

Contribution of biogenic sources to secondary organic aerosol in summertime in Shaanxi, China

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Abstract: A revised Community Multi-scale Air Quality (CMAQ) model with updated secondary organic aerosol (SOA) yields and a more detailed description of SOA formation from isoprene (ISOP) oxidation was applied to study the spatial distribution of SOA, its components and precursors in Shaanxi in July of 2013.

The emissions of biogenic volatile organic compounds (BVOCs) as the CMAQ input were generated using Model of Emissions of Gases and Aerosols from Nature (MEGAN). Emissions of ISOP and monoterpene (MONO) mostly were the highest with 1.73×10^9 mol and 1.82×10^8 mol in July in total, respectively. The spatial distribution of BVOCs emission was significantly correlated with the vegetation coverage distribution in Shaanxi. ISOP and its intermediate semi-volatile gases were the highest among BVOCs in the ambient with highest concentrations of about 7.0 and 1.4 ppb, respectively, and formaldehyde from biogenic sources was up to ~3 ppb in South Shaanxi.

Predicted SOA was generally $2\text{--}6 \mu\text{g}/\text{m}^3$, of which biogenic SOA (BSOA) from biogenic source in the study region accounted for as high as 84% in average in Shaanxi. Three main BVOCs Precursors included ISOP (58%) and MONO (8%) emit in the studied domain, and ISOP transported from south China (9%). The Guanzhong Plain had the highest BSOA concentrations of $3\text{--}5 \mu\text{g}/\text{m}^3$, and the North Shaanxi had the lowest of $2\text{--}3 \mu\text{g}/\text{m}^3$. More than half of BSOA was due to reactive surface uptake of ISOP epoxide (IEPOX) ($0.2\text{--}0.7 \mu\text{g}/\text{m}^3$, ~19%), glyoxal (GLY) ($0.2\text{--}0.5 \mu\text{g}/\text{m}^3$, ~11%) and methylglyoxal (MGLY) ($0.4\text{--}1.4 \mu\text{g}/\text{m}^3$, ~32%), while the remaining was due to the traditional equilibrium partitioning of semi-volatile components (SEMI) ($0.1\text{--}1.2 \mu\text{g}/\text{m}^3$, ~25%) and oligomerization (0.2–0.4 $\mu\text{g}/\text{m}^3$, ~12%). Overall, SOA formed from ISOP (iSOA) contributed $1\text{--}3 \mu\text{g}/\text{m}^3$ (~80%) to BSOA, of which GLY and MGLY accounted for 13% and 39%, respectively.

Keywords: CMAQ, MEGAN, precursors, isoprene, BSOA

