

Overview of the Chesapeake Bay Program's Airshed Model

Presented to the Water Resources Technical
Committee

May 10, 2012

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Presentation Overview

Chesapeake Bay Program system of models

Chesapeake Bay Airshed Model

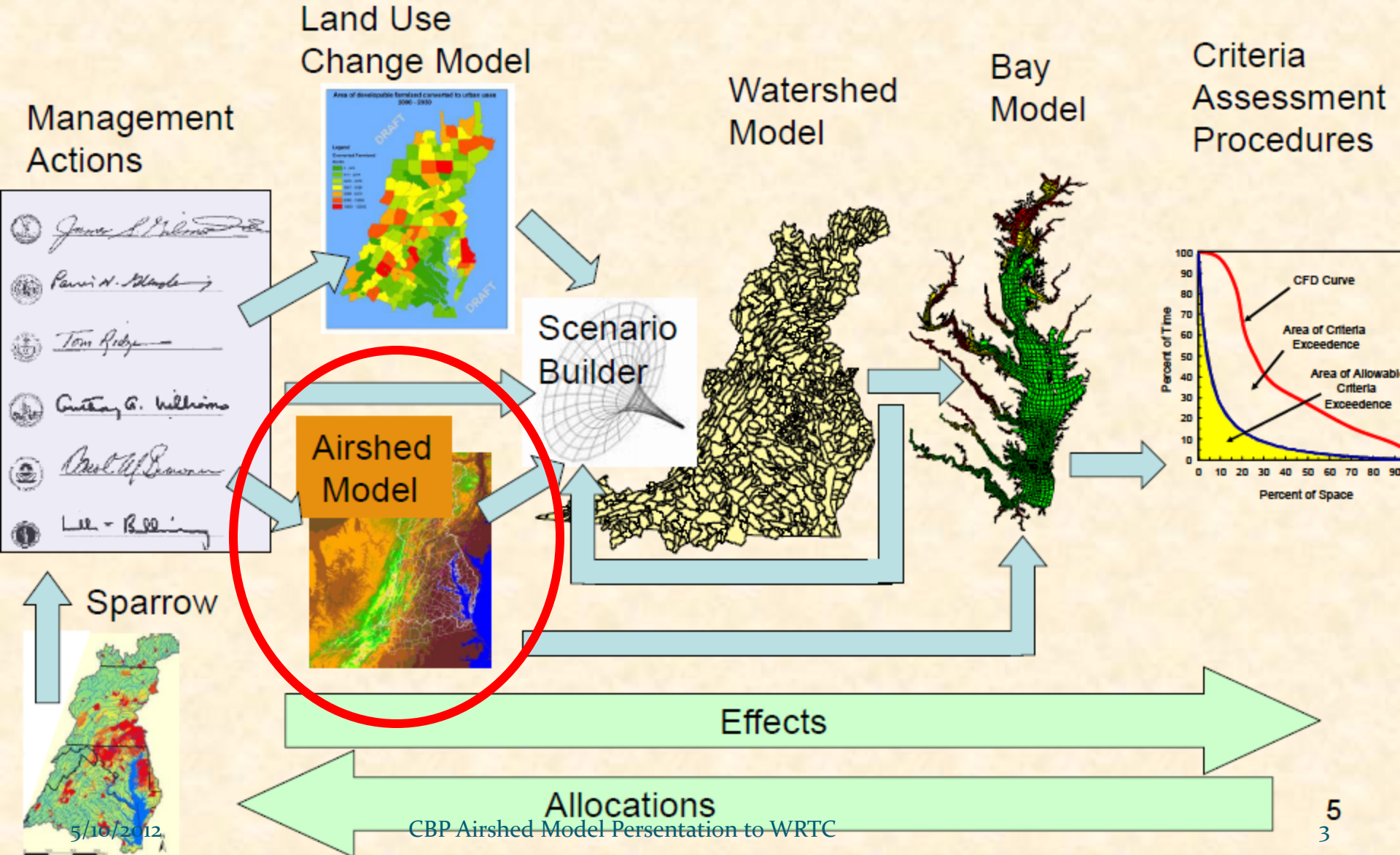
How much of the load is coming from the air?

