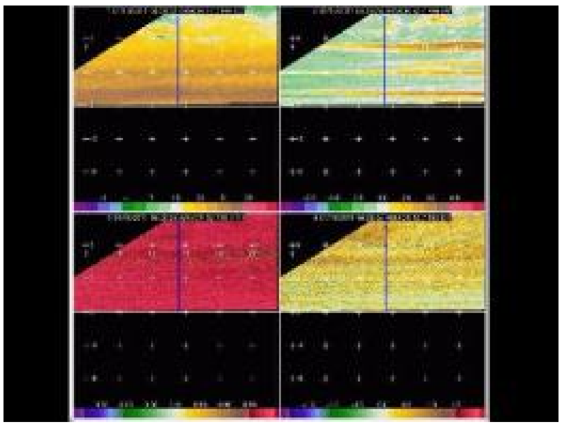
Researchers get close view of winter storm

January 31 2011, By Daniel Horton



These images show four ARMOR radar vertical cross-sections through the snowstorm that blanketed Huntsville, Ala., on Jan. 10, 2011. They were taken at 10:28 p.m. CST over the NASA/University of Alabama in Huntsville science center.

(PhysOrg.com) -- Who would have guessed that the perfect place to gather detailed scientific data from a powerful snowstorm would be in Alabama?

That turned out to be the case recently, however, as scientists at The University of Alabama in Huntsville and NASA's Earth Sciences Office used a network of mobile and on-site instruments -- many designed to study severe thunderstorms -- to get some of the most detailed measurements ever taken of a major snow storm in action.

Another group of UAH scientists working with NASA recently collected data about snowstorms in Finland.

"This was much more economical and efficient," said Dr. Kevin Knupp, a professor of atmospheric science and the director of UAHuntsville's severe weather research. "We have all these instruments around here and we can deploy them at a moment's notice. We have the luxury of grabbing data on significant weather systems as they go through."

To help grab data on the Jan. 9-10 storm, the research team used university and NASA instruments at Cramer Research Hall, two lightning detector networks, an advanced dual polarization Doppler radar at Huntsville International Airport, and the National Weather Service Doppler radar at Hytop in Jackson County. Knupp also sent the university's mobile dual polarization Doppler radar unit to set up outside of New Market in northeastern Madison County.

"We are studying the storm's 'comma,' the area of small scale waves or instabilities near the end of a storm system," said Ryan Wade, a student in UAHuntsville's atmospheric science Ph.D. program, as he helped set up the radar in New Market. "Those instabilities can dump large amounts of snow over small areas. That's why you might have a storm that drops four inches of snow across a hundred miles, but eight inches in one place and a dusting in another.

What causes these waves isn't well studied or understood. This is a unique opportunity to study the comma part of this storm."

Learning more about what happens in the comma of a snowstorm was the plan. Then the storm got ... interesting.

The interesting things included thundersnow -- with one lightning flash stretching about 50 miles from the top of Monte Sano to just south of Moulton -- and almost a dozen gravity waves rippling westward from the top of Monte Sano, apparently triggering some of the heaviest snowfall in North Alabama records.

Lightning detection networks set up by NASA and UAHuntsville scientists detected seven lightning flashes during the snowstorm, including four that hit a broadcast tower on Monte Sano. The 50-mile-long flash hit just after 10:30 p.m., and included four cloud-to-ground strikes: Normal lightning detectors would have seen that single lightning bolt as four separate events.

Lightning occurs in snowstorms only under special conditions, which include the presence of updrafts. Ice particles carried aloft on these updrafts bump against each other, swapping electrons and building an electric charge.

But sustained updrafts are uncommon in snowstorms. That's where the gravity waves come in. A gravity wave is simply a wave in the atmosphere similar to waves in the water. Air is pushed up the front of the wave and falls down the back. These waves can start in a number of ways, such as a violent updraft in a thunderstorm or a sudden change in the jet stream.

Knupp says the 11 gravity waves that rippled across Huntsville and western Madison County and into eastern Limestone County the night of January 9 were caused by wind blowing out of the east bumping into and being pushed over Monte Sano after atmospheric conditions got right.

"The storm had almost continuous gravity waves, especially at the start. The first was about 9 p.m., just before the snow started," Knupp said, stopping to think. "That's interesting, too ... they started around the time the snow started. That might make sense."

In addition to providing the updrafts needed to trigger lightning, the

waves also cause rapid cooling in clouds as ice and supercooled water in them are pushed upward. This might trigger heavy precipitation: One gravity wave went over minutes before a National Weather Service employee reported that one inch of snow fell in only 20 minutes.
The research team also found evidence of the storm waves they were looking for in the first place. "There were wave-like motions going on in different directions at different scales," said Knupp. "There were bands of snow coming from the southwest.

"At one point, between 9 a.m. and midnight, the Huntsville airport reported four inches of snowfall in one hour. That might happen in the Midwest, but not often. It will be very rare down here. I won't be surprised if that was caused by the interaction of one of these bands with a gravity wave."

Of course, one of the challenges with having a few dozen instruments gathering data on a weather event is finding resources to analyze the vast amount of data that is collected. For instance, one UAH radar unit operating on campus was pointed straight up so it could get a vertical profile of the passing storm's structure six times a second.

"We can't analyze everything. There's just too much," Knupp said. "It's frustrating but also good."

Provided by University of Alabama in Huntsville

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