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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Organic photolysis reactions in tropospheric aerosols: effect on secondary organic aerosol formation and lifetime" *by* A. Hodzic et al.

Anonymous Referee #1

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This is –as far as I can tell, not being a chemist– an excellent work on a difficult subject. The manuscript shows the importance of photolysis reactions (both gas-phase and in-particle) on the formation rate and lifetime of secondary organic aerosols. The manuscript combines nicely some box model calculations with a global chemistry model simulation. I think however that the authors need to improve the presentation and language if they want to be understood by non-chemist aerosol scientists. Below is a list of comments:

The conversion of lifetimes from permanent daylight conditions to equivalent summer or winter conditions is a little unclear (although I understand what the authors mean).

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There is no reason to mix 45° SZA and mid-latitude conditions as it is done in a number of places (eg line 10 in the abstract, line 7 on page 8120, or in caption of figure 1). Likewise on line 25 on page 8120, why mention the 45° SZA here? A solar zenith angle of 45° is a solar zenith angle of 45° and can occur at many latitudes. So I would simply say that the effects of J_{NO_2} for a SZA of 45° under permanent light conditions corresponds to (roughly) twice the effects of a varying J_{NO_2} in summer mid-latitude conditions. Or maybe the "mid-latitude conditions" correspond to something else than the SZA but that's not clear in the manuscript. It is required also to say how the equivalence was done (or in what sense it is an equivalence) and what the uncertainty on this equivalence is.

Some chemical terms and notations would benefit from being explicited. In particular the notation on line 21 page 8122 (and also in Fig 2) is not clear to me. Sorry if I sound stupid, but what does the H add to a K functional group that already has two R groups?

What is an activation value (line 10, page 8123)? Is this a dimensionless quantity?

It would be interesting to show what actinic wavelengths are involved. Can the effects of the photolysis (calculated here at pretty low concentrations) saturate with the amount of organics present in the atmosphere? or be amplified in the presence of aerosols and clouds? I would think that a figure showing the distribution and strengths of absorbed wavelengths would be useful to the reader.

In section 3.1 the whole discussion is in terms of formation rate, why not discuss the effects on concentrations as well?

In section 3.2 for the first approach, it seems to me that there is another assumption which is that radiation at actinic wavelengths penetrates through the particle and can induce photolysis in the whole volume of the particle. I think this is a different thing than the “caging” effects mentioned by the authors. This may not be a bad assumption for small accumulation mode particles, but may not be correct for the larger particles and the smaller wavelengths. I must say I am not sure of this though but it would be good to discuss it!

line 25, page 8124: do the authors mean “urban scale” or “urban conditions” here? or is it the time the air mass passes over a urban area that is relevant?

A mass absorption coefficient of 10 m^2g^{-1} is not credible for SOA, and even less so if all the absorption occurs between the 300–400 nm wavelength range. Values of 10 m^2g^{-1} are typical for black carbon with absorption throughout the solar spectrum.

I am not sure Eqn. 1 and 2 are consistent, the first one depends on J_{NO_2}, the second not. Or is one of the J_{NO_2} for normalized conditions in Eqn 1 but not the other one? What is the unit of the 0.4 value in Eqn 2?

Line 13 on page 8127: 1.2 must be 1.2% or what?

Line 14 on page 8128: is the lifetime of 20 days a summer equivalent one? or for continuous daylight conditions?

Table 1: the J_{NO_2} exposure in 1 day is a complicated term accompanied by a complicated footnote to say that it is the same quantity as in the previous column but in unit of day^{-1} instead of s^{-1}. Or am I missing something?

Figure 2: the sums of the C atom ratios in each plot is far from 1. Where is the rest of the C mass? How many SOA constituents in total?

Figure 4 is particularly unclear and the caption and the associated text calling Figure 4 did not help me at all. What is C^*? Why is volatility expressed in mass concentrations of SOA?

The caption of Figure 5 does not describe what is represented on the figure. The figure represents SOA concentration, not SOA formation, as a function of time, although I agree it tells something on SOA formation.

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On Figure 7, bottom panels, it should be Δ[SOA]/[SOA] rather than just Δ[SOA].

The figures are far too small and I had to zoom many times to be able to read them. I also noted that figures are not called in order in the text.

Interactive comment on Atmos. Chem. Phys. Discuss., 15, 8113, 2015.