# NASA heads to Pacific Northwest for field campaign to measure rain and snowfall

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The trailer is used to mount instruments to measure rain and snow above accumulating snow pack. The instruments on the trailer operate unmanned throughout the winter season. Credit: Credits: University of Washington

From Nov. 10 through Dec. 21, NASA and university scientists are taking to the field to study wet winter weather near Seattle, Washington. With weather radars, weather balloons, specialized ground instruments, and NASA's DC-8 flying laboratory, the science team will be verifying rain and snowfall observations made by the Global Precipitation Measurement (GPM) satellite mission.

The Pacific Northwest was chosen because of its frequent and persistent winter rain and snowfall. On average 100 to 180 inches of precipitation fall a year, making it one of the few rainforests outside of the tropics in the world.

"The time that we're out there is the wettest time of the year," said Lynn McMurdie, senior research scientist and project manager for OLYMPEX at the University of Washington in Seattle, which is hosting the campaign. "We don't get a lot of heavy rain, but we have steady rain," she said. November alone gets an average of 16 inches, and heavier rainfall events make the region prone to floods, landslides and other rain-related hazards.

Drenching storms arrive from the Pacific Ocean, traveling over the coast and into the Olympic Mountains less than fifty miles away. Once in the mountains, the slopes act like rocks in a river, forcing the clouds in the storm system up and around and effectively changing the character of the precipitation. Following the storm systems' course from the ocean to the mountains provides the science team with a natural laboratory of highly variable terrain that leads to highly variable conditions for rainfall and snowfall - which are difficult to measure from space because they change quickly over short distances.

GPM is an international mission led by NASA and the Japan Aerospace Exploration Agency to observe rainfall and snowfall around the world. The program is managed by NASA's Goddard Space Flight Center in

Greenbelt, Maryland. The advanced instruments on the GPM Core Observatory satellite, launched Feb. 27, 2014, provide the next generation of precipitation measurements, including the new capability to detect snow and light rain.

"The GPM mission is up. We're flying right now. We're making measurements. So the questions are, what can we do right now and what do we have to do to improve?" said Walt Petersen, GPM's deputy project scientist for ground validation at NASA's Marshall Space Flight Center in Huntsville, Alabama, who is leading the field campaign, called OLYMPEX, short for Olympic Mountain Experiment.

"We've designed an experiment where we have aircraft that are pretending to be the satellite," said Bob Houze, professor of Atmospheric Science at the University of Washington and principal investigator of the campaign.

NASA's DC-8 flying laboratory, managed by NASA's Armstrong Research Center in Palmdale, California, will fly at an altitude of 36,000 feet above storm clouds that approach the Quinault and Chelhalis River basins on the Olympic Peninsula. In mid-November it will be joined by NASA's ER-2 aircraft, funded by NASA's Radar Experiment to study clouds, which will fly at 65,000 feet. Both planes will carry instruments similar to those flown in space to simulate satellite observations. At the same time, another aircraft, the University of North Dakota Citation, will be flying through the clouds taking direct measurements of the droplets and ice crystals within.

On the ground, advanced weather radars will be looking up at the clouds, studying their internal structure and how it changes as the storms move from the ocean inland. Arrays of rain gauges and other instruments on the ground will collect data on how much rainfall or snowfall reaches the surface. They will also image and count individual raindrops and snowflakes to assess on the micro-scale what heavy or light rain or snowfall looks like.

"This stack of measurements lets us connect the dots between what we see from space, what happens in the clouds and what we measure on the ground," said Petersen. In addition, the detailed ground measurements help the science team understand the fundamental processes within clouds that cause different types of rain to form.

"All of these measurements are aimed at determining if the assumptions that we're making about interpreting the satellite measurements are correct," said Houze.

Light rain, heavy rain, snowfall - each type of precipitation has a different "signature" seen by the satellite, and those signatures change depending on the size of the precipitation droplets or ice crystals and the intensity with which they fall. The GPM satellite science team designs and uses computer programs that automatically convert those signatures into rain and snow rates and estimates of how much has fallen. Those programs involve assumptions about the nature of the raindrops and ice particles inside the clouds that are not in the observations but may affect the estimates.

The same amount of rainfall can occur due to two different sets of cloud conditions. So getting those assumptions right is important in order to reduce inaccuracies for when those different conditions lead to different results, Houze said. And not just for the satellite measurements. The same types of assumptions are used in day-to-day weather forecasting.

"We want to know that we're getting the right amount for the right reasons," Houze said.

For OLYMPEX, NASA is partnering with researchers at the University of Illinois, University of Utah, Texas A&M University, McGill University, Stony Brook University, Colorado State, State University of New York, Environment Canada, as well as the U.S. Forest Service, the National Science Foundation, Quinault Indian Nation and the National Park Service.

Provided by NASA's Goddard Space Flight Center

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