RESULTS FROM THE BGS SOUTH ATLANTIC OBSERVATORIES: ASCENSION ISLAND AND THE FALKLAND ISLANDS

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INTRODUCTION

In the early 1990s the British Geological Survey (BGS) installed two magnetic observatories in remote locations: one on Ascension Island and one on the Falkland Islands. The aim of this was to improve the distribution of observatories worldwide with the view to providing data for global magnetic modelling. In order that these observatories meet current INTERMAGNET standards in sample rate, data retrieval and baseline stability, the original systems were replaced in 2002 with tri-axial fluxgate magnetometers and proton precession magnetometers. New data acquisition hardware, software and network communications were also installed.

We introduce the observatories locations and instrumentation and show results obtained over the last decade. We examine the data quality and baseline stability of the two observatories, looking particularly at improvements to the results since upgrading the observatory systems. We discuss whether the results indicate that these two island observatories now meet the requirements for INTERMAGNET Magnetic Observatory (IMO) status.

Falkland Island observatory on Sapper Hill.

Ascension Island observatory on Donkey Plain.

Falkland Islands Observatory Statistics

Geographic:	051° 42' 15'' S	302° 06' 24'' E
Geomagnetic:	041° 38' 06'' S	011° 24' 00'' E
Height above MSL:	135m	

Ascension Island Observatory Statistics

Geographic:	7° 56' 58'' S	345° 37' 27'' E
Geomagnetic:	2° 18' 42'' S	056° 31' 30'' E
Height above MSL:	177m	

The British Geological Survey (BGS), as part of a programme funded by a consortium of oil companies, installed two magnetic observatories in remote locations in the South Atlantic Ocean. The aim of these installations was to improve the global distribution of magnetic observatories as coverage over oceans is much more sparse than on land. Improving the global coverage can help produce more accurate global models of the Earth's magnetic field and secular variation.

In August 1992 equipment specially designed to be operated in remote locations was installed on a site adjacent to the Cable and Wireless Earth Station on Donkey Plain, Ascension Island. This was followed in February 1994 with a similar installation on a site adjacent to a Cable and Wireless radio transmission site on Sapper Hill, Falkland Islands. Operating remotely means that the observatories are unmanned with absolute observations taken only once a month. Temperature control is also difficult due to limitations with the power supply.

The original equipment installed at each observatory was a $\delta D/\delta I$ Helmholtz coil system and a proton precession magnetometer (PPM). This Proton Vector Magnetometer (PVM) was capable of measuring total field (F) and changes in declination (δD) and inclination (δI) at one-minute intervals. Absolute observations of declination (D) and inclination (I) were made in order to derive baselines and obtain definitive vector data. This PVM system did not meet the INTERMAGNET standards with regard to sample rate, baseline stability or communications.

In June 2001 (Ascension) and February 2002 (Falklands) the PVM systems were replaced with tri-axial fluxgate magnetometers supplied by the Danish Meteorological Institute and PPMs reused from the PVM. The fluxgate is orientated to measure variations in horizontal (H) and vertical (Z) intensities and the orthogonal horizontal component, proportional to the variations in D. The fluxgate has a good temperature stability (<0.3 nT/°C) and also has increased insulation. Temperature recording equipment was also introduced although there is still no temperature control at the observatories.

New data acquisition hardware, software and network communications were also installed to sample and communicate one-second values of D, H and Z and ten-second values of F thus meeting IMO sampling and transmission requirements. This new BGS observatory system, the Geomagnetic Data Acquisition System (GDAS), is identical to those operating at the three BGS observatories in the UK.

As before absolute observations are made monthly by BGS trained local observers and by BGS staff during their annual service visits.

Left - *The original Falkland Islands PVM system.*

Right - *The same hut with the replacement fluxgate mounted on a concrete plinth.*

Right - *A close up of the GDAS system in the new fibreglass huts. The PPM is mounted on a pole to the right of the photo.*

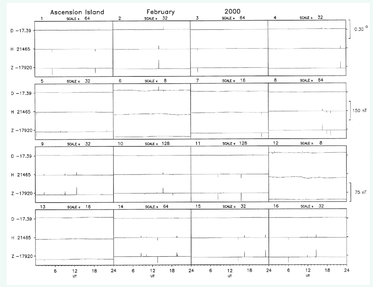
INTERMAGNET Magnetic Observatory minimum requirements

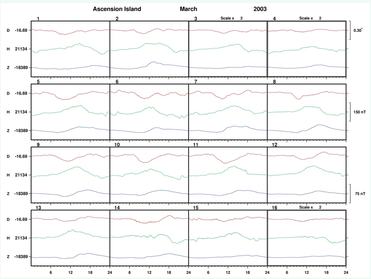
Definitive Data
Accuracy: ±5 nT

Vector Magnetometer
Resolution: 0.1 nT
Dynamic Range: 6000 nT (Auroral & Equatorial)
2000 nT (Mid Latitude)
Band Pass: DC to 0.1 Hz
Sampling Rate: 0.2 Hz (5 sec)
Thermal Stability: 0.25 nT/°C
Long Term stability: 5 nT/year

Scalar Magnetometer
Resolution: 0.1 nT
Sampling Rate: 0.033 Hz (30 sec)
Accuracy: 1 nT

