Relative Responsibility Assessment of Sectors and States: Oxidized-Nitrogen Deposition in 2020 (final numbers)

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Annapolis, MD

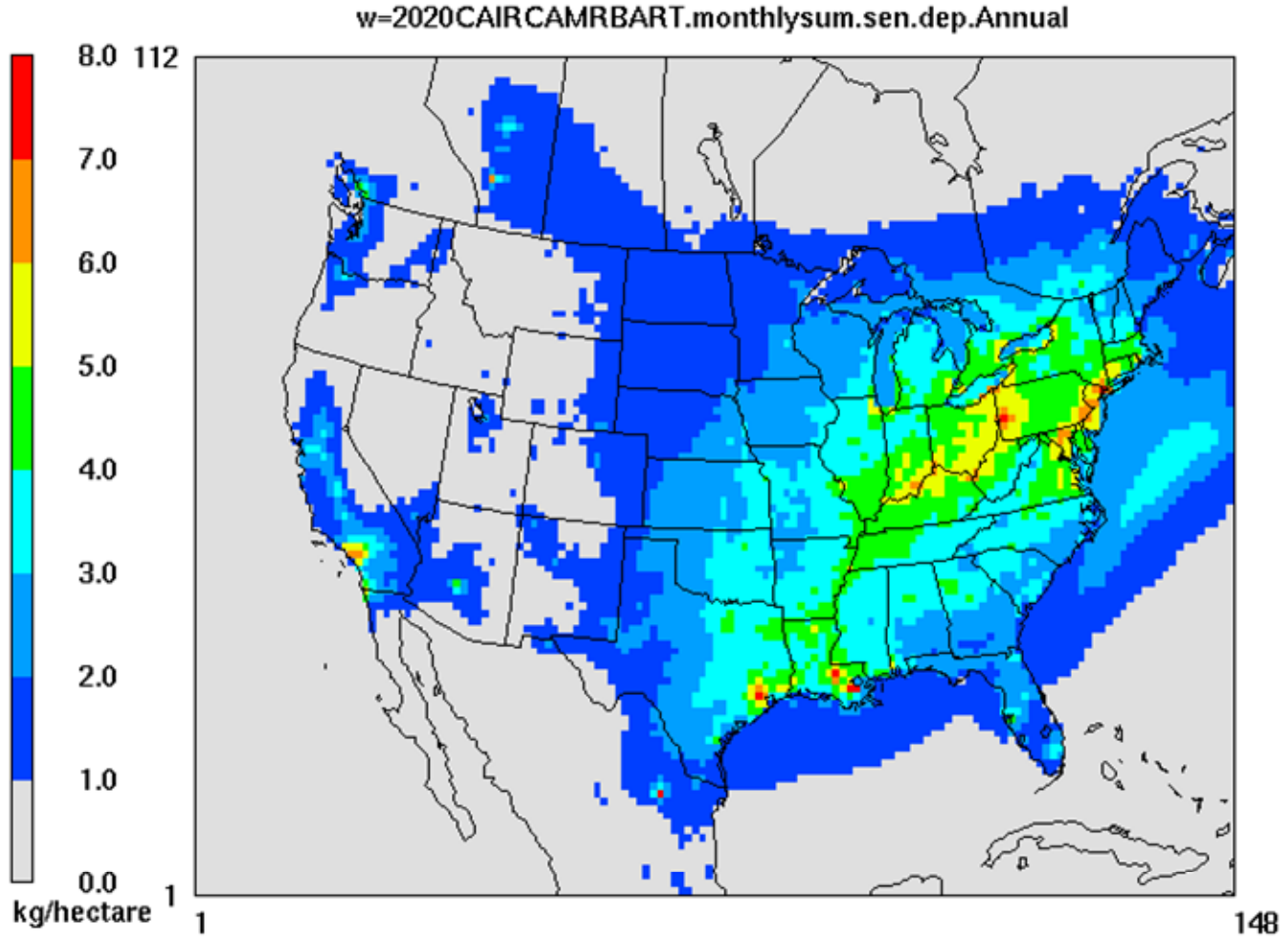
- Used a new sensitivity version of CMAQ, with DDM-3D (direct decoupled method in 3-D) that uses native equations of the model to estimate ox-N deposition sensitivities to very small changes in NOx emissions, hence, avoiding many nonlinearities. Expected to be more accurate than brute force.

- First application for deposition (it worked well)

- 36-km CMAQ
  - dry, average and wet years
  - 2020 emissions

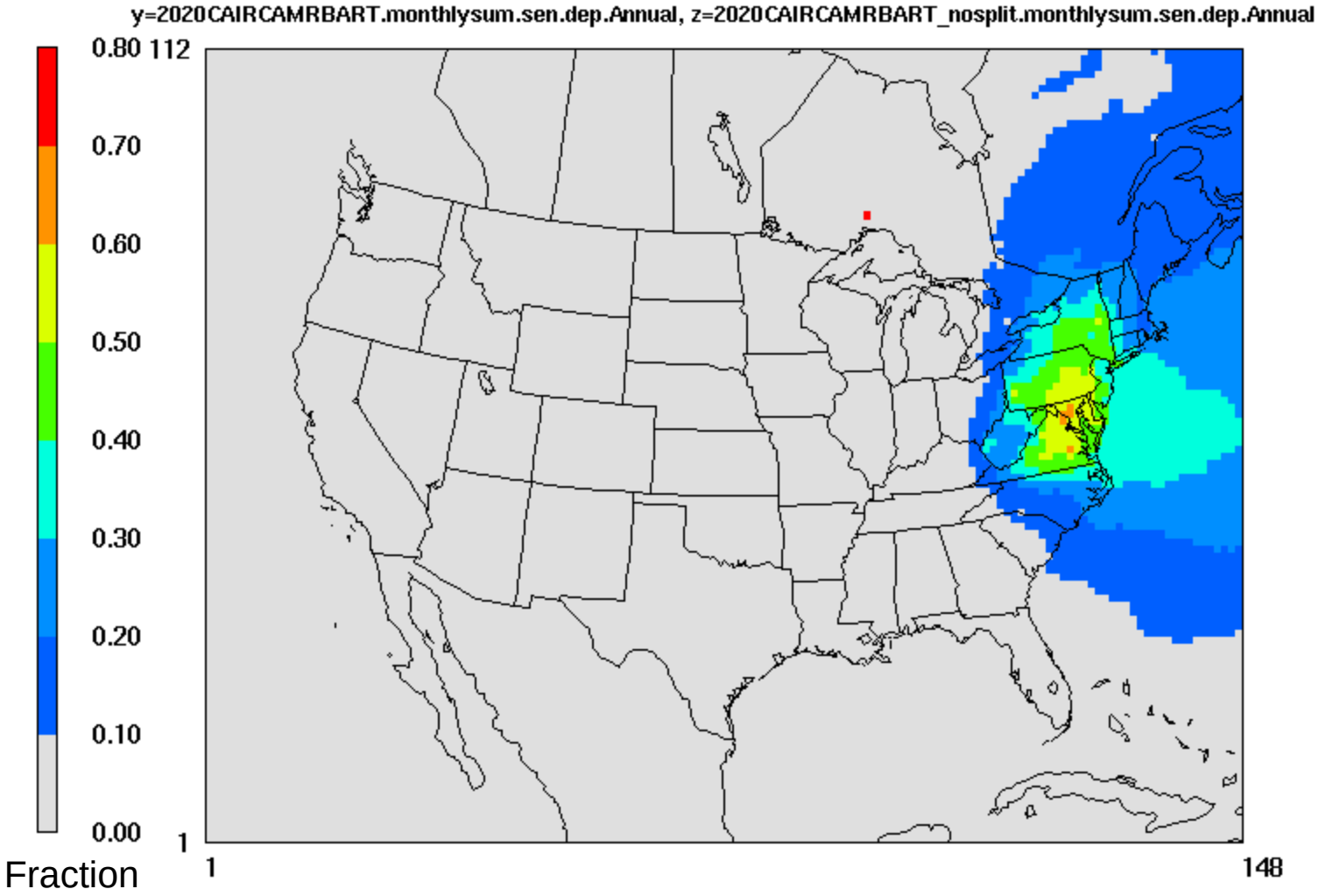
Bay States

Total Ox-N Deposition: 2020

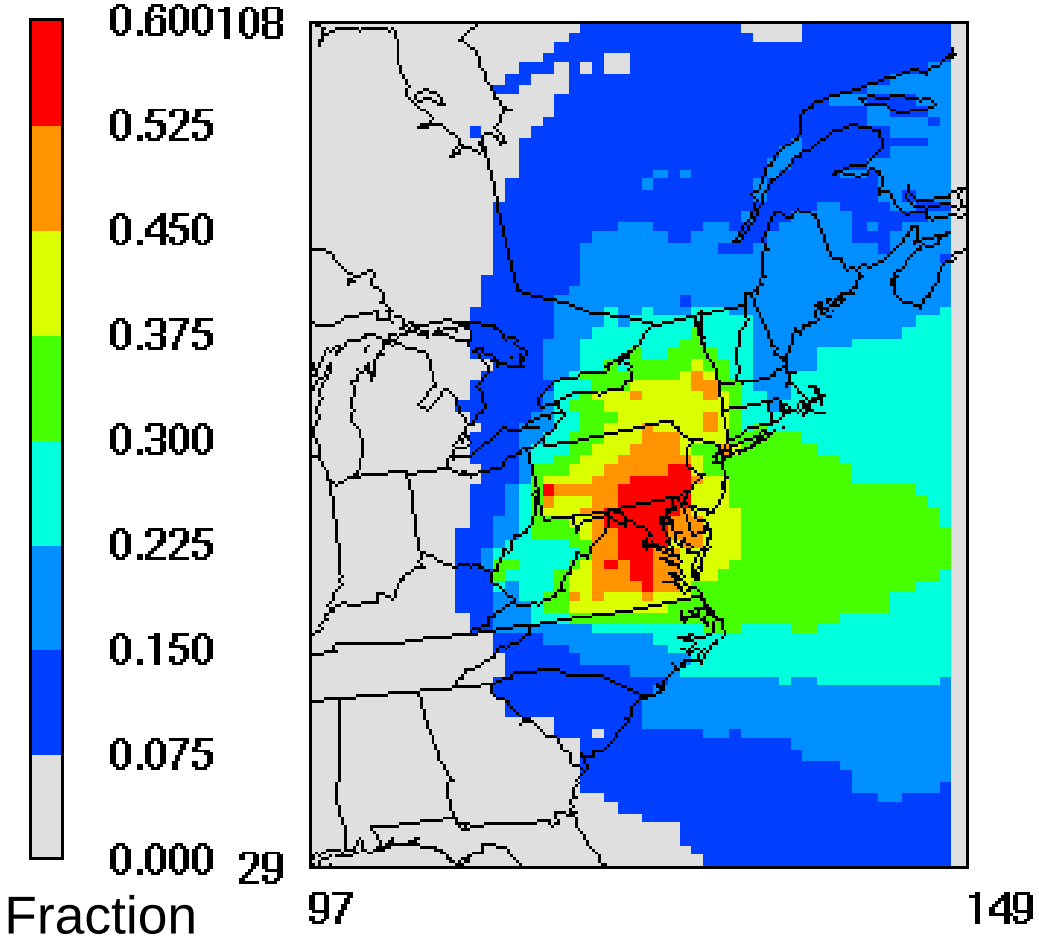


2020 Wet + Dry N Deposition (Ox-N) 36-km
(wet, dry, normal year average)

Relative Influence of 6 Bay States: 2020
National View



Relative Influence of 6 Bay States: 2020
Mid-Atlantic View



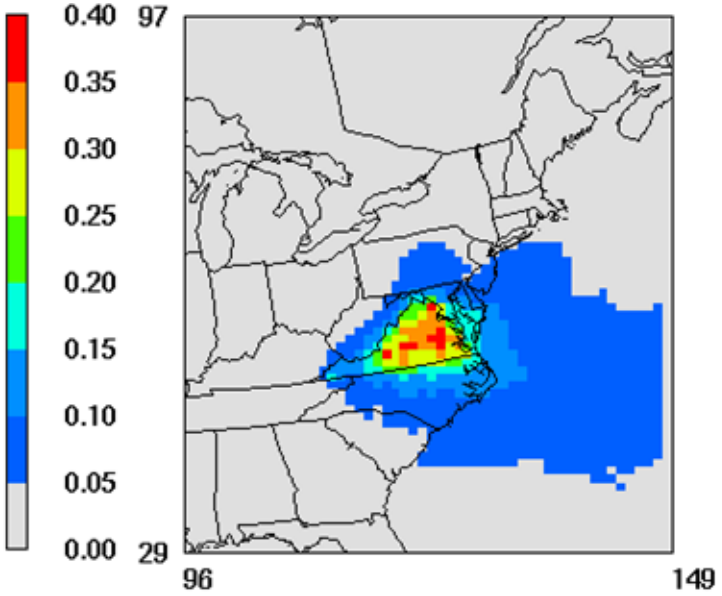
6-State Influence 2020:

