Atmospheric Mercury Measurements in the Gulf of Mexico and mid-Atlantic Regions

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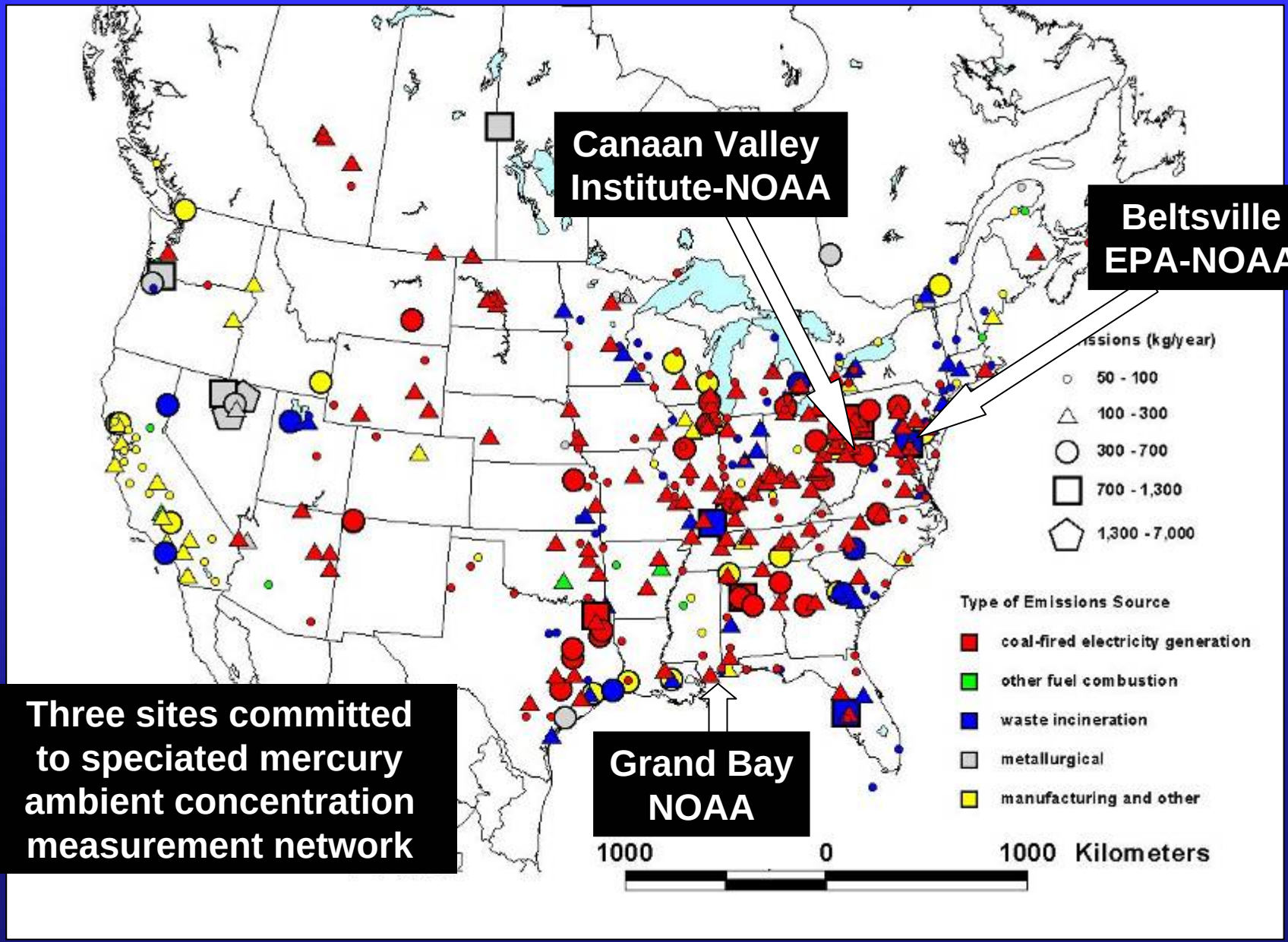
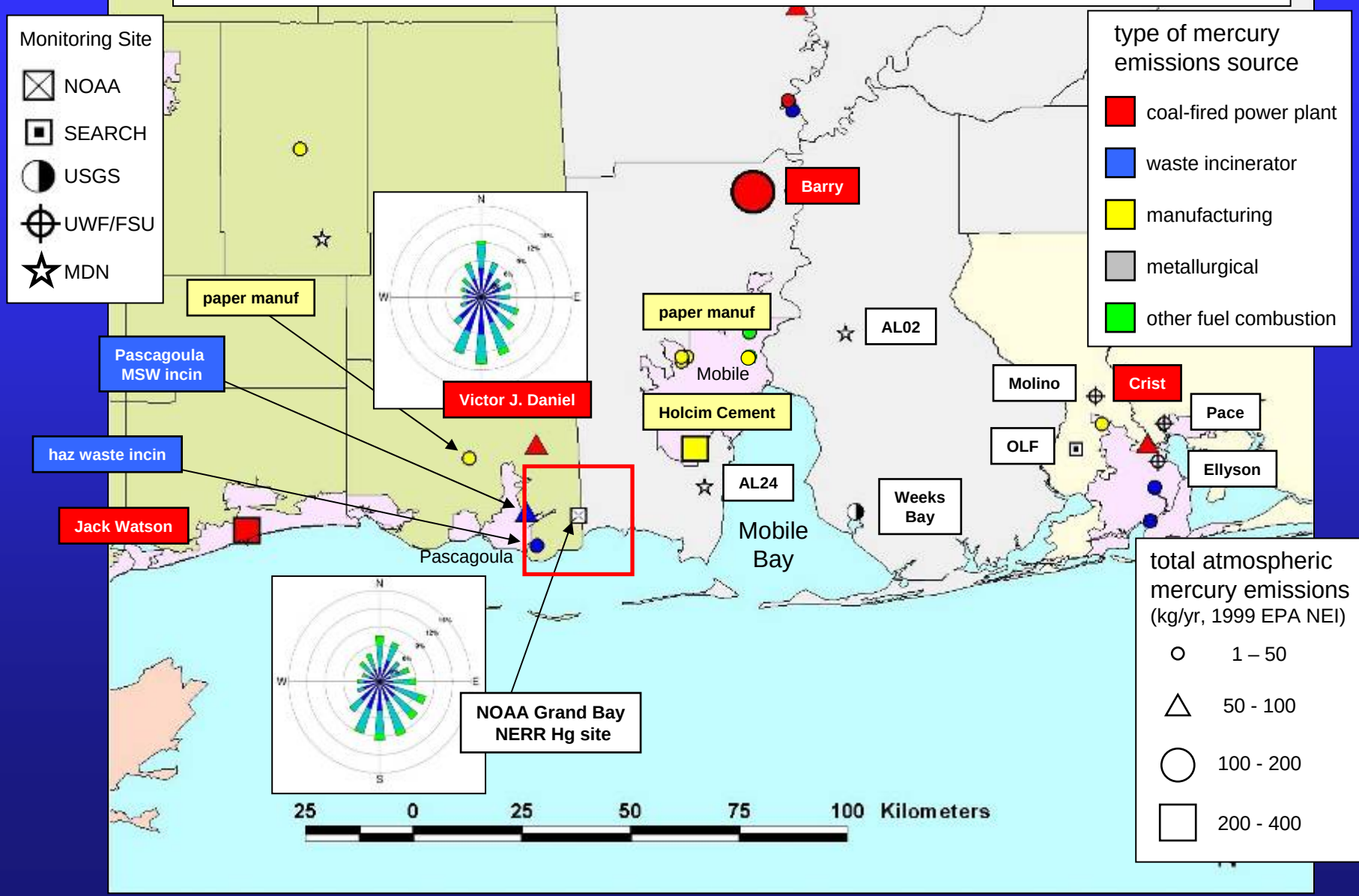
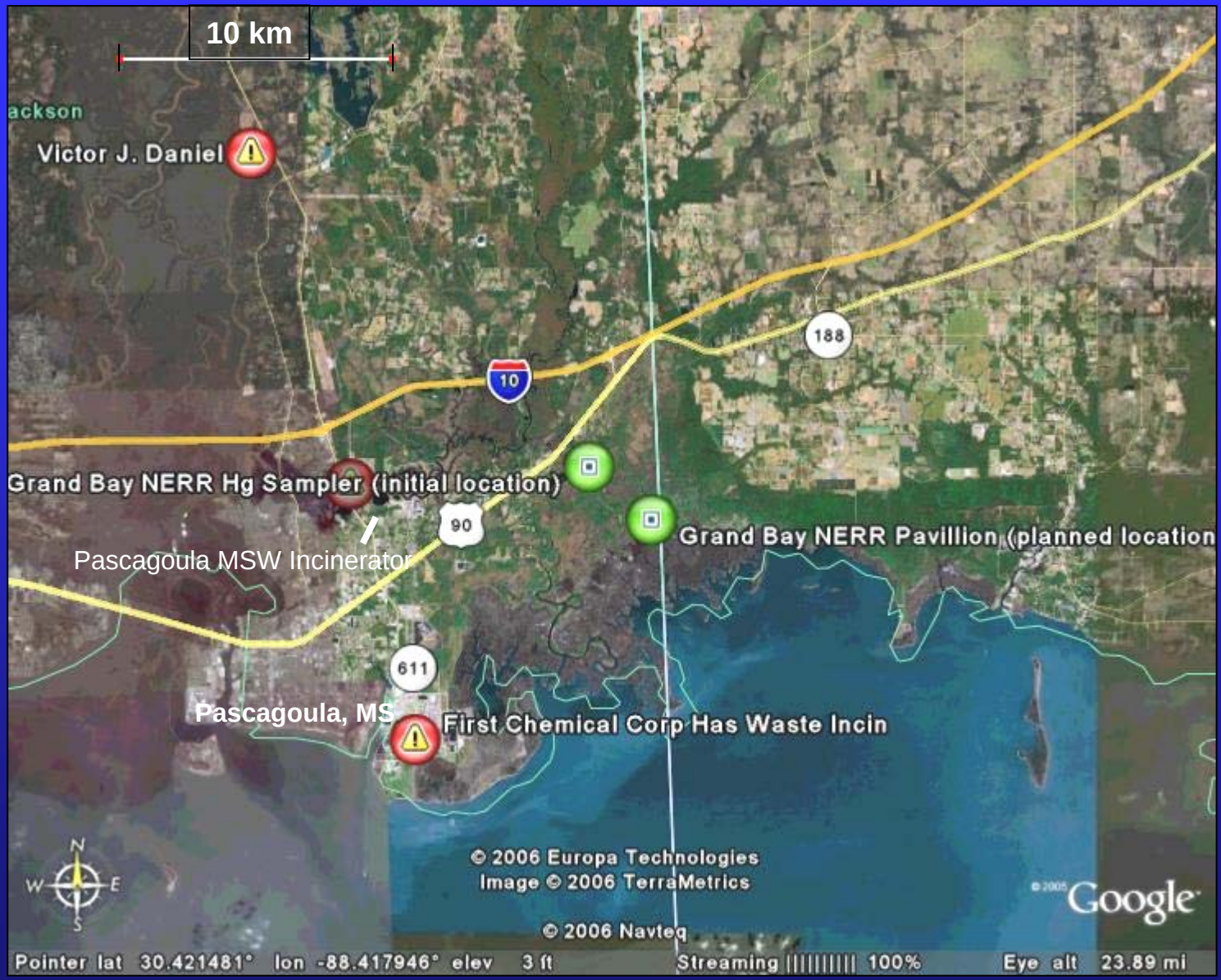
NOAA Collaborative Mercury Sites



Location of the NOAA Grand Bay NERR Atmospheric Mercury monitoring site, other atmospheric Hg monitoring sites, and major Hg point sources in the region (EPA 1999 NEI emissions inventory)



Grand Bay NERR Site

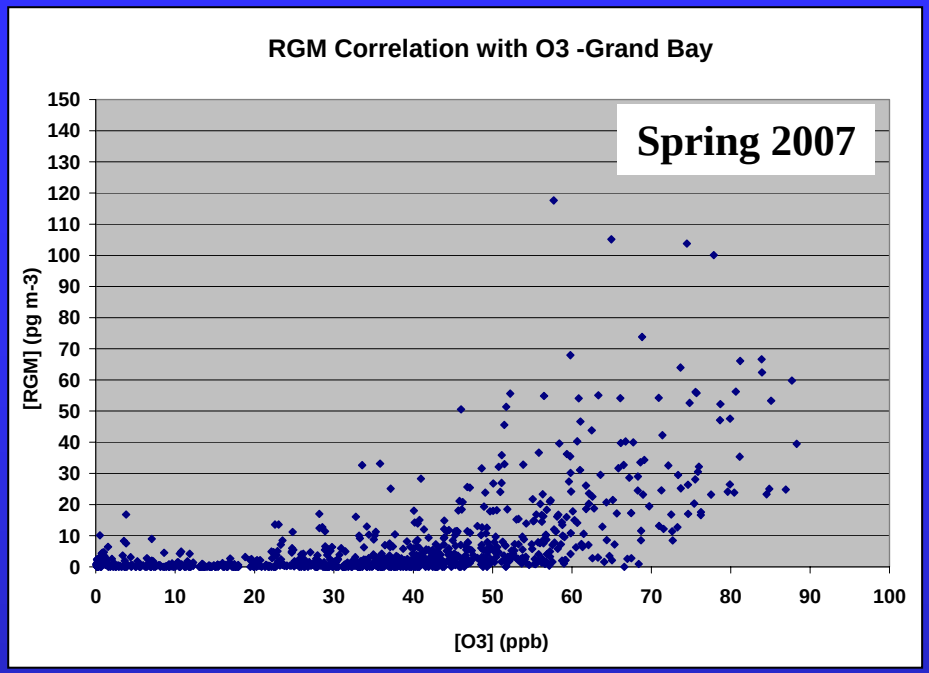


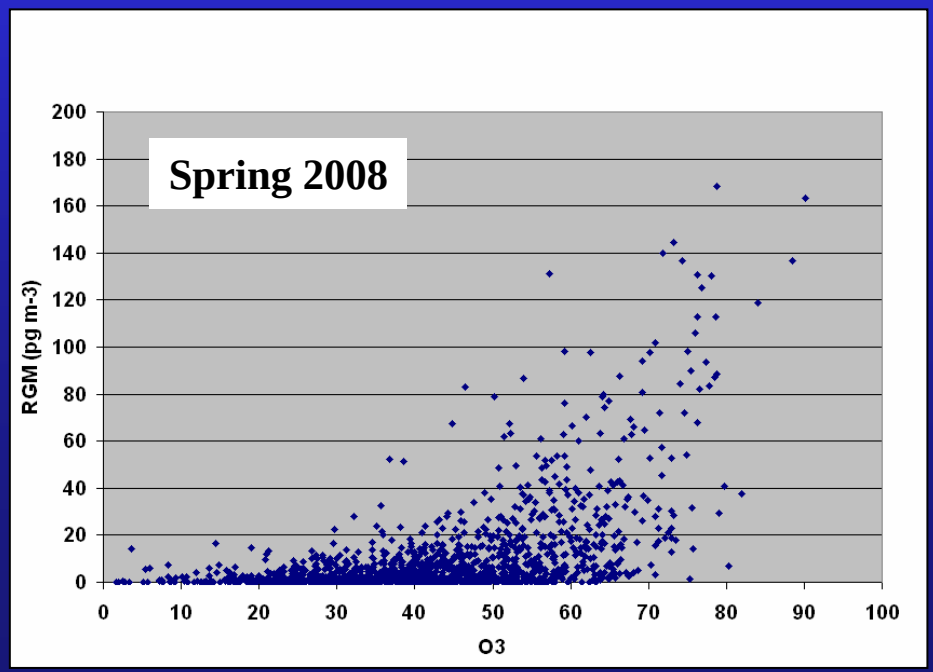
Measurements at Grand Bay NERR, MS

Measurement
Elemental mercury * 2
Fine particulate mercury *2
Reactive gaseous mercury *2
Sulfur dioxide
Ozone
Carbon Monoxide
Nitrogen Oxides (NO, NOy)
Wind speed
Wind Direction
Relative Humidity
Temperature
Precipitation

View from top of 10 m tower looking at the southerly (prevailing wind) sampling sector over at Grand Bay NERR.

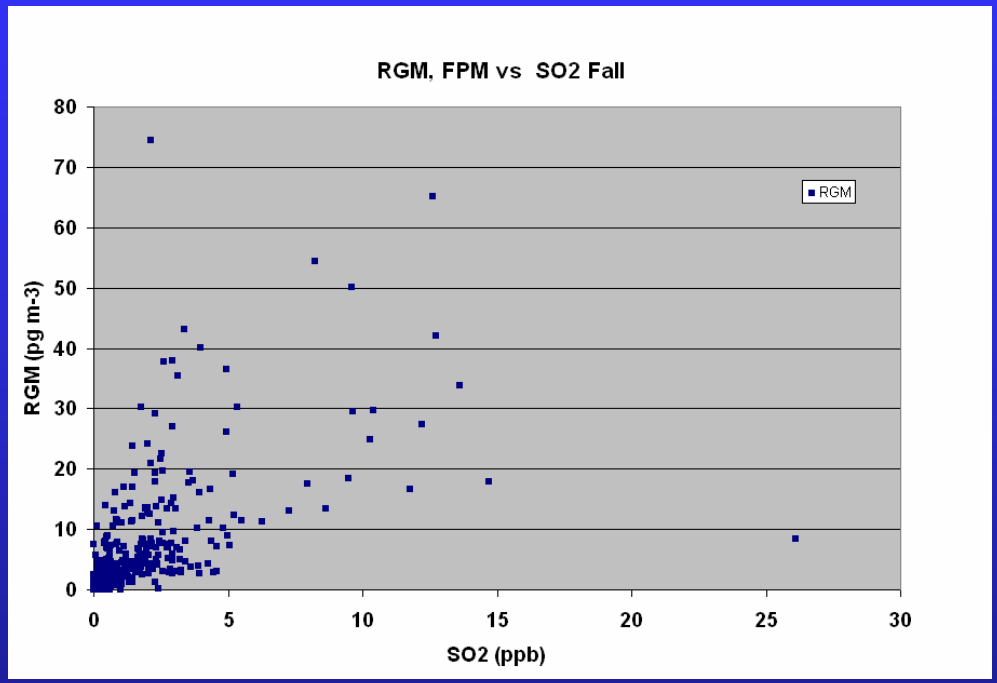
A composite view inside the NOAA trailer at Grand Bay



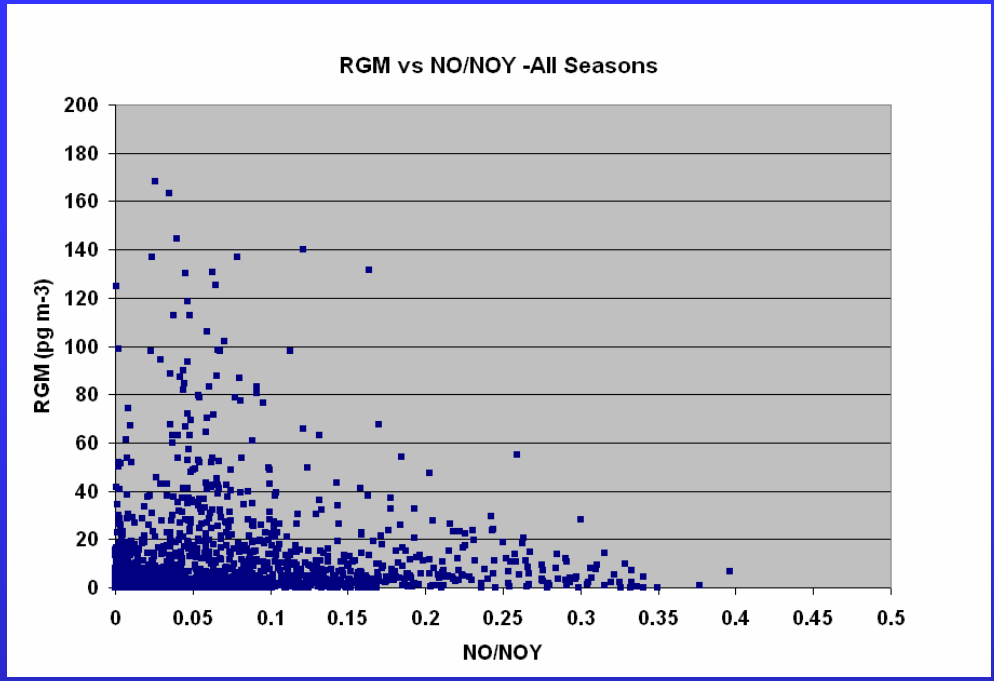


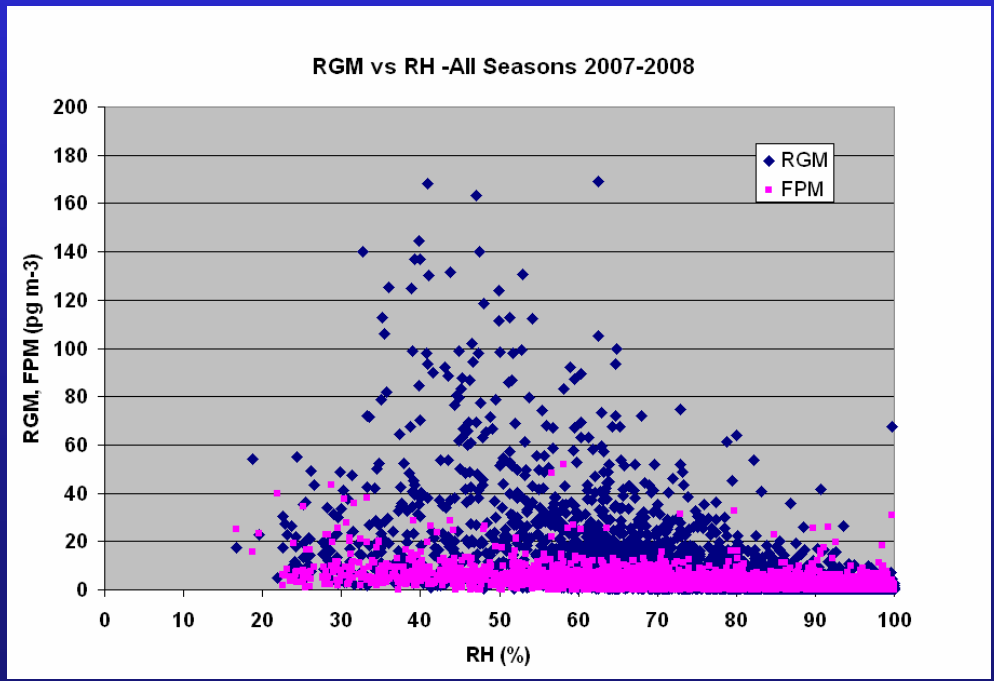
As in 2007, most pronounced correlation was between ozone and RGM, especially during the Spring (March-May).

