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ESA Space Weather Study (ESWS)  
WP500. European Co-ordination

# Catalogue of European Space Weather Resources

**ESWS-RAL-RP-0001**  
**Issue 1.1 19 November 2001**

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## 1 Preface

### 1.1 Document change record

Issue	Date	Notes/remarks
0.1	26 Nov 2000	First draft for internal review
1.0	04 Jan 2001	First version for delivery to ESA
1.1	19 Nov 2001	Revised version: <ul style="list-style-type: none"> <li>• More resources included</li> <li>• Updated statistical results</li> <li>• Deleted analysis of distribution by consortium</li> <li>• Added deeper analysis of measurement resources</li> </ul>

### 1.2 Purpose of the document

This report is a summary catalogue of European space weather resources. This has been prepared as the first stage of WP500 of the Study for an ESA Space Weather programme (ESTEC Contract No. 14069/99/NL/SB). The work package is concerned with analysis of options for co-ordination of European space weather resources. Thus its first stage is to identify those resources as is done in this report.

### 1.3 Definitions, acronyms and abbreviations

BIRA	Belgian Institute for Space Aeronomy
EISCAT	European Incoherent Scatter Radar
ESA	European Space Agency
ESTEC	European Space Technology Centre
FMI	Finnish Meteorological Institute
SPEE	Study of Plasma and Energetic Electron Environment and Effects
SPENVIS	Space Environment Information System
SQL	Structured Query Language
SuperDARN	Super Dual Auroral Radar Network
SWEN	Space Weather Euro News
WP	Work Package

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#### **1.4 Important Documents**

- D1 Statement of Work for ESA Space Weather Programme, Appendix 1 to AO/1-3533/99/NL/SB
- D2 Study for an ESA Space Weather programme, RAL/RRS/116/99, Proposal in Response to ESA ITT AO/1-3533/99/NL/SB.
- D3 Roadmap for European co-ordination in space weather, ESWS-RAL-RP-0003
- D4 ESWS-RAL-TN-0001, A definition of instruments needed for space weather measurements

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## 2 Introduction

This report is a catalogue of some 222 European space weather resources that have been identified as a result of a survey undertaken during the course of our study. The catalogue has been used to analyse options for better co-ordination of European space weather activities [D3].

Any catalogue of this kind is inevitably a sample of a larger population. Thus it is important to understand the nature of the sampling, to explore its limitations and to develop ways of overcoming those limitations. To support this the report includes a statistical analysis of results. This has allowed us to identify possible weaknesses and to propose ideas for future improvements to the catalogue.

In this updated version of the catalogue some of the weaknesses in version 1.0 of the catalogue have been addressed. In particular, we have much better coverage of European resources in terms of expertise to build space instrumentation. But there remain important areas in which this work could be taken further – see section 6.

## 3 Structure of the document

The rest of this report is structured as follows:

- Section 4 describes the methodology used to collect and store information on space weather resources. This includes a discussion of what is considered as a European space weather resource, the various methods by which data have been obtained, the way in which resources have been classified and a short description of the relational database used to store data on resources.
- Section 5 presents the results of several statistical analyses of the result – namely the distribution of the resources according to a number of parameters, e.g. data sources, countries, resource types, etc. It now includes a deeper statistical analysis of ground-based measurement resources in Europe. This is a very large group of resources (95 out of the total 222) and is therefore susceptible to deeper statistical analysis.
- Section 6 presents options for further extension of the catalogue.
- Annex A presents a summary list of all European space weather resources that we have so far identified.

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## 4 Methodology

### 4.1 What is a European space weather resource?

This catalogue will be the basis for subsequent analysis of options for co-ordination of European space weather resources. Thus we have adopted an inclusive strategy to ensure the widest input to that analysis. We have included all of the following:

- Resources under the control of organisations based in any European country and not just the ESA Member States. This will allow the subsequent analysis to consider options for ESA collaboration with non-Member States.
- Resources under the control of organisations based in Canada – in view of Canada’s participation in ESA activities
- Resources controlled by pan-European and international organisations with European participation, e.g. ESA itself.
- Collaborative programmes led from the US but with significant European participation, e.g. SuperDARN

Note in particular that we have NOT restricted the catalogue to resources geographically based in Europe. There are many European resources in other geographic regions, e.g. there are significant British and French facilities in Antarctica and its surrounding regions.

Note also that this catalogue is just a list of resources and their technical capabilities. No attempt has been made to judge the relative merits of different resources. That would be a further major task that is beyond the scope of resources available to compile the catalogue.

### 4.2 Data sources

This catalogue is primarily based on a survey that took place between August and October 2000, but has been updated thereafter as new information have become available<sup>1</sup>. A variety of sources of information were used as follows:

- We solicited inputs from operators of space weather resources. A note was distributed to the ESA electronic newsletter Space Weather Euro-News (SWEN) and to European users of the Space Environment Information System (SPENVIS) operated by BIRA.
- We analysed the European entries on two web servers providing information on space weather resources. These were (a) the SPEE server built by FMI under an earlier ESA contract and now maintained by them, and (b) the space weather server at ESTEC.
- We analysed information contained with our own proposal for the present contract and information that has arisen in the course of work under the contract
- We received several helpful inputs from ESA
- We made much use of the wide personal knowledge of the study team
- Most importantly, we examined the web sites of resources found using the sources described above. The links from these web sites led us to many other interesting resources.

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<sup>1</sup> Further inputs are welcome – please contact Mike Hapgood (Email: <mailto:M.Hapgood@rl.ac.uk>).

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- A large amount of data was also obtained as feedback from WP421, the payload definition work package [D4].

### 4.3 Types of resources

As the survey progressed it became clear that there was a considerable variety of types of resources that might usefully be considered. The table below lists the types that have so far been identified, together with a short description of each type.

Note that this list includes existing facilities (Data centre, Ground-station, Information, Measurement), technological resources (Instrument, Platform), research activities from which new facilities might be developed (Concept), modelling activities that can be used to generate space weather products (Model) and programmatic resources (Network).

We also include a category of Historical resources; these are examples of historical studies that may illuminate future programmes. The examples recorded in this catalogue relate to military space weather studies performed in Europe during the Second World War. They indicate the long-standing nature of some of the problems caused by space weather.

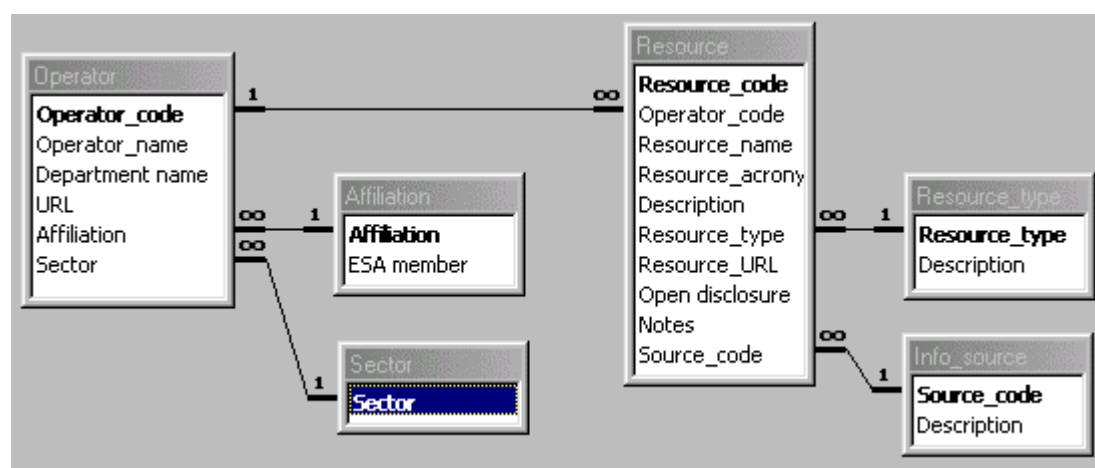
Resource Type	Description
Concept	Intellectually developed concept relevant to future space weather activities.
Data centre	Centre which archives and disseminates data that may be relevant to space weather
Ground-station	Station for reception of spacecraft telemetry – and possibly uplink of commands
Historical	Record of historical space weather studies that may illuminate future programmes.
Information	Source of general information (not just data) relevant to space weather
Instrument	Scientific instrument that can be used for measurements of parameters relevant to space weather
Measurement	Service that provides regular measurements of parameters relevant to space weather
Model	Model or software from which space weather services are or might be provided
Network	Group of people and/or organisations that plays a role in European space weather activities
Platform	Expertise in satellite platforms – especially the smaller types (mini-, micro- and nano-satellites) that may be important for a space weather programme



#### 4.4 Database

Information on individual space weather resources has been recorded in a relational database. This allows considerable flexibility in the production of different reports on the resources, e.g. statistical analyses, different classification hierarchies. The reports based in the rest of this document are derived from the database. Other report formats are possible.

In designing the database every attempt has been made to ensure normalisation of the basic tables. For example, the diagram below shows the core database tables and their relationships. The key factor is that information about operators has been separated from that about resources (because many operators control multiple resources). Some key attributes of the main tables are controlled by referential integrity rules linked to subordinate tables. For example, the affiliation (country, international organisation, etc) of an operator is controlled by reference to a list of allowed affiliations.



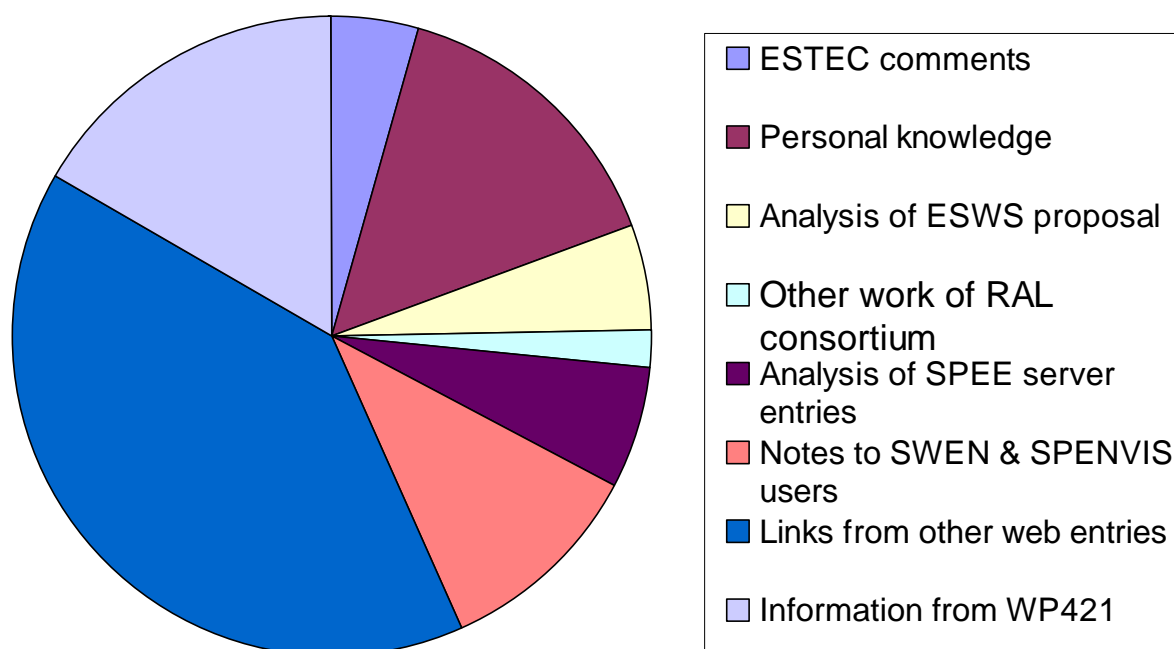
For a description of the fields shown in this diagram see the summary list of resources in Annex A. You may also find it helpful to examine the statistical results presented in the next section.

## 5 General statistical results

The results presented in this section were derived from our database of space weather resources. In each case we prepared an SQL query that would extract a list of the suitable data, typically a list of numbers of resources in various categories. This list was copied into an Excel spreadsheet where it was processed to generate the graphics and tables shown below.

### 5.1 Distribution by data source

The pie chart below shows how the information on resources was distributed from different sources. You can see the dominant role played by the tracing of web links. Personal knowledge, the instrument definition work (WP421) and users' own inputs are also very important.

