Influence of Transport on Air Quality in Richmond, Virginia

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Background

Tropospheric ozone is identified by the Environmental Protection Agency (EPA) as a criteria air contaminant, meaning that it is harmful to the public and the environment. Ozone is created via a photochemical reaction from emissions of nitrogen oxides (NOx) and volatile organic compounds (VOCs). In humans, ozone triggers numerous respiratory problems ranging from coughing and wheezing to more chronic health problems such as the development of asthma. Ozone has also been shown to be toxic to plants, with some species showing signs of damage at concentrations as low as 40 ppb.

The EPA sets National Ambient Air Quality Standards (NAAQS) for all criteria pollutants identified by the Clean Air Act. An area can be designated as attainment if it meets the standard for a particular pollutant, or nonattainment if they do not meet the standard. The NAAQS for ozone has become more stringent after several revisions, and is currently at 75 ppb for an 8-hour average (EPA, 2014).

Long-Term Ozone Trends

Fishman et al. (2014) analyzed ozone concentrations of air entering and exiting the St. Louis metropolitan area over 32 years. The concentration of ozone in “dirty air” leaving the city decreased considerably over that time period, but levels of ozone in “clean air” entering the city increased at a similar rate. Therefore, while St Louis may experience better air quality in terms of less extreme ozone maximums, the background levels of ozone are rising steadily.

Richmond Ozone Spike – July 16th & 17th

Ozone concentrations at all six air quality monitoring sites follow the same trend, which is to be expected as most historical ozone events in the mid-Atlantic occur over large, multi-state areas (MARAMA, 1997). On the 10th, the ozone trend begins to decline. Contributions to this may include light rain in North Carolina and strong easterly flow removing NOx from the region. By July 13th, flow was beginning to swing clockwise back towards the Richmond area. The daily overpass from OMI picks up Richmond’s NOx signature, but also shows a region of extremely low NOx which disconnects Richmond from the coal plants in North Carolina. On the 14th and 15th, Richmond experiences rain heavier than the surrounding region, but cloud cover limits ozone production at all sites. NOx is however still detected by OMI on the 15th, and emissions from Roxboro arrive in Richmond on the morning of the 16th. On both the 16th and 17th, Richmond experiences higher ozone concentrations than the surrounding region, peaking at 109 ppb. OMI shows a clear pathway for NOx to travel to Richmond from Roxboro. After this sudden spike, Richmond returns to following the trend observed by the other sites in North Carolina.

Acknowledgements

This work was supported by the Long-term Engagement in Authentic Research with NASA (LEARN) project with funding provided through a NASA SMP EPDSSS grant. Data used was provided by AirNowTech, the EPA Air Quality System, Google Earth, NOAA's HYSPLIT model, and MY NASA DATA. I would like to express my sincere gratitude and thanks to Dr. Margaret Pippin for her mentoring throughout this project. I would also like to thank her various research assistants for their help, and especially thank my colleagues in the LEARN program for their questions, answers, and support.