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WRF-SBM-MOSAIC Simulations of a Deep Convective Cloud Case over the Houston area

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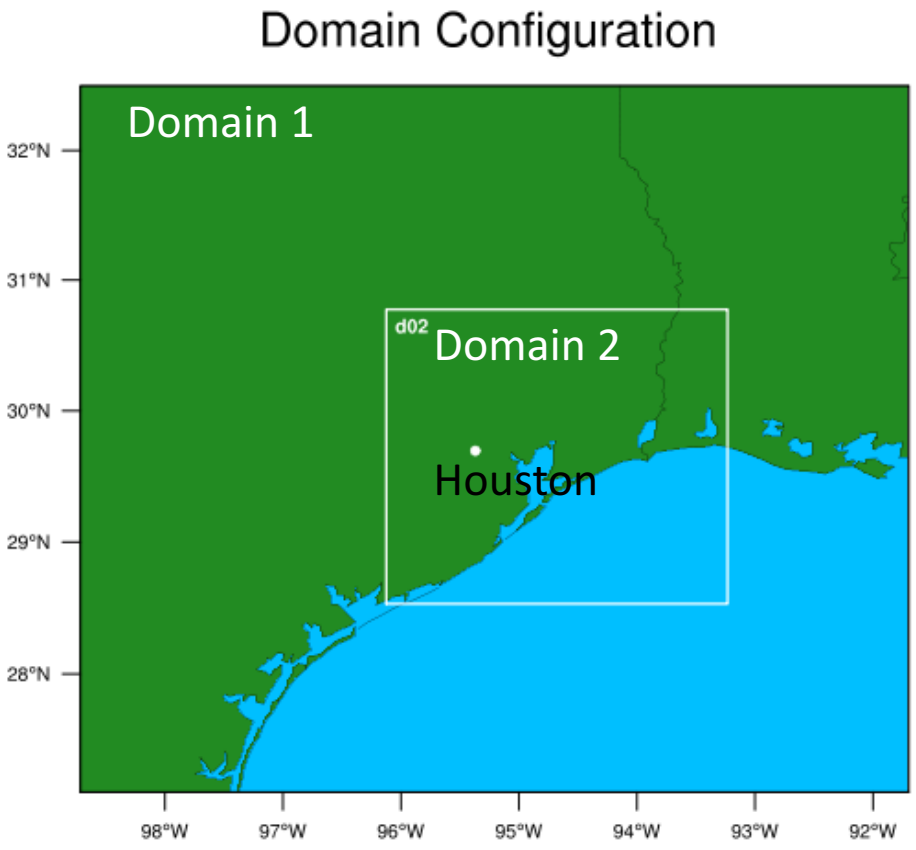
Introduction

- To understand aerosol properties at different scenarios over the Houston area: (a) urban polluted, (b) clean continental, and (c) maritime
- To examine how convective and cloud properties are different under the influences of the three aerosol scenarios.
- To demonstrate if Houston is an ideal location for exploring and quantifying aerosol- DCC interactions
- A simulation for virtual field campaign to design the real field campaign (optimize and prioritize observations)

Model Experiments



D01:

Regular WRF-Chem with Morrison microphysics:

- 2-km resolution 353×301×51 grids.
- Meteorological IC/BC: Merra2
- Chemistry IC/BC: global WRF-Chem
- Emission:

✓ Anthropogenic : NEI 2011

✓ Biogenic : MEGAN

✓ Biomass burning: FINN

- Initial time: Jun 14 00UTC

D02:

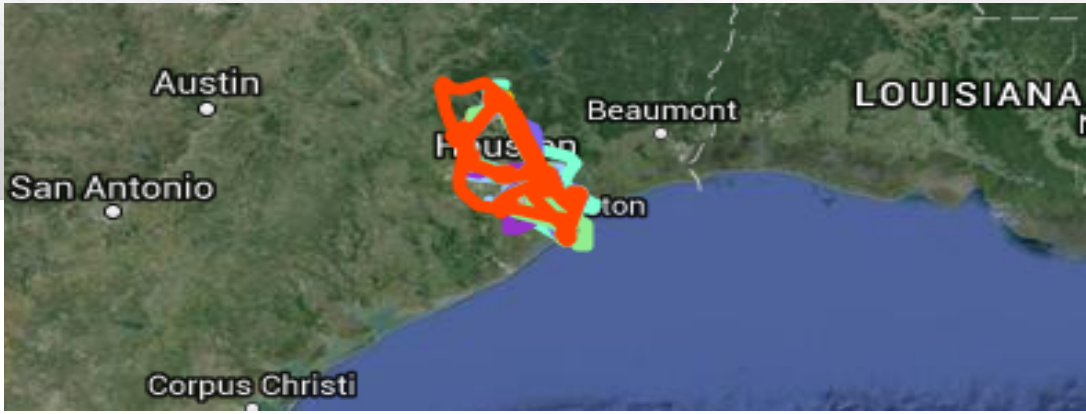
WRF-MOSAIC-SBM simulation with aerosols/gas species interpolated from D01 (hourly interpolation):

