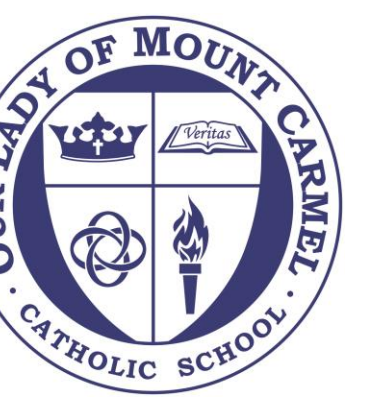# Long Range Transport of Smoke Plumes from the 2011 Lateral West Fire

Angela Rizzi, Our Lady of Mount Carmel School, Newport News, VA

Background

The Lateral West Fire or Great Dismal Swamp fire started on August 4, 2011 and burned for a total of 111 days despite Hurricane Irene dumping over 1 foot of rain on the fire on August 28, 2011. It burned over 6500 acres including underground peat and destroyed over 230,000 Atlantic White Cedar trees which were planted in 2008. (Dept. of Interior, 2011) The objective of this research was to track smoke plumes from the fire using historical data. Over land, PM 2.5 and CO species were used as possible indicators of smoke. These data were collected using ground station data obtained from AirNow Tech. Over the Atlantic Ocean there are no ground stations. Therefore, CALIPSO AOT data were used for ocean locations. Once a location with the possible presence of smoke was identified, HYSPLIT trajectories were run to track the source of the smoke. Finally, NOAA HMS images obtained from AirNow Tech Navigator provided additional evidence of smoke from the Dismal Swamp reaching the target location.

Observatory image by Robert Simmon, using Landsat 5 data NASA Earth from the USGS Global Visualization Viewer.

Measurements

- PM 2.5 is particulate matter that is less than 2.5 micrometers which is smaller than the width of a human hair. Because it is so small, it can travel deep into the lungs and cause respiratory problems. Levels over 40 micrograms per cubic meters are considered unhealthy. One source of PM 2.5 is burning plants. (EPA, 2014)
- Carbon monoxide is a colorless, odorless gas which is also emitted in combustion processes. When elevated levels of both species were detected near the same time, the possibility of smoke was identified. (EPA, 2014)
- AOT, Aerosol Optical Thickness, measures atmospheric aerosols by the degree to which light transmissions are absorbed or scattered. CALIPSO data identify different aerosol types at given altitudes. (NASA, 2013) Smoke can be seen in the Aerosol Subtype images.
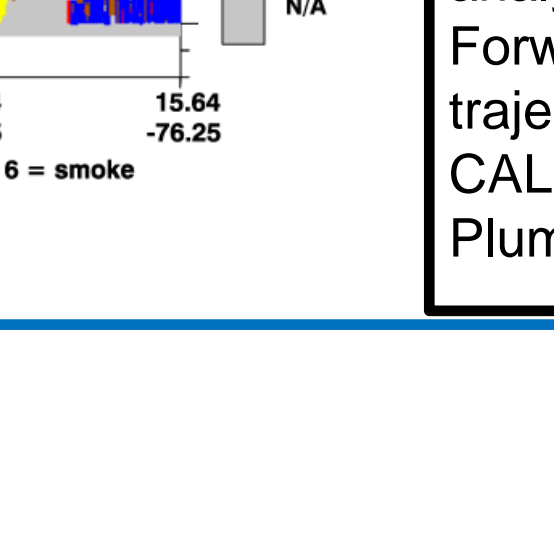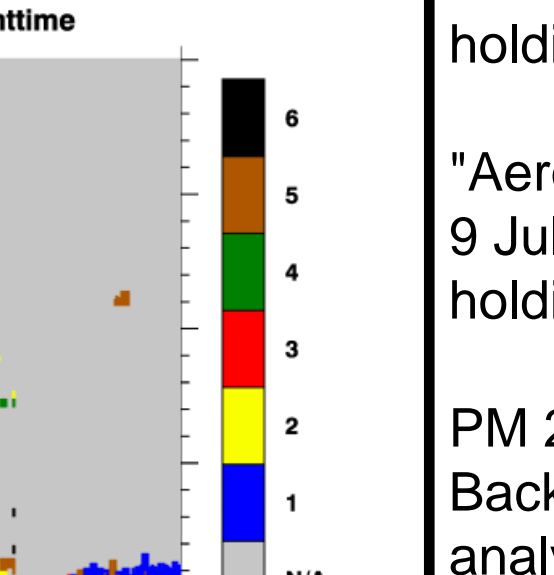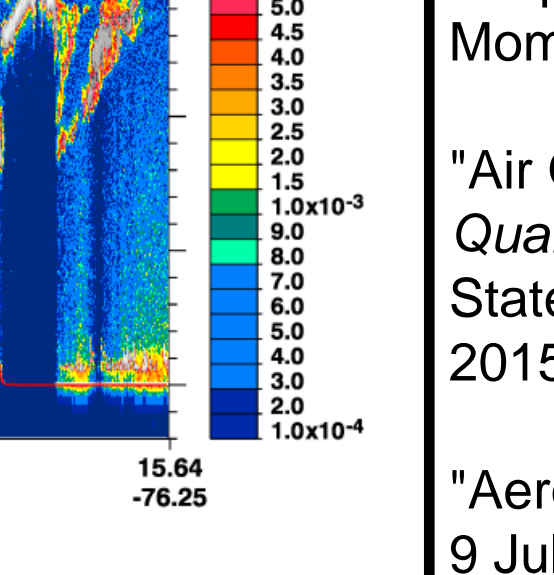
LAND

