Ozone Source Apportionment Modeling to Support Policy Initiatives in the Eastern United States

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Outline

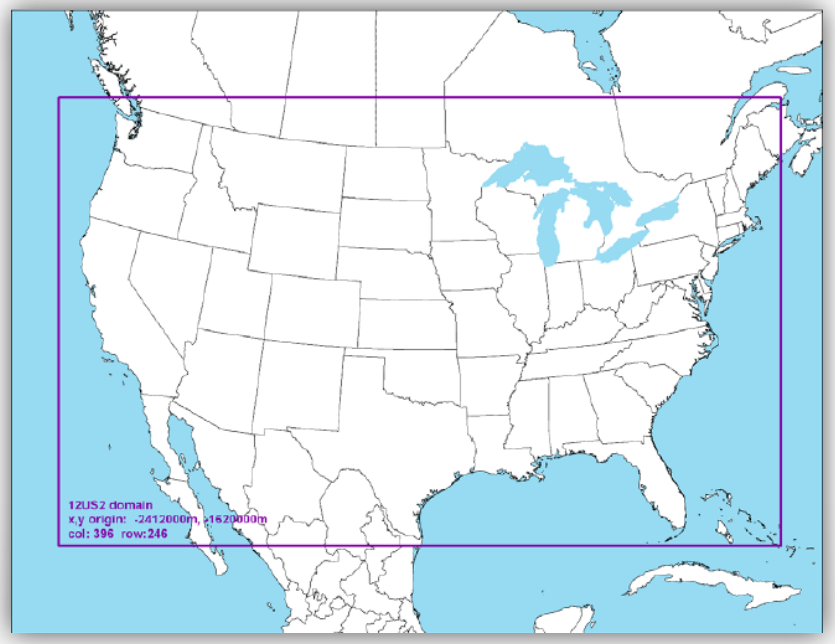
- Motivation
- Modeling approach
- Results: multiple sources examples
- Results: single-source example
- Summary and insights

Motivation

- **Interstate transport** has become increasingly important for addressing NAAQS attainment issues.
- **Source apportionment** has become an important tool to quantify source impacts on downwind ozone and guide policy decisions (e.g., CSAPR).
- **CSAPR modeling** provides state-level source contributions.
- **STI** conducted new source apportionment modeling with detailed tagging to support policy initiatives in the eastern United States.

Modeling Approach

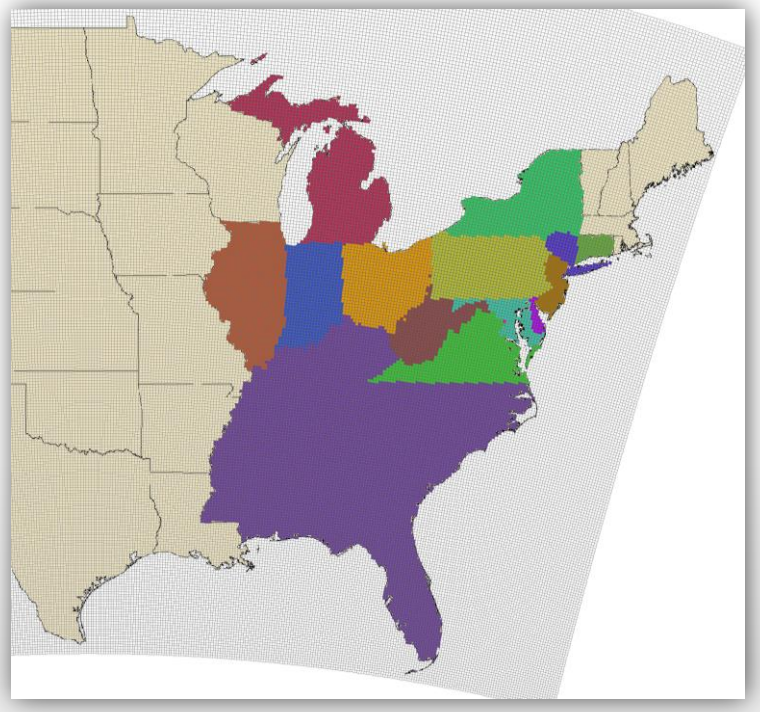
- 2011 ozone season (May-September) simulation with CAMx version 6.1
- Configurations based on EPA's 2011 modeling platform
  - WRF version 3.4
  - 2011 NEI Version 1
  - GEOS-Chem boundary conditions
  - Carbon Bond 6r2
- Ozone Source Apportionment Technology (OSAT) with APCA



APCA = Anthropogenic Precursor Culpability Analysis

Source Apportionment Tagging

Category	Tags
Individual coal-fired power plants	52
Groups of coal-fired power plants (several dozen EGU)	49
Groups of non-EGU points sources within a region	12
Non-point sources (biogenic, on-road, non-road, "other") within 16 regions	64
Initial and boundary conditions	2