Similar concentrations of RGM and O_3 were observed in Springtime 2007 and 2008. Higher RGM in Summer ’08 than Summer ‘07



The most coherent relationship between RGM and SO_2 was seen in Fall, and to a lesser extent during the winter. The lack of a consistent relationship in all seasons probably reflects the influence of different source types impacting the site, as well as differing chemical and physical transformation and removal processes.

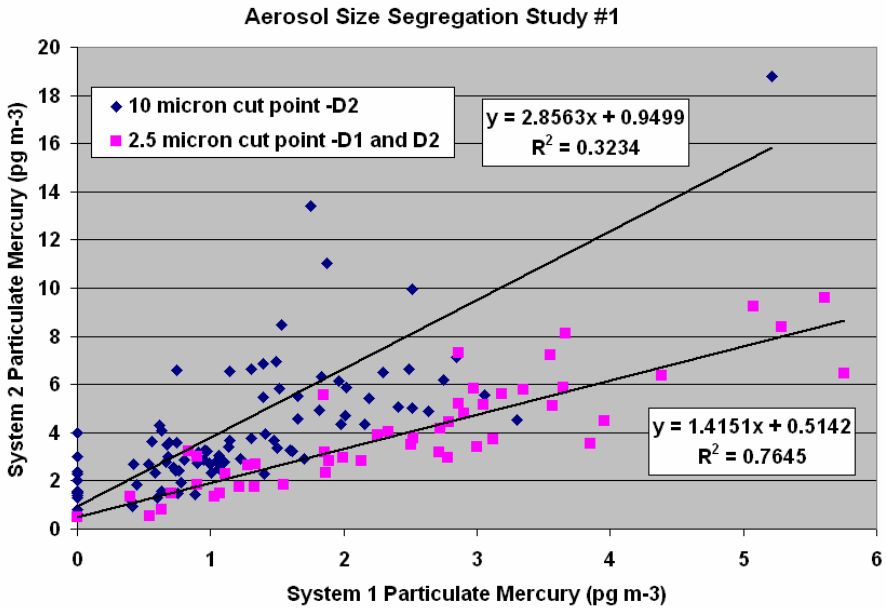


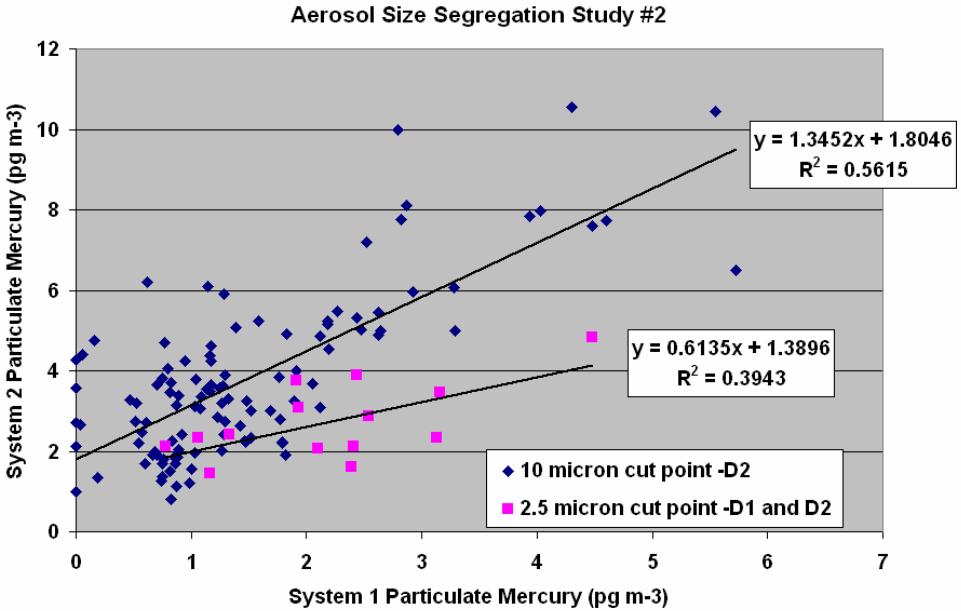


Across all seasons, higher RGM levels were associated with drier air parcels containing aged emissions. Together with the RGM/O_3 correlation, this suggests that aged continental emissions, not extremely local sources, are responsible for enhanced RGM at the site.

Downward mixing from the middle and upper trop, and photochemistry may be involved as well.

Lack of increase of FPM at high RH suggests no phase partitioning of RGM to small particles, but sea salt aerosols may take up RGM.





Two systems were configured identically (pink), then System 2 was fitted with a 10-micron cut point elutriator (blue) over the course of several days.

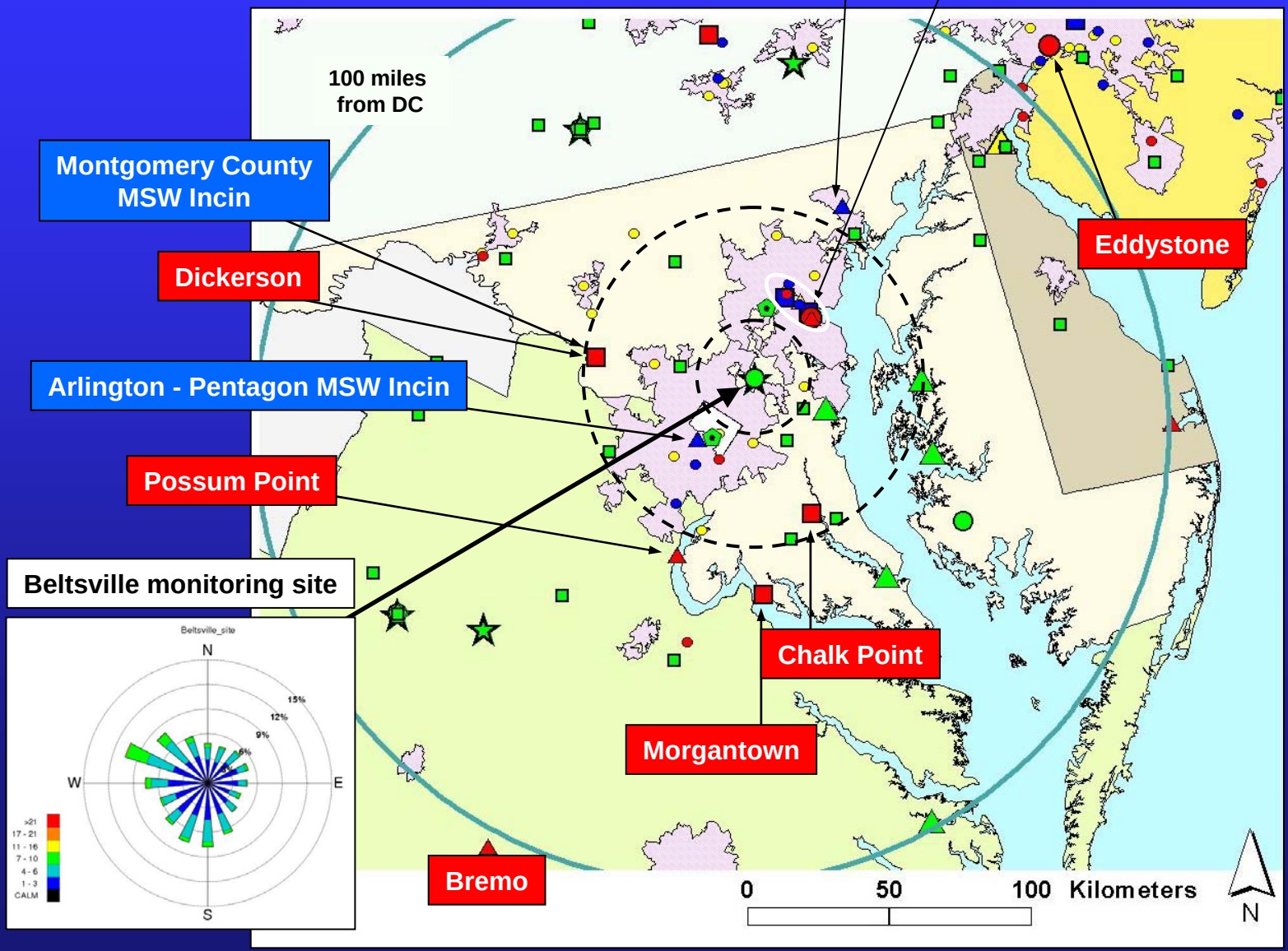
Results suggest that there may be as much mercury in the coarse (sea salt) aerosol fraction as in the fine fraction.

Studies will be repeated periodically at the site.

Measurements at Beltsville, MD CASTNet Site

Measurement	
Elemental mercury * 2	(NOAA/EPA)
Fine particulate mercury *2	
Reactive gaseous mercury *2	
Sulfur dioxide	(EPA/MACTEC)
Ozone	
Carbon Monoxide	
Nitrogen Oxides (NO, NOy)	
Wind speed	
Wind Direction	
Relative Humidity	
Temperature	
Precipitation	
SO_4^{2-}, NO_3^-, NH_4^+, HNO_3, SO_2 (Weekly)	
Total mercury in precip (weekly)	(MD DNR/UMD)
Major ions in precip(weekly)	

Beltsville, MD CASTNet Site



Monitoring sites

- rural AQS
- other AQS
- NADP/MDN
- CASTNet
- Hg site
- IMPROVE

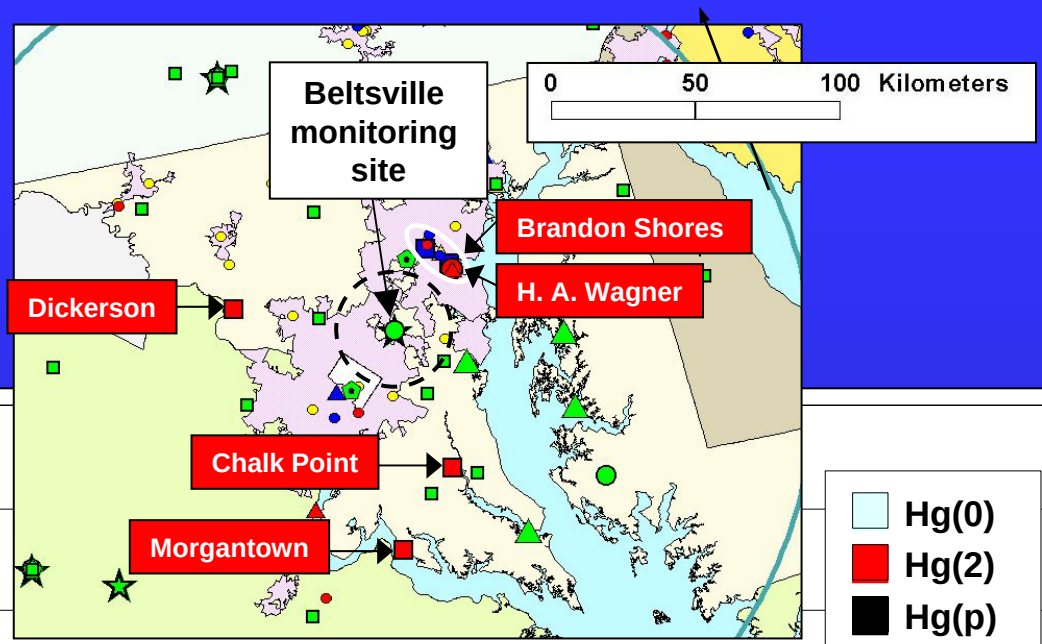
Symbol color indicates type of mercury source

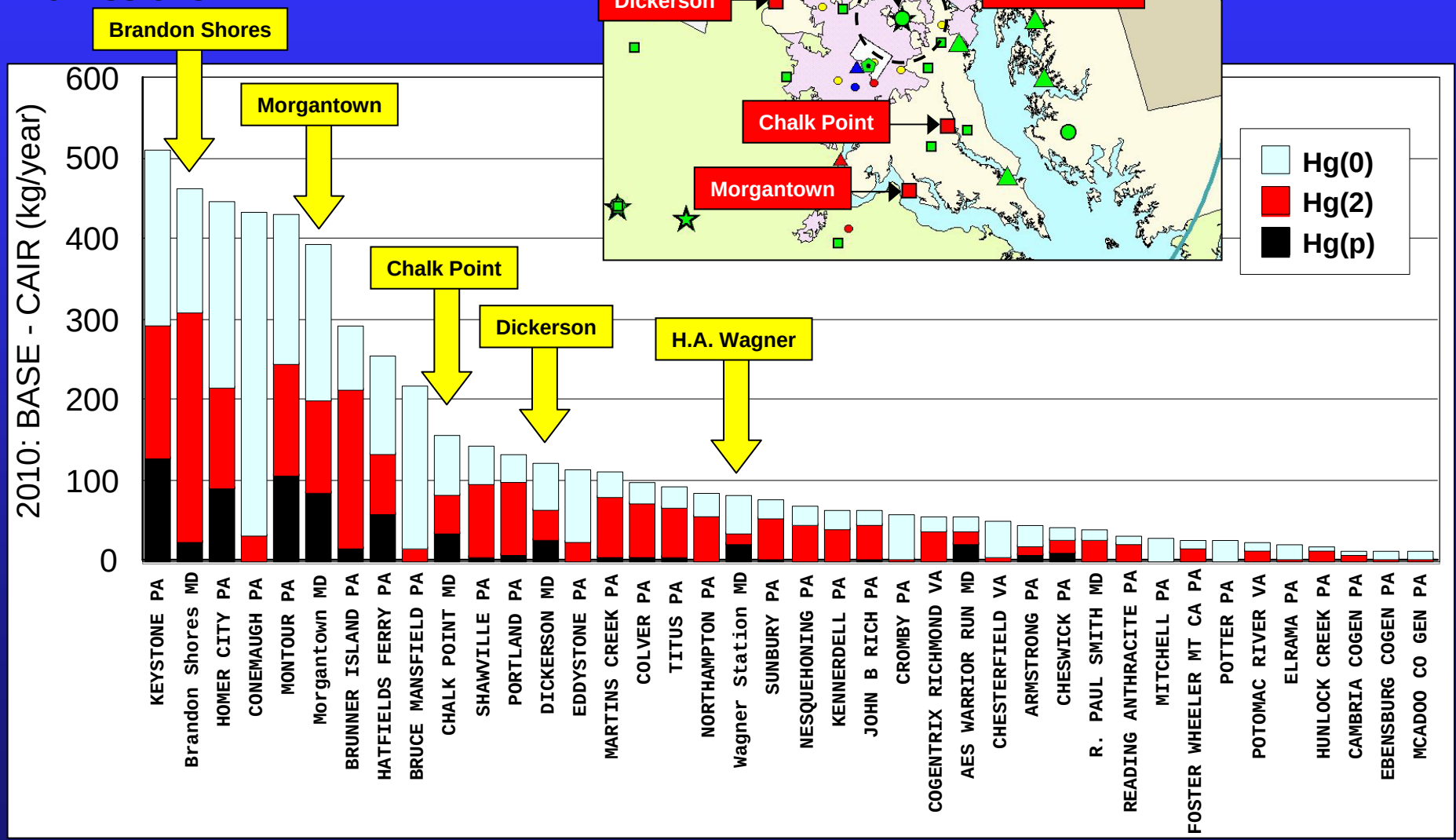
- coal
- incinerator
- metals
- manuf/other

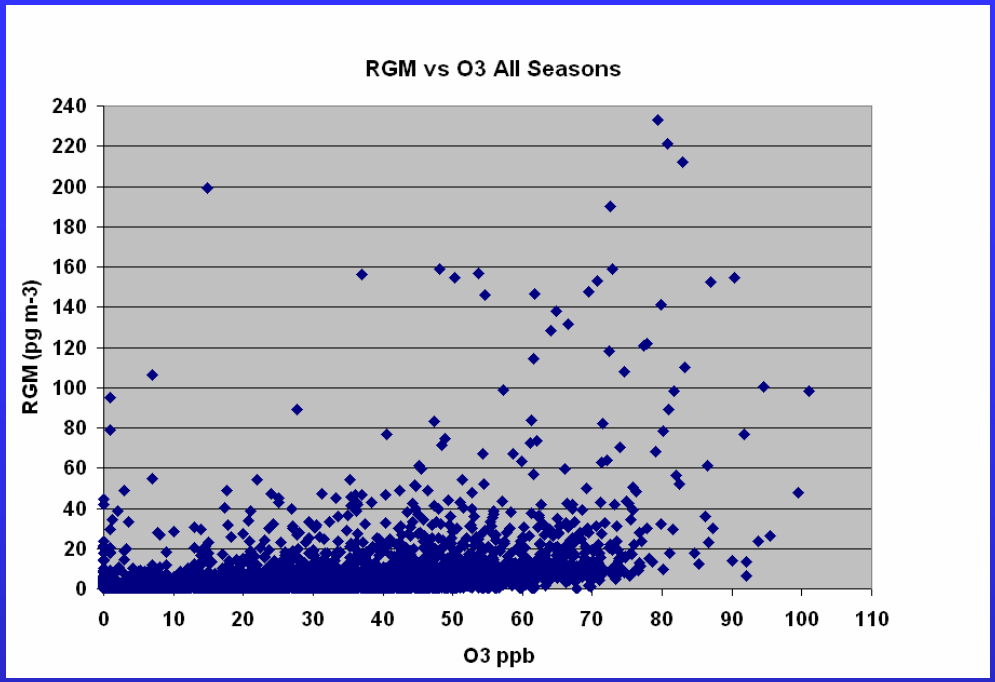
Symbol size and shape indicates 1999 mercury emissions, kg/yr

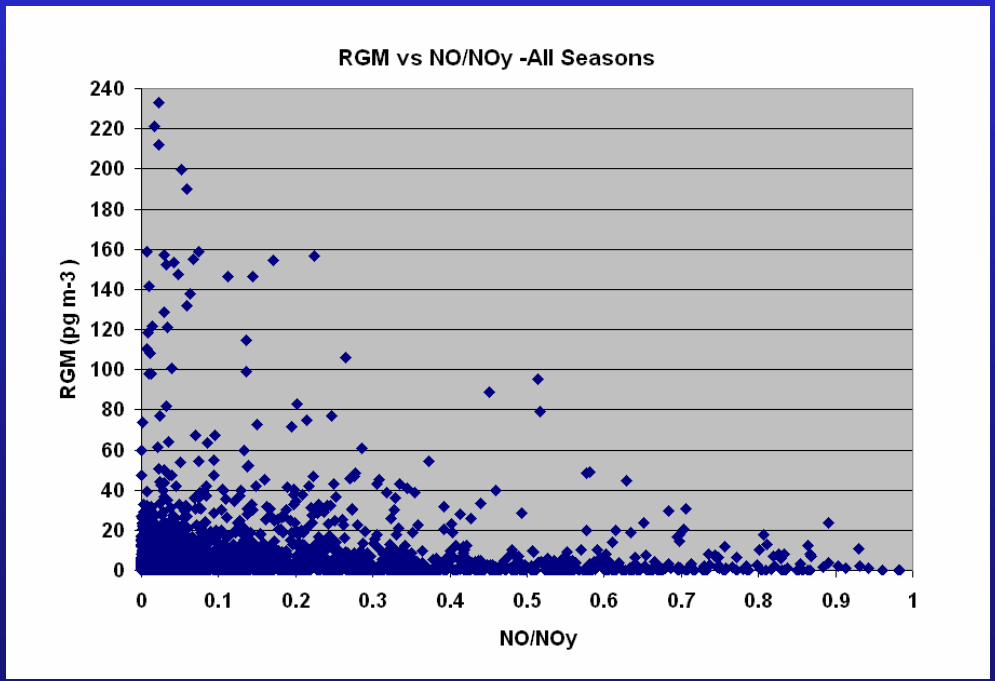
- 1 - 50
- 50 - 100
- 100 - 200
- 200 – 400
- 400 - 700
- 700 – 1000
- > 1000

Coal-fired power plants in MD, VA, PA, and DE with the largest projected differences between 2010 base and (defunct) 2010 Clean Air Interstate Rule (CAIR) emissions

