

# Porting CAM Physics Packages to WRF

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- ▶ Why are we doing this?
  - There has historically been a “disconnect” between the Global and regional modeling communities
  - Regional Climate Modelers use different parameterizations
    - Sometimes better, sometimes worse: when, why?
    - Do global parameterizations break down at high resolution?
    - How do they compare?
- ▶ Most straightforward evaluation uses a common dynamical core with mesh refinement
- ▶ Alternate approach moves CAM parameterization to WRF
  - Much experience and knowledge, many tools for study at regional and cloud scale in WRF

# CAM - the Atmospheric Component of CCSM/CESM

Model Component	CCSM4 (2010)	CESM1 (Jun 2010)
Atmosphere	CAM4 (L26)	CAM5 (L30)
Boundary Turbulence	g-Boville	Bretherton-Park (09) Moist Turbulence
Shallow Convection	ack	Park-Bretherton (09) Shallow Convection
Deep Convection	McFarlane et al.(08) Rasch (08)	Zhang-McFarlane Neale et al.(08) Richter-Rasch (08)
Cloud Microphysics	g et al. Mavrus' mods.	Park-Bretherton-Rasch (10) Cloud Microphysics
Stratiform Microphysics	JK Moment	Morrison and Gettelman (08) Double Moment
Radiation	MRT	RRTMG Iacono et al.(08) / Mitchell (08)
Aerosols	AM	Modal Aerosol Model (MAM) Liu & Ghan (2009)
Dynamics	Volume	Finite Volume
Ocean	2 - BGC	POP2.2
Land	4 - CN	CLM4
Sea Ice	ICE	CICE

