# Custom-designed radar measures Antarctic ice with millimetre accuracy

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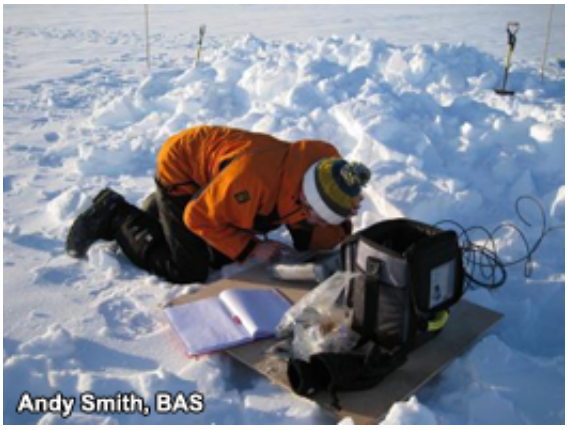


Researcher Matt Ash monitors signals on the Pine Island Glacier, Antarctica

A series of radars just deployed on Antarctica will give researchers their first ever day-by-day measurements of the health of one of the ice shelves that surround the frozen continent.

The radars, developed with funding by the Engineering and Physical Sciences Research Council (EPSRC), have been placed on the ice shelf surrounding Pine Island by University College London (UCL) and British Antarctic Survey (BAS) scientists to record changes of the Antarctic ice in unprecedented detail.

The ice shelves around Antarctica can be up to 2 kilometres thick, but preliminary trials show the new radar system can detect changes of as

little as a millimetre – about the amount the Pine Island Glacier melts in just 30 minutes.

"Although we've previously taken snapshots of the ice with radar, this is the first time year-round monitoring has been possible," said Dr Keith Nicholls of the British Antarctic Survey. "Where changing ocean currents interact with the underside of the ice shelf, the rate of melting can change season by season, month by month, even over days or hours. The advantages of this new system cannot be overstated."

The purpose-built radars were developed in the labs of Paul Brennan, Professor of Microwave Electronics at University College London.

"The millimetre accuracy of the system is made possible by a phase-sensitive processing technique that we specially developed for the project," Professor Brennan explained. "We have also redesigned the electronics to minimise noise, so that the units are highly sensitive at low power."

Indeed, each radar unit runs off a single 6V battery that can last a whole year and can be topped up by a small wind generator, and solar cells during summer. When running, the radar draws 5 watts of power, the same as a low-energy light bulb; standby power is 1 milliwatt.

The units also boast antenna arrays – Multiple Input Multiple Output (MIMO – different from the WiFi router philosophy) – that allow the researchers to construct 3D images of the ice.

"This will be very useful because of the uneven shape of the ice-sheet's underside," Dr Nicholls commented. "We will be able to see how the shape of the surface influences the melt rate."

Pine Island Glacier is thought to be highly sensitive to climate variability

and has thinned rapidly over recent decades.

"The main culprit is warm water in the circumpolar current, which is eating away at the underside of the ice shelf floating at the edge of Pine Island Glacier," said Dr Keith Nicholls of the British Antarctic Survey. "A continuous record of seasonal changes, which is what the new array should give us, will give us a far better understanding of how that's happening."

The deteriorating state of the ice shelf was revealed in another way by the recent mission: the plan had been to emplace eight of the small radar stations, but new crevassing of the ice prevented the team landing by plane at many planned locations

"The increased crevassing may be a result of accelerated movement of the ice shelf, or stresses from channels melted into the underside of the ice – they were certainly unexpected from our planning survey," said Dr Nicholls.

Daily bulletins remotely posted by the installed radars reveal they are working well. The data though will remain a mystery until the researchers return to download them in person next year.

"It is only when visiting Antarctica that its breathtaking scenery and beauty can be appreciated, and the region's importance regarding sea level rise," said Dr Matt Ash from the UCL team, who accompanied BAS on the NERC iSTAR misson. "We hope that our work will make some contribution to understanding and mitigation of the processes involved."

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