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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol decadal trends – Part 2: In-situ aerosol particle number concentrations at GAW and ACTRIS stations" *by* A. Asmi et al.

Anonymous Referee #2

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The paper analyses trends in aerosol particle number concentrations over the period 2001 to 2010. The potential for different processes to explain the observed trends are explored. This paper represents one of the first attempts to quantify long term (10 yr) trends in particle number concentrations and makes an important contribution to understanding trends in aerosol. The generated datasets will be a valuable resource to the community. I recommend publication after the following minor issues have been addressed.

Minor points

P20878, L10-14. Please clarify what is meant by "negative effects".

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P20870. I think this section (4.4) is a useful exploration of some of the possible drivers of the observed trends. As the authors concede a full exploration would require a detailed global aerosol model which beyond the scope of this work. However, I think some of the potential drivers are more complicated than suggested by the authors. For example, it is not always obvious to me in which direction the drivers will push the system. I have highlighted some potential complexities below which I think deserve some discussion.

P20870. It might be useful to discuss in the context of Tai et al. (2012) who used long-term PM observations to help understand the meteorological variables driving aerosol mass.

P20871, L5. I think it would be the trend in nucleation rate (not N) that would be dependent on temperature. Previous work has demonstrated that sensitivity to N is less than the sensitivity to nucleation rate, suggesting a reduced sensitivity of N to temperature.

P20871, L20. It is possible that interactions between T, BVOC and aerosol number may be more complicated than suggested here. The impact of changes to BVOCs on aerosol number will depend on the role of these compounds in controlling particle growth rates and particle formation. If oxidation products of BVOCs do play a role in atmospheric nucleation (e.g., Metzger et al., 2010) then the sensitivity between BVOC and N should be greater. In contrast, increases in BVOC and biogenic SOA will act to increase the condensation sink which would act to suppress nucleation. This would result in an opposite relationship to that suggested in the paper. Therefore it is not clear to me whether increasing BVOC should lead to increased aerosol number. A short discussion on these points might be useful.

P20872, L16. Please re-word this sentence.

P20872, L21. Precipitation will mostly remove larger particles, so an increase in precipitation could lead to reduced condensation sink, increased nucleation and an increase

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in particle number (N). Please dicuss.

P20871, L5. What is the spatial resolution of these datasets? Did you apply some spatial averaging as done for emissions?

P20873, L21-L23. Please explain the statement “quantitative agreement in the trends between FT temperature and N is evident”. Do you mean qualitative agreement?

References

Metzger, A. et al. PNAS, 2010

Tai et al. Atmos. Chem. Phys., 12, 3131–3145, 2012.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 20849, 2012.