**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.

Anonymous Referee #2

Received and published: 12 July 2012

Review of "Simulating ultrafine particle formation in Europe using a regional CTM: Contribution of primary emissions versus secondary formation of aerosol number contration," by C. Fountoukis et al., submitted to APCD.

This paper discusses a modeling study of aerosol particle formation and evolution with a sectional 3-D model. The paper is generally well written and has important new information. Below are some requested edits and calculations.

Introduction. Mention that secondary particles also form by in cloud processing of

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aerosols followed by cloud drop evaporation, releasing a modified aerosol.

P. 13588. "...assuming a density of 1.4 g/cm3." Is this a constant density assumed for all particles of all sizes and for all times? What about when soil dust particles are present in larger size bins?

P. 13588. "For the integration of the differential equations during nucleation..." Does this mean that nucleation is operator split from condensation? If so, please state explicitly.

P. 13588. "Condensation of ammonia..." Ammonia is more likely to dissolve in solution than condense. Is its dissolution treated? What about crystallization to ammonium nitrate or ammonium sulfate?

P. 13588. "We limit the ammonia condensation flux in each time step to prevent condensing more than what is available..." Shouldn't the flux also be constrained by the pH of solution in drops of each size, which itself is a function of all other acids and the condense or dissolve (e.g., Jacobson, Aerosol Science, and Technology 39, 92-103, 2005). Even if this is not included, it would be useful to clarify what the ammonium concentration in solution is a function of.

P. 13592. "The first two days of each simulation were excluded..." Did you check whether results from the first two days are really inaccurate compared with other days or were they just automatically excluded? I would suggest to check whether there really was much error.

P. 13597. What was the operator-splitting time step used and what was the order of calculation?

P. 13597. Since the authors are operator splitting nucleation and growth, I think it is important to do the following two sensitivity tests:

1) Solve condensation before rather than after nucleation each time step to see whether the depletion of sulfuric acid (and ammonia) during condensation reduces the nucle-

ation rate. 2) Reduce the operator-split time step between nucleation and condensation to see whether increased competition reduces the nucleation rate.

Table 2. Use the same number of significant digits for the model and observations.