Wet Scavenging of Soluble Species in Deep Convective Clouds

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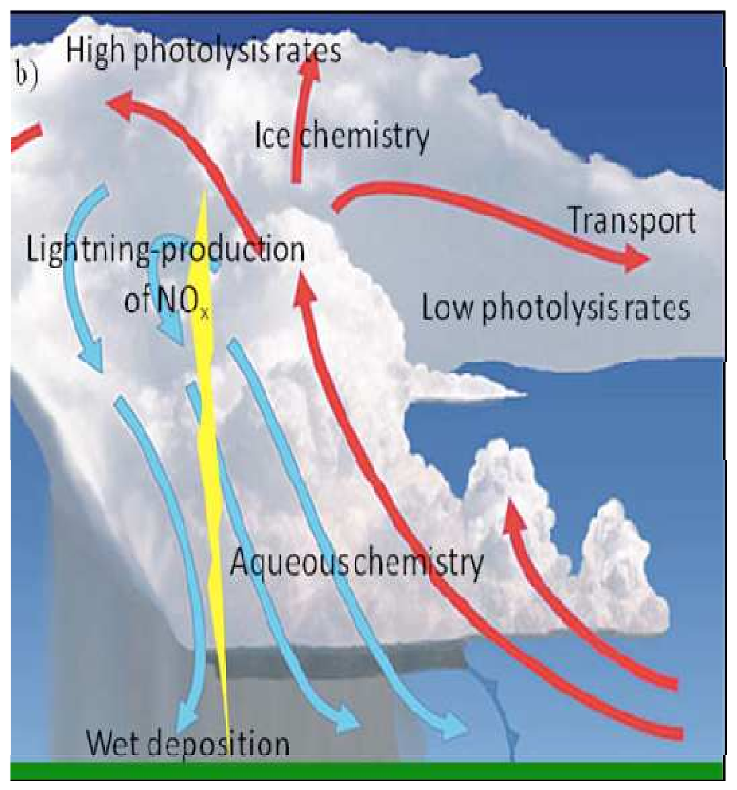
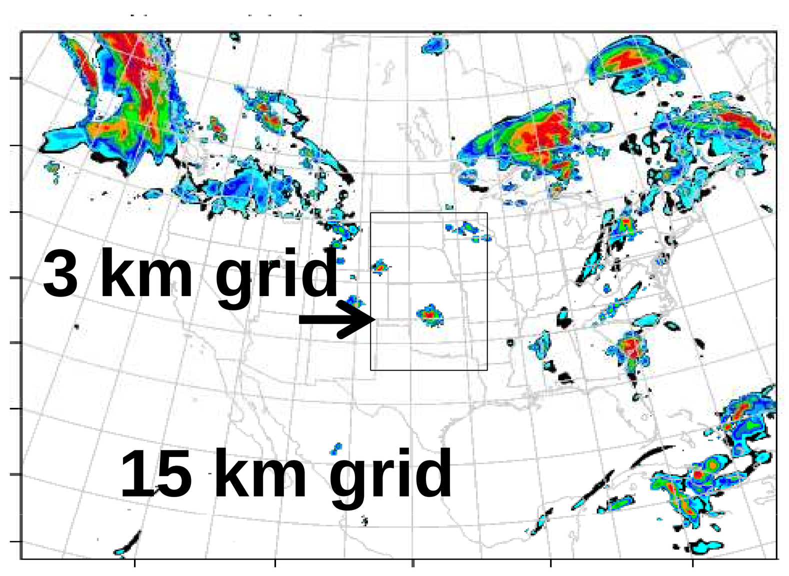
Background

Convective transport of HO_x precursors controls upper troposphere O_3 production. Measurements in storm inflow and outflow during the Deep Convective Cloud Chemistry (DC3) Field Experiment (central and southeast US, May-June 2012) will help improve representation of chemistry and scavenging of soluble species in regional models.



