

## 5.039 Drivers of global chemical climate forcing 1990 - 2010.

Early Career Scientist

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Abstract:

In the last few decades, Earth's atmosphere has experienced large-scale changes in the concentrations and distributions of the short-lived climate pollutants (SLCPs) ozone, methane, and aerosols, driving an imbalance in Earth's radiation budget. The recent changes in atmospheric chemical composition are driven by a number of inter-related processes, including changes in: the distribution and magnitude of emissions of reactive precursor pollutants; global land cover; atmospheric CO<sub>2</sub> concentration; and physical climate. We apply multiple observational datasets and a global carbon-chemistry-climate model (NASA ModelE2-YIBs) to quantify the magnitude of recent SLCP concentration changes and the associated radiative forcing for each chemical species over the period 1990 - 2010. Attribution studies evaluate the contributions of the various drivers (precursor emissions, land cover, and climate) to chemical forcing. We additionally quantify the forcing induced by SLCP changes resulting from changes in dry deposition and biogenic volatile organic compound emissions driven by exposure of the biosphere to enhanced atmospheric CO<sub>2</sub> concentrations over this period. NASA ModelE2-YIBs features fully interactive gas and aerosol chemistry, an interactive land carbon cycle, and a BVOC emission algorithm in which isoprene production is biochemically linked to photosynthesis. Time-slice simulations are forced with monthly anthropogenic and biomass burning air pollution emissions from the MACCity inventory and nudged with large-scale winds from the NASA GMAO MERRA reanalysis dataset. The calculated global-average radiative forcing > 0.1 W/m<sup>2</sup> from changes in the SLCPs over the period 1990 - 2010 is approximately 25% of the magnitude of the forcing from CO<sub>2</sub> concentration change over this period and is primarily driven by changes in reactive anthropogenic precursor emissions. In the mid- to upper-troposphere, though, climate change has a larger influence on ozone concentrations than do emission changes. The simulated climate state and atmospheric chemical composition are evaluated using reanalysis data, MODIS AOD, and TES ozone concentrations.