

NASA Goddard Regional Air Quality Modeling for the DISCOVER-AQ Field Campaign

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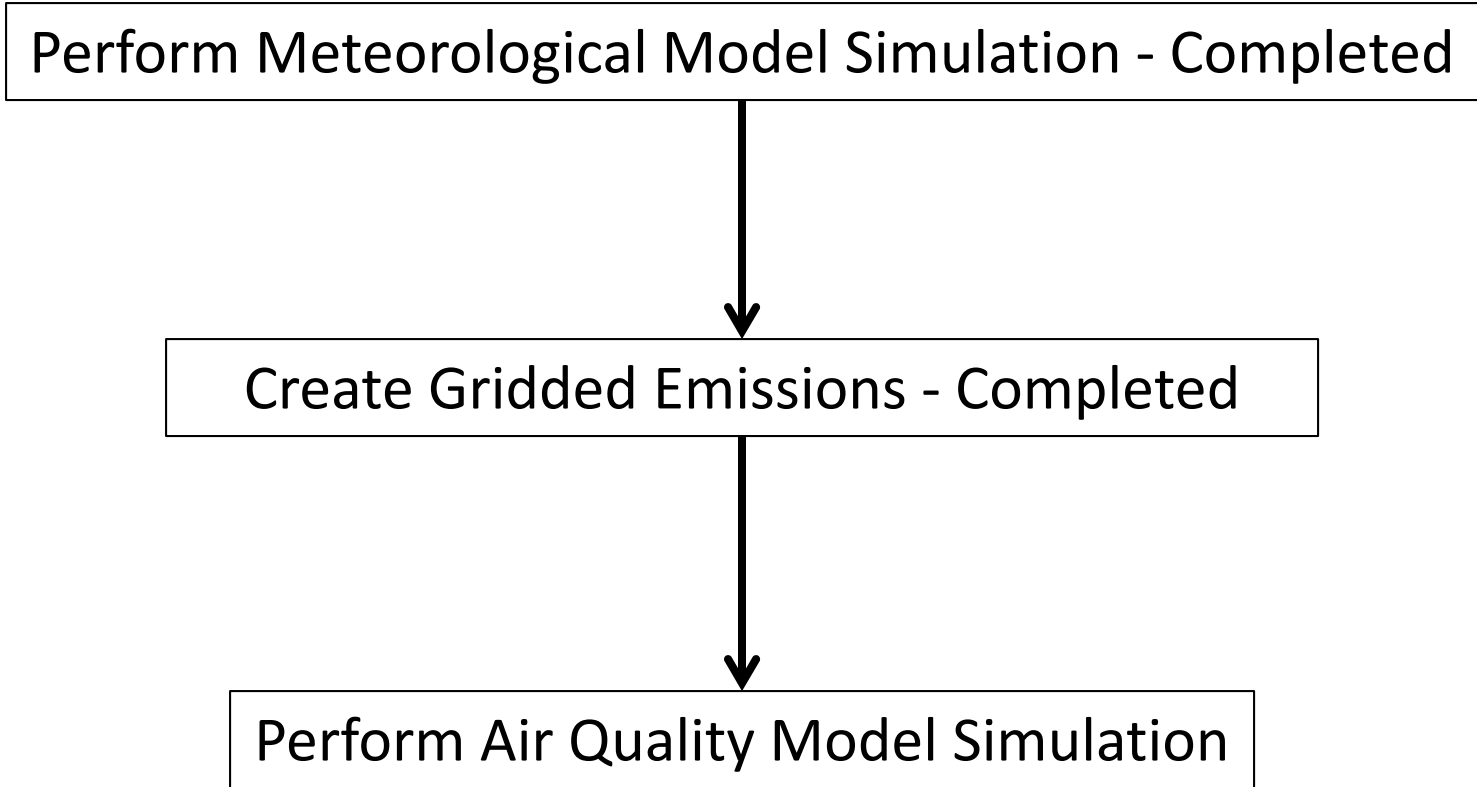
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WRF-Chem and CMAQ Modeling Approach