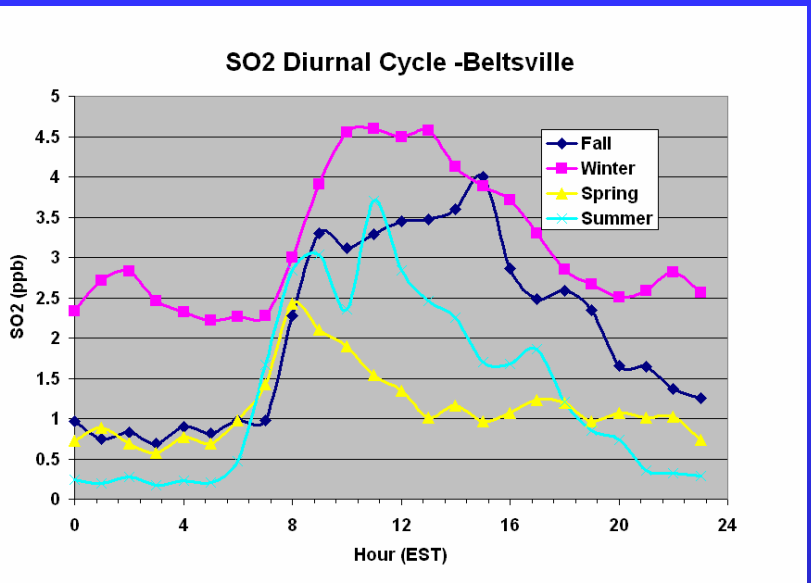




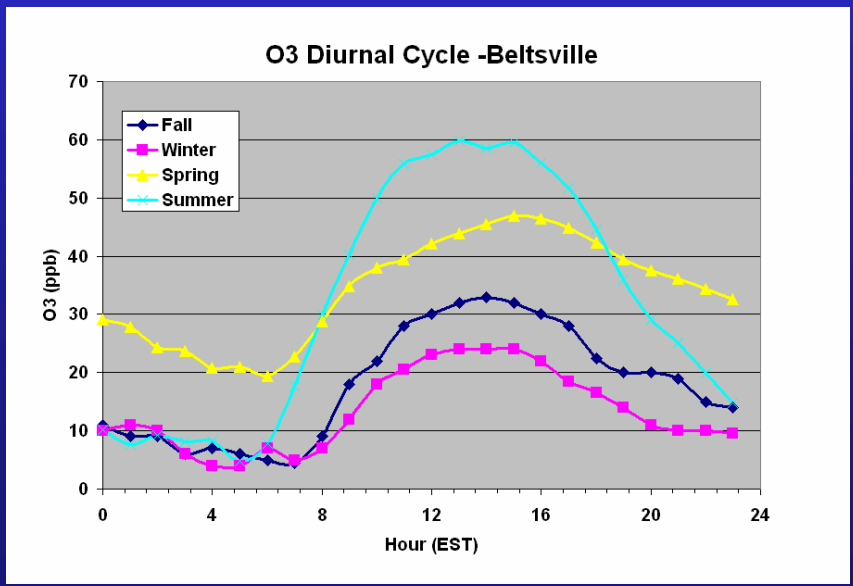


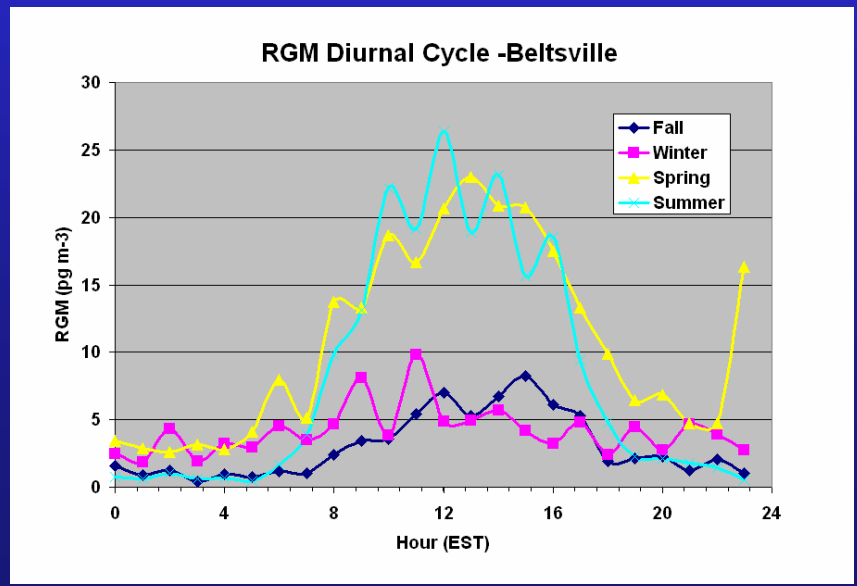


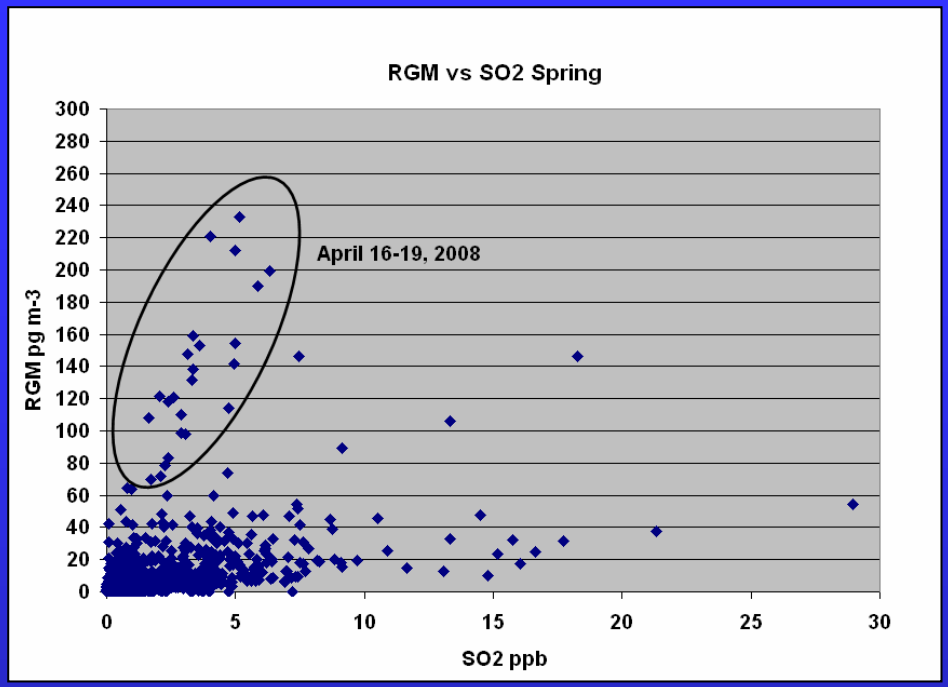
As at Grand Bay, higher RGM is typically associated with high O_3 concentrations and chemically aged air masses, suggesting that reactive gaseous mercury concentrations at the site reflect the influence of regional continental emissions.

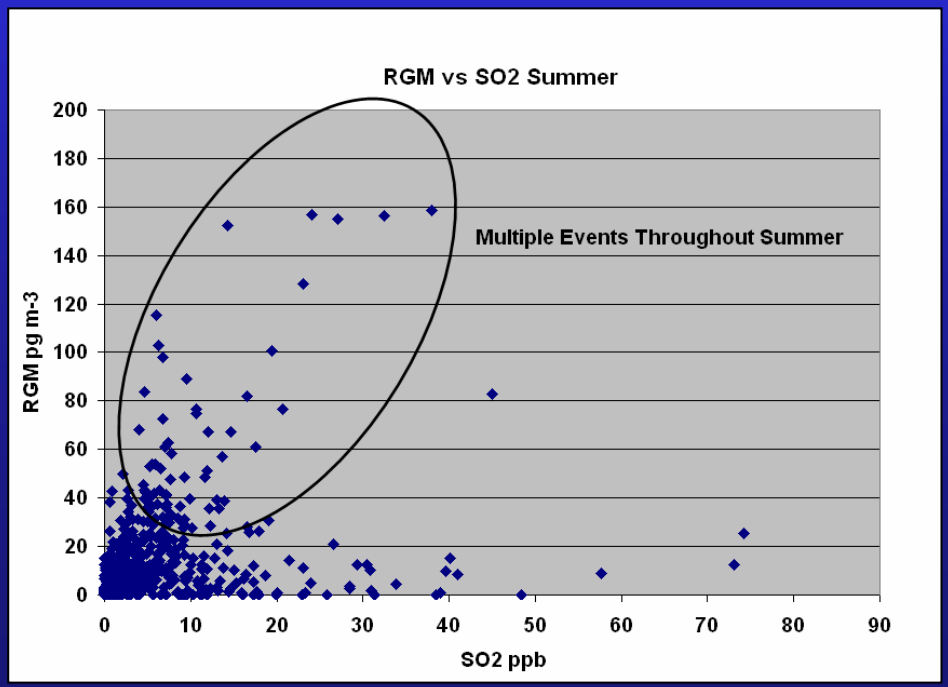


Diurnal profiles of RGM behave more like those of O_3 (i.e., concentrations are higher in the warm, sunny months) rather than the primary pollutants SO_2, CO, and NO_Y (higher concentrations in winter, when PBL heights are low and removal processes slow), suggesting that RGM concentrations are also influenced by transport and photochemistry, not only primary source impacts.



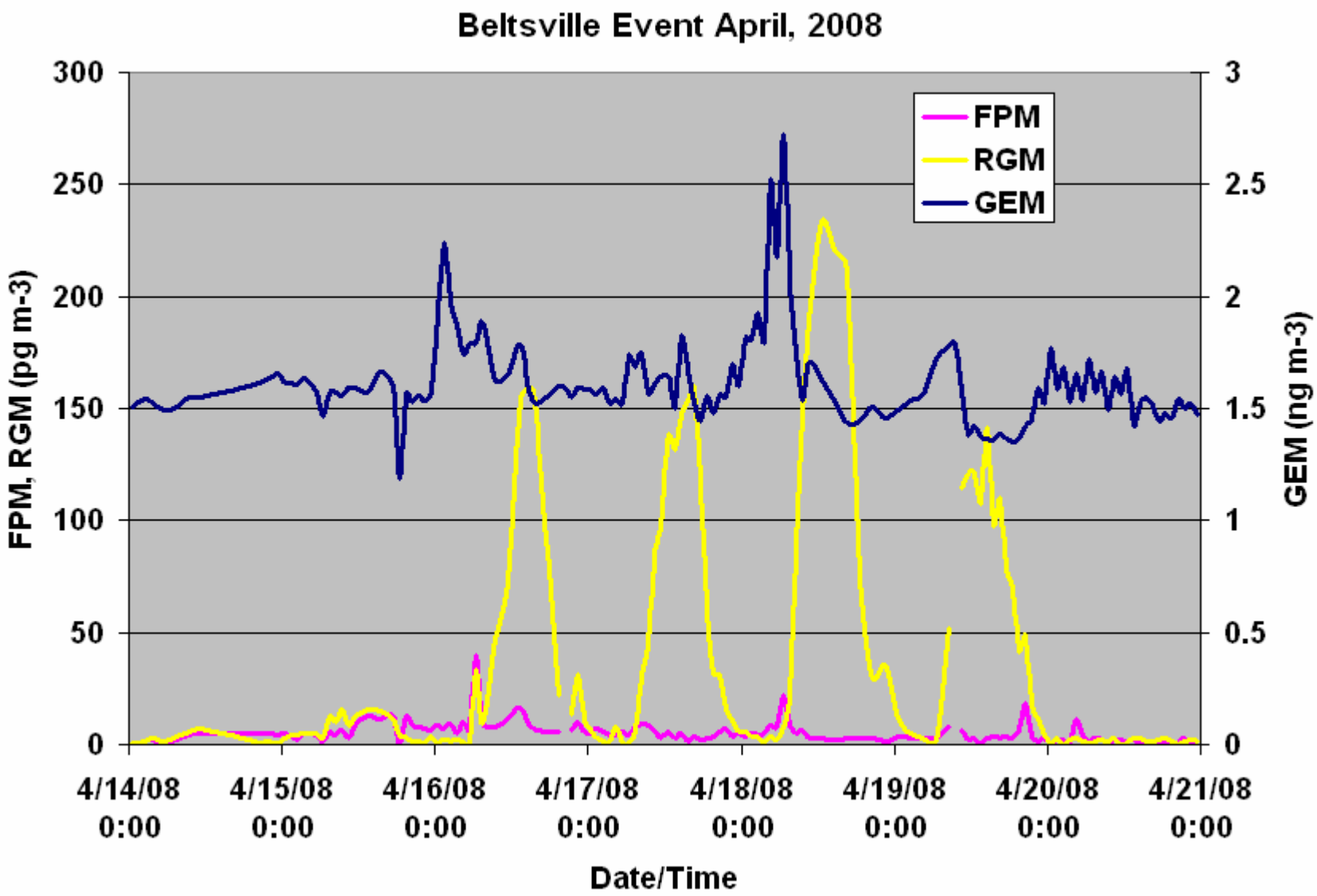




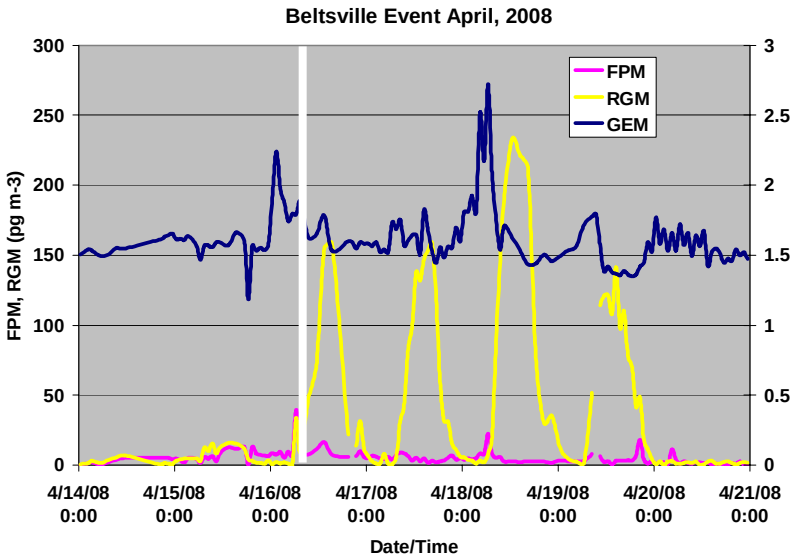


The Beltsville site is impacted by a variety of local-regional sources with unique emissions characteristics. Coupled chemical-meteorological analysis will yield important insights into mercury emissions, transport, transformation, and removal at the site.

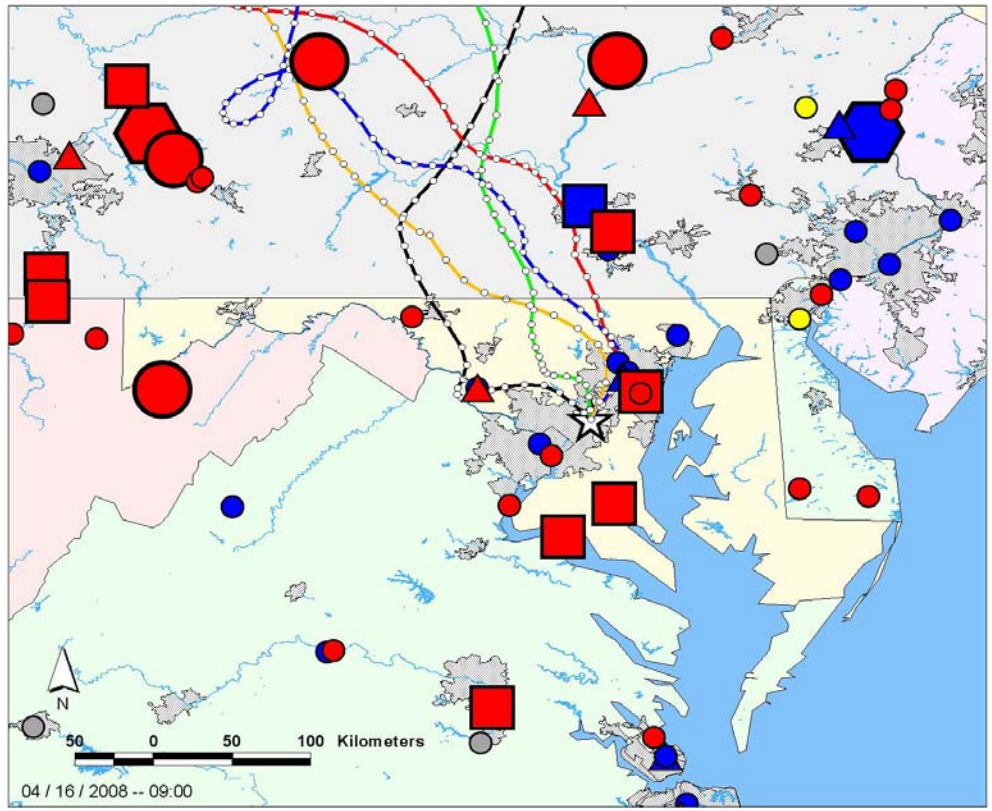
Multi-Day RGM Event, April 16-19, 2008



Back trajectories run with 12 km resolution met data



Large Point Sources of Reactive Gaseous Mercury (RGM) Emissions Based on the 2002 U.S EPA National Emissions Inventory (NEI)



Back-trajectories starting at the indicated fraction of the mixed layer height. Circles on the trajectories mark the hourly positions

- 0.1
- 0.3
- 0.5
- 0.7
- 0.9

size/shape of symbol denotes amount of mercury emitted (kg/yr)

- 10 - 50
- 50 - 100
- 100 – 200
- 200 - 400
- 400 - 600

color of symbol denotes type of mercury source

- coal-fired power plants
- other fuel combustion
- waste incineration
- metallurgical
- manufacturing & other

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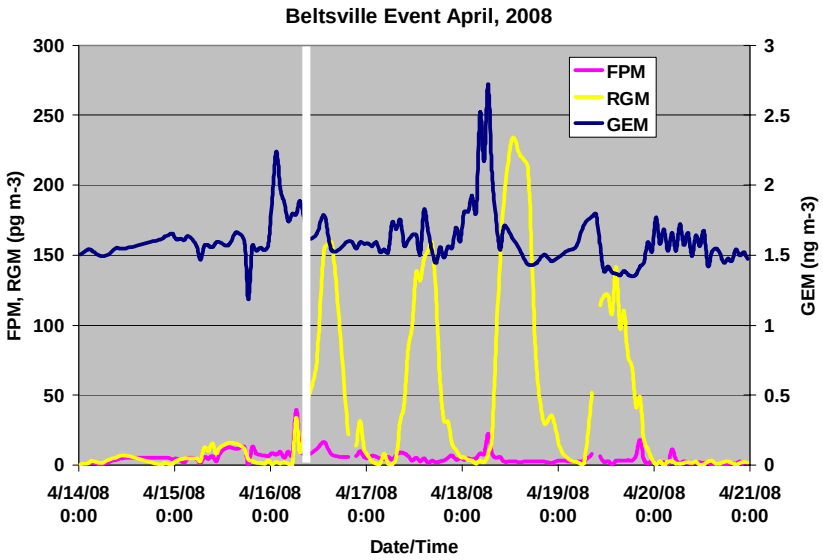

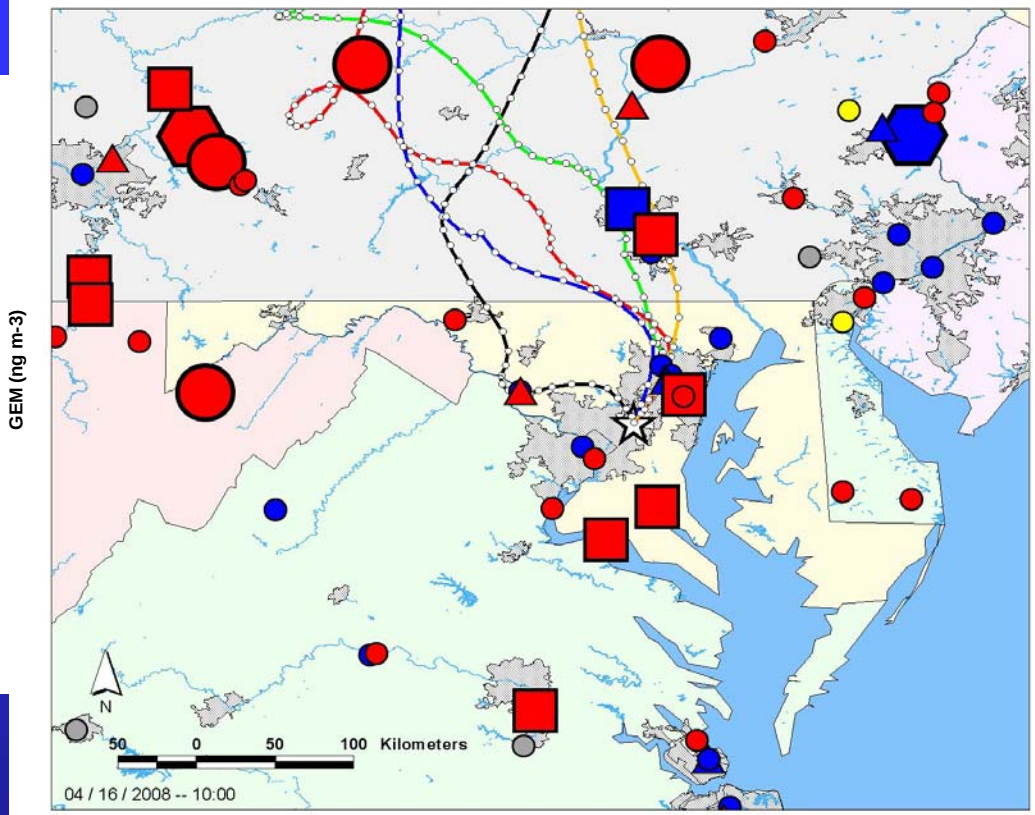

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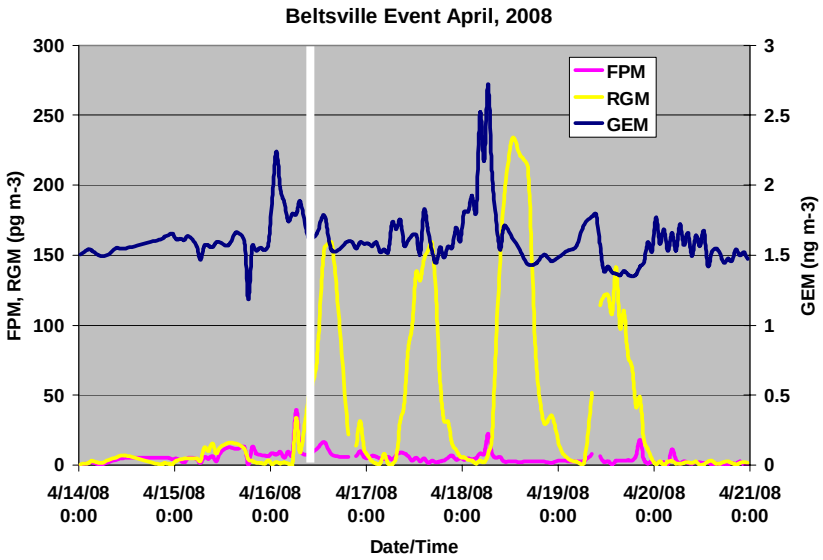

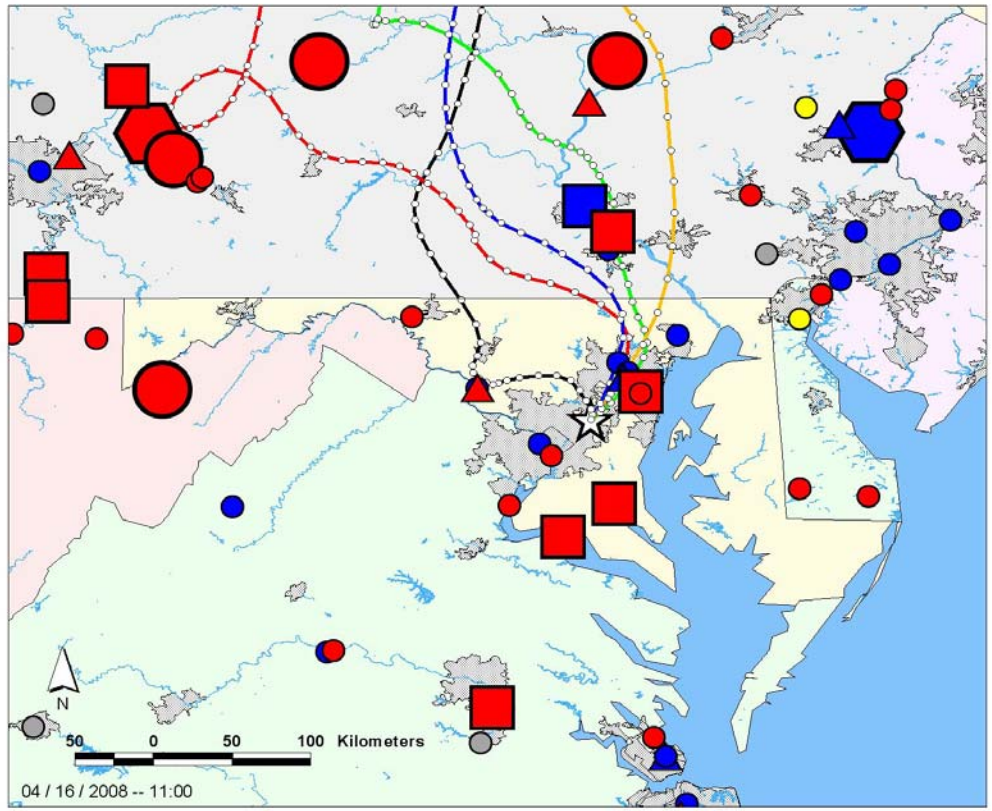

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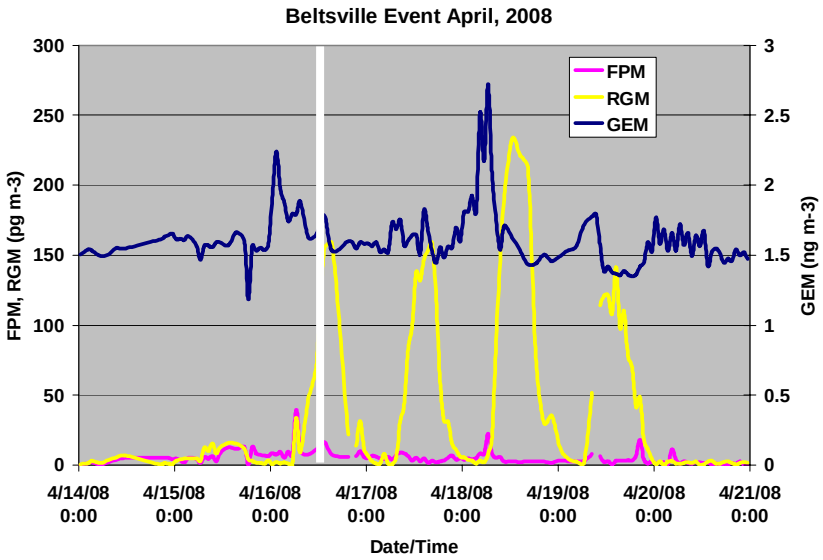