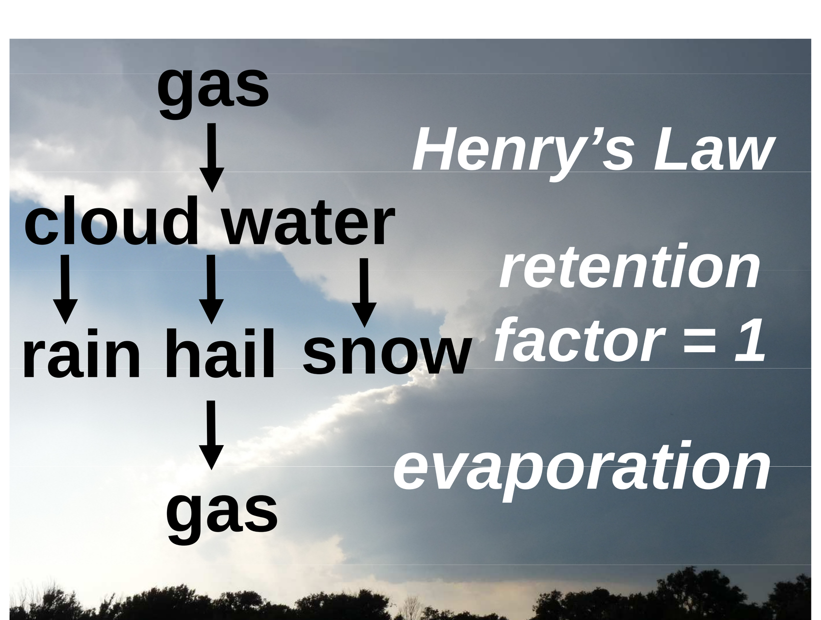
WRF-Chem Simulations

Cloud-resolving (3km) simulations with the WRF-Chem meteorology-chemistry model are used to answer: *What fractions of species of varying solubility in storm inflow are scavenged by hydrometeors?*



3 km grid configuration
Morrison cloud physics
MYJ PBL scheme
MOZART gas chemistry
GOCART aerosol scheme
No lightning NO_x sources

Wet Scavenging in the WRF-Chem Model



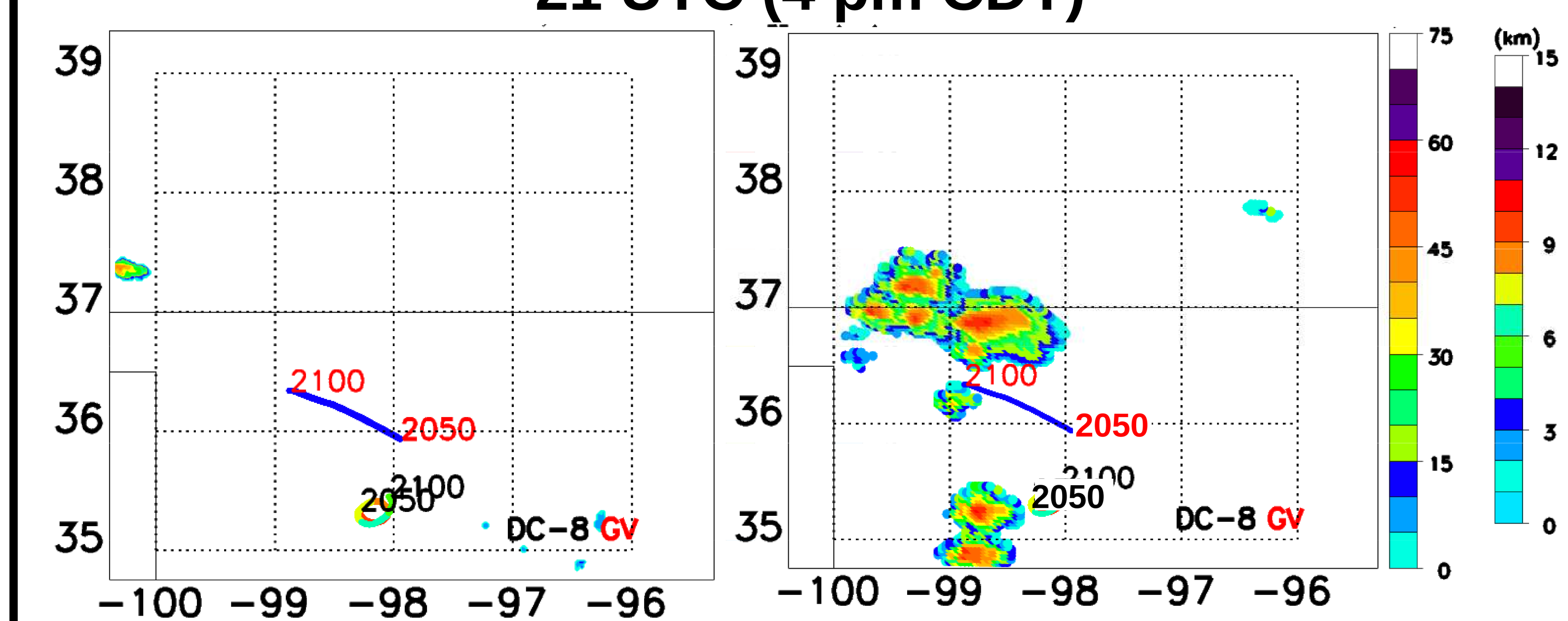
WRF-Chem wet scavenging scheme does not include release of trace gases to gas phase when droplets freeze