Done,

Almost Done

Not Done

Other Stuff/Unresolved  
CLM

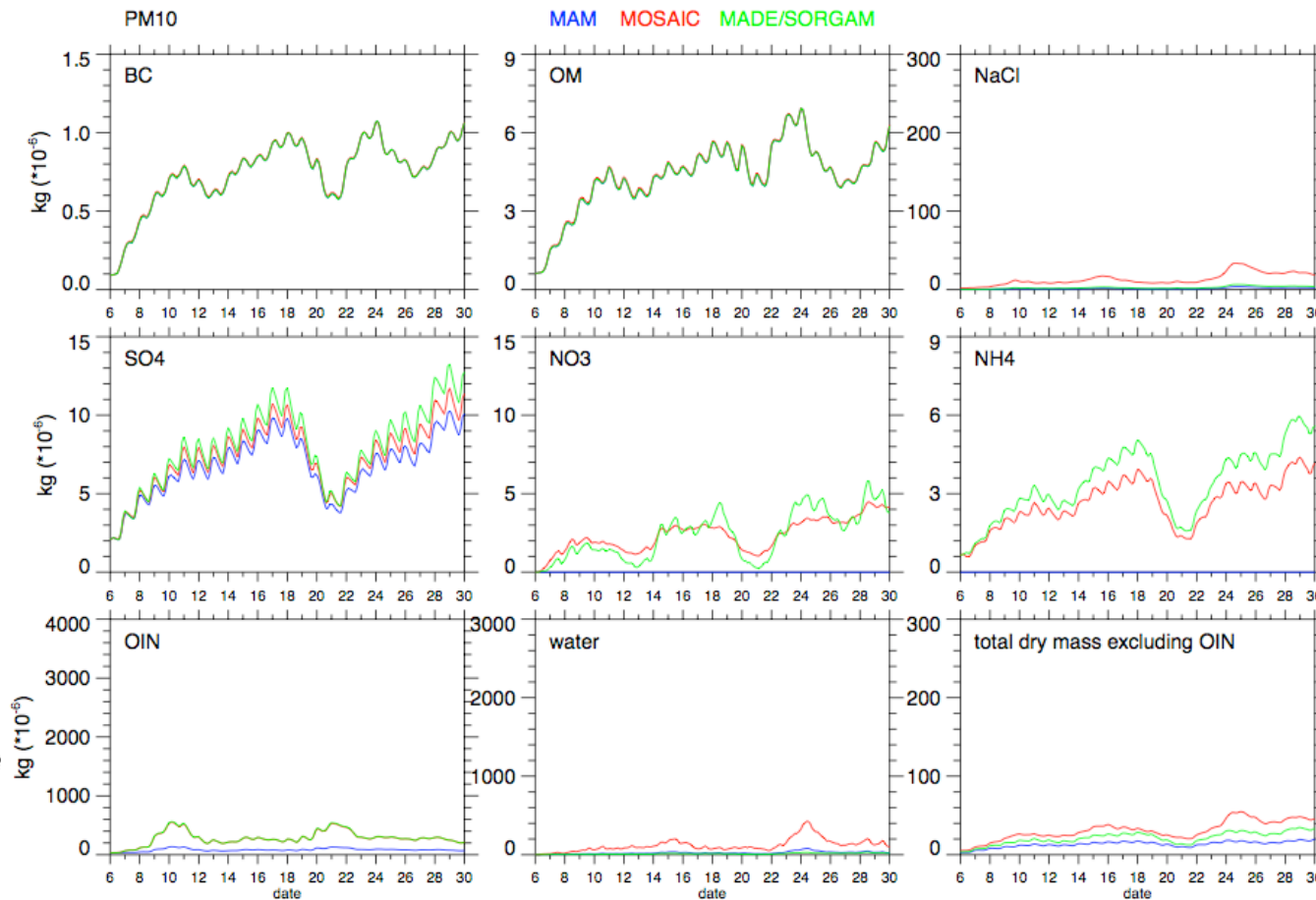
# First Steps in Evaluation

- ▶ Strategy 1:
  - Move one parameterization at a time to WRF and evaluate at a higher resolution with respect to existing formulations
- ▶ Strategy 2:
  - Move all parameterizations to WRF and evaluate at a resolution similar to the global model
  - Increase resolution to explore behavior of suite at high resolution
- ▶ Strategy 3:
  - Some combination of the above



# Model diverge more at smaller particle sizes

- ▶ Partially due to size resolution
- ▶ Water uptake
- ▶ Many issues ignored in faster, simpler formulations

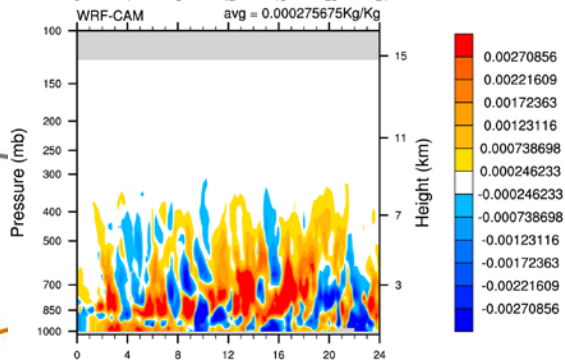
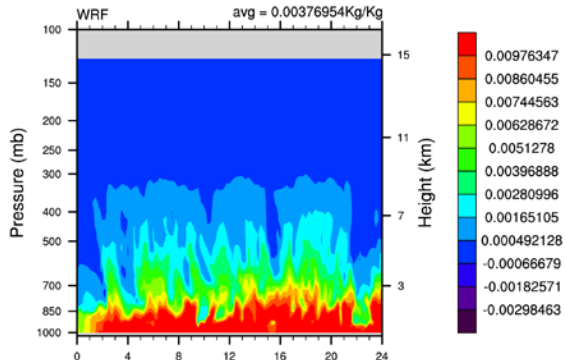
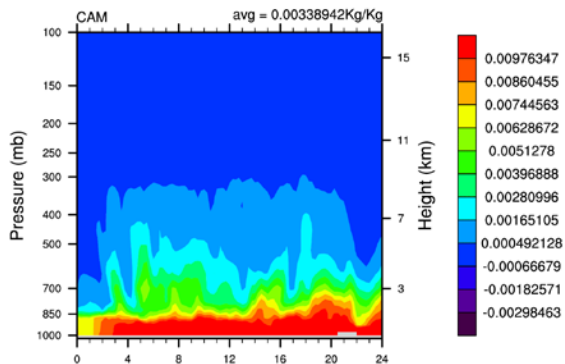


