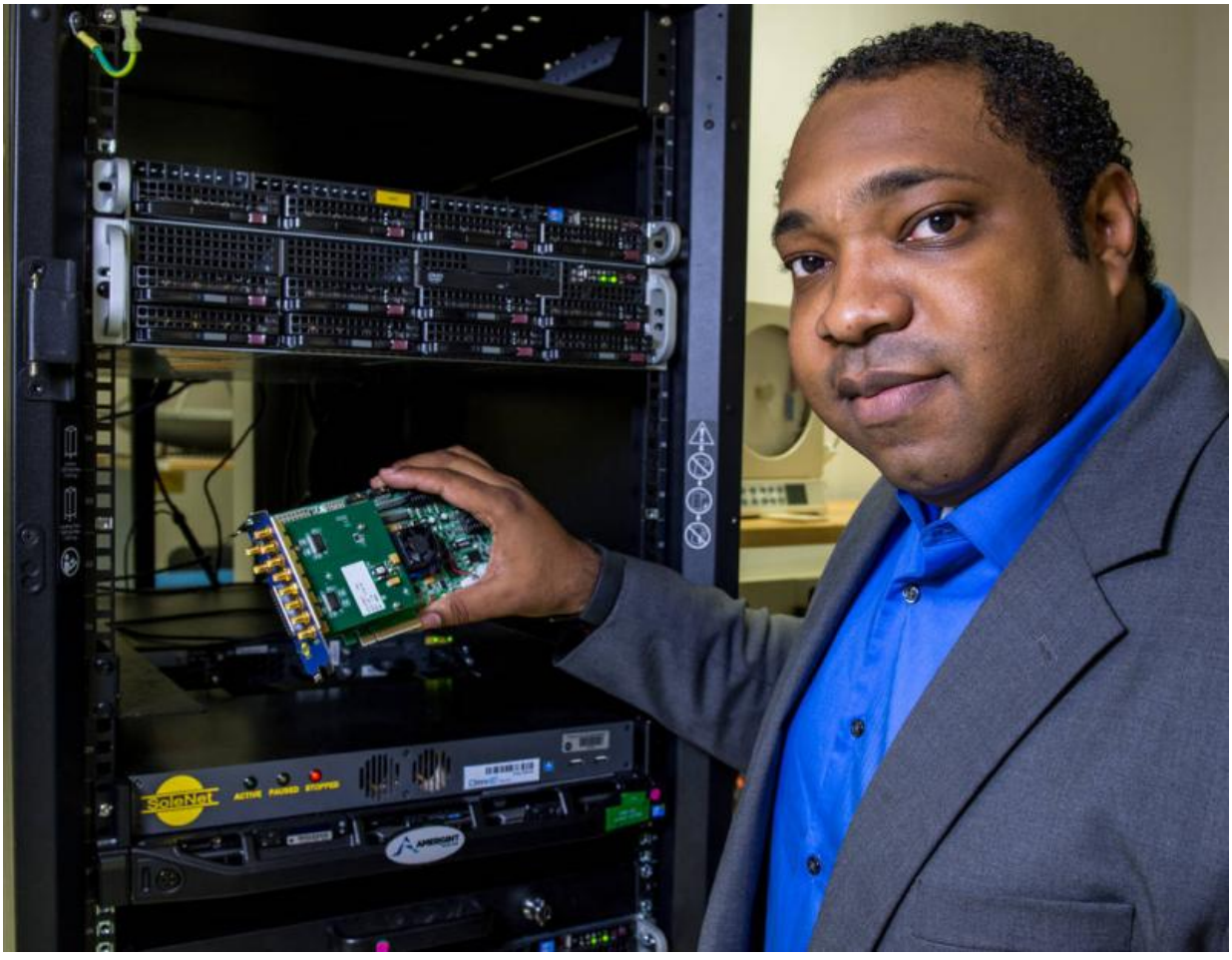
New system giving SMAP scientists the speed they need

