



Interactive comment on “Efficient modeling of sun/shade canopy radiation dynamics explicitly accounting for scattering” by P. Bodin and O. Franklin

R. Dickinson (Referee)

robted@jsg.utexas.edu

Received and published: 14 December 2011

Bodin and Franklin manuscript

This paper’s objective is to obtain a profile of scattered total solar radiation within a canopy as an improvement over an expression developed by Goudriaan in 1982. Whether this is an improvement or not, not demonstrated, its usefulness is questionable and crop models that today use such an expression could easily be improved by attention to their objective, which I believe is photosynthesis.

First, the radiation needed is PAR, closely equivalent to visible. My guess is that 30 years ago, total radiation was highlighted as the only radiation quantity that could be
C1188

measured. Because of the strong spectral dependence of leaf optical properties, any calculation of scattering using total radiation is likely to be highly inaccurate. Fortunately, the scattering in the visible is weak so that approximate treatments of that radiation are more likely to be successful.

Second, what is needed is not a profile of scattered radiation but the PAR absorbed separately by sunlit and by shaded leaves. Since as Eq. (3) of the paper shows, there is a larger fraction of sunlit leaves higher in the canopy, where also diffuse radiation fluxes are higher. The diffuse radiation on the sunlight fraction is likely not to contribute much as these leaves are radiation saturated. Simple expressions for this absorption of PAR by shaded leaves and its contribution to photosynthesis are widely available in climate models, for example in CLM4 that can be downloaded from NCAR.

Some other issues are the paper’s lack of attention to the issue of leaf optical properties and leaf orientation. Leaves usually have very different transmission and reflection properties, and depending on sun angle, the upward and downward beams of scattered radiation consist of some combination of transmitted and reflected radiation. An other concern is the uncritical adoption of a 1-D plane parallel model for the radiation as 3-D effect can introduce large sun angle dependent differences in the profiles of absorbed PAR.

Robert Dickinson

Interactive comment on Geosci. Model Dev. Discuss., 4, 1793, 2011.