Connecticut Department of Energy and Environmental Protection

Connecticut Department of ENERGY & ENVIRONMENTAL PROTECTION

Technical Analysis for Regional Haze Planning

SIPRAC, August 10, 2017
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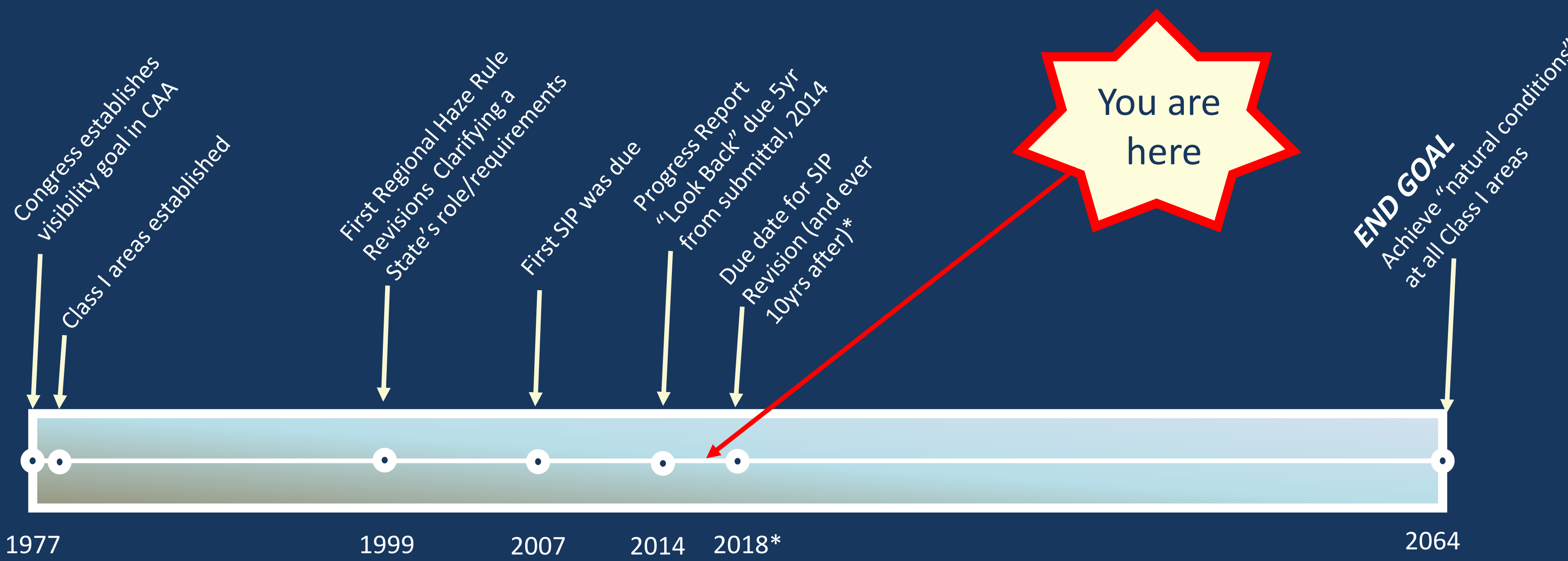
Gina McCarthy Auditorium

Connecticut Department of Energy and Environmental Protection

Regional Haze

CAA Section 169A established the national goal of preventing any future and improving existing visibility impairment in Class I areas (156 national parks and wilderness areas).

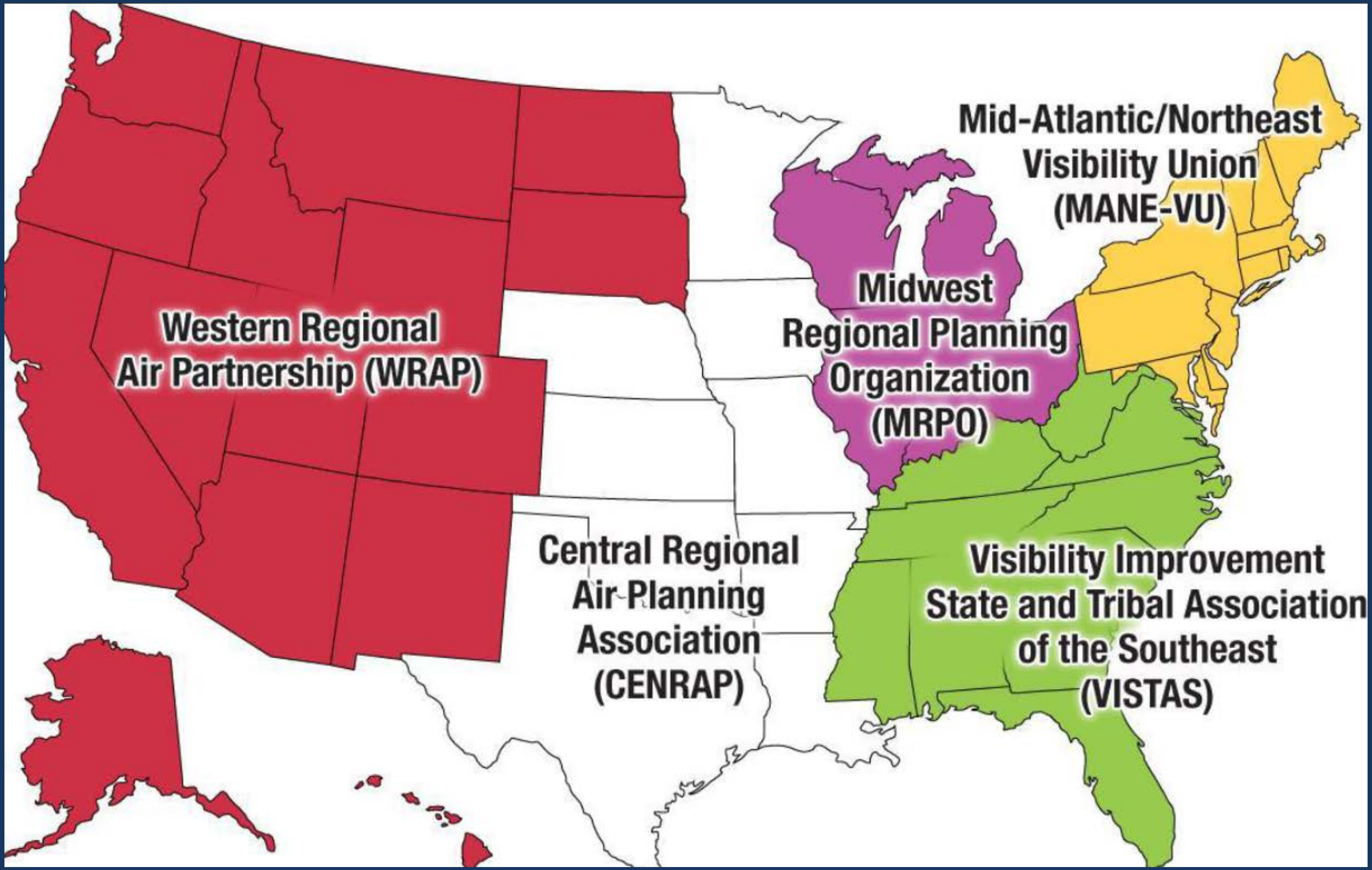
EPA's Regional Haze Rule (40 CFR 51.300 - 51.309) established the time frame, method and metrics.



**EPA's revised Regional haze rule allows for submittals in 2021. However, 10yr revisions are tied to the 2018 date.*

MANE-VU

The following work is a collaborative process through the Mid Atlantic Northeast Visibility Union (MANE-VU)



Overview of Process in Technical Analysis

Monitoring Data (Species Concentrations/Impact on Visibility)

Provided perspective on which pollutants to focus efforts on and gave Class I areas understanding of current problem to establish 10yr goals.

Annual Inventory Analysis (2011 and 2018)

Provided perspective on potential sectors to focus on or sectors with "On the Books" reductions we did need to focus on.

