Numerical solution of a complete surface energy balance model for simulation of heat fluxes and surface temperature under bare soil environment

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Abstract

Surface energy balance model is an essential approach for heat flux and evaporation estimation in applied meteorology and hydrology. Due to the complexity of soil–air interface system, the model has been simplified for different purposes in many researches. A complete model with full description of its complex factor relationships and its numerical solution has not been yet implemented in practical use. This paper presents a complete surface energy balance model with its inner relations cited from different researches. The model couples soil temperature change simultaneously with soil moisture movement, which makes the solution of the model uneasy. A detailed methodology of numerical approximation to the complete model is presented in the study for practical use. Soil heat and latent heat fluxes in the model are determined according to both soil temperature change and soil moisture movement, which are described as two differential equations. Crank–Nicolson implicit method is used to expand the differential equations into two sets of simultaneous linear equations, which are then solved by applying Gauss's elimination method. Latent heat flux is determined at the balance when evaporation from the surface is equal to the soil water loss. And surface temperature is

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0096-3003/02/$ - see front matter
PII: S0096-3003(01)00089-3