

Interactive comment on “Retrieval techniques for airborne imaging of methane concentrations using high spatial and moderate spectral resolution: application to AVIRIS” by A. K. Thorpe et al.

Anonymous Referee #1

Received and published: 9 December 2013

The manuscript of Thorpe et al., submitted for publication in AMT, addresses a relatively new and important topic, namely to detect and quantify elevated atmospheric methane concentrations due to emissions by localized sources using airborne remote sensing. The manuscript is very well written, it contains new material and the topic is appropriate for AMT. I therefore recommend its publication after the items listed below have been considered by the authors.

Section 1:

Page 8545, line 16: please explain MMT.

C2913

Section 2:

Page 8546, line 12 following: As shown in Krings et al., 2013, using MAMAP it was already possible to quantify local methane emissions, i.e., much more has been achieved than “offer the potential to measure local emissions” and “detect elevated CH₄ concentrations”. The text needs to be modified to consider this.

Page 8546, line 18 following: Concerning: “However, increased spatial resolution requires reduced spectral resolution”. This is not true but depends on the technology used. For example it is planned to extend MAMAP with a 2D CCD detector which would result in increased spatial sampling (same resolution) but would maintain the spectral resolution. The text needs to be adjusted to consider that the current statement refers to existing instruments but not to a fundamental limitation / tradeoff. The same comment applies to page 8566, line 18 following.

Section 3:

Please improve the explanations of the equations: e.g., (i) Eq.(1): this equation appears to be valid for a single absorber and not, as stated in the text, to multiple absorbers, (ii) what is an ideal instrument?, (iii) why is tau the measured differential (!?) optical density (Eq. (2)) ?

Page 8549, line 14: The listed SCIAMACHY numbers are valid for spectral resolution, not for spectral sampling intervals.

Page 8549, line 15-19: Order of citations: Gerilowki et al., 2011, needs to be cited first (for MAMAP instrument details and mission goals) followed by Krings et al., 2011, for CO₂ emissions from power plants, followed by Krings et al., 2013, for methane emissions.

Page 8549, line 24 following: Please add a reference or more details to justify the statement that scattering can be ignored here.

Section 4:

C2914

Page 8550, lines 20 and 27: Please also give local time (in addition to UTC) as this is more relevant in the context of this study (meteorology, etc.).

Section 5:

Page 8551, line 16: Please add the spatial and temporal resolution of the used NCEP data.

Page 8553, line 12: "each n layer": n is not the number of layers but the number of atmospheric state vector elements, or ?

Section 7:

Page 8556, line 11: Here "c" is mentioned for the first time and the reader may wonder where "c" is coming from. This is explained (much) later but it would be nice to at least shortly mention here that later it will be explained how the "optimum" c is being determined.

Section 9:

Page 8558, line 25: "sensor saturation"? What does this mean? Totally useless spectra as the maximum possible values (ADC output) are exceeded or values that are above a given threshold, e.g., defined by detector linearity, i.e., no "true saturation". Please add more details on this.

Page 8559, line 1 but also various other places: "uW" ? What does this mean? Microwatt ? If yes, please use a different (more common) notation (e.g., greek letter) or at least give clear definition / explanation when used for the first time.

Section 10:

Page 8561, line 26: What does "0.0075" mean? Is this the relative signal variation (i.e., 0.75%) or are some other units involved here ?

Section 11:

C2915

Page 8563, line 4: 2x typo "threshold".

Page 8563, line 8: I recommend to replace "validated against" by "compared with". Same paragraph: It would be nice of a more detailed explanation of the CTMF method would be given.

Caption Fig. 1: Replace "spectral sampling" interval by "spectral resolution" (as this is relevant for convolution).

Fig. 15: I guess that an offset has been added to the images. If yes, please list which offsets have been added. xy-plot bottom right: The green and blue color are hard to distinguish in a printout. I recommend to replace "light blue" by "dark blue".

Interactive comment on Atmos. Meas. Tech. Discuss., 6, 8543, 2013.

C2916