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Modeling the transpiration using the Schymanski-Or formula on alpine grassland sites

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In a recent study (Schymanski and Or, 2017) a new approach was used to evaluate the latent heat emitted by a leaf, highlighting an important omission of the Penman-Monteith equation. However, this result was obtained under ideal conditions, i.e. on a synthetic leaf in a controlled atmosphere in laboratory and without any kind of environmental stress factors. In this study we evaluate the performance of this newly proposed method on real case studies. After having implemented the method in the GEOframe modelling system, we compare it with some of the classical hydrological approaches for estimating evapotranspiration, like the Penman-Monteith (PM-FAO) and the Priestley-Taylor (PT) equations and with the fully distributed hydrological model GEOtop. To the scope, the approach developed by Schymanski-Or (SO) was modified, in order to upscale it at canopy level, including a canopy radiation transfer model and a dependency to the leaf-area-index. Moreover, empirical stress functions were introduced, allowing us to compute the actual evapotranspiration, in particular under water stress. The approach of SO allows to compute also the sensible heat and the leaves temperature. It is therefore possible to close the energy budget and further validate the method. We considered two alpine grassland sites: the Mazia/Matsch LTER site and the Viote FLUXNET site in the Trentino Alto Adige region. In these two sites, detailed canopy and micrometeorological observations are available and both sensible and latent heat were measured with eddy covariance stations. In addition, the two sites have different soil moisture conditions, allowing us to cope with vegetation both under and without water stress. Preliminary results show that latent heat estimates of the proposed extended SO approach are in between PM-FAO and PT estimates. Leaves temperature are more accurate with respect to the GEOtop model, but the SO approach tends to be highly sensitive to the amount of transpiration coming from shadowed leaves. A further step in the work will be to extend the model to more complex canopies as forests and orchards.