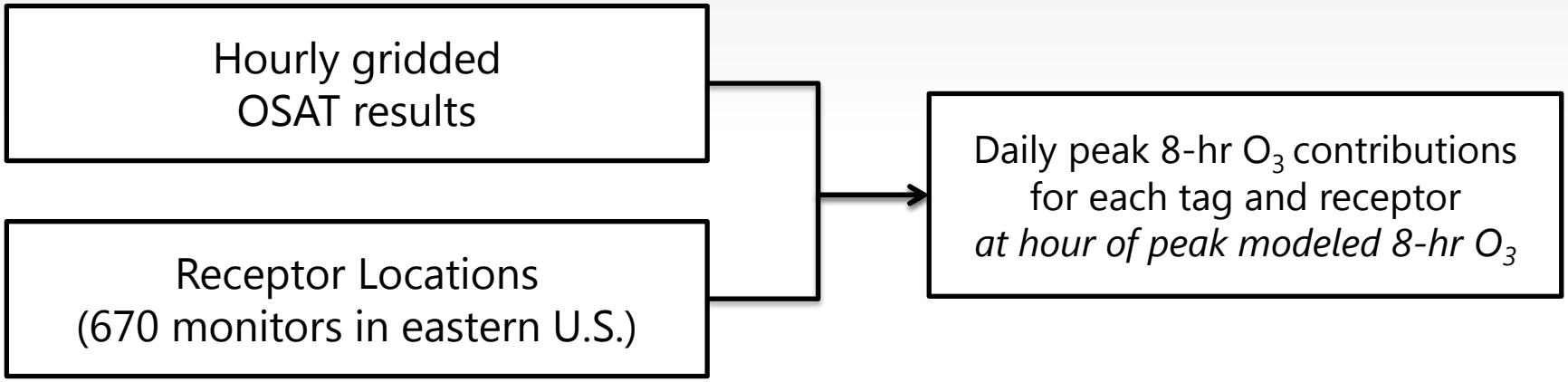
OSAT regions for non-point source category

Source Apportionment Tagging

Simulation	Description
1	Point source tags (set 1)
2	Point source tags (set 2)
3	Geographic tags (e.g., on-road)

- Processor: 16 CPU per simulation (2 nodes)
- Memory: 10-12 GB RAM per node per simulation
- Clock time: 3-4 weeks