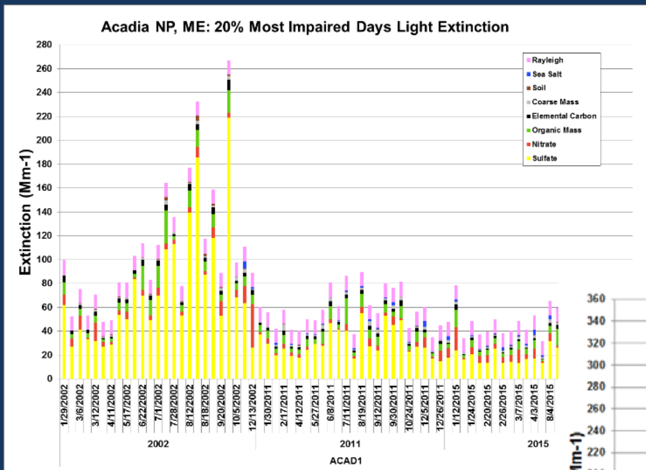
Q/D*C Mapping Analysis(2011 and 2018)

Provided perspective on potential sectors to focus on or and geographic area to consider.

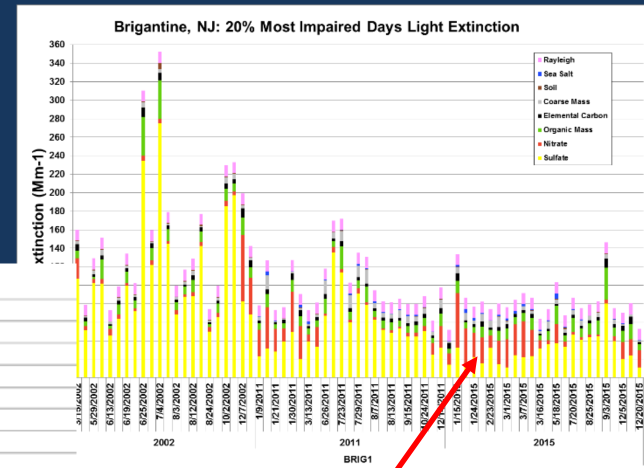
More detailed analyses:

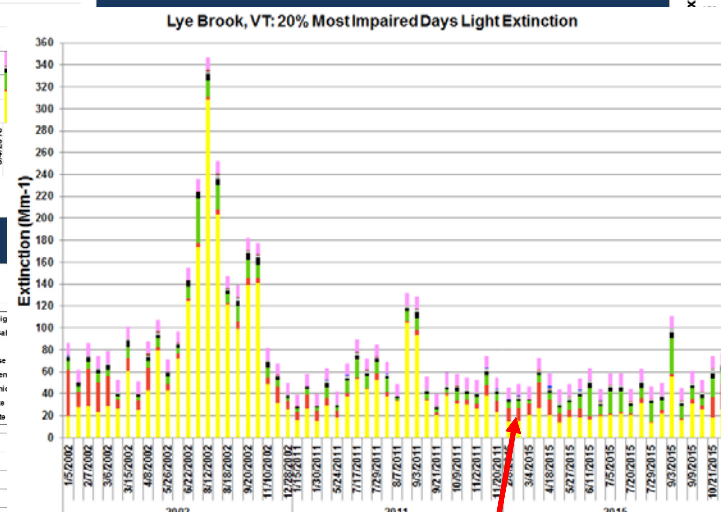
1. Industrial Sources
2. Update on 167 Stacks
3. CALPUFF modeling
4. Impact of High Electric Demand

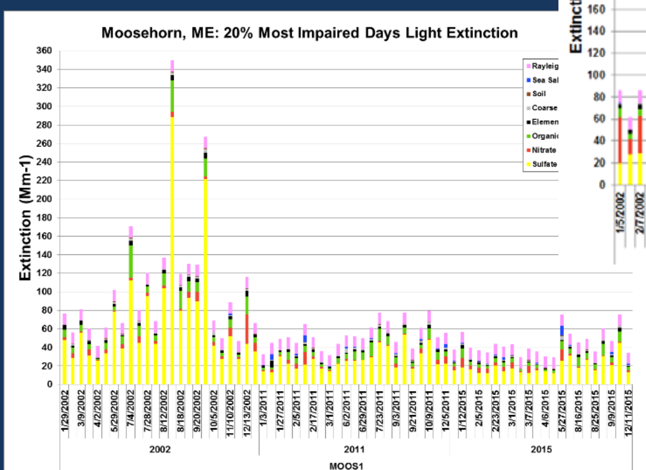
Review of Monitoring Data

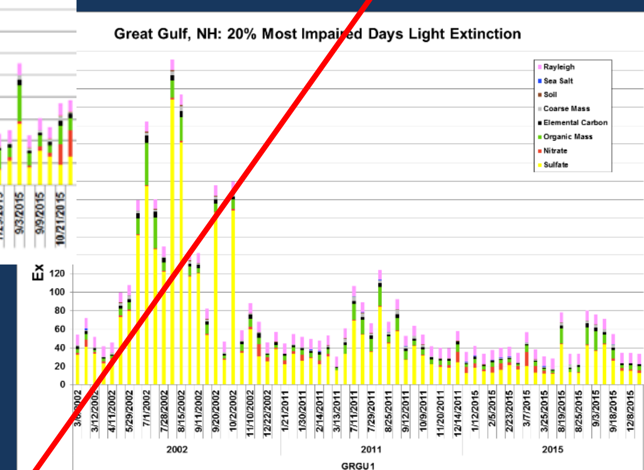


Overall, sulfate is still the dominate pollutant .



