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Interactive comment on "Technical Note: An efficient method for accelerating the spin-up process for process-based biogeochemistry models" *by* Yang Qu et al.

Anonymous Referee #1

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This topic is of considerable interest, as spin-up provides the initial conditions for biogeochemical model simulations but usually requires a significant amount of computation time. In the manuscript, authors want to propose a new method in order to accelerate spin-up processes at monthly and daily time steps, which modeled steady variables show a cyclic pattern. However, I am not completely convinced that the proposed method is efficient and reliable due to several reasons as follows:

1. Authors introduce many variables in Section 2.2, but most of them are not well illustrated. I feel confused about the difference between k-1/2and k-1 in Eq. 12. If the spin-up is driven by monthly climatology, to my understanding, the Jk matrix should

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depend on a constant matrix of transfer rate among pools and a matrix of pool size for each time step (k) in a specific year. It is vague and confusing that how to calculate the matrix of mean process rate constants (Line 104) for time step k (J(k-1/2)). Section 2.2 is the core of this new method, but authors simply list equations and do not explain how actually they have used it.

Additionally, in line 109, Eq. 12 can't be written as Eq. 15 when using yk=τf(k-1/2), but it is valid by using yk=τf(k-1). Authors should carefully check all the equations before submission.

2. In line 111, the cyclic boundary condition of this method is x1=x(T+1). As stated in the manuscript, when spin up is made at the monthly time step, T equals to 12 and x1 is the size of carbon pools in January. That means boundary condition is only applied to January carbon pools. This study mainly uses the Harvard Forest site (even though the authors listed seven sites in Table 1) which PFT is deciduous forests. The fluctuation of carbon pool/flux is the largest during the growing seasons. The method is not designed to reach a steady state for all state and flux variables during other months. As this method aims to derive a cyclic steady state, it is supposed to set a threshold or a boundary condition for each month/day or seasonal cycles, as well as for annual carbon balance (NEP).

3. Authors only present one table (Table 2) that contains the result of the proposed method, and other figures/tables are results from the original spin-up method. I didn't get the idea why to do this. In the Introduction (Line 42-43), it says that 'the model will check the stability of the simulated carbon and nitrogen fluxes as well as state variables with specified threshold values'. I didn't see much of these in Section 2 and 3.

Authors list seven sites to apply the new method, but I only see the results at Harvard Forest site, what about the results at other sites?

I would like to see more analyses and comparisons of flux trajectories and state variable trajectories for all carbon pools between original method and the new method

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at site-level and pixel-level. The current results are not convincing to state the high efficiency of this new method.

Some specific comments:

Introduction: too many repetitive information in the first three paragraphs.

Line 42, is 2000 correct? In abstract, it is '200 years'. Need some references here.

Method:

Line 86, should Vc be written as Cv? Each variable name should be consistent throughout the manuscript.

Line 93, what does g(x0,k-1) represent? Please add explanations of each variable introduced in the equations.

Line 102, in boundary condition equation, T+i and i should be subscripted. Please check all the variable names.

Line 107-113, I suggest that all variables should be written as matrixes because authors introduce I as identify matrix in Line 107.

Line 115, please spell out LU.

Line 118-199, there is no Eq. 3a in the referred paper. Please check the citation.

Line 126-130, what are the matrixes with single quotes? What is D1 in line 127?

Line 127, it is unnecessary to be included in the manuscript.

Line 142, what is the exact value of n in TEM?

Results and Discussion:

Line 172-181, this paragraph would fit better in the Method.

All of the figures need more detailed captions.

References:

Line 252, loss of information.

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