IMAGE Newsletter

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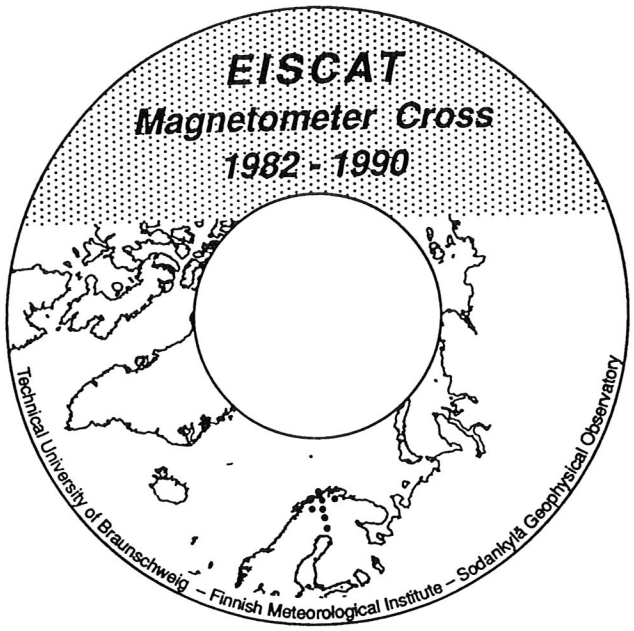

EISCAT Magnetometer Cross data for 1982-1990 on CD-ROM

We are pleased to announce that the EISCAT Magnetometer Cross CD-ROM is now ready for distribution. The CD contains all magnetometer data from the EISCAT cross starting from its beginning in October 1982 to December 1990. During this time the cross comprised seven stations which were recording the field at a resolution of 1 nT and with a 20 second sampling period.

The magnetometer data in the CD is stored in GADF-format (Geophysical Archiving Data Format, developed at the Danish Meteorological Institute). The CD-ROM is accompanied by a 3.5" diskette which contains software for converting data from GADF format into other formats (IAGA, WDC and simple TEXT format) and also for manipulating the data. Furthermore there is a program for generating postscript files containing stack magnetogram plots (see Figure 1 on page 2). The latest version of the accompanying software is also available by anonymous FTP from the server 'sumppu.fmi.fi' in the directory /pub/data/image/CD.

The EISCAT Magnetometer Cross CD-ROM is available from Finnish Meteorological Institute. The price is 500 FIM (≈ US$ 120) + 22 % VAT . Order form may be found on page 3. For further information contact Lasse Häkkinen (fax. +358-0-1929539, e-mail: Image@fmi.fi).

The data of EISCAT magnetometer cross from January-91 to August-91 and of the subsequent IMAGE network from September-91 to December-94 will fill another CD-ROM. Work for putting this data into CD-ROM is well on the way and we expect to get the CD ready for distribution in the second half of 1995.

IMAGE and WWW

IMAGE has joined the World Wide Web (WWW) information distribution system. You can connect with your favourite web browser to our home page at http://www.geo.fmi.fi/image. There you will find a lot of information about the IMAGE project and associated things. As most WWW sites this site is still under rapid development so expect some great changes and additions in near future. All comments and suggestions about IMAGE WWW-server are welcome and should be directed to Ari Viljanen at FMI (Ari.Viljanen@fmi.fi).

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

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Eastward electrojet and electron precipitation

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An interesting question with regard to the appearance of electrojets in the auroral zone is whether the eastward electrojet as well as the westward one is caused not only by convection but also by explosive unloading process. Indeed there are some indications that this is the case which is, however, opposed to the general valid opinion today. Some of the observations which promote this conception were summarized by *Grafe* (1988).

The convection eastward electrojet is mainly caused by the convection electric field. It is an essential question whether energetic electron precipitation is observed also in the region of appearance of eastward electrojet. In order to answer this question by observations it was necessary to extend the EISCAT magnetometer cross equatorwards. This was one of the goals of the IMAGE project and was accomplished by the addition of stations Oulujärvi, Hankasalmi and Nurmijärvi. Only now the total width of the eastward electrojet can be observed. On the other hand it is a favourable condition that the Swedish satellite Freja was launched in autumn 1992. FREJA gives electron precipitation data and the orbit has a position which at certain times in the afternoon sector crosses field lines which have their footprint in the eastward electrojet region (March, April 1993). By using IMAGE and FREJA data of two eastward electrojet events some interesting results concerning the occurrence of an explosive eastward electrojet were found and will be reported here.