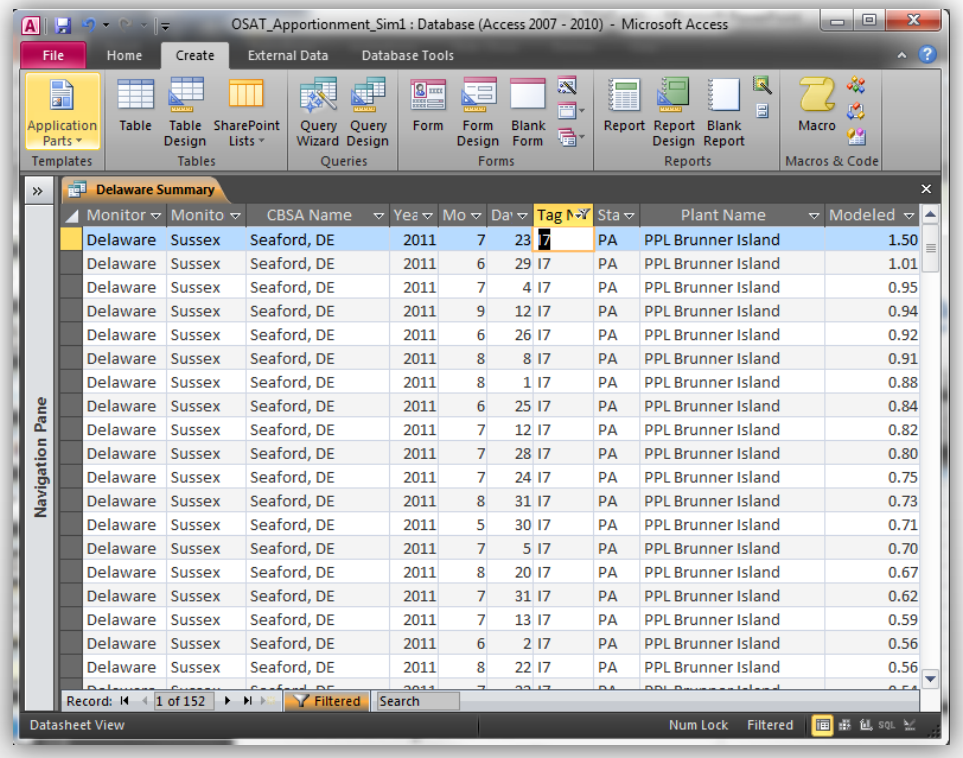
OSAT Post-Processing



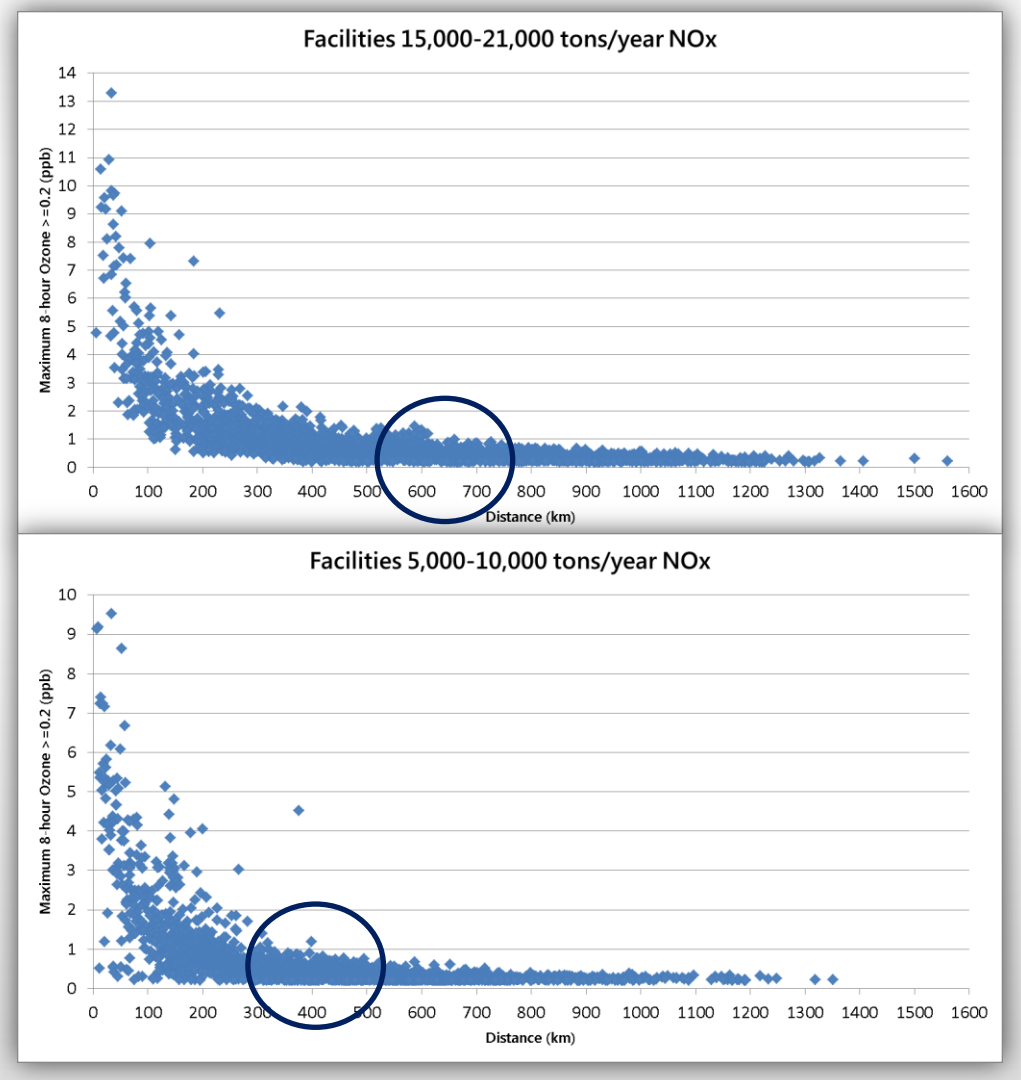
- Reflects contributions during time periods when ozone concentrations are highest
- Guarantees that daily ozone contributions from all source tags sum to the total modeled 8-hr concentration

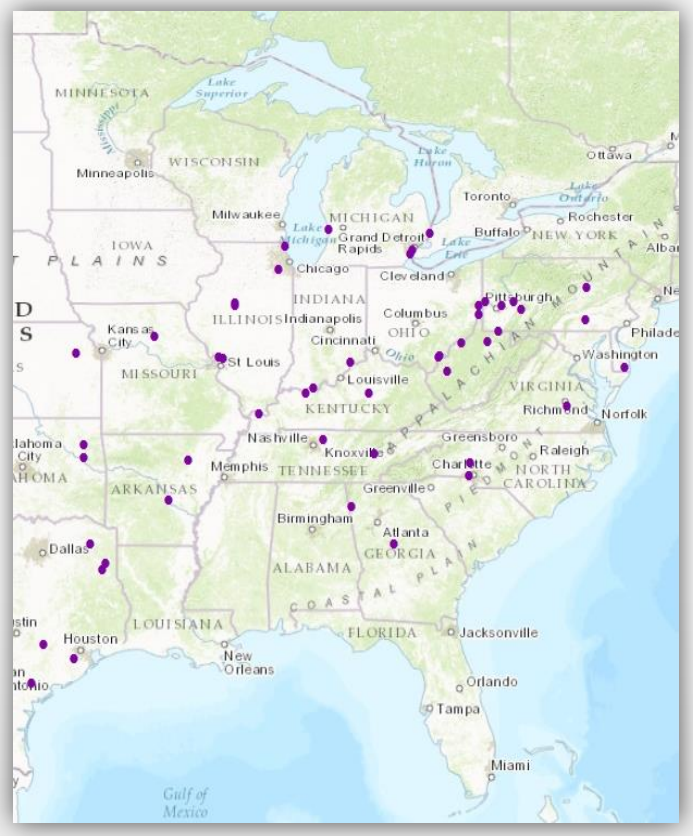
Access Database

- Extracted ozone contributions for all tags at 670 monitoring sites across the eastern U.S.
- Developed sample queries to facilitate data exploration
- Opportunity for future data mining