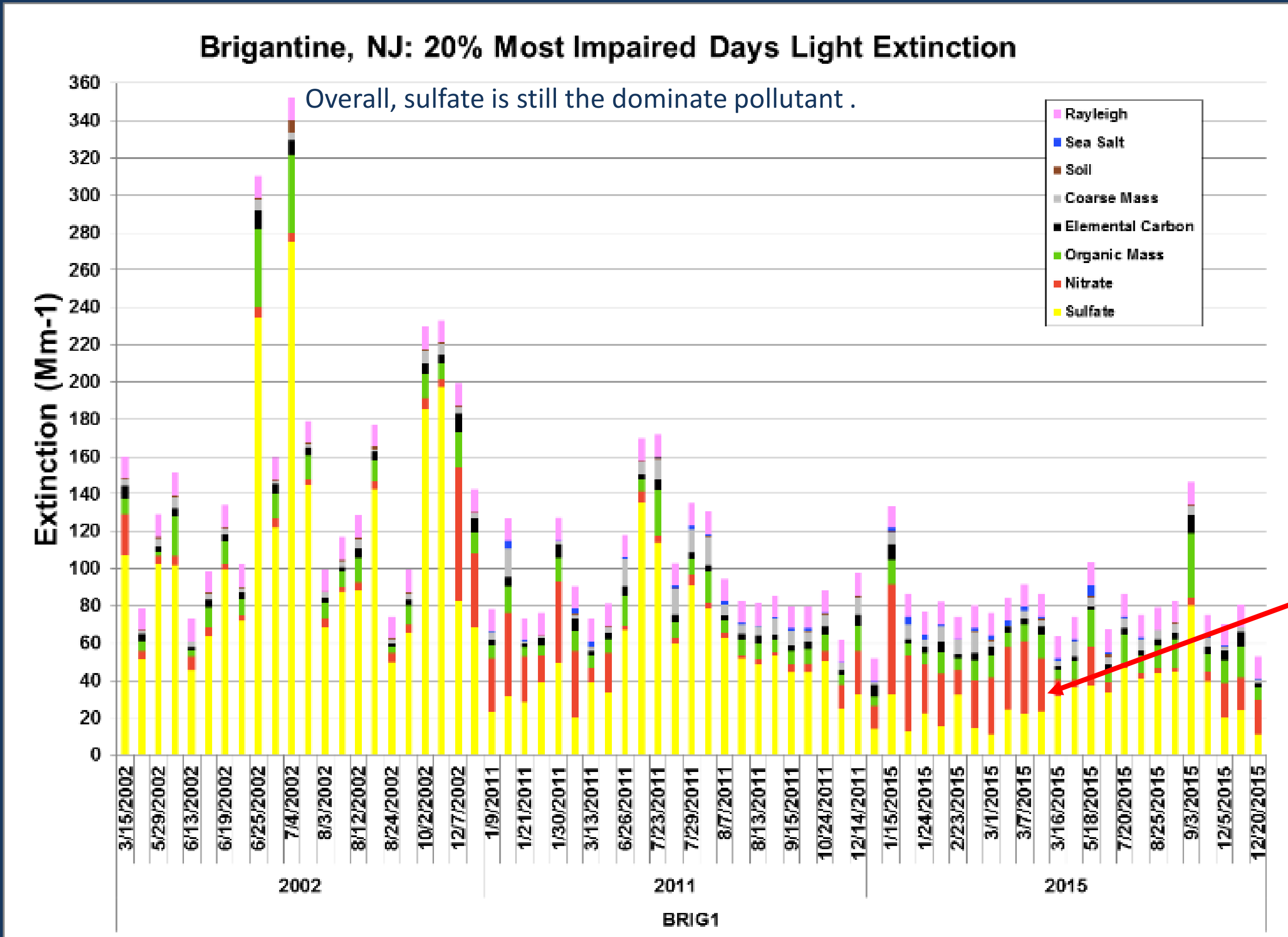






However, a change is being observed. Note at Lye Brook and Brigantine nitrate is becoming a dominate pollutant on many of the impaired days.

Review of Monitoring Data



However, a change is being observed. Note at Brigantine (and Lye Brook not shown here) nitrate is becoming a dominate pollutant on many of the impaired days.

Inventory Analysis

Annual inventories were analyzed. 2011 and 2018

	MANE-VU		SESARM		LADCO		CENSARA	
	2011	2018	2011	2018	2011	2018	2011	2018
Agriculture	232.33	171.09	4,024.16	3,217.08	2,794.34	2,278.85	7,343.12	7,343.12
Area Comm./Inst.	41,883.65	16,120.21	7,997.42	6,394.31	3,769.14	3,672.57	367.89	367.88
Area Industrial	14,779.10	8,715.45	51,012.03	43,529.67	5,418.87	5,333.68	34,283.65	33,956.16
Area Residential	77,939.54	30,579.93	7,365.06	6,689.54	13,764.88	14,259.29	3,032.51	3,071.90
EGU	451,574.98	225,871.85	1,083,115.43	506,739.65	1,510,168.48	501,901.33	1,119,575.96	965,319.37
ICE	2,873.30	2,708.71	1,306.93	2,896.20	2,364.32	1,939.88	2,900.14	2,185.38
Industrial Process	37,386.68	31,785.80	110,879.32	90,803.45	115,918.66	101,723.86	150,157.26	111,363.89
Nonroad	27,525.51	6,110.23	33,239.93	4,707.97	8,435.52	3,142.67	25,288.54	4,811.39
Onroad	5,069.48	1,948.30	6,040.19	2,546.71	5,474.86	2,271.97	5,594.50	2,450.87
Space Heaters	91.23	83.25	78.50	77.97	7.62	6.19	6.39	6.09
Stationary Comm./Inst.	5,785.57	1,827.03	11,689.73	4,465.13	20,381.36	10,713.74	12,058.22	11,986.26
Stationary Industrial	57,749.62	27,527.16	115,421.65	26,318.99	196,868.92	75,131.49	56,458.54	24,194.37
Waste Disposal	5,020.48	4,896.39	2,797.33	2,718.22	5,223.60	5,006.14	865.56	874.77
Other	29.29	30.44	108.44	67.41	246.68	239.23	1,544.01	1,716.91
SO2 Total	727,940.76	358,375.85	1,435,076.13	701,172.32	1,890,837.24	727,620.88	1,419,476.29	1,169,648.37

Results:

- Narrowed our focus to the largest emitting sectors (EGUs, Industrial)
- Highest priority for analysis is SO_2 controls from coal fired power plants

Inventory Analysis

Annual inventories were analyzed. 2011 and 2018

Table 3: Annual NOX emissions by upper level category and RPO in 2011 and 2018

	MANE-VU		SESARM		LADCO		CENSARA	
	2011	2018	2011	2018	2011	2018	2011	2018
Agriculture	591.93	568.80	8,697.65	7,220.71	3,348.21	3,322.08	19,367.63	19,362.48
Area Comm./Inst.	68,116.28	67,369.67	19,598.15	17,271.55	48,720.57	48,386.55	18,696.73	18,519.33
Area Industrial	16,082.96	17,732.96	43,981.63	30,063.88	31,692.06	31,457.95	61,005.47	60,763.91
Area Residential	104,301.04	103,002.78	37,371.64	35,392.05	91,699.84	92,486.19	40,264.60	40,452.39
EGU	187,633.05	120,756.45	409,221.01	351,634.74	423,802.46	268,811.61	432,393.59	368,074.94
ICE	34,870.25	22,913.36	102,505.62	29,597.66	80,208.59	23,615.12	335,286.01	99,992.81
Industrial Process	99,925.45	130,154.05	181,807.80	223,460.16	156,713.49	131,340.72	512,196.12	541,454.54
Nonroad	368,092.20	282,103.43	614,266.09	412,904.89	521,911.17	373,721.73	707,065.55	554,820.28
Onroad	699,944.19	345,810.72	1,245,114.31	577,072.41	1,064,831.89	527,639.35	1,150,395.05	574,792.29
Space Heaters	418.88	441.94	511.70	504.18	920.89	917.63	290.42	275.30
Stationary Comm./Inst.	7,388.05	6,421.80	6,600.86	6,545.29	11,141.03	9,053.09	6,366.74	6,392.39
Stationary Industrial	31,282.47	25,172.63	95,701.85	82,414.42	76,172.49	63,844.03	66,616.20	67,096.80
Waste Disposal	28,698.95	27,753.08	22,538.13	21,601.65	16,576.93	14,827.24	8,710.97	8,265.79
Other	362.04	373.48	1,066.97	1,006.57	912.09	911.95	891.71	973.28
NOX Total	**1,647,707.75**	**1,150,575.17**	**2,788,983.43**	**1,796,690.16**	**2,528,651.70**	**1,590,335.22**	**3,359,546.81**	**2,361,236.54**

- Narrowed our focus to the largest emitting sectors (EGUs, Industrial)
- Highest priority for analysis is SO_2 controls from coal fired power plants

Q/d*C Contribution Assessment

Class I Area (Receptor)	Rank	2002 Analysis (2002 emissions)	2012 Analysis (2007* emissions)	2015 Analysis (2011 emissions)
Acadia	1	Pennsylvania/Ohio	Pennsylvania	Ohio
	2		Ohio	Pennsylvania
	3	New York	Indiana	Indiana
	4	Indiana	Michigan	Michigan
	5	West Virginia/ Massachusetts	Georgia	Illinois
Brigantine	1	Pennsylvania	Pennsylvania	Pennsylvania
	2	Ohio	Maryland	Ohio
	3	Maryland	Ohio	Maryland
	4	West Virginia	Indiana	Indiana
	5	New York	West Virginia	Kentucky
Dolly Sods	1	New to 2007 analysis, no 2002 data	Pennsylvania	Ohio
	2		Ohio	West Virginia
	3		West Virginia	Pennsylvania
	4		Indiana	Indiana
	5		North Carolina	Kentucky
Great Gulf	1	Analysis not done	Pennsylvania	Ohio
	2		Ohio	Pennsylvania
	3		Indiana	Indiana
	4		Michigan	Michigan
	5		New York	Illinois
James River Face	1	New to analysis not available for earlier years		Ohio
	2			Pennsylvania
	3			Indiana
	4			Kentucky
	5			West Virginia
Lye Brook	1	Pennsylvania	Pennsylvania	Pennsylvania
	2	Ohio	Ohio	Ohio
	3	New York	New York	Indiana
	4	Indiana	Indiana	New York
	5	West Virginia	Michigan/West Virginia	Michigan
Moosehorn	1	Pennsylvania/ Ohio	Pennsylvania	Ohio
	2		Ohio	Indiana
	3	Indianan/New York	Indiana	Illinois
	4		Michigan	Michigan
	5	Michigan	Texas/Missouri/Illinois/West Virginia/New York	Texas
Shenandoah	1	Ohio	Pennsylvania	Ohio
	2	Pennsylvania	Ohio	Pennsylvania
	3	West Virginia	West Virginia	Indiana
	4	North Carolina	Maryland	West Virginia
	5	Maryland	Indiana	Virginia

Goal was to eliminate geographic areas/sectors that were not of concern with least resource intensive method but still accurate enough method for a screening level exercise.

