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Atmospheric Measurement Techniques Discussions

Interactive comment on "Interannual and seasonal variations in aerosol optical depth of the atmosphere in two regions of Spitsbergen Archipelago (2002–2018)" *by* Dmitry M. Kabanov et al.

Anonymous Referee #1

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General comments

The manuscript "Interannual and seasonal variations in aerosol optical depth of the atmosphere in two regions of Spitsbergen Archipelago (2002-2018) prepared by Dmitry M. Kabanov, Christoph Ritter, Sergey M. Sakerin raises very important issues connected to the climate change through the variations of its component, the measurements of Aerosol Optical Depth. This study is exceedingly relevant for climate variability in both global and regional scales, which in these times becomes extremely important. This manuscript still requires small and mostly editorial minor revision be-

fore publication. The article is concise and contains logical and thoughtful information. The paper is well organized – all chapters are written properly and point the attention of a reader towards an actual information. It also fits well according to the AMT scopes. The manuscript was written in proper English, also it does not contain too many language errors, and those that appear in the article are small and do not affect the substantive assessment of this work. I maintain that the manuscript will be clarified an rich enough for publication after including those corrections. The subject of Aerosol Optical Depth is quite often discussed in many articles due to the amount of reliable information that this parameter carries. Often, AOD information alone is an insufficient regional attribute, therefore related parameters, e.g. aerosol background or Angstrom parameter are added, or information not related to sun photometry (modeling results, information from satellite images or lidar data) are added. As I mentioned, this parameter is a very good characteristic, but photometric observations in the polar circle are very difficult and quite punctual, which is why I believe that the authors took up an important topic of long-term measurements - their seasonality and cyclicality. Over Spitsbergen, such measurements were already compared between Hornsund and Ny-Ålesund, as the authors mention at work, but the period of these comparisons concerned period. An important element of this work is to indicate that those comparison change a lot through years, it seasonal variations and episodic outflow determine the amplitude of interannual AOD variations in the Arctic atmosphere more by smokes from massive forest and agricultural fires. The authors also emphasize how important it is to analyze separately fine and coarse AOD components, having different spectral properties, origins, and lifetimes and how important is the character of the Arctic during AOD measurements, as demonstrated by the results from 2003, as imprecise values due to the insufficient number of measurements.

Specific comments about the substantive content:

Line 65 and 125: Citation needed

Line 135-140: After reading this paragraph, the question immediately arises, where

do such differences between stations derive from? This way of presenting and writing this paragraph causes that the reader is became less trustable to the authors. I propose that the authors reformulate the text, because this discrepancy between stations results both in measurements with two different instruments and in time shifting, i.e. the difference in time and direction of air mass inflow over a given station. For specific aerosol events, it is worth comparing the air backward trajectories to determine what is the time difference that the air mass data reached the various stations, which the authors often repeated in their other articles.

Line 165: The authors describe AOD very accurately, but they put the Angstrom formula into the text without first explaining. It would be worth harmonizing to make the article technically complete. Simple explanation will be satisfying.

Line 180: “and m and n are the parameters analogous to those in the Ångström formula.” – please define the analogy, that is analogous to the β and α, which will make the text easier to follow for the readers.

185: In this paragraph it is worth highlighting what does it mean "independent data". This question arises immediately after the end of this paragraph, and the authors do not answer this question in a logical sequence, in the next paragraph.

Line 300: Is this predominance connected to the location of the station and orography, and also tendency that the direction of each outflow is less transformed at the north of Spitsbergen?

Fig 1 and 9: I would prefer adding a grid, even the same as on fig 3. It will facilitate reading it.

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