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Planetary Obliquity Impacts Wet-Dry Cycling and the Potential for an Origin of Life in Warm Little Ponds

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As the exploration and classification of exoplanets advances, establishing precise criteria for identifying planets with genuine life-bearing potential becomes imperative. Habitability is typically defined by a planet's ability to maintain surface liquid water. While this definition is informative, the stability of liquid water does not fully inform a planet's capacity to host an independent origin of life. 'Urability' is an emerging concept that focuses on the conditions necessary for life's origin [1], and searching for the planets most likely to originate life (urable worlds) would be highly complementary to traditional habitability-based strategies for life detection.

This presentation will examine the urability of Earth-like planets, focusing on the potential for an origin of life in freshwater environments on volcanic islands [2]. Central to this scenario is the potential for wet-dry cycles [3]. However, not all planets are equally likely to experience these cycles because features like planetary obliquity can drastically impact precipitation and evaporation cycles. We use ExoPlaSim, a General Circulation Model, to simulate the sensitivity of spatiotemporal temperature and precipitation patterns to various planetary obliquities on Earth-like planets. We then examine how these variations impact wet-dry cycling and prospects for an origin of life.

References:

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[2] Damer, B., & Deamer, D. 2020, Astrobiology, 20, doi: 10.1089/ast.2019.2045

[3] Pearce, B. K. D., et al. 2017, PNAS, doi: 10.1073/pnas.1710339114