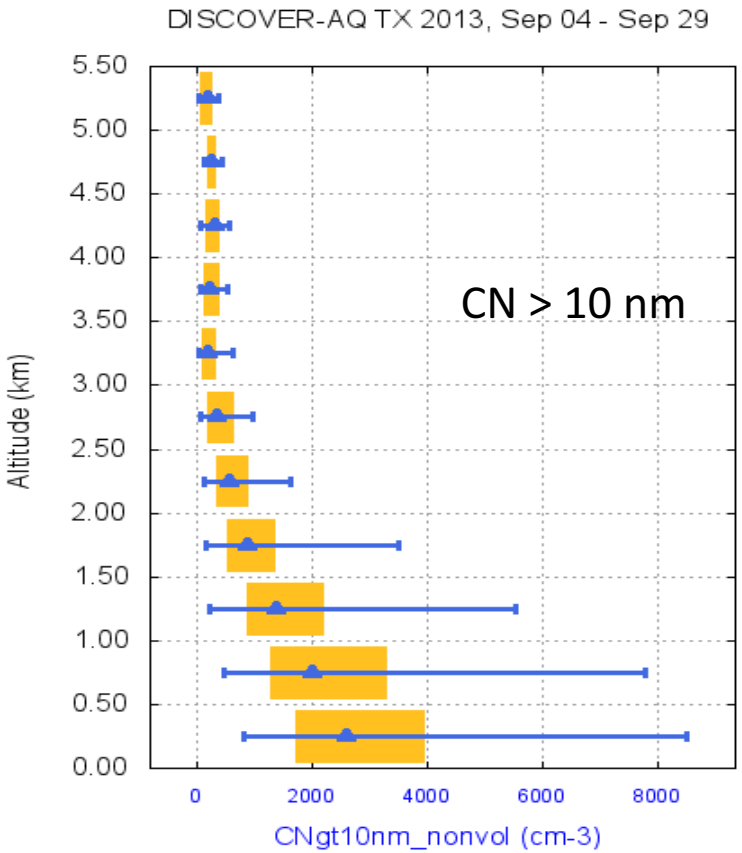
- 0.5-km resolution(501×401×51)
- Meteorological IC/BC: Merra2
- Initial time: Jun 18 12UTC

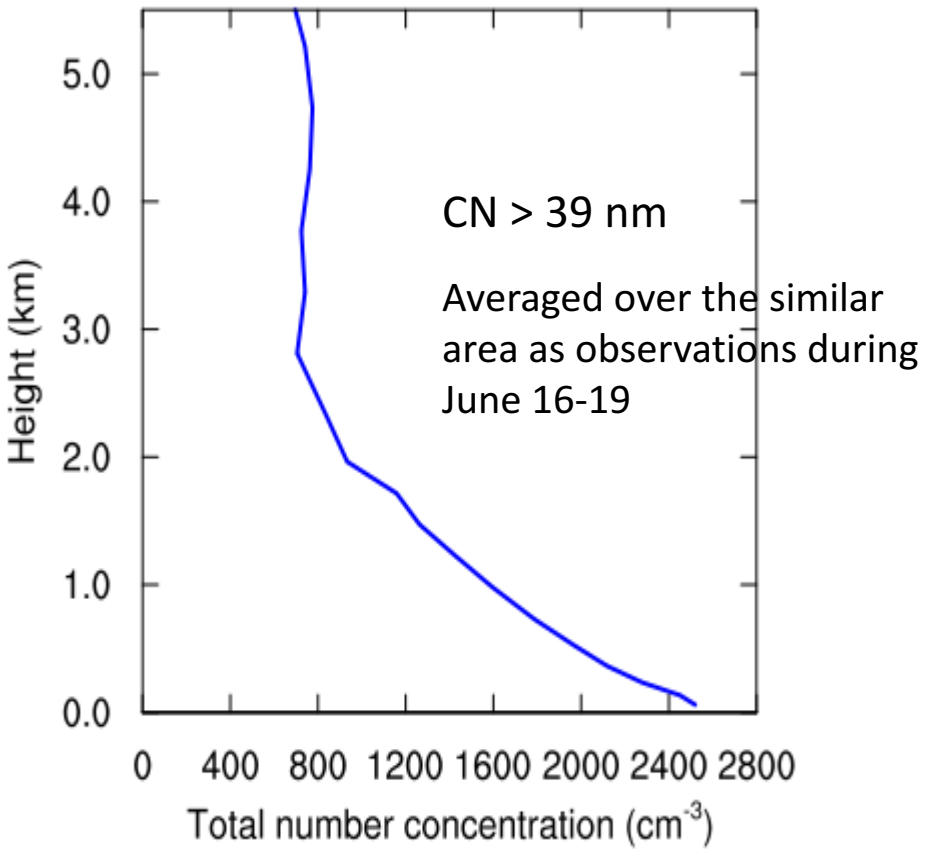
The HUCM polarimetric simulator is incorporated

Aerosol properties from WRF-Chem simulation (Domain 1)