Management scenarios used

Modeling and Analysis Tools for the 2017 “Mid-point Assessment”

Opportunities for input

Chesapeake Bay Program Modeling



The Chesapeake Bay Airshed

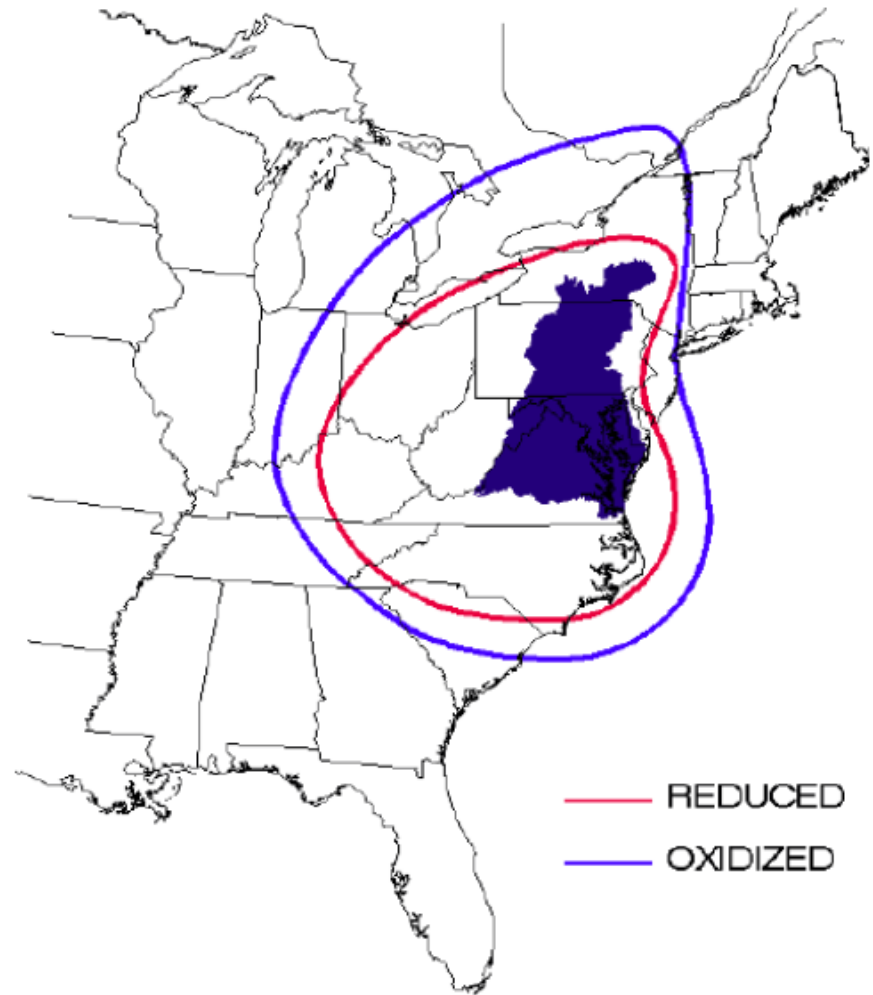
About 570,000 square miles

Seven times the size of the Bay's Watershed.

50 percent of the nitrate deposition to the Bay is from air emission sources in Bay watershed states.

25 percent of the atmospheric deposition load to the Chesapeake watershed is from the remaining area in the airshed