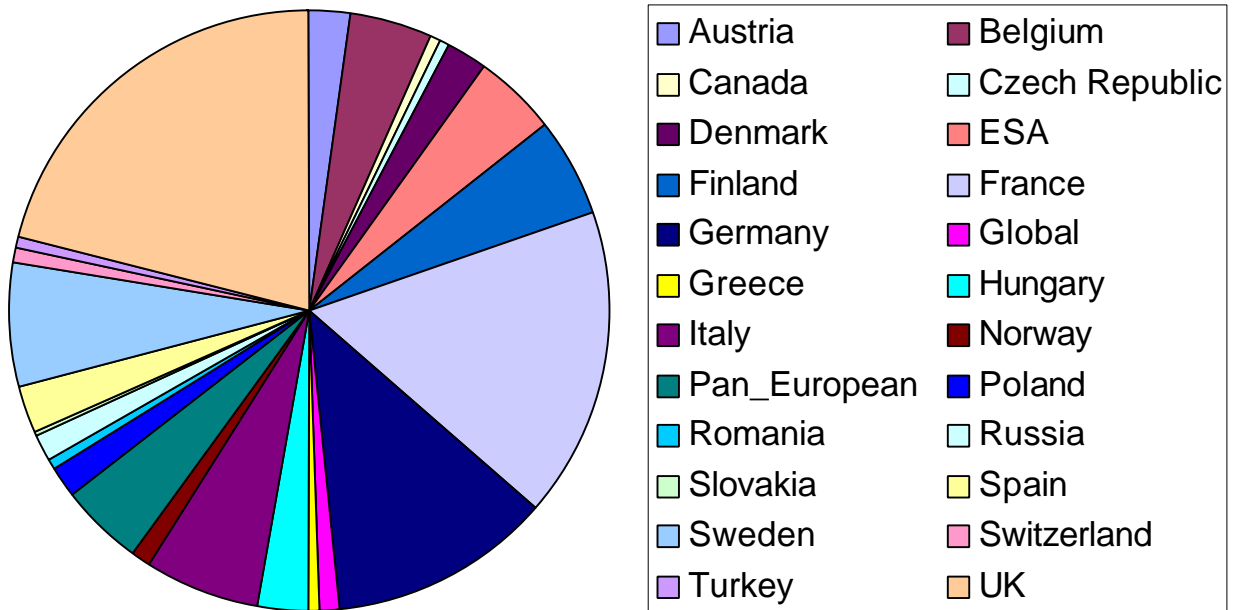


**Figure 1 Distribution of catalogued resources by data source**

The significant role of personal knowledge is unavoidable (the alternative would be to ignore that knowledge) but must be treated with caution as it may bias some of the other results discussed below.

### 5.2 Distribution by country

The pie chart below shows the distribution of catalogued resources according to the country in which their operator is based. Note that there are three special categories in addition to countries. These are (a) resources operated by ESA, (b) resources operated by other pan-European organisations (e.g. EISCAT), and (c) resources operated by global organisations (with European participation).

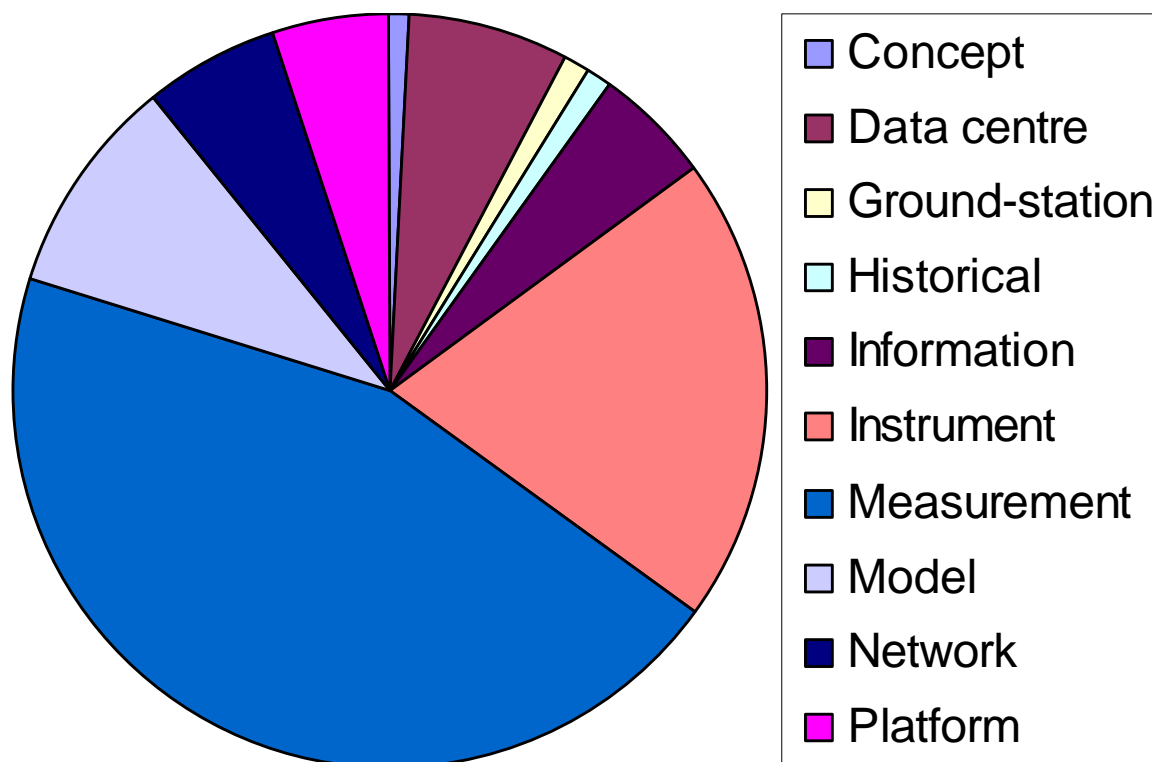


**Figure 2 Distribution of catalogued resources by country**

The countries with the largest numbers of catalogued resources are France, Germany and the UK as one might expect given their strong economic position and interest in solar-terrestrial physics. Italy is also well-represented if at a slightly lower level. The apparently greater number of UK resources is probably a bias arising from the author's personal knowledge of UK resources. It should be corrected as further resources are added to the database. Most of the Scandinavian countries (Denmark, Finland and Sweden) are also well represented - as one would expect given their strong role in studies of solar-terrestrial physics. However, the tiny fraction of entries from Norway seems bizarre - but it must be remembered that Norway is the host to many resources operated by pan-European organisations. The latter are strongly represented in the catalogue and include several key resources located at Tromsø and on Svalbard.

### 5.3 Distribution by type

This pie chart below shows how the catalogued resources are distributed between the different types of resources that were identified in the course of the survey.



**Figure 3 Distribution of catalogued resources by type**

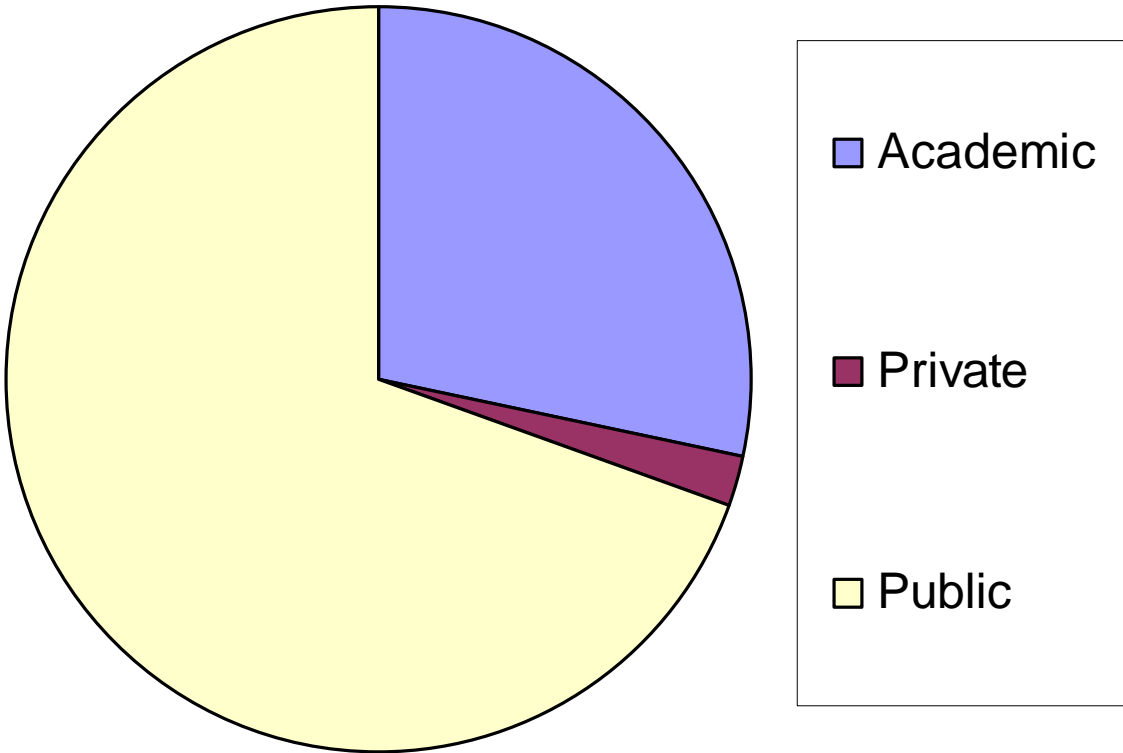
You can see that the catalogued resources are pre-dominantly measurements of space weather parameters together with the associated expertise in instrumentation. Modelling and information services (data centres and information servers) are also well-represented. The growing community interest in space weather is also clear – as represented by the significant contribution of network resources.

The representation of resources that could underpin the development of a new space-based programme of measurements of space weather parameters is somewhat variable. There is strong representation of instrument expertise and significant representation of platform expertise. But ground-station resources are poorly represented. Additional data is needed in the last area.

One area that is poorly represented is concept resources - research knowledge that could be used to develop new technologies for space weather measurements and prediction techniques. It is difficult to believe that this represents the real situation in Europe and thus it is proposed that a further survey should be carried out after the end of the study - with the aim of capturing more data from this category.

#### 5.4 Distribution by sector

The pie chart below shows the distribution of resources between those operated by different types of organisations - namely academic, private sector and public sector. As one might expect, the field is almost entirely dominated by academic and public sector bodies. There is, as yet, little private sector activity in terms of European space weather resources.



**Figure 4 Distribution of catalogued resources by sector**

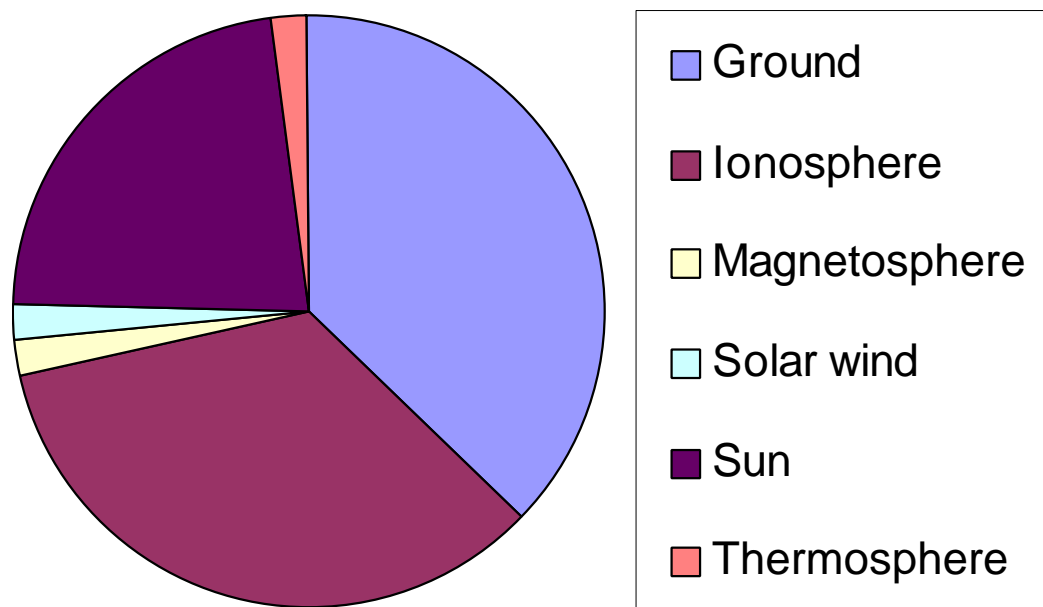
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### 5.5 Statistical analysis of ground-based measurement resources