DISCOVER-AQ TX Sep 2013

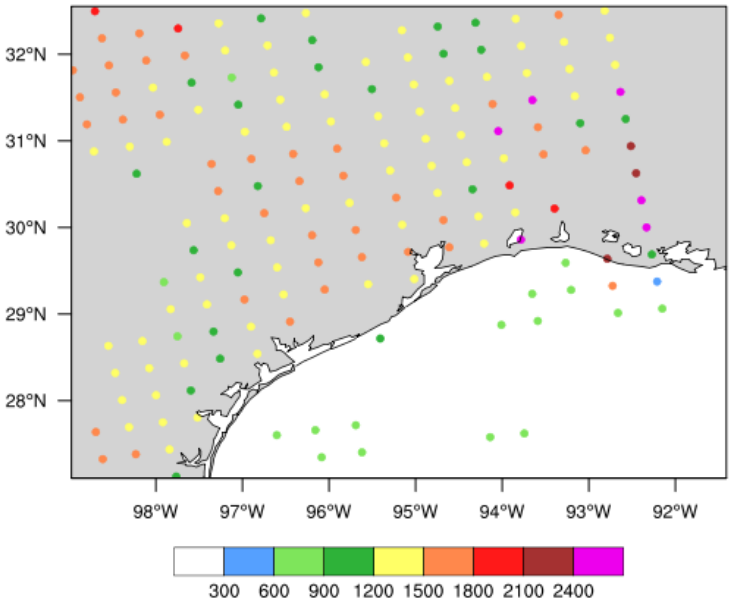




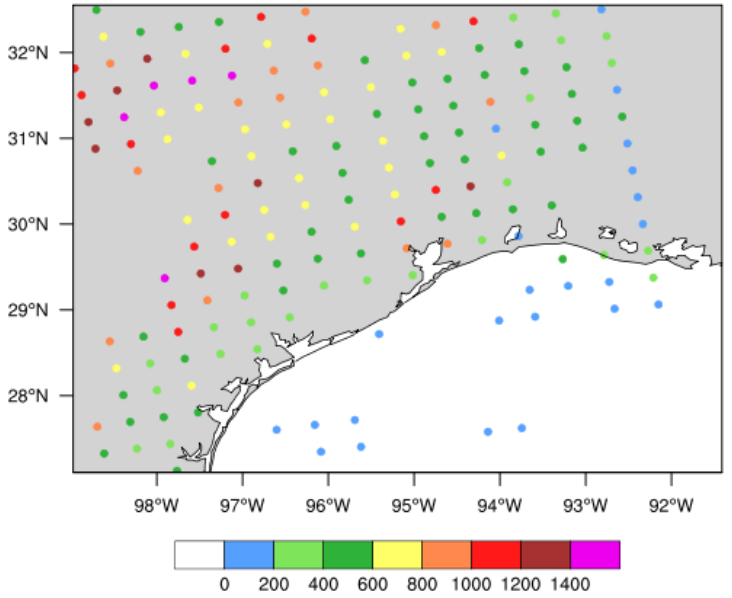


Satellite retrieval (19:43)

Cloud base height (m)



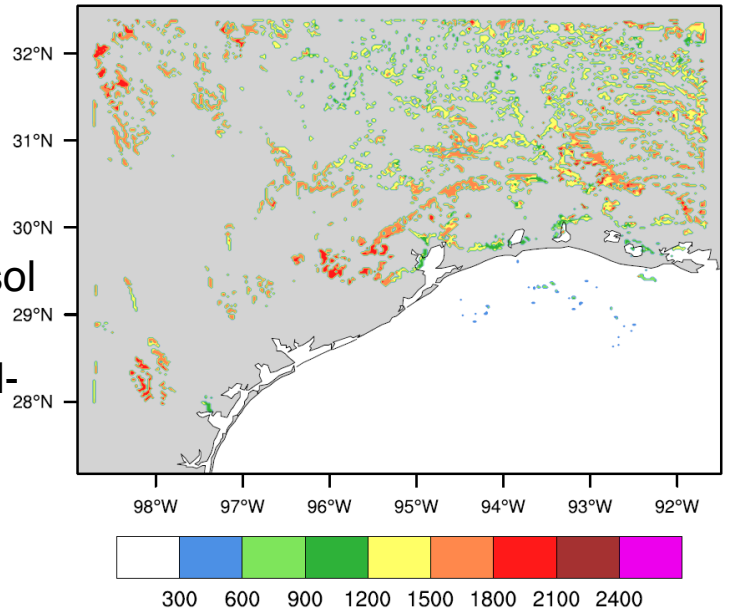
CCN at cloud base (cm^{-3})



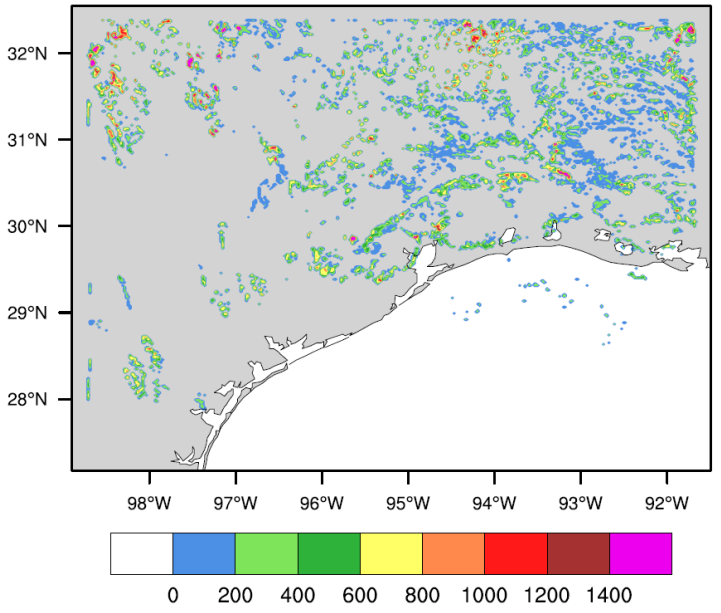
WRF-Chem (20:00)

Note that aerosol activation is based on Abdul-Razzak and Ghan, 2002.

