

The manuscript by Graßl et al, with Title “Does the Asian Summer Monsoon Play a Role in the Stratospheric Aerosol Budget of the Arctic?” analyses the contribution of Asian Tropopause Aerosol Layer during the Asian summer monsoon to the lower polar stratosphere about Ny-Ålesund, Svalbard. One year of lidar data are analysis with respect to their backscatter, depolarisation, and colour ratio, i.e. 475/481 quality assured hours of data, including the vertical distribution and seasonality. In addition, FRP was used to describe the long-term trend of Russian/Canadian Forest fires, meteorological radio-soundings, and model data for the determination of the tropopause altitude. Particle size estimates were presented based on Mie calculations. The origin of the air-masses was calculated using CLaMS simulations, and for two cases back trajectory ensembles were presented, which nicely illustrate the source regions and transport patterns. Thus, it is an interesting publication, and a valuable contribution to the journal, and the science to better understanding the lower Arctic stratospheric aerosol in the Arctic.

I find the article easy to read, well structured, and it is easy to follow the argumentation. Nevertheless, I have a few general comments, which I find should be addressed by the authors. In addition, a number of more specific comments are given below.

General comments:

L 82ff: Description of the article structure, give 3.3., 3.5, 4, 5

... please complement with description of Section 2, Section 3

L205 ff which data have you used, please give a reference to the FRP dataset, MODIS acquires data at 3 spatial resolution, 250 m (B1-2), 500 m (3-7) and 1 km (8-34), so the gridded data set is not equal to the spatial resolution of the observations

Fig. 3 Using MODIS data for “trend» studies is not as easy, because you will need to account for flaring, industrial pollution (pot. volcanic signals) which also show heat-signatures, account for cloud-cover, and oversampling of off-nadir pixels. Therefore, it might be more useful to use assimilated data (e.g. GFAS) for this. Alternatively, there should be a disclaimer pointing this out clearly. In addition, it might be easier to see pot. trends if one would plot averaged data for the fire-seasons only (e.g., May/April-Sept/Oct.).

Compare also with: Zhu et al, 2021 <https://doi.org/10.1029/2021GL096095> or Bondur et al., 2023, <https://doi.org/10.3390/fire6030099>.

It would be good to make the distinction between what you consider as forest fires and biomass burning a bit clearer throughout the manuscript. It is understandable, but as forest fires are “biomass” burning, it can lead so a bit confusion for the reader. Thus, an additional sentence could help to prevent this.

Specific comments:

L19/20 Stratospheric aerosol can either be long-range transported or even directly created in the stratosphere and has a high sulfuric content

... maybe have long-range transported/injected .... In contrast to directly created in ....

L32/33 The absence of water vapour and removal by precipitation does not take place in the stratosphere

... this sentence is unclear. Maybe: Due to the absence ...

L40 This is comparable with all volcanic eruptions from 2000 to 2015 (Yu et al., 2017).

... could you add how much this is compared to Pinatubo, just for the curious reader...

L54 by Vernier et al. (2011) who used satellite data by CALIPSO observations

...who used observations by Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO)

L 50 As Notholt et al. (2005) show, the sulfur ... are constantly decreasing

... can you find a newer publication (I don't think so, but it could have changed in 20 years)

L65 This observation is becoming more frequent in recent years (Zielinski et al., 2020)

... not really a "trend paper", maybe e.g. recent observations from Zielinski...

L78/80 It is therefore important to understand the ... It is therefore important to understand the

... to improve the style, I would like to propose to rephrase one of the sentences

L85 and we have a qualitatively good Lidar data set for every month

... for every month of the year

L105 ff LR

.... can you give a reference for this choice, what do these values represent?

L121ff: Aren't there no PCSs observed below 27 km? Should be easy to filter those out?

L136ff: LR can be calculated

.... – you have not done this, or ... If I understand it correctly you used literature values (L105ff) ?

L150 9173 m ..

... maybe give a standard deviation

L162 to adjacent data

... typo: two adjacent data

L164 finding a good agreement

... maybe finding a good balance

L178 ERA 5

.. approx. which vertical resolution / pressure level of model level data ?

Fig. 4 I would think the individual observations would be more clear (instead of the difference,) as these show the seasonal variations ... but maybe it is better the way it is presented (was just a thought).

L250 has a higher potential temperature than in winter

... in summer than in winter

L255f In the following study we just concentrate on the year 2021, since we have 481 h for 532 nm and 474 h for 355 nm of qualitatively good Lidar measurement time and is available throughout the entire year as well as every month.

... rephrase sentence, In the following we concentrate on... good Lidar measurements...

L259 103 h of measurement time is available

... 103 hours of measurements

L279 of the analysed year

... of the CR in 2021

L285 decreases towards the end of 285 the year in the discussed altitude range of 330 K to 410 K, but

... to 410 K and with decreasing

**Fig. 6 Can the overlapping dots be replaced by small-non-overlapping rectangular symbols ?**

Fig 7/8 I would remove the x-axis “beta\_.” of the upper panels to make the plots more clean

L316: should be weak 2-5, medium 5-10 (otherwise, because >2 would otherwise also include the data > 5)

Table 3: are the values in Feb and Nov “0” (Feb has only few data, but November), maybe add a comment about them.

Fig 9/16 ... would it make sense to add standard deviations to the profiles (if it does not make the plot to messy) ? In addition, it could be helpful to indicate the tropopause altitudes in the plots.

L353f “The red marks, – and +, represent the monthly median and mean respectively. The blue box indicates the 25th and 75th percentiles, while the black lines stand for the 9th and 91th percentiles.”

... can be removed from the text, is identical to the Figure caption

Figure 11. Annual cycle of stratospheric aerosol backscatter coefficient  $\beta_{532}$  in 360 K and 18 km height.  
... typo: 380 K

L366 While the values of  $\beta_{532}$  are by about a factor of 2 smaller t  
... factor of 1.5 -2

L 375 by a non-absorbing medium takes is described  
... non-absorbing medium is described

Equation 6: describe n, k

L379 effective radius r - Equation 7: describe r

L395 refractive index of biomass burning aerosols  
... do you have a reference for this value as well ?

L462 ... model run time  
... what was set as max time ?

L471 one exemplary trajectory  
.... trajectory ensemble

L504  $\delta$  decreases afterwards with increasing height  
... decreases with increasing heights

L505 depolarisation throughout the entire lower stratosphere is four for 12 UT  
... ?

L562 small, it is probable that they are long enough in the stratosphere.  
... sentence seems incomplete - stratosphere to ....

L595ff Conclusion and Outlook

... either all with “.” or none

L611: coefficient very well fit to the physical

.... fit very well

L621/622: A regional radiative forcing of  $-0.1 \text{ W/m}^2$  caused by the ATAL was calculated from CALIOP measurements ...

... where is this coming from – reference or your work / I don't see CALIOP measurements in the actual manuscript

L625 volcanic eruptions since 2000. argue that

... there seems to be a reference missing

L630 ff any recommendation for in-particular-under sampled areas, which should be prioritised?

What about CALIOP/EarthCARE .. should they be mentioned?

References: need to be checked, sometimes abbreviations for journals, sometimes full names, partly with small letters, doi is given for parts of the references, for others not, ... CO 2 (L 810), ...

Is the following paper of relevance?

Yan, X., <https://doi.org/10.5194/egusphere-2024-782>, 2024.