

# The EURISGIC database: a tool for GIC research

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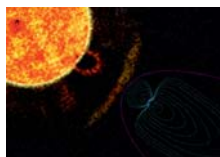
## INTRODUCTION

The first ever risk map of Geomagnetically Induced Currents (GIC) throughout Europe; the first European-wide real-time prototype forecast service of GIC in power systems; these research goals require well organised, easy to access, good quality, well defined and relevant geophysical data.

Four categories of measurements make up the main components of the database:

- In-situ solar wind;
- Ground based geomagnetic field;
- Ground based geoelectric field; and
- GIC in power systems.

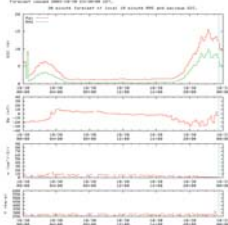
Good spatial coverage across the continent is important, as is coincident measurements from each category, over a wide mixture of geomagnetic activity levels. The period 1996 to 2008 has been selected as the main time period to focus on, covering a full solar cycle. Data from selected earlier/later major storms will also be included where data are available.



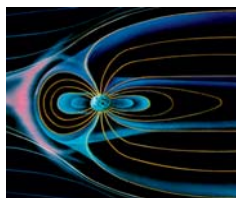
## SOLAR WIND DATA

The solar wind data are collated from various missions (see table below), with the primary spacecraft for EURISGIC being the ACE satellite. The data are held in the ODI database at IRF-Lund.

These data will be used in forecast development, evaluation of simulations (Solar Shield and GUMICS-4) and real time forecasts of GIC. An example of the 30 minute ahead GIC predictions using solar wind data from the archive is shown for the storm of 30th October 2003.



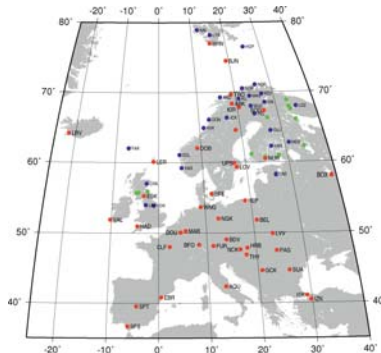
Data Source	Solar Wind Location	Measurements	Data collected from	Data availability
ACE Spacecraft	L1	Mag & Plasma	SWFC/NOAA	ODI Database IRF, Lund
SOHO Spacecraft	L1	Plasma only	Univ. of Maryland	
WIND Spacecraft	Various	Mag & Plasma	GSFC/NASA	
OMNI Database	Various (shifted near bow shock nose)	Various	GSFC/NASA	



## GEOMAGNETIC FIELD DATA

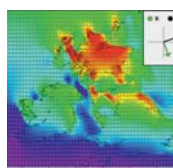
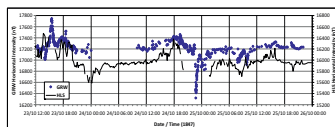
There is wealth of ground based geomagnetic field data across Europe from both magnetic observatories and variometer stations (see map). The work of the project is to establish a common type and format for all data sets. The table at the bottom summarises the current data availability. These data will be used in the analysis of GIC risk, geoelectric field modelling, research into the worst case scenarios, forecast development and empirical evaluation of forecasts.

Type	Independent QC	Organisation/Network	Responsible Institute	Data availability
Observatory (red spots)	full	INTERMAGNET	GSC (+others)	WDC, Edinburgh
	part	WDC	BGS (+others)	
Variometer (blue spots)	part	IMAGE	FMI (+others)	FMI, Helsinki BGS, Edinburgh
	part	SAMNET	Lancaster Univ.	



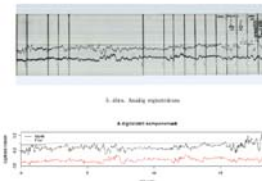
Note: Green spots are the locations where direct GIC measurements are made or have been made in the past - discussed in the section on GIC data.

