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Comparison of the performance of artificial neural networks and conventional equations for daily reference evapotranspiration estimation in the region of Álava (Northern Spain).

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The determination of reference evapotranspiration (*ETo*) is a key factor for water balances and irrigation scheduling. Evapotranspiration can be measured directly by high cost micrometeorological techniques or can be estimated by mathematical models. The combination equation of Penman-Monteith modified by Allen et al. in 1998 (PM56) is the reference equation for the estimation of evapotranspiration and calibration of other equations and mathematical models, which are recommended under situations of absence of data of any of the meteorological parameters necessary for the application of PM56. In addition to the utilization of classic *ETo* equations, the adoption of Artificial Neural Network models (ANNs), as models of estimation of daily *ETo* under situations of absence of the appropriate data for the application of PM56, has been evaluated in this study. ANNs are mathematical models whose architecture is inspired in biological neural networks. They are very appropriate for the modelization of non linear processes, which is the case of the evapotranspiration process. Thirteen Artificial Neural Networks (ANNs) (with different combination of inputs) have been implemented and compared with ten local calibrated empirical and semi empirical *ETo* equations and variants of these equations (with estimated meteorological parameters as inputs). The comparisons have been based on error statistical techniques using PM56 daily *ETo* values as a reference. ANNs have obtained better results than the *ETo* local calibrated equations among the three groups of evaluated methods: temperature

and/or relative humidity based methods (ANN3 had 0.385 mm day^{-1} of RMSE), solar radiation based methods (ANN10 showed 0.258 mm day^{-1} of RMSE), methods based on similar requirements to those that are necessary for the application of PM56 except for the estimation of solar radiation and/or relative humidity (ANN12 had 0.285 mm day^{-1} of RMSE).

Keywords: reference evapotraspiration, artificial neural networks, *ETo* equations.