Science Video

Mysteries of Thunderstorms
Atmospheric Scientists Link Lightning to Ice Particles In Clouds

October 1, 2006 — Satellite imaging is now helping atmospheric scientists link the amount of charged ice in clouds to lightning activity. Ice particles in thunderstorms can help increase precipitation, the scientists found. Different-sized ice particles within a cloud also carry a positive or negative charge, and as the particles collide, that charge builds up, leading to lightning.

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HUNTSVILLE, Ala. -- There's no mistaking the billowing clouds, the noise, the rain, and the lightning of a thunderstorm. But why do some dark and ominous clouds form into huge masses of rain and lightning while others just pass us by?

We'll likely see a big storm roll-in on warm days, but you might be surprised to learn thunderstorms are also filled with ice!

"Ice plays a big role in the amount of rain that you see," says Walter Petersen, an atmospheric scientist at University of Alabama, Huntsville.

He says ice in clouds is the key to really big electrical storms. Ice creates lightning and often heavy rain.

"A fair amount of rain that you see over continents actually is the result of melting ice that's created high up in the, high up in the development of thunderstorms," Petersen says.

Ice is vital to the development of lightning. Different-sized ice particles within a cloud carry a positive or negative charge. As the particles collide, that charge builds up. When the charge is released -- we see lightning.

Satellites watch lightning flashes from space, helping scientists to learn more about them.

"We know how much ice is associated with a given number of lightning flashes," Dr. Petersen says. "Then we can say something about the amount of rain that falls out of those clouds." Knowing the rain that falls was once ice above you -- a heads up about what's really inside a thunderstorm.

BACKGROUND: Most people know that thunderstorms tend to form on warm days, but new satellite observations indicate that in order for lightning to form, thunderstorm clouds need to have a high content of ice.

THE RESEARCH: Walter Petersen, a meteorologist at the University of Alabama, Huntsville, analyzed observations of lightning and precipitation from 1998 to 2000 taken from the Tropical Rainfall Measuring Mission (TRIMM), launched in 1997. The relationship between the number of lightning strikes and how much ice crystals are present in clouds is the same regardless of different atmospheric environments over oceans, coasts, and continents. The relationship between rain and lightning, in comparison, does not show this same level of consistency. The results support previous assumptions about the basic physics of lightning and ice. As a result, the density of lightning in a storm could be used in the future to predict the amount of ice that is present.

HOW STORMS DEVELOP: Storm clouds form as moisture evaporates from the earth into the atmosphere, where the droplets jostle against each other. The air cools off rapidly with as it reaches higher altitude. Sometimes a cold front – the boundary between where the cold air from one thunderstorm meets the air outside the storm for example – will force the moist air upward into the colder air. This moist air cools off and the water vapor "condenses" into liquid drops, forming clouds. The process continues: more and more water vapor turns into liquid, and the moist air warms up even more and rises higher and higher. A thunderstorm results.

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positively charged. Eventually the growing negative charge becomes so intense that electrons on the Earth's surface are repelled and burrow deeper into the Earth. The Earth's surface becomes positively charged, and hence very attractive to the negative charge accumulating in the bottom of the cloud. All that is needed is a conductive path between cloud and Earth, in the form of ionized air.

The American Meteorological Society contributed to the information contained in the TV portion of this report.