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The Nitrogen Constraint on Habitability of Planets of Low Mass M-stars

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Abstract

The traditional habitable zones around stars are defined based on the stability of liquid water over geological timescales. Being too far away from the stars, the planet would be incapable of maintaining a warm surface and thus no liquid water. Being too close to the star, the planet would experience a 'runaway' greenhouse phase, during which its oceans could be lost quickly, and end up similar to our sister planet, Venus.

The definition of tranditional habitable zones does not consider the availability of other elements important for life. All life as we know it needs nitrogen. Our calculations of upper planetary atmospheres show that nitrogen could be lost rapidly from planetary atmospheres with CO2 concentrations lower than certain threshold. This suggests that life on planets around low mass M-stars may be self-limiting, and planets of low mass M-stars are less favorable places to search for life than G- or K-type stars.