Can a satellite sensor detect lower tropospheric ozone responses to its precursor emission reductions?

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Surface ozone has detrimental effects on plants and human health and tropospheric ozone has green house effect. Production mechanism of ozone is highly non-linear and thus the response of emission reduction to ozone concentration is hard to understand. Satellite observation is a powerful tool to monitor the spatial and temporal variations of trace components, but it has been quite hard for tropospheric ozone due to the abundance of stratospheric ozone.

Hayashida et al. (2015) developed an algorithm to detect lower tropospheric ozone (0 - 3 km above surface level) by Ozone Monitoring Instrument (OM) of Earth Observing System (EOS) Aura and showed lower tropospheric ozone enhancement over the central part of China. The legitimacy to the method has been given by the comparisons with a global chemistry-climate model MRI-CCM2 and a cluster analysis, since then.

In this study, a regional meteorology chemistry model NHM-Chem has been applied to the simulation of tropospheric ozone over East Asia in June 2006 and compared with the observed ozone by OMI, in order to show whether the satellite observation can detect responses of surface and lower tropospheric ozone to the reductions in the precursor gases such as NOx and NMVOCs, even though the satellite observation of the lower tropospheric ozone is affected by ozone in the upper layers and is available on only sunny days. The reductions of precursor gases by 25%, 50%, and 90% caused 5-10%, 15-25%, and 30-50% decrease in the lower tropospheric ozone concentrations, and the responces are significant over 40%, 50%, and 60% of the East Asian regions for a two-sided 99% confidence interval, respectively.

Keywords: Lower troposheric ozone, Satellite observation, Regional meteorology-chemistry model, Emission control

