Appendix A- Acadia Supplement

Trajectory analysis results at Acadia National Park.

Equations for Different Metrics

Everyday Residence-time Probability

$$EP = \left({n_{ij}} \big/ {N} \right)$$

n_{ij} = total endpoints passing through grid cell i, j

N = total endpoints passing through all grid cells from all trajectories

High Day Residence-time Probability

$$HP = \left({m_{ij}} \big/ {M} \right)$$

m_{ij} = total high day endpoints passing through grid cell i, j

M = total high day endpoints passing through all grid cells from high day trajectories

Incremental Probability

$$IP = HP - EP$$

Cluster-Weighted Probability

$$CWP = \frac{1}{\overline{C}} \left(\sum_{i=1}^{L} (\overline{C})_i \cdot RP_i - \overline{C} \cdot EP \right)$$

L = total number of clusters calculated

$(\overline{C})_i$ = Average pollutant concentration (based on observations associated with cluster i)

$\overline{C}$ = Average pollutant concentration (based on all days)

Description of Figures

- Central Trajectory (CT)- Trajectory with the largest number of nearest neighbors in the dataset.

- Frequency Based Clusters- These clusters are formed by finding the "central" trajectory which has the greatest number of neighboring trajectories within a subjectively selected radius of proximity (R). These trajectories are then removed from the dataset and the process is applied to the remaining trajectories.

- Proximity Based Clusters- Clustering relies on the frequency-based cluster groups, but forms trajectory groups based on proximity rather than frequency. In the first step, the frequency-based approach is used to identify the central trajectories that represent the most populated frequency-based clusters (approximately 10 clusters typically contain at least 98% of the trajectories in the dataset using R=12 and 120 hour back-trajectory (BT) time).   These 10 central trajectories are then used to develop 10 proximity-based clusters by assigning every trajectory in the dataset to its nearest central trajectories (calculated back to 72 hours).

- Incremental Probability- Difference between the everyday probability (probability derived from all the trajectories in the dataset) and high day probability (probability derived from trajectories arriving at the site on the subset of high pollution days).

- Cluster Weighted Probability- Each PATH-derived cluster's residence-time probability is weighted by the average sulfate (or other pollutant) value for any measurements corresponding to a trajectory which is a member of that cluster. The weighted residence-time probability is summed over *all* clusters calculated for a site. The everyday probability is subtracted from the sum of cluster-weighted probabilities to identify areas of increased (or in the case of negative values, decreased) probability of being associated with a meteorological pathway for pollutant transport.

Acadia All Trajectories 00-04, Top 10 Clusters

Modes defined at: R=12, 120hr BT, 500m Start ht, 5111 Valid Trajectories, 9264 Invalid

