

Rain making bacteria

A team of American and French scientists has found [evidence](#) that rain-making bacteria are widely distributed in the atmosphere. The remarkable findings shed an entirely new light on how rain is formed. The biological particles they discovered could factor heavily into the precipitation cycle, affecting climate, agricultural productivity and even global warming. What is more, the research findings could potentially supply knowledge that could help reduce drought from America to Africa.

The team published their [results](#) in *Science* today.

Brent Christner, Louisiana State University (LSU) professor of biological sciences in partnership with David Sands, Montana State University (MSU) professor of plant sciences and plant pathology, and colleagues Christine Foreman (MSU) professor of land resources and environmental sciences, Rongman Cai (LSU) and Cindi Morris of the Institut Nationale de la Recherche Agronomique, examined precipitation from locations across the world to show that the most active ice nuclei are actually biological in origin.

Nuclei are the seeds around which ice is formed. Snow and most rain begins with the formation of ice in clouds. Dust and soot can also serve as ice nuclei. But biological ice nuclei are different from dust and soot nuclei because only these biological nuclei can cause freezing at warmer temperatures.

Biological precipitation, or the 'bio-precipitation' cycle, is basically is this: bacteria form little groups on the surface of plants. Wind then sweeps the bacteria into the atmosphere, and ice crystals form around them. Water clumps on to the crystals, making them bigger and bigger (picture, [click to enlarge](#)). The ice crystals turn into rain and fall to the ground. When precipitation occurs, then, the bacteria have the opportunity to make it back down to the ground. If even one bacterium lands on a plant, it can multiply and form groups, thus causing the cycle to repeat itself.

The team's work is far-reaching. Professor Sands and his colleagues have found the bacteria all over the world, including Montana, California, the eastern U.S., Australia, South Africa, Morocco, France and Russia.

The role that biological particles play in atmospheric processes has been largely overlooked. However, we have found biological ice nuclei in precipitation samples from Antarctica to Louisiana - they're ubiquitous. Our results provide an impetus for atmospheric scientists to start thinking about the role

these particles play in precipitation. This work is truly multi-disciplinary, bridging the disciplines of ecology, microbiology, plant pathology and climatology. It represents a completely new avenue of research and clearly demonstrates that we are just beginning to understand the intricate interplay between the planet's climate and biosphere. - Brent Christner, LSU professor of biological sciences

The team's research shows that most known ice-nucleating bacteria are associated with plants and some are capable of causing disease.

Bacteria have probably been around for a million years. They live on the surface of plants, and may occasionally cause plant disease. But their role in rain-making may be more important. - David Sands,

MSU professor of plant sciences and plant pathology

Indeed, the implications of a relationship between rain and bacteria could be enormous, though they are yet to be proven, Sands said. For example, a reduced amount of bacteria on crops could affect the climate. Because of the bio-precipitation cycle, overgrazing in a dry year could actually decrease rainfall, which could then make the next year even drier. Drought could be less of a problem once we understand all of this:

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Professor Sands (pictured), who earned a doctorate in pathology and bacteriology from the University of California Berkeley, proposed the concept of bio-precipitation approximately 25 years ago, but few people believed him.

Since that time, he said, better tools have changed the research climate, because new DNA technology allows researchers to distinguish the bacteria, and giant computers allow people to do meteorological studies with satellites. Time and technology proved him right and the concept of 'bio-precipitation' is now a reality.

More studies must be done, though, because questions remain. For example, since the bacteria do not grow above 84 degrees, precipitation could be affected if the world's weather creeps up and reaches a cut-off point. The researchers are also examining the bacteria to find out if they vary by region.

A diverse group of people should be interested in the research, because bio-precipitation could affect many things, from agriculture and water availability to local climate and even global warming.

Top picture: Cells of ice nucleating bacteria (green dots) entrapped in ice crystals. *Credit:* Brent Christner.

References:

Brent C. Christner, Cindy E. Morris, Christine M. Foreman, Rongman Cai, David C. Sands, "[Ubiquity of Biological Ice Nucleators in Snowfall](#)", *Science* 29 February 2008: Vol. 319. no. 5867, p. 1214, DOI: 10.1126/science.1149757