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Interactive comment on "Photooxidation of cyclohexene in the presence of SO_2: SOA yield and chemical composition" *by* Shijie Liu et al.

Anonymous Referee #2

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This manuscript presents laboratory measurements on the photooxidation of cyclohexene, with a focus on the change of SOA yield and chemical composition as a function of SO2 concentrations. The authors concluded that competitive reaction of OH radicals with SO2 and VOCs was the main reason that dictates the cyclohexene SOA yields, and presented FTIR, IC, and ESI-HR-MS data to support the formation of organosulfates in this specific system. Overall, this study provides useful information relevant to a better understanding of cyclic alkene SOA formation. However, there are a few major concerns regarding the connections between the reported data and the speculated mechanisms that need to be addressed before publication can be considered. Also, more in depth discussions are needed to improve the current manuscript. Below I listed a few specific questions for the authors' clarification.

1) In the abstract line 14-17, these two sentences are very confusing and somewhat

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contradictory with other statements in the manuscript. What is the real impact of acid catalyzed-mechanisms on cyclohexene SOA formation? 2) Did cyclohexene react completely in each experiment? The experimental profile presented in Figure S1 didn't include the traces of VOC precursor and main gas phase products. Since in section 2.2 the authors mentioned that these compounds were measured by TD-GC-MS measurements, these data should be included in discussion. 3) What is the connection between OH-limited scenario presented here (that leads to competitive reactions) and the real atmospheric environment? This is not clearly stated in the manuscript. 4) How does the chemical composition of SOA change in the absence versus in the presence of SO2? Without the initial input of SO2, the SOA yield was already substantial. It appears that with and without SO2 addition, SOA was formed through different pathways (homogeneous nucleation versus heterogeneous uptake/partitioning). This needs to be discussed in more detail. Also, the authors provided a full set of FT-IR spectra and sulfate concentrations. Are the corresponding ESI-MS data available? These will be useful to strengthen the discussion on organosulfate formation. 5) In the last paragraph of section 3.2, the authors stated that SOA yield was enhanced by acid-catalyzed heterogeneous reactions when SO2 concentrations are high. Is there direct evidence to support the proposed acid-catalyzed reactions? Was aerosol acidity measured or estimated? What is the potential role of particle sulfate contents for surface or bulk accommodation?

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