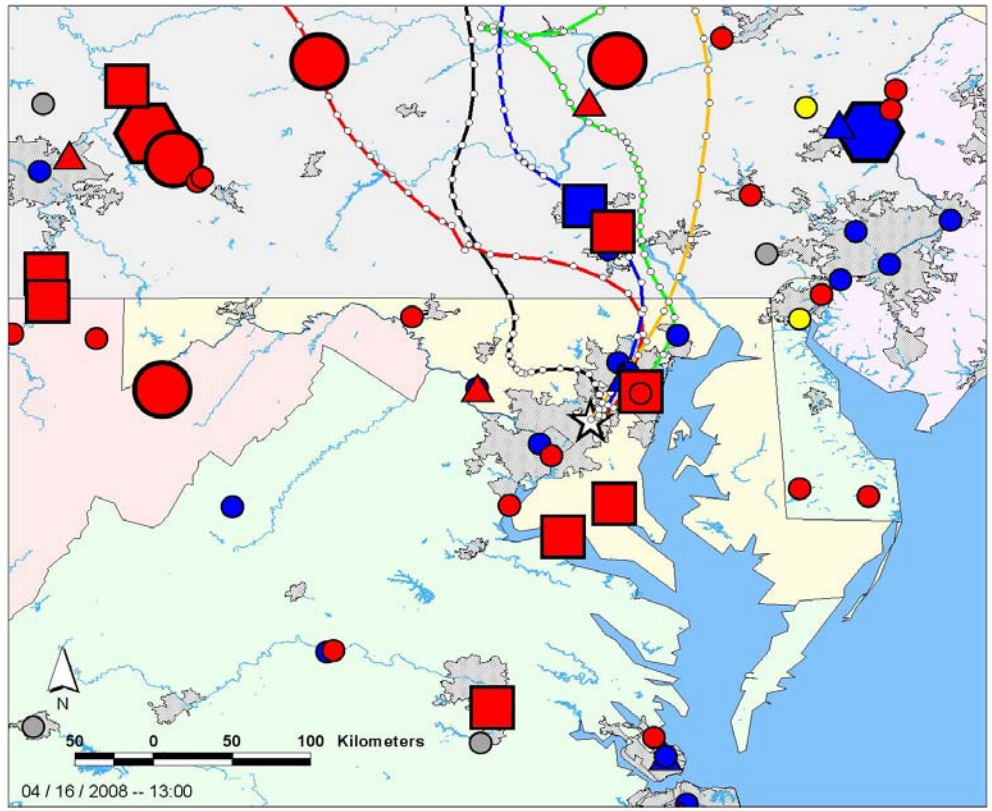

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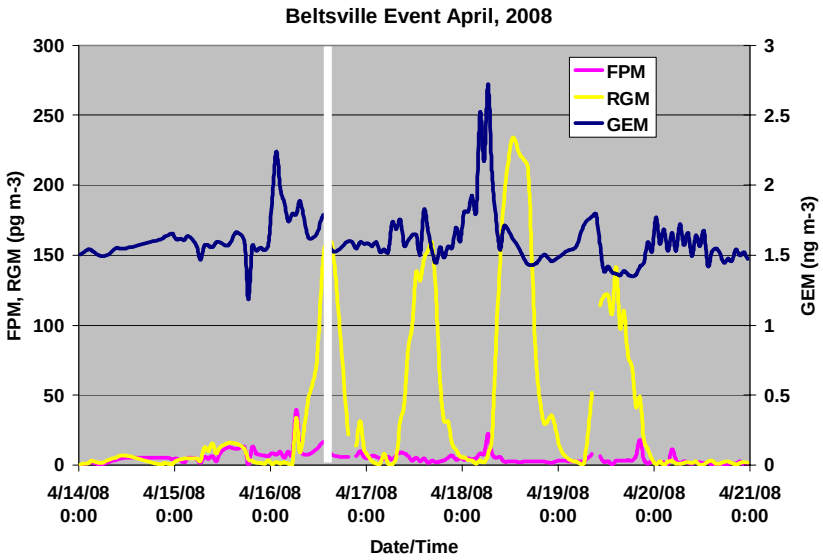

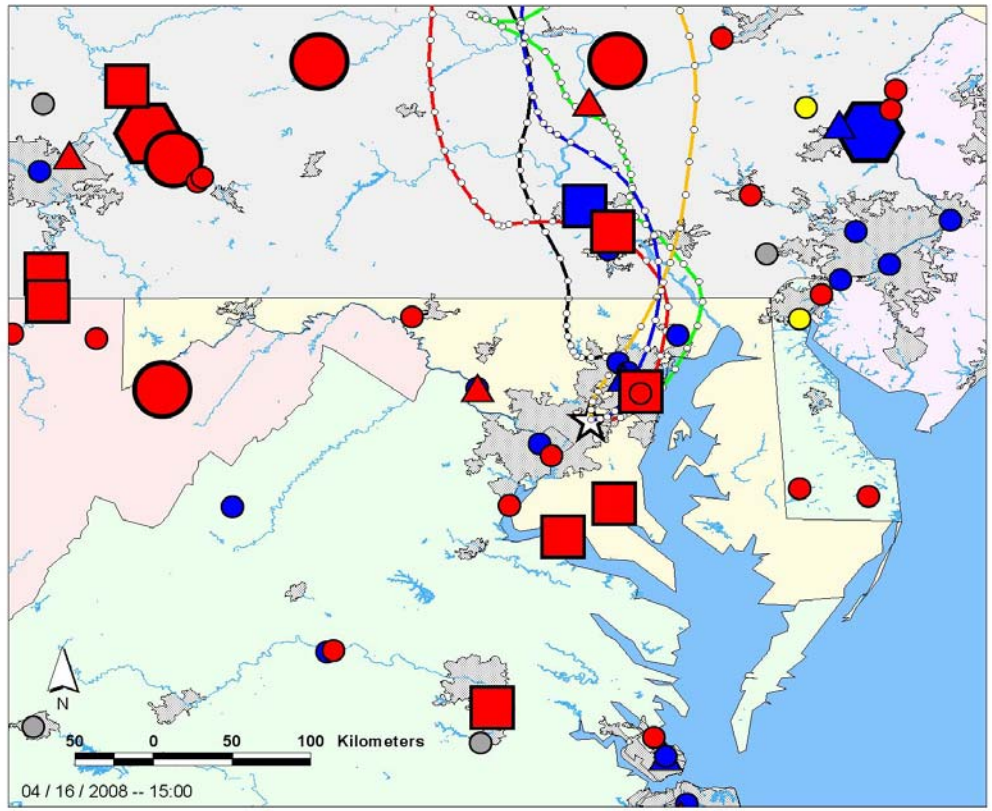

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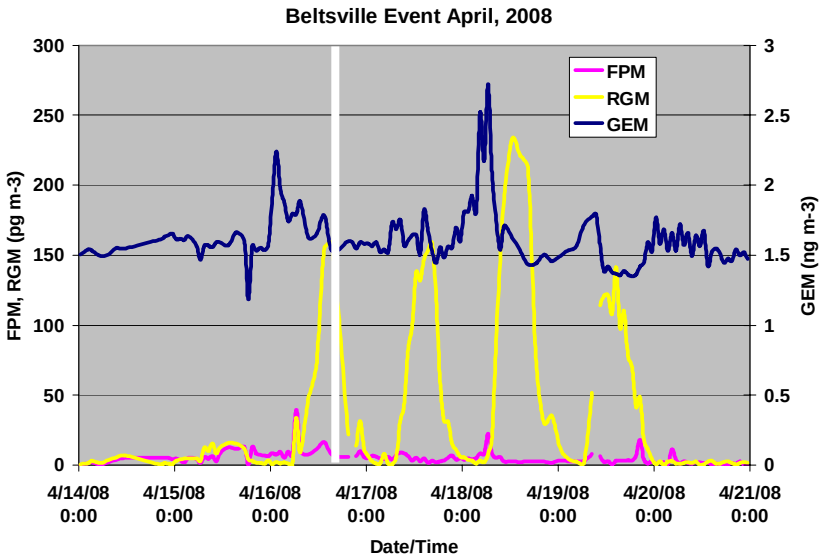

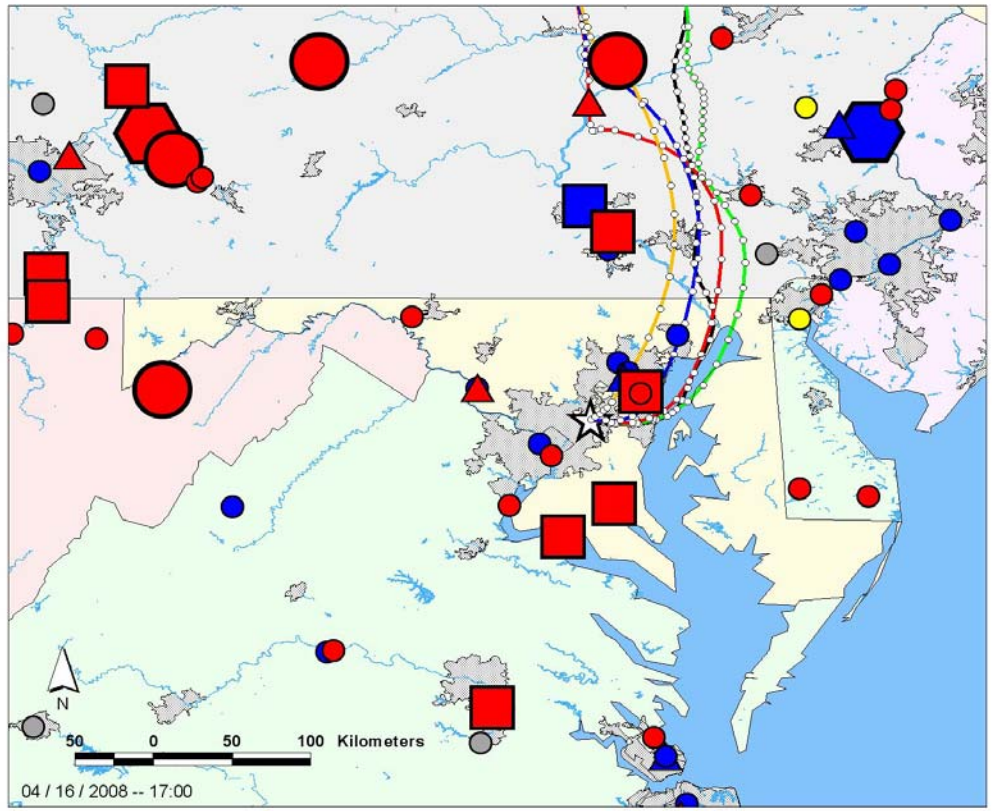

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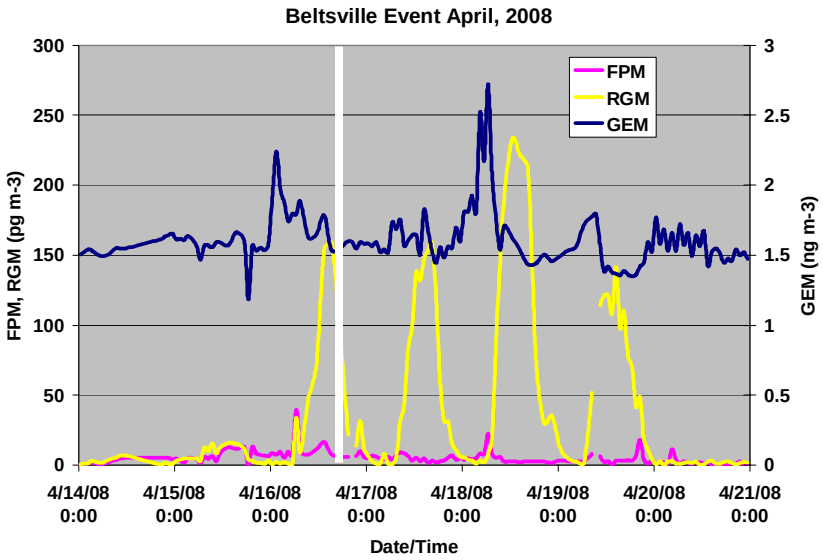

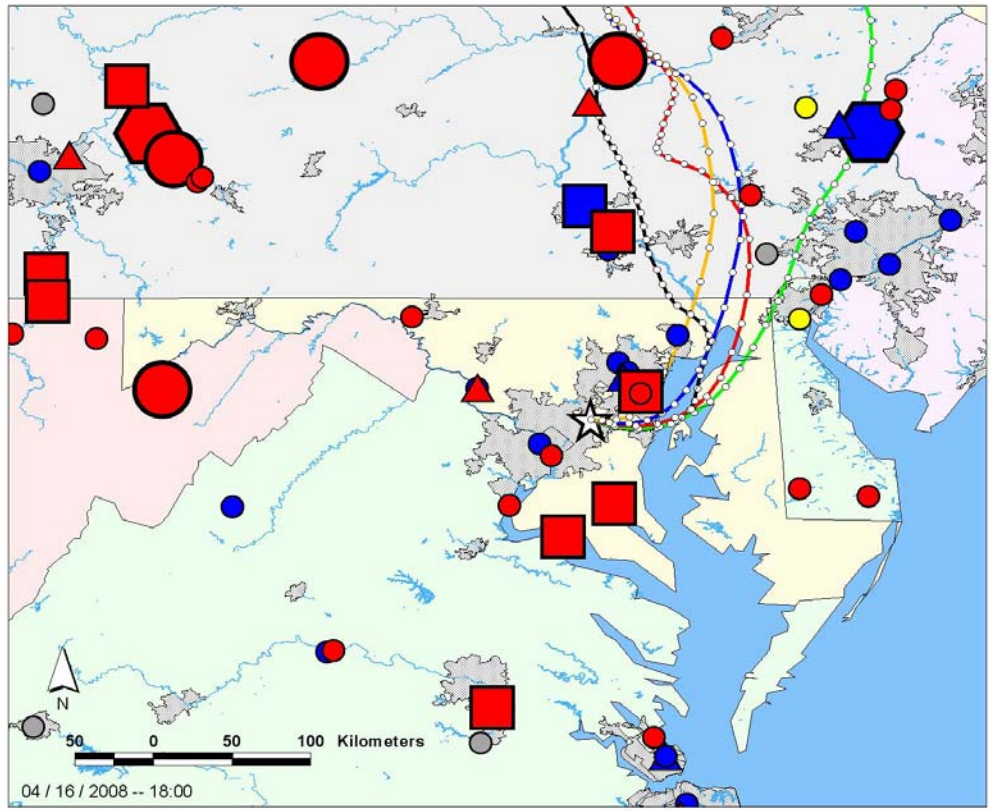

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The next day…

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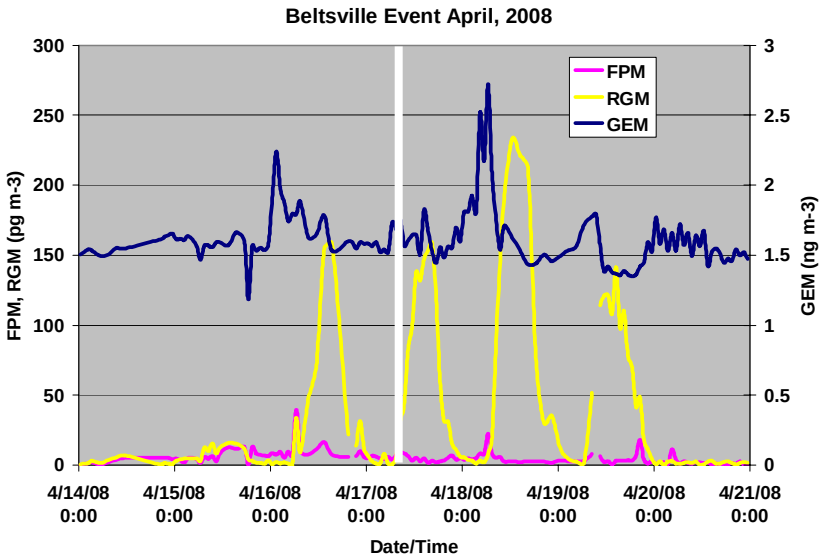

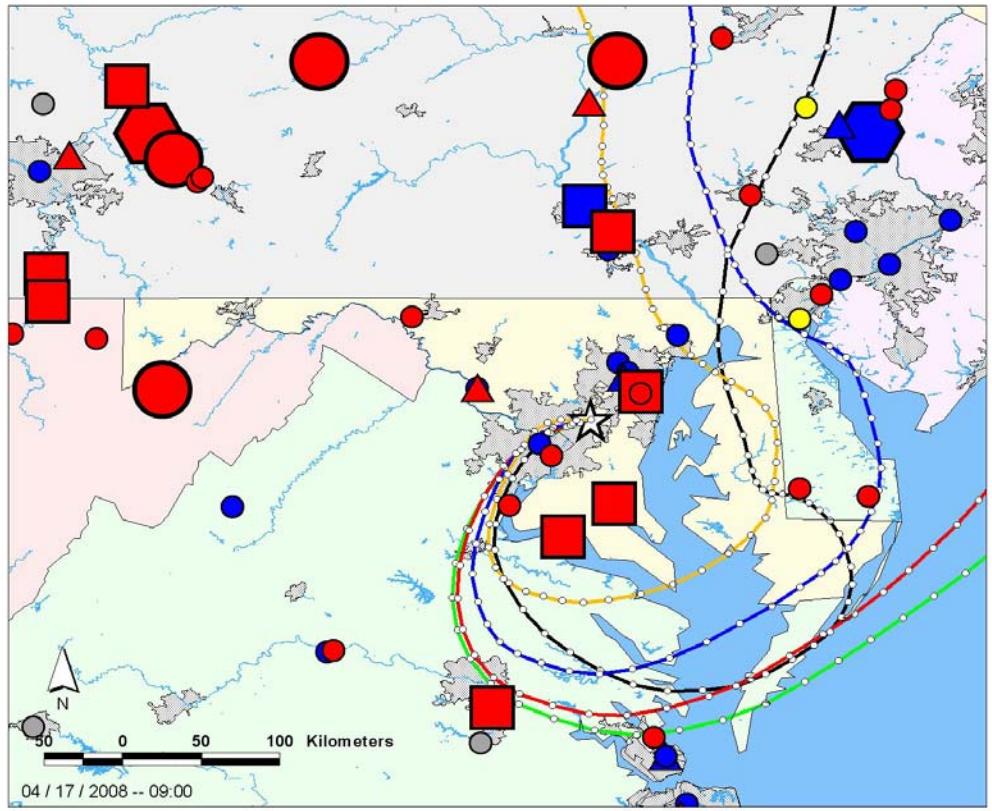

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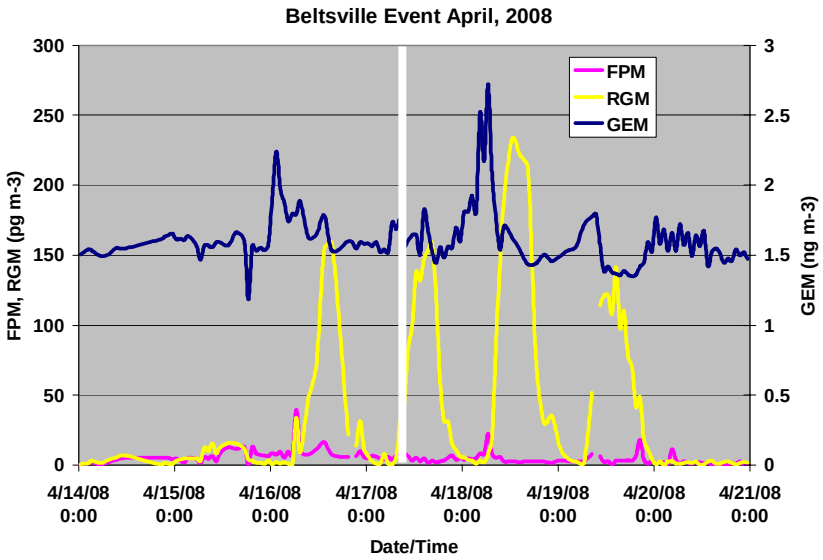

