

Journal: AMT

Title: Applying FP_ILM to the retrieval of geometry-dependent effective Lambertian equivalent reflectivity (GE_LER) to account for BRDF effects on UVN satellite measurements of trace gases, clouds and aerosols

Author(s): Diego G. Loyola et al.

MS No.: amt-2019-37

General comments

#	page	line	comment
1			<p>The paper describes a novel method to derive the geometry dependent Lambert Equivalent Reflectance of the Earth scene, which is an important parameter needed for the retrieval of trace gases. The method is shown to have many benefits over the use of a climatology, as has been used often for past missions. The introduction of the paper is well written and of good quality, nonetheless, the remainder of the paper is a bit thin when it comes to provide evidence of the improvements over existing climatologies. Only comparisons with OMI are given while there exists more climatologies based on other missions. Also the directional aspect of the GE_LER needs more validation. The paper covers new and interesting topics and techniques, and after the comments (some of which major) and corrections have been adequately addressed, the paper could certainly be published.</p>
2			<p>Although the paper stresses the importance of the inclusion of BRDF in the newly derived TROPOMI surface reflectivity, this is not the only factor that plays a role, and probably not the strongest factor. Since the radiation field in the UV is largely diffuse, the actual BRDF of the surface is not so important. The better inclusion of snow/ice areas and the higher spatial resolution probably play a stronger role. Please discuss this point, and try to separate the effects of the three factors: BRDF, snow/ice, and spatial resolution in the comparison of TROPOMI GE-LER with OMI-LER climatology.</p> <p>The improvement that is found in the TROPOMI total ozone retrieval in Fig. 11 when using the TROPOMI GE-LER instead of the OMI-LER is apparently due to the better snow/ice mapping at high latitudes, not to BRDF effects.</p>
3			<p>Are the GE_LER data available to the community? Please specify whether and how you plan to distribute the GE_LER and G3_LER data products. In order for other people to reproduce your results and claims they need open access to the data presented in this paper.</p>
4			<p>Which are the wavelengths for which GE_LER is retrieved? In the paper it is not so clear for which wavelength the results apply. For instance, only in the caption of Figure 6 this is mentioned.</p>

Specific comments

#	page	line	comment
1	1		The title is hardly readable due to the many acronyms. Please make the title clearer. In the rest of the paper the construction "FP_ILM GE_LER" is hardly readable. Can you think of a better name?
2	2	16	These are not fundamental problems of a climatology itself, but rather information missing in the currently available climatologies. It would definitely be possible to create a climatology that includes the viewing angle dependency, or address separately snow and snow-free conditions.
3	3	15	The drawbacks mentioned for lookup tables are not very convincing, consider rephrasing this sentence.
4	4	8	The smart sampling technique should be explained in a bit more detail because readers may not want to read the full paper referred to.
5	4	16	I do not understand this sentence: " <i>Machine learning techniques perform best with low-dimensional datasets by avoiding the effects of the curse of dimensionality.</i> "
6	5	27	What about the azimuth dependence of ρ ? This also holds for other places in the paper. Please clarify in Sect. 2 how you deal with the solar zenith angle and relative azimuth dependence of the BRDF.
7	7	9	How did you calculate the standard deviation, is it based on all simulations in the validation training set? Figure 5 on page 22 seems to indicate larger errors (up to 0.01) for individual LER retrievals. What are these red error bars in this figure? How does this error propagate in the final accuracy of the trace gasses?
8	7	15	Why do you use Z as symbol for pressure and not P? Z can easily be confused with height.
9	7	21	The histograms presented in Figure 7 are not discussed in detail.
10	7		<p>section 4.3 / Figure 9:</p> <p>This should become a separate main section, with a thorough and complete validation of the product. The comparison that is presented is not sufficient. Comparisons can be performed with a number of the surface LER -databases that were mentioned in the introduction (OMI, SCIAMACHY, GOME-2), but also with BRDF information from MODIS. Using MODIS BRDF would mean adjusting the retrieval to retrieve wavelengths of the nearest MODIS band. Can this be done?</p> <p>The differences have to be analysed properly. The difference plot in Figure 9(b) does not allow the reader to study differences on the order of 0.02, which is the typical difference/error one would expect for snow-free areas.</p>
11	8	2	" <i>from the couple of days</i> ": how many days did you use?
	8	11	Figure 8 needs more explanation, what order polynomial is used, what do the blue error bars represent? Why do land, water and snow scenes all have more or less the same relative albedo (around 1.0 – 1.6)? Have you calculated this average using all global pixels? This implies that you have mixed different land types in the calculation of the average. How representative is the viewing angle dependency then for individual land types?
12	8	15	Please check which version of the OMI LER was used; the second version covers 5 years of data between 2005 – 2009, released in 2010.
13	8		Which field of the OMI-LER is used to compare with? Is it the

			"MonthlyMinimumSurfaceReflectance" field or is it the "MonthlySurfaceReflectance" field?
14	11 ff		References: please put all references in alphabetical order.
15	Fig. 5		Did you also consider the sensitivity of the GE_LER error due to ozone profile assumptions?
16	Fig. 8		What do you mean with " <i>relative mean albedo</i> "? Can you please also provide the GE_LER itself?
17	Fig. 9		These maps are not very informative because the dynamic range is too large. Please choose a color scale and albedo range that provides spatial information on the distribution of surface albedo in the UV.

Technical corrections

#	page	line	comment
1	1	21	AMF abbreviation not explained
2	2	1	Typo mayor → major
3	9	5	Typo worst → worse, also in caption of figure 10
4	all		everywhere: "Lambertian-equivalent reflectivity" (with a "-")
5	2	12	page 2: "The unprecedented spatial resolution of TROPOMI..." → add "for a spectrometer"