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# Time Scale Optimization and the Hunt for Astronomical Cycles in Deep Time Strata

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A valuable attribute of astrochronology is the direct link between chronometer and climate change, providing a remarkable opportunity to constrain the evolution of the surficial Earth System. Consequently, the hunt for astronomical cycles in strata has spurred the development of a rich conceptual framework for climatic/oceanographic change, and has allowed exploration of the geologic record with unprecedented temporal resolution. Accompanying these successes, however, has been a persistent skepticism about appropriate astrochronologic testing and circular reasoning: how does one reliably test for astronomical cycles in stratigraphic data, especially when time is poorly constrained? From this perspective, it would seem that the merits and promise of astrochronology (e.g., a geologic time scale measured in $\leq$400 kyr increments) also serves as its Achilles heel, if the confirmation of such short rhythms defies rigorous statistical testing.

To address these statistical challenges in astrochronologic testing, a new approach has been developed that (1) explicitly evaluates time scale uncertainty, (2) is resilient to common problems associated with spectrum confidence level assessment and 'multiple testing', and (3) achieves high statistical power under a wide range of conditions (it can identify astronomical cycles when present in data). Designated TimeOpt (for "time scale optimization"; Meyers 2015), the method employs a probabilistic linear regression model framework to investigate amplitude modulation and frequency ratios (bundling) in stratigraphic data, while simultaneously determining the optimal time scale. This presentation will review the TimeOpt method, and demonstrate how the flexible statistical framework can be further extended to evaluate (and optimize upon) complex sedimentation rate models, enhancing the statistical power of the approach, and addressing the challenge of unsteady sedimentation.

Meyers, S. R. (2015), The evaluation of eccentricity-related amplitude modulation and bundling in paleoclimate data: An inverse approach for astrochronologic testing and time scale optimization, Paleoceanography, 30, doi:10.1002/ 2015PA002850.