

## **Revisiting the Surface Energy Balance**

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The traditional surface energy balance (SEB) based on the matching upward and the downward heat energy flux at the air-land interface lacks a proper derivation from the first law of thermodynamics. The thermal energy transfer between the soil and the atmosphere is related to the heat energy balance within the soil layer between the surface and the depth where the soil heat transfer is measured and the atmospheric layer where the heat transfer is dominated by molecular thermal conduction from the surface. Applying the first law of thermodynamics to the two layers jointly at the surface, additional heat energy transfer terms are identified that missed in the traditional SEB and have strong diurnal variations. The most important missing heat energy term in the traditional SEB is associated with the water flow across the soil layer driven by water evaporation at the surface with temperature changes from the relatively steady value down below to the large diurnal varying value at the top.

Based on the observation from the Cooperative Atmosphere-Surface Exchange Study 1999 (CASES-99) field experiment, the sum of all the missing heat energy terms approximately balances the residual of the traditional SEB. The investigation emphasizes the contribution of the relatively slow molecular thermal conduction in the heat transfer across the air-earth interface, which cannot be replaced by the relatively fast turbulent mixing in the heat transfer in the atmosphere as commonly practiced in numerical models.

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Thursday, 9 June 2016, 3:30 PM Refreshments 3:15 PM NCAR-Foothills Laboratory 3450 Mitchell Lane Bldg 2 Main Auditorium, Room 1022



