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Comment

Interactive comment on “Characterisation of ecosystem water-use efficiency of european forests from eddy covariance measurements” by F. G. Kuglitsch et al.

Anonymous Referee #4

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General comments

The paper quantifies the diurnal, seasonal, and inter-annual variability of WUE_e in relation to meteorological conditions, and analyses between site variability of WUE_e as affected by vegetation type and climatic conditions, across sites in European forest-ecosystems. The topic is very relevant for understanding how forest ecosystems use water in relation the their capacity of sequestering atmospheric carbon under a perspective of warming climate, and it is thus of great interest. The paper relies upon a consistent and harmonized set of data from a network of European eddy covariance flux towers covering a wide range of forest types. The presented comparison of the

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different ways of calculating water-use efficiency (WUE_e) from eddy covariance measurements is an original element in addressing the topic. The analysis of data however does not seem still thorough for the scope, particularly in dealing with the influence of different vegetation types on WUE and comparing different sites. Some methods used to calculate WUE_e are based on assumptions that need to be verified. The clarity of the manuscript might benefit from restructuring the discussion of results in one single section, particularly the comparison to other literature, and keeping it separated from conclusions.

Specific comments

Page 4485, line 4: the authors state that the topic of water use efficiency has received attention from several scientific disciplines but support this by citing a single old paper. More citations, related to the mentioned fields of science, should be added.

Fig.1: I would not represent the boundary of the agronomy set on the x axis (space) strictly limited to meso-scale (plants). It would rather deal also with agro-ecosystems.

Page 4487, paragraph 2.2 In the performed calculation, the uncertainty in WUE values arising from the uncertainty in GPP and ET from eddy covariance data is not taken into account. The authors calculate the variance of the mean monthly WUEGPP for each site. However in order to compare the mean annual WUE between different sites and conclude that there are significant differences (page 4492, lines 16-17), an analysis of the uncertainty of WUE estimates would be advisable.

Page 4488 , lines 1-4: is there not a minimum threshold of precipitation set to define a rainy day? The change in WUE after precipitation would be influenced by the amount of rain fallen, and thus the results shown at page 4489, lines 9-14, would be dependent on the precipitation regime typical of each site.

Fig.3: I guess that in the graph daily sums of NEP and GPP are plotted against daily sums of ET and that daily values are obtained from the aggregation of half-hourly

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measurements. If so, the caption it is not clear, as it seems that daily sums of NEP and GPP are compared against 30 min. measurements of ET.

Page 4489 Lines 9-14: it is stated that coniferous forests show a WUEGPP decrease up to the second day after the rain event. If so, by excluding rainy days (and subsequent ones) in the calculation of the long term water-use efficiency (in fig.4) one should get a higher value than using all days. Figures shown in fig. 4 are though inconsistent with reported results since water-use efficiency calculated excluding days with potentially wet surfaces is lower than when all days are included.

Fig. 5: caption missing. The present one refers to figure 4. Panel (d): the y axis is WUENEP and not WUEGPP, as illustrated at page 4489, line 24. The slope of the WUEGPP vs mGPP plot (panel b) cannot be higher than that of WUEGPP vs mNEP (panel d) if mGPP and mNEP distribute almost along a 1:1 line (panel a).

Page 4490, line 1: The result of WUEGPP being always greater than mGPP casts a doubt on the appropriateness of the use of a linear regression to fit the 30 min GPP versus ET plot. Is the relation between these two variables of linear type? The results obtained would indicate it is not. The authors should address this issue.

Page 4490, lines 11-16: the paragraph is awkward for the reader. It would be better to distinguish more clearly the time scale at which NEP, GPP, ET are considered (half-hourly, daily integrated).

Page 4492 lines 10-17 The analysis of the spatial variation of WUEe does not take into account differences in the percent vegetation cover of the forest sites: since evapotranspiration (ET) includes evaporation of water from soil and wet surfaces, this parameter should also be addressed in order to characterize the influence of vegetation types on WUEe and its variability within each vegetation type.

Page 4492 lines 18-23- In considering similar environmental conditions to focus on the direct influence of vegetation on WUEe, soil water content was not considered within

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the variables to set within a standard range. Clearly soil water content varies across climate and vegetation types, but decreasing soil water potentials due to drying soils influence negatively the transpiration and evaporation processes under given meteorological conditions. For this reason, the inclusion of soil water deficit to the set of environmental variables would be an improvement of the analysis.

Page 4494, lines 23-27: the authors state that WUEGPP decrease is attributed to an increase in solar radiation during daytime that causes a shift between earlier GPP and the later ET maximum and that VPD seems to play a minor part. But at page 4495, lines 6-8, the decrease of WUEGPP is attributed to increasing VPD. The authors should reformulate the paragraph to avoid falling in contradiction. and explaining more clearly the effect of the different drivers (solar radiation, VPD, stomatal conductance) on WUEe.

Technical corrections

Table 2: replace mNEE with mNEP

Fig. 1: a is used in stead of epsilon in the caption.

Page 4448, line 23: the formula of the standard deviation (SDx) is missing

Check subscripts: WUEGPP is mistyped several times in the manuscript, including in the captions.

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