Air Quality Modeling for \( \text{PM}_{2.5} \), Haze, and Ozone

VISTAS- SESARM

MARAMA meeting

February 11, 2009
Planning for Next SIPs

- One-Atmosphere approach to air quality modeling and regulatory demonstrations
  - Daily PM$_{2.5}$ SIPs due spring 2012
  - Revised 8-hr ozone SIPs due summer 2013
  - Regional haze progress demonstration due Dec 2012

- Use one modeling platform for all three issues even if need to model more than one year to address all requirements
One Atmospheric Approach to Air Quality Management

Modeling Lessons Learned

- Need good meteorological performance to get good air quality performance
  - Use as fine grid resolution as can afford
  - Focus on wind speed, boundary layer, moisture
  - May need more than one regional configuration

- CMAQ and CAMx air quality model performance
  - Generally acceptable for SO$_4^-$, NH$_4^+$, EC, ozone
  - Need improvements for NO$_3^-$, OC, soil
    - Improve inventories
    - Improve model treatment of SOA formation
  - Except soil, models generally under predict PM$_{2.5}$ and components
VISTAS CMAQ 2002 Actual Base G2 12k

IMPROVE

(+) Goal  (-) Goal  (+) Criteria  (-) Criteria

CM  EC  NO3  OC  SO4  SOIL  NH4  PM25

Fractional Bias (%) vs. Average Concentration (ug/m3)
CMAQ and CAMx Model Performance Across All Sites in VISTAS Region

2002 CAMx & CMAQ

Quarter Average Modeled and STN data (VISTAS)
Modeling Lessons Learned

- Boundary conditions are important
  - Re-circulation of continental emissions over Atlantic and back into modeling domain
  - May need to extend eastern modeling domain further east for accurate source apportionment
Daily PM2.5 Standard

- EPA designated non-attainment areas
  - Based on 2005-2007 PM$_{2.5}$ values
  - Some areas already demonstrating attainment, other areas same as annual PM$_{2.5}$ non-attainment

- Attainment plans due in spring 2012, demonstrate attainment by 2014
  - Attainment modeling needs to be completed spring 2011 to allow SIP development
  - Suggests 2005 as initial base year; 2012 or 2013 as initial projection year

- In particular need to understand role of fire and exceptional events
Revised Ozone Standard

- EPA promulgated Mar 2008
- States to recommend non-attainment areas for revised ozone standard (0.075 ppm) in spring 2009, based on 2006-2008 data
- EPA to designate based on 2007-2009 data
- Demonstrate attainment in 3 years (2013) for marginal areas, 6 years (2016) for moderate areas, 9 years for serious areas
  - Suggests 2008 as base year, 2012 or 2013 as one demonstration year
  - NC and VA need to evaluate implications of 2008 fires
Ozone Modeling

- Best and Final modeling assumes CAIR is implemented
- 1997 ozone standard (0.08 ppm)
  - All areas attain by 2009, except Atlanta, GA and northern VA, which attain by 2012
- 2008 ozone standard (0.075 ppm)
  - In 2009, 32 non-attaining monitors
  - In 2012, 23 non-attaining ozone monitors
2012 Regional Haze Demonstration

- 2012 reasonable progress demonstration will focus on monitoring trends and emissions inventory data
  - Are actual emissions consistent with projected emissions reductions (especially for CAIR)?
  - Are we on track to meet reasonable progress goals in 2018?
  - Air quality modeling results for daily PM2.5 will also benefit reasonable progress demonstration
- Consult with FLM/EPA early and often
Planning for Next SIPs

- Meteorological Model
  - MM5 no longer supported
  - States are migrating to WRF
  - States will begin modeling spring-summer 2009

- Emissions model
  - CONCEPT is conceptually more transparent model than SMOKE but better documentation needed for new users
  - States expect to continue to use SMOKE
Planning for Next SIPs

- Air Quality Model
  - CMAQ is EPA-supported, community add-ons
  - CAMx was developed by ENVIRON but other firms, states are running CAMx
  - CMAQ and CAMx have comparable model performance
  - Both CMAQ and CAMx have source apportionment tools
    - CAMx-PSAT most widely demonstrated to date
  - States currently have more experience running CMAQ but open to use either or both models for next SIPs – decision in 2009
Planning for Next SI Ps

- VI STAS states will assume in-house regional modeling responsibilities for next SI Ps
  - VI STAS to release request for proposals for met, em, and air quality modeling this spring 2009
  - Intend contractor to help define model base year configurations based on model performance
  - Transfer base year model run to states to benchmark and operate
- States in lead modeling role with contractor support
  - GA and NC will have lead responsibilities
  - VA capabilities split between OTC and VI STAS
  - SC developing capabilities
Planning for Next SI Ps

- State Collaborative modeling
  - Advantages: common modeling platform, common assumptions
  - Disadvantages: 36 km domain, LADCO inventory assumptions, not as good model performance as VISTAS modeling
- VISTAS states expect to continue to participate in State Collaborative modeling and to conduct southeastern regional modeling
Planning for Next SI Ps

- Modeling decisions
  - Modeling Domain
    - Expand eastern border of 36-km national grid?
    - 12-km southeastern regional grid
      - States may need 4-km grid for specific non-attainment areas
  - Modeling Platform: WRF, SMOKE, CMAQ/CAMx
  - During 2009 GA and NC intend to conduct initial WRF meteorological model performance evaluation for 2005 and 2008 with contractor support
Model Performance: VISTAS IMPROVE Network: SO$_4$

The “Good”
Model Performance: VISTAS STN Network: SO$_4$

![Graphs showing model performance for different years and models for SO$_4$](image_url)
Model Performance: VISTAS IMPROVE Network: OC

The “Bad”

- 2002 CAMx V4.5
- 2002 CMAQ V4.5 SOAmods
- 2005 CAMx V4.5
Model Performance: VISTAS STN Network: OC

The “Ugly”