# First Steps in evaluation using Strategy 2: (move full suite to WRF and evaluate)

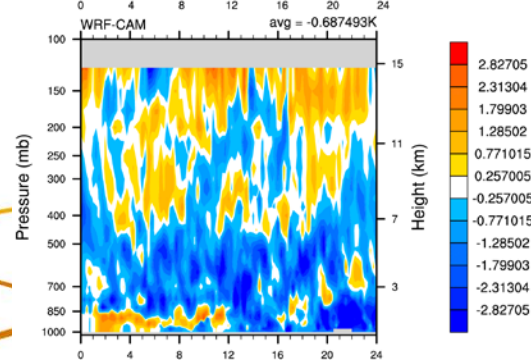
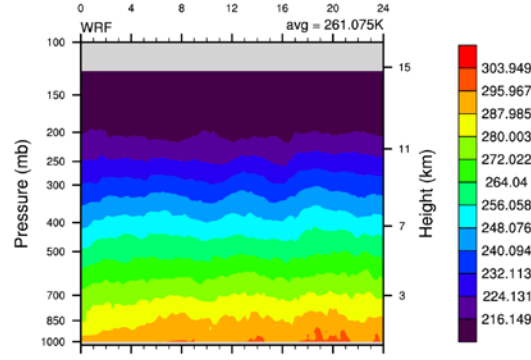
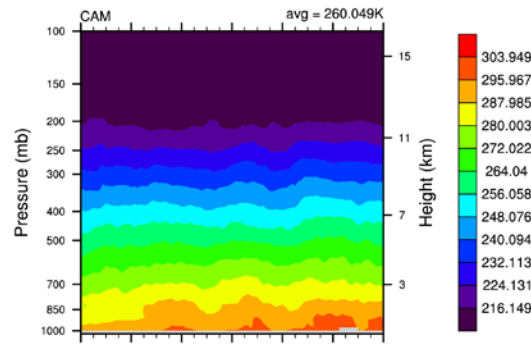
- ▶ WRF driven from CAM boundary Conditions
- ▶ CAM, 1.9x2.5, 30L, data archived @ 3hr intervals
- ▶ WRF ~10km, 30L
  - Consistent initial conditions but interpolation problem over topography
  - Consistent surface fluxes for aerosols and precursors but no DMS
  - Inconsistent surface fluxes for water vapor, heat, momentum
- ▶ Comparison at
  - Mexico city
  - Central Gulf of Mexico

# Gulf of Mexico Comparison

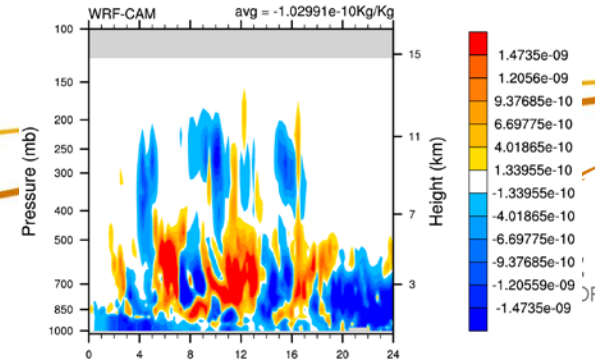
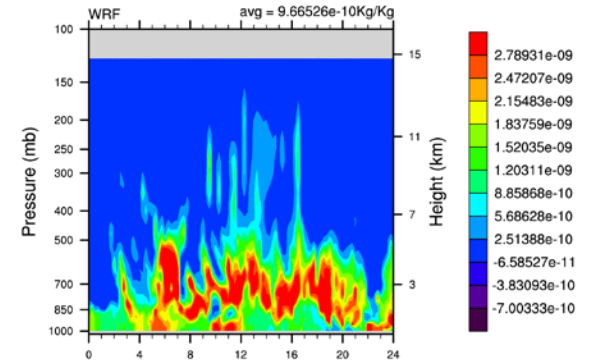
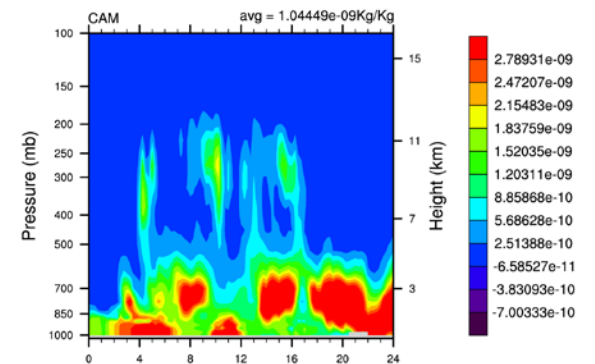
WV at Gulf\_of\_Mexico



