

FRONT & CENTER

edited by Lynn Elsey
and Andrea Klee

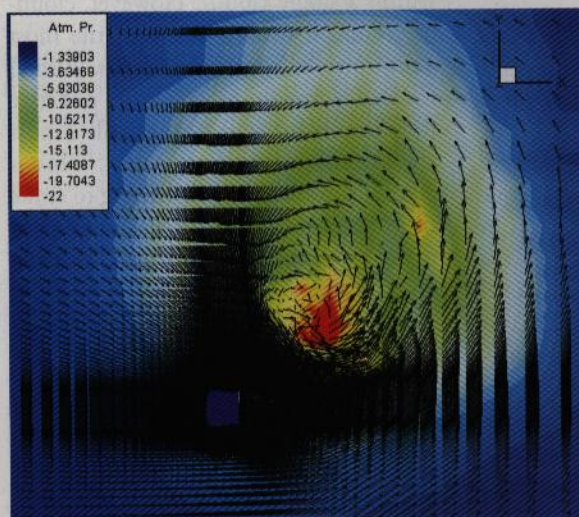
Predicting the Unpredictable

Researchers at the University of Arkansas have developed a three-dimensional model that may help alleviate the damaging impact of tornadoes on buildings and help predict the direction of their destructive paths.

Panneer Selvam, a wind engineer and professor of civil engineering, has been studying the wind structure of tornadoes for more than 20 years. Selvam and graduate student Paul Millett recently developed and tested a model that simulates the interaction between a tornado and a building.

Selvam and Millett's results were presented at the 10th International Conference on Wind Engineering in Lubbock, Texas. Previous research assumed that tornadic winds were straight-line winds that remained constant, when, in reality, they change. According to Selvam and Millett, the complexity of tornado systems, characterized by rapidly changing wind speed and direction, has made previous tornado-wind studies difficult. "The amount of research aimed at determining exactly how tornadoes affect buildings has been incredibly meager over the past few decades," they said. "Since the tornado changes its wind speed and direction rapidly, it is difficult to study the effects of a tornado on a building in a wind tunnel." Selvam and Millett's model, using a large-eddy simulation turbulence model in a three-dimensional environment, allows investigation of the wind characteristics, from any angle, at any instance in time.

The model acknowledges the high turbulence and viscosity found in tornadic winds and also indicates interactions with structures encountered along a tornado's path. The model shows that this structural interaction can change



A model of the interaction of tornadic wind (45-degree approach) and a cubic building

the course, and force, of the tornado. According to Selvam, documenting this interaction needs to take into account a variety of factors, including details of the tornado wind speed and turbulence from the ground up to 100 meters. The model indicates that a tornado can exert an upward force that is 10 times stronger than the force of gravity on a building. Also, "a tornado produces higher overall forces on the walls (45 percent more) and roof (100 percent more) of a building than quasi-steady wind," according to the researchers. "In addition, these forces change magnitude and direction quickly when the tornado core is near the building."

Although Selvam and Millett's model was designed to explore tornado-resistant building design, the results also may provide new information on tornado movement.

"When we set up the tornado to move directly toward a building, we were surprised to find that the vortex of winds around the building actually caused the tornado to veer to the side of the structure," Selvam said. "Because it is a 3-D model, we can change the height and

shape of the building. Although we are primarily interested in exploring the tornado's impact on buildings, we can also see that the building has an impact on the tornado's path."

Weather Spawns Witch Killings

Finding a link between weather, the economy, and witch killings in Tanzania was an unforeseen outcome for Edward Miguel,

an assistant professor at the University of California, Berkeley. Miguel's research on political and economic development in Third World nations led to this surprising conclusion.

He discovered that extreme weather—periods of either drought or heavy rain—which lowers crop yields in villages in rural Tanzania, prompts relatives to kill the elderly women in their families. The women are branded as witches and murdered—typically with machetes.

According to Miguel's study, during years of inclement weather, crops yield less of a harvest or can fail altogether.

