

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

### **Anonymous Referee #2**

Received and published: 15 June 2016

#### **1 Summary**

This work describes different methods to determine the pointing error of satellite measurements in limb geometry. The accurate knowledge of this error is required for precise information on stratospheric trace gas and aerosol extinction profiles. Rayleigh Scattering Attitude Sensing (RSAS), Absolute Radiance Residual Method (ARRM) and the Knee method are evaluated using measurements of the Ozone Mapping and Profile Suite (OMPS) Limb Profile. All three methods are categorized into different latitude regions where they are applicable depending on the stratospheric aerosol distribution. The paper does comprehensively describe these methods and lists potential difficulties that can be investigated in future studies. However, the paper would benefit from some corrections and minor revisions. In the following I will list general suggestions, followed by suggested corrections to grammar and spelling and comments on the figures.

C1

#### **2 Minor Revisions/Suggestions**

- Line 64 to 67: Maybe focus on profile information instead of low cost as satellite measurements are usually very expensive.
- Line 68: Could you further explain, what are these science requirements that result in a TH accuracy of 100 m.
- Line 79: "effect of aerosols [...] are small" - small compared to what? How low does the aerosol extinction have to be?
- Line 112 to 114: What about particles (like meteoric dust) at altitudes  $\geq 35$  km ?
- Line 119 to 121: What is the effect of the vertical resolution? Typically, limb measurements can only provide limited information on  $dn/dz$ .
- Line 144: "... estimate  $r_c$ ..." Why do you estimate a simulated value? Maybe write "simulate" instead?
- 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.
- Line 158: Where do you get the climatological ozone values from? And how do you deal with the transition between measured profile and climatology?
- 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?
- 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

C2

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).

- Line 265: How do you deal with high altitude clouds for equatorial RSAS data?
- Line 360: You mention MERRA GPH, but not the temperature. What about uncertainties in the MERRA temperatures, mentioned in Line 358?

### 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 ')
- Line 70: "difficult if not impossible" - this phrase is reoccurring. I suggest to reformulate it.
- Line 73: "... that compare the radiances measured by the instrument to model calculations of radiances." → "... that compare measured and simulated radiances."
- Line 74: "methods'" → "methods" (no ')
- Line 79: "... radiances are small." compared to what? I would also suggest to reformulate the following sentence as it appears more complicated than necessary.
- Line 84: "... than absolute errors" → Add "in limb altitude registration."
- Line 92: "from aerosols" → "by aerosols"

C3

- 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.
- Line 97: "difficult if not impossible" - this formulation is reoccurring - maybe reformulate it.
- Line 98: "variations in it." → "variations within."
- 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."
- Line 109: "that change... changes" → "that the gradient... changes"
- Line 127/128: "... to be at or below 20 km..." → "... to be  $\leq$  20 km..." (there is a less-equal sign in word and latex)
- Line 133: "... more important..." → "... more significant..."
- 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..."
- Line 139: "... more heavily..." → "... more..." (leave out heavily)
- Line 144: "... at and above 40 km." → "... for altitudes  $\geq$  40 km."
- Line 159: "The principal difficulty ... at 65 km." (full sentence) → "The main difficulty in applying ARRM is the inaccuracy of GPH data near 0.1 hPa required to calculate 295 nm radiances at 65 km."
- Line 163: "Though it may be... meteorological data." - I dont understand this sentence. Could you reformulate it?

C4

- Line 170: "... right side provide..." → "... right side of equation (2) provide..."
- Line 194: "... the knee the ozone..." → "... the knee ozone..." (you can cancel the "the" in front of ozone)
- Line 196: "... shape allows one to..." → "... shape allows to..."
- 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."
- Line 199: "However, this comes at a penalty; the method..." → "However, the method..."
- Line 203: "... errors that is..." → "... errors that are..."
- Line 251: "... are used in the..." → "... are sufficient for the..."
- Line 284: "... is closer to 100 m." → "... is about 100 m."
- Line 301: "... 14%/km near 40 km." → "... 14 %/km around 40 km."
- Line 306: "3hPA" → "3 hPa"
- Line 312: "... and both may..." (both what?) maybe "... and both values of the GPH may..."
- Line 321: "measure" → "measurements"
- Line 327: "Fig. 11" → I think you mean Fig. 12. If not: Fig 12 is not referenced anywhere else in the text.
- Line 348 to 350: Could you plot this correlation?

C5

- Line 358: "... ozone units..." → "... ozone number densities to mixing ratios..."
- Line 373: "attitude" → "altitude"
- Line 374: "... is also not..." → "... is not..."
- Line 376: "... as we have seen with the SNPP spacecraft." - Do you have sources for this? What are you referring to here?
- Line 382: "... precision also within..." → "... precision within..."
- Line 386/387: "... of the atmospheric pressure vertical profile..." → "... of the vertical profiles of pressure and temperature..."
- Line 388: "... as both well as..." → "... as well as..."
- Line 391: "... that ARRM is capable of multi-year trend..." → "... that ARRM is capable of deriving multi-year trend..."

#### 4 Figures

- All axes should have a unit description or (AR) for arbitrary unit.
- All unit descriptions should be uniform. So either choose "(unit)", e.g. in Fig. 4 "Altitude (km)", or ", unit" as in Fig. 1 "Altitude, km"
- All axes should have the same spelling for the label (e.g., Latitude vs. latitude)
- I would suggest to write numbers below 13 as words ("one" instead of "1")
- Figure 1: "normalized to 40.5 km" → "normalized at 40.5 km"

C6

- "field of view and includes no aerosols." → "field of view without aerosols."
- "is caused by" → "originates from the"
- "tangent point starts" → "tangent point start"
- "varies by 8-10%/km" With respect to what? Is it variation for the whole dataset?
- Figure 3: Maybe show the dependency on the scattering angle, perhaps by including an axes for the scattering angle?
- Figure 4: "no aerosols as a function of altitude" Do you mean no aerosols? Or altitude independent aerosol extinction? Please clarify.
- 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.
- Figure 8: Is this really the tropopause or just the 380 K isentropic surface?
- Figure 11+12: Figure description is the same as in the main text. I suggest to reformulate the figure description.

---

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