

Interactive comment on “Accounting for the photochemical variation of stratospheric NO₂ in the SAGE III/ISS solar occultation retrieval” by Kimberlee Dubé et al.

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1 General comments

The manuscript presents the results of the investigation of the importance of correctly accounting for the diurnal cycle of NO₂ in solar occultation experiments, in particular for the NO₂ product of SAGE-III onboard ISS. A few previous papers had already studied this effect, but the present work addresses a clear case as the current SAGE-III retrieval algorithms do not achieve this level of sophistication. The method proposed in this work can easily be transposed to other past or future solar occultation experiments, such as

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balloon-borne campaigns, or satellite instruments such as ALTIUS.

Overall, the manuscript is an excellent piece of work: the scope of the study is clearly described, the datasets used for testing the hypotheses are well chosen, the figures are all appropriate, and of very good graphical quality, and the text is in general very clear. I only have a couple of questions, and spotted a few typos.

2 Specific comments

1. On line 144, it is explained that the PRATMO model is not used above 40km in order to avoid unphysical values. This tends to indicate that the authors sought to use it on a larger vertical extent, but faced reliability issues. As a result, the disagreement between the two products (original SAGE-III NO₂ profiles, and those corrected for diurnal variability) tends to fade away as the altitude increases (Fig.6). As a note towards readers willing to apply the same correction technique, could you elaborate a bit on the reasons which forced you to not implement the diurnal correction above 40km? Is it due to the model itself? or to the specified O₃, pressure, and temperature profiles?... Was there any reliability concerns raised at lower altitudes?
2. It is not entirely clear if Fig.4, which shows the scaling factors applied to the path segment matrix X, shows an average scaling taking into account the two disymmetric sides of the light path, or if it only shows the factors for one half of the path. In the latter case, which half is it? Could you make it a bit clearer in your description?
3. On page 10, the authors point out that the agreement of the improved NO₂ profiles is better at sunrise than sunset. The discussion about this difference is somewhat vague, especially that, to my knowledge, OSIRIS is sounding the atmosphere both close to local sunset and sunrise. Could this topic be slightly

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expanded? For instance by listing the possible reasons for this pending bias. In particular, did you consider to restrict the coincidence criteria to less than 24 hours, in order to limit the time gap which needs to be solved by the PRATMO model?

3 Technical corrections

4. Line 52: double "the"
5. Line 221: "... between with ..." should read "... with ..."

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