

Long-Term Estimation of soil heat flux using single layer time series data of soil temperature

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Abstract

Soil heat flux may play an important role in surface energy balance. In this study, we examined the performances of two methods for predicting soil heat flux from single layer time series data of soil temperature. The first one is the traditional method, which an analytical solution of soil heat flux can be obtained by assuming the surface soil temperature varies sinusoidally. The second one is the connection between surface soil temperature and soil heat flux derived by half order derivative/integral, and is based on a simple model of heat transfer described by a one-dimensional diffusion equation with a constant heat diffusivity. Good agreements between measured and predicted soil heat fluxes were found for both methods. However, it was shown that the half order derivative method has a better capability to capture flux accuracy and trend than the traditional method for long-term soil heat flux estimation.

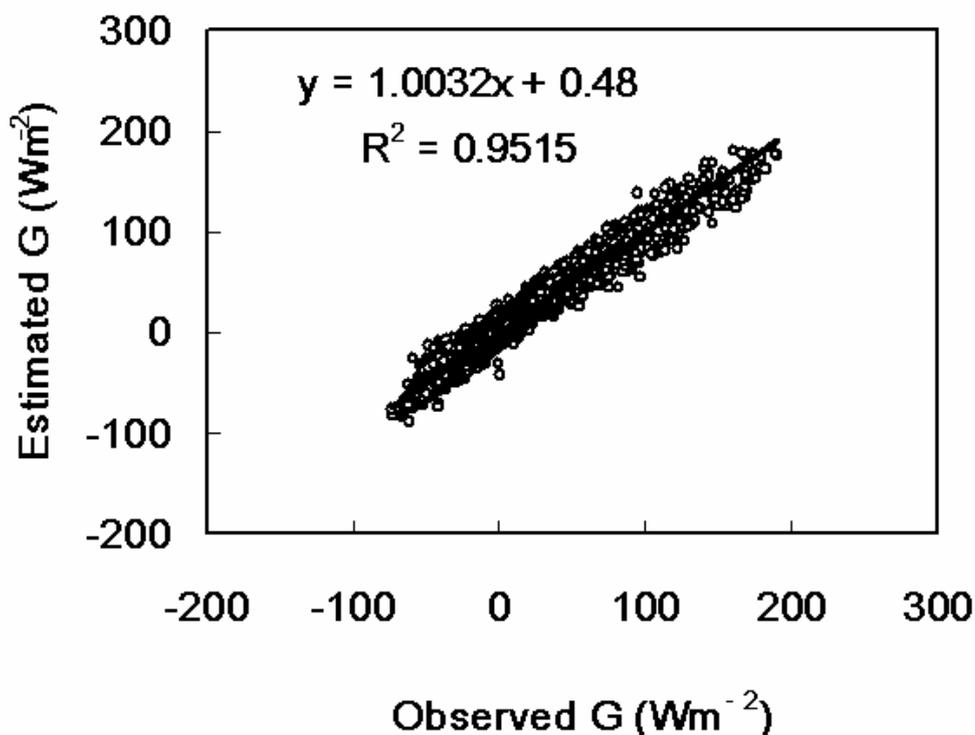


Figure 1. Scatter plot of estimated versus observed soil heat fluxes (by the half order derivative/integral method).

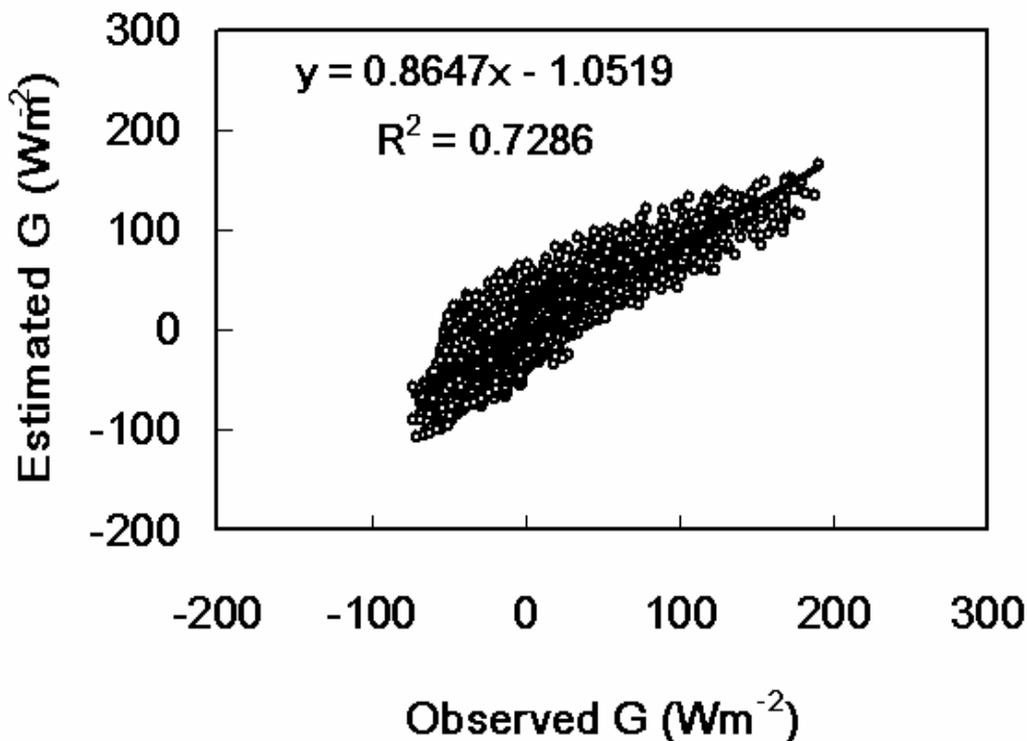


Figure 2. Scatter plot of estimated versus observed soil heat fluxes (by the traditional method).

References

- Beltrami, H., E. Bourlon, L. Kellman, and J. F. Gonzalez-Rouco, 2006, Spatial patterns of ground heat gain in the Northern Hemisphere, *Geophys. Res. Lett.*, 33, L06717, doi: 10.1029/2006GL025676.
- Carslaw, H. S., J. C. Jaeger, 1986, *Conduction of heat in solids*, 510pp., Clarendon Press, Oxford.
- Campbell, G. S. and J. M. Norman, 2000, *An introduction to environmental biophysics*, 286pp., Bartlett Press, Marietta, GA.
- Delworth, T. L., and T. R. Knutson, 2000, Simulation of early 20th century global warming, *Science*, 287, 2246-2250.
- Idso, S. B., J. K. Aase, R. D. Jackson, 1975, Net radiation - soil heat flux relations as influenced by water content variations. *Boundary - Layer Meteorol.*, 9, 113-122.
- Kustas, W. P., and C. S. T. Daughtry, 1990, Estimation of the soil heat flux / net radiation ratio from spectral data, *Agric. Forest Meteo.*, 49, 205-223.
- van Loon, W. K. P., H. M. H. Bastings, E.J. Moors, 1998 Calibration of soil heat flux sensors, *Agric. Forest Meteo.*, 92, 1-8
- Wang, J., R. L. Bras, 1998, A new method for estimation of sensible heat flux from air temperature, *Water Resour. Res.*, 34, 9, 2281-2288.