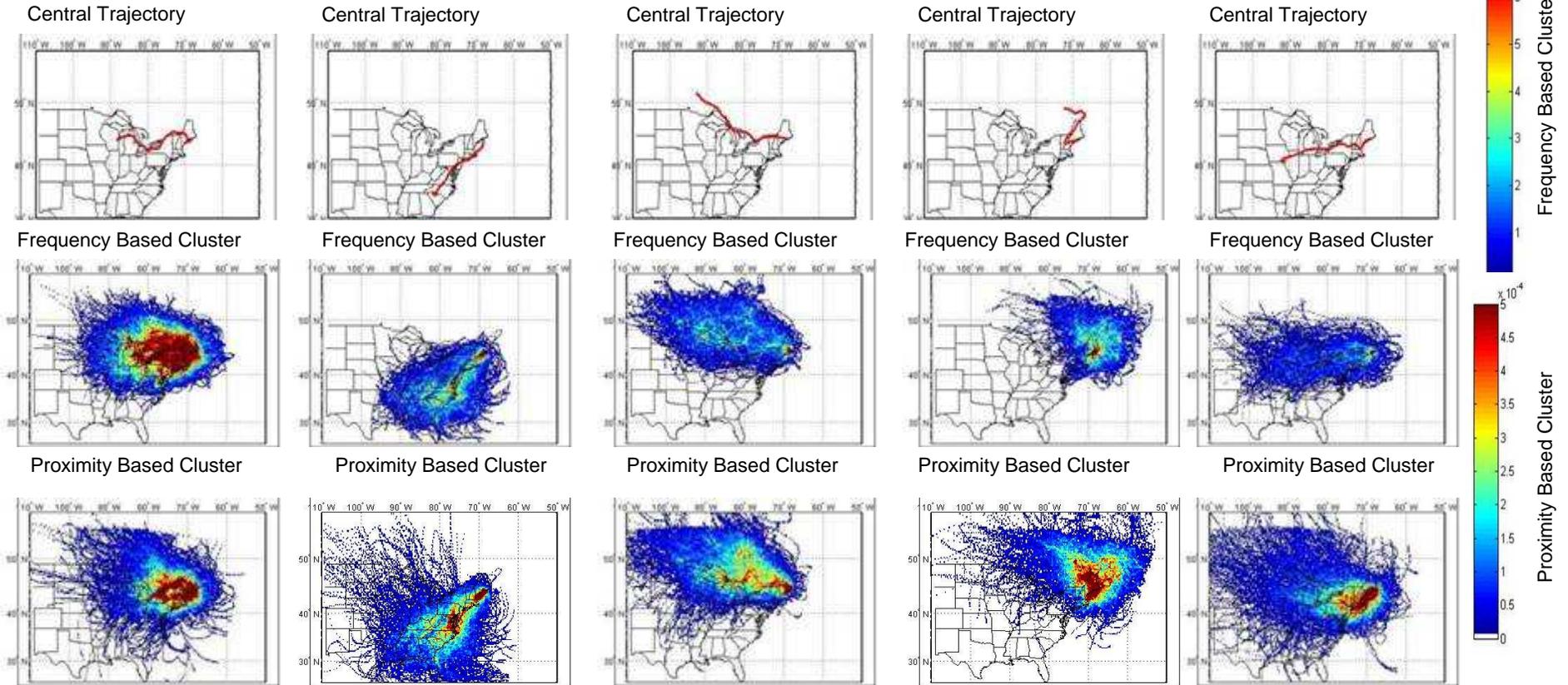Reassigned Trajectories Based on 72hr BT, 500m Start Ht, 8274 Valid Trajectories

Cluster 1

	Frequency	Proximity
Sulfate	2.60	2.45
Bext	52.19	50.35
PM	6.91	6.54
OC	1.63	1.57
# Trajs	3811	1347
# Trajs w. Poll	1056	373

Cluster 2

	Frequency	Proximity
Sulfate	2.17	3.14
Bext	44.79	59.88
PM	6.01	7.92
OC	1.55	1.52
# Trajs	1302	738
# Trajs w. Poll	324	195

Cluster 3

	Frequency	Proximity
Sulfate	2.76	1.79
Bext	54.39	39.91
PM	6.92	5.42
OC	1.36	1.49
# Trajs	817	1058
# Trajs w. Poll	221	302

Cluster 4

	Frequency	Proximity
Sulfate	1.30	1.40
Bext	29.89	30.83
PM	4.04	4.09
OC	1.21	1.04
# Trajs	487	1032
# Trajs w. Poll	137	245

Cluster 5

	Frequency	Proximity
Sulfate	1.31	3.13
Bext	30.24	57.88
PM	3.86	7.80
OC	1.15	1.58
# Trajs	321	1165
# Trajs w. Poll	97	389

Acadia All Trajectories 00-04, Top 10 Clusters

Modes defined at: R=12, 120hr BT, 500m Start ht, 5111 Valid Trajectories, 9264 Invalid
Reassigned Trajectories Based on 72hr BT, 500m Start Ht, 8274 Valid Trajectories

## Cluster 6   Cluster 7   Cluster 8   Cluster 9   Cluster 10

Central Trajectory · Central Trajectory · Central Trajectory · Central Trajectory · Central Trajectory

