IMAGE Newsletter

Number 5 IMAGE Team June 1997

IMAGE magnetometer network - information update -

IMAGE (International Monitor for Auroral Geomagnetic Effects) consists presently of 19 stations (Fig. 1, Table 1). There are now involved 9 institutes from 6 countries (Finland, Germany, Norway, Poland, Russia, Sweden). Institutes operating the stations are listed in Table 1. The German partners, Technical University of Braunschweig and GeoForschungsZentrum Potsdam, have been responsible for the final verification of most of the data.

The main change that occurred in 1996 was the addition of 4 new sites to the network: Andenes, Kiruna, Lovozero and Sodankylä. This provides a denser network in the auroral region as well as additional east–west extent.

The prime objectives of IMAGE are to study auroral electrojets and moving two-dimensional current systems. The long profile covering geographic latitudes from 60 to 79 degrees is especially favourable for studies of simultaneous eastward and westward electrojets and electrojet splitting. Together with other ground-based recordings (by radars, riometers, all-sky cameras) and satellite observations, IMAGE is an essential part in the investigations of high–latitude magnetospheric–ionospheric physics. Together with its pre-decessor, the EISCAT magnetometer cross started in 1982, IMAGE also provides high-quality data useful for studies of geomagnetic induction and long–term geomagnetic activity in the auroral region. Data are typically used in combined investigations with observations from e.g. radars, all–sky cameras and satellites.

After verification, IMAGE data are stored in the IAGA format (*IAGA News* No. 20, p. 112), presently with a 10 s sampling interval. Data are available for scientific use. Distribution occurs mainly by WWW or ftp, and two CD–ROMs are available too. Due to the growing interest in space weather events (e.g. Jan 10–11, 1997 and Apr 10–11, 1997), the IMAGE group has put effort to produce preliminary near–real time data, which are nowadays available from most of the stations. Concerning details of data, see the back cover of this Newsletter.

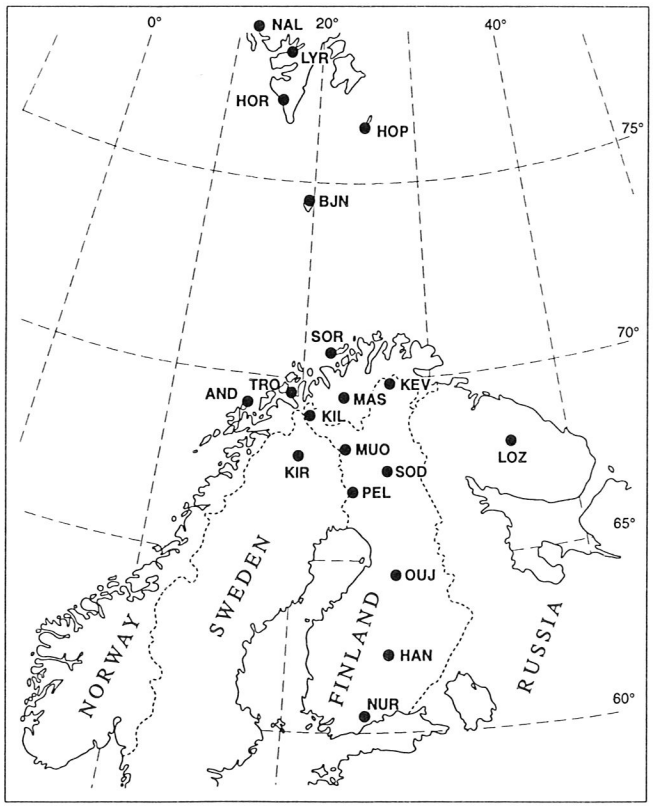

Fig. 1. IMAGE magnetometer stations.

IMAGE *Newsletter* is published every-so-often by the IMAGE Team - people working within the IMAGE project.

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Table 1. Geographic and corrected geomagnetic coordinates of the IMAGE stations.

The last column indicates the institute having the main responsibility of operating the station.
AO = Auroral Observatory (University of Tromsø), FMI = Finnish Meteorological Institute,
IGF = Institute of Geophysics (Polish Academy of Sciences), IRF = Swedish Institute of Space Physics,
PGI = Polar Geohysical Institute (Kola Science Centre), SGO = Sodankylä Geophysical Observatory,
UO = University of Oulu.
Corrected Geomagnetic Coordinates (CGM) for the year 1997 were calculated by the online service on the World Wide Web at http://nssdc.gsfc.nasa.gov/space/cgm/cgm.html.

