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Comment on acp-2022-92

Anonymous Referee #1

Referee comment on "Chemical analysis of the Asian tropopause aerosol layer (ATAL) with emphasis on secondary aerosol particles using aircraft-based in situ aerosol mass spectrometry" by Oliver Appel et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-92-RC1, 2022

Appel et al. discuss the results of aerosol in-situ observations taken on board a high-altitude aircraft within the European Union's project StratoClim from Kathmandu/Nepal in July and August 2017. The paper concentrates mainly on particle composition within the Asian Tropopause Aerosol Layer (ATAL) probed with an aerosol mass spectrometer. It is shown that the aerosol particles of the ATAL as observed during the flights were mainly composed of ammonium nitrate and organics. While ammonium nitrate as a major component of the ATAL has already been reported in a previous publication, the role of organics is an important new finding of this work. Moreover, the authors present convincing arguments for the importance of secondary particle formation for the majority of the aerosols observed within the ATAL.

The manuscript provides an extremely important contribution to our understanding of an (concerning in-situ measurements) under-sampled region of the Earth's atmosphere – also given the uncertainties connected to aerosols and their radiative direct and indirect impacts within the climate system. The analysis of the measurements and their interpretation is convincing. The paper is well written containing clear graphical illustrations. Thus, I strongly support its publication after taking into consideration some minor comments below and after making available the datasets ('Data availability').

Specific comments:

L69: ‘from the CRISTA instrument’

Many of the data in the quoted publication stem also from the MIPAS/Envisat instrument.

L176: ‘During the StratoClim aircraft campaign 2017 we found an average detection limit of 0.12 µgm−3’

Please add ‘(NTP)’ where applicable.

Figure 2:

It would be good to show (perhaps in the supplement) the number of data points per altitude bin, since lower altitudes are only sampled during take-off and landing while much more measurements exist at flight level.

L298: ‘in the ATAL is predominantly existent in the form of ammonium nitrate (AN)’

Shouldn’t ammonium sulfate also be present and (at the top of the ATAL) be of similar importance?

L317 and Fig. 4: ‘Nevertheless, the data show that the ATAL for the time of StratoClim was not only confined in the vertical direction but also indicates a decrease towards the edge of the AMA in the horizontal distribution.’

It is not very clear to me where to see in Fig. 4 the horizontal confinement in the altitude region of the ATAL. There might be a slight decrease in organics, however in nitrate, the data of which reaches to much lower equivalent latitudes, I cannot see a clear decrease.

L321: ‘Stratmann et al., 2021’

This paper has not been published. Is it available elsewhere?

L324, Figure 5:

It is not clear what this Figure should tell: NO is steadily increasing with altitude and nitrate has a maximum within the ATAL. Can any more information be derived from the regression lines?

L404-416:

This paragraph seem a bit detached at its current position. May to be possible to transfer it into the 'Conclusions'?

L465: 'Apparently volatile organic precursors are still available, while the precursor for ammonium nitrate, i.e. ammonia from ground emissions, is not available in relevant concentrations.'

This conclusion seems rather indirect. Are there any independent measurements of the precursor gases to support it? Furthermore, what might be the reason for it?

L521: 'which appears as exceedingly difficult considering the current geopolitical situation'

I don’t think that this statement provides any information within the scope of the manuscript.

L528: ‘The ERICA mass spectrometry data will be available in the Edmond database (Edm, 2017) and the Halo database (Hal,2017).’

Is the dataset available now?

Technical comments:

L4 (and elsewhere): ‘high altitude’ -> ‘high-altitude’

L13 (and elsewhere): ‘analyzed’ vs. ‘vapour’ (L163) : AE and BE seem to be mixed in the manuscript

L27: Comma after ‘As a consequence’ missing; (also elsewhere: commas seem to be missing on similar expression at the beginning of a sentence)

L206: ‘sonde’ -> ‘probe’

L219: ‘2021a, b, ,’ -> ‘2021a, b, ’

L316: ‘(Fig. 4a)).’ -> ‘(Fig. 4a).’