

We thank the reviewer for their time and comments, which are reproduced in *italic font* below. Our responses are shown in regular font. Text added to the manuscript is underlined.

Anonymous referee #4

This paper shows the new instrument for the simultaneous measurements of ambient HONO and NO₂ by BBCEAS, and its assessment. This paper is well written and the authors pay attention to the analysis. Unfortunately, it is not "novel" technique for the ambient measurements of HONO and NO₂ by BBCEAS because there are many similar reports, as authors show. However, there is a little example for the application of the BBCEAS to the ambient measurements for the trace species. In addition, the comparison of the simultaneous measurements of HONO and NO₂ between IBBCEAS and the other technique is important. Therefore I recommend that this paper is published after the clarification some questions shown below.

1. For this instrument, there is no some experimental conditions. What company do you use for the spectrometer and CCD camera?

Response: We inserted the requested information (on line 103):

"The grating spectrometer (spectrograph and camera; Princeton Instruments Acton SP2156) has been described by Jordan et al. (2019)."

How much is the flow rate of the sample/ambient air (important information due to the next concern)?

Response: As stated on line 140, "Air was sampled at a flow rate of 2–3 slpm". No changes were made to the manuscript.

2. For the intercomparison of the simultaneous measurements of HONO and NO₂ by BBCEAS and TD-CRD, the authors tried to the estimation of the effects of the NO titration and NO₂ oxidation by box model. In this experiments, the concentration of HONO is 23.9 ppbv. Therefore, the OH radicals must be produced the same concentration in the TD cell. I think the concentration of OH radical can not ignore compared with that of NO₂ (109 ppbv).

Comment: In the heated section, HONO dissociates to NO and OH. The NO is oxidized to NO₂ after the heater using excess O₃. Thus, in the heated section, most of the NO_x is present as NO. If OH reacts with NO, it produces HONO, which (thermally) dissociates again.

In the TD cell, the reaction of OH with NO₂ must be caused and nitric acid must be produced. Womack et al. (Atmos. Meas. Tech., 10, 1911–1926, 2017) shows the temperature and flow rate dependences of the thermal dissociation of nitric acid. According to the Womack's paper, nitric acid may not be dissociate due to the lower temperature under the author's experimental condition. I think that the retrieval of NO₂ may be underestimate due to the formation of nitric acid.

Response: The conversion temperatures vary between quartz heaters and are a function of residence time. In our experience, the TD profiles of HONO and HNO₃ overlap (and also do for the NOAA

instrument - see (Wild et al., 2014)). Also, we observe linear correlations between CEAS and TD-CRDS - two very different measurements - throughout the mixing ranges tested (up to ~100 ppbv). If there were significant secondary effects like HNO₃ formation, we would not expect to see linear correlations with a parallel measurement. We hence do not agree with the reviewer that HNO₃ formation poses a significant interference.

No changes were made to the manuscript in response to this comment.

How do the author estimate the effect of the reaction of OH? And do the author consider the effect of the retrieval of HONO on the underestimation of NO₂?

Response: It seems that the lifetime of OH within the quartz heaters is rather short since there is no evidence for OH adducts (i.e. HONO or HNO₃ formation). We previously observed similar behaviour with ClNO₂ (Thaler et al., 2011), for which we expected non-linear thermal conversion to NO₂ (due to reaction of Cl with NO₂ to ClNO₂) but we have never observed that. We can only speculate as to the fate of OH, which may be lost due to collision with the quartz, but may also react with other gas-phase constituents of the sampled air, the bulk of which is generated using a NO_x-free zero air generation system which may contain light hydrocarbons (e.g., methane).

No changes were made to the manuscript in response to these questions.

References

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- Thaler, R. D., Mielke, L. H., and Osthoff, H. D.: Quantification of Nitryl Chloride at Part Per Trillion Mixing Ratios by Thermal Dissociation Cavity Ring-Down Spectroscopy, *Anal. Chem.*, 83, 2761-2766, 10.1021/ac200055z, 2011.
- Wild, R. J., Edwards, P. M., Dube, W. P., Baumann, K., Edgerton, E. S., Quinn, P. K., Roberts, J. M., Rollins, A. W., Veres, P. R., Warneke, C., Williams, E. J., Yuan, B., and Brown, S. S.: A Measurement of Total Reactive Nitrogen, NO_y, together with NO₂, NO, and O₃ via Cavity Ring-down Spectroscopy, *Environm. Sci. Technol.*, 48, 9609-9615, 10.1021/es501896w, 2014.