The catalogue contains 95 items that represent ground-based measurements of space weather parameters. The figure below shows how these can be used to monitor various different space weather domains:

- ground effects (e.g. neutron monitoring, geomagnetic variations)
- ionosphere (e.g. critical frequencies, total electron content, convection velocities)
- magnetosphere (e.g. particle precipitation)
- solar wind (e.g. interplanetary scintillation)
- Sun (e.g. H-alpha, magnetographs, white light imagery)
- thermosphere (e.g. doppler measurements of neutral winds)

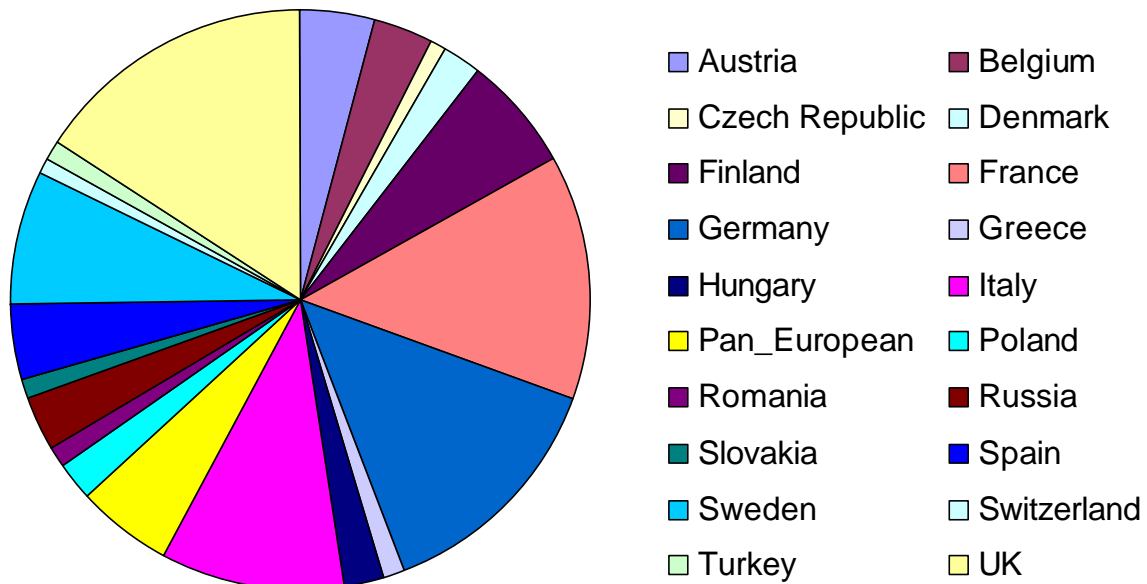
Note that some space weather measurements can monitor more than one domain. These are treated as multiple entries in the plot below.



**Figure 5 Distribution of ground-based measurements by space weather domain**

You can see that ground-based measurements are primarily focussed on ground effects, the ionosphere and the Sun. The focus on ground effects is obvious as these can be measured directly. In contrast the measurements of the ionosphere and the Sun are remote sensing observations. The ionospheric measurements are primarily active measurements that monitor the effect of ionospheric conditions on the propagation of radio waves from dedicated sources (e.g. satellites, radars). The relative proximity of the ionosphere and its strong effects on radio propagation make this feasible. In contrast, solar observations are passive measurements that monitor the natural emissions from the Sun. It is the great power of those natural emissions that makes this feasible.

We have also looked at the distribution of ground-based measurements by country. The figure below shows this.



**Figure 6 Distribution of ground-based measurements by country**

The result is similar to that for all resources (Figure 2). There are strong contributions from France, Germany, Italy, Scandinavia and the UK – plus a significant Pan-European element.

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## 6 Options for extension of the catalogue

The statistical analysis suggests that the catalogue could be extended by acquisition of additional data. In particular:

- To collect more data on ground-station resources that could contribute to a space-based programme of measurements of space weather parameters.
- To collect more data on research knowledge that could be used to develop new technologies for space weather measurements and prediction techniques (concept, model).

Some types of resources could be resolved into further detail. For example one could classify models according to the technique used (neural network, magnetohydrodynamics, etc). The underlying space weather resources database can easily be adapted to store these lower level attributes. But it is important to identify priority areas for deeper analysis so that limited resources can be applied in the most useful manner.

Another important way in which the catalogue could be extended would be to add some judgement about the relative merits of different resources and thus overcoming the limitations discussed in section 4.1. Thus, for example, we could rate a major facility like a SuperDARN radar more highly than an isolated ionosonde measurement. This addition would allow us to obtain an improved assessment of the relative scale of space weather activities in different European countries



# ***Catalogue of European Space Weather Resource***

## ***Annex A - Resource Summary***

Issue 1.1  
17 November 2001

### **INTRODUCTION**

This summary was generated from an Access database of space weather resources using a report generator named "Resource Summary". In this case, the individual resources are summarised by type and by country (other summary formats can easily be prepared by creating a suitable report generator). For each resource, we provide the name of the resource, the name of its operator, a short description of the resource and, where available, a web address from which further information may be obtained.

For more information on the database fields see the main part of this document.

### **CAVEAT**

This catalogue is based on information obtained in good faith from a variety of sources discussed in the main part of this document. Thus its accuracy and completeness reflect the accuracy and completeness of those sources. Thus we can accept no liability for any errors or omissions in the catalogue. But we greatly welcome any comments that correct existing catalogue entries or add new entries. Please send comments to Mike Hapgood (Email: M.Hapgood@rl.ac.uk).

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## **Resource type: Concept**

---

### **Germany**

---

*Name:* ELF detection of energetic particle precipitation

*Operator:* Universität Frankfurt  
Institut für Meteorologie und Geophysik

*URL:* <http://www.geophysik.uni-frankfurt.de/~fuellekr/eicr.html>

*Description:* Demonstrated use of ELF measurements to detect change in Schumann resonance parameters associated with solar energetic particle precipitation, e.g. JGR 104, p 10111 (1999)

---

*Name:* Use of ELF measurements to determine lower ionospheric parameters

*Operator:* Universität Frankfurt  
Institut für Meteorologie und Geophysik

*URL:* <http://www.geophysik.uni-frankfurt.de/~fuellekr/eicr.html>

*Description:* ELF measurements combined with appropriate models can be used to determine ionospheric parameters. See M. Füllekrug, Physics Letters A, Oct 2000, in press.

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## **Resource type: Data centre**

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### **Belgium**

---

*Name:* Regional Warning Centre Brussels

*Operator:* Royal Observatory of Belgium  
Solar Physics Department

*URL:* <http://sidc.oma.be/index.php3>

*Description:* ISES regional warning centre

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*Name:* World Data Center for the Sunspot Index  
*Operator:* Royal Observatory of Belgium  
Solar Physics Department  
*URL:* <http://sidc.oma.be/index.php3>  
*Description:* The official source for the international Sunspot index

---

## France

---

*Name:* BAse de données Solaires Sol 2000  
*Operator:* CNRS  
Institut National des Sciences de l'Univers  
*URL:* <http://bass2000.bagn.obs-mip.fr/>  
*Description:* New database of French solar "Ground" data - to standardise those data similar to SOHO data and provide new scientific tool from storage, distribution and exploitation of the solar data obtained on the ground.

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*Name:* Centre de Données de la Physique des Plasmas  
*Operator:* Centre d'Etude Spatiale des Rayonnements  
*URL:* <http://cdpp.cesr.fr/>  
*Description:* French national data centre for space plasma physics

---

*Name:* International Service of Geomagnetic Indices  
*Operator:* Centre d'études des Environnements Terrestre et Planétaires  
*URL:* <http://www.cetp.ipsl.fr/~isgi/homepag1.htm>  
*Description:* Data base of geomagnetic indices based on the report of magnetic observatories distributed all over the planet

*Name:* Paris Geomagnetic Information Node for INTERMAGNET

*Operator:* Institut de Physique du Globe de Paris

*URL:* <http://obsmag.ipgp.jussieu.fr/INTERMAGNET/homepage.html>

*Description:* Collection and dissemination node for real-time data within INTERMAGNET.

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## Hungary

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*Name:* Greenwich and Debrecen Photoheliographic Results

*Operator:* HELIOPHYSICAL OBSERVATORY, DEBRECEN,

*URL:* <http://fenyi.sci.klte.hu/activities.html>

*Description:* classical photospheric database, contains the positions and areas of sunspot groups for all days. Based on observations at former Royal Greenwich Observtaory between 1878 and 1976 and on Debrecen observations since 1976.

---

*Name:* Historical Solar Image Database

*Operator:* HELIOPHYSICAL OBSERVATORY, DEBRECEN,

*URL:* <http://fenyi.sci.klte.hu/activities.html>

*Description:* Database of Hungarian solar images - taken at Kalocsa and Ógyalla between 1873 and 1920 - and at Debrecen between 1958 and 2000

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## Italy

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*Name:* ARTHEMIS

*Operator:* Osservatorio Astronomico di Capodimonte  
Solar Physics and Stellar Atmosphere Group

*URL:* <http://arthemis.na.astro.it/>

*Description:* ARTHEMIS is a new class of solar data archives based on modern relational database management systems.

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## Poland

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*Name:* Helio-Geophysical Predictions Service

*Operator:* Polish Academy of Sciences  
Space Research Centre

*URL:* <http://www.cbk.waw.pl/rwc/rwc.html>

*Description:* ISES Regional Warning Centre in Warsaw

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*Name:* Ionospheric Dispatch Centre in Europe

*Operator:* Polish Academy of Sciences  
Space Research Centre

*URL:* <http://www.cbk.waw.pl/rwc/idce.html>

*Description:* Provides access to some recent ionospheric data from vertical incidence sounders located mainly within European area as well as to data available in ISES network. Established as a result of COST251.

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## UK

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*Name:* British Isles GPS archive Facility

*Operator:* University of Nottingham  
IESSG

*URL:* <http://ukcogr.iessg.nottingham.ac.uk/~eosi>

*Description:* Archive of GPS data from a network of continuously operating GPS receivers in the UK. Funded for use on geodetic applications. TBD if useful for Space Weather.

---

*Name:* Edinburgh Geomagnetic Information Node for INTERMAGNET

*Operator:* British Geological Survey  
Global Seismology and Geomagnetism Group

*URL:* <http://www.gsrp.nmh.ac.uk/intermagnet/>

*Description:* Collection and dissemination node for real-time data within INTERMAGNET.

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*Name:* Geomagnetism Information and Forecast Service  
*Operator:* British Geological Survey  
Global Seismology and Geomagnetism Group  
*URL:* [http://www.nerc-murchison.ac.uk/gifs/on\\_line\\_gifs.html](http://www.nerc-murchison.ac.uk/gifs/on_line_gifs.html)  
*Description:* Service for use by the academic community and those engaged in bone-fide research. It is not for commercial use, or for use by those engaged in commercially funded projects.

---

*Name:* World Data Centre C1 for STP  
*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology  
*URL:* <http://www.wdc.rl.ac.uk>  
*Description:* Part of the network of World Data Centres. It is one of several STP data centres in Europe.

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## ***Resource type: Ground-station***

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### **Germany**

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*Name:* DLR ground station Neustrelitz  
*Operator:* Deutschen Zentrum für Luft- und Raumfahrt  
*URL:* <http://www.nz.dlr.de/>  
*Description:* Satellite ground station operated by DLR at Neustrelitz

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## UK

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*Name:* RAL ground station

*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology

*URL:* <http://ssdwacs.bnsc.rl.ac.uk/>

*Description:* S band ground station at RAL. Currently used as one of the stations providing real-time downlink of solar wind data from ACE.

