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Evapotranspiration estimation under variable bulk canopy resistance

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This work examines a model for estimating canopy resistance (r_c) and reference evapotranspiration (ET_o) on an hourly basis. The experimental data refer to grass at two sites in Spain with semiarid and windy conditions in a typical Mediterranean climate. Measured hourly ET_o values were obtained over grass during a four year period between 1997 and 2000 using a weighing lysimeter (Zaragoza, NE Spain) and an eddy covariance system (Córdoba, S Spain). The present model is based on the Penman-Monteith (PM) approach, but incorporates a variable canopy resistance r_c as an empirical function of the square root of a climatic resistance r^* that depends on climatic variables. Values for the variable r_c were also computed according to two other approaches: with the r_c variable as a straight line function of r^* (Katerji and Perrier, 1983), and also as a mechanistic function of weather variables as proposed by Todorovic (1999).

In the proposed model, the results showed that the ratio r_c/r_a (where r_a is the aerodynamic resistance) presents a dependence on the square root of r^*/r_a, as the best approach with empirically derived global parameters. When estimating hourly ET_o values, we compared the performance of the PM equation using those estimated variabler_c with the PM equation as proposed by the FAO, with a constant r_c value equal to 70 s m^{-1}. The results confirmed the relative robustness of the PM method with constant r_c, but also revealed a tendency to underestimate the measured values when ET_o is high. Under the semiarid conditions of the two experimental sites, slightly better estimates of ET_o were obtained when a estimated variable r_c was used. Although the improvement was limited, the best estimates were provided by the Todorovic and the proposed method. The proposed approach for r_c as a function of the

square root of r^* may be considered as an alternative for modeling r_c, since the results suggested that the global coefficients of this locally calibrated relationship might be generalized to other climatic regions. It may also be useful to incorporate the effects of variable canopy resistances into other climatic and hydrological models.