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Hydrology and Earth System Sciences Discussions

Interactive comment on "Measurements of energy and water vapor fluxes over different surfaces in the Heihe River Basin, China" *by* S. Liu et al.

S. Liu et al.

smliu@bnu.edu.cn

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Dear Anonymous Referee#2: We are very grateful for you review our paper and give us very useful suggestions. We will try to take advantage of your advice for improving the manuscript. For an easier comprehension, your comments are also reported. We respond below to your comments item by item.

General comments:

I recognize that this paper cost the authors many years' labor, but I am sorry I have to point out some flaws that should be corrected. Further, I'd like to suggest that the annual variations in water balance at the three sites situated in irrigated cropland, alpine

meadow and spruce forest in the Heihe River basin should be focused on a little more, because it could give this paper its originality more.

Thanks for the Referee#2's suggestion. We will add more description about the annual variations in water balance at the three sites in the revised manuscript.

Specific comments:

Referee#2: Evapotranspiration (ET) is closely connected with other water balance components such as rainfall, irrigation and capillary rise, and hence not only ET but also other water balance components should be analyzed and discussed as well. At least, seasonal variations in precipitation should be shown in "3 Results and discussion".

Thanks for the Referee#2's suggestion. Although we have mentioned some water balance components in P.8758 L.14-21, we don't very focus on them. We will add some discussions about water balance over the three sites in Sec.3.2.3 in the revised manuscript, such as the seasonal variation of precipitation.

Referee#2: About Table 2: Does "Monthly G0" mean the cumulative heat flux at the soil surface in a month? If so, it is strange that it was positive all through the year, because, if the monthly Rn was positive, the result suggests that the ground absorbed heat on a yearly basis. If energy balance is made, we have LE/Rn + H/Rn +G0/Rn = 1 However, numerical values listed in Table 2 do not met this demand. Is this imbalance "the energy imbalance of EC" you write in this paper? Further explanation of this phenomenon should be given in this context related to Table 2.

We obtain the monthly G0 in two steps: firstly, we calculate the monthly average diurnal course of G0 in a month; secondly, the monthly G0 is calculated according to the diurnal course of G0. In Table 2, we calculate ratios of monthly LE, H, G0 to Rn only during the daytime period (8:00-19:00, Beijing standard time), which contained most fluxes in a day and ensured the data quality. Thus, the ratio in Table 2 is positive. We will add

the time description. In Table 2, LE/Rn + H/Rn +G0/Rn do not equal to 1, which can be called 'energy imbalance', and we have explained some causes of this phenomenon at the three sites in Sec.3.2.1. In order to describe it more clearly, we will add some explanations in Sec.3.2.2 in the revised manuscript.

Referee#2: About estimating G0: You made measurements of soil heat flux at a depth of 0.05 m and of soil temperature at depths lower than 0.05 m. Thus, when estimating G0 by Eq. (8), you need to assume the depth profile of soil temperature in the upper 0.05 m. How you determined the temperature profile (using the surface temperature measurement Ts?). The accuracy of the estimates of G0 made by the method should be discussed, because it seems to have a large influence on your results.

Like the Referee#2 mentioned, the soil temperature profile is obtained from the surface temperature (obtained from the measurements of longwave radiation fluxes, P.8751 L.12) and soil temperature at different depth. This method (Eq. (8)) calculates soil surface heat flux according to the soil temperature and soil moisture profile, and it does not relate to the measured soil heat flux (Yang et al., 2008). Zuo et al. (2010) compared this method (Eq. (8)) with the soil heat flux plate measurement (HFP01SC, 5 cm depth) and the harmonic analysis method. The results showed that there were good agreement among this method, the harmonic analysis method and the observations, the determined coefficient was 0.99 and 0.97, respectively. The 5 cm depth soil heat flux calculated by this method was a litter larger than the observations (about 6%). However, the surface soil heat flux calculated by this method and the harmonic analysis method had only 1% difference. We also compared this method with the harmonic analysis method at AR site (not shown in the manuscript), the result showed a good agreement between the two methods. So the accuracy of the estimates of G0 made by the method should be acceptable.

Referee#2: About Eqs.(7) and (8): If z and Gz are defined as positive downward, integral and summation should be done from z = 0 to z = zr, which seems to be the opposite in direction to that these equations say. The time interval Δt used in this

calculation also should be mentioned (30 min?).

We have checked the mistake and will revised it in the revised manuscript, and the time interval Δt is 30 minutes in P.8751, L. 6.

Referee#2: About Fig.4: If G0 were underestimated, the coefficient a would also be underestimated. You emphasize that all of the instruments were calibrated and carefully maintained, but your description "the soil heat flux . . .was already considered (p.8755, 23-24)" does not succeed in emphasizing the reliability of G0.

In Fig.4 the "G" is "G0", and it does not mean the 0.05m depth soil heat flux. G0 was calculated according to our soil temperature and moisture profile measurement (in Sec2.2.3), thus, we said that we have considered the soil heat storage in P.8755, L.23-24. We will check our processing steps on G0 carefully in the revised manuscript.

Finally, we are grateful for the Referee#2's supplement suggestions. We will revise them item by item in the revised manuscript.

Reference:

Yang, K. and Wang, J. M.: A temperature prediction-correction method for estimating surface soil heat flux from soil temperature and moisture data, Sci. China Ser. D, 51, 721–729, 2008.

Zuo, J.Q., Wang, J.M., Huang, J.P., Li, W.J., Wang, G.Y., Ren, H.L.: Estimation of ground heat flux for a semi-arid grassland and its impact on the surface energy budget, Plateau meteorology, 29(4):840-848, 2010. (In Chinese with English abstract)

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/7/C4447/2010/hessd-7-C4447-2010-supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 7, 8741, 2010.