Figure 1 shows the X-components of the IMAGE magnetometers on March 30, 1993 and April 4, 1993. For the event of April 4 it is seen that the eastward electrojet is active first at higher latitutes and later exceptionally active at the southernmost station Nurmijärvi. For the event of March 30 on the left side of Figure 1 the eastward electrojet is discernible only weakly at the Nurmijärvi station.

Figure 2 shows the orbit of FREJA on March 30 having the footprints of the magnetic field lines from 1540 UT to 1543 UT between the stations Pello and Hankasalmi. During this time the eastward electrojet is active. In figure 2 represented are also three cases of the FREJA electron precipitation. The upper curve shows the total electron count rate, the middle representation shows the parallel electron flux and the lower one gives the perpendicular electron flux. The dotted line designates the time 1542 UT which is also shown in the IMAGE data of figure 1. The footprint is located respectively near Oulujärvi.

Figure 2 shows that at the time of the electrojet activity no electron precipitation appeared. The conditions for the event of April 4, 1993 are completely different. In figure 3 three successive orbits are drawn and for three time intervals the electron precipitation data are represented. The marked moments are the same as in figure 1 (right side). From this figure we get the following result:

From 1337 UT to 1340 UT no electron precipitation is discernible. For this time the IMAGE data show no development of the eastward electrojet. It starts later. During the second satellite passage from 1532 UT to 1534 UT the eastward electrojet has moved distinctly equatorwards. Near Nurmijärvi an enhancement of the total electron count rate is discernible already.

Obviously the strong enhancement of the electron precipitation between 1523 UT and 1530 UT is connected with the appearance of a westward electrojet polewards. During the third satel-

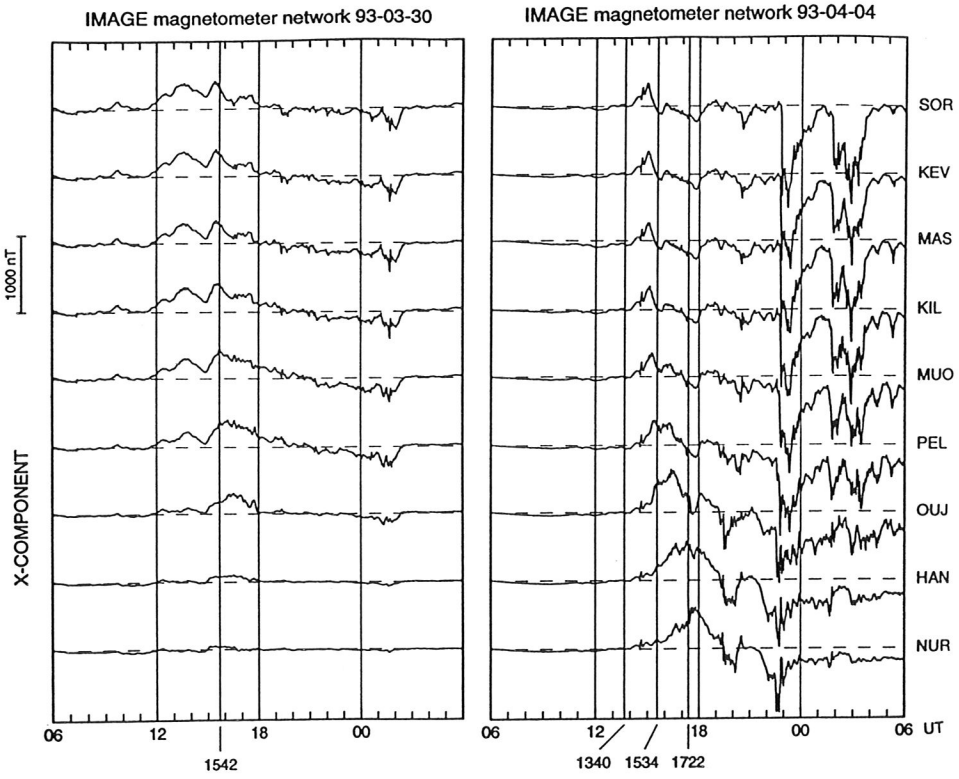

Figure 1. X-components of the IMAGE magnetometer network stations on March 30, 1993 (left side) and on April 4, 1993 (right side).