Watershed
49%

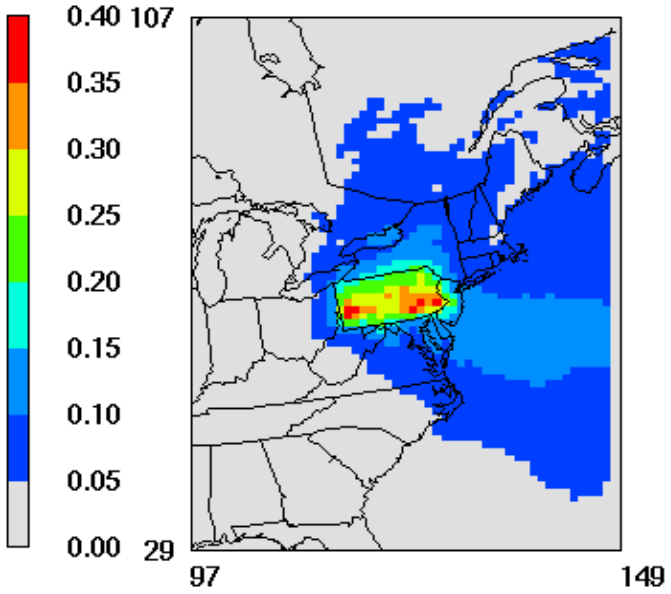
Above Fall-Line
48%

Below Fall-Line
54%

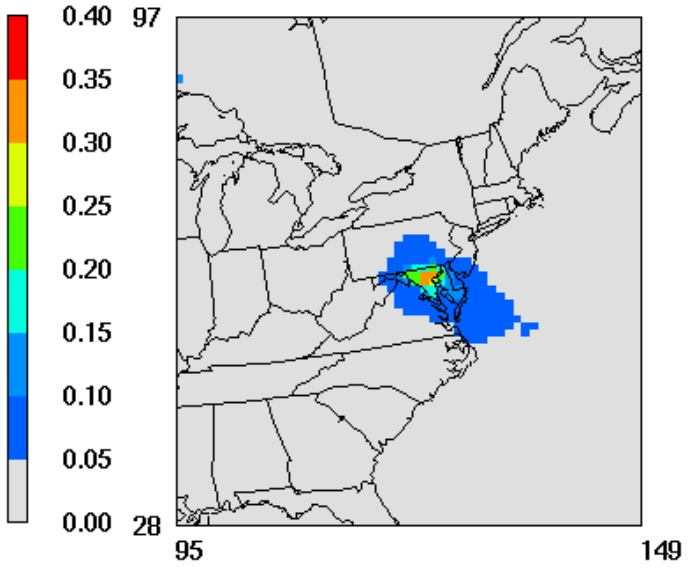
Virginia



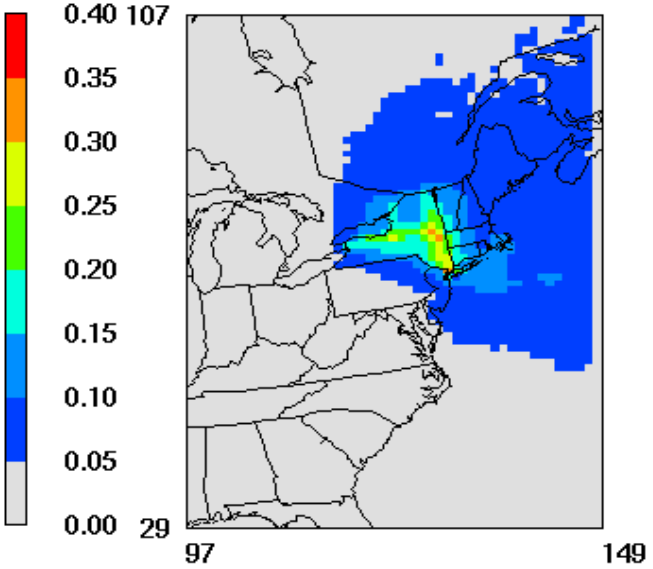
Pennsylvania



Maryland



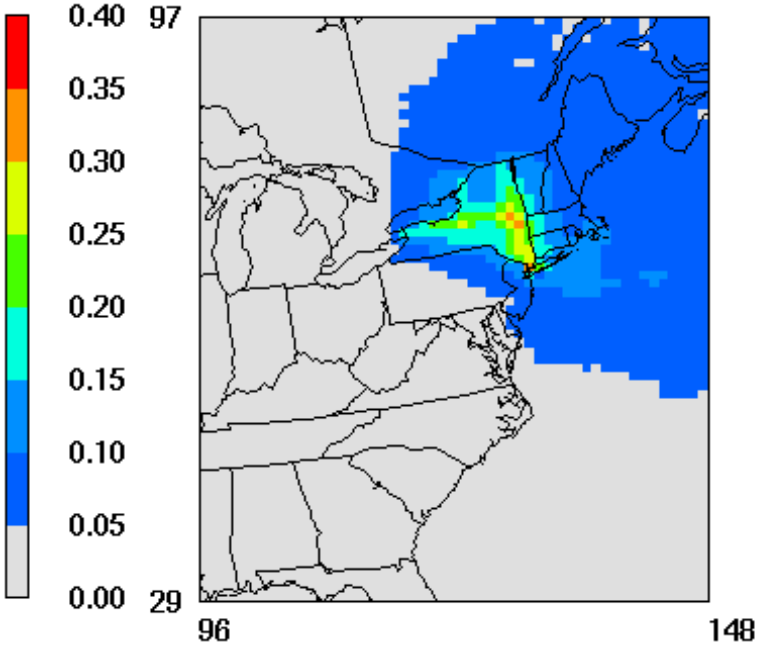
New York



Oxidized Nitrogen Deposition
State Responsibility

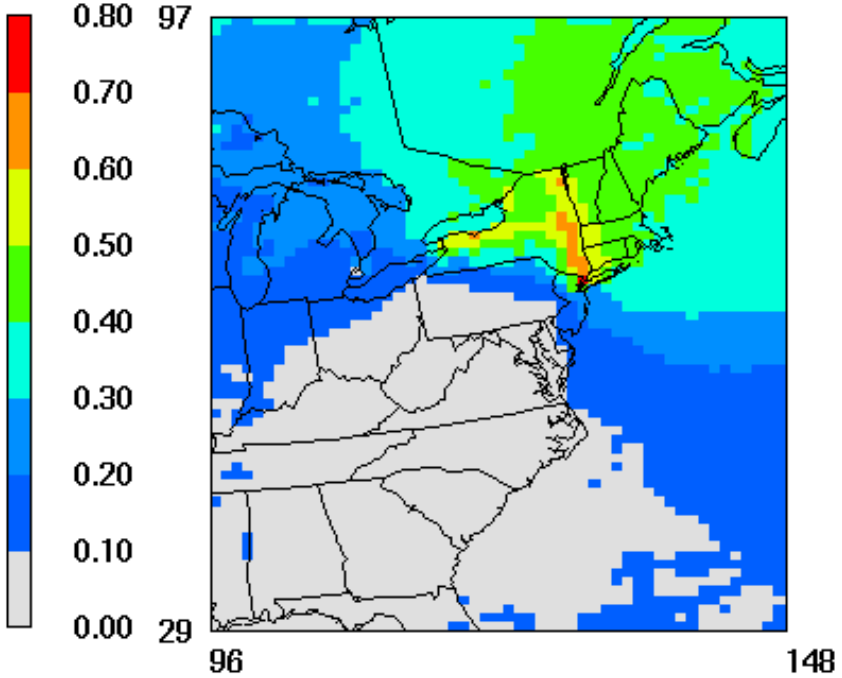
Chesapeake Bay Watershed		
	1990	2020
Delaware		1.2%
Maryland	9.1%	7.9%
New York		4.6%
Pennsylvania	16.8%	16.4%
Virginia	10.4%	14.9%
West Virginia		4.6%
Six State (calculated as a group)		49.3%