---

*Name:* West Freugh ground station

*Operator:* Qinetiq (former Defence Evaluation and Research Agency)  
Space Department, Farnborough

*URL:* [http://www.dera.gov.uk/html/space/west\\_freugh\\_ground\\_station.htm](http://www.dera.gov.uk/html/space/west_freugh_ground_station.htm)

*Description:* Ground station at West Freugh in Scotland

---

## *Resource type: Historical*

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### Germany

---

*Name:* Hainberg Solar Tower

*Operator:* Georg-August-Universität Göttingen  
Universitäts-Sternwarte Göttingen

*URL:* <http://www.uni-sw.gwdg.de/geninf/hainberg/sonnenturm/esonnenturm.html>

*Description:* The solar tower was built with military funds during 1942-43. The then director convinced military officials that solar research could be used to predict solar storms and so the occurrence of radio disturbances

## UK

---

*Name:* Operation Gearbox  
*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology

*URL:*

*Description:* Ionosonde placed on Svalbard by UK military during 1942-43 to support HF comms - under Operations Gearbox and Locomotive. Some records held by RAL World Data Centre. See also (add reference)

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***Resource type: Information***

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## Belgium

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*Name:* TRapped Radiation ENvironment model Development  
*Operator:* Belgian Institute for Space Aeronomy

*URL:* <http://www.magnet.oma.be/home/trend/trend.html>

*Description:* ESA-funded programme to develop improved (time-dependent) models of the radiation belts

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## ESA

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*Name:* ESA Space Weather server  
*Operator:* European Space Agency  
Space Environments and Effects Analysis section

*URL:* <http://www.estec.esa.nl/wmwww/spweather/>

*Description:* Space Weather server at ESTEC



---

*Name:* Space Weather Euro-News  
*Operator:* European Space Agency  
Space Environments and Effects Analysis section  
*URL:* <http://www.estec.esa.nl/wmwww/spweather/NEWSLETTER/newsletter.html>  
*Description:* Electronic newsletter on space weather activities. Searchable database on <http://www.esrin.esa.it:8766/esa/> (include SWEN in list of keywords)

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## Finland

---

*Name:* Forecasts for auroral tourism  
*Operator:* Finnish Meteorological Institute  
Geophysical Research  
*URL:*  
*Description:*

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*Name:* Freja Charging Database  
*Operator:* Finnish Meteorological Institute  
Geophysical Research  
*URL:* [http://www.geo.fmi.fi/spece/freja\\_light/Data\\_Tools/Freja/freja\\_for\\_spine.htm](http://www.geo.fmi.fi/spece/freja_light/Data_Tools/Freja/freja_for_spine.htm)  
*Description:* Database of information on spacecraft charging events identified during the operation of the Freja satellite

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*Name:* Geomagnetically induced currents information  
*Operator:* Finnish Meteorological Institute  
Geophysical Research  
*URL:* <http://www.geo.fmi.fi/MAGN/GIC/>  
*Description:* General information of GIC research at FMI/GEO concerning power systems and pipelines. Includes measured data (co-operation with industrial companies).

*Name:* Space Weather Information Server

*Operator:* Finnish Meteorological Institute  
Geophysical Research

*URL:* <http://sumppu.fmi.fi/spee>

*Description:* Searchable database of space weather resources. Search form available on [http://sumppu.fmi.fi/spee/spee\\_search.html](http://sumppu.fmi.fi/spee/spee_search.html)

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## France

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*Name:* French Space Weather study

*Operator:* Centre National d'Etude Spatiale

*URL:*

*Description:* Report of French study group

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*Name:* Report on key parameters for Space Weather studies

*Operator:* Laboratoire de Planétologie de Grenoble

*URL:* <ftp://ftp-lpg.obs.ujf-grenoble.fr/archives/Document-Atelier-Meteo.pdf>

*Description:* Report compiled following a November 1999 workshop on . In French

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## Italy

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*Name:* Whole Sun Catalog

*Operator:* Osservatorio Astronomico di Capodimonte  
Solar Physics and Stellar Atmosphere Group

*URL:* <http://arthemis.na.astro.it/wsc/wsc.html>

*Description:* Joint project of SOHO, BASS2000, and ARTHEMIS with goal of creating a central catalogue of all solar observations made around the world every day. will contain basic information on the observations, and information and/or links on how to get the data

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## UK

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*Name:* AuroraWatch UK

*Operator:* University of York  
Magnetospheric Physics Group

*URL:* <http://www.aurorawatch.york.ac.uk/>

*Description:* This web site allows you to monitor geomagnetic activity in real time, and will let you know when aurora may be visible from the UK.

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***Resource type: Instrument***

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## Austria

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*Name:* Magnetometer expertise

*Operator:* Institut fuer Weltraumforschung

*URL:*

*Description:* Expertise in space magnetometers

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## Belgium

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*Name:* Expertise in space-based solar imaging

*Operator:* Royal Observatory of Belgium  
Solar Physics Department

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to EIT on SOHO and SECCHI on STEREO

*Name:* Expertise in space-based solar imaging

*Operator:* Centre Spatiale de Liège

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to EIT on SOHO and SECCHI on STEREO

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## Canada

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*Name:* Space-based dosimetry

*Operator:* Thomson & Nielsen Electronics Ltd

*URL:*

*Description:* Construction of simple instruments for dosimetry measurements in space (as well as on the ground)

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## ESA

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*Name:* CLUSTER

*Operator:* European Space Agency  
Science Programme

*URL:* <http://sci.esa.int>

*Description:* ESA science mission to study the Earth's magnetosphere and its interaction with the solar wind. 4 identical spacecraft will allow full resolution of space plasma phenomena in time and all three spatial dimensions.

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*Name:* Expertise in measurement of electric fields

*Operator:* European Space Agency  
Space Science Department

*URL:*

*Description:* Expertise in instruments to measure electric fields in space, e.g. EFW on Cluster

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*Name:* Expertise in space measurements of high energy particles

*Operator:* European Space Agency  
Space Science Department

*URL:*

*Description:* Expertise in instruments to measure high energy particles in space, e.g. IMPACT on STEREO

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*Name:* Space expertise in high energy particle detectors

*Operator:* European Space Agency  
Space Environments and Effects Analysis section

*URL:*

*Description:* Expertise in simple high energy particle detectors for radiation monitoring in space

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## France

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*Name:* Expertise in space measurements of energetic particles

*Operator:* Centre d'Etude Spatiale des Rayonnements

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. IMPACT on STEREO, radiation detector on Newton-XMM, CIS on Cluster

---

*Name:* Expertise in space measurements of energetic particles

*Operator:* Observatoire de Paris  
Département d'Astronomie Solaire

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. IMPACT on STEREO

---

*Name:* Expertise in space measurements of energetic particles

*Operator:* Office National d'Etudes et de Recherches Aéronautiques  
Département Environnement Spatial

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. SPICA

---

*Name:* Expertise in space-based radio wave detectors

*Operator:* Observatoire de Paris  
Département d'Astronomie Solaire

*URL:*

*Description:* Expertise in space-based radio detectors, e.g. contributions to SWAVES on STEREO, also experiments on WIND

---

*Name:* Expertise in space-based solar imaging

*Operator:* Observatoire de Paris  
Département d'Astronomie Solaire

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to SECCHI on STEREO

---

*Name:* Expertise in space-based solar imaging

*Operator:* Institut d'Optique Théorique et Appliquée

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to EIT on SOHO and SECCHI on STEREO

---

*Name:* Expertise in space-based solar imaging

*Operator:* Laboratoire d'Astronomie Spatiale

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to EIT on SOHO and SECCHI on STEREO

---

*Name:* Expertise in space-based solar imaging

*Operator:* Institut d'Astrophysique Spatiale

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to EIT on SOHO and SECCHI on STEREO

---

*Name:* SPICA-ICARE

*Operator:* Centre National d'Etude Spatiale

*URL:*

*Description:* Electron and ion detector for radiation belt energies

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*Name:* Système Compact d'Investigation de Propagation IONosphérique

*Operator:* École Nationale Supérieure des Télécommunications de Bretagne  
Groupe Ionosphère

*URL:* <http://www-iono.enst-bretagne.fr/scipion.html>

*Description:* new state of the art digital sounder for ionospheric monitoring and research.

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## Germany

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*Name:* Expertise in measurement of electric fields

*Operator:* Max-Planck-Institut für Extraterrestrische Physik

*URL:*

*Description:* Expertise in instruments to measure electric fields in space, e.g. EDI on Cluster

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*Name:* Expertise in space magnetometry

*Operator:* Technische Universität Braunschweig

*URL:*

*Description:* Expertise in space-based magnetometry, e.g. involvement in FGM on Cluster

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*Name:* Expertise in space measurements of energetic particles

*Operator:* Max-Planck-Institut für Aeronomie

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. IMPACT on STEREO, CELIAS on SOHO and RAPID on Cluster

---

*Name:* Expertise in space measurements of energetic particles

*Operator:* Technische Universität Braunschweig

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. CELIAS on SOHO and CIS on Cluster



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*Name:* Expertise in space measurements of energetic particles

*Operator:* University of Kiel

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. IMPACT on STEREO, COSTEP on SOHO

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*Name:* Expertise in space measurements of energetic particles

*Operator:* Max-Planck-Insitut für Extraterrestrische Physik

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. PLASTIC on STEREO, CELIAS on SOHO and CIS on Cluster

---

*Name:* Expertise in space-based solar imaging

*Operator:* University of Kiel

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to SECCHI on STEREO

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*Name:* Expertise in space-based solar imaging

*Operator:* Max-Planck-Insitut für Aeronomie

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to LASCO on SOHO and SECCHI on STEREO

*Name:* Global TEC & vertical electron density profiles

*Operator:* Deutschen Zentrum für Luft- und Raumfahrt

*URL:* <http://www.kn.nz.dlr.de>

*Description:* Use of satellite-borne GPS (e.g. CHAMP) to derive TEC on global scale. In particular radio occultation measurements shall be used to deduce vertical electron density profiles on global scale (100..200 profiles per day). Prototype phase, operational 2001

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## Hungary

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*Name:* DEBRECEN photoheliograph

*Operator:* HELIOPHYSICAL OBSERVATORY, DEBRECEN,

*URL:* <http://fenyi.sci.klte.hu/activities.html>

*Description:* observes the full disc of the Sun in the continuous visible light, Chromospheric observations with H-alpha monochromator

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*Name:* Expertise in space magnetometry

*Operator:* KFKI Research Institute for Particle and Nuclear Physics

*URL:*

*Description:* Expertise in space-based magnetometry, e.g. involvement in FGM on Cluster

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## Italy

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*Name:* Expertise in space measurements of energetic particles

*Operator:* Istituto di Fisica dello Spazio Interplanetario

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. CIS on Cluster

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## Norway

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*Name:* Expertise in space measurements of energetic particles

*Operator:* Norwegian Defence Research Establishment

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. PEACE on Cluster

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*Name:* Expertise in space measurements of energetic particles

*Operator:* University Bergen

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. RAPID on Cluster

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## Sweden

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*Name:* Expertise in measurement of electric fields

*Operator:* Royal Institute of Technology

*URL:*

*Description:* Expertise in instruments to measure electric fields in space, e.g. EFW on Cluster

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*Name:* Expertise in measurement of electric fields

*Operator:* Swedish Institute of Space Physics  
Uppsala Division

*URL:*

*Description:* Expertise in instruments to measure electric fields in space, e.g. EFW on Cluster

*Name:* Expertise in space measurements of energetic particles

*Operator:* University of Bern

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. CELIAS on SOHO, PLASTIC on STEREO, CIS on Cluster

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## Switzerland

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*Name:* Radiation Environment Monitor

*Operator:* Paul Scherrer Institut  
Laboratory for Astrophysics

*URL:* [http://www1.psi.ch/www\\_lap\\_hn/astr\\_rem/astr\\_rem.html](http://www1.psi.ch/www_lap_hn/astr_rem/astr_rem.html)

*Description:* Instrument to measure the charged massive particles encountered by satellites in space

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## UK

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*Name:* Auroral imager

*Operator:* University of Leicester  
Radio and Space Plasma Physics Group

*URL:*

*Description:* Development of a space-qualified auroral imager

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*Name:* Cosmic Radiation Effects and Dosimetry

*Operator:* Qinetiq (former Defence Evaluation and Research Agency)  
Space Department, Farnborough

*URL:*

*Description:* radiation experiments designed and manufactured by DERA

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*Name:* Expertise in space magnetometry

*Operator:* Imperial College London  
Space and Atmospheric Physics Group

*URL:*

*Description:* Expertise in space-based magnetometry, e.g. leadership of FGM on Cluster and Ulysses

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*Name:* Expertise in space measurements of energetic particles

*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. PEACE and RAPID on Cluster

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*Name:* Expertise in space measurements of energetic particles

*Operator:* Mullard Space Science Laboratory

*URL:*

*Description:* Expertise in instruments to measure energetic particles in space, e.g. PEACE on Cluster

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*Name:* Expertise in space-based solar imaging

*Operator:* University of Birmingham

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to LASCO on SOHO and to SECCHI on STEREO

*Name:* Expertise in space-based solar imaging

*Operator:* Mullard Space Science Laboratory

*URL:*

*Description:* Expertise in space-based solar imaging, e.g. contributions to SECCHI on STEREO

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*Name:* Expertise in space-based solar imaging

*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology

*URL:*

*Description:* Expertise in space-based solar spectroscopic imaging, e.g. contributions to CDS on SOHO, also contributions to SECHHI on STEREO

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*Name:* Radiation monitor

*Operator:* Mullard Space Science Laboratory

*URL:* [http://www.mssl.ucl.ac.uk/www\\_plasma/research/spaceweather\\_research.html](http://www.mssl.ucl.ac.uk/www_plasma/research/spaceweather_research.html)

*Description:* Development of a "black box" detector to be carried by future commercial satellites, part-funded by the satellite insurance industry. This will add much needed data to what are currently sparse records of the radiation environment near the Earth.

