THE UNITED KINGDOM GEOMAGNETIC OBSERVATORY NETWORK - DISSEMINATING ONE-SECOND DATA IN NEAR REAL-TIME

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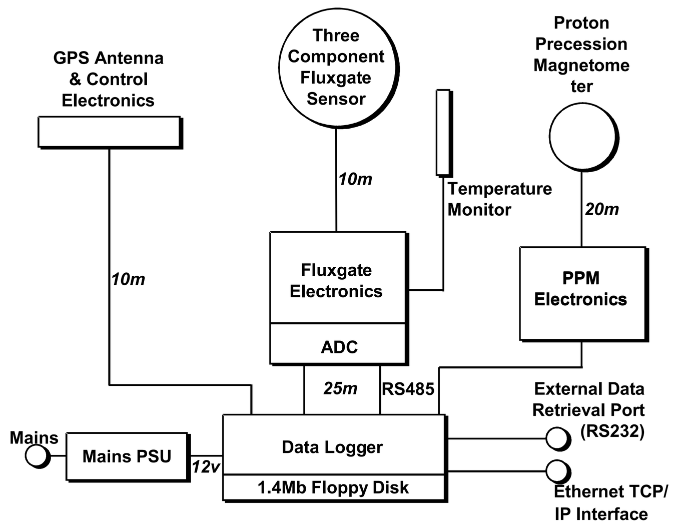
IUGG- Sapporo, Japan. July 2003. Session GAV.01

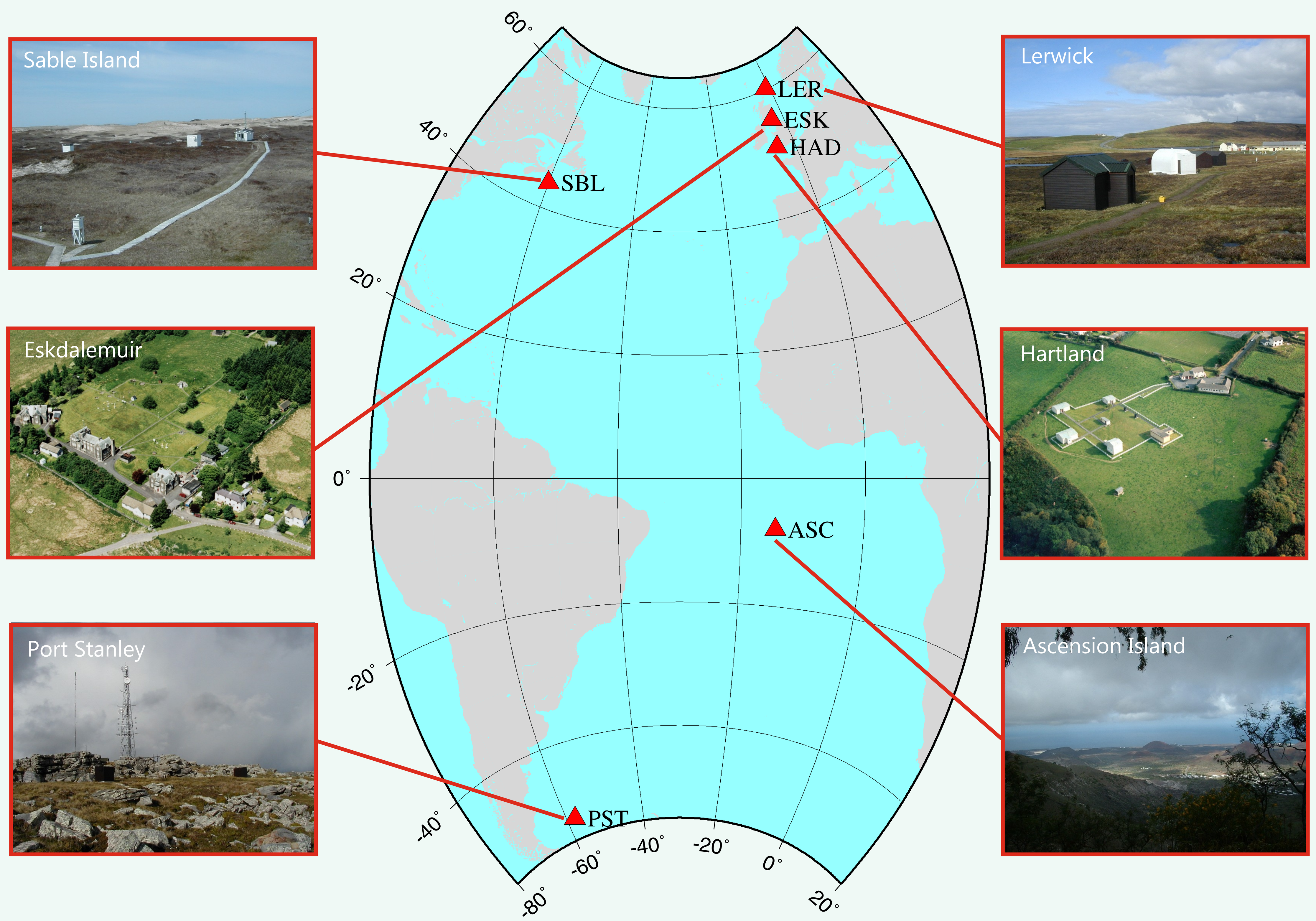
As the cost of processing power, data storage and communications have fallen, it has become increasingly viable to sample, store and transmit data at rates higher than the INTERMAGNET recommended standard of one-minute. The British Geological Survey (BGS) has completed an upgrade programme of its three United Kingdom geomagnetic observatories, in addition to those operated in the Falkland Islands and Ascension Island, to one-second data capture with near real-time communication. By fully automating the observatory recording equipment and data transmission to the processing centre, BGS has a reliable geomagnetic observatory network capable of meeting the current and predicted scientific and commercial demands for United Kingdom observatory data.

