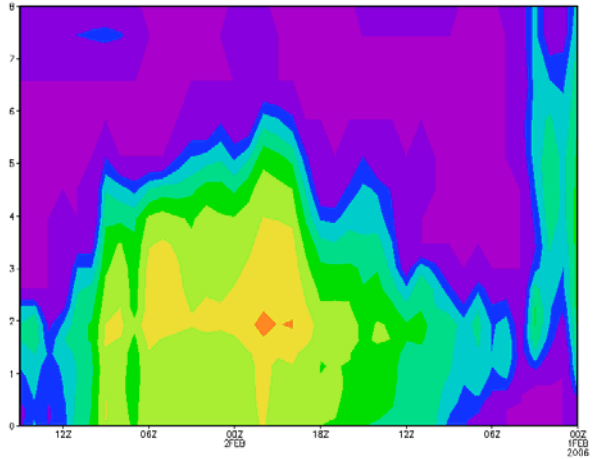
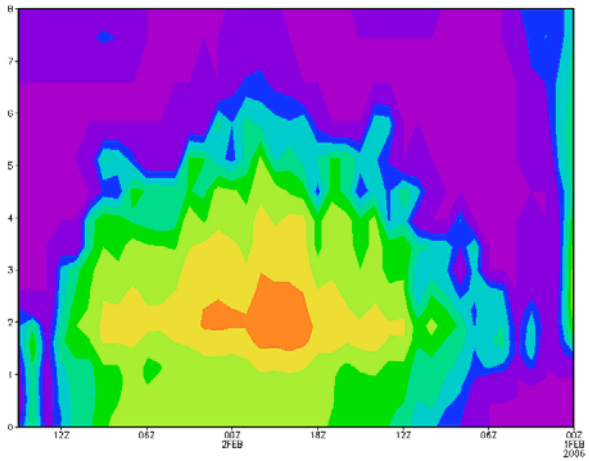
ATA 02012006 NBB RADAR REFLECTIVITY



