Response to Anonymous Referee #1

We thank referee #1 for the constructive and detailed review on this paper. In the following, we provide an item-by-item response to the comments. Reviewer's comments are written in italic; authors' responses are shown in blue and upright font.

This paper is really interesting to remote sensing based ET estimation. The authors reported that EF remains nearly constant during daytime based on a statistics analysis using a global fluxnet measurements. They also divided the weather into clear sky, cloudy sky and partly cloudy sky. These work are encouraged to publication. The writing is clear.

However, I still have several major comments and encourage them to do more analysis. They are using energy balance measurement over grassland, savannas, broadleaf forest, needleleaf forest, shrubland etc. Why don't they plot similar fig. 3 by using land cover classification like weather classified into clear, cloudy sky? The land surface partition between sensible heat and latent heat flux can be influenced by the land surface. Certainly EF is also influenced by the canopy type or land cover. So I suggest them to check whether land surface or biome types classification does help us understand the EF constant assumption. Whether it is valid over different land surface or whether the daytime constant EF is feasible for all kinds of canopy or not. This will help the ET satellite application community pay attention to daytime constant EF applied to specific land surface.

Response：We fully agree on this and our first intention actually was to examine the hypothesis of EF self preservation across a wide range of biome types. Therefore, we summarized the results into one figure to get the general conclusion of the EF self preservation assumption. But we agree that it would be interesting to check the influence of land cover types on EF constant assumption. The corresponding analysis work was done and the results were summarized in Table 2 (also see below). Besides, the box plots of the comparisons between EF at different time periods and daytime EF over different biome types are now provided in the Supplementary material as Figure 1. An additional paragraph has also been added in Section 3 to discuss the effects of land cover types to EF self preservation. The revised part of the paper can be found in the following:

Table 2. Statistical results for the comparisons between midday EF and daytime EF over different biome types.

Biome type	R^2	RMSD	Relative error(%)	Sample size
Croplands	0.954±0.026	0.051±0.008	-2.81±1.50	8
Deciduous broadleaf forests	0.956±0.034	0.043±0.008	-4.48±1.64	9
Evergreen needleleaf forests	0.904±0.053	0.051±0.014	-5.40±1.35	21
Grasslands	0.901±0.062	0.053±0.015	-2.01±3.62	9
Mixed forests	0.902±0.052	0.054±0.013	-4.70±2.03	11
Woody Savannas	0.946±0.028	0.041±0.010	-4.05±0.93	4
Savannas	0.966±0.000	0.042±0.000	-11.15±0.00	1
Open shrublands	0.915±0.063	0.049±0.019	-7.12±1.60	3
Closed shrublands	0.968±0.016	0.035±0.002	-2.06±0.67	2

Evergreen broadleaf forests	0.894±0.031	0.053±0.011	-5.63±1.53	4
All types	0.920±0.053	0.050±0.013	-4.47±2.48	72

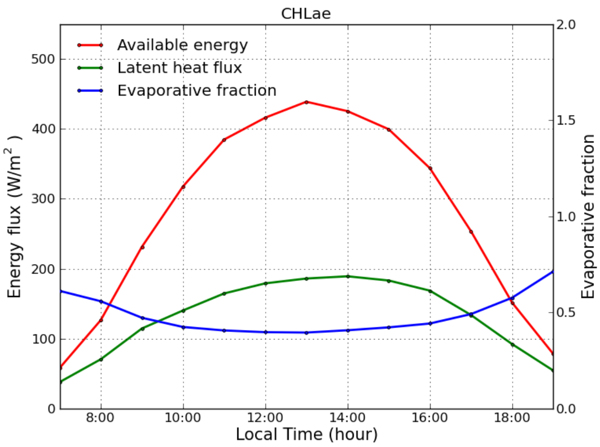
"As the FLUXNET sites cover a wide range of climates and biome types (croplands, deciduous broadleaf forests, evergreen needleleaf forests, grasslands, mixed forest, woody savannas, savannas, open shrublands, closed shrublands, and evergreen broadleaf forests), we investigate the influences of biome types on the self preservation of the EF. Table 2 gives a comprehensive summary of the statistical metrics for the comparisons between midday EF and daytime EF for different biome types. It can be observed that the self preservation of the EF over different biome type has similar performance with R^2 higher than 0.894, RMSD lower than 0.054, and RE less than 10.15%. The detailed comparison results between instantaneous EF at different time periods and daytime EF over different biome types are provide in Supplementary material Figure 1. Therefore, little evidence was found from the above results based on FLUXNET data that the biome type affects the self preservation of the EF."

