

Measurement of grassland evaporation using a surface-layer scintillometer

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Abstract

A dual-beam surface-layer scintillometer (SLS) was used to estimate sensible heat flux (H) every 2 min for a path length of either 50 or 101 m, for more than 30 months in a mesic grassland in eastern South Africa. The SLS method relies on Monin-Obukhov similarity theory, the correlation between the laser beam signal amplitude variances and the covariance of the logarithm of the beam signal amplitude measured using 2 laser detectors. Procedures for checking SLS data integrity in real-time are highlighted as are the post-data collection rejection procedures. From the H estimates, using SLS and measurements of soil heat flux and net irradiance, evaporation rates were calculated as a residual of the shortened energy balance equation and compared with grass reference evaporation rates (ETo). Inconsistent hourly ETo values occur in the late afternoon due to the incorrect assumption that the soil heat flux is 10% of net irradiance. The SLS estimates of H and the estimates of evaporation rate as a residual compared favourably with those obtained using the Bowen ratio and eddy covariance methods for cloudless days, cloudy days and days with variable cloud. There was no evidence for the eddy covariance measurements of H being underestimated in comparison to the Bowen ratio and SLS measurements. On many days, the diurnal variation in SLS H was asymmetrical, peaking before noon.

Keywords: energy balance, Bowen ratio, eddy covariance, grass reference evaporation, rejection criteria