

Interactive comment on “Altitude Registration of Limb-Scattered Radiation” by Leslie Moy et al.

Leslie Moy et al.

leslie.moy@ssaihq.com

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We would like to thank the reviewer for their considered comments. Below is our response and attached in a new version of the paper.

2 Minor Revisions/Suggestions – Line 64 to 67: Maybe focus on profile information instead of low cost as satellite measurements are usually very expensive. Included words to focus on profile information provided by limb sensors. – Line 68: Could you further explain, what are these science requirements that result in a TH accuracy of 100 m. Rewritten: To meet long-term ozone monitoring needs (3% precision between 15 and 50 km) requires the altitude registration of the radiances to be accurate to within ~100 m. – Line 79: "effect of aerosols [...] are small" - small compared to what? How low does the aerosol extinction have to be? We can never be certain we are aerosol free we can only minimize the aerosol contamination – changed text to explain this. – Line 112 to 114: What about particles (like meteoric dust) at alti-

tudes 35 km ? The RSAS method determines the absolute TH error. We used results before the Kelud eruption which had the smallest values (the cleanest atmosphere) to normalize the ARRM results. The 20 and 40 km altitudes used in the RSAS method are not in the Junge layer.
â€” Line 119 to 121: What is the effect of the vertical resolution? Typically, limb measurements can only provide limited information on $d\ln I/dz$. OMPS LP has a vertical resolution of ~ 2 km. However, the calculation shown in Figure 1 shows the slope is \sim linear near 20km and \sim vertical near 40km so vertical resolution does not constrain our determination of the slope.
â€” Line 144: "... estimate rc..." Why do you estimate a simulated value? Maybe write "simulate" instead? Done.
â€” Line 152/153 and Line 182: Again the question of the influence of meteoric dust arises. If the extinction of those particles is too small to be of importance, than I would suggest to at least mention this. We do not believe there is persistent dust at 65km, and passing meteoric dust would be averaged out in the zonal means.
â€” Line 158: Where do you get the climatological ozone values from? And how do you deal with the transition between measured profile and climatology? Our climatology is GMAO (GEOS-5 FP_IT Np). Our point is that whatever ozone values we use at 65km, it will not affect our results greatly because of the sensitivity of the 295nm radiance to ozone above 65 km is small.
â€” Line 207: You say, that the Knee method is unreliable and depends on the O3 profile - how can you use it to evaluate the other two methods? We do not use the Knee method for validation. We use ozone comparisons – the sentence is rewritten to make this clearer.
â€” Line 260: Have you thought of using ECMWF Operational Analysis data? It is not well suited for long term analysis, since it changes model configuration frequently. However, in order to quantify the GPH uncertainties you can use it for case studies: Since February 2006 this model reaches up to 0.01 hPa (80km) with a temporal resolution of 6h (should be sufficient for the higher atmosphere). Thank you for this suggestion. We will take this up in future work.
â€” Line 265: How do you deal with high altitude clouds for equatorial RSAS data? We first considered RSAS at the South Pole where the aerosols are normally at a minimum. When comparing it to the equatorial region before the Kelud eruption we found it to be

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cleaner. So we conclude the contamination was at a minimum then. Line 360: You mention MERRA GPH, but not the temperature. What about un- certainties in the MERRA temperatures, mentioned in Line 358? Sentence includes temperature now.

3 Grammar/Spelling/Typos/Suggestions The suggestions listed below are according to my best knowledge. Not all items are mandatory corrections. Line 70: "earth's" ! "Earths" (capital E and no use of ') Earth was capitalized but we kept the apostrophe. Line 70: "difficult if not impossible" - this phrase is reoccurring. I suggest to reformulate it. Done Line 73: "... that compare the radiances measured by the instrument to model calculations of radiances." ! "... that compare measured and simulated radi- ances." Done Line 74: "methods" ! "methods" (no ') Done Line 79: "... radiances are small." compared to what? I would also suggest to re- formulate the following sentence as it appears more complicated than necessary. Rewritten for clarity. Line 84: "... than absolute errors" ! Add "in limb altitude registration." Done Line 92: "from aerosols" ! "by aerosols" Done Line 95: "tropospheric clouds, aerosols and surfaces" ! "tropospheric clouds, aerosols and surface albedos". I think it would be even better to separate clouds and aerosol that are within the "circular cone" and clouds and surface albedo that are below said cone in its footprint. Done Line 97: "difficult if not impossible" - this formulation is reoccurring - maybe reformulate it. Done Line 98: "variations in it." ! "variations within." Done Line 108: "... by one of the authors (Bhartia) ca 1992." ! "... by Bhartia in 1992." I am not used to the type of quotation you chose. Also, "ca" should be "ca.". Done Line 109: "that change... changes" ! "that the gradient... changes" Done Line 127/128: "... to be at or below 20 km..." ! "... to be 20 km..." (there is a less-equal sign in word and latex) Done Line 133: "... more important..." ! "... more significant..." Done Line 135: "... it is quite complicated (Fig. 3) and difficult to model since it is determined by subtle..." ! "... it is difficult to model (Fig. 3) due to determination of subtle..." Done Line 139: "... more heavily..." ! "... more..." (leave out heavily) Done Line 144: "... at and above 40 km." ! "... for altitudes 40 km." Done Line 159: "The principal difficulty ... at 65 km." (full sentence) ! "The main difficulty in applying ARRM is the inaccuracy of

