Astronomy, astrophysics, and upper-atmosphere studies

First automatic geophysical observatory installed on the polar plateau

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The first of six automatic geophysical observatories (AGOs) planned by the U.S. Antarctic Program was installed on the polar plateau in December 1992 (figure 1). Located about 480 kilometers from the South Pole (85°40'S 46°23'W), the AGO is an unstaffed research facility that provides power, data acquisition, heat, and shelter as a host to experiments that are investigating the high-latitude ionosphere and magnetosphere. When all six AGOs are deployed, a network of identical, synchronously operating experiments will give unprecedented ground-based coverage of the upper atmosphere in the polar cap.

The AGOs have been designed and built by Lockheed Palo Alto Research Laboratories to operate unattended for a year between service visits in the extreme conditions of the antarctic interior. They must tolerate temperatures to –90°C, high winds, and accumulating snow. Fifty watts of continuous electric power is provided by a propane-fueled thermoelectric generator that uses no moving parts. A thermally controlled heat exchanger maintains the interior at a constant warm temperature, allowing the use of low-cost commercial-grade electronics. Data from the science experiments are continuously sampled, and 2.7 gigabytes are stored in optical disks for annual retrieval. Health and status are read out hourly through the ARGOS satellite data system.

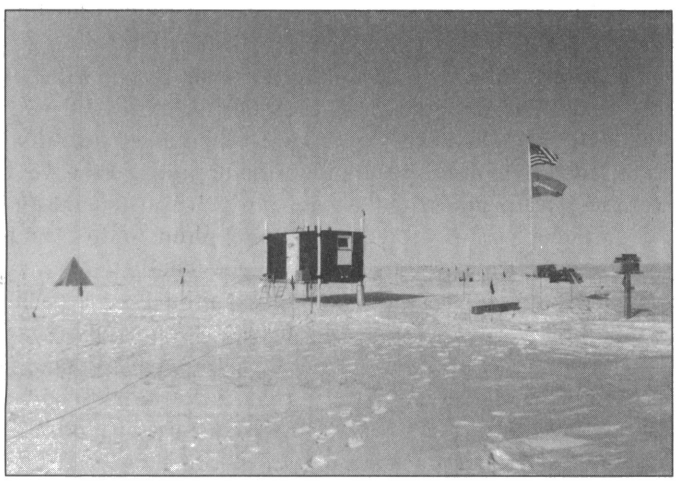

Figure 1. The AGO deployed at 85°40'S 46°23'W. The Lockheed field team included Jack Doolittle, Ev Paschal, Mark Anderson, and Mike Trimpi.

The science investigations from the high-latitude network of AGOs will attempt to correlate simultaneous observations over a large spatial extent made by a standard set of geophysical sensors. The experiments are being conducted by investigators from 15 institutions under National Science Foundation sponsorship and are intended to enhance similar studies being made using data from staffed antarctic stations and satellites. The experiments include several channels of very-low-frequency, low-freqency, and high-frequency radio receivers; three-axis magnetometers using search-coil and fluxgate techniques; an imaging riometer; an intensified all-sky auroral camera; and weather measurements including temperature, barometric pressure, and wind velocity.

Three AGOs were set up temporarily in November 1992 near McMurdo Station for integration of the science apparatus (figure 2). This allowed for the correction of low levels of electromagnetic interference identified between some of the experiments. The three AGOs were prepared for deployment to sites on the polar plateau, but competing demands on aircraft support resulted in only one AGO being deployed this season. The other two fully integrated AGOs were stored at Williams Field for deployment next season. Three other AGOs arriving by ship in February 1994 were also put into storage for later integration and deployment.

The deployment of the first AGO to a remote site occurred on 14 December 1992. During delivery, the shelter was turned over by the propeller blast from the LC-130 aircraft. Fortunately, the AGO shelter was not damaged because it is a very strong structure of foam-core fiberglass construction. The experiment electronics mounted in securely anchored racks also escaped damage.

The AGO installation proceeded quickly, with the power module brought up within the first 2 hours at the site. By the end of the first day, the facility was lifted on struts to minimize snow drifting and was secured by guy anchors. Sensors and antennas were deployed over the next 2 days, and all experiments were made operational. Fine-tuning and calibra-