- Two emissions sets: 2011 and 2018
- Two methods: State total emissions and point only by each point location.

Results:

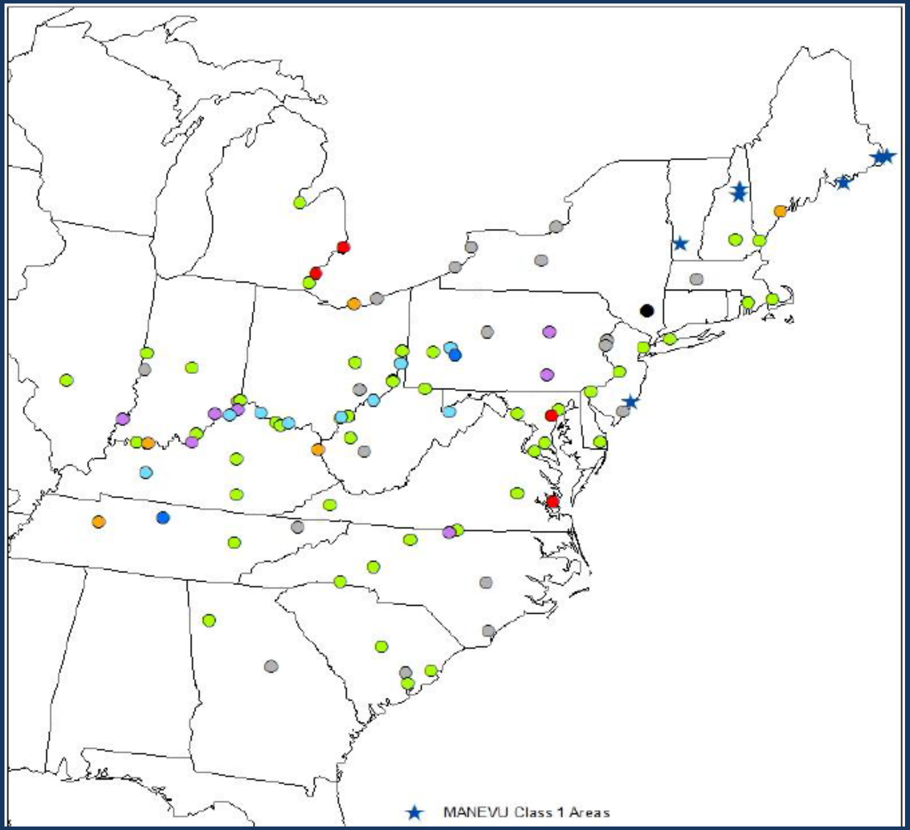
- Supported the focus on Industrial and EGU sector.
- Defined the geographic boundaries for consultation. (Or more accurately a first cut list)

Update on 167 Stack Analysis

2008 requested 90% or greater reduction of SO_2 emissions from 167 Stacks.

Only 4 Stacks did not meet the 90% reduction of SO_2 emissions:

- Trenton Channel, MI,
- St. Clair, MI,
- Herbert A. Wagner, MD, and;
- Yorktown, VA



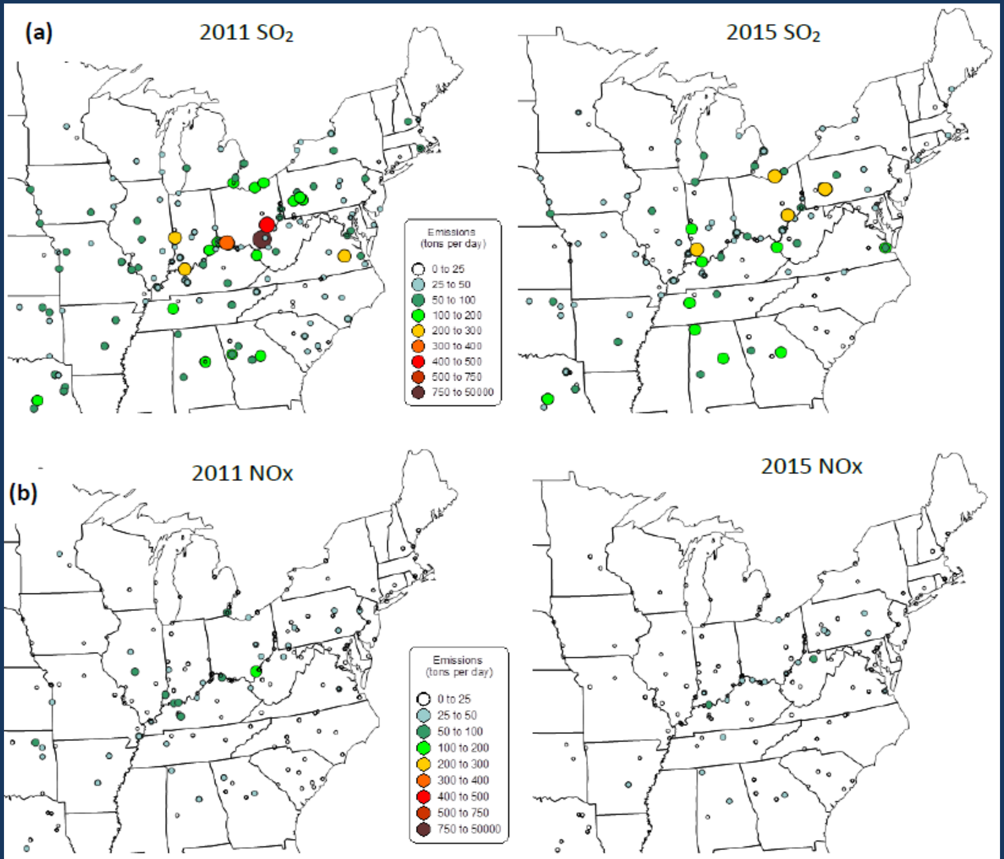
*Herbert Wagner may require updated info soon

Review of Industrial Sources

- Top 50 industrial contributors to MANE-VU Class I Areas
- Facilities in 16 states: IL, IN, KY, MA, MD, ME, MI, NC, NH, NJ, NY, OH, PA, TN, VA, WV
- 29 facilities are in the top 50 contributing to 5 MANE-VU Class I Areas
- Top 50 were facilities in categories such as cement plants, paper mills, steel processing etc…

CALPUFF Modeling Report

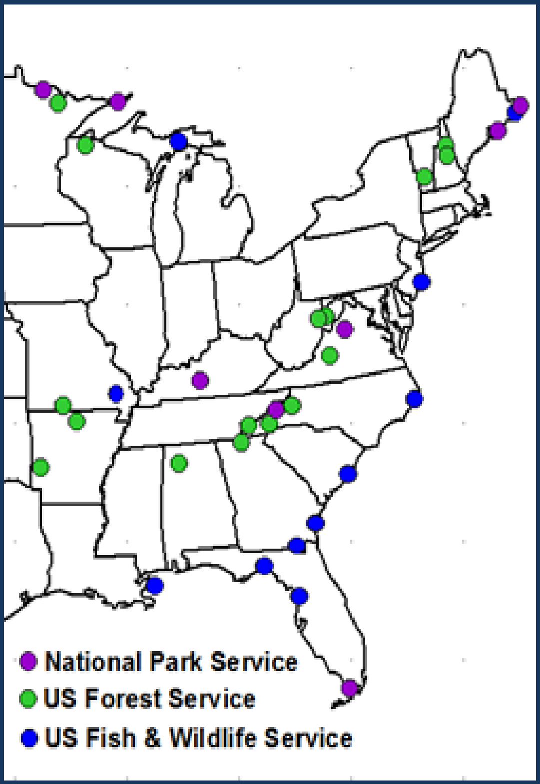
- Focus on largest sources identified in the earlier screening analyses (EGUs and large industrial sources)
- 3 different years of meteorology
- Used 2011 and 2015 emissions