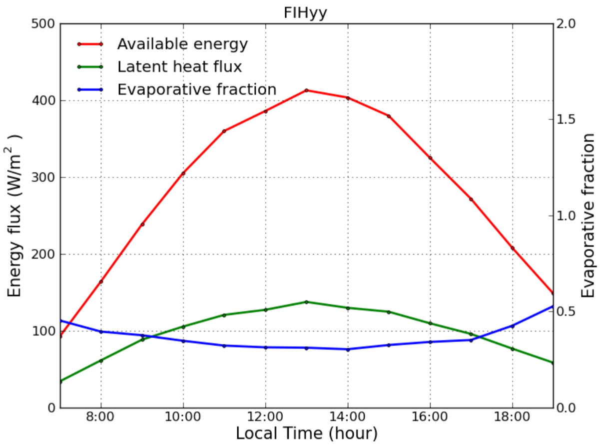
Another major comments is about the equation 1 and 2. I am also using the FLUXNET dataset. I am not sure whether all the sites have calibrated the heat flux plate measurement to ground heat flux. The authors need to address this clear. Please also notice that the heat storage in the canopy is not considered in their equation 1 and 2. I need them provide us reference or their results to say how much percent of surface net radiation does the heat storage in the canopy (especially over forest) take? Or why this part of energy is not considered in the energy partition when they use bowen ration correction method.

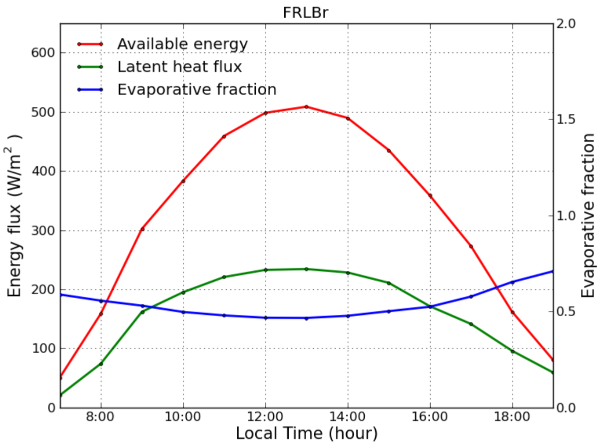
Response：The FLUXNET dataset used in our study are all calibrated and quality controlled. The relevant FLUXNET methodologies and summaries can be found in the research of Aubinet et al. (1999) and Baldocchi et al. (2001), as well as the Fluxdata.org website. The heat storage term is not relevant for the present analysis as it is first of all small and second proportional to R_n (e.g. Meyers and Hollinger 2004; Wilson et al., 2002). The reason for using equations 1 and 2 is that they are widely used in practical remote sensing applications (e.g. Jia et al., 2009; Rwasoka et al., 2011). Besides, the EF can also be written as EF = 1/(1+H/LE). The errors in H and LE are assumed to be similar and uncorrelated in the Bowen Ratio method, which allows the lack of energy closure to cancel out mathematically.

Another question is about their conclusion that 'It is found that the EF during daytime from 11:00 to 14:00 LT is nearly constant under clear sky conditions (R2>0.75, RMSD<0.087).' As I understand that this is a conclusion, which should be based on the results. However, from the paper, I only see the coefficient of determination is high during 11:00- 14:00. A high coefficient of determination says two variables corresponds well or have similar variation, not saying they are same values. If they insist this, it's better to plot the observational result like their fig. 1. Conversely, they provide us with a conceptual framework for the diurnal variations of surface energy components and EF. I am wondering why they doesn't using the measurement to plot this figure?