Code	Name	Lat	Long	CGM–Lat	CGM–Long	Institute
NUR	Nurmijärvi	60.50	24.65	56.84	102.48	FMI
HAN	Hankasalmi	62.30	26.65	58.66	104.94	FMI
OUJ	Oulujärvi	64.52	27.23	60.92	106.51	FMI+UO
PEL	Pello	66.90	24.08	63.49	105.37	FMI+SGO
SOD	Sodankylä	67.37	26.63	63.85	107.71	SGO
KIR	Kiruna	67.84	20.42	64.63	103.14	IRF
LOZ	Lovozero	67.97	35.08	64.12	114.90	PGI
MUO	Muonio	68.02	23.53	64.65	105.70	FMI+SGO
KIL	Kilpisjärvi	69.02	20.79	65.81	104.32	FMI+SGO
AND	Andenes	69.30	16.03	66.40	100.94	AO
MAS	Masi	69.46	23.70	66.10	106.94	AO+FMI+SGO
TRO	Tromsø	69.66	18.94	66.57	103.47	AO
KEV	Kevo	69.76	27.01	66.23	109.75	FMI+SGO
SOR	Sørøya	70.54	22.22	67.27	106.74	AO+FMI+SGO
BJN	Bear Island	74.50	19.20	71.35	108.82	AO
HOP	Hopen Island	76.51	25.01	72.94	116.03	AO
HOR	Hornsund	77.00	15.60	74.04	110.62	IGF
LYR	Longyearbyen	78.20	15.82	75.13	113.17	AO
NAL	Ny Ålesund	78.92	11.95	76.08	112.44	AO

Magnetospheric convection of various scale observed from IMAGE data

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An interesting situation in magnetospheric convection took place over the northern part of the IMAGE magnetometer network on December 1, 1993, at 0410 UT. Magnetograms (Fig 1) show a well isolated variation of different character on each station. The simplest one, with relatively long characteristic period, was in Ny Ålesund. At more southern stations, shorter period oscillations were more pronounced. The equivalent current vector sequences (Fig 2) suggest at a first glance that we can reconstruct ionospheric current structure (ICS) and its motion. A more detailed analysis reveals, however, that this ICS is too complicated.

Some further information can be obtained from the time-dependent covariance matrix (TCM) defined as

$$M_{AB}(t)=b(t)*b^{T}(t)$$

where b isthe analytic representation of the vector of magnetic variations, and b^{T} is the complex conjugate and transpose of b (e.g. Krainski, 1993).

Sequences of 2–minute averages of some elements of TCM of this pulsation are shown in Fig. 3. The ellipses, very close to partial hodographs of overhead currents vectors, represent M_{XX}, Re(M_{XY}) and M_{YY} elements, and are turned 90 degrees. So, the long axis of the ellipse shows the dominating variation of overhead current in actual time segment. The arrows represent imaginary parts of M_{XZ} and M_{YZ}. They show the direction of the ICS "phase motion", which is usually declined from its true motion direction to the one perpendicular to the overhead ICS.

The length of the arrow does not indicate the motion velocity but the square root of the product of horizontal and shifted vertical amplitudes of magnetic variation.

TCM element sequences of Hopen, Bear Island and Sørøya suggest a westward drift of ICS, while sequences of the three northernmost stations, Hornsund, Longyearbyen and Ny Ålesund, suggest an eastward drift.

The simplest interpretation of the whole picture seems to be as follows:
1) Some external disturbance propagating in the

magnetosphere downwards to the ionosphere excited the oscillations with a period of about 7 minutes in the geomagnetic field line shell intersecting Hopen. These oscillations are well visible in Bear Island and slightly worse in Hornsund and Sørøya.

2) Magnetospheric field line shells intersecting Hopen and more internal ones drifted westward, while more external shells drifted eastward. These opposite motions of magnetospheric plasma caused the deformation of ICSs elongated to NNE–SSW and the convection of parts of ICSs in the opposite directions.