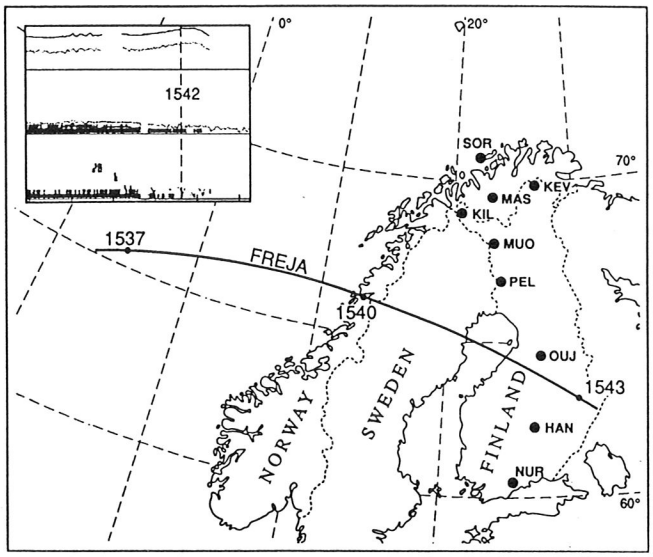

Figure 2. FREJA orbit on March 30, 1993 from 1537 UT to 1543 UT over Scandinavia and the FREJA electron data for this time period. Uppermost curve shows the total electron count rate, middle curve shows the parallel electron flux and the lowest curve gives the perpendicular electron flux.

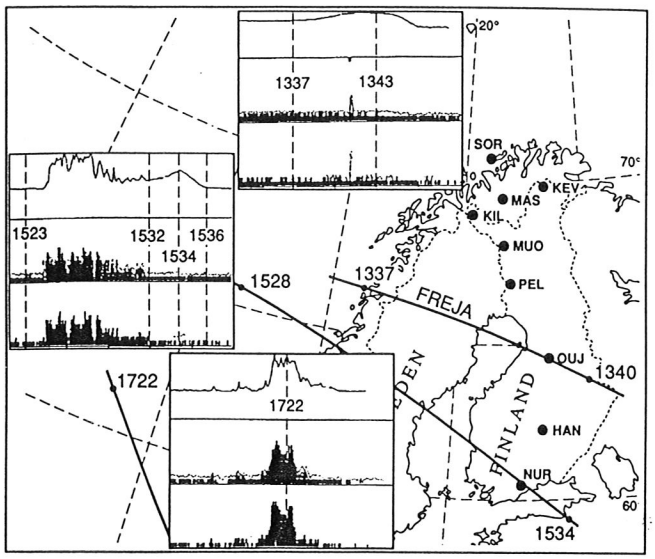

Figure 3. Three FREJA orbits on April 4, 1993 from 1337 UT to 1340 UT, 1523 UT to 1530 UT and from 1722 UT to 1723 UT.

lite passage over Scandinavia, when FREJA is moving towards subauroral latitudes westward of Hankasalmi, a strong increase of the electron precipitation is observed at 1722 UT. Exactly at this time the maximum activity of the eastward electrojet occurs at Hankasalmi and Nurmijärvi (see Fig. 1). In this case the eastward electrojet is an explosive one connected with strong electron precipitation. Contrary to this the eastward electrojet shown in Fig. 1 (left side) is a convective one. Up to now some other events of the explosive eastward electrojet accompanied by strong electron precipitation could be found. A description of all these cases, however, is not possible within this article.

