Geerts hopes to answer mysteries of cloud seeding through supercomputing model

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Bart Geerts, a UW professor of atmospheric science, plans to use the supercomputer in Cheyenne to better understand cloud seeding. He's particularly interested in determining how much snowfall is created due to the artificial inducement as well as figure out the best locations to use cloud seeding.

Bart Geerts likes to chase storms high in the mountains. And, oftentimes, he helps contribute to them.

Geerts, a University of Wyoming professor of atmospheric science , studies cloud seeding and how different nuclei can affect and enhance snowfall.

During cloud seeding, a form of artificial weather modification, silver iodide is released into the clouds through generators that have been strategically placed upwind of the ridges of the Medicine Bow and Sierra Madre mountains in southern Wyoming. The silver iodide facilitates ice crystal formation in super-cooled water clouds.

During snowstorms, Geerts says it has been difficult to assess how much snowfall happens naturally and how much is artificially induced. Geerts uses Wyoming Cloud Radar and the UW King Air aircraft as tools to help him. But he needs more.

Geerts hopes that his use of the NCAR-Wyoming Supercomputing Center (NWSC) will provide snowfall models that are as detailed or more so than those currently captured on radar -- and perhaps answer the following questions: "When measuring snowfall, what amount is natural snowfall, and what is artificially induced through cloud seeding?" and "Where are the most effective regions to use cloud seeding?"

"We do not have a good understanding of the effectiveness of cloud seeding," Geerts says. "We don't yet know which clouds can be most effectively seeded. Through testing and observation, we can test the efficiency for seeding clouds in order to enhance snowfall."

Geerts uses lidar and radar to collect precipitation data. Lidar, an acronym for light detection and ranging, is an optic remote sensing technology that can detect and measure cloud droplets in the atmosphere. Snow is detected by radar.

From the aircraft, Geerts observes the effects of ground-based seeding. At the silver iodide generators located on the mountain ridges, propane burns a stick of silver iodide, which then releases the iodide crystals into the air. The radar and lidar map out the precipitation and clouds along the flight track in very fine detail, at a pixel resolution of about 100 feet.

"With the supercomputer, we want to simulate the airflow and cloud down to the same resolution, about 100 feet. We want to see if the model can reproduce what our radar sees," Geerts says. "In radar and the models, we want to see what cloud seeding really does."

Still, Geerts notes radar observations are limited in time and space. Radar observations are limited in time due to the high cost of operating a research aircraft for four hours. Because "the radar only captures transects of weather" below the flight level of the aircraft, very limited data are recorded and are not continuous in time or space, he says.

But Geerts notes a computer model can run for the entire duration of a flight, in three dimensions.

"It provides very rich data," he says.

In his research, Geerts has been trying to represent unresolved features in cloud seeding with parameterization, which is essentially trying to explain some effect you can't resolve.

"You know it's happening, but you can't see it. Modeling is intended to resolve these processes," he says. "These nuclei are microscopic to begin with. The airflow over mountains is very complex. That's why you really need high resolution. You can only get that through supercomputing."

Due to water shortages and droughts in some states and in countries around the world, cloud seeding is seen as a potential way to increase water supplies for communities and to irrigate crops. Cloud seeding is typically paid for by water resource managers, power companies (hydropower) and agricultural interests.

"Water is almost as important as oil is in the western United States. Water is quite a valuable commodity," Geerts says.

Geerts, who teaches courses on weather analysis and forecasting, as well as an introduction to meteorology at UW, says he has always been fascinated by the weather.

The NWSC is the result of a partnership among the National Center for Atmospheric Research (NCAR); the University of Wyoming; the state of Wyoming; Cheyenne LEADS; the Wyoming Business Council; Cheyenne Light, Fuel and Power; and the University Corporation for Atmospheric Research. NCAR is sponsored by the National Science Foundation (NSF).

The NWSC will contain some of the world's most powerful supercomputers (1.6 petaflops, which is equal to 1.6 quadrillion computer operations per second) dedicated to improving scientific understanding of climate change, severe weather, air quality and other vital atmospheric science and geo-science topics. The center also will house a premier data storage (11 petabytes) and archival facility that holds irreplaceable historical climate records and other information.

Provided by University of Wyoming

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