



Clouds in Antarctica can influence weather the world over.

## CLIMATE SCIENCE

# Antarctic cloud study takes off

*Scientists probe atmospheric physics above ice sheet for the first time since the 1960s.*

BY ALEXANDRA WITZE

On Antarctica's Ross Island, a short drive from the US McMurdo research station, high-tech radar antennas and other atmospheric instruments gaze skyward, gathering detailed measurements of West Antarctic clouds. Remarkably, these are the first such data to be gathered in five decades — even though weather patterns in the region can influence those half a world away.

The US\$5-million project, known as the Atmospheric Radiation Measurement West Antarctic Radiation Experiment (AWARE), began to observe the skies near McMurdo in November and will run until early 2017. A second measurement station, 1,600 kilometres away in the ice sheet's interior, will operate until the end of this month. (The site is so remote that it can be used only during the Antarctic summer.)

A similar experiment in the Arctic in 1997–98 relied on an instrument-laden ship that was deliberately frozen into sea ice. It yielded fundamental insights into the physics of northern polar clouds<sup>1</sup>, and AWARE scientists hope that their project will do the same

for the south. “This is going to be a sea change in our understanding,” says Lynn Russell, an atmospheric scientist at the Scripps Institution of Oceanography in La Jolla, California, and a co-principal investigator on AWARE.

Antarctica's massive ice sheet acts as a global heat sink. As a result, changes in Antarctic clouds, such as the amount of ground they cover or how much radiation they absorb, can have ripple effects as far away as the tropics. Climate modellers need to understand

the physics of these clouds if they are to correctly work out how weather around the globe will change as the polar regions warm.

Scientists have not made detailed, in-place measurements of the skies above West Antarctica since 1967, when weather-balloon launches ceased a decade after they began during the 1957–58 International Geophysical Year, says Russell.

AWARE, which is led by Scripps atmospheric scientist Dan Lubin, aims to get the best data yet on clouds and aerosol particles above

West Antarctica. That includes mixed-phase clouds, which occur in polar regions and combine supercooled water with ice. Studies have shown that clouds moving across Antarctica's interior are mostly ice, whereas those moving onshore from the coast contain more liquid water<sup>2</sup>. The composition of these clouds plays a major part in determining how much sunlight they reflect into space — which helps to shape atmospheric circulation and weather patterns below.

Satellites such as NASA's CloudSat and CALIPSO (Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations) can probe the internal structure of Antarctic clouds<sup>3</sup>, but in only a narrow ribbon as seen directly beneath the spacecraft's orbit. AWARE uses multiple radar instruments and a sophisticated lidar system to explore the clouds' many layers, examining properties such as phase and particle size at various altitudes.

Early AWARE data show mixed-phase clouds over McMurdo, in the first detailed measurements of such cloud systems outside the Arctic. “The Antarctic is a very different environment than the Arctic, because it is colder year-round and also has a very pristine atmosphere,” says Lubin. Team scientists reported early results on 16 December at the American Geophysical Union meeting in San Francisco, California.

The team has also clocked pulses of humidity swinging in and out of the McMurdo area as a storm passed through, altering how the clouds transmit radiation.

Getting the basic data should help scientists to better understand how Antarctic clouds will respond to a changing climate, Russell says. West Antarctica is warming by as much as 0.4°C per decade, and as its ice melts, sea levels will rise. The AWARE measurements from the West Antarctic interior are designed to capture the height of the summer melt season.

One major question is how climate change may be intensifying westerly winds around Antarctica, and what those changes will do to southern polar clouds, says Andrew Vogelmann, an atmospheric scientist at Brookhaven National Laboratory in New York. With one AWARE location near the coast and another in the interior, project scientists aim to compare how atmospheric systems passing through West Antarctica affect both locations, and how those changes translate to wider global shifts.

One final twist, Vogelmann adds, is the presence this year of the El Niño weather pattern, which could affect conditions at the poles. “We may be able to catch some of that,” he says. ■

1. Intrieri, J. M., Shupe, M. D., Uttal, T. & McCarty, B. J. *J. Geophys. Res.* <http://dx.doi.org/10.1029/2000JC000423> (2002).
2. Scott, R. C. & Lubin, D. *J. Geophys. Res. Atmos.* **119**, 6702–6723 (2014).
3. Adhikari, L., Wang, Z. & Deng, M. *J. Geophys. Res.* **117**, D04202 (2012).