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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Lower-stratospheric aerosol measurements in eastward shedding vortices over Japan from the Asian summer monsoon anticyclone during the summer of 2018" *by* Masatomo Fujiwara et al.

Anonymous Referee #1

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In this manuscript, Fujiwara and co-authors present observational data from two lidars in Japan indicating the presence of aerosol particles from the Asian Tropopause Aerosol Layer (ATAL) over the stations just above the tropopause in August and September 2018. The origin of these particles from inside the Asian monsoon anticyclone is indicated by trajectory analyses as well as CAMS reanalysis data of CO and MLS satellite observations of water vapor. Further, the authors exclude the influence of volcanic eruptions and forest fires by inspecting the global condition of aerosols in the UTLS through space borne limb-scatter (OMPS LP) and lidar (CALIOP) observations.

A central point of this work is the depolarization of the observed particles of around 5%. This indicates that at least a part of the aerosols was non-spherical (i.e. not liquid) but solid, however, not as strongly depolarizing as cirrus particles.

In general, the manuscript is well written and logically organised with clear figures. It presents a novel dataset on aerosols from the ATAL embedded in the interpretation of the general atmospheric situation. To my knowledge it is also the first one of an eastward shedding event over Japan and explicitly including the particle depolarization. Therefore, I recommend publication in ACP after taking into account the comments below.

Specific comments

L97-L110, Lidar error estimation:

In L98 the BSR uncertainties are stated as 2-3%, but in L106, additional BSR errors are discussed. I would suggest to clearly state first all error terms for the BSR (random and possible systematic ones) and then include those in the discussion on PDR.

L135, 'in this data product, clouds and Polar Stratospheric Clouds (PSCs) have been removed':

Please add the information, how cirrus clouds have been removed.

L145:

Please discuss also the event around Aug, 9th, over Tsukuba since there has been a clear eastward shedding as can be seen in Figs. 7 and 8. It is not clear to me if the particles were above or below the tropopause since there is quite a strong change in tropopause height visible by the red dots in Fig. 1.

L181, 'PDR values of 1%–3%':

The difference between the PDR values between Tsukuba, showing clearly enhanced signals, and Fukuoka is tentatively explained by the different measurement periods.

In case of Tsukuba, quasi no event has been shown with values of PDR less than 2 (see Fig. 2), while there are many above Fukuoka. Please discuss whether this might hint to some unidentified bias in one of the instruments. It would e.g. be informative to present some observations before June or after September where both instruments show consistently low/high values of PDR.

L196, '3.2 Trajectories and airmasses':

From the trajectories shown, it is not clear if they reach altitudes below the tropopause. Could you provide any discussion on this point?

L240:

I would be interested if the CAMS CO data could be supported by MLS measurements of CO. This should be easy by providing a figure similar to Fig. 8 but for MLS CO.

L283:

Is any direct comparison/match of the ground based lidars with the CALIOP lidar possible during the relevant time period?

L317:

For ATAL studies, the applied CALIOP filter on cirrus clouds has been a depolarization ratio threshold of 5% (e.g. Vernier et al., 2015): (1) why has a different limit been applied for the present ground based observations? (2) could you discuss which effect the finding of this work indicating 5% depolarization and more for ATAL particles would have on the CALIOP data analysis?

L327, 'with an average BSR value of 1.05 being a systematic feature':

Is there any information on the depolarization available from the OHP-lidar?

L337:

One may add the information from Fig. 2 in Wagner et al., 2020a, that the depolariza-

tion ratio obtained in the laboratory for solid ammonium nitrate particles was around 9%. Further, in Wagner et al., 2020b, from electron microscope images of ammonium nitrate particles Fig. 2c reveals 'that the crystalline AN particles are of rather compact shape with aspect ratios predominantly in the range from 0.80 to 1.25.'

Technical corrections

Figure 4:

The CO isolines for different months cannot be distinguished easily. Perhaps use different line styles.

L223:

Please add in this sentence the information 'from the CAMS reanalysis data'.

L224, 'A potential temperature of 400 K corresponds to altitudes of 17.1 km at Tsukuba and 17.3 km at Fukuoka, on average, during July–September 2018':

This information should be provided before, e.g. where the trajectories are discussed.

L286, 'not have reached':

'have not reached'

L298, '. Rectangular':

'. The rectangular'

L341, 'France, any enhancement':

'France, no enhancement'

References

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