Biogeosciences Discuss., 11, C6848–C6849, 2014
www.biogeosciences-discuss.net/11/C6848/2014/

Interactive comment on "Analysis of water use strategies of the desert riparian forest plant community in inland rivers of two arid regions in northwestern China" *by* Y. N. Chen et al.

Anonymous Referee #1

Received and published: 19 November 2014

In this study, the authors have analyzed and compared the water use characteristics of two typical woody species (Populus euphratica and Tamarix ramosissima) in two desert riparian forests, China. Because water is the most important limiting factor for plant growth and distribution in dry land, evaluation of these characteristics is extremely important in plant physiological ecology and forest hydrology. However, I found the very weak points in demonstration of the authors' object for following reasons:

(1) In two regions of Heihe and Tarim, although comparing various parameters, it is very questionable whether the data can be evaluated as a representative (specific) value of the site. It should be carefully evaluated the response characteristics in a wide range under variations in the environmental conditions in each region. From such a point,

rather than the data for just one or few days, and should be evaluated by a long-term measurement.

(2) Considerations are mixed in the result. In addition, to the contents of the considerations is a little redundant, interpretation is often leap. To begin with, in the value of each parameter are different between the two sites, either due the environmental conditions at the time of the measurement is different, or the measured environmental conditions are substantially the same or response itself differs, is not clear. As for this point, it has not been clearly demonstrated in this experiment design, it is not logically discussed properly.

Interactive comment on Biogeosciences Discuss., 11, 14819, 2014.

Response：

(1) Yes, we agree with the reviewer's viewpoint that the data from a wide range are better to represent values of a large area than those from a small site. And we also recognize that the paper will be more valuable if these data (all of the parameters) in the paper are collected along the lower reaches of Tarim River Basin and Heihe River Basin. However, the lower reaches of Tarim River and Heihe River are 312 km and 333 km, respectively, which include a large area. It is impossible to measure all of these places at a growing season of plants in every year. Therefore, we just can select some sites to represent the lower reaches of the two rivers. Long-term plants ecological and physiological investigation showed that (in Tarim River we had set up 9 sections since 2000, including Akedun, Yahepumahan, Yingsu, Kerdayi, Abudale, Tugemailai, Alagan, Yiganbujima and Kaogan.) the section-Yingsu could represent the upper and middle of the lower Tarim River. About this, we have published many papers, and some of them were as follows:

Chen YN, Wang Q, Li WH, et al. 2006. Rational groundwater table indicated by the ecophysiological parameters of the vegetation: A case study of ecological restoration in the lower reaches of the Tarim River. Chinese Science Bulletin, 51(suppl. 1): 8–15

Hao, Xing-Ming; Chen, Ya-Ning; Guo, Bin; Ma, Jian-Xing. Hydraulic redistribution of soil water in Populus euphratica Oliv. in a central Asian desert riparian forest. Ecohydrology, 6(6), pp 974-983, 2013.

Li, Weihong; Zhou, Honghua; Fu, Aihong; Chen, Yapeng. Ecological response and hydrological mechanism of desert riparian forest in inland river, northwest of China.Ecohydrology, 6(6), pp 949-955, 2013.

Ma, Jian-Xin; Huang, Xiang; Li, Wei-Hong; Zhu, Cheng-Gang. Sap flow and trunk maximum daily shrinkage (MDS) measurements for diagnosing water status of Populus euphratica in an inland river basin of Northwest China. Ecohydrology, 6(6), pp 994-1000, 2013.

Chen, Yaning; Zhou, Honghua; Chen, Yapeng. Adaptation strategies of desert riparian forest vegetation in response to drought stress. Ecohydrology, 6(6), pp 956-973, 2013.

Hao Xingming, Li Weihong, Guo Bin, Ma Jianxin. Simulation of the effect of root distribution on hydraulic redistribution in a desert riparian forest. Ecological Research, 28.(0), pp :653-662, 2013/1/1.

