

Responses to the reviewers

Reviewer 1

We thank Reviewer Jianli Chen for his positive comments on this short note. We provide below our responses to each comment.

- Comment 1: We will replace the term "atmosphere" by "superficial fluid envelopes" .
- Comment 2: We will remove the word "recent" when quoting Watkins et al., 2018. We did not quote Ding and Chao, (2018) due to the limited number of references (15) allowed in ESD Ideas. We provide a more comprehensive literature review in Pfeffer et al., 2023 (submitted, <http://dx.doi.org/10.2139/ssrn.4388237>).
- Comment 3: A detailed description of the 6-yr cycle in the climate system is provided in Moreira et al., (2021) and Pfeffer et al., (2023). These two studies, quoted in this note, show that the 6-yr cycle is quite significant, well above the noise level, in particular in the GMSL rate, precipitation, TWS, etc.
- Comment 4: We will rephrase the sentence as: " According to the current literature, core dynamics is the favored mechanism to explain the 6-yr cycle in LOD. We thus may conclude [...]"

Updated reference:

Pfeffer et al., 2023 has been updated into: "Pfeffer, J., Cazenave, A., Rosat, S., Moreira, L., Manda, M. and Dehant, V. (2023), A 6-Year Cycle in the Earth System. In review to Global Planetary Change. Available at SSRN: <http://dx.doi.org/10.2139/ssrn.4388237>"

Reviewer 2

We thank Rev.2 for his comments about our ESD Ideas manuscript.

- Due to the limited number of references allowed in ESD Ideas, we could not quote the Home & de Viron paper but we are well aware of Rev.2 pioneering analysis of the 6-year cycle in LOD.
- Recent analyses of LOD data updated to present still show the presence of a 6-year cycle. Recent publications as well as our own work show that a 6-year cycle is detectable in the atmospheric angular momentum (AAM) that is in opposition of phase with the 6-year cycle in LOD, suggesting that the atmosphere oscillates in phase with the solid Earth mantle at this particular frequency.
- In a longer manuscript (Pfeffer et al., A 6-year cycle in the earth system, in revision at Global and Planetary Change ; manuscript available on the SSRN platform –see reference below-), we investigate in detail the significance of the 6-year cycle detected in the deep Earth (waves in the liquid core, magnetic field), in the gravity field and in several climate parameters. We find phase (or phase opposition) consistency at the 6 year frequency between magnetic field, gravity field, LOD, AAM and some climate parameters (e.g., mean Earth temperature). In land hydrology (i.e. vertically integrated water storage), the phase of the 6 year cycle is not geographically uniform, which can

be explained by the complex response of the regional water balance to meteorological forcing and the potential delay in water propagation in soil from the surface to the underground aquifers. This issue will be mentioned in the revised version of Pfeffer et al.'s manuscript.

- Finally we agree with Rev.2's comment saying that our paper is just a start that needs to be followed by deeper investigations, in particular in terms of physical mechanism able to explain what drives the coupled system «mantle + atmosphere» at the 6-year frequency. As our study is clearly pluridisciplinary involving dynamical processes occurring in the deep Earth (core flow and magnetic field), geodesy (Earth rotation and gravity field), atmospheric and climate sciences as well as land hydrology, we think that this short note should motivate novel interdisciplinary studies from a wide research community.
- Reference : Pfeffer, J., Cazenave, A., Rosat, S., Moreira, L., Manda, M. and Dehant V. (2023). A 6-Year Cycle in the Earth System. In revision, Global and Planetary Change. Preprint available at SSRN: <http://dx.doi.org/10.2139/ssrn.4388237>