Authors' Response to Short Comment by B. Mitra

Short Comments:

A well analyzed article. One particular aspect that can influence upscaling is spatial autocorrelation. Previous studies which have compared chamber measurements with eddy covariance measurement have found discrepancies in the evapotranspiration estimates. One possible way to overcome this discrepancy involves incorporation sufficient number of sample points. The other factor involves incorporation of spatial heterogeneity. While in this paper, spatial heterogeneity does not appear to be a significant factor, previous studies have found the spatial structure of transpiration in forests to be modulated by the temporal drivers of transpiration (Adelman et al. 2008; Loranty et al. 2008). Future analysis of spatial autocorrelation can help to mechanistically scale up spatiotemporal processes.

Response:

Thank Dr. Mitra very much for the comments, and we sincerely appreciate the insightful suggestions. We agree with Dr. Mitra the spatial heterogeneity is a very important factor that affects the upscaling results and should be taken into account during the process of scale transformation. In fact, we have considered the different water availability between wide-row cotton and narrow-row cotton in this study. Since the drip pipe is located in the middle of four rows of cotton, the wide-row cotton possesses more favorable soil water condition, resulting in more transpiration than narrow-row cotton. Therefore, during the experiments, two wide-row plants and two narrow-row plants were selected to install the four sap flow sensors for all the analyzed periods, and the averaged value was used to represent the individual plant transpiration rate. Based on the data, we found that the transpiration rate of wide-row cotton was 1.05 times higher than that of narrow-row cotton.

However, compared with the measurements conducted in the forest, the impacts of spatial heterogeneity on upscaling process are expected to be less *in the farmland. That is because of the single crop species, homogeneous vegetation distribution pattern and low spatial variability of water availability in farmland (Loranty et al., 2008), which make it straightforward and feasible to extrapolate the point observation to representative area value so as to estimate the field ET, obtaining high credibility of reasonable scaled result (Allen et al., 2011a). Therefore, we just considered the water availability variation of different cotton rows in this study, but not all the factors of spatial heterogeneity.*

Meanwhile, it is challenged to carry out scale transformation in farmland owning to rapid crop growth and quick change of leaf area or stem diameter (Chabot et al., 2005). That is to say, the temporal heterogeneity might be significant in farmland. To solve this problem, we establish dynamic relationships between leaf areas and stem diameters in cotton growth season to perform scale transformation. This approach overcomes the limitation brought by rapid growth and achieves a good result in deriving field evapotranspiration.

In this study, we found that evapotranspiration by EC and transpiration by sap flow agree well for low and mid rates, but disagree for higher flux rates. One potential reason to explain this phenomenon is that there was a saturation level for plant transpiration above which transpiration stayed constant and more evaporation occurred. Vapor pressure deficit (VPD) may affect the saturation level and the spatial pattern of VPD should also be considered in upscaling process in further researches (Adelman et al., 2008).

Overall, more sample points should be measured to conduct spatial autocorrelation in further researches. Based on the spatial autocorrelation, more reliable results can be obtained during the scale transformation processes.

Reference:

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Allen, R. G., Pereira, L. S., Howell, T. A., and Jensen, M. E.: Evapotranspiration information reporting: I. Factors governing measurement accuracy, Agric. Water Manage., 98, 899-920, 2011a.

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