25 percent of deposition is from the area outside the airshed



Total Nitrogen Input Loads

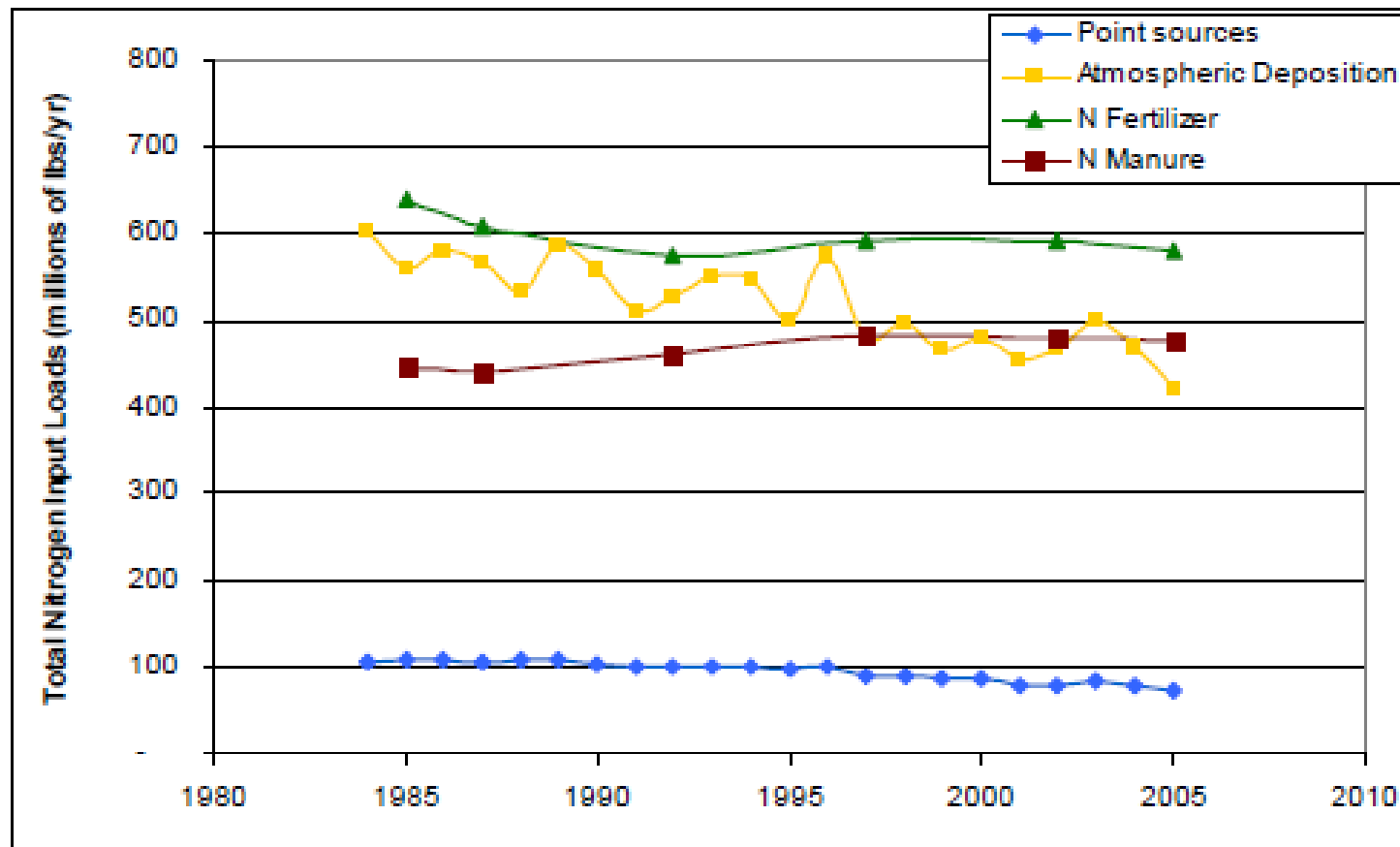
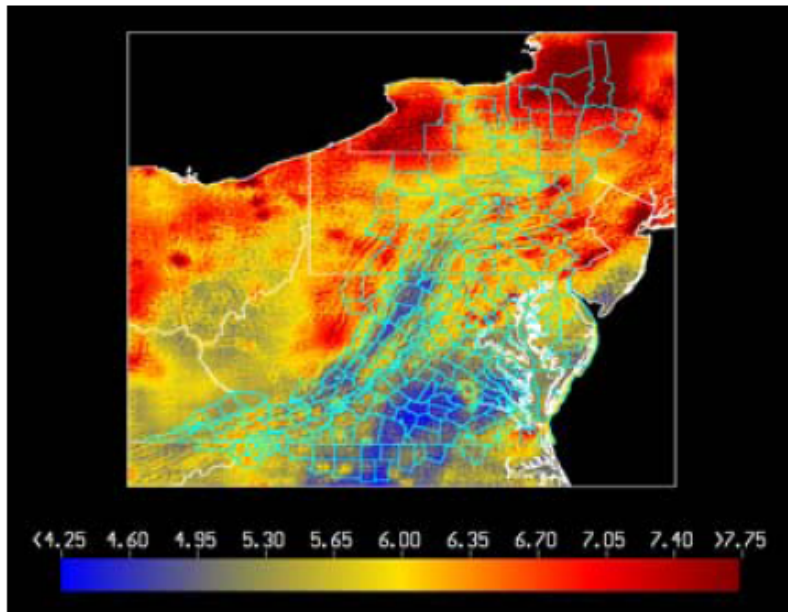


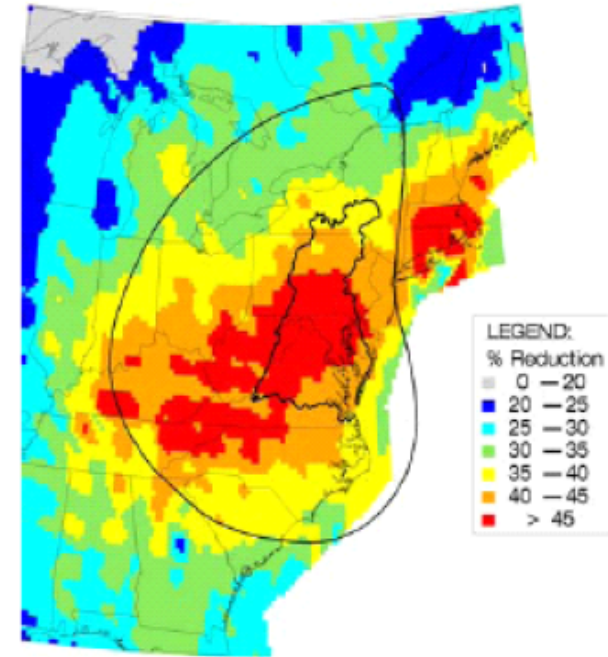
Figure 5-1. Time series of atmospheric, fertilizer, manure, and point source total nitrogen input loads to the Chesapeake Bay Watershed Model (Phase 5.3 calibration).