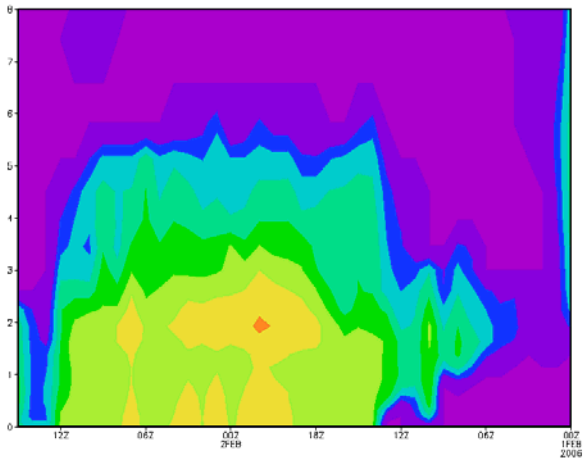
Observed



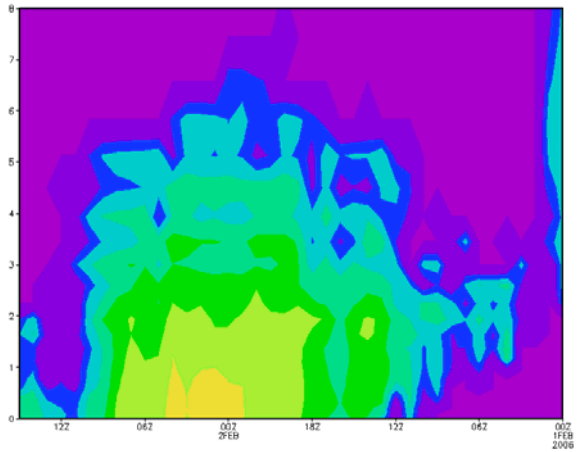
Lin



WSM6

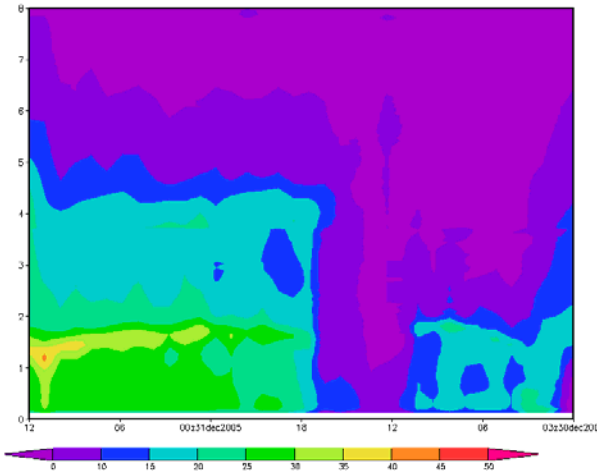


Thompson

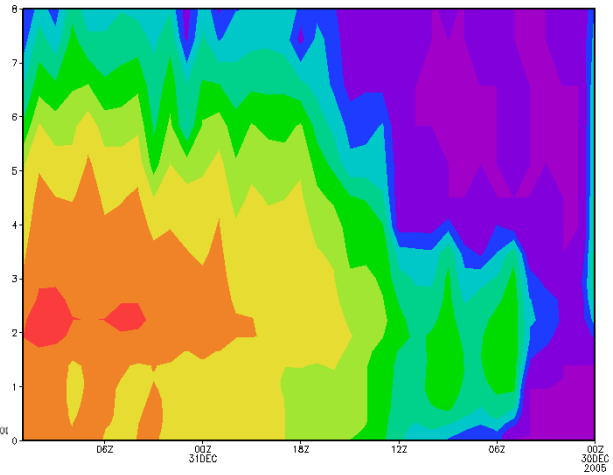


Schultz

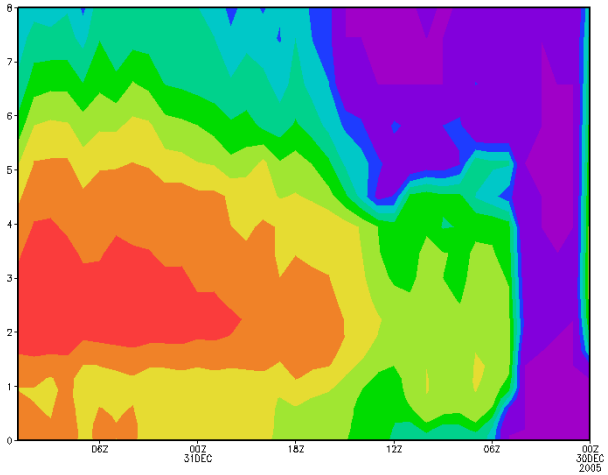
ATA 12302005 BB RADAR REFLECTIVITY



Observed



Lin



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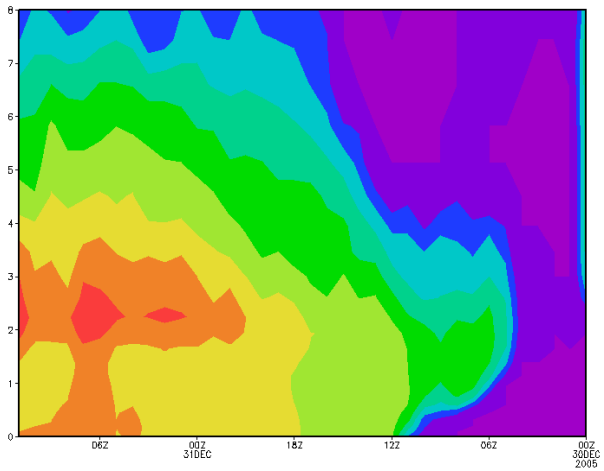
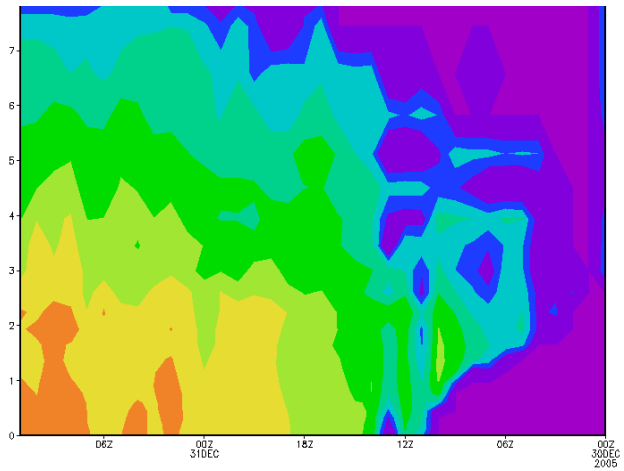