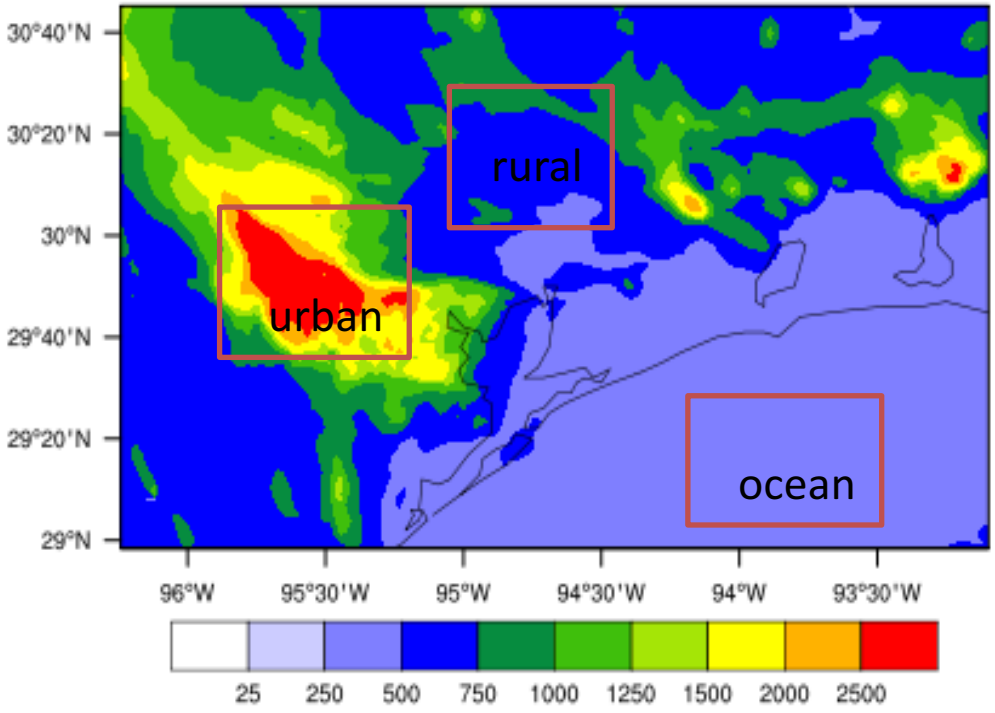
Cloud base height (m)



