Atmospheric Chemistry and Physics Discussions

Atmos. Chem. Phys. Discuss., community comment CC1
https://doi.org/10.5194/acp-2022-514-CC1, 2022

Comment on acp-2022-514

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Community comment on "Interactive stratospheric aerosol models' response to different amounts and altitudes of SO_2 injection during the 1991 Pinatubo eruption" by Ilaria Quaglia et al., Atmos. Chem. Phys. Discuss., https://doi.org/10.5194/acp-2022-514-CC1, 2022

I am making this reviewer comment as one of the co-authors of the Quaglia et al. manuscript, in relation to the interesting question the reviewer raises about the altitude of the Cerro Hudson aerosol cloud, and re: the challenge the Pinatubo case provides in relation to testing interactive stratospheric aerosol models ability to capture the observed transport of the Pinatubo aerosol to the Southern Hemisphere.

The reviewer has noted the differences in injection height given in two different volcanic SO2 emission inventories – with 4Tg SO2 at 12-18km altitude in the MSVOLSO2L4 inventory and 1.5Tg SO2 between 11 and 16km in the Neely and Schmidt inventory.

The purpose of this comment is to point out the analysis by Pitts and Thomason (GRL, 1993), which demonstrates that the SAGE-II measurements show conclusively that the Cerro Hudson volcanic aerosol cloud, in the months after it emerged in September 1991, remained at altitudes below 15km, centred at ~12-13km or so.

By contrast, the Pinatubo aerosol cloud was at much higher altitude, at ~19-24km or so.

I agree with the reviewer that the case could present an interesting test for the models, and, in relation to the emission altitudes cited from the SO2 emissions inventories of course being best estimates for the SO2 altitude soon after the eruption, the aerosol cloud forming mostly after oxidation to sulphate aerosol, of course then potentially progressing to differing altitudes.

The main point for this comment however is to note the difference in altitude between the Pinatubo and Cerro Hudson aerosol clouds.

Whilst for climate model integrations the mid-visible strat-AOD may be the most important metric for the solar dimming from the volcanic aerosol in these months, simulating the altitude of the aerosol is important not only re: impacts on stratospheric chemistry, but also considering there can be differences in radiative transfer re: the altitude of the volcanic aerosol in relation to the stratospheric ozone layer and other radiatively active species.

References:

Pitts, M. C. and Thomason, L. W. (1993)

The impact of the eruptions of Mount Pinatubo and Cerro Hudson on Antarctic aerosol levels during the 1991 austral spring,
Geophys. Res. Lett., vol. 20, no. 22, pp. 2,451-2,454.
https://doi.org/10.1029/93GL02160