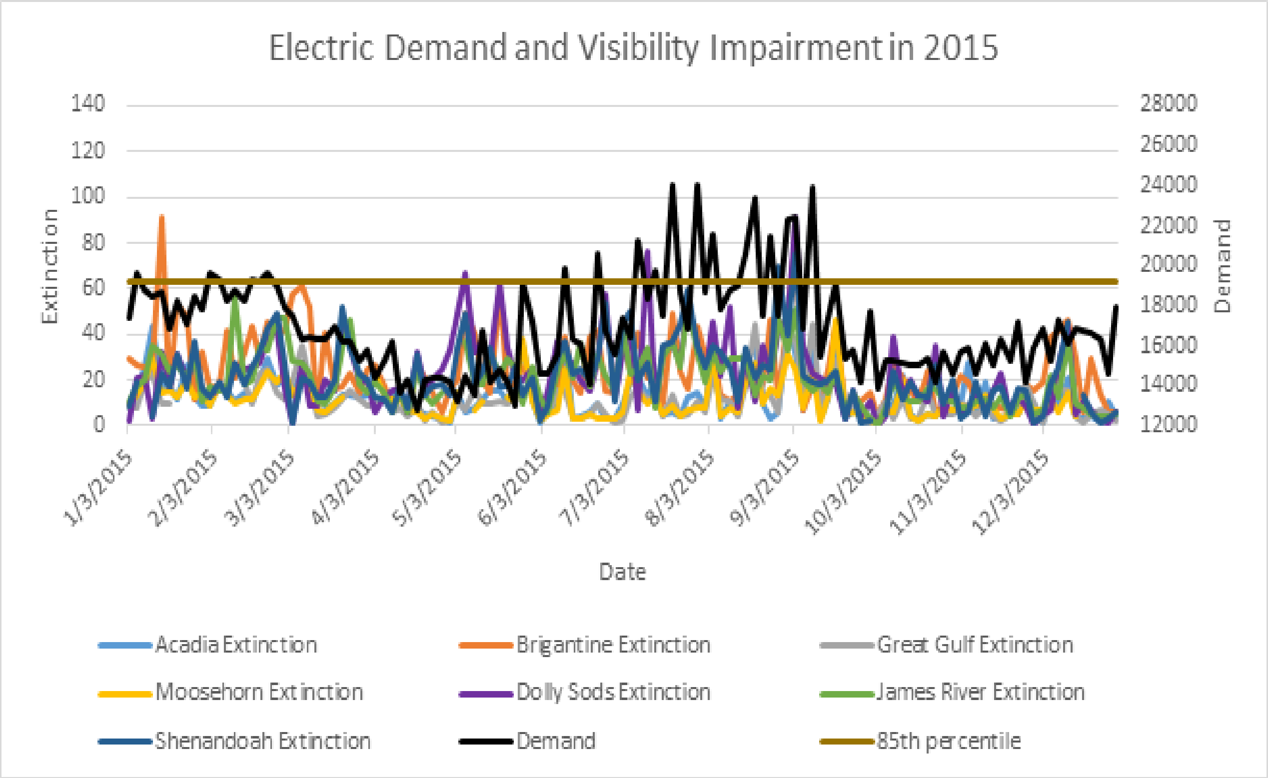


ISO-NE High Electric Demand Day (HEDD) Analysis

How is the visbility of the Federal Class I Areas impacted by HEDD?

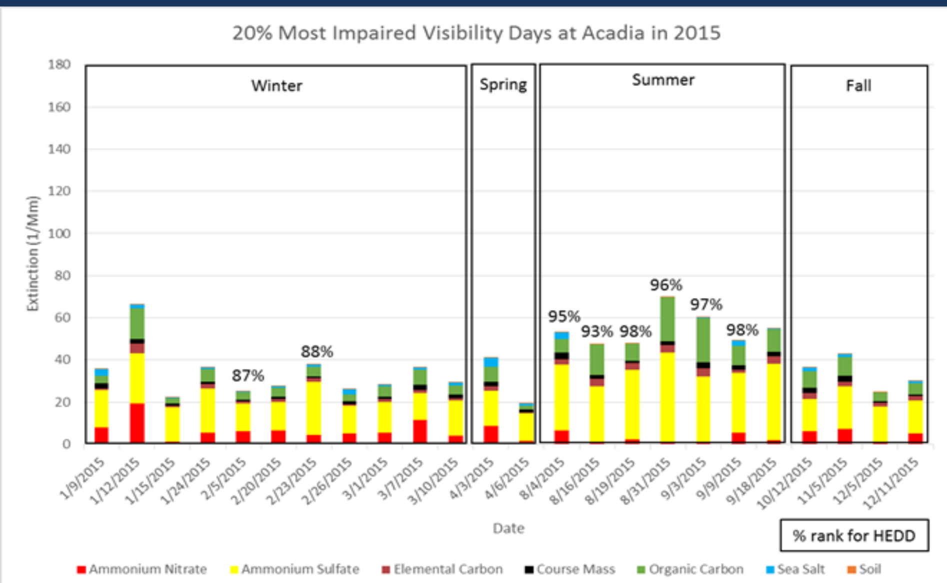
- Top 15% high electric demand days in New England
- IMPROVE Monitoring Data
- Visibility impairment at MANE-VU Class I Areas: 20% most impaired days



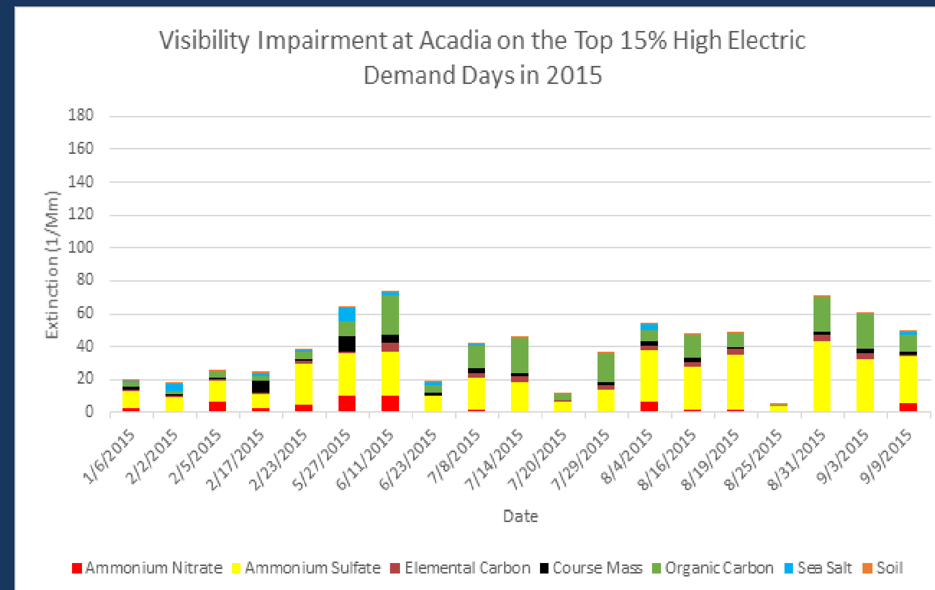


HEDD Analysis- Acadia 2015

Understanding the region's impact…



*20% most impaired IMPROVE days (121 sample days)



*Top 15% HEDD on IMPROVE days (60 HEDD for the year, graph depicts sample days only)

Top IMPROVE/HEDD days

: HEDD

MID Dolly Sods

Date	DEMAND (mW/hr)
1/4/2013	18417
1/7/2013	18316
2/3/2013	17713
3/29/2013	14677
4/1/2013	15770
6/3/2013	18361
6/12/2013	15790
6/18/2013	17980
7/18/2013	26406
7/30/2013	19648
8/2/2013	19641
8/11/2013	16216
8/20/2013	20724
8/23/2013	18923
8/29/2013	17558
9/4/2013	18384
9/10/2013	17660
9/16/2013	15649
9/19/2013	16028
9/22/2013	14780
9/25/2013	15659
10/4/2013	15346
12/18/2013	19465

