Decadal trend of ozone-NOx-VOC sensitivity over New York City: the view from space

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Abstract

Determining the most effective strategy for mitigating local surface ozone pollution requires knowledge of the relative ambient concentration of NO_x to VOCs in the air. Satellite observations of the tropospheric column ratio of HCHO (a marker of VOCs) to NO_2 (a marker of NO_x) have been used as an indicator to identify areas which would benefit from reducing NO_x emissions (NO_x-sensitive), and areas where reducing VOC emission leads to lower ozone (VOC-sensitive or NO_x-saturated). However, quantitative use of this indicator ratio is subject to three major uncertainties: 1) correlations between O_3 sensitivity and the indicator species may shift under different meteorological and photochemical conditions; 2) the ratio of the vertically integrated column may not represent the near-surface environment; 3) products retrieved from satellite instruments may contain errors. We use the GEOS-Chem global chemical transport model to evaluate the quantitative utility of FNR observed from the Ozone Monitoring Instrument (OMI). We find that FNR in the model surface layer is a robust predictor of the near-surface O_3 production regime. The extension of this surface-based predictor to a column value requires accounting for differences in HCHO and NO_2 vertical profiles. The space-based observation reveals earlier spring transition to NO_x-limited regimes New York City between 2005 and 2015. Increasing NO_x sensitivity implies that NO_x emission reductions will improve O_3 air quality more now than it would have a decade ago.