Quantifying the decay rate of volcanic sulfur dioxide in the stratosphere

Thank you for the detailed comments on the paper. Our response to these comments in below in red. All line numbers refer to the revised manuscript.

Minor comments:

Fig 1 caption: please modify the figure legend text to reflect the manuscript's use of the term "decay timescale" rather than "e-folding time".

The figure has been updated.

Line 240: If M1 is not equal to M0, then this implies that at t=0, there is a non-zero amount of sulfate aerosol. Is this an intentional choice, to represent some directly injected aerosol? Otherwise, a normal procedure would assume that the mass of aerosol is zero at t=0, which provides a boundary condition that requires M1=M0. This provides a cleaner expression for sulfate aerosol mass, and perhaps the results of the analysis would be identical as presented here. Please consider, but if you keep the present form, a few more words on the physical meaning of M1 and M0 would be useful to include.

Thank you for raising this point. We were not trying to represent any directly injected aerosol, and we agree that having M_1 = M_0 allows for a cleaner expression for the sulfate aerosol. We have updated the equations in the manuscript to reflect this (Line 240). This update in notation doesn't have any impact on the results of the analysis.

Line 243: Don't you use a log fit here (or a linear fit to the log(Mso4) time series)?!

This has been clarified in line 243-244. The text now reads:

> "We then take the natural log of the resulting curve and use a linear fit to estimate τ."

Line 563: This is not actually accurate, since the ACE-FTS instrument measures SO2 and is currently operating. See e.g., Cameron et al., 2021). Please modify this statement.

Cameron, W. D., Bernath, P., and Boone, C.: Sulfur dioxide from the atmospheric chemistry experiment (ACE) satellite, J. Quant. Spectrosc. Radiat. Transf., 258, 107341, https://doi.org/10.1016/j.jqsrt.2020.107341, 2021.

This text has been updated as follows (Line 563):

> "Furthermore, the forthcoming loss of MLS (the only limb-sounding SO_2 instrument in operation with continuous coverage over global latitudes and longitudes) will leave a significant gap in our ability to monitor the stratosphere."