

Version 1.6

A new set of derived heat-flux calculations were added to the data based on Philip's correction:

$$G_s = G_m[1 - \beta r(1 - \epsilon^{-1})]$$

Where G_s is the soil heat-flux, G_m is the measured heat flux, β is a constant (1.31 for Thermonetics, 1.70 for REBS), r is the aspect ratio of the heat-flux plate (thickness/width; ~0.15 for Thermonetics, 0.102 for REBS), and ϵ^{-1} is the ratio of thermal conductivity of the soil to the heat-flux plate, λ_s/λ_p .

Soil thermal conductivity was estimated from the site empirical model:

$$\begin{aligned}\lambda_{\text{unburned}} &= 0.1234\rho_b + 8.21\theta_v \text{ (Wm}^{-1}\text{K}^{-1}\text{)} \\ \lambda_{\text{burned}} &= 0.486\rho_b + 2.70\theta_v \text{ (Wm}^{-1}\text{K}^{-1}\text{)}\end{aligned}$$

where ρ_b is the soil bulk density and θ_v is the soil volumetric water content. During the April 2004 burn, the model was changed from unburned to burned the moment that sensible heat-flux due to the burn was detected.

Soil bulk density was estimated from the site empirical model:

$$\begin{aligned}\text{rep 1: } \rho_b &= 1.405 + 1.18z \text{ (Mgm}^{-3}\text{)} \\ \text{rep 2: } \rho_b &= 1.203 + 1.18z \text{ (Mgm}^{-3}\text{)} \\ \text{rep 3: } \rho_b &= 1.300 + 1.18z \text{ (Mgm}^{-3}\text{)}\end{aligned}$$

where z is the depth (m), and rep 1 is the "old-slash" site, rep 2 is the "new-slash" site, and rep 3 is the "chipped" site.

Volumetric water content was estimated by linearly interpolating θ_v measurements at 0.05 and 0.15 m to 0.02, 0.10, and 0.20 m for each 30 minute period. Missing water content data after 0.02, 0.10, and 0.20 m estimates were created were linearly interpolated over time. An exception was the order of interpolation during the April 2004 burn. The 0.05 and 0.15 m data was interpolated, and then the estimates at 0.02, 0.10 and 0.20 m were calculated. The volumetric water content data during the April 2004 was also used to apply the Philip correction to the 2 minute data by linearly interpolating from 30 to 2 minutes.

Thermal conductivity of the Thermonetics heat-flux plates were estimated from:

$$\lambda(T) = K(T) * (NP_c t)$$

where $K(T)$ is the temperature dependent heat-flux plate calibration (introduced in version 1. 4), N is the number of junctions per heat-flux plate, P_c is the thermoelectric power ($5/9 * 0.023 \text{ mVC}^{-1}$), and t is the plate thickness (m). Missing temperature data was linearly interpolated over time.

Thermal conductivity of the REBS plates was $1.22 \text{ Wm}^{-1}\text{K}^{-1}$.

References:

Philip, J.R. 1961. The theory of heat flux meters. J. Geophys. Res. 66:571-579.