New York



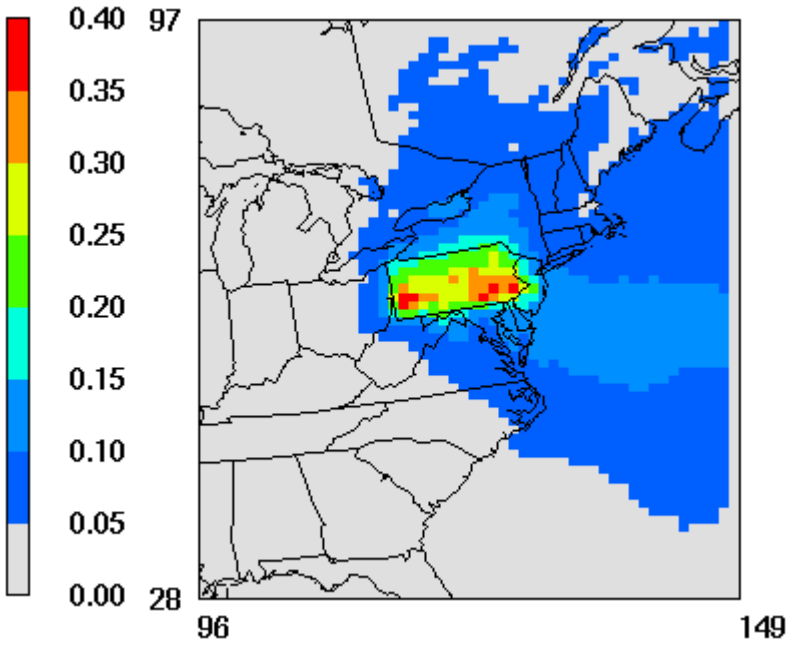
New York Fraction of Total

New York



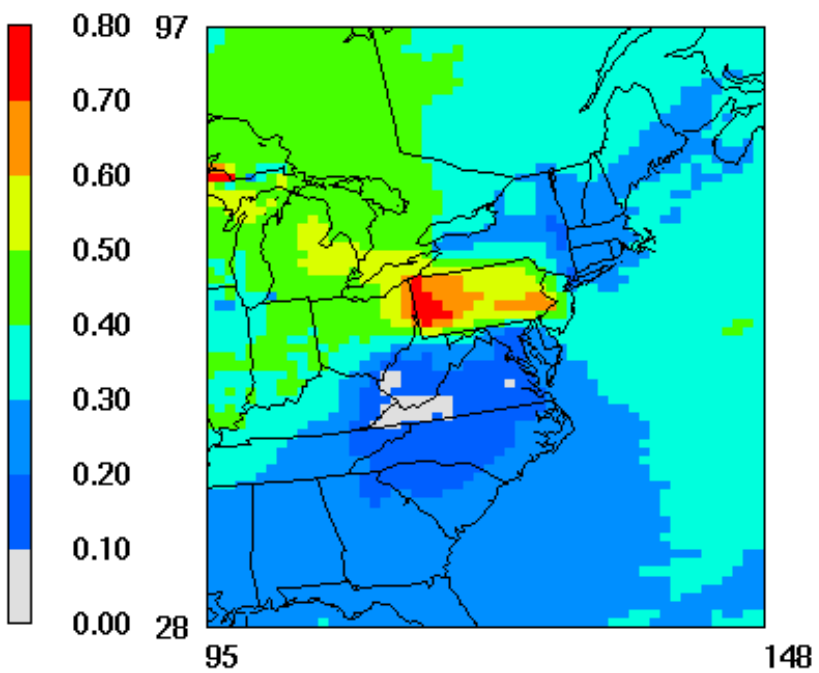
New York Fraction of 6 States

Pennsylvania



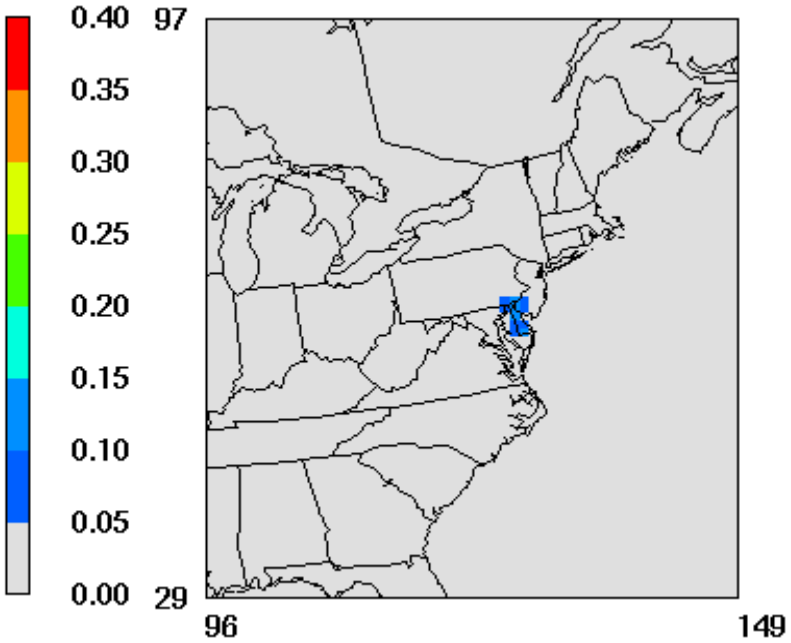
Pennsylvania Fraction of Total

Pennsylvania



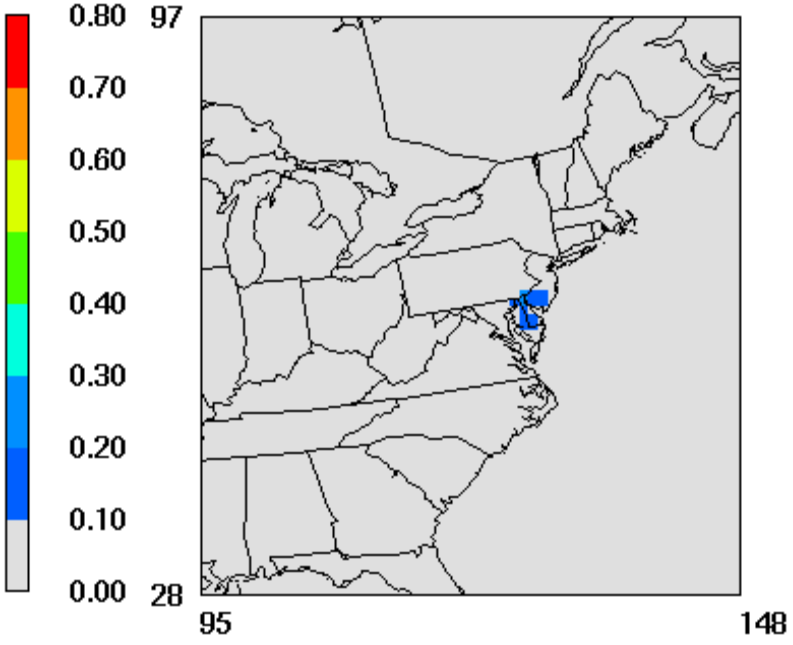
Pennsylvania Fraction of 6 States

Delaware



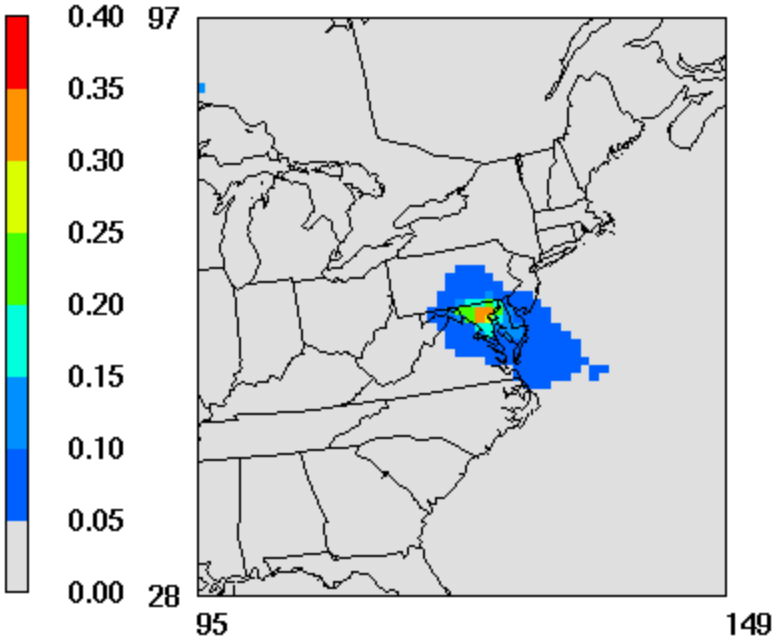
Delaware Fraction of Total

Delaware



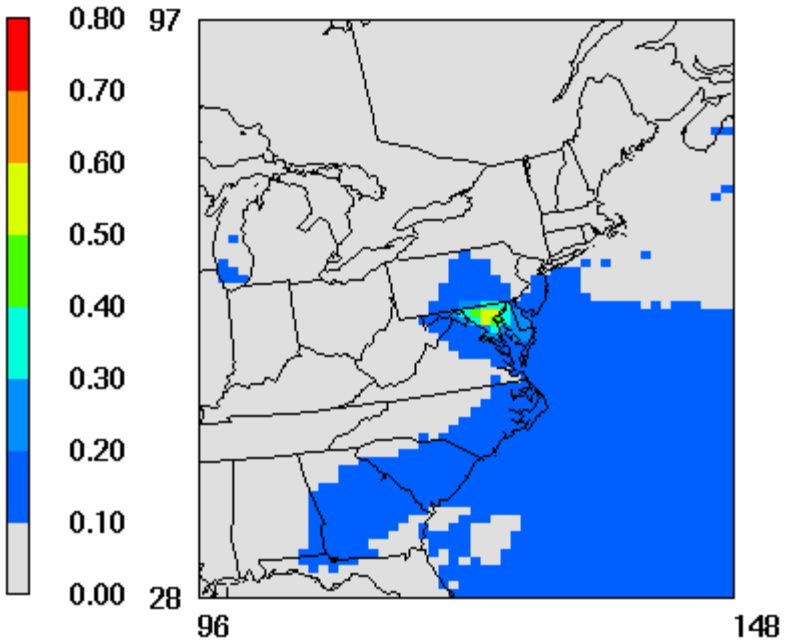
Delaware Fraction of 6 States

Maryland



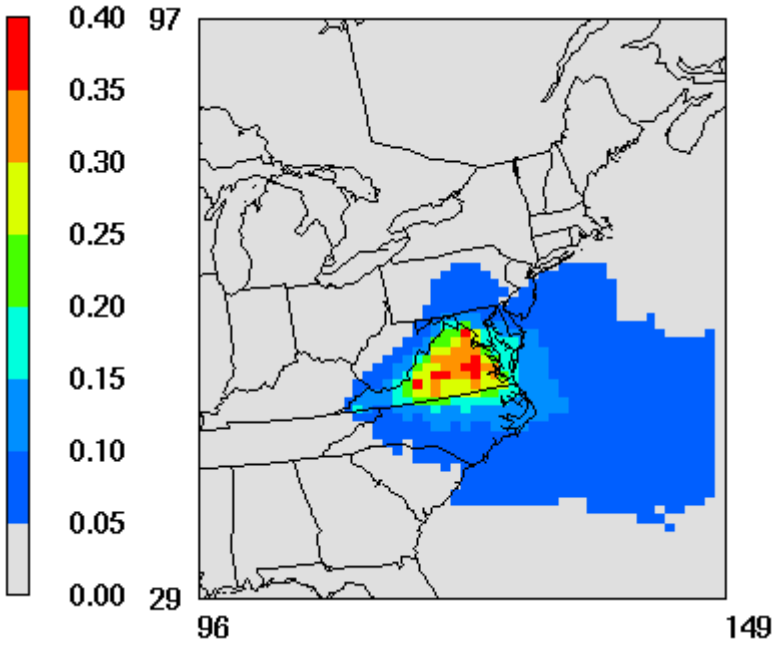
Maryland Fraction of Total

Maryland



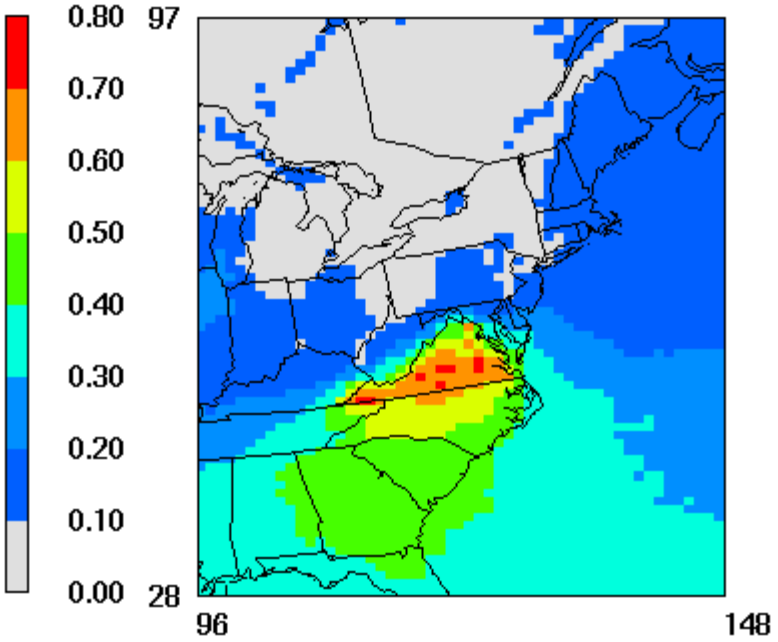
Maryland Fraction of 6 States

Virginia



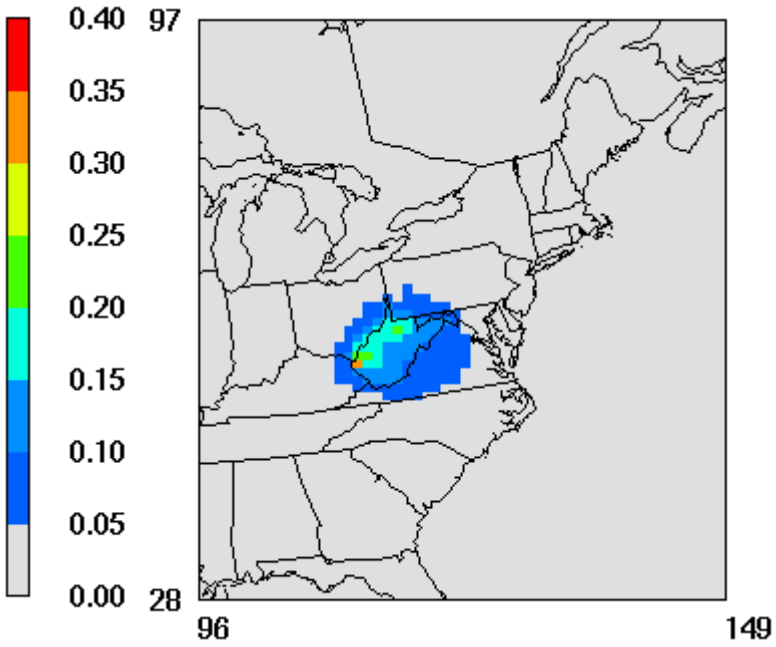
Virginia Fraction of Total

Virginia



