Thank you for providing an interesting study.

I have a few questions here:

1. The title of the paper is featured in "high-resolution". Readers may expect that the differences in radiative forcing, etc., may be attributed to different resolutions. However, the major differences between the experiments M16 and S21-3D/S21-1D are not raised because S21-3D and S21-1D have a higher vertical resolution but because S21-3D and S21-1D assumed more sulfur was injected into the stratosphere. However, the title might make people think that S21-3D and S21-1D have the same integrated sulfur at the same vertical levels as M16, but only S21-3D and S21-1D have higher vertical resolutions. However, if we average S21-3D and S21-1D to a coarser vertical resolution than in M16, they still show more sulfur in the stratosphere than in M16.

   The difference in radiative forcing is mainly caused by the higher SO2 injection altitudes in our S21 dataset, not by the higher SO2 mass. The S21 simulations will show higher radiative forcing than M16 if implemented at coarser resolution, but that is not the main point here. The high-resolution dataset provides detailed information on the SO2 profile. The M16 dataset positioned most of the SO2 at too low altitudes. Hence, SO2 and the formed particulate SO4, is transported to the troposphere more rapidly in M16. Therefore, M16 underestimated both the magnitude and longevity of the volcanic impact on the climate. Please see further discussion on this in point 2 below.

2. In our study, we calculated about 58% of the SO2 (0.81 Tg) was injected directly into the stratosphere during the eruption (Wu et al., 2017, ACP). (There might be further troposphere-to-stratosphere exchange that may transport a little more sulfur into the stratosphere later.) The number (58%) is actually closer to the 75% from the M16 experiment in your study. 95% is too much, which is not in agreement with observations.

   Sandvik et al., (2021) compiled their high resolution SO2 data based on a UT/LS SO2 product provided by Fred Prata. Hence, SO2 located at low altitudes were not included in the data.

   Some differences in radiative forcing are caused by different SO2 masses in the simulations, but most of the differences stem from deeper stratospheric injections for the S21 simulations (see answer to point 1 above). The SO2 mass injected to the stratosphere differ by ~10% among the simulations, i.e. ~1.03 Tg for the S21 simulations (95% of 1.09 Tg) and 0.9 Tg (75% of 1.2 Tg) for M16. Decreasing the volcanic stratospheric SO2 mass in S21 by 10% over the entire vertical SO2 profile would not result in substantial differences in the simulated AODs.

3. Fig.7 further demonstrates the above problem. The AOD from experiments S21-3D and S21-1D looks to have better agreements with the AOD from CALIOP, which proves the results from S21-3D and S21-1D have significantly overestimated the AOD caused by the sulfate aerosol from the Sarychev eruption. Because the AOD from CALIOP is composed of all kinds of aerosol information (NOT only sulfate aerosol) unless you have excluded the other aerosol species from the CALIOP AOD.

CALIOP and the simulations both include background aerosol and volcanic SO2. We simulated the stratospheric AOD by adding SO2 to the stratosphere. The model includes also the background stratospheric aerosol. Sarychev added only small amounts of ash to the stratosphere. This is evident in the low depolarization ratios observed by CALIOP in the weeks following the eruption (e.g. Prata et al., 2017: https://doi.org/10.5194/acp-17-8599-2017), i.e. sulfate is the dominating component in the volcanic aerosol.

Regards,

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