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Interactive comment

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 #2

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This manuscript describes lab measurements of the ability of two bacteria species present in cloudwater to react with phenol and catechol molecules. The authors then run simple day and nighttime box model simulations to apportion the reactivity of these molecules to three bins: gas phase, aqueous phase chemical and aqueous phase biological reactivity. They find that bacterial transformation of catechol is an important loss process during the day, comprising 17% of the total losses in the daytime model. Daytime biotransformation of phenol, and nighttime biotransformation of either species, are minor loss pathways. This work will be of interest to those interested in SOA formation and cloud processing, and is publishable after minor revision.

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Specific Comments

Table 2: How realistic is it to model bacterial degradation rates as the fastest measured in Figure 2? Some discussion on this point could strengthen the conclusions.

Line 283: The text states that at 10⁹ cell concentrations catechol biodegradation "was too fast to be detected within the time resolution of the experiments (Figure 3)." However, the 10⁸ data is identical to the 10⁹ data, and should be included in this statement.

Figure 3 is not very relevant to the aims of the paper and could be moved to the SI section.

Figure S-3 is much more relevant to the aims of the paper, even though it doesn't necessarily strengthen the conclusions that biotransformation of catechol is significant during daytime. I urge the authors to move Figure S-3 into the manuscript, along with appropriate discussion.

Line 315: The statement about catechol degradation rates "Values are only available for Ps. putida EKII" is confusing, given that values are listed for a second strain listed in Table 2 (from Razika 2010). Only by reading the supplemental information section can the reader ascertain that the Ps. aeriginosa catechol degradation rate listed in the table in the row marked "Razika 2010" was not measured by Razika, but is actually the phenol rate times the ratio 12 (measured for another Pseudomonas strain. This is unintentionally misleading. I suggest that the table entry be "ND" and the phenol rate x 12 be given in the table caption, or in some other way that makes it clear that it is not a measurement of Razika et al.

Line 318: The claim that biodegradation rates of phenol or catechol are generally higher for Pseudomonas than for Rhodococcus has no statistical validity and cannot be made, especially in light of my previous comment. The variability between Pseudomonas strains is larger than the difference between the two species.

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Figures 4cd and S-3cd: Some of the statements made in the text discussing Figure 4 appear to be quantitatively incorrect when looking at Figure S-3. For example, line 344 "The total microbial activity in the aqueous exceeds that of the chemical reactions (Figure 4c) and contributes up to 17% to the total loss of catechol in the multiphase system." According to Figure S-3c, this statement is likely true when reaction with dissolved OH is the only chemical reaction considered. The statement should be modified to reflect the information shown in both figures.

Line 356: These sentences correspond with measurements in Figure 2, but do not correspond with the results shown in Figure 4, where the different processes are compared under the same conditions. It seems that with catechol (not phenol), photo- and biotransformations are of the same order or magnitude, and with phenol reactions with dissolved OH are significantly more important.

Line 379: This conclusion needs more support. It is clear from this work that microbial processes must be included to give a complete representation of cloudwater chemistry. Whether this complete representation is necessary to improve air quality or climate predictions has not been established.

Technical corrections

Line 176: "turned" should be "tuned"

Figure 2 caption should specify the Rhodococcus cell concentration.

Figure S1: the figure legend does not match the description in the caption. Is the blue line the lamp spectrum or the absorption spectrum of phenol?

Line 360: "might" should be "slightly"?

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