

Dear Reviewer,

Thank you very much for your attention and comments on our manuscript. Please find below our detailed replies on your comments.

Reviewer #2. Main comment:

It does not become fully clear which changes and improvements in the presented algorithm lead to the improvement of the high-resolution temperature profiles. In my understanding, the improvement stems from the optimization approach (Bayesian regularization) in the new method leading to main improvements at lower altitudes and for oblique occultations. It includes full covariance information instead of variance information only for optimal weighting of measurements and a priori. However, what is the effect of dropping the condition of cross-correlation coefficient <0.7 between the photometer signals as used in the old approach. What exactly are the changes compared to former algorithms or other available algorithms and what is the effect of these changes? I recommend including a discussion on this, maybe a short summarizing paragraph at the end of section 3. Also in the conclusions section this information should be included.

Authors

Yes, the main effect is the introduced statistical optimization (Bayesian regularization). The effect of dropping the condition $CCC < 0.7$ is clearly seen in Figure 5. The regions with $CCC \leq 0.7$ are clearly visible in the panel D, where the blue line has drops from 1. The main rationale of the V6 retrieval method was using minimum a priori information in retrievals.

During the development of the algorithm, we tested the dropping $CCC < 0.7$ condition (and applying weighting at all altitudes, not only at layers with low correlation. This is the equivalent of Bayesian regularization with diagonal matrices). As expected, profiles were smoother than in V6. We found (also expectedly) that the best results are when covariance matrices have off-diagonal elements: it is also justified by the retrieval principle.

There have been only two previous versions of the H RTP algorithm. In the first H RTP algorithm (developed before the launch), the values with $CCC < 0.7$ were replaced with ECMWF-estimated time delay. The jumps in temperature profiles were sharp and unrealistic. In V6, the values with $CCC < 0.7$ are replaced with the weighted mean of measured and a priori time delay. The unrealistic jumps became smaller, but still H RTP fluctuations are too large for oblique occultations.

In the revised version, we added more details in Section 3 (including illustration of averaging kernels, as suggested by Reviewer #1). In the discussion section, we also included the information about the main changes with respect to V6 and their influence on retrievals.

Reviewer#2, Minor comments:

Page 6, line 5 to 9: You jump right into this section by saying that the new retrieval starts at 32 km and afterwards explain why. But it does not get entirely clear. I find the explanation that you give in paragraph two of the summary section much clearer. I recommend starting in section 3.1 with a more general explanation on the main limiting factors of the H RTP retrieval (at upper and lower altitudes) along the explanation given in the summary. Also check that the altitude limits are stated consistently throughout the text.

Authors: this was also the comment by Reviewer#1. We added a short explanation on the selection of the upper level equal to 32 km, as well as a note that this will be discussed in more detail below.

P6, L7: "estimated using ECMWF data" and P12, L18: "ECMWF&MSIS" Please specify which ECMWF data (analyses, forecasts) and MSIS data you are using a priori.

In the revised version, we clarified that ECMWF analyses data are used and MSIS90 model (Hedin, 1991).

P8, L10: "This approximation is valid for large samples." Can you give a number or magnitude?

Like generally in statistics, "large" is considered when $n > \sim 100$. If $n < \sim 50$, the estimates based on Student's t-distribution are used.

P12, L12: "The error due to horizontal gradients of the refractive index at right angles to the direction of light propagation has been estimated in (Healy, 2001; Sofieva et al., 2004); it is less than 1 % for altitudes." The sentence is unclear, please reformulate: "right angles" change to "perpendicular to" " : : less than 1% for altitudes." Please state for which altitudes the error is less than 1%.

Sorry, the end of the sentence was missing: " for altitudes above 10 km".

P14, L4-5: "These temperature profiles are collocated with high-resolution radiosonde data from the SPARC data center (http://www.sparc.sunysb.edu/html/5_hres.html)." Please include at this place the complete information on the radiosonde data and on the collocation criteria you are using for your comparison. You provide it later in the section (Page 17, line 17 to page 18, line 6) so you just need to move the paragraph to the beginning of this section.