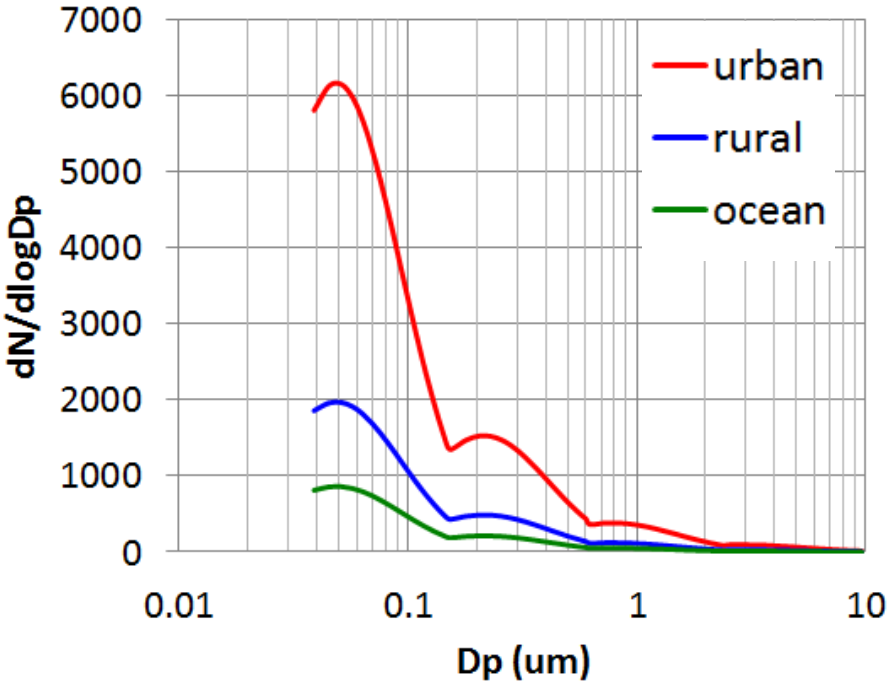
Nc (cm^{-3}) at cloud base



Three aerosol scenarios



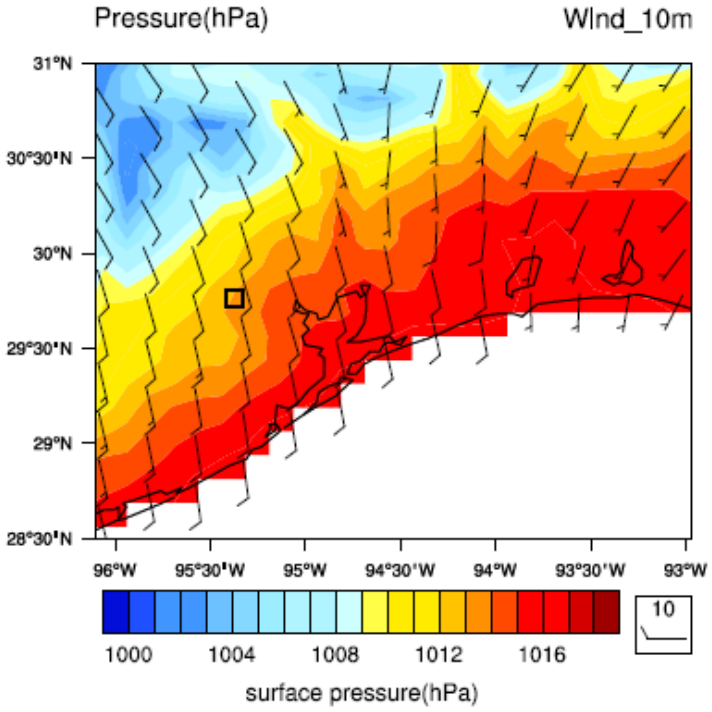
Averaged over June 19



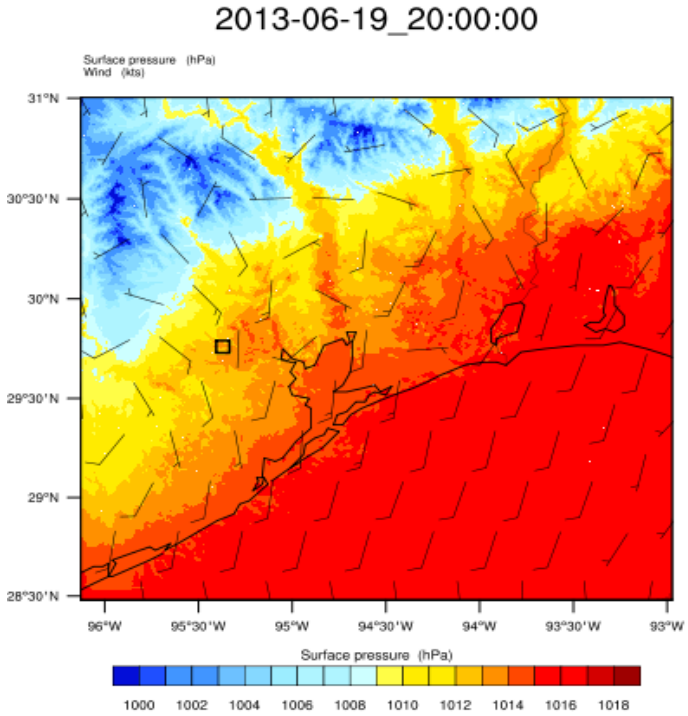
Evaluation of WRF-SBM-MOSAIC simulation (Domain 2)

