NOAA Global Monitoring Laboratory Virtual Global Monitoring Annual Conference (eGMAC)

COVID-19 Related Emissions and Regional Impacts

August 7, 2020, 8:30-10:35am MDT

Time (MST):	Speaker	Title
8:30 - 8:35	Colm Sweeney	Introduction: COVID-19
8:35 - 8:50	Corinne Le Quere	Assessing the reduction in daily global CO2 emissions during the COVID-19 using activity data
8:50 - 9:05	Greg Frost	Overview of NOAA Research on Atmospheric Impacts Related to the COVID-19 Pandemic
9:05 - 9:20	Shobha Kondragunta	Impact of COVID-19 Shutdown on Aerosols and Air Quality
9:20 - 9:35	Break	
9:35 - 9:50	Pieter Tans	Quantifying the impact of Covid-19 on atmospheric CO_2 is difficult
9:50 - 10:05	Vanessa Monteiro	What multi-city atmospheric observations tell us about greenhouse gas emissions during the COVID-19 shutdown
10:05 - 10:25	East Coast Outflow (ECO) experiment during pandemic times	East Coast Outflow (ECO) experiment during pandemic times
10:25-10:35	Audience	Discussion/Wrapup

Session Abstracts

Corinne Le Quere

Title: **Assessing the reduction in daily global CO2 emissions during the COVID-19 using activity data**

Abstract:
Activity data for six economic sectors have been used to quantify the effect of confinement measures on sectorial emissions. Data shows a reduction in activity by sector that is distinct across sectors. This information is used, along with the stringency of the confinement measures for 67 countries representing 97% of the global emissions, to estimate the daily change in global emissions during Jan-June 2020. The peak drop in daily emissions was estimated at 17% (11% to 25%) in early April, compared to an average day in 2019. Plausible scenarios of the evolution of the confinement measures this year lead suggest an annual decrease in global CO2 emission of around 4% if confinement measures return to pre-Covid conditions by mid-June, and 7% if some measures remain in place to the end of the year.

Greg Frost

Title: **Overview of NOAA Research on Atmospheric Impacts Related to the COVID-19 Pandemic**

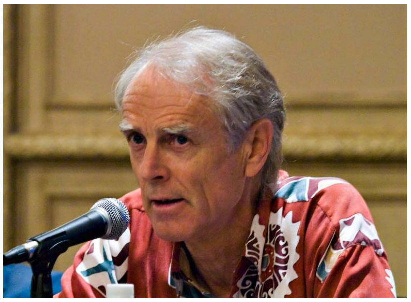
Abstract:
The COVID-19 pandemic is causing worldwide disruptions to economic activity, transportation, and society as a whole. Since the beginning of the crisis, NOAA's research enterprise has been working to assess the pandemic's impacts on the atmosphere and to use this unique opportunity to better understand human influences on the Earth system. Through its measurements and modeling, NOAA is quantifying the atmospheric state during the economic slowdown and eventual recovery. NOAA's studies provide information on pandemic-related

emissions perturbations and the role of emissions relative to other drivers of atmospheric composition changes. NOAA's research aims to understand how COVID-related societal disruptions are impacting air quality, the Earth's radiative balance, and the broader Earth system. These research advances have the potential to transition to operational applications, including NOAA air quality and weather forecasts, satellite products, and epidemiological predictions.

Shobha Kondragunta

Title: **Impact of COVID-19 Shutdown on Aerosols and Air Quality**

Abstract:
Most countries around the world took actions to control COVID-19 virus spread by asking their citizens to practice social distancing, limiting air and ground travel, closing schools, suspending sports leagues, closing factories etc. leading to an economic shutdown. The reduced traffic and human movement in 2020 due to shutdown compared to Business as Usual (BAU) scenario was tracked by Apple and Android cellphone use. The data show substantial reductions in mobility in all major cities/urban areas during the months of March, April, and May compared to February when it was BAU. The reduced human activity is captured in satellite data, especially in tropospheric column nitrogen dioxide (NO_2) observed by Sentinel 5P Tropospheric Ozone Monitoring Instrument (TROPOMI) and Suomi NPP Ozone Mapping Profiling Suite (OMPS). The tropospheric NO_2 in cities like Los Angeles and New York correlated well with on-road NO_x emissions measured in 2020 by OAR scientists. For on-road NO_x emissions corresponding to BAU, surprisingly there was no positive correlation with tropospheric NO_2 despite stratifying the data to wind speeds less than 10 m/s. There was also no correlation of tropospheric NO_2 changes between 2020 (corresponding to shutdown) and 2019 (BAU) with reductions in powerplant emissions reported by the Environment Protection Agency (EPA), leading us to conclude that powerplants are no longer the major source of NO_2 in the United States. The positive correlation between TROPOMI NO_2 and Suomi NPP Visible Infrared Imaging Radiometer Suite (VIIRS) aerosol optical depth (AOD) measurements in urban regions were found for data in both years 2019 and 2020, indicating common source sectors for NO_2 and aerosols/aerosol precursors. Preliminary results from this ongoing research will be presented.