Temperature at Gulf\_of\_Mexico



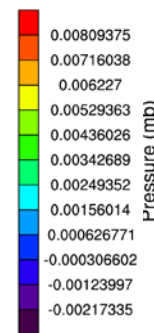
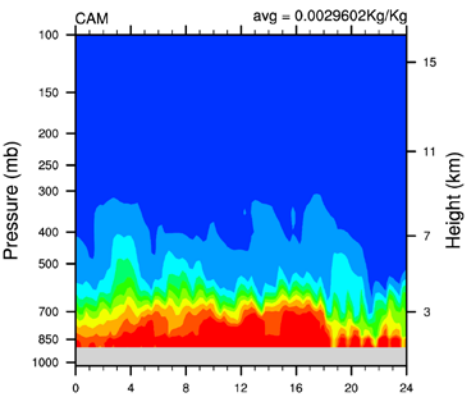
SO4 at Gulf\_of\_Mexico



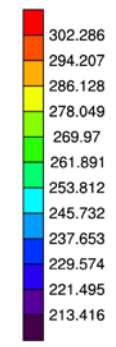
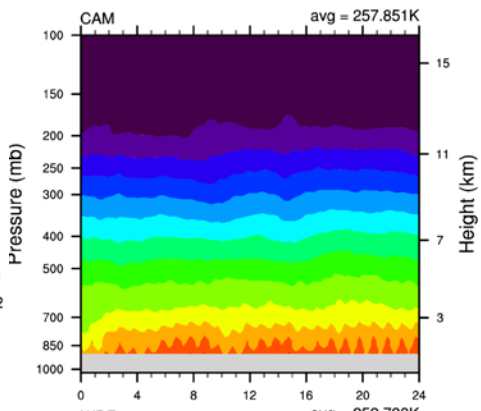
DRY