Reference: Krainski,W., Time-dependent covariance matrix in irregular magnetic pulsations (IPCL) analysis. *J. Atmos. Terr. Phys.*, **55**, 1449–1457, 1993.

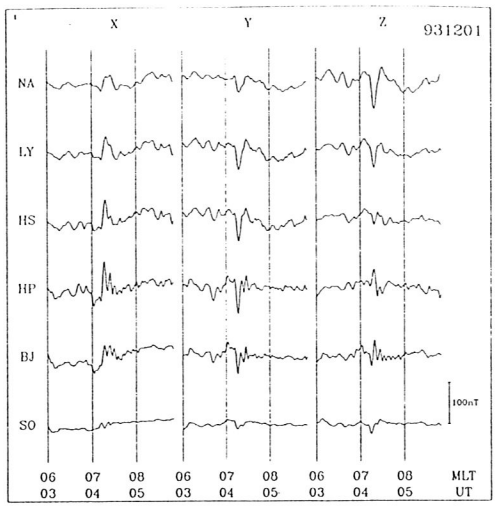

Fig. 1. *X*, *Y* and *Z* variations of the geomagnetic field at the 6 northern stations of the IMAGE magnetometer network.

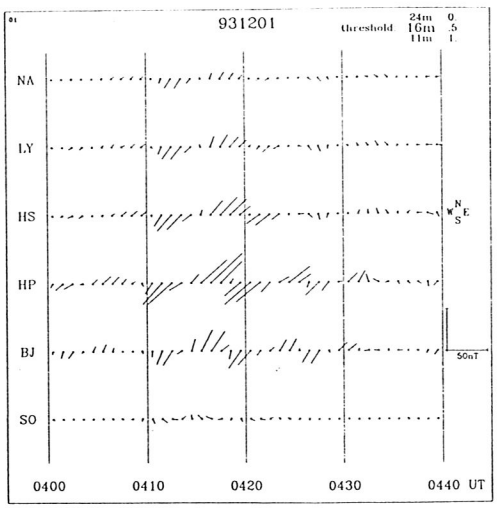

Fig. 2. Vectors of horizontal variations of the geomagnetic field at the 6 stations.

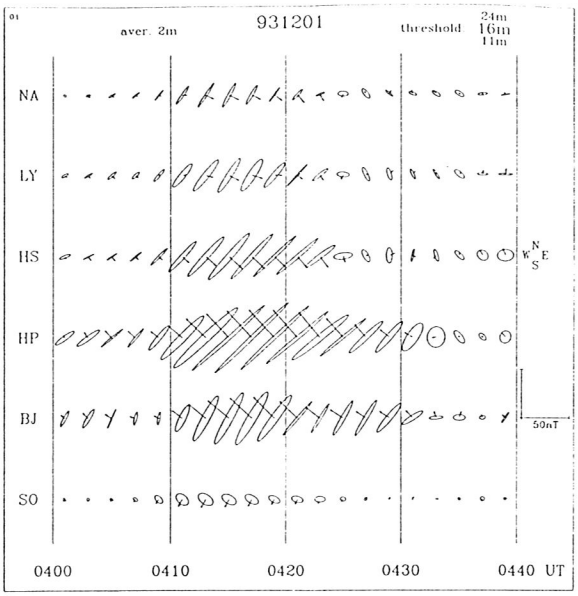

Fig. 3. Sequences of 2-minute averages of some elements of TCM are shown with
a) ellipses representing M_{XX}, Re(M_{XY})and M_{YY} elements, and are turned 90 degrees,
b) arrows representing imaginary parts of M_{XZ} and M_{YZ}.

6th IMAGE meeting in Poland, April 14-15, 1997

The 6th meeting between the IMAGE team members from Finland, Germany, Norway and Poland was held in Warsaw and Belsk, Poland, on April 14–15, 1997. The organizer was the Polish Academy of Sciences. Altogether about 25 scientists were participating.

The first meeting day in Warsaw included status reports of each contributor, information of co–operation with other projects, and scientific presentations. The second day included the presentation of the Belsk observatory, and discussions about the future of IMAGE. All groups hope to be able to continue their IMAGE work. The next meeting is planned to be arranged in Tromsø in September 1998.