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## **Resource type:** *Measurement*

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### **Austria**

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*Name:* Kanzelhöhe Vacuum-Telescope

*Operator:* Karl-Franzens-Universität, Graz  
Kanzelhöhe Solar Observatory

*URL:* [http://www.solobskh.ac.at/docs/gen\\_frame\\_en.html](http://www.solobskh.ac.at/docs/gen_frame_en.html)

*Description:* high resolution vacuum-spectrograph

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*Name:* Magneto-Optical Filter  
*Operator:* Karl-Franzens-Universität, Graz  
Kanzelhöhe Solar Observatory

*URL:*

*Description:* allows bidimensional Doppler and magnetic measurements to be carried out simultaneously in the Na (or K) lines with high spectral stability & high time cadence. developed at University of Rome, in cooperation with Trieste Astronomical Observatory

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*Name:* Photometric Solar Telescope  
*Operator:* Karl-Franzens-Universität, Graz  
Institute of Astronomy

*URL:* <http://www.kfunigraz.ac.at/astwww/mst/project.html>

*Description:* small multi-band imaging system for full-disk observations of the Sun in various wavelengths.

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*Name:* Überwachungsinstrument  
*Operator:* Karl-Franzens-Universität, Graz  
Kanzelhöhe Solar Observatory

*URL:* [http://www.solobskh.ac.at/docs/gen\\_frame\\_en.html](http://www.solobskh.ac.at/docs/gen_frame_en.html)

*Description:* Set of four refractors used for patrol monitoring of the Sun - to observe sunspots, in green light, in H-alpha and take magnetograms

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## Belgium

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*Name:* Belgian ionosonde  
*Operator:* Royal Meteorological Institute of Belgium

*URL:* [http://www.meteo.oma.be/IRM-KMI/rmi\\_tree/geopdesc.html](http://www.meteo.oma.be/IRM-KMI/rmi_tree/geopdesc.html)

*Description:* Ionosonde operated by RMI - at Dourbes?

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*Name:* Belgian magnetometers  
*Operator:* Royal Meteorological Institute of Belgium

*URL:* [http://www.meteo.oma.be/IRM-KMI/rmi\\_tree/geopdesc.html](http://www.meteo.oma.be/IRM-KMI/rmi_tree/geopdesc.html)

*Description:* Two magnetometers operated by RMI - one at Dourbes and one at ?

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*Name:* Belgian neutron monitor  
*Operator:* Royal Meteorological Institute of Belgium

*URL:* [http://www.meteo.oma.be/IRM-KMI/rmi\\_tree/geopdesc.html](http://www.meteo.oma.be/IRM-KMI/rmi_tree/geopdesc.html)

*Description:* Neutron monitor operated by RMI

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## Czech Republic

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*Name:* Budkov Geomagnetic Observatory  
*Operator:* Academy of Sciences of the Czech Republic  
Geophysical Institute

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imobdv\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imobdv_e.html)

*Description:* Magnetometer at Budkov in the Czech Republic (49.1N, 14.0E)

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## Denmark

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*Name:* Brorfelde Geomagnetic Observatory  
*Operator:* Danish Meteorological Institute  
Solar-Terrestrial Physics Division

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imobfe\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imobfe_e.html)

*Description:* Magnetometer at Brorfelde in Denmark (55.6N, 11.7E)



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*Name:* Greenland magnetometer chain  
*Operator:* Danish Meteorological Institute  
Solar-Terrestrial Physics Division  
*URL:* <http://web.dmi.dk/projects/chain/>  
*Description:* Magnetometer chain in Greenland . Main chain is 17 sites on west and east coasts, operated by DMI. Also linked with 5 inland sites (MAGIC = Magnetometer Array on the Greenland Ice Cap) run by Space Physics Research Laboratory, University of Michigan.

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## ESA

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*Name:* SOLAR AND HELIOSPHERIC OBSERVATORY  
*Operator:* European Space Agency  
Science Programme  
*URL:* <http://sohowww.estec.esa.nl/>  
*Description:* Solar Observatory at L1 point.

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*Name:* Solar orbiter  
*Operator:* European Space Agency  
Science Programme  
*URL:* <http://sci.esa.int>  
*Description:* New science mission to study the Sun at unprecedented resolution - by injection into an orbit which allows the spacecraft to co-rotate with the Sun at perihelion

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*Name:* Ulysses  
*Operator:* European Space Agency  
Science Programme  
*URL:* <http://sci.esa.int/home/ulysses/index.cfm>  
*Description:* Heliospheric spacecraft exploring regions away from ecliptic plane

## Finland

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*Name:* IMAGE

*Operator:* Finnish Meteorological Institute  
Geophysical Research

*URL:* <http://www.geo.fmi.fi/image/>

*Description:* Magnetometer network in Fennoscandia and Svalbard

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*Name:* Magnetometers - Ionospheric Radars- Allsky Cameras Large Experiment

*Operator:* Finnish Meteorological Institute  
Geophysical Research

*URL:* <http://www.geo.fmi.fi/MIRACLE/>

*Description:* Multi-instrument ground-based network in Fennoscandia and Svalbard consisting of magnetometers (IMAGE), radars (STARE, CUTLASS) and all-sky cameras

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*Name:* Metsähovi Radio Observatory

*Operator:* Helsinki University of Technology  
Metsähovi Radio Observatory

*URL:* <http://kurp-www.hut.fi/>

*Description:* 14 m diameter radio telescope used at frequencies 10-100 GHz. Used for solar radio mapping at 22.2 GHz or at 36.8 GHz. Operates in a campaign mode (I.e. not continuously) especially in summer.

---

*Name:* Oulu Cosmic Ray station

*Operator:* University of Oulu  
Space Research Group

*URL:* <http://spaceweb.oulu.fi/projects/crs/>

*Description:* Cosmic ray monitor at 65.05°N, 25.47°E. Counts of the neutron monitor are accumulated over 1-minute and 1-hour intervals. Data collection with 10 seconds recording time is also available. Data sent to WDCs.

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*Name:* Sodankylä ionosonde  
*Operator:* Sodankylä Geophysical Observatory

*URL:* <http://space.sgo.fi/htmls/ionosonde.html>

*Description:* Ionosonde at Sodankylä in northern Finland

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*Name:* Sodankylä riometer network  
*Operator:* Sodankylä Geophysical Observatory

*URL:* <http://space.sgo.fi/htmls/riometer.html>

*Description:* Riometer network with five sites in Finland, 1 in Sweden, 1 in Svalbard and 1 on Iceland. A number of other sites exist but are not currently operational.

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## France

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*Name:* Détermination d'Orbite et Radiopositionnement Intégrés par Satellite  
*Operator:* Centre National d'Etude Spatiale

*URL:* <http://www.ign.fr/fr/PI/activites/geodesie/DORIS/>

*Description:* Radio-electrical system for high accuracy orbit determination and station positioning. Also provides data on global ionospheric behaviour - see <http://www.ign.fr/fr/PI/activites/geodesie/DORIS/#ionosphere>.

---

*Name:* H-Alpha Coronagraph  
*Operator:* Observatoire du Pic du Midi

*URL:* <http://www.omp.obs-mip.fr/omp/pic/coroseng.htm>

*Description:* SURVEY PROGRAM relative to dynamic phenomena of solar corona's cold area, observed in the H-Alpha hydrogen line.

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*Name:* Iceland West (Stokkseyri) radar

*Operator:* Laboratoire de Physique et Chimie de l'Environnement

*URL:* [http://web.cnrs-orleans.fr/~web/pce/recherche/plasmas\\_spatiaux/ventsolaire/ventsolair](http://web.cnrs-orleans.fr/~web/pce/recherche/plasmas_spatiaux/ventsolaire/ventsolair)

*Description:* HF radar based at Stokkseyri, Iceland to measure ionospheric convection.

---

*Name:* Kerguelen cosmic ray monitor

*Operator:* Institut Français pour la Recherche et la Technologie Polaires

*URL:* <http://www.ifremer.fr/ifrtp/pages/progge.html>

*Description:* Kerguelen cosmic ray monitor. Responsible scientist is P.Lantos at Meudon.

---

*Name:* Nancay Radioheliograph

*Operator:* Observatoire de Paris  
Département d'Astronomie Solaire

*URL:* [http://www.obs-nancay.fr/html\\_fr/rh\\_new.htm](http://www.obs-nancay.fr/html_fr/rh_new.htm)

*Description:* The Nancay Radioheliograph (NRH; located at 47 N 02 E) provides since the TWO dimensional images of the radio brightness of the Sun with second time resolution.

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*Name:* Observatoire Magnétique de Chambon la Forêt

*Operator:* Institut de Physique du Globe de Paris

*URL:* <http://obsmag.ipgp.jussieu.fr/Obs/clf.html>

*Description:* Magnetometer at Chambon la Forêt near Paris

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*Name:* Observatoire Magnétique de Dumont d'Urville

*Operator:* Institut de Physique du Globe de Paris

*URL:* <http://obsmag.ipgp.jussieu.fr/Obs/drv.html>

*Description:* Magnetometer at Terre Adélie, Antarctica (66.6S, 140.0E)

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*Name:* Observatoire Magnétique de Kourou

*Operator:* Institut de Physique du Globe de Paris

*URL:* <http://obsmag.ipgp.jussieu.fr/Obs/kou.html>

*Description:* Magnetoemeter at Kourou in French Guiana (2.2 N, 307.3 E)

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*Name:* Observatoire Magnétique de Martin de Viviers

*Operator:* Institut de Physique du Globe de Paris

*URL:* <http://obsmag.ipgp.jussieu.fr/Obs/ams.html>

*Description:* Magnetometer on Amsterdam Island in the Indian Ocean (37.8S, 77.6E)

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*Name:* Observatoire Magnétique de Pamataï

*Operator:* Institut de Physique du Globe de Paris

*URL:* <http://obsmag.ipgp.jussieu.fr/Obs/ppt.html>

*Description:* Magnetometer on Tahiti in the Pacific Ocean (17.6 S, 210.4 E)

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*Name:* Observatoire Magnétique de Port Alfred

*Operator:* Institut de Physique du Globe de Paris

*URL:* <http://obsmag.ipgp.jussieu.fr/Obs/czt.html>

*Description:* Magnetometer at Possession Island in the Crozet Islands in the southern Indian Ocean (46.4S, 51.9E)

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*Name:* Observatoire Magnétique de Port aux Français

*Operator:* Institut de Physique du Globe de Paris

*URL:* <http://obsmag.ipgp.jussieu.fr/Obs/paf.html>

*Description:* Magnetometer on Kerguelen in the southern Indian Ocean (49.4 S, 70.3 E)

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*Name:* SuperDARN Kerguelen

*Operator:* Laboratoire de Physique et Chimie de l'Environnement

*URL:* <http://www.ifremer.fr/ifrtp/pages/progge.html>

*Description:* Kerguelen station of SuperDARN. Responsible scientist is J.P. Villain at LPCE Orleans

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*Name:* Terre Adélie cosmic ray monitor

*Operator:* Institut Français pour la Recherche et la Technologie Polaires

*URL:* <http://www.ifremer.fr/ifrtp/pages/progge.html>

*Description:* Terre Adélie cosmic ray monitor. Responsible scientist is P.Lantos at Meudon.

