IMAGE Newsletter

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The Adolf-Schmidt-Observatory for Geomagnetism in Niemegk of the GeoResearchCentre Potsdam

Armin Grafe
Adolf-Schmidt-Observatory for Geomagnetism

In 1930 the Adolf-Schmidt-Observatory for Geomagnetism was founded in Niemegk to continue the magnetic observations which had been started in 1890 in Potsdam where due to artificial magnetic disturbances it was not possible to carry on the observations of the natural geomagnetic field.

The Niemegk observatory is situated south-west of Berlin at a distance of about 100 km from the centre. The geographic co-ordinates are φ = 52°04.3' N and λ = 12°40.5' E and the geomagnetic ones are Φ = 51°56' and Λ = 96°56'. On the whole the geological structures of the station are magnetically undisturbed. Since January 1, 1992 Niemegk observatory is part of the GeoResearchCentre Potsdam.

At present the operation of the observatory is in a transition phase. Both the technique of absolute measurements and the registration of the variations are subjected to fundamental changes. Now well proven classical methods and modern electronic techniques are used with the intention of changing over to the latter eventually which allow a more or less automatic operation.

In the past the Niemegk observatory has performed comparisons of the absolute magnetic level with other observatories, especially with those in the eastern and southeastern part of Europe and in Scandinavia.

The results of the observatory are given in:

- Monatsbericht des Adolf-Schmidt-Observatoriums für Erdmagnetismus in Niemegk
- Jahrbuch des Adolf-Schmidt-Observatoriums für Erdmagnetismus in Niemegk
- Microfilms sent quarter annually to the World Data Center for Geomagnetics containing magnetograms, tellurograms and tables of the hourly mean values.

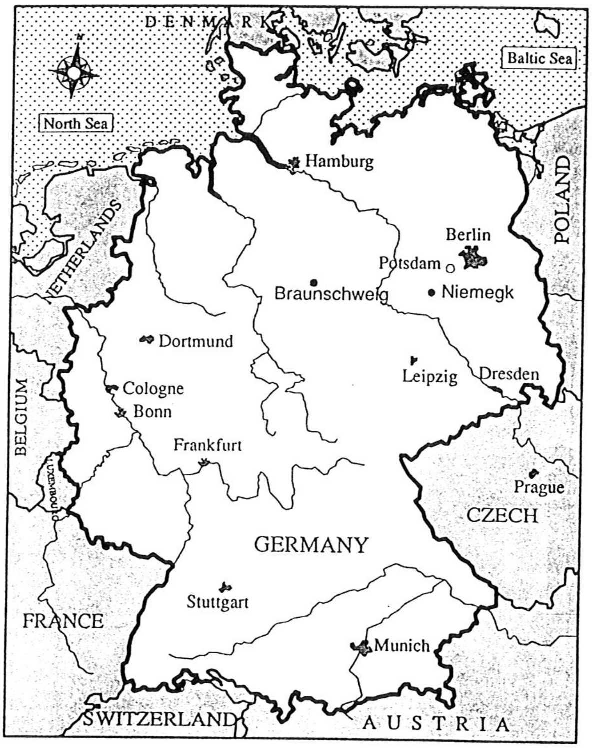

Figure 1. The Niemegk observatory is located about 100 kilometers south-west of Berlin.

Since September 1991 the Niemegk observatory is participating in the IMAGE project with the processing of primary data. The Finnish Meteorological Institute at Helsinki sends the data of all stations of the IMAGE magnetometer network as raw data on digital audio tapes (DAT) to the Niemegk observatory. These data have to be corrected, scaled and converted to the IAGA 20 format. Finally overview plots are generated. DATs containing the final data and a set of plots are sent to the institutions participating in the IMAGE project.

