Review ACPD – MS No.: acp-2012-586 Asmi et al.

Report: Journal: Atmospheric Chemistry and Physics (ACP)
Title: Aerosol decadal trends (II): In-situ number concentrations at GAW and ACTRIS stations
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MS No.: acp-2012-586, MS Type: Research Article

1) Scientific Significance: Excellent
2) Scientific Quality: Excellent
3) Presentation Quality: Excellent
   For final publication, I consider that the manuscript could be accepted in its present form.

General comments:

The manuscript shows a consistent analysis of aerosol number concentration trends in the decade of 2001-2010 in sites located in Europe, North America, Antarctica, and Pacific Ocean islands. The method used for the calculation of trends and confidence intervals is appropriated and well described. The discussion about the possible drivers of aerosol number concentration trends is very interesting and supported by reasonable arguments. The paper clearly shows the importance of long term time series of aerosol measurements to better investigate trends, drivers and possible impacts on climate and air quality. The statistical treatment with generalized least squares (GLS) and autoregressive bootstrap (ARB) estimation of confidence intervals is excellent, because it do not require an assumption of the distribution. There is no discussion on comparing the observed trends with AERONET or MODIS AOD or with global models trends. They would certainly enhance the manuscript. In a certain sense, the manuscript is a bit too much particle number centric, but a broader approach would be nice to enhance the discussion in the final part of the manuscript. They left most of the discussions to the companion paper, but we feel a bit that the discussion could be enhanced a bit in this manuscript.

I recommend publication on ACP after the observation of the following minor editorial issues:

1) Page 20851, Line 21: provide a more recent reference for decreased visibility associated with aerosol number concentration. For example, you could refer to one of the several studies conducted under the scope of the US Interagency Monitoring of Protected Visual Environments (IMPROVE) like BRAVO and MOHAVE.
2) Page 20852, Line 3: sounds better if you omit the word “more”.
3) Page 20853, Lines 2-3: the sentence “Numerous and highly variable nano-particles with diameters less than approximately 50nm do not act as CCN” is misleading, since it gives the impression that nano-particles do not have any impact on CCN formation or on climate. In the following paragraph you clearly explained that these particles may act as CCN if the grow. So I suggest you rephrase the refereed sentence.
4) Page 20853, Line 11: the sentence “Such growth does not directly affect the particle number concentration total” is not strictly correct, since growth by coagulation affects the aerosol particle number concentration.
5) Page 20854, Line 23: I suggest you add the term “mass concentration” after “particulate matter (PM)”
6) Page 20855, Line 4: suppress "or optical", since optical properties is enclosed into "physical properties"
7) Page 20867, Line 13: in all available datasets BUT PAL.