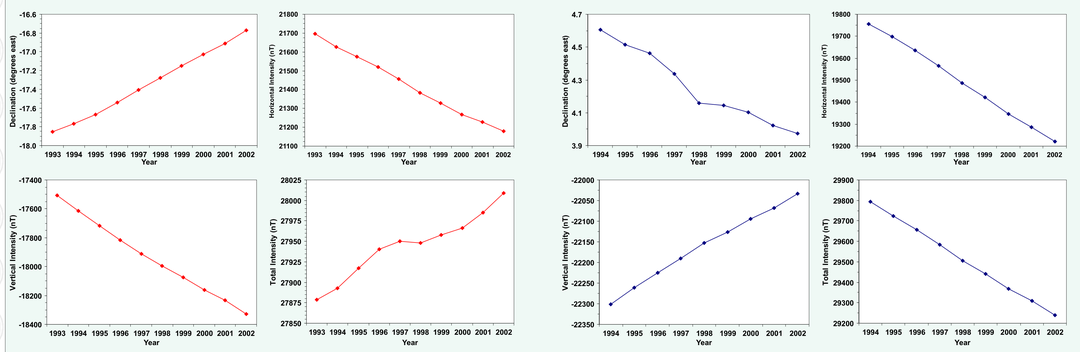
Transmission
By satellite of other electronic means within 72 hours of acquisition to a Geomagnetic Information Node (GIN).



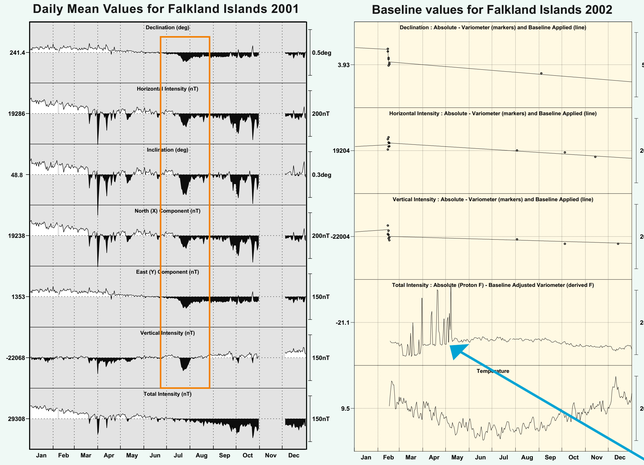


Above *-These two plots show 16 days of raw uncorrected data for Ascension Island. The plot to the top was recorded using the PVM system and shows frequent spikes and occasional data gaps. The plot to the bottom is data from the new GDAS system showing a significant improvement in data quality.*

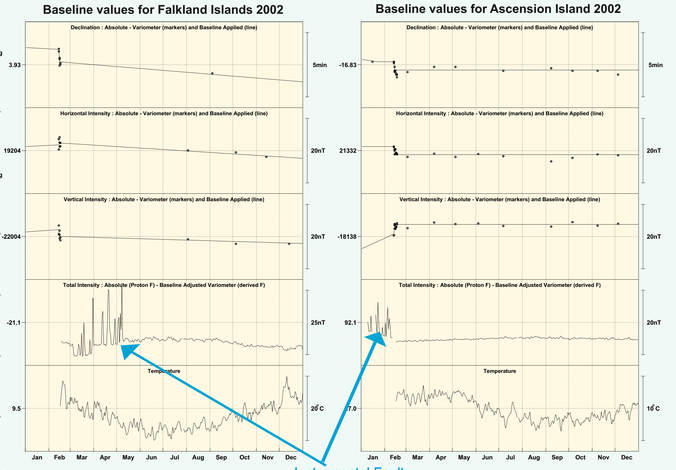
10 YEARS OF ANNUAL MEAN VALUES



Above *- The complete annual mean data for Declination, Horizontal and Vertical Intensity and Total Field for Ascension Island (Red) and the Falkland Islands (Blue). This shows that although the PVM systems were not up to INTERMAGNET standards it was still possible to produce monthly and annual mean values which are of consistently good quality.*



Above *- This plot shows the daily mean values for the Falkland Islands in 2001 recorded using the PVM. The highlighted section shows an anomalous variation not consistent with other observatory data. Since the observatory was established in 1994 we have found that during the winter months (June-Aug) the cold temperatures can affect the PVM measurements. In extreme cases ice has formed under the coil supports, changing the orientation of the instrument. This is the most likely cause of the type of drift shown in the plot. The GDAS fluxgate magnetometer (from DMI) uses suspension to overcome this problem and the installation of a new hut should reduce the build up of water that can later freeze. Evidence of the success of these changes is given by the stability of the baselines throughout the winter months of 2002.*



Above *- These plots show the baseline values for both Ascension and Falkland Islands for 2002. At Ascension an instrumental fault was corrected in February and since that time the baseline and the absolute observations have been very consistent. At the Falkland Islands shortly after the installation of GDAS in February a fault with the electronics was discovered. This caused the large closing errors from March to May when the electronics were replaced. Since then the baseline quality has been good.*

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CONCLUSION

The new observatory equipment at Ascension Island Observatory and the Falkland Islands Observatory meets the standards required by INTERMAGNET. Both observatories were accepted into INTERMAGNET in 2003. Daily data from these sites are made available globally through the world-wide web (www.intermagnet.org). The data will also be published on the annual INTERMAGNET CD-ROM.