

# ***Interactive comment on “A generic biogeochemical module for earth system models” by Y. Fang et al.***

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## **General comments**

This manuscript presents a framework to implement new biogeochemical processes within the Community Land Model (CLM). The approach is interesting and can potentially help developers of other large models to include new processes. This type of manuscripts are of great value and deserve publication in Geoscientific Model Development. However, I have concerns about the reproducibility of the framework presented here. The manuscript lacks detailed descriptions of the mathematical framework and its implementation. In my opinion, this manuscript may only be of value for people already familiar with CLM, unless the authors make an extra effort and present the

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framework in more detail and perhaps with more explicit mathematics.

In particular, I found hard to understand the reaction pathways depicted in Tables 2 and 3. Perhaps it would help the reader if the reactions in this table are also presented in terms of systems of ODEs that more explicitly represent the process. The terms  $R$  in these formulas are ambiguous and it is not completely clear to me if they are calculated as a first-order linear reaction (e.g.,  $R = kC$ ), or whether the term  $R$  generically represents a flux calculated either as linear or non-linear interaction.

In this regard, the use of the word 'reaction' in the manuscript may be confusing. In geosciences it is common to discriminate between fluxes (units of mass per time) and rates (units of per time). The authors use the word reaction rate for  $R$ , but my impression is that they are referring to a flux. I know chemists prefer the term reaction for what could be considered a flux, so I recommend the authors to define better their terminology and the exact meaning of  $R$ .

### Technical/minor comments

- Introduction. Although the discussions here on sulphur and microbial dynamics are interesting, it seems disconnected from the rest of the paper. There are no references at the end of the manuscript on how sulphur or microbial dynamics can be implemented in the framework. I suggest the authors to either make the connection more explicitly in the discussion or remove this part from the introduction.
- Equation 2. If  $[I]$  is the identity matrix, why do you need it there to multiply the vector of differential equations? If you multiply by the identity matrix you get the same vector back. Am I missing something? Do you mean something different when you say 'unit' matrix? Please explain this better.

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- Page 3217, line 11. Can you give more detail about how the ODEs are implemented and solved in CLM? Is there a standard library called to solve the ODEs or are they solved explicitly within the model?
- Page 3219, line 21. Can you point out where the user manual can be found? Can you add it as supplementary material for this manuscript? Please see GMD submission guidelines and be aware that manuscripts in this journal usually include user manual and access to source code.
- Page 3020, line 2. What are p and c?
- Page 3223, line 4. What do you mean by 'recent technology'? I guess you probably want to say recent 'advances' or 'contributions'. By the way, are you familiar with other P cycling models? You may want to look at Goll et al. (2012, Biogeosciences 9: 3547), and Buendia et al. (2010, Biogeosciences 7: 2025).
- Supplementary material. Please add a commented heading explaining what this code does. If possible, also add inline comments within the code.

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Interactive comment on Geosci. Model Dev. Discuss., 6, 3211, 2013.

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