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Interactive comment on "Comparative analysis of atmospheric radiative transfer models using the Atmospheric Look-up table Generator (ALG) toolbox (version 2.0)" *by* Jorge Vicent et al.

Jorge Vicent et al.

jorge.vicent-servera@magellium.fr

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Dear anonymous referee

First, we would like to thank you for your interest in reviewing our publication. That being said, we clearly see the strengths of our work and tend to disagree with some of your remarks. Please allow us to show our arguments and eventual discrepancies to your comments (in blue). We hope that, through iteration, we can improve the quality of the paper.

Firstly, you state that "*the paper is a technical software [. . .] description and that the* *results of the model intercomparison [. . .] are not very meaningful since the authors do not explain the reasons for discrepancies between the codes*". We acknowledge that this paper is a technical software description, as it is stated in the goals of our paper (introduction section: "*to describe the ALG tool from a functional and software design perspective*") and in the conclusions section ("*the main design concept and features of ALG have been described*"). The intercomparison study is presented in this paper as an exercise (or application example) of how ALG could facilitate the tedious tasks of writing consistent input, running RTMs efficiently and harmonizing RTM outputs. That being said, we consider that the presented global sensitivity analysis results offer an additional comparative analysis of the studied RT models.

Secondly, you think that "*the compared quantity (global sensitivity analysis) is not well suited for a model intercomparison, because it does not give much insight in reasons for discrepancies*". However, we consider that global sensitivity analysis can help to understand how the key input variables drive the spectral outputs. The global sensitivity analysis approach is able to quantify the sensitivity to each of the model variables and their interactions, which cannot be done using doing local analysis limited to a few wavelengths and geometric/atmospheric conditions (e.g. [Kotchenova et al. 2008]). Global sensitivity analysis provides therefore a statistical perspective of the entire (global) differences between models. Thus, these analyses provide a useful tool when used in combination to more specific/local analysis like [Kotchenova et al. 2008]. In fact, we also partly carried out the same analysis of Kotchenova et al. in the second part of Section 4. Our results are compatible with Kotchenova et al and demonstrates the consistency of the simulations. By no means we aim to replace the analysis done in previous validation papers, but to give a complementary analysis from the global sensitivity analysis perspective. Maybe the title of the paper is misleading and we should better change it to something like "*Global sensitivity analysis comparison of . . .*".

Thirdly, you state that "*providing exactly the same input is a difficult task, and obviously, the presented toolbox cannot generate exactly the same input*". We acknowledge the difficulty of this task. As you well indicate, RT models can have different description in their parameterization (e.g. aerosol optical properties, gaseous absorption, vertical profiles or even definition of viewing/illumination geometric conditions). We are aware of that and that is why, in the last 3 years of ALG development, we have taken a special care of ensuring consistency of model input configuration as much as the implemented RT models allow it. To do that, we have (1) studied carefully the RT user manuals, (2) done our internal analysis of input configuration and comparison of model outputs, and (3) contacted model developers (MODTRAN, libRadtran and 6SV) for user-support. The difficulty (or even impossibility) of ensuring exactly the same model input configuration using ALG is also not different than any other researcher would face when implementing their own RT model input generation, running and comparison scripts.

To conclude with the previous point, you add "*I think that it is important that one works directly with the RT model instead of using a wrapper which hides the specific features of the individual models*". You come back later to this point ("*...the danger is that the users do not understand the physics behind radiative transfer, which they learn better when they work directly with the RT models*"). We respect your opinion but tend to disagree. It is clear that users who want to have a deeper insight of the model will always work with the RT models directly if needed. Still, they can also benefit from the use of ALG e.g. to alleviate the complex tasks of model configuration and of execution of large datasets. Instead of being applied to ALG, this comment could be also applied to any other software tools designed for a specific RT model such as libRadtran's GUI, Ontar's PcModWin, MOSPAT, AEROgui and others (cited in the paper). However, nobody doubts about the usefulness of these tools to facilitate model configuration and execution. In that sense, ALG is not much different from these referenced software tools, but goes beyond in offering a tool that harmonizes the RT model streamlining and parameter definitions (whenever possible). The toolbox does not hides the specific features of the individual models as the RTM input files written by ALG are always stored and available to users. Moreover, the tool is freely available to the community and users can participate as developers, having access to the (Matlab) code repository in GitLab. They can therefore report any eventual software bug or disagreement in input configuration and model outputs. We would like to add that the tool can potentially be used for education purposes (e.g. to master and PhD students in Remote Sensing). Under supervision of an expert/professor, students can learn the basics of atmosphere radiative transfer and get familiar with the inputs and outputs of RT models.

Finally, you declare to be "*a little skeptical whether the tool is really useful for the scientific community*". ALG v2.0 (and precursor unpublished versions) has been used in various scientific and industrial projects with related publications (see Section 5). Particularly, ALG is used in several ESA's FLEX mission activities such as end-to-end mission simulation (scene generation) and atmospheric correction. The toolbox is also used in a CNES project, in which atmospheric RT model comparison (MODTRAN6, libRadtran, 6SV, ARTDECO and SOSabs) and large database generation are key tasks. These examples shows the utility of ALG in practical scientific and industrial projects. Moreover, we have informally contacted and demonstrated ALG in front of RT model developers and users, and we have always received positive feedback and demonstration of interest in the tool. In addition, ALG is conceptually based on the ARTMO toolbox (www.artmotoolbox.com), which is a similar tool for the operation of a wide variety of vegetation (leaf-canopy) RT models. ARTMO is actively being used in several European scientific and industrial studies and several publications, conference presentations and tutorials demonstrate the interest of (and usefulness for) the scientific community. Our experience in ARTMO makes us confident that the tool can therefore be of interest for the remote sensing and atmospheric scientific community.

To conclude, we are confident that a broader scientific community might be interested in using the provided tool and that its use should not hamper the user understanding of RT models. That being said, we would kindly appreciate to receive additional comments and advice to improve the scientific content of the manuscript. We trust that, through iteration, we can further improve the quality of the paper.

Kind regards,

The Authors

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Discussion paper