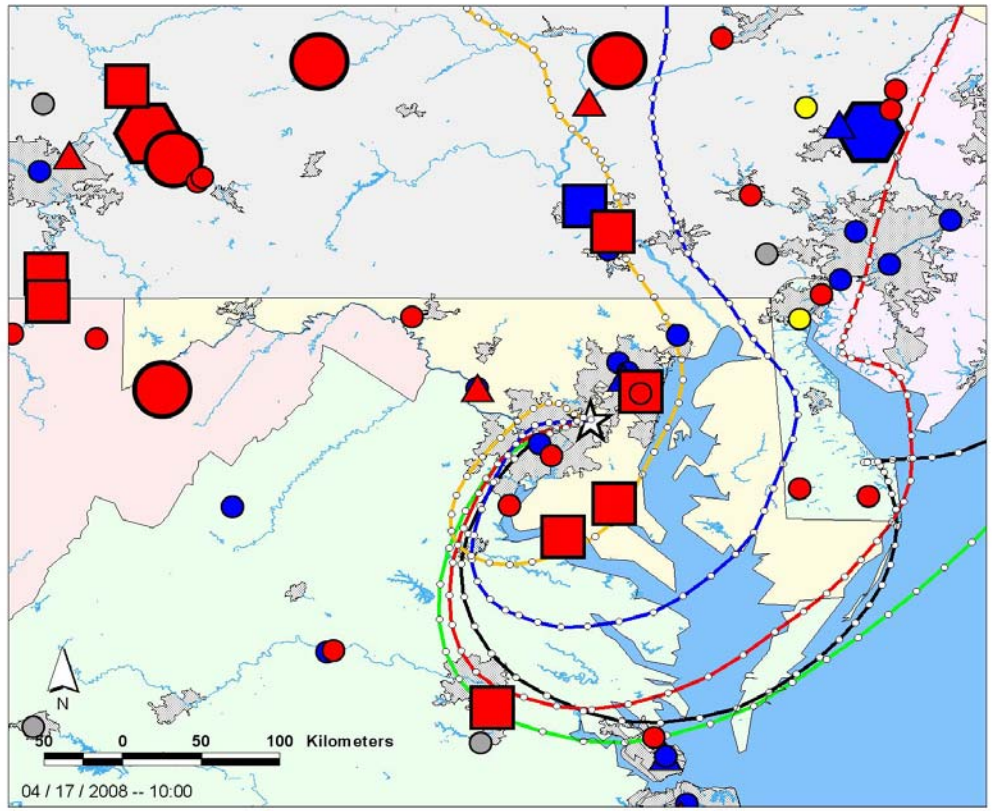

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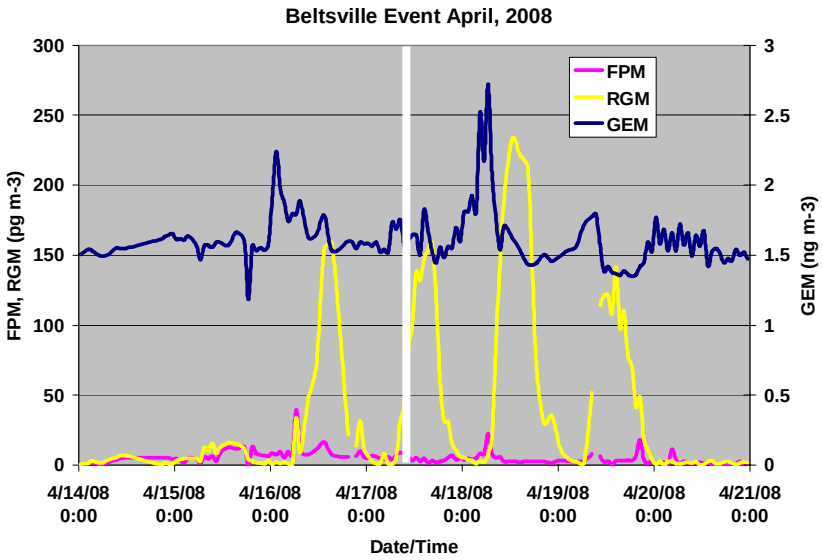

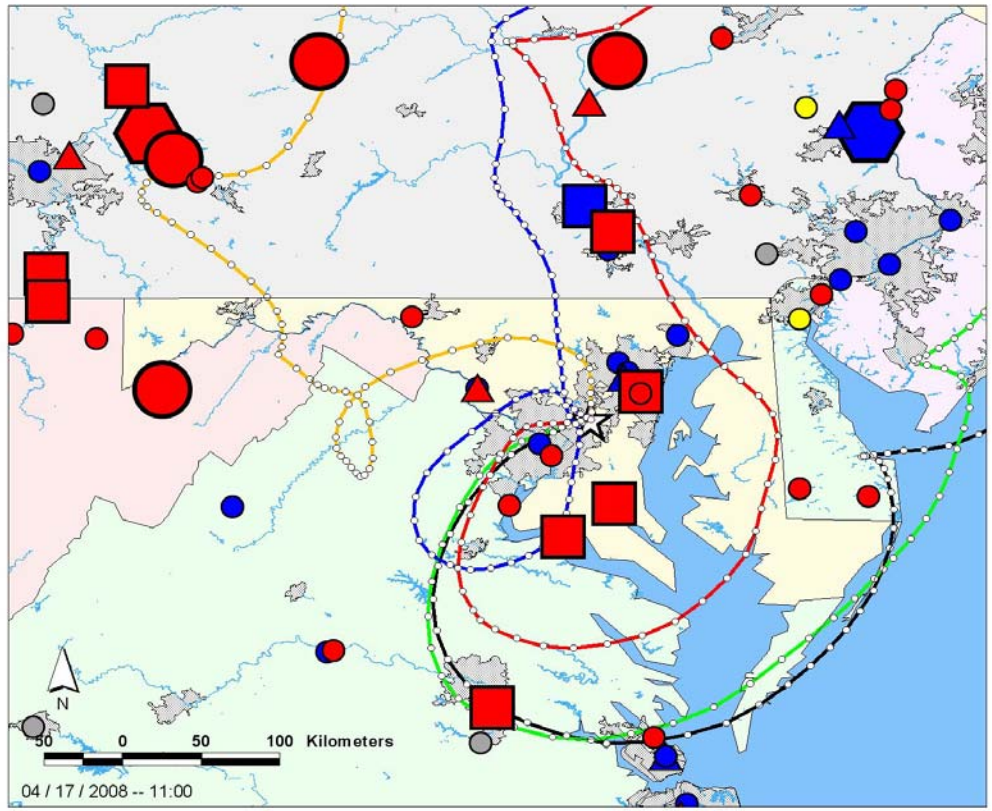

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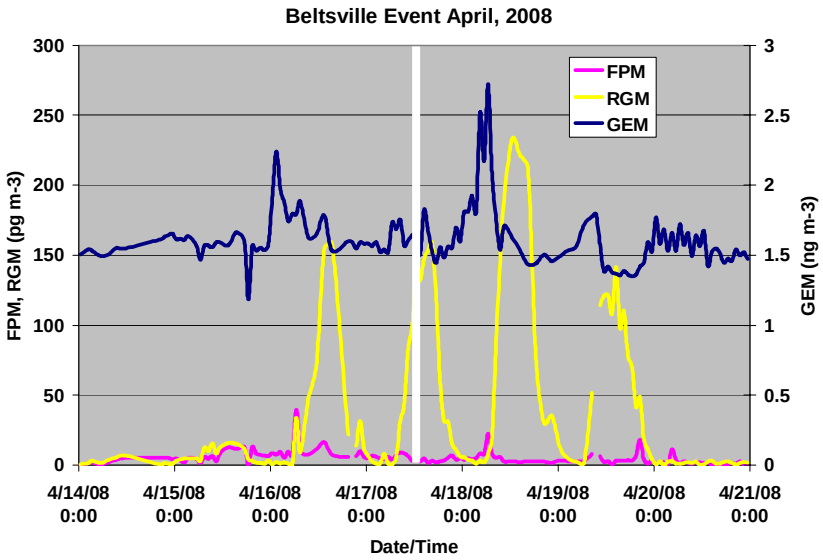

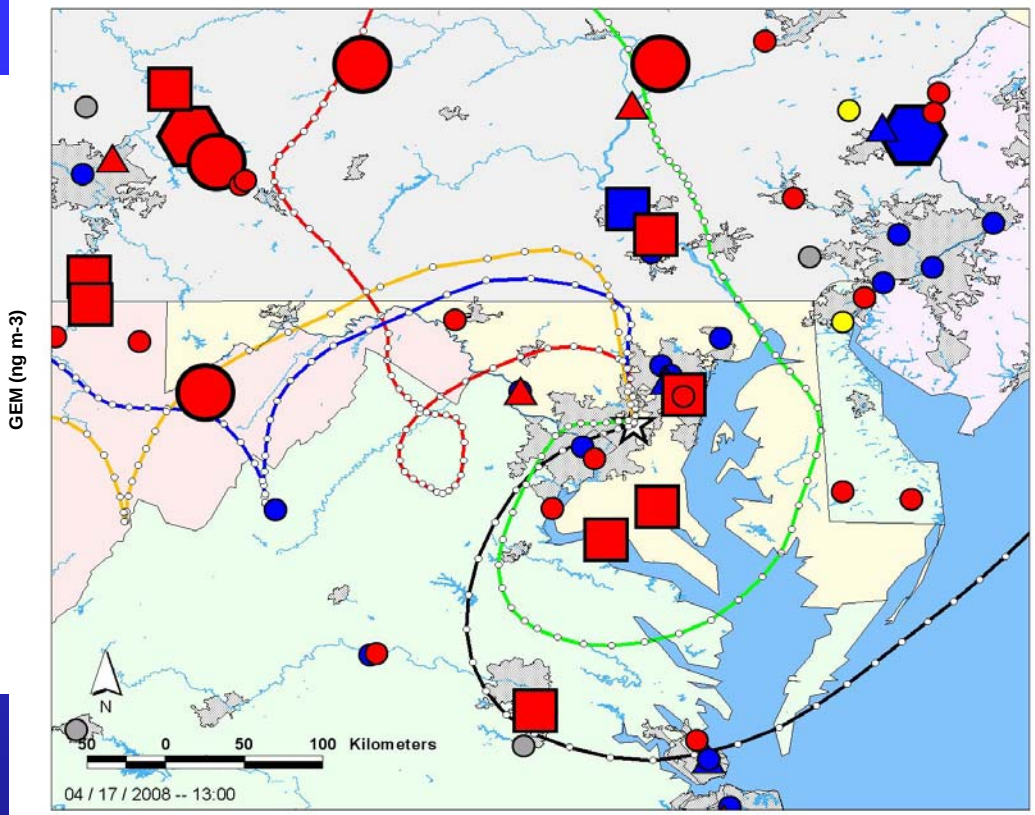

Back-trajectories starting at the indicated fraction of the mixed layer height. Circles on the trajectories mark the hourly positions

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size/shape of symbol denotes amount of mercury emitted (kg/yr)

- 10 - 50
- 50 - 100
- 100 – 200
- 200 - 400
- 400 - 600

color of symbol denotes type of mercury source

- coal-fired power plants
- other fuel combustion
- waste incineration
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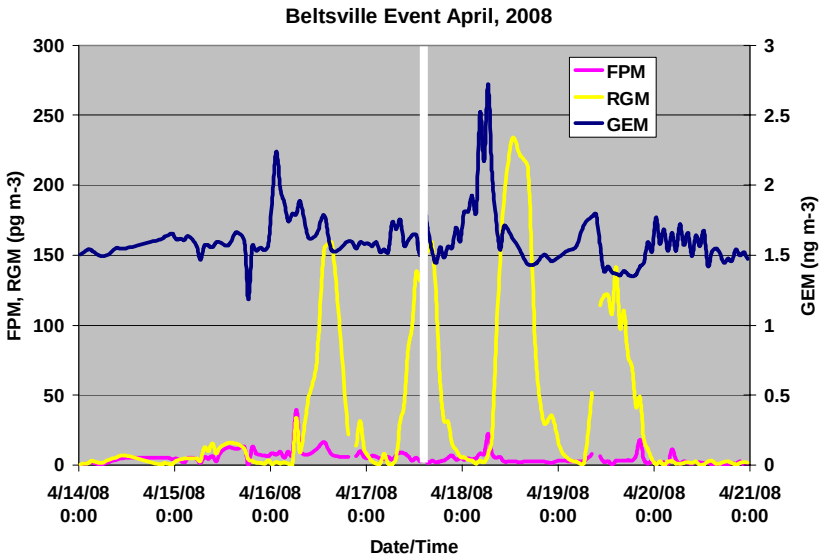

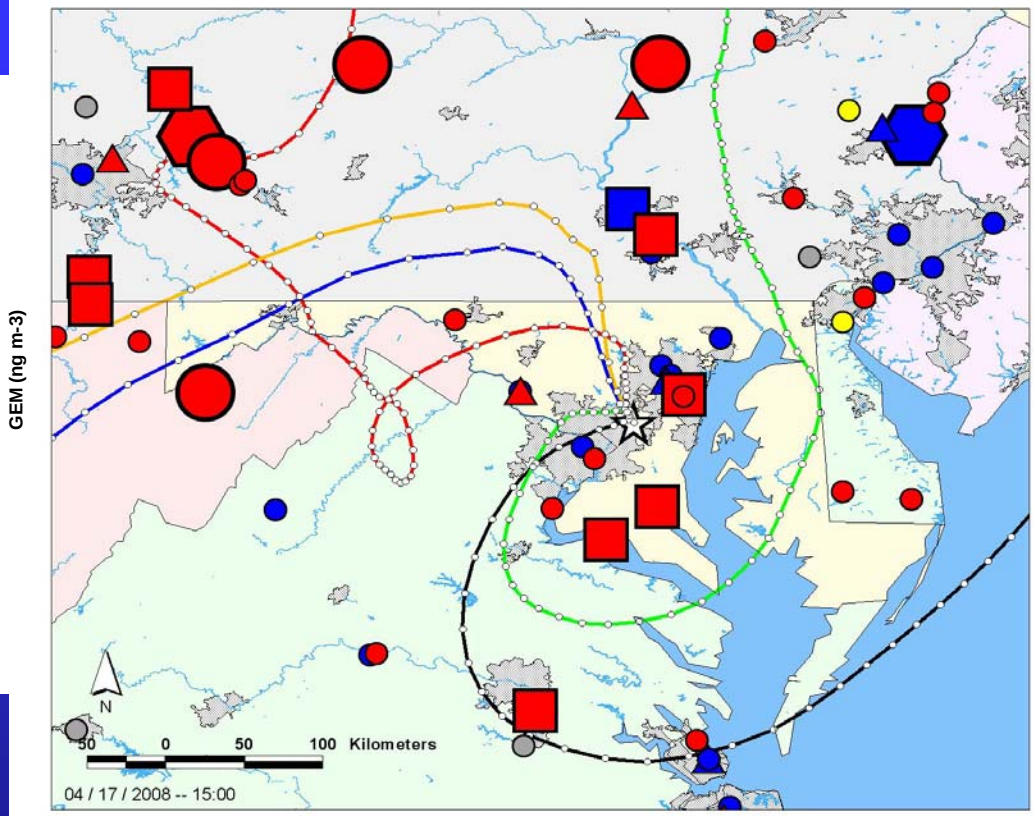

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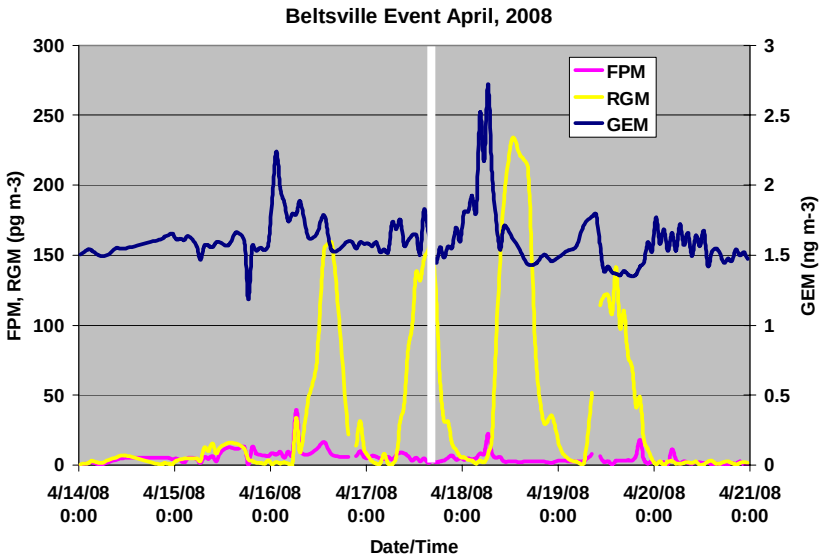

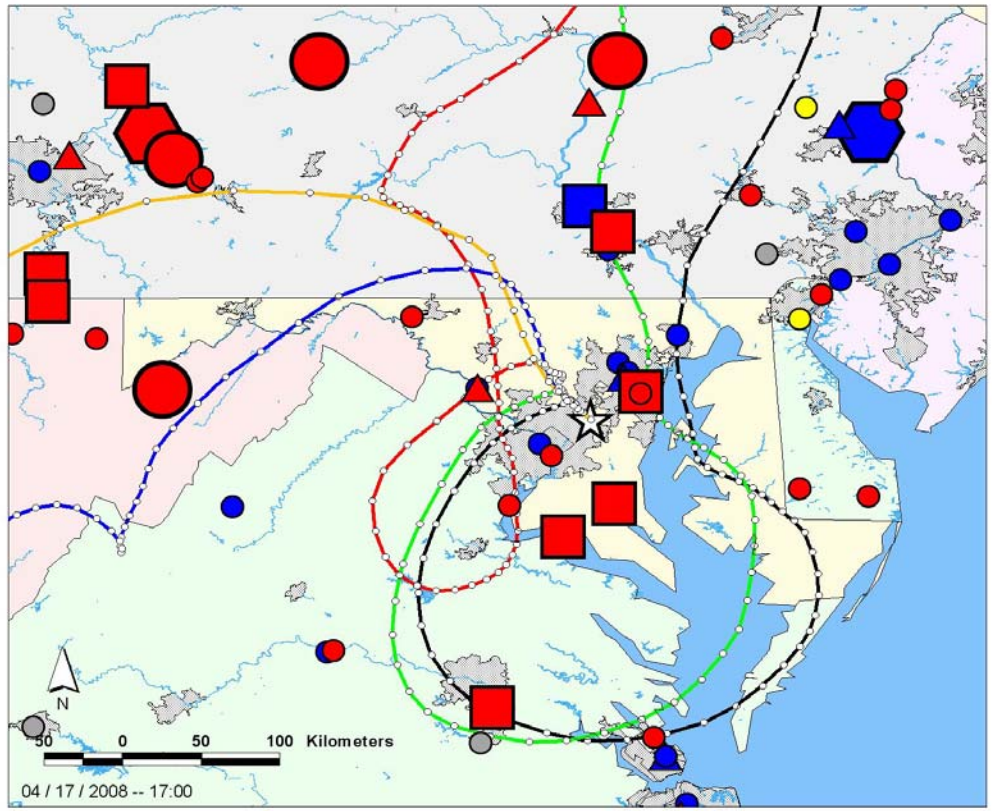

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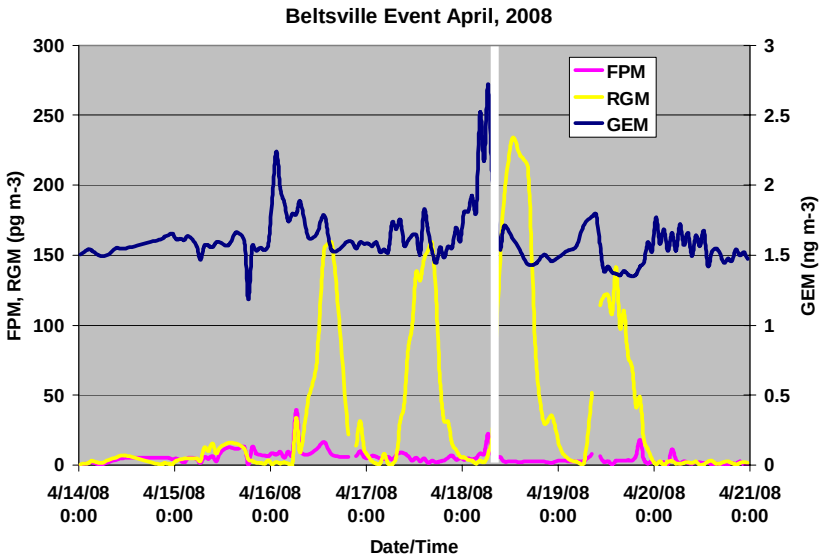

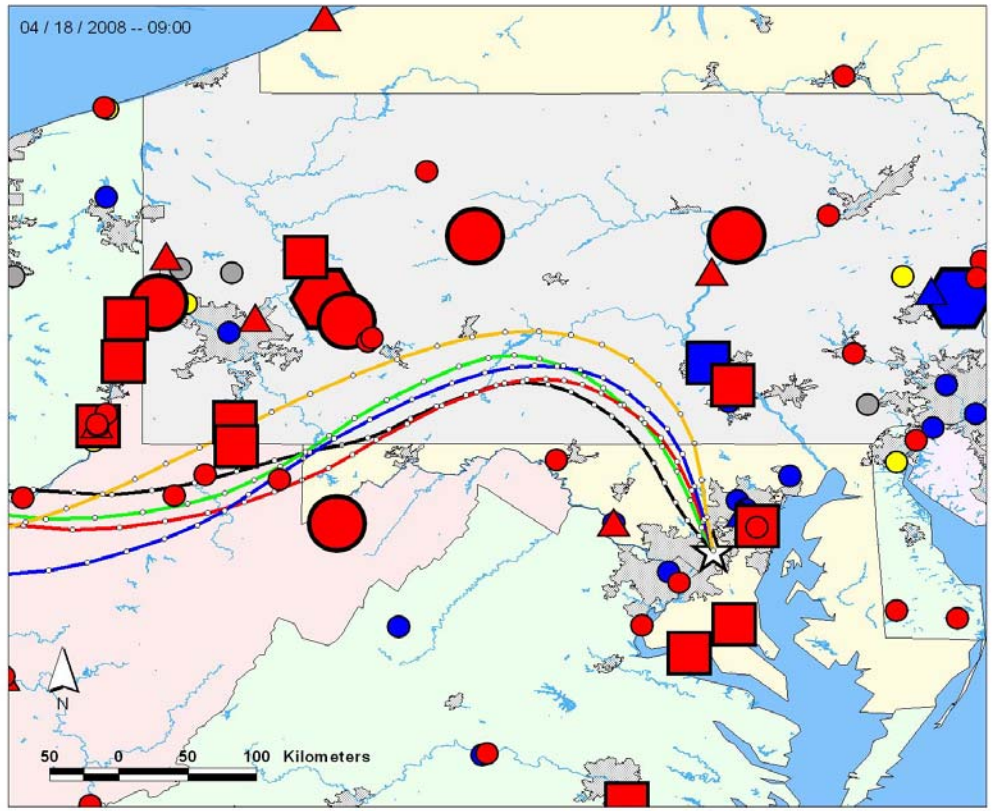

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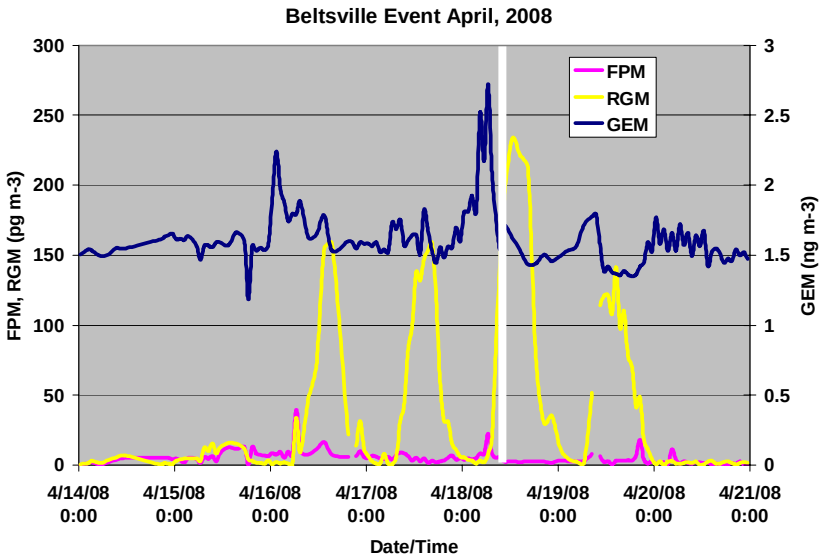

