Atmos. Meas. Tech. Discuss., 8, C5481–C5488, 2016
www.atmos-meas-tech-discuss.net/8/C5481/2016/

Atmospheric Measurement Techniques Discussions

Interactive comment on "New temperature and pressure retrieval algorithm for high-resolution infrared solar occultation spectroscopy: analysis and validation against ACE-FTS and COSMIC" *by* K. S. Olsen et al.

K. S. Olsen et al.

ksolsen@atmosp.physics.utoronto.ca

Received and published: 11 February 2016

1 Anonymous Referee 1

1.1 General Comments

This is an interesting and technically competent paper that acts as a nice follow-on to Stiller et al. [1995] for pressure/temperature retrievals by occultation instruments, and the authors make a good case for revisiting

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

it for measurements in the Mars atmosphere where a priori information is lacking. Validation of their method is against (Earth-based) ACE-FTS and COSMIC P/T retrievals. The paper *could* go as written with minor changes, but I think it is too long and contains too much extra detail about ACE-FTS and COSMIC. This can be reduced without hurting the scientific value of this work, and would make a better paper.

We thank the referee for taking the time to read and evaluate our manuscript. The comments are valuable and have helped to improve the readability of the paper.

1.2 Specific Comments

Page 10825, lines 12–16

All we need to know is that methane has been detected in Mars' atmosphere. The history of the measurements is not needed for this paper, and I recommend cutting these lines.

We feel that several references in these lines are essential to a discussion of methane in the atmosphere of Mars. Removing these references will not impact the length or readability of the manuscript as they are mentioned very briefly, in a single sentence.

Page 10826

The description and history of MATMOS can be made much sorter. We only need know the spectral range and resolution of MATMOS and ACE – we don't need to know CSA did this and Bomem did that, etc.

Including this information was specifically requested by our collaborators at JPL and

AMTD
8, C5481–C5488, 2016

is otherwise unavailable in peer-reviewed literature, so we feel strongly that this paragraph remain intact.

Page 10827, line 26

> Change "but recently. . . " to "and recently. . . "

Changed "but recently. . . " to "and recently. . . "

Page 10828, lines 17–25

> This is a very long sentence. Suggest breaking it up, or making a bulleted list.

We reorganized this sentence into an organized list.

Page 10829, line 6

> Suggest noting that Norton [1991] used an onion-peeling approach rather an a global fit.

This is an important point, but for completion, needs to also include the methods used by Irion et al. (2002) (global fitting) and the current version (optimal estimation). Changed to:

> GGG grew out of software developed for the Atmospheric Trace Molecule Spectroscopy (ATMOS) Space Shuttle mission (Norton and Rinsland, 1991) (using an onion-peeling scheme) and was used by Irion et al.

AMTD
8, C5481–C5488, 2016

(2002) for the final version of analysis of ATMOS spectra (using the global-fitting approach of Carlotti (1988)). GGG is now used by the Total Carbon Column Observing Network (TCCON) (Wunch et al., 2011) and MkIV balloon program (Toon, 1991) (using a limited optimal estimation scheme for each spectrum described in Wunch et al. (2011))

Page 10829, line 14

Change to the singular "... The practical advantage of developing a new method is..."

Changed to "The practical advantage of..."

Page 10832

The methodology presented is difficult to follow when only presented in words. Strongly suggest a block diagram accompanying the text.

To keep the discussion of the ACE-FTS retrieval scheme short, we have presented a streamlined and simplified overview of the method, accompanied with an ordered, enumerated list on page 10831. A block diagram, which is somewhat more complex, can be found in Boone et al. (2005).

Page 10834, line 22

"VSF" is only defined later on the next page. It should be defined here when first used.

This is now corrected, however, the first instance of VSF is in an itemized list made in response to Referee 2's comments.

AMTD
8, C5481–C5488, 2016

Page 10835, lines 9–13

> Use a bulleted list rather than a long sentence for defining the symbols in Eq. 1.

As part of our response to Referee 2, this sentence has already been changed to reflect major changes to Section 2.3.

Page 10837, lines 4–20

> Again, a block diagram would make this easier.

The text on page 10837 has been heavily re-organized in response to comments made by Referee 2 in order to make the description more clear. The method has a linear flow, so an ordered, enumerated list, shown on page 10834, should suffice.

