
Response to Reviewer #2

1. This paper reported the vertical measurement of formic and isocyanic acids in a typical urban region. In this paper, the authors fully assessed the uncertainty caused by the ~400 m long tube sampling techniques, they showed the tubing has a negligible and minor influence on the formic and isocyanic acids, and confirmed the feasibility in vertical measurement by using the long PFA tube. By analyzing the vertical measurement dataset, they characterized the variation and formation of the two species on a diurnal and vertical scale and highlighted the limitations of using the ground measurement dataset to look insight to their chemical behaviors on the boundary layer scales. This paper contributed very useful sampling technique and a comprehensive monitoring dataset to atmospheric chemistry from the perspective of vertical scale, I would like to recommend this paper be published in ACP as a Measurement report type subject to the following minor comments.

Reply: We appreciate your valuable comments and suggestions, which are very helpful for the improvement of our manuscript.

2. The characterization of the tubing section is interesting and very useful to the community; thus I would like to encourage the authors to add one sentence to introduce this part in the abstract.

Reply: We greatly appreciate your suggestion and we have provided a brief description about the tubing assessment in the abstract. [see P: 2; L: 17-22]

“To address this issue, we assessed the impact of long tubes on the measurement uncertainties of formic and isocyanic acids and found that the tubing impact was negligible. Then, we conducted continuous (27 days) vertical gradient measurements (five heights between 5-320 m) of formic and isocyanic acids using long tubes based on a tall tower in Beijing, China, in the summer of 2021.”

3. Line 27-28 and Line 29-31, is it possible to switch the order of the two sentences?

Since the daytime vertical gradient and the causes can be illustrated clearly first. By the way, the sentence in Lines 27-28 cannot be well understood as, to why the positive gradient at nighttime can be indicative of the dominating role of photochemistry in the formation of the two species.

Reply: We appreciate your valuable suggestions and we have rearranged the order of two sentences. During the field campaign, formic acid exhibited a significant positive gradient both during the day and at night, which indicates the enhancement of their contributions from the sources aloft. As we discussed in lines 397-399, large amounts of these two species will accumulate near the surface with strong negative vertical gradients if primary emissions dominate its contributions, as manifested by vertical toluene profiles. [see P: 2; L: 29-34]

“The positive vertical gradients of formic and isocyanic acids in daytime imply the enhancement of their secondary formation in urban regions aloft, predominantly due to the enhancements of oxygenated volatile organic compounds. Furthermore, the afternoon peaks and positive vertical gradients of formic and isocyanic acids in nighttime also indicate their minor contributions from primary emissions from ground-level sources.”

4. Figure 3b, what happened in the result of 200 m with a much higher k and R²?

Reply: Thank you for your valuable comments. During the test of the 200 m tubing, meteorological conditions significantly changed with lower temperatures and stronger winds in comparison to the days on which the tests of the other lengths of tubes were performed. As shown in Figure A1, the concentrations of formic acid and isocyanic acid were evidently enhanced and significantly varied during the 400 m tubing test. In contrast, ambient concentrations of formic and isocyanic acid were relatively low and slightly varied, resulting in the exceedingly large or low values of k and R² between the concentrations of formic acid measured with and without the 200 m long tubing. However, according to the results of the test, the average concentration difference of formic and isocyanic acid measured with and without the 200 m tubing agreed well

within 4%, suggesting that the 200 m long tube has minor effects on the measurements of formic and isocyanic acid.

