



**British
Geological Survey**

NATURAL ENVIRONMENT RESEARCH COUNCIL



Applied geoscience for our
changing Earth

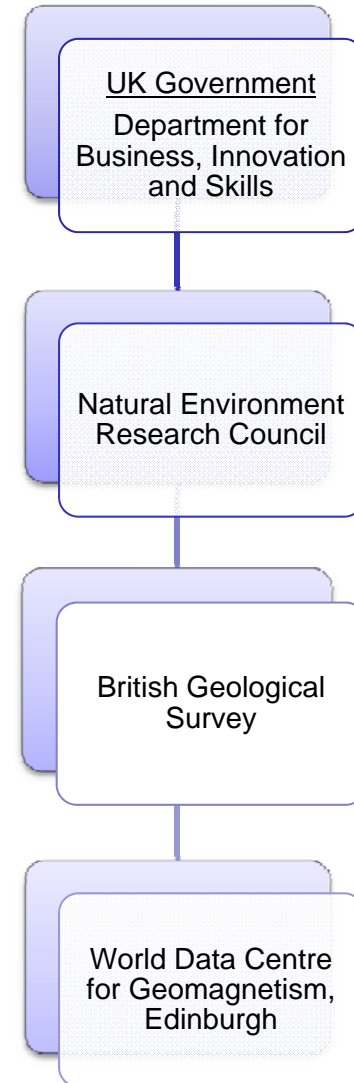
Operations of the World Data Centre for Geomagnetism (Edinburgh)

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Ewan Dawson, Susan Macmillan, Simon Flower,
Tom Shanahan, Thomas Humphries

<http://www.wdc.bgs.ac.uk>

Introduction

- The World Data Centre (WDC) for Geomagnetism in the UK was established in 1966 at Herstmonceux in Sussex and moved to Edinburgh in 1977.
- It is operated by British Geological Survey (BGS) a research institute funded by the UK government (see right).
- There are 7 staff directly involved in its operation as part of a wider Geomagnetism Team.
- Staff and the WDC have links to professional geomagnetic bodies IAGA and INTERMAGNET (including office bearer positions).



Staff Expertise

- Our WDC operations are part of a wider geomagnetism team.
- We also have experience in:
 - **Producing data** – we run geomagnetic observatories
 - **Using the data** – through scientific research
- So we have good all-round knowledge of geomagnetic data; how it is produced, how it is stored and how it is used scientifically.



The BGS Geomagnetism Team in 2009

Applications of our WDC Data

WDC Geomagnetism data can be used to help to provide scientific insight into:

The Deep Earth Interior

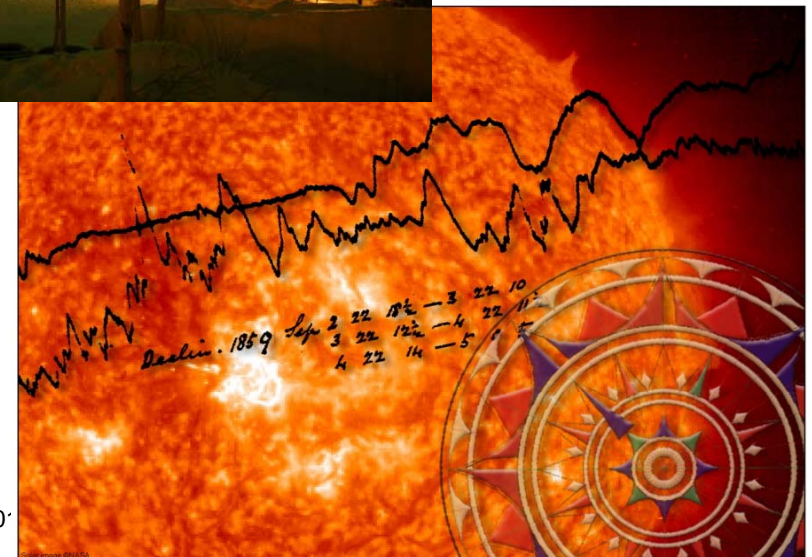
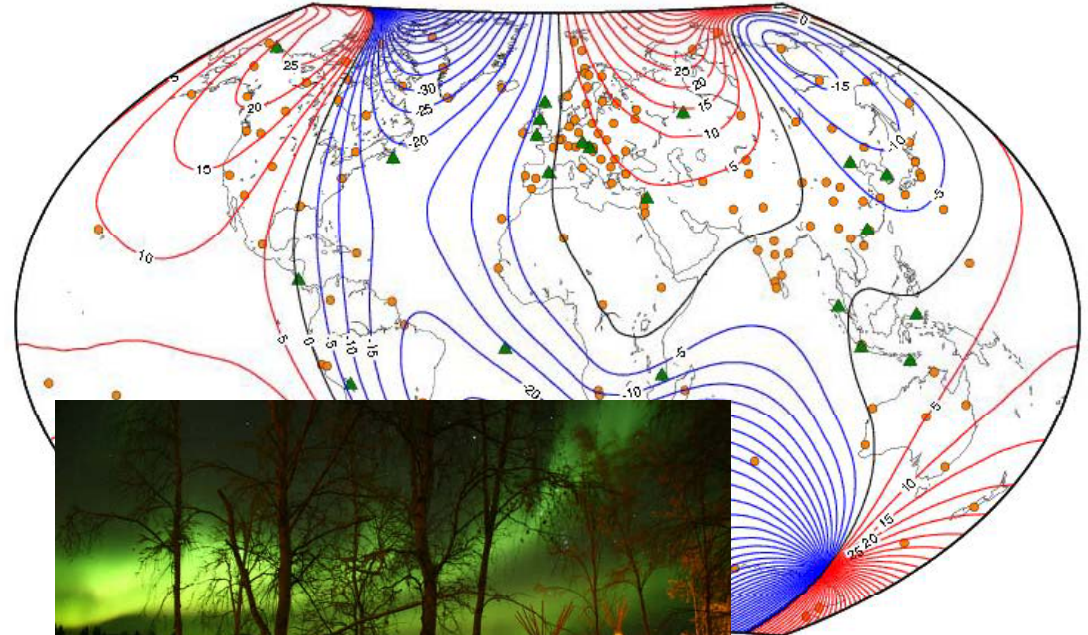
- long-term change - years to centuries - in the dynamo that sustains our magnetic field