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## Germany

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*Name:* Furstenfeldbruck Geomagnetic Observatory

*Operator:* Ludwig-Maximilians-Universität München

*URL:* [http://www.gsrg.nmh.ac.uk/intermagnet/english/imos/imofur\\_e.html](http://www.gsrg.nmh.ac.uk/intermagnet/english/imos/imofur_e.html)

*Description:* Geomagnetic observatory at Furstenfeldbruck near Munich

---

*Name:* GPS and GNSS monitoring

*Operator:* Deutschen Zentrum für Luft- und Raumfahrt

*URL:* <http://www.dlr.de/KN/KN-NL>

*Description:* GPS and GNSS monitoring at DLR Oberpfaffenhofen

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*Name:* GPS Derived TEC Maps

*Operator:* Deutschen Zentrum für Luft- und Raumfahrt

*URL:* <http://www.kn.nz.dlr.de/>

*Description:* TEC maps over Europe derived from GPS monitoring. Work of Institute for Communication and Navigation, External research team Neustrelitz

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*Name:* GREGOR

*Operator:* Kiepenheuer-Institut für Sonnenphysik

*URL:* <http://www.kis.uni-freiburg.de/GREGOR/>

*Description:* New 1.5m telescope with a 1.5m aperture and an alt-azimuthal mounting - to be installed at the Observatorio del Teide, Tenerife. equipped with adaptive optics and a polarimetry system. Replaces Gregory-Coude Telescope (GCT). Operational in 2004.

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*Name:* Gregory-Coude Telescope  
*Operator:* Georg-August-Universität Göttingen  
Universitäts-Sternwarte Göttingen  
*URL:* <http://www.uni-sw.gwdg.de/>  
*Description:* 45 cm telescope at Obervatorio del Teide, Tenerife. Has an effective focal length of 25 m. It feeds a horizontal Echelle spectrograph. To be replaced by larger telescope GREGOR.

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*Name:* Juliusruh Ionosonde  
*Operator:* Universität Rostock  
Leibniz-Institut für Atmosphärenphysik  
*URL:* [http://www.iap-kborn.de/radar/Technik/Ionosonde/index\\_eng.htm](http://www.iap-kborn.de/radar/Technik/Ionosonde/index_eng.htm)  
*Description:* Ionosonde at Juliusruh, Germany

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*Name:* Niemegek Geomagnetic Observatory  
*Operator:* GeoForschungsZentrum Potsdam  
*URL:* [http://www.gsrg.nmh.ac.uk/intermagnet/english/imos/imongk\\_e.html](http://www.gsrg.nmh.ac.uk/intermagnet/english/imos/imongk_e.html)  
*Description:* Geomagnetic observatory at Niemegek near Potsdam

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*Name:* Scandinavian Twin Auroral Radar  
*Operator:* Max-Planck-Insitut für Aeronomie  
*URL:* <http://www.linmpi.mpg.de/english/projekte/stare/>  
*Description:* VHF(?) backscatter radar



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*Name:* SOLAR RADIO ASTRONOMY

*Operator:* Astrophysikalisches Institut Potsdam

*URL:* <http://www.aip.de/groups/osra/>

*Description:* Radio spectral observations are carried out at in Trensdorf 15 km SE of Potsdam. 4 sweep spectrographs (10 sweeps per second in the ranges 40-90 MHz; 100-170 MHz; 200-400 MHz and 400-800 MHz).

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*Name:* Sonnenobservatorium Einsteinturm

*Operator:* Astrophysikalisches Institut Potsdam

*URL:* <http://aipsoe.aip.de/descr/soe-overview-e.html>

*Description:* equipped with a double spectrograph and two photoelectric polarization analyzers which allow to determine the spatial distribution of the magnetic field vector and its gradient

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*Name:* Vacuum Newton Telescope

*Operator:* Kiepenheuer-Institut für Sonnenphysik

*URL:* <http://www.kis.uni-freiburg.de>

*Description:* 40cm telescope at Observatorio del Teide, Tenerife. 35m focal length, evacuated.

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*Name:* Vacuum Tower Telescope

*Operator:* Kiepenheuer-Institut für Sonnenphysik

*URL:* <http://www.kis.uni-freiburg.de>

*Description:* 70cm telescope at Observatorio del Teide, Tenerife. 45m focal length, evacuated, spectrograph and additional instruments.

*Name:* Wingst Geomagnetic Observatory

*Operator:* GeoForschungsZentrum Potsdam

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imowng\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imowng_e.html)

*Description:* Geomagnetic observatory at Wingst near Hamburg

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## Greece

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*Name:* Athens Ionosonde

*Operator:* National Observatory of Athens

*URL:* <http://www.iono.noa.gr>

*Description:* Digisonde

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## Hungary

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*Name:* Nagycenk Geomagnetic Observatory

*Operator:* Hungarian Academy of Sciences  
Geodetic and Geophysical Institute

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imonck\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imonck_e.html)

*Description:* Magnetometer at Sopron in west of Hungary (47.6N, 16.7E)

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*Name:* Tihany Geomagnetic Observatory

*Operator:* Hungarian Geological Survey  
Eötvös Loránd Geophysical Institute

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imothy\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imothy_e.html)

*Description:* Magnetometer on Tihany Peninsula on the shore of Lake Balaton

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## Italy

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*Name:* Castello Tesino GEOMAGNETIC OBSERVATORY

*Operator:* Istituto Nazionale di Geofisica

*URL:* <http://www.ingrm.it/geomag/ictesino.htm>

*Description:* Geomagnetic observatory at Castello Tesino in northern Italy. Part of Italian national programme (<http://www.ingrm.it/geomag/iosserva.htm>)

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*Name:* Gibilmanna Ionosonde

*Operator:* Istituto Nazionale di Geofisica

*URL:* <http://io.ingrm.it/aeronomi/eniongb.htm>

*Description:* Digisonde at Gibilmanna, near Palermo in Sicily. Part of the Italian national ionospheric service (<http://io.ingrm.it/aeronomi/ensin.htm>). Southern-most ionosonde in Europe.

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*Name:* H-alpha observations of the Sun

*Operator:* Osservatorio Astrofisico di Catania  
Ricerche di fisica del Sole

*URL:* <http://w3c.ct.astro.it/cd-oac-web/oss-sistematica.html>

*Description:* H-alpha observations of the Sun. See <http://www.ct.astro.it/sunoacc.html> for images.

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*Name:* L'AQUILA GEOMAGNETIC OBSERVATORY

*Operator:* Istituto Nazionale di Geofisica

*URL:* <http://www.ingrm.it/geomag/ilaquila.htm>

*Description:* Geomagnetic observatory at L'Aquila in central Italy. Part of Italian national programme (<http://www.ingrm.it/geomag/iosserva.htm>)

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*Name:* Precision Solar Photometric Telescope

*Operator:* Osservatorio Astronomico di Roma

*URL:* <http://www.rm.astro.it/rise/pspt.html>

*Description:* Measures CaK line as a good proxy of solar magnetic activity and of ultraviolet emissions

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*Name:* Rome Ionosonde

*Operator:* Istituto Nazionale di Geofisica

*URL:* <http://io.ingrm.it/aeronomi/enionrm.html>

*Description:* Digisonde at Rome. Part of the Italian national ionospheric service (<http://io.ingrm.it/aeronomi/ensin.htm>). Real-time data available via <http://dps-roma.ingrm.it/>

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*Name:* Terra Nova Bay Ionosonde

*Operator:* Istituto Nazionale di Geofisica

*URL:* <http://io.ingrm.it/aeronomi/eniontn.html>

*Description:* Ionosonde at Terra Nova Bay, Antarctica. Part of the Italian national ionospheric service (<http://io.ingrm.it/aeronomi/ensin.htm>).

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*Name:* Trieste Solar Radio System

*Operator:* Osservatorio Astronomico di Trieste  
Solar Astrophysics Group

*URL:* <http://radiosun.ts.astro.it>

*Description:* Two solar multichannel radio polarimeter which operate at 6 fixed frequencies - 237, 327, 408, 610, 1420 and 2695 MHz on a routine daily basis

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*Name:* White light observations of Sun  
*Operator:* Osservatorio Astrofisico di Catania  
Ricerche di fisica del Sole  
*URL:* <http://w3c.ct.astro.it/cd-oac-web/oss-sistematica.html>  
*Description:* White light observations of Sun. See <http://www.ct.astro.it/sunoacf.html> for sunspot data

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*Name:* White light solar observations at Rome  
*Operator:* Osservatorio Astronomico di Roma  
*URL:* <http://www.rm.astro.it/bollettini/boll.html>  
*Description:* white light observations are carried out routinely to describe sunspot regions properties (O.A.R. bulletin "Solar Phenomena")

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## **Pan\_European**

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*Name:* Dynasonde at Tromsø  
*Operator:* EISCAT Scientific Association  
*URL:* <http://seldon.eiscat.uit.no/dynasond.html>  
*Description:* digital HF sounder covering ca. 1-30 MHz. It is sometimes referred to as a frequency agile sounder, or Advanced Ionospheric Sounder. can be run like an ionosonde or in other modes such as fixed frequency soundings

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*Name:* EISCAT Svalbard radar  
*Operator:* EISCAT Scientific Association  
*URL:* <http://www.esr.eiscat.no/>  
*Description:* Two beam incoherent scatter radar on the island of Svalbard. Can measure density, temperature, velocity and composition of ionospheric plasma

*Name:* European Incoherent Scatter radar

*Operator:* EISCAT Scientific Association

*URL:* <http://seldon.eiscat.uit.no/instrumentation.html>

*Description:* Tri-static radar in Northern Scandinavia. Can measure density, temperature, velocity and composition of ionospheric plasma. Can also be used for interplanetary scintillation studies.

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*Name:* Ionospheric Heating facility

*Operator:* EISCAT Scientific Association

*URL:* <http://seldon.eiscat.uit.no/heater.html>

*Description:* Ionospheric heating facility

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*Name:* Télescope Héliographique pour l'Étude du Magnétisme et des Instabilités Solaires

*Operator:* THEMIS S.L.

*URL:* <http://www.themis.iac.es/>

*Description:* new generation solar telescope to obtain very precise measurements of the solar magnetic field vector from simultaneous observations in a number of different polarized spectral lines. Located on Tenerife (28.3N, 16.5W, 2456m). Also funded by CNR Italy

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## Poland

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*Name:* Belsk Geomagnetic Observatory

*Operator:* Polish Academy of Sciences  
Institute of Geophysics

*URL:* <http://www.igf.edu.pl/belsk/belsk.htm>

*Description:* Magnetometer at Belsk, Poland (51.8N, 20.8E) - near Warsaw

*Name:* Hel Geomagnetic Observatory

*Operator:* Polish Academy of Sciences  
Institute of Geophysics

*URL:* [http://www.igf.edu.pl/hel/index\\_e.htm](http://www.igf.edu.pl/hel/index_e.htm)

*Description:* Magnetometer at Hel, Poland (54.6N, 18.8E) - on Baltic coast

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## Romania

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*Name:* Surlari Geomagnetic Observatory

*Operator:* Geological Survey of Romania

*URL:* [http://www.gsrn.nmh.ac.uk/intermagnet/english/imos/imosua\\_e.html](http://www.gsrn.nmh.ac.uk/intermagnet/english/imos/imosua_e.html)

*Description:* Magnetometer at Surlari, Romania (45.3N, 26.3E)

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## Russia

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*Name:* Moscow magnetometer

*Operator:* IZMIRAN  
Magnetism

*URL:* [http://www.izmiran.rssi.ru/magnetism/mos\\_data.htm](http://www.izmiran.rssi.ru/magnetism/mos_data.htm)

*Description:* Magnetometer near Moscow

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*Name:* Moscow neutron monitor

*Operator:* IZMIRAN  
Magnetism

*URL:* <http://helios.izmiran.troitsk.ru/cosray/main.htm>

*Description:* Neutron monitor at 55.47 N 37.32 E

*Name:* Vasil'sursk radio facility

*Operator:* NIRFI

*URL:* <http://esapub.esrin.esa.it/pff/pffv5n4/kloov5n4.htm>

*Description:* Facility at latitude 56N07, longitude 46E00, 140km east of Nizhny Novgorod. Can operate below 10 MHz in both radar mode and receive only mode. In radar mode acts as an ionospheric heating facility. Effective power is 19.2 MW at 9.05 and 9.31 MHz.

