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Comment on amt-2021-19

Anonymous Referee #2

Referee comment on "Intercomparison of IBBCEAS, NitroMAC and FTIR analyses for HONO, NO_2 and CH_2O measurements during the reaction of NO_2 with H_2O vapour in the simulation chamber CESAM" by Hongming Yi et al., Atmos. Meas. Tech. Discuss., https://doi.org/10.5194/amt-2021-19-RC2, 2021

Paper: "Intercomparison of IBBCEAS, NitroMAC and FTIR for HONO, NO2 and HCHO measurements during the reaction of NO2 with H2O vapor in the atmospheric simulation chamber of CESAM", by Yi, H. et al.

The paper describes a IBBCEAS which, on the contrary to many existing set-ups, introduces the innovation of its in-situ installation, avoiding unwanted invasive use of pumps, etc. The system can measure HONO and, simultaneously, NO2 and CH2O. To evaluate its performance, an intercomparison against other instruments, NitroMAT, FTIR and NOx monitor is carried out. The paper is well written and results are well discussed. There is a detailed description of the instrumentation, procedures and error analysis. For these reasons I recommend its publication after considering the following aspects:

24: The title says HONO, NO2 and HCHO, but the introduction mainly talks about HONO. HONO measurement is challenging, while the detection of NO2 and HCHO is better stablished. Nevertheless, I would suggest to either include brief information on NO2 and HCHO, or explain that the main interest is measuring HONO although NO2 and HCHO absorb in the same region and are also tracked, being an advantage of the technique.

80: This work introduces some changes in the set-up of the instrument but it is based in previously developed IBBCEAS. Please, add some reference.

225: Can you confirm that DL for CH2O is 5ppb? The emission of the LED below 356nm is very low (Fig 3). The absorption for 143.3ppb in Fig 4 doesn't seem to suggest that an absorption of 5ppb will be detectable with such noise. DL has been calculated from 1-σ in Fig 4 through the region 351-378 nm as it is the analysis region, but 1-σ in the region where CH2O absorbs is much higher, therefore, the real DL would be higher. That noise would also explain the noisy profile in Fig 9. Please, comment.

580: There are -15ppb of CH2O in Fig 9. It might be due to interference with HONO. On the one hand, in general, these unrealistic data can be withdrawn as they are below the DL. Indeed, those data seem to have been withdrawn from Fig 9b since, looking at the 0ppb of concentration for IBBCEAS, data for NITROMAC do not replicate the whole set of data in Fig 9a, so they can be removed from Fig9a. On the other hand, they give information on how HONO is interfering, therefore, if the authors decide to include these data, some comment should be made in the text.

157: There were 4 experiments. At the beginning, the first experiment is described, and in line 174, it is said that there were 4 days of experiments. It can be mentioned that they were done under the same conditions as the first one.

172 and 198: Cavity mirror reflectivity is a key parameter in IBBCEAS for calculating the concentration. Having a NO2 monitor, why did you use FTIR for its determination? The NOx analyzer shouldn't have interferences during calibration as NO2 pure is introduced and there is no NOy (unless RH was not zero in the chamber). Is it related to accuracy? Please, add some comment.

240: Table 1 reflects the spectral regions corresponding to the IBI. Are these the analysis regions used for the analysis of each compound? If not exactly, please include this information in Table 1 or in the text.

255: Rephrase: 'and 120 such acquisition data'… to 'and 120 of such acquisition data' or '120 data acquired in this manner were'

276: detection limit of 10 ppbv at a sampling time of 1 min, compared… (or similar, to distinguish from DL of 5 ppb at sampling time of 5 min in line 130).

277: In Fig 7a, NO2 by FTIR is underestimated when there is HCHO. Was CH2O included as pure reference spectra in the analysis of NO2?

295: The reference from Stutz is widely used by the scientific community showing good agreement with others, but not with Brust. Apart of the error due to using different HONO references, the hypothesis of the mixing fans makes sense, and then I wonder: it would imply that also in the first peak in Fig 7 the mixing fan speed was increased since NitroMAC tracks FTIR data as in the 4th peak, while it doesn't in the 2-3rd peaks. How was the mixing fan in the day of the first peak?

300: "NitroMAC values were slightly larger than IBBCEAS". Slope NitroMAC vs IBBCEAS is 1.27, I would remove the word slightly.

325: “relative low detection limit” à do you mean high instead of low?

334: The authors might comment on how feasible is to use this in-situ system in other chambers.

575: Fig 8c, HONO IBBCEAS doesn’t have error bars

575: Did the authors try to analyze HONO (and NO2) in the region 357-380nm? To analyze HCHO, the selected region is adequate as both the HONO absorption at 368nm and NO2 in the whole region help in a better calculation of the HONO fit, and therefore, the error due to the interference of HONO around 353nm when calculating HCHO is reduced. But, to analyze HONO and even NO2, the absorption of HONO at 368nm is high enough to determine it in 357-380nm, and it would avoid the interference with HCHO in a region with high noise. Would Fig 8.a be the same?

Some editing comments:

80 and 87: installed on à installed in

108: reagent as soon as a few à reagent a few?

115: standard solutions was à standard solutions were

126: (see Fig. 1-insert) à (see Fig. 1)

155: 370), a FTIR spectrometer à 370) and a FTIR spectrometer

157: The experiment, the experiments or the first experiment?

163: Check sentence “When…”

168: Check sentence “As described…”

175: allows à allow

268: between two instruments à between the two instruments

279: weighed à weighted

565: Figure 6, X axis. Month (not moth)