Space weather

- short-term changes - seconds to days - in near Earth space and on the ground

Space climate

- long-term change - decades to centuries - in solar activity and consequences for Earth's environment



Current Holdings

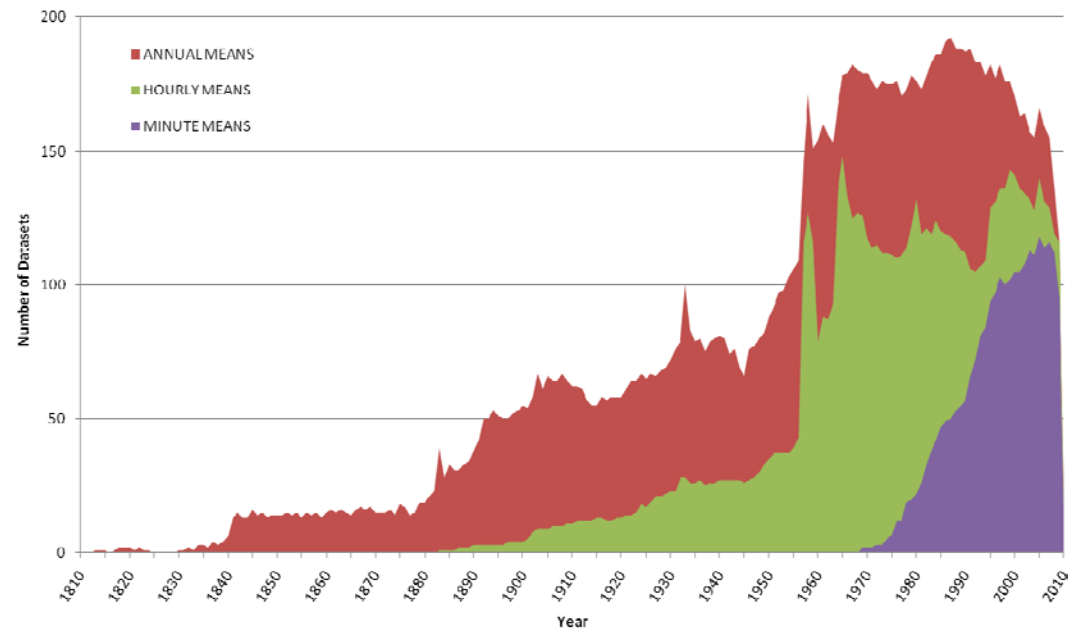
- Our largest data holdings are of geomagnetic observatory data.
- We hold annual, hourly, minute means for ~280 observatories worldwide.
- The data catalogue of minute & hourly means was previously held at WDC Copenhagen and transferred to us in 2007.

Top: Location of current & past observatories where we hold either annual, hourly or minute data.

Bottom: The number of data holdings by sample rate and year.