MID Shenandoah

Date	DEMAND (mW/hr)
1/4/2013	18417
1/7/2013	18316
2/6/2013	18446
2/21/2013	18394
2/24/2013	17007
3/2/2013	15854
3/23/2013	15115
3/29/2013	14677
6/12/2013	15790
7/18/2013	26406
7/24/2013	21999
7/30/2013	19648
8/2/2013	19641
8/11/2013	16216
8/23/2013	18923
8/29/2013	17558
9/1/2013	17758
9/4/2013	18384
9/10/2013	17660
9/16/2013	15649
10/25/2013	15655
11/30/2013	17013
12/24/2013	17254

MID James River

Date	DEMAND (mW/hr)
1/7/2013	18316
1/25/2013	19306
2/6/2013	18446
3/2/2013	15854
3/17/2013	15998
4/1/2013	15770
4/28/2013	13620
6/12/2013	15790
7/18/2013	26406
7/24/2013	21999
7/30/2013	19648
8/2/2013	19641
8/5/2013	16889
8/11/2013	16216
8/14/2013	16875
8/23/2013	18923
8/29/2013	17558
9/1/2013	17758
9/4/2013	18384
9/7/2013	14635
9/10/2013	17660
9/16/2013	15649
10/4/2013	15346
12/15/2013	18952

MID Brigantine

Date	DEMAND (mW/hr)
1/4/2013	18417
1/7/2013	18316
1/22/2013	19549
2/3/2013	17713
2/6/2013	18446
2/12/2013	17710
2/15/2013	16495
2/24/2013	17007
3/17/2013	15998
3/23/2013	15115
4/1/2013	15770
4/28/2013	13620
6/9/2013	15292
7/18/2013	26406
7/24/2013	21999
8/2/2013	19641
8/29/2013	17558
9/10/2013	17660
10/1/2013	16213
10/19/2013	14133
10/31/2013	15897
12/12/2013	19818
12/18/2013	19465

MID Great Gulf

Date	DEMAND (mW/hr)
1/1/2013	17830
1/4/2013	18417
1/7/2013	18316
2/15/2013	16495
3/20/2013	16869
4/4/2013	15662
4/7/2013	14561
4/16/2013	14774
4/22/2013	15218
4/28/2013	13620
5/31/2013	22130
6/24/2013	24739
7/6/2013	22960
7/18/2013	26406
7/30/2013	19648
8/20/2013	20724
8/26/2013	18301
10/1/2013	16213
10/31/2013	15897
11/6/2013	16476
12/3/2013	17707
12/21/2013	16361
12/27/2013	18383

MID Acadia

Date	DEMAND (mW/hr)
1/1/2013	17830
1/4/2013	18417
1/10/2013	17647
2/15/2013	16495
3/14/2013	17371
4/22/2013	15218
4/25/2013	14661
4/28/2013	13620
5/1/2013	14629
5/16/2013	15180
5/31/2013	22130
6/3/2013	18361
6/30/2013	19030
7/6/2013	22960
8/2/2013	19641
8/14/2013	16875
8/20/2013	20724
8/26/2013	18301
9/1/2013	17758
10/19/2013	14133
10/22/2013	15983
10/31/2013	15897
12/18/2013	19465
12/27/2013	18383

MID Moosehorn

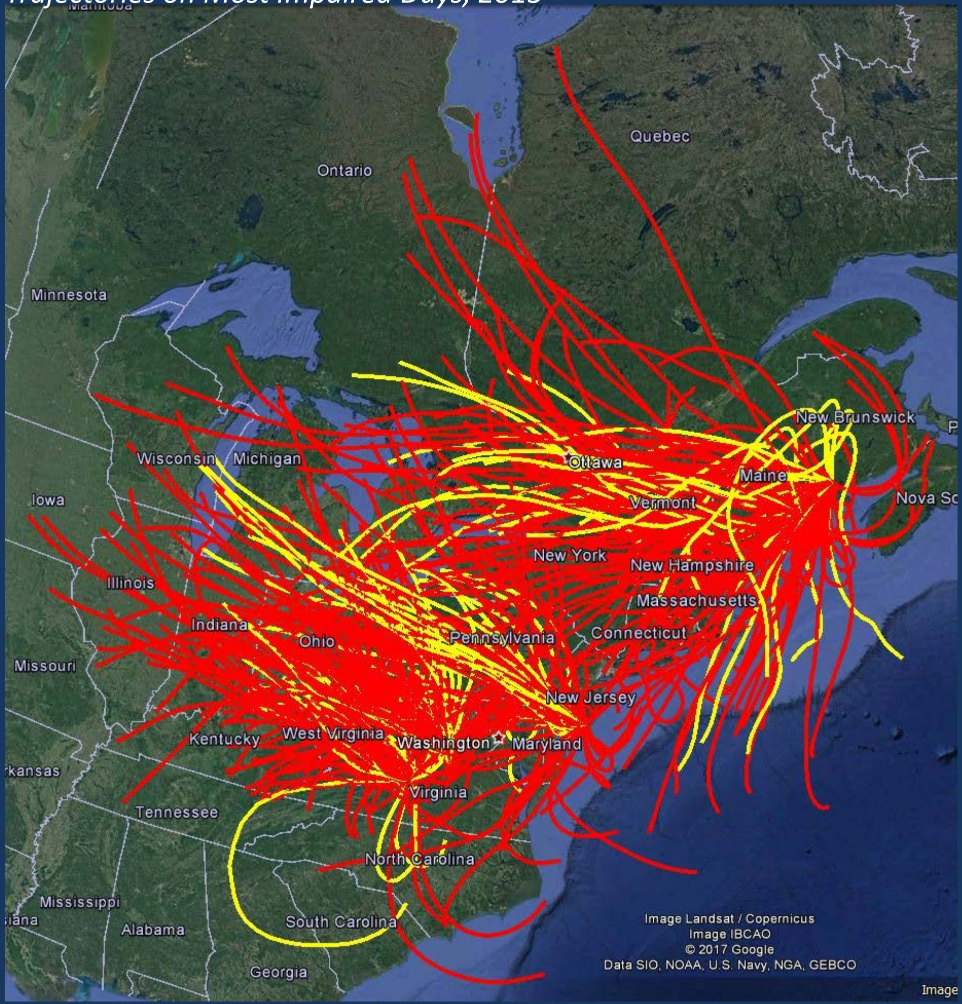
Date	DEMAND (mW/hr)
2/15/2013	16495
3/14/2013	17371
4/7/2013	14561
4/10/2013	15177
4/22/2013	15218
4/25/2013	14661
5/16/2013	15180
5/31/2013	22130
6/3/2013	18361
6/24/2013	24739
6/30/2013	19030
7/6/2013	22960
8/2/2013	19641
8/14/2013	16875
8/20/2013	20724
9/13/2013	18488
10/19/2013	14133
10/22/2013	15983
10/31/2013	15897
12/6/2013	17205
12/18/2013	19465
12/21/2013	16361

MID Dolly Sods	MID Shenandoah	MID James River	MID Brigantine	MID Great Gulf	MID Acadia	MID Moosehorn
17%	17%	21%	26%	26%	21%	27%

