Geosci. Model Dev. Discuss., 8, C2195–C2200, 2015
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Geoscientific Model Development Discussions
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GMDD
8, C2195–C2200, 2015

Interactive Comment

Interactive comment on "A simplified gross primary production and evapotranspiration model for boreal coniferous forests – is a generic calibration sufficient?" *by* F. Minunno et al.

F. Minunno et al.

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Received and published: 25 September 2015

The paper by Minunno et. al. (2015) is a well written and describes a thorough study of Gross Primary Production (GPP) and Evapotranspiration (ET) over the boreal regions of Finland and Sweden. The paper makes use of a well defined Bayesian framework to conduct a sensitivity analysis and calibration on the PRELES model that is statistically comprehensive. The results of this research are very interesting, a little surprising (given the results of Peltoniemi et. al. (2015)) and thorough enough to be published. However, I agree with the previous reviewer that this study is a bit too similar to the previous study by Peltoniemi et al. (2015). As such, I feel this paper needs to be

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expanded to show more new results furthering the work of Peltoniemi et. al. (2015) to be published in GMD.

Reply: Dear referee #2 we are glad to hear that you found the paper interesting and the analyses comprehensive. As we replied already to the referee #1 (please see above (*)) our modelling exercise went further from the Peltoniemi et al. (2015) work, allowing us to draw much stronger conclusion about the regional applicability of the model.

In the second sentence of your abstract the authors argue that simple models are "suitable only at local scale". This assertion seems to be at odds with the rest of the paper as the study shows that the simplified model PRELES can be used to achieve a good estimate of a regional carbon balance, in this case over the boreal regions of Sweden and Finland.

Reply: The sentence is: simple models “MIGHT BE suitable only at local scale. I.e., we were testing it in our paper.

Later in the introduction the author describes some of the reasons why a simplified model may fail to capture regional or larger areas (Lines 18-31 of the introduction). The use of a simple model with differing calibrations to test what the best sites to use for your regional estimate is a very interesting question that is called "quantitative network design". A good paper on this topic is by Kaminski et. al. (2012). This is a very interesting avenue of research, as an optimal network of stations for the measurement of some key ecosystem processes (such as GPP) is currently unknown, as the heterogeneity within even a small area of forest or soil can be significant and hard to estimate. So if it is possible, as your work suggests, to optimize a simple model with just one or two measurement sites and then get a strong estimate for the much larger region of Northern Sweden and Finland, that information would be extremely useful to measurement groups like ICOS.

Reply: Thanks for the interesting paper and the positive comment. We added these concepts in the discussion.

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The results of your study are very intriguing but before I convience myself that all the boreal trees are sufficeintly similar to those found at Hyytiälä, and therefore that it is possible to calibrate a model for the whole of the boreal region from that one site, I would like to see a few more tests: âĂć In section 2.2, Minunno et. al. (2015) lists the data used in the study and has chosen to use the gap-filled product from Fluxnet. This however brings up some potential issues, as the procedure of gap-filling is to adjust the data where it is doubtful and extrapolate the good data to fill the gaps using a simple ecosystem/statistical model. The risk is that when using data that has already been through a model is that some of the inputs that are required to run the gap-filling model are the same as the inputs that were used by PRELES in this study, such as climate data. The result is that model output from PRELES and the gap-filled data are no longer independent and therefore poor choices for a Bayesian data assimilation. It would be an interesting test to see how much the results of this study change if the raw data was used instead of the gap-filled.

Reply: We already did an analysis with gap-filled data. We did different calibrations including data with a flag of 0.3, 0.5, 0.7 and 0.9 and the result was that parameter estimates and model predictions were really similar independently from the data used to calibrate the model; i.e., gap filled data seem to be consistent with measurements. We did not include these analyses in the paper because otherwise it would have been too heavy. We mentioned in M&M (section 2.6 “Model calibration and comparison”) that preliminary data using only ungapfilled data showed very similar results. Furthermore, note also that in the uncertainty model we are using (eq. 23) less weight is given to the gap-filled data.

âĂć It would be useful to extend the sensitivity analysis to also include the other input variables T, P and D.

Reply: We do not think that this analysis will be relevant to this work, because it will not add much more insights to our modelling exercise. A sensitivity analysis of the model to T, P and D was already carried out by Peltoniemi et al. (2015).

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In section 2.5, you choose to vary the LAI from 0-16, which is _100% of the average of 8. How does this range compared with the measured standard deviation at Hyytiälä?

Reply: The measured standard deviation is around 2 much lower than the value used in our analysis. But the 0-16 variation covers the variability across stands in Finland. In section 3.2, there is the acronym "MCMC", which I assume stands for Markov Chain Monte Carlo but no expansion is given. Furthermore, if MCMC does indeed stand for this I feel that this method should have a paragraph describing how it works in the methods section (probably section 2.6).

Reply: We added in the 2.6 section the reference to the Markov chai Monte Carlo algorithm that we used.

2 Grammer comments âĂć Line 9 of the abstract: I think you should remove "Model calibrations and evaluations were carried out by the means of the Bayesian method;" as this makes the sentence very long, harder to read and says the same thing twice.

Reply: The abstract was simplified.

âĂć Line 23 of the abstract: Swap the "underlined also" to "also underlined,".

Reply: Changed as suggested.

âĂć Line 1 of the introduction now, should have a "the" in front of "atmosphere".

Reply: Changed as suggested.

âĂć Line 24: There should be a comma after detail.

Reply: I do not think so.

âĂć Line 27: The sentence would read better if the "on the other hand" was at the start of the sentence.

Reply: Changed as suggested.

âĂć Line 33: Currently reads "applied in regional scale in the MODIS algorithm" but

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could be changed to "applied in the regional scale MODIS algorithm".

Reply: Changed as suggested.

âĂć Line 54: Change "canopy element level" to "the canopy level".

Reply: Changed as suggested.

âĂć Line 57: Currently reads "for parameters for which direct measure measurements" but you can switch it to "for the parameters, where direct measurements".

Reply: Changed as suggested.

âĂć Line 64: There should be a "s" on the end of allow.

Reply: No because the subject “developments” is plural.

âĂć Line 67: "providing" should be "provides". There should also be a "which" after the comma.

Reply: Changed as suggested.

âĂć Line 321: There should be a comma after "three analyses".

Reply: Changed as suggested.

âĂć Line 323: "cover" should be "covers".

Reply: Changed as suggested.

âĂć Line 587: After the first comma there should be a "there".

Reply: I was not able to locate the comma. can you specify the section and the words around the comma?

âĂć Line 680: Currently starts with "Eddy-covariance network" but should be changed to "The eddy-covariance network".

Reply: Changed as suggested.

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âĂć Line 712: The sentence "From carbon modelling perspective, use of a few aerially representative sites with long and high quality records would be optimal" should be re-written.

Reply: The sentence has been re-written.

âĂć In Table 2. continued, is the annual temperature of CAge75yr 29_C or 2.9_C

Reply: The annual temperature has been corrected to 2.9

âĂć In figure 1, I think the arrows and the key at the bottom a little bit messy. I was wondering if the Figure would work just as well without them?

Reply: The arrows in Figure 1 have been removed.

Interactive comment on Geosci. Model Dev. Discuss., 8, 5089, 2015.

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