Author's Response: amt-2017-229 originally submitted on 07 Jul 2017
Title: Drift corrected Odin-OSIRIS ozone product: algorithm and updated stratospheric ozone trends
Authors: A. Bourassa, C. Roth, D. Zawada, L. Rieger, C. McLinden, D. Degenstein

Thank you to both referees for the helpful reviews. The referee comments are provided below, with our response in blue.

Referee #2:

Major issue: This study assumes that the initial average and "stable" altitude bias of +200 m until ~2011 as derived from RSAS is a modelling artifact (p.5,l.26) and then assumes that the true bias must be zero, thus offseting the entire time series of altitude shifts by -200 m (making the initial average bias zero). One argument in favor for doing this was that without altitude corrections the ozone bias from prior data versions with respect to other measurements (Adam's papers) was showing no meridional structure. I find this argument not convincing as we should not favor a certain procedure just to optimize a bias to some external data. It would be certainly better to show that indeed high level clouds introduce a systematic error in RSAS based upon RTM simulation. Alternatively, one could consider to show that by limiting OSIRIS data to cloud free scenes indeed a zero altitude bias can be found (at least on average). Figure 3 is in my regard only a hand waving argument.

This is a very good point and we have studied this in some detail. We have found that the RSAS correction over the 2004-2010 baseline time period is a monotonically increasing function of retrieved effective surface reflectance (albedo). This "effective surface" reflectance also incorporates the effect of clouds on the upwelling radiation. The mean RSAS offset over the 2004-2010 time period and associated standard deviation, is shown in a new figure (now labelled Figure 4 and shown below). For low values of albedo, the average RSAS offset is essentially zero (basically following the reviewer's suggestion to check the result for cloud-free scenes). The RSAS offset increases to approximately 400 m at high albedo. For a typical albedo of 0.3, the RSAS offset is ~200 m. This shows that for low values of albedo, the RTM simulation and thus the RSAS result is quite robust, and when the albedo increases, the uncertainty in the tropospheric conditions increases leading to a bias in the RTM simulation and the derived RSAS offset. This discussion has been added to the revised version of the paper.

Minor comments:

p.1,l.23: In the list of references profile trend papers are cited, but the Weatherhead paper is a total ozone trend paper. Why is this paper cited?

Citation removed.

p.2,l.8-10: Which of the three points raised by Harris et al. (2015) are addressed by this paper (probably i and ii), please state them.

Yes, we have added the statement that "this work contributes to the first two of these three points."

p.4,l.25; change "350 km" to "350 nm".

Done, thank you for catching this.

p.4.,l.26: Why is the match done for radiances at 40 km and not higher? Does the albedo change if other altitudes are used? Please clarify.

Increasing stray light and decreasing signal-to-noise limit the ability to use higher tangent altitudes. This statement has been added to the text.

p.4,l.27: omit "the scan is".

Done.

p.6,l.5: are " albedo, stratospheric aerosol extinction, NO2, and O3" retrieved simultaneously or is the same algorithm (with different settings) used to retrieve the various quantities separately. Please specify. You may want to add a reference here.

This is specified in Degenstein et al., 2009, which we now reference here.

p.6,l.5-7: The sentence "No changes were made to the retrievals of the other species other than the pointing correction to the radiances; the impact of this correction on these other species has yet to be assessed." sounds awkward. What are "other species" than listed in the sentence before. You probably meant that the impact of the altitude corrections has only been assessed for ozone so far.

Yes, the statement is now clarified to say exactly that: "The impact of the RSAS correction has only been assessed for ozone so far."

p.6,l.8: The sub phrase "is not equivalent to simply shifting the retrieved ozone profile by the RSAS correction" implies that somebody has used that simple solution. If yes, then please cite the study or explain where this has been done.

This has not been done with a published product to our knowledge; however, we thought it pertinent to point out since a simple shift of the retrieved profile might seem tempting to a naïve observer. In fact, we tried this with the OSIRIS data set and found that the non-linearity of the inversion does impact the results, especially at low altitude.

p.7,l.24ff: The trend results should be compared to more recent results from Steinbrecht et al. (2017) and Sofieva et al. (2017) that are also part of this special issue.

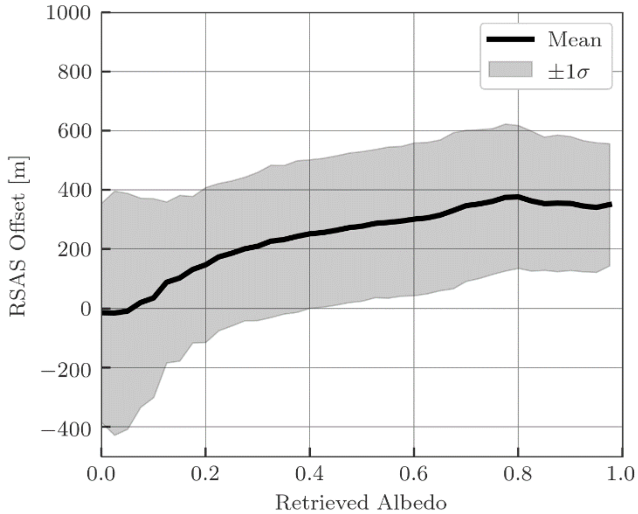
The trend results are very consistent with those presented by Steinbrecht et al., 2017, and Sofieva et al., 2017, which also use this drift-corrected OSIRIS data in combination with SAGE II, OMPS and other limb data records. This is noted in the text.

Figure 3: a better color scale for the contour plot that distinguishes between negative and positive values would be good.

Done. See response to referee #1.

Figure 4: Replace "GEOGRAPHIC AVERAGE FIGURE" in the caption by the correct figure number (guess Fig. 2).

Done. Yes, it's figure 2.



New Figure 4: The dependence of the mean derived RSAS offset (and standard deviation) on retrieved effective surface reflectance over the same 2004-2010 time period.