Land Track

PM 2.5 and CO ground data were obtained for the three sites on the map.

1. Hartman St. Math and Science Center, Richmond, VA
2. Howard University, Beltsville, MD
3. CAPABLE site at NASA Langley Research Center, Hampton, VA

The points are numbered in the time sequence of concurrent PM 2.5 and CO spikes in data values. This indicates a plume path from Richmond, VA to Beltsville, MD to Hampton, VA. HYSPLIT forward trajectories show the air flow following the same path. The trajectories were also animated to show the air mass flow.
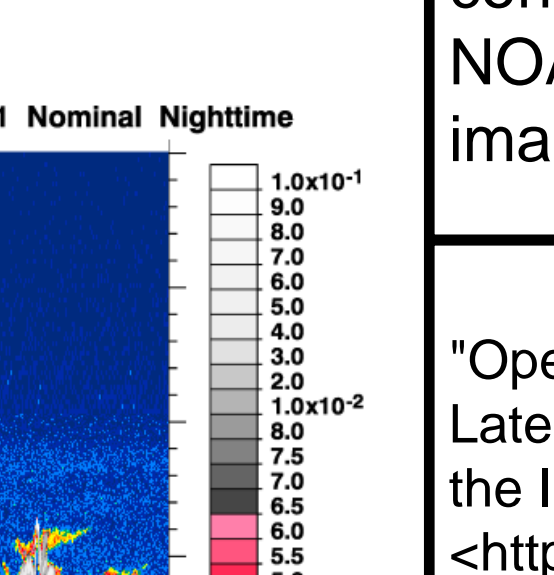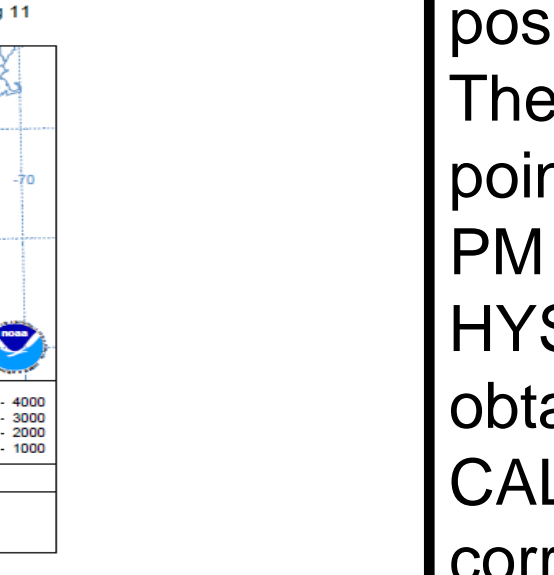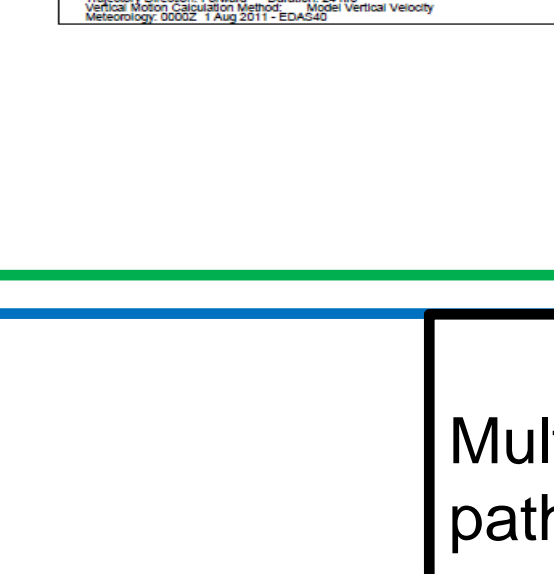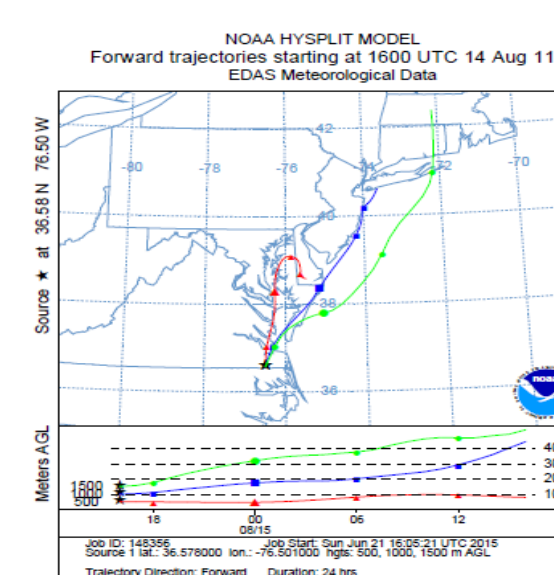

