'Goldilocks' clue to habitable planets

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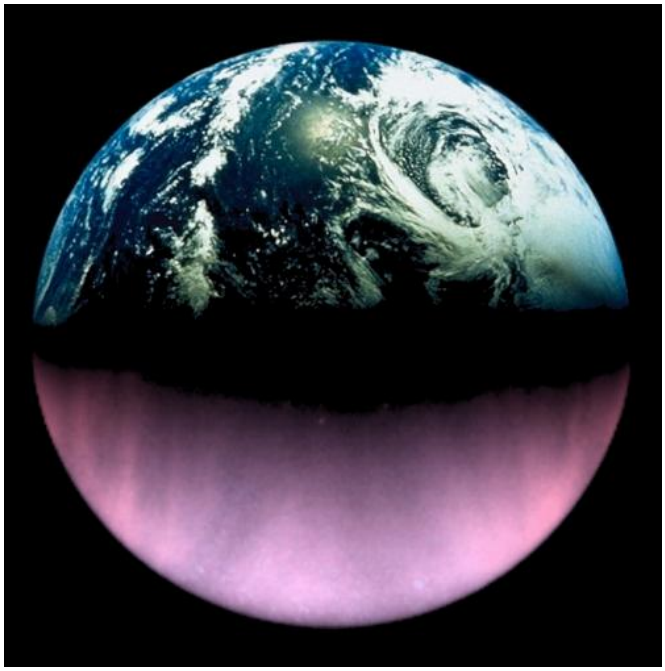


The Earth and Venus, although not very different in size, have had a very different climate history. In the future, the Earth may look like Venus. Credit: Jeremy Leconte

The bad news: Earth's oceans will evaporate away. The good news: It won't happen for another billion years or so.

Those are the conclusions of a new study into the so-called Goldilocks zone—the distance from a star at which water on a rocky planet can exist as a liquid rather than as permanent ice or vapour.

As in the fairy tale, a planet's temperature has to be not too hot and not too cold, but just right for sustaining the stuff for life as we know it.

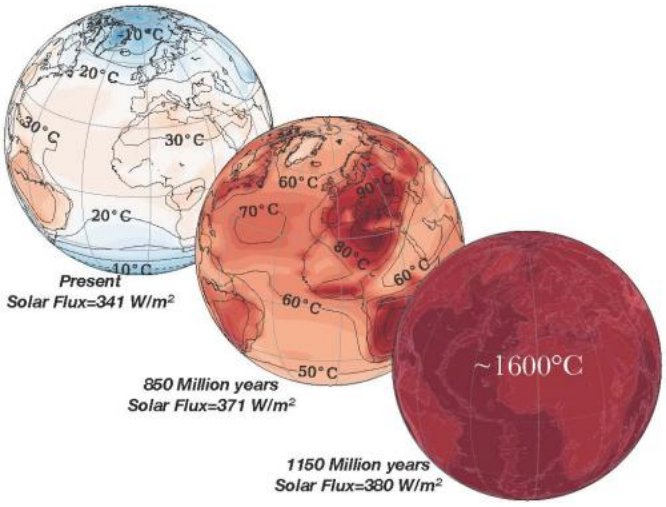
Jeremy Leconte of the Pierre Simon Laplace Institute in Paris investigated a well-known phenomenon in astrophysics: as a star ages, it increases in brightness.

In their simulation of Earth, the Sun's rising luminosity will eventually cause a runaway greenhouse effect, they found.

Water vapour is a greenhouse gas. This means that beyond a certain point, increasing vapour from the warming oceans will stoke Earth's surface temperature—which in turn causes more sea water to evaporate, and thus adds to the warming, and so on.

In around a billion years, liquid water on the surface of the planet will have completely disappeared, leaving an utterly desiccated surface, according to their model.

The time estimate for ocean loss is "several hundred million years later" than previously thought, France's National Centre for Scientific Research (CNRS) said in a press statement.



Simulation of the increase with time of the surface temperature (here at the spring equinox) caused by the increase in solar flux. Around 1 billion years, the runaway greenhouse climate instability is predicted to vaporize all the oceans until a very high temperature is reached (The mean temperature in panel 3 is an extrapolation of the temperatures after oceans are fully vaporized). Credit: Jeremy Leconte

The high-tech modelling includes a 3-D simulation that factors in solar heat per square metre, the seasons and the vapour cycle.

Previous models have tended to simulate the Earth as having a simple and uniform climate system. They usually place the start of the evaporation as soon as 150 million years from now, which is relatively brief in geological terms.

The study, published in the journal *Nature* on Wednesday, concludes that the Goldilocks zone may be somewhat bigger than thought.

The precious zone starts at 0.95 Astronomical Units (AU) for a star that is the size and present age of the Sun, it says.

One AU is 149.6 million kilometres (92.95 million miles), being the average distance between the Earth and the Sun—the orbit of our planet is slightly elliptical.

By comparison, Venus, Earth's sister planet in size, lies at 0.75 AU: it is just a bit too close to the Sun.

In its infancy, it may have had oceans, when solar luminosity was less than today, some astrobiologists believe.

Today, scorched, bone-dry and barren, it is shrouded with thick, roiling clouds of carbon dioxide.

The findings could be useful for understanding exoplanets, or planets that orbit stars outside our Solar System, say the authors.

The hope is to locate a rocky planet in the Goldilocks zone, so if the zone is wider than thought, this boosts the statistical chances.

So far, astronomers have only discerned uninhabitable planets made of gas, or rocky planets that are so close to the Sun that any atmosphere they had will have probably been stripped away.

More information: Paper: dx.doi.org/10.1038/nature12827