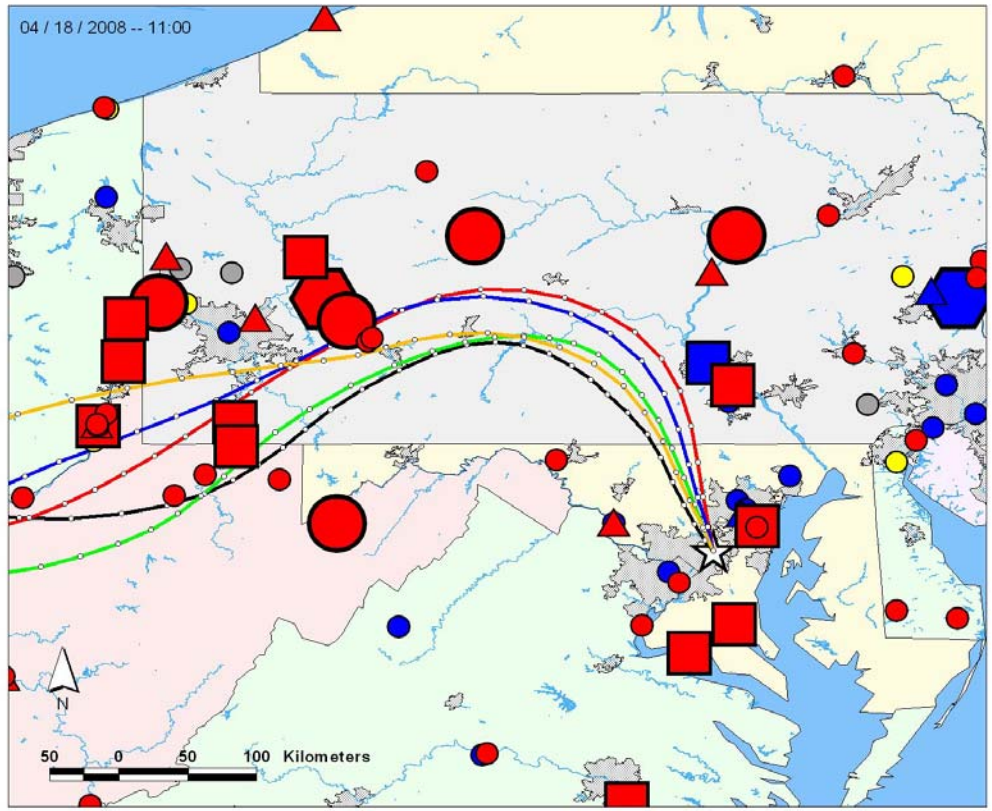

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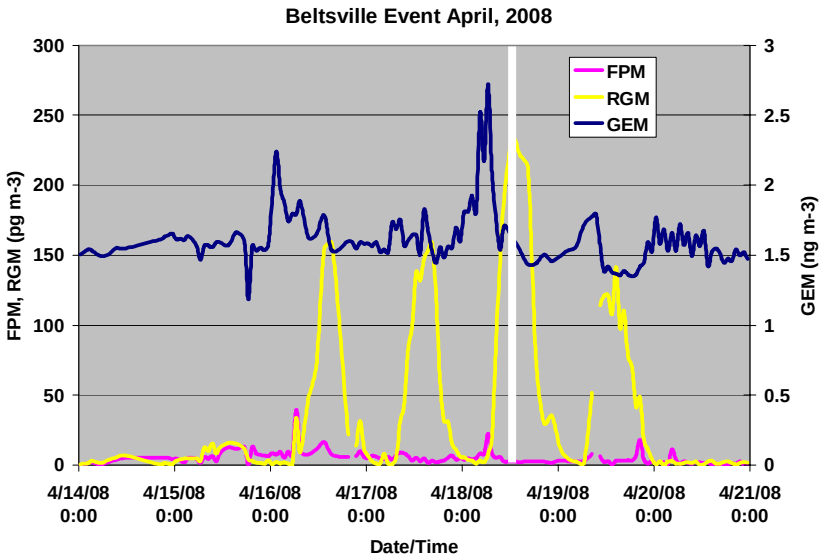

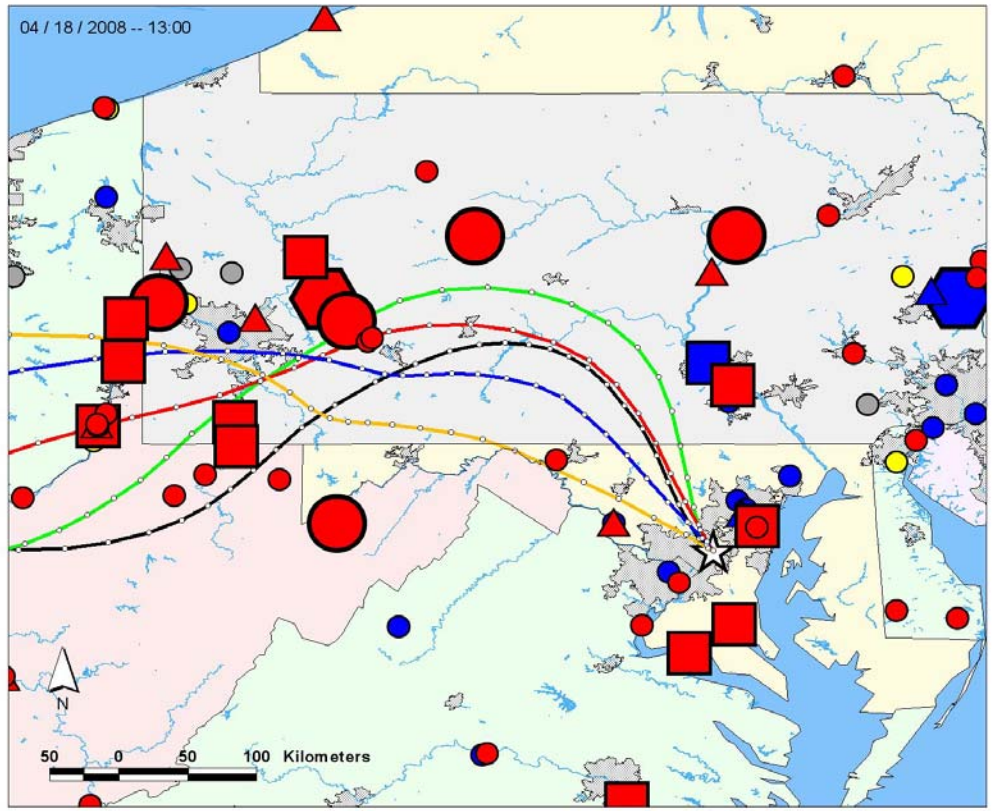

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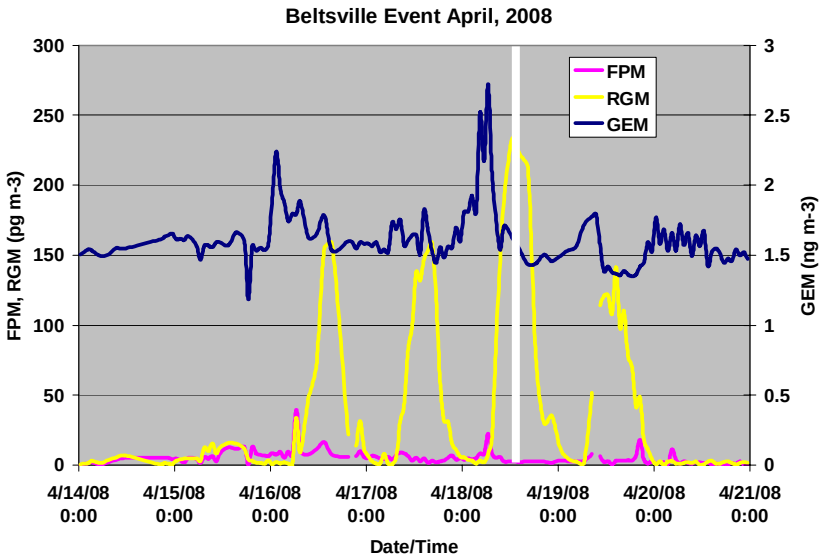

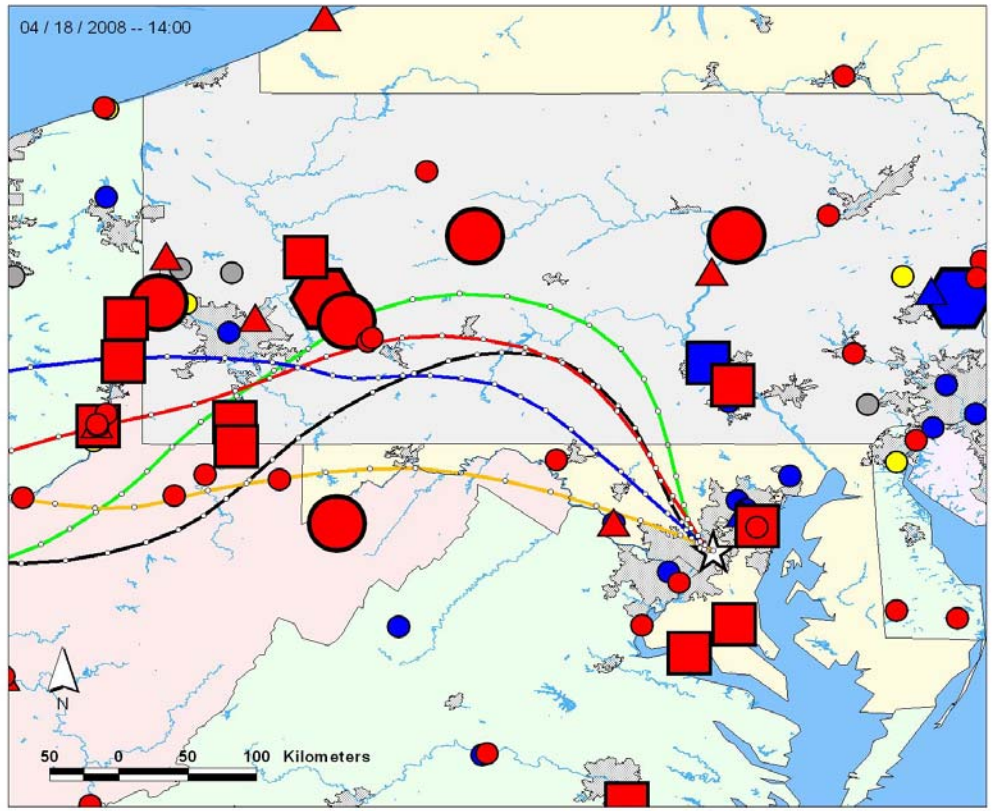

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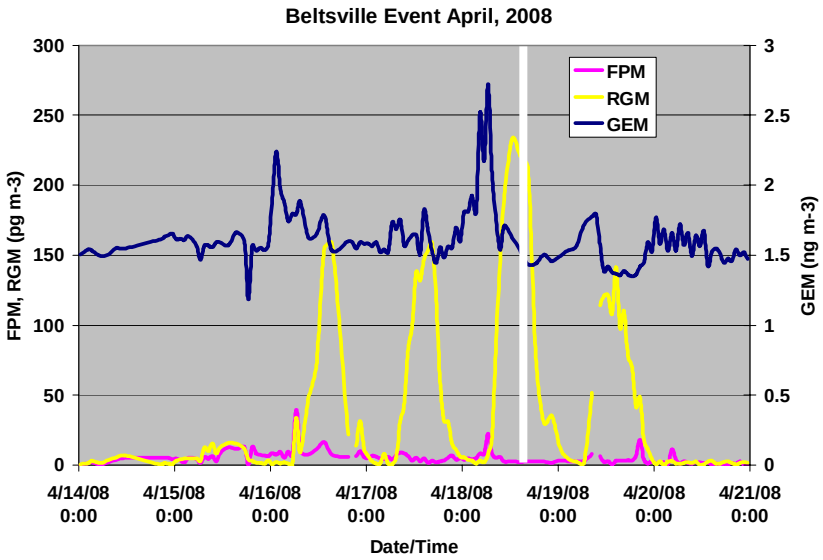

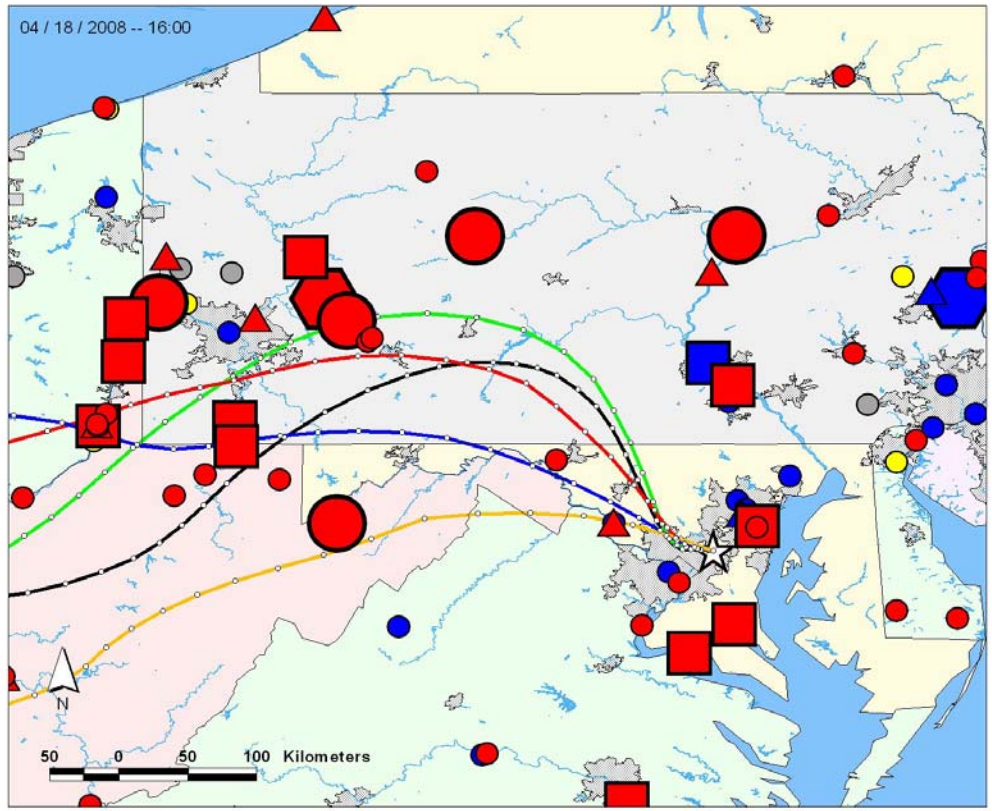

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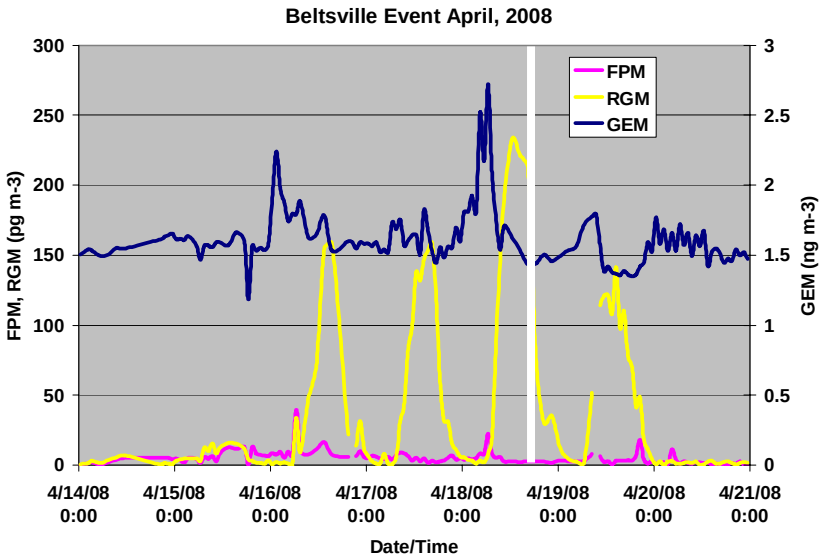

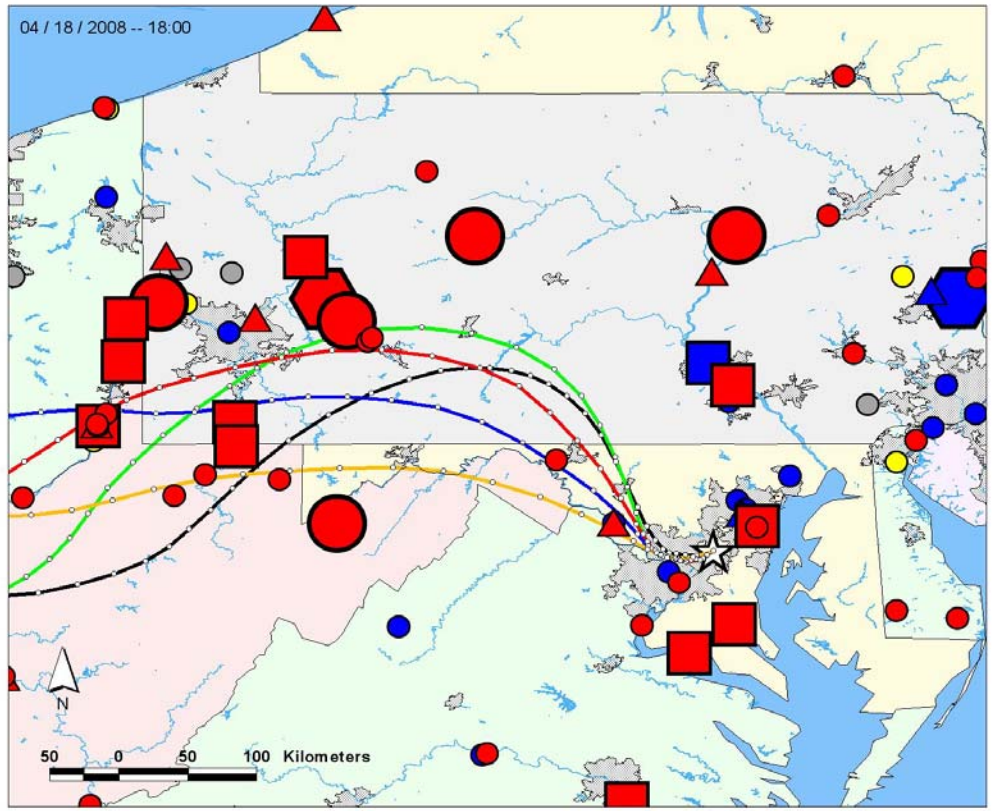

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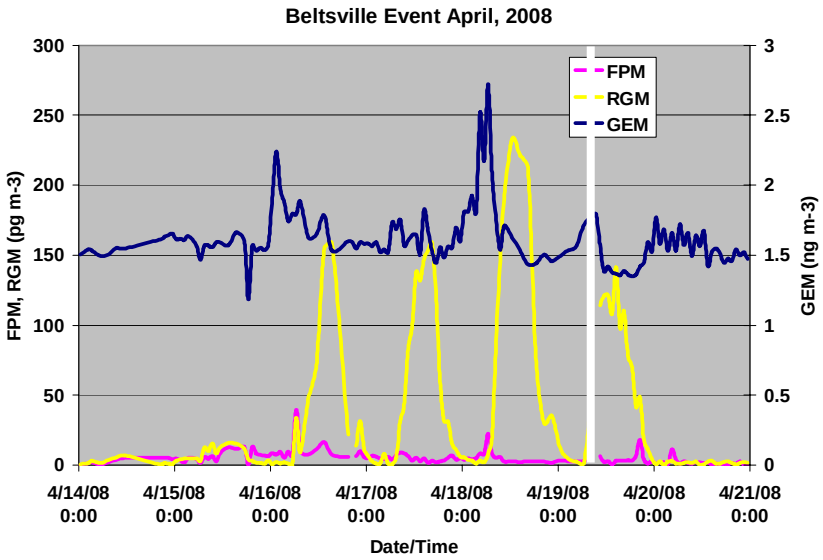

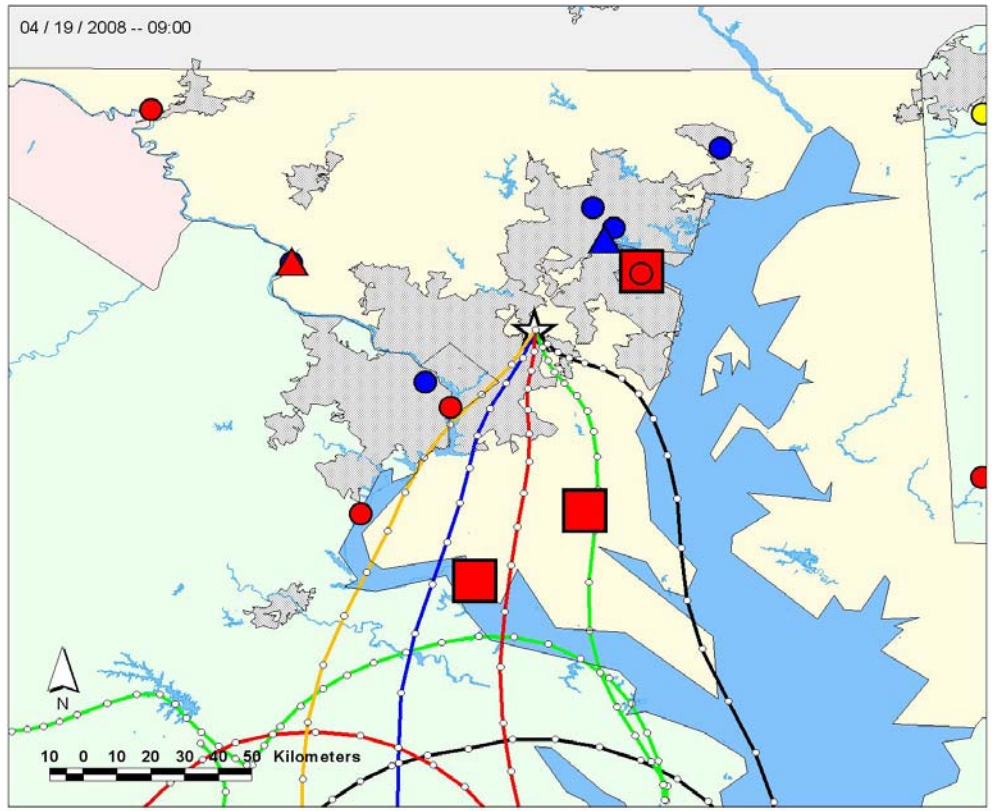

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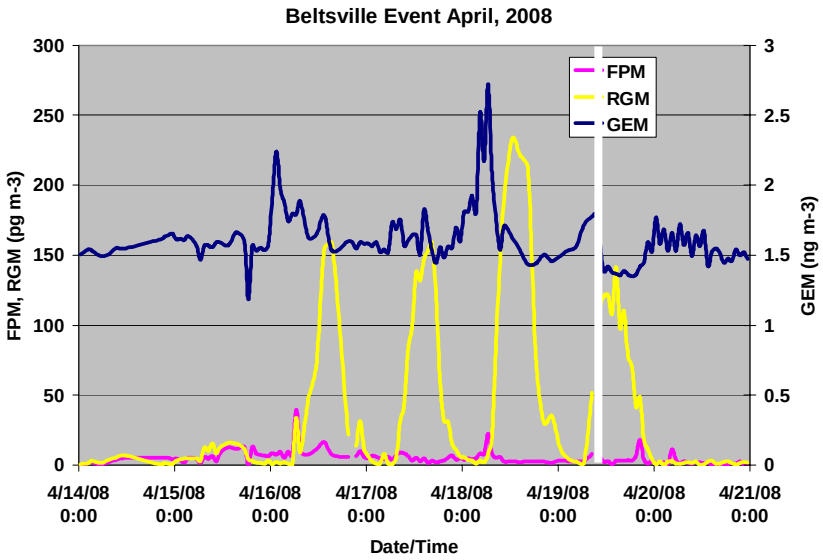