Since May 2001, BGS has undertaken a modernisation programme of its observatory recording equipment to take advantage of improvements in communications and reducing costs in data storage. The recording equipment developed by BGS to meet this purpose is the Geomagnetic Data Acquisition System (GDAS) which, in addition to a fluxgate magnetometer, proton precession magnetometer and network communications provides near-real time, one-second data to the central data processing node in Edinburgh. Since the observatories operated by BGS are largely unmanned, GDAS has provided BGS with greater control over their operation, resulting in data quality improvements and a more reliable data service to BGS's academic and commercial customers. The installation of GDAS in Port Stanley and Ascension Island has brought these observatories to the standard required for INTERMAGNET Magnetic Observatory (IMO)application.

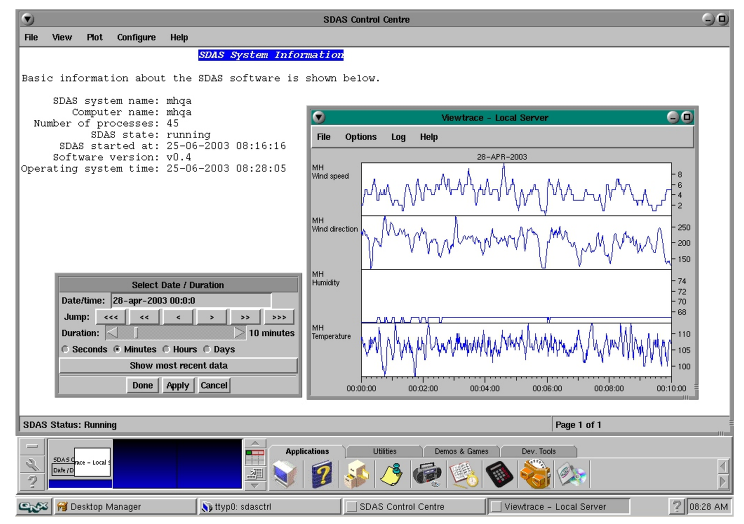
Central to GDAS is a low-power processor module which polls the sensors directly or via a 16-bit analog-to-digital converter synchronised to an internal, GPS-corrected, clock. Data are stored in a non-volatile buffer and are made available for dissemination through either a network port, RS232 serial port or floppy disk. The processor and the sensors are powered by a single mains-voltage supply with a 24 hour battery reserve. The architecture of the operating system and the design of the acquisition software provide a versatility that allows new sensors to be readily incorporated such that

