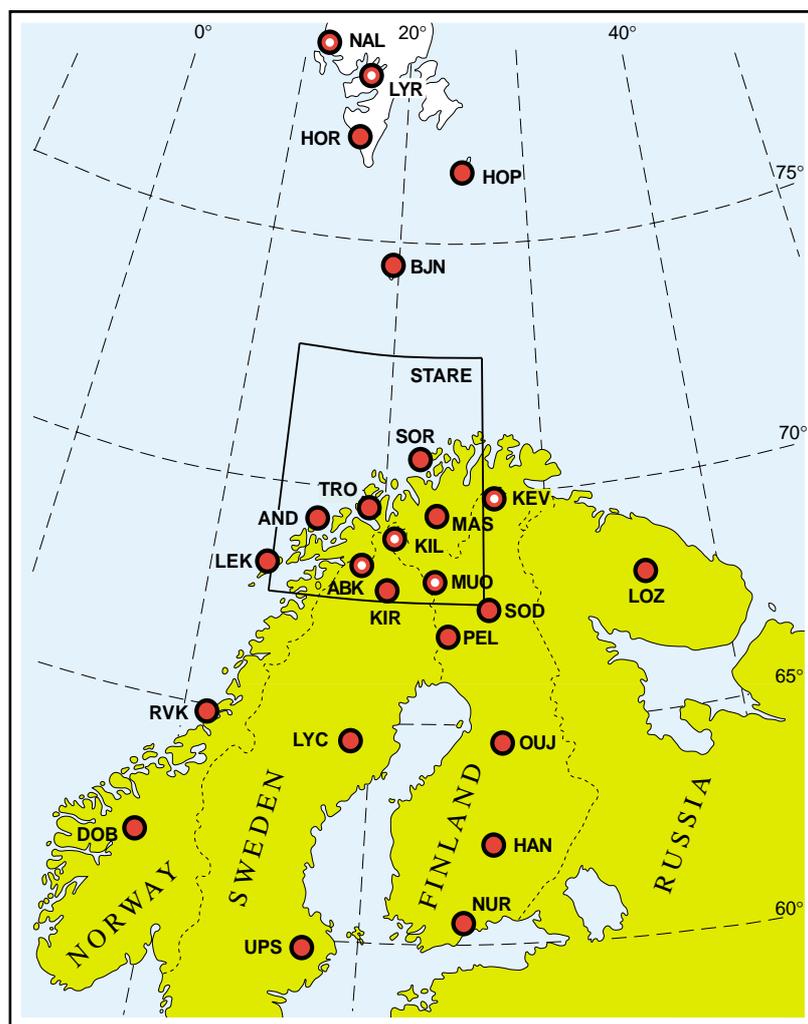




IMAGE – the backbone of MIRACLE



- Magnetometer
- Magnetometer and all-sky camera

January 2000

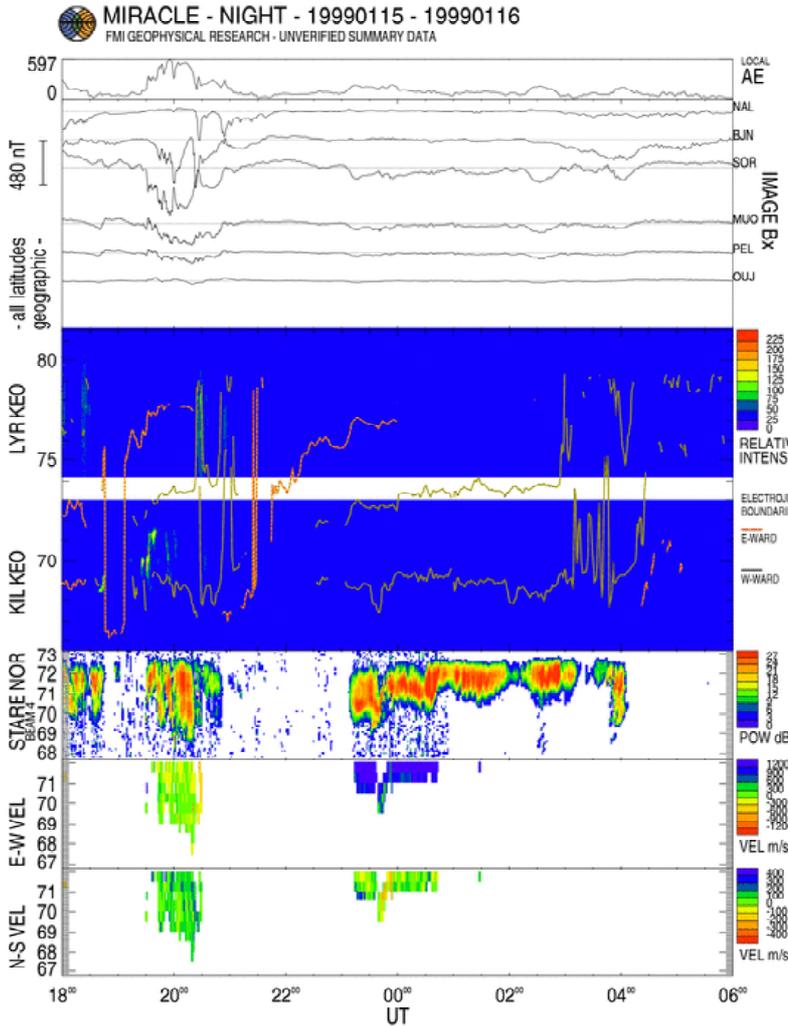
MIRACLE: Magnetometers – Ionospheric Radars – All-Sky Cameras Large Experiment
The map shows the locations of the IMAGE magnetometer stations, digital all-sky cameras and the STARE field-of-view.

