Analyzing Air Quality and Climate Change Data During the COVID-19 Pandemic What Can We Learn?

April 18, 2020

Background – For over 30 years, the Maryland Department of the Environment (MDE) and the University of Maryland College Park (UMCP) have worked in partnership to conduct policy-relevant research on air quality and climate change. This partnership has often involved collaboration with other partners like NASA, NIST, NOAA, and other universities like Howard University and the University of Maryland Baltimore County. This collaborative research effort has led to some of the States' and the Nation's most successful efforts to reduce air pollution and protect public health. The Maryland Departments of Transportation and Natural Resources have also provided support to the current effort.

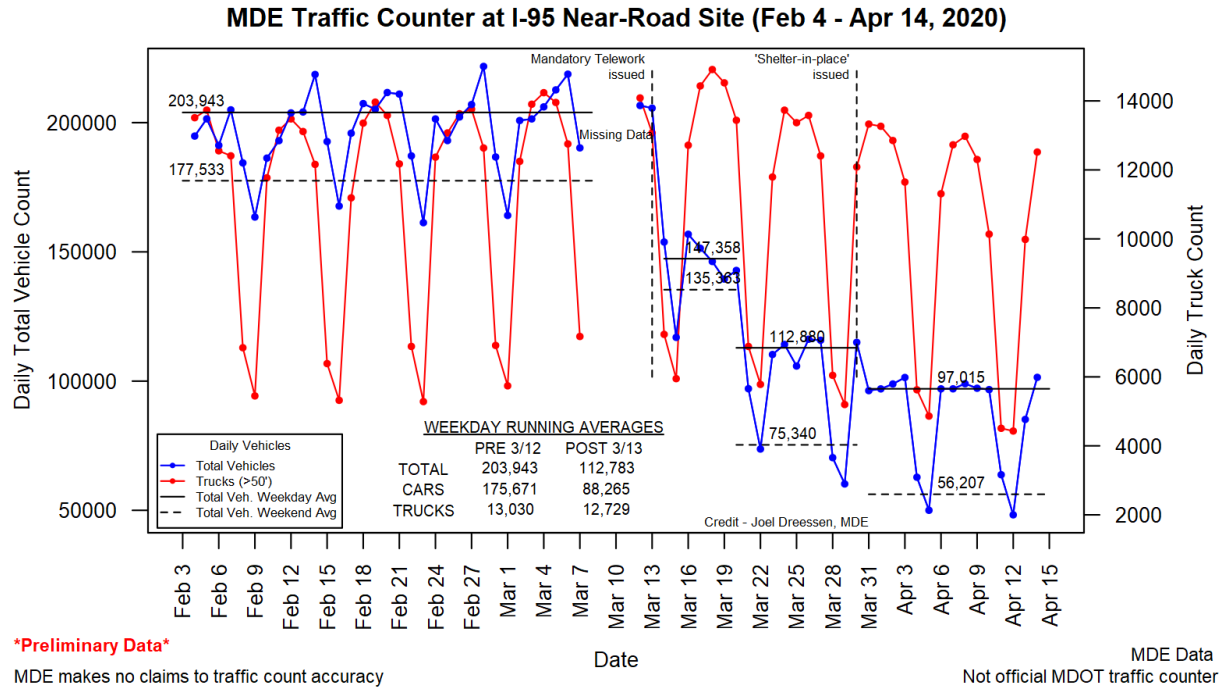
COVID-19 Analyses – This effort, which started in early March, is using traffic, satellite, air quality/greenhouse gas (GHG) and other data to analyze how reduced traffic and other changes linked to social distancing during the COVID-19 pandemic are affecting pollutants that contribute to poor air quality and climate change. The goal of the research is to help inform policy makers working on efforts to further improve air quality and to reduce GHGs. The analyses are still in a very early stage of development and it is not possible to draw definitive conclusions at this time, but the data is extremely interesting.