Observed and Simulated Storm Structure

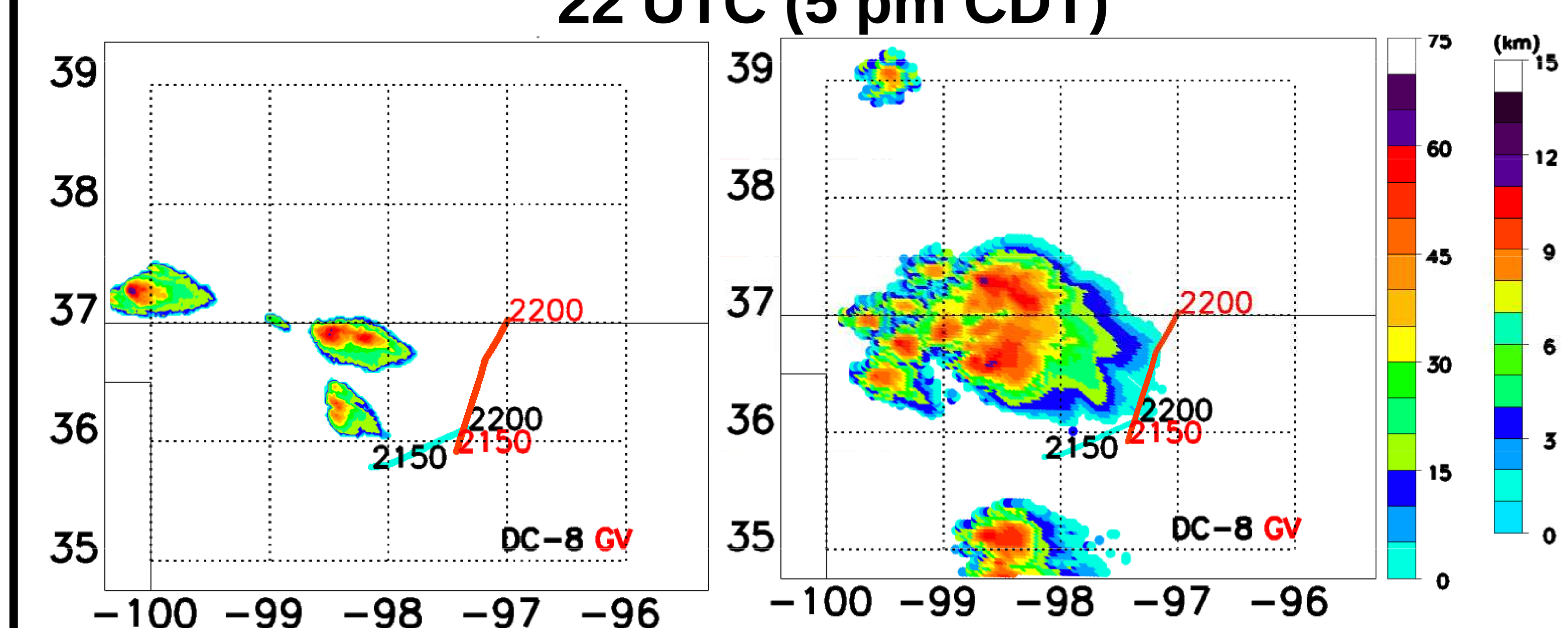
Structure and location of May 29, 2012 Oklahoma storm is represented by model, but triggers early and grows too large

