

Dear reviewer,

Thank you very much for your review and positive feedback on the manuscript and the comments that helped to improve it. We appreciate the time you took to review the manuscript. Below is our response to your review in blue.

However, while the paper is comprehensive, it would be useful to include more information on the validation of the model and comparison with observational data. I believe that by adding information on how well the model can reproduce the observed data, the reliability of both the model and the paper will be enhanced, so please consider this aspect.

We appreciate your comment and your suggestion. Unfortunately, there are no observations for solid particle injections into the stratosphere. Thus, it is not possible to compare the model to observations. However, potential limitations and uncertainties resulting from agglomeration in sub-ESM plume processes after injection of solid particles e.g. from an aircraft are discussed in detail in the “Discussion“-Section of the manuscript. Concerning the validation of the model there are many previous papers which demonstrate for example that SOCOL is accurately representing present-day climate (Stenke et al., 2013, Sukhodolov et al., 2021), stratospheric chemistry and ozone (Friedel et al., 2022), stratospheric aerosol burden and size distributions (Brodowsky et al., 2024) and deposition (Feinberg et al., 2019) as well as the effects of volcanic eruptions (Sukhodolov 2018, Clyne et al. 2021, Quaglia et al., 2022). The solid particle model presented here was thoroughly sanity checked against the original version SOCOL-AERv2 (Feinberg et al., 2019) by performing simulations with the same initial and boundary conditions. Given the many previous publications which demonstrate the performance of SOCOL-AER as well as the detailed discussion of limitations of the model in the last section we think that the model is sufficiently validated. We added a sentence to the manuscript in Section 2 (first paragraph on page 5, line 141 to 145) to point to these validation papers:

“Despite the lack of in-situ solid particle measurements in the stratosphere to evaluate the solid particle module, the SOCOL models have been extensively evaluated against observations for climate (Stenke et al., 2013, Sukhodolov et al., 2021, Morgenstern et al., 2022), stratospheric chemistry (Friedel et al., 2022), background aerosol (Brodowsky et al., 2024) and volcanic aerosol (Sukhodolov 2018, Clyne et al., 2021, Quaglia et al., 2022) in the past.”

Sincerely,

Sandro Vattioni and Co-Authors

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