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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Evolution of the human–water relationships in Heihe River basin in the past 2000 years" *by* Z. Lu et al.

Z. Lu et al.

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We thank you for considering our manuscript "Evolution of the human–water relationships in Heihe River basin in the past 2000 years" (Submission Reference: hess-2014-560) and our response (in red) to your comments (in black) are provided below.

1. Comment: The estimation of E is not clear to me. Is E estimated by equation (2) or (3) for the basin or for cultivated oases and natural oases separately? Is w=3.5 for all the historical periods? Should the value of w be different between cultivated oases and natural oases? Should w even change with time depending on the type and intensity of crops?

E is estimated by equation (2) for cultivated oases and by (3) natural oases. w=3.5 for

all the historical periods in our manuscript. We totally agree that the value of w will vary among different land use types and could change with time depending on the type and intensity of crops. However, due to the lack of historical documents or data for natural oases (forest and grassland) in this region, it is impossible for us to characterize w for the natural oases in the historical periods. In addition, in equations (2) and (3), when w is larger than 3, the impact of changes in w on E is likely to be small, especially in this arid region where E0/P is large, and the available water for evapotranspiration becomes the determining factor (Zhang et al., 2001; Zhang et al., 2004). Therefore, we consider that using w=3.5 for all the historical periods is reasonable. However, we will discuss this issue as a limitation of this manuscript in the Discussions and Conclusions section. 2. Comment: Water supply is computed as the summation of local precipitation and irrigation (or groundwater ET). Is irrigation water pumped from groundwater or surface water withdrawal?

Irrigation water was obtained by surface water withdrawal from upstream reaches in historical periods. It has been both pumped from groundwater and diverted from surface water since the establishment of New China in 1949 as the surface water resource was insufficient for rapid development of agriculture. The development of pumping and drilling technology during this period also facilitated this change. We will improve the description of irrigation in the revised manuscript to clarify this. 3. Comment: Is a portion of local precipitation recharged to the groundwater? If not, the groundwater is fully replenished by the precipitation recharge at the upstream (mountain).

Yes, a very small part of local precipitation recharges the groundwater in the extremely wet years in the mid and lower stream reaches of our study area. We agree that most of the groundwater is replenished by the precipitation recharge in the upper catchment (mountains). We will clarify this in the description of the groundwater recharge in our revised manuscript.

4. Comment: Line 15 page 1061: change to ", e.g., water"

We agree. We will make this change in our revised manuscript. 5. Comment: Lines 1-3 page 1062: There are some recently published papers which are for explanatory and predictive purpose, e.g., “A prototype framework for models of sociohydrology: identification of key feedback loops and parameterisation approach” by Elshafei et al. (2014 HESS)

Thanks for introducing this very useful reference to us to improve the quality of our manuscript. We have read it and will reference it in our revised manuscript.

6. Comment: Lines 24-25 page 1062: some information is repeated at lines 4-9.

We agree. We will delete the repeated information in our revised manuscript. 7. Comment: Line 15 page 1064: “Budyko and Miller, 1974;” Double check this.

We agree. We will double check it and make any necesseary change in our revised manuscript. 8. Comment: Line 20 page 1064: change to “respectively; ” Similar changes are applicable for other locations.

We agree. We will make this suggested change throughout our revised manuscript. 9. Comment: Line 16 page 1066: correct “Fu (1981) fFor details,” We agree. We will make this suggested change in our revised manuscript. 10. Comment: Line 24 page 1066: change “PET” to “E0” or define PET.

We agree. We will change “PET” to “E0” in our revised manuscript. 11. Comment: Lines 24 page 1066 – line 1 page 1067: E0 is assumed to be the same between the historical period and the instrumental period. This assumption needs to be justified or the uncertainty on estimated E due to this assumption needs to be discussed.

Thanks for the point raised. We will add some sentences to discuss the uncertainty of estimated E in our revised manuscript. 12. Comment: Line 15 page 1067: since “I” has been used for irrigation in Equation (5), you can use “J” to replace “I” in equation (5).

Thanks for the point raised. We will make the suggested change in our revised

manuscript. 13. Comment: Line 2 page 1074: “m3/year”? Check the unit in Table 2 too.

We agree. We will use “m3/year” in Table 2 in our revised manuscript.

14. Comment: Lines 10-11 page 1076: The period from 2000-2010 is short. I am not sure whether it has already reached a new equilibrium stage. Natural oasis may continue to increase from Figure 5.

Thanks for the points raised. We will develop in-depth discussion on the equilibrium stage in our manuscript. At this moment, we think that changing “a new equilibrium stage” to “a new state” is a more appropriate expression. 15. Comment: Line 13 page 1077: Are predictions of its possible future dynamics discussed? How to predict future dynamics?

Thanks for the point raised. We did not mean that the future dynamics are predictable at this stage, rather that our findings can inform attempts towards this. We will make the discussion on this issue clearer in our revised manuscript. 16. Comment: Lines 15-18 page 1077: I think the claim is over stated. The manuscript can be shortened, but the “transition theory” needs more description and discussion.

Thanks for the point raised. We agree. We will rewrite this section and add more description and discussion on transition theory in our revised manuscript.

Additional references: Zhang, L., Dawes, W., and Walker, G.: Response of mean annual evapotranspiration to vegetation changes at catchment scale. Water resources research, 37, 701-708, 2001. Zhang, L., Hickel, K., Dawes, W., Chiew, F.H., Western, A., and Briggs, P.: A rational function approach for estimating mean annual evapotranspiration. Water resources research 40, W02502, doi:10.1029/2003WR002710, 2004.

Please also note the supplement to this comment:
http://www.hydrol-earth-syst-sci-discuss.net/12/C661/2015/hessd-12-C661-2015-

supplement.pdf

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 12, 1059, 2015.