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Coupling the Schymanski-Or formula with a multi-layer canopy model.

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During the last year a new formula for the transpiration was proposed (Schymanski and Or, 2017). That study was carried on a single leaf and highlights omissions in the classical transpiration formula (Penman-Monteith) that implies an error of more than 50% on the transpiration estimate. The main advantages of this new formulation are given by the correct representation of hypostamatous leaves and the two sided exchange of sensible heat in a planar leaf.
In this study it is presented a method for the application of the Schymanski-Or formula at the canopy-scale. One of the main issue is represented by the spatial heterogeneity that affects one of the principal forcing of the transpiration, like the solar radiation. In fact, radiation is affected by the geometry of the canopy, by the inclination of each leaf and the reflected and diffuse radiation inside the canopy.
To avoid this complexity, it is possible to model the canopy as a multi-layer absorbing model using the Lambert-Beer law, with its height equal to the canopy thickness and with properly value for albedo, transmittance and absorptivity bounded to the leaves density and the leaf area index.
In this way is estimate how many radiation is absorbed from the canopy in each layer and integrate the latent heat along the vertical, from the top of the canopy to the bottom. Furthermore, it is possible to evaluate the vertical profile of the temperature of leaves. The leaves equilibrium temperature it is calculated iteratively in order to satisfy the energy balance.

Reference:
Schymanski, S. J. and Or, D.: Leaf-scale experiments reveal an important omission in the Penman–Monteith equation, Hydrology and Earth System Sciences, 21, 685-706.