




# Dust Begets Dust



Marshall Space  
Flight Center

**Everyone knows that dry weather leads to dusty soils, but new research suggests that dust might in turn lead to dry weather.**

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**May 22, 2001** -- Windblown desert dust can choke rain clouds, cutting badly needed rainfall. This new discovery made with the help of NASA satellites suggests that droughts over arid regions, such as central Africa, are made even worse by land management practices that expose new dust and accelerate the growth of deserts.

In other words: Dust begets dust!



These findings, reported in the [Proceedings of the National Academy of Sciences](#), present a new view of the decades-long drought in the African Sahel, a semi-arid region of Africa adjacent to the Sahara Desert. The grassy savannas of the Sahel once provided natural pasture land for livestock, but increasing demands on the land due to population growth have led to desertification, which has been accompanied by increasing levels of airborne dust during the rainy season.

**Above:** Dust and other particles in the air cause water droplets in clouds to be smaller, leading to decreased rain. In this illustration, the cloud on the right is over a forest fire, which releases tiny airborne particles (called "aerosols") in its smoke. Click on the image for an [animation](#) illustrating the principle.

More airborne dust is not necessarily a result of decreased rainfall but rather its cause, according to scientists from Israel's Hebrew University and the Weizmann Institute. "This impact of desert dust on rainfall was not known before," says lead author Daniel Rosenfeld, Hebrew University, Jerusalem. Furthermore, it was the opposite of what scientists expected.



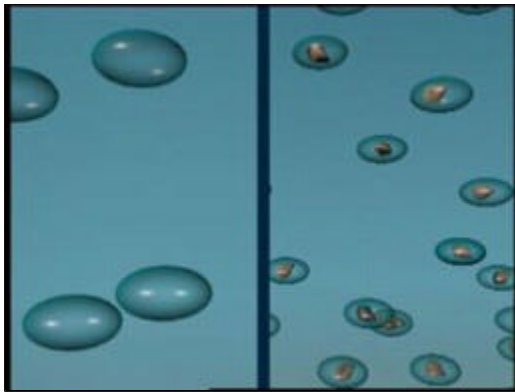
Before Rosenfeld *et al.*'s research, many scientists thought that large airborne dust particles would speed the formation of rain by forming giant cloud condensation nuclei and larger cloud droplets.

Not so.

"Our laboratory analysis of the desert dust showed that [dust] particles contained very little water-absorbing matter," says co-author Yinon Rudich of the Weizmann Institute. "As a result, even large dust particles form relatively small cloud droplets."

The research shows dust actually amplifies the process of creating deserts. Activities that

expose and disrupt topsoil, such as grazing and agricultural cultivation, can increase the amount of dust blown into the air. More dust reaching rain clouds produces less rainfall, which exacerbates the drought conditions and contributes to the desertification of the landscape. In desert regions, dust storms can often kick up clouds of dust that blanket thousands of square miles of land, dramatically illustrated by the [record-setting dust cloud](#) that blew from Asia to North America last month.



**Left:** Water droplets that form around dust grains and other aerosols, like those on the right, tend to be smaller than droplets that don't. The size of the water droplets in a cloud determines whether gravity will dominate over the tendency of the air molecules to keep the droplets suspended.

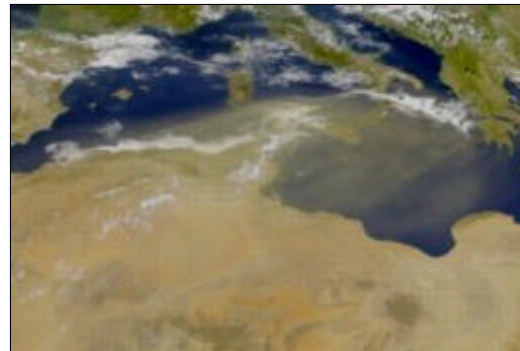
Dust and other types of [aerosol](#) particles blowing into clouds act as nuclei where water vapor can condense to form cloud droplets. If a lot of dust enters a cloud, the available water is spread over many small droplets. These small droplets grow more slowly through collisions with one another to the size of a raindrop, and the cloud yields less rainfall over the course of its lifetime.

What the researchers saw in two separate cases, using different satellite observations, was that cloud droplets were smaller as dust concentrations increased.

NASA's Tropical Rainfall Measuring Mission ([TRMM](#)) spacecraft captured images of clouds over the Atlantic Ocean off the coast of northern Africa during a major March 2000 dust storm. Droplet sizes steadily increased the farther the clouds were from dust-filled air. Rain was falling only from the dust-free clouds even though all the clouds contained equal amounts of water.

The researchers also observed similar behavior in clouds over the eastern Mediterranean Sea in March 1998, using data from aircraft and a U.S. weather satellite.

**Right:** By using TRMM to observe dust storms such as the one depicted in this SeaWiFS image, scientists noticed that the dust appeared to inhibit precipitation. Credit: the [SeaWiFS Project](#) and [ORBIMAGE](#)



Rosenfeld has used TRMM observations in two other recent studies to show that aerosols from biomass-burning smoke and urban air pollution also reduce rainfall. Combined with the negative impact of desert dust, Rosenfeld believes the aerosol rainfall-suppression effect can have a major impact on regional and global climate.

"The recent observations of the impact on precipitation of all kinds of aerosols, each with a major human contribution, show a major climate change issue that has nothing to do with greenhouse gases," says Rosenfeld. "Still, this is perhaps the climate-change effect with the greatest socio-economic impact on water-scarce areas."

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*TRMM is a joint U.S.-Japanese mission and part of NASA's Earth Science Enterprise, a long-term research program designed to study the Earth's land, oceans, air, ice and life as a total system. Each day, the TRMM spacecraft observes the Earth's equatorial and tropical regions, including the southernmost United States and all of Africa.*

*All SeaWiFS images and data presented or referred to in this website are for research and educational use only. All commercial use of SeaWiFS data must be coordinated with ORBIMAGE (<http://www.orbimage.com/>).*

### Web Links

[The Pacific Dust Express](#) -- *Science@NASA* article: North America has been sprinkled with a dash of Asia! A dust cloud from China crossed the Pacific Ocean recently and rained Asian dust from Alaska to Florida. Scientists think that air pollution also travels on this "Pacific Express."

[Tropical Rainfall Measuring Mission](#) -- more information on the TRMM satellite

[Proceedings of the National Academy of Sciences](#) -- the publication in which Rosenfeld's paper appears

[Desert Dust, Dust Storms, and Climate](#) -- an explanatory website from NASA's Goddard Institute for Space Studies

[Introduction to Aerosol](#) -- general information about aerosols, including sources of aerosols, chemical composition, and influences of aerosols on the environment and human health

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