THE U.S. EPA CMAQ MODELING SYSTEM – FUTURE DEVELOPMENT PLANS

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Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy.
Spatial Scales

• Urban/Regional
  – Has been and continues to be primary focus

• Fine/Neighborhood Scale
  – ~1 km grids, or finer
  – Pilot programs now; may grow into larger program
  – Emphasis on air toxics and human exposure applications; homeland security
  – Exploring stochastic approaches within grid modeling context
    • PDFs; sub-grid variability
• Hemispheric/Global Scale
  – New project in conjunction with EPA/NCEA’s assessment of impacts of potential climate change on regional/urban air quality
  – Purpose: Perform AQ simulations under current and future climate scenarios to study the sensitivity of air quality predictions ($O_3$, PM) to climate change. Model simulations developed to support the USEPA Global Change Research Program (GCRP) national air quality assessment (2007, 2010 reports).
– **Modeling Tools**

- USEPA Community Multiscale Air Quality (CMAQ) model for national-scale simulations
- MM5 regional climate simulations performed by Ruby Leung (PNNL)
- Global Climate and Chemical Transport Modeling fields provided by STAR grantees (Harvard, CMU)
- Future Emission Scenarios requires collaboration with NRMRL for future technology scenarios, OAQPS, OTAQ, FY03 and FY04 STAR grantees
- Planned Products from the CIRAQ model study
  - 5-yr current and future CMAQ simulations: Test sensitivity of AQ simulations to climate forcing (IPCC A1B scenario)
  - Analysis of CMAQ results for (1) climate sensitivity
  - Results and analyses from CMAQ simulations will be provided for the USEPA GCRP 2007 national assessment report
  - Future CMAQ simulations (2) climate + emissions, schedule depends on…
    - Future AQ emission developments
    - Steps needed to integrate these developments into “model-ready” emissions
    - Plan to complete these simulations to contribute to the USEPA GCRP 2010 national air quality assessment report.
Other New Dimensions

• Annual simulations
  – Most of the new applications require longer-term model simulations of seasons to years

• New chemical species
  – Air toxics, metals, Hg, PBTs, POPs, etc.

• Links with other models
  – Water quality (through deposition)
  – Ecological and human exposure
  – Global climate, general circulation, global chemistry
• New applications
  – AQ Forecasting
    • Air quality climatological model database and analyses
    • Links with regulatory process through long-term model data archive
    • Collaborations with CDC on links with health data
Meteorology

• Transition from MM5 to Weather Research and Forecast (WRF) Model
  – Add data assimilation (nudging) to WRF
  – Add PX Land surface model to WRF

• WRF physics options
  – Sensitivity tests for AQ applications
  – Linkage with CMAQ
  – Dynamic cores
    • Mass
    • NMM
    • Ensembles
Emissions

- Biogenics
- Fire emissions
- Blowing dust
- Mobile sources
  - New modal mobile models
- Bi-directional fluxes
  - e.g., NH$_3$
Chemical Transport Model

• Aerosol research and integration
  – Source apportionment
  – Fine/coarse interactions
  – External mixtures

• Chemistry
  – Mechanisms; morphecules

• Efficiencies
  – Creation of engineering model (?)

• PBL and land-surface processes

• Clouds (physics and chemistry)

• Data assimilation/ satellite data
• WRF-Chem
  – Integrated model
  – Two-way; feedbacks
    • Radiation
    • Cloud microphysics