Forward Trajectories

Forward HYSPLIT trajectories were run from the fire location to see if the smoke traveled to the identified smoke locations. Each location had a trajectory showing air flow from the fire to the site at the identified date and time.
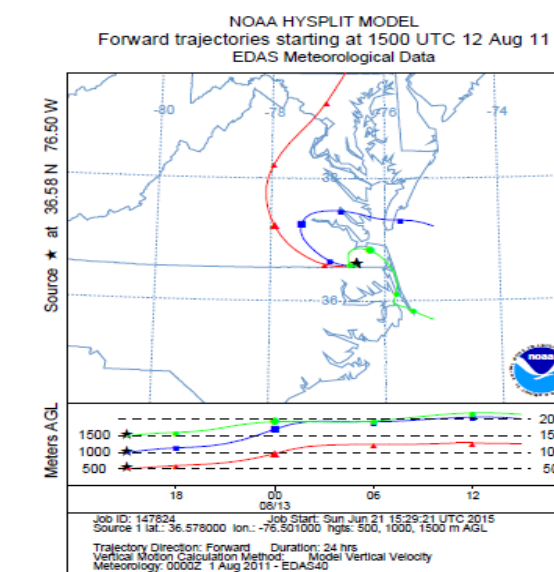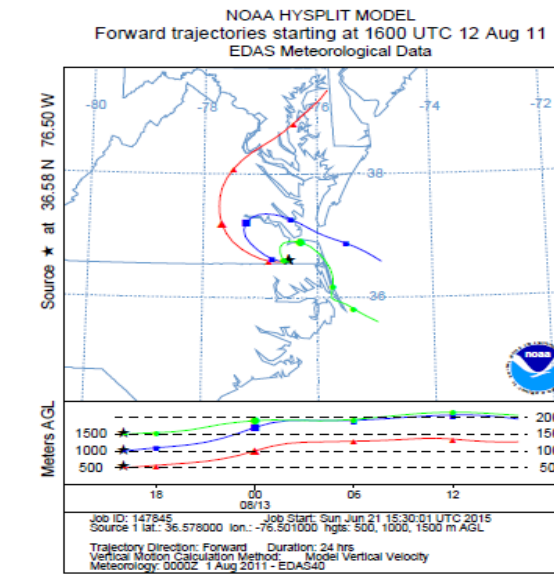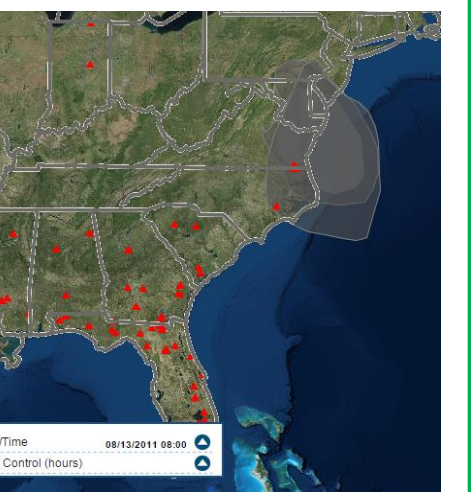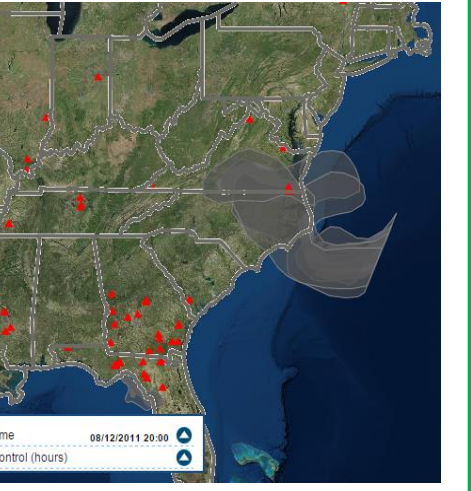
NOAA HMS Images