IMAGE *Newsletter* is published every-so-often by the IMAGE Team - people working within the IMAGE project.
PI of the IMAGE project: Hermann Lühr, Technical University of Braunschweig, D-38106 Braunschweig, Germany.
Fax: +49-531-391-5220, e-mail: luehr@geophys.nat.tu-bs.de
Editor of the IMAGE Newsletter:
Lasse Häkkinen, Finnish Meteorological Institute, P.O.Box 503, FIN-00101 Helsinki, Finland.
Fax: +358-0-1929539, e-mail: lasse.hakkinen@fmi.fi

On induction effects at EISCAT magnetometer stations

Ari Viljanen, Kirsti Kauristie and Kari Pajunpää
Finnish Meteorological Institute

A basic study concerning any magnetometer site is to find out induction effects due to earth currents. Such studies were performed at and near the Nurmijärvi and Sodankylä observatories in 1982 and 1988, respectively, as a co–operation between the Polish Academy of Sciences and FMI/GEO.

Induction effects can be divided into two types: normal and anomalous. Normal induction means induction in a layered earth, anomalous induction is due to lateral variations in the earth's conductivity.The anomalous contribution is studied using transfer functions between the vertical magnetic field (Z) and the horizontal field (X and Y). Transfer functions are defined in the frequency domain by the formula

$$Z(\omega) = A(\omega)X(\omega) + B(\omega)Y(\omega)$$

Results are usually described in terms of (real) induction vectors defined by

$$-\mathrm{Re}(A(\omega))\,\mathbf{e}_x - \mathrm{Re}(B(\omega))\,\mathbf{e}_y$$

The sign convention ensures that the vector points towards higher conductivity (currents in conductivity anomalies). This interpretation requires that the primary source field is laterally uniform. Suitable events must be selected with a great care at auroral latitudes. We have used two different methods in induction vector calculations: a Polish algorithm by *Wieladek* and *Ernst* (1977) and a program prepared by *Alan Jones*. (1981). Results are satisfactorily similar in most cases.

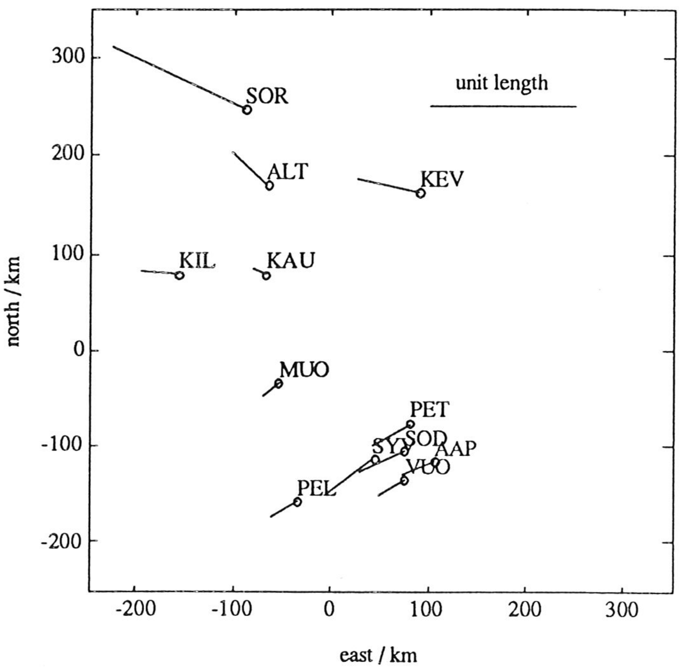

Figure 2. EISCAT magnetometer chain (1990) reversed real induction vectors (Polish method), T = 512 s.

Figure 2 shows an example of induction vectors of EISCAT stations and Sodankylä region in the frequency of 512 *s*, which also represents well the wider period range of 300...2500 *s*. At the five northern stations, the vectors point approximately to the north–west to the ocean. The ocean effect at Sørøya makes the vertical field highly anomalous. At other stations the vectors are clearly shorter, so the anomalous behaviour is not considered serious. At Muonio and Pello the vectors point to the south–west which refers to an inland conductivity anomaly.

An interesting feature is that for short periods (60...300 *s*) vectors near Sodankylä still point nearly into the same direction as in the figure, and are as long, whereas at Pello the length is very small. This indicates that there is a conductivity contrast or an anomaly near Sodankylä. To obtain further information, magnetotelluric measurements would be necessary.

