Atmospheric
Measurement
Techniques
Discussions

Interactive comment on "Mirror contamination in space I: approach" *by* J. M. Krijger et al.

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The paper by Krijger et al. on the effect of mirror contamination of contamination and degradation sensitive instrumentation in the UV to visible spectral range is a very important contribution to quantify and eventually correct time series of radiance measurements in this spectral region. Many instruments measuring in the UV to visible region suffer from degradation especially towards the shorter wavelength and especially in case they make use of mirrors which are very much exposed to the open environment (which is usually the case for scanning instruments of this type). While other parts of the full optical chain may also suffer from degradation through e.g. self-contamination of the instrument (this is very likely the case for GOME-2) there will always be a contribution to the overall observed throughput loss and its spectral dependence of the scanning unit, which so far could not exactly be modelled.

The paper provides a model of throughput loss due to up to two different layers of contamination distributed over potentially more than only one mirror and fully taking into account the impact of the degree and orientation of polarisation of the incoming light, and therefore of effects known to introduce viewing-angle dependent biases. In addition they show how to include a diffuser as an additional mirror surface in the overall sequence of mirrors by modelling the latter as a large number of mirror facets which are randomly orientated with respect to the entrance slits normal.

They verify their model with the special case of SCHIAMACHY, which in limb geometry uses a sequence of two entrance mirrors potentially exposed to contamination and show that they can age the observation acquired in the lab for various degrees and orientation of polarisation. They show that especially for a two mirror combination the specific type of additional contamination is crucial in the short wavelength rage for acquiring exact results. Via this approach the type of contamination (for SCHIAMACHY in the lab this occurs to be a thin oil film) may even be identified.

The paper is a very useful and important contribution for targeting and eventually mitigating the effects of throughput degradation form contamination on the level-1b (radiance) data quality fo instruments of this type and therefore for a potentially significant improvement of long-term data-series quality. I therefore can recommend it for publication in AMT considering some minor specific comments and editorials.

Specific comments:

1) A short discussion on potential limitation of the model for shorter wavelength than 250 nm should be added. The applicable wavelength range is not explicitly mentioned so the reader can only infer form some hints on what the limitations could be, e.g. like the availability of refractive index reference data or the availability of trustworthy lab-data from the on ground calibration campaigns for verification (because of limited signals of the sources), etc..... A short discussion or mentioning of this lower limit and potential accuracy limitations is definitely needed as the region between 250 and 320

nm is critical for many retrievals but also critical for its response to contamination.

2) In principle it would be interesting to show how the results on throughput (Fig. 8) scale with different contamination heights, especially for the single layer case where the exact type of contamination might be of less importance according to the finding of the paper.

3) In the introduction the authors claim that "The great value of this model is that it is generally applicable and can be easily applied to all satellites both in low and geostationary orbit, employing (scan-)mirrors or other optics suffering from degradation due to contamination." We are lacking an outline on how easy it really is. As the program for the companion paper seems to be the focus on SCIAMACHY the potential user of this model may very much benefit from a list of assumptions made, which either be retrieved from external sources (like refractive index databases of contaminants) or must be fitted 9like probably contamination layer thickness in time etc.. This list of "complications" may either be put in the introduction (in case they are summarised shortly) or even better need to be listed and explained in the body of the paper.

Editorials:

p. 1222, l. 11f: The mentioning of sub-indices j and k can/should be avoided here since they are never used (layers are referenced explicitly with numbers).

p. 1222, l. 15: Theta -> Phy_1

Eq: 26: Angles phi_mi1 and phi_mir2 = phi_esm and phi_asm.

Figure 3/4: change angles 'i' to 'phi' in the plot (as well as in other plots).

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