Thompson



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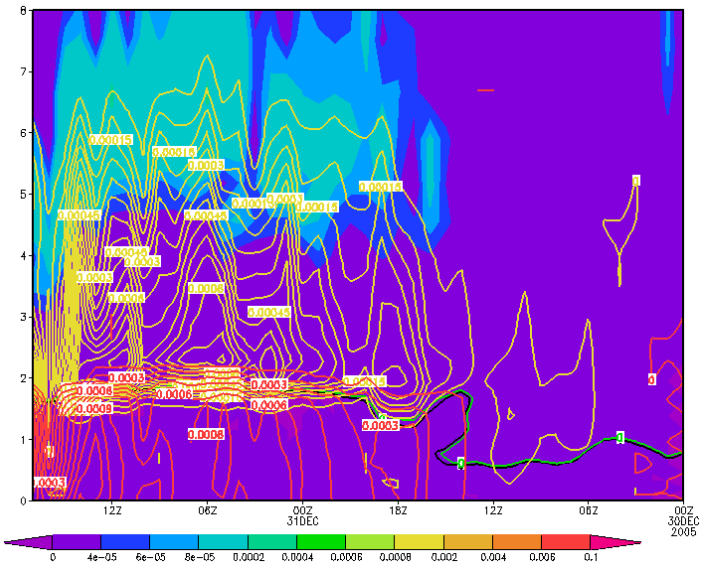
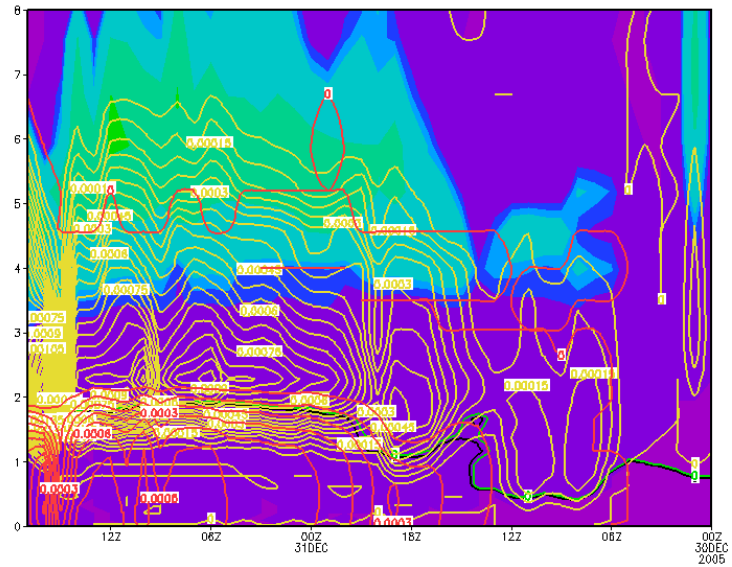
QSNOW+QRAIN+QGRAUPEL+ 0°C temp. and wet-bulb temp ATA 12302005

Lin





WSM6

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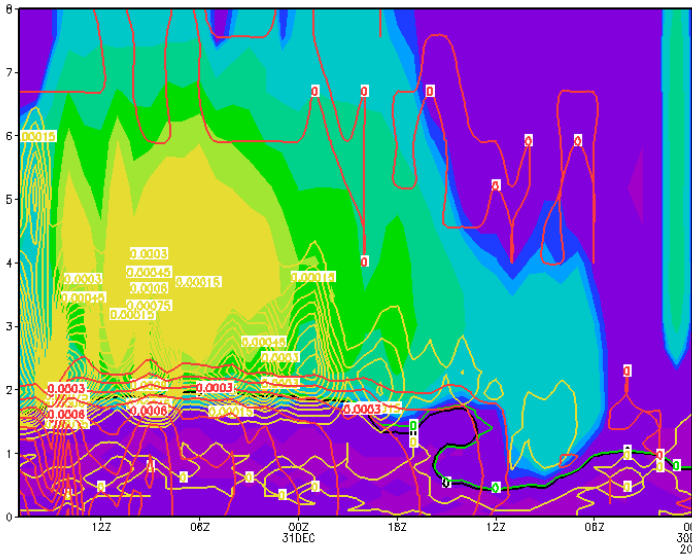