Results concerning IMAGE will be calculated when we have simultaneous data from all stations. Geologic interpretation of the results will be performed by *Toivo Korja* (University of Oulu, Department of Geophysics).

Normal induction will be studied using bay events due to approximately EW–directed currents. The field will be separated into external and internal part using the Siebert and Kertz method. These results together with induction vectors give the base for interpretating IMAGE recordings in terms of ionospheric currents.

References

Wieladek, R. and Ernst, T., 1977. *Publ. Inst. Geophys. Pol. Acad. Sc. G-1:110*, pp. 3–12.
Jones, A.G., 1981. *J. Geophys.*, **50**, pp. 23-36.

Changes in addresses:

New postal codes for German institutes:
Braunschweig: D–38106 Braunschweig
Niemegk: D–14823 Niemegk

Johannes Kultima
Sodankylä Geophysical Observatory
FIN-99600 Sodankylä
phone: +358-693-619817, fax: +358-693-619875
e-mail: kultima@convex.csc.fi

Kari Pajunpää at Nurmijärvi Observatory may be reached on e-mail at: Kari.Pajunpaa@fmi.fi

Locating auroral electrojets during magnetic substorms by means of the EISCAT magnetometer chain

Kirsti Kauristie
Finnish Meteorological Institute

The magnetometer chain consisting of EISCAT stations PEL, MUO, KAU, ALT and SOR covers the latitude range from 66.85° N to 70.60° N. Quite often during moderate substorms the location of the auroral electrojet can be detected by studying B_X (north component) and B_Z (vertical component) recorded at these stations. If the current distribution of the electrojet is assumed to vary only in NS-direction, the position of the centre line and the southern and northern boundaries can be approximated. B_Z vanishes and B_X has its maximum under the centre line and the peaks of B_Z and the half-values of B_X mark the boundaries.

So far we have mainly concentrated on isolated substorms with AE-index between 500 nT and 1200 nT and duration less than six hours. Figure 3 shows the AE-index and the locations of the centre line and the boundaries during one such substorm. The electrojet has been located using B_X and B_Z contour plots. This is naturally somewhat subjective task and hence the final results would be more reliable if at least two persons analyzed the contour plots.

Unfortunately, often the latitude range of 4 degrees is too narrow for monitoring the entire width of the electrojet and especially during the recovery phase and in the evening sector the electrojet seems to move northward beyond reach of the chain. However, if the contours show positions of the centre line and one of the boundaries, the location of the other boundary can be estimated by assuming a symmetric current distribution within the electrojet. More accurate studies can be performed when we get data from the whole IMAGE chain including stations BJN (Bear Island, 74.52° N) and NAL (Ny Ålesund, 78.92° N).

Determining the average position of the auroral electrojet is a part of a wider study of the dynamics and morphology of the auroral oval during substorms. In addition to EISCAT magnetometer data recordings of the Finnish all-sky camera stations and satellite data are analyzed. The study described here gives us more information about the connection between the auroral electrojet and visible aurorae and how the electrojet is related to the ionospheric areas which get the main energy flux precipitating from the magnetosphere.