It is also hoped to be able to supplement the geomagnetic database with data from selected major storms from the historical archives held by BGS. Digitisation of the UK archive of analogue magnetograms and yearbooks is on-going. Selected events in 1847 at Greenwich have been digitised from the Yearbook to test the usefulness of these data. An example is shown compared with measurements made at Helsinki over the same time period.



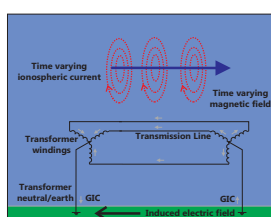
## GEOELECTRIC FIELD DATA

Geoelectric field measurements started at Nagycenk Geophysical Observatory in 1957 and have continued ever since. This long running series is being used in the research project to develop conductivity models for Europe and for comparisons with modelled geoelectric field calculations.



Digital data are available from 1997 and there is an on-going campaign to extract digital values from the analogue records over the 40 years prior to this, to complete the series. The data are held at GGRI. (Also, see poster by Vesztergom *et al* in this same session).

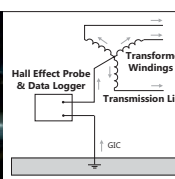
A demonstration of the manual digitisation process is shown here, including the tablet used, an example of an original analogue record (top) and a plot of the data extracted from it (middle).



## GIC DATA

GIC flowing in power systems can be measured directly at the transformer earth line. Various historical measurements from Finland (from 1996), Sweden (1990s), Russia (mid 2000s) and UK (2000-2005) are available for the GIC database.

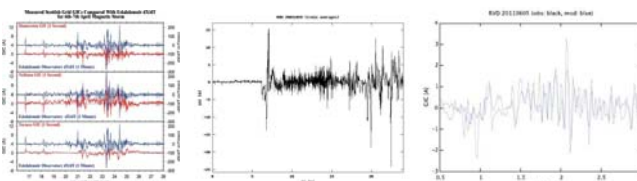
Continuous GIC measurements are now being made at five sites in the North-West Russian power grid (see poster by Sakharov *et al* in this same session). These data are collected in near real time and are available through the [eurisgic.org](http://eurisgic.org) website, where plots are also publicly available (see poster by Katkalov *et al* in this same session). Continuous measurements are also made in Finland and Scotland with plans to do so in England. GIC



measurement locations are marked by green dots on the map in the geomagnetic field section.

This picture and diagram, courtesy of Scottish Power and A.J. Mackay, show a typical example of the set up required to measure and record GIC.

Plotted examples of GIC data held are shown from April 2000 (Scottish Power), October 2003 at Rauma (Fingrid Oij) and more recently, June 2011 at Revda (IDGC of the North-West, Russia).



## CURRENT AND FUTURE DEVELOPMENT

An evaluation of the quality of the various data sets is now required and work to investigate this is underway. A full catalogue of all data holdings is also being prepared and technical documentation is planned.

Magnetic and geoelectric indices will be included to enable analysis over a longer period than the current higher time resolution data sets allows. Appropriate indices for GIC research will be selected.

The data archive will be maintained and updated into the future to provide a tool for EURISGIC activities and to ensure data availability for future GIC research.

## Acknowledgements

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We also acknowledge the following organisations for their support and the provision of the GIC recordings: Fingrid Oij and Gasum Oy, both of Finland; the Centre for Physical and Technical Problems of Energy in Northern Areas, Federal Grid Company of Unified Energy System and IDGC of the North-West all of Russia; Elforsk, Syd Gas and E.ON Sverige AB all of Sweden; and Scottish Power and National Grid, both of the UK.

Scientific data providers of the in-situ solar wind and geomagnetic field discussed in the paper are also acknowledged.

We also acknowledge all other colleagues and institutes within the EURISGIC consortium, especially colleagues of the Polar Geophysical Institute for the GIC recordings archive.