Thank you for your suggestion. In the revised version, we moved the information about the radiosondes to the beginning of Section 4.

P14, L24: " : : previous H RTP validation results : : ." Please add a reference here.

The reference (Sofieva et al., 2009c) is added

Reviewer#2 Technical/editorial comments:

Please check consistent writing of "Sect.", "Section" and of "Figure or "Fig." throughout paper text.

Checked.

Please check throughout the manuscript citations integrated in the text, should be written (e.g., at P3, L13/14): " : : in Dalaudier et al. (2006) and Sofieva et al. (2009c): : ."

Corrected

P1, L18: "in in-orbital plane occultations" change to "for in-orbital plane occultations"

P1, 24: "analysis" change to "analyses" or "for the analysis of"

Corrected

P2, L2: insert "instrument" after "(GOMOS)"

Done

P2, L32: "For the stratosphere, it covers roughly a decade between 10 and 100 meters(of vertical scale): : ". Suggest to rather use "a magnitude of 10 m to 100 m" instead of "decade : : :".

Changed to: "For the stratosphere, it is roughly between 10 and 100 meters"

P3, L4: " : : :to understand better: : : " change to " : : :to better understand: : :"

Corrected

P3, L27: "Section 4" correct to "Section 5" (on gravity wave analysis).

This is the remark explaining why H RTP V6 data were not recommended for GW research, and the illustration is provided in Sect.4

P3, L30: It is unusual and there is no need to have a separate section on the paper structure. Please remove the section header. "1.3 The paper structure". Just make a separate paragraph at the end of section one explaining the contents of the paper. I suggest to merging the last sentence in section 1.2 with the first sentence in current section 1.3.

Corrected according to the suggestion.

P4, L1-2: Remove the sentence "The information about the GOMOS H RTP dataset and data access is presented in Section 6."

P4, L2: "conclude the paper (Sect. 7)" correct to "conclude the paper in Section 6."

Corrected

P6, figure2: There is no reference in the manuscript text to Figure 2.

The references are added. In the revised manuscript, this is Figure 1.

P6, L6: "strength of scintillation" change to "the strength of scintillations"

Done

P8, L9: " : : : where n is the size of samples participating in: : : " rather write " : : :where n is the sample size used in : : :"

Done

P8, Figure 4 (right): The thin light blue line and thin light red line are hardly visible in the plot. Please make it better visible and also mention them in the last sentence in the caption of Figure 4.

In the revised version, we use more distinct colors: black and grey. They are now mentioned in the caption of Figure 4.

P9, L11: " produce scintillation during stellar occultation" Use plural ? scintillations, occultations

P9, L24: "photometers" change to "photometer"

Corrected

P10, Figure 5: Please make the green lines a bit thicker, especially in sub-panels B and D.

We made the green lines ticker.

P11, L7: "(7)" change to "(Eq.7)"

P14, L12: "raise" change to "rise"

P15, L15: "in other occultations" change to "for other occultations"

Corrected

P14, L6-7: "The collocated temperature profiles are shown by blue lines in the left panels of Figs. 6 and 7, and the information about the spatio-temporal difference is provided in the figure." This sentence can be removed as the information is given in the figure caption.

We would prefer keeping this sentence, because in the beginning of the paragraph we note that H RTP are shown by red lines.

P15, L6: change "Figure" to "figure title".

P20, L23: "of polar night jet" change to "of the polar night jet"

P20, L23: "The enhancements in the equatorial region is also observed, which seem to be:" change to "The enhancement in the equatorial region is also observed, which seems to be:"

P22, L7: "occultations bright stars" change to "occultations of bright stars"

P22, L20: "constitute absolute majority" change to "constitute the majority"

Corrected