Brief Summary of H-CMAQ Status and Future Plan for HTAP2

HTAP-WRAP Joint Workshop

Modeling Air Quality from Global to Local Scales

Joshua Fu

Department of Civil and Environmental Engineering
University of Tennessee

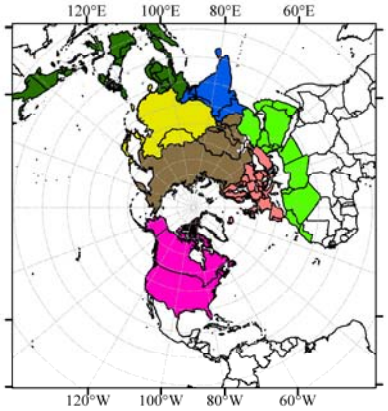
Research Plan Overview

- Objectives
  - Quantify source-receptor relationship between different continents
  - Investigate long-range transport impacts
  - Examine possible air quality benefit from emission control
  - Examine model's capability by comparing H-CMAQ with global models

- Method
  - Model Platform: WRF / Hemispheric CMAQ (H-CMAQ) / Response Surface Method (RSM)
  - Source region design
    - RSM design only need to consider source region definition. The impact from pre-defined source region could be derived for any receptor region
    - H-CMAQ is hemispheric scale, so we group the HTAP source regions over north hemisphere to 7 source regions
  - 42 Pollutant/Sector/Region Control Factors for O_3 and 42 for $PM_{2.5}$
  - Response surfaces based on total of 228 simulations each for O_3 and $PM_{2.5}$

HTAP original source regions

RSM source regions



Define 7 source regions over North Hemisphere:

HTAP-source regions	**RSM**
North America	(1). North America
Europe	(2). Europe
Rus, Bel, Ukr	(3). Russia
South Aisa	(4). South Asia
East Asia	(5). East Asia
Southeast Aisa	(6). Southeast Asia
North Africa	(7). Africa_MiddleEast
Middle East	

H-CMAQ Simulations

- Emissions Inputs
  - Speciation, temporal allocation, and vertical distribution: derived from US EPA SMOKE (profiles and cross-reference file for different sectors)
  - Natural biogenic emission: GEIA (plan switch to MEGAN)
  - Biomass Burning: GFEDv4
- Model Configuration: WRF/CMAQv4.7.1
  - Use CMAQv4.7.1 because it's only compatible version with RSM
  - polar projection
  - model top: 50mb
  - horizontal resolution: 108x108 km (actual grid size vary along latitude)
  - outputs: hourly averages, 3-D fields
- Current Status
  - Base run 2010 done and submitted
  - RSM test run ongoing

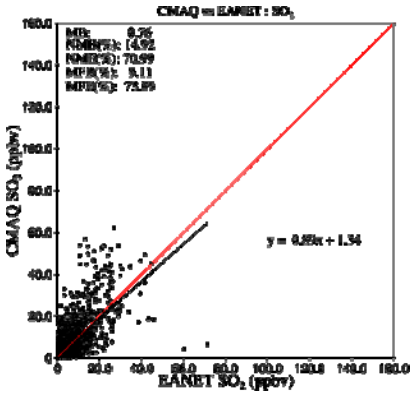
Base Evaluation

Surface

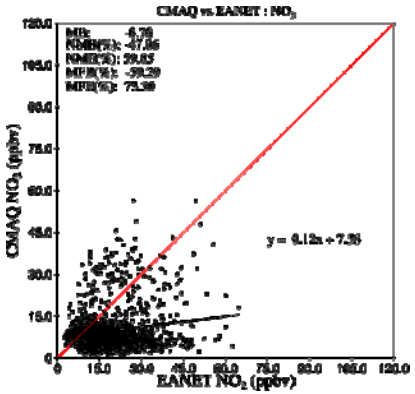
Over Asia

Over U.S.

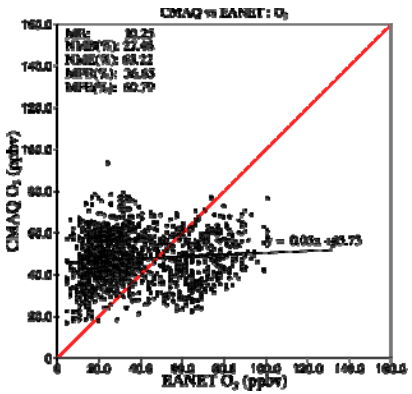
SO_2



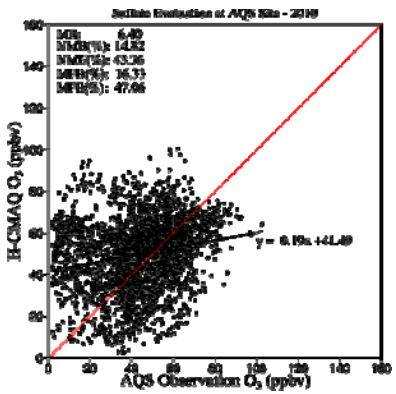
NO_2



O_3



O_3



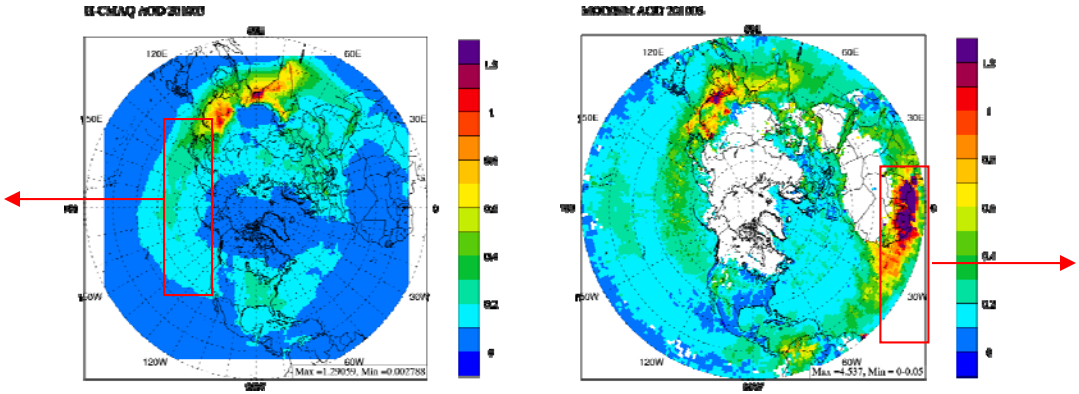
Generally acceptable, but need further investigation for more variables with more observations.

Column AOD

Model can generally capture the spring time long-range transport from Asia to North America

H-CMAQ

MODIS



AOD over Sahara was significantly underestimated, because there is no dust plume rise module in CMAQv4.7.1. We will use CMAQv5.0.2 for new baseline simulation with dust emission.

Next Step

- Base simulation
  - Refine 2010 base simulation
    - use MEGAN for biogenic emission
    - add dust emission with CMAQv5.0.2
    - thorough evaluation with more observations
  - Nest down to 36-12-4km (global to local scales)
  - Simulate 2008, 2009 base cases

- RSM
  - Test run analysis for source-receptor relationship
  - Production run for 2010