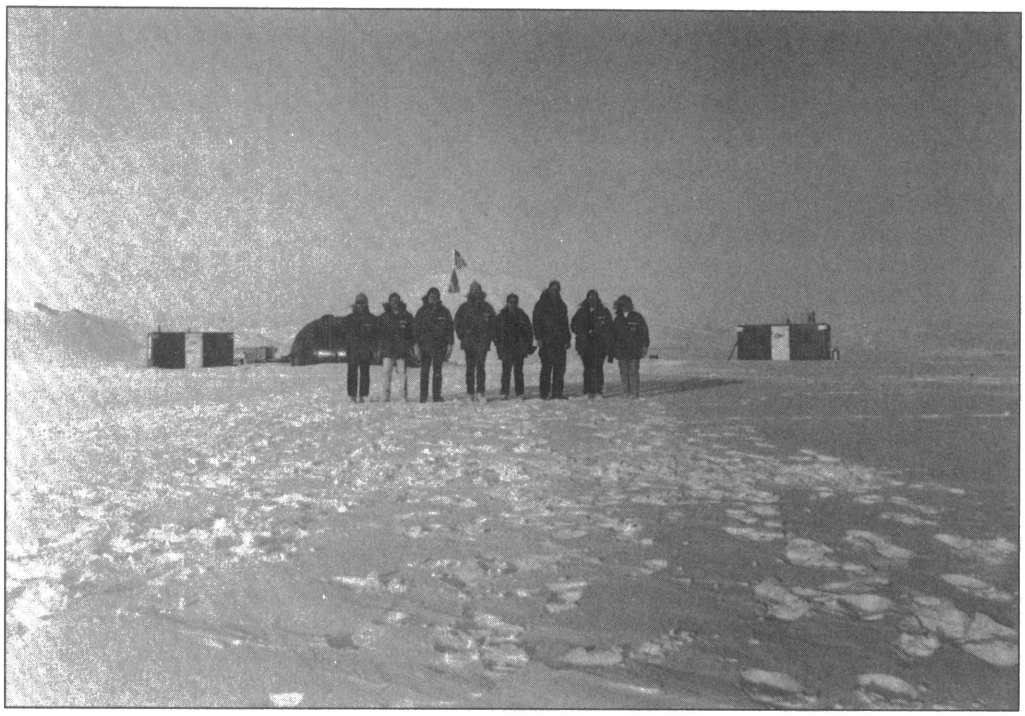

Figure 2. The AGOs were first set up near McMurdo Station to allow for experiment integration. The team of investigators who installed, checked out, and calibrated the experiments shown here (left to right) are Makoto Taguchi (Tohoku University; search coil), Mark Anderson (Lockheed), Mike Trimpi (Lockheed), Ev Paschal (Lockheed), Dan Detrick (University of Maryland; imaging riometer), Jack Doolittle (Lockheed; all-sky camera), Umram Inan (Stanford University; very-low-frequency receiver), and Carol Maclennan (AT&T Bell Laboratories; fluxgate magnetometer). Not shown is Alan Weatherwax (Dartmouth College; low-frequency/high-frequency receiver).

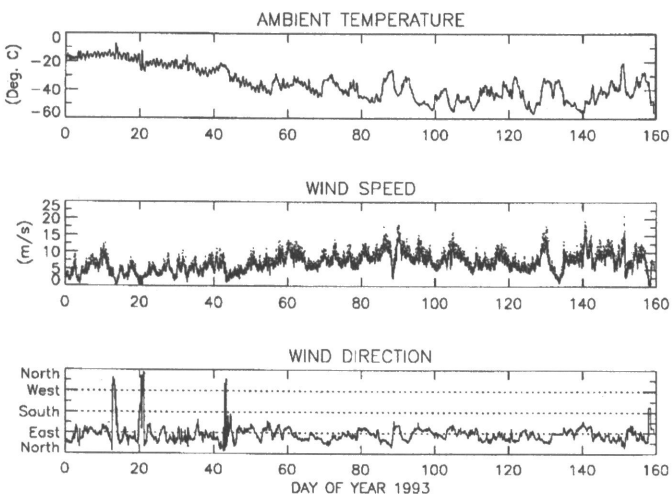

Figure 3. Weather data for the AGO returned by the ARGOS satellite data-retrieval system during 1993. Health and status data of the AGO vital parameters allow close monitoring of the facilities' performance and provide information useful for diagnosing operational discrepancies and planning site visits

tion were completed by the 6th day. The crew remained at the site for a total of 2 weeks due to aircraft delays. The extended visit at the remote site proved the benefits of providing a comfortable habitat and work space for the service crew.

The pullout flight brought in the year's supply of propane fuel, which was hooked up to an awaiting fuel line connected to the AGO. During the 2 hours that the aircraft was at the site, the facility was secured for unstaffed operation, then it was left to collect data until the service crew returns the following year.

Figure 3 shows weather data retrieved by the ARGOS satellite system during the AGO operations in 1993. The AGO operated normally until 1 June 1993, when an optical disk drive failed to shut off, resulting in the draining of the AGO batteries. Health and status telemetry, which also depends on the batteries, was disrupted on 10 June. Although heat and power to the experiments are believed to have been sustained, data logging ceased until the next annual service visit, planned for December 1993. During the 5 months of operation, the AGO logged about 700 megabytes of science data.

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