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New NASA Theory May Help Improve Weather Predictions

ScienceDaily (Nov. 27, 2002) — Less precipitation and more lightning eventually may be forecast as a result of a NASA study that shows that cloud droplets freeze from the outside inward instead of the opposite.

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The new theory of how super-cooled water droplets in clouds freeze, which appears in this week's on-line edition of the Proceedings of the National Academy of Sciences, reverses a 60-year-old assumption.

"Our initial thoughts are that as a result of our theory, researchers may well predict less precipitation and more lightning, but scientists need to do more research to determine how long-range climate predictions could change," said Azadeh Tabazadeh, lead author of the paper and a scientist at NASA's Ames Research Center, located in California's Silicon Valley. Her co-authors are Yuri Djikaev, also of NASA Ames, and Howard Reiss from the University of California, Los Angeles.

"We are seeing many more particles in the atmosphere in recent years," Tabazadeh said. "When the air becomes humid, these tiny particles transform into super-cooled water, and the droplets freeze into ice at a faster rate." Super-cooled water exists as a liquid below freezing at temperatures as low as minus 40 degrees Celsius (minus 40 degrees Fahrenheit) . "Because the number of small particles is increasing in the atmosphere, there is a greater surface area that can trigger tiny droplets to freeze," Tabazadeh said. "This greater surface area in the atmosphere makes us think that there could be more lightning and less precipitation." Scientists know that when lightning occurs, liquid water can turn into ice, depending upon temperature.

"If ice begins to form on the surfaces of very small water droplets, they will quickly freeze and may remain floating in the air," she said. "On the other hand, larger drops have a smaller surface area than the same volume of a fine mist, and the big drops will freeze at a slower rate."

Freezing rates of super-cooled water vary by as much as 100,000 times, according to the authors. The presence or absence of tiny amounts of acid or organic impurities in water droplets may help to explain these big differences in freezing rates and may relate to why water fog can exist at extremely low temperatures, Tabazadeh said.

"For almost 200 years, persistent liquid fogs have been observed at temperatures well below the frost point, and there has been a continued, vigorous interest in understanding why," she said. Emissions into the atmosphere "can eventually condense either on preexisting particles" or change from gases into particles in the atmosphere, Tabazadeh said. The increased presence of human-derived aerosol particles in Earth's air can change the rate of ice formation in the atmosphere, she explained.

"Such processes affect the Earth's climate and chemistry, and therefore it is important to understand the basic physical process by which atmospheric particles change their phase," she said. The phase of a substance can be gas, liquid or solid.

Publication-size images are available at:

http://amesnews.arc.nasa.gov/releases/2002/02images/cloudsAZA/cloudsAZA.html

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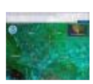

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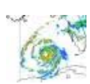

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