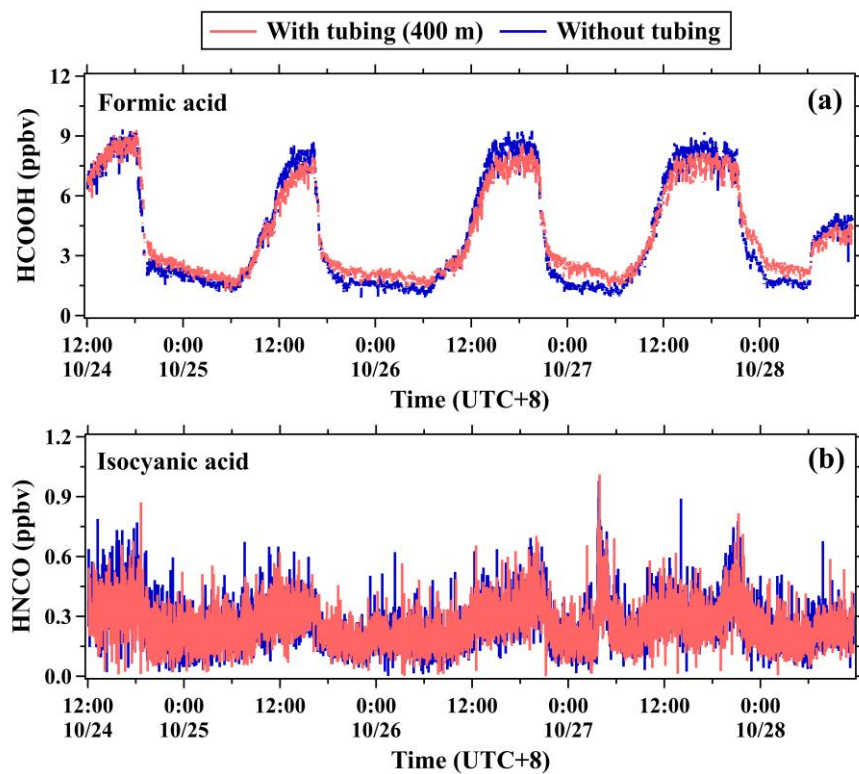


Figure A1. Time series of (a) formic and (b) isocyanic acid concentrations measured with and without the 400 m long tube.

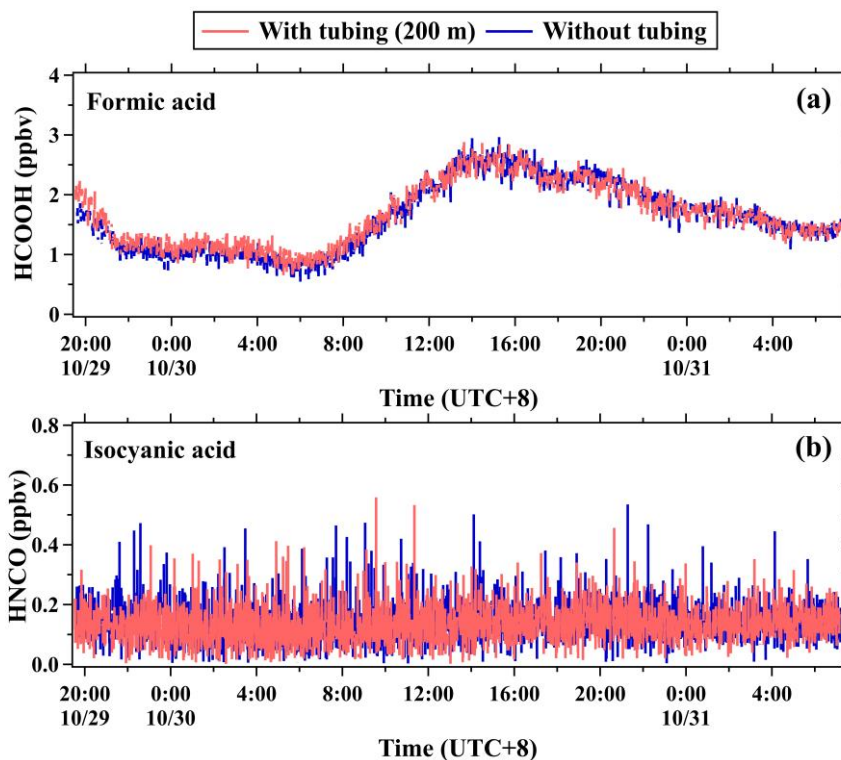


Figure A2. Time series of (a) formic and (b) isocyanic acid concentrations measured with and without the 200 m long tube.

5. According to Figure 2, I propose that the impact of formic and isocyanic acids is quite similar, the difference may be caused by the ambient concentration of the two species, even if the conclusion is not changed that the influence is small.

Reply: We appreciate your valuable comments. We agree with your opinion that the effects of long tubes on measurements of both formic and isocyanic acids were similarly affected by the changes in their ambient concentrations. As we discussed in the manuscript, formic acid exhibited more significant variation in ambient concentration than isocyanic acid, and therefore, it was more affected by the usage of long tubes.