Atmos. Meas. Tech. Discuss., 3, C2755–C2759, 2011
www.atmos-meas-tech-discuss.net/3/C2755/2011/

Atmospheric Measurement Techniques Discussions

Interactive comment on "LIDAR technology for measuring trace gases on Mars and Earth" *by* H. Riris et al.

H. Riris et al.

HARIS.RIRIS@NASA.GOV

Received and published: 17 February 2011

Page 4676-4678, Introduction: Significant information on the status of remote sensing instruments for CH4 is missing in the manuscript: - In the context to passive sensors methane measurements with SCIAMACHY on ENVISAT need to be mentioned since those data have already been used in flux inversion studies (P. Bergamaschi et al). I agree with reviewer's comment and will add references to SCIAMACHY and passive sensors

- In case of active remote sensing of CH4 reports on operational instruments for gas leak detection operating in the 3.3 _m or 1.6 _m spectral regions are available in the literature, For example, Milton M.J.T., T.D et al, 1997, Minato A. et al. (1999). Menyuk

N. and D. K. Killinger (1987). Fix A. et al. G. Ehret, A. Proc. 22nd International Laser Radar Conference, ESA SP-561, (2004) or others? What's the difference to those systems and what is the development status of the selected technology compared to previous similar systems. We will address the reviewer's questions and compare the development status of the selected technology compared to previous similar systems. The main difference is the application: space vs. ground or airborne based.

- In addition, as a reader, I found myself wanting more information about the measurement/ instrumental requirements for methane observation on Earth versus Mars. I assume that the requirements are quite different because the different level of knowledge and research goals. Will add more details for methane observations on Earth versus Mars. The instrument requirements are in somewhat flux since there is no NASA (lidar) instrument in development to measure methane on Mars or Earth.

- The phrase ": : : increased production of methane by methanogenic microbes : : :" needs a reference. Will add a reference.

Page 4679, lines 19-25 - The statement that the 3.3 _m spectral region is not well suited for methane measurements in the Earths's atmosphere is questionable. As above mentioned, the 3.3 _m spectral region is well suited for gas leak detection. The authors should be more precise on this point. Why not use spectral lines around 2.2 _m? I completely agree that the 3.3 um region has been used for methane measurements on Earth and it is well suited for gas leak detection. However, the variability of water vapor in the atmosphere, the strength of the methane absorptions in this region, and the long pathlength (several km), make accurate measurements from space very difficult indeed. The 2.2 um region is more difficult to access with an OPA. The 3.3 um spectral region is easily accessed using 1064 nm and telecom lasers at 1.55 um. However, the reader's question is valid. In order to address his/her concerns I will expand the reasons why the 3.3 um region is not well suited and why the 2.2 um region was not used.

Page 4680, lines 1-12 - This is textbook style information and should be shortened. OPO's and their modifications have widely been used in the past and many systems are reported in the literature. The authors should refer here to the literature.

C2523 Agree – I can shorten the section.

AMTD 3, C2522–C2525, 2011

Line 20: - Here some information about the spectral bandwidth requirement is missing. The assumption that the NPRO provides transform-limited pulses should be better justified or shown by a measurement. Will add a measurement and/or specifications from the manufacturer.

Lines 21-25: - the design and spectral performance of the seed-laser system is not adequately described. Not only the line width is a critical parameter but the temperature sensitivity or spectral drift of the DFB-laser would be of interest. What is the cause of the Erbium- doped fiber amplifier? What happens to the spectral performance of the DFB-laser after passing the amplifier stage. Will add details on temperature sensitivity, spectral drift, and spectral performance of the DFB-laser and explain the use of the EDFA.

Page 4681, paragraph 3.1 - In this paragraph the OPA performance is characterized. The authors mention in line 13, that a 20 dB intensity suppression over the gain bandwidth of 2 nm could be achieved, when the OPA-setup is seeded. I don't agree that this value would be sufficient for any high accurate methane measurements in the Earth's atmosphere. It is mandatory that the authors commend on the level of spectral purity that can be achieved with the proposed OPG setup. Furthermore, the measured value should be compared to the requirements for soundings on Mars and the Earth. - Besides severe lack of information on the spectral purity, this paragraph is in general too short with respect to fully characterize the performance of the selected OPG-setup. In particular, the results presented in the figures need more discussion. For instance, it is not clear to the reader, where are the limitations in terms of optimum seed power,

pulse energy, spectral bandwidth, spectral purity, and overall efficiency. Fig 7 should be discussed in more detail. What was the basis for the theoretical calculation. Also a brief comparison to similar systems that using OPOs or other radiation sources would certainly improve the quality of this manuscript, substantially. We will revise this paragraph to address the reviewer's assessment. We will provide adequate information on the spectral purity and add more discussion of the results presented in the figures.

Page 4682, line 6: - The version of which HITRAN data base was used should be added . Will add the HITRAN version used (2008).

Page 4683, line 4-7: - The calculation of the measurement sensitivity on Mars is not clear to the reader

C2524 I agree with the reviewer's assessment that the calculation of the measurement sensitivity is not clear. This was an unfortunate choice on my part because of ITAR restrictions on the specific detector used in the calculation. We plan to revise this section (without references to the specific detector) and make it clearer to the reader.

AMTD 3, C2522–C2525, 2011

- The sentence, " : : : with a well engineered instrument : : :we can increase the detection sensitivity limit even further" is an empty phrase and should be deleted. Will delete the phrase

Page 4684, lines 1-10: - More or less a repetition of what was said in the section 2 lines 20-26. Needs revision. Will revise

Page 4685, lines 1-5: - Description of Fig. 16/17 is a bit thin. What is the measured column-integrated mixing ratio and what is the measurement precision? We now have much better measurements with the measured column-integrated mixing ratio and the measurement precision. Also we include a comparison with an in-situ standard. With the editor's approval we would like to revise the manuscript and include those measurements instead.

lines 5-20. - The conclusion needs major revision. The formulation is too general and does not really reflect the results of the study. Will revise the conclusion and be more specific.

References: s. comment to the introduction Table 1. should be described in the text. The paper does not report on how the calculations are of the SNR are performed. We propose a major revision of the SNR section. We will adequately explain the SNR calculations and Table 1.

Fig. 3: What are the other lines in the spectrum? Will identify the lines in the spectrum (by color) or shorten the span to include only a couple of lines

Fig. 4: textbook info should be deleted Will be deleted

Fig. 5: Erbium doped amp. not described in the text. Also other sub-systems not explained. This will be remedied as described earlier

Fig. 9: the transmission should be given in log coordinates Will correct

Fig. 12: not clear to the reader. What is meant by methane mixture? Why is the transmittance larger than 1? Also the app. Wavelength must be described. Fig. 13: similar to Fig. 12 "Methane mixture" is the methane concentration (in air) used in the experiment. The transmittance is greater than 1 because of a large baseline slope (fringe) – the normalization point is somewhat arbitrary resulting in transmittance is greater than 1. Will correct the normalization so that the transmittance is never greater than 1. Will also correct the label approximate Wavelength.

Fig. 17: difference between on- and off-line not visible in a black and white copy Agree – will revise the figure

---

Interactive comment on Atmos. Meas. Tech. Discuss., 3, 4675, 2010.