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## ***Interactive comment on “Influence of wave phase difference between surface soil heat flux and soil surface temperature on land surface energy balance closure” by Z. Gao et al.***

**Anonymous Referee #3**

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The paper addresses the long standing issue of observed surface energy imbalance. This is a relevant subject since this uncertainty hampers the use of surface flux observations in evaluation of atmospheric and hydrological models

General remarks:

In section 2 the authors argue correctly that the soil surface heat flux (G) is not in phase with the soil surface temperature (TS). Subsequently they assume that net-radiation (Qn), sensible heat flux (H) and latent heat flux (LE) are all in phase with the soil surface temperature. The logical outcome of this assumption is of course a surface energy imbalance. But this shows nothing more than that the assumption of

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equal phase of Qn, H, LE and TS is incorrect. By looking at observations of clear days this can readily be seen. For example for a well evaporating vegetation it is observed that sensible heat flux already changes sign 3 hours after noon. In reality the phases of the various components of the energy budget are the outcome of all the interactions taking place at the atmosphere soil/vegetation interface. The whole point of using soil vegetation atmosphere schemes is to solve the surface energy budget equation.

Other remarks:

P1092, L17: Interestingly the convective soil heat flux as outlined in eq 2. is not observed with conventional heat flux plates. It would be interesting to quantify the influence of the water transport term in Eq.2 on the soil surface heat flux for realistic soil vegetation systems and compare it with the influence of the normal temperature diffusion term.

P1099,L28: The heat storage above the soil heat flux sensors is in general a significant term and in some cases even a dominating term in the soil surface heat flux. In the past, authors have applied ingenious ways to estimate this term (see for example De Bruin and Holtslag (1982). The measurement configuration described in this paper with temperature sensors ( 5 and 10 cm) at and below the soil heat flux sensors (5 cm) is inadequate to provide a good estimate of storage over the short time scales (diurnal cycle) considered here.

A notational remark: In the field of micro meteorology radiation components are more likely notated as SWD, SWU, LWD, LWU (short wave, long wave upward downward) at least different notations for the same quantity should be avoided (see OSR (p1097)and USR(p1100))

Bruin H. A. R. de and A. A. M. Holtslag (1982). A simple parameterization of the surface fluxes of sensible and latent heat during daytime compared with the Penman-Monteith concept. *J. Appl. Meteorol.*, 21, 1610-1621.

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