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Earth System Dynamics Discussions

Interactive comment on "Geologic constraints on earth system sensitivity to CO_2 during the Cretaceous and early Paleogene" *by* D. L. Royer et al.

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On a quick skim, I can give a few comments:

1. Is equation (1) really a definition of climate sensitivity? Seems almost like a definition of 'f'.

2. This sentence seems too strong: "This is an important observation because the PETM is considered a paleo-analog of present day climate change in terms of rate and magnitude of carbon release ...". Should be, at the least, "This is an important observation because the PETM is considered by some to be a paleo-analogue of present day climate change in terms of rate and magnitude of carbon release ...". I think the

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paleo-analogue status of the PETM has been overblown. How similar were rates of CO2 release to today's rates?

3. I have not read this carefully enough, but do the authors exclude the possibility that the changes in the Earth System that are concurrent with CO2 changes may not be caused by CO2 and thus are not really feedbacks? For example, in glacial times, Milankovic forcing encouraged growth of ice sheets resulting in a drawdown of CO2 through a complex web of interactions. This CO2 drawdown promoted ice sheet growth. However, if we were to regress ice sheet albedo feedbacks against CO2, we might ascribe a greater degree of feedback than would obtain in today's world, because we would be ignoring the causal role of milankovic forcing.

How do we know that in the past, say, new vegetation types did not spread that increased planetary albedo (perhaps surface albedo or low cloud cover) and also drew down CO2 levels. In such a case, a regression based approach would ascribe high climate sensitivity to CO2, but CO2 would not be the sole causal agent. Maybe the CO2 and temperature increases followed the waxing and waning of causal factors that had both CO2 and climate implications, thus muddying analysis in terms of feedbacks on CO2 changes.

It seems that the authors can either conclude high climate sensitivity to CO2 or that the some causal factors cause both cooling/warming and CO2 decreases/increases.

Forgive me if these points were covered in the manuscript, but I missed it in my quick read.

Interactive comment on Earth Syst. Dynam. Discuss., 2, 211, 2011.