

Appendix A- Dolly Sods Supplement

Trajectory analysis results at Dolly
Sods Wilderness Area.

Equations for Different Metrics

Everyday Residence-time Probability

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

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

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

Incremental Probability

$$IP = HP - EP$$

High Day Residence-time Probability

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

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

Cluster-Weighted Probability

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

L = total number of clusters calculated

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

\bar{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.

Dolly Sods All Trajectories 00-04, Top 9 Clusters

Modes defined at: R = 12, 120hr BT, 500m Start Height, 8954 Valid, 5421 Invalid Trajectories
 Reassigned Trajectories Based on 72hr BT, 500m Start Height, 12177 Valid Trajectories

Cluster 1

Cluster 2

Cluster 3

Cluster 4

Cluster 5

Central Trajectory



Central Trajectory



Central Trajectory



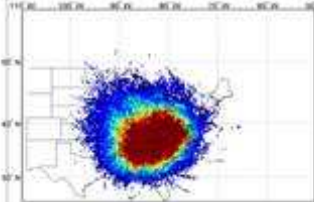
Central Trajectory



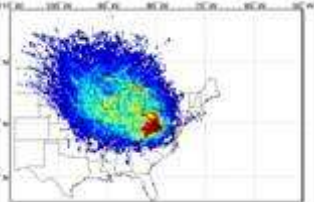
Central Trajectory



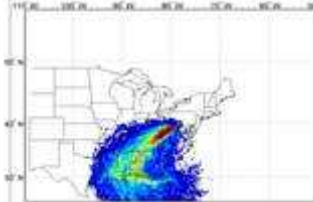
Frequency Based Cluster



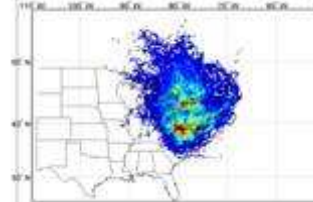
Frequency Based Cluster



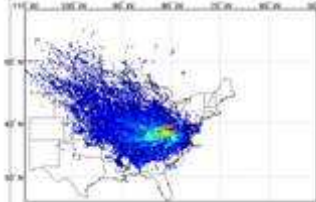
Frequency Based Cluster



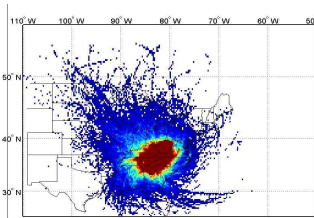
Frequency Based Cluster



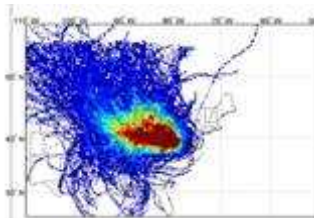
Frequency Based Cluster



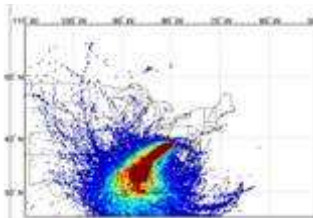
Proximity Based Cluster



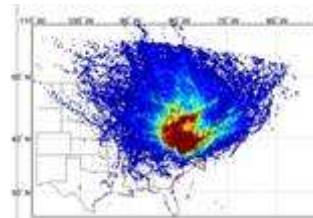
Proximity Based Cluster



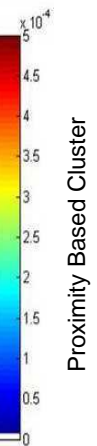
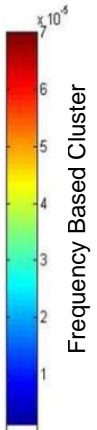
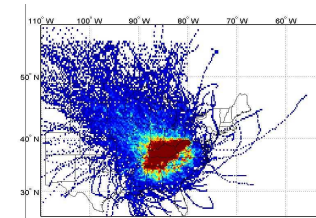
Proximity Based Cluster



