Understanding and constraining global secondary organic aerosol amount and size-resolved condensational behavior

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While many global models contain only biogenic sources of secondary organic aerosol (SOA), recent studies have shown that an additional source of SOA around 100 Tg yr^{-1} may be required to match measurements. Many models also treat SOA solely as semivolatile, which leads to condensation of SOA proportional to the aerosol mass distribution (MD); however, recent closure studies with field measurements show nucleation mode growth can be captured only if it is assumed that a significant fraction of SOA condenses proportional to the aerosol surface area (SA). This suggests a very low volatility of the condensing vapors. We explore the significance of these findings using the GEOS-Chem-TOMAS global aerosol microphysics model and global observations of aerosol size distributions. The change in the number concentration of particles of size $D_p > 40$ nm (N40) within the boundary layer (BL) assuming SA condensation compared to MD net condensation yielded a global increase of 11% but exceeded 100% in biogenically active regions. The percent change in N40 within the BL with the inclusion of the additional 100 Tg(SOA) yr^{-1} compared to the base simulation solely with biogenic SOA emissions both using SA condensation yielded a global increase of 14%, but exceeded 50% in regions with large anthropogenic emissions.