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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Multidecadal trend analysis of aerosol radiative properties at a global scale" *by* Martine Collaud Coen et al.

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This manuscript gives a thorough and comprehensive overview of the long term measurements of aerosols optical- and physical properties. The analysis is robust with a thorough screening of the data for inconsistencies, evaluation of the QA/QC done and comparing different statistical tool. It gives confident in the assessment. I have some comments, which you may take into account:

P7, line 35. Why are the trends based on daily medians and not mean? It would have been nice to include a sentence of the choice of aggregation.

Page 11. If as stated in line 39 that the TFPW rejection rate is too high, why is the criteria as stated in line 35 significant trend considered only when both PW procedures

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gave ss?

Page 11 line 49. What does it actually mean that the seasons are homogeneous?

Figure 2. Spelling mistake in caption. RMN should be MRN

Page 12. Line 40. GLS/ARB trends for MLO: "the longer periods exhibit ss negative trends". Should read positive trends if to be similar as MK, and it also looks like positive trends in Figure 3.

Figure 3. The fitted curves are for the longest periods I assume, (small) different fit for shorter periods?

Figure 4. ALT is missing on the map. The site is present in Figure 5.

P 12, L 43-45. If the seasonality fit is better using daily median compared to the GLS/ARB data, why not also use daily data for the LMS analysis. That would make all three methods more comparable to the data used in the MK test?

P13, 42-44. The paragraph of MLO seems a bit station specific, while the rest of the bullet point represent regions. Maybe add a sentence that this site represents the Pacific as in table 4 and then maybe include CGO?

P14, line 18. GLR does not turn up as ss positive in Figure 12 or 4, though in Table 2

P14, lin20. “PM10 trends are five times larger than PM1”, maybe rewrite to “scattering trends of PM10 aerosols are five times larger than PM1”. Do not find separate results for the different size cut off. Could they be included in Table 2 and Figure 12? And maybe indicate which size are chosen for Figure 4 and 5?

P14 line 27-31. Do not understand the possible “enhanced” NPF. The references only describes that you may have more NPF at high altitudes but not the possible trends. If the NPF should mask the trend we would expect more NPF in present day than earlier, or?

P14 line 43. Not only ALT with positive trend, also NMY.

P15 line 8. WLG show negative trend in Figure 6, Table 2 and Figure 13.

P15 line 11-12. NMY (and ALT) show positive trend

Figure 6. Seems like several of the sites miss information (outside circles) of longer trends than the last 10 years. I.e. JFJ, FKL, IPR, UGR etc.

There are two Figure S7. The first with backscatter trend should maybe be in the paper?

P15, line 33. Not sure about "Mostly decreasing". The mean trend is decreasing maybe (Table 4), but only 1 site with ss negative trend (SGP)

P16 line 9-10. Why not mentioned that the polar sites ALT and ZEP show positive trends?

Chapter 3.2. When I read chapter 3.1, I used the Figures developed for 3.2 since they are connected and give a more complete picture. Think the presentation of trend results would have benefited to combine these chapters.

P17 line 36. I don't find the trends in Figure 12 that much scattered, and I am not sure if one can track the differences back to abatement strategies. The UGR site is urban and influence by Saharan dust and is not representative for detecting general trends in Europe. The increase in SMR the latter periods might be do to increase emissions of BVOCs from the boreal forest? The trends in observed and modelled chemical composition in Europe are non linear due to changes in atmospheric chemistry. Maybe refer to some model/observation studies Europe trends for comparison. E.g:

Banzhaf, S., Schaap, M., Kranenburg, R., Manders, A. M. M., Segers, A. J., Visschedijk, A. J. H., Denier van der Gon, H. A. C., Kuenen, J. J. P., van Meijgaard, E., van Ulft, L. H., Cofala, J., and Builtjes, P. J. H.: Dynamic model evaluation for secondary inorganic aerosol and its precursors over Europe between 1990 and 2009, Geosci.

Model Dev., 8, 1047–1070, https://doi.org/10.5194/gmd-8-1047-2015, 2015.

Ciarelli, G., Theobald, M. R., Vivanco, M. G., Beekmann, M., Aas, W., Andersson, C., Bergström, R., Manders-Groot, A., Couvidat, F., Mircea, M., Tsyro, S., Fagerli, H., Mar, K., Raffort, V., Roustan, Y., Pay, M.-T., Schaap, M., Kranenburg, R., Adani, M., Briganti, G., Cappelletti, A., D'Isidoro, M., Cuvelier, C., Cholakian, A., Bessagnet, B., Wind, P., and Colette, A.: Trends of inorganic and organic aerosols and precursor gases in Europe: insights from the EURODELTA multi-model experiment over the 1990–2010 period, Geosci. Model Dev., 12, 4923–4954, https://doi.org/10.5194/gmd-12-4923-2019, 2019.

P26 line 26. Does it have to be anthropogenic sources? Changes in natural sources, typically BVOC may contribute? May a change in atmospheric composition contribute to smaller aerosols, i.e. less sulfate aerosols and more ammonium nitrate which potentially might be smaller?

P22 line 46- Bodhain and Dutton, 1993 is a quite old reference, maybe add e.g. Hand et al 2012 for a longer trend analysis for especially sulfate. Further, one should probably mention that the in Asia the decrease started rapidly after 2013 when the China's Clean Air Action was implemented. Maybe add Paulot et al (2018), which gives a nice global overview of trends using satellites and models

Hand, J. L., Schichtel, B. A., Malm, W. C., and Pitchford, M. L.: Particulate sulfate ion concentration and SO2 emission trends in the United States from the early 1990s through 2010, Atmos. Chem. Phys., 12, 10353–10365, https://doi.org/10.5194/acp-12-10353-2012, 2012.

Paulot, F., Paynter, D., Ginoux, P., Naik, V., and Horowitz, L. W.: Changes in the aerosol direct radiative forcing from 2001 to 2015: observational constraints and regional mechanisms, Atmos. Chem. Phys., 18, 13265–13281, https://doi.org/10.5194/acp-18-13265-2018, 2018.

P23. Line 49 Pandolfi et al (2016) only show PM trends in NE Spain. There are several other national PM trend studies in Europe (e.g. Germany, France, Switzerland). For a complete overview of Europa it is possible to refer to EMEP TFMM assessment report showing PM trends from both EMEP and AIRBASE for 2002-2012: Colette et al 2016: https://projects.nilu.no//ccc/reports/cccr1-2016.pdf (chapter 3.6.1)

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