Frequency Based Cluster · Frequency Based Cluster · Frequency Based Cluster · Frequency Based Cluster · Frequency Based Cluster

Proximity Based Cluster · Proximity Based Cluster · Proximity Based Cluster · Proximity Based Cluster · Proximity Based Cluster

Cluster 6

	Frequency	Proximity
Sulfate	1.07	3.19
Bext	22.28	64.16
PM	2.85	8.19
OC	0.75	1.91
# Trajs	264	805
# Trajs w. Poll	78	222

Cluster 7

	Frequency	Proximity
Sulfate	3.28	1.70
Bext	59.81	33.20
PM	8.02	4.25
OC	1.46	0.81
# Trajs	235	543
# Trajs w. Poll	75	137

Cluster 8

	Frequency	Proximity
Sulfate	1.03	2.21
Bext	23.62	44.48
PM	3.23	6.11
OC	1.10	1.52
# Trajs	168	1177
# Trajs w. Poll	23	331

Cluster 9

	Frequency	Proximity
Sulfate	1.50	2.10
Bext	31.53	44.05
PM	4.05	5.95
OC	0.62	1.52
# Trajs	122	1358
# Trajs w. Poll	29	324

Cluster 10

	Frequency	Proximity
Sulfate	1.99	1.41
Bext	46.99	28.96
PM	5.59	3.78
OC	1.25	0.89
# Trajs	105	699
# Trajs w. Poll	20	208

Acadia All Trajectories 00-04, Best/Worst Sulfate

Modes defined at: R=12, 120hr BT, 500m Start ht, 5111 Valid Trajectories, 9264 Invalid
Reassigned Trajectories Based on 72hr BT, 500m Start Ht, 8274 Valid Trajectories

Highest Sulfate (Proximity Based)
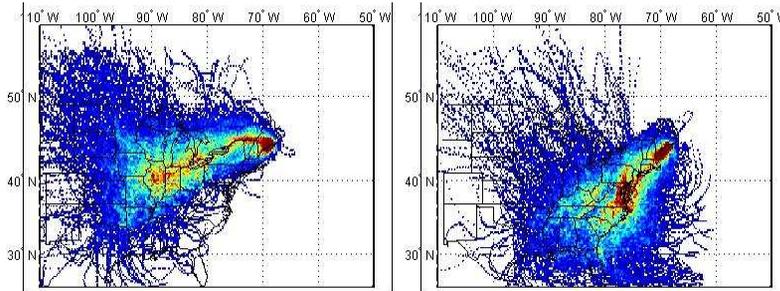
	Frequency	Proximity
Sulfate	1.07	3.19
Bext	22.28	64.16
PM	2.85	8.19
OC	0.75	1.91
# Trajs	264	805
# Trajs w. Poll	78	222

	Frequency	Proximity
Sulfate	2.17	3.14
Bext	44.79	59.88
PM	6.01	7.92
OC	1.55	1.52
# Trajs	1302	738
# Trajs w. Poll	324	195

Lowest Sulfate (Proximity Based)
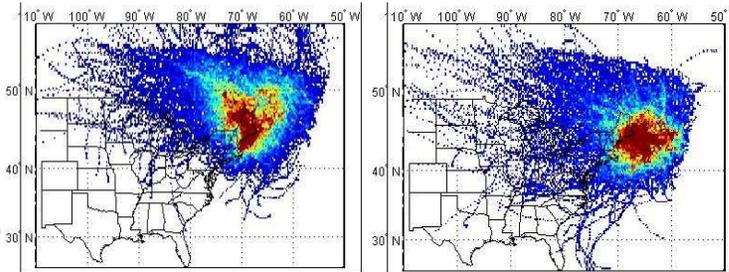
	Frequency	Proximity
Sulfate	1.30	1.40
Bext	29.89	30.83
PM	4.04	4.09
OC	1.21	1.04
# Trajs	487	1032
# Trajs w. Poll	137	245