Zhu Chenggang, Chen Yaning, Li Weihong, Yang Yuha. Photosynthetic performance of two poplar species in shelterbelt under water-saving irrigation in arid Northwest China. Nordic Journal of Botany, 0(0), p 0, 2013/10/11.

Fu Aihong, Chen Yaning, Li Weihong. Analysis on water potential of Populus euphratica oliv and its meaning in the lower reaches of Tarim River, Xinjiang. Chinese Science Bulletin.2006,51,supⅠ,221-22.

Similarly, the plants ecological and physiological investigation showed that the section-Ulan Tug could represent the upper and middle of the lower Heihe River. About this, you can see these two literature:

Fu Aihong, Chen Yaning, Li Weihong. Water use strategies of the desert riparian forest plant community in the lower reaches of Heihe River Basin, China. Science China Earth Sciences, 2014,57(6):1293-1305.

Zhou, Honghua; Chen, Yaning; Li, Weihong; Ayup, Mubarek. Xylem hydraulic conductivity and embolism in riparian plants and their responses to drought stress in desert of Northwest China. Ecohydrology, 6(6), pp 984-993, 2013.

Moreover, the Yingsu and Ulan Tug sections have many similar characteristics except for the groundwater depth. These two sites are both part of the Meso Cenozoic sedimentary basin, in which the earth's surface is deposited with alluvial-proluvial unconsolidated sediment hundreds of meters thick. The basically similar sedimentary texture and lithofacies determine similar aquifer distribution and groundwater runoff movement characteristics. Their soils are both composed of alleviation and lacustrine deposits, and their structures are relatively simple. Moreover, their soil-forming processes, structural compositions, and physicochemical properties are similar. The salinization and wind desertion are severe. Their climatic characteristics are similar, both belonging to typical warm temperate zone continental arid climate, with little rainfall and strong evaporation. They also both belong to a desert zone, and the underground water relies on river feeding. Therefore, we think that these two sites (Yingsu section and Ulan Tug section) are comparable and are feasible for representing the lower Tarim River and Heihe River. About the environmental condition, please see the part of introduce and study area.

Likewise, we agree with the reviewer's viewpoints that data from a long-term measurement are more valuable than those from one or few days. In our paper, our data including all of various parameters were the average values from multi-years investigation and measurement (from 2010 to 2012). Therefore, we did get these data by a few days in a growing season of each year. However, we think they are useful and basically represent the physiological and ecological change characteristics of plants because these data were repeated measurements in three years, including 2010, 2011 and 2012, in the same site and the same time period each year. About this, we described it in the section of material and methods.

(2) We measured all of these parameters at the two sites in the growing season each year, and the time difference is less than a month. Indeed, we measured these parameters in Yingsu section (lower Tarim River) in the beginning of July, and measured them in Ulan Tug section (lower Heihe River) in later of July or beginning of August each year. Every year, we selected the sunny days and three trees to measure these parameters. Moreover, we repeated measured them three years at the same period time each year and calculated their mean values for analysis to exclude the effects of environmental conditions at the time of the measurement. Additionally, these two sites had a similar climate, soil and plants except for the groundwater depths . Therefore, it is reasonable to assume that the values of each parameter are different between in the two sites resulted from the groundwater depth, that is the different drought stresses. The detail describes about the environmental conditions of the two sites please see the sections of introduce and study area.

Considering the reviewer's suggestions, it was a fact that we did not clearly describe the experiments design in materials and methods. Therefore, we will add some contents to clearly demonstrate the experiment design and detail measurement process in the section of materials and methods. The detail revisions about methods we attached as follows:

3 Materials and methods

3.1 Layout of sections

This paper selected the Yingsu section of the downstream of the Tarim River and Ulan Tug section of the downstream of the Heihe River as the test site due to the similar climate, geology and soil condition, and established 7 groundwater monitoring wells of different distances perpendicular to the riverway. Among them, the mean groundwater depth of the downstream of the Tarim River (Yingsu section) was 5.05 m, with the minimum buried depth of 3.59 m and the maximum buried depth of 8.68 m. The mean groundwater depth of the downstream of the Heihe River (Ulan Tug section) was 2.75 m, with the minimum buried depth of 3.96 m and the maximum buried depth of 1.05 m. Near each monitoring well, a 50 m × 50 m plant sample plot and soil moisture monitoring section were set. From 2010 to 2012, the plant physiological and ecological characteristics, groundwater depth and soil sampling were monitored in the Yingsu section of the downstream of the Tarim River during July and Ulan Tug section of the downstream of the Heihe River during August every year.