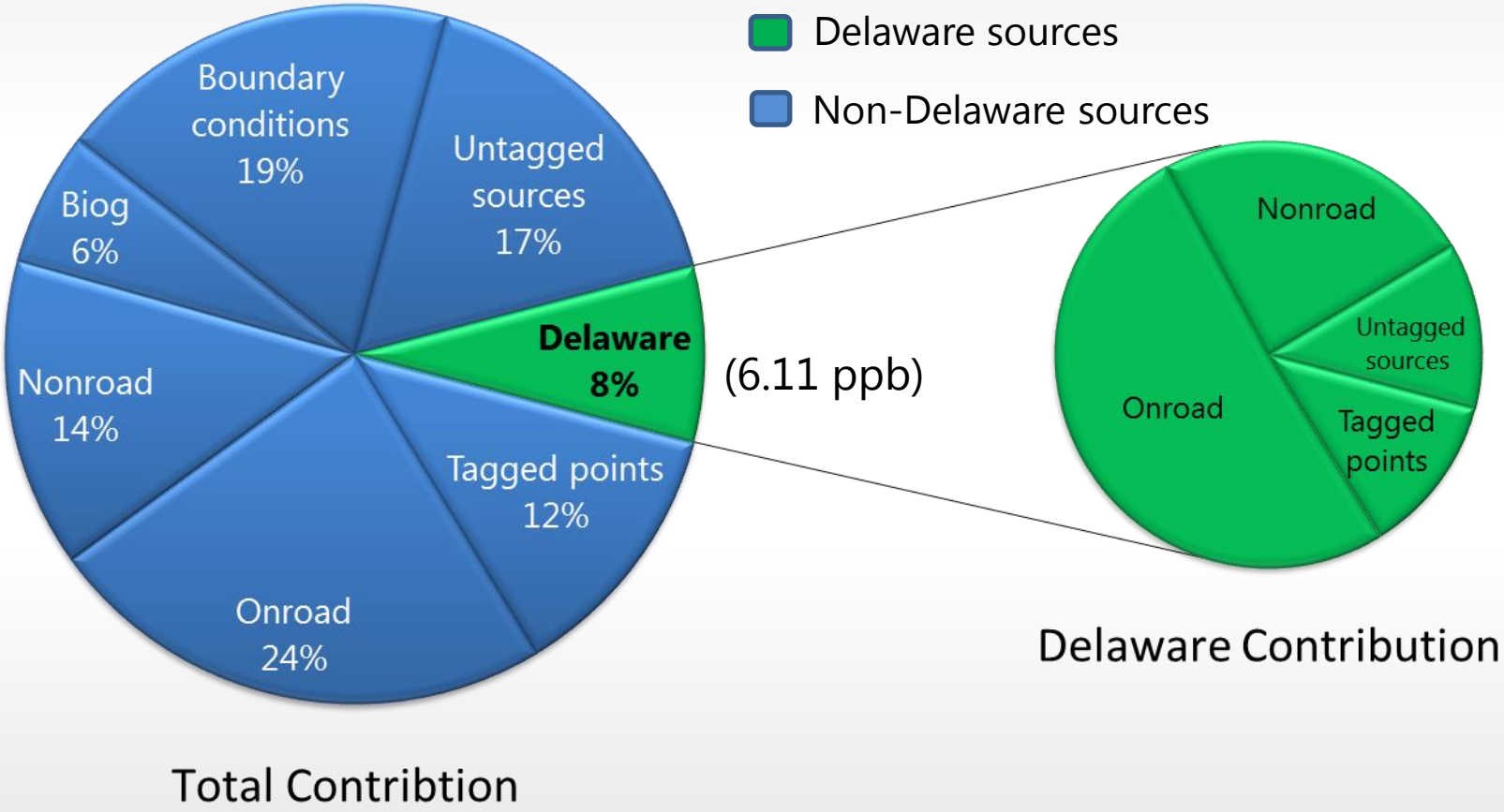
Ozone Impacts vs. Distance





1 ppb is the proposed NAAQS significant impact level (SIL) for single-source ozone impacts.

Single Receptor Analysis

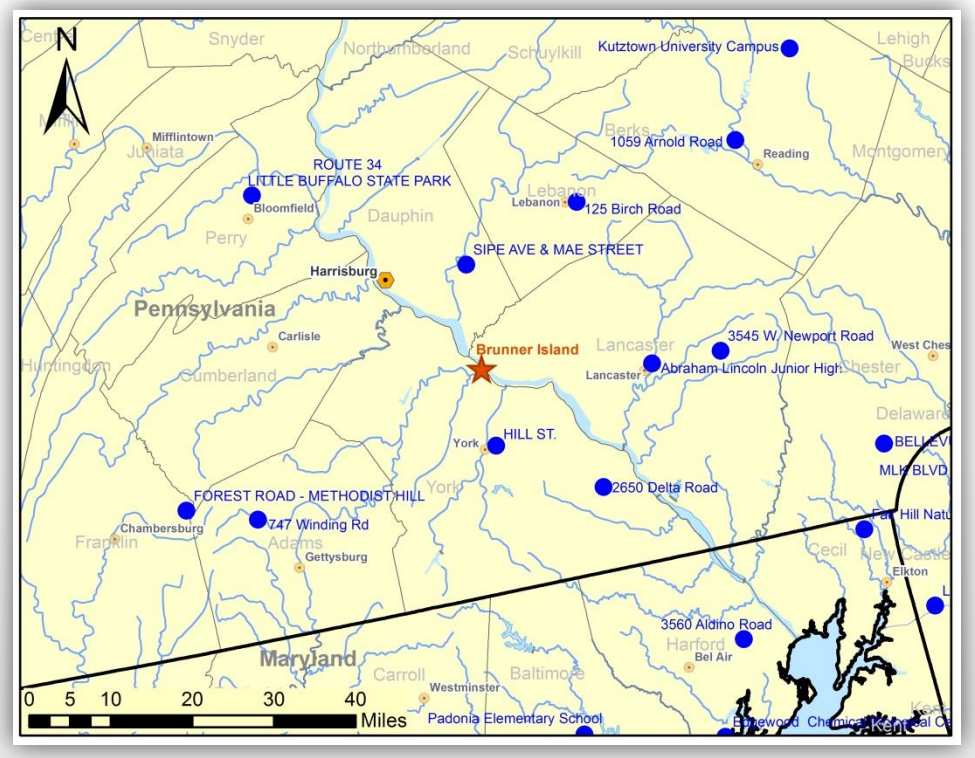


Ozone contributions in Sussex County, DE, when modeled ozone was greater than 70 ppb (13 days)