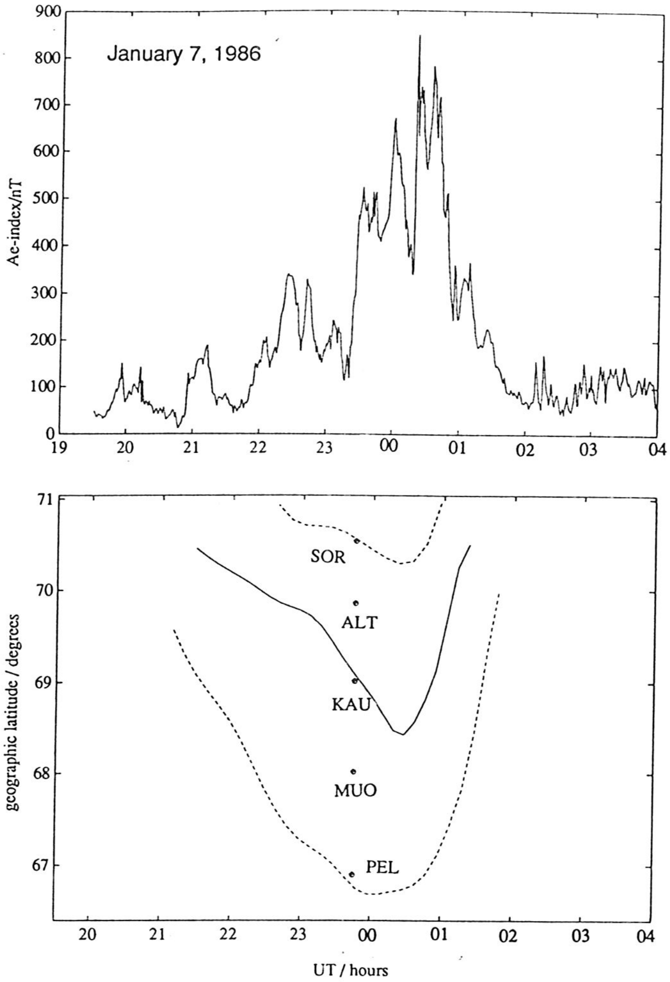

Figure 3. Ae-index (upper panel) and the location of the auroral electrojet (lower panel, solid curve is the centre line and dashed curves are the boundaries) during a magnetic substorm on January 7, 1986.

About the EISCAT CD-ROM

As mentioned in Issue #1 of the *IMAGE Newsletter* a CD-ROM disc containing the whole EISCAT magnetometer chain data from 1982 to 1991 is under preparation. The original goal of getting the disc into circulation in the first quarter of 1993 was not achieved. The main reason for this delay is that the software to be included in the CD disc for handling and manipulating the data is not ready. As it sometimes happens, the programmer who originally wrote some software for the CD-disc was transferred to another job in the middle of the project. This resulted in a delay of several months and even now there is not a full-time programmer working on this project. The current schedule is that all software and data would be in final form at the of October-93 after which it would take about a month to produce the CD-ROM. For more information about the status of the CD-ROM contact Lasse Häkkinen (e-mail: Lasse.Hakkinen@fmi.fi).

IMAGE network expands to north, east and west

Five new stations will be added to the IMAGE magnetometer network during this fall. After these additions the network will consist of 14 stations and cover about 2000 kilometers or 18 degrees in magnetic latitudes in the north-south direction.

In the north three Norwegian stations, Bear Island (Bjørnøya, BJN), Hopen (HOP) and Ny Ålesund (NAL) have been operated by the Auroral Observatory of the University of Tromsø already for several years. Digital recordings with ten second resolution are now being carried out continuously. These three stations are well located as they continue the current IMAGE chain to the north. Discussions between the Auroral Observatory, Braunschweig University and the Finnish Meteorological Institute (FMI) indicate that the data from these two stations could be merged into the IMAGE data set from October 1st onward. With this major contribution the University of Tromsø is recognized as a full fleshed member of the IMAGE Team. The person responsible at Tromsø is Truls Hansen.

In the west the Abisko Observatory (ABK) in northern Sweden has made recordings of the earth's magnetic field since 1921. The observatory is operated by the Geological Survey of Sweden. Last spring a new digital magnetometer with ten second time resolution was installed at the observatory. As with the Norwegian stations the data from Abisko will be added to the IMAGE data set also from the start of October.

In Russia the Polar Geophysical Institute (PGI) at Apatity has operated several magnetometer stations at Kola peninsula. For the IMAGE network the station at Lovozero (LOZ) near Murmansk has been equipped with a modern three-axis flux gate magnetometer. The instrument is built by the Danish Meteorological Institute and is similar to those used at Nurmijärvi, Hankasalmi and Oulujärvi stations. The instrument was supplied by FMI which also calibrated and installed it during this September. From Lovozero the data will be delivered to FMI once a month in floppy disks. As with all the other new stations it is planned that the ten second data from Lovozero station will added to the IMAGE data set from October 1st onward.

