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The habitable zone: using it inside and outside our solar system

The habitable zone, an important tool in the search for potentially habitable exoplanets, is the circular region around a star where standing bodies of liquid water *could* exist on the surface of a rocky planet. The classical definition suggests that habitable planets in other stellar systems will orbit main-sequence stars and have an atmospheric greenhouse effect dominated by CO_2 and H_2O (as is the case with Earth). Although these conditions have yielded life for our planet, I argue that employing such an Earth-centric approach may not suffice to predict life elsewhere because it ignores key considerations. These include starting surface temperature conditions, different atmospheric compositions, the size of the initial water budget, alternate biogeochemical cycles, atmospheric escape, and stellar age, which all influence how the habitable zone boundaries change over time. In this talk, I discuss how these additional factors could impact the habitability of solar system planets and exoplanets. I argue that utilizing solar system data (including modeling results) is one of the keys to understanding exoplanetary habitability. For example, I discuss how the potential habitability of early Mars can inform us about exoplanetary habitability. Likewise, I evaluate the habitability of the TRAPPIST-1 system in the context of ocean worlds. I also discuss how our knowledge of terrestrial biology can help us find complex life elsewhere. Finally, I argue that this holistic approach to habitability allows us to devise improved metrics in the search for potentially habitable exoplanets.

BIO:

I am a research scientist that studies potentially habitable worlds. I develop atmospheric models to assess the physical processes that make planets habitable. This includes improving definitions of the habitable zone that are used to target potentially habitable worlds and studying the habitability of worlds within our solar system to better understand extrasolar planet habitability. I am also a member of the Martians Moons exploration (MMX) science team and a collaborator/advisor with LUVOIR and LIFE. My work is at the leading edge of the emerging field of dynamic habitability.