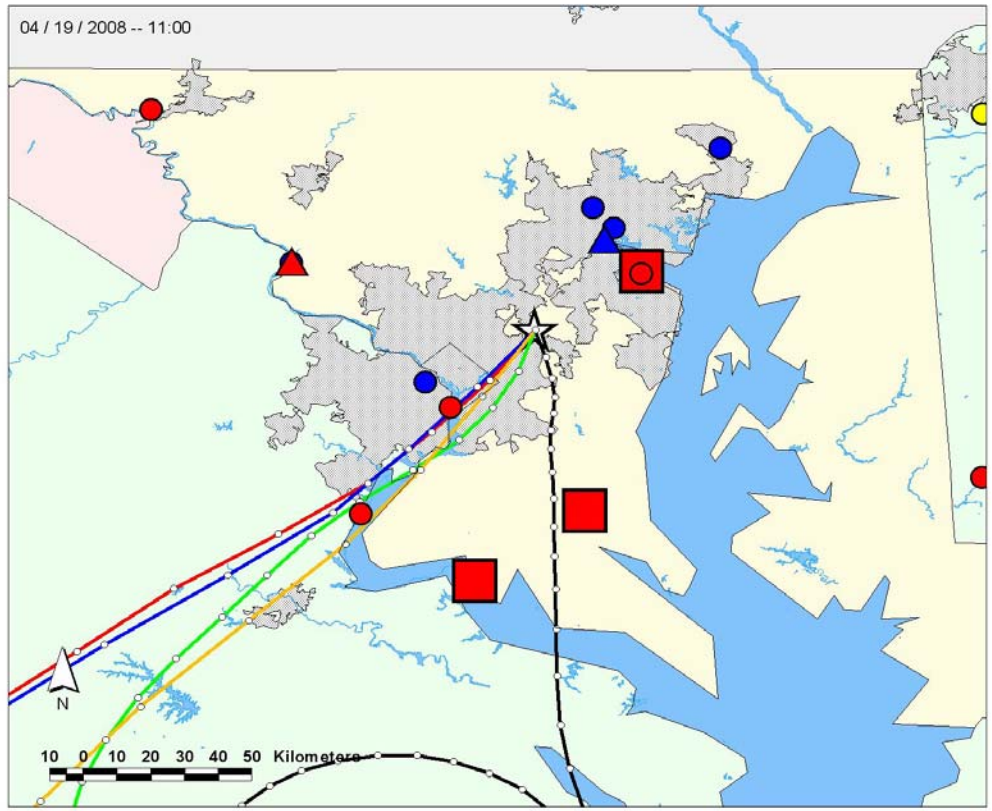

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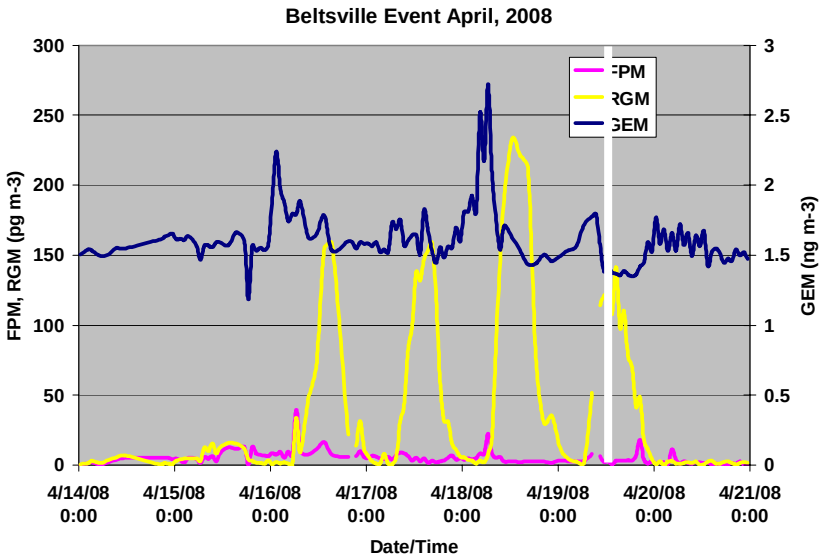

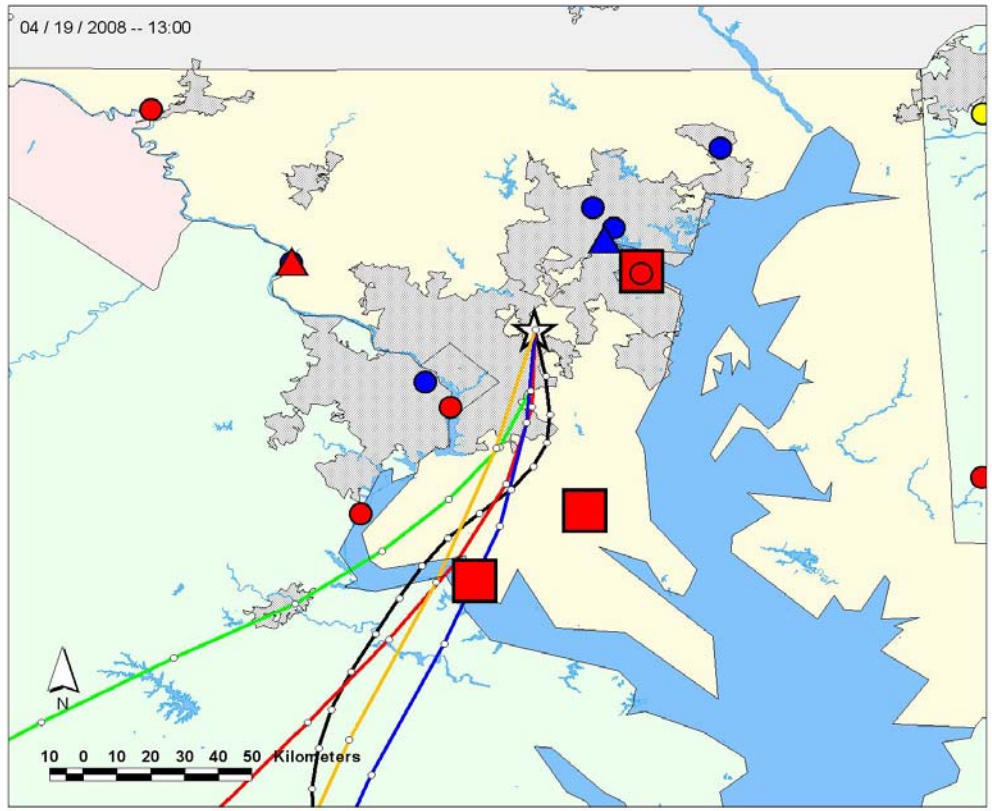

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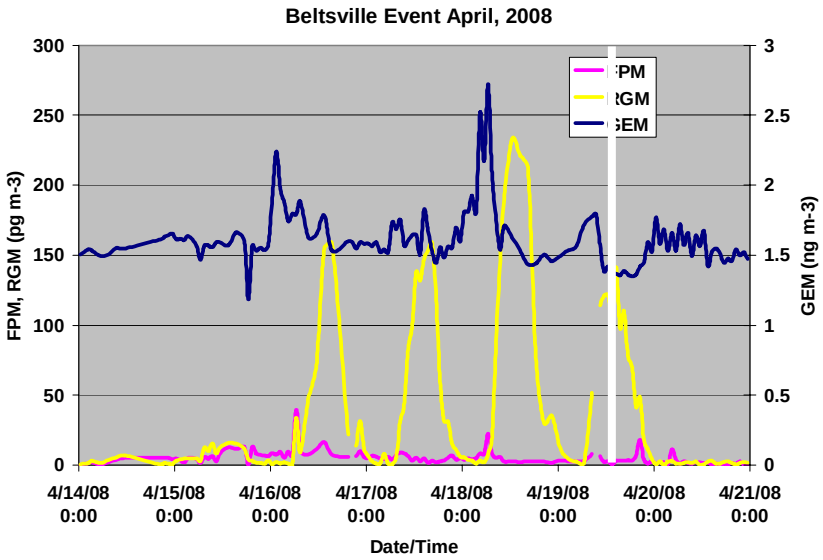

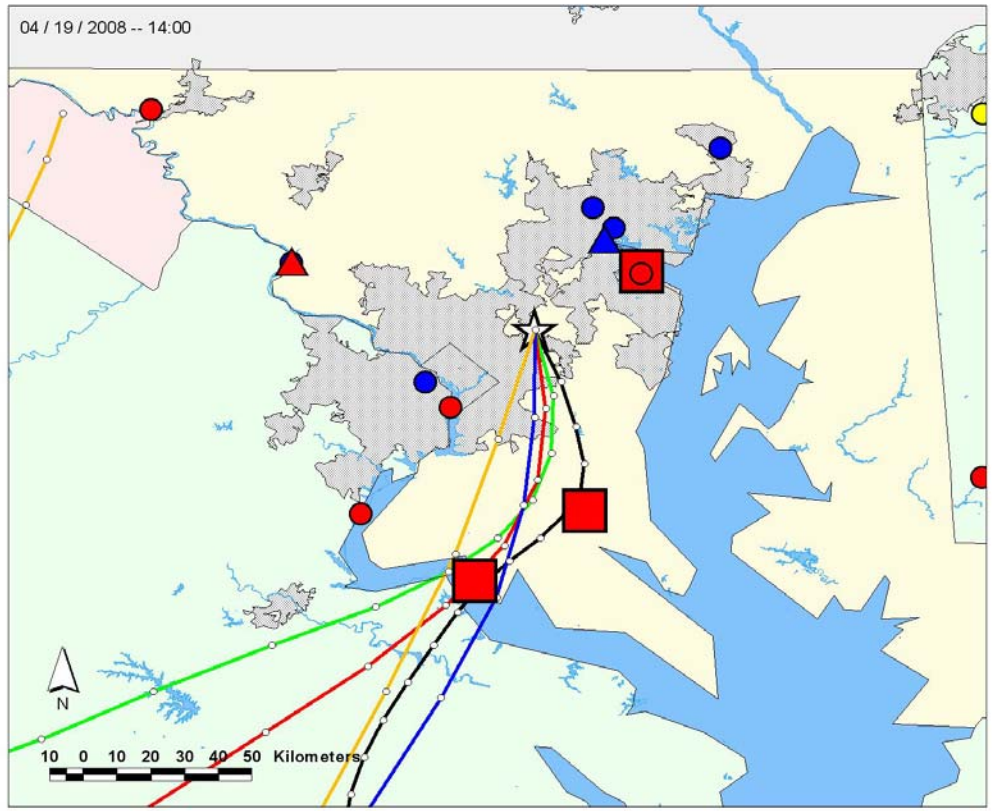

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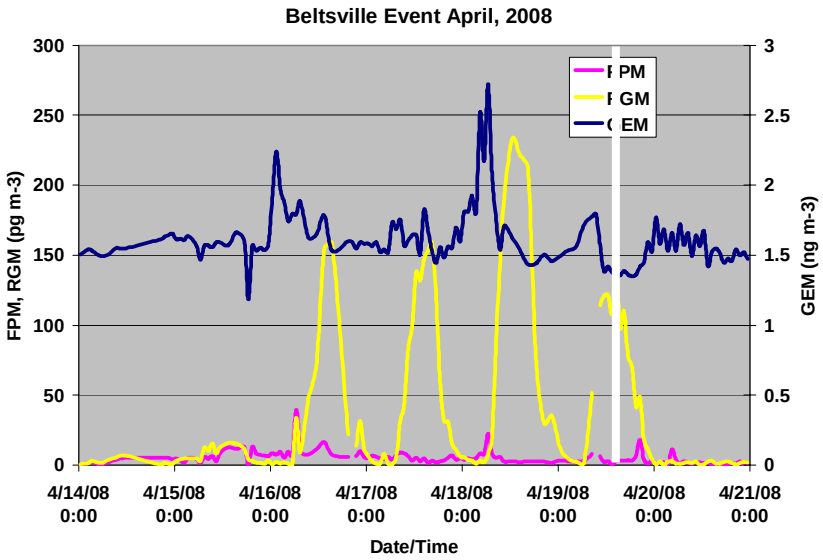

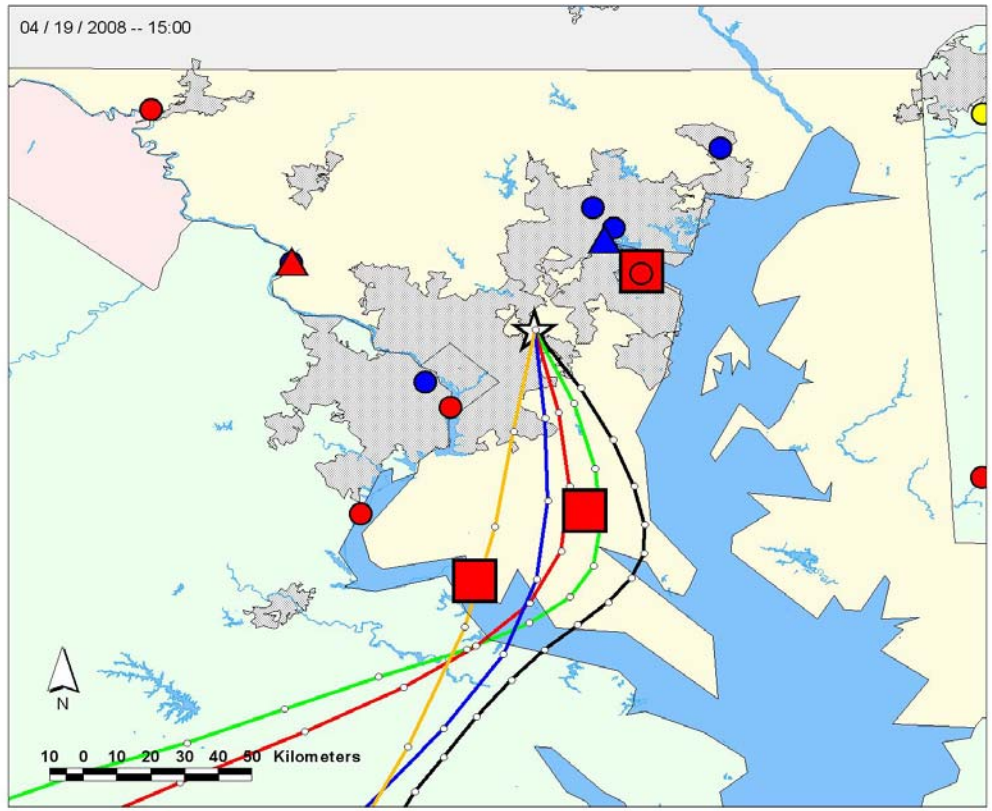

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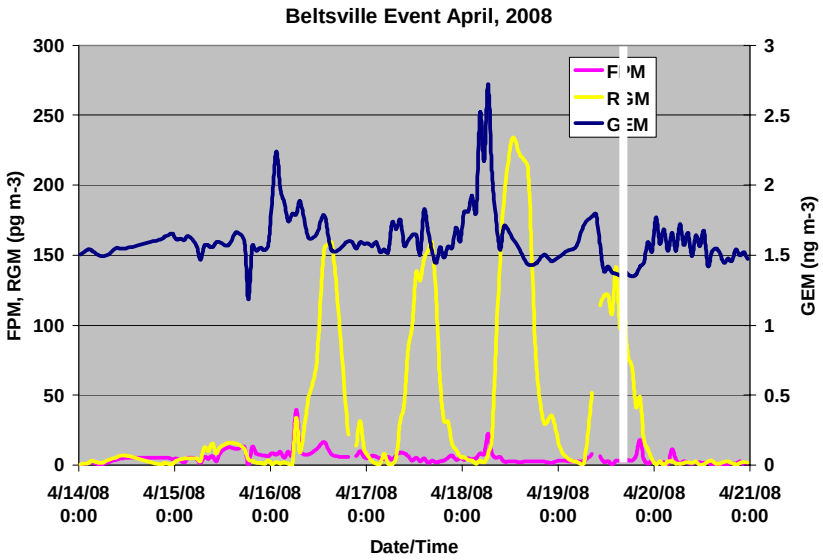

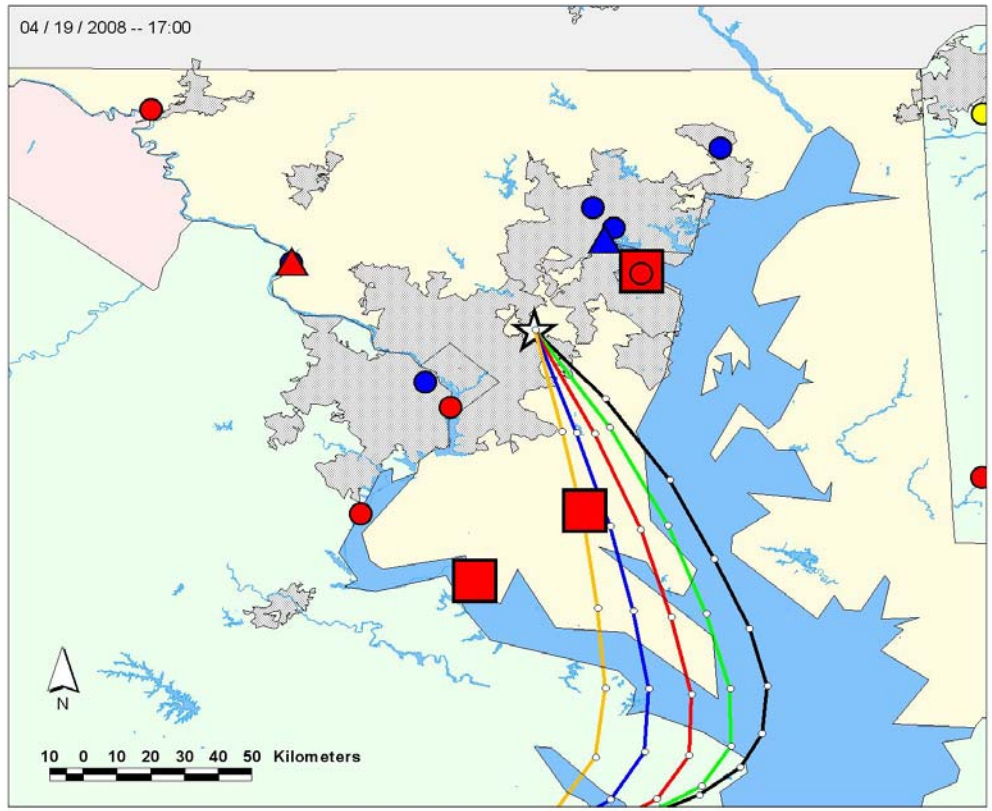

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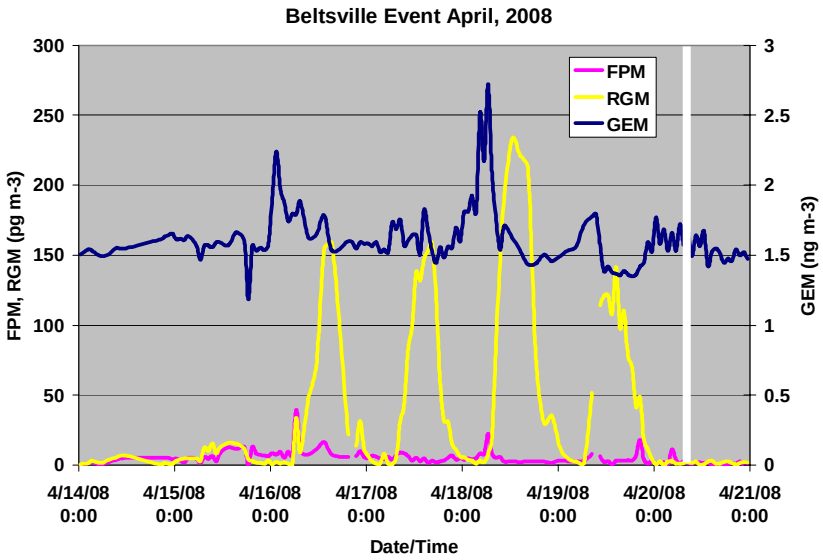