NOAA HMS images were obtained from AirNow Tech Navigator with smoke and fire layers to see if smoke was in the locations indicated. These images were retrieved after adjusting UTC to EST. The images for the two times at Beltsville, MD were the same. The image for Hampton, VA did not show any smoke. However, there was no smoke for any site in the US for the entire day.

OCEAN

Ocean Track

Points 4-6 on the map to the left show locations where CALIPSO data indicated the possible presence of smoke. The CALIPSO tracks are shown above the Total Attenuated Backscatter images. Points 4 and 5 were on the same track on 08/11/2011. Point 6 was from the track on 08/12/2011.

HYSPLIT

The HYSPLIT model is a system for computing simple and complex air parcel trajectories. It was developed jointly by NOAA and Australia's Bureau of Meteorology. Trajectories can be run at different altitudes and can be run forward or backward from a given latitude and longitude. Forward trajectories will show where air flows. Backward trajectories show where air at a point originated. (ARL, 2015)

SMOKE

CALIPSO data were retrieved for 19 days in August 2011. Paths in the general vicinity were identified and examined further to determine the presence of an aerosol subtype for smoke. The latitude and longitude from these points was used to run backward HYSPLIT models at the altitudes indicated by the CALIPSO data to see if the trajectory would show an origin at or near the Great Dismal Swamp. In the 19 days, three points were identified where the HYSPLIT model showed air flow originating in the vicinity of the Great Dismal Swamp. The NOAA HMS fire images also suggest the same plume path.

Conclusion

Multiple data sources were used to identify smoke paths. Often one data source would suggest the possibility of smoke without other data supporting it. The paths that were identified had more than one data point to support each location on the path. Over land, PM 2.5 and CO data were correlated with forward HYSPLIT trajectories and NOAA HMS smoke images obtained from AirNow Tech. Over the Atlantic Ocean, CALIPSO smoke subtype identification data were correlated with backward HYSPLIT trajectories and NOAA HMS smoke images where available. MODIS images would help further with path identification.

References and Resources

"Open Spaces, A Talk on the Wild Side - 5 Key Moments of the Lateral West Fire." *U.S. Fish and Wildlife Service*. Department of the Interior, 12 Dec. 2011. Web. 19 Mar. 2015. <http://www.fws.gov/news/blog/index.cfm/2011/12/12/5-Key-Moments-of-the-Lateral-West-Fire->.

"Air Quality Index - A Guide to Air Quality and Your Health." *Air Quality Index - A Guide to Air Quality and Your Health*. United States Environmental Protection Agency, 3 Oct. 2014. Web. 9 July 2015. <http://airnow.gov/index.cfm?action=aqi_brochure.index>.

"Aerosol Optical Thickness." *GES DISC*. NASA, 1 May 2013. Web. 9 July 2015. <http://disc.sci.gsfc.nasa.gov/data-holdings/PIP/aerosol_optical_thickness_or_depth.shtml>.

"Aerosol Optical Thickness." *GES DISC*. NASA, 1 May 2013. Web. 9 July 2015. <http://disc.sci.gsfc.nasa.gov/data-holdings/PIP/aerosol_optical_thickness_or_depth.shtml>.