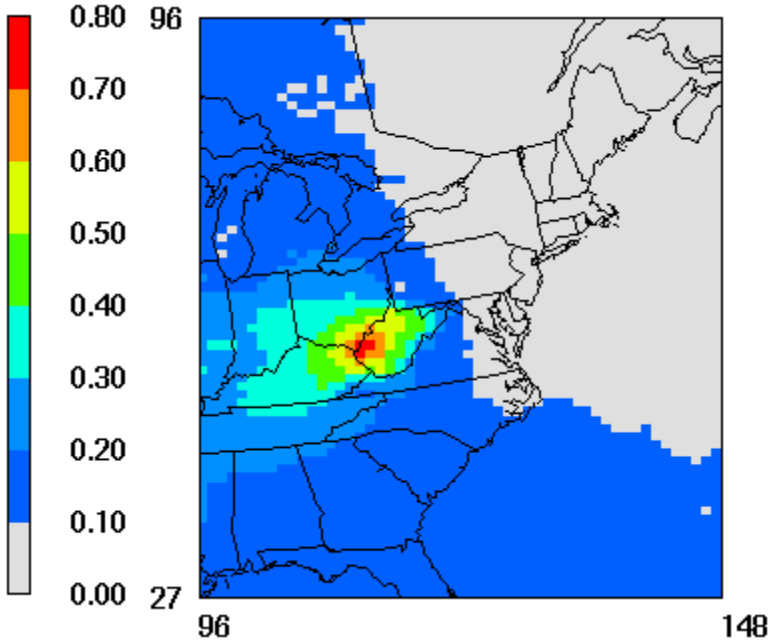
Virginia Fraction of 6 States

West Virginia



West Virginia Fraction of Total

West Virginia



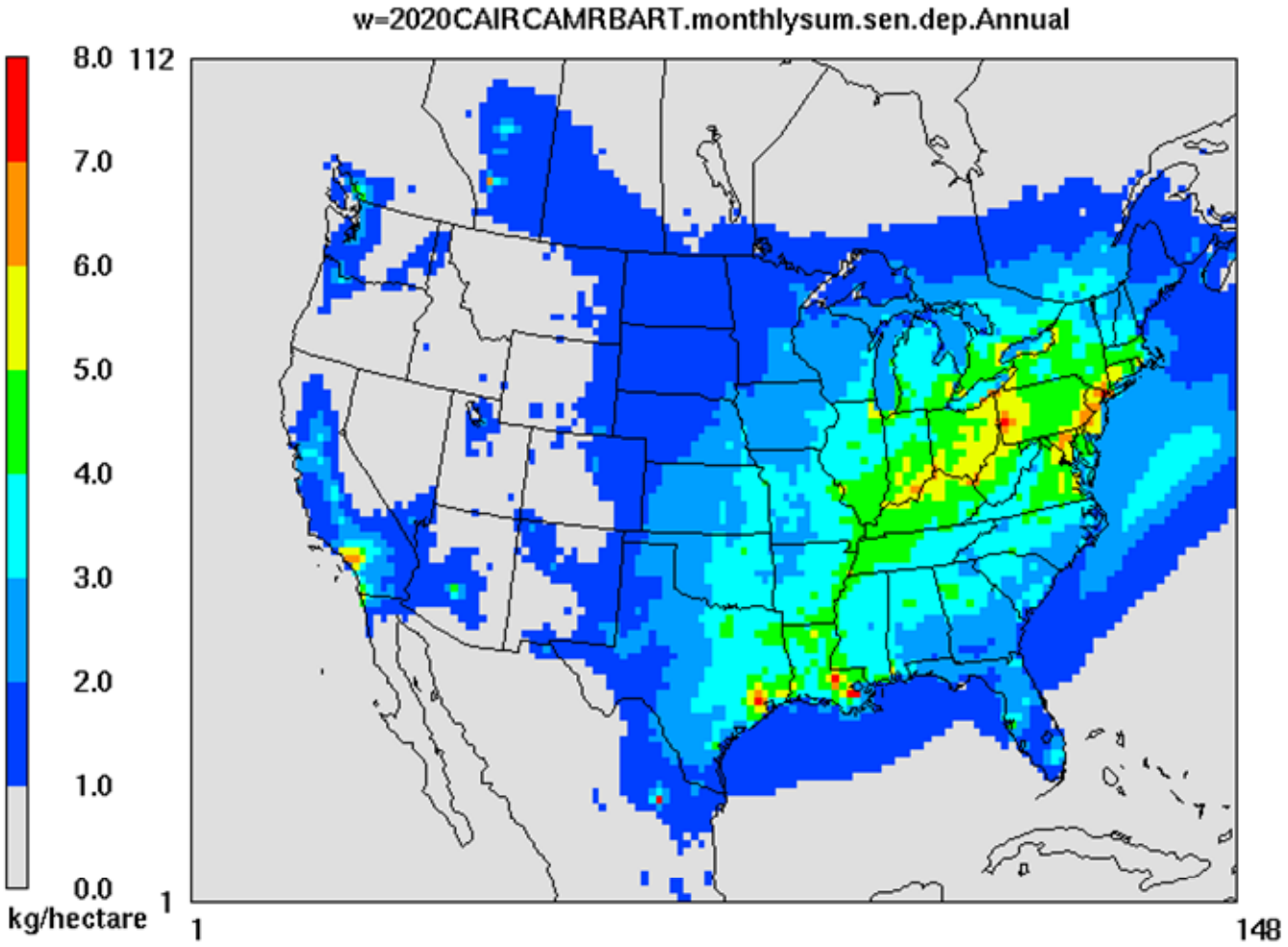
West Virginia Fraction of 6 States

Summary – 2020 State Responsibility

- 6 Bay States responsible for ~ Half of the deposition to the Bay watershed (49%)
- PA and VA top the list (total = 31%)
- Slight increase for 1990 to 2020 for MD, PA & VA
  - 1990 – 36%
  - 2020 – 39%
- Maximum deposition occurs mostly within a state's boundary
  - WV is the exception. Main deposition is west along Ohio R.

Sectors

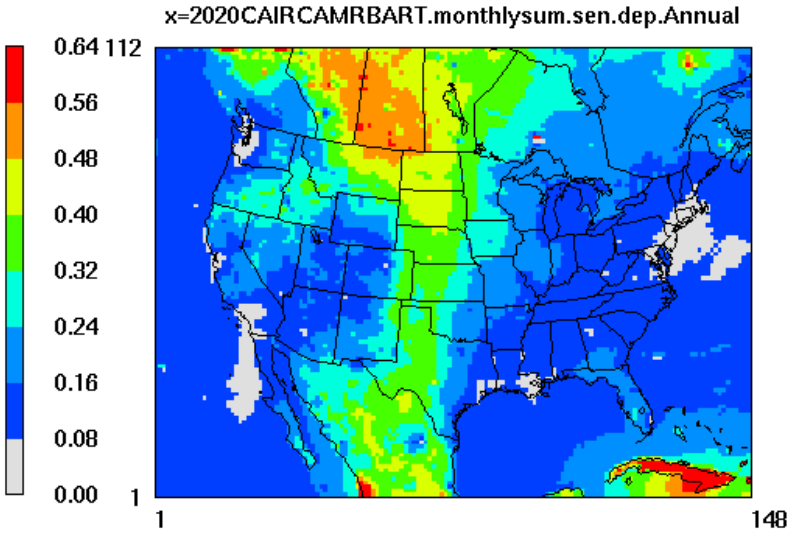
Total Ox-N Deposition: 2020



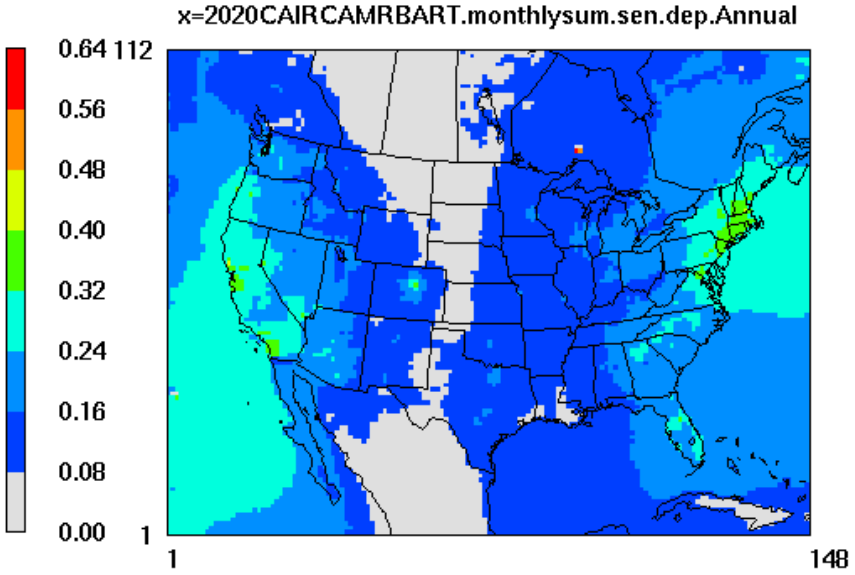
2020 Wet + Dry N Deposition (Ox-N) 36-km
(wet, dry, normal year average)

