Shifting Patterns of Global Emissions and Ozone Chemical Regime Linked to Human Activity and Natural Processes using A Decadal Chemical Reanalysis

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Abstract

Changes in economic activity, emission controls, and climate change over the past several decades have led to substantial changes in anthropogenic emissions globally. However, the attribution to individual emission sources and chemical processes remains unclear due to the difficulty of combining multiple types of observations and the complex chemical mechanisms relating emissions to atmospheric concentrations. We have developed a state-of-the-art chemical data assimilation (DA) system to combine various satellite observations with chemistry transport models. This framework has successfully been applied to quantify emission changes and their impacts on ozone for the past decade by ingesting a suite of satellite measurements including those from Aura, Aqua, Terra, but a lack of information on pollutants that determine ozone chemical regime, aerosol formation, and oxidation capacity has been a key limitation for air quality and climate studies. This study extends this framework to utilize multi-sensor data from new generation satellites, including Suomi-NPP CrIS and VIIRS and Sentinel-5P TROPOMI and from long-term satellite data from the Aura and other satellites to characterize processes that form ozone, aerosols, and other pollutants in the atmosphere and attribute changes in their concentrations to short- and long-term variations in human and natural activity. By utilizing the new generation satellite data, we simultaneously optimize anthropogenic and biogenic emissions of NOx, SO2, VOCs, CO, and aerosols to provide an improved representation of global tropospheric profiles and to better represent driving mechanisms of decadal changes of various chemical species, their chemical regime, and the oxidative capacity. Recent applications of the extended chemical reanalysis, such as the impacts of COVID-19, wildfires, and decadal changes, will also be discussed to provide a greatly enhanced understanding of multi-year changes in air pollutants and their response to changes in emission efficiency and human activity.

Early Career Scientist

NO, I am not an early career scientist.

IGAC Activities

AMIGO: Analysis of eMIssions usinG Observations, TOAR: Tropospheric Ozone Assessment Report, GEIA: Global Emissions Initiative, MAP-AQ: Monitoring, Analysis and Prediction of Air Quality

IGAC Regional Working Groups

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