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Atmospheric Chemistry and Physics Discussions

Interactive comment on "From a polar to a marine environment: has the changing Arctic led to a shift in aerosol light scattering properties?" *by* Dominic Heslin-Rees et al.

Anonymous Referee #1

Received and published: 14 July 2020

Summary:

The analysis outlined in this manuscript utilizes long-term (17 year) aerosol measurements from Zeppelin observatory in Svalbard, Norway to explore if observed climate changes in the Arctic are apparent in characteristics of the aerosol population. Trends in aerosol light scattering, backscattering, scattering Ångström exponent, and hemispheric backscattering fraction are computed. The authors find a statistically significant increase in aerosol light scattering coefficient at wavelength 550nm and a decrease in scattering Ångström exponent at wavelengths 450 and 550nm, indicating a shift to more coarse-mode aerosol. The conclusion is that the observatory is measuring more

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Discussion paper

coarse mode aerosol, sea salt in particular, due to shifts in winds bringing more air masses from the southwest (as opposed to influence of melting sea ice).

General Comments:

This manuscript presents an important scientific analysis of aerosols at one Arctic monitoring station, the results of which are well within the scope of ACP. The quality of the scientific methods are clear- the approach is methodical and thorough, exploring multiple physical mechanisms that could explain the trends in aerosol data. Results and supporting evidence are convincing and communicated efficiently. The manuscript is very well written; I found very few technical corrections.

Specific Comments:

In abstract: The sentence "The scattering Ångström exponent and the particle light scattering coefficient exhibit statistically significant decreasing of between -4.9 and -6.3 % per year (using wavelengths of λ = 450 and 550 nm) and increasing trends of between 2.3 and 2.9 % per year (at a wavelength of λ = 550 nm), respectively" is easy to misinterpret. It took much too long to decipher what was being communicated. Considering clarifying the sentence with a simple change like this: "The scattering Ångström exponent exhibits statistically significant decreasing of between -4.9 and -6.3 % per year (using wavelengths of λ = 450 and 550 nm), while the particle light scattering coefficient exhibits statistically significant increasing trends of between 2.3 and 2.9 % per year (at a wavelength of λ = 550 nm)."

In methods section: Please include temporal resolution of the sampling from the nephelometer. Page 5, Line 150 mentions that 5 data points are used to compute hourly medians, but it is not clear what percentage of the total hourly data points that is.

Page 6, Line 166: Is there a large diurnal cycle in aerosol properties at ZEP? When computing long-term trends, is it important that that diurnal cycle is obscured by using daily medians? In other words, do you have any reason to suspect the long-term trends

in daytime vs. nighttime (or maxima vs. minima) aerosol properties look different?

Figure 2 (& Figure 4): What is the pink bar surrounding the 'all seasons' bars? If it is just to set apart the all seasons from the other seasons, it is a bit misleading on the bar plot because it looks like it is a bar representing data- I looked for a legend or explanation for the pink bars for a while. Maybe just a black line separating the 'all seasons' from the other seasons would be sufficient. Or simply specifying what the pink shading is in the caption would be helpful for the reader.

Page 11, Line 277: What happens if a back trajectory crosses multiple specified regions (SE, SW, NW, NE), as I'm sure happens quite often? How is it classified? Is it classified by where the back trajectory originated, or by the sector from which it directly approached the station immediately before arrival? It might be good to clarify this in the methods section when discussing the back trajectory region definitions.

Technical Corrections:

Page 2, Line 33: 'report' should be 'reports' (since the Panel is singular)

Page 3, Line 71: add 'respectively' after 'wavelengths λ1 and λ2.'

Page 5, Line 140: remove ',' after 'Approximately'

Page 6, Line 157: 'studies often use a constant' threshold

Page 6, Line 158: add units after σsp > 1 (Mm-1)

Page 7, Line 204: remove '-' after (Jones et al., 2001)

Page 13, Line 310: Remove the first 'that' in 'It is noticeable that in Fig. 6b that the'

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