Response：Thank you for pointing this out. From the high R^2, it is indeed not suitable to conclude that the EF is constant from 11:00 LT to 14:00 LT under clear sky conditions. The sentence has been modified to "It is found that the EF during daytime from 11:00 LT to 14:00 LT agrees well with daytime EF under clear sky conditions (R^2>0.75, RMSD<0.087, -10.15%<RE <3.79%) "In order to support our conclusion, Figure 3 was adjusted by adding the RE (relative error) between instantaneous EF and daytime average EF. It can be seen from Figure 3a that the RE between instantaneous and daytime average EF during daytime from 11:00 LT to 14:00 LT is in the range from -10.15% to 3.79%. We use a conceptual framework rather than measurements, because the theoretical framework is based on the performance of measured surface energy components. In the following, the diurnal variation of mean values of surface energy components and EF is shown for sites CHLae, FIHyy and FRLBr. Thus, we think that the use of the conceptual framework is more general and suitable.







Below are some minor comments.

ON page 2020, 'And the midday overpass satellites (e.g. MODIS and AVHRR) would provide better results than other 5 overpass time platforms (e.g. Landsat).' needs to be specified, like due to EF at former satellite passover time does represent daytime EF than later…

Response：Thank you, we agree. This conclusion is based on the results that the instantaneous EF from 11:00 LT to 14:00 LT is much closer to daytime EF than EF of other time periods. Therefore, the daytime ET estimates based on midday overpass satellites are more suitable than the other overpass time platforms. In order to make our statement more clear, the sentence "And the midday overpass satellites (e.g. MODIS and AVHRR) would provide better results than other overpass time platforms (e.g. Landsat)." has been changed to "Because the midday EF is closest to daytime EF, the midday overpass satellites (e.g. MODIS and AVHRR) are expected to provide better results than platforms which have an overpass time in the morning or late afternoon (e.g. Landsat)."

On page 2020,' cloudiness could induce a decrease in the available energy and the latent heat flux, which further causes the increase in both instantaneous EF and daytime EF.' I can understand that the cloudiness can cause decrease in the available energy and latent heat flux. However, doesn't it influence sensible heat flux? Why cloudiness can further increase instantaneous EF according to equation 1?

Response：Yes, the sensible heat flux is also influenced by clouds. In our description, the available energy includes both sensible heat flux and latent heat flux. From equation 1, we only find that the cloudiness can induce variability in available energy and the rate of surface heating. Then, the EF becomes more variable under cloudy conditions compared to clear sky conditions. Thank you for pointing that out, the sentence has been modified to "This is because cloudiness causes significant fluctuations in available energy and the rate of surface heating, which further leads to variability in both instantaneous EF and daytime EF."

On page 2020, 'Nevertheless, the above results have no substantial influence on the remote sensing applications, since optical satellites only provide useful data under clear sky conditions.' Do you consider about the microwave sensors (LST from AMSR_E) when used to derive land surface temperature and ET estimates?

Response：The motivation of our study is to examine the EF self preservation under different conditions. That is why we classified the weather conditions into clear, partly cloudy and cloudy in the present study. There are two important findings. The first one is that the EF during daytime from 11:00 LT to 14:00 LT is nearly constant under clear sky conditions. It means the EF constant assumption can be used to extrapolate instantaneous estimates based on optical and thermal satellites to daytime values. The second conclusion is that the EF exhibits more variability during cloudy conditions. Therefore, one need to be very careful when the EF self preservation is used for extrapolating estimates from microwave sensors (e.g AMSR-E). In order to state our results more clearly, the sentence has been modified to:

"It is necessary to consider the effects of cloudiness, when the EF self preservation assumption is used to upscale instantaneous estimates to continuous longer time periods (Brutsaert and Sugita, 1992; Van Niel et al., 2012). The above results provide additional information on the uncertainty resulting from cloudy sky conditions for the EF daytime estimates."

On page 2020, 'It is found that the EF during daytime from 11:00 to 14:00 LT is nearly constant under clear sky conditions (R2 > 0.75, RMSD < 0.087), and the EF in 12:00– 13:00 LT is almost equal to daytime EF.' as I said, high R2 does not say 'the EF during daytime from 11:00 to 14:00 LT is nearly constant'.

Response：Yes, we agree. In order to support our results, the relative error between instantaneous EF and daytime EF estimates has been added in Figure 3.

ON page 2021, 'The important conclusion from the present study is that the EF constant assumption is valid over a wide range of ecosystems and climates.' I suggest to divide the result into different land cover and make this conclusion more solid.

Response：We fully agree on this. An additional paragraph has been added in Section 3 to discuss the effects of land cover types to EF self preservation.

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