

FIELDWORK REPORT FOR 2009/2010
"Remote GPS measurements to improve SAR ice monitoring" [AFI9/18]
University of Bath and British Antarctic Survey

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2009/2010* and 2010/2011** field personnel

Project Abstract:

Space-borne synthetic aperture radar (SAR) observations can be used to measure structure and velocity within the Antarctic ice sheet. Most SAR missions to date have used L-band frequencies (1-2 GHz) but interest is now turning to lower-frequency P-band signals (around 430 MHz) because they have greater penetration of the ice. Both the University of Bath and BAS are currently involved in feasibility studies relating to P-band SAR design for future ESA satellites. P-band SARs in polar orbits such as the ESA BIOMASS satellite due to launch in 2014, have the potential to map out the three-dimensional structure of ice sheets. However, their signals will suffer from significant ionospheric effects including Faraday rotation, range defocusing, range delay and interferometric phase bias. The ionosphere must be taken into account in the system design but the necessary ionospheric measurements to do this do not currently exist. This project will deliver the measurements for the Antarctic region and lay the foundation for successful P-band SAR missions.

This project involves equipment development, fieldwork and analysis. The objective of the fieldwork is to deploy modified GPS receiving equipment that will for the first time take measurements of total electron content (TEC), plasma velocity and ionospheric scintillation at remote locations across the Antarctic. To achieve this, eight new GPS receivers will be deployed to undertake long-term measurements in the auroral and polar-cap regions over a two year period. Additional data from lower Antarctic latitudes will be provided by international partners. The measurements will be used to develop a multi-scale model of the Antarctic ionosphere. This model will be a critical input to SAR design that will minimize the impact of the ionosphere on ice measurements for future satellite missions.

Fieldwork aims:

1. To deploy GPS scintillation receivers that will monitor the upper atmosphere (ionosphere) and run automatically until data collection in the following season.
2. Magnetometer servicing (See Part 2)

Part 1.

Equipment: Novatel/GSV4004 GPS scintillation receivers, wind turbines, solar panels and lead-acid batteries.

Deployment locations: Eagle (also known as M81 or A80), South Pole (additional site) and Owl

	Latitude (deg:min)	Longitude (deg:min)
Eagle	80:53	33:17
Owl	89:34	42:53

The layout within the site Eagle is shown in Figure 1

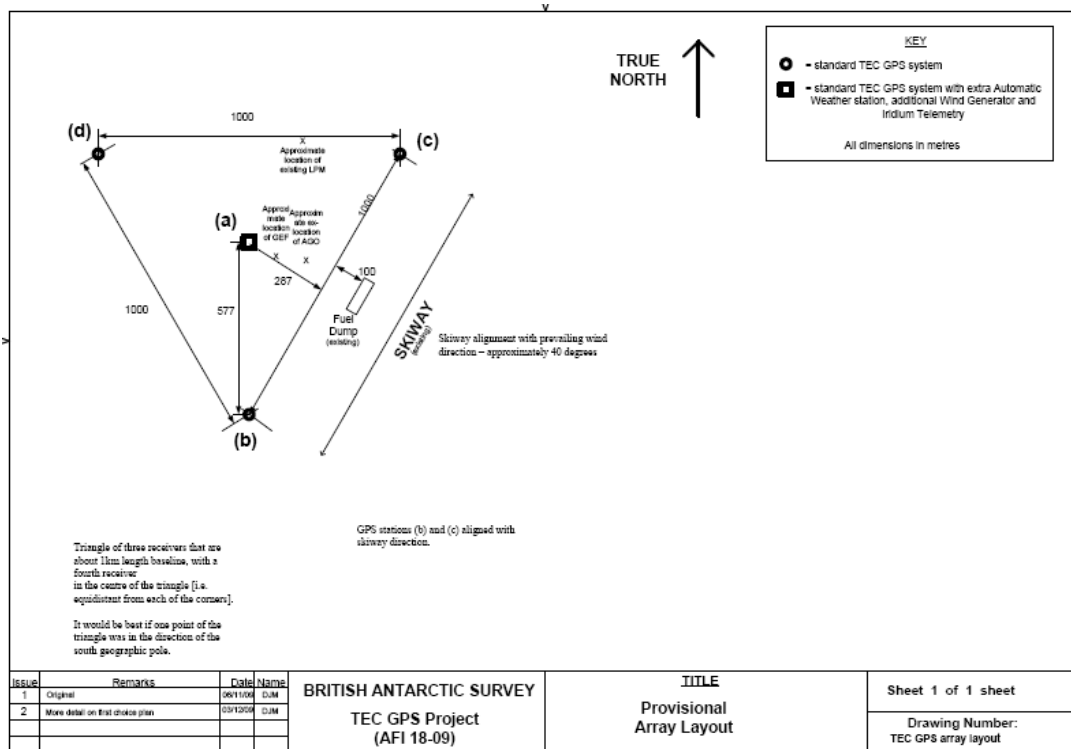


Figure 1. Provisional (and final) layout of receivers at Eagle.