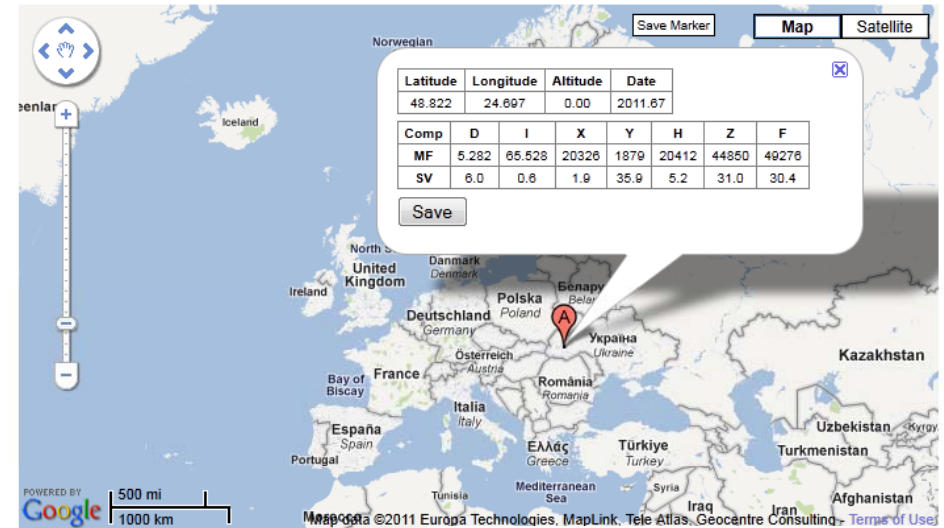
WDC Edinburgh Data Holdings



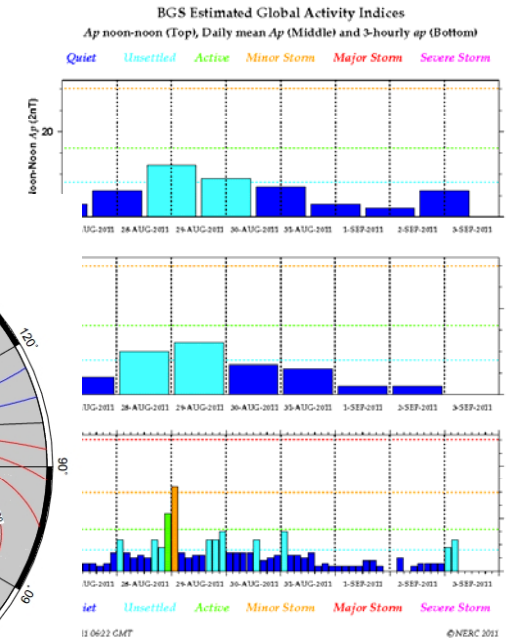
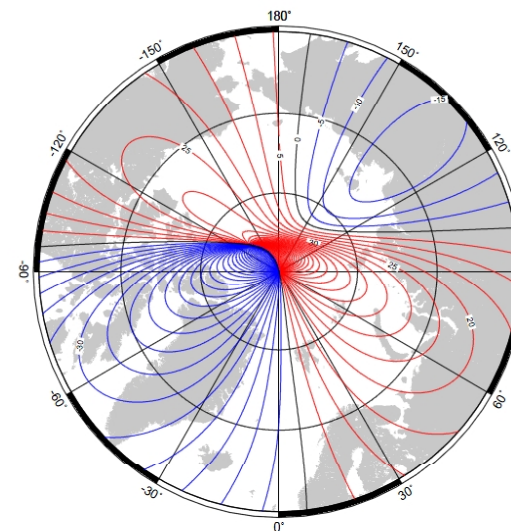
Current Holdings

We also hold the following types of data:

- Global & local magnetic model information
- Land, marine, aeromagnetic and repeat stations survey
- Solar & geomagnetic indices
- Analogue magnetograms
- Historical yearbooks, memoirs, logs etc.
- Ship-borne data
- Observatory metadata

