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Poster
This project investigates the ability of satellite-based column CO2 observations, combined with prior knowledge of the temporal characteristics of emissions and the spatial distribution of infrastructure, to separate the atmospheric signals of distinct emissions sectors and detect sector-specific regional emissions trends. We focus on the eastern United States, a region that has experienced a sharp decrease in electric sector emissions in recent decades and has extensive power plant fuel consumption data available via the Energy Information Administration (EIA). We model the atmospheric signal of within-region power plant emissions and other fossil emissions, advected and globally mixed power plant and other fossil emissions, and biosphere fluxes over a study period of 2009 through 2018, tracing the movement of CO2 for each sector. These CO2 pseudo-data are sampled as column CO2. The rate of accumulation or depletion of atmospheric CO2 from each of these sources and sinks with respect to time over the study area represents the regional atmospheric signature of rates of emissions and advection. We quantify the unique trends, seasonal cycles, and meteorologically driven variability of these atmospheric signatures for total CO2 and for CO2 tracers associated with emissions from individual sectors. We determine whether a statistically significant trend in sectoral emissions, such as the trend that occurred in regional power plant emissions over the study period, corresponds to a statistically significant regional trend in the accumulation rate of column CO2 for the corresponding tracer, and if so, whether such a trend is detectable in the presence of other sources and sinks and advected CO2. Further, we assess tracer-specific spatial distributions that correspond to spatial patterns of infrastructure and how these geographical characteristics of column CO2 enhancement are obscured by meteorology at a fine temporal scale. More generally, we assess how the temporal frequency and spatial density of satellite-based column CO2 observations affect the ability to quantify trends at individual locations and spatial patterns over a region in the presence of meteorological variability.
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