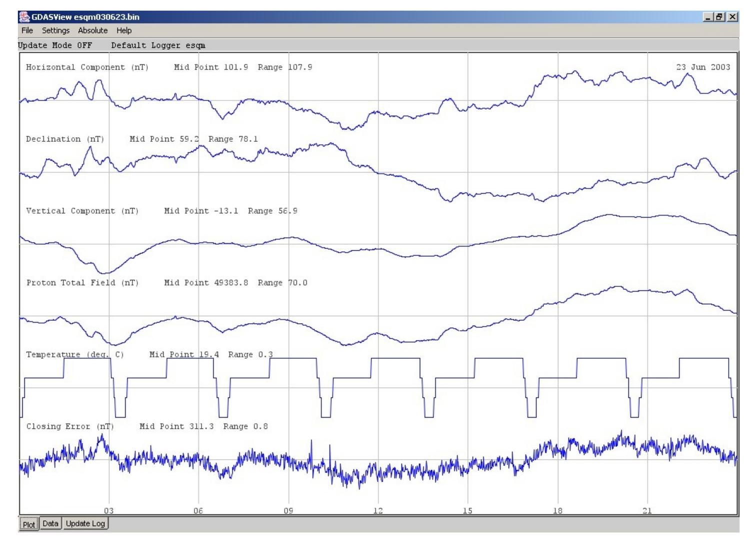


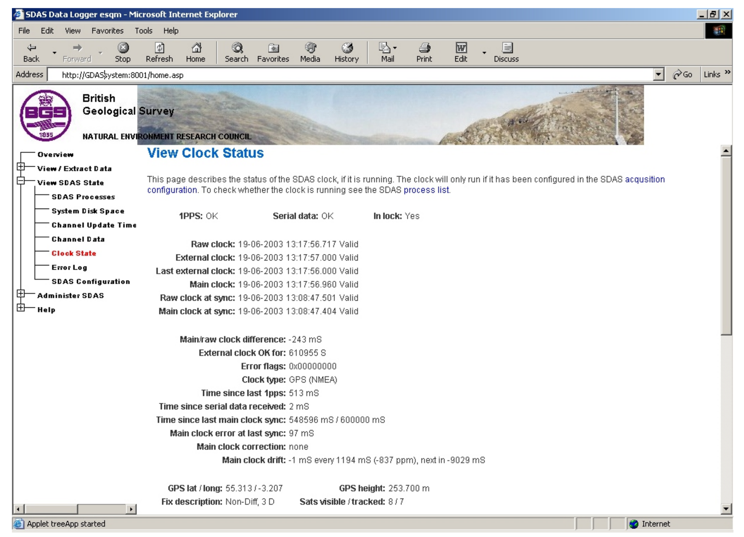
BGS Operated Observatories



In a standard GDAS configuration, one-second, three-component fluxgate magnetometer data, ten-second proton data and temperature are recorded in addition to one-minute filtered data and closing error (F_{PPM}-F_{flux}). The acquisition software can be controlled and data plotted locally using a graphical user interface running under QNX Photon. BGS has also developed software, including a set of Java classes, for remotely maintaining an observatory system. GDASView is a Java-based, Microsoft Windows utility for retrieving, recording and plotting data from a remote observatory GDAS recorder; while the SDAS acquisition software provides an HTML interface, for monitoring and

