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Atmospheric Measurement Techniques Discussions

Interactive comment on "A compact Incoherent Broadband Cavity Enhanced Absorption Spectrometer (IBBCEAS) for trace detection of nitrogen oxides, iodine oxide and glyoxal at sub-ppb levels for field application" *by* Albane Barbero et al.

Anonymous Referee #1

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Barbero et al. describe a cavity enhanced spectrometer for detection of NO2, IO, glyoxal, and O3. The instrument fits in a 19" rack mount and is temperature and pressure controlled and detection limits of 9, 0.3, 8 ppt and 40 ppb respectively in 22 minutes. The size and detection limits represent a step forward in the portability of IBBCEAS instruments, as well as the low power requirements. I recommend the paper for publication after addressing the following major and minor comments.

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Major Comments:

Line 150: The authors present a calibration procedure using NO2 as the calibration gas calibrated against a chemiluminescence (CLD) NOx detector as the standard. This seems counter intuitive to use an instrument that has a multitude of known flaws with regards to NO2 detection and interference to standardize your instrument. If the authors had shown using a more consistent and reliable technique (such as the one employed by Washenfelder as referenced in the paper) and compared the mirror calibration to show that their NO2 process is reliable, then this would have been an acceptable way to proceed.

Figure 3: The authors then show a time trace of good agreement of the IBBCEAS instrument with a CLD instrument. Of course, this isn't surprising, since the IBBCEAS was calibrated to the CLD instrument.

Line 120: The argument that flow calculations show that the air doesn't impact the mirrors and therefore, no purge is necessary seems insufficient. Some air will impact on the mirrors, bringing humidity, organics and other material that will deposit out on the surface of the mirror and degrade the reflectivity over time. The authors present no further justification for whether this worked. What was the rate of decay in the mirror reflectivity over time? Did the lower reflectivity to start with impact the ability to get away with this set up?

Line 212: Here it states that the instrument is sensitive to temperature and pressure drifts. While these all together can be tested through the variance analysis presented (in combination with any drift in the spectrometer noise), was there any effort to quantify how sensitive the instrument is to pressure changes?

Table 1: Comparisons are made to other IBBCEAS systems. While this is good, there is no effort to show them in a head to head comparison with comparable integration times which seems less useful, especially as the integration time listed for this instrument is 6 times longer than the next longest time in the table.

Line 351: This appears to be in conflict with the journal data policy. The data must be available in a repository or other source, not just on request.

Minor Comments:

Title: glyoxal is listed as a species of interest but never demonstrated. O3 while demonstrated is only useful for the NOx (NO+NO2) version of the instrument in verifying how much O3 is being used to titrate the NO. 40 ppb is not a useful LOD for ambient O3 measurement.

Line 56: “Leading (to) different”

Section 4.2: It would be simple to use the IBBCEAS instrument as the primary standard for the NO2 determination for the bottle if calibrated with N2 and He as described previously in the literature. Given the issues with CLD instruments and how extremely far off the measured bottle concentration was from the standard.

Figure 6 caption: “Certain extend” change to extent.

Figure 7 caption: How important are the outliers? They seem to be very far out. Is there something that caused them that they could be filtered out and removed in the analysis. It would be reasonable to remove 10 points out of >5000 if there was some software or hardware issue (pressure spike) that caused them.

Table 1: The column labeled FWHM is not the instrument resolution, but the fit window, update to be consistent (if the FWHM was 30 nm, the instrument would not be measuring any of these species).

Line 274: Provide a reference for the Tenua software.

Line 309: Replace “Last reaction” with “One more reaction”

Line 312: Change to “In urban environments OH radicals can be observed up to 4 x 10ˆ6 cmˆ-3”

Line 322: Mention is made here with regard to water interference, and that it is fit, but no accuracy is stated for the retrieved water concentrations or their effect on the fits of other species and the RMS noise.

Line 333: “absorption”, this should be extinction. IBBCEAS instruments measure the sum of absorption + scattering (extinction).

Line 334: “Thanks to the broadband feature”, the broadband feature or features of which species? Usually, these fits are sensitive to the narrow-band features which is what allows for simultaneous detection of multiple species.

Line 341: “A better”, just start with Better. . .

Line 344: Revise to “The dynamic range, detection limits, and"

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