Proximity Based Cluster



Proximity Based Cluster



Frequency Proximity

Sulfate	5.76	6.21
Bext	93.59	100.66
PM	12.49	13.65
OC	2.37	2.62
# Trajs	6263	1820
# Trajs w. Poll	1780	505

Frequency Proximity

Sulfate	2.86	5.54
Bext	54.24	89.60
PM	7.05	12.19
OC	2.11	2.48
# Trajs	1353	834
# Trajs w. Poll	420	220

Frequency Proximity

Sulfate	3.58	4.55
Bext	63.26	76.80
PM	8.25	10.38
OC	1.88	2.14
# Trajs	880	1208
# Trajs w. Poll	222	376

Frequency Proximity

Sulfate	4.09	4.78
Bext	70.99	78.82
PM	9.12	10.32
OC	2.21	2.05
# Trajs	759	1686
# Trajs w. Poll	214	425

Frequency Proximity

Sulfate	4.13	5.81
Bext	71.82	93.76
PM	9.51	12.93
OC	2.06	2.33
# Trajs	753	712
# Trajs w. Poll	241	196

Dolly Sods All Trajectories 00-04, Top 9 Clusters

Modes defined at: R = 12, 120hr BT, **500m** Start Height, 8954 Valid, 5421 Invalid Trajectories

Reassigned Trajectories Based on **72hr** BT, 500m Start Height, 12177 Valid Trajectories

Cluster 6

Cluster 7

Cluster 8

Cluster 9

Central Trajectory



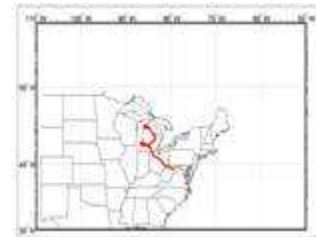
Central Trajectory



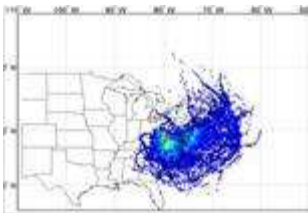
Central Trajectory



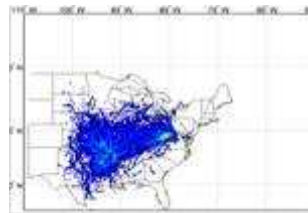
Central Trajectory



Frequency Based Cluster



Frequency Based Cluster



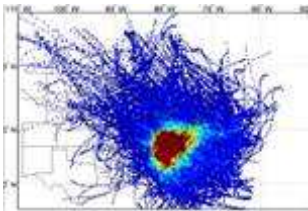
Frequency Based Cluster



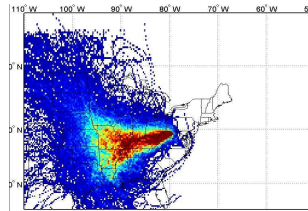
Frequency Based Cluster



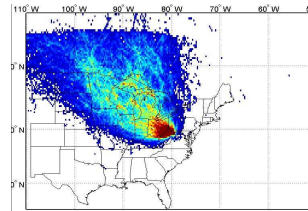
Proximity Based Cluster



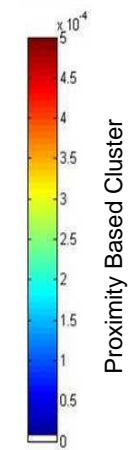
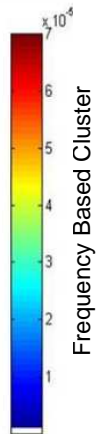
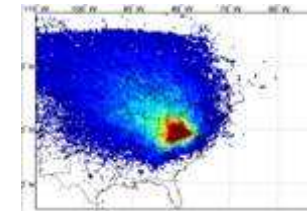
Proximity Based Cluster



Proximity Based Cluster



Proximity Based Cluster



	Frequency	Proximity
Sulfate	4.54	5.16
Bext	76.59	84.18
PM	10.11	10.95
OC	1.83	1.89
# Trajs	286	1008
# Trajs w. Poll	91	278