	Frequency	Proximity
Sulfate	1.99	1.41
Bext	46.99	28.96
PM	5.59	3.78
OC	1.25	0.89
# Trajs	105	699
# Trajs w. Poll	20	208

Sulfate- Sulfate ion Conc. (ug/m3)
Bext- Extinction (Mm-1)
PM- Particulate Matter Conc. (ug/m3)
OC- Organic Carbon Conc. (ug/m3)
Num Trajs- Number of trajectories in cluster
Num Trajs w. Poll- Number of trajectories in cluster with associated pollution measurement (Based on number of IMPROVE samples taken during the 2000-2004 period).

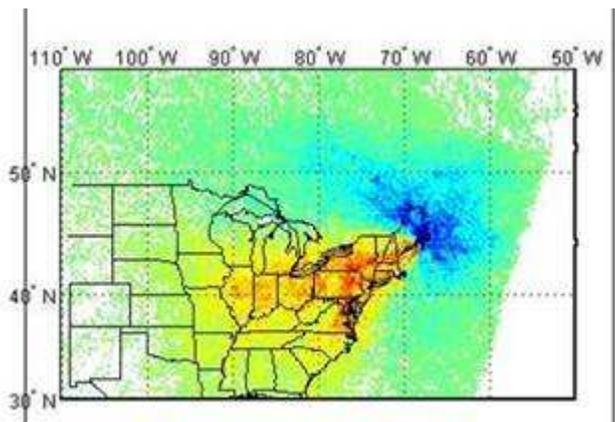# Acadia All Trajectories 00-04, Incremental Probability
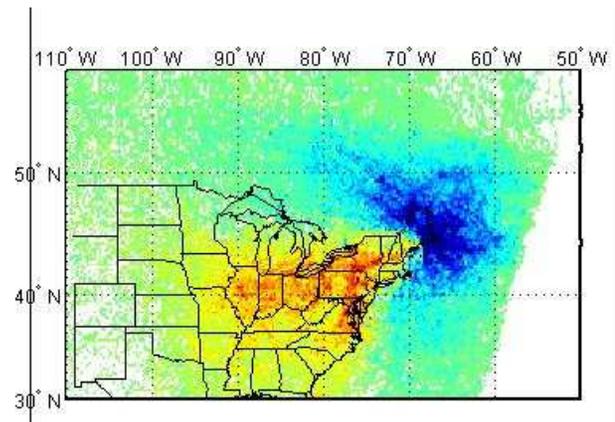
IP Based on Top10%

