Atmos. Meas. Tech. Discuss.,
doi:10.5194/amt-2017-129-RC2, 2017
© Author(s) 2017. This work is distributed under
the Creative Commons Attribution 3.0 License.

Atmospheric Measurement Techniques Discussions

Interactive comment on "Deriving the slit functions from OMI solar observations and its implications for ozone-profile retrieval" *by* Kang Sun et al.

R. Lang (Referee)

ruediger.lang@eumetsat.int

Received and published: 10 July 2017

The paper by Sun et al, is an important contribution to the currently expanding field of studying the spectral response functions – or slit-functions – of satellite based hyper-spectral instruments measuring in the UV to near or short-wave infra-red region in-orbit. Until recently, and for this type of instrumentation for which a very high accuracy of slit-function characterisation is required in order to meet the accuracy requirement of the level-2 products, predominantly on-ground pre-flight slit-function data has been used. However, since both the launch, as well as instrumental changes notably in the thermal environment, may often significantly affect the spectral response of the instrument, it

Printer-friendly version

Discussion paper

is important to be able to derive the slit-function data also from in-orbit data, with a reasonable to high accuracy.

The paper by Sun et al. explores various slit-function functional forms (stretch, Gaussian, and super-Gaussian), which can be used for in-orbit characterization using a high spectral resolution solar reference spectrum together with in-flight measured solar spectra. The paper describes the main differences between in-orbit derived slit-functions and the pre-flight derived slit-function for the Ozone Monitoring Instrument (OMI) on-board the AURA platform. After a thorough discussion of the observed differences they apply the various slit-functions to their ozone profile retrieval algorithm in order to evaluate their performance by comparing the results to ground based ozonesonde network data. The conclusion of this work is that there, are partially significant, differences in the derived slit-function parameters between on-ground and in-orbit, but less between their various functional forms. The paper shows, that OMI-retrievals can benefit, from applying in-orbit derived slit-functions, depending on the spectral region applied. The paper also confirms that the OMI instrument is sufficiently stable that a fixed set of in-orbit derived slit-functions suffices to improve the retrievals for the full OMI records.

I can recommend the paper for publication in AMT, since it is a significant contribution to improving our practical knowledge on how to derive in orbit slit-functions and by this improve the level-2 products from the increasing suite of hyper-spectral UVNS instruments. I have only a few comments, which may require minor revisions of the paper.

1) Overall there is a quite thorough description of the technical approach to derive in-orbit slit-functions. However, the paper lacks some detail on the minimization procedure for the slit-function fitting. What kind of minimization has been applied, what kind of site constrains have been applied, and also with respect to the spectral band edges. The paper could provide some more details on these aspects in section 2.1.1.

Printer-friendly version

Discussion paper

CC BY

2) The functional form of the slit-function used for pre-flight measurements and its performance with respect to the Gaussian and the super-Gaussian, which are used for the in-orbit measurements, is not discussed in the paper. In principle one should test the three functional forms on the same data-set, e.g. the pre-flight data-set, in order to see if they provide the same results, i.e. if the changes observed between on-ground and in-orbit are clearly instrument related, or due to the usage of different functional forms. In addition, in order to avoid that the worse performance, e.g. for a spectrally changing asymmetry, is just a result of missing information (i.e. due to the null space of the problem using the solar spectrum, which itself is spectrally dependent) it could be considered to derive spectrally dependent parameter from fitting the on-ground measured, dedicated slit-function spectra, with higher information content for the spectral response.

3) I would propose to move the section on the comparison of the results for the pre-flight and in-flight slit-function parameters (section 3 and 4) directly after the description of the method (section 2.1), since for me these sections form a closed entity of instrument characterization including its result, which is then applied, in a next step, for an evaluation of its respective performance in the level-2 retrievals.

4) In section 4 on the temporal evolution of the in-orbit slit function, in case there would be a small in-orbit seasonal variation of the instrument slit-function, e.g. due to temperature variations, how would this affect the MgII index itself. Should we then not potentially expect a correlation of the results in first place, but not due to the solar variability but due to the slit-function changes itself? 5) At the end of section 4, the authors speculate about the reason why “the retrieval using standard Gaussian slit functions shows the smallest variations of biases and variations of residual RMS, which is not fully understood.” And they hint at issues like stray-light, scene in-homogeneity or intra-orbit changes. But why would this not affect the super-Gaussian and the stretched pre-flight functional forms in the same way?

Editorial:

CC BY

Page 14, line 17, “lost” -> loss

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2017-129, 2017.

Printer-friendly version

Discussion paper

CC BY