

Interactive comment on “A Bayesian Approach to Evaluation of Soil Biogeochemical Models” by Hua W. Xie et al.

Anonymous Referee #1

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General comments: The manuscript “A Bayesian Approach to Evaluation of Soil Biogeochemical Models” by Hua W. Xie et al. presents a Bayesian approach to soil biogeochemical models. This study provides valuable insight – soil biogeochemical models need to be assessed by Bayesian goodness-of-fit metrics, not a widely used metric, i.e., R-squared. Furthermore, they compared between linear and nonlinear models – first-order linear ordinary differential equation and non-linear Michaelis-Menten function, respectively. Despite somewhat expected the main conclusion, e.g., more data could help model to constrain parameters so that it could be possible to define the strengths and limitations of linear vs. nonlinear models; this comparison based on the Bayesian perspective suggested that soil biogeochemical model(s) need to consider the matrix of the Bayesian goodness-of-fit for a better model selection, having strong

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predictive skills.

This manuscript fits the scope of the Biogeosciences journal and identifies the potential implement for current generation of soil biogeochemical models. While the approach and analysis presented in the manuscript are generally correctly conducted and concluded, there are some minor issues in the manuscript. I offer specific comments for improving the manuscript below.

Specific comments:

Methods

L 86-91: lacks model descriptions; and nitrogen-related increases in complexity has not been addressed in the entire manuscript. I suggest you may discuss in the discussion. Also, figure 1 has not been mentioned in the manuscript

L 166: Log Pseudomarginal Likelihood (LPML) has popped up without prior introduction

Results

L 185: “The difference in curve shape (Fig. 3a, b) . . .”

L 189: Is it different between “95% confidence interval” and “95% model response ratio credible interval”?

L 196: a bit confused as well as missing figure annotation. It would be better to choose clear points to address why CON and AWB are showing differences

L 198: rewording to emphasize “how the steady state pool size ratio has been changed based on increasing MIC”; the unit should be mg C g⁻¹ (uppercase); Please check other lines as well

L 199: need to clarify. By the way, what is the function of the trend lines? Have you tried polynomial function? It seems similar patterns between them.

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L 203-206: Is it possible to replace the supplemental figure 3 to represent SOC loss rather than “SOC fraction remaining”? It is difficult to interpret.

L 205: “decreased from 16.3 to 11.3 %”. Please check other lines as well

L 218: R2; Annotation for varying SOC: “SOC = 50 -> SOC50”

Discussion

L 231: not sure this manuscript compared models through AIC and DIC with WAIC and LOO

L 255-259: which Figures showing this? Also, the sentences are too complex. Please re-write simpler sentences

L 273: is 50 mg SOC g-1 soil same in line 218 (SOC =50)? Please use consistent unit

L 275: Supplemental Table 3?

L 316: Supplemental Fig. 5

L 322: Supplemental Fig. 8a, b. . .

Typing error

1. Please check upper case expression; r-squared is R2 (uppercase)
2. L 156: mg C g-1 soil
3. Put period after abbreviation of figure, e.g., Fig. xx
4. Please double-check figures and table numbers
5. Supplemental or supplementary?

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