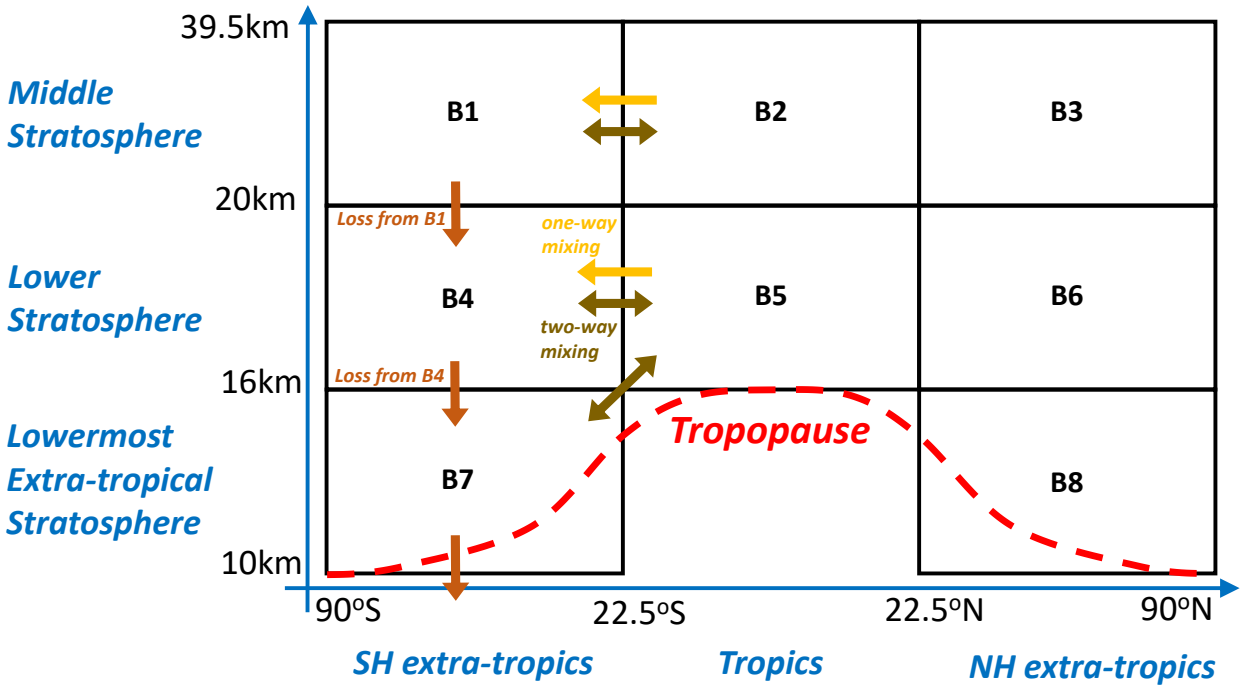

Overview of the structure of the EVA_H volcanic aerosol box model, with the 8 boxes of the model representing the stratosphere. The tropopause is sketched by the red dashed line. The boxes are indexed from top to bottom and South to North. Arrows represent examples of SO_4 fluxes from and into the southern hemisphere boxes (boxes 1,4 and 7).

The EVA_H model takes a list of eruption source parameters characterizing SO_2 injections by a sequence of volcanic eruptions and returns time, space and wavelength dependent optical properties in the stratosphere, along with sulfate aerosol mass and effective radius. All files required to run the model are provided in the EVA_H.zip archive as supplementary material of the companion paper. It is also available on Thomas Aubry's personal website and GitHub where updates will be provided. Scripts are written and to be run either with the Matlab software (version R2018b or more recent ones), which is provided via many universities and academic institutions, or with Python, which is open source.

Please cite the companion paper if you use any product of this model, and refer to it for a complete description of the model:

T.J.Aubry, M.Toohey, L.Marshall, A.Schmidt and A.M.Jellinek, A new volcanic stratospheric sulfate aerosol forcing emulator (EVA_ H): Comparison with interactive stratospheric aerosol models, Journal of Geophysical Research: Atmospheres.

The three .zip archives provided give you with three ways to run the model:

1) Graphical user interface (EVA_H_app.zip) (Matlab)

Open the archive and double-click on file EVA_H.mlapp. A gui opens where you can choose various eruption parameters (e.g. mass of SO2, eruption latitude), model parameters (e.g. production and loss timescale of sulfate aerosol). Once done, just press "run". Two plots will be produced showing the

stratospheric aerosol optical depth (SAOD) at 550nm for your chosen eruption parameters, as well as a time series of its global mean. Both variables are saved in the file SAOD_boxmodel_appresults.mat. The intent of this gui is to help you getting started with the model, in particular if you are not a proficient Matlab user yet. However, it has limited flexibility in terms of the inputs you can run the model with and the outputs you can retrieve.

2) Base scripts which you can adapt to your needs (EVA_H_scripts.zip) (Matlab)

The EVA_H.zip archive contains the following items:

- **EVA_H_main.m** : A script running the model and plotting a few select outputs.

- **parameterfile.m** : A script where the user can set the value of all model parameters, including parameters which we set to values resulting in no effect following our calibration process. For example, the default value we propose for the amplitude of the seasonal cycle of mixing timescales in this script is 0 because we found that adding a seasonal cycle to mixing timescale did not significantly improve the model performance. However, comments in this script detail our parameterization for a seasonally dependent mixing and how to turn it on.

- **eightboxequations.m** : A function containing the model equations to be solved by the ordinary differential equation solver in EVA_H_main.m.

- **so2injections_8boxes.m** : A function converting a list of eruption source parameters (eruption date, location, mass of SO_2, height of injection, local tropopause height) into the list of times of injection in the model and the masses of SO_2 to be injected in each of the model box.

- **postproc.m** : A function taking the list of model parameters and the time series of sulfate mass in each box outputted by the model, and returning key variables including global mean stratospheric aerosol optical depth, extinction, single scattering albedo, and scattering asymmetry factor.

- **ncep_tropo.m** , **shapefunctions.m** and **eva_Mie_lookuptables.nc** : Files containing, respectively: i) the zonal mean tropopause height from 1979 to 2015 from the NCEP-NCAR reanalysis (*Kalnay et al. 1996*); ii) the shape functions of the model; and iii) the look-up tables to calculate wavelength-dependent extinction, single scattering albedo and scattering asymmetry factor.

- **volSO2_Carn2016.xlsx** and **singleinjection.xlsx** : Files containing examples of inputs to be passed to the model in EVA_H_main.m. The first file contains a list of eruption source parameters based on the SO_2 emission inventory from Carn et al. (2016). The second file contains parameters for a single eruption, which can be changed and/or replicated by the user to run idealized experiments and test the model sensitivity to eruption source parameters.

3) The exact same scripts, but written in Python (EVA_H_Python_scripts.zip) (Python)

See description above for the Matlab scripts, the same applies.

Please contact the corresponding author for any question on the model or script provided:

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