3.2 Measurement of plant water potential

A portable water potential pressure chamber (3115, SEC Inc, USA) was adopted to measure the daily variation of stem water potential of the constructive species on the selected section, *Populus euphratica* and *Tamarix ramosissima.* For better comparability and scientificity, three plants similar in DBH (diameter at breast height) and plant height in each section were selected, and each plant selected 3-5 normally growing twigs to measure water potential at the direct solar radiation point. The monitoring time was from predawn (5:00-5:40 LT) to afternoon (18:00 LT). Monitoring was performed every three hours, and the measurements all were selected in sunny days.

3.3 Measure of plant water use and consumption

Three plants of *Populus euphratica* with similar stand structures and DBH were, respectively, selected in the Yingsu section and Ulan Tug section as sample trees. Sap flow meter (SFM1 Sap Flow Meter, ICT International Pty, Ltd., Australia) was adopted to monitor the daily variation of sap flow rate. Digital automatic meteorological station (ICT International Pty., Ltd., Australia) was adopted to simultaneously monitor environmental parameters, such as air temperature, relative air humidity, wind speed, and vapour pressure deficit (VPD). Monitoring time was 7-10 continuous days (day and night) in each site every year.

3.4 Measurement of plant hydraulic conductivity

Three plants of mature, and disease and insect pest-free *Populus euphratica* and *Tamarix ramosissima* with similar DBH/crown breadth and height were, respectively, selected in the Yingsu section and Ulan Tug section as sample trees. A xylem conductivity and embolization measuring system (Xylem embolization meter, Bronkhorst, Montigny-les-cormeilles, France) was used to measure the root and branch xylem conductivity and embolization, with a diameter of 2 mm ≤ d < 5 mm. 3-5 root and branch segments from each tree were measured. The determination method was used as shown in the literature (Zhou et al., 2013).

3.5 Measurement of plant root hydraulic lift

Three plants of mature and healthy *Populus euphratica* with 10 m distance, 15-20 cm DBH, and 10-15 m height were, respectively, selected in the Yingsu section and Ulan Tug section as sample trees. HRM (Heat Ratio Method) and stem flow meter (ICT International, Australia) was used to measure the plant root stem flow. The determination method was used as shown in the literature (Hao et al., 2013). A CNC 100 neutron probe was used to real-time monitor the soil moisture in layer. The night increment of soil moisture in the study was viewed as night lifting water of plant root. Monitoring time was 7-10 continuous days (day and night) in each site every year. The difference between the maximum and minimum soil moisture content within 24 hours was viewed as plant transpiration water consumption (Warren et al., 2011).

3.6 Measurement of plant water sources

Samples were taken from the plant xylem. 3-5 disease and insect pest-free *Populus euphratica* and *Tamarix ramosissima* with proper crown breadth were selected. Branch xylem with 0.3-0.5 mm diameter and 3-5 cm were cut from stems of over two years old. The soil samples were collected from underground 0-10 cm, 10-20 cm, 20-30 cm, 30-40 cm, 40-50 cm, 50-75 cm and 75-100 cm, until the soil saturated zone. Samples in each layer were collected twice, once for measuring water isotope and once for measuring soil moisture content. Regarding groundwater sampling, underground water was collected from the monitoring well.

$\delta^{18}O$ in different water bodies were measured with LGR (America LGR Company LWIA-V2[LDT-100]) liquid water isotope analyzer.

Additionally, We have some revision through out the text for improving the clear and scientific statement. At the same time, we rearranged the references. All of the revisions will be submitted as revised manuscript later through the Journal's website.