PM 2.5 and CO Data obtained from AirNow Tech.
Back Trajectories created using NOAA's HYSPLIT back trajectory analysis.
Forward Trajectories created using NOAA's NYSPLIT forward trajectory analysis.
CALIPSO data obtained from NASA at calipso.larc.nasa.gov
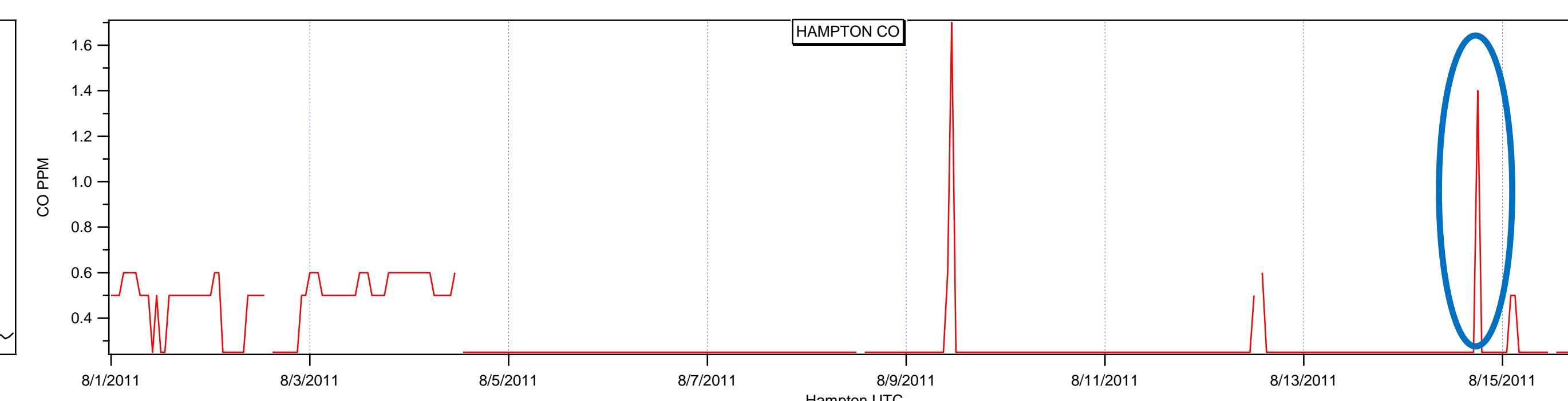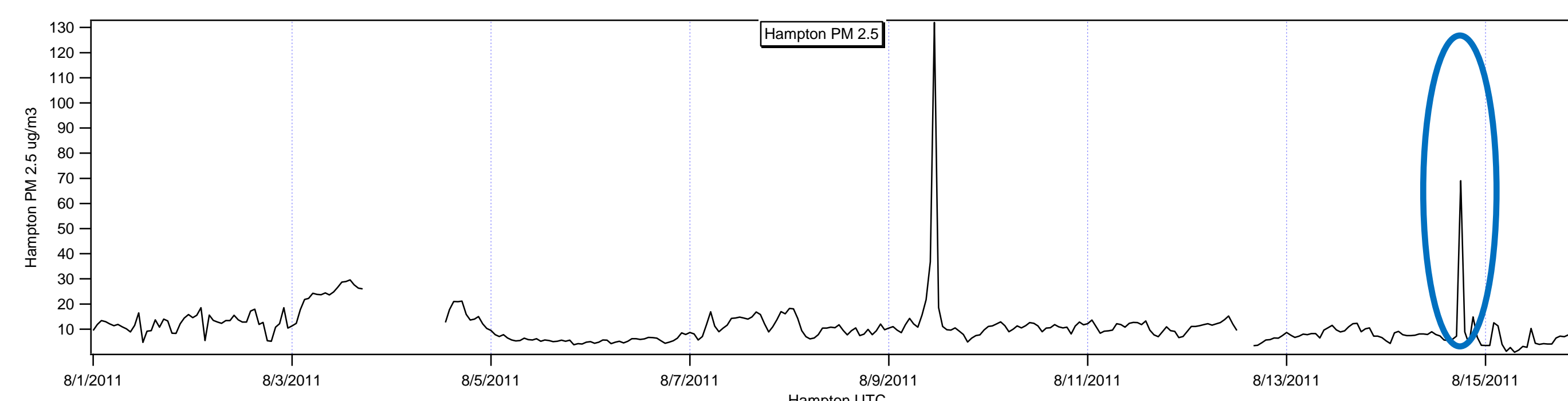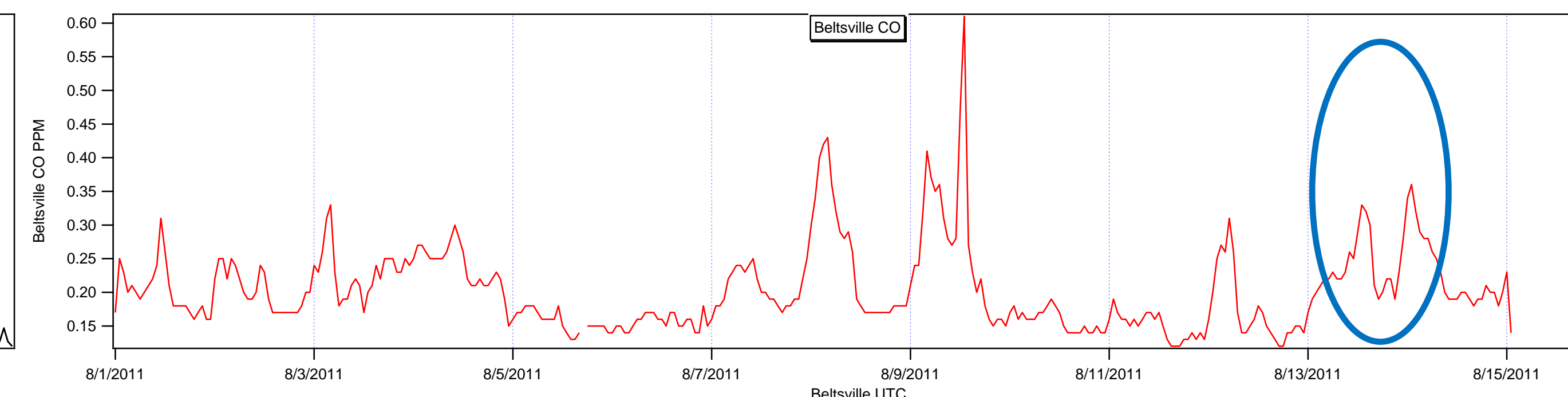