	Frequency	Proximity
Sulfate	3.23	4.03
Bext	55.31	69.20
PM	7.02	9.20
OC	1.22	2.07
# Trajs	226	1053
# Trajs w. Poll	56	303

	Frequency	Proximity
Sulfate	3.55	2.60
Bext	68.90	51.45
PM	8.76	6.67
OC	2.01	2.09
# Trajs	220	1272
# Trajs w. Poll	80	438

	Frequency	Proximity
Sulfate	4.41	4.48
Bext	72.35	76.78
PM	9.86	9.92
OC	1.89	2.10
# Trajs	199	2584
# Trajs w. Poll	58	721

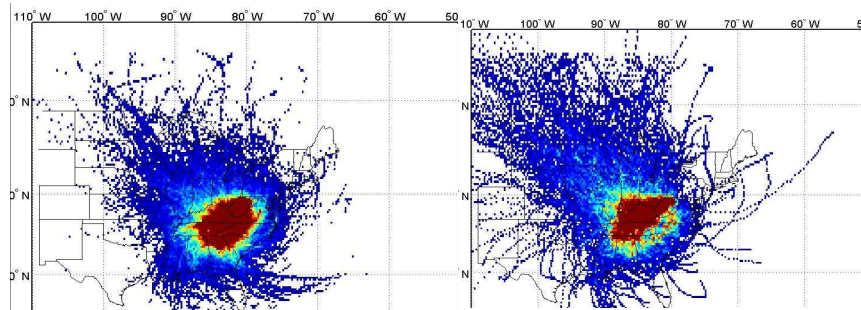
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Best/Worst Days

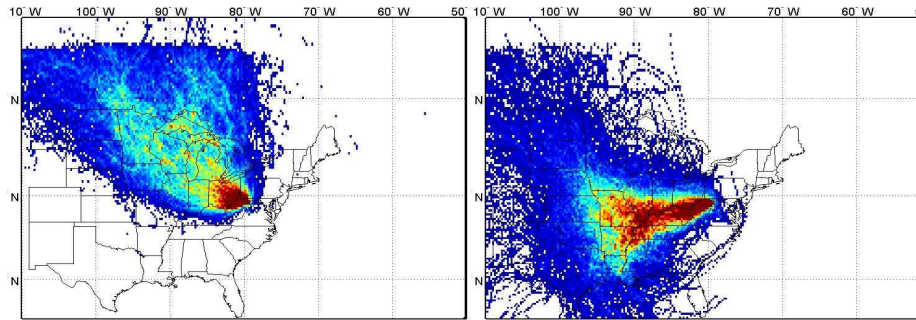
Highest Sulfate
(Proximity)



	Frequency	Proximity
Sulfate	5.76	6.21
Bext	93.59	100.66
PM	12.49	13.65
OC	2.37	2.62
# Trajs	6263	1820
# Trajs w. Poll	1780	505

	Frequency	Proximity
Sulfate	4.13	5.81
Bext	71.82	93.76
PM	9.51	12.93
OC	2.06	2.33
# Trajs	753	712
# Trajs w. Poll	241	196

Lowest Sulfate
(Proximity)



	Frequency	Proximity
Sulfate	3.55	2.60
Bext	68.90	51.45
PM	8.76	6.67
OC	2.01	2.09
# Trajs	220	1272
# Trajs w. Poll	80	438

	Frequency	Proximity
Sulfate	3.23	4.03
Bext	55.31	69.20
PM	7.02	9.20
OC	1.22	2.07
# Trajs	226	1053
# Trajs w. Poll	56	303

Sulfate- Sulfate ion Conc. (ug/m3)

Bext- Extinction (Mm-1)

PM- Particulate Matter Conc. (ug/m3)

