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Atmospheric Measurement Techniques Discussions

Interactive comment on "High-resolution temperature profiles (HRTP) retrieved from bi-chromatic stellar scintillation measurements by GOMOS/Envisat" *by* Viktoria F. Sofieva et al.

Anonymous Referee #2

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The authors present an improved retrieval algorithm for high-resolution temperature profiles (HRTP) based on bi-chromatic stellar scintillation measurements from the GOMOS instrument onboard Envisat, i.e., based on two photometers at different wavelengths measuring the time delay between the signals of different wavelengths which is proportional to the refraction angle difference. The retrieval algorithm is described in detail from computing the refraction angle profile, its inversion to the refractivity index profile and to the retrieval of temperature profiles. The resulting exemplary high-resolution temperature profiles are presented for different conditions (vertical/oblique occultations, bright/non-bright stars). Validation with collocated temperature profiles from radiosondes shows good agreement. Furthermore, the use of these

high-resolution temperature profiles for gravity wave analysis is demonstrated.

The paper is well written and well structured. The retrieval algorithm is described in good detail. I just have one major comment and a range of minor comments. I recommend publishing the manuscript after revision taking into account the reviewer's recommendations and providing necessary clarifications. Please find the list of comments below.

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.

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 HRTP 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.

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

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

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 sentences 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%.

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.

P14, L24: “. . .previous HRTP validation results . . .” Please add a reference here.

Technical/editorial comments:

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

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). . . ”)

P1, L18: “in in-orbital plane occultations” change to “for in-orbital plane occulations”

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

P2, L2: insert “instrument” after “(GOMOS)”

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 . . .”.

P3, L4: “. . .to understand better. . . ” change to “. . .to better understand. . .”

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

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.

P4, L1-2: Remove the sentence “The information about the GOMOS HRTP dataset and data access is presented in Section 6.”

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

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

P6, L6: “strength of scintillation” change to “the strength of scintillations”

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

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.

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

P9, L24: “photometers” change to “photometer”

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

and D.

P11, L7: “(7)” change to “(Eq.7)”

P14, L12: “raise” change to “rise”

P15, L15: “in other occultations” change to “for other occultations”

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.

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. . .”

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