**Atmospheric
Measurement
Techniques
Discussions**

Interactive comment on "Fast and simple model for atmospheric radiative transfer" by F. C. Seidel et al.

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Reply to referee 2

General Comments

Comment I *"The primarily purpose of this model is to perform atmospheric corrections but to few references for such correction are given which would have help to understand the actual model requirements. The manuscript would gain in clarity is this aspect is better developed. It would, in particular, be useful to evaluate the model accuracy as a function of the wavelength"*
Reply Like with many other radiative transfer models (RTM), the primary objective of SMART is the simulation of the radiative processes in the atmosphere and at the sur-

face. However, the paper does not yet discuss the invertibility of SMART in detail, which would be a requirement for subsequent atmospheric correction. A main use of SMART will be fast estimates of surface reflectance factors to be used in probability density functions for inverse problems. We agree with this reviewer that if atmospheric correction would be the prime use of SMART, then a more detailed assessment of this capability would be needed.
We wish to emphasize that all computations performed for this contribution are wavelength dependent.

Comment II *"The required accuracy for this fast RTM is defined to be between 5% and 10%, though this magnitude is not justified. I would recommend the authors to better quantify the impact of each of the approximations (only a limited number is analysed) against realistic cases including large non-spherical particles, gaseous absorption or non-Lambertian surfaces."*
Reply We discuss in Sect. 3.1 a quantification of the uncertainties introduced by Rayleigh scattering and polarisation (Sect. 3.1.1), aerosol scattering with Mie phase function (Sect. 3.1.2), aerosol scattering with HG phase function (Sect. 3.1.3) and the neglected coupling between the aerosol and molecule scattering (Sect. 3.1.4). There are no more approximations in SMART expect of the surface term (Eq. 14), which was not analyzed by intention (see p. 2235, line 9). An extensive discussion of Eq. (14), large non-spherical particles, gaseous absorption and non-Lambertian surfaces are relevant issues, but will be part of another contribution.

Comment III *"A very similar model has been recently published in JGR (Carrer, D., J.-L. Roujean, O. Hautecoeur, and T. Elias (2010), Daily estimates of aerosol optical thickness over land surface based on a directional and temporal analysis of SEVIRI MSG visible observations, J. Geophys. Res., 115, D10208, doi: 10.1029/2009JD012272) which account for non-Lambertian surface. How such model compares with the proposed SMART model?"*
Reply We appreciate the reviewer's referral to the paper of Carrer et al. There are

similarities in both approaches since the physics and the publications on approximated and parameterized solutions of the radiative transfer equation are mostly the same. Both models are using the HG phase function and (almost) the same aerosol scattering and transmittance functions. Nevertheless, we find also significant differences. While Carrer's work implements non-Lambertian surfaces, it relies on a correction factor for aerosol multiple scattering, which we found not to be sufficiently accurate for our purpose. We therefore explicitly calculate the second order scattering using Eq. (11), which is not only a function of AOD, but also of μ, μ_0, θ, the single scattering albedo and most importantly also of the aerosol phase function. Eq. (11) can be extended to a third or even higher order, if required, later. Furthermore, we do not have to rely on Rayleigh corrected data, since Rayleigh scattering is inherently computed within SMART. We will, however include surface coupling using non- Lambertian surfaces in a future update of SMART.

Specific comments

Comment I *"Section 2, p2: replace "The code can be run at ... " by "The SMART model accepts ..." "*
Measure We changed this sentence on page 2229, line 3 to "SMART accepts any combination of ..."

Comment II *"Section 4, p6: The speed-up of the SMART model against 6S should be evaluated for the same compiler, otherwise the comparison is pretty meaningless."*
Reply SMART is written in IDL and 6S in FORTRAN and therefore present substantial different computational approaches. We compare the run-time of the models *as-is*, assuming middleware integration to take place for both approaches in most cases. It is a purely user driven approach, without assuming computational complexity of both approaches.