Project: **1128**

Project title: **Investigation of the influence of air pollution on DMS and its role in the Earth's climate**

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Report period: **2020-01-01 to 2020-12-31**

In the current allocation period, computing time has been used for a global modelling study on the effect of DMS chemistry on the formation of MSA and sulfate and their impact on radiation, using the climate-chemistry model ECHAM6.3-HAM2.3-MOZ1.0. For this purpose, the current DMS scheme in the model has been updated and extended for a more realistic representation. It includes now a reactive uptake of MSIA on aerosol surfaces to be in line with the importance of multiphase chemistry on MSA formation. Different evaluation simulations have been performed for the year 2016. The final simulations have been performed for the year 2017, as here MSA gas-phase measurements are available to verify the simulations. Sensitivity studies have been performed in which the changes are successively incorporated to see the effect of the different changes (see Figure 1). In addition to these schemes, an aerosol-only simulation with the old parameterization, as included in the aerosol module HAM, has been performed.

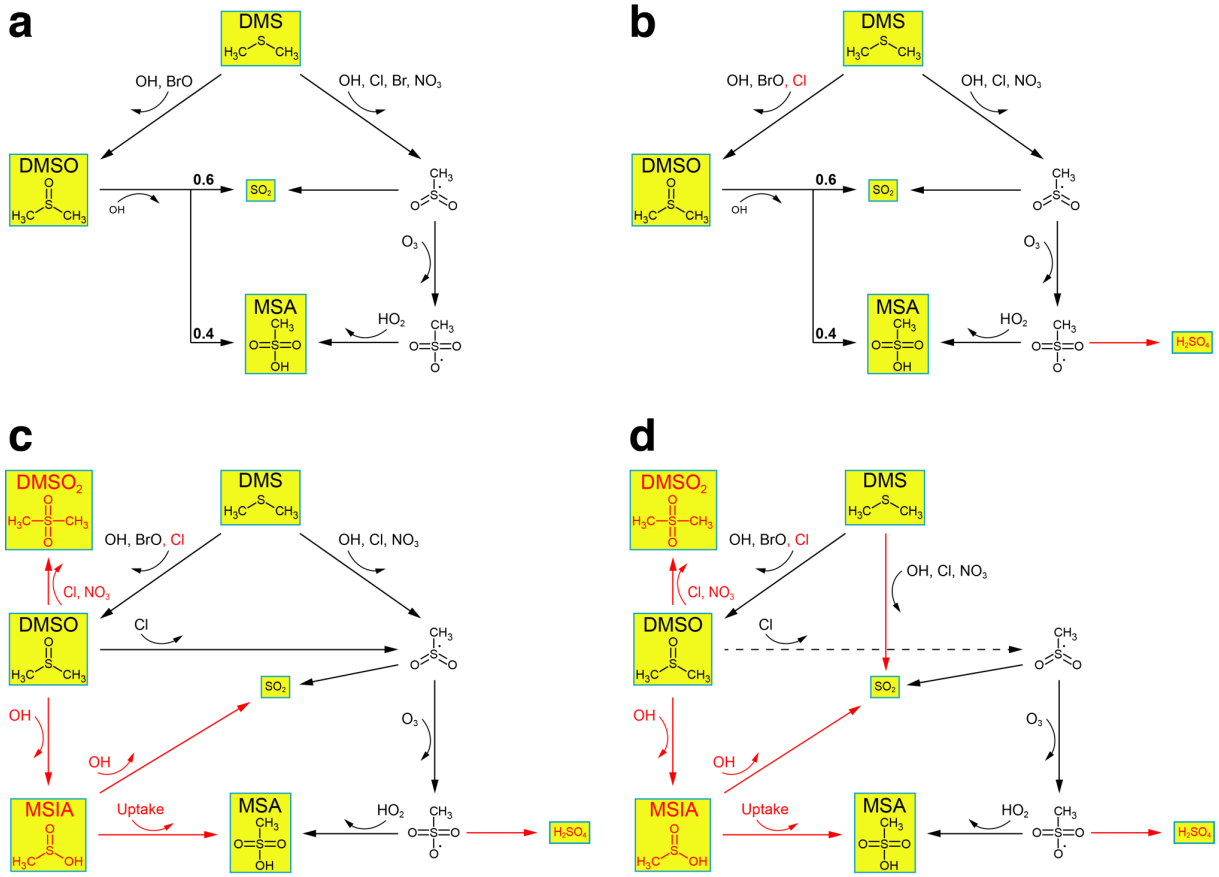

Figure 1 The applied DMS oxidation schemes with the first five simulations. (a) for the simulation 'MOZART', (b) for the simulation 'ABSTRACTION', (c) for the simulations 'GAMMA01' as well as 'GAMMA1' and (d) for the simulation 'SO2'

From the different schemes strong differences have been simulated regarding the yield of MSA, SO_2 and H_2SO_4 and subsequently formation of sulfate. It could be shown that considering the reactive uptake leads better comparison of simulated with field measurements for MSA (compare Table 1 with Figure 2). Furthermore, in the simulations with parametrised gas-phase MSA formation high concentrations in high altitudes are modelled. As MSA formation is strongly linked to aqueous-phase chemistry, this result shows biases in the current DMS-Oxidation scheme, which importance on the depending radiation budget has to be further analysed in more detail.