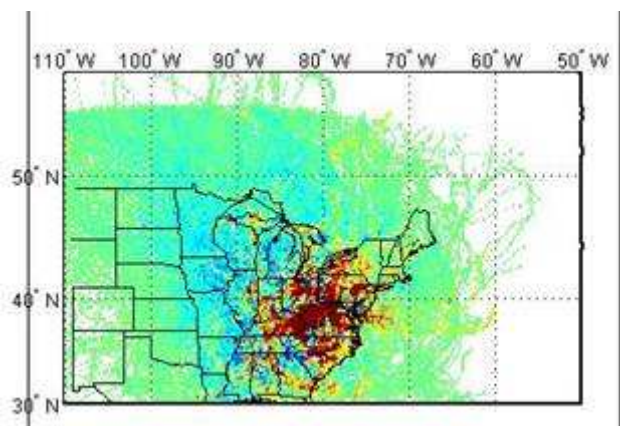
OC- Organic Carbon Conc. (ug/m3)

Num Trajs- Number of trajectories in cluster

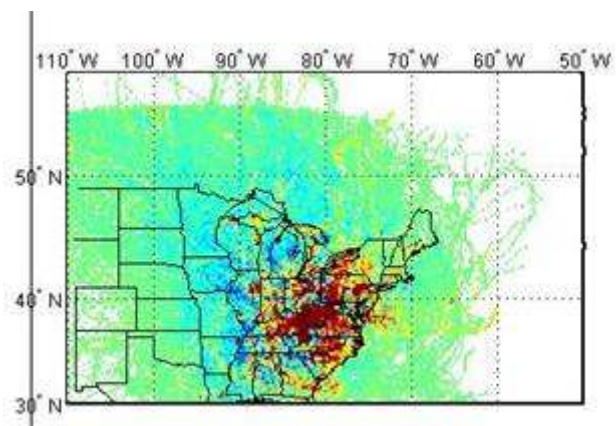
Num Trajs w. Poll- Number of trajectories in cluster with associated pollution measurement (Based on number of IMPROVE samples taken during the 2000-2004 period).