October 29 2015, by Lori Keesey



Philip Baldwin holds the custom-designed high-speed interface card that enables data transfer from Antarctica to White Sands, New Mexico, at about 300 Mbps. The electronics rack in the background is similar to the one inside the radome housing the new equipment. Credit: NASA/W. Hrybyk

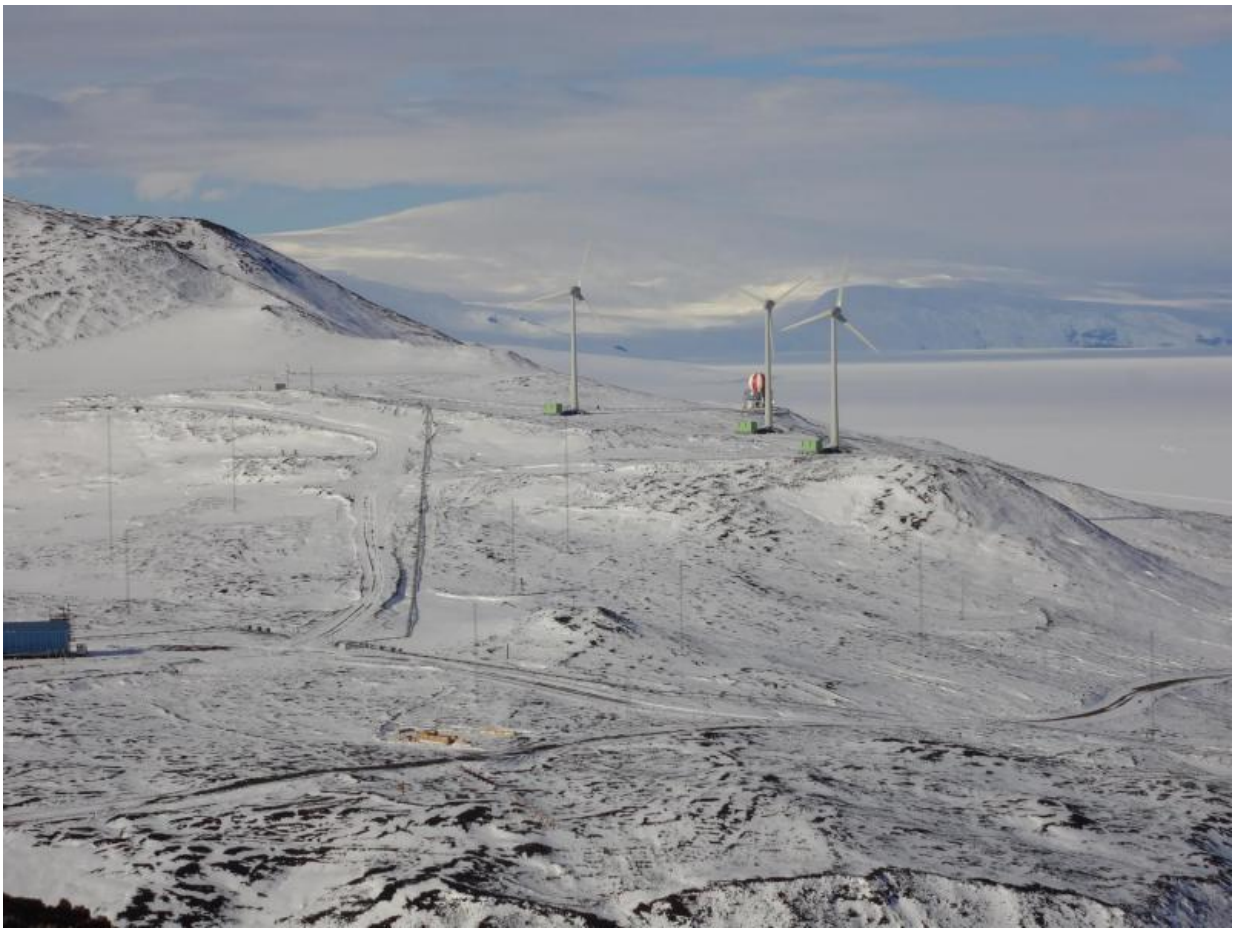
For scientists now studying the voluminous amounts of data collected daily by NASA's Soil Moisture Active Passive (SMAP) mission, speed is everything. A new NASA-developed data-transmission technology installed at the U.S. Antarctic Program's McMurdo Station in Antarctica is giving them the speed they need.

