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Biogeosciences Discussions

Interactive comment on "An integrated model of soil-canopy spectral radiance observations, photosynthesis, fluorescence, temperature and energy balance" *by* C. van der Tol et al.

Anonymous Referee #2

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Journal: Biogeosciences Discussions Title: An integrated model of soil-canopy spectral radiance observations, photosynthesis, fluorescence, temperature and energy balance

Authors: van der Tol et al.

General comments The paper presents a very interesting model of canopy processes, including both hyperspectral energy transfer in the visible- to thermal domain and water and carbon exchange, as well as chlorophyll fluorescence radiance. It is a rare and welcome attempt to integrate different fields and provide a comprehensive representation of vegetation characteristics, which could provide a powerful tool for the integration of ground- and satellite-based observations. I cannot but recommend its publication on

Biogeosciences Discussions. I have just a few comments and questions that I hope could result in an improved draft and extend the applicability of the model to a wider range of conditions

Detailed comments

Page 6026, line 4: . . . radiation, energy and carbon balance. . .

Page 6027, line 4: . . . by inverting a radiative transfer model on satellite-derived hyperspectral reflectance data.

Page 6028, line 4: . . .(although, unlike CUPID, a site water balance is not calculated at present, thus requiring direct information on soil water content).

Page 6028, line 9: . . . of water, carbon and energy fluxes. . .

Page 6029, line 19: . . . outgoing radiation spectrum

Page 6031, line 1: It would appear as if not only spatial heterogeneity (resulting from both incomplete canopy cover and crown shape; e.g. Huemmrich 2001, also based on the SAIL model structure) but also leaf clumping in twigs and branches are not included in the description. Is this correct? Inclusion of leaf clumping (Smolander and Stenberg 2003) could improve the representation of canopy energy transfer in coniferous canopies in future model applications.

Page 6036, line 11: Why is this considered only for sunlit leaves? A vertical temperature gradient could also be expected for shaded leaves.

Page 6042, line 20: Are computations included in the 'Leaf biochemistry' block also included in the iterative procedure? Stomatal conductance (as derived from the Farquhar-Cowan model) has a strong effect on latent heat fluxes, and therefore on leaf energy balance.

Page 6043, line 14: An explanation of the rationale for the simulation of leaf and canopy fluorescence should perhaps be included in the Introduction.

Page 6044, line 14: Please give a reference for the response function of photosynthetic parameters to temperature. Several algorithms have been proposed in the literature.

Page 6041, line 18: Please note that slightly different algorithms should be used for hypo- and amphystomatous leaves (see Nikolov et al. 1995; Guilioni et al. 2008), as sensible and latent heat exchange take place from different surfaces in the two cases.

Page 6049, line 1: Where are these 'fluorescence amplification factors' coming from? Are they based on the assumption of an 'a priori value of chlorophyll fluorescence (as a fraction of absorbed PAR) in low light conditions' or on the more realistic model of the interactions between fluorescence and photosynthesis recently proposed by the Authors themselves (van der Tol et al. 2008)?

References

Guilioni L, Jones HG, Leinonen I, Lhomme J-P (2008) On the relationships between stomatal resistance and leaf temperatures in thermography. Agricultural and Forest Meteorology 148 1908-1912.

Huemmrich KF (2001) The GeoSail model: a simple addition to the SAIL model to describe discontinuous canopy reflectance. Remote Sensing of Environment 75 423-431.

Nikolov NT, Massman WJ, Schoettle AW (1995) Coupling biochemical and biophysical processes at the leaf level: an equilibrium photosynthesis model for leaves of C 3 plants. Ecological Modelling 80 205-235.

Smolander H, Stenberg P (2003) A method to account for shoot scale clumping in coniferous canopy reflectance models. Remote Sensing of Environment 88 363-373.

van der Tol C, Verhoef W, Rosema A (2008) A model for chlorophyll fluorescence and photosynthesis at leaf scale. Agricultural and Forest Meteorology 149 96-105.

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