

Interactive comment on “Reduced Carbon Cycle Resilience across the Palaeocene-Eocene Thermal Maximum” by David I. Armstrong McKay and Timothy M. Lenton

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Received and published: 26 July 2018

Thank you Valerie for a thoughtful and clear review of our paper. Here we will respond in brief to your comments and describe how we will subsequently revise the paper.

We indeed should have cited Held & Kleinen (2004), and will include this and other additional references – regarding tipping points and resilience in general as well as specifically on the alternative drivers of indicator behaviour (such as for skewness or kurtosis) and Peng et al (1994) for DFA – in the revised manuscript.

The difference in dates in Figure 1 are the result of differing age models between

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the global Cenozoic isotope compilation (Zachos et al, 2008) and the more recent and localised high-resolution record with an updated age model from Westerhold et al (2015). We have left them as is to maintain consistency with the published records, but will mention and explain this difference in the revised manuscript in order to avoid confusion.

The binned metrics are indeed a special case of the rolling window, although with differing sized bins for pre-PETM, PETM-ETM2, and post-ETM2. The key aspect is that in contrast to the rolling window run over the whole dataset for the binned analysis the data from the events themselves are removed and so not included in these bins, avoiding the indicators being biased by the events themselves. However, we agree that the way this section is currently phrased is a bit confusing, so we will rephrase this section and the comment on page 5 line 21 in the revised manuscript to make this clearer.

DFA could also be done on a rolling window along with the other EWS indicators. This was originally excluded due to time constraints in the initial project (with AR1 used as the main ‘memory’ indicator and DFA added later to just the binned section), but we can run and include this additional analysis in the revised manuscript. A continuous range of rolling window length rather than just a comparison of 25 / 50 / 75% windows would also be advantageous, and so we will also attempt a more robust sensitivity analysis of rolling window size.

In the abstract (page 1 line 17) by “differing carbon cycle dynamics preceding the PETM and ETM2” we refer to the drivers of variance being different for each event, with an increase in jump intensity (and overall conditional variance) in the $\delta^{13}\text{C}$ prior to the PETM versus an increase in diffusion (and a decrease in jump intensity) prior to ETM2. This difference suggests potentially differing carbon cycle dynamics prior to each event, which we discuss in Section 3.3. However, this could be phrased more clearly in the abstract and so will clarify this line (along with Section 3.3) in the revised manuscript.

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