

Interactive comment on “Geologic constraints on earth system sensitivity to CO₂ during the Cretaceous and early Paleogene” by D. L. Royer et al.

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Received and published: 10 April 2011

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.