"...In this part of the world, the main source of economic shocks is the weather: The vast majority of residents rely on rain-fed agriculture for their income, and bad weather spells hunger and disaster for poor households," Miguel said.

Bad weather leads to economic shortages and, when coupled with large families, strains the families' meager resources. "In years of extreme rainfall, crops are likely to fail, in which case there may not be sufficient household income to sustain all household members," Miguel said.

Elderly village women generally do not or cannot assist with the harvest, so they are viewed as expendable. "The patriarch chooses the individual with the lowest future production to be reduced to zero consumption, and concentrates all resources on survivors," Miguel said. "Reducing someone to zero consumption can be thought of literally starving them to death, driving them out of the household and community, or murder."

Villagers feel a need to create justification for the killings; therefore, the elderly women are accused of witchcraft and murdered.

To test his theory, Miguel studied local rainfall variations in 70 Tanzanian villages in the Meatu region from 1992 to 2002. He found that in years when the rainfall is extremely high or low and crops fail, twice as many witch killings occur compared with normal rainfall years.

"These extreme rainfall years (drought or flood) occur about once every five years or so," he said. "In an extreme rainfall year, the number of witch killings roughly doubles—a truly huge effect."

Unlike other societies where all crime increases when the economy sours, in rural Tanzania, "the type of crime that increases in these bad rainfall years is crime that eliminates 'less productive' household members," Miguel said. "There is no overall jump in random violence in these years."

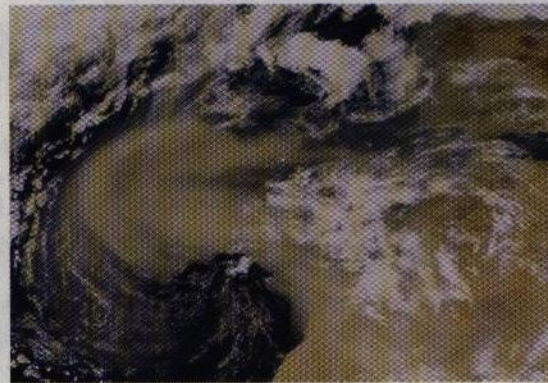
For more information or to read Miguel's complete report, visit <<http://emlab.berkeley.edu/users/emiguel/index.shtml>>.

Out of Africa

Does African dust have transatlantic powers? Research by Natalie Mahowald and Lisa Kiehl indicates that dust particles from North Africa are interacting with clouds and altering patterns of rainfall as far away as Barbados. According to the researchers, these particles, called mineral aerosols, interact with clouds over a broad area, from Africa across the Atlantic.

Mahowald, a scientist at the National Center for Atmospheric Research (NCAR) and the University of California Santa Barbara (UCSB), and Kiehl, a

graduate student at UCSB, studied 16 years of data from NASA satellites, ground measurements, and computer models. They discovered a positive correlation between low-altitude clouds (such as cumulus and stratocumulus) and the dust along the North African coast. Their study confirms earlier observations that the mineral aerosols provide surfaces, or kernels, that precipitate water vapor or ice-crystal formation. In low clouds near the Sahara Desert, water attaches to the particles of dust. A high concentration of dust causes the water to disperse among the particles, preventing the drops from becoming heavy enough to fall. The result is an increase in thin, low clouds and a decrease in rain. Mahowald and Kiehl's study supports the theory that dust particles create sites for the formation of water drops in the thin, low clouds.

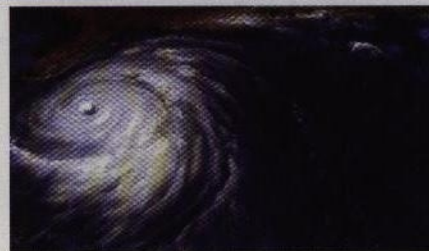


Saharan dust cloud leaving Africa's west coast

North African dust has blown, in increasing amounts, into the atmosphere since the 1960s, which some scientists attribute to human activity. Mahowald and Kiehl believe that the interaction between the mineral aerosols and clouds is a necessary element in understanding climate change, since clouds are involved in reflecting and absorbing rays from the sun as well as affecting the Earth's radiation.

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