The CBP Airshed Model

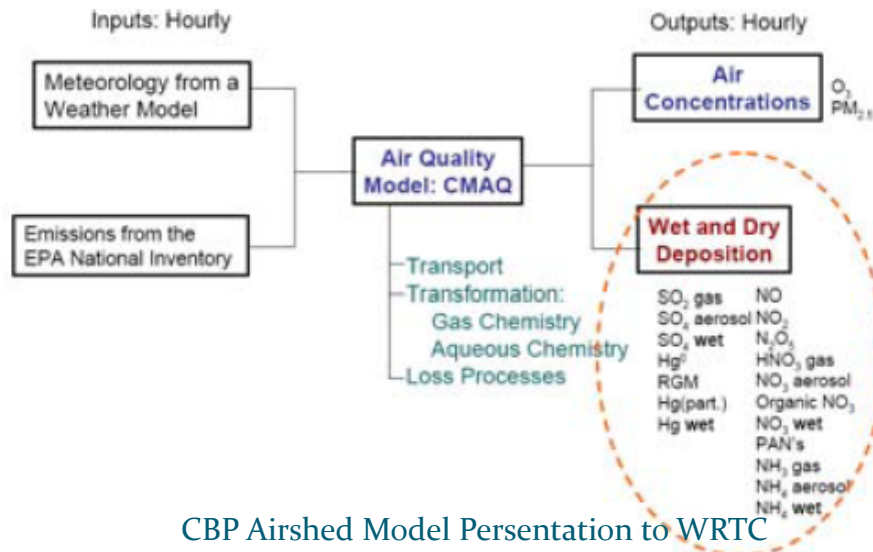


Combining
a regression
model of
wetfall
deposition...

NOx SIP Reg +
Tier II Mobile +
Heavy Duty Diesel Regs
2020
ox-N Dep % Change from 1990



...with
CMAQ
estimates
of dry
deposition
for the
base



...and using the
power of the
CMAQ model for
scenarios.



How the Atmospheric Deposition Simulation Works

The CBP applies a regression model (J Lynch & J Grimm) to the monitoring station wetfall data to get spatially detailed daily ammonia and nitrate deposition.

For the detailed spatial scales of the Phase 5, the CBP refined spatial and temporal variations in wet deposition.