Point Source Analysis
Brunner Island

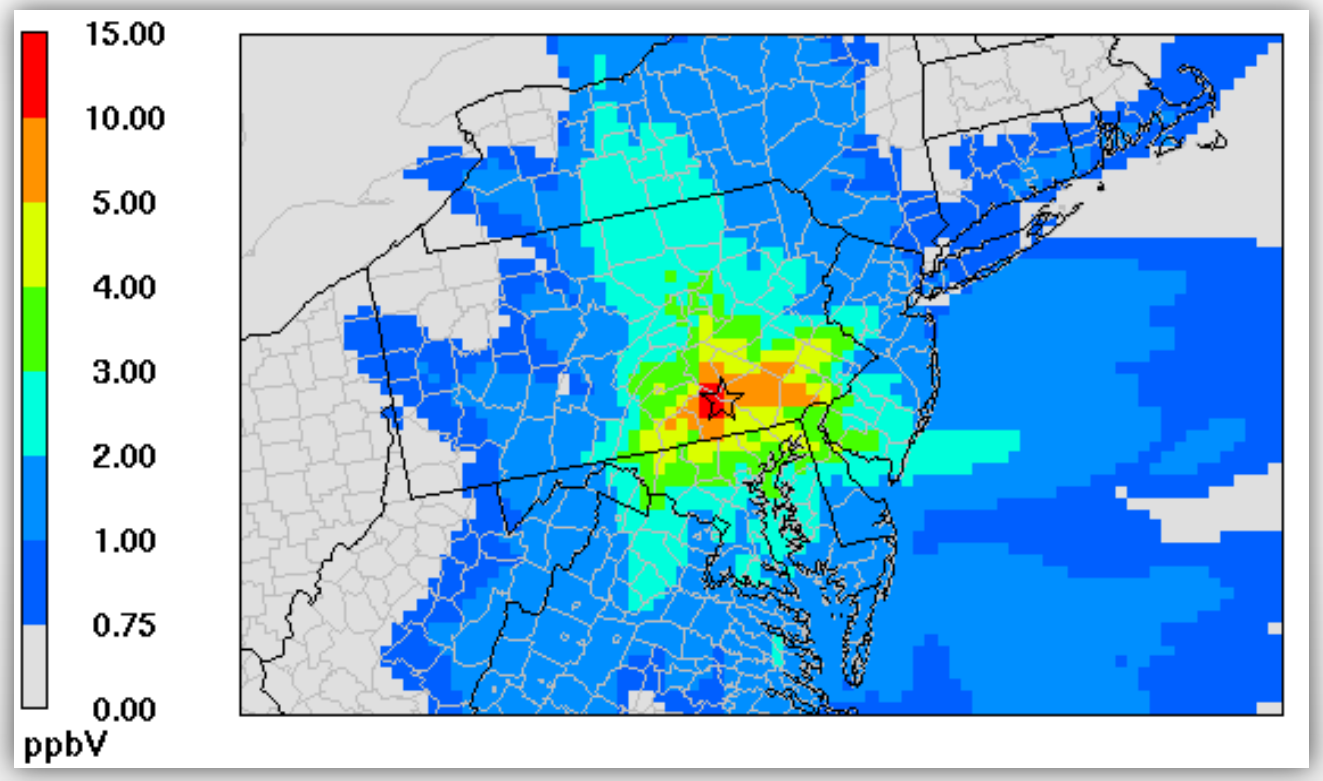
- York Haven, PA
- 1411 MW generating capacity
- 2011 NO_x emissions: 16,800 tons

www.talenenergy.com



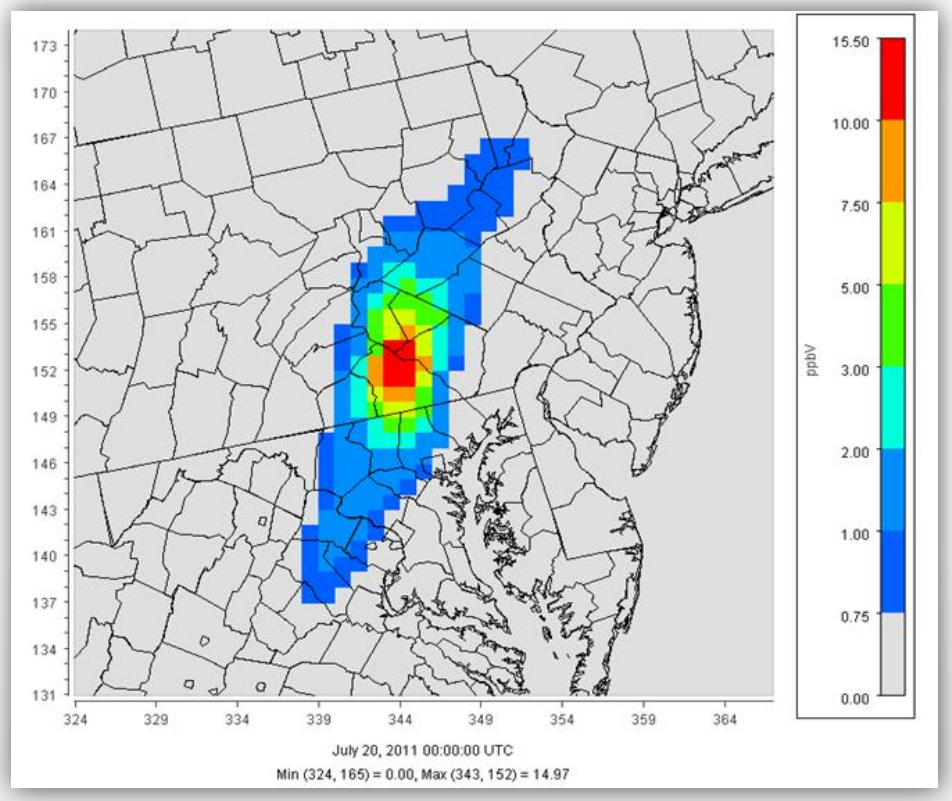
Brunner Island power plant in southeast Pennsylvania and nearby air quality monitoring sites.