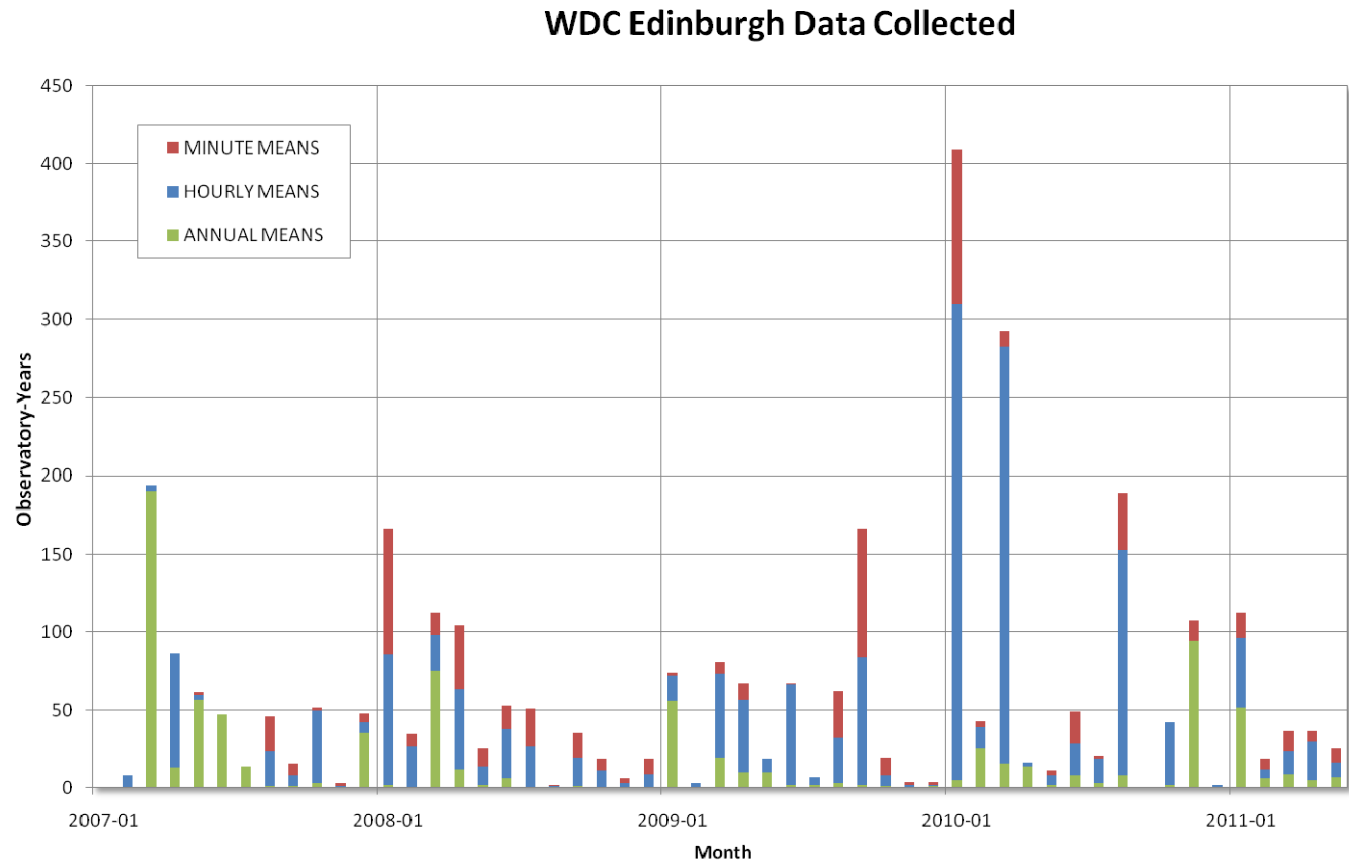


	D = Declination	I = Inclination	X = Nor Intensit
MF = Main Field	degrees east	degrees down	nT
SV = Secular Variation	arcmin/year	arcmin/year	nT/yea



A growing and active data centre

- We actively seek out data.
- We email an individually-tailored 'call for data' to each data-producing institute annually
- We also collect data from websites, INTERMAGNET and other WDCs.

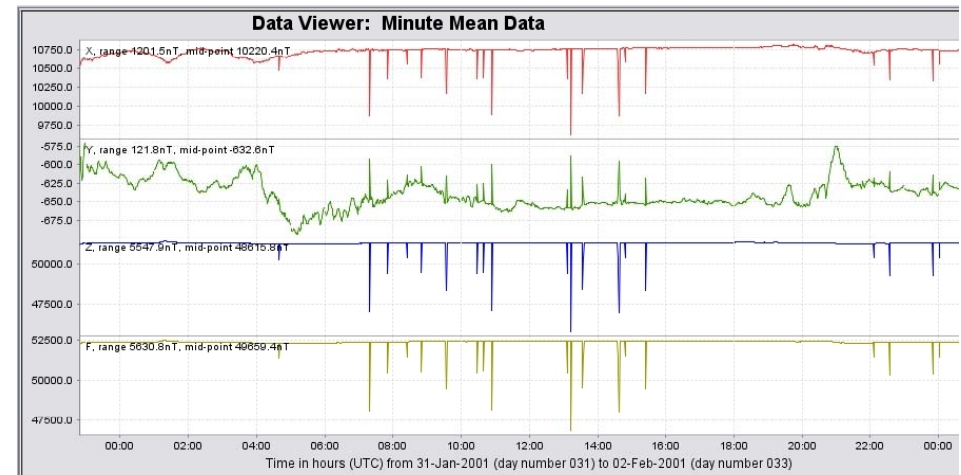
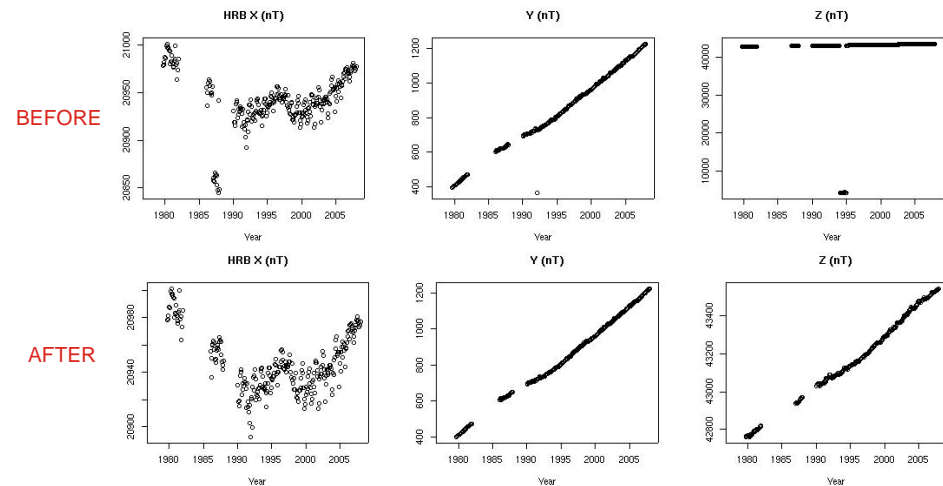


