

# NASA Finds Polluted Clouds Hold Less Moisture & Cool Earth Less

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A NASA study found some clouds that form on tiny haze particles are not cooling the Earth as much as previously thought. These findings have implications for the ability to predict changes in climate.

Andrew Ackerman, a scientist at NASA's Ames Research Center, Moffett Field, Calif., and his colleagues found, when the air over clouds is dry, polluted clouds hold less water and reflect less solar energy. Ackerman is the study's principal author.

Contrary to expectations, scientists observed polluted, low-lying clouds do not generally hold more water than cleaner clouds. Low clouds cool the planet by reflecting sunlight away from the Earth's surface, and more water makes a cloud more reflective.

Previously, scientific consensus was, since polluted clouds precipitate less, they should contain more water and reflect more sunlight back into space. Most predictions of global climate change assume less precipitation will result in clouds holding more water, reflecting more sunlight and counteracting greenhouse warming.

"The natural laboratory we used to look at the contrasts between clean and polluted clouds is a phenomenon called ship tracks, which are long lines of clouds with smaller cloud droplets that form on the exhaust particles from ships," Ackerman said.

"The results of this work should provide for more realistic treatment of polluted clouds in climate models, improving predictions of future climate," Ackerman said. "In the meantime, it's critical that we thoroughly test these new theoretical results. NASA's latest generation of Earth-observing satellites provides a powerful tool for doing just that, by observing how ship tracks are affected by the humidity of the air above them," he said.

Ship track measurements were taken off the west coast of the United States from polar-orbiting satellites and aircraft flying through the clouds. The Moderate Resolution Imaging Spectroradiometer (MODIS) Airborne Simulator instrument (comparable to the MODIS instruments on NASA's Terra and Aqua satellites), aboard a NASA ER-2 aircraft flying above the clouds, was also used to gather data. The measurements show cloud water decreases more often than it increases in polluted clouds.

To understand how cloud water changes in polluted clouds, the team of scientists created a 3-D computer model to simulate atmospheric motions and the formation of precipitation by clouds. They tested their model by comparing its predictions with measurements from field projects devoted to characterizing marine stratocumulus clouds.

After verifying the model reproduced the behavior of real clouds, the scientists asked their computer model how pollution affects clouds. In agreement with previous work, their computer simulations showed, when air over a cloud is humid, cloud water increases in polluted clouds. However, when air over a stratocumulus cloud deck is dry, surprisingly, water decreased in polluted clouds, consistent with the behavior observed in ship tracks.

Ackerman's co-investigators included Michael Kirkpatrick, University of Tasmania, Hobart, Australia; David Stevens, Lawrence Livermore National Laboratory, Livermore, Calif.; and O. Brian Toon, University of Colorado, Boulder. The researchers' findings appear in today's issue of the journal *Nature*.

Source: NASA

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