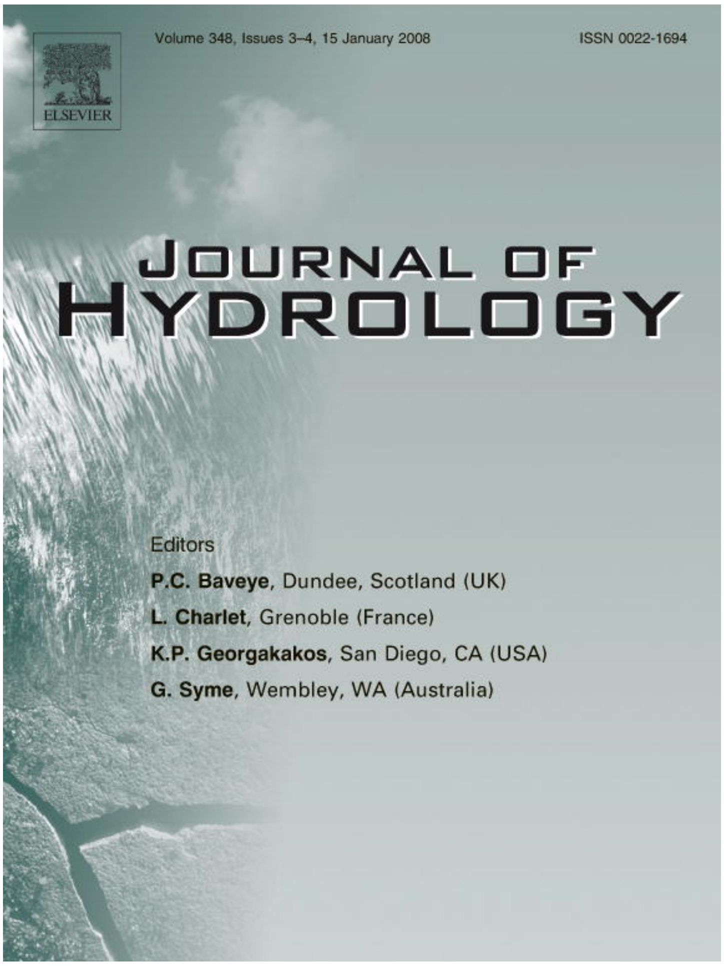
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DISCUSSION

Comment on ''Comparison of 15 evaporation models applied to a small mountain lake in the northeastern USA'' by D.O. Rosenberry, T.C. Winter, D.C. Buso, and G.E. Likens [J. Hydrol. 340 (3–4) (2007) 149–166]

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The authors employ 15 evaporation models in a humid environment (the ratio of mean annual precipitation and evaporation is about 2.5) to estimate evaporation of a small lake (Mirror Lake) of an area of 0.15 km^2 in a forested, mountainous landscape. With the exception of the incident global radiation measurements, all other meteorological measurements were taken at a platform near the center of the lake. The different model estimates were compared to Bowen-ratio budget results. From the best performing four models, three (the Priestley and Taylor (1972), Penman (1948), and the Advection–Aridity model [1979] of Brutsaert and Stricker (1979)) gave almost identical multiyear mean values of lake evaporation. The aim of the present comment is to point out that this is not by chance, but rather, a direct consequence of the complementary relationship (CR), first introduced by Bouchet (1963).

The CR states that actual (*E*) and potential evaporation (PE) rates change in a complementary fashion as the water availability of the environment changes. With growing aridity of the environment, PE increases while *E* decreases and vice versa, *E* increases while PE decreases as the environment is becoming more humid. This complementarity, however, is only true in a water-limited environment, i.e., when actual evaporation is smaller than its potential maximum value under the same environmental conditions but with an abundant water supply. Under the latter conditions, when evaporation is not limited by ready access to water but rather by the available energy, the complementarity between *E* and PE changes ceases since the two become identical. This identical value is the evaporation rate (*PEW*) of the now completely wet environment. The conditions *around and over* Mirror Lake with an annual mean precipitation of about 1220 mm and an annual mean evaporation of only 490 mm, most probably are very close to such an energy-limited environment year round. Note that evaporation from such a small lake in a hot desert environment would not necessarily be equal to PEW due to possible sensible heat advection and mixing of dry air from its surroundings. This so-called ''oasis-effect'' is more pronounced with

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increasing aridity of the environment and decreasing size of the free open water surface.

It was Brutsaert and Stricker (1979) with their Advection–Aridity model, who first quantified the three different evaporation terms in the CR framework. Namely, the PE was estimated by the Penman equation, the wet environment evaporation term, PEW, by the Priestley–Taylor equation, and finally, actual evaporation as $E = 2\text{PEW} - \text{PE}$, exactly the three evaporation models of Rosenberry et al. (2007) that gave almost identical estimates for the lake evaporation.

In the light of this, generalization of the results of Rosenberry et al. must be done with a little caution. Namely, the three equations will perform almost identically *only* in energy-limited environments or where the size of the lake is sufficiently large, the latter only when the required measurements are taken over the lake, as in this study. The more arid the environment generally becomes and the smaller the size of the lake the more the three models will differ in their evaporation estimates. (As a technical issue: the Penman equation is required to be used with measurements unaffected by the presence of the open water surface. At least that is how its wind function was calibrated. So application of the Penman equation with, especially, humidity measurements taken over the lake naturally leads to diminished evaporation estimates causing the three models to yield similar rates even in arid environments.) So in general, the highest evaporation rates among the three models are expected by the Penman equation, followed by the Priestley–Taylor approach, and the smallest, by the Brutsaert–Stricker model. This is so, even if some meteorological variables are measured over the lake (thus implicitly taking into account its size), since the Priestley–Taylor approach, which is driven primarily with radiation data only, assumes that the wet environment has a regional extent while the actual size of the lake in general has a rather limited effect on these radiation components.

As a final thought, in practice it is rare to have any measurements over the lake the evaporation rate of which must be inferred. It is much more common that the necessary meteorological data is only available over land surfaces. It would have been interesting, and would have contributed added practical value to the study of Rosenberry et al., if evaporation methods that expressly rely on such data (as well as take into account the relatively small size of the lake in question), *beside the Penman equation*, could have been included. Such approaches are found e.g., in Brutsaert (1982) and Maidment (1993).

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