Percent HEDD impaired to total impaired

Trajectories Methodology

Trajectories on Most Impaired Days, 2013

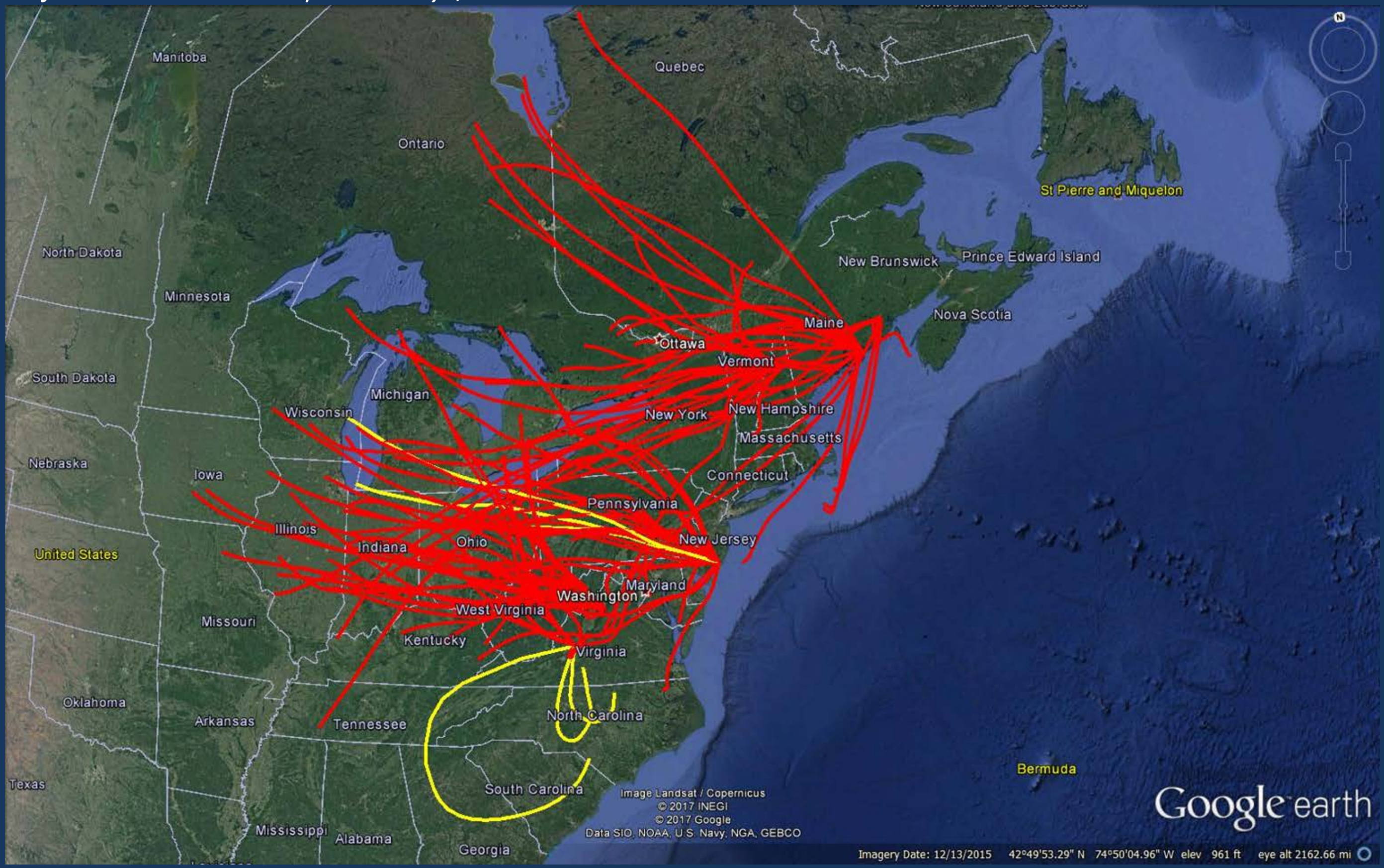


Courtesy of NOAA HYSPLIT model

- Evaluated the top 15% impaired days using 24 hour backward trajectories starting at 4 pm
  - NOAA HYSPLIT
  - 100 m, 500 m, 1000 m
  - NAM 12 km model
- Yellow trajectories: both impaired and HEDD
- Red trajectories: only impaired

Winter

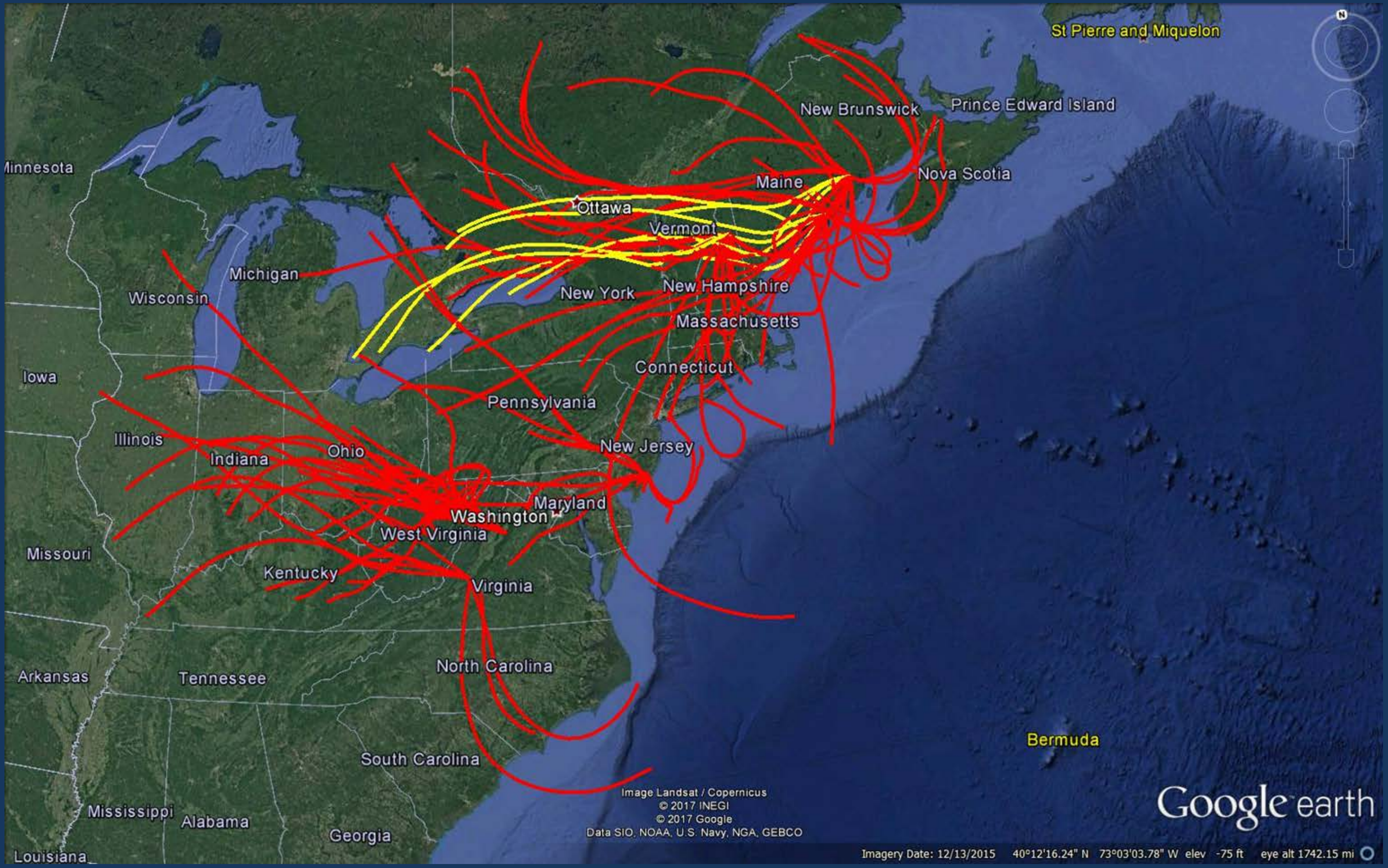
Trajectories on Most Impaired Days, Winter 2013



Very few winter impaired days correlated with a HEDD
Trajectories are consistent with what we expect

