



## PRESS RELEASE

Geneva | October 12<sup>th</sup>, 2021

**WARNING: embargoed until October 13<sup>th</sup>, 2021, 3pm GMT**

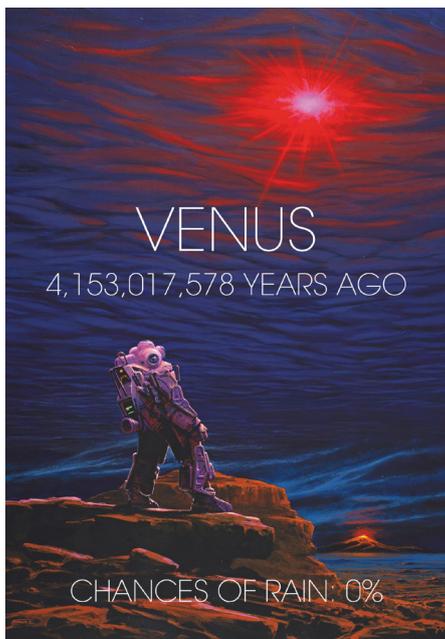
### Did Venus ever have oceans?

Astrophysicists led by the UNIGE and the NCCR PlanetS have investigated the past of Venus to find out whether Earth's sister planet once had oceans.

The planet Venus can be seen as the Earth's evil twin. At first sight, it is of comparable mass and size as our home planet, similarly consists mostly of rocky material, holds some water and has an atmosphere. Yet, a closer look reveals striking differences between them: Venus' thick CO<sub>2</sub> atmosphere, extreme surface temperature and pressure, and sulphuric acid clouds are indeed a stark contrast to the conditions needed for life on Earth. This may, however, have not always been the case. Previous studies have suggested that Venus may have been a much more hospitable place in the past, with its own liquid water oceans. A team of astrophysicists led by the University of Geneva (UNIGE) and the National Centre of Competence in Research (NCCR) PlanetS, Switzerland, investigated whether our planet's twin did indeed have milder periods. The results, published in the journal *Nature*, suggest that this is not the case.

Venus has recently become an important research topic for astrophysicists. ESA and NASA have decided this year to send no less than three space exploration missions over the next decade to the second closest planet to the Sun. One of the key questions these missions aim to answer is whether or not Venus ever hosted early oceans. Astrophysicists led by Martin Turbet, researcher at the Department of Astronomy of the Faculty of Science of the UNIGE and member of the NCCR PlanetS, have tried to answer this question with the tools available on Earth. "We simulated the climate of the Earth and Venus at the very beginning of their evolution, more than four billion years ago, when the surface of the planets was still molten", explains Martin Turbet. "The associated high temperatures meant that any water would have been present in the form of steam, as in a gigantic pressure cooker." Using sophisticated three-dimensional models of the atmosphere, similar to those scientists use to simulate the Earth's current climate and future evolution, the team studied how the atmospheres of the two planets would evolve over time and whether oceans could form in the process.

"Thanks to our simulations, we were able to show that the climatic conditions did not allow water vapour to condense in the atmosphere of Venus", says Martin Turbet. This means that the temperatures never got low enough for the water in its atmosphere to form raindrops that could fall on its surface. Instead, water remained as a gas in the atmosphere and oceans never formed. "One of the main reasons for this is the clouds that form preferentially on the night side of the planet. These clouds cause a very powerful greenhouse effect that prevented Venus from cooling as quickly as previously thought", continues the Geneva researcher.



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Artist's view of the surface and atmosphere of early Venus, more than 4 billion years ago. In the foreground is a mysterious explorer surprised to see the oceans completely vaporised in the sky.

**High resolution pictures**

## Small differences with serious consequences

Surprisingly, the astrophysicists' simulations also reveal that the Earth could easily have suffered the same fate as Venus. If the Earth had been just a little closer to the Sun, or if the Sun had shone as brightly in its 'youth' as it does nowadays, our home planet would look very different today. It is likely the relatively weak radiation of the young Sun that allowed the Earth to cool down enough to condense the water that forms our oceans. For Emeline Bolmont, professor at UNIGE, member of PlaneS and co-author of the study, "this is a complete reversal in the way we look at what has long been called the 'Faint Young Sun paradox'. It has always been considered as a major obstacle to the appearance of life on Earth!" The argument was that if the Sun's radiation was much weaker than today, it would have turned the Earth into a ball of ice hostile to life. "But it turns out that for the young, very hot Earth, this weak Sun may have in fact been an unhoped-for opportunity", continues the researcher.

"Our results are based on theoretical models and are an important building-block in answering the question of the history of Venus", says study co-author David Ehrenreich, professor in the Department of Astronomy at UNIGE and member of the NCCR PlanetS. "But we will not be able to rule on the matter definitively on our computers. The observations of the three future Venusian space missions will be essential to confirm – or refute – our work." These prospects delight Emeline Bolmont, for whom "these fascinating questions can be addressed by the new Centre for Life in the Universe, which has just been set up within the UNIGE's Faculty of Science."

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**DOI: [10.1038/s41586-021-03873-w](https://doi.org/10.1038/s41586-021-03873-w)**

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