# Mexico City

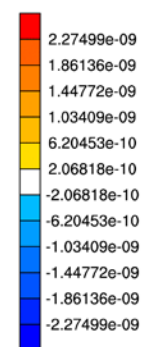
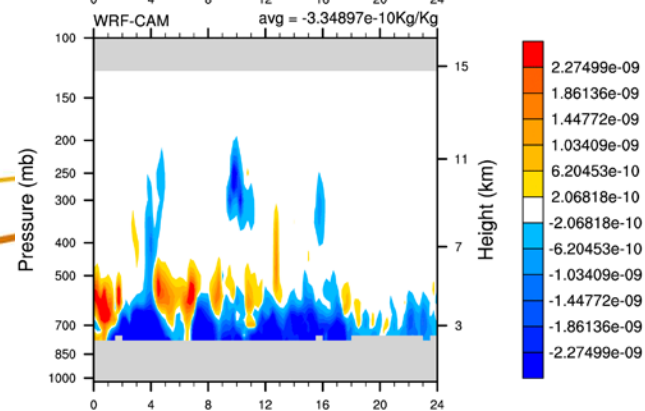
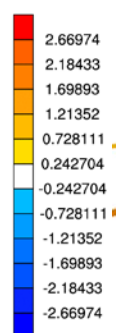
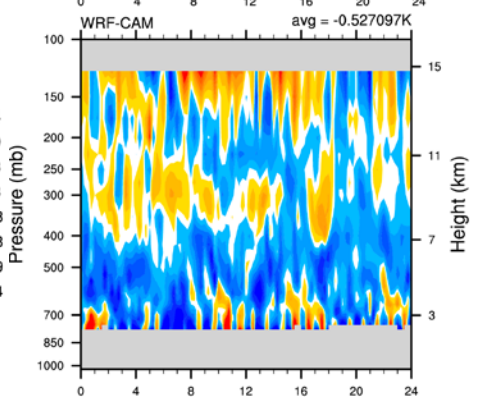
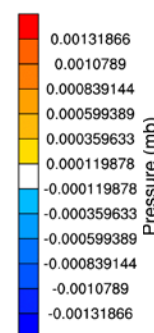
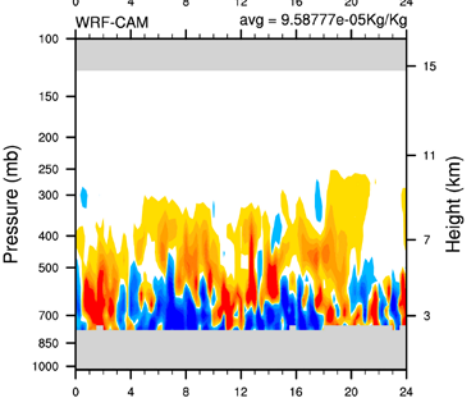
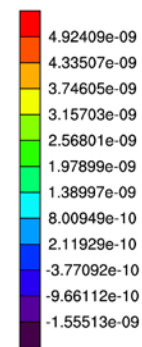
