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Atmospheric Measurement Techniques Discussions

Interactive comment on "A high-resolution oxygen A-band spectrometer (HABS) and its radiation closure" *by* Q. Min et al.

Anonymous Referee #3

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General

This paper focuses on a description of measurements of O2 A-band spectra in directly and diffusely transmitted sunlight using a high-spectral resolution ground-based spectrometer, called HABS. In addition a comparison with computed spectra is performed, and differences are shown. The HABS instrument is a very interesting development for research, because of its high spectral resolution and its capability to measure the Stokes parameters I, Q and U (only V is not measured).

The application of these HABS measurements to get profile information of aerosols and clouds is mentioned several times but not investigated. Please reduce the repeated mentioning of the application without showing it. Showing results of the application is

not essential in the present paper, but it should be clarified what the aim is of the paper.

The topic of the paper fits well into AMT. The text reads well and the figures are clear. However, several clarifications are needed. The paper could be accepted after several major and minor modifications, mentioned below, are performed. The paper contains quite some typos; please correct the text carefully.

Specific comments

1. The main finding of the paper is the comparison between the measurements and the model results for a few cases. The differences are 5-9 %, in direct and diffuse radiation. What would be important to add is a deeper discussion of the cause of these differences: is it purely instrumental, or also an oxygen cross-section problem? From this discussion the readership could benefit.

2. The abstract and introduction are quite confusing regarding applications of the O2 A-band for aerosols and cloud profiling. What should be added to the paper is a discussion of the (fundamental) difference between O2 A-band observations from space, in reflected light, and from the ground, in transmitted light, which is the topic of this paper. The cloud/aerosol profile information content of space-based observations is much larger than of ground-based observations, due to the difference in atmospheric penetration depth of weak and strong lines for reflected light.

The abstract starts with: "The pressure dependence of oxygen A-band absorption enables the retrieval. . .": this is an unclear sentence. For profile retrieval from reflected light, no pressure dependence of the oxygen cross-sections is needed; the depth of the lines is determined by the level at which scattering takes place. Please clarify the formulation.

3. Are the solar Fraunhofer lines included in the calculated spectra, and if so which source was used?

4. There are many references to publications of the authors but missing are relevant

references from European groups observing and modelling O2 A-band spectra from space and ground. Papers to be referred to are e.g. :

- Stam et al., 1999, on modelling the polarisation of the O2 A-band

- Boesche et al., Applied Optics, 2005, and Boesche et al., JQSRT, 2006, on measuring and modelling the polarisation of the O2 A-band

- Koelemeijer et al., 2001, on GOME O2 A-band measurements

- Kokhanovsky et al., 2006, on SCIAMACHY O2 A-band measurements

5. It would be worth mentioning the GOSAT satellite, which has an FTS onboard with a similar spectral resolution as HABS, namely 0.015 nm (Kuze et al., Applied Optics).

6. p. 1032: equation 4 should be removed since the HABS instrument is not measuring V. So in equation 5, V should be removed. Then DOP becomes the degree of linear polarisation. Please refer to Van de Hulst 1957 for the definition of the Stokes parameters.

7. p. 1034, l. 15: this statement is not true: the O2 A-band lines are not individually resolved by HABS. This could be seen by comparison with a line-by-line calculation using e.g. HITRAN.

8. p. 1034: l. 16-18: this is an unsubstantiated claim. Please remove this sentence.

9. p. 1038: l. 2-3: this is quite vague; please explain.

10. p. 1038:l. 21: how is the relative difference defined, and what is the unit of the difference (percentage or fraction) ?

11. p. 1040, l. 11-14: how do you explain the fact that the direct beam radiance differs this much and in the same amount as the diffuse radiance, while the latter is expected to be more difficult to model than the direct radiance?

12. p. 1040, l. 18 until end of Sect. 5: this part does not belong in the summary but in

the introduction. Please remove here.

13. Figures:

Captions: GMT > UTC

Fig. 10: how are the spectra normalized? what is the unit of the difference spectra? Are the oscillations in the difference spectra caused by a spectral shift? Could you shift the spectra to reduce the oscillations?

Fig. 11: why is the deepest part of the O2 A-band missing in (a)? Why are there two dotted lines in (b)?

Fig. 12: diffuse spectra > diffuse zenith sky spectra

Textual errors:

p. 1028:

- l. 9: 0.16 nm > 0.016 nm (this mistake occurs several times)

- l. 11: combing > combining

- l. 12: HTRAN > HITRAN (this mistake occurs several times)

- l. 16: (-0.06, 0.05): please clarify. What is the unit? Fraction ? Percent / 100? These confusing numbers occur several times in the paper.

p. 1029:

- l. 3: the atmosphere > the atmospheric spectrum

p. 1030:

- l. 19: monochrometer > monochromator (this occurs several times)

p. 1031:

- l. 15/16: the absorption spectrum

p. 1032:

- l. 1: enhances

- l. 2: are > have

p. 1033:

- l. 1: spectrum shape > spectral shape (please check for more occurrences in the paper)

- l. 2: a filter function

p. 1037:

- l. 3: and etc. > etc.

- l. 4: DISORT model

- l. 5 : remove the word super, this is meaningless (occurs more often)

- l. 5: spectra > spectral

- l. 27: the slit function

p. 1039:

- l. 27: 0.16 > 0.016

Interactive comment on Atmos. Meas. Tech. Discuss., 7, 1027, 2014.