The Scott Base Geomagnetic Observatory

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The Scott Base Geomagnetic Observatory (SBA), operated by GNS Science with support provided by Antarctica New Zealand, is continuously monitoring the changes of the Earth's magnetic field within the Southern polar regions as an important contributor to the INTERMAGNET global magnetic observatory network. With the current technology, a measurement of variations in strength and direction of the magnetic field is automatically being taken every second by magnetometers located inside the two small "geomag" huts at Scott Base. The data are being processed and submitted to INTERMAGNET on an hourly basis. Increased accuracy and areal extension of the SBA data set is gained by magnetic surveys at Cape Evans and Lake Vanda, which were first conducted in 1911 and 1974, respectively, and are repeated about every 5 years. The scientific value of SBA needs to be become more widely recognised within New Zealand; to ensure the observatories continuation, we need to explain and highlight their significance on a global scale.

The Southern Hemisphere is an area that is only sparsely covered by INTERMAGNET geomagnetic observatories (IMOs). The Scott Base Observatory (SBA), established in 1958, is located on Ross Island, Antarctica. The two "geomag" huts (Fig.1) are placed on volcanic rocks within a small area between the ocean and Scott Base.

Figure 1: Data continuously recorded in the Variometer Hut (left) every second are corrected to match the absolute observations conducted once a week by a Scott Base technician in the Absolute Hut (right). The huts are located on volcanic rock and next to the ocean (white background).

The noise caused by electromagnetic interference and power supply voltage variations (Fig 2.) is small compared to natural variations in the magnetic field. The surface rocks around Scott Base are highly magnetised and their magnetic properties have significant temperature coefficients. The temperature variation between summer and winter are large, causing seasonally varying localised gradients in the magnetic field; baseline values differ by ~50 nT between seasons. Repeat magnetic measurements conducted every five years away from Scott Base become important for obtaining a more robust picture of changes in the Earth's magnetic field in the Ross Sea region. The two sites are located on dry rock: Cape Evans was first measured in 1911-12 by the Scott expedition, measurements at Lake Vanda are dating back to 1974.

The remote location of SBA together with the long-term record of observations adds value to the global network. About 80,000 SBA daily files were downloaded for scientific use from INTERMAGNET in 2017.

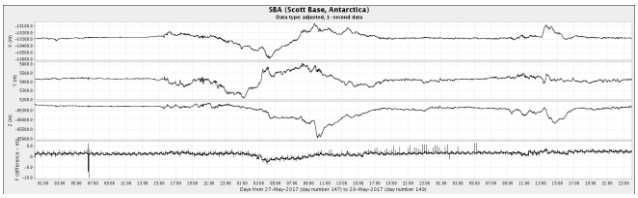

Figure 2: Three days of SBA 1-second data [nT]. XYZ are recorded by a FGE fluxgate magnetometer. F difference (the total field F', calculated from XYZ, minus F recorded independently by an Overhauser proton magnetometer) is a data quality indicator: the large spike is caused by a person entering the hut, the small ones by the nearby ionosonde and the frequent steps are due to an on/off heater system.

Scientists around the globe and within New Zealand use data from IMOs to study our Earth's protective shield, its interactions with the ionosphere, and the impact geomagnetic storms could potentially have on our modern society [e.g., Mac Manus et al. 2017; Rodger et al. 2017]. The International Geomagnetic Reference Model (IGRF) and World Magnetic Model (WMM), largescale representations of the Earth's magnetic field, are calculated from measurements made at IMOs and by satellites. The IGRF is used for applications in Space Physics, Exploration Geology/Geophysics, Deep Earth Geophysics, and Biology studies of animal migration. The WMM provides course correction for the world's smartphones, navigational systems of ships & airplanes, and geological applications such as drilling and mining.

References:

D. H. Mac Manus, C. J. Rodger, T. Petersen, 2017. Magnetic field variations during substorms: Scott Base, Macquarie Island, and New Zealand. New Zealand Antarctic Science Conference, Dunedin, 26-28 June 2017, abstract.

C. J. Rodger, D. H. Mac Manus, M. Dalzell, A. W. P. Thomson, E. Clarke, T. Petersen, M. A. Clilverd, T. Divett, 2017. Long term geomagnetically induced current observations from New Zealand: Peak current estimates for extreme geomagnetic storms. Space Weather, 15(11): 1447-1460; doi: 10.1002/2017SW001691

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