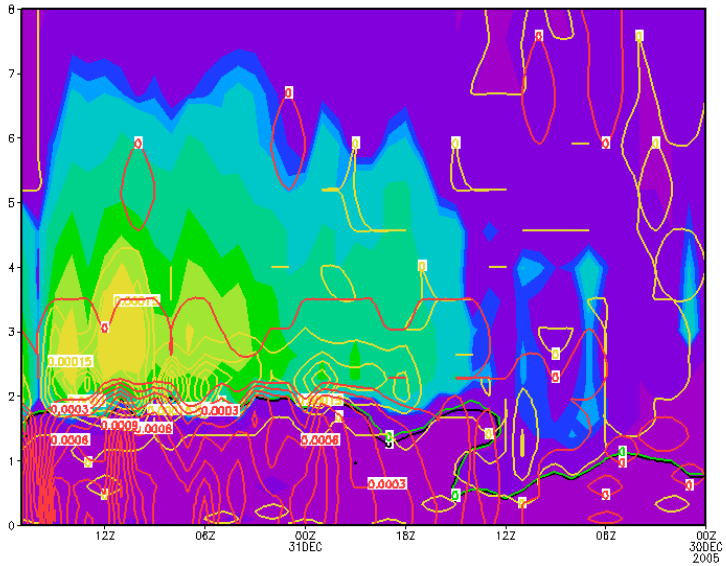

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HYPOTHESES

1. Hypothesis: Underestimation of precipitation for NBB cases at CZD by all models and consequently large overestimation of precipitations upstream (at ATA) may be related to the fact that the microphysical schemes are adjusted for continental masses.

Schultz
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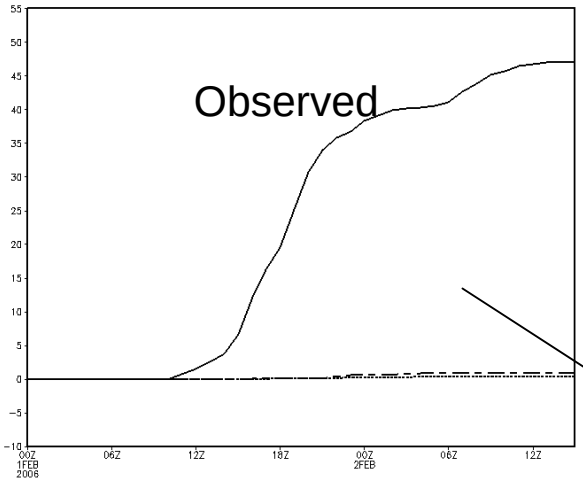
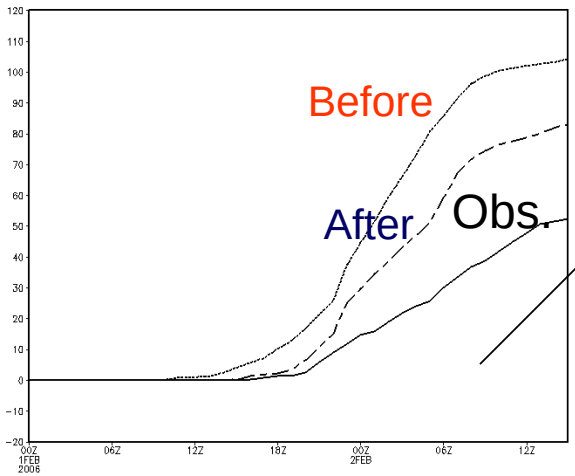
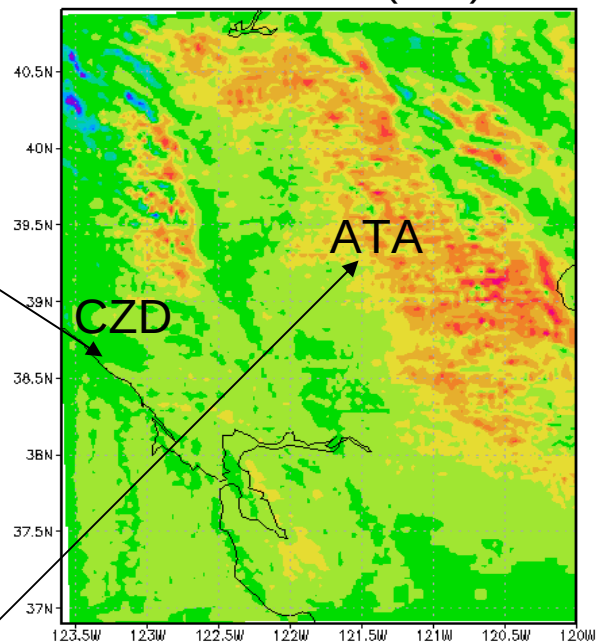
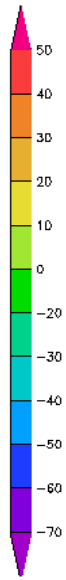
42h simulation





Precipitation accumulation
Before-After (mm)

