

Geosci. Model Dev. Discuss., referee comment RC1  
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## **Comment on gmd-2021-24**

Sergey Loginov (Referee)

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Referee comment on "ChAP 1.0: a stationary tropospheric sulfur cycle for Earth system models of intermediate complexity" by Alexey V. Eliseev et al., Geosci. Model Dev. Discuss., <https://doi.org/10.5194/gmd-2021-24-RC1>, 2021

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### **General comments**

### **Scientific significance**

The manuscript represents a substantial contribution to modelling science within the scope of this journal. A method is proposed to combine the quality of the calculation and the minimum time required to perform the calculations.

The manuscript presents a substantiated stationary computational scheme for CHAP-1.0 (Chemical and aerosol processes, version 1.0) for modeling the sulfur cycle in the troposphere of the earth. The scheme is designed for models of medium complexity (EMIC) and takes into account the emission of sulfur dioxide to the atmosphere, its deposition on the surface, oxidation to sulfates, as well as dry and wet deposition of sulfates on the surface.

ChAP-1.0 implements only the anthropogenic part of the atmospheric sulphur cycle, but a

authors plan to extend the scheme in future.

## **Specific comments**

## **Scientific quality**

The calculations with the scheme are performed forced by anthropogenic emissions of sulphur dioxide into the atmosphere for 1850-2000 adopted from the CMIP5 dataset and by the ERA-Interim meteorology assuming that natural sources of sulphur into the atmosphere remain unchanged during this period. The ChAP output is compared to changes of the tropospheric sulphur cycle simulations: with the CMIP5 data, with the IPCC TAR ensemble, and with the ACCMIP phase II simulations.

In addition, in regions of strong anthropogenic sulphur pollution, ChAP results are compared to other data, such as the CAMS reanalysis, EMEP MSC-W, and with individual model simulations.

However, as can be seen from the comparison of the modeling results with the data of CMIP5, IPCC TAR and with II ACCMIP, (Fig. 5,7, 9), there is a systematic excess of the model values of concentrations by several times in the territories in the western and central parts of Eurasia, South America. Is this related to the peculiarities of the advection calculation scheme, since it is possible to imagine a situation in which the flow within the cell moves in opposite directions and the average velocity over the cell will be zero?

## **Scientific reproducibility**

The description given in the manuscript as a whole allows other scientists to reproduce the simulation.

## **Technical corrections**

## **Presentation quality**

Numbering in Fig.

5-7 do not correspond to the figure captions - there are no designations d, e.

Please also note the supplement to this comment:

<https://gmd.copernicus.org/preprints/gmd-2021-24/gmd-2021-24-RC1-supplement.pdf>