The Cryosphere Discuss., 9, C2123–C2127, 2015
www.the-cryosphere-discuss.net/9/C2123/2015/
© Author(s) 2015. This work is distributed under
the Creative Commons Attribute 3.0 License.

The Cryosphere
Discussions
Open Access

Interactive comment on "Radiative transfer model for contaminated slabs: experimental validations" *by* F. Andrieu et al.

Anonymous Referee #2

Received and published: 3 November 2015

REVIEW

F. Andriu et al.: Radiative transfer model for contaminated slabs: experimental validations, submitted to Cryosphere, TCD 9, 5137–5169, 2015

The present manuscript describes an effort to validate a theoretical radiative-transfer model published earlier in Applied Optics (referenced in the manuscript). It further describes new Bayesian inverse methods for the retrieval of the model parameters from the experimental measurements. The manuscript can become publishable in Cryosphere after it is revised according to the following comments.

In studies of close-packed particulate media, the radiative-transfer-type models are experiencing a golden era due to the recent quantitative, positive comparison between

CC BY

radiative-transfer-type and exact electromagnetic computations for the same particulate systems published in

Muinonen, K., Mishchenko, M. I., Dlugach, J. M., Zubko, E., Penttil\"a, A., and Videen, G. (2012). Coherent backscattering numerically verified for a finite volume of spherical particles. Astrophysical Journal 760, 118, 11~p. (doi:10.1088/0004-637X/760/2/118).

Concerning the radiative-transfer coherent-backscattering part of this comparison, see, in particular:

Muinonen, K. (2004). Coherent backscattering of light by complex random media of spherical scatterers: Numerical solution. Waves in Random Media 14(3), 365-388.)

The authors seem not to be aware of these works that, indeed, strengthen their science case and need to be referenced in the present article. Furthermore, the authors seem to be unaware of

Muinonen, K., Nousiainen, T., Lindqvist, H., Munoz, O., and Videen, G. (2009). Light scattering by Gaussian particles with internal inclusions and roughened surfaces using ray optics. Journal of Quantitative Spectroscopy and Radiative Transfer 110, 1628-1639.

that comes very close to their work in having a Monte Carlo radiative-transfer solution within a host medium. As the Monte Carlo ray-tracing solutions are highly parallelizable, the computational feasibility is no longer an obstacle in developing increasingly realistic theoretical models. It would be prudent for the authors to realize this fact and not to stress the slowness of Monte Carlo approaches (Abstract, p. 5138, l. 18).

As to the Bayesian inversion of the experiments for the theoretical model parameters, this is a step most welcome in radiative-transfer analyses.

Continuing into more detailed comments, on page 5141, line 1, the authors discuss spherical inclusions. It is not evident from the present manuscript what such inclusions are and why they are spherical. Presumably, these have been discussed in the earlier paper (Andriu et al. 2015, Applied Optics) but the present paper should include sufficient description about the theoretical modeling to be validated. Later, on line 21, what do the authors mean by "every following transit is considered isotropic"? Again, mode description is needed.

Then, on page 5144, line 9, the authors state that a thin coverage of slab ice is enough to strongly flatten the BRDF. In terms of geometric optics, what is the reason for this flattening? The well-known divergence of rays when they refract back from the medium through the interface of ice and air?

On page 5145, line 12, what is the so-called "element"? It is difficult to understand on the basis of the present description so describe more thoroughly.

On page 5146, something is wrong with the a posteriori probability density function in Eq. 5: First, what is the quantity "x" transposed in the equation? Second, there should be a transpose of the column vector (F(m)-d_mes) multiplying Cˆ-1. The problem repeats itself in Eq. 8.

On page 5151, the authors address the specular lobe and its maximum. Whereas the authors are rightfully carrying out an assessment of the orientation of their sample for a better match between the theoretical and measured lobe, they need to become aware of the fact that the angular position of the maximum can depend on the asymmetric diffraction patterns of the surface elements. For further information, see, for example,

Muinonen, K. (1989). Scattering of light by crystals: a modified Kirchhoff approximation. Applied Optics 28, 3044-3050.

More description is required for the challenges in the actual inversion encountered on page 5153, line 29: if the parameter definition domain is too narrow, why not make it wider to obtain more realistic a posteriori distributions?

Detailed comments, mostly on the language:

1) page 5138

TCD

9, C2123–C2127, 2015

Interactive Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

line 2: approximated -> approximate (also at 5140, 2 and 5140, 8) line 9: media -> medium line 20: density probability -> probability density

2) page 5140

line 19: inspired from -> inspired by

3) page 5144

line 24: inverse -> invert

4) page 5148

line 2: variability -> configuration of the parameters?

5) page 5149

line 20: wavelengths -> wavelength

6) page 5151

line 10: what is meant by "of the measure"?

7) page 5153

line 10: inversions points -> inversion points

8) page 5154

line 1: what is meant by "the measure of sample 1"? I assume this does not refer to the size of sample 1 but the measurements of sample 1.

9) page 5154

line 15: various thickness -> varying thickness

10) page 5159

Figure 1: subtrate -> substrate

TCD

9, C2123–C2127, 2015

Interactive Comment

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper

11) page 5166

Figure 8: Marginal probability density functions a posteriori -> Marginal a posteriori probability density functions

12) page 5169

Figure 11: Marginal probability density functions a posteriori -> Marginal a posteriori probability density functions

---

Interactive comment on The Cryosphere Discuss., 9, 5137, 2015.

TCD

9, C2123–C2127, 2015

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper