

Interactive comment on “Uncertainty in aerosol hygroscopicity resulting from semi-volatile organic compounds” by Olivia Goulden et al.

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This short comment is the same as the RC2 and, therefore, has the same responses:

- 1) “As noted above, the concept of varying input parameters over likely ranges and determining the sensitivity of the resultant products (S_{max} , D_{min} , κ) to this is not foreign to most readers, so a terse explanation and tabulation of the ranges used would probably suffice. I would particularly recommend minimizing the discussion surrounding the core model (Sec. 3), where few new physical insights were produced.” A: The length of the paper has been reduced and hopefully addresses this point.
- 2) “I would particularly recommend minimizing the discussion surrounding the core model (Sec. 3), where few new physical insights were produced” A: We disagree that

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“few new physical insights were produced). The purpose of the involatile aerosol section is to try to demonstrate that the uncertainty in our model is similar to that in experiments with a view to justifying the suitability of our model to represent real-world problems. This is surely important for a model. Additionally, it is found that the uncertainty in κ when SVOCs are included is smaller than that of the involatile aerosol. This is, perhaps, an unexpected observation as noted by Reviewer 1 (“Page 13, line 313-315”) and can only be drawn if the involatile aerosol is studied in isolation. Hopefully the more concise wording of this section in response to the reviewers’ comments has addressed this issue.

3) there is too much discussion of the intermediate test cases (e.g. KnoCC) A: Large-scale models that include VOCs often only consider the condensed phase of the organics under subsaturated conditions (REF). These models effectively work with the KnoCC parameter, which only takes into account the condensed phase of organics at subsaturated conditions. KnoCC is not, therefore, an intermediate step but an important parameter in the discussion of how well current models may be representing the effect of SVOCs on cloud. An additional paragraph has been added to the introduction (lines 94-104) that discusses challenges and methods involved in different experimental and modelling methods.

3a) The presentation of the levoglucosan results should be strongly caveated, since the results are apparently contradictory to the general thrust of the paper. A: We do not believe the results for levoglucosan are contradictory. The effect of the SVOCs is clearly dependent on the composition of the involatile aerosol and the results for levoglucosan show this: producing a higher κ with SVOCs than without while the other 3 compounds have lower κ with SVOCs than without. Q: Clearly this is an extreme case where a very hygroscopic core is exposed to a relatively less hygroscopic SVOC and the final product is still an apparently easy to activate particle. A: We, also, do not believe that levoglucosan is an extreme case; it is quite a common compound to use in models and its hygroscopicity is not outside of the range of typical κ values

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that have been measured for other compounds (See Petters and Kreidenweis, 2007). It is also fairly hydrophobic, not “very hygroscopic”, we assume this is just a typo.

4) It appears to me that the authors recommend simply “adjusting” the hygroscopicity of well-characterized particle types upward to account for the SVOC/water co-condensation A: We are suggesting that the hygroscopicity can be adjusted to account for the co-condensation of SVOCs to produce similar numbers of CCN. We are not, however, suggesting that this be done “without regard for the amount or nature of the SVOC that the aerosols are likely to have been exposed to”. The results in this paper are only to illustrate typical trends in the hygroscopicity that might be expected and we do not suggest that the hygroscopicity of sodium chloride, for example, be replaced with a value of 2.1. Our method could be repeated with whatever SVOC properties and abundance is used in a particular model. Specifically, our method would be useful for models such as GLOMAP (Mann et al., 2010) that have no capacity to treat SVOCs. To include their effects would involve running multiple large-scale models to redefine the parameters used in GLOMAP. Our method, in contrast, could be carried out off-line and the modified hygroscopicities used in the existing GLOMAP model instead.

Mann, G.W. et al., 2010. Description and evaluation of GLOMAP-mode: a modal global aerosol microphysics model for the UKCA composition-climate model. *Geoscientific Model Development*, 3(2), pp.519–551. Available at: <http://www.geosci-model-dev.net/3/519/2010/>.

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