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Atmospheric Chemistry and Physics Discussions

Interactive comment on "Biodegradation of phenol and catechol in cloud water: Comparison to chemical oxidation in the atmospheric multiphase system" *by* Saly Jaber et al.

Anonymous Referee #1

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The manuscript by Jaber et al. asks the important question of whether biological (enzymatic) oxidation of phenol and catechol in simulated cloud water is important in the atmosphere. Bacterial (enzymatic) degradation of organic matter in cloud water is an understudied area of atmospheric chemistry that deserves more attention. In the present study, the authors carried out microcosm studies on cloud water surrogates to study biodegradation rates of phenol and catechol by Rhodococcus enclensis, a bacteria strain found to be quite active at oxidizing phenols during a recent (2018) survey of microbes in real cloud water samples. The derived biodegradation rates, along with chemical kinetics data on abiotic degradation of these compounds were combined in a box model to assess the relative importance of chemical and microbial degradation

processes in the fate of phenol and catechol in the atmosphere. The manuscript is well organized, concise, and well-written. Not only does the work show that phenol/catechol are consumed by Rhodococcus, but the authors use the derived degradation constants to compare it to abiotic loss processes in the atmosphere. This combination of laboratory and modeling work is a strength. The results conclude that microbial degradation has the potential to be as important as chemical loss processes of the compounds in cloud water, especially in the case of more reactive species such as catechol. This is an important finding that is a valuable contribution to the atmospheric community. I am supportive of publishing this work in ACP after the following questions are addressed.

The only major questions I have for study have to do with the applicability of the chosen laboratory experimental conditions to atmospheric conditions. I see that a temperature of 17 degrees Celsius has been chosen as a working temperature for all experiments. I assume this has been chosen to be a typical cloud water temperature? I note an absence of any information on solution pH, which is a significant environmental variable that controls both the chemistry (Fe speciation, ROS chemistry) and microbiology (viability of microbes, and enzyme turnover rates). I suggest the authors clarify under which pH conditions all experiments were carried out. Was a buffer used to control pH in these experiments or was solution pH adjusted in any way? Furthermore, it would be useful to discuss how the pH conditions used in their experiments compare to actual cloud water pH. A discussion of pH should also factor in when discussing the results shown in Figure 2 & 3. Does pH change during these experiments and could that explain trends in the phenol/catechol loss rates over time? Under what pH were the studies listed in Table S-2 carried out under? In the absence of the authors own data on pH effects, does the literature provide any insights into the effect of pH on phenol monooxygenases/hydroxylases and/or the activity of Pseudomonas and Rhodococcus strains? Under what pH is the modeling carried out under? Although not done in this communication, future work should be focused on characterizing these rates as a function of T and pH. On line 354-355, the authors state, "...we caution that these results likely represent an upper estimate that might not correspond to the moderate

pH values encountered in clouds." Please elaborate on this in light of the abovementioned questions. What do the authors mean by "moderate" and why wouldn't their experiments be applicable to the moderate pH values encountered in clouds? I feel that the lack of attention to pH is a major issue that needs to be addressed in the final manuscript. Lastly, for the modeling work, simulations are performed on monodisperse cloud droplets with a diameter of 20 microns, with specific drop number concentration and liquid water content. Please indicate how these were chosen and whether they are representative of typical cloud water.

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