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

— from quick-look plots to high-level scientific products —

Standard MIRACLE quick-look plot



<- The local AE index which is based on IMAGE recordings and produced similarly as the global AE index.

<- Magnetograms of the X component at selected stations along the middle meridional chain of IMAGE.

<- All-sky camera (ASC) keograms and electrojet boundary locations. The keograms are intensity versus latitude plots, which show the auroral intensity along the middle meridians of two ASC stations, Kilpisjärvi and Longyearbyen. The provisional electrojet boundary locations are based on profiles of the X variations along the middle meridian of IMAGE.

<- Range-Time-Intensity (RTI) plot of STARE shows the intensity of ionospheric backscatter along one beam of the Norwegian radar.

<- East and north components of the electron velocity are derived from the merged data of the two STARE radars.

WWW page:
<http://www.geo.fmi.fi/MIRACLE/qlform.shtml>

MIRACLE instruments

- **Magnetic field:** IMAGE magnetometer network with 25 stations (10 s sampling interval).
- **Auroras:** Six digital all-sky cameras (imaging interval 20 s, wavelengths 557.7, 630.0, and 427.8 nm, circular field-of-view with the diameter of about 600 km).
- **Ionospheric electric field:** STARE (coherent scatter radars in Norway and Finland, sampling rate 20 s, common field of view 400 km x 400 km).

MIRACLE and space weather

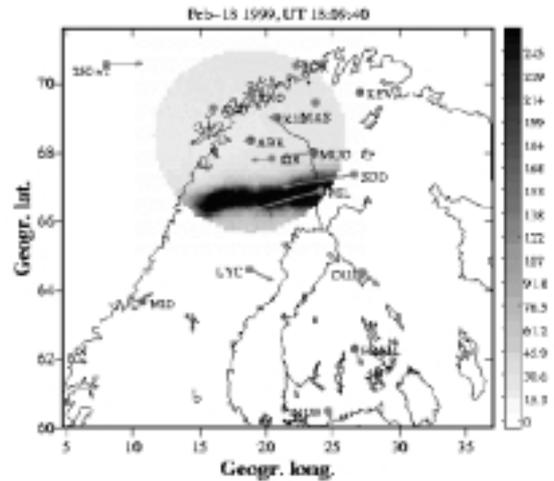
Space weather refers to the time-variable conditions in the near-Earth space that may cause problems to space-borne or ground-based technological systems. In particular, rapid geomagnetic disturbances at the Earth's surface are associated with electric fields, which drive geomagnetically induced currents (GIC) in man-made conductors. For example, in power transmission grids GIC may cause saturation of transformers and in gas pipelines GIC may disturb corrosion protection. GIC are not directly related to large values of the magnetic field variations, but to its large time derivatives (up to tens of nT/s).

On February 18, 1999, after 1809 UT large GIC values were recorded in the Finnish high-

voltage power system (Fingrid Oyj) and in the natural gas pipeline network (Gasum Oy). Recordings made at Sodankylä (the closest IMAGE station to a GIC recording point of the power transmission grid) show that GIC was related to a short-lived, intensive bay. The largest time derivative, $dX/dt = -32$ nT/s, was recorded at 1810 UT. According to the equivalent currents, Sodankylä was below a narrow, strong westward current. Auroral images at Abisko show that the large GIC was associated with a fast westward propagating fold in a pre-existing arc. The arc brightened immediately after the fold and broke up to rayed north and southward spreading structures.

MIRACLE observations show that the rapid magnetic field changes were caused by ionospheric currents which concentrated within a narrow conductivity channel. The channel was created by the electron precipitation related to the bright auroral strip which propagated westward with the speed of 15 km/s. The fast motion of the strip as well as the intense precipitation which it carried along were the crucial features causing the large dB/dt values and consequently the large GIC.

The figure shows the all-sky camera image recorded at Abisko at 1809:40, together with equi-



valent current vectors recorded at IMAGE stations.

