How water forms where Earth-like planets are born

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(PhysOrg.com) -- In a study that helps to explain the origins of water on Earth, University of Michigan astronomers have found that water vapor can form spontaneously in habitable zones of solar systems, and that it develops into a protective layer that shields other water and organic molecules from harmful stellar radiation.

Organic molecules such as sugars and amino acids are the precursors to life.

The findings are published in the Dec. 18 edition of *Science*.

"When you're close to a star, the radiation is destructive to most molecules. But we were able to prove that water could form quickly enough to shield itself and other molecules from that radiation," said Ted Bergin, an associate professor in the Department of Astronomy.

Bergin and Thomas Bethell, a postdoctoral astronomy researcher, conducted a computational analysis to come to this conclusion.

They determined that the series of chemical reactions necessary for water vapor to be created are only activated at temperatures higher than 300 degrees Kelvin (which is about 80 degrees Fahrenheit.) These temperatures are only present relatively close to a star—in the areas where terrestrial planets such as Earth would form. Out farther, at Jupiter's distance, the gasses are too cold for water vapor to form.

Once the water vapor starts to form, the scientists found, it forms fast enough to build a shell similar to Earth's ozone layer, which acts like an umbrella to protect the life below it from solar radiation. Not only does this astronomical "ozone layer" of water vapor protect other water molecules behind it, it would also shelter organic molecules.

"There's a rich organic chemistry that precedes the birth of stars," Bergin said. "It's simpler, but similar to the chemistry of life. The behavior of water can allow that chemistry to proceed. Without the protection water vapor provides, those organic molecules would be destroyed."

Conceivably, some of this water and organic matter could be incorporated into nascent, Earth-like worlds.

The paper is called "Formation and Survival of Water Vapor in the Terrestrial Planet-Forming Region." This research is funded by NASA.

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