Geoscientific
Model Development
Discussions

Interactive comment on "A user-friendly forest model with a multiplicative mathematical structure: a Bayesian approach to calibration" *by* M. Bagnara et al.

Anonymous Referee #2

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[General comments]

This paper compares 3 MCMC methods for 2 simple GPP models, to examine the convergence of the posterior parameter distribution. The conclusion that simple models' advantage is limited due to the difficulty in parameter tuning even for new MCMC methods is important, and could be considered for publication on GMD.

However, the current version has some significant problems, which should be fixed before going to the next stage. In particular, my main concern is generality of the results. The experiments were carried out only for one case. Discussion on the application of the results for other sites and for other type of forests is needed. It is also needed to

discuss the influence of GPP uncertainty, i.e. effect of changing the term y_j in eq. (7).

In addition, I also have some concerns in methods:

- The trials and errors in determining the appropriate initial conditions, the scale and the orientation of the sampling (for MHRW and AM) should be described in detail. Otherwise we can not evaluate how effective DEMC is. Is it always promised that MHRW and AM have similar posteriors as DEMC, or it was just by chance?

- In the two-step method, rather than using a linear regression, to sample considering the coefficient of correlation in the proposal distribution looks more reasonable. Discussion on what you lose by taking a linear regression is needed.

[Specific comments]

Title: current one may be too general. I may recommend something like "Bayesian calibration of a simple forest model with a multiplicative mathematical structure: a case study with . . .".

Page 6998 Abstract: Introduction part is too long. The first two paragraphs should be shortened and the third one should be more in detail (e.g., consider including one of the conclusions, recommendation of DEMC).

Page 6999 Lines 4-10: Eddy-covariance is more ground-based observation method than remote sensing. Thus it is a bit strange for me to mention EC just after remote sensing without any words. It also may be helpful to add advantage and disadvantage of remote sensing and EC.

Page 6999 Line 11: Better to add a notation that difference of GPP and Re is the carbon balance (relating to Line 2).

Page 7001 Lines 15-16: Add literature (or other basis) for "The efficiency of the MCMC technique is highly dependent on the model structure."

Page 7001 Lines 19-21: Do you think "use of very long chains" is a good method? So

why you stick to the speed of convergence in this study?

Page 7001 Lines 21-22: Describe what "more efficient algorithms" are like.

Page 7002 Line 16: How multiple chains learn scale and orientation from each other?

Page 7002 Lines 19-20: Add a notation that calculation time is shortened, but the total computational resource needed is not reduced by DEMC.

Page 7004 Lines 19-24: Why you did not use MODIS's fAPAR product? http://modis.gsfc.nasa.gov/data/dataprod/dataproducts.php?MOD_NUMBER=15

Page 7004, Line 25: Do you mean you used the data of 292 days (of one point)? Describe calibration process more in detail.

Page 7005 Line 21: Only the initial condition is different in the 100 pairs? Describe how the initial condition for each chain was determined.

Page 7006 Lines 8-9: Are there any specific reasons why description of GPP and the units in LUE and APAR are different from Eq. 1?

Page 7007 Line 9: Tabulate the parameters and their ranges like Table1, as it is not clear which rows in Table 2 of Horn and Schulz (2011a) are used.

Page 7007 Lines 11-12: Describe the basis for the re-parameterization you applied here. The result indicates the re-parameterization itself is not effective, or just your way of re-parameterization is not appropriate?

Page 7008 Lines 10-11: "For the DEMC algorithm, only the chain with maximum log-likelihood was chosen for this purpose." Describe why you look at the best one, not the average. In presenting the posterior distribution for DEMC, you present the result of the best chain, or that of all chains?

Page 7008 Lines 18-21: and Fig 2: Note and discuss some exceptions like γ for DEMC (blue line).

Page 7008 Lines 22-24: it looks strange, as Fig 2 shows different results in γ, X_0, S_max for DEMC from other methods. Describe why the optimized values for those parameters (in Table 2) are almost same in DEMC too.

Page 7009 Lines 17-20: Give comments on exceptions: LUE for MHRW and AM, and T_opt/W_i for DEMC.

Page 7010 Section 3.1.4: Present the coefficients of correlations (Table 3 shows for 10^6 iteration case, but how about those for 10^4 and 10^5 iterations?) and coefficients in linear regression used here.

Page 7010 Section 3.1.4: Is the linear relationship you get here by chance, or results of over-parameterization?

Page 7010 Section 3.1.4: Add discussion on the comparison with the result of the 10^6 iteration case in the single-step method.

Page 7011 Line 16: Why can you say "possibly the main factor"? The slower convergence for the LUE model indicates different possibility.

Page 7012 Line 22: Present the result to support "this did not result in better model performances over all".

Page 7012 Lines 25, 28: Describe the trials and errors you did for MHRW and AM before starting calibration more in detail (see general comment too).

Page 7021 Table 3: Test the statistical significance and show the results. Also, high-lighting the different sign case may not be so useful, as the difference of 0.006 and -0.021 is not significant (both of them indicate no correlation).

Page 7023 Fig. 1: It is hard to get useful information from the figures for DEMC. How about presenting the average and the range of uncertainty (e.g., standard deviations) for 100 chains (or presenting the best one?). Same for other figures too.

Page 7024 Fig. 2: Is it no problem that sometimes red lines are invisible? Also check

if the ranges of y axis are appropriate with DEMC for X_0 and S_max (see blue lines).

[Technical corrections]

Page 6999 Line 7: Eddy-covariance -> "Eddy-Covariance (EC)" and then use EC for later parts.

Page 7003 Line 5: FL_j, FS_j, FD_j are included as F_ij in Eq.1? If so specify i=L,S,D, and replace FL_j, FS_j, FD_j with F_Lj, F_Sj, F_Dj.

Page 7005 Line 9: (Mäkelä et al., 2008a) -> Mäkelä et al. (2008a). In some parts you cite "Mäkelä et al. (2008a)", but in the reference list there is only one Mäkelä et al. (2008).

Page 7005 Line 26: Do you mean ZF is used as Ts in eq (9)?

Page 7007 Line 1: What is "(-)" after α?

Page 7007 Line 18: "faster the convergence" -> "the (a?) faster convergence,"

Page 7010 Line 6: 3.1 -> 3.1.1?

Page 7010 Lines 6, 8: τ -> X_0?

Page 7010 Lines 9-10: Markov Chain Monte Carlo -> MCMC

Page 7011 Line 4: "6-parameters empirical model" -> "6-parameter empirical model"

Page 7019 Table 1: Add that the distribution is uniform.

(end)