Above: The amount of new data ingested at the WDC each month since 2007.



Quality Control within our WDC

- We conduct quality assurance on all submitted data.
- We work with institutes & WDCs to improve or correct data.
- We recently conducted a programme to correct typographical errors in WDC.
- We are currently examining differences in data between Edinburgh & Kyoto WDCs.
- We are introducing quality information to observatory metadata.

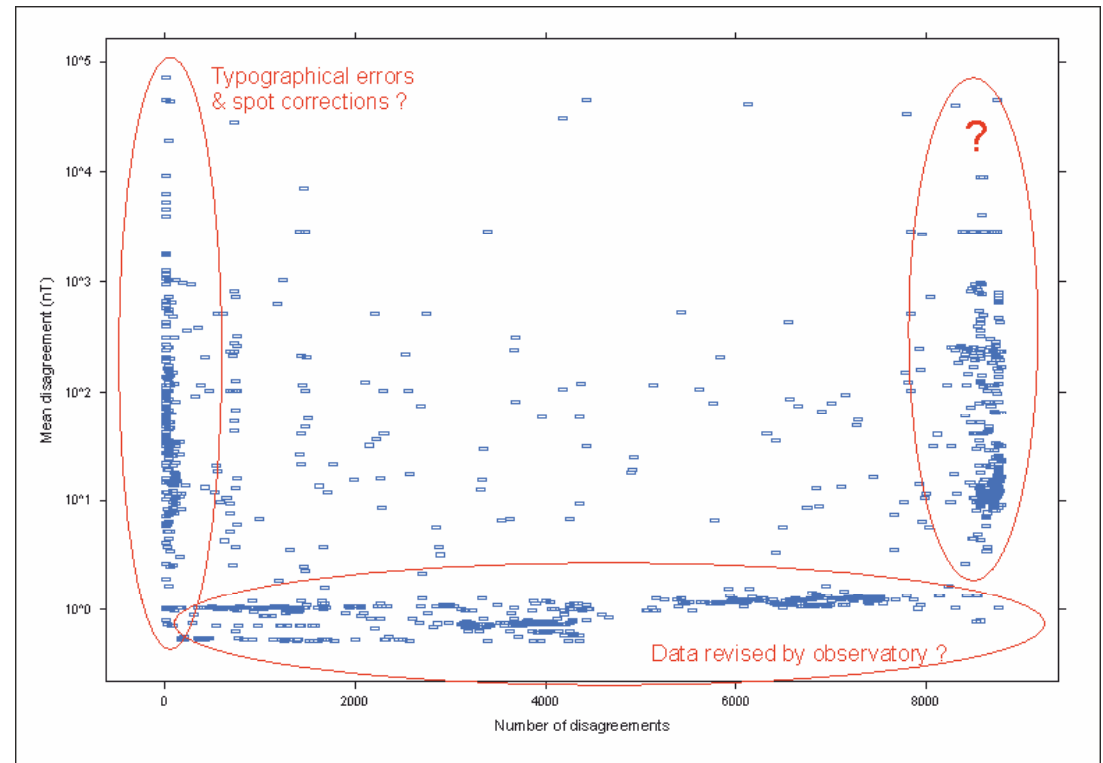


Example QC plots of hourly (top) and minute (bottom) data



Quality Control – Comparison with other geomagnetic data centres

- There are 286 observatories with hourly mean data held at both WDCs in Edinburgh and Kyoto.
- This spans 7,409 observatory-years of data.
- Almost 80% of these are in total agreement.
- For most, where there is disagreement they are small.
- For a small number of observatories the level of disagreement is high.
- We will try to correct these first.



Above: The total number of disagreements in an annual dataset compared to the mean disagreement.