Surface pressure and 10m wind

NLDAS 2013-06-19_20:00:00



WRF-MOSAIC-SBM



Radar Reflectivity at 2.5 km 06-19-21:00

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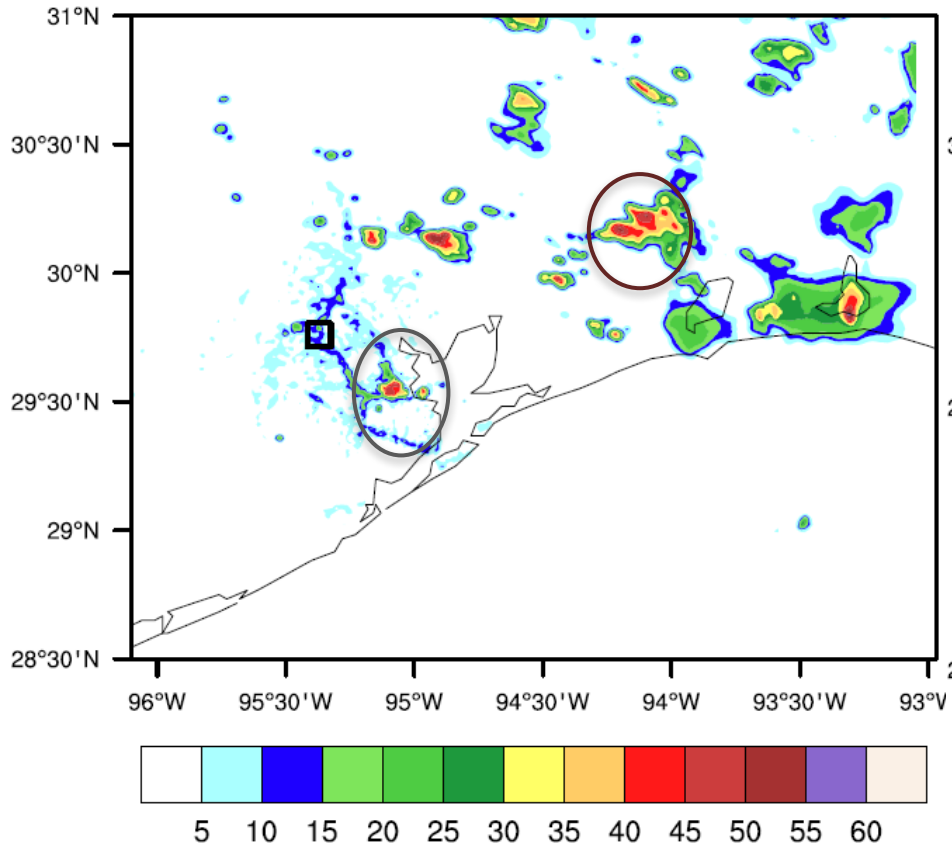
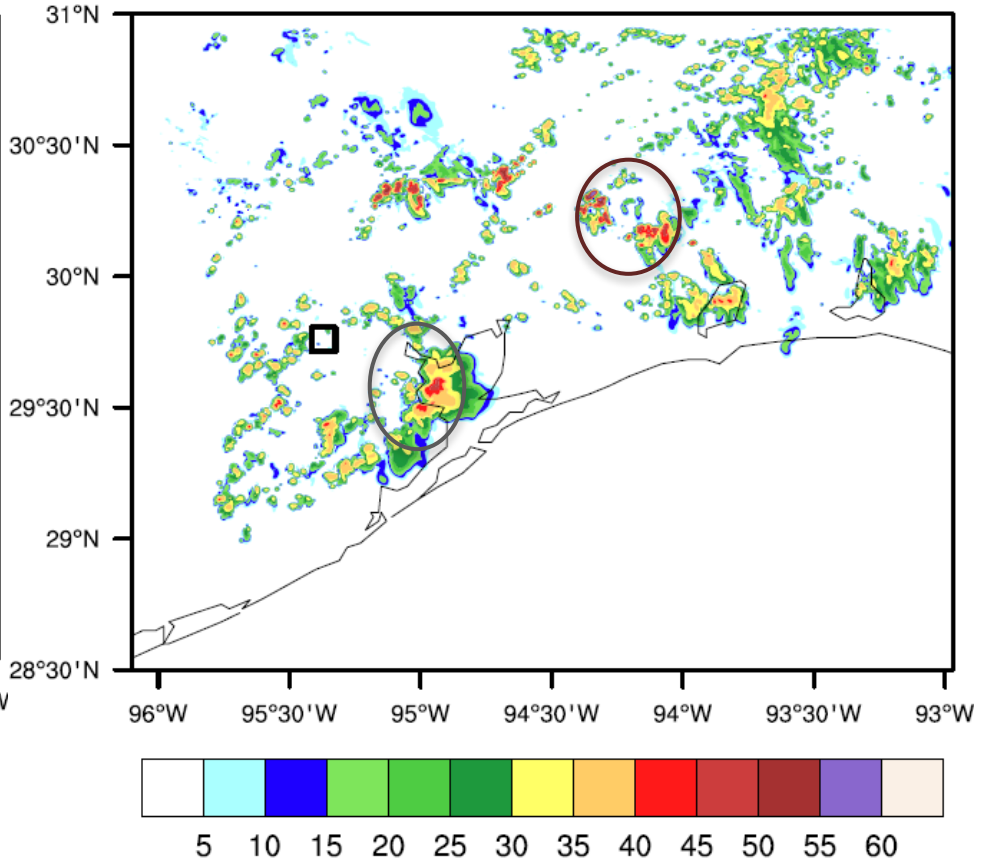
NEXRAD

