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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Efficiency of cloud condensation nuclei formation from ultrafine particles" *by* J. R. Pierce and P. J. Adams

Anonymous Referee #1

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This clear and well-written paper presents a new model (PUG), developed in order to predict probabilities for ultrafine particles to grow to CCN size. In addition to presenting the model features, the example calculations address two intresting questions regarding CCN formation: 1) What is the effect of emissions uncertainties? and 2) Can one single moment of the size distribution used to predict CCN concentrations? The paper is definitely interesting to the atmospheric research community and deserves publication, after some points are addressed in more detail.

Major comments: 1) As the authors explain, coagulation may be an important growth mechanism in polluted conditions. I am worried that the 'book-keeping-procedure' presented (eq. 2, page 10997) might be inaccurate (or even incorrect?). If one wishes to determine the growth rate at a certain size of a coagulating aerosol, is it enough to

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look at the collisions at that size with all smaller particles? Did the authors check this method with a case in which coagulation dominates (or, causes all) growth, by using their more detailed model?

Minor comments: 2) In the beginnig of section 3, it is stated that a constant background is assumed. This might be severe in some cases, since growth to CCN size can take a while. In addition, loss to background is very sensitive to the background distribution. Were any test simulations done with a varying background? (with TOMAS?)

3) Based on the paper, it remains unclear, if PUG is intended to be used as a 'separate' tool for quick estimation purposes or can it be implemented into a larger code to speed up things etc. Please clarify.

4) Equation 4 is by no means straightforward. Please derive or explain. (Growth and scavenging is expected to result in exponentially decaying concentrations, why is this not visible in eq. 4?)

5) On page 11004, when discussing the differences in PUG and TOMAS results, it is stated that the differences are only from initial distributions. Is this really true? Does this also apply to cases in which coagulation dominates growth?

6) In fig. 4, is loss of number by self-coagulation taken into account?

7) In fig. 4, 'mass doubling lifetime' is given as a varible. This should be made more clear by giving some examples of e.g. corresponding growth rates (in nm/h).

8) On page 11006, it is stated that a single size distribution shape is used. What is this shape?

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6, S5785–S5786, 2006

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