Brunner Island Ozone Impacts



Peak modeled 8-hr ozone impacts from the Brunner Island power plant during the 2011 ozone season.

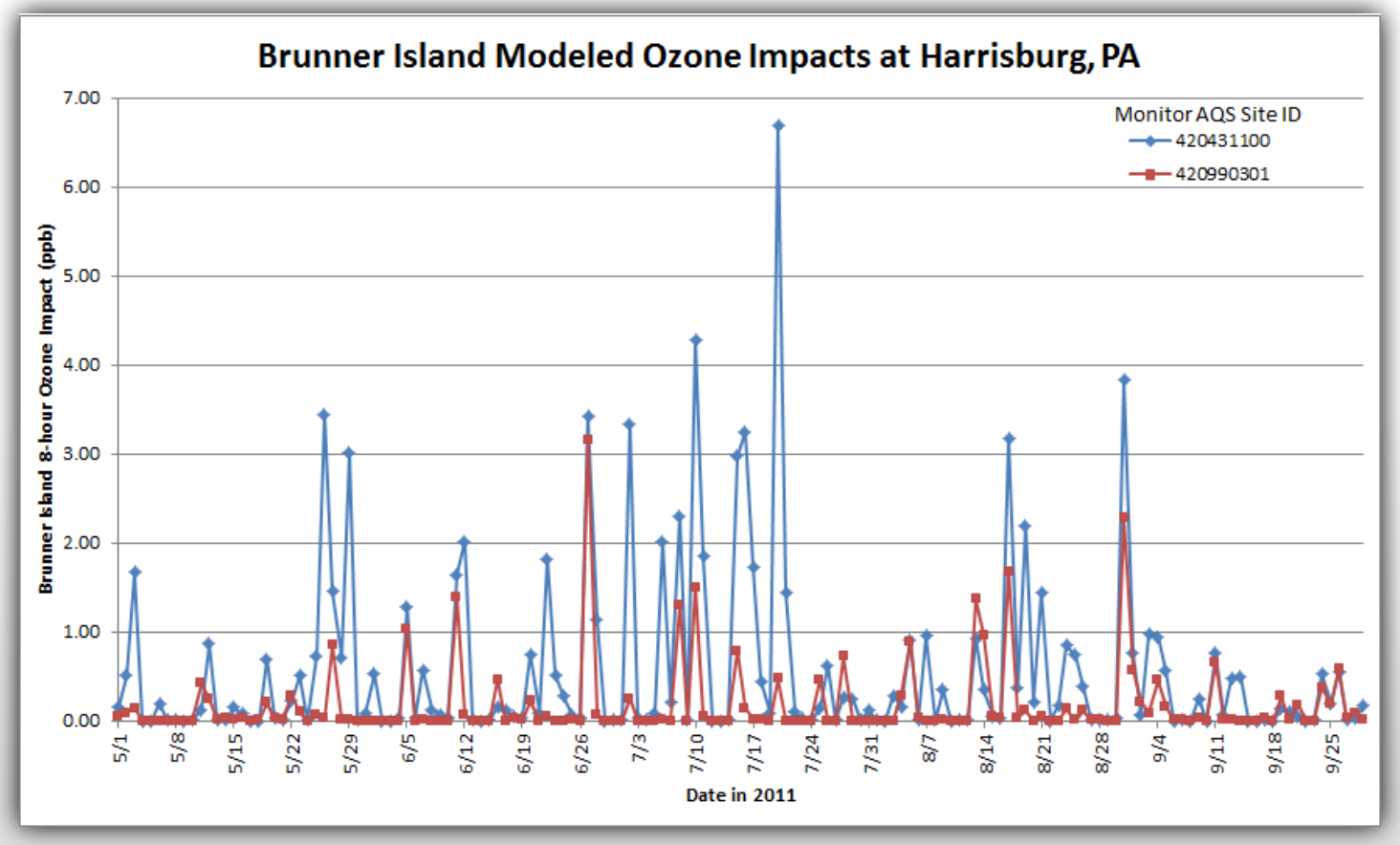
Brunner Island Ozone Impacts



Peak modeled 8-hr ozone impacts from the Brunner Island power plant on July 20, 2011.

Daily Ozone Contributions

Significant (>0.75 ppb) 8-hr ozone impacts were modeled at one or more PA monitor(s) on 86% (79 of 92) of days during June-August.