The GPS equipment was deployed at Eagle, becoming operational between 17th and 24th January 2010.

The GPS equipment was deployed at Owl, becoming operational between 25th January and 2nd February 2010.

The deployment at Owl was subject to modification from original plans when it became apparent that there was an option to put a receiver into the US station at South Pole (only 40 km away from Owl). This offered the advantage of continuous power from the stations and over-wintering personnel to monitor the equipment.

Consequently three GPS receivers were deployed at Owl (South, North West and Centre) in the same orientations as shown in Figure 1. The fourth 'Owl' receiver was deployed at the South Pole on the roof of the main building.

Figure 2 shows the equipment after deployment at (a,b) Eagle (c) Owl and (d) South Pole

Part 2

Magnetometer Servicing

Four magnetometer sites were visited. Site Vulture (M88/316) was visited en-route between site Eagle and South Pole station on 24th January 2010. The remaining three sites; Osprey (M87/028), Raptor (M87/068) and Merlin (M85/095) were visited on 29th January 2010. All data modules were successfully changed.

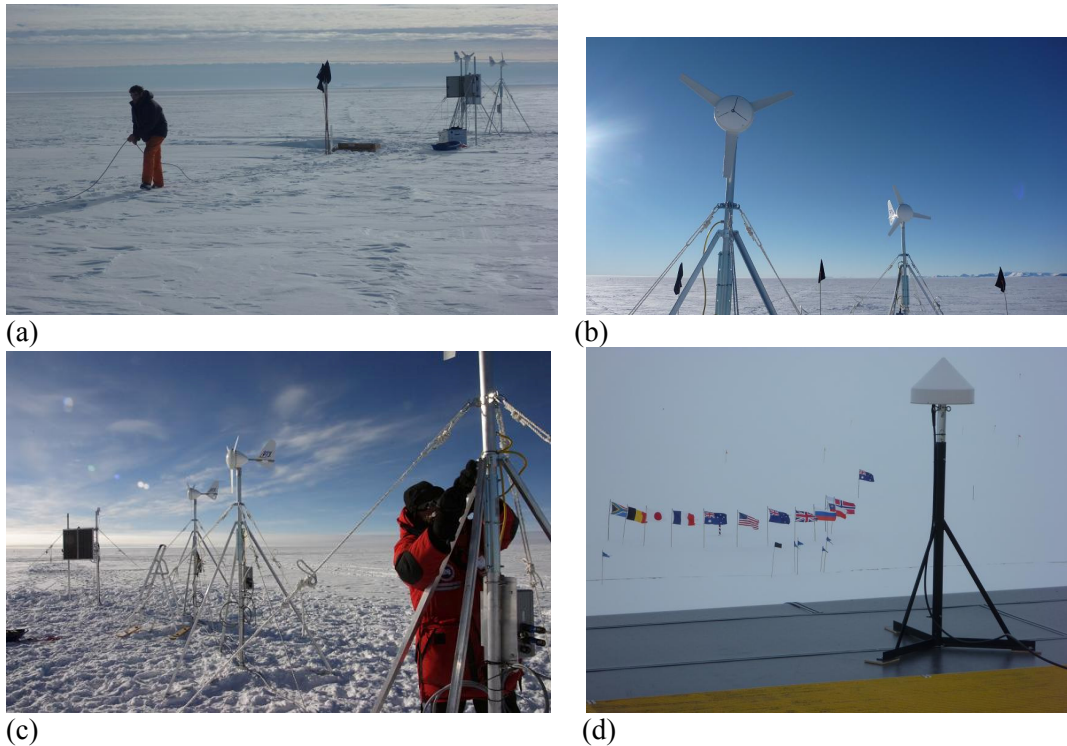


Figure 2. Photographs at sites (a,b) Eagle (c) Owl and (d) South Pole

Summary

All of the equipment was successfully deployed. Initial checking showed the receivers to be working as expected and we now await the data collection in the following season (2010/2011).

All four 'close to south pole' magnetometer sites were visited and the data modules were changed. The other seven Antarctic plateau magnetometer sites were serviced on flights unconnected with the AFI9-18 project.