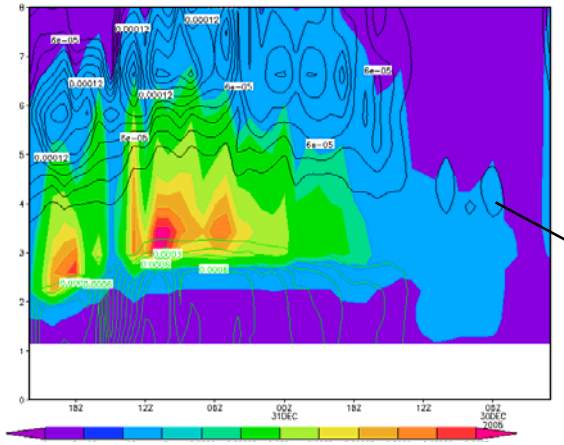


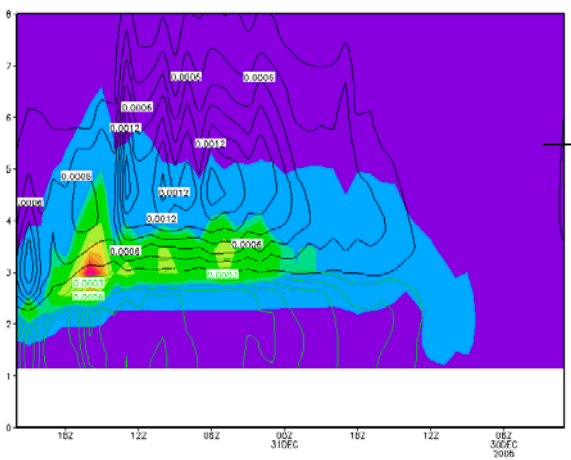


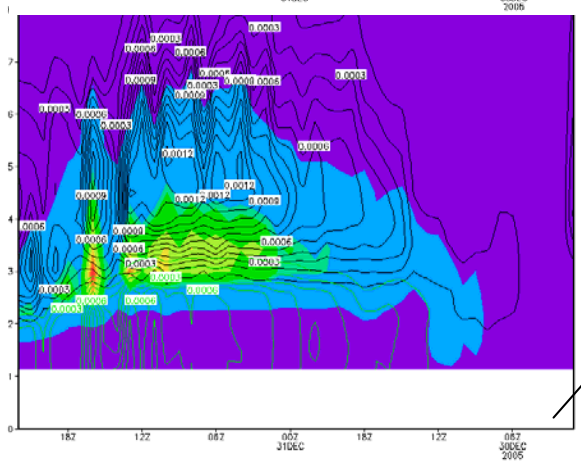
2. Hypothesis:
Precipitation overestimation may be related to the Lin scheme being too efficient in graupel formation.

Accretion of snow by graupel = 0.

ACS + autoconversion of snow to graupel reduced







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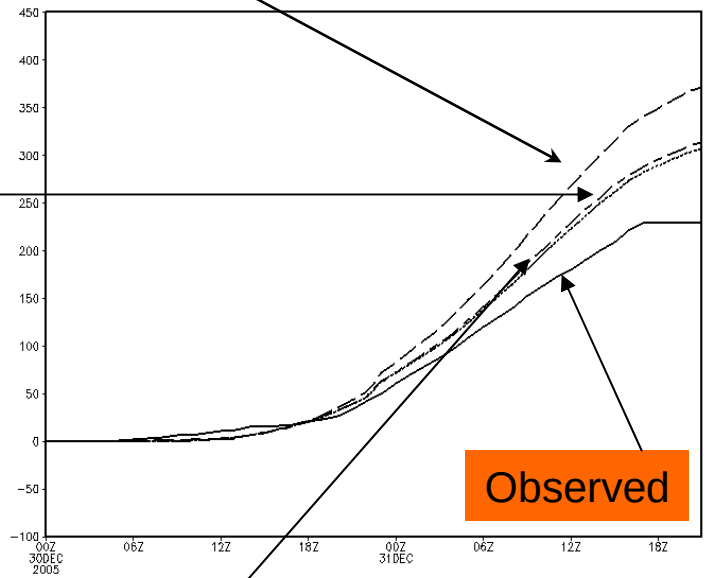

SUMMARY

• For the events characterized by “atmospheric rivers” setting simulated precipitation amounts indicated high sensitivity to: precipitation type (BB vs. NBB), verifying location and the choice of microphysical scheme.

• Simulated reflectivity was highly influenced by the choice of the microphysical scheme (possible related to differences in partition of water substance between the schemes).

• Future work will be on an improvement of the non-convective precipitation accuracy by objective estimation of the individual contributions of parameterized processes which lead toward generation and depletion of the bulk hydrometeor quantities.

ACKNOWLEDMENTS

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