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Geoscientific Model Development Discussions

Interactive comment on "Modeling stomatal conductance in the Earth system: linking leaf water-use efficiency and water transport along the soil-plant-atmosphere continuum" *by* G. B. Bonan et al.

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Authors reply to: Interactive comment on "Modeling stomatal conductance in the Earth system: linking leaf water-use efficiency and water transport along the soil-plant-atmosphere continuum" posted by S. Otto

1. The formula of Goudriaan's G-function approximation G = phi1 + phi2*μ is not correct. It holds G = phi1 + phi2*|μ|

Response: CLM calculates solar zenith angle over the range 0-π/2 so μ (cosine of solar

zenith angle) is equal to |μ|

2. The usage of Goudriaan's G-function approximation is not the best one in my opinion. There are better approximations of Dickinson and deRidder. Moreover, there are exact formulas of G for various standard leaf normal distributions functions (spherical, uniform, planophile etc.). Why aren't they applied?

Response: The intent of this study was to investigate alternative stomatal conductance parameterizations for Earth system models, not radiative transfer schemes. However, as clarification we note that CLM uses the two-stream radiative transfer parameterization (developed by Robert Dickinson and Piers Sellers) and also implemented in the SiB series of land surface models by Sellers et al. The G-function is used to calculate parameters required by the two-stream approximation in addition to direct beam extinction coefficient (average inverse diffuse optical depth per unit leaf area; single scattering albedo).

3. Since the G-function is (not only) part of the solar exponential term of the radiative transfer equation, small deviations (e.g. due to inaccuracies) in G can have a big impact on the transported radiation, photosynthesis calculations and so on. How do both facts influence the results of your work?

Response: The intent of this study was not to investigate radiative transfer schemes. Moreover, many parameters are used by CLM and other such land surface models. Uncertainty in the G-function would need to be investigated as part of a larger study of parameter/parameterization uncertainty in land surface models. Our study clearly demonstrates that error in stomatal conductance response to soil moisture stress has a large impact on model simulations and provides a path forward to implement soil moisture stress. That (not radiative transfer)is the motivation of the study.

Interactive comment on Geosci. Model Dev. Discuss., 7, 3085, 2014.