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A new approach to the determination of soil heat flux below vegetated surfaces for remote sensing applications

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In this work we propose that physically-based equations should be combined with remote sensing techniques to enable a more theoretically rigorous estimation of soil heat flux, G.

First, it is shown that by employing a simple equation utilising information on soil type (porosity), combined with an estimation of soil moisture status, a good approximation of soil thermal inertia (*TI*) can be inferred. This approach can be undertaken remotely by utilising extant soil surveys and databases to determine soil type, and from monitoring rainfall to estimate the soil moisture status.

However to employ a standard equation (such as the Exact or Analytical method) also requires harmonic analysis of soil surface temperature, to determine the diurnal course of G. This is problematic as remote sensing can only provide a composite (vegetation plus soil) radiometric brightness temperature. To solve this a simple equation is presented that relates the sum of the harmonic terms derived for the composite radiometric surface temperature to that of below canopy soil surface temperature.

To assess the success of the method proposed for the estimation of the diurnal shape of G, a comparison was made between 'remote' and in-situ calculated values from various field sites. This indicated that the proposed method was suitable for the estimation of the shape of G,for a range of canopy densities, leaf area indices and IR thermometer view angles.

Thus, by combining the estimates of *TI* and the diurnal course of G, it was shown that the Exact Method could be employed successfully using remotely sensed variables.

The thus predicted values of G were also compared with those obtained from empirical methods found in the literature. This indicated that the method proposed in this work resulted in more realistic predictions of G compared to the other methods.

Therefore we assert that our method provides the basis for a more transparent and readily interpretable method for the estimation of G; without the requirement for in-situ instrumentation. Moreover, such an approach ensures a more universally applicable method than those derived from purely empirical studies (employing vegetation indices and albedo for example).