Observed Max. Reflectivity (NEXRAD) | **WRF-Chem Max. Reflectivity**

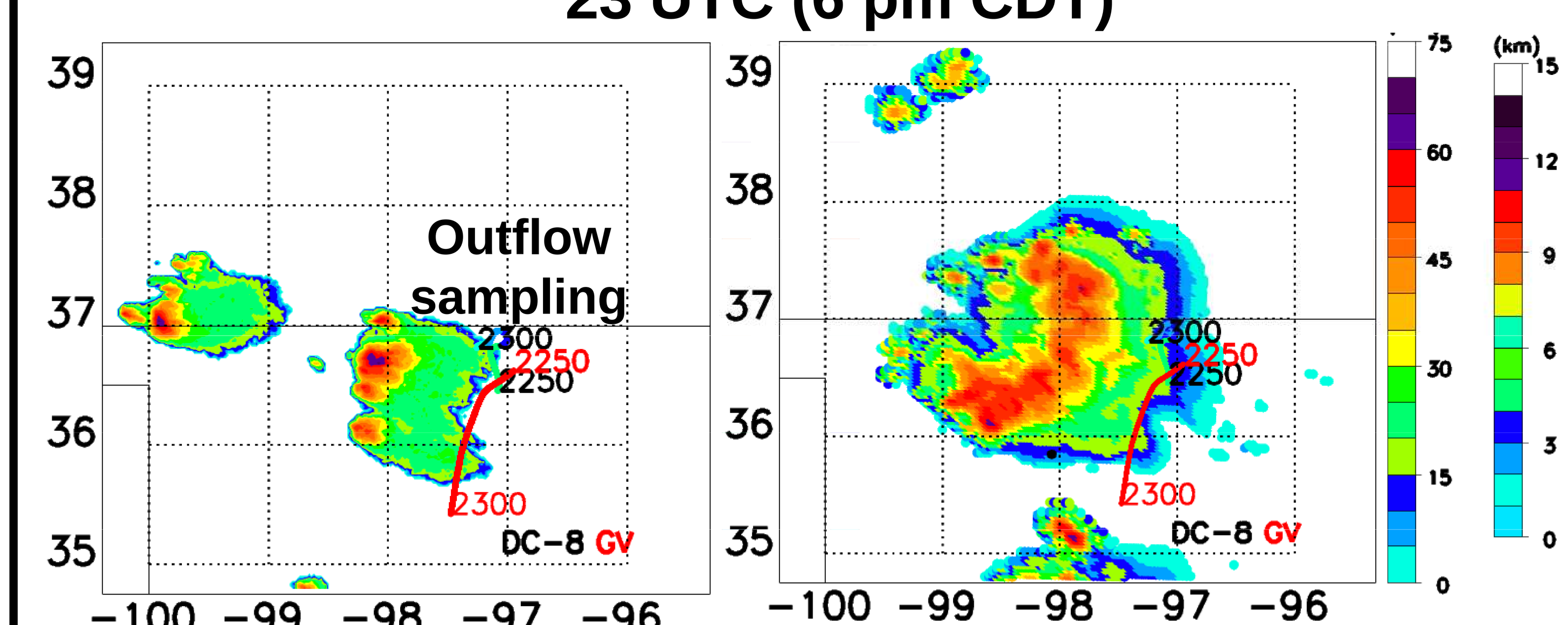
21 UTC (4 pm CDT)



