Geoscientific Model Development Discussions

Geosci. Model Dev. Discuss., referee comment RC2
https://doi.org/10.5194/gmd-2020-405-RC2, 2021
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Comment on gmd-2020-405

Anonymous Referee #2

Referee comment on "A model for marine sedimentary carbonate diagenesis and paleoclimate proxy signal tracking: IMP v1.0" by Yoshiki Kanzaki et al., Geosci. Model Dev. Discuss., https://doi.org/10.5194/gmd-2020-405-RC2, 2021

General Comments:

This paper presents a new model (IMP) that builds on previous reactive-transport models, aiming to better decipher proxy signals while addressing complications due to bioturbation and chemical erosion. The model includes complexity previously not addressed in similar models, as the authors break down CaCO3 particles into “classes” based on recorded proxy values and biologic and physiochemical characteristics. Further, they investigate the effects of sediment mixing and dissolution in their model using stable isotope records of a hypothetical environmental change event. Generally, the paper is very well written and undoubtedly of interest to the audience of Geoscientific Model Development. The authors do a good job laying out the motivation for their model and experiments and clearly outline the methods and assumptions. This work will help to improve understanding and interpretation of marine proxy records, providing a strong theoretical basis for disentangling geospatial variability in records from similar archives. I applaud the authors for providing such a well-revised, organized and thought-out manuscript. My critique is minimal and provided as a suggestion for two general areas of improvement: (1) expansion of explanation of transition matrices, namely automation-based and (2) expansion of the discussion.

Specific Comments:

The manuscript would benefit from an expansion on the LABS simulation approach; automation-based transition matrices described in the methods could be more thorough. As written, the paper requires unfamiliar readers to investigate this approach outside of the paper. This could also be achieved in the introduction.

While this model will be applied to interpreting archives of geologic events and such events are cited as motivation, there is little to no discussion later in the paper of the significance of their experiments with regard to these events. For example, what is the significance of the model result in which coarse fraction species become more dominant, in terms of records of past abrupt events of environmental change? Perhaps the authors decided to stay away from interpreting their model development results in terms of geologic applications, but some model-data comparison may be warranted in the discussion. This may or may not include a more representative simulation of an early Eocene hyperthermal event.

Following this more generally, the discussion section of the manuscript is slightly limited and could be expanded. For example, how does this new model and the results of experiments in this study inform understanding of examples of processes outlined in the introduction? How might the findings here bias proxies in specific geologic archives (e.g., size fraction differences previously unaccounted for in proxy records)? This type of expansion would not necessarily require re-interpretation of records of e.g. the PETM, but rather clearly lay out the implications of their experiments which may be significant to a proxy-based researcher in the field.