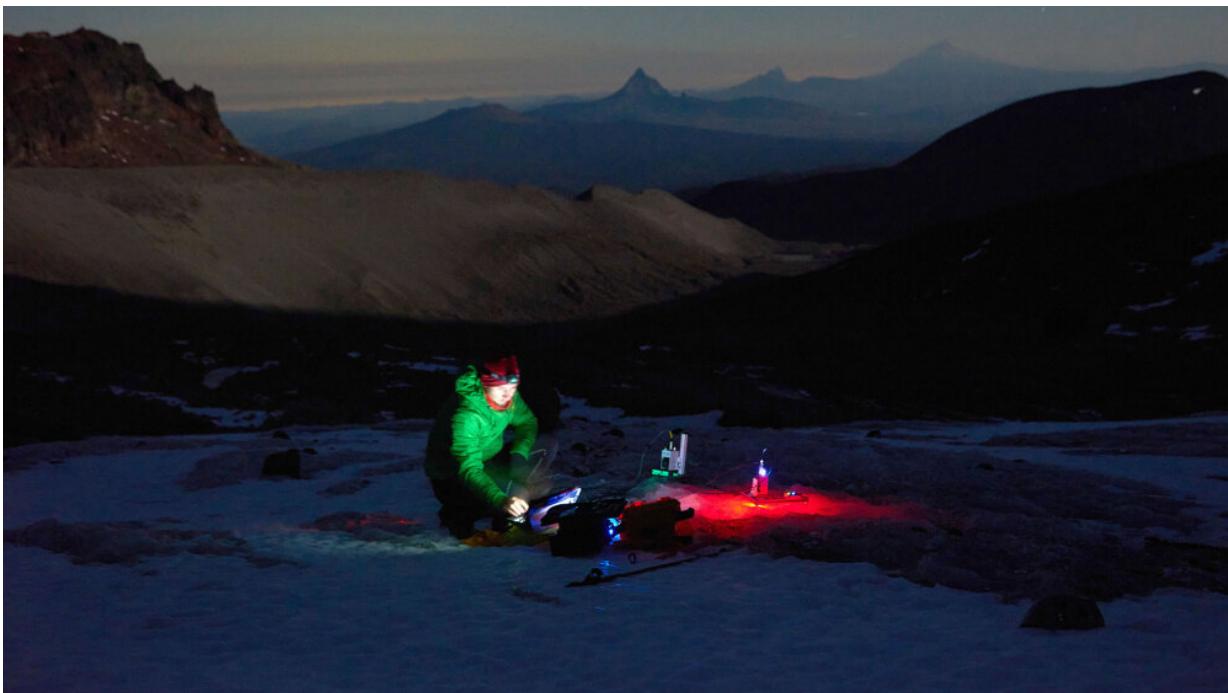


# Researchers use lasers to get a new view on Oregon's glaciers

July 13 2022, by Laurel Hamers



Credit: University of Oregon

The latest technology to study glaciers fits in a backpack and can be carried up steep mountains.

University of Oregon researchers have developed a portable tool that uses lasers to measure the composition of glacial ice, [data](#) that can help determine how fast that ice is melting. The instrument can be used to

study glaciers in remote [wilderness areas](#), like those in Oregon's Cascade Mountains. And it can help verify satellite data collected about bigger glaciers, like those in Greenland and Antarctica.

Oregon's glaciers feed [mountain streams](#) and buffer against drought in the late summer once the annual snowpack has melted. Their cold melt water is important salmon and trout habitat. But the glaciers are now shrinking rapidly, one more casualty of global climate change.

"Studying how these glaciers respond to [climate change](#) is important for informing streamflow management both now and in the future," said Johnny Ryan, a geographer at the UO who is using the new instrument in his research. Plus, "Many of the processes that we observe on Oregon glaciers also occur on the Greenland and Antarctic ice sheets. Oregon's glaciers provide a great testing ground for new instrumentation and hypotheses."

Oregon's glaciers sit high on mountain slopes, in designated wilderness areas where motorized vehicles are prohibited. Scientists can't trek in heavy equipment via helicopter and snowmobile, as they otherwise often do to collect samples of ice to analyze. The new tool is a way to gather data in wilderness areas, said Markus Allgaier, a postdoctoral physicist who led the design of the tool. He and his colleagues describe the development in a recent paper in the *Journal of Glaciology*.

Allgaier's instrument works by measuring the way light scatters back from glacial ice. The device shoots a [laser beam](#) into the ice. Photons, tiny particles of light, bounce back when they hit air bubbles in the ice. By measuring how long it takes photons hitting the ice to reach a detector positioned a few feet away, scientists can estimate the composition of the ice.

And that, in turn, can provide insight into how much sunlight the glacier

is absorbing versus reflecting. That data can be used to estimate how fast the ice is melting.

Allgaier usually builds devices that are used in a lab. If something malfunctions, he can adapt on the spot. Designing something that would be used in remote environments was a new challenge, he said.

"With field research, it has to work," Allgaier said. "You may not get another chance to come back and try again."

He and his colleagues had to wait for the perfect weather window to test the instrument in the mountains: late enough in the summer that the snow had melted off the surface of the glacier to expose bare ice but before new snow started falling. So first, they did lots of testing both in the lab and around town, finessing the instrument.

When conditions were right, Allgaier and his colleagues lugged the device to Crook Glacier on Broken Top, about a 3-mile hike in. The main device itself fits into a hard-shell plastic carrying case the size of a small briefcase. All the gear necessary to make it run, like batteries and extra cables, can be trekked up by a couple of people with backpacks.

They set up near the edge of the glacier during the day. Ambient light disrupts the [data collection](#), so they waited till the sun set to turn on the lasers and carefully start making measurements on the chilly ice.

On a second, longer trip, they trekked to North Sister's Collier Glacier, which has been studied by UO researchers for almost 100 years. It's named after George H. Collier, a former professor of physics and chemistry at UO, and one of the university's first faculty members.

The team used funding from the Office of the Vice President for Research and Innovation's Renee James Seed Grant Initiative to develop

the prototype device. Now, they plan to take it further.

"We're hoping to take the instrument to Alaska and use what we've learned to do ground truthing of satellite data," Allgaier said, meaning it would make sure the data collected about glaciers from satellites squares with what's recorded on the ground.

Ryan and UO geographer Sarah Cooley work with data from the NASA satellite ICESat-2, which measures elevation changes of ice sheets and sea ice.

"There are some uncertainties about how much the laser penetrates in snow and ice," Ryan said. "We can use our ground-based instrument to measure the penetration depth of green laser in snow and ice and see how it varies across space and time."

That will allow them to correct inaccuracies in this [satellite data](#), ultimately improving the climate and environment predictions that are based on it.

**More information:** Markus Allgaier et al, Direct measurement of optical properties of glacier ice using a photon-counting diffuse LiDAR, *Journal of Glaciology* (2022). [DOI: 10.1017/jog.2022.34](https://doi.org/10.1017/jog.2022.34)

Provided by University of Oregon

Citation: Researchers use lasers to get a new view on Oregon's glaciers (2022, July 13) retrieved 28 June 2024 from <https://phys.org/news/2022-07-lasers-view-oregon-glaciers.html>

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