

Interactive comment on “Quasi-100 ky glacial-interglacial cycles triggered by subglacial burial carbon release” by N. Zeng

Anonymous Referee #2

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Review of “Quasi-100 ky glacial-interglacial cycles triggered by subglacial burial carbon release ” by N. Zeng.

In this manuscript, the author describes a mechanism that may produce quasi-100 kyr glacial-interglacial cycles of the coupled carbon-climate system. This mechanism relies on the glacial burial hypothesis, in which large amount of organic carbon is buried under the ice sheets of the Northern Hemisphere during glacial periods. This hypothesis has already been described in 2003 (N. Zeng, Glacial-Interglacial atmospheric CO₂ change - the Glacial Burial Hypothesis, Adv. In Atm. Sciences, 20, 5, 667-693). Here, Zeng suggests that the switch from glacial maximum to deglaciation is triggered by the ejection of glacial burial carbon when northern hemisphere icesheets grow over a specific size. A simple carbon-climate model is used and when a very simplified rep-

resentation of subglacial transport of organic carbon is introduced, the coupled model produces quasi-steady glacial-interglacial cycles with a period of 93 kyr.

I find the manuscript well written and the glacial burial hypothesis in itself is interesting, but I am disappointed by the advances presented in this manuscript when compared to the paper by N. Zeng, 2003. In his previous paper, N. Zeng proposes several key steps that could further advance our understanding of the potential role of the glacial burial hypothesis in glacial-interglacial CO₂ cycles : 1. Search for direct evidence of glacial burial carbon under the the former ice sheets, 2. Looking at high resolution measurement of atmospheric carbon-13 in ice cores, 3. Transient coupling to high resolution ocean models so as to compare with the vast array of ocean sediment data for the both the carbon and carbon-13, 4. Validation of the terrestrial carbon model used in this study and comparison with other terrestrial carbon models. However, the present manuscript does not go in any of those directions. To my view, it adds even more speculative material to the glacial burial hypothesis, which in itself is still very speculative. I would not recommend the present manuscript for publication in its present form and without any new arguments that would substantiate the glacial burial hypothesis.

Specific comments:

1. Ice sheet dynamics and transport of glacial burial carbon. I find the parameterization used to describe the transport of glacial sediment including burial carbon very simplistic. In particular, there is no justification for the second term v_0 of equation A10, that, if I understood well enough, is crucial in driving the quasi-100 ky oscillations.
2. C13. As suggested by Zeng himself in his previous paper, the use of carbon stable isotopes is a key to gain more insight into this problem. Would it be possible to introduce C13 in the modeling approach presented in this manuscript? (I know C13 is already embedded in the ocean carbon model used here).
3. Timing of events around terminations. A few papers have been published over the last few years, in which the authors have tried to come up with a detailed chronology

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of events around terminations. In Caillon et al. Science 2003 for example, ice core bubbles analysis has led the authors to conclude that “The sequence of events during Termination III suggests that the CO₂ increase lagged Antarctic deglacial warming by 800 ± 200 years and preceded the Northern Hemisphere deglaciation”. How do the glacial burial hypothesis and the mechanism proposed by Zeng take place in this chronology? I think it is necessary to discuss this point.

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