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GPH data near 0.1 hPa required to calculate 295 nm radiances at 65 km." Done

Line 163: "Though it may be... meteorological data." - I dont understand this sentence. Could you reformulate it? Rewritten

Line 170: "... right side provide..." ! "... right side of equation (2) provide..." Done

Line 194: "... the knee the ozone..." ! "... the knee ozone..." (you can cancel the "the" in front of ozone) Done

Line 196: "... shape allows one to..." ! "... shape allows to..." Done

Line 197: "The principal advantage of this method is that one can use shorter wavelengths where aerosols are not a problem." ! "As one advantage of this method shorter wavelengths with less sensitivity to aerosol can be used." Rewritten

Line 199: "However, this comes at a penalty; the method..." ! "However, the method..." Done.

Line 203: "... errors that is..." ! "... errors that are..." Done

Line 251: "... are used in the..." ! "... are sufficient for the..." Done

Line 284: "... is closer to 100 m." ! "... is about 100 m." Done

Line 301: "... 14%/km near 40 km." ! "... 14 %/km around 40 km." Done

Line 306: "3hPA" ! "3 hPa" Done

Line 312: "... and both may..." (both what?) maybe "... and both values of the GPH may..." rewritten for clarity

Line 321: "measure" ! "measurements" Done

Line 327: "Fig. 11" ! I think you mean Fig. 12. If not: Fig 12 is not referenced anywhere else in the text." Done

Line 348 to 350: Could you plot this correlation? The correlation coeffs are: [0.909405 0.965083 0.984190 0.994004], respective for the days.

Line 358: "... ozone units..." ! "... ozone number densities to mixing ratios." Done

Line 373: "attitude" ! "altitude" Done

Line 374: "... is also not..." ! "... is not..." Done

Line 376: "... as we have seen with the SNPP spacecraft." - Do you have sources for this? What are you referring to here? GLEN

Line 382: "... precision also within..." ! "... precision within..." Done

Line 386/387: "... of the atmospheric pressure vertical profile..." ! "... of the vertical profiles of pressure and temperature..." Done

Line 388: "... as both well as..." ! "... as well as..." Done

Line 391: "... that ARRM is capable of multi-year trend..." ! "... that ARRM is capable of deriving multi-year trend..." Done

4 Figures

All axes should have a unit description or (AR) for arbitrary unit. Done.

All unit descriptions should be uniform. So either choose "(unit)", e.g. in Fig. 4

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"Altitude (km)", or ", unit" as in Fig. 1 "Altitude, km" Done. âĀĀ All axes should have the same spelling for the label (e.g., Latitude vs. latit)Done. âĀĀ I would suggest to write numbers below 13 as words ("one" instead of "1") Done for some numbers. . . âĀĀ Figure 1: "normalized to 40.5 km" ! "normalized at 40.5 km" Done. âĀĀ "field of view and includes no aerosols." !"field of view without aerosols." Done. âĀĀ "is caused by" ! "originates from the" Done. âĀĀ "tangent point starts" ! "tangent point start" Done. âĀĀ "varies by 8-10%/km" With respect to what? Is it variation for the whole dataset? Done. âĀĀ Figure 3: Maybe show the dependency on the scattering angle, perhaps by including an axes for the scattering angle? Done âĀĀ Figure 4: "no aerosols as a function of altitude" Do you mean no aerosols? Or altitude independent aerosol extinction? Please clarify. Done. âĀĀ Figure 6: Altitude != TH/Elevation - I think both terms are mixed up in the y axes description. It would also help to include a more detailed figure description on west/center/east slits as the meaning became clear only after reading the main text. Done. âĀĀ Figure 8: Is this really the tropopause or just the 380 K isentropic surface? The tropopause line is from GMAO data. âĀĀ Figure 11+12: Figure description is the same as in the main text. I suggest to reformulate the figure description. Done.

Please also note the supplement to this comment:

<http://www.atmos-meas-tech-discuss.net/amt-2016-103/amt-2016-103-AC2-supplement.pdf>

Interactive comment on Atmos. Meas. Tech. Discuss., doi:10.5194/amt-2016-103, 2016.

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