Sensitivity Analysis of Individual VOC Species to Reduction of Atmospheric Ozone

Kouhei Yamamoto¹, Kazuo Nakajima¹, and Hikari Shimadera²
1) Graduate School of Energy Science, Kyoto Univ., Japan
2) Center for Environmental Innovation Design for Sustainability, Osaka Univ., Japan

Outline

・The sensitivities of anthropogenic VOCs to the reduction of atmospheric ozone in Kinki area, Japan were investigated by using CMAQv5.0.1 with WRFv3.4.1.
・Emission inventories of precursors were introduced from JATOP (Japan AuTo-Oil Program), and MEGANv2.04 for biogenic sources.
・SAPRC-99 model was adopted in CMAQ for gas phase chemistry.
・The sensitivity analysis of VOCs to ozone reduction in the child domain was conducted by estimating the change rates (CRs) of ozone concentrations in case of using 20% reduced emission of each VOC species.
・Seven species of VOCs such as ALK3, ALK4, ARO1, ARO2, OLE2, ETHENE, HCHO were selected for sensitivity analysis, and the CR of each grid was sorted by values of each VOC concentration divided by NOx concentration.
・As remarkable decreases were shown in case of the reduction of former five species, the sum of five VOCs divided by NOx was proposed as a photochemical index for ozone reduction.
・The CRs under various ranges of ozone peak concentrations were estimated as a function of this developed index, and in the case that the index was below 0.2, the reduction rates were more prominent.

Model Domain

VOCs emission in Kinki area

CMAQ performance

Pre-estimation of ozone productivity P of VOCs

\[ P = \frac{(MIR_i \times VOC_i)}{\sum (MIR_i \times VOC_i)} \]

Sensitivity analysis of individual VOC to CR

\[ CR (\%) = \frac{100 \times (C_{reduced} - C_{original})}{C_{original}} \]

Availability of the index under various ranges of peak concentration

Acknowledgement

This work was supported by The Kyoto University Foundation