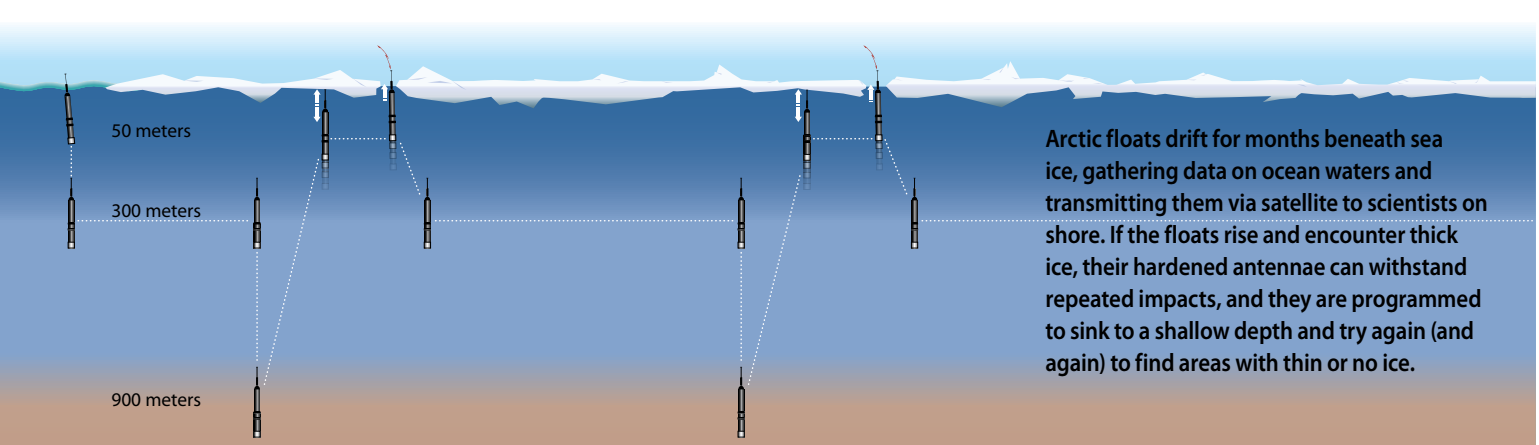

Arctic floats drift for months beneath sea ice, gathering data on ocean waters and transmitting them via satellite to scientists on shore. If the floats rise and encounter thick ice, their hardened antennae can withstand repeated impacts, and they are programmed to sink to a shallow depth and try again (and again) to find areas with thin or no ice.

Jayne Doucette, WHOI

Under-ice floats offer a 'breakthrough'

New instrument proves its mettle in an icy ocean

The Arctic Ocean, home to fierce winds, punishing temperatures, and thick sea ice, is no place for wimpy people—or machines. So when WHOI physical oceanographers Peter Winsor and Breck Owens set out to explore the largely unknown currents beneath the polar sea ice, they had to design an instrument with true grit.

"We needed the ultimate Arctic machine: intelligent, tough, and durable," Winsor said.

In recent years, oceanographers have employed torpedo-shaped instruments called floats that drift, nose pointed up, at various depths through the oceans while measuring water temperature and salinity. The floats are programmed to rise to the surface periodically and send data via satellite antenna to scientists on shore.

More than 2,000 of these floats are now dispersed to collect data over wide swaths of ocean territory for many years. Similar floats could work beneath the ice, but scientists have struggled to figure out how the floats would surface in ice-covered waters to transmit data.

Over the years, Owens has seen several proposals to overcome this barrier. They have included systems to give floats the capacity to melt ice, or devices that reflect sound signals off ice.

"But there are just too many things that can go wrong with complex designs," Owens said. "Our mantra was: the simpler, the better."

The floats he, Winsor, and WHOI engineers developed are smooth-sided and free of external machinery that could snag on ice. Next the scientists added toughness—particularly in the antenna, which is made of hard polyurethane that can withstand repeated impacts against the hard underside of sea ice.

Finally, they incorporated the "intelligence." When the float rises and encounters ice, it is programmed to simply sink to a shallow depth and try again (and again, up to 100 times). Eventually it rises in an ice-free area, or in narrow cracks called leads between sea ice.

"Bounce, bounce, bounce—the float antenna knocks against the underside of the ice," Winsor said. "It knows it should go back down, wait awhile, then test again for open water."

This summer, Winsor deployed three experimental floats into ice-clogged waters during a seven-week voyage across the Arctic Ocean aboard the Swedish icebreaker *Oden*. Though the floats were launched simply to see if they would work, Winsor is basking in their apparent success. This fall, back at WHOI, he and Owens have received e-mails from the floats every few days or weeks, as the floats find open water to surface and get in touch. (They have been corresponding less frequently as winter ice builds in the Arctic).

"It's like Christmas," Winsor said in mid-November, one day after the third float he deployed in heavy ice near the North Pole finally communicated with WHOI scientists. "It told us, in its own float language, 'Here I am, and here's the data I've collected so far.' "

Winsor and Owens are now working on proposals that could eventually seed the Arctic with floats. "Imagine what we could learn if we could have many of these roaming around the Arctic Ocean," said Winsor, who is a WHOI Ocean and Climate Change Institute fellow.

Additionally, they want to tweak their technology to include, for example, two-way communications that would give scientists the ability to modify the floats' missions from shore.

Winsor said the floats won't replace scientists on icebreakers visiting the Arctic, but will allow year-round research in a remote region where for months on end it is simply "too dark, too icy, too dangerous, and too cold" for even the toughest scientists.

"We joke that we've developed these floats because we're just jealous of oceanographers who work in the tropics," he said. "We say our ultimate dream is to create something that lets us sit on the beach with our laptops and collect data while the Arctic snow flies."

—Amy E. Nevala

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Peter Winsor, WHOI

◄ WHOI scientist Luc Rainville, on the Swedish icebreaker *Oden* in August, prepares to test an experimental float designed for under-ice operations in the Arctic.