

Interactive comment on “Conceptual study on nucleation burst evolution in the convective boundary layer – Part I: Modelling approach” by O. Hellmuth

Anonymous Referee #1

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Conceptual study on nucleation burst evolution in the convective boundary layer - Part I: Modelling approach O. Hellmuth

First of all, the review part of the introduction is excellent. I really shows a good conversance to the topic. The whole set of four papers is good, even though a rather huge task for a referee (I apologize for my delayed comments).

Explanation for closures in pages 11416-11417 is very good as well.

Page 11415: add a reference to QUEST special issue in ACP

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Page 11418, beginning of section 2: I suggest the author could shortly describe the situation in boreal forest as well; see e.g. a recent article from 8 years continuous measurements:

S. Hyvönen, H. Junninen, L. Laakso, M. Dal Maso, T. Grönholm, B. Bonn, P. Keronen, P. Aalto, V. Hiltunen, T. Pohja, S. Launiainen, P. Hari, H. Mannila, M. Kulmala "A look at aerosol formation using data mining techniques " Atmos. Chem. Phys., 5, 3345-3356, 2005 In that article, also turbulence observations were analyzed by data-mining methods.

Pages 14124-25:

"Recently, Berndt et al. (2005) performed laboratory experiments on NPF, in which an 25 atmospheric pressure flow-tube was irradiated with ultraviolet light to produce H₂SO₄ in situ through reaction of OH with SO₂. Newly formed particles were observed for H₂SO₄ concentrations above 70E106 cm⁻³. For a temperature of 293 K, relative humidities ranging from 28-49.5% and NH₃ concentrations below 0.5 pptv, the authors ob-

served a nucleation rate of 0.3-0.4cm⁻³ s⁻¹ for a H₂SO₄ concentration of 107 cm⁻³ (particle size 3nm). This nucleation rate was found to be inline with the lower limit of the nucleation rates observed in the atmosphere. Because of the very low NH₃ concentration of 0.5 pptv in the flow tube compared to 100 to 10 000 pptv in the continental boundary layer, the authors called the substantial role of NH₃ in the nucleation process 5 into question. £From a comparison of the experimental nucleation rates with theoretical ones of Vehkamäki et al. (2002) and Napari et al. (2002a) the authors concluded that the H₂SO₄ concentration required for substantial binary nucleation is 1010 cm⁻³, i.e., which is far above the experimental values. In view of the very low NH₃ concentration, its influence onto nucleation was excluded. Hence, currently available binary 10 nucleation theories, ion-induced nucleation, as well ternary NH₃-influenced

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nucleation were excluded from explaining observed NPF. The power law dependency of nucleation rate on H₂SO₄ concentration, obtained by Berndt et al. (2005), is very similar to a kinetically controlled nucleation mechanism."

This section is quite difficult to follow: Could it be slightly rewritten?

In this first article, I would also like to see a section in which the author describe all tests carried out for this model. Conservation of mass, stability for small changes on initial values etc. This kind of large model can very easily contain smaller or bigger errors, and for that reason such testing is extremely important and worth of a sub-section. I don't think a comparison with observations (Paper II) is enough since the aim of the study is to explain the observations. If we have a model with e.g. numerical error which is able to explain the results, do we really have explained the observations? Simply, a short description of basic tests.

Unfortunately, I did not have time to scroll all equations trough for typos. I hope that the author uses some poor local students as a slave labour for that purpose.

Interactive comment on Atmos. Chem. Phys. Discuss., 5, 11413, 2005.

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