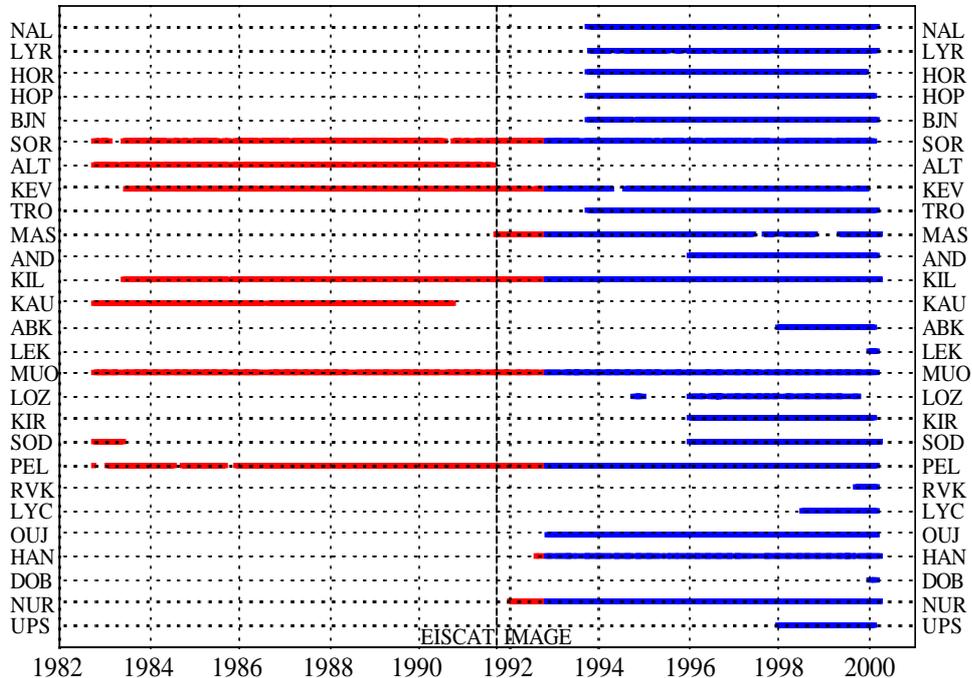
For more information about MIRACLE, see

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

or contact the PI Kirsti Kauristie

kirsti.kauristie@fmi.fi

Data availability: EISCAT/IMAGE magnetometers (1982-2000)



The diagram shows the availability of digital data files of the EISCAT and IMAGE magnetometers. The EISCAT magnetometer cross started recordings in October 1982 with a 20 s sampling interval. The name was changed to IMAGE in October 1991, and the sampling interval to 10 s in November 1992. Yearly datacharts are available at <http://www.geo.fmi.fi/image/datacharts.html>.

IMAGE WWW pages

The main information channel of IMAGE are the web pages maintained by the Finnish Meteorological Institute. All important topics can be easily found by starting from the homepage

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

Data are available in several ways:

- Daily magnetograms:
<http://www.geo.fmi.fi/image/gif/>
- User-defined magnetograms:
http://www.geo.fmi.fi/image/gif/gif_form.html
- Data files in different formats:
<http://www.geo.fmi.fi/image/request.html>
- Near real time magnetograms:
<http://www.geo.fmi.fi/image/prel/>
- Local "AE index":
<http://www.geo.fmi.fi/image/gif/ae.html>

Other useful information:

- List of IMAGE publications:
<http://www.geo.fmi.fi/image/publications.html>
- Map and coordinates of stations:
<http://www.geo.fmi.fi/image/stations.html>

The maps are available in PostScript and PDF formats, and they may be modified freely, for example for publications.

New IMAGE stations

The total number of IMAGE magnetometer stations is now 25. Data from two new sites in Norway (Dombås and Leknes) are added to the IMAGE database from the beginning of year 2000. Both stations are operated by the Tromsø Geophysical Observatory. Real-time magnetograms from most Norwegian sites and other useful information are available at <http://geo.phys.uit.no/geomag.html>.

Data on CD-ROMs

The whole EISCAT magnetometer dataset is available on a CD-ROM. IMAGE data (1991–97) are on three CD-ROMs, and the data of 1998 will be available in summer 2000. The CD-ROMs can be ordered from the Finnish Meteorological Institute at a price of 500 FIM (84 euros) each (+VAT if applicable).

IMAGE meeting 2000

The 8th IMAGE team meeting was held in Nurmijärvi and Helsinki, Finland, on 10–11 February 2000. The organizer was the Finnish Meteorological Institute. The total number of participants was about 20.

Following traditions, the first day included status reports on instrument and data questions. We also got an overview of the Greenland magnetometer array. The second day included an overview of MIRACLE, discussion about new stations and other future items, and a few scientific presentations.

Several new IMAGE stations were suggested to fill some magnetometer gaps in the STARE field of view and in the east–west direction along the auroral oval.

The next meeting is planned to be organized in autumn 2001. The place is to be decided later.

IMAGE teams

- **Finland:**
Finnish Meteorological Institute / Geophysical Research Division
University of Oulu / Sodankylä Geophysical Observatory
- **Germany:**
GeoForschungsZentrum Potsdam
Technical University of Braunschweig
- **Norway:**
University of Tromsø / Tromsø Geophysical Observatory
- **Poland:**
Polish Academy of Sciences / Institute of Geophysics
- **Russia:**
Russian Academy of Sciences / Polar Geophysical Institute
- **Sweden:**
Geological Survey of Sweden
Swedish Institute of Space Physics

Contact information at
<http://www.geo.fmi.fi/image/addresses.html>

This Newsletter is available as a colour copy (PDF file) at URL <http://www.geo.fmi.fi/image/newsletter/news7.pdf>