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## Slovakia

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*Name:* Hurbanovo Geomagnetic Observatory

*Operator:* Slovak Academy of Sciences  
Geophysical Institute

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/countrys/cy\\_svk\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/countrys/cy_svk_e.html)

*Description:* Magnetometer at Hurbanovo in Slovakia

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## Spain

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*Name:* El Arenosillo absorption data

*Operator:* Instituto Nacional de Técnica Aeroespacial

*URL:*

*Description:* Measures D-region absorption at 2.83 MHz on path from Madrid

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*Name:* El Arenosillo ionosonde

*Operator:* Instituto Nacional de Técnica Aeroespacial

*URL:*

*Description:* Digisonde 256 at 37.1 N, 6.7 W



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*Name:* Guimar - Tenerife Geomagnetic Observatory

*Operator:* INSTITUTO GEOGRAFICO NACIONAL

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imogui\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imogui_e.html)

*Description:* Magnetometer at Guimar on Tenerife (28.3N, 343.6E)

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*Name:* San Pablo- Toledo Geomagnetic Observatory

*Operator:* INSTITUTO GEOGRAFICO NACIONAL

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imospt\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imospt_e.html)

*Description:* Magnetometer at San Pablo de los Montes in mainland Spain (39.5N, 355.6E)

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## Sweden

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*Name:* Abisko Geomagnetic Observatory

*Operator:* Geological Survey of Sweden

*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imoabk\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imoabk_e.html)

*Description:* Magnetometer at Abisko in northern Sweden (68.4 N, 18.8E)

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*Name:* Auroral Large Imaging System

*Operator:* Swedish Institute of Space Physics  
Kiruna Division

*URL:* <http://alis.irf.se/alis/>

*Description:* System of unmanned ground-based auroral imaging stations located in a grid of about 50x50 km in Northern Sweden. Each station is equipped with a high-resolution CCD detector.

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*Name:* Kiruna Ionosonde  
*Operator:* Swedish Institute of Space Physics  
Kiruna Division  
*URL:* <http://www.irf.se/~ionogram/>  
*Description:* Ionosonde at Kiruna, Sweden (67.8N, 20.4E)

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*Name:* Lovo Geomagnetic Observatory  
*Operator:* Geological Survey of Sweden  
*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imolov\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imolov_e.html)  
*Description:* Magnetometer at Lovo near Stockholm (59.3 N, 17.8E)

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*Name:* Lycksele Ionosonde  
*Operator:* Swedish Institute of Space Physics  
Kiruna Division  
*URL:* <http://www.irf.se/~ionogram/>  
*Description:* Ionosonde at Lycksele, Sweden

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*Name:* New Swedish Solar Telescope  
*Operator:* Stockholm Observatory  
*URL:* <http://www.astro.su.se/groups/solar/solar.html>  
*Description:* The New Swedish Solar Telescope will have twice as large aperture as its predecessor. This telescope will be installed at La Palma and should start operation during 2001.

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*Name:* Uppsala Ionosonde  
*Operator:* Swedish Institute of Space Physics  
Kiruna Division

*URL:* <http://www.irf.se/~ionogram/>

*Description:* Ionosonde at Uppsala, Sweden

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## Switzerland

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*Name:* PHOENIX-2  
*Operator:* ETH ZURICH  
Radio Astronomy and Plasma Physics group

*URL:* <http://www.astro.phys.ethz.ch/rapp/>

*Description:* broadband radio spectrometer to register the flare emission of the full sun. In the frequency range of operation, 0.1 to 4.0 GHz, both modes of circular polarization are recorded continuously.

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## Turkey

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*Name:* Kandilli Geomagnetic Observatory  
*Operator:* Bogazici University  
Kandilli Observatory and Earthquake Research Institute

*URL:* <http://www.koeri.boun.edu.tr/geomagnt/MAGENG/Main.htm>

*Description:* Magnetometer at Istanbul (41.1N, 29.1E)

## UK

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*Name:* BAS magnetometer network

*Operator:* British Antarctic Survey  
Upper Atmosphere Science Division

*URL:* <http://www.nerc-bas.ac.uk/public/uasd/instrums/magnet/intro.html>

*Description:* Magnetometers located at Halley, Antarctica and at three automated geophysical observatories on the ice cap.

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*Name:* BAS VLF Receivers

*Operator:* British Antarctic Survey  
Upper Atmosphere Science Division

*URL:* <http://www.nerc-bas.ac.uk/public/uasd/instrums/vlf/intro.html>

*Description:* ELF/VLF receiving systems designed to monitor the electromagnetic spectrum in the ELF (0.3-3.0 kHz) and VLF (3-30 kHz) frequency bands. Located at Halley, Antarctica and at three automated geophysical observatories on the ice cap.

---

*Name:* Chilton ionosonde

*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology

*URL:* <http://www.wdc.rl.ac.uk/ionosondes/ralsite.html>

*Description:* Digital ionosonde located at the RAL site. Successor to Slough ionosonde. Together with Slough forms the longest sequence of ionosonde data in the world.

---

*Name:* Co-operative UK Twin Located Auroral Sounding System

*Operator:* University of Leicester  
Radio and Space Plasma Physics Group

*URL:* <http://ion.le.ac.uk/cutlass/cutlass.html>

*Description:* Two HF radars located in Iceland and Finland, both looking north into a volume over the Svalbard archipelago. Use of two radars enables the ionospheric convection velocity vector perpendicular to the Earth's magnetic field to be resolved.

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*Name:* DERA Tromsø Ionosonde  
*Operator:* Qinetiq (former Defence Evaluation and Research Agency)  
Radio Science and Propagation Group, Malvern  
*URL:* <http://digisonde.phys.uit.no/>  
*Description:* Ionosonde in Tromsø, Norway, measuring electron density and convection. See also <http://rasp.dera.gov.uk/ifs/ionosonde.htm>

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*Name:* Eskdalemuir magnetometer  
*Operator:* British Geological Survey  
Global Seismology and Geomagnetism Group  
*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imoesk\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imoesk_e.html)  
*Description:* Magnetometer at Eskdalemuir in southern Scotland. Kp station

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*Name:* Halley dynasonde  
*Operator:* British Antarctic Survey  
Upper Atmosphere Science Division  
*URL:* <http://www.nerc-bas.ac.uk/public/uasd/instrums/dyna/intro.html>  
*Description:* The dynasonde at Halley remotely senses the structure and motion of plasma 60-500 km up in the ionosphere and within a horizontal radius of about 500 km.

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*Name:* Hartland magnetometer  
*Operator:* British Geological Survey  
Global Seismology and Geomagnetism Group  
*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imohad\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imohad_e.html)  
*Description:* Magnetometer at Hartland Point in Devon in the south-west of England. Successor to earlier magnetometers in south of England at Greenwich and Abinger. Northern station for the aa index, is a Kp station.

---

*Name:* Imaging Riometer for Ionospheric Studies  
*Operator:* University of Lancaster  
Department of Communication Sciences  
*URL:* <http://www.dcs.lancs.ac.uk/iono/iris/>  
*Description:* Imaging Riometer sited at Kilpisjärvi in northern Finland

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*Name:* Lerwick magnetometer  
*Operator:* British Geological Survey  
Global Seismology and Geomagnetism Group  
*URL:* [http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imoler\\_e.html](http://www.gsrq.nmh.ac.uk/intermagnet/english/imos/imoler_e.html)  
*Description:* Magnetometer at Lerwick in the Shetland Islands. Kp station.

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*Name:* Measurements of thermospheric winds  
*Operator:* University College London  
Atmospheric Physics Laboratory  
*URL:* [http://cat.apg.ph.ucl.ac.uk/FPI\\_Intro.html](http://cat.apg.ph.ucl.ac.uk/FPI_Intro.html)  
*Description:* Fabry-Perot measurements of thermospheric winds at Kiruna, Sweden (67.8N, 20.4E), Kilpisjarvi, Finland (69.1N, 20.8E), Longyearbyen (78.2N, 15.6E) and Bear Lake, Utah (41.9N, 111.4W).

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*Name:* Port Stanley ionosonde  
*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology  
*URL:* <http://www.wdc.rl.ac.uk/ionosondes/falsite.html>  
*Description:* Ionosonde based on Falkland Islands. Provides a near-continuous sequence of ionospheric soundings from 1945 to the present day.

---

*Name:* Southern Hemisphere Auroral Radar Experiment

*Operator:* British Antarctic Survey  
Upper Atmosphere Science Division

*URL:* <http://www.nerc-bas.ac.uk/public/uasd/instrums/share/intro.html>

*Description:* Radar at Halley, Antarctica - remotely senses ionospheric convection, started operation in Jan1988 under the acronym PACE. Now part of tripartite experiment, other elements provided by Johns Hopkins University and University of Natal. Part of SuperDARN

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*Name:* Space Plasma Explorationby Active Radar

*Operator:* University of Leicester  
Radio and Space Plasma Physics Group

*URL:* <http://ion.le.ac.uk/~jaq/speardoc.html>

*Description:* A new active HF space plasma sounder for Svalbard

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*Name:* UK Sub-Auroral Magnetometer Network

*Operator:* University of York  
Magnetospheric Physics Group

*URL:* <http://samsun.york.ac.uk/>

*Description:* Network of 9 stations equipped with fluxgate magnetometers which continuously record natural variations in the Earth's magnetic field - in sub-auroral regions in the UK, the Faroe Islands, Sweden, Norway , Finland, Iceland and Russia.

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## **Resource type:** *Model*

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### **Belgium**

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*Name:* Statistical ELF and VLF Environment Models

*Operator:* Belgian Institute for Space Aeronomy

*URL:* <http://www.magnet.oma.be/sevem/>

*Description:* To make statistical maps of the VLF, ELF and plasma wave distribution in the magnetosphere, and to develop empirical and statistical models of the 3-dimensional distribution of wave parameters such as amplitude, polarization and frequency.

---

*Name:* UNIRAD

*Operator:* Belgian Institute for Space Aeronomy

*URL:* <http://www.magnet.oma.be/home/unirad/unirad.html>

*Description:* UNIRAD is a software package developed by and for ESA for evaluation of the radiation fluences and doses expected in a spacecraft for a mission defined by given orbital characteristics.

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### **Denmark**

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*Name:* Linear Modeling of Ionospheric Electrodynamics

*Operator:* Danish Meteorological Institute  
Solar-Terrestrial Physics Division

*URL:* <http://dmiweb.dmi.dk/fsweb/projects/spw/spw.html>

*Description:* Specification and forecast of ionospheric parameters (field-aligned currents and electric potentials) based on solar wind data (e.g. ACE)



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*Name:* Real-time prediction of geomagnetic storms  
*Operator:* Danish Meteorological Institute  
Solar-Terrestrial Physics Division  
*URL:* <http://dmiweb.dmi.dk/fsweb/solar-terrestrial/staff/wu/spwrtpdst.html>  
*Description:* Real-time prediction of geomagnetic storms using solar wind parameters B, Bs, N and V, e.g. from ACE.

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## Finland

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*Name:* Grand Unified Ionosphere-Magnetosphere Coupling Simulation  
*Operator:* Finnish Meteorological Institute  
Geophysical Research  
*URL:* <http://www.geo.fmi.fi/~pjanhune/gumics3/>  
*Description:* Simulation of ionosphere-magnetosphere coupling. It is a global MHD simulation coupled with a comprehensive ionospheric model.

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## France

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*Name:* Collecte Localisation Services  
*Operator:* Collecte Localisation Services  
*URL:* <http://www.cls.fr/previsol/>  
*Description:* Daily forecasts of solar flares, protons & magnetic activity & previous day's solar & mag indices are available free of charge, 3 day ahead forecasts via limited access. Outreach material to be added by end 2000.