From "A comparison of data holdings at World Data Centres for Geomagnetism in Edinburgh and Kyoto"
E Dawson, S Macmillan, T Humphries, C Beggan
IUGG 2011 poster



Metadata in Geomagnetism

Metadata Standards

- With WDCs Boulder and Kyoto we have examined establishing a metadata standard for geomagnetic data. We have encountered many issues with this.
- It is difficult to apply a standard to time-series data. Common metadata standards (e.g. ISO-19115 , FGDC) are based on spatial data which do not change with time. With geomagnetic data the metadata changes with time; most commonly as a result of a change in instrumentation or data processing and therefore data quality.
- Metadata standards are also complex. Records are long and the language of metadata may not be readily understandable. It is challenging to encourage observatories to adopt and populate standard metadata records.



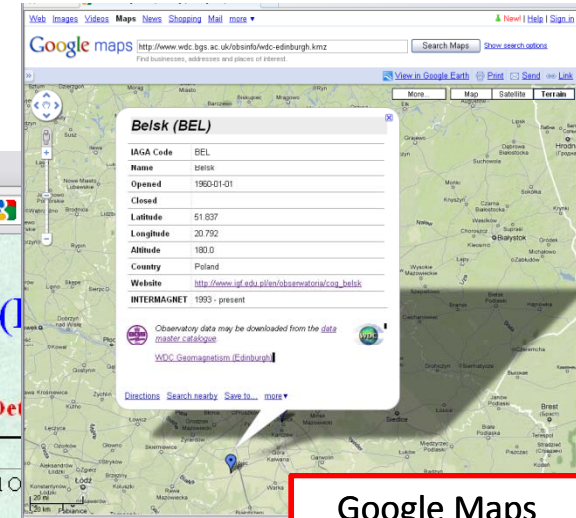
Metadata in Geomagnetism

Metadata in our WDC

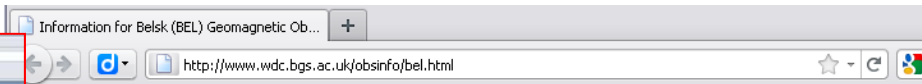
- We have focused on the acquisition of metadata in whatever form it takes.
- We now request metadata from operators during the annual 'call-for-data'.
- We have increased the scope of the metadata held (see next) encouraging links to other sources of metadata such as yearbooks and websites. Yearbooks remain the most complete metadata records available.
- We have a new free-form 'Notes' field to record any known QC issues. This will help users working with these data, inform observatory operators and give the WDC a place to note any modifications they make.



WDC metadata records



Google Maps Can view the location of all observatories in the WDC and their metadata.



World Data Centre for Geomagnetism (WDC)

Observatory Details

IGAGA Code	BEL
Name	Belsk
Opened	1960-01-01
Closed	
Latitude	51.837°N
Longitude	20.792°E
Altitude	180.0m
Country	Poland
Website	http://www.igf.edu.pl/en/obserwatoria/cog_belsk
INTERMAGNET Member	1993 - present
Notes	

Contact Details

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Fax	+48 48 6610840

Yearbooks

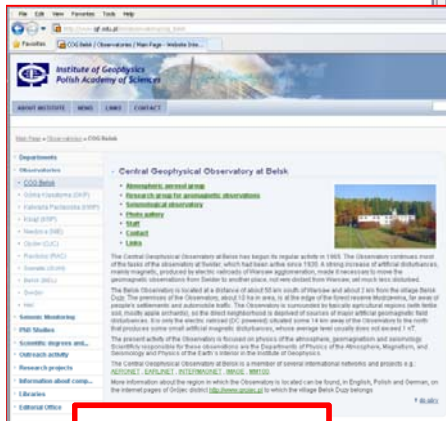
2008	ftp://ftp.nmh.ac.uk/wdc/yearbooks/poland_2008.pdf
2007	ftp://ftp.nmh.ac.uk/wdc/yearbooks/poland_2007.pdf
2006	ftp://ftp.nmh.ac.uk/wdc/yearbooks/poland_2006.pdf

Instrumentation

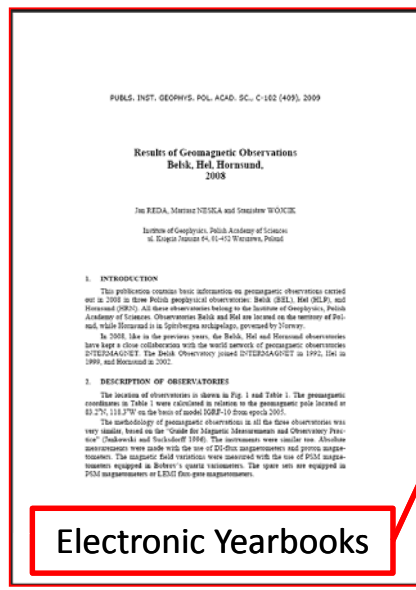
Instrument	Type	In Use From	In Use To
PMP-8 proton precession magnetometer (Institute of Geophysics PAS)	Scalar		
PSM Bobrov-type quartz variometers (Institute of Geophysics PAS)	Vector (XYZ)		
DI-fluxgate magnetometer (type ELSEC 810)	Absolute		

Instrumentation Records Including date fields to capture the time-varying aspect of an observatory's metadata.

