

Interactive comment on “Global modeling of heterogeneous hydroxymethanesulfonate chemistry” by Shaojie Song et al.

Anonymous Referee #1

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Hydroxymethanesulfonate has been recently identified as an important organic sulfate component in atmospheric aerosols in field measurements. Current understanding for this organosulfate chemistry is largely lacking due to sparse field measurement data and modeling studies. This manuscript presents results from a modeling study of aqueous hydroxymethanesulfonate chemistry on a global scale using latest version GEOS-Chem model. Control, default, and ten specific simulations were performed under different modeling settings by incorporating comprehensive SO₂ chemistry into GEOS-Chem. The results show both spatial and seasonal variations for the mass concentration and hydroxymethanesulfonate/sulfate ratio distribution and several hotspots were identified including East Asia, Europe, and North America. The paper will improve understanding of atmospheric organosulfate chemistry in aerosol composition,

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in particular, for regions with high concentrations of hydroxymethanesulfonate such as northern China. The manuscript is well written and it is recommended to be published after a minor revision. Several minor comments include:

- 1) The differences between control and default simulations were not explicitly shown, specifically, for reaction of SO₂ with H₂O₂, what exactly were the differences between the two simulations since in both cases k_4 was taken from Liu et al. (2020) according to Table 1?
- 2) In control simulation, seven pathways were considered for the heterogeneous SO₂ reactions. In Fig. 3, only three reactions were shown. The authors should give a clear explanation why those reactions were far more important than others. Several sentences will be beneficial to the readers in order to better understand the order of the importance for the seven reactions.
- 3) Table 5 shows the comparison between simulated and measured values for the HMS to sulfate or MSA. Since the techniques used for measurements of HMS were significantly different which would affect the accuracy. It would be beneficial to point this out in Sect. 3.4.
- 4) The sensitivity simulation was conducted using 10 min as Δt (L26 on p11). Why 10 min rather than for example 5 min was used? Using a Δt of 5 min may correspond to median probability density in a residence time range of 1 to 20 min as shown in Fig. 3.
- 5) Several typos or corrections: L17 on p6, not quite understand what does this mean? “under the dark conditions of sample storage and treatment”; L1 on p10, it is suggested to rewrite “the reactants’ Henry’s law constants” to “the Henry’s law constants of the reactants”; L12 on p14, for the next? Is something missed after “next”.

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