Response to Anonymous Referee #4

Montoya et al. investigate secondary organic aerosol (SOA) formation from OH oxidation of indole. They clearly demonstrate that this typical heterocyclic nitrogen-containing compound is an effective SOA precursor with a yield of ~1. SOA from indole strongly absorb sunlight in the UV region, contributing to brown carbon in the atmosphere. This comprehensive study is important for understanding SOA formation, and the manuscript should be published in Atmospheric Chemistry and Physics (ACP), after considering the individual comments below.

4.1 Introduction: Indole can also be emitted from animal husbandry (Feilberg et al., 2010; Yuan et al., 2017). Previous study has showed that animal feeding facilities in Los Angeles areas can be an important emission source for many pollutants (e.g. ammonia) (Nowak et al., 2012). The emission from animal feeding should be included in the discussion and in the chemical transport model as well.
This is a good point. We added the following paragraph in the introduction: "An additional potential source of indole is animal husbandry, however, the emission rate of indole from this source remains uncertain. In concentrated animal feeding operations (CAFOs), indole is primarily emitted from animal waste (Yuan et al., 2017), and can contribute significantly to the malodors in cattle feedyards and swine facilities (Feilberg et al., 2010; Wright et al., 2005). While Yuan et al. (2017) indicated that indole is emitted from dairy operations, beef feedyards, sheep feedyards, and chicken feedyards, the emission rate for indole from these sources was not quantified. Other studies have quantified the emission rate for indole, but only for pig facilities (Feilberg et al., 2010; Hobbs et al., 2004). The United States Department of Agriculture (USDA) 2012 census agriculture atlas maps show no hogs or pigs in the model domain used in this study. Furthermore, Hobbs et al. (2004) showed only trace emissions of indole from cattle slurry, and did not detect indole from laying hen manure. Thus, emissions of indole from animal husbandry are not included in this study, but should be considered when modelling areas with active pig facilities."

4.2 P8 L22: Please correct this citation
Citation was corrected.

4.3 P9 L16: Isatoic anhydride should be $C_8H_5O_3N$
Formula was corrected.

4.4 P8-P9: I would suggest moving Figure S2.3 and Figure S3 to the main text. These two graphs are really important to understand the oxidation chemistry of indole.
We elected to keep these figures in the SI for two reasons. Firstly, we have too many figures already. Secondly, the interpretation of these figures is complicated somewhat by the impurities present in the indole samples we used, as well as adsorption of sticky indole oxidation products to the PTR-ToF-MS sampling lines. While these technical complications do not change the main conclusion of the paper in a critical way, they would be too distracting to the readers in the main text. We think the SI section is an appropriate place for these figures under the circumstances.

4.5 P11: The reaction of NO_3 and indole is not investigated and considered here in this paper. Could you provide some discussion on this. What if you assume NO3 oxidation of indole has a similar SOA yield as photooxidation in the chemical transport model?

Inclusion of the reaction of NO_3 and indole in the simulations is a good idea. It is possible that it makes a non-negligible amount of SOA given that the rate constant for the NO_3+indole reaction is the same order of magnitude as the OH+indole reaction. However, we elected not to include the NO_3+indole reaction in this study because we have no experimental information on the yield or chemical composition of SOA produced via the NO_3+indole reaction. We are interested in exploring this reaction in a follow up study with corresponding laboratory experiments - thank you for the suggestion.

4.6 Figure 3: Do you consider the wall loss of semi-volatile organic compounds for the chamber experiments.

Based on the high value of the SOA mass yield, and the fast rate of production of particles in the chamber, the wall effects must be minimal. We added the following statement in the paper to address this: "Indole oxidation products could be lost to the walls reducing the apparent yield and contributing to its scatter. However, this effect is probably minor given that the apparent yield is quite high." in section 4.1, paragraph 2.

4.7 Figure 5: Could you indicate the locations of the important secondary products in the mass spectra.

The five most abundant peaks in each mass spectrum are now denoted in the updated figure.

4.8 Figure 7: Could you add reference lines for the labelled compound names.

Reference lines were added for the bold-face assignments.

4.9 Figure 8: Could you provide a colored version of this graph.

The reference spectra have been changed from black to blue.

4.10 Figure 9: Could you combine (a) and (b) to provide a more combined mechanism for the reactions. Based on Atkinson et al. 1995, 2-formyl-formanilide is the large oxidation product of OH+indole. This information needs to reflect in Figure 9.

We are not trying to provide a comprehensive mechanism in Figure 9; its main purpose is to propose possible formation mechanisms of the light-absorbing compounds. We did attempt to merge parts a and b, but it made the figure too cluttered. However, adding 2-formyl-formanilide is a good suggestion. The figure has been modified to include it.

References:

Feilberg, A., Liu, D., Adamsen, A. P. S., Hansen, M. J., and Jonassen, K. E. N.: Odorant Emissions from Intensive Pig Production Measured by Online Proton-Transfer-Reaction Mass Spectrometry, Environmental Science & Technology, 44, 5894-5900, 10.1021/es100483s, 2010.

Nowak, J. B., Neuman, J. A., Bahreini, R., Middlebrook, A. M., Holloway, J. S., McKeen, S. A., Parrish, D. D., Ryerson, T. B., and Trainer, M.: Ammonia sources in the California South Coast Air Basin and their impact on ammonium nitrate formation, Geophysical Research Letters, 39, L07804, 10.1029/2012GL051197, 2012.

Yuan, B., Coggon, M. M., Koss, A. R., Warneke, C., Eilerman, S., Peischl, J., Aikiin, K. C., Ryerson, T. B., and de Gouw, J. A.: Emissions of volatile organic compounds (VOCs) from concentrated animal feeding operations (CAFOs): chemical compositions and separation of sources, Atmos. Chem. Phys., 17, 4945- 4956, 10.5194/acp-17-4945-2017, 2017.

Relevant references from this list have been added, thank you for the suggestion.