

Review of “Further improvement of wet process treatments in GEOS-Chem v12.6.0: Impact on global distributions of aerosol precursors and aerosols”

General comments

The study attempts to improve the simulation of aerosol precursors and aerosols in GEOS-Chem via multiple updates in wet processes in the model. The updates in the treatment of wet processes have been described in details and the results are also evaluated with a large set of in-situ measurements from both surface monitoring networks and aircraft campaign. While the evaluation shows significant improvement in model results, it is not immediately clear how significant the update in each wet process actually is.

First, the updates in wet processes in this study including pH calculation for cloud, rain and wet surface, fraction of cloud available for aqueous phase chemistry, rainout efficiencies, washout efficiencies and wet surface uptakes during dry deposition. Evaluation of each update is necessary to understand the factors contributing to the uncertainties in the simulation of aerosol precursors and aerosols so that similar improvement could be applied to other models.

Second, the update in aqueous phase chemistry seems important for aerosol precursors and the corresponding aerosol species. But to what extent is the cloud/rain pH and subsequent dissolution in WETrev different from those in GC12?

In summary, this paper is well written and is easy to follow along. Its topic fits “Geoscientific Model Development” and it is worthy of publication subject to addressing these and specific comments below.

Specific comments

p. 6, line 27-30: what is the range of the calculated rainwater pH in this study?

p.11, line 3-4: In which way is ICCW related to wet scavenging? In other words, which equation is ICCW applied for?

p.12, line 2: why are the washout coefficients different between hydrophobic and hydrophilic aerosols? The mechanism associated with washout includes processes such as diffusion, interception, and impaction. Not sure how and to what extent it is affected by the water solubility of the aerosols.

p.15, line 19: it also enhances so₂ at Zeppelin in January and February, but not December, why?

p.16, line 17-21: I see the opposite way, where WETrev significantly underestimates nitric acid at the upper troposphere from Fig. 5

p. 34: reduce the xrange of the figure so that the difference among these lines can be seen more clearly