Organizational change

The Sodankylä Geophysical Observatory (SGO) will be joined to the University of Oulu as a separate unit since August 1, 1997. SGO will continue the IMAGE co–operation as previously, i.e. running the Sodankylä magnetic observatory and maintaining Lappish stations together with FMI.

Availability of EISCAT and IMAGE magnetometer data

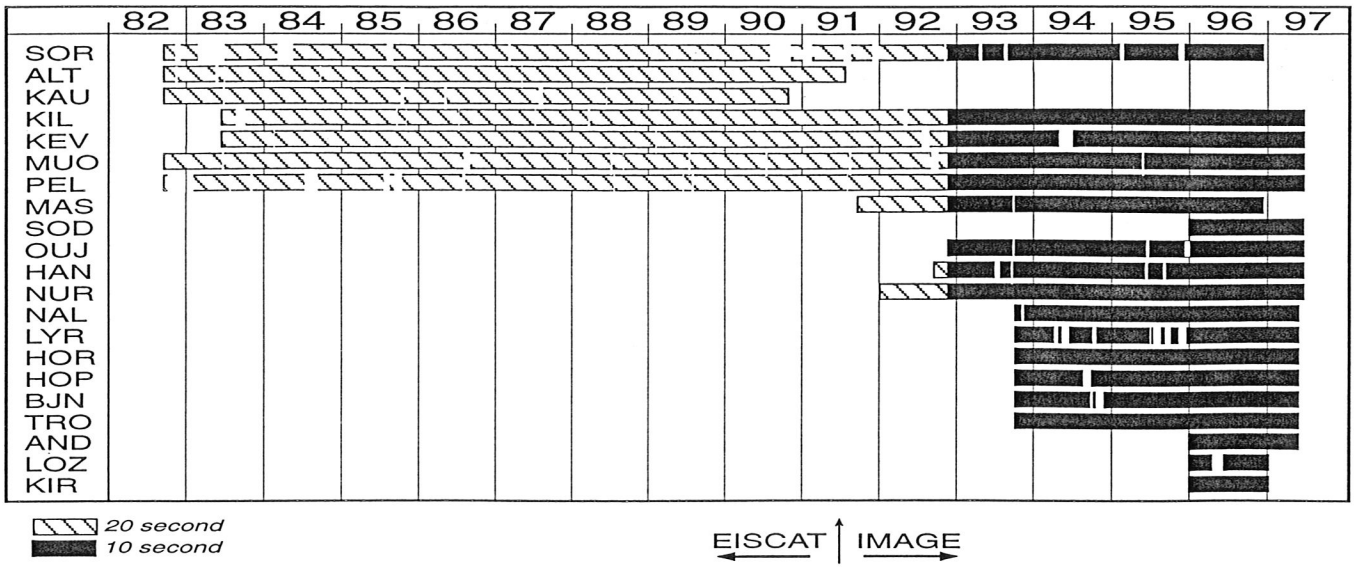

IMAGE magnetometer data of 1991–1994 on CD–ROM

This CD–ROM is second in a series of CDs which contain data of the EISCAT magnetometer cross and the IMAGE magnetometer network. The first CD contained data from Oct–82 to Dec–90, while the second one covers the period Jan–91 to Sep–94. CD–ROM can be ordered from the Finnish Meteorological Institute for a price of 500 FIM (+ VAT if applicable).

The data are in daily files in General Archival Data Format (GADF) developed at WDCC1–Copenhagen/Division of Geophysics. Software for manipulating data in GADF-format is included. The most recent versions of the software are available from anonymous ftp server sumppu.fmi.fi in the directory /pub/data/image/software.

IMAGE Web pages

The most recent information of IMAGE is available on WWW. We present here some useful pages especially concerning data:

• http://www.geo.fmi.fi/image/ :
Home page
• http://www.geo.fmi.fi/image/data.html :
Links to IMAGE data pages.
• http://www.geo.fmi.fi/image/gif/ :
Online daily magnetograms (gif files stored on a hard disk).
•http://www.geo.fmi.fi/gif/gif_form.html :
User–defined magnetograms (gif and PostScript).
•http://www.geo.fmi.fi/image/request.html :
Instructions for online data requests.

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