CMAQ 2020 Sector Responsibility

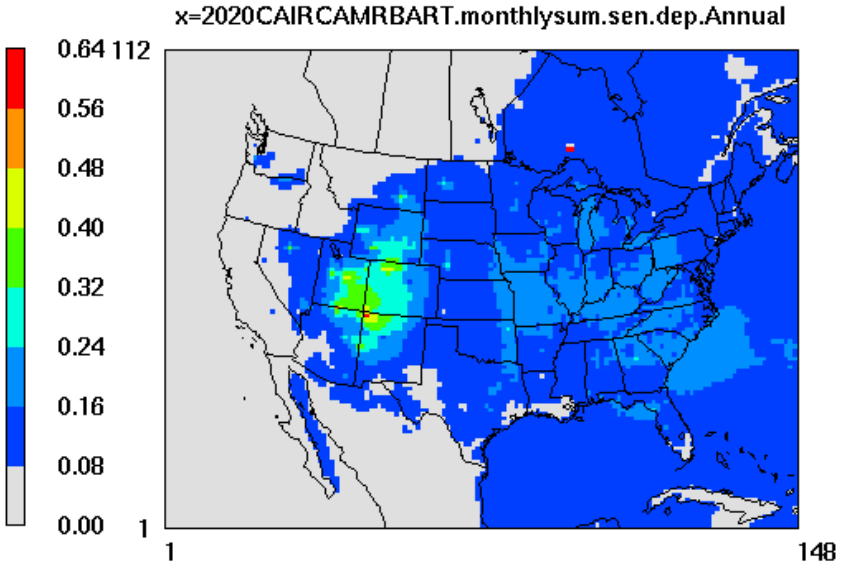
Fires & Ag in the Plains



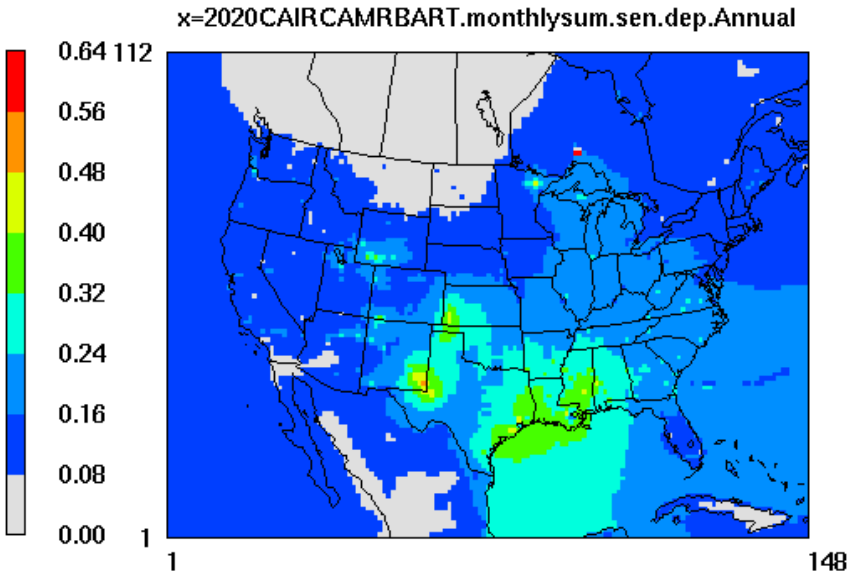
Mobile on Either Coast



Power Plants in the West



Industry in the Gulf



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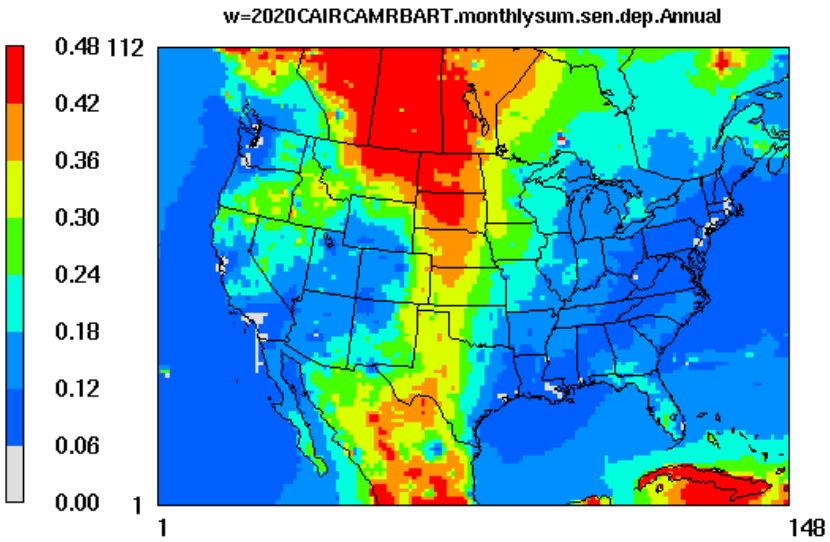

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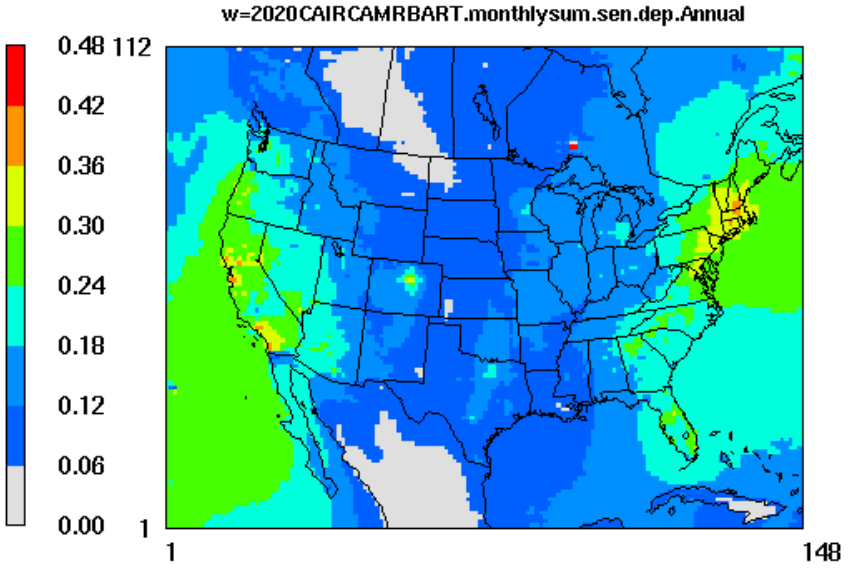

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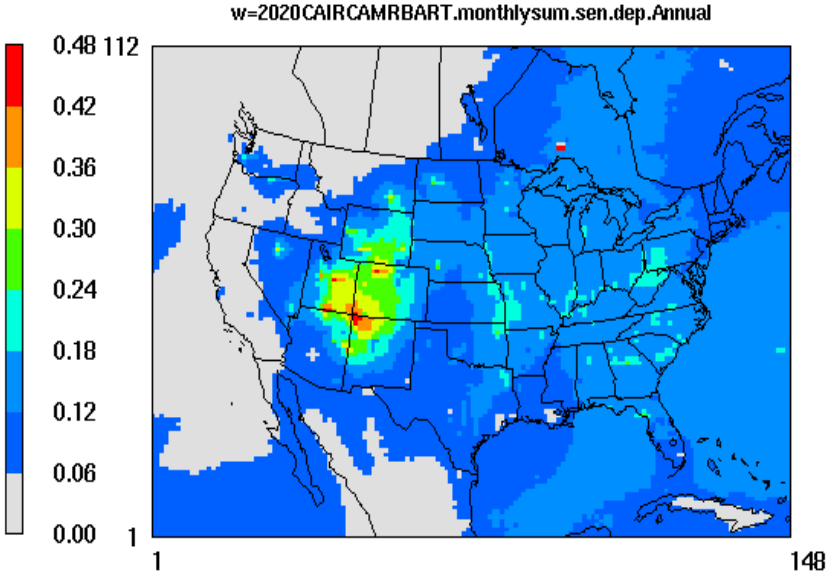

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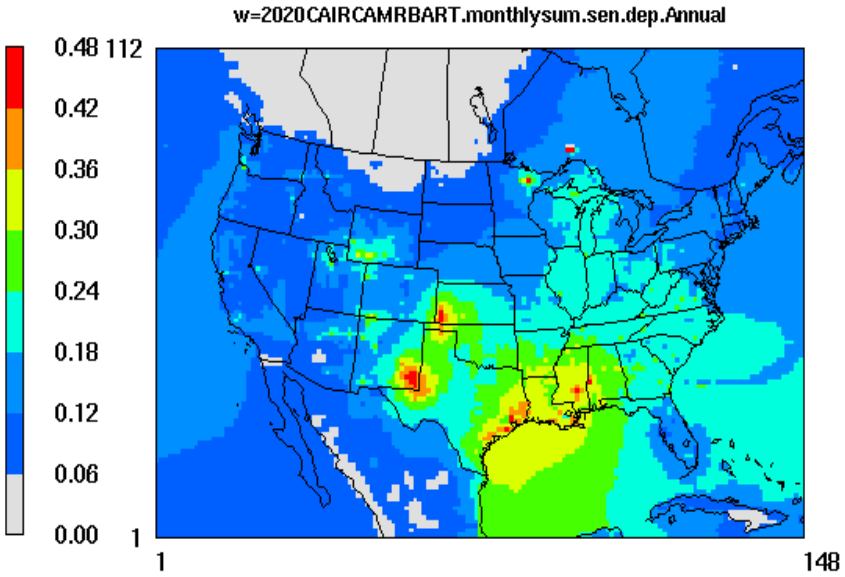
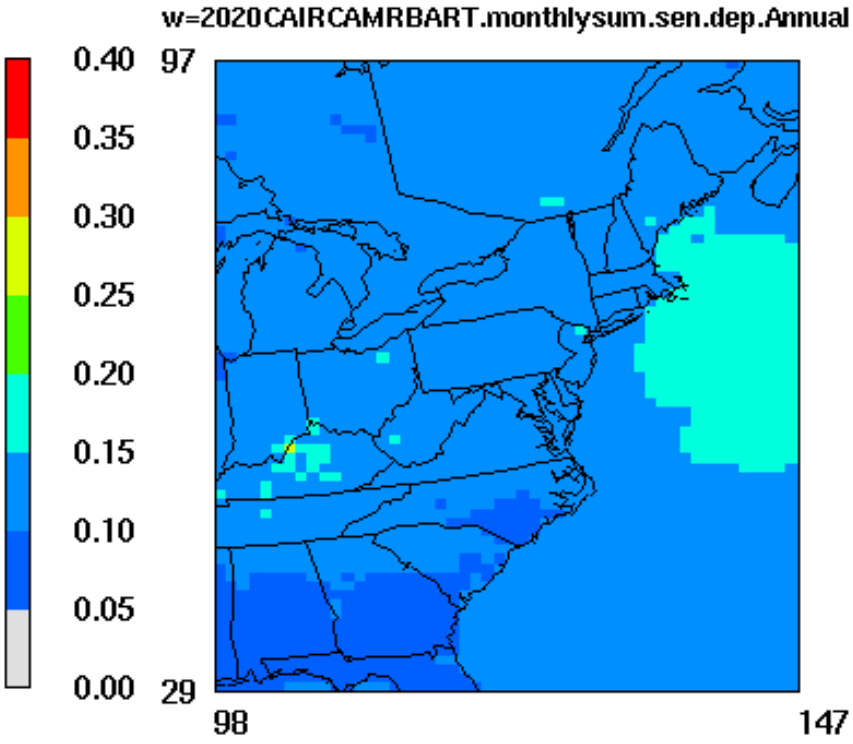