Reference

Grafe, A.: The eastward electrojet and magnetospheric substorm, in *Proceedings of International Symposium of Polar Geomagnetic Phenomena*, May 25-31, Souzdal, USSR, Apatity, p. 57-69, 1988.

Use of scaled analogue model measurements for geomagnetic induction studies in the IMAGE region

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As was reported in IMAGE *Newsletter* 2, induction effects on the EISCAT and IMAGE magnetometer recordings were found out by calculating geomagnetic induction vectors. An interesting approach to the same problem is to use a scaled analogue model. It makes possible to construct geometrically complicated structures, which are numerically difficult or impossible to treat.

As a co–operation between GGRI and FMI, analogue model studies have been performed in Sopron, Hungary, in 1990, 1991 and 1993. A schematic plot of the analogue model at GGRI is shown in figure 4. The primary source is an electrojet at the height of 30 cm above the surface (corresponding to 100 km in nature). The Arctic Ocean was constructed of aluminium plates (thickness 0.8 mm, conductivity $4 \cdot 10^7$ $\Omega^{-1}m^{-1}$). Other areas were mainly salt water (thickness 19 cm; conductivity 1.0 $\Omega^{-1}m^{-1}$, corresponding to 0.001 $\Omega^{-1}m^{-1}$ in nature). Graphite pieces (thicknesses 2–4 cm; conductivity 10^4 $\Omega^{-1}m^{-1}$) simulated the highly–conducting inland anomalies. The frequency of the time–harmonic current was 200 kHz. (The scaling condition is $\omega\mu\sigma L^2$ = constant).

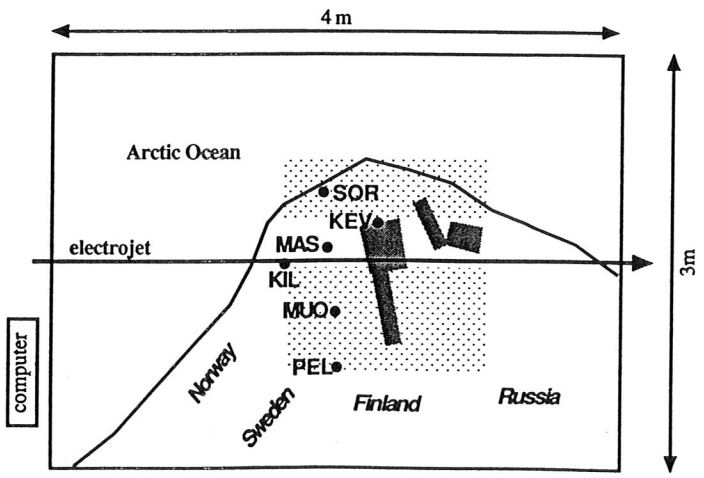

Figure 4. Schematic presentation of the analogue model. The two shaded rectangles depict the measuring area. The darker regions indicate the graphite pieces.

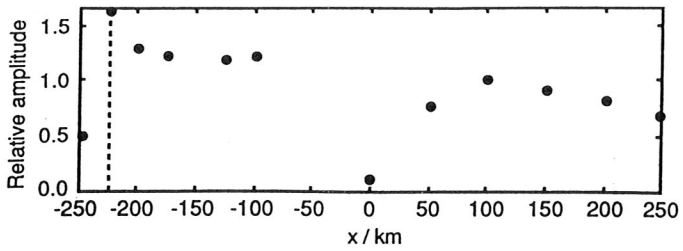

Figure 5. Profile plot of $|B_z|$ approximately along the PEL–SOR line. The distance from the electrojet is x. The amplitude at x=100 km is normalized to unity. The coast line is marked by a dashed line. In this model, inland anomalies were not added.

The main purpose was to study the behaviour of the vertical magnetic field near the coast, and also farther in continent to find out the "range" of the coast effect. One example of results is shown in figure 5. Two typical features can be seen:

1) The northern maximum ($x \approx -100$ km) exceeds the southern one ($x \approx 100$ km).
2) Another northern maximum is reached at the coast.

In this case, two maxima of $|B_z|$ are detectable north of the electrojet. However, there may be only one maximum at the coast depending on the geometry.

Acknowledgements

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