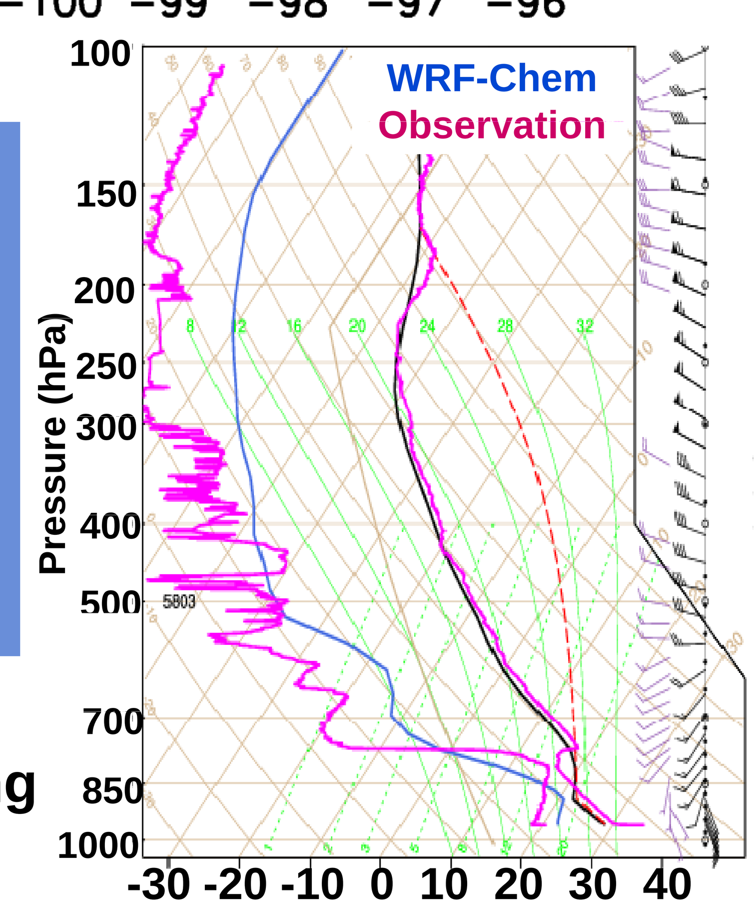
22 UTC (5 pm CDT)



23 UTC (6 pm CDT)



Early and fast-growing convection could be due to an overly moist PBL in WRF-Chem, as shown by comparison with pre-storm soundings