Page 10839, line 1

> The statement that g and M are left constant to keep the retrieval algorithm general and adaptable to other planets needs justification, although they make the case for Mars later.

Functions of altitude for g and M necessarily differ between bodies. For Earth, $M(z)$ and $g(z)$ are derived from models and empirical knowledge, respectively (e.g., page 10832, line 14), which are not currently well enough known on Mars. A future iteration of this software, when applied to a follow up MATMOS-like mission may include suitable altitude dependence in these parameters. The statement in the manuscript is a little misleading, so we have changed the sentence to: "The acceleration due to gravity, g, and the mean molar mass of air, M, are left constant to keep the integration general and quickly adaptable to other planets."

AMTD
8, C5481–C5488, 2016

Page 10842, Sec 3.2

> This is a long section about the validation of ACE-FTS P/T retrievals that I don't think really belongs here. The thrust of the paper should be the methodology and utility of the new algorithm. It's necessary only to give an outline of the ACE P/T accuracies and precisions with references to other papers.

Since this paper not only presents a method for retrieving temperature and pressure, but also includes analysis of real, Earth-observation data, an important seasonal comparison between two satellite instruments, and one of the first published presentations and uses of ACE-FTS v3.5 data, we feel strongly that a brief, but complete, review of previous comparisons is necessary. In order for our results to be fairly evaluated, and overview of the work preceding this is needed, and is the purpose of this section, which is followed by results of our own temperature intercomparison. The manuscript, formatted for publication (two-column), is 20 pages long and this discussion takes $2/3$ of one page, removing it entirely will not significantly affect the paper length, but will hinder our discussion of our results and remove the context of our interpretation of our results. Shortening this discussion will leave out important published results or negatively impact the readability.

Page 10848, lines 11 – page 10849, line 6

> Same complaint. An outline of the COSMIC accuracies and precisions are only needed, with references to other papers.

Please the response above, to comments made about Page 10842, Sec. 3.2.

AMTD
8, C5481–C5488, 2016

Page 10850, line 11

> I'd change "new technique" to "improved technique." After all, this follows on from Stiller's paper.

Agreed, changed "A new technique" to "An improved technique."

Figure 1 caption

> Suggest spelling out what "VSF" is so that someone reading and skipping to the figures will understand what they're showing.

We agree, but, because VSF is included in a mathematical expression, we have instead referred the reader to Eq.5.

Figures 4, 5, 7, and 8

> Suggest writing "Arctic 2010," "Middle East," "Arctic Fall," etc., near the appropriate curves in the figures themselves instead of (a), (b), (c), etc., to make it easier for the reader.

We tried this, but find that with six columns, and the smaller figure size used in the two-column publication format, the text becomes too tight or too small to read comfortably, especially with longer names, such as "Antarctic Spring."

2 List of Changes

Page and line numbers refer to the AMT Discussions paper.

- Page 10825, line 5 changed to: "...on the Sample Analysis at Mars suite (Webster et al., 2015), confirming earlier observations made by three independent groups: Formisano et al. (2004); Krasnopolsky et al. (2004) and Mumma et al. (2009)."
- Page 10825, lines 12–16 removed.
- Page 10827, line 26: changed "but recently..." to "and recently..."
- Page 10828, lines 17–25: broke up this sentence into an itemized list.
- Page 10829, lines 5–9: changed to:

> GGG grew out of software developed for the Atmospheric Trace Molecule Spectroscopy (ATMOS) 200 Space Shuttle mission (Norton and Rinsland, 1991) (using an onion-peeling scheme) and was used by Irion et al. (2002) for the final version of analysis of ATMOS spectra (using the global-fitting approach by Carlotti (1988)). GGG is now used by the Total Carbon Column Observing Network 205 (TCCON) (Wunch et al., 2011) and MkIV balloon program (Toon, 1991) (using a limited optimal estimation scheme for each spectrum described in Wunch et al. (2011)).

- Page 10829, line 14: changed "Practical advantages of..." to "The practical advantage of..."
- Page 10839, line 1: changed to "...to keep the integration general and quickly adaptable to other planets."
- Page 10850, line 11: changed "A new technique" to "An improved technique."

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 10823, 2015.