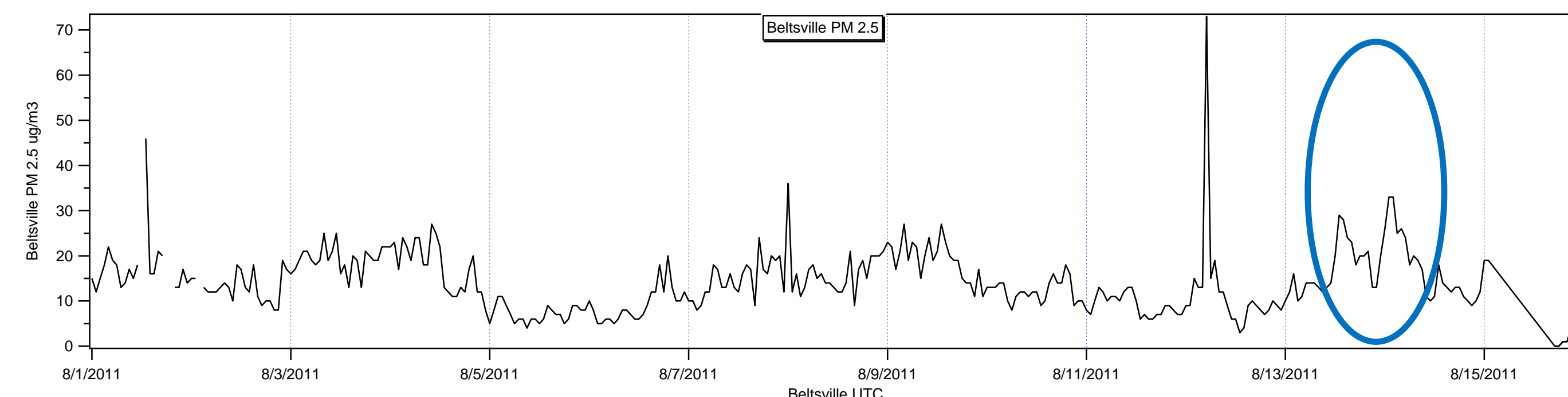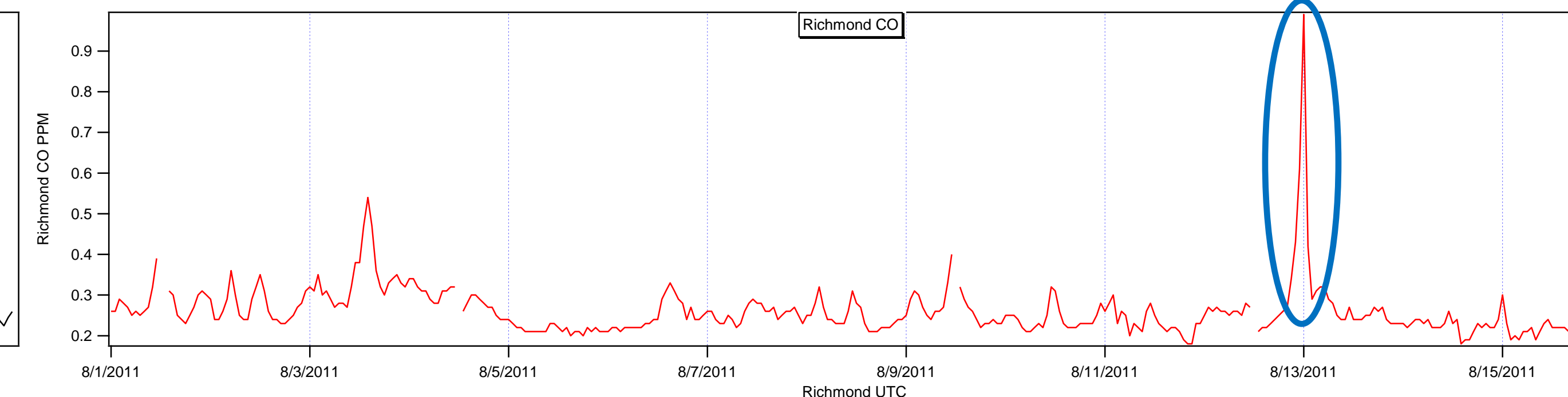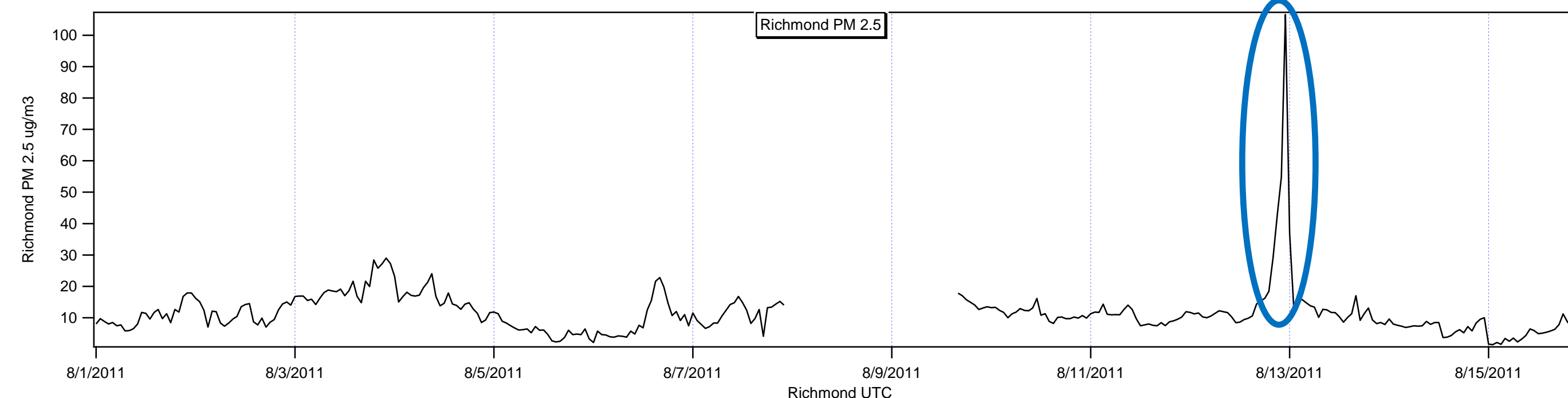Plume map paths generated using copypastemap.com.