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.

Anonymous Referee #2

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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 growth 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-existing particles has been eliminated? How much would the results change if the pre-existing particles are taken into account?

Other comments:

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

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.

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

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

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

3.1. lines 3-4: I assume that the 16% variation in C(GR=1,H2SO4), due to temperature and 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%. How did you handle this in regard to C(GR=1,H2SO4)?

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