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Quantification of Evaporation from a Small Water Storage Reservoir: An Inter-comparison of the Scintillometry and Eddy Covariance Methods

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The demand for knowledge about the surface energy balance in a variety of environments has led to the need for micrometeorological flux measurements in areas that do not comply with the generally accepted requirements of terrain complexity, fetch and homogeneity (Schmid 1997). Small water bodies represent such a complex environment where near shore terrain is likely to be affecting the turbulence structure at the instrumentation. As a result, “Studies of open water evaporation from fresh water systems are biased towards the larger end of the size spectrum” (Rosenberry et al 2007, p.150). This is due to the theoretical and practical problems associated with flows above small water bodies. The dimensions of small reservoirs means measurements can rarely be made in flow that meets the conditions of stationarity and homogeneity (Assouline et al. 2008). In contrast to a large reservoir with considerable upwind fetch, at a small reservoir concerns about whether measurements can be made within the internal boundary layer of the water surface cannot be ignored.

In arid areas, where water storages are essential for agricultural practices, small reservoirs can represent a significant surface area and have a substantial monetary value. Accurate quantification of evaporation from small water storage reservoirs while presenting a significant research challenge is essential for effective water resource management in water scarce regions, in particular those where rapid growth in demand for water exceeds natural supply. In order to ascertain suitable methods for direct measurements of evaporation, two of the most scientifically advanced evaporation measurement techniques, eddy covariance and scintillometry, have been applied to a small reservoir in South-East Queensland, Australia.

The scintillometry methodology adopted in this study (McJannet (2010)) represents a unique approach for determining evaporation over open-water. In addition, the use of eddy covariance instrumentation mounted on a floatable pontoon is also an approach few studies have adopted before. The spatial extent of the instrument’s measurement footprints were analysed through conventional footprinting models, and supplementary measurements of the wind profile at different locations around the dam. In order to account for the complex terrain and inhomogeneous flow the footprint model used in this analysis was the SCADIS model (Sogachev and Lloyd 2004). This model was adopted for the specific environment of Logan’s Dam and uses a one and a half turbulence closure scheme to simulate turbulent transport in the boundary layer. Results indicated that the footprints over small reservoirs are much smaller than over water bodies with larger fetches, due to the influence of turbulence generated by near shore terrain (trees and dam walls) being advected over the reservoir. This allows for reasonable confidence that measurements were recording evaporation from the reservoir and not external sources under the majority of atmospheric conditions. Results suggest that the two techniques are producing remarkably similar results across a range of weather conditions and that the method developed by McJannet et al. (2010) for evaluating the latent heat flux over open-water using scintillometry, provides evaporation measurements that are just as accurate as those made by eddy covariance which has generally been regarded as the most accurate evaporation measurement technique.

Assouline, S., S. W. Tyler, J. Tanny, S. Cohen, E. Bou-Zeid, M. B. Parlange, and G. G. Katul. 2008. Evaporation from three water bodies of different sizes and climates: Measurements and scaling analysis. Advances in Water Resources 31 (1):160-172.
McJannet, D.L., F.J. Cook, R.P. McGloin, H. A. McGowan, and L.S. Burn. 2010. Estimation of evaporation and sensible heat flux from open water using a large aperture scintillometer. Water Resources Research. Submitted.
Schmid, H. P. 1997. Experimental design for flux measurements: matching scales of observations and fluxes.

Agricultural and Forest Meteorology 87 (2-3):179-200.

Sogachev, A., and J. Lloyd. 2004. Using a one-and-a-half order closure model of the atmospheric boundary layer for surface flux footprint estimation. Boundary-Layer Meteorology 112 (3):467-502.