Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC1
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Comment on gmd-2021-439

Pengwang Zhai (Referee)

Referee comment on "Introduction of the DISAMAR radiative transfer model: determining instrument specifications and analysing methods for atmospheric retrieval (version 4.1.5)" by Johan F. de Haan et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2021-439-RC1, 2022

This paper describe the Determining Instrument Specifications and Analysing Methods for Atmospheric Retrieval (DISAMAR) computer code, which performs both forward radiative transfer model and inversion simulations for the Earth's atmosphere with different components, for instance, trace gases, aerosols, and clouds, and properties of the ground surface from passive remote sensing observations of the Earth. The main novelty is that DISAMAR flexibly uses a variety of radiative transfer methods when solving multiple scattering of light in the atmosphere, including the layer-based orders of scattering method, adding and doubling, integration of source function, etc. For weakly gas absorbing spectral region, the DISMAS (DIfferential and SMooth Absorption Separated) method is developed to significantly expedite the simulation time while keeping the accuracy. Jacobian (differential of radiance field with respect to retrieval parameters) can be calculated semi-analytically, which is a great advantage in comparison with the finite difference method. The manuscript is clearly written and organization is logical. I suggest the publication of this paper at Geoscientific Model Development (GMD) with some minor revisions. Specifically:

- Figure 1 and 2 are referenced out of order. I suggest the authors revise the manuscript to reference them in sequence. Minimally, they could simply rename Fig. 1 as Fig. 2 and vice versa.
- Figure 2, the selection of wavelength grids is quite vague to me, especially when absorbing lines are involved in the channel. I strongly recommend the author revise the description the wavelength selection scheme.
- Figure 3, I thought it would be more natural to use optical depth as a vertical coordinate in radiative transfer. Thus to me using pressure as the vertical coordinates is a bit unusual. This is just a comment and I won't force the authors to make any changes, as this would be most likely an overhaul of the computer code.
- Line 150-151, the paper discussed different Gaussian quadrature points for different optical depth situation. Again it would much natural to use optical depth as the vertical grid, so that you would easily built a universal criterion of how many discrete layers are

needed in terms of optical depth. By the way, how large is the optical depth considered as “thick”?

- Line 408, please give a list of “strong” absorbers and their associated wavelength ranges to which DISMAS should not be applied. How strong of a gas absorption line is considered strong?
- For the spherical shell correction, there are some new developments recently. Specifically:
- Korkin, E.-S. Yang, R. Spurr, C. Emde, P. Zhai, N. Krotkov, A. Vasilkov, A. Lyapustin,

Numerical results for polarized light scattering in a spherical atmosphere, Journal of Quantitative Spectroscopy and Radiative Transfer, Volume 287, 2022, 108194, ISSN 0022-4073, https://doi.org/10.1016/j.jqsrt.2022.108194.

(https://www.sciencedirect.com/science/article/pii/S0022407322001297)

Peng-Wang Zhai, Yongxiang Hu, An improved pseudo spherical shell algorithm for vector radiative transfer, Journal of Quantitative Spectroscopy and Radiative Transfer,

Volume 282, 2022, 108132, ISSN 0022-4073,
https://doi.org/10.1016/j.jqsrt.2022.108132.

(https://www.sciencedirect.com/science/article/pii/S0022407322000693)

- For Raman scattering and other inelastic scattering in the ocean waters, there are some new development as well:

Peng-Wang Zhai, Yongxiang Hu, David M. Winker, Bryan A. Franz, and Emmanuel Boss, "Contribution of Raman scattering to polarized radiation field in ocean waters," Opt. Express 23, 23582-23596 (2015)

Peng-Wang Zhai, Yongxiang Hu, David M. Winker, Bryan A. Franz, Jeremy Werdell, and Emmanuel Boss, "Vector radiative transfer model for coupled atmosphere and ocean systems including inelastic sources in ocean waters," Opt. Express 25, A223-A239 (2017)