Atmospheric Chemistry and Physics Discussions

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Comment on acp-2021-505

Anonymous Referee #1

Referee comment on "Atmospheric composition in the European Arctic and 30 years of the Zeppelin Observatory, Ny-Ålesund" by Stephen M. Platt et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2021-505-RC1, 2021

This is a comprehensive overview on measurements conducted in the Zeppelin observatory during the past 30 years. The text is longish, which is understandable and acceptable for this kind of a paper. While the manuscript can be considered well-structured in general, its technical quality is somewhat mixed. The paper has a well-written introduction (section 1), an interesting historical overview (section 2), and proper descriptions of both observatory and related measurements (sections 3 and 4). Overview of the obtained results (section 5) has several scientific problems, as outlined below in more detail, and these problems need to be fixed before the paper can be accepted for publication. Concerning section 6, I am not fully in favor of putting strategic/political (section 6.1) and scientific (sections 6.2 and 6.3) aims side by side, but it is up to the editor to decide whether this requires some restructuring of the text.

Scientific issues related to sections 5 and 6

Section 5.1.

I do not understand the first statement of section 5.1 (lines 652-653). Based on figure 6, it is impossible to see whether OC and EC resemble each other at any time (their concentrations levels certainly do not, and resemblance of concentrations ratios is also questionable). Overall, I do not see how Figure 6 could tell anything about the similarities in OC and EC source regions.

The statement on lines 575-677 is unclear. I suppose that the authors mean that the CF conversion factor typical for aged aerosols should be applicable for Zeppelin because of its remote location from main sources. The wording (complies well with) gives an impression that this thing has somehow confirmed for Zeppelin.

Russian is a very large territory. Do the authors have more detailed information on the main source areas for high sulfur episodes, e.g. the Kola Peninsula area discussed a lot in previous literature?

When discussing about past trends of inorganic ion concentrations in atmospheric aerosols (lines 686-696), I wonder why the authors refer to targeted emission reductions during 1990-2010, not the real emission reduction that took place. Data on actual emission reductions during that period is certainly available.

Section 5.2.

This section is about aerosol physical and optical properties (the word optical could be included into the title), so why do the author start the section by mentioning CCN and cloud properties which are not discussed at all in this section?

lines 702-704: The authors assume implicitly here that the particle size is some sort of proxy for its ageing. This is probably true but should be explained for readers not familiar with combined effects of aerosol sources and aerosol dynamics taking place during atmospheric transportation.

Please explain in more detail what is meant by “light period” and “summer” (lines 710 and 711), and whether “sunlit period” (line 724) means something else.

The discussion about aerosol optical properties is vague (lines 732-745). The authors try to relate changes in optical properties to those in particle concentrations (number or mass, not explained?), but the relevance or purpose of this exercise has not been explained. I do not understand what the authors mean be stating the particle concentrations increase through the year (line 740). This whole paragraph needs to be re-written.

The discussion on lines 755-764 is rather general and appears to be loosely connected

with other contents of section 5.2.

Section 5.3

What is the point of bringing up CO2 concentration in 2019 and its increase from the previous year? The CO2 increase is a well-known fact, while its annual increase rate varies from year to year. Data from one single year provide little insight on this matter (lines 766-768).

What is the basis for stating that the CO2 concentration increase rata is exponential? (line 769)

line 793: any explanation for the stated pause of CH4 mixing ratio?

There is repetition of text between the lines 838-844 and lines 858-869. Also figure 12 appears twice in the paper.

Section 5.6: Based on measurements of just one site in Arctic and one site outside Arctic, it is impossible to make any general statement about differences between Article areas and those outside Arctic (lines 992-994).

Section 6.2: There is much new scientific work and findings on arctic amplification and related issues that seem to be missing in the introductory part of this section (lines 1204-1212).

Section 6.3, lines 1325-1326: I do not think statements like this should be included when discussing future aspects of research.

Technical and minor scientific issues

line 227: something is missing from here (e.g. … during 1971 to 1980)

line 435: INP should be in parenthesis

line 440 (and later line 765): The term "climate gases" is not commonly in use. Please consider modifying the titles.

line 711: Figure 8 does not tell anything about nucleation and particle growth, so it should not be referred to here but later in the text.

line 795: is it possible to measure the CH4 concentration with a 5-digit accuracy?

line 801: an increase from 28 to 32 is not consistent with 25% increase.

lines 811 and 815: suggest à suggested

line 1008: MC or MCM?

lines 1013-1014: it is enough to explain GEM one time.

line 1037: … Asia, including China, contribute…

line 1092 vs. line 1143: please use only a single term for LOE (episodes of very low ozone vs. low ozone episodes).

lines 1119-1121: Unclear sentence, please modify.

lines 1166-1168: the first sentence of section 6 is unclear. Please re-write.

line 1184: please correct the grammar (that need study)

line 1125: a paper in preparation is not a proper reference.

line 1316: please correct the grammar (will need study)

lines 1332 and 1334: CEAC or CEC?

lines 1363-1364: unclear sentence, please modify

Some of the figures (figs. 13, 14 and 20) are of poor technical quality.

Figures 12 and 18 appear twice in the text.