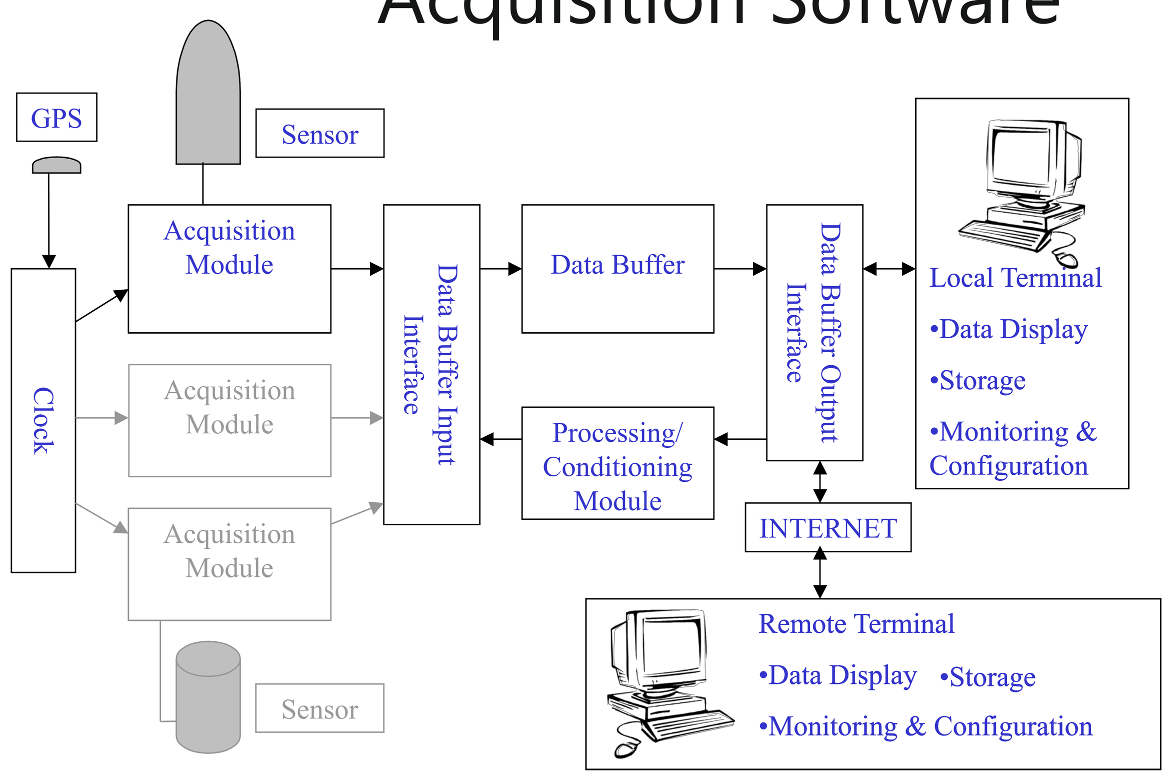






GDAS uses BGS's Simple Data Acquisition Software (SDAS) package. This is a modular package which runs under the Unix-like, QNX4 operating system and is designed to provide a versatile acquisition core onto which a full observatory application can be built. This is achieved by creating an interface with the internal clock and the data buffer such that only small individual drivers are required to capture and store data samples at periods between 1ms and 1hour. Since the output interface to the data buffer is similarly defined, these drivers may take the form of processing or conditioning modules, which extract data and process from one or more input streams, generating a new input stream. As an example, GDAS implements data filters and quality control in this manner.

Acquisition Software



A benefit of the modular architecture is the data may be disseminated to a number of output resources simultaneously. Possible resources include a local graphical display, removable media such as floppy disks or transmission media i.e. network or PSTN modem. Since the data buffer interfaces incorporate network communication protocols, the data collection in Edinburgh is implemented using an SDAS system with drivers configured to mirror the data buffer of the observatory systems across a network connection.

In addition to the data interface, SDAS also provides an interface to its operational status. Again this interface contains network protocols allowing an observatory system to be monitored and configured remotely.

The versatility of SDAS is intended to enable new hardware to be easily incorporated and as such, SDAS has found application beyond geomagnetic observatories including

GDAS Specifications

Mains Power Supply:	110/220 V, 50/60 Hz
DC Power Supply:	13.8 V, 1200 mA
Battery Backup:	38 Ah (>24 Hours)
Processor:	DSP Design TP400, 200 Mhz 4x RS232 Serial Ports 1x IBM Compatible Parallel Port 1x 10/100 Base-T Ethernet Port 20 Gbyte Internal Hard Drive 1.44 Mbyte Floppy Disk Drive
Data Storage:	>4 Years
Operating System:	QNX v4.25j
Acquisition Software:	SDAS v0.2
GPS Receiver:	Garmin GPS35-HVS
GPS Time Resolution:	±0.1s
ADC:	2x Advantech ADAM-4017
ADC Resolution:	1 & 10 μV
ADC Input Range:	±5 & ±10 V
ADC Sampling Rate:	4 channels/s

Vector Magnetometer

Type:	DMI FGE Suspended Sensor Fluxgate Magnetometer
Resolution:	0.2 nT
Dynamic Range:	Adjustable, ±1 to ±64 μT
Frequency Response:	DC - 1 Hz
Temperature Coefficient:	<0.3 nT/°C
Components:	Vertical and two horizontal plus temperature

Scalar Magnetometer

Type:	Gem Systems GSM-90 Overhauser effect Proton Precession Magnetometer
Resolution:	0.01 nT
Dynamic Range:	±20 to ±120 μT