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Hydrology and Earth System Sciences Discussions

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 #2

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General comments: This paper gives some new thoughts on the way to solve (understand) the concerned 'surface energy balance closure failure'. However, it needs a substantial revision before it could be published. I was surprised by the major conclusion: 'The sum of sensible heat flux (H) and latent heat flux (LE) is always less than surface available energy (Rn-G0), even if all energy components are accurately measured, their footprints are strictly matched, and all corrections are made.' The first half of this saying (H+LE < Rn-G0) is commonly true in many filed measurements, especially with eddy-covariance method in the observation of H and E; But if with '. . .all corrections' made the problem is still kept, then the classical principle of 'energy conservation' would be negated?

Major comments: 1. The principle of 'energy conservation' is independent of neither spatial nor temporal scale. For a specific layer (volume) as concerned in 'surface energy balance' investigation, all possible budget components should be 'balanced' in any time scale, as commonly 10 minutes to one day, but not related to the changing phases of each component. The 'imbalance' is from, in present stage, the inabilities of observation instruments (including Eddy-covariance system) as well as data processing procedure. 2. In Section 2.2 of this paper, the authors assume that the components Rn, H, and LE 'have identical phases with soil surface temperature'. Even the authors mentioned later it is 'in reality not', following derivations were still based on the assumption. This is a misleading. The 'surface temperature' used in their analysis (as in Figure 6) was very likely measured by a 'radiation thermometer' or calculated from OLR (by a downward long-wave radiometer). It is sure with the same phase as OLR. 'In reality', surface temperature measured by any direct method has always a phase delay to the Rn, meanwhile, the G0 is always in advance. The 'surface' we talked is not infinitesimal thin but actually a volume with some depth, where we investigate the energy budget.

Minor comments: 1. P.1091, line 6. Please refer more recent papers by Foken. I suggest that the authors read carefully the recent papers by Foken et al., also the papers by Oncley et al., Jacobs et al, etc., to understand the issue in more depth. 2. If the authors are going to prove their findings in section 2.2, then the theoretical basis described in Section 2.1.2 is enough. The complicated formulation in 2.1.1, although it was from an excellent work by the same author, just does not give more help here. The convection of liquid water in upper soil layer may have minor effect on the calculation of ground heat flux, but has almost no effect in proving the new finding in this paper. 3. P.1097 mentioned the calculations of H and LE by 'gradient + resistance' method (as the bulk method in many models). This is not the case commonly used in study the energy imbalance nowadays. Actually, people are very concerned the possible inability (and corrections) of eddy-covariance method in measuring fluxes, even it is still now the best method in flux observations. 4. The left of Figure 3 (i.e., before 10:30 the

closure ration > 1, while in afternoon, <1) has no observation support. 5. The data for Figure 6 may not be a good example. From the GAME-Tibet data web site, that day was not a 'clear' day, but with some cloud and even some rain in late afternoon. The result is that we could not clearly see the peaks of each energy component (and Tsfc). Even for GAME-Tibet, there are still plenty choices. You can also use those from the EBEX data set.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 6, 1089, 2009.