HABITABILITY OF EARTH-LIKE PLANETS

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The histories and fates of the three terrestrial planets Venus, Earth, and Mars suggest that a combination of distance from the Sun, planetary size, as well as geologic and biologic evolution control the habitability of a planet.We present a new conceptual Earth system model to investigate the long-term co-evolution of geosphere and biosphere from the geological past up to 1.5 billion years into the planet's future. The Earth system model consists of the componets solid Earth, hydrosphere, atmosphere, and biosphere. It evolves under the external forcing of increasing solar luminosity.As a major result of our investigations we calculate the terrestrial life corridor, i.e. the biogeophysical domain supporting a photosynthesis-based ecosphere throughout planetary history and future. Furthermore, we model the behavior of our virtual Earth system at various distances from the Sun, using different insolations. In this way we can find the habitable zone as the band of orbital distances from the Sun within which an Earth-like planet might enjoy moderate surface temperatures and carbon dioxode partial pressures needed for advanced life forms. We calculate an optimum position at 1.08 AU for an Earth-like planet at which the biosphere would realize the maximum life span. According to our results, an Earth-like planet at Martian distance would have been habitable up to about 500 Ma ago while the position of Venus was always outside the habitable zone.