What Have We Seen to Date? – Traffic is way down. In particular, car traffic is dramatically down with only about half as many light-duty vehicles on I-95. Numbers of semi-truck and large diesel vehicle traffic has persisted, with a slower delayed drop compared to light-duty vehicles. Satellite data indicates that air pollution levels should likely be lower. Traffic data and other data suggest that GHG emissions are also lower. Overall electricity usage in the US is down by only about 7% from seasonally adjusted expected rates (New York Times, page B3, 10 April 2020).

Traffic Data - Initial and primary analyses of traffic data uses MDE's roadside monitoring station located at the I-95 rest stop between Baltimore and Washington. The unofficial traffic counts

are obtained through a remote sensing instrument and are generally consistent with MDOT data. Official statewide analysis from MDOT is under development.

As shown below, light duty gasoline vehicle traffic (cars and passenger trucks) have dropped dramatically, by at least 50%. Traffic counts show two clear phases associated with Maryland policies on mandatory telework and shelter-in-place. Over that same time period, truck traffic had an initial, minor increase for a week. Truck numbers have been dropping since then, but by only a smaller percentage. The data also provides a clear opportunity to measure the influence of both gasoline and diesel vehicles on air quality and climate change at the I-95 site.

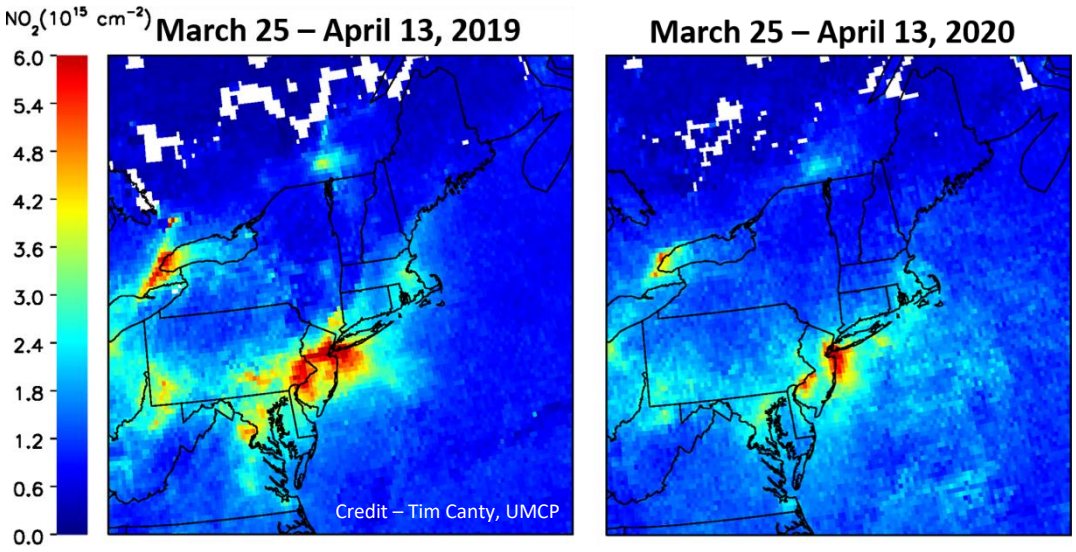


Satellite Data – Satellites have become a powerful tool to analyze air quality and climate change. NASA works closely with UMCP and MDE on satellite data analysis. UMCP has been using the satellite data* to look at changes in column nitrogen dioxide (NO_2). These data are directly related to ozone air pollution and are also a good indicator for changes in emissions of combustion sources (power plants and vehicles). The data shown below, which is still very preliminary shows maps of NO_2 acquired before and after the COVID-19 pandemic.