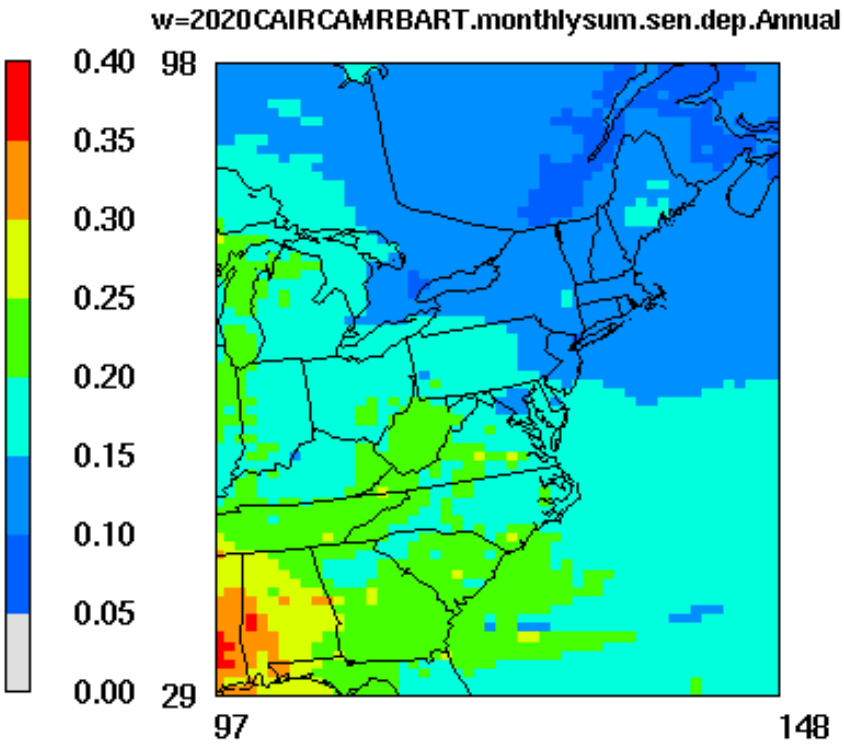
Oxidized Nitrogen Deposition Sector Responsibility

Chesapeake Bay Watershed		
	1990	2020
Power Plants (EGU's)	40%	14.8%
Mobile Sources (on-road)	30%	26.5%
Industry	8%	16.9%
Off-road; Construction; Marine; Residential & Commercial	20%	20.6% 12.1%
Other	2%	9.1%

