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Influence of dry deposition of semi-volatile organic compounds (VOC) on secondary organic aerosol (SOA) formation in the Mexico City plume

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The dry deposition removal of organic compounds from the atmosphere and its impact on organic aerosol mass is currently unexplored and unaccounted for in chemistry-climate models. The main reason for this omission is that current models use simplified SOA mechanisms that lump precursors and their products into volatility bins, therefore losing information on other important properties of individual molecules (or groups) that are needed to calculate dry deposition. In this study, we apply the Generator of Explicit Chemistry and Kinetics of Organics in the Atmosphere (GECKO-A) to simulate SOA formation and estimate the influence of dry deposition of VOCs on SOA concentrations downwind of Mexico City. SOA precursors considered here include short- and long-chain alkanes (C3-25), alkenes, and light aromatics.

The results suggest that 90% of SOA produced in Mexico City originates from the oxidation and partitioning of long-chain (C>12) alkanes, while the regionally exported SOA is almost equally produced from long-chain alkanes and from shorter alkanes and light aromatics. We show that dry deposition of oxidized gases is not an efficient sink for SOA, as it removes <5% of SOA within the city's boundary layer and ∼15% downwind. We discuss reasons for this limited influence, and investigate separately the impacts on short and long-chain species. We show that the dry deposition is competing with the uptake of gases to the aerosol phase, and because dry deposition of submicron aerosols is slow, condensation onto particles protects organic gases from deposition and therefore increases their atmospheric burden and lifetime. In the absence of this condensation, ∼50% of the regionally produced mass would have been dry-deposited.