*OMI (the Ozone Monitoring Instrument) and TROPOMI (the TROPOspheric Monitoring Instrument)

Average Tropospheric Column NO_2 for March 25 - April 13, 2019 (left) and 2020 (right) as Observed by TROPOMI

Data Are Only Used When Cloud Cover is Less Than 30%

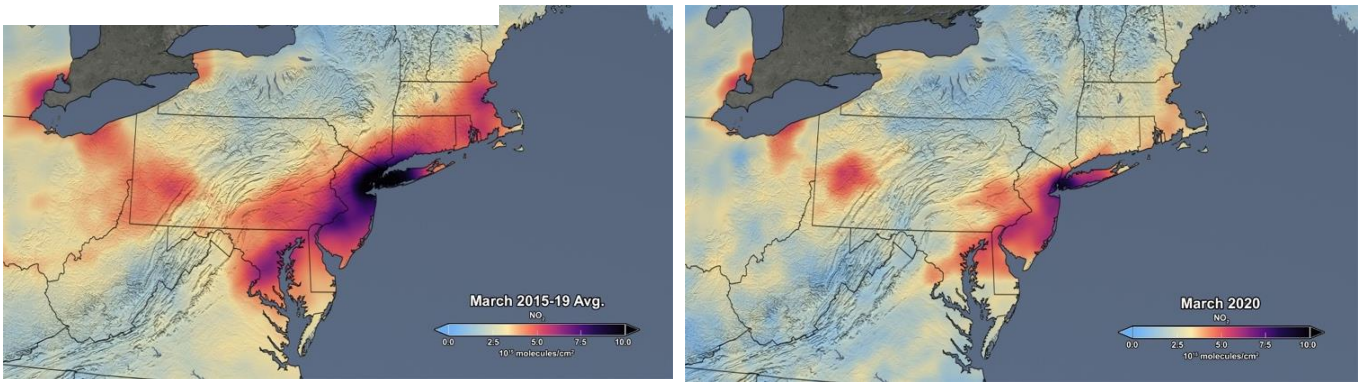


Emissions Data – Very preliminary analysis of Continuous Emissions Monitoring (CEM) data indicates that both carbon dioxide (CO_2) and nitrogen oxide (NOx) emissions from a small sample of power plants are down during the month of March. This is a very preliminary analysis, but for the small sample of units looked at, NOx and CO_2 emissions were down about 40% and 10% respectively. NOx is a critical emission associated with ozone and fine particle air pollution. CO_2 is the most significant GHG emission linked to climate change.

Federal Partners – NASA, one of our federal partners is also analyzing satellite data. The figures below compare measurements of tropospheric NO_2 obtained by the NASA OMI tool in the Mid-Atlantic during March of 2015 to 2019 and in March 2020. Further information about these two figures is available at https://svs.gsfc.nasa.gov/4810. The maps below were recently released by NASA and indicate the dramatic reduction in pollution related to fossil fuel combustion. To determine the exact amount of the reduction related to reduced activity due to the pandemic will require numerical simulations, but these preliminary results provide a suggestion of what the air quality and climate change benefit could be expected if half the light-duty vehicle fleet were replaced by electric cars.

NASA Observations of Nitrogen Dioxide (NO_2) Showing Major Decreases in March 2020

Credit - NASA



NIST operates a network of high precision GHG monitors on towers in the Baltimore Maryland/Washington, DC area. We are working with NIST to use the observations and numerical models to quantify the reduction in emissions due to reduced consumption of fossil fuels driven by the response to the pandemic.

The Future – The next update of what is being learned from this accidental experiment will be released in late May. The update will include analysis of additional pollutants (NO_2, black carbon, ozone, etc.) by MDE, UMCP GHG trends analysis from the MDE I-95 roadside site and additional traffic count and emission data analysis from MDE, UMCP and MDOT. UMCP has added CO_2 and methane (CH_4) instruments to the MDE monitors at the I-95 rest stop.

UMCP will also begin flying their research aircraft to measure changes in air pollution and GHGs before and after the pandemic. UMCP is also measuring GHGs including, short-lived pollutants, at an on-campus site. These data should be available soon. We will also continue to collaborate with NASA and NIST. NASA is focused on collection and analysis of satellite data and NIST scientists are operating an array of GHG instruments on towers throughout MD and DC to quantify the change in emissions of CO_2 and CH_4.

For Additional Information – For additional information contact Tad Aburn (george.aburn@maryland.gov) or Russ Dickerson(RRD@UMD.EDU). A summary of the UMCP/MDE partnership may be found at https://www2.atmos.umd.edu/~rammpp/