2013-06-19_21:00:00



WRF-MOSAIC-SBM



Radar Reflectivity at 2.5 km 06-19-22:00 when rain rate peaks

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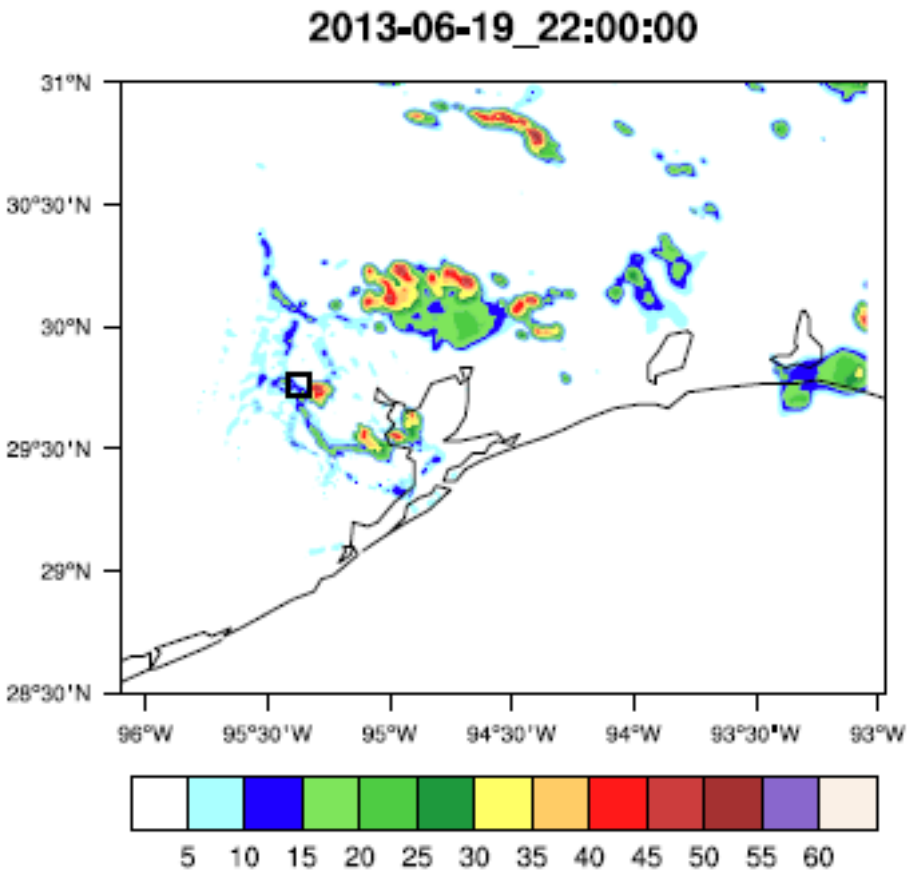
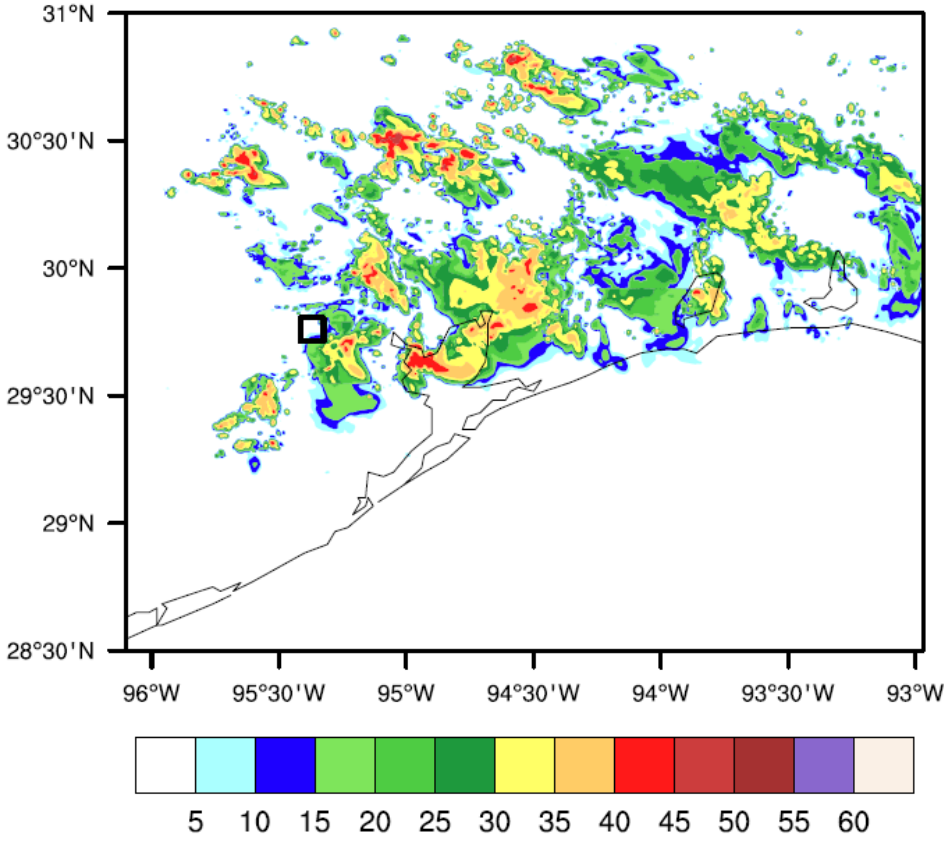
NEXRAD



