

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 #3

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General comments :

This article presents four methods (already published in previous works) to discriminate the fine and coarse mode components of the aerosol optical depth in a limited spectral range, for two locations, in Spitsbergen islands. One method (IM1) is then selected based on its performance with respect to a more accurate base method, using a larger spectral range. The subsequent inter and intra-annual analysis based on those aerosol modes follows the similar work published for the Tomsk region, pointing to the fact that summer time maximums is mainly due to sporadic smoke intrusions. While the article

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looks more as an incremental step in the work of the authors, I think it represents a significant and necessary contribution in updating the aerosol dynamics knowledge in the Spitsbergen islands and in the Arctic in general. However, I think the sections describing the fine/coarse mode discrimination methods lack of clarity. It is difficult to understand and eventually reproduce them by a reader, particularly IM1 and IM2. They are relying too much on information available on references hard or even impossible to find, like those on the Russian journal “Atmospheric and Oceanic Optics”, unavailable online prior to 2009. Some details seem actually never published. I think this is the part where the paper needs the most improvement. My specific comments below are actually only refereeing to that part. While this may look at first as a potential major revision, since it can be easily fixed in a short time, I consider it minor revision.

Specific comments:

P01L27: The reason for 10 or 20 year periods is not enough explained. The best would be a reference. If not, may be based on the expected tendency and natural variability, one may figure out what would be a significant period.

P02L49: Stratospheric aerosol from Kasatochi (or later produced from volcanic SO₂) lasted until the end of the year 2008, with some reminiscence at the beginning of the next year. I think pollution from every source going into stratosphere may last months, even smog from firestorms.

P05L142: “A comparison of the statistical characteristics showed that the average AOD values are a little larger in Barentsburg than in Ny-Ålesund“. This cannot be concluded from Fig 1 without showing error bars on the linear fit.

P05L145: “At the same time, we note that the AOD differences are minor (comparable with the error)“. As a reader, I have no idea what is the error at this stage.

P05L148: “ $\Delta = 0.004 - 0.024$ “ is this the difference between Barentsburg and Hornsund? What is the error on such measurement? 0.004 is less than the possible achiev-

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able error (0.007 in Table 2). 0.004 is also 6 times less than 0.024 ! How can we trust such numbers?

P06L168: “Numerous studies... showed”. Since it is a well-known concept, may be a textbook reference is appropriate.

P06L179: In the context of the equation (2) and related Fig 2, you may mention that the departure from linearity in Fig 2 may be due to a second order behavior of alpha, as used in the SDA, but ignored in this simpler approach. You may however suggest that this simpler method may be less prone to error propagation.

P07L191: “ $P < 0.0001$ ” – P was never defined. Even if for some people it may be a well known parameter, it’s not necessarily obvious what it is. You need to briefly mention what it is and may give a reference for further details, like a textbook.

P07L199: “The lifetime of fine aerosol is a few days”. As mentioned previously, stratospheric aerosol can last longer than those in the troposphere. So, one should precise here what aerosols are we talking about.

P08L214: “ $\tau_{f,0.5}(\tau_c)$ ” what does it mean, $\tau_{f,0.5}$ as a function of τ_c ? It’s not really obvious! Please explain!

P08L217: Reference [Kabanov et al., 2019], is it “a” or “b” ?

P08L221: It took me a long time to understand what RM1 and RM2 are! Most readers do not have access to your [Kabanov et al., 2019] and particularly [Kabanov and Sakerin, 2016] references, without which is impossible to understand. I think you need to provide a minimal info to facilitate the understanding of what are you are doing! Actually, in your text is not even mentioned that you need specifically to check [Kabanov and Sakerin, 2016] in order to understand RM1 and RM2. Also, you should mention that Fig 3 is a reproduction of Fig 2 from [Kabanov et al., 2019].

P08L228: Table 2 should be located after you introduce IM1 and IM2! Why did you changed from “ $\tau_{f,0.5}(\tau_c)$ ” to “ $\tau_c(\tau_{f,0.5})$ ” ? Why do you have a space

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below $\tau_{0.5}$?

P08L230: You need to mention [Kabanov and Sakerin, 2016] section 3, in order to justify “conditions of a specific region”.

P09L238: You need to provide much more info about the IM1 and IM2 methods, to a point that a reader can reproduce your work. For example, dV/dr is not even mentioned in your only reference [Sviridenkov, 2001] with respect to those calculations. Actually, you should not even assume that the reader can consult [Sviridenkov, 2001], as the “Atmospheric and Oceanic Optics” references are not available online prior to 2009 (and older hard-copies are probably available only in Russia).

P09L256: 0,086 should be 0.086.

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