P43. Sensitivity of Simulated Convection-Driven Stratosphere-Troposphere Exchange in WRF-Chem to the Choice of Physical and Chemical Parameterization

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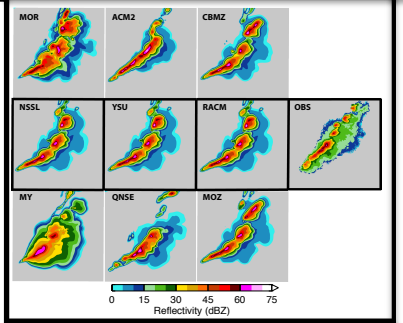
Introduction

- Tropopause-penetrating convection is capable of rapidly transporting air from the lower troposphere to the upper troposphere and lower stratosphere (UTLS), where it can have important impacts on chemistry, the radiative budget, and climate.
- Obtaining in situ measurements of convection and convective transport is difficult and such observations are historically rare. Modeling studies, on the other hand, offer the advantage of providing output related to the physical, dynamical, and chemical characteristics of storms and their environments at fine spatial and temporal scales.
- Since the characteristics of simulated convection depend on the chosen model design, we examine the sensitivity of simulated convective transport to the choice of physical (bulk microphysics or BMP and planetary boundary layer or PBL) and chemical parameterizations in the Weather Research and Forecasting model coupled with Chemistry

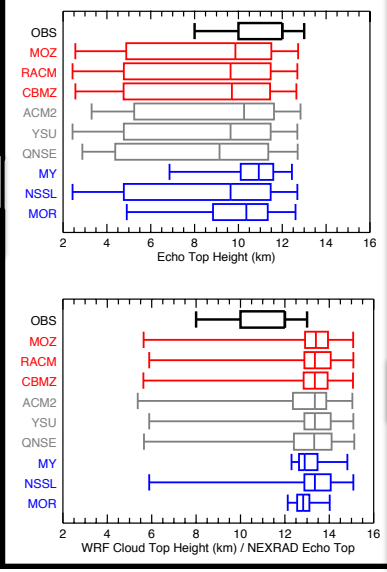
Cases and Parameterizations

- Three cases where in situ observations are available from the DC3 field campaign:
  - **19-20 May 2012 (shown here)**
  - 29-30 May 2012
  - 1-2 June 2012
- 3 Bulk Microphysics Parameterizations, Planetary Boundary Layer Parameterizations, and Chemical Mechanisms were evaluated:
  - **BMP**: NSSL 2-mom, Morrison 2-mom, and Milbrandt and Yau 2-mom
  - **PBL**: YSU, QNSE, and ACM2
  - **Chemical Mechanisms**: RACM/VBS/SOA, CBMZ/MOSAIC 4-bin, and MOZCART

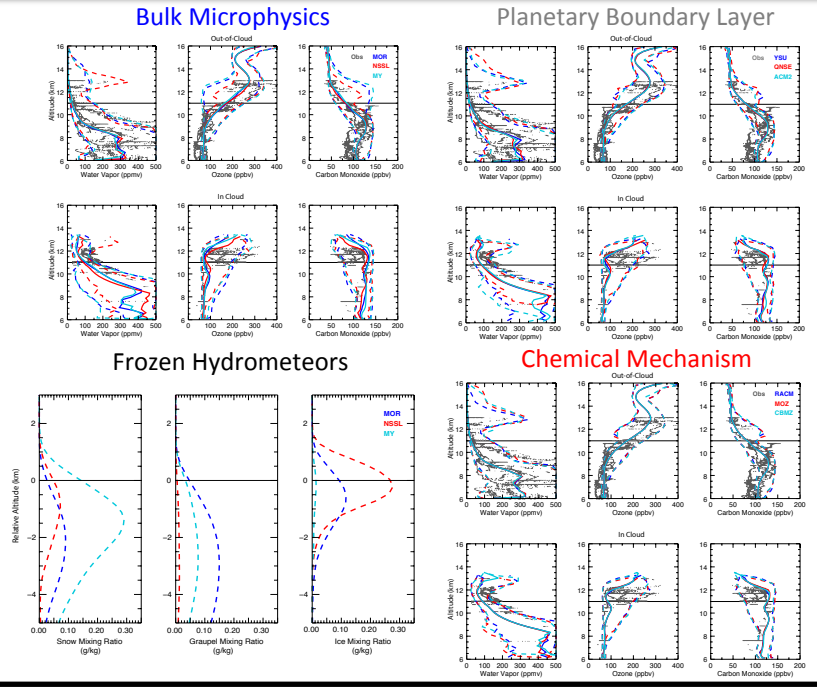
Comparisons of Storms



Box and Whisker Plots of 5 dBZ Echo Top and Cloud Top



Vertical Profiles of Trace Gases* and Hydrometeors^



*Dashed lines show the minimum and maximum trace gas profile while solid lines show the mean profile. The gray dots show the aircraft observations. Profiles are calculated for points within cloud and outside of cloud.
^Profiles of mean frozen hydrometeor concentrations show highest concentrations of ice with the NSSL BMP, resulting in the highest concentrations of water vapor injected into the stratosphere.

Summary

WRF-Chem simulations were most sensitive to choice in BMP. There is measurable sensitivity of the organization, vertical extent of convection, and injection of water into the stratosphere. NSSL 2-moment BMP provided the best results among BMPs. There was little sensitivity to choice in PBL parameterization and chemical mechanism. This work has been published in *Earth and Space Science*, doi: 10.1002/2017EA000287