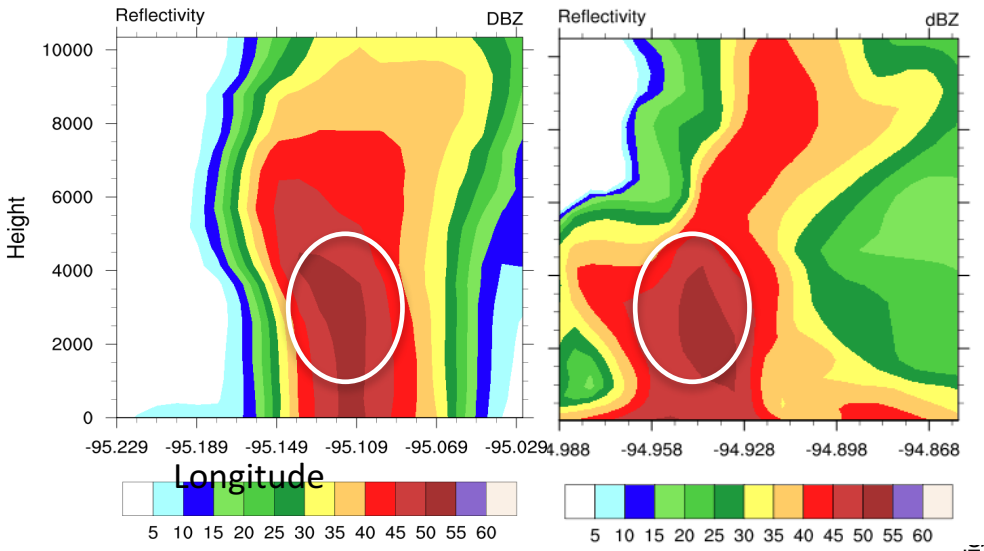
WRF-MOSAIC-SBM



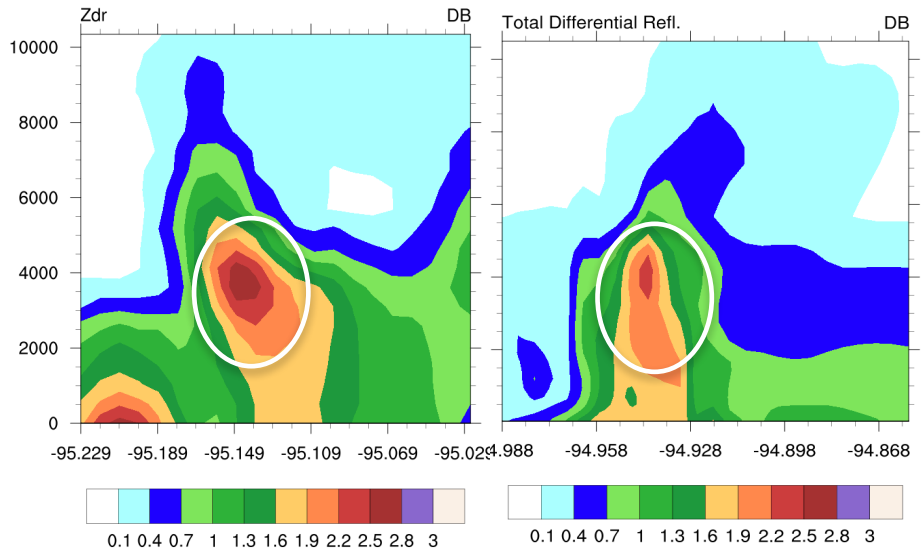
West-East cross section at the largest radar reflectivity (Ze) for convection around Houston at 06-20-21:00

Ze

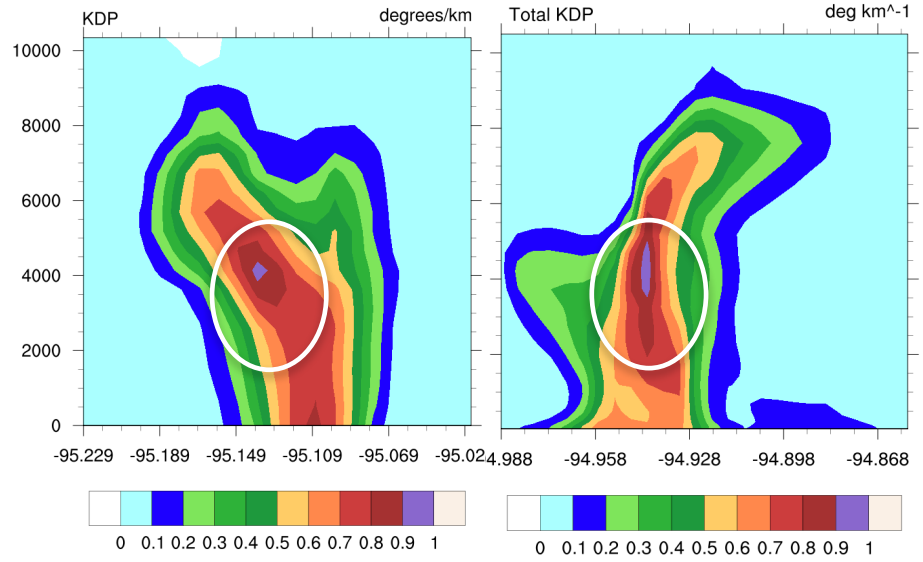
NEXRAD **WRF-MOSAIC-SBM**



ZDR **NEXRAD** **WRF-MOSAIC-SBM**



KDP



- The large rain drops at low-levels are well simulated.
- Above 6-km, model simulates similar ZDR and KDP as observations, indicating model may gets hydrometeor types well, but higher Ze indicates ice particles size may be overestimated.

Follow-on work

- Convection and precipitation seem too strong. Try different large-scale forcing.
- Conduct sensitivity tests by reducing anthropogenic emissions to examine the susceptibility of clouds to aerosols at the Houston area

Discussion

- Effect over a long time?
- Purpose of the Houston field campaign
- Virtual field campaign in model simulations to design the field campaign and prioritize measurements (like the pilot study we proposed?).