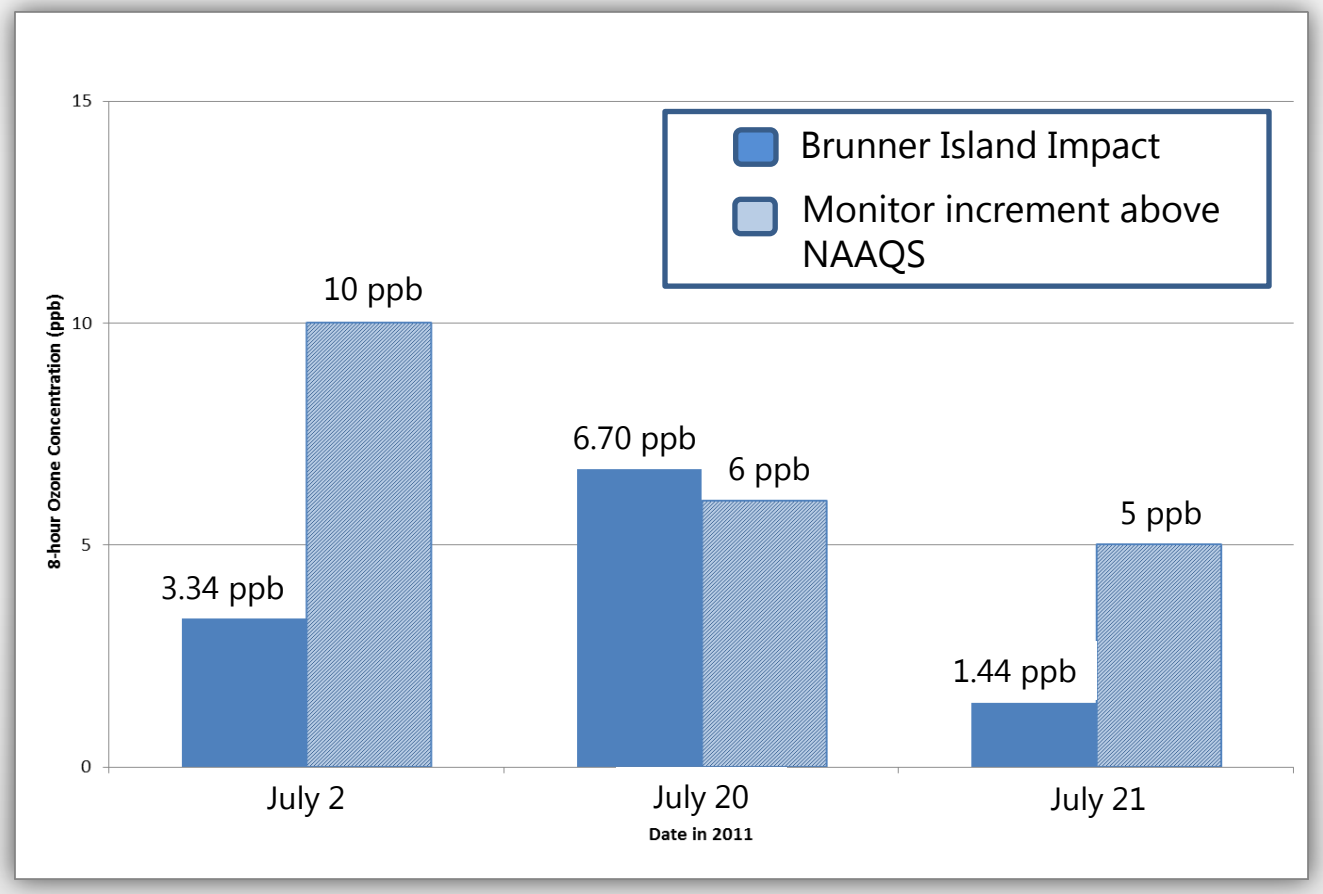


Ozone Contributions at Pennsylvania Monitors

Significant (>0.75 ppb) 8-hr ozone impacts were modeled on at least one day at 75% of Pennsylvania monitoring sites.

AQS Site ID	Monitor County	Core Based Statistical Area	Maximum Modeled Contribution (ppb)	Number of Significant Impact Days
421330008	York	York-Hanover, PA	10.58	50
420431100	Dauphin	Harrisburg-Carlisle, PA	6.70	31
420710007	Lancaster	Lancaster, PA	5.56	36
420710012	Lancaster	Lancaster, PA	5.17	31
420019991	Adams	Gettysburg, PA	5.01	14
420750100	Lebanon	Lebanon, PA	4.78	33
421330011	York	York-Hanover, PA	4.65	48
420110011	Berks	Reading, PA	3.93	22
420290100	Chester	Philadelphia-Camden-Wilmington, PA-NJ-DE-MD	3.85	26

Impacts on High-Ozone Days



Modeled 8-hr ozone impacts >0.75 ppb from Brunner Island and incremental monitored ozone concentrations above the NAAQS on days when the NAAQS was exceeded at the Sipe Ave. monitor near Harrisburg.

