

Interactive comment on “Implementation of methane cycling for deep time, global warming simulations with the DCESS Earth System Model (Version 1.2)” by Gary Shaffer et al.

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This is a thorough and polished description of the extension of an existing earth system climate model to deal with the impacts of massive methane releases on climate, ocean chemistry, and the carbon cycle. I don't think it's certain that methane is the culprit in all of the carbon isotope excursions in the past, but it might have been, and certainly a model of how this would work is a useful thing. Some of the pieces incorporated into the model are recent developments, like the IR absorption coefficients of overlapping gases. As this is new modeling territory, it is helpful to have a model description, in the spirit of GMD. The model description is generally detailed but some of the first-order information is omitted, like what an ocean sector is, or how the ocean circulates. I'm

C1

sure it's described elsewhere but it should be here also. The results are clearly and attractively presented in the figures.

Page 2

2. For me, encoding often-repeated phrases into acronyms like CIE, TM, and MH do not make a paper more readable, I don't see the point of it. It's easy to miss the definition, in which case you have to go back and find it, and even after you have it you have to train yourself to decode it every time.

17. Organic carbon could be liberated from a fossil organic source, or peat degradation; it need not be limited by the size of the terrestrial biosphere.

24. CO₂ can also be released when magma intrudes into sediments. To the extent that it comes from CaCO₃, it could tend to “dilute” the negative imprint of methane.

29. “sustain” solubility misleads, makes it sound like a process, rather than a concentration. Although it is a process, since there is an upward diffusive gradient, but this is not explained.

Page 3

30. Clarify: the ocean model is 1-D (vertical)? What is an ocean sector? Explain the “high latitude zone” of the ocean (page 7). A diagram including the atmosphere and ocean would be very helpful.

Page 10

4. It might be acknowledged here that much faster oxidation time scales are possible in places with ongoing methane availability, the biota builds up. Like the Gulf of Mexico.

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C2