Pieter Tans

Title: **Quantifying the impact of Covid-19 on atmospheric CO_2 is difficult**

Abstract:
The steady and accelerating increase of CO_2 in the atmosphere since pre-industrial times is entirely generated by human activities. The production of CO_2 from the burning of fossil fuels became the dominant process already in the late 19 th century. Yet, even today, at seasonal and annual time scales the observed variations of atmospheric CO_2 are dominated by two-way exchange between terrestrial ecosystems and the atmosphere as it is impacted by changes in temperature, precipitation, soil moisture, etc. I will present statistics of such natural variations at "background" sites, against which the slowdown of fossil fuel burning must stand out. It is also difficult even for urban areas where the emissions are intense so that the local CO_2 signals are larger. However, meteorological conditions are a much larger source of CO_2 variability than emissions themselves. Inside, and upwind of most urban areas the vegetation produces a significant portion of CO_2 variability. Measurements of proxy variables such as NOx, CO, and others are used but their correlation with CO_2 can vary. Only measurements of the relative depletion of ^{14}C in CO_2 can cleanly single out "old" fossil CO_2 from "modern" CO_2 signals produced by terrestrial ecosystems, but also in this case we need to know air transport and mixing well.

Vanessa Monteiro

Title: **What multi-city atmospheric observations tell us about greenhouse gas emissions during the COVID-19 shutdown**

Abstract:
The sudden changes in economic activity due to the COVID-19 pandemic led to a reduction in emissions of greenhouse gases (GHG). Traffic counts, in particular, decreased abruptly

beginning in March 2020 and have slowly been returning toward pre-COVID levels. This unique event provides an opportunity to use in situ data collected from GHG observing networks deployed across multiple cities to measure changes in GHG emissions related to the COVID-19 pandemic. We explore in situ observations of GHGs and data concerning human activity associated with GHG emissions across six cities. We explore different observational approaches to identifying the signature of the shutdown, including vertical gradients, eddy covariance fluxes, spatial enhancements in GHG mole fractions, and tracer ratios. We examine their behavior across time in 2020 and across multiple years, and the degree to which the COVID signature is complicated by temporal variations in meteorology and biological activity. We are working toward a multi-city description of the changes in GHG emissions caused by the shutdown. Our results demonstrate the methodological tools needed to extract the signature of this shutdown, and yield insights into the measurement networks required to quantify rapid temporal changes in emissions.

Israel Lopez Coto
Title: **East Coast Outflow (ECO) experiment during pandemic times**

Abstract:
On March 11 th , 2020, the World Health Organization (WHO) characterized the COVID-19 respiratory disease caused by the coronavirus (SARS-CoV-2) as a Pandemic due to “the alarming levels of spread and severity”. Shortly after, countries around the world started to declare forced or encouraged “stay at home” orders and many non-essential activities were stopped, reduced or performed remotely. The largest reduction in human activity in the large metropolitan areas along the east coast of the United States occurred during the months of April and May.
Two years prior, during April and May 2018, the intensive East Coast Outflow (ECO) airborne experiment was conducted to measure the outflow of CO_2, CH_4, CO and other gases from 5 major cities along the northeast corridor of the US (Washington, D.C., Baltimore, MD, Philadelphia, PA, New York, NY, and Boston, MA). The 2018 campaign provides a valuable point of comparison for a new experiment in 2020 and, thus, in April and May 2020, the ECO campaign was quickly deployed again and a series of flights were conducted to assess the impact of the reduction in human activity on air quality and greenhouse gas emissions.
In this work, a set of high resolution WRF simulations are conducted for both aircraft campaigns including a total of 30 passive tracers that allow us to simulate the concentration of CO2 , CO

and CH_4 using different emission inventories. We include source separation by inventory sectors, biogenic CO_2 fluxes as well as urban areas independently. Simulated tracer-tracer ratios are compared to those derived from the measurements and differences and similarities are discussed. In addition, emissions from the sampled urban areas are quantified based on several scaling approaches and compared between methods and between campaigns. Preliminary results and conclusions will be presented.