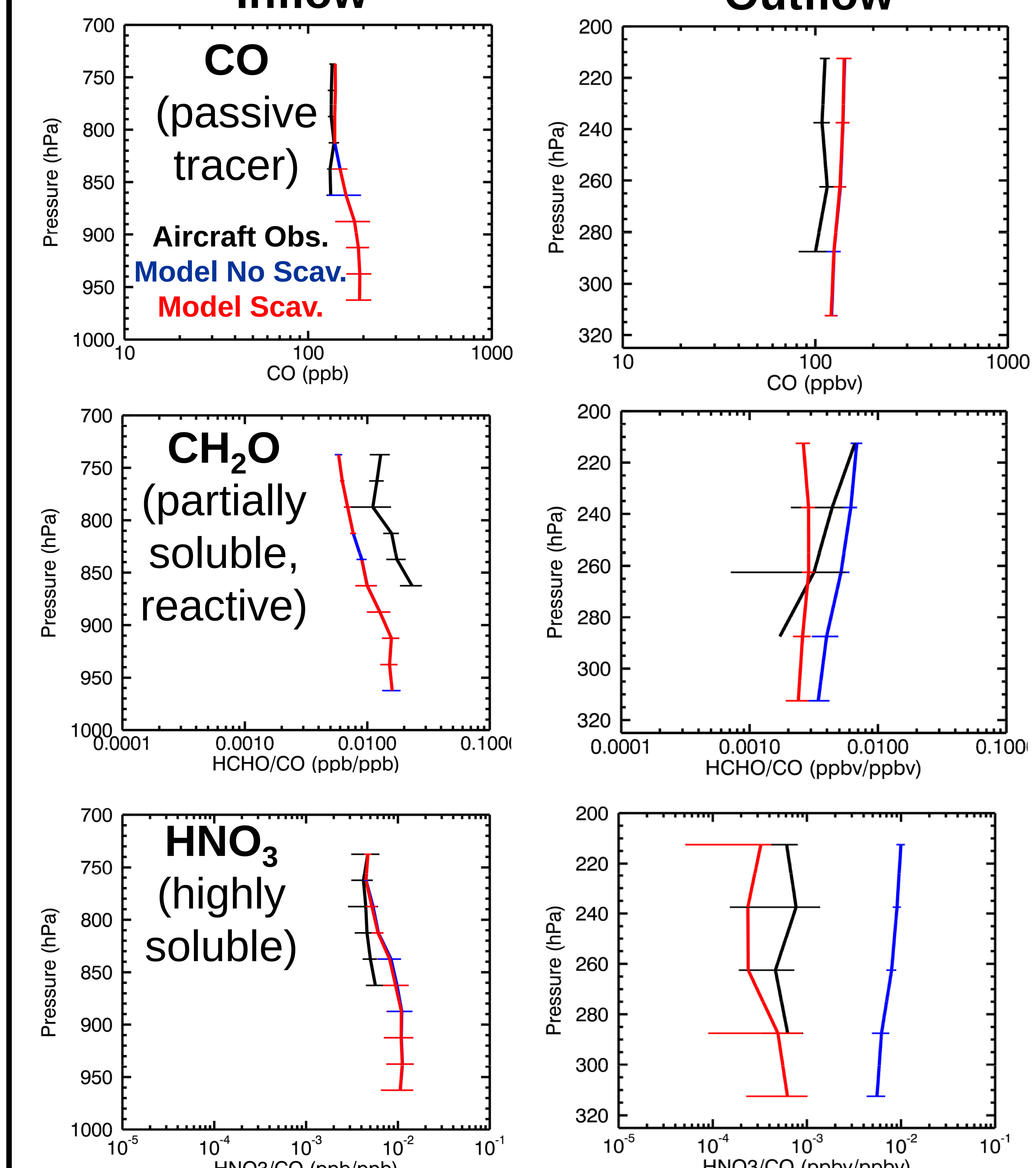


Pre-Storm NESSL Sounding
35.67°N, 98.34W
May 29 20Z (3pm CDT)

Comparison of WRF-Chem to Observations

Inflow: fairly well represented by WRF-Chem, although CH_2O is underpredicted by ~30%
Outflow: CO is overpredicted by ~25%
Mixing ratios of soluble species in outflow are lower than observed, suggesting not fully retained in ice

Inflow | **Outflow**



Outflow only: ratios to (CO - 25 ppb)

Conclusions

- **WRF-Chem simulation represents dynamic/chemical characteristics of DC3 thunderstorm, including scavenging of soluble species**
- **Comparison of model to observations suggest soluble species are overly scavenged in model; this may be because ice degassing not included in model**
- **Future work will add a wet scavenging scheme that includes ice degassing and tracks dissolved species in individual hydrometeor types**