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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Simulating ultrafine particle formation in Europe using a regional CTM: contribution of primary emissions versus secondary formation to aerosol number concentrations" *by* C. Fountoukis et al.

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(1) *This manuscript simulates atmospheric aerosol formation over Europe using a regional modeling framework. The investigated research topic is very important, yet very few investigations like this have published before. As a result, I consider the paper very welcome to the scientific community. The paper itself is clearly written and easy to follow. The presented analysis appears scientifically sound, but it should be expanded a bit in order to get a better idea how robust the obtained results really are.*

We do appreciate the positive comments.

Major issues:

(2) *As the authors point out in section 2 (the top of page 13589), organic vapors do not assist the growth of <100 nm in the current model implementation. This is understandable considering the current complexities in simulating secondary organic aerosol formation. However, since organics probably do play an important role in ultrafine aerosol growth in many parts of Europe, the authors should bring out this thing in a bit concrete manner when discussing the results and their implications. The model evaluation is based only on comparing particle number concentration. The capability of the model to reproduce observed growth rate could be investigated as well, at least for the sites for which such information has been published in the literature. Such an analysis, if possible carry out based on model output information, would immediate give some hints whether "missing organic condensation" is a serious problem and where.*

This is a valid concern. As suggested, we have calculated predicted growth rates (from the model output, based on the method describe in Hirsikko et al. 2005) and compared with observed values that are reported in Manninen et al. 2010. We have added a new figure showing this comparison and a new section (new paragraph 5.2) discussing the results as well as the possible effect of limited organic condensation on the results. As expected, the model underpredicts the growth rates in all studied sites, most probably due to insufficient organic condensation in the model. This is now stated in the paper more clearly as suggested by the reviewer.

(3) *Concerning the sensitivity analysis, is there any possibility to investigate how sensitive the results are on the availability of condensable vapors (other than sulfuric acid)? For example, could one think of artificially enhancing the ultrafine particle growth rate by a certain factor to mimic what organics might do for these particles.*

We have performed a new sensitivity run to quantify the effect of organics condensation as suggested by the reviewer. The secondary OA contribution to the particle growth rate was artificially enhanced by assuming that a fraction of the new secondary organics has zero volatility. Enhancing the organics condensation resulted in an increase of N_{100} by 10 percent on average over the whole domain. However, during nucleation event days the predicted increase was larger. In Melpitz for example, where frequent nucleation events are predicted (and observed), N_{100} increased by 30 percent in this test. This was the largest increase predicted in N_{100} among the 7 sites studied. At the same the total OA concentration in the new simulation increased on average by approximately a factor of 1.7. Text has been added discussing the results in the new section 5.2 (second paragraph).

Minor/technical issues:

(4) *The kinetic approach (equation 2) was suggested already by McMurry and Friedlander (1979, Atmos. Environ., p 1635) and should therefore be cited here.*

We have added the reference to the original work.

(5) *Page 13597, lines 9-10: organics contributing to the growth of fresh particles are considered to be low-volatile rather than semi-volatile.*

Corrected.

References

Hirsikko, A., Laakso, L., Horrak, U., Aalto, P. P., Kerminen, V.-M., and Kulmala, M.: Annual and size dependent variation of growth rates and ion concentrations in boreal forest, Boreal Env. Res., 10, 357–369, 2005.

Manninen, H. E., Nieminen, T., Asmi, E., Gagne, S., Hakkinen, S., Lehtipalo, K., Aalto, P., Vana, M., Mirme, A., Mirme, S., Horrak, U., Plass-Dulmer, C., Stange, G., Kiss, G.,

Hoffer, A., Toro, N., Moerman, M., Henzing, B., de Leeuw, G., Brinkenberg, M., Kouvarakis, G. N., Bougiatioti, A., Mihalopoulos, N., O'Dowd, C., Ceburnis, D., Arneth, A., Svenningsson, B., Swietlicki, E., Tarozzi, L., Decesari, S., Facchini, M. C., Birmili,W., Sonntag, A., Wiedensohler, A., Boulon, J., Sellegri, K., Laj, P., Gysel, M., Bukowiecki, N.,Weingartner, E.,Wehrle, G., Laaksonen, A., Hamed, A., Joutsensaari, J., Petaja, T., Kerminen, V.-M., and Kulmala, M.: EUCAARI ion spectrometer measurements at 12 European sites – analysis of new particle formation events, Atmos. Chem. Phys., 10, 7907–7927, doi:10.5194/acp-10-7907-2010, 2010.

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