Biogeosciences

*Interactive comment on* "The asynchronous response of carbon gain and water loss generate spatio-temporal pattern of WUE along elevation gradient in southwest China" *by* Xiangyang Sun et al.

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Dear Professor D. Obrist, Thank you very much for your detailed comment on my manuscript. But I have to say, because the English is not my native language, some of the words or sentences may not express accurately. In the past studies, lots of work were carried out to study the water use efficiency (WUE) along elevation gradient, and most of these works used carbon stable isotope (Luo TX et al. 2005; Li CY et al. 2009; Li JZ et al. 2009). I also sampled the leaves of Abies fabri, and measured the variation of carbon stable isotope to determine the WUE. After the comparison of WUE derived

from both carbon stable isotope and model, we convinced that the model result was right, and then did the following analysis. The WUE was defined by scientists, two important processes were included, such as evapotranspiration and carbon gain, which can't be separated by carbon stable isotope. The previous studies also shown that the response of evapotranspiration and carbon gain to meteorological and environmental variables was different (Yu et al. 2008). Therefore, I tried to explain if the actually variation of WUE along elevation gradient was also the asynchronous response of evapotranspiration and carbon gain to these variables. We only chose Abies fabri because different forest type showed different pattern with climatic or environmental variables, which can't present the altitudinal effect on WUE.

As you said, it was not easy to measure the spatial heterogeneity in meteorological conditions in mountain terrain. So we only choose one valley in Gongga Mountain, named Hailuogou valley. When I examined the manuscript, I also noticed the problem about the description of meteorological variables. Actually, all of the meteorological variables were measure in Hailuogou valley along elevation gradient at altitudes of 2200 m, 3000 m, 3500 m and 4200 m. We even install another four meteorological stations in Hailuogou valley at altitudes of 2000 m, 2800 m, 3300 m and 4000 m in 2015. The linear interpolation was used to interpolate the temperature and precipitation along elevation gradient based on the four meteorological stations at altitudes of 2200 m, 3000 m, 3500 m and 4200 m (Campbell Inc, USA). We choose linear interpolation because generally the wind was from bottom to the summit of the mountain. Based on the observation of meteorological variables, we found that temperature decreased with elevation increasing. Precipitation increased from 2200 m to 3500 m, and then decreased from 3500 m to 4200 m. When combined all of the meteorological stations together, the increasing or decreasing trend of temperature and precipitation were right in manuscript. The Abies fabri distributed between the altitude of 2800 m and 3700 m in Hailuogou valley, therefore, we convinced that the meteorological stations can be used to distinguish the variation of climatic factors.

Soil moisture was not present in this research article. In this study area, the annual precipitation was 1940 mm, annual temperature was 4.2 âĎČ, and annual relative humidity was 90% at the altitude of 3000 m based on the 25 years observation. While the annual evapotranspiration was 587~706 mm between 2008~2011. Therefore, the soil moisture was not the limitation of tree growth in this region. Even the treelines showed that the treeline trees may suffer from a winter carbon shortage, not the nitrogen limitation or temperature limitation, while the soil humidity class was moist at altitudinal of 2750 m and mesic at altitudinal of 3670 m (Li et al. 2008). However, if the study was carried out in arid or semi-arid region, the soil moisture may control the growth of trees and water use efficiency. Based on the study in Hailuogou valley, the soil moisture was between 0.15~0.25 m3/m3 in Abies fabri forest using moisture meter (HH2, Delta-T Devices Ltd, UK) from the depth of 0 to 100 cm below ground (Lin 2010). We also found that there were no significant relationship between precipitation and WUE in this study area. Therefore, soil moisture was not present in this study, especially for the analysis along elevation gradient.

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