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High fidelity astrochronology and quantitative integrated stratigraphy through Earth history

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While an integrated approach to stratigraphy utilizing several independent dating methods is clearly important, the integration is yet commonly done in a qualitative and little reproducible rather than a rigorous quantitative way. Of these methods, astrochronology is one of the most important techniques for constructing time scales of Earth history. However, one factor currently limiting its use in a more quantitative way is uncertainty in the length of Earth's obliquity and precession in the past.

Here, we present a reconstruction of precession- and obliquity frequencies for the Devonian from a suite of published datasets. Results are consistent with the Milankovic period evolution suggested by Laskar et al. (2004), and shorter than those suggested by Berger et al. (1992). Because our results are based on a suite of datasets from different (paleo)continents and settings, we are confident about the outcome. Results are based on a newly developed method which allows the use of more noisy datasets than a recently proposed technique (Meyers and Malinverno 2018), thereby largely extending the datasets that can be used for the testing. We succeeded to reduce uncertainty by analysing time-parallel datasets and considering results that are in agreement with all datasets. Next, we demonstrate the effect of (un)knowns in the length of precession- and obliquity periods for integrating radio-isotopic- and astrochronological data, and test the effect of an improved knowledge on precession- and obliquity length.

Finally, the lack of reproducibility in astrochronologic correlation approaches, and the need for the open availability of data are briefly discussed.