

Conditions for continuously habitable planets

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Existence of liquid water on the surface is usually used as a proxy of the habitable condition, that is, the conditions of planetary surface environment required for sustaining life. We also adopt this proxy, however, it may give a rather restricted condition than real habitable condition, even if we consider only 'life' similar to those found on the Earth. Some life lives in quite extreme environment. For example, some are known to live in the deep underground, where the environment is scarcely affected by the surface environment.

The continuous existence of liquid water on a planet requires, 1) supply of water on the planet, 2) resistance against escape from the planet, 3) resistance against the degassing into the planet, and 4) stability of liquid water on the planet. In the previous (e.g., Kasting et al. 1993), mainly the condition 4 and partly the condition 2 are discussed. Conditions 1 and 3 are not much discussed in the previous studies.

Condition 4 is related to the understanding of the planetary atmosphere and climate and rather extensively investigated, they are restricted for a global average climate. Since the globally and annually averaged climate is quite different from that with seasonal and latitudinal change, these conditions must be reevaluated.

Here, we review previous understanding and difficulties. Then, we report some results of ongoing studies in our group.