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Atmospheric Measurement Techniques Discussions

Interactive comment on "Near infrared nadir sounding of vertical column densities: methodology and application to SCIAMACHY" *by* S. Gimeno García et al.

Anonymous Referee #4

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General comments:

This manuscript gives a detailed description of the BIRRA (Beer Infrared Retrieval Algorithm), a new operational algorithm developed at DLR that is currently used to retrieve CO vertical column density from SCIAMACHY channel 8 and is being prepared to retrieve CH4 from channel 6. Unlike the DOAS approach, it directly analyzes the radiance spectra (instead of the logarithm of the radiances) with a forward radiative transfer model and a nonlinear least squares fitting. The retrieved vertical column densities are normalized to simultaneously derived CH4/CO2 column densities to de-

rive dry-air column density, which partly accounts for the neglect of scattering in the forward model. The authors first describe the forward model and inversion of the retrieval algorithm and then discuss the important sources of errors in both level 1 data and atmospheric parameters. Finally, they show examples of CO retrievals and initial CH4 results to demonstrate the BIRRA capabilities. A more detailed discussion of the results including validation will be given in a forthcoming paper.

This subject of this paper is suitable for publication on AMT. Generally, this paper is well written and organized. But as have been pointed out by previous reviewers, some important information about the operational product is missing: what are the output and its auxiliary information (e.g., vertical column density, dry-air column fraction, error, averaging kernels, ...), product availability, precision, cloud information, a priori information. Most of the information can be easily provided. Averaging kernels are one of the most important quantities for retrievals and their scientific applications, and can be derived from the inversion process. Example of averaging kernels should be provided. Also the paper lacks quantitative error analysis. Although a thorough error analysis involves not only a lot of sensitivity studies but also extensive validation, the authors should at least show examples of retrieval precision (e.g., global map of errors). Overall, I recommend it for publication on AMT after addressing these concerns and the following specific comments.

Specific comments:

1. Title: "Sounding" usually means measuring the vertical distribution of some parameters. Since vertical column densities are retrieved here, I suggest changing it to "retrieval"

2. Equation (8) is for a priori optical depth since n(priori) is used and the molecular scale factor is not multiplied in this equation.

3. Section 2.2.2, I think that the main advantage of separate least squares is to slightly speed up the retrieval processes. Can you mention that how much faster with this sep-

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arate least squares fitting approach? Which method is finally used in the operational processing? Although forward model varies linearly with the baseline correction parameters, but these parameters will change at each iteration if using a single iterative nonlinear least squares fitting approach. Do you get the same answers for all the parameters compared to the use of a single nonlinear least squares fitting? Normally, the fitting results will be better when simultaneously fitting all the parameters.

4. Section 2.23, line 17, it says that highest altitude sensitivity is located in the troposphere. I think that some of the altitude variation is simply due to the use of mixing ratio in the denominator (same mixing ratio contains more molecules at lower altitudes). To really examine the altitude variation of sensitivity, it is better to look at the sensitivity of radiance to partial column density of the specific gas.

5. In section 2.3.1, what a priori is used for CO and CH4?

6. In section 2.3.2 or in a new section: it is good to show examples of random-noise retrieval errors for CO and CH4 (e.g., 6-day composite maps of absolute/relative errors and retrieved vertical columns).

7. In section 2.3.2, what is the fraction of retrievals normally rejected due to each quality criteria? Very different criteria are used for cloud screening over land (below 20%) and over the ocean (above 20%). How clouds are treated in the retrievals? I guess that clouds are not treated as scattering medium in the algorithm. But are clouds treated as Lambertian surfaces? Please clarify this. It was said that over land cloud is a source of uncertainties. But this is true also for ocean. For example, where to put the cloud may significantly affect the retrieved CO VCD both over the ocean and overland depending on the vertical distribution of CO.

8. Section 3.4, line 10: how is the sun reference spectrum derived: daily or averaged over several days? Please mention it.

9. Page 3701, line 14: suggest changing “any artificial feature is” to “most artificial

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features are ” since measuring SMR and Earth spectrum does not share all the optics.

10. Page 3706, line 24, it misses to mention the MLS instrument that can also measure CO (e.g., Filipiak et al., JGR, 2005).

Technical corrections:

Page 3687, line 5: change “UV nadir sounding” to “nadir-viewing UV spectra.”

Page 3687, line 17, please spell out WFM

Section 3.2, line 4, please spell out DBPM or add “(DBPM)” in the title of section 3.2.

Page 3708, line 8, change “(Dils et al., 2006)” to “Dils et al. (2006)”

Interactive comment on Atmos. Meas. Tech. Discuss., 4, 3685, 2011.