2.094 The roles of volatile organic compound deposition and oxidation mechanisms in determining secondary organic aerosol production, a global perspective.

Early Career Scientist

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Abstract:

Secondary organic aerosol (SOA) is important from both air quality and climate perspectives, yet the processes governing SOA production remain uncertain. Across modelling studies, treatment of SOA precursor deposition and oxidation mechanisms both vary substantially. In this study, we quantify the role of VOC deposition and oxidation mechanisms on the global SOA budget using a global composition-climate model. Including dry deposition of VOCs reduces global SOA production by 2– 24 Tg (SOA) a^{-1} (2-32 %), with the range reflecting uncertainties in surface resistances. Including wet deposition of VOCs reduces global SOA production by 12 Tg (SOA) a^{-1} (15 %) and is relatively insensitive to changes in effective Henry's Law coefficient. The influence of oxidation mechanisms on SOA was explored by focussing on the anthropogenic and biomass burning VOC precursors of SOA ($VOC_{ANT/BB}$), which were varied in a) parent VOC reactivity, b) number of reaction intermediates, and c) accounting for differences in volatility between oxidation products from various pathways. The reactivity of VOC $_{ANT/BB}$ was varied across a series of compounds, including aromatic hydrocarbons and monoterpene. The number of reaction intermediates for $VOC_{ANT/BB}$ oxidation was increased by introducing the peroxy radical (RO_2). The difference in volatility between the products of competitive RO_2 reactions was accounted for by assigning different reaction yields to these pathways. We find that assuming the reactivity of monoterpene, undergoing a single step oxidation, and applying a single SOA yield, global SOA production form $VOC_{ANT/BB}$ is 18 Tg (SOA) a^{-1}. Assuming the reactivity of aromatic hydrocarbons, global $VOC_{ANT/BB}$ oxidation reduces by 3 – 66 % compared to when using monoterpene. Introducing RO_2 alone does not affect SOA production. However, by accounting for the difference in volatility between RO_2 oxidation products, global SOA production increases by a factor of 2.5, to 45 Tg (SOA) a^{-1}.