Since SMAP began gathering soil-moisture measurements in the spring, the upgraded McMurdo TDRSS Relay System (MTRS) operating as part of NASA's Near Earth Network has transmitted terabytes of data via NASA's Tracking and Data Relay Satellite System (TDRSS) at a whopping 200 megabits per second (Mbps).

SMAP measures the amount of water in the top two inches of soil everywhere on Earth's surface, distinguishing between ground that is frozen or thawed. The mission is now producing its global measurements with just its radiometer instrument after it was found this summer that the SMAP radar could no longer return data.

With the SMAP radiometer data, scientists will produce global maps to improve their understanding of how water and carbon in its various forms circulate. The data also will enhance scientists' ability to monitor and predict natural hazards like floods and droughts. In addition, SMAP data have additional practical applications, including improved weather forecasting and crop-yield predictions.

"The mission is downloading terabytes of data; hence the need for a faster link," explained Philip Baldwin, a systems engineer at NASA's Goddard Space Flight Center in Greenbelt, Maryland, who led a six-member team that spent five years redesigning and building the system that allows for one of the fastest data transfer off the Antarctic continent.



The orange-and-white radome that houses the upgraded McMurdo TDRSS Relay System is about 1.5 miles from the actual McMurdo Station, Antarctica. Credit: Philip Baldwin/NASA

"Not only do they have a lot of data to downlink, the mission's data also is time-sensitive. We have only 30 minutes to deliver the data from one pass. So far, we haven't lost any data, and SMAP is happy with the service we're able to provide," he said, adding that MTRS is actually capable of 300 Mbps data-transfer speeds.

Other Polar-Orbiting Spacecraft Will Benefit

Although developed to accommodate SMAP's titanic data and tight time requirements, MTRS eventually will function as a multi-mission asset under the Near Earth Network and become available to other polar-orbiting spacecraft. "This will greatly increase Goddard's ability to support an even greater range of science missions," Baldwin added.

The system's performance is striking, Baldwin said, adding that it went operational in March when SMAP started gathering data. "It really has improved data flow," he said.

As the polar-orbiting SMAP flies over Antarctica, it downlinks roughly 10 gigabytes of data during each pass to an X-band receiver located at the McMurdo Ground Station. (Due to TDRSS visibility, SMAP downloads up to six times a day.)

A fiber-optic cable carries the data to the MTRS equipment housed 1.5 miles away inside an orange and white radome covering the MTRS 4.6-meter antenna dish and the system's high-speed terminal consisting of two boxes or racks of electronic equipment. Every 12-hour period, the data are transferred to a TDRSS spacecraft that then downlinks the data to NASA's Space Network ground station at the White Sands Complex, east of Los Cruces, New Mexico, for ultimate delivery to SMAP scientists.

To create the capability, the team upgraded an existing system that Goddard initially developed 15 years ago to demonstrate data transfer from McMurdo to White Sands. The previous incarnation of the system was last used in 2005 and had remained dormant since. Among other issues, the existing equipment fell far short of SMAP's operational readiness for data transfer and timing. "We assessed what we needed to do and basically started over," Baldwin said.

The team, which visited Antarctica five times to complete the job,

designed, upgraded, and refurbished every aspect of the system, Baldwin said. It created the software, custom transceivers, and high-speed computers to produce the fastest data link off the world's southern-most continent.

"It's certainly faster than my Internet service at home," he added.

Provided by NASA's Goddard Space Flight Center