

Earth Syst. Dynam. Discuss., referee comment RC2  
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## **Comment on esd-2021-27**

Anonymous Referee #2

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Referee comment on "Quantifying memory and persistence in the atmosphere–land and ocean carbon system" by Matthias Jonas et al., Earth Syst. Dynam. Discuss., <https://doi.org/10.5194/esd-2021-27-RC2>, 2021

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In this work, the authors studied the memory and persistence in the atmosphere-land/ocean carbon system. They introduced three parameters, the delay time, memory, and persistence to characterize the system, and found that since 1850, the atmosphere-land/ocean system has been trapped progressively in terms of persistence. This is a very interesting topic, which I also believe to be very important for better understanding the global warming. However, I am afraid that the current version of the manuscript still requires a major revision. Particularly, the readability needs to be improved.

1) One of my main concerns is about the stress-strain model. Why is this model useful in understanding the memory/persistence in the system? More detailed discussions and arguments are needed.

2) The "Abstract" should be improved. Now it is quite similar to the first three paragraphs of the "Motivation".

3) A more detailed overview of the previous progresses on climate persistence may be helpful. In the current version, the authors only mentioned the previous studies very

briefly, as shown on page 7 (lines 24-25), page 8 (lines 1-4). However, what are the limitations of the previous studies? I would suggest the authors to make a more detailed introduction.

4) The definitions of "delay time", "memory", and "persistence" should be clearly given in the main text. What is the differences between "memory" and "persistence"?

5) Regarding the "Data and Conversion Factors" section, I would suggest the authors to add more information (about the data used in this study) here. It is not convenient for the readers to search for the data information in the supplementary information. At least, some basic information should be provided in the main text.

6) When estimating the compression modulus  $K$ , why is the atmosphere assumed to be represented by a Hooke element in the MB? What is a Hooke element?

7) The current manuscript is very technical. For me, I would like to see more explanations of the results from the perspective of climate sciences.