Atmos. Meas. Tech. Discuss., 8, C2284–C2287, 2015
www.atmos-meas-tech-discuss.net/8/C2284/2015/

Atmospheric Measurement Techniques Discussions
Open Access

AMTD

8, C2284–C2287, 2015

Interactive Comment

Interactive comment on "Real-time remote detection and measurement for airborne imaging spectroscopy: a case study with methane" *by* D. R. Thompson et al.

Anonymous Referee #2

Received and published: 28 July 2015

Review publication by D. R. Thompson et al., submitted to AMT The manuscript presents the development and application of a real-time signal processing system for data collected by the airborne spectral imager AVIRIS-NG. The fast processing enables the detection of features of interest in real-time which allows taking "tactical decisions" regarding flight survey strategy and to guide other airplanes and mobile ground-teams to the most interesting targets. Furthermore, the manuscript describes several plume detection methods from simple qualitative to computationally more expensive but quantitative approaches and demonstrates their application during the joint NASA/ESA COMEX campaign conducted over fossil fuel production sites and other methane sources in California in 2014.

The manuscript is generally well written, presents robust science, and has a number of innovative aspects that make it clearly suitable for publication in AMT. The main novel aspect is the real-time processing of imaging spectroscopy data for trace gas detection which is clearly challenging given the high data rate and computationally demanding data processing required for the more elaborate (but more sensitive and accurate) methods.

The manuscript is somewhat lacking focus (is the main point the tactical remote imaging, the presentation of a novel plume detection method, the results during the COMEX campaign?) and is not always clearly structured (notably sections 2.3 and 2.4), which makes it difficult for the reader to grasp the main messages. However, I consider this as only a minor weakness.

I have a few main points and recommendations for improvements and a few minor points to consider. All this will not require major changes.

Main points:

1. The introduction and Section 2 are missing to mention that tactical remote measurement has been conducted already for decades using airborne radars for hunting thunderstorm clouds, hurricanes etc.. More recently real-time Lidar data analysis (e.g. from the DLR Falcon) has been used extensively to take tactical decisions during flight missions to direct aircraft to cirrus clouds, thunderstorms or biomass burning plumes. It would be good to mention this context and to work out more clearly that the true novelty of the present study is not tactical remote sensing itself but rather its application to remote trace gas imaging spectroscopy.

2. Section 2.3 describes different plume detection methods and presents the matched filter as “the current system”. However, later on in Section 3 the reader learns that during the COMEX campaign either none (June) or only the band-ratio algorithm (Septem-

ber) was available but not yet the more sophisticated matched filter method, which therefore should not be called “current”. It seems that the measurement campaign was actually a major driver for developing the real-time algorithms and if that was the case, this should be mentioned in the introduction. It should also be mentioned already in the introduction that during the COMEX campaign only a simple algorithm was available and that a more sensitive and quantitative real-time processing system was developed and tested post-campaign as described in detail in this manuscript. This scheme will be available for future missions.

3. The manuscript contains a large number of figures (14 in main part + 2 in appendix) but not all of them are very informative. Figures 6 and 7, for example, show photographs of the MAMAP aircraft and AMOG ground team whose data are only marginally (MAMAP) or not at all (AMOG) used in the manuscript. On the other hand, the manuscript repeatedly mentions the importance of the communication between the platforms and the command center (in Sections 3, 3.1, 4) and the corresponding technical solutions, but it is difficult for the reader to get a clear picture of the communication pathways. I feel that rather than showing the platforms individually in figures 1, 6 and 7, it would be more useful to show a schematic of the communication links between them. Such a schematic could potentially integrate the photographs in Figures 1a and 6 and could thus replace Figures 1 and 6 entirely. Figure 7 seems unnecessary in any case.

Minor points:

Page 6288, line 14: Change placing of parentheses from (Thorpe et al., 2013) to Thorpe et al. (2013). Same problem also on P6292, L21.

P6290, L10: The term "concentration length" is not quite appropriate since the basic units of the measurements are not concentration (mass per volume) but rather mixing ratio. I thus suggest changing the term to “dry air mixing ratio length” or simply “mixing ratio length”.

AMTD

8, C2284–C2287, 2015

Interactive Comment

P6290, L16-17: I didn't quite understand why the approximation log(x) $\approx$ x-1 is introduced. Wouldn't it be much more straightforward to introduce the approximation exp(x) $\approx$ 1+x for x«1 which results from the Taylor expansion of exp(x)?

P6291, L5: Why "As before"?

P6291, L19-21: The IMAP-DOAS method was mentioned earlier in Section 2.3. The last two sentences in Section 2.4 could be deleted.

Section 2.5.: The operator display doesn't seem to display any coordinates. Isn't this a major weakness?

Section 3.2 analyzes CH4 detection sensitivity and finds a NECL of 140 ppm for the most sensitive method. Why isn't this value mentioned also in the conclusions? Why is a detection sensitivity of 500 ppm suggested in the conclusions (as well as on P6294, L13).

P6297, L10: I don't think that "airborne in situ measurements" were mentioned before. What kind of measurements? On which platform?

P6298, L13: "increases, becomes" -> "increases, it becomes"

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 6279, 2015.