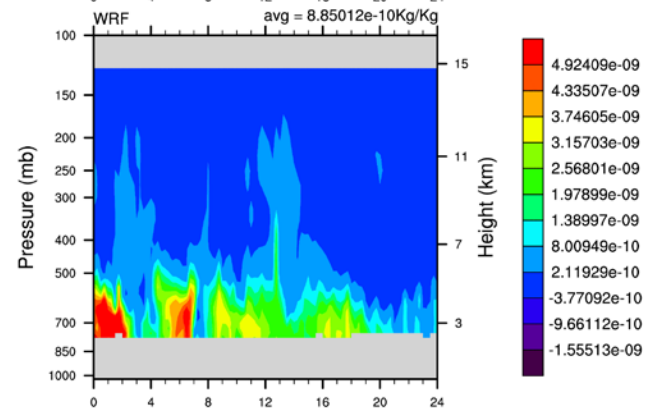
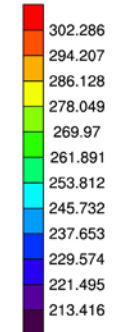
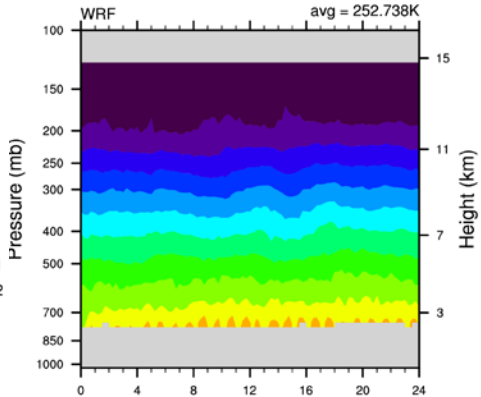
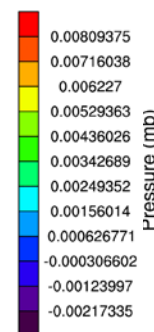
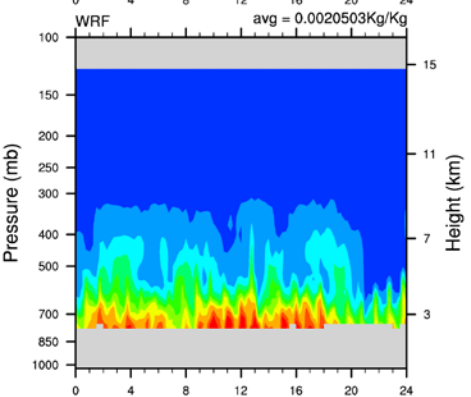
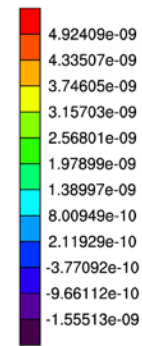
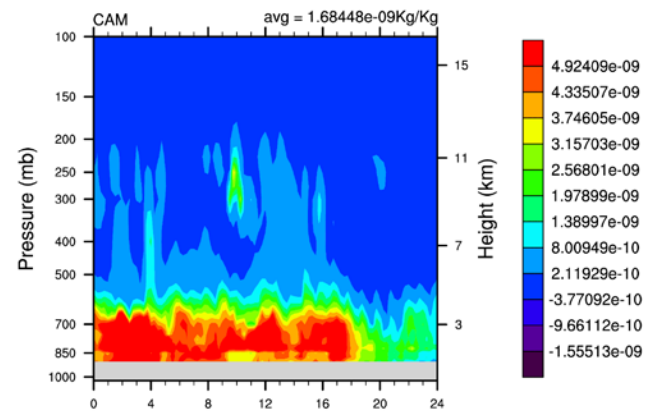
## WV at Mexico\_City



