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Interactive comment on "Uncertainty analysis of gross primary production partitioned from net ecosystem exchange measurements" *by* R. Raj et al.

Anonymous Referee #1

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General comment

Raj et al. present a new way to evaluate the uncertainty tied to the estimation of the gross primary productivity (GPP) derived from the eddy covariance measurements of net ecosystem exchange (NEE). They use a Bayesian approach, moving from the regression analysis of rectangular hyperbola fitting daytime data. The argument treated is within the scope of Biogeosciences and the computational instrument they developed is promising. Nevertheless, at this current stage the study suffer from several limitations, not only in the presentational form but also in the substance. In fact, several sources of uncertainty exist in the partitioning the GPP from eddy covariance data. GPP is not directly measured and must be extrapolated from available NEE. Both extrapolation

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approaches, from night-time or daytime data, can suffer from systematic errors. At least, the authors should acknowledge that a) day respiration can be significantly different from night respiration in reason of the different processes occurring at leaf level (photorespiration or dark respiration). Lower respiration values are expected during the day, see Sun et al. (2015), although compensatory effect could occur (Reichstein et al, 2005); b) the shape of the light response curve measured by eddy covariance can be significantly biased by an inadequate quantification of the storage contribution of the NEE flux, particularly if measurements are taken above high canopies like in the present study. I'm unsure that the authors can quantify these potential sources of bias using the data they have, but at least they should clearly state that they analysed only a component of the possible uncertainty sources. Overall, the approach used by Beer et al., 2010, still seems more solid.

Structure of the paper

Much of the text is used to present and define the computational approach used. If this could perfectly fit for a Journal like Geoscientific Model Development, it could become probably excessively complicated for a wide audience like that of Biogeosciences. Even more importantly, the sections defined as '4. Results' and '5. Discussion', are similarly presenting some of the results and partially discuss them. In the revision, I recommend to decide if the paper will have a discussion section separated from the presentation of the results, since what is done in the current text version is confusing. Overall, I recommend this study for publication, but only after a thorough work of revision.

Specific comments

P13972 L23 'ecosystem scientists' use positive values of GPP. To my knowledge, GPP is always positive since it represents a production, and production was represented with positive values much earlier than Brahmagupta, in the 7th century, described negative numbers. If we use the micrometeorological approach, the most correct term will

be probably gross ecosystem exchange (GEE), which is defined as negative since it represents the quantity of CO_2 which enters in the ecosystem.

P13972L16-18 Units are missing in the passage from 'Pa' to 'GPP'. In fact, NEE is generally expressed in terms of micromoles m-2 s-1, and GPP with the same units or in terms of g m-2 d-1. Here, in table 1, both quantities are expressed in terms of g CO_2 m-2 s-1, so the proposed conversion factor of 12/44 shouldn't be present. In any case, it converts for instance micromoles of CO_2 into micrograms of C.

P13974 L13-14 'NEE data were corrected for storage of CO_2 in the air between the sensor and the ground'. The storage is a relevant component or in the mixing ratio conservation equation (e.g, Kowalski and Argueso, 2011) and hence in the correct computation of NEE. Although the storage terms tend to cancel out when producing annual sums, it is well established that they can asymmetrically influence the apparent light response curve, presenting opposite values in the evening and in the morning and a significant hysteresis. It has been clearly established that a convenient number of measurement points have to be established when measurements are dove above forests (Yang et al., 2007), but there is no mention about the instrumentation used. More information is needed!

P13982 'credible interval spanned zero'. After this sentence there is one paragraph of discussion. What the authors mean exactly? Was the mean zero and the distribution of values partially above it, or there was a bias?

P1396 L2 'was obtained from the literature'. Please be specific.

P13978: 'the photosynthetic capacity. . .is reached when the photosynthesis is Rubisco limited varies among different tree species'. At canopy level, the photosynthetic capacity depends also on the structure of the canopy, when multiple leaf layers are present Amax increases. Please read carefully the cited paper of Ruimy et al., 1995.

P13978 L15. 'in the literature were 0.0097. . .', again, please be specific on the sources

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and also add units (is mg CO2 m-2s-1 valid for all the numbers reported?).

P13980 L 13-14: 'but was short enough that we could observe temporal change between the 10-day blocks'. This is strange, possibly the authors were meaning the contrary (long enough)?

P13982 L6-7: 'The chains were thoroughly interdigitating, indicating that the the Markov chains had mixed and converged...' Besides the repeated article, I cannot understand. In any case, I recommend to avoid lab jargon.

Figure 1: Please define what Y axis represents.

Figure 3: What are the frequency units in the Y axes?

Figure 4: What are the units in the Y axes?

Figure 5: What are the units in the Y axes? I add that in this set of images, a magnifier is needed to distinguish what is reported along the axes, at least for many readers including myself.

Minor/language remarks Page (P) 1397 Line (L) 21 'a non linear empirical models': please check the consistency between article and noun. P1397 L26-27: 'a single optimized values', same as above.

P13974 L8 Cambell->Campbell

P13982: Lay->Laid

P13984 L24-25. 'In order to undertake a Bayesian analysis it is necessary to specify the prior distributions on the NRH parameters.' Written in this way, it seems that the use of NRH parameters is a general rule in Bayesian analysis, but it is not.

13985 L8-9: 'This wide variation in Amax was chosen as the non-informative priors led to spikes in the value of Amax in the posterior (Fig. 5e).' Remove 'was' and possibly reformulate the sentence.

P13987 L18: 'The scope of this study can therefore be further widen', better 'widened'.

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