Dolly Sods All Trajectories 00-04, Incremental Probability

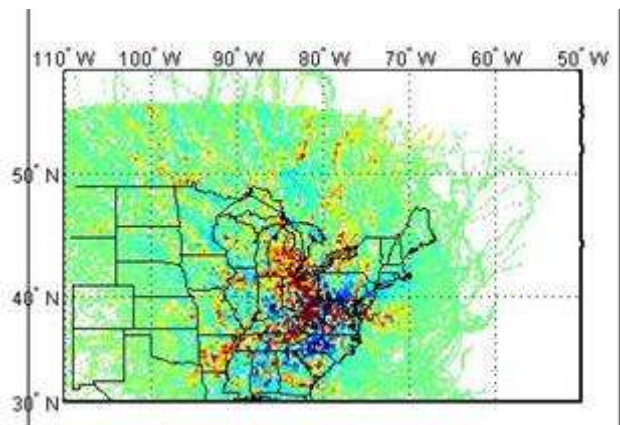
IP Based on Top10%, 500m



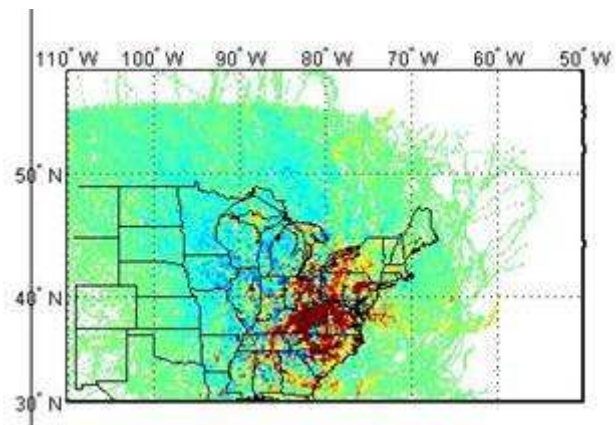
Sulfate



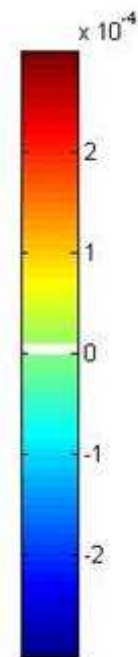
PM



OC

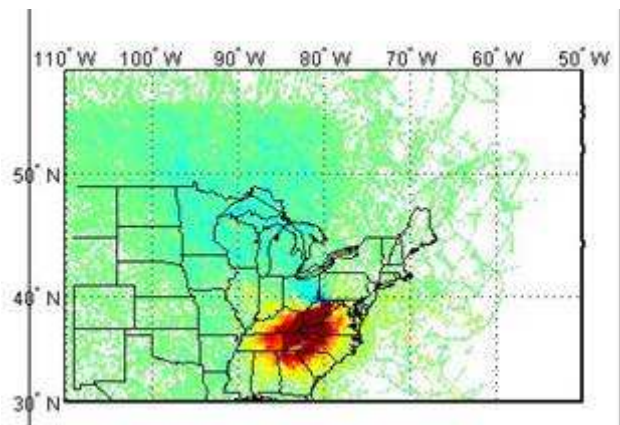


B-ext

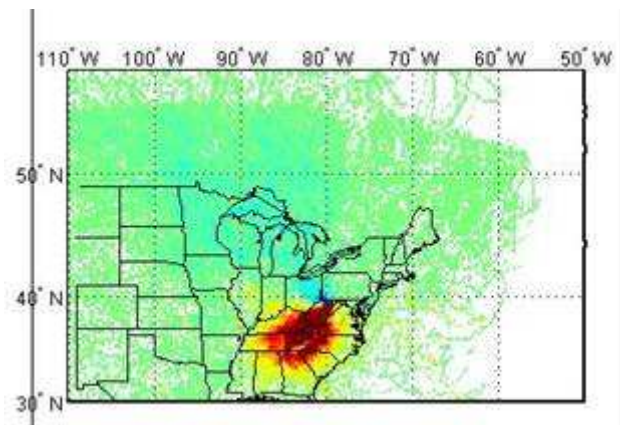


Dolly Sods All Trajectories 00-04, Cluster Weighted Probability

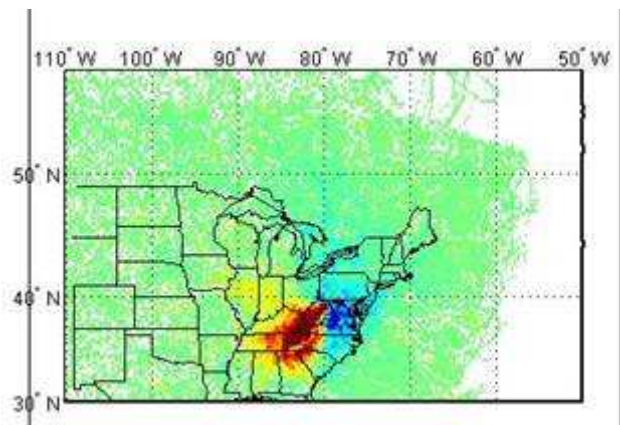
Calculated using Proximity Based Clusters, 500m



