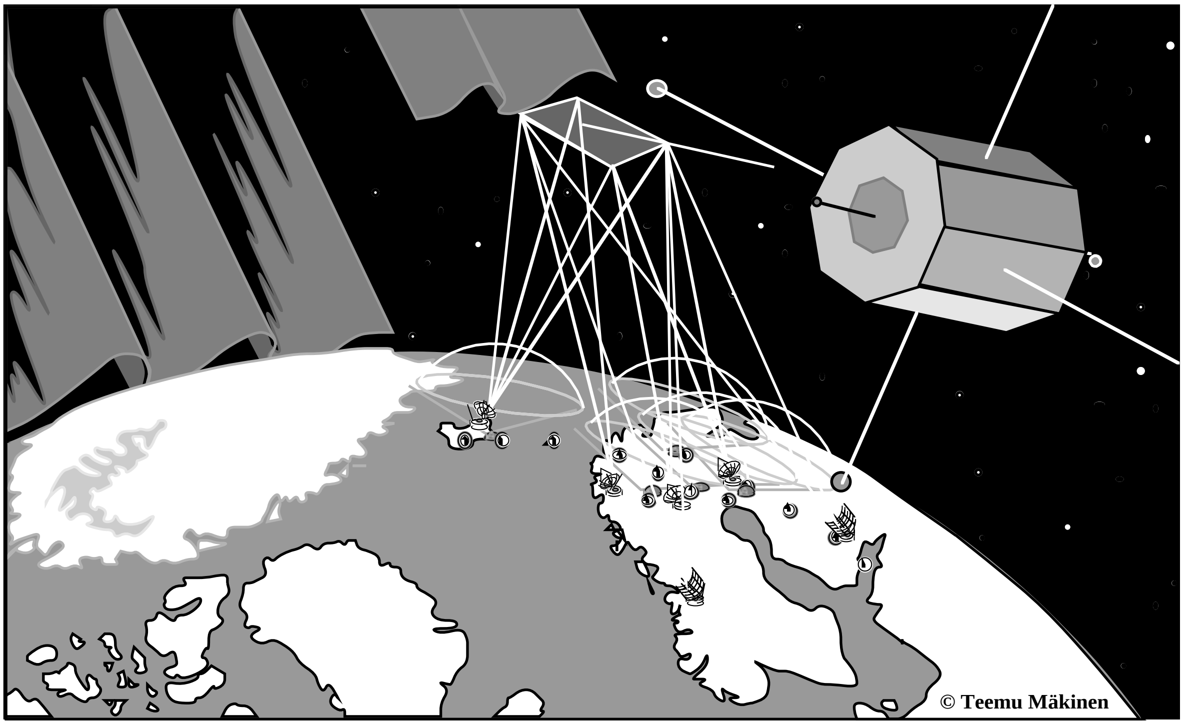
IMAGE Newsletter

Number 8 IMAGE Team **February 2002**

Extension of IMAGE
– improved possibilities to investigate ionospheric physics –

The prime objectives of IMAGE are to study auroral electrojets and moving two–dimensional current systems. The long profile presently covering geographic latitudes from 58 to 79 degrees is especially favourable for electrojet studies. The dense two–dimensional part of the array in northern Fennoscandia allows for a detection of east–west structures too. Together with other ground–based recordings of the MIRACLE network (by radars and all–sky cameras) and satellite observations, IMAGE contributes to the full three–dimensional description of auroral ionospheric electrodynamics.



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Scientific analysis tools for IMAGE and MIRACLE

Starting from basic principles, magnetic field variations measured by a ground–based network can be explained by equivalent current systems flowing on a horizontal plane. Without going to mathematical details, equivalent currents fully explain the observed magnetic field. However, there is an infinite number of possible current configurations. So the true (3–D) ionospheric currents cannot be determined with the use of ground magnetometers only. We will present here some methods, which are in a routine

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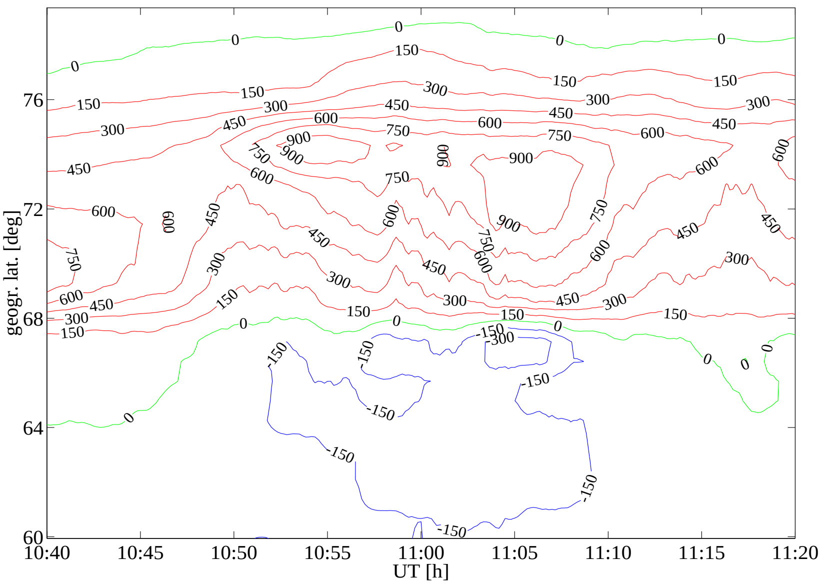


Fig. 1. Eastward (red) and westward (blue) current densities calculated with the 1–D upward continuation using the north component of the ground magnetic field along the profile NUR–NAL.

use with IMAGE data.

The simplest approach is to assume that ionospheric currents flow only parallel to the east–west direction transverse to the north–south magnetometer chain. Then it is possible to determine the ionospheric current density by using the north (and downward) component of the magnetic field. A conventional method is called upward continuation of the field to the ionospheric level (Fig. 1), but a number of other techniques exist.

Strictly speaking, the variation field is also affected by induced currents in the earth. Their contribution can be estimated with a classical field separation procedure. In most situations, it is quite reasonable to neglect induction effects.

A recent step forward is the development of the method of spherical elementary current systems. It allows for calculating 2–D equivalent currents in regions of any size, even globally, assuming that ground measurements are available in the area of interest (Fig. 2). It is also possible to perform the field separation into external and internal parts by setting an additional equivalent current layer inside the earth.

To determine the true 3–D ionospheric currents, ionospheric radars are of special importance, as they yield the ionospheric electric field. With estimations of ionospheric conductivities, it is possible to derive plane maps of ionospheric conductances and true horizontal and field–aligned currents for single timesteps. There are also approaches which utilize satellite data to directly infer field–aligned currents.

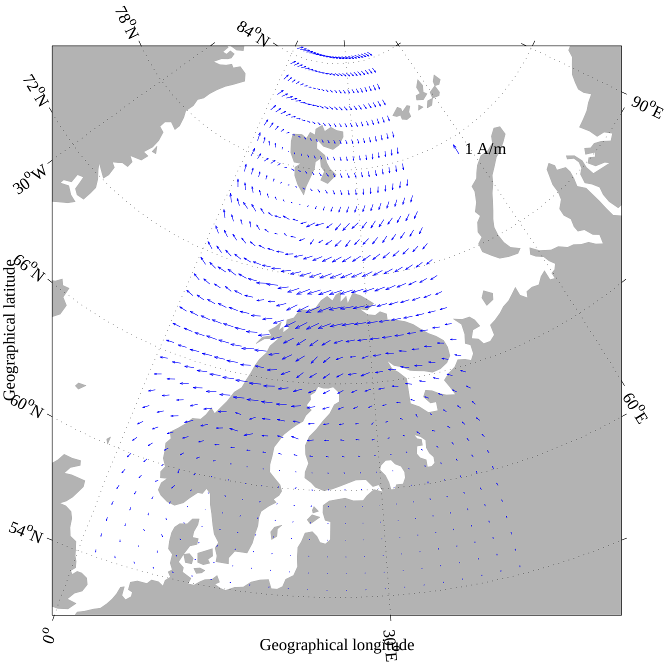
