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A novel method to partition evapotranspiration based on the concept of underlying water use efficiency

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Evapotranspiration (ET) is dominated by transpiration (T) in the terrestrial water cycle. However, continuous measurement of transpiration is still difficult, and the effect of vegetation on ET partitioning is unclear. The concept of underlying water use efficiency (uWUE) was used to develop a new method for ET partitioning by assuming that the maximum, or the potential uWUE is related to T while the averaged or apparent uWUE is related to ET. T/ET was thus estimated as the ratio of the apparent over the potential uWUE using half-hourly flux data from 17 AmeriFlux sites. The estimated potential uWUE was shown to be essentially constant for the 14 sites with a single vegetation type, and was broadly consistent with the uWUE evaluated at the leaf scale. The annual T/ET was the highest for croplands, i.e. 0.69 for corn and 0.62 for soybean, followed by grasslands (0.60) and evergreen needle leaf forests (0.56), and was the lowest for deciduous broadleaf forests (0.52). The enhanced vegetation index (EVI) was shown to be significantly correlated with T/ET and could explain about 75% of the variation in T/ET among the 71 site-years. The coefficients of determination between EVI and T/ET were 0.84 and 0.82 for corn and soybean, respectively, and 0.77 for deciduous broadleaf forests and grasslands, but only 0.37 for evergreen needle leaf forests. This ET partitioning method is sound in principle and simple to apply in practice, and would enhance the value and role of global FLUXNET in estimating T/ET variations and monitoring ecosystem dynamics.