Earth's days are numbered

Researchers calculate that the planet will leave the Sun's 'habitable zone' in about 1.75 billion years.

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19 September 2013

Reto Stöckli/Robert Simmon/MODIS/USGS/DMSP/NASA

A method to calculate Earth's 'habitable lifespan' could also identify other planets capable of supporting life.

Earth will be able to host life for just another 1.75 billion years or so, according to a study published on 18 September in *Astrobiology*[1]. The method used to make the calculation can also identify planets outside the Solar System with long 'habitable periods', which might be the best places to look for life.

The habitable zone around a star is the area in which an orbiting planet can support liquid water, the perfect solvent for the chemical reactions at the heart of life. Too far from a star and a planet's water turns to permanent ice and its carbon dioxide condenses; too close, and the heat turns water into vapour that escapes into space.

Habitable zones are not static. The luminosity of a typical star increases as its composition and chemical reactions evolve over billions of years, pushing the habitable zone outward. Researchers reported in March that Earth is closer to the inner edge of the Sun's habitable zone than previously thought[2].

The inner edge of the Sun's habitable zone is moving outwards at a rate of about 1 metre per year. The latest model predicts a total habitable zone lifetime for Earth of 6.3 billion–7.8 billion years, suggesting that life on the planet is already about 70% of the way through its run. Other planets — especially those that form near the outer boundary of a star's habitable zone or orbit long-lived, low-mass stars — may have habitable-zone lifetimes of 42 billion years or longer.

The authors suggest that scientists searching for life on other planets should focus on those that have occupied their habitable zones for at least as long as Earth has — such as HD40307g, which is 12.9 parsecs (42 light-years) away from Earth.

Life is complicated

But it is possible that Earth took an atypically long time to develop advanced life, says Caleb Scharf, an astrobiologist at Columbia University in New York. "It's the age-old problem of over-interpreting a single data point," he says. Study co-author Mark Claire, an astronomer at the University of St Andrews, UK, agrees, but adds that if he were running a mission to find life on a terrestrial planet, he would probably point his telescopes at planets that had been in the habitable zone for as long as possible.

Critics also suggest that the formula the researchers used is too simple. The model assumes that extrasolar planets have Earth-like atmospheres, compositions and tectonic-plate action. Colin Goldblatt, a planetary climatologist at the University of Victoria in Canada, says that without including climate dynamics such as atmospheric composition and volume, the results are not very useful for predicting habitability. "If you want me to build a habitable planet where Venus is, I can do that; if you want me to build a dead planet

where Earth is, I can do that," Goldblatt says.

"There is plenty of room for new formulations of the habitable zone," agrees Claire. For now, researchers don't know much about these extrasolar planets. But habitable zone calculations could prove interesting closer to home as well.

Just as the sun brightens and the Earth becomes too hot for life, Mars will be entering the habitable zone. "If humans are going to be around in a billion years, I would certainly imagine that they would be living on Mars," Claire says.

Nature | doi:10.1038/nature.2013.13788

References

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2. Kopparapu, R. K. *et al*. *Astrophys. J.* **765**, 131 (2013).