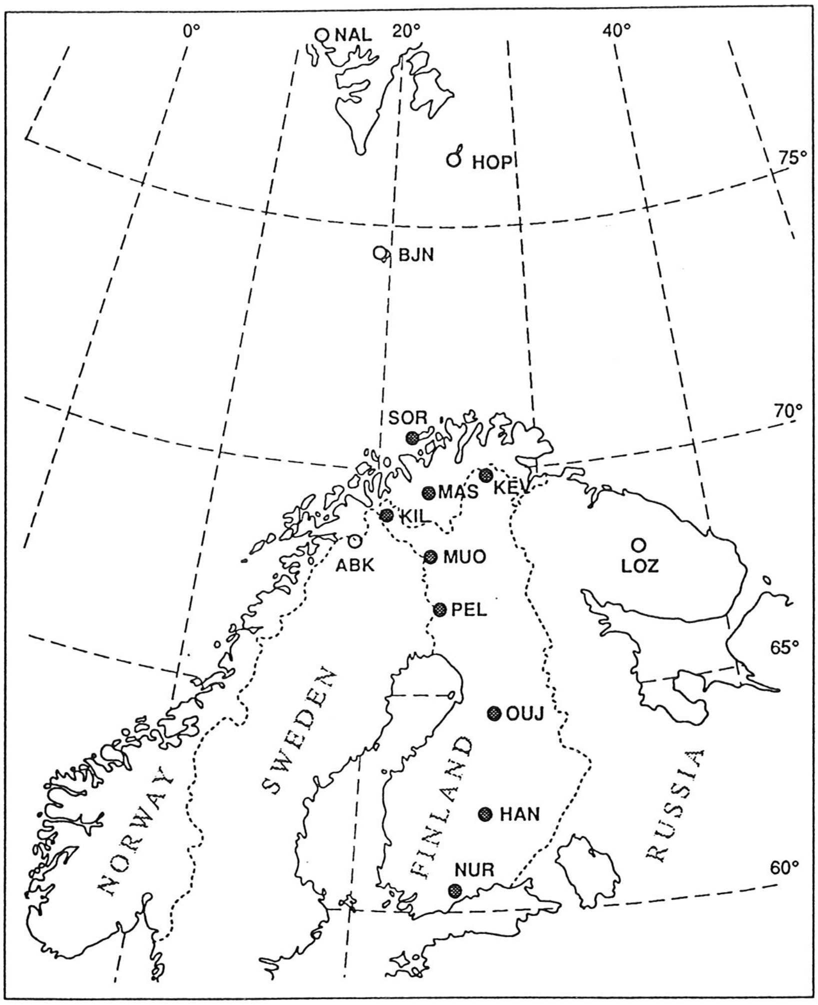

Figure 4. A map showing the locations of the current IMAGE stations (dark circles) and the fivenew stations NAL, HOP, BJN, ABK and LOZ (light circles).

Table 1. The coordinates of the IMAGE stations

Station Name	Code	Geographic Lat(°)	Geographic Long(°)	Magnetic[1)] Lat(°)	Magnetic[1)] Long(°)	Appr. L value
Sørøya	SOR	70.54 N	22.22 E	66.08 N	110.30 E	6.6
Masi	MAS	69.46	23.70	64.89	110.58	6.0
Muonio	MUO	68.02	23.53	63.53	109.38	5.5
Pello	PEL	66.90	24.08	62.40	109.07	5.1
Kilpisjärvi	KIL	69.02	20.79	64.81	107.93	6.1
Kevo	KEV	69.76	27.01	64.80	113.39	5.9
Oulujärvi	OUJ	64.52	27.23	59.73	110.23	4.2
Hankasalmi	HAN	62.30	26.65	57.65	108.60	3.8
Nurmijärvi	NUR	60.50	24.65	56.16	106.06	3.5
Ny Ålesund	NAL	78.92	11.95	74.85	114.29	16.5
Hopen Island	HOP	76.51	25.01	71.36	118.68	10.5
Bear Island	BJN	74.50	19.20	70.13	112.07	9.5
Abisko	ABK	68.37	18.82	64.43	105.85	6.0
Lovozero	LOZ	67.97	35.08	62.20	118.48	4.8

[1)] Eccentric magnetic dipole model.