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Atmospheric Measurement Techniques Discussions

Interactive comment on "High resolution and Monte Carlo additions to the SASKTRAN radiative transfer model" *by* D. J. Zawada et al.

Anonymous Referee #1

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General comments on Zawada et al. [2015]:

This paper contains several important improvements of the SASKTRAN radiative transfer model, and illustrates the value of these improvements in the context of OSIRIS ozone retrievals. Some of the explanations given for the model improvements and the terminology used should be clarified, but the paper clearly is valuable.

Specific comments:

Sect. 2.1:

"All SASKTRAN engines treat the planet and atmosphere in a fully spherical geometry." Could you clarify what this statement means? I believe you're making a distinction be-

tween SASKTRAN and explicitly "pseudo-spherical" models. Many flavors of "pseudo-spherical" models exist, but that's a separate discussion . . . do you mean that all path lengths and angles are computed using a spherical geometry?

Sect. 2.2:

Some sort of illustration would be useful to define the angles, directions and points referenced in equations (1) – (3) more clearly.

I thought it was curious to call the quantity defined in equation (2) the "optical depth". This usually connotes a vertical coordinate, while the quantity in this case is the optical path length along a general line of sight.

The k variables are defined with names such as "extinction" and "scattering extinction", but I've more commonly heard this quantity defined as the "extinction coefficient" or "scattering coefficient".

The following 2 sentences are confusing:

"Line segments bounded by shell intersections are called cells. Inside the cells bounded by the spherical shell intersections the extinction and source function are assumed to be constant, allowing for numerical evaluation of the line integrals."

Could you clarify how a cell that is not bounded by spherical shell intersections occurs? I think this can happen if a line segment exits the cell through a vertically-oriented boundary (rather than the spherical shells), but in that case I don't understand the definition given for a cell.

The text in this section also inappropriately uses the word "all" several times:

"Solar rays are attenuated to all points. . ."

". . . once again, scattered at all points. . ."

". . . the diffuse field calculated for all local look directions and all altitudes . . ."

This is strangely interspersed with text that describes the (finite) discretization of solar rays, altitudes, etc. that is used.

Finally, a picture illustrating the directional interpolation triangle would also be helpful.

Sect. 2.3.1:

How is the "start" of a cell defined? Again, an appropriate illustration would clarify this section greatly.

Reference should be changed to "Loughman et al. (2015)".

Sect. 2.4.1:

This section mentions that the scalar radiative transfer equation is used "for brevity" – has a vector implementation of SASKTRAN been added? I don't see it mentioned elsewhere, so I assume not, but this should be clarified in any case.

In equation (16), is s_end still < 0, as it was in equation (1)? And how is s (the limit of the integral that computes the extinction) defined? I can somewhat appreciate the logic of reversing the direction of the path integral for the Monte Carlo section, but overall I find both versions of the path integral (equation 1 and equation 16) confusing as presented. Again, a picture would help.

How does the definition of Jnθ (the second line of equation 20) connect to the earlier equations? That symbol never appears before or after equation (20).

Sect. 2.4.2:

The following sentences create some confusion for me:

"If the ray intersects the ground it is terminated with transmission zero."

I think this simply means that photons are not allowed to penetrate the solid Earth. But the question of how surface reflection is handled is not clearly addressed (except that the other text mentions simulations for non-zero surface albedos). Or is the sentence

below meant to describe surface reflection?

"If the ray hits the ground and the target 15 transmission is smaller than the ray's transmission through the atmosphere, the scatter is said to happen at the ground intersection."

Sect. 5:

A passing reference to cirrus clouds appears in this section – could you say more about this adaptive integration step, as well as the representation of these clouds overall? Are they spherical shells, or do they have "edges"? And how is the non-Mie scattering by such clouds modeled?

Fig. 2:

The axis labels are extremely difficult to read as presented.

Interactive comment on Atmos. Meas. Tech. Discuss., 8, 3357, 2015.