SOA formation from anthropogenic and biogenic precursors: comparison to outdoor chamber experiments, effect of oligomerization and reactive uptake of aldehydes

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New parameterizations for the formation of organic aerosols have been developed. These parameterizations cover SOA formation from biogenic and anthropogenic precursors, NO_x dependency, oligomerization and the reactive uptake of pinonaldehyde. Those parameterizations are based on available experimental results.

The effect of those parameterizations are tested against various experiments carried out inside the outdoor chamber Euphore. Two datasets of experiments were used : the anthropogenic experiments (were SOA is formed from a mixture of toluene, 1,3,5-trimethylbenzene and oxylene) and the biogenic experiments (were SOA is formed from α-pinene and limonene). SOA formation inside the chamber was simulated by using the Secondary Organic Aerosol Processor (SOAP) model (Couvidat and Sartelet, 2015) to take into account the dynamic evolution of concentrations.

Satisfactory results were obtained for the biogenic experiments and most of the anthropogenic experiments. However, the anthropogenic experiments seem to indicate a complex NO_x dependency that could not be reproduced by the model.

The uptake of pinonaldehyde onto acidic aerosols is too slow to occur under atmospheric conditions but less volatile or more reactive aldehydes could react in acidic aerosols. Some 3D models use an equilibrium parameterization of the uptake of pinonaldehyde (Pun and Seigneur, 2007). The use of this parameterization leads to a significant overestimation of SOA concentrations from biogenic precursors as shown in Fig. 1.

Oligomerization was found to have a strong effect on SOA composition and could have a strong effect on the formation of SOA. Indeed, as shown in Fig. 2, oligomerization could under atmospheric conditions lead to a significant increase of the SOA mass after several hours of aging.

Couvidat, F. and Sartelet, K. (2015), *Geosci. Model Dev.*, **8**, 1111-1138.
Pun, B. and Seigneur, C. (2007), *Atmos. Chem. Phys.*, **7**, 2199-2216.

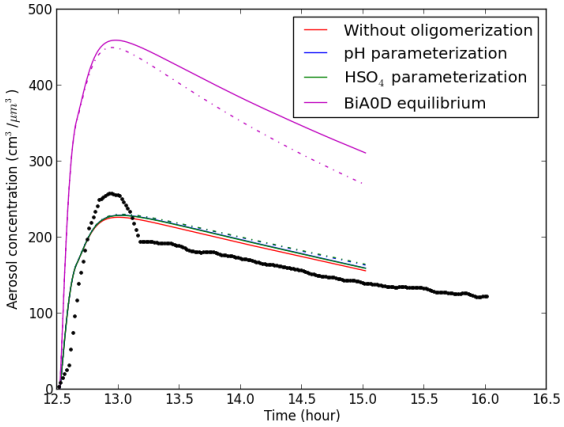

Figure 1: Aerosol concentration formation from the oxidation of several biogenic precursors with SO_2 with different assumption for the uptake of pinonaldehyde. BiA0D equilibrium refers to the parameterization of Pun and Seigneur (2006). The pH and HSO_4 paramerizations refer to the two parameterizations for the dynamic uptake of pinonaldehyde used in this study.

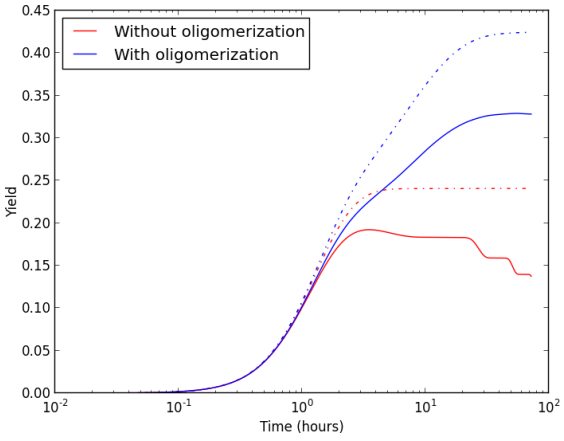

Figure 2: Evolution of the SOA yield from α-pinene oxidation as a function of time for an organic mass loading of 5 μg m^{-3} at RH=70%. Solid lines correspond to SOA formation with aging. Dashed lines correspond to SOA formation without aging.