1.057 Equatorward Redistribution of Emissions Dominates the Tropospheric Ozone Change, 1980-2010.

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Abstract:

Since 1980, global emissions of ozone precursors have shifted toward the equator as less industrialized nations have increased their emissions and industrialized mid-latitude nations have reduced emissions. Modeling studies have also shown that the global tropospheric ozone burden is much more sensitive to changes in emissions in the tropics than in the mid-latitudes. However, previous research has not previously quantified the importance of the historical change in emission location on the tropospheric ozone burden. Here we use global model simulations to separate changes in the global tropospheric ozone burden from 1980 to 2010 into components due to changes in: i.) the global spatial distribution of emissions, ii.) the total magnitude of global emissions, and iii.) the global methane concentration. Using the CAM-chem global atmospheric model, we show that the change in the spatial distribution of emissions is responsible for over half of the net ozone burden change from 1980 to 2010 – more than the effects of the global emission magnitude and the methane change combined. This greater sensitivity to tropical emissions is caused by the strong convection, fast photochemistry, and highly NOx-sensitive conditions in this region, despite the shorter lifetime of ozone. We present evidence suggesting that emissions increases from Southeast Asia, East Asia, and South Asia have been most important for this global ozone increase. The spatial distribution of emissions, particularly emissions from the tropics, dominate global ozone. Previous analyses may have put too much emphasis on emission magnitude and too little on emission location. For example, a continued equatorward shifting of emissions may cause global ozone to continue to increase even if global ozone precursor emissions decrease.