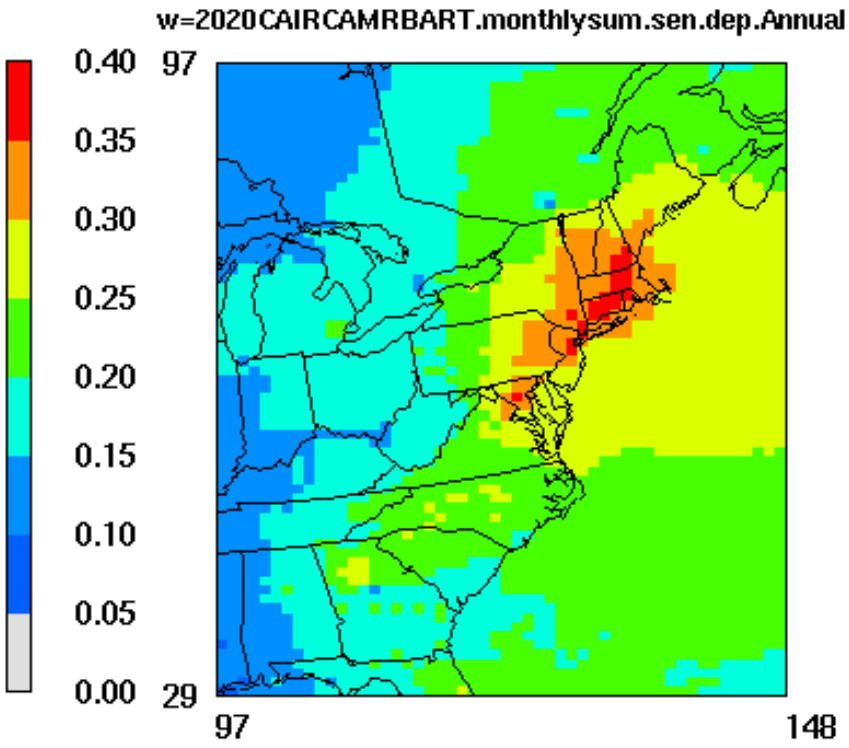
Area



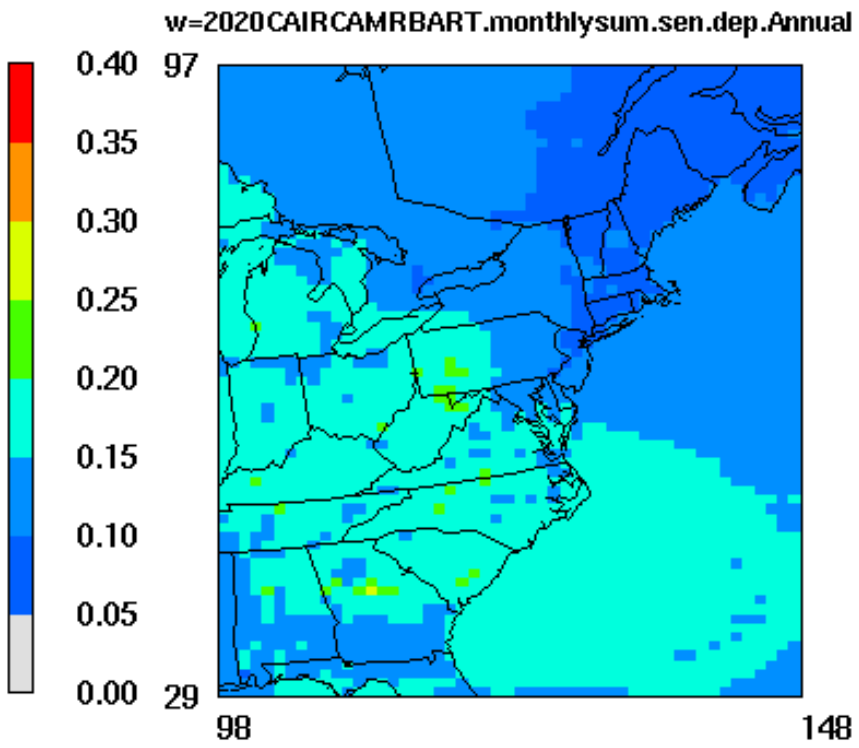
Industry



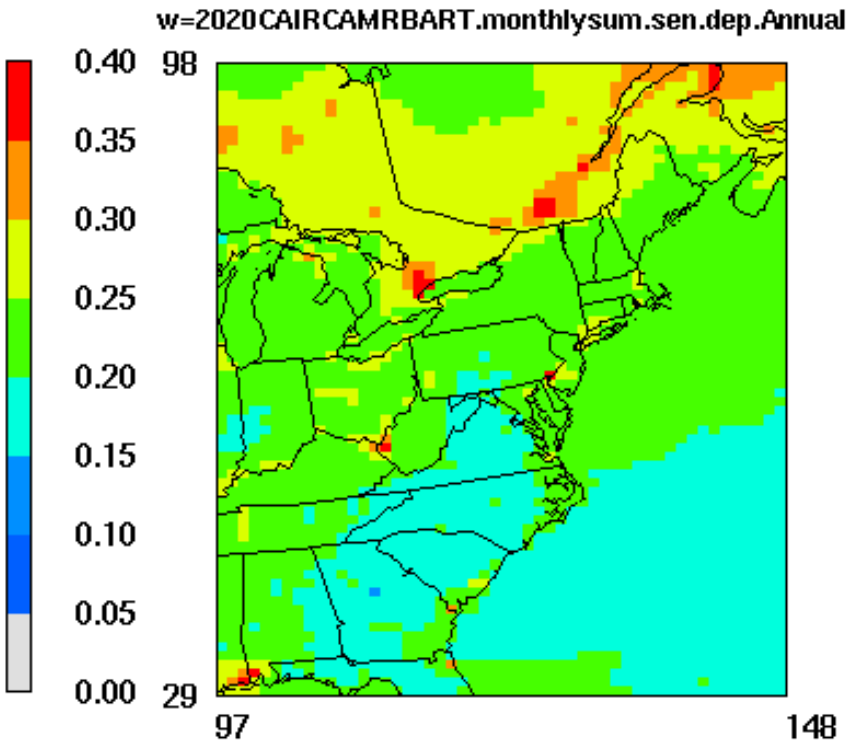
Mobile Sources



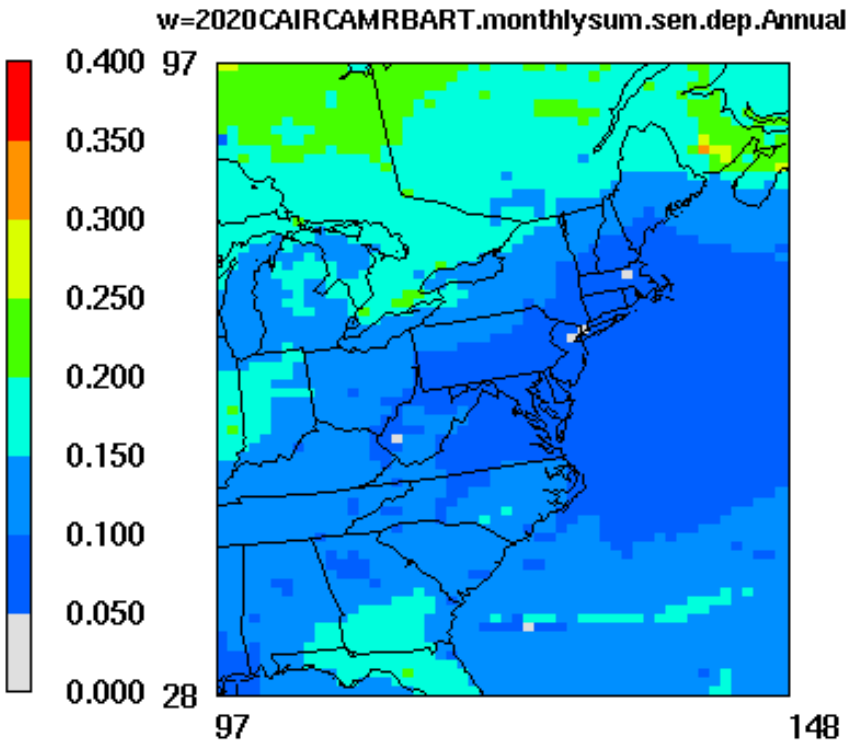
Power Plants



Non-Road Sources



Other

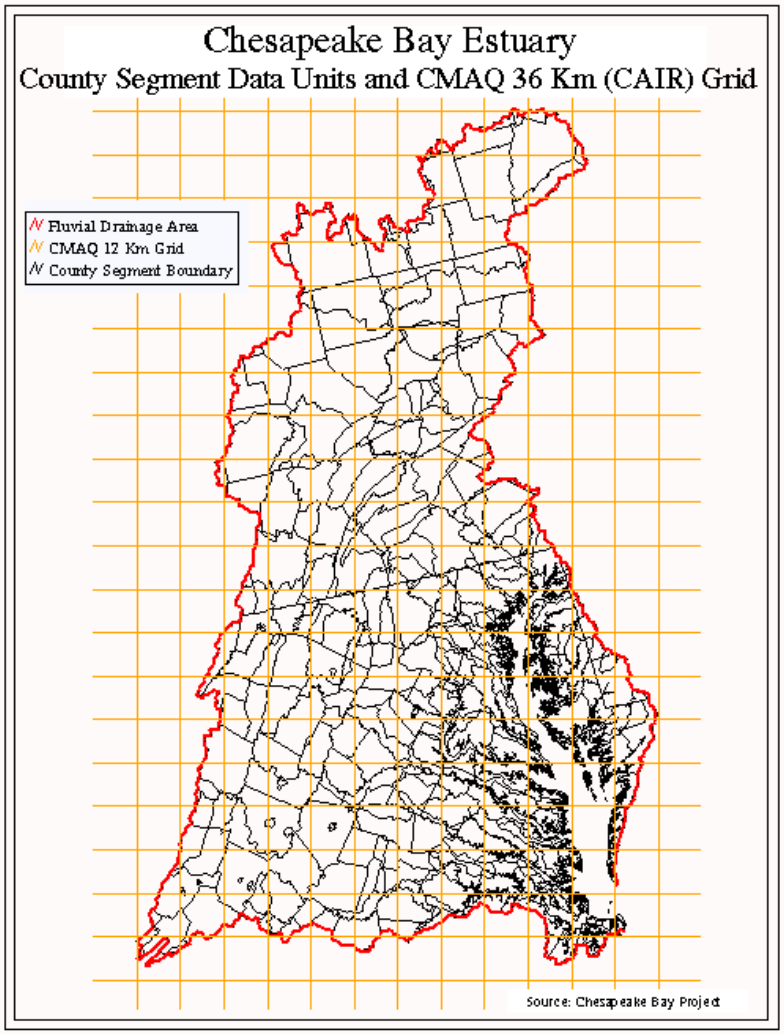


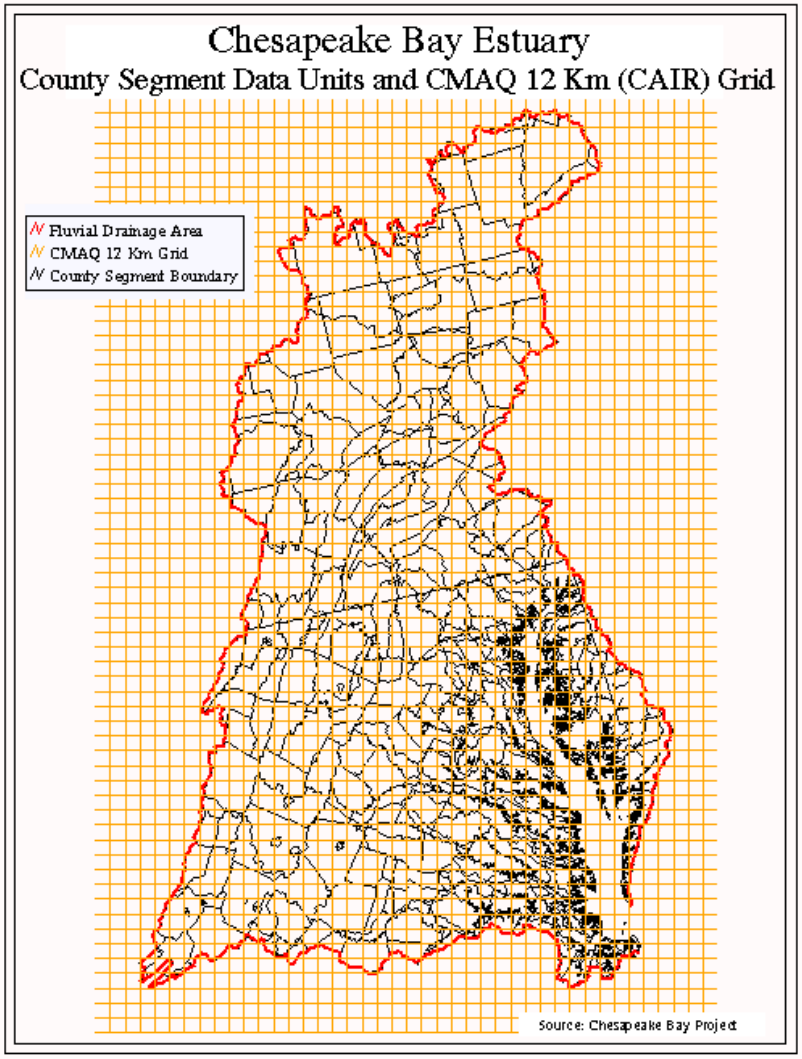
Summary – 2020 Sector Responsibility

- Power Plant (EGU) responsibility went down a lot!
  - 1990 – 40%
  - 2020 – 15%
- Mobile Sources remained important
  - 1990 – 30%
  - 2020 – 27%
- EGU + Mobile down to less than half
  - 1990 – 70%
  - 2020 – 42%
- Industry responsibility expected to double to 17%
- Off-road + Res. & Commercial + Other nearly doubled
  - 1990 – 22%
  - 2020 – 42%
- Industry + Mobile at 43%

Hint of Things to Come

View of 12-km versus 36-km Deposition Patterns


Chesapeake Bay Estuary
County Segment Data Units and CMAQ 36 Km (CAIR) Grid
Fluvial Drainage Area
CMAQ 12 Km Grid
County Segment Boundary
Source: Chesapeake Bay Project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County Segment Data Units and CMAQ 12 Km (CAIR) Grid
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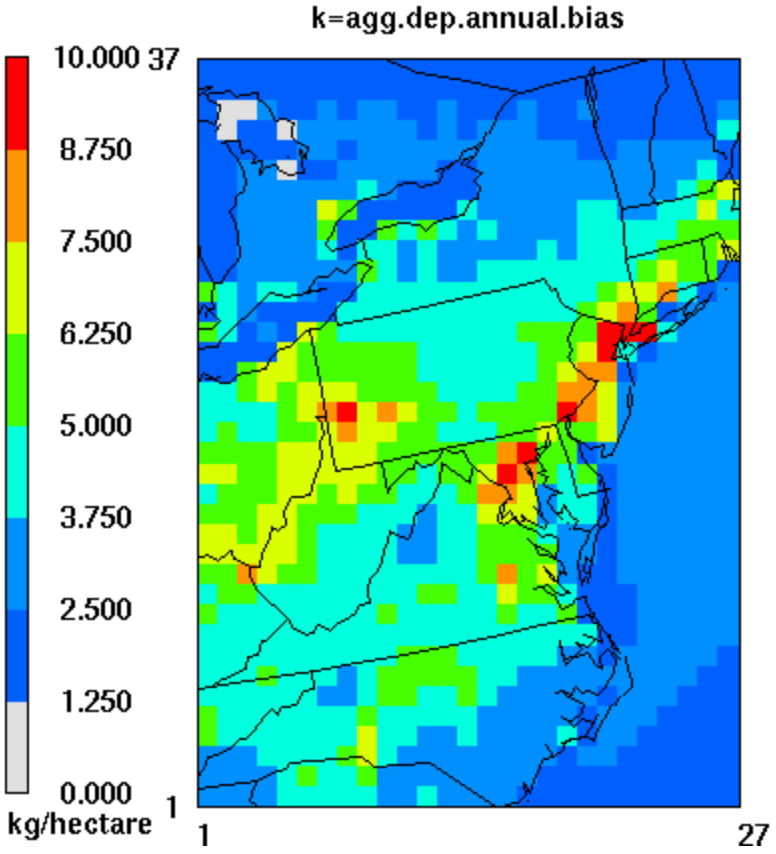
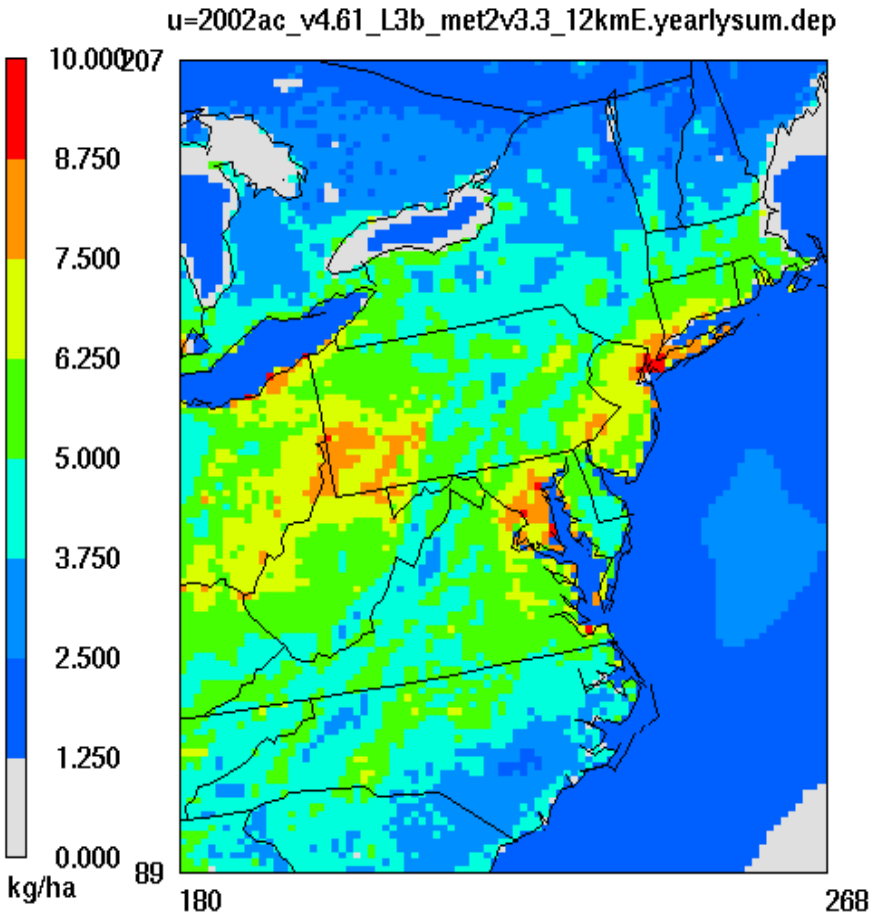
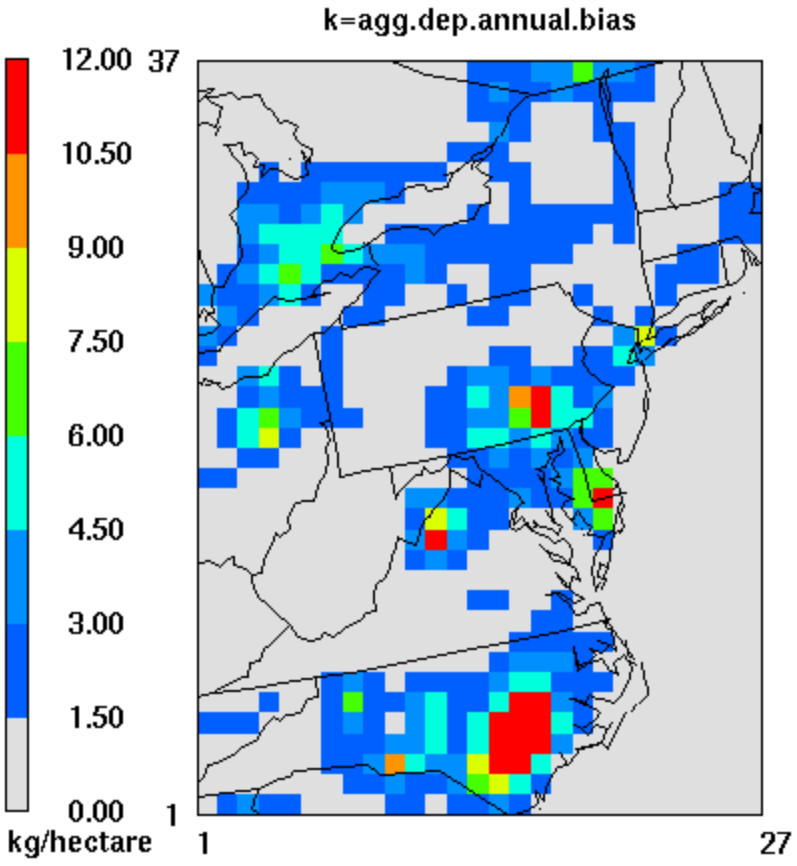
Dry Oxidized-N Deposition 36-km