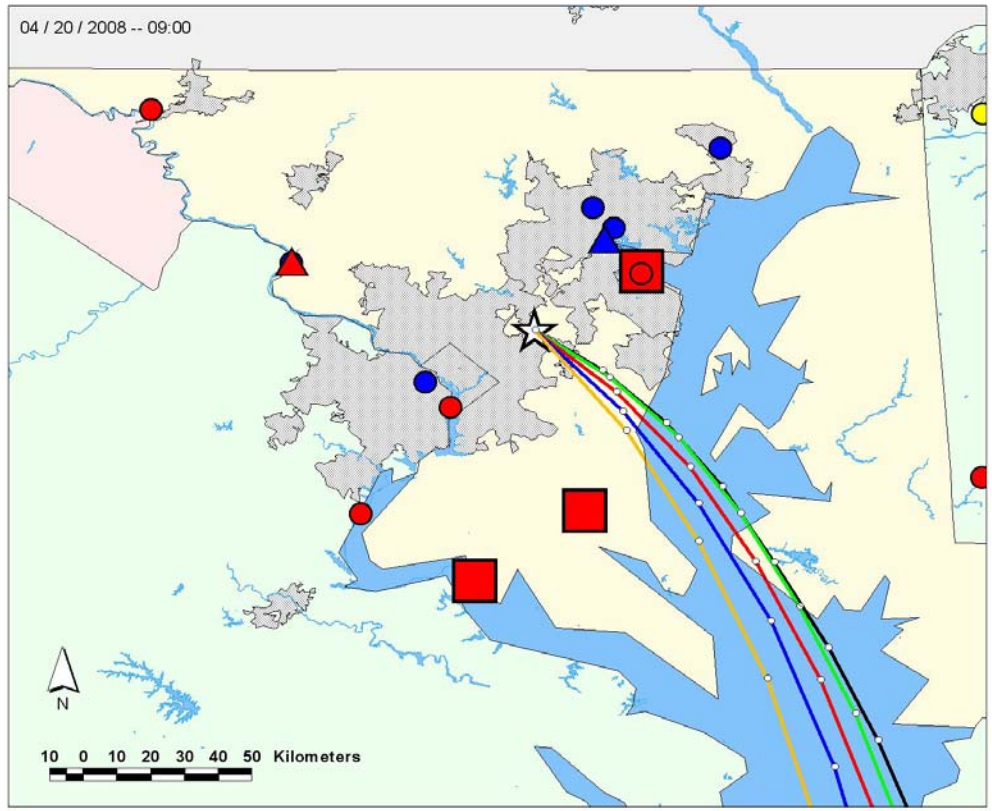

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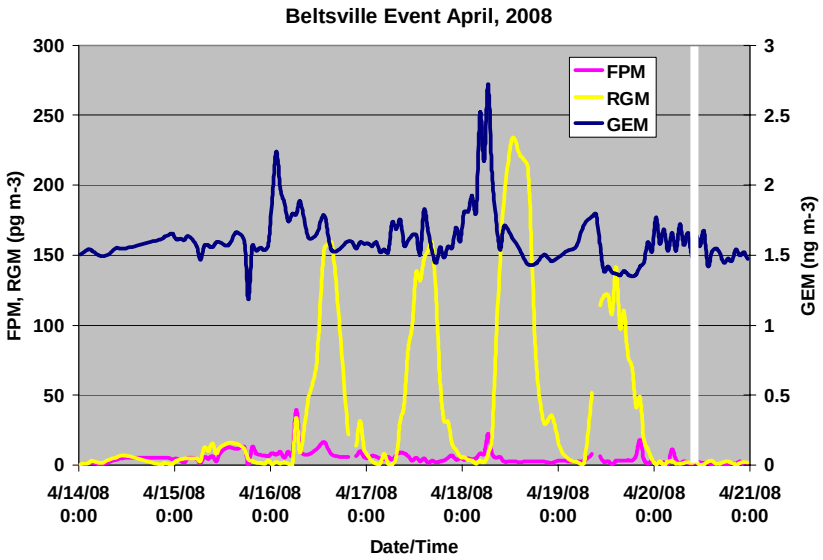

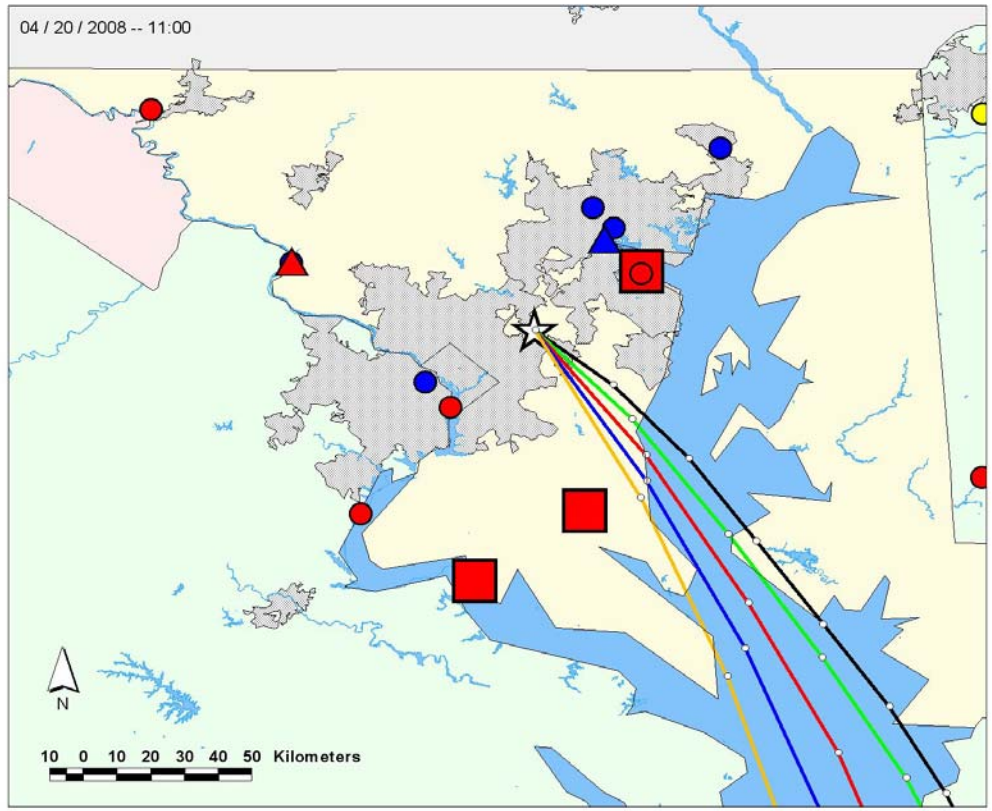

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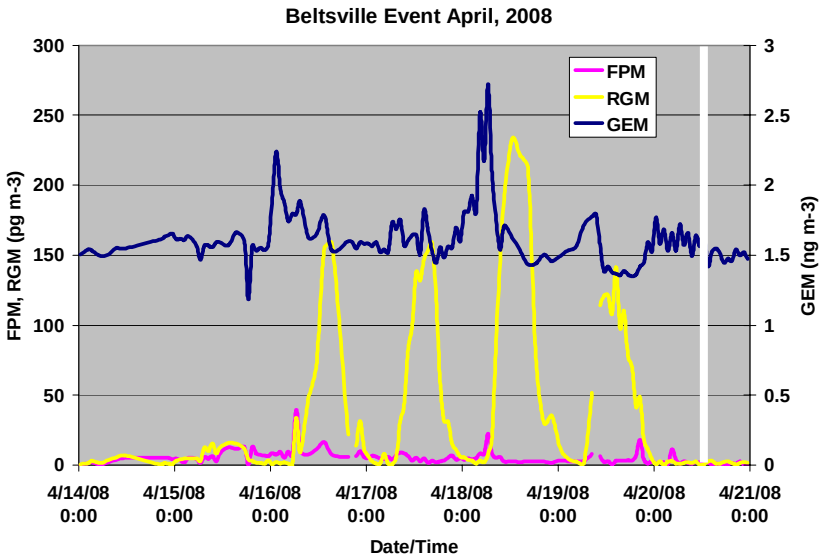

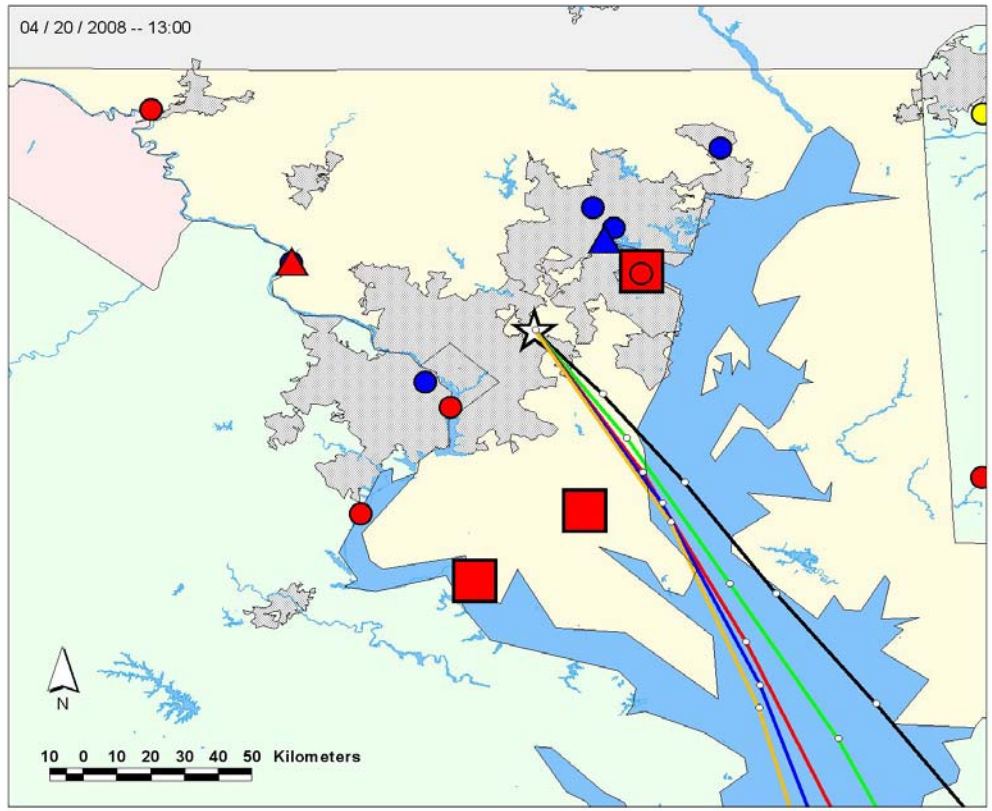

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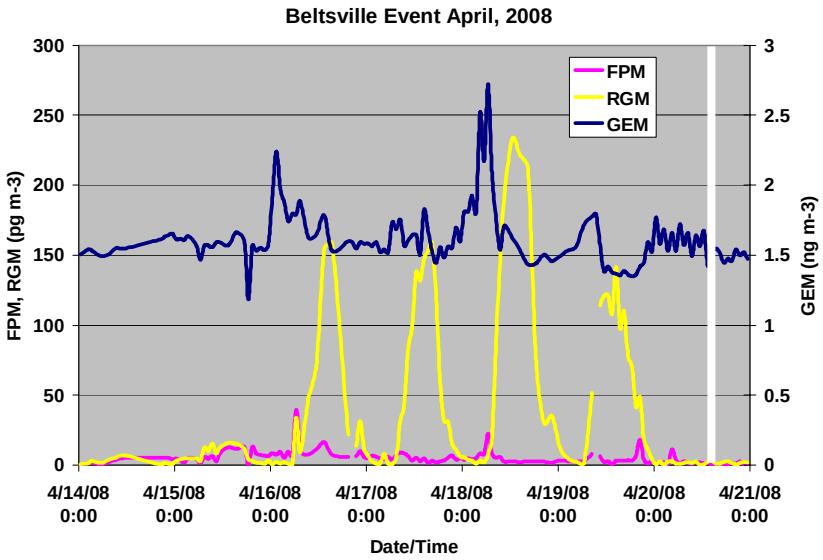

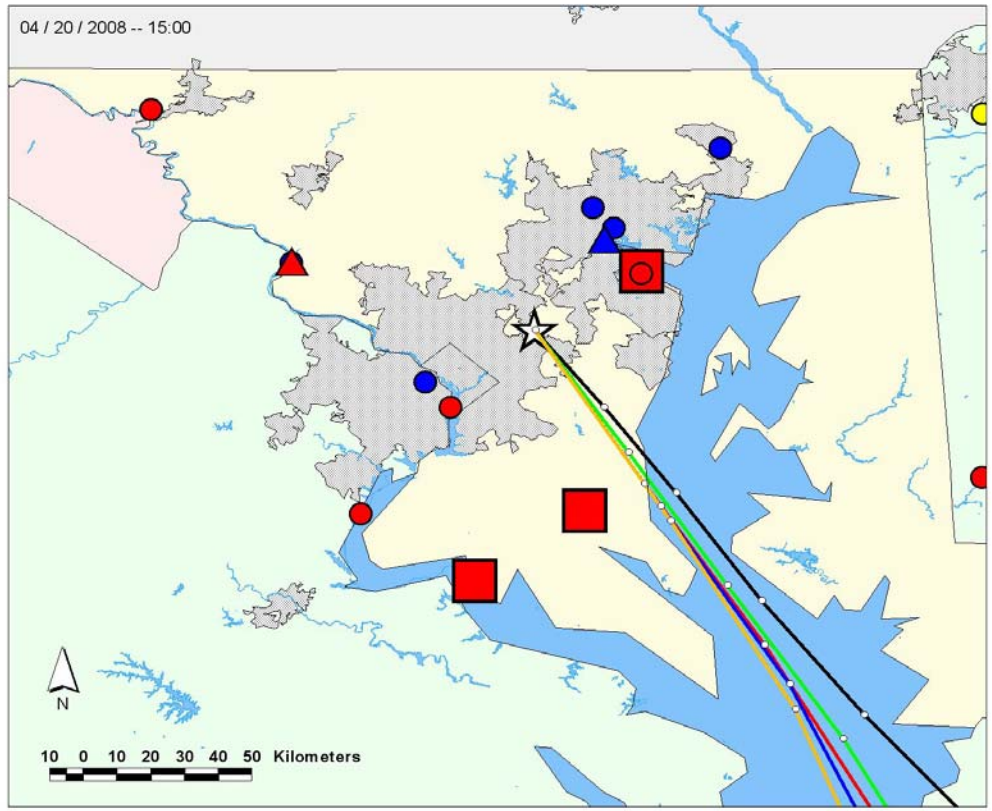

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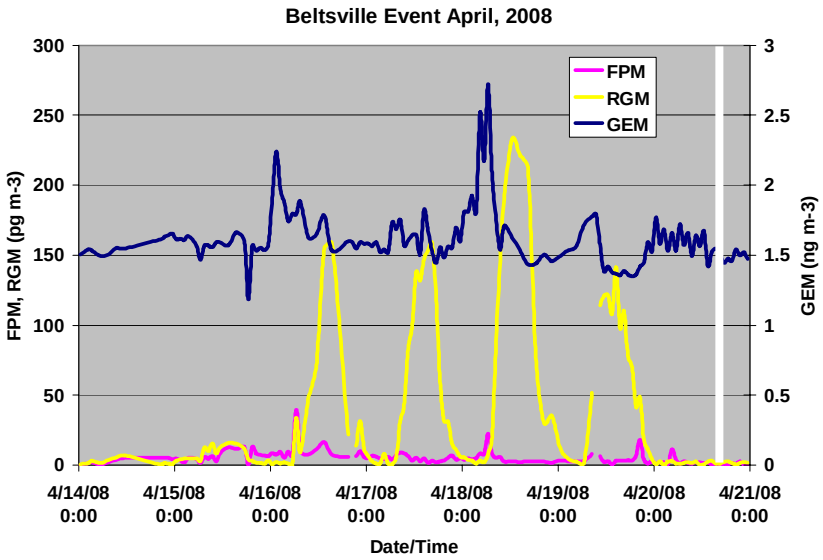
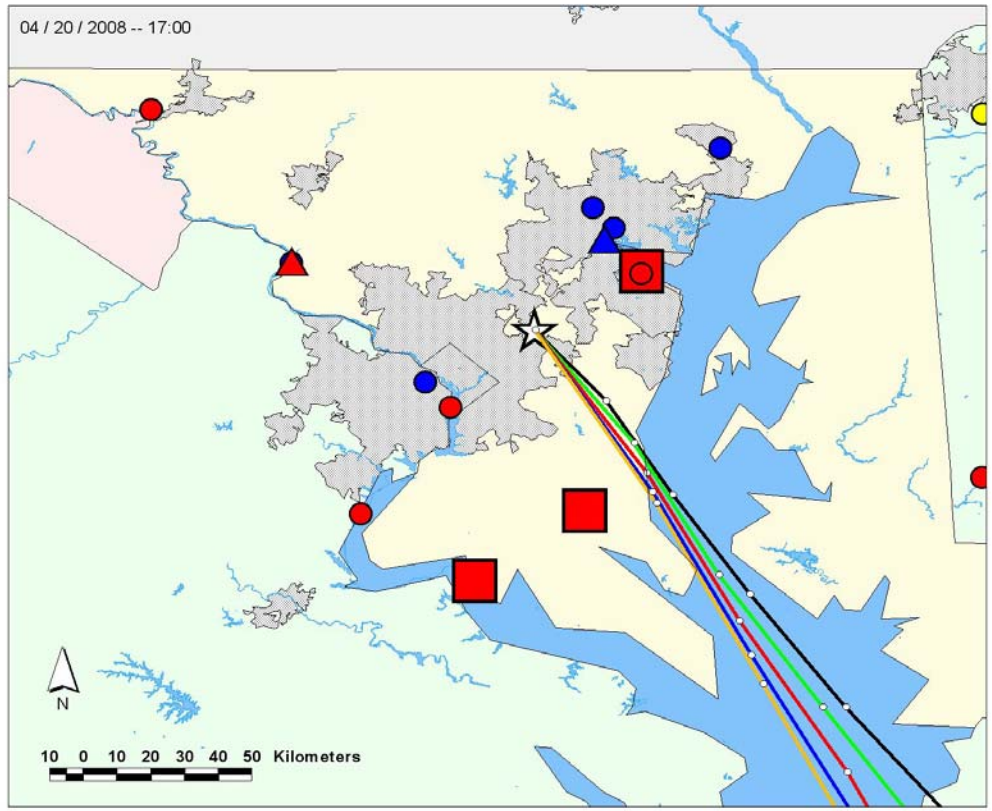
Large Point Sources of Reactive Gaseous Mercury (RGM) Emissions Based on the 2002 U.S EPA National Emissions Inventory (NEI)





Back-trajectories starting at the indicated fraction of the mixed layer height. Circles on the trajectories mark the hourly positions

- 0.1
- 0.3
- 0.5
- 0.7
- 0.9

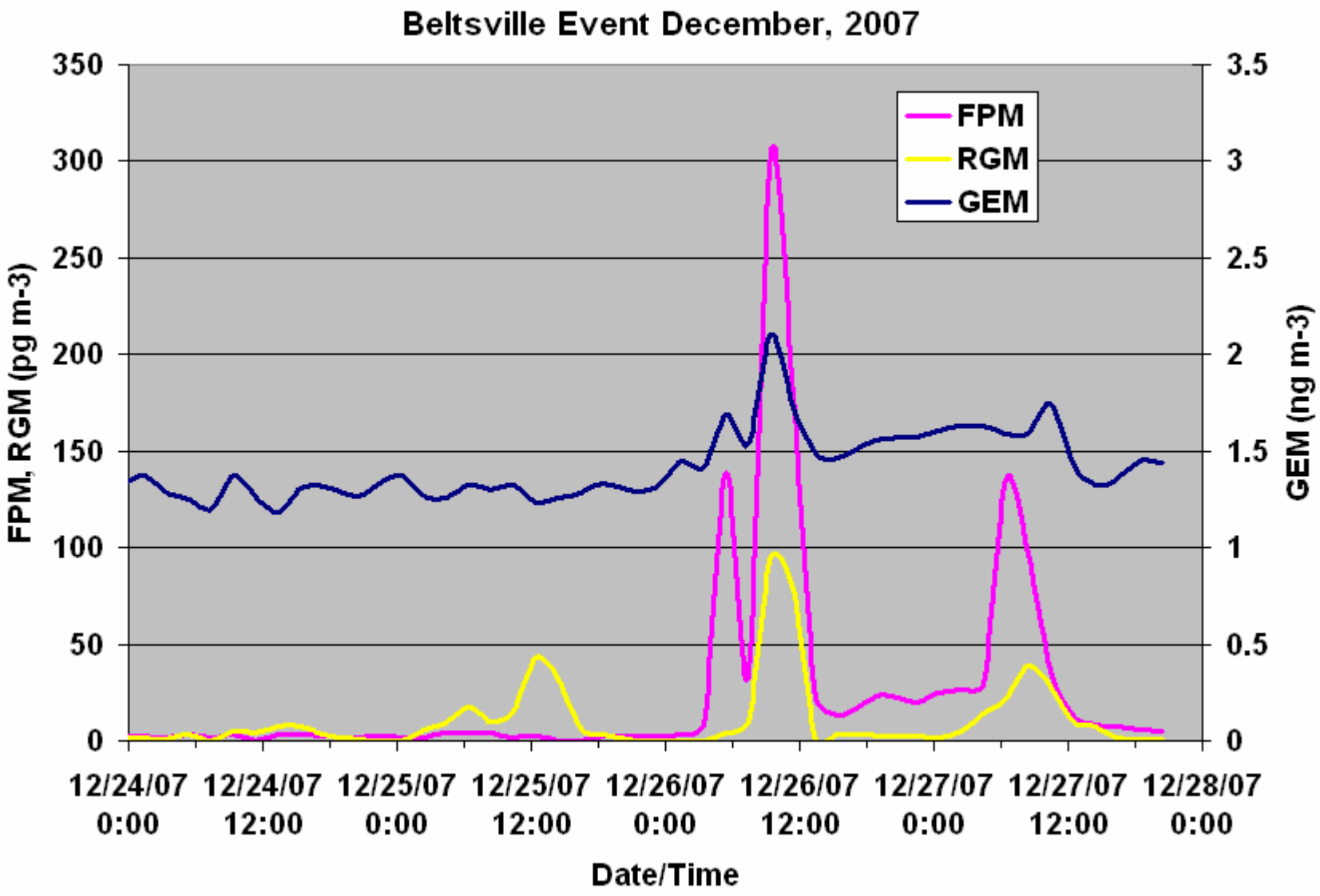
size/shape of symbol denotes amount of mercury emitted (kg/yr)

- ○ 10 - 50
- △ 50 - 100
- □ 100 – 200
- ◯ 200 - 400
- ⬡ 400 - 600

color of symbol denotes type of mercury source

- coal-fired power plants
- other fuel combustion
- waste incineration
- metallurgical
- manufacturing & other

RGM Event, December, 2007



Summary and Conclusions

- High RGM typically associated with high O_3 in Spring and Summer, and with dryer air characteristic of aged continental emissions (low NO/NO_Y)
- Diurnal profiles of RGM behave more like those of O_3 (higher concentrations in Spring and Summer) rather than the primary pollutant SO_2 (higher concentrations in winter and fall when PBL heights are low and removal processes slow), affirming that RGM concentrations are also influenced by transport and photochemistry, not only primary source impacts.
- Preliminary studies suggest that in the marine PBL there may be as much particulate mercury in the 10-2.5 μm (sea salt) fraction as in smaller particles.
- The Beltsville site is impacted by a variety of local-regional sources with unique emissions characteristics. Coupled chemical-meteorological analysis will yield important insights into mercury emissions, transport, transformation, and removal at the site.

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