Phase 4 Watershed Model

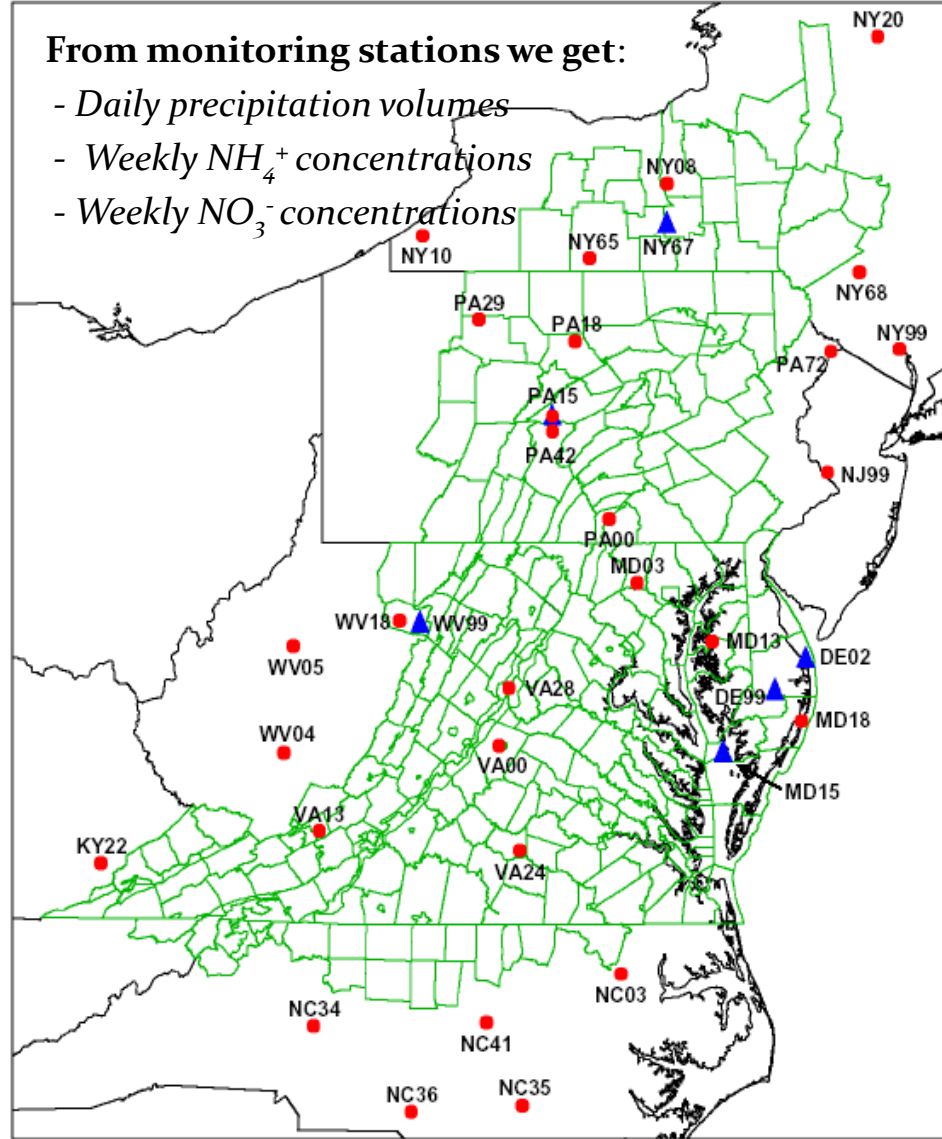
- 15 NADP/NTN monitoring stations
- 1984-1992

Phase 5 Watershed Model

- 29 NADP/NTN monitoring stations
- 6 AirMoN monitoring stations
- 1984-2001

From monitoring stations we get:

- Daily precipitation volumes
- Weekly NH_4^+ concentrations
- Weekly NO_3^- concentrations