Dry Oxidized-N Deposition 12-km



Dry Reduced-N Deposition 36-km



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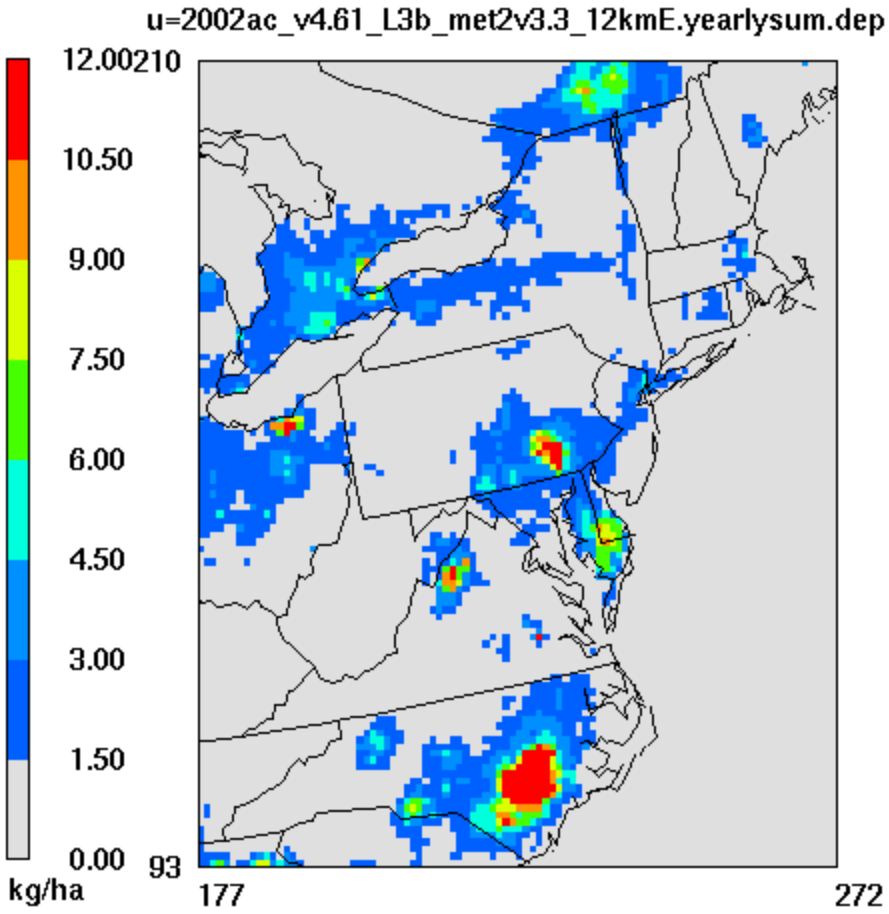
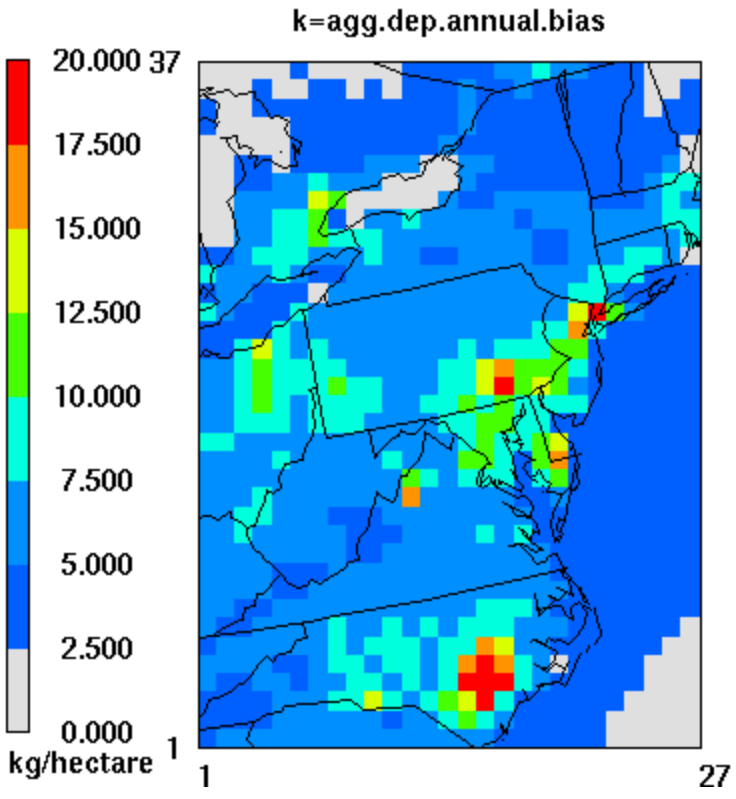
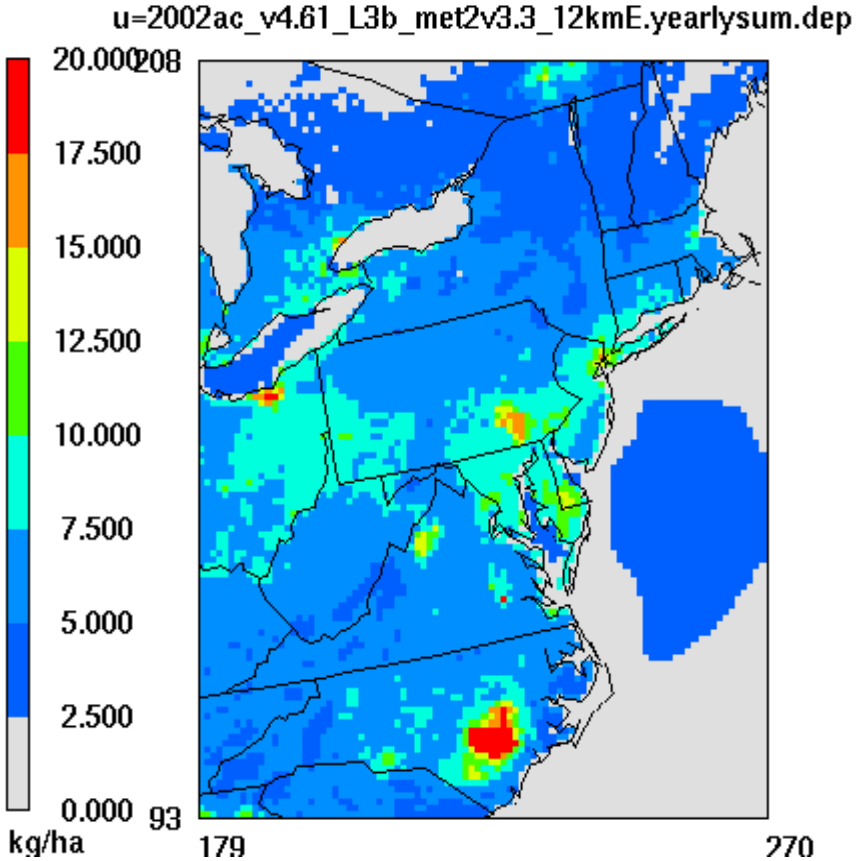


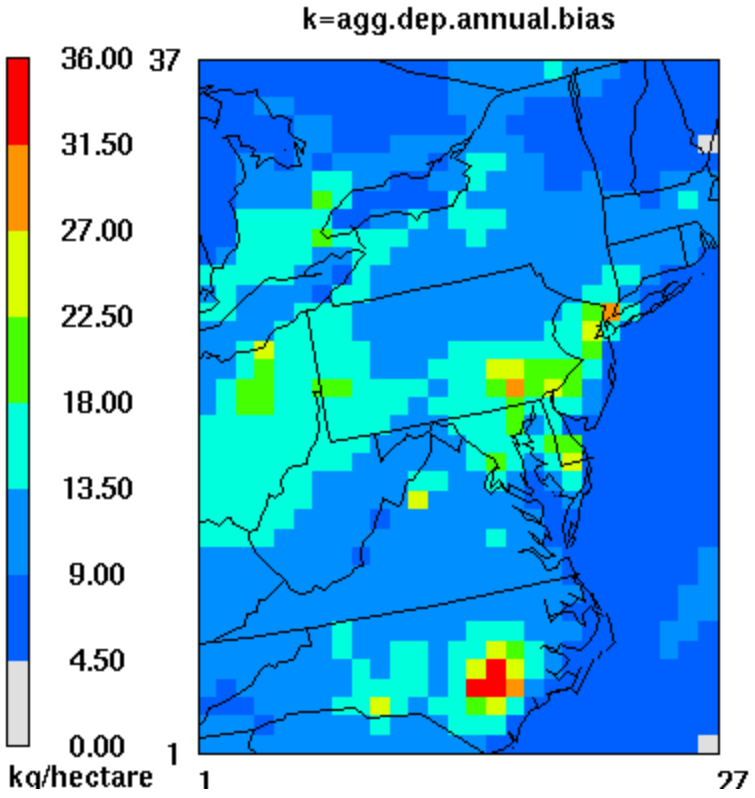
Total Dry N-Deposition 36-km



Total Dry N-Deposition 12-km



Total (Wet+Dry) N-Deposition 36-km



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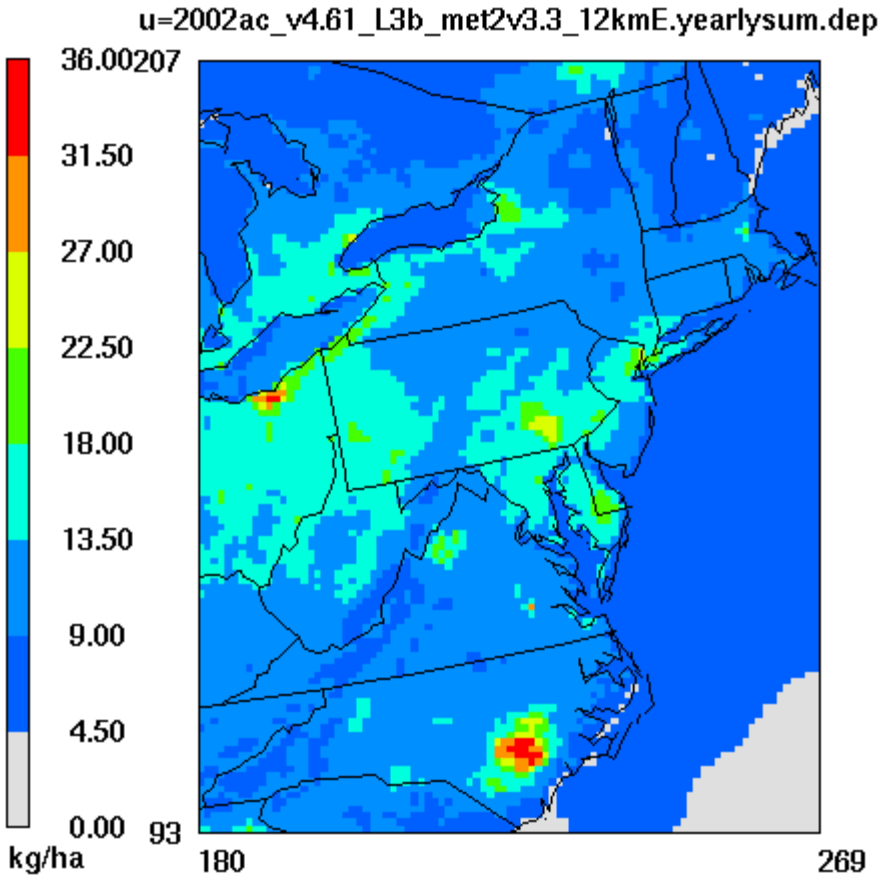

New Ship Emissions

More Realistic Spatial Allocation

2002 SECA 4km NOx Emissions [tons/yr]