500m

Sulfate   PM   OC   B-ext
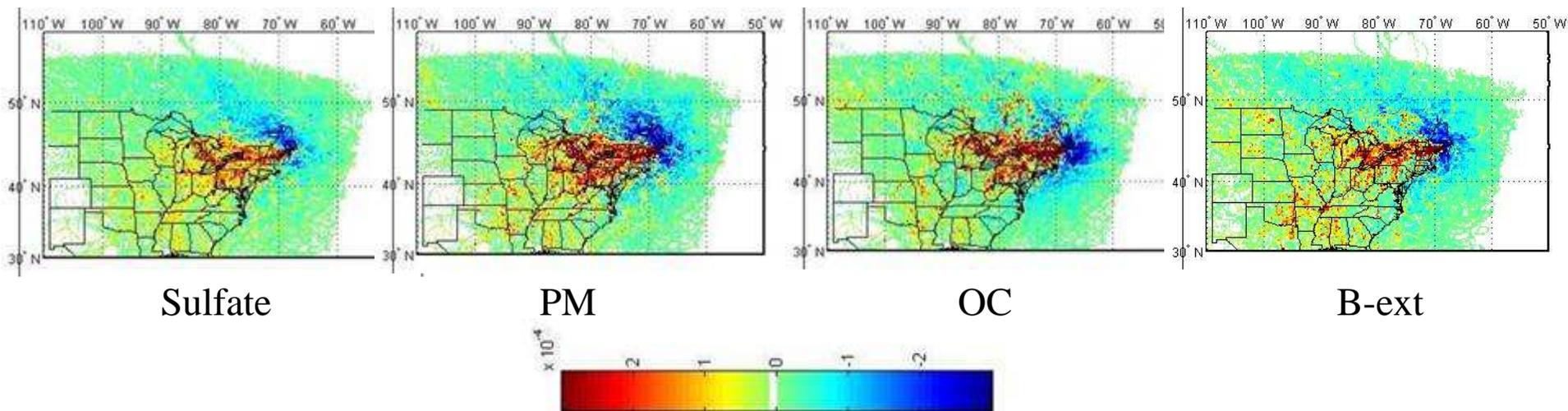
1000m
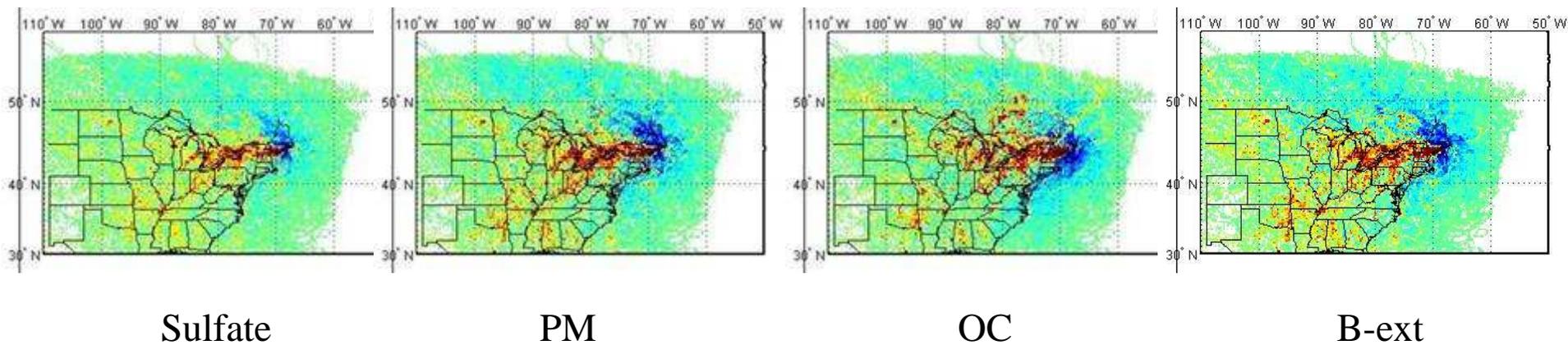
Sulfate   PM   OC   B-ext