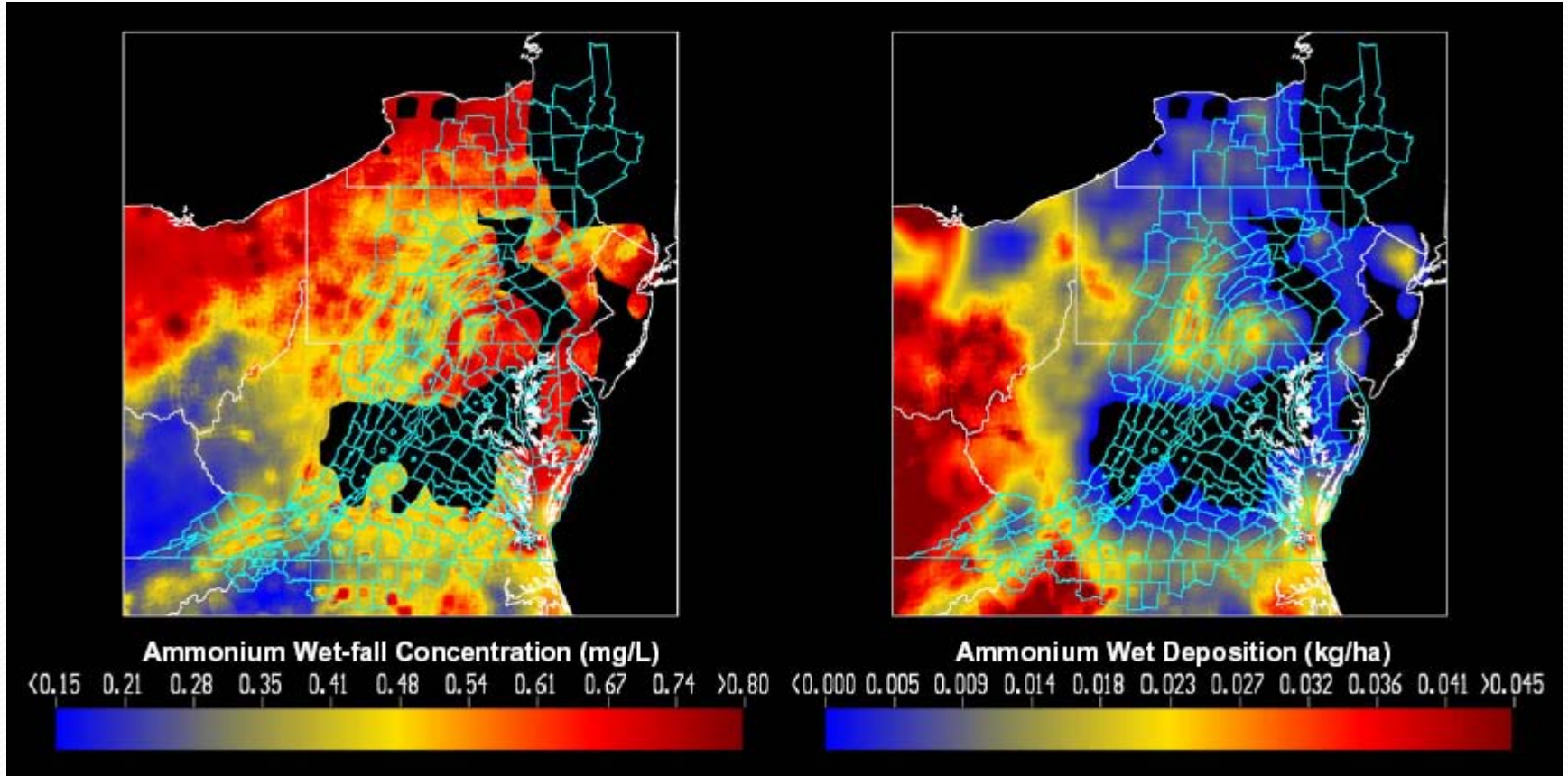




Regression Model Estimated Atmospheric Deposition

NH_4^+ Wet-fall Concentration (mg/L)
May 1, 1998

NH_4^+ Wet-fall Deposition (kg/ha)
May 1, 1998



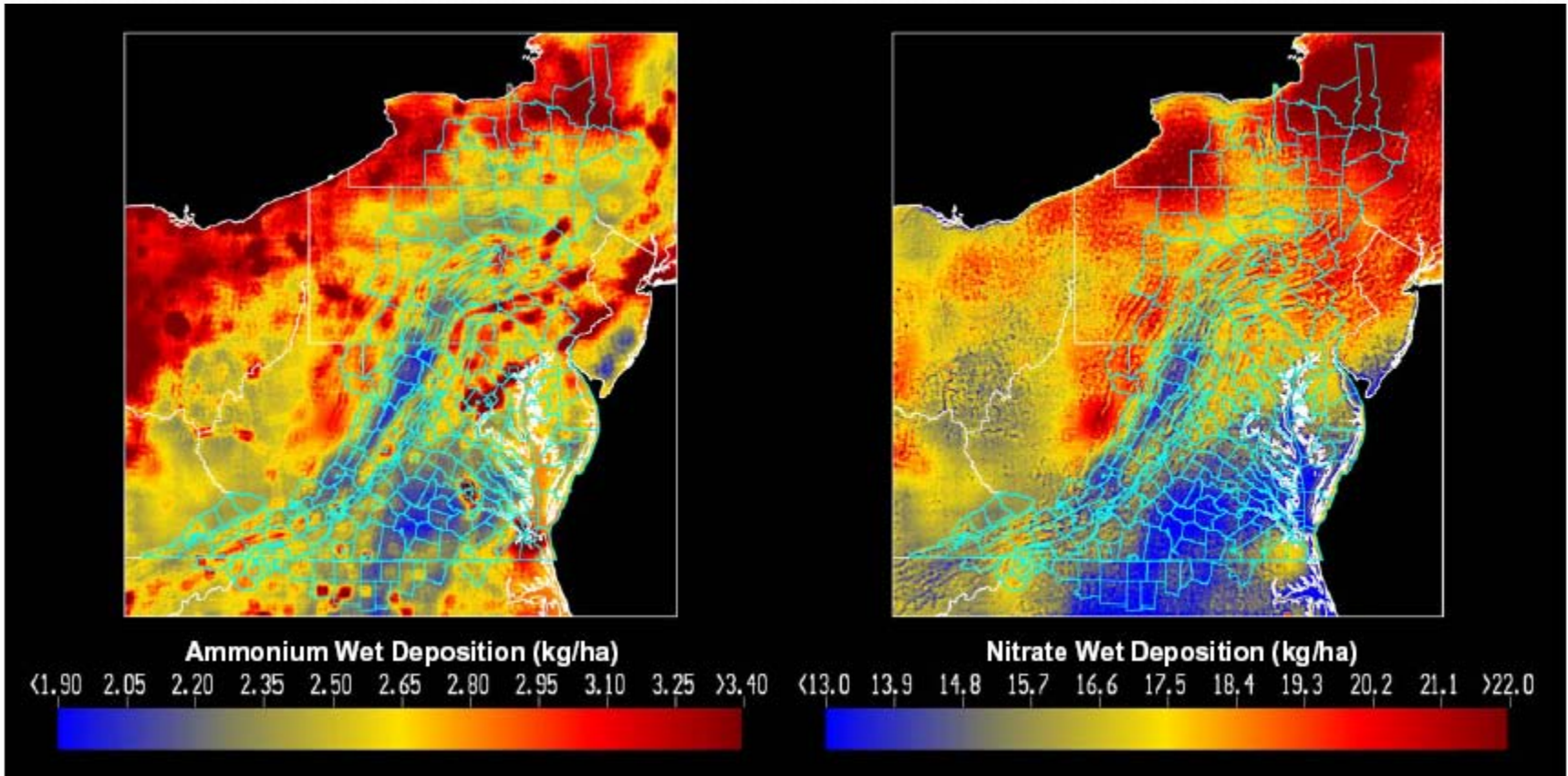
Estimates produced by applying daily ammonium concentration model to grids of estimated daily precipitation from the National Weather Service Climate Prediction Center's U.S. Daily Precipitation Analyses.



