

Soil Heat Flux - Net Radiation Relations for some Surfaces

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Abstract

Accurate estimates of the net radiation, R_n , and the soil heat flux, Q_g , are important for many studies involving the surface energy balance. In particular, the difference between them is the primary term for the determination of evapotranspiration. The paper reports the net radiation and soil heat flux measured for two areas, Legon and Dawhenya in the Greater Accra Region. The purpose was to use them in determining latent heat and sensible heat fluxes. The results are shown for October 1994 and August 1995 for Legon, and April 1996 for Dawhenya. The soil heat flux showed good correlation with net radiation. Gradients of soil heat flux and net radiation plots ranged between 0.2 and 0.45 for short grass (1994), and between 0.16 to 0.22 for corn (1995) at Legon. At Dawhenya, it showed values between 0.19 and 0.27 (1996). Gradients for the regression lines agree with reported ratios of Q_g to R_n .

Introduction

Net radiation, (R_n), and soil heat flux, (Q_g) are two most important components of the Earth's surface energy balance. This is because the difference between them is the primary term for the formulations for evapotranspiration (Davies, 1971; Idso *et al.*, 1975; Dugas *et al.*, 1991). The soil derives its heat almost entirely from the Sun and loses much of it by radiation into the sky (Payne & Gregory, 1968). The absorbed radiation is dissipated in four different ways: re-radiation to the sky, latent heat of evaporation of soil water, increase in temperature of the surface soil and through conduction. A very small amount is absorbed by green plants for photosynthetic activities. The surface energy balance is given by the relation

$$R_n = Q_g + Q_e + Q_h + Q_{PS} + Q_m \quad (1)$$

where Q_e is the latent heat flux and Q_h is the sensible heat flux Q_{PS} is the flux due to photosynthesis and Q_m is due to miscellaneous energy changes. Thus, any approach at determining the partition

between evaporation and sensible heat flux depends on the proper evaluation of the difference between the net radiation and the soil heat flux, ($R_n - Q_g$), assuming photosynthetic conversion and other miscellaneous energy changes are negligible.

The importance of the accurate estimates of the soil heat flux is that it is used in many studies involving the surface energy balance. Some examples are the use along with the other components of the surface energy balance to infer properties of vegetation canopies (Hatfield, 1985) for verification of eddy correlation approach to flux measurements (Massman *et al.*, 1990), and for the verification of biosphere parameterization in large scale models (Sellers *et al.*, 1986). Massman (1992) discussed an error which can arise when measuring soil heat flux by the combination approach and outlined a method to correct it. The combination method, developed by Fuchs & Tanner (1968), estimates the soil heat flux by measuring the heat flux at a depth, z , below the surface and adding on to it the heat storage in the overlying soil layer.

The ground heat flux is obtained from the