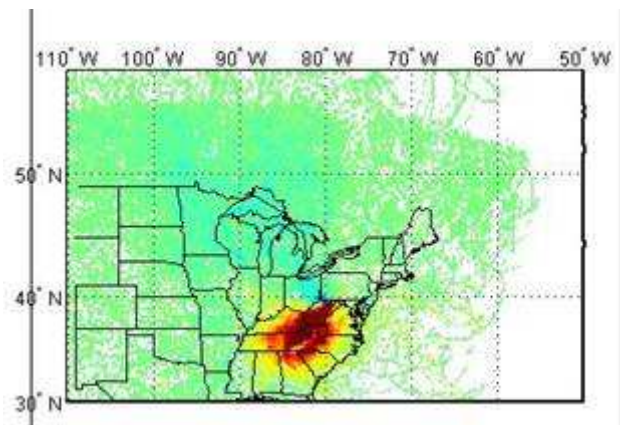
Sulfate



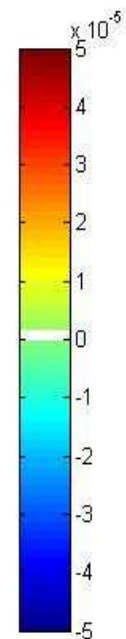
PM



OC

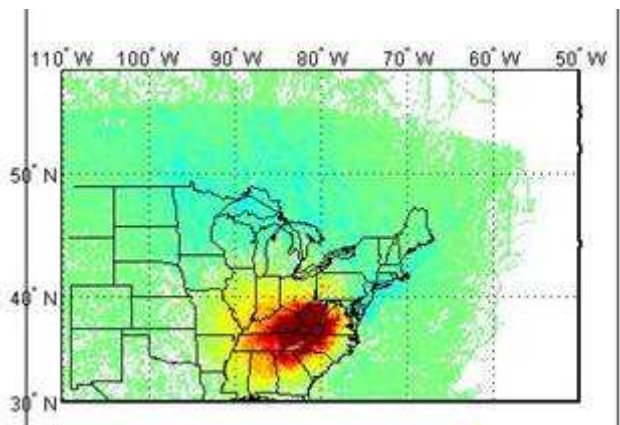


B-ext

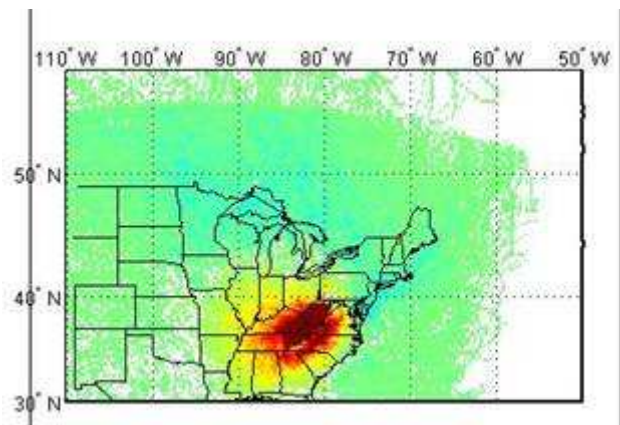


Dolly Sods All Trajectories 00-04, Cluster Weighted Probability

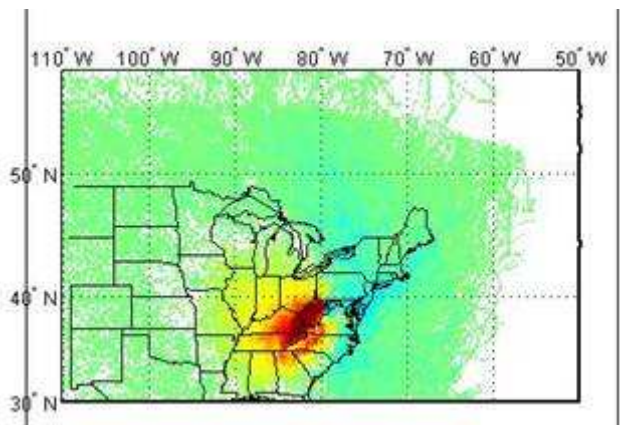
Calculated using Frequency Based Clusters, 500m



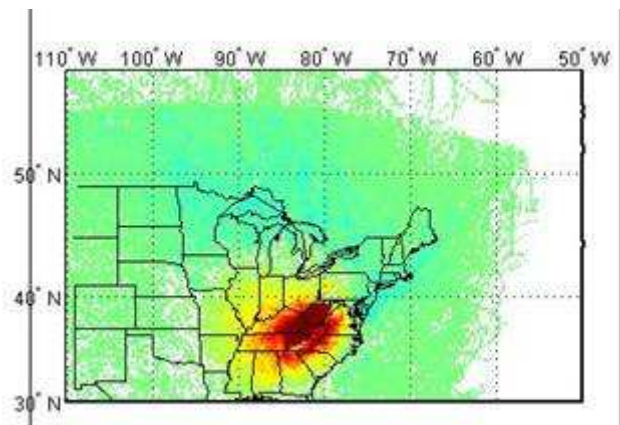
Sulfate



PM



OC



B-ext

