

Replies to comments by Referee 2

Comments, replies, „changes in the manuscript“

References to added publications not already cited in the first version of the paper are listed in the replies.

This article presents satellite observations of stratospheric steamers and frozen-in anticyclones in the enhancement of aerosol extinction at mid and high latitudes. This is the first study to document these phenomena using observations of stratospheric aerosols. The article demonstrates that these events can contribute significantly to the transport of sulphuric acid aerosols to the stratosphere at mid- and high-latitudes. The article is well-written and well documented. It provides new information on stratospheric air transport between tropical and higher latitudes following major SSWs. It is worthy of publication in Egusphere after a few minor revisions, as detailed below.

Thank you very much for the helpful comments and suggestions.

Line 32: The definition of major SSWs by the reversal of zonal wind at 60°N-10 hPa was first proposed by Labitzke (1981), well before Charlton and Polvani (2007).

There were also other SSW definitions prior to Labitzke 1981, and they all differ slightly from Charlton and Polvani 2007. Labitzke 1981 refers to a WMO CAS definition, which was slightly modified in her study.

For our study, Labitzke 1981 is referenced in relation to the definition of minor SSWs. For major SSWs, we opted for the simplified definition according to Charlton and Polvani 2007, which only includes the criterion of the reversal of the zonal-mean zonal winds at 10 hPa and 60° latitude. It is frequently applied, and no wind reversal due to major SSWs can be observed in the two years under consideration.

Line 165: The phrase “vertical resolution greater than 7 km” may be confusing. I suggest “vertical resolution better than 7 km”.

You are right this phrase was misleading. The sentence now reads:

”For both data sets, only retrieved profiles with a vertical resolution better than 7 km were used to ensure high data quality at all altitudes.”

Lines 180-184: It is true that the possibility of negative values for extinction can lead to a negative mean value, but conversely, the exclusion of negative values can lead to a positive bias in the mean value.

That is correct. This paragraph should serve as a general reference to the problems of SAGE III retrieval above ~32 km, especially at small wavelengths. At the 449 nm channel, approximately two-thirds of the measurements at an altitude of 35 km are negative and one-third are positive, whereas one would expect a maximum of 50% negative values as the altitude increases and the signal strength decreases.

However, the solution algorithm for the PSD only works if the extinction coefficient is positive in all channels used in the algorithm (Knepp et al. 2024).

In the subsection, a few sentences were rearranged and the following information was added:

”Their solution algorithm for the PSD only works if the extinction coefficient is positive in all channels used in the algorithm.

“Therefore, the robustness of the derived PSD also decreases with altitude.”

Figure 2: The zonal wind reaches a value close to 0 for the SSW event occurring at the end of February. I wonder if it should be classified as a major SSW.

It is close, but since there is no reversal of the zonal wind, we have classified this event as a minor SSW, as have Eswaraiah et al. 2019, Gogoi et al. 2023 and Li et al. 2023. The following sentence has been added to the text:

„Two events, which are classified as minor warmings, are recorded at the beginning and end of February, which is consistent with the observations in Eswaraiah et al. 2019, Gogoi et al. 2023 and Li et al. 2023.“

Section 5: Sources of error: it would be preferable to place this section before the Discussion section.

Thank you for the suggestion, we have now moved section 5 before the discussion.

Line 468-469: the sentence on the non-significant contribution of increased aerosol on the radiative transfer in the conclusions is not supported by any results in the text of the paper. It should be removed from the conclusions or supported by some argumentation in the core of the paper.

This sentence has now been removed and the conclusions section revised.