Regression Model Estimated Atmospheric Deposition

NH_4^+ Wet Deposition (kg/ha)
Mean annual (1985-2001)

NO_3^- Wet Deposition (kg/ha)
Mean annual (1985-2001)



Estimates produced by applying daily ammonium and nitrate concentration model to grids of estimated daily precipitation from the National Weather Service Climate Prediction Center's U.S. Daily Precipitation Analyses.



How the Atmospheric Deposition Simulation Works

- Community Multi-scale Air Quality (CMAQ) Model:
 - Replaces Regional Acid Deposition Model (RADM).
 - Provides estimates of wet:dry for nitrate and ammonium providing dry and total deposition and completing the base daily deposition data set.
 - In scenario mode, CMAQ provides estimates of nitrogen deposition resulting from changes in emissions from utility, mobile, and industrial sources due to management actions or growth. The base deposition determined by regression is adjusted by a reduction ratio deposition determined by CMAQ.
 - CMAQ estimates the influence of source loads from one region on deposition in other regions.

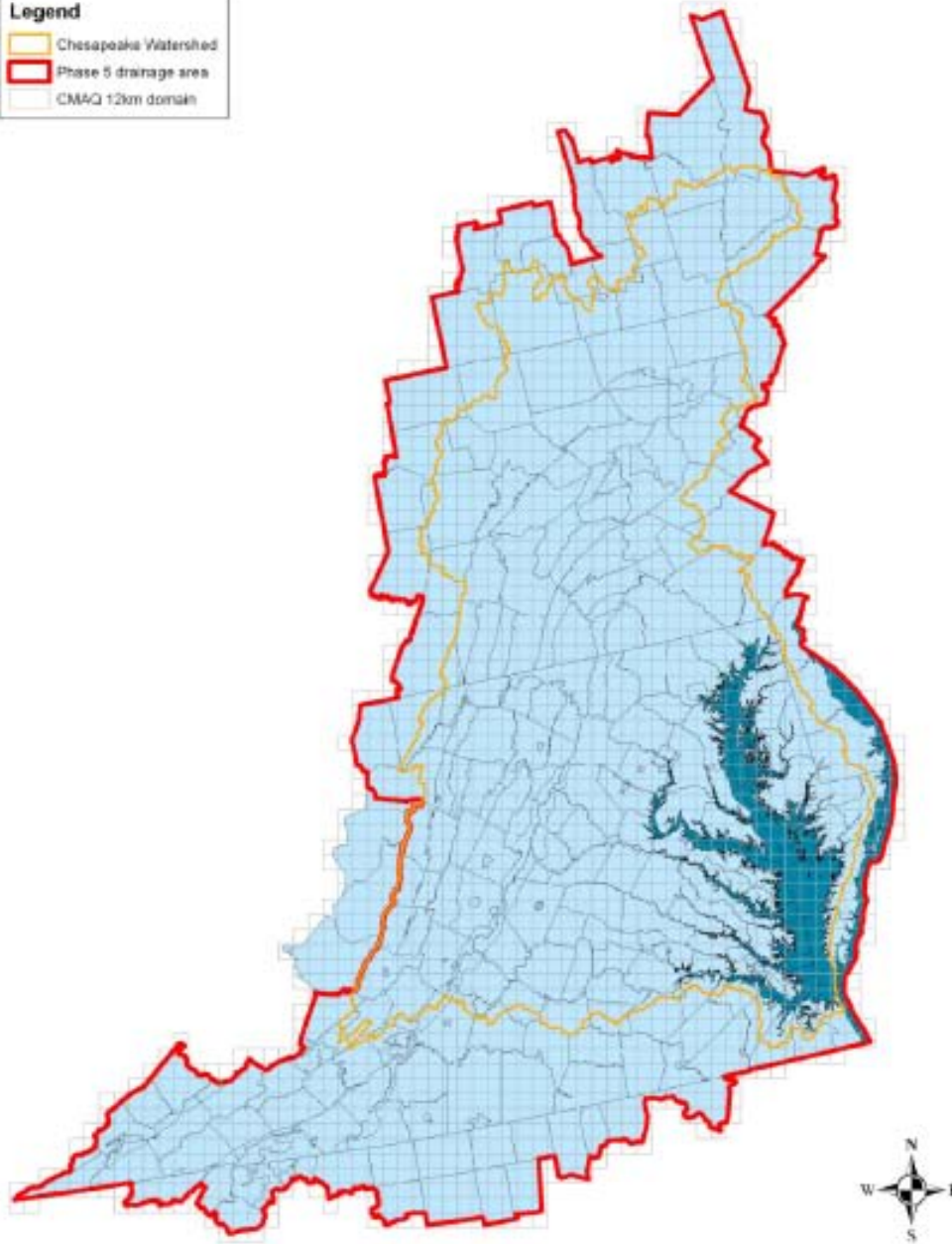


Figure 5-10 CTR-CMAQ 12km Grid Presentation for Phase 5 WRFG.



Example CMAQ Scenarios Supporting the Reevaluation

The following list of key air scenarios are illustrative of what was used for the CBP Reevaluation:

- 2015 CAIR (all current national air regulations included) 1/06.
- 2020 CAIR (all current national air regulations included) 1/06.
- 2020 CAIR with additional, aggressive utility or electric generating units (EGU) controls 7/06.
- 2030 CAIR with aggressive EGU controls 4/06.
- 2020 CAIR with additional, aggressive EGU, industry, and mobile source controls (to approximate a Limit of Technology future) 7/06.
- Allocation of Bay State responsibility to watershed deposition for PA, VA, MD, DE, WV, NY 9/06 (each State requires a separate scenario).



Next Generation Models for Mid-Point 2017 Assessment

The overall timeline might look something like this:

December 2010 - Phase I WIPs published with Phase 5.3 WSM and existing Bay Model.

December 2011 – Draft Phase II WIPs due to EPA with Phase 5.3.2 WSM and recalibrated Bay Model. **March 30, 2012** – Final Phase II WIPs due to EPA.

January 2012 - Begin post TMDL 2-year milestone tracking with Phase 5.3.2 WSM and Bay Model.

December 2013 - Airshed Model updates planned and tracked for bi-modal NH_3 & Hg and new CMAQ scenarios.

December 2015 - Fully calibrated and operational Watershed Model and next generation Bay Model ready for analysis of Phase III WIPs.

2016 – Jurisdictions develop Phase III WIPs with respect to what remains to be done in the final 7 years of planning (2018 -2025) to fully achieve the Bay water quality standards.

2017 – Jurisdictions submit Phase III WIPs with 2018 - 2025 actions and controls for review and approval.

Partnership Input Processes

- Normal BMP process for updating existing efficiencies with new research
- Issues related to inputs, land uses, BMPs, etc. will be discussed in source workgroups, WTWG, and WQGIT
- Issues of model theory, structure, and calibration will be discussed *by the Modeling Team* in the Modeling Quarterly Reviews.



2017 Air Model Recommendations

- **Update the wet deposition model from current 1985-2005 to ~1980 to 2012 or beyond.**
- **Include CMAQ Model refinements of bi-directional ammonia.**
- **Develop a new 2007 emissions/meteorology base to update the current 2002 emissions/meteorology base.**
- **New library of CMAQ Scenarios of:**
 - **current conditions**
 - **2025**
 - **2030**
 - **Maximum Feasible**
- **A regional modeling center for CMAQ Scenarios of local interest linked to CBP's WSM and WQSTM.**

Summary of key points and next steps

2012 is the timeframe for COG to provide input on potential Airshed Model changes and scenarios.

COG Air & Water staff coordinating to assess the Airshed & Watershed Models and their assumptions/scenarios.

WRTC's July 12th Meeting

- Special Speaker - John Sherwell, MD-DNR
- COG staff will also have updates and recommendations

What additional questions/information would the WRTC like to have addressed?

Please feel free to call or email with questions:

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