Atmospheric
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Discussions

Interactive comment on "Study on the measurement of isoprene by Differential Optical Absorption Spectroscopy" *by* Song Gao et al.

Anonymous Referee #1

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The manuscript of Sao Gong and co-authors is a very interesting work on new kind of isoprene measurements using active DOAS (Differential Optical Absorption Spectroscopy) in the deep UV spectral range between 200 and 230nm. It is to my knowledge the first manuscript presenting so clearly the possibilities for quantitative isoprene measurements with this technique and fit well in the scope of AMT. The manuscript contain all basic information on instrumentation, characterization, data analysis and a field comparison experiment. Some of the information are incomplete and should be corrected. I recommend the publication of this manuscript after correction of the following points:

Major points:

1. Section 2.1 after line 115: It is not clear how the Reference I0 spectrum of the light

source is recorded and how it is considered in the spectral fit. The shape and spectral properties should be considered. How I0 measurements are made in measurements of section 3.1?

2. l. 128: NO absorption cross section was recorded with a reference gas. At which concentration and slant column (cell length). Is the NO signal representative for the atmospheric concentration over 75m? NO absorption contain narrow absorption bands which go into saturation. If the NO concentration is not representative these saturation effects should be considered.

3. Please explain in more detail the spectra preparation before the DOAS fit.

4. l. 133 and following: Provide DOAS fit errors for the derived concentrations. You may use the method of Stutz, J. and Platt U., Numerical analysis and estimation of the statistical error of differential optical absorption spectroscopy measurements with least-squares methods, Appl. Opt., 35 (30), 6041-53, 1996. Include errors of the measurements also in section 3 and 4.

5. Figure 1: Include all fitted reference gases.

6. l. 165 show a 6.6% underestimation. Please include an error estimation. Is this within the error? What are possible reasons? Could it be due to spectrometer stray light? Did you check the spectrometer stray light below 230nm?

7. l. 239: Your DOAS fit like in Fig. 1 is not dominated by noise but by a remaining spectral structure. This is dominating here your error. Apply a proper DOAS error calculation (see comment above). You can not simply translate the zero noise to a measurement noise over 75m. In the later case you have also interference's from other gases and imperfect spectral data, and likely also changes of our light source. The zero noise estimation is a lower limit and true error will be higher.

Minor points:

l. 101: include reference "(see Figure 2)"

l. 105: "the aperture of the transmitting telescope is 76mm, and the primary mirror is the UV enhanced spherical mirror...". - What is the focal length. Rephrase to make the sentence clear e.g.: The aperture of the transmitting telescope is 76mm, with a UV enhanced spherical mirror with a focal length of XXXmm. The aperture of the receiving telescope is 152mm, with a XXX mirror with a focal length of XXXmm.

l. 116: Specify the high pass filter.

l. 147: include the accuracy of the isoprene concentration in the bottle.

l. 198 – 199: The isoprene observed by DOAS at night is most of the time significantly above zero and does not reach zero later in the night. Could this not be a systematic offset e.g. due to missing I0 reference spectra?

l. 212: Here the argument for the difference is the sampling height. Before it was the night measurement. Put both arguments together in a merged explanation.

l. 214: "Isoprene will rise up and diffuse after emission from plants, so higher measurement points will catch higher concentration of isoprene." → This is completely wrong. Concentration can not accumulate and will always be same or lower with larger distance from the source.

l. 216: Specify expected losses in sampling tubes.

l. 217: Include estimation of (systematic) DOAS errors and if this can explain the difference.

l. 235: include measurement errors as example.

l. 251: It is not explained how the spectral structure of the lamp is corrected.

l. 254: "remain after the spectral fitting" , Include why they include → due to. . .. imperfect reference spectra

l. 260: How do you derive the influence of NO on isoprene measurements?

l. 274: Define the high pass filter for the differential absorption spectra. Is it the same like for the spectral analysis?

l. 275: Figure 7a), why these spectra are not shown as differential spectra?

Language:

l. 19 – 21, rephrase: The correlation coefficient between DOAS and on-line VOCs instrument observed from 23 days field observation is 0.85 with a slope of 0.86.

l. 43 – 45, rephrase: Due to the existence of multiple double bonds, the additional reaction with OH will lead to the formation of a variety of products and the formation of RO2.

l. 58: measure the isoprene → meausre isoprene

l. 61: spectrometry → spectrometer

l. 63: is not easy → difficult

l. 91: direction → possibility

l. 103: space → separation or distance

l. 104: source, → source.

l. 109: record spectrum → record the spectrum

l. 115: in atmosphere → in the atmosphere

l. 119: fitting differential → fitting the differential

l. 158: Fig. 3 is the linear fitting of the calibration→ Fig. 3 shows the linear fit of the calibration

l. 162: For the future → For further

l. 171 & l. 182: of DOAS → of the DOAS

l. 185: with DOAS → with the DOAS

l. 189: is lightpath → is the lightpath

l. 196: 0.217ppb, → 0.217ppb respectively,

l. 197: that on-line → that of the on-line

l. 252: isoprene. → isoprene absorption spectrum.

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