We appreciate Dr. Jaramillo’s comments on our manuscript and the comments would be great help for improving the presentation.

We would like to discuss the two problems arisen by Dr. Jaramillo herein with some new Figures on the conditions in the Hailiutu River catchment (HRC), China.

1. Why did not we use ET=P-Q in calculating the actual annual ET?

In fact, we did such a calculation and obtained the “REAL” data of annual ET. However, we found that the data were wrong because the change in storage was ignored in the estimation while it should not be ignored.

We plotted the data in the Budyko-type space with coordinates of E0/P and (P-Q)/P. As shown in Figure 1, it exhibits a negative trend of the “REAL” ET/P with increase in the aridity index, which is contrary to the Budyko framework. Istanbulluoglu et al. (2012) also found this abnormal trend in an American basin and they demonstrated that the trend was due to ignoring the change in storage. They used long-term monitoring data of groundwater level to estimate the change in groundwater storage and obtained more reasonable results of the “REAL” ET. However, this kind of long-term monitoring was not available in the HRC, China. Thus, we used a monthly model to estimate the “REAL” ET.

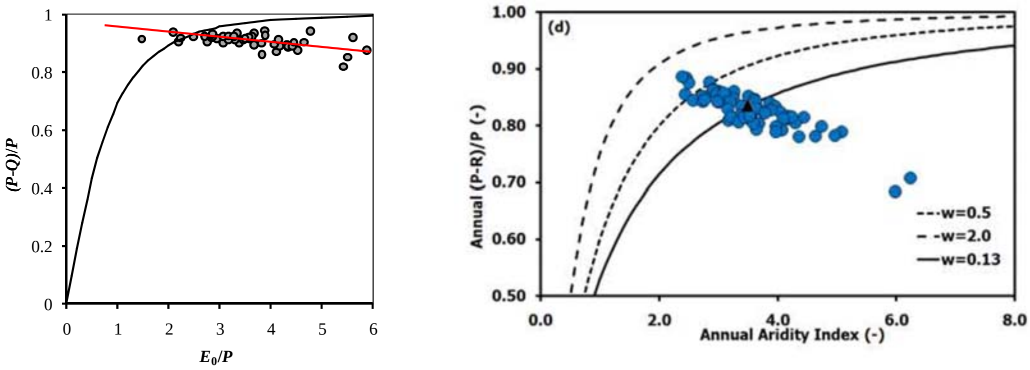

Figure 1 Plots of the annual (P-Q)/P data in the HRC (left, this study) and in the NLRB (right, Istanbulluoglu et al., 2012)

Dr. Jaramillo mentioned that in the conclusion the presentation “Budyko hypothesis is not valid for the inter-annual variability of catchment water balance with groundwater dependent evapotranspiration” is not rigorous, because the Budyko hypothesis was just available for long-term average behavior. We agreed with this opinion and is ready to replace the sentence with “The Budyko hypothesis should not be applied for the inter-annual variability of catchment water balance with groundwater dependent evapotranspiration”. The purpose of presenting this conclusion is to remind researchers who try to use Budyko framework in analyzing the annual water balance behavior in catchments but not aware of the impacts of groundwater dependent evapotranspiration.

Dr. Jaramillo’s comment on the impact of the irrigation activities is constructive and we will discuss the problem in more detail way in the revised manuscript. In the HRC, China, irrigation water is mainly introduced from reservoirs or dams in the river channel. We noticed that Jaramillo and Destouni (2014, 2015) have found that land surface evapotranspirtion and water storage at global scale have been significantly influenced by land use and irrigation, varying with different trend driven by climate change. It would be a good idea to be referenced in analyzing the role of human activities in the hydroclimatological behaviors of the HRC, China.

For separately plotting Zone-1 and Zone-2 in Budyko space, we use the separately estimated ET from the two zones to calculate different values of ET/P and then plotted them into the Budyko space. The Budyko space was not applied to illustrate the whole water balance but just show how ET/P varies with the aridity index, even through the water systems are not closed in the separated Zone-1 and Zone-2. If we have to analyze all the water balance components, we need other coordinates, for example, plot data of R/P or Q/P versus E0/P and then the system should be closed. However, in this case we just use the Budyko space (ET/P versus E0/P) to analyze the response of ET on the aridity index.

2. The term "Groundwater Evapotranspiration"

This term has been widely used in the communities of hydrogeology. It does not mean that groundwater would be directly transformed to vapor in the atmosphere. The process must occur with capillary rise of groundwater into the soil-vegetation-atmosphere transfer (SVAT) system and then become vapor in the atmosphere. The process can be driven by both transpiration through vegetation and evaporation in the soil with shallow water table. To avoid the misunderstanding on the term, we would rather use "groundwater dependent evapotranspiration" than "groundwater evapotranspiration".

Groundwater dependent evapotranspiration mainly occur in the area of shallow water table (*i. e.*, depth to water table is less than 2 m or less than the root depth of plants). The landscape characteristics, distribution of groundwater depth and vegetation index in the HRC, China, have been presented in Lv et al. (2013), as shown in Figure 2.

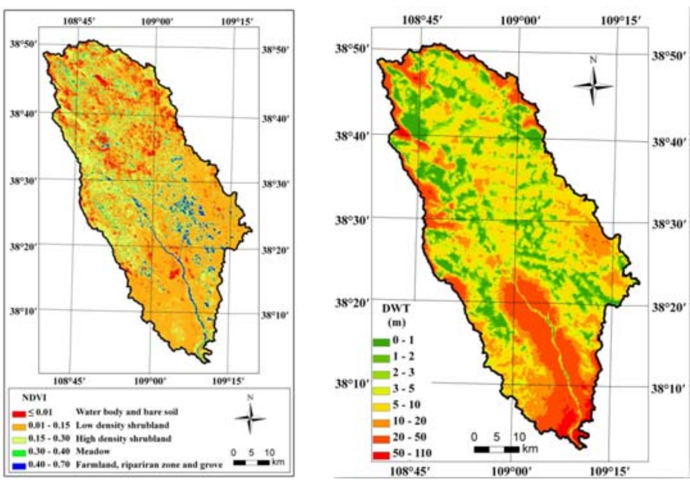

Figure 2 Distribution of vegetation (left) and groundwater depth(right) in the HRC (Lv *et al*, 2013)

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