Satellite view of cloud tops might warn of storms brewing

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For three years a new way to use data collected by NOAA weather satellites has been giving North Alabama short-term warnings of "pop-up" thunderstorms.

Developed by scientists at The University of Alabama in Huntsville, this new computer program is now spreading to other parts of the U.S. and the world: Later this summer a version of the UAHuntsville weather program will begin forecasting storms throughout Central America, Southern Mexico and the Dominican Republic.

The UAHuntsville Satellite Convection AnalySis & Tracking System (SATCASTS) monitors cumulus clouds as they develop, move and grow through time, according to the person who brainstormed the idea behind the program, Dr. John Mecikalski, an assistant professor of atmospheric science at UAHuntsville.

The program uses data from NOAA's GOES weather satellites to provide 15-minute to one hour warnings of local thunderstorms. This is the first time forecasters anywhere have had a tool to forecast storms that develop locally. This differs from Doppler radar, which only tracks rain after it starts to fall.

"The radar tells you what's happening, but not what's going to happen," said Wayne MacKenzie, a research associate in UAHuntsville's Earth System Science Center and a member of the SATCASTS development team.

Operated by UAHuntsville scientists for the National Weather Service forecast office in Huntsville for about three years, SATCASTS has been accurate in its storm forecasts between 65 and 75 percent of the time. It has successfully identified hazards generated by thunderstorms, including lightning, hail, high wind, flash floods and turbulence.

Mecikalski got the idea for SATCASTS in 2001, when he was affiliated with NOAA's Cooperative Institute for Meteorological Studies. He was looking for a way to determine which of the thousands of cumulus clouds present on any given summer afternoon will become thunderstorms. (One percent or less of clouds develop into rain clouds.) He has continued his research since joining the faculty at UAHuntsville in January 2004.

Using data from the GOES visible and infrared sensors, SATCASTS tracks changes in both cloud temperature (height) and water vapor. This data is updated every 15 minutes.

The UAHuntsville team has determined that one of the most important factors in predicting thunderstorms is temperature change. If the top of a cloud cools by 4 C (about 7.2 degrees Fahrenheit) or more in 15 minutes, that means the cloud is growing quickly and there is a growing probability of rain beginning within 30 minutes to an hour. A 4 C drop in temperature typically means a cloud top has climbed between 1/4 to 1/3 of a kilometer.

Based on its success in the Huntsville forecast office, scientists at UAHuntsville are working with the National Weather Service to transition SATCASTS into the storm prediction systems in forecast offices in Birmingham, AL, and Nashville, TN, as well as both Melbourne and Miami, FL.

The UAHuntsville team is also working with NASA and the Federal

Aviation Administration (FAA) to test SATCASTS' possible utility in aviation and air traffic control. The system is being tested at the FAA's New York City air traffic control center. If successful, SATCASTS might be used worldwide to warn pilots of storms, turbulence and other weather threats before they occur.

Other organizations evaluating the operational implementation of the SATCASTS algorithm include the European Meteorological Satellite agency and the South African Weather Service. Discussions are also underway to bring SATCASTS capabilities to East Africa.

While SATCASTS joins a sophisticated and extensive network of weather monitoring systems in the U.S., it is expected to have special value in regions where storm forecasting and monitoring have been limited or non-existent. The system is relatively inexpensive to install and operate, since it uses freely distributed weather data from existing satellite sensors.

NOAA-funded research at UAHuntsville will focus on expanding SATCASTS' capabilities. In areas where Doppler radar networks do not exist, SATCASTS might be used in the future to track frontal storm systems and provide severe weather warnings that are not presently available, Mecikalski said.

"This makes SATCASTS and satellite-based rainfall predictions very relevant in many developing countries, when ground-based radar is absent but high quality satellite data are in place."

The UAHuntsville SATCASTS team includes Mecikalski, two other scientists and three graduate students. The project has been supported by more than $1 million in funding from NOAA, NASA and the FAA.

Research on improving SATCASTS is ongoing and is expected to

continue for at least five years. New areas of research include 30-to-90-minute lightning and flash flood forecasts.

The UAHuntsville team is also working on a next generation SATCASTS, which will take advantage of the improved sensing systems that will be available when NOAA launches it GOES-R series of satellites beginning in 2016. Sensors on those satellites will collect data in more channels, more often and at higher resolution.

Source: University of Alabama in Huntsville