Spring

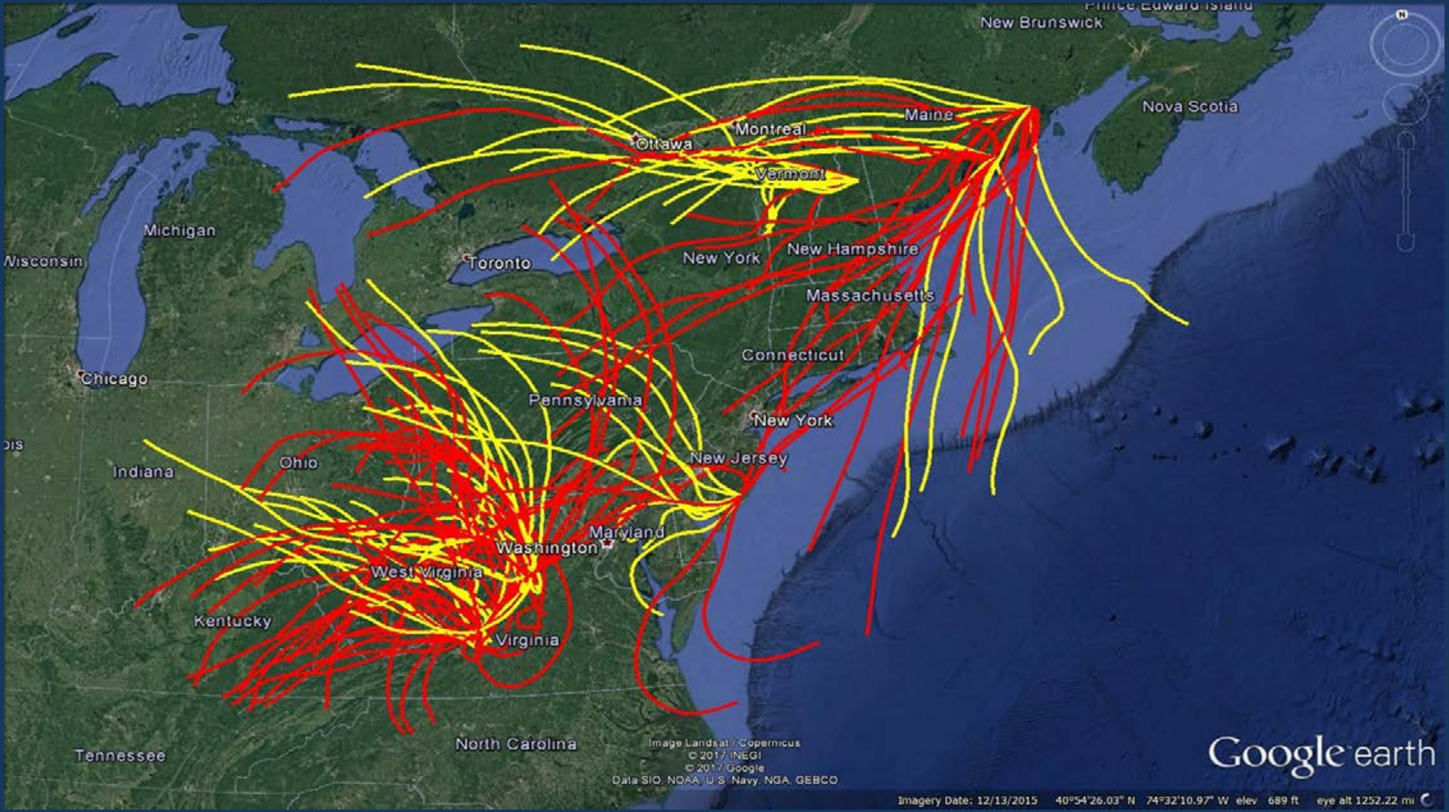
Trajectories on Most Impaired Days, Spring 2013



Fewer impaired days and HEDD occurred in the spring.
However the correlation was stronger than in the winter.
(Note: Despite the correlation trajectories indicate minimal path over ISO-NE area.)

Summer

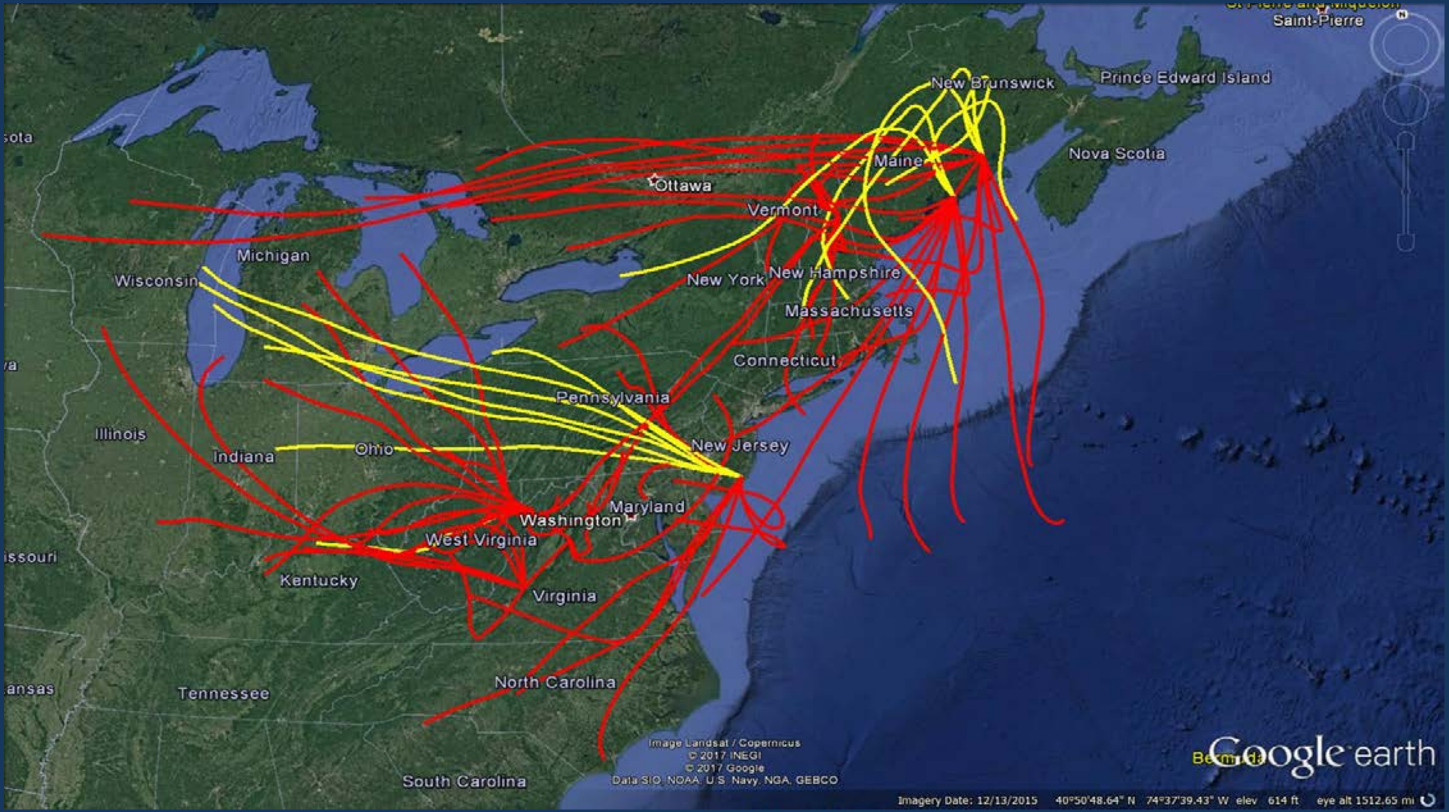
Trajectories on Most Impaired Days, Spring 2013



Greatest correlation between ISO-NE HEDD and the impaired visibility occurred in the ozone season. (Note: Despite the correlation trajectories indicate minimal path over ISO-NE area.)

Fall

Trajectories on Most Impaired Days, Fall 2013



Fewer impaired days and HEDD occurred in the fall than the summer and winter.
However the correlation was stronger than in the winter and summer.
(Note: This season could be of greater concern, due to the frequency of correlating trajectories that pass through ISO-NE region.

Trajectory Summary

- No definitive conclusion in HEDD and impaired trajectories
- Majority of trajectories show little coverage over ISO-NE area for 2013
- HEDD from other states could be affecting visibility in other states
- Preliminary analysis: Units in the ISO-NE region are not the <u>primary</u> contributor to worst visibility and HEDD days in 2013.

Next Steps…

- Work is ongoing…including additional analyses with the other ISOs

- Class I states have begun to consult with the areas identified in the technical work

Questions?

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