Ozone Contributions on Neighboring States

State	Monitors with Significant Ozone Contributions	Max. # of Days With Significant Ozone Contribution at any One Monitor	Peak Ozone Contribution (ppb)	Average of Significant Ozone Contributions (ppb)
Pennsylvania	**40**	**50**	**10.58**	**1.63**
Connecticut	6	2	0.93	0.85
Delaware	7	28	4.83	1.69
Maryland	20	35	4.06	1.56
New Jersey	17	15	3.12	1.29
New York	16	6	2.31	1.00

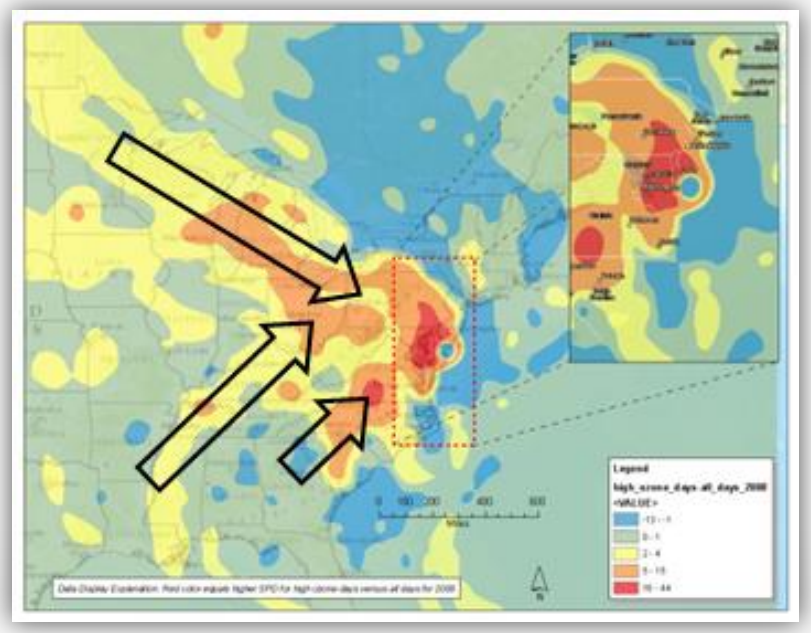
Summary of significant (>0.75 ppb) modeled 8-hr ozone contributions from Brunner Island at monitoring stations in Pennsylvania and neighboring states.

Summary and Insights

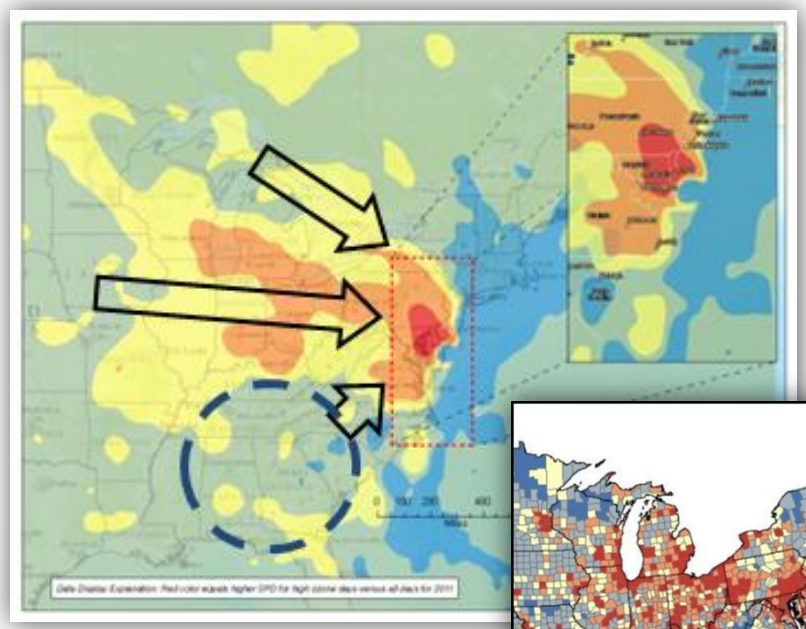
- Conducted source apportionment modeling to support policy initiatives in the eastern United States
- Developed a database to support current analysis and future data mining
- Multiple sources examples
  - 1-ppb impacts possible several hundred kilometers from large NO_x sources
  - At some receptors, in-state ozone contributions are small compared to out-of-state contributions
- Single-source example (Brunner Island)
  - Significant (>0.75 ppb) ozone impacts in Pennsylvania on most summer days
  - Significant impacts at Harrisburg on three NAAQS exceedance days in 2011
  - Significant ozone contributions extend several hundred kilometers into neighboring states
- Further discussion: Representativeness of modeling results from a *transport perspective*

Trajectory Spatial Probability Density

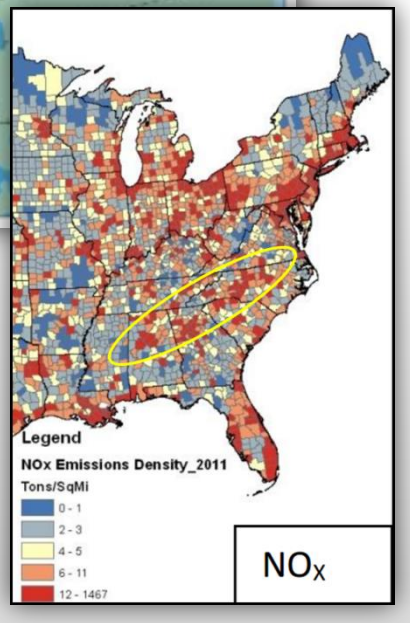
(Difference plots: high-ozone days vs. all days)



2008



2011



Southwesterly transport toward Delaware is less pronounced in 2011 than in other years.

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