User Notes Free-form area to note known issues with a data set.



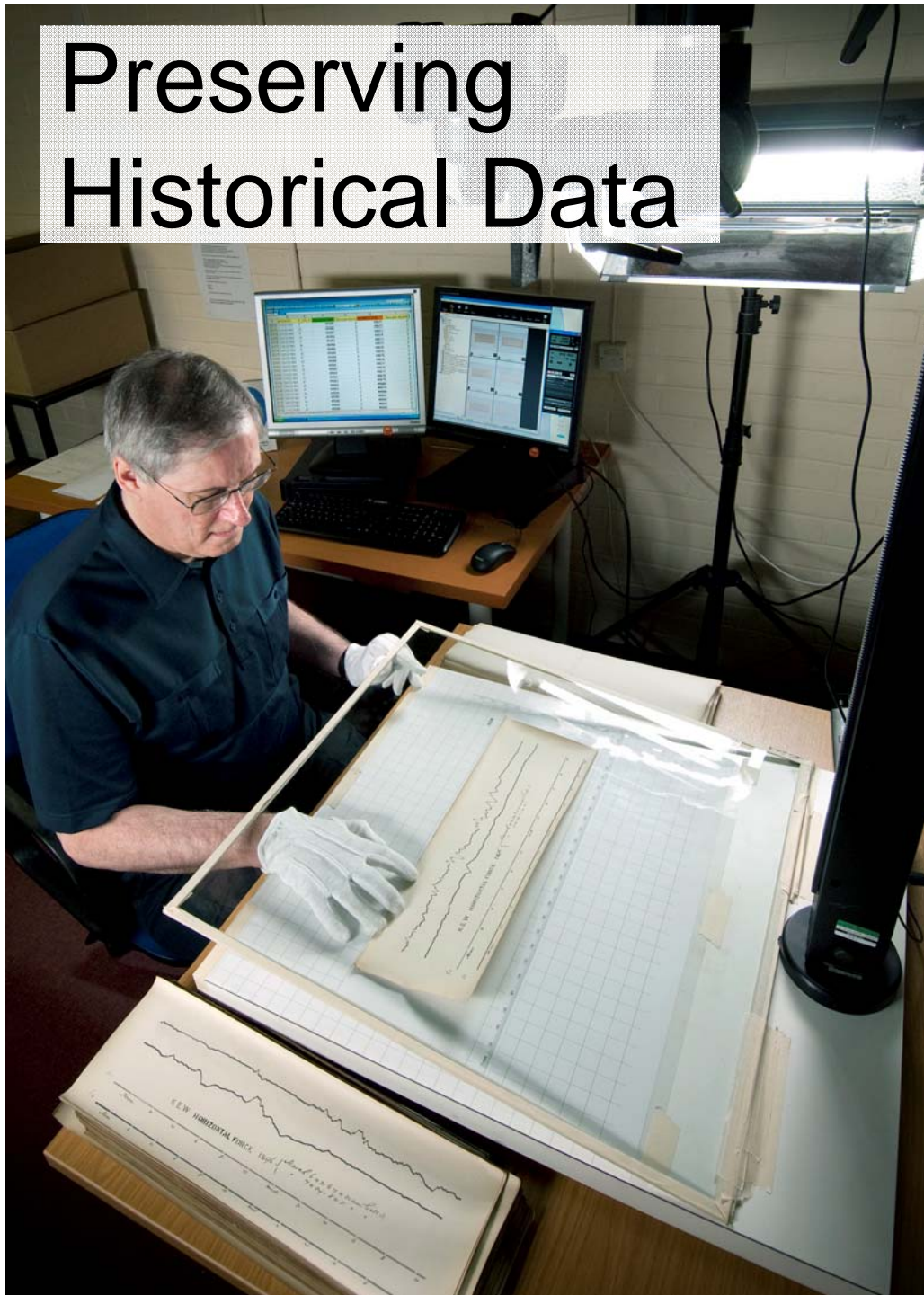
Website Links



Electronic Yearbooks



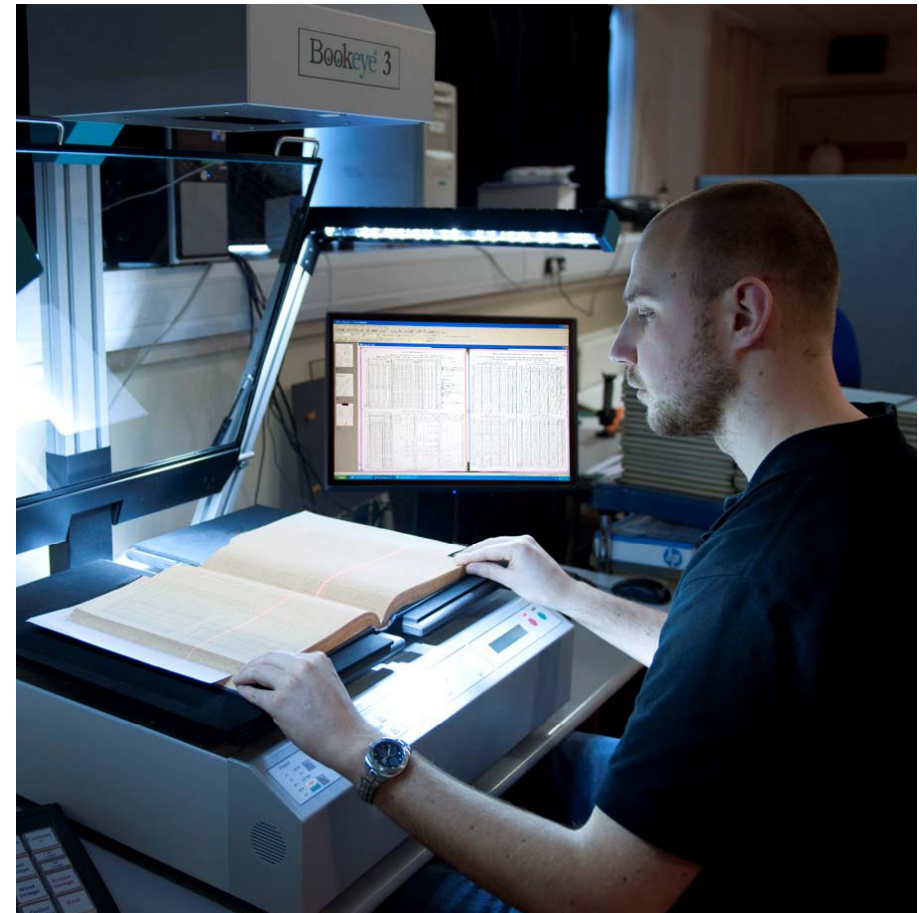
Preserving Historical Data



- In 2008 we began a programme of work to capture digital images of all historical UK magnetograms
- There are of 287,934 magnetograms in total (126,170 are fully complete and available, 125,764 magnetograms 'in processing' and 36,000 await scanning).
- The system (left), designed and developed by BGS includes a 21 megapixel resolution camera. It uses a flat plane macro lens to minimise distortion and a fixed focal length.

Preserving Historical Data

- We also have >500 ‘yearbooks’ and related old scientific papers
- Observatory yearbooks contain
 - Metadata for interpreting magnetograms
 - Other results, e.g. lists of storms, not reproduced elsewhere
 - 2-hourly and ‘extraordinary’ absolute measurements
- Magnetograms and yearbooks are stored in a climate controlled environment.



How to access to the digital archive

The screenshot shows the British Geological Survey website. The header includes the BGS logo and the tagline "Applied geoscience for our changing Earth". The main content area is titled "Historical UK magnetic observatory magnetograms and yearbooks". It features a search bar, a sidebar with navigation links, and a main text area with an image of the aurora borealis. The sidebar lists various services and data categories, with "Magnetograms" highlighted. The main text area contains a search button and a section titled "So what's the attraction of magnetograms?" which explains the value of the collection and lists key features like long-term changes, space weather, and