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Discussions

Interactive comment on "Comment on "Estimating actual, potential, reference crop and pan evaporation using standard meteorological data: a pragmatic synthesis" by McMahon et al. (2013)" *by* T. A. McMahon et al.

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General Comments

The original paper, "Estimating actual, potential, reference crop and pan evaporation using standard meteorological data: a pragmatic synthesis," applied a correction to the Advection-Aridity (AA) approach by Brutsaert and Stricker (1979). Specifically, the air temperature at which the slope of the saturation vapor pressure curve is evaluated in the Priestley-Taylor equation was corrected to the equilibrium temperature as

suggested by Szilagyi and Jozsa (2008). However, in some cases this resulted in equilibrium temperatures warmer than the air temperature. In the comment under review, a further correction is applied by forcing the equilibrium temperature to equal the air temperature if the equilibrium temperature is calculated to be larger than the air temperature. The scope of this comment is rather narrow, as it is an additional correction to a method to correct the equilibrium temperature in the Priestley-Taylor equation. However, key theoretical issues related to the complementary relationship for evaporation are at stake in this discussion.

The correct way to evaluate the slope of the saturation vapor pressure curve in evaporation equations has been a topic of discussion for many years (e.g., see the discussion by Milly, 1991), and the method taken in the work described above is at least plausible. I agree that the equilibrium temperature should ideally be lower than the air temperature of a drying region. That is, the theory predicts that equilibrium temperatures will be lower than actual air temperatures for a drying region. What concerns me is that at some of the measurement sites there appear to have been many cases where the theory was wrong. In looking at Table 1, the application of the limit to equilibrium temperature resulted in a relatively large difference (between columns 4 and 5 of the table) of about 4% to 11% of the original annual evaporation estimates (column 4). The three sites with the lowest annual precipitation all had a difference of approximately 11%. This implies that the calculated equilibrium temperature is often (or possibly is very far) into the non-physical range of values. Since equation (2) is central to the concept of equilibrium temperature, I am interested to know why the calculated equilibrium temperature of the driest sites so greatly (or so often) exceeded the air temperature and reached unphysical values.

Specific Comments

Specifically, I would like to see additional discussion of when and why equilibrium temperature exceeds air temperature. On page 8784, on lines 13-18, the comment discusses the fact that imperfect measurements along with conditions under which the assumptions of the method are not met can result in unrealistic estimates of equilibrium temperature. Clearly, the “assumptions in the method” are not always met, and “the measurements are not perfect.” But it is not clear to me why the best way to correct these problems is by placing a limit on the equilibrium temperature. This should be explained and defended.

On page 8785, lines 13-15, it states that “four of the corrected values of SJ....are less than the mean annual precipitation which indicates the model is performing satisfactorily.” I am concerned with this because a wide range of evaporation models is available that would give annual evaporation estimates lower than annual rainfall for these sites, but this does not mean that all these models are “performing satisfactorily.” Estimating evaporation to be greater than rainfall on an annual basis does seem like an indication of problems with a method. But estimating evaporation below annual rainfall does not necessarily indicate a satisfactory method.

Technical Corrections

The developers of the advection-aridity model are Brutsaert and Stricker (not “Strickler”).

References

Brutsaert, W. and Stricker, H.: An advection-aridity approach to estimate actual regional evapotranspiration, Water Resour. Res., 15, 443-449, 1979.

Milly, P. C. D.: A refinement of the combination equations for evaporation, Surveys in Geophysics, 12, 145-154, 1991.

Szilagyi, J. and Jozsa, J.: New findings about the complementary relationship-based evaporation estimation methods, J. Hydrol., 354, 171-186, 2008.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 10, 8781, 2013.