Table 1 Measured gaseous MSA levels of the "Xuelong" cruise during leg I (Nov. 27 2017 to Dec. 04 2017, Yan et al., 2019.

Latitude	*Average [MSA] / pptv*
43-51	*19.5 ± 5.2*
64-69	*11.7 ± 5.1*
63	*4.2 ± 0.5*
61	*2.9 ± 0.2*
72-75	*6.7 ± 2.2*
62	*5.3 ± 0.3*

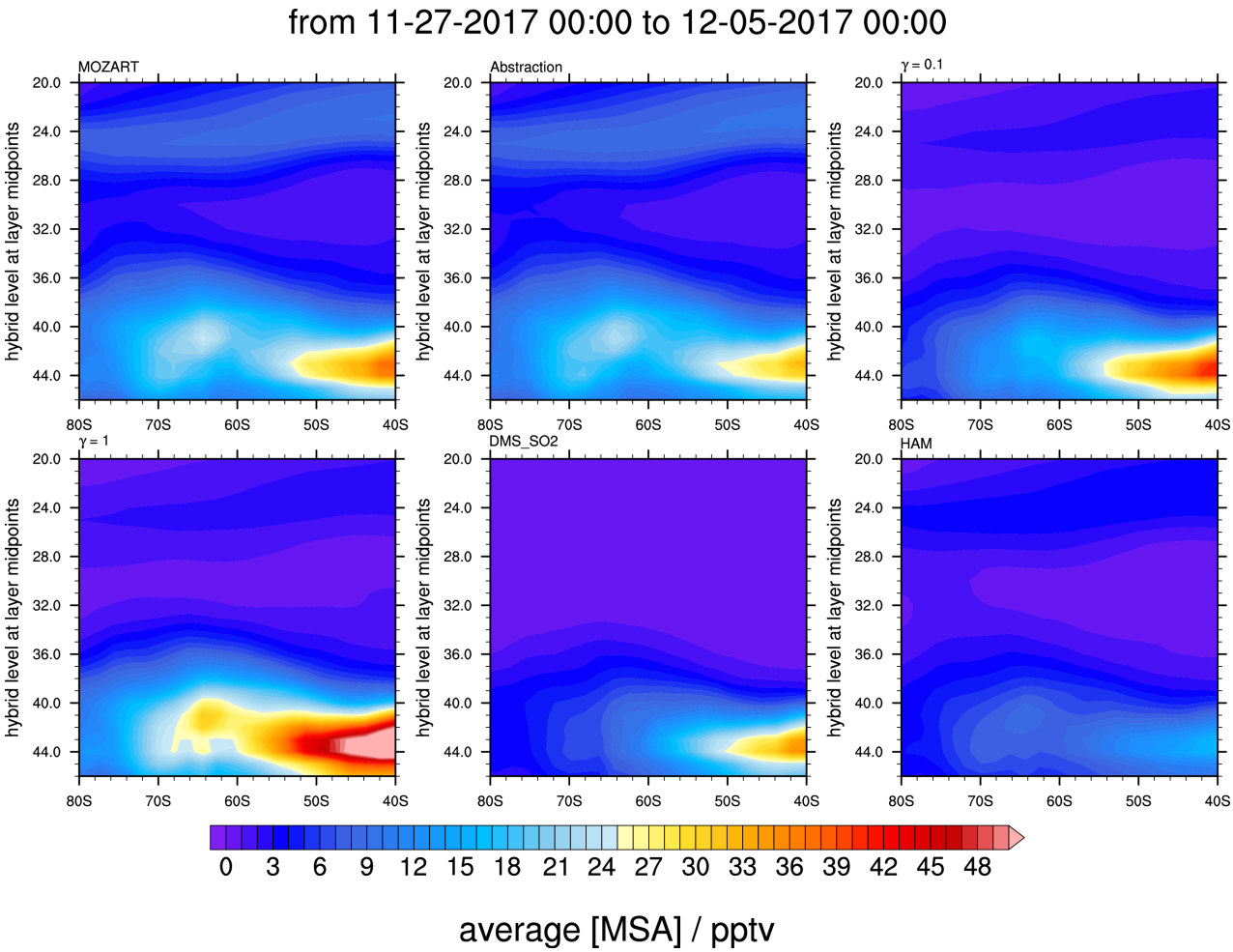

Figure 2 Modeled mixing ratio of MSA averaged over time and longitude. The longitude and time have been chosen to be consistent with the "Xuelong" cruise during leg I (Nov. 27 2017 to Dec. 04 2017, Yan et al., 2019.

Overall, the simulations indicate the importance of the NO_3-Radical related DMS oxidation on the sulfate budget at the northern hemisphere that is more polluted than the southern hemisphere. Furthermore, multiphase chemistry processes drive the formation of MSA in the gas-phase influencing the simulated sulfate concentration, especially at the Southern Ocean. Strong variations in the radiative budget of the Earth have been calculated accordingly.

A paper draft with the results is in preparation for submission to the high-impact journal Geophysical Research Letters. Follow-up simulations are assumed for answering possible occurring Reviewer Comments and also to do simulations to investigate the effect on climate.