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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Aerosol decadal trends – Part 1: In-situ optical measurements at GAW and IMPROVE stations" *by* M. Collaud Coen et al.

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The manuscript presents results from a long-term (~8-18yr,site-dependent) trend analysis of near-surface insitu-measured aerosol visible light scattering from 24 monitoring sites with well-established measurement protocols developed by NOAA, EMEP, and IMPROVE. Trends (or lack thereof) in the hemispheric backscatter fraction and scattering angstrom exponent (proxies for particle size distribution) are also reported for some sites and aerosol visible light absorption coefficient trends are reported for the limited number of sites measuring absorption. A majority of these sites (17) are in the U.S., with five in Europe. The sites provide a nice mix of lower/higher elevation sites and continental/marine sites. Due to differing program objectives, the IMPROVE sites measure light scattering at ambient RH while the NOAA and EMAP sites measure at lower

RH (<50%). The different RH sampling conditions sometimes make for difficult comparisons of the scattering data (particularly for sites located in humid regions) but the authors do a nice job of stating the methods and the assumptions used in the analysis, along with degree to which scattering measurements made using the two protocols are comparable.

The manuscript partially fills a critical need for long term trend analysis of key aerosol radiative properties with enough spatial and temporal coverage to examine the seasonal and regional variability in the observed trends in lower tropospheric light scattering, and to a lesser degree, trends in particle size information. In this respect, the study is unprecedented. As scattering can serve as a proxy for aerosol loading in most regions, the study also provides the basis for comparisons with trend studies of column-integrated extinction and angstrom exponent based on AERONET data (Yoon, 2012 and others) and near-surface mass loading (Murphy, 2011). The authors do an excellent job of summarizing their trend analysis and placing it in the context of results from other trend analyses, including the Yoon and Murphy works. Their statistical approach also appears to be very sound and is well explained, although I am not qualified to critically evaluate the use of these statistical techniques. Their conclusions are well laid-out and are consistent with the data presented. The one limitation of the study (in my opinion) is due to the lack of participating sites currently possessing long-term data sets of spectral absorption coefficient. This is especially true in the continental U.S. where only the Bondville, IL and Trinidad Head, CA sites measured both scattering and absorption (neglecting SGP, whose absorption measurements were not included). The lack of spatial coverage for the absorption measurements negates a unique advantage that the NOAA and EMEP networks have over other networks such as AERONET, namely near-continuous direct measurements of single-scattering albedo (and absorption angstrom exponent) under low-loading conditions. Such information would have been particularly useful in studying the western U.S. and other regions influenced by dust and biomass burning, whose scattering trends alone were sometimes difficult to interpret. Future studies should be somewhat stronger in this regard (although still

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somewhat limited spatially), as some of the newer NOAA North American sites (EGB , APP, others) employing both spectral light scattering and absorption measurements accumulate sufficiently long data sets for inclusion in the trend analysis. To their credit, the authors do point out this limitation.

The overall presentation is well-structured and reasonably clear. It could possibly benefit from a final author read-over to fine-tune the sentence structure in certain places but the manuscript is certainly publishable in its current form. I found only one passage that I believe should be fixed:

Page 20804: Lines 10-20 state that "There was no consistent trend in scattering for the five sites located in the arid, southwestern state of Arizona (HGC, SCN, IBB, PAZ, and SIA). Decreasing trends were found for the two sites in Southern Arizona (SIA and PAZ) for all methods. . .. . "

I believe that the first sentence should read "There was no consistent trend in scattering for the five sites located in the arid, southwestern part of the state of Arizona. . ...", as you otherwise are contradicting your first statement in the remainder of the paragraph. The paragraph should be fixed to avoid this contradiction, regardless of my correctness in interpreting the first line.

Overall, I believe that the manuscript is very well-written, timely, and employs sound methods that are clearly laid out. I recommend it for publishing, after improving the clarity of the passage on page 20804.

Interactive comment on Atmos. Chem. Phys. Discuss., 12, 20785, 2012.