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Atmospheric Chemistry and Physics Discussions

Interactive comment on "On the roles of sulphuric acid and low-volatility organic vapours in the initial steps of atmospheric new particle formation" *by* P. Paasonen et al.

P. Paasonen et al.

pauli.paasonen@helsinki.fi

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Referee #2: This paper describes the model studies on predicting the formation rate of 2 nm particles by using activation and kinetic sulphuric acid nucleation mechanisms along with six other mechanisms involving a low volatility organic vapour which cannot yet be identified. The growth rates of particles from 2 to 4 nm in diameter were calculated from the measurements of gaseous H2SO4 and ultrafine particle size distributions performed in four different sites in Europe. The results showed that the most promising candidate compared with the measurements was the kinetic homomolecular nucleation of H2SO4 together with the heteromolecular homogeneous nucleation of

H2SO4 and organic vapour.

The study is scientifically sound, and nicely applies the measurements to model calculations,even though explicit values of low volatile organic vapour concentrations are missing. I can recommend publication in ACP. However, I have some points that should be addressed before publication.

My main comment concerns equation (2) where the growh rate of 2 to 4 nm particles due to H2SO4 is calculated. The authors have assumed that the observed concentration of H2SO4 ([H2SO4]det) is totally available for making the 2 nm particles grow to 4 nm sizes. Why the condensation sink of H2SO4 due to pre-exising particles has been eliminated? How much would the results change if the pre-existing particles are taken into account?

Response: The collision rate of vapour molecules with a particle is directly proportional to the concentration of the vapour molecules. The pre-existing particles act as a sink for the vapour molecules, here H2SO4, but do not change the relation between the actual vapour concentration and the growth of a specific particle population.

Referee #2: Other comments:

2.2.2 What is the time resolution of CIMS? Were all measurements performed at ground level?

Response: These details are going to be added to the manuscript.

Referee #2: 2.3. lines 15-17: " : : : and the concentrations of H2SO4 and other vapous condensing on sub 4 nm particles" should read : : :on 2-4 nm particles.

Response: The requested change is going to be made

Referee #2: 2.3.1 lines 9-13: please, clarify these two sentences.

Response: We will clarify these sentences.

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Referee #2: 2.3.2 line 14: assumption of density of 1200 kg/m3 needs a reference

Response: Reference will be added.

Referee #2: 2.3.4. line26: please, add a reference for parabolic differentiation algorithm whereas the lines 9-10 (2.4.2) give too elementary information and thus are not necessary

Response: The origin of the algorithm will be explained. Exact reference may not be available, but we will note that the fitting-method is a standard function provided by the Matlab program.

We feel that the example in lines 9-10 of page 20 is needed in order to clarify to the readers why we are looking for slope value one from the figures. We will modify the example in order to make it more easy to understand.

Referee #2: 3.1. lines 3-4: I assume that the 16and RH between the different sites, has been taken into account. However, the uncertainty due to the two CIMS instruments was as high as up to 50

Response: We will add to the discussion section a paragraph describing how the estimated worst case standard difference between the two CIMSs (50

Interactive comment on Atmos. Chem. Phys. Discuss., 10, 11795, 2010.