
Adaptable habitability, niche filling and exo-climate change

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Abstract

Planetary orbits may change due to gravitational perturbations by external bodies. Such changes can occur both on short and long timescales, and give rise to significant changes in the planetary climate and habitability. Such changes may render the climate inhabitable for any original pre-existing organisms. However, if the climate change timescale is longer than the timescale for organism genetic adaptation over several generations, the population of pre-existing organisms may evolve and adapt to the new conditions. This raises the possibility for the existence of planets in which life formed and evolved under favorable conditions, and then adapted to extreme conditions once significant climate-change occurred. Such planets may therefore appear today as having too-extreme conditions as to allow for the emergence of life, even though life could have formed at earlier epoch at which time the planet climate differed. One can therefore discuss the possibility of "adaptable habitability", which relies not only on the current conditions but on the climate history and the dynamics of the planetary system. Moreover, once life emerges and evolves to the stage in which rapid adaptability is possible, organisms may adapt as to fill extreme environmental niches (e.g. extremophiles on Earth). Once climate-change leads to overall extreme planetary conditions, such originally extreme-niche filling organisms can prevail and occupy the main environments of the planets, where as such extreme planetary conditions, if they existed primordially, wouldn't have allowed for the emergence of life to begin with. We discuss these issues, and provide detailed planetary dynamics examples for such adaptable habitability to occur.

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