## Temperature at Mexico\_City



## SO4 at Mexico\_City

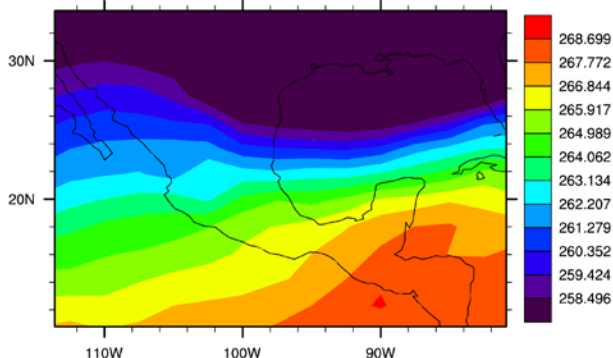




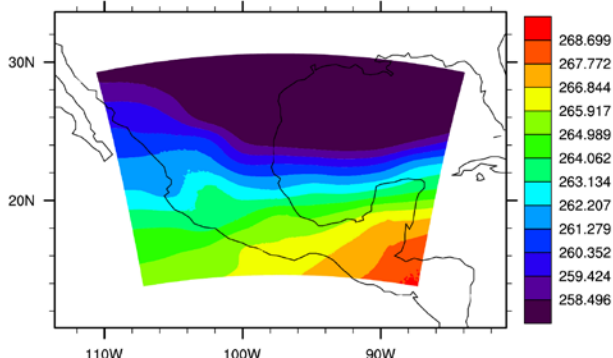
# Temperature 500 mb

T at 500hPa

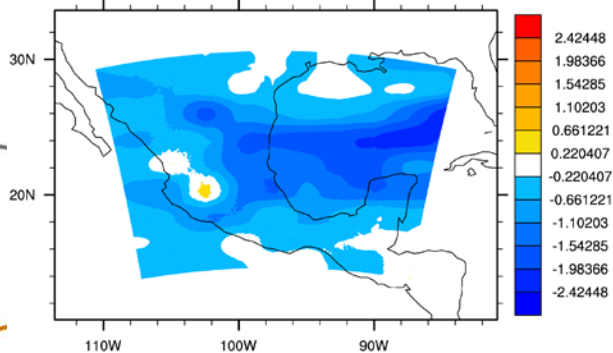
CAM\_2006-03-06\_06Z avg = 262.42K



WRF\_2006-03-06\_06Z avg = 261.58K

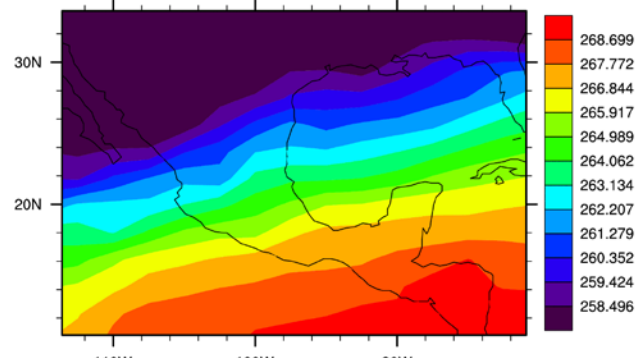


WRF-CAM\_2006-03-06\_06Z avg = -0.725462K

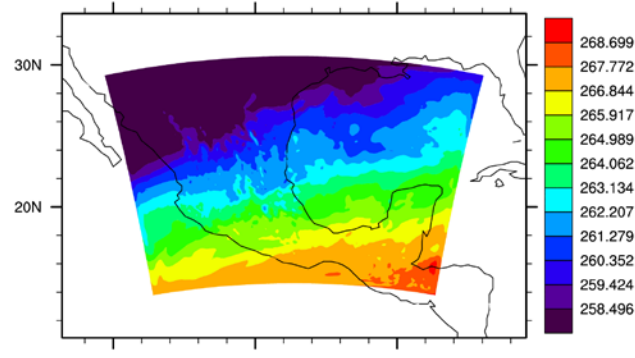


T at 500hPa

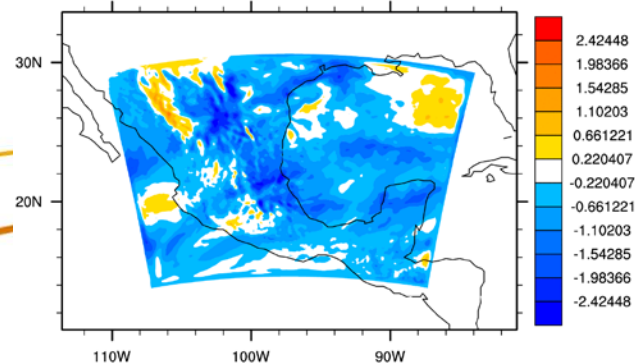
CAM\_2006-03-11\_06Z avg = 263.173K



WRF\_2006-03-11\_06Z avg = 262.547K

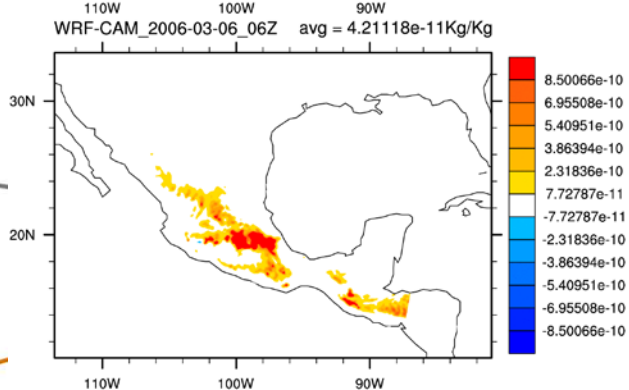
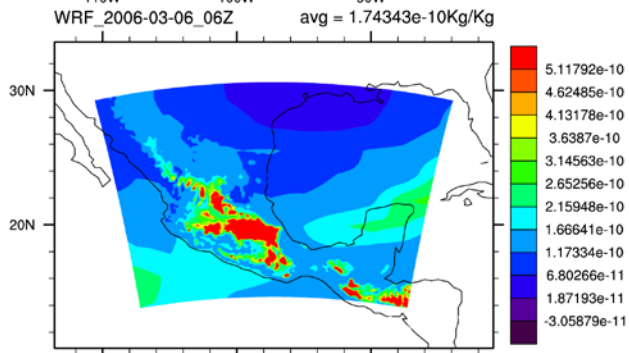
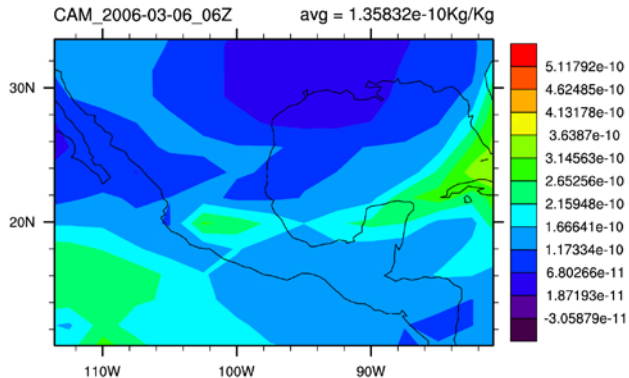


WRF-CAM\_2006-03-11\_06Z avg = -0.596647K

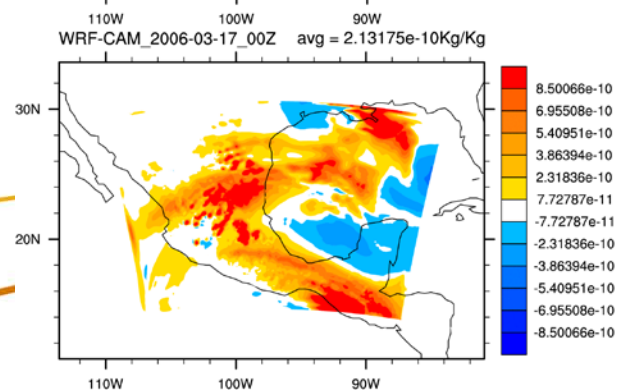
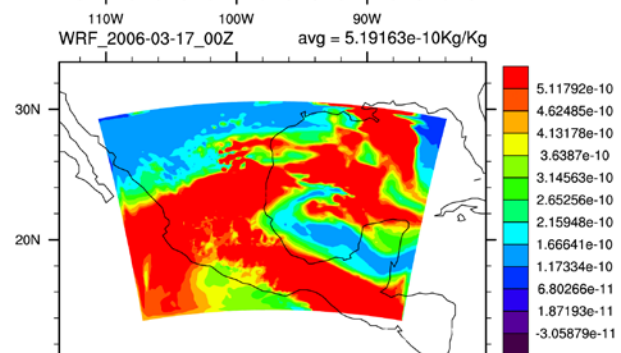
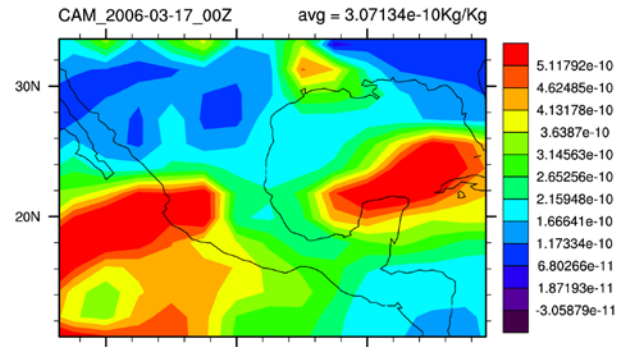


# Sulfate 500 mb

SO4 at 500hPa



SO4 at 500hPa



# First results:

- ▶ Simulations are stable
- ▶ Surface flux formulations need to be reconciled
- ▶ Macrophysics need to be reconciled
- ▶ Scavenging needs to be connected
- ▶ Exploration of time step dependencies and resolution dependencies