Study reveals 'topsy turvy' ocean circulation on distant planets

April 4 2016

This artist's concept depicts a planetary system. Credit: NASA/JPL-Caltech

The salt levels of oceans on distant Earth-like planets could have a major effect on their climates - according to new research from the Centre for Ocean and Atmospheric Sciences at the University of East Anglia.

A study published today reveals that the circulation in extremely salty or

fresh water extra-terrestrial seas would influence their temperatures - and could in fact make for more habitable conditions for alien life.

Until recently, computer simulations of habitable climates on Earth-like planets have mainly focused on their atmospheres. But studying their oceans is vital for understanding climate stability and habitability - as on our own Earth.

Not only this, but until now, researchers had not considered that the seas on distant Earth-like planets might not be quite like ours - they might be significantly more or less salty than the oceans on Earth.

Prof David Stevens, from UEA's School of Mathematics, said: "The number of planets being discovered outside our solar system is rapidly increasing. Our research helps to answer whether or not these planets could sustain alien life.

"We think that many planets may be uninhabitable because they are either too close or too far from their sun. A planet's habitable zone is based on its distance from the sun and temperatures at which it is possible for the planet to have liquid water.

"Oceans play a vital role in sustaining life and also have an immense capacity to control climate. But previous studies on ocean circulation on other planets have made the assumption that fundamental ocean properties - such as the salinity and depth of water - would be similar to that on Earth.

"We wanted to find out what might be happening on other planets which might appear superficially similar to Earth, but where conditions such as salinity are radically different to our own planet."

The research team used computer models of ocean circulation on

exoplanets to see what would happen when their oceans had different salinity levels to Earth. They considered oceans with very low salinity (similar to freshwater), salinity similar to the average value of Earth's oceans, and high salinity (similar levels to the Dead Sea).

Dr Manoj Joshi, from UEA's School of Environmental Sciences, said: "On Earth, we have a circulation where warm water moves towards the poles at the surface, before being cooled, then sinking at high latitudes and travelling towards the equator at depth.

"Our research shows that oceans on other planets with a much higher salinity could circulate in the opposite direction - with polar water flowing towards the equator at the surface, sinking in the tropics and travelling back towards the poles at depth. We also found a similar pattern emerging for freshwater oceans.

"These circulation patterns are the opposite of what happens on Earth, and would result in a dramatic warming in the polar regions.

"Such a circulation scenario might extend the planet's range of habitability.

Jodie Cullum, from UEA's School of Mathematics, said: "Of course, on any given exoplanet, many other properties are likely to differ from their Earth-like values, some of which may also have a significant influence on ocean circulation - such as tidal forces, planetary rotation, ocean depth and the location of continents.

"But this is important work which will help us better-understand the habitability of distant planets in more accurate detail than ever before."

More information: Importance of ocean salinity for climate and habitability, *PNAS*, www.pnas.org/cgi/doi/10.1073/pnas.1522034113

Provided by University of East Anglia