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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Model study of multiphase DMS oxidation with a focus on halogens" *by* R. von Glasow and P. J. Crutzen

Anonymous Referee #1

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General Comments

This paper investigates a major topic in tropospheric chemistry. A 1-dimensional model of the marine boundary, which includes a full treatment of gas phase, aerosol and cloudwater chemistry, is used to identify the multiphase oxidation pathways of dimethyl sulphide (DMS). The purpose of the study is to identify the fraction of DMS that produces H2SO4, and can form new cloud condensation nuclei, versus the fraction that form condensable sulphur species such as methane sulphonic acid, that condense onto pre-existing particles and cause them to grow. A particular focus of this paper is the role of bromine oxide in affecting the final partitioning of the DMS oxidation products.

The paper describes a very comprehensive study of this complex subject, with many

interesting conclusions. It will be of great interest to marine and atmospheric chemists, as well as climate scientists. It should certainly be published in ACP, but there are some points that the authors should consider.

Specific Comments

The model is used to examine the oxidation of DMS in effectively a multi-dimensional parameter space, of which the most important parameters are: time-of-day, vertical height in the boundary layer, degree of cloudiness, three different latitudes, two seasons, degree of alkalinity of sea-salt aerosol, product branching ratio of the OH + methane sulfinic acid reaction, and, finally, the presence of bromine. It does therefore not make for light reading! Even though the subsections often have a conclusion attached to them and contain interesting nuggets of information, this reader found it quite difficult to keep the bigger picture in mind.

I would therefore suggest that the Abstract has much of the quantitative detail of the model runs removed (since, as the authors show, significant uncertainties remain in the kinetics and mechanism), and instead lists the important conclusions more succinctly. Otherwise, these have a tendency to disappear into the details.

The authors chose 30 degrees N for the "process studies", and then carried out further sets of model runs for the "tropics" and Cape Grim, Tasmania. There is no explanation given for these choices. Presumably Cape Grim was chosen in order to compare with the large database of observations available from this site, so why not make this the test case for the model process studies?

This paper will be read by several communities within atmospheric science. It caters well for laboratory experimentalists and modellers by listing the important unknowns in the reaction mechanisms to which the model is sensitive. For field observers, it would have been very interesting to include more detail of the predicted vertical gradients within the boundary layer (these are mentioned in some cases, but some diagrams would be useful), for the planning of future fieldwork.

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A final point is the omission of any discussion of the role of iodine. Recent measurements of IO at Mace Head (Ireland), Tenerife and Cape Grim show that this halogen radical occurs, at least in coastal areas, at mixing ratios of several pmol/mol. At these levels, IO couples with BrO to deplete ozone very efficiently, is a major oxidant of DMS to DMSO, and the uptake of HOI and INO3 on sea-salt aerosol is a significant pathway to activate bromine and chlorine. This surely merits some discussion in view of the title of the paper?

Technical Corrections

The figure captions (particularly Figs. 4 and 5) require more explanatory detail.

Abstract: the acronyms MSIA, MSA and DMSO need to be spelled out.

p. 6736, line 16: what do Sc and St stand for?

p. 6736, line 19: cloud, not clouds

p. 6740, line 2: changed so as to be able

p. 6741, line 20: Table 2, 2, and 3 ?

p. 6746, line 25: then, not than

p. 6750, line 23: why is the BrO mixing ratio so high under these conditions? A sentence of explanation should be provided here.

p. 6751, line 23/24: Tables 2 and 2 ?

p. 6755, line 5: chemistry is included

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Interactive Comment