space climate. A small chart shows the archive holdings of UK analogue magnetogram data from 1840 to 1980, listing observatories like Abinger, Eskdalemuir, Falmouth, Greenwich, Hartland, Kew, Lerwick, and Stonyhurst. A "Scanning the archive" section mentions a project started in January 2009.

The screenshot shows a web browser window displaying a digital magnetogram viewer. The browser title is "djatoka Viewer, based on IIPMooViewer 1.1 - Microsoft Internet Explorer provided by The British Geological Survey". The address bar shows the URL "http://kwrntsjava1:8480/adore-djatoka/viewer.html?url=info:mags/MAG4". The main content area shows a large, detailed magnetogram plot with a grid. Above the plot, there is handwritten text: "light shifted at 7 22 35" and "Cylinder not put forward at 8 22 3". To the right of the plot, there is a smaller inset image of a physical magnetogram. Below the plot, there are navigation controls including arrows and a magnifying glass icon. The browser interface includes standard menu items like File, Edit, View, Favorites, Tools, and Help, as well as a status bar at the bottom showing "Done" and "Local intranet".

<http://www.bgs.ac.uk/data/Magnetograms/home.html>

Future Developments

- WDS application submitted.
- Better data access & interface – Web Services ([See Ewan Dawson's poster](#)).
- Community tools – e.g. data format conversion web service.
- Better data quality – working with partner WDCs and institutes.
- Improving metadata records.
- More historical analogue data and yearbooks available electronically.
- One-second data - increasing demands on storage and distribution.



More Information?

Please speak to:



Sarah Reay

or



Ewan Dawson

at the conference.