---

*Name:* NEURAL NETWORK FORECAST OF THE SOLAR CYCLE  
*Operator:* Observatoire de Paris  
Département d'Astronomie Solaire  
*URL:* <http://previ.obspm.fr/previ/eneurweb.htm>  
*Description:* NEURAL NETWORK FORECAST OF THE SOLAR CYCLE

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*Name:* SALAMMBO  
*Operator:* Office National d'Etudes et de Recherches Aérospatiales  
Département Environnement Spatial

*URL:* <http://www.onera.fr/desp-en/envvehspa/index.html>

*Description:* Model of radiation belt

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*Name:* SIEVERT  
*Operator:* Observatoire de Paris  
Département d'Astronomie Solaire

*URL:*

*Description:* Provides radiation dose calculations for airline flights. Uses neutron data from Terre Adélie and Kerguelen together with energetic particle transport model. Operated in conjunction with Direction Générale de l'Aviation Civile.

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## Sweden

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*Name:* AI Methods in Spacecraft Anomaly Predictions  
*Operator:* Swedish Institute of Space Physics  
Lund Division

*URL:* <http://www.irfl.lu.se/saaps/>

*Description:* The aim of this project is to develop tools for the analysis and prediction of spacecraft anomalies. The main methods will be the use of artificial intelligence (AI) such as neural networks and fuzzy systems.

## UK

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*Name:* COUPLED THERMOSPHERE-IONOSPHERE MODEL

*Operator:* University College London  
Atmospheric Physics Laboratory

*URL:* <http://cat.apg.ph.ucl.ac.uk/model1.html>

*Description:* Self-consistent model of upper atmosphere temperature, density and composition

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*Name:* DERA Internal Charging Threat Assessment Tool

*Operator:* Qinetiq (former Defence Evaluation and Research Agency)  
Space Department, Farnborough

*URL:* <http://www.space.dera.gov.uk/idc/index.html>

*Description:* tool for assessing the threat from internal charging.

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*Name:* ESABASE

*Operator:* ALSTOM Energy Technology Centre

*URL:* <http://www.technology.energy.alstom.com/ebas.htm>

*Description:* Software environment for space system analysis. Includes applications to analyse problems related to debris impact and charged-particle radiation

---

*Name:* European Ionospheric Forecast and Mapping software

*Operator:* Rutherford Appleton Laboratory  
Radio Communications Research Unit

*URL:*

*Description:* Windows-based software to forecast foF2, M3000F2, MUF3000F2 and TEC over Europe

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*Name:* Geant4 Collaboration  
*Operator:* Qinetiq (former Defence Evaluation and Research Agency)  
Space Department, Farnborough  
*URL:* [http://www.space.dera.gov.uk/space\\_env/geant\\_mn.html](http://www.space.dera.gov.uk/space_env/geant_mn.html)  
*Description:* Development of a new generation of radiation shielding tools for civil space applications -in collaboration with CERN other members of the Geant4 collaboration. See <http://wwwinfo.cern.ch/asd/geant4/geant4.html>

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*Name:* IF2 prediction  
*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology  
*URL:* <http://www.wdc.rl.ac.uk/wdcc1/data.html>  
*Description:* Prediction of ionosphericly effective sunspot numbers IF2 and IG - as approved by CCIR

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*Name:* Integrated Debris Evolution Suite  
*Operator:* Qinetiq (former Defence Evaluation and Research Agency)  
Space Department, Farnborough  
*URL:*  
*Description:* Software for debris impact risks, platform optimisation and protection measures

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*Name:* Ionospheric Forecasting  
*Operator:* Rutherford Appleton Laboratory  
Radio Communications Research Unit  
*URL:* <http://www.rcru.rl.ac.uk/iono/maps.htm>  
*Description:* foF2, MUF(3000)F2 and TEC forecasts across Europe for up to 24 hours ahead

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*Name:* Ionospheric Forecasting Demonstrator  
*Operator:* Qinetiq (former Defence Evaluation and Research Agency)  
Radio Science and Propagation Group, Malvern  
*URL:* <http://rasp.dera.gov.uk/ifs/ifs.html>  
*Description:* forecasting electron density in UK 24 hours ahead using radial basis function neural networks

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*Name:* Predictor of Geoeffective Solar Wind Structures  
*Operator:* Imperial College London  
Space and Atmospheric Physics Group  
*URL:* <http://www.sp.ph.ic.ac.uk/~cargill/spw.html>  
*Description:* algorithm to feed out a continual prediction of whether the solar wind at any given time is going to be "geoeffective".

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*Name:* Space Environment Database and Analysis Tools  
*Operator:* Rutherford Appleton Laboratory  
Space Science and Technology  
*URL:* <http://www.wdc.rl.ac.uk/sedat/>  
*Description:* Database of charged particle flux data developed under ESA contract

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## **Resource type: *Network***

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### **ESA**

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*Name:* Spacecraft Plasma Interactions Network in Europe  
*Operator:* European Space Agency  
Space Environments and Effects Analysis section  
*URL:* <http://www.estec.esa.nl/wmwww/Spine/>  
*Description:* Network to share resources and to co-ordinate efforts in all domains related to the interaction of Spacecraft with the space plasma.

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## Finland

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*Name:* Space Weather in the Antares Programme

*Operator:* Academy of Finland

*URL:* <http://akseli.tekes.fi/Resource.phx/tivi/antares/en/swape.htx>

*Description:* Finnish national programme for a omprehensive study of physics of space weather. Consists of basic space research and new instrument development.

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## France

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*Name:* Programme National Soleil-Terre

*Operator:* CNRS  
Institut National des Sciences de l'Univers

*URL:* <http://www.medoc-ias.u-psud.fr/pnst/pnst1.htm>

*Description:* French national programme - includes spaxce weather as one of four themes within the programme

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## Global

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*Name:* INTERMAGNET

*Operator:* INTERMAGNET

*URL:* <http://www.gserg.nmh.ac.uk/intermagnet/>

*Description:* INTERMAGNET is a global network of cooperating digital magnetic observatories, using modern standard specifications for measuring and recording equipment, to facilitate data exchanges and the production of geomagnetic products in close to real time.

*Name:* Ionosonde Network Advisory Group

*Operator:* Ionosonde Network Advisory Group

*URL:* <http://www.ips.gov.au/INAG/>

*Description:* INAG is Working Group 1 of URSI Commission G. It is responsible for: collecting together information on analysis of ionograms, maintaining conventions for reduction of ionograms, a forum for people interested in obtaining reliable data from ionograms

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*Name:* SuperDARN

*Operator:* SuperDARN

*URL:* <http://superdarn.jhuapl.edu/>

*Description:* SuperDARN is a global network of high-frequency radars used to study the Earth's ionosphere in the two auroral zones. There are 9 radars in the north (3 run by European groups) north and 6 in the south (2 run by European groups).

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## Italy

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*Name:* Area of Astrogeophysics Research

*Operator:* Area of Astrogeophysics Research

*URL:* <http://astrogeofisica.univaq.it/en/meteo.asp>

*Description:* Consortium of institutes from the Abruzzo Region to pursue scientific activities in astronomy and geophysics. Has Space Weather as a major theme.

## Pan\_European

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*Name:* COST 271 - Effects of upper atmosphere on terrestrial and Earth-space comms

*Operator:* European Union

*URL:*

*Description:* New COST action to study the effects of the upper atmosphere on terrestrial and Earth-space communications. Starts autumn 2000

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*Name:* COST251 - IMPROVED QUALITY OF SERVICE IN IONOSPHERIC TELECO

*Operator:* European Union

*URL:* <http://www-cost251.rcru.rl.ac.uk/>

*Description:* Collaboration to demonstrate the practical improvement to terrestrial and Earth-space radio systems of COST 238 derived ionospheric models, and to promote their use & to further refine these models and to widen their geographical area of applicability

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*Name:* European Solar Magnetometry Network

*Operator:* European Solar Magnetometry Network

*URL:* <http://www.phys.uu.nl/~ruttent/tmr/>

*Description:* collaboration of eight European solar physics research groups. funded by a grant from the EU TMR programme for 4 years from May 1, 1998. integrates development and usage of European solar telescopes with space observation, data interpretation and theory



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*Name:* Joint Organization for Solar Observations

*Operator:* Joint Organization for Solar Observations

*URL:* <http://joso.oat.ts.astro.it/>

*Description:* Group set up in 1968/60 to search for an "ideal" observatory site, construct a "Joint European Solar Observatory", a "Large European Solar Telescope" and stimulate more effective solar research in Europe. Led to current facilities at Tenerife & La Palma

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*Name:* Space Processes and Electrical Changes Influencing Atmospheric Layers

*Operator:* European Science Foundation

*URL:* <http://www.sgo.fi/SPECIAL/>

*Description:* ESF Network to generate global, regional & local models to relate electrical changes in ionosphere to distribution of galactic, solar & magnetospheric charged particles, to quantify the relationship between these & the distribution of cloud and rainfall.

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## UK

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*Name:* UK SOLAR-TERRESTRIAL PHYSICS NATIONAL FACILITIES

*Operator:* Particle Physics & Astronomy Research Council

*URL:* <http://ion.le.ac.uk/~jaq/tbj.html>

*Description:* Set of UK national facilities including radars (UK part of EISCAT + Cutlass), ionosondes, imaging riometer (IRIS), magnetometer network (SAMNET) and World Data Centre c1 for STP. See separate entries for these resources.

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## **Resource type: Platform**

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### **Denmark**

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*Name:* The Ørsted satellite

*Operator:* TERMA Elektronik AS

*URL:* <http://web.dmi.dk/projects/oersted/homepage.html>

*Description:* 62 kg microsatellite for geomagnetic measurements.

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### **France**

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*Name:* Detection of Electro-Magnetic Emissions Transmitted from Earthquake Regions

*Operator:* Centre National d'Etude Spatiale

*URL:* <http://sads.cnes.fr:8060/DEMETER/Fr/Welcome.html>

*Description:* First CNES micro-satellite mission. Will measure selectromagnetic signals generated by seismic or volcanic events. Due fo launch in mid-2001. About 100 kg mass.

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*Name:* PICARD

*Operator:* Centre National d'Etude Spatiale

*URL:* <http://sads.cnes.fr:8060/PICARD/Fr/Welcome.html>

*Description:* Second CNES micro-satellite mission. Will measure solar diameter and irradiance. Due for launch in 2002-2003. Spacecraft mass of about 100 kg including 40 kg payload.

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## Spain

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*Name:* MINISAT

*Operator:* Instituto Nacional de Técnica Aeroespacial

*URL:* <http://www.inta.es/areas/progra/minisat/peque.html>

*Description:* Minisatellite programme which seeks to give the Spanish aerospace industry the proper capability to design, produce, integrate and operate a complete space system. Mass up to 500 kg.

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## Sweden

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*Name:* ASTRID-2

*Operator:* Swedish Space Corporation

*URL:* <http://www.ssc.se/ssd/msat/astrid2.html>

*Description:* 30 kg microsatellite for space plasma research

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*Name:* Munin satellite

*Operator:* Swedish Institute of Space Physics  
Kiruna Division

*URL:* <http://munin.irf.se/>

*Description:* 6kg nano-satellite carrying science instruments for auroral research

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*Name:* The ASTRID satellite

*Operator:* Swedish Space Corporation

*URL:* <http://www.ssc.se/ssd/msat/astrid.html>

*Description:* 27 kg microsatellite for space plasma research

*Name:* The FREJA satellite  
*Operator:* Swedish Space Corporation

*URL:* <http://www.ssc.se/ssd/ssat/freja.html>

*Description:* 214 kg small satellite for space plasma research

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## UK

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*Name:* Space Technology Research Vehicle  
*Operator:* Qinetiq (former Defence Evaluation and Research Agency)  
Space Department, Farnborough

*URL:* <http://www.dera.gov.uk/html/space/strv/over.htm>

*Description:* Series of microsatellites (about 100 kg) developed by DERA - carrying a variety of scientific and technological payloads - including measurements of energetic charged particles

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*Name:* SSTL enhanced microsatellites  
*Operator:* Surrey Satellite Technology

*URL:* [http://www.sstl.co.uk/services/subpage\\_services.html](http://www.sstl.co.uk/services/subpage_services.html)

*Description:* For missions between 50 and 100 kg, SSTL has a flight proven modular microsatellite core

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*Name:* SSTL nanosatellites  
*Operator:* Surrey Satellite Technology

*URL:* [http://www.sstl.co.uk/services/subpage\\_services.html](http://www.sstl.co.uk/services/subpage_services.html)

*Description:* tiny (<10 kg) nanosatellites with significant capabilities can be constructed in very short periods of time and at extremely low cost, Surrey's first nanosatellite, SNAP-1, is a 6.5 kg spacecraft