

Clim. Past Discuss., referee comment RC1
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Comment on cp-2022-49

Anonymous Referee #1

Referee comment on "Abrupt climate change and millennial-scale cycles: an astronomical mechanism" by Alison Kelsey, *Clim. Past Discuss.*,
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The manuscript under consideration is a modified version of the manuscript rejected seven years ago. I did not review the previous version of this manuscript and did not make a detailed comparison between them, but the main results, figures and references are very similar. In particular, I found that practically all cited papers were published more than ten years, which is a serious shortcoming of the manuscript since significant progress in the understanding of Quaternary millennial-scale variability has been achieved during the past decade. The reviewers of the first version of the manuscript mainly criticized the central premise formulated in the first sentence, namely, that "the existence of a 1470-year cycle of abrupt climate change is well-established". Now the author admits that the Bond cycle is "controversial". Below I discuss the manuscript in a more general context. The appraisal of the manuscript depends on the answers to three questions:

- Is the 1470-yr cycle really observed in climate records?
- Does millennial-scale Quaternary variability associated with DO events and IRDs (i.e. Heinrich and similar events) require any external forcing?
- Is there any evidence that astronomical factors discussed by the author can influence Quaternary millennial-scale climate variability?

The answer to the first question, as has already been argued by the reviewers of the first version of the manuscript, is definitely no. 1470-yr cycle was popular at the beginning of 2000th primarily thanks to a very influential publication by Bond et al. (1997). However, later this periodicity went out of fashion since the existence of this cycle was not corroborated by other studies.

The answer to the second question is also no. Numerous modelling studies performed during the past decades demonstrated that the millennial-scale variability, such as Dansgaard-Oeschger and Heinrich events) can be fully explained by the internal

instabilities emerging in the ocean-atmosphere system and ice sheets under glacial conditions without any external forcing (see, for example, review by Menviel et al, 2020).

Concerning the potential astronomical forcing of millennial-scale variability. The author considers two astronomical processes which together may produce 1470-yr cycle. The first is the well-known solar cycles. However, recently solar cycles were additionally "downgraded", and the current estimates of changes in TSI at multi-centennial time scales is only 0.1% which is too small to have any appreciable impact on climate. How the 133-yr cyclicality in Earth-Sun and Earth-Moon distances can affect climate, the author does not explain. Moreover, this periodicity is not seen in climate records. Thus, the answer to the third question is also no.

This is why I cannot recommend this manuscript for publication in *Climate of the Past*.

Menviel, L.C., Skinner, L.C., Tarasov, L. and Tzedakis, P.C., 2020. An ice-climate oscillatory framework for Dansgaard-Oeschger cycles. *Nature Reviews Earth & Environment*, 1(12), pp.677-693.