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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evaporation in a Mediterranean environment by energy budget and Penman methods, Lake Baratz, Sardinia, Italy" *by* F. Giadrossich et al.

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Answer to the referee's comments. Point 1) The referee makes a very important observation regarding the need to calculate the Penman equation using the available energy for evaporation. The available energy for evaporation is less than the net radiation by an amount equal to the heat storage plus an advection term. However, in many circumstances, the heat storage term is unknown because lake temperature at depths is not measured. This term is thus usually ignored (i.e., set to zero). In our investigation, we measured these temperatures but our point was to evaluate the Penman equation assuming only the data that are commonly available (i.e., net radiation only).

In our article our point of view is to compare the energy budget with the Penman equation for cases where data are scarce and heat storage is not available (this is the most common situation for practitioners and also the most reported case in the scientific literature). In that way the reader can compare the bias between the energy budget method and the Penman equation (the former method using all terms of the heat budget so a kind of "reference model" for estimation of evaporation). Our comparison with other lakes includes three papers that compute the Penman equation using only net radiation (Shanahan et al. 2007; Vallet-Coulomb et al., 2001; Yin and Nicholson, 1998) and two papers that estimate the heat storage and subtract it from the net radiation (Winter et al., 1995, and Rosenberry et al., 2007). There is clearly no fixed standard and the use of the Penman equation energy term depends on the available data. We recomputed evaporation for Lake Baratz subtracting the heat storage term from the net radiation in the Penman equation. The figure below shows the results. Although monthly values between the two calculations of the Penman equation (with and without heat storage) differ, the yearly value of evaporation is nearly identical (3 mm/year difference out of 1121 mm/y).

We agree with the referee that we should better state our objective for this paper which is to evaluate the Penman equation when data is scarce (no measure of heat storage) eventhough we have the data to correct the energy term. It is unfortunate that no papers address the problem of including or not the heat storage term (see Penman, 1948; Brusaert, 1982; or Shuttleworth, 1993). It seems that from a theoretical standpoint heat storage and other components are always considered while for practical applications these terms are usually neglected, except for a few articles. In the literature there is a lack of sensitivity analysis with respect to the heat storage term in the Penman equation at different time scales, different climates, and different lake sizes.

Point 2) Although our objective for this paper is the comparison of the energy budget method with the Penman equation with minimal data (using no heat storage data), we will consider, in another publication, the calibration of the Penman equation for Lake

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Baratz using all available data. As suggested, we also plan on building a heat storage model for Lake Baratz and are working on modelling the water temperature profile using the General Lake Model (GLM, an open source model, where input are similar to the widely used DYRESM model).

We thank Prof. Shuttleworth for his comments and are available for any other questions and suggestions.

References

Brutsaert, W.: Evaporation into the Atmosphere: Theory, History, and Applications, Dordrecht, the Netherlands, Kluwer Academic Publishers, 1982. 8

Penman, H. L. :Natural evaporation from open water, bare soil and grass, in Proceedings of the Royal Society of London A: Mathematical, Physical and Engineering Sciences, Vol. 193, No. 1032, pp. 120-145, 1948. The Royal Society.

Rosenberry, D. O., Winter, T. C., Buso, D. C., and Likens, G. E.: Comparison of 15 evaporation methods applied to a small mountain lake in the northeastern USA, J. Hydrol., 340, 149–166, 2007. 3, 4, 21, 23

Shanahan, T. M., Overpeck, J. T., Sharp, W. E., Scholz, C. A., and Arko, J. A.: Simulating the response of a closed-basin lake to recent climate changes in tropical West Africa (Lake Bosumtwi, Ghana), Hydrol. Process., 21, 1678–1691, doi:10.1002/hyp.6359, 2007. 4, 21, 23

Shuttleworth, W. J.: Evaporation, in: Handbook of Hydrology, edited by: Maidment, D. R., McGraw-Hill, New York, USA, 4.1–4.53, 1993. 8, 11

Vallet-Coulomb, C., Legessea, D., Gassea, F., Travic, Y., and Chernetd, T.: Lake evaporation estimates 5 in tropical Africa (Lake Ziway, Ethiopia), J. Hydrol., 245, 1–18, 2001. 4, 23

Winter, T. C., Rosenberry, D. O., and Sturrock, A. M.: Evaluation of 11 equations for

determining evaporation for a small lake in the North Central United States, Water Resour. Res., 31, 983– 993, 1995. 4, 21, 23

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 1901, 2015.

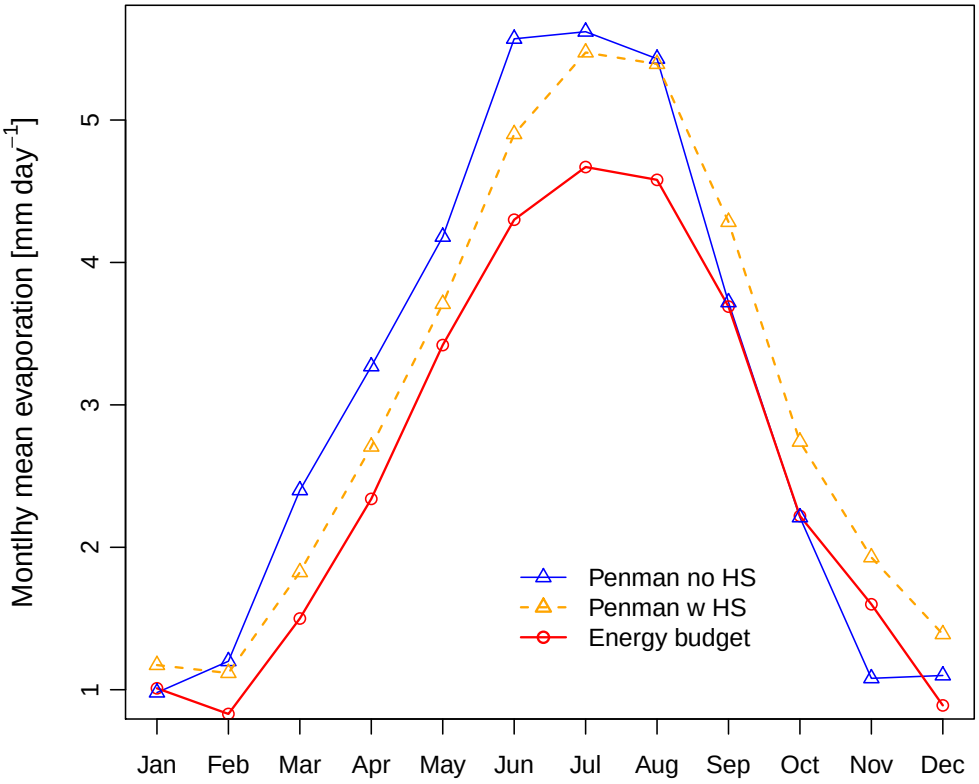

Fig. 1.

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