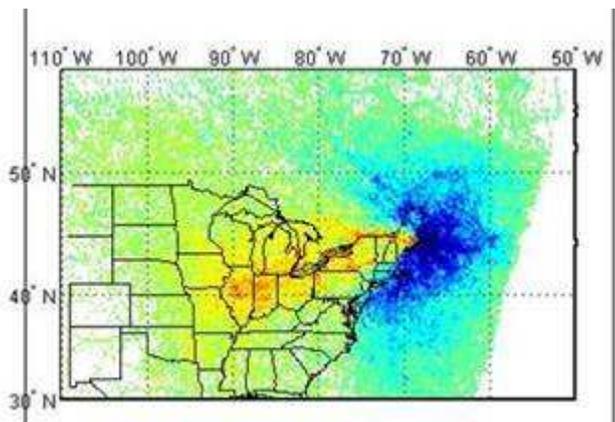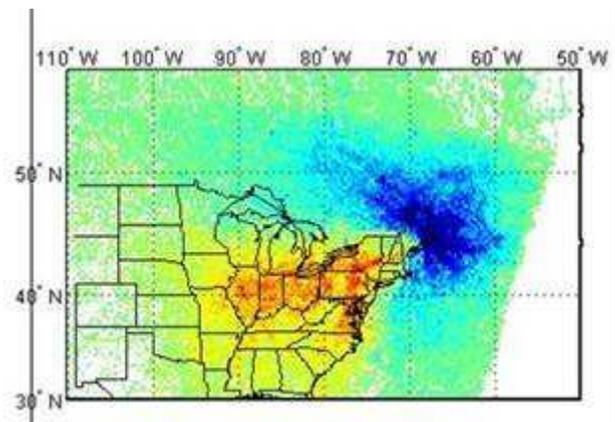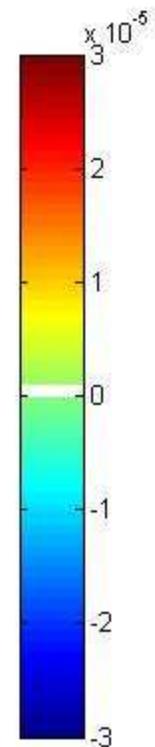# Acadia All Trajectories 00-04, Cluster Weighted Probability
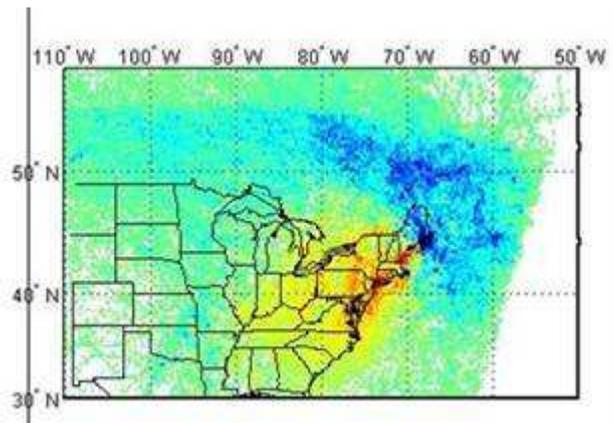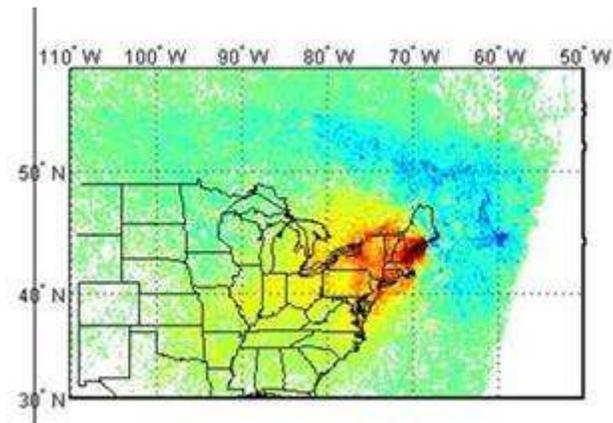### Calculated using Proximity Based Clusters, 500m

Sulfate

PM

OC

B-ext

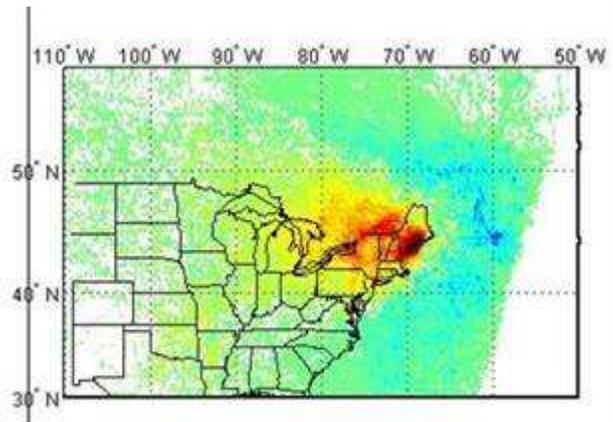# Acadia All Trajectories 00-04, Cluster Weighted Probability
Calculated using Frequency Based Clusters, 500m

Sulfate

PM

OC

B-ext