

NASA aims to measure vital snow data from satellites

February 21 2017, by Dan Elliott



This Feb. 17, 2017, photo shows a Navy P-3 Orion aircraft used for a NASA-led experiment called SnowEx, on an airfield at Peterson Air Force Base in Colorado Springs, Colo. Instrument-laden aircraft are surveying the Colorado high country this month as scientists search for better ways to measure how much water is locked up in the world's mountain snows - water that sustains a substantial share of the global population. (AP Photo/Brennan Linsley)

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month as scientists search for better ways to measure how much water is locked up in the world's mountain snows—water that sustains a substantial share of the global population.

A NASA-led experiment called SnowEx is using five aircraft to test 10 sensors that might one day be used to monitor [snow](#) from satellites. The goal: Find the ideal combination to overcome multiple obstacles, including how to analyze snow hidden beneath forest canopies.

"It would be, I would say, a monumental leap in our ability to forecast [water](#) supply if we had this kind of information," said Noah Molotch, a member of the science team for the experiment.

One-sixth of the world's population gets most of its fresh water from snow that melts and runs into waterways, said Ed Kim, a NASA researcher and lead scientist for SnowEx. "Right there, it's hugely important for people," he said.

Snow has other consequences for society as well, including floods, droughts and even political stability when water is scarce, Kim said.

The key to predicting how much water will pour out of mountain snows each spring is a measurement called snow water equivalent. The global average is 30 percent of snow depth, Kim said—10 inches of snow melts down to 3 inches of water.



In this Feb. 17, 2017 photo, NASA's lead aircraft integration engineer Eugenia De Marco works inside the Navy P-3 Orion aircraft used for a NASA-led experiment called SnowEx, at Peterson Air Force Base in Colorado Springs, Colo. Instrument-laden aircraft are surveying the Colorado high country this month as scientists search for better ways to measure how much water is locked up in the world's mountain snows - water that sustains a substantial share of the global population. (AP Photo/Brennan Linsley)

But a single mountain snowbank contains multiple layers with different snow water equivalents, making measurement difficult. The layers were dropped by successive storms with different moisture contents, and then lingered under different weather conditions before the next storm covered them.

A further complication: At times during the winter, some snow melts, so water will flow through the interior of the snowbank, distorting or absorbing signals from remote sensors.

No single instrument can overcome all the obstacles.

"We have these different sensing techniques. Each one works to a certain degree," Kim said. "What's the optimal combination?"

Two SnowEx sensors will measure snow depth: Radar and LIDAR, which stands for light detection and ranging. LIDAR uses laser pulses to measure distance.



In this Feb. 17, 2017 photo, military ground crew attend to a Navy P-3 Orion aircraft used for a NASA-led experiment called SnowEx, on an airfield at Peterson Air Force Base in Colorado Springs, Colo. Airplanes are scanning the Colorado high country with an array of sensors as scientists search for better ways to measure how much water is locked up in the world's mountain snows. (AP Photo/Brennan Linsley)

Four sensors will measure [snow density](#): three other types of radar, plus a passive microwave instrument, which detects how much of the Earth's natural microwave radiation the snow is blocking.

Two thermal infrared sensors will measure temperature.

A hyperspectral imager and a multispectral imager will measure how much sunlight the snow is reflecting, which helps determine how fast it will melt.

Aircraft will take the instruments on multiple passes over two areas in western Colorado, Grand Mesa and Senator Beck Basin. Ground crews will also analyze the snow to verify how accurate the instruments are.

One key technology used to predict snow runoff in the American West is the Snow Telemetry Network, or SNOTEL, operated by the U.S. Department of Agriculture's Natural Resources Conservation Service.



In this Feb. 17, 2017, photo, Ed Kim, a NASA researcher and lead scientist for a NASA-led experiment called SnowEx, stands near a Navy P-3 Orion aircraft used for SnowEx, at Peterson Air Force Base in Colorado Springs, Colo. Airplanes are scanning the Colorado high country with an array of sensors as scientists search for better ways to measure how much water is locked up in the world's mountain snows. (AP Photo/Brennan Linsley)

More than 800 automated SNOTEL ground stations scattered across the West measure the depth and weight of the snow, the temperature and other data and transmit them to a central database. Federal agencies use SNOTEL to produce daily state-by-state reports and maps on how the current snow water equivalent compares to the long-term average.

Water utilities, farmers, public safety agencies and wildland firefighters track the updates closely to help predict how much drinking and irrigation water will be available in the spring and whether they will face floods or fire-inducing droughts.

SNOTEL collects data from individual points, but the "holy grail of mountain hydrology" is a way to estimate the distribution of snow water equivalent across broad mountain landscapes, said Molotch, who is also director of the University of Colorado's Center for Water, Earth Science and Technology.

SnowEx could be a step toward that, he said.

Government agencies that forecast the spring runoff say satellite data on snow water equivalent would help them, although they base their predictions on multiple sources of information, including rain, temperature and current river flows.



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The Colorado Basin River Forecast Center in Salt Lake City, one of 13 National Weather Service centers that predict floods or river shortages nationwide, uses some NASA satellite data now, hydrologist Paul Miller said.

Satellite images show how much of the region has snow cover and how much dust is on the snow, he said. Dusty snow is darker, so it absorbs more heat and melts faster.

Snow [water equivalent](#) data from satellites "would be another source of information that we could look toward as guidance," Miller said. "It would definitely be something we would monitor and we would explore."

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