Evaporation from a small water reservoir: direct measurements and estimates

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Knowing the rate of evaporation from surface water resources such as channels and reservoirs is essential for precise management of the water balance. However, evaporation is difficult to measure experimentally over water surfaces and several techniques and models have been suggested and used in the past for its determination. In this research, evaporation from a small water reservoir in northern Israel was measured and estimated using several experimental techniques and models during the rainless summer. Evaporation was measured with an eddy covariance (EC) system consisting of a three-dimensional sonic anemometer and a Krypton hygrometer. Measurements of net radiation, air temperature and humidity, and water temperature enabled estimation of other energy balance components. Several models and energy balance closure were evaluated. In addition, evaporation from a class-A pan was measured at the site. EC evaporation measurements for 21 days averaged 5.48 mm day-1. Best model predictions were obtained with two combined flux-gradient and energy balance models (Penman-Monteith-Unsworth and Penman-Brutsaert), which with the water heat flux term, gave similar daily average evaporation rates, that were up to 3% smaller than the corresponding EC values. The ratio between daily pan and EC evaporation varied from 0.96 to 1.94. The bulk mass transfer coefficient was estimated using a model based on measurements of water surface temperature, evaporation rate and absolute humidity at 0.9 and 2.9 m above the water surface, and using two theoretical approaches. The bulk transfer coefficient was found to be strongly dependent on wind speed. For wind speeds below 5 m s-1 the estimated coefficient for unstable conditions was much larger than the one predicted for neutral conditions.