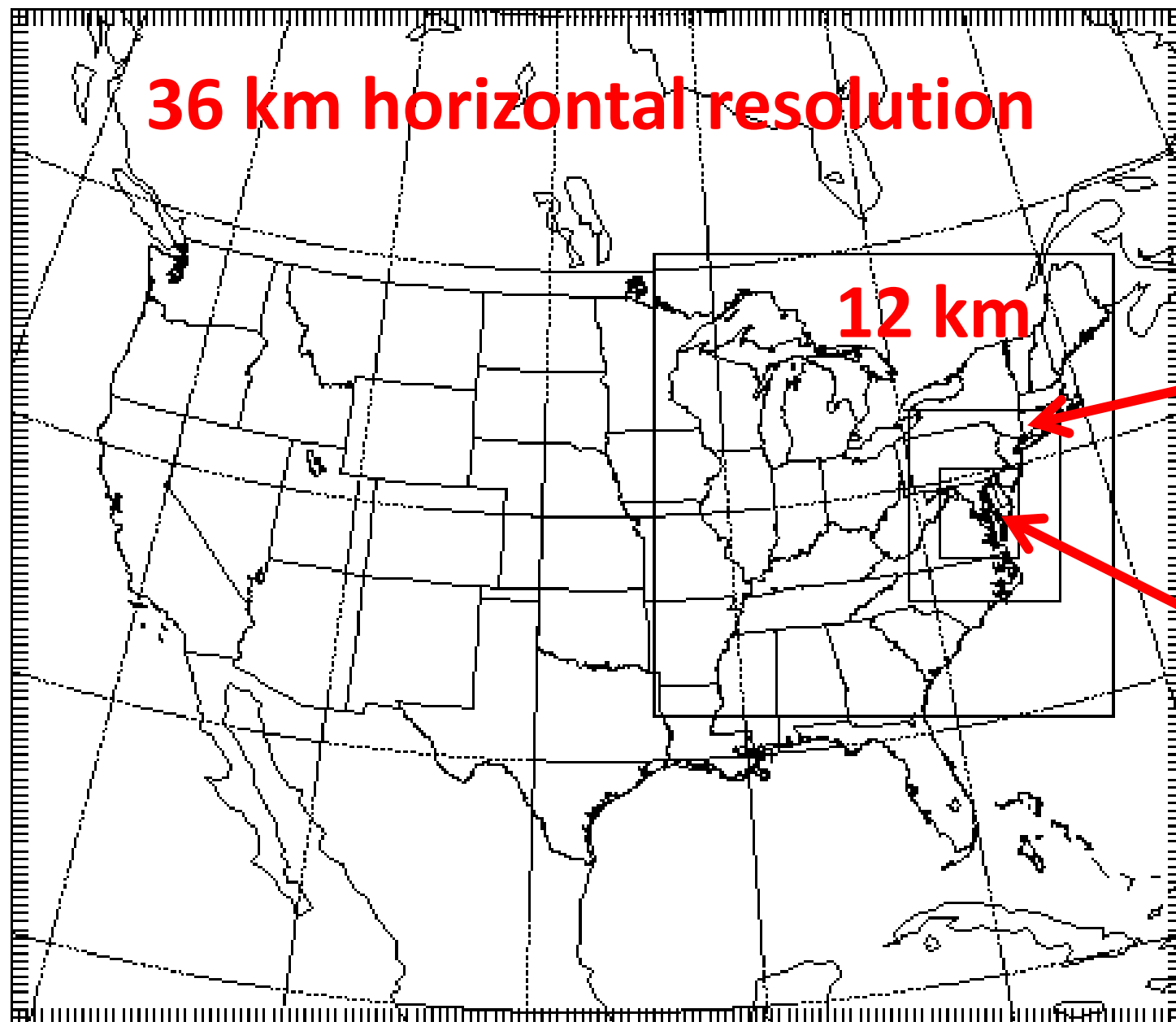
WRF-Chem and CMAQ Modeling Domains

36 km horizontal resolution

12 km

4 km

**1.3 km
(CMAQ
only)**



Weather Research and Forecasting (WRF) Model Options

Time Period	May 24 – August 5, 2011
Re-initialize	Every 3 days except for soil temperature and soil moisture
Length of each run	3.5 days (first 12 hours of each run are discarded)
Initial and Boundary Conditions	NCEP Final Reanalysis
Radiation	LW: RRTM SW: Goddard
Surface Layer	Pleim-Xiu
Land Surface Model	Pleim-Xiu
Boundary Layer	ACM2
Cumulus	Kain-Fritsch (none for 1.3 km domain)
Microphysics	WSM-6
Nudging	Observational and analysis nudging
Damping	Vertical velocity and gravity waves damped at top of modeling domain

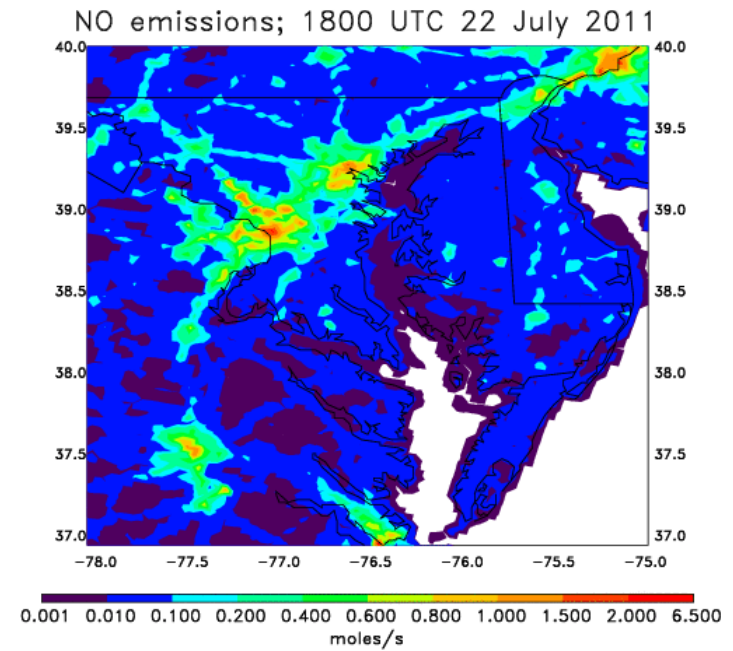
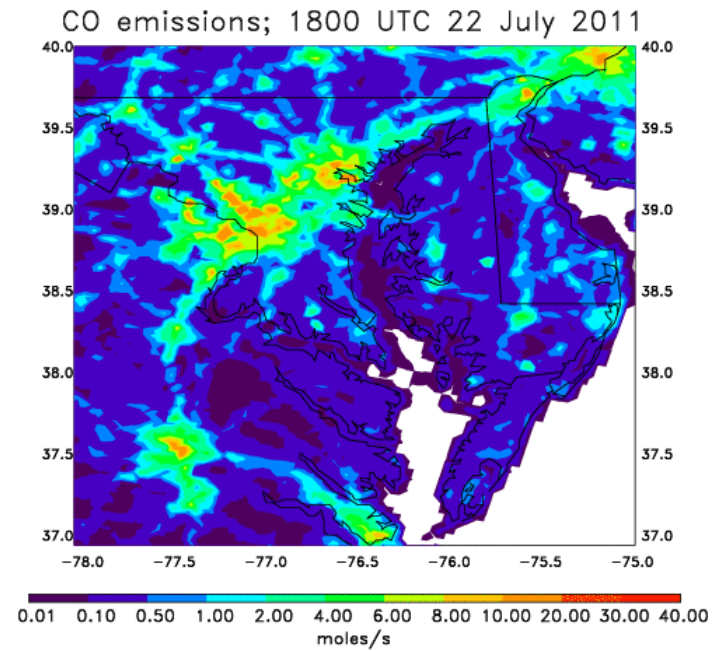
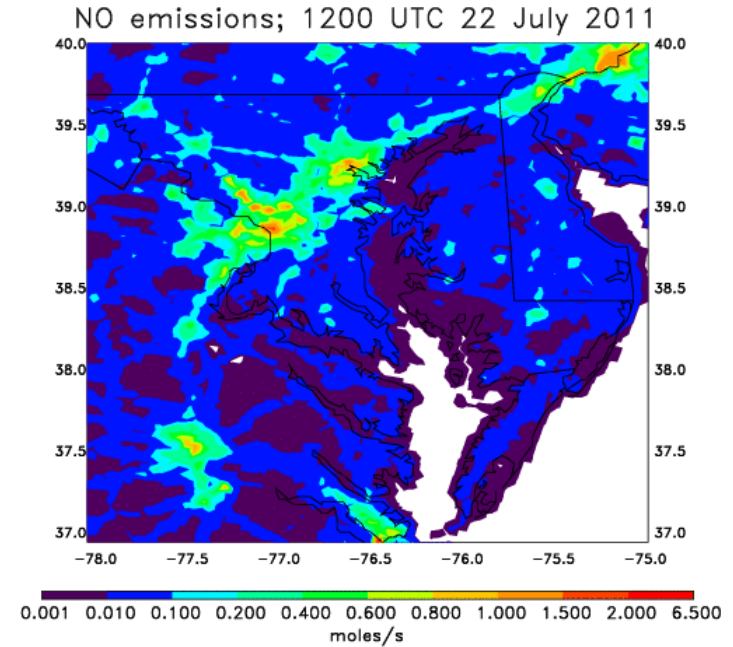
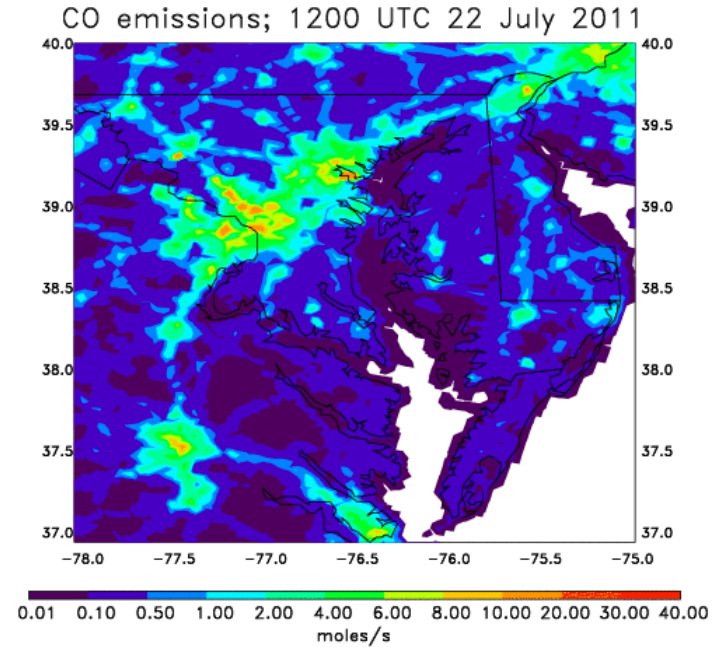
Emissions Processing

- Anthropogenic emissions: Projected 2012 emissions based on the 2005 National Emissions Inventory (NEI) processed with SMOKE.
 - Area sources
 - Point sources
 - Mobile sources
- Biogenic emissions: Model of Emission of Gases and Aerosols from Nature (MEGAN) calculates biogenic emissions at 1 km² resolution and is driven by weather, land cover, and atmospheric chemical composition.
- Biomass burning emissions: Fire Inventory from NCAR version 1.0 (FINNv1) estimates biomass burning emissions with a resolution 1 km² based on fire hot spots, area burned, land cover maps, and biomass consumption estimates from MODIS products.

Emissions Version 2

- Point source emissions will be updated with Continuous Emissions Monitoring (CEM) emissions data when available.
 - CEM data: observed emissions datasets from industrial stacks
- Mobile emissions will be updated with highway traffic data and used to verify the day of the week patterns in the SMOKE emissions processing system.

4 km anthropogenic CO and NO emissions



Work in progress

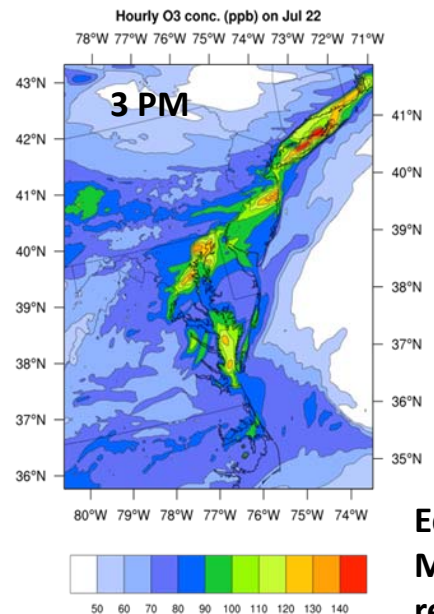
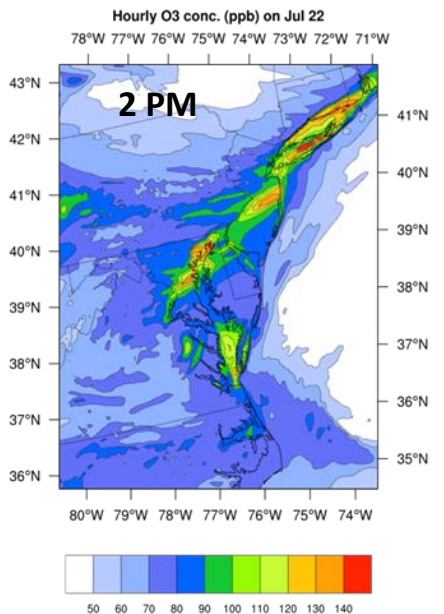
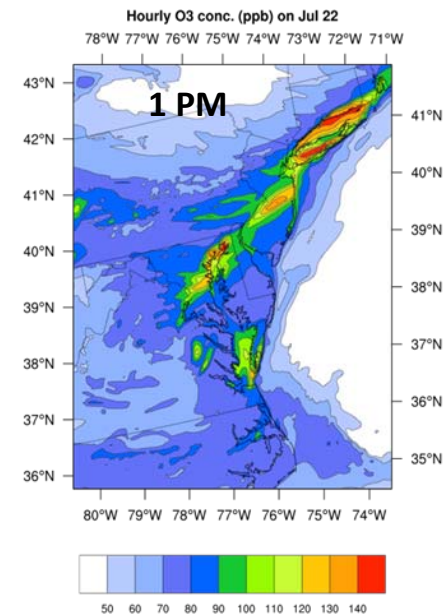
Air Quality Model Simulations

CMAQ	Horizontal Resolution: 36, 12, 4, and 1.3 km Time Period: Late May through July
WRF-Chem	Horizontal Resolution: 36, 12, and 4 km Time Period: Late June through July
WRF-Chem (NCAR)	Horizontal Resolution: 12 km domain covering the entire continental US Time Period: Late June through July
NASA Unified WRF (NU-WRF) Initial run completed	Horizontal Resolution: 36, 12, 4 km Time period: Late June through July

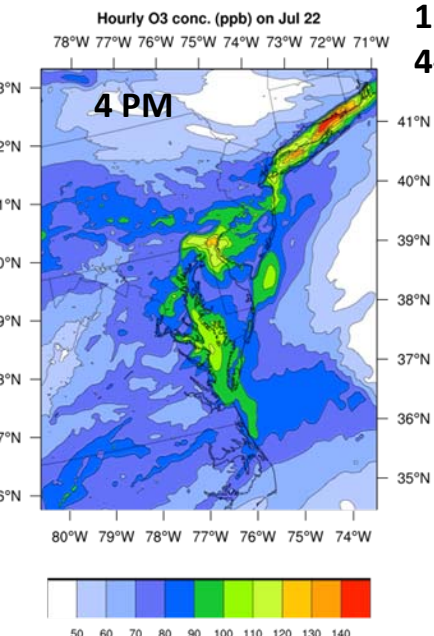
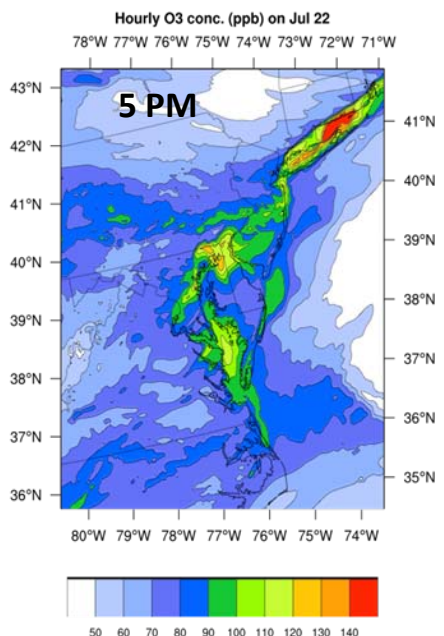
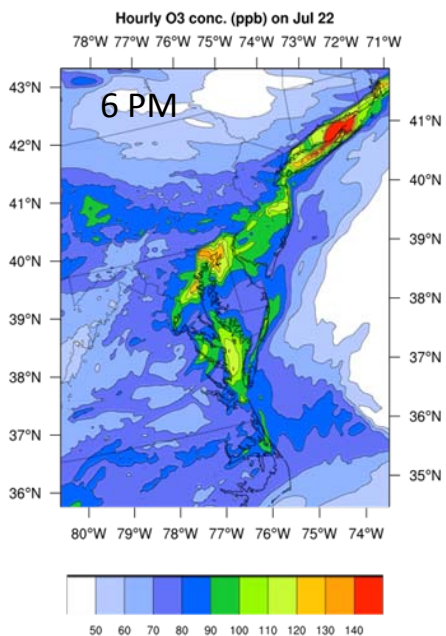
Model Options

WRF-Chem Version 3.3.1	
Chemical Mechanism	CBMZ
Aerosols	MOSAIC 8 bins Direct and indirect effects
Chemical initial and boundary conditions	MOZART CTM
Dry deposition	Wesely
NASA Unified WRF (NU-WRF)	
Chemical Mechanism	RADM2
Aerosols	GOCART Direct and indirect effects
Chemical initial and boundary conditions	MOZART CTM
Dry deposition	Wesely
CMAQ Version 5.0	
Chemical Mechanism	CB05
Aerosols	AE5
Chemical initial and boundary conditions	MOZART CTM
Dry deposition	M3DRY Bi-directional flux of ammonia

NU-WRF Surface Ozone -- July 22, 2011



**Edgewood
MDE Obs.
reached
120-130 ppbv
4-5 PM EST**



WRF-Chem Model Output (CBMZ/MOSAIC)

- Meteorology variables: temperature, pressure, humidity, wind velocity, mixing ratios (water vapor, liquid, ice), precipitation, shortwave and longwave radiation, PBL height, surface energy fluxes, cloud optical thickness
- 53 trace gas species
- 13 aerosol species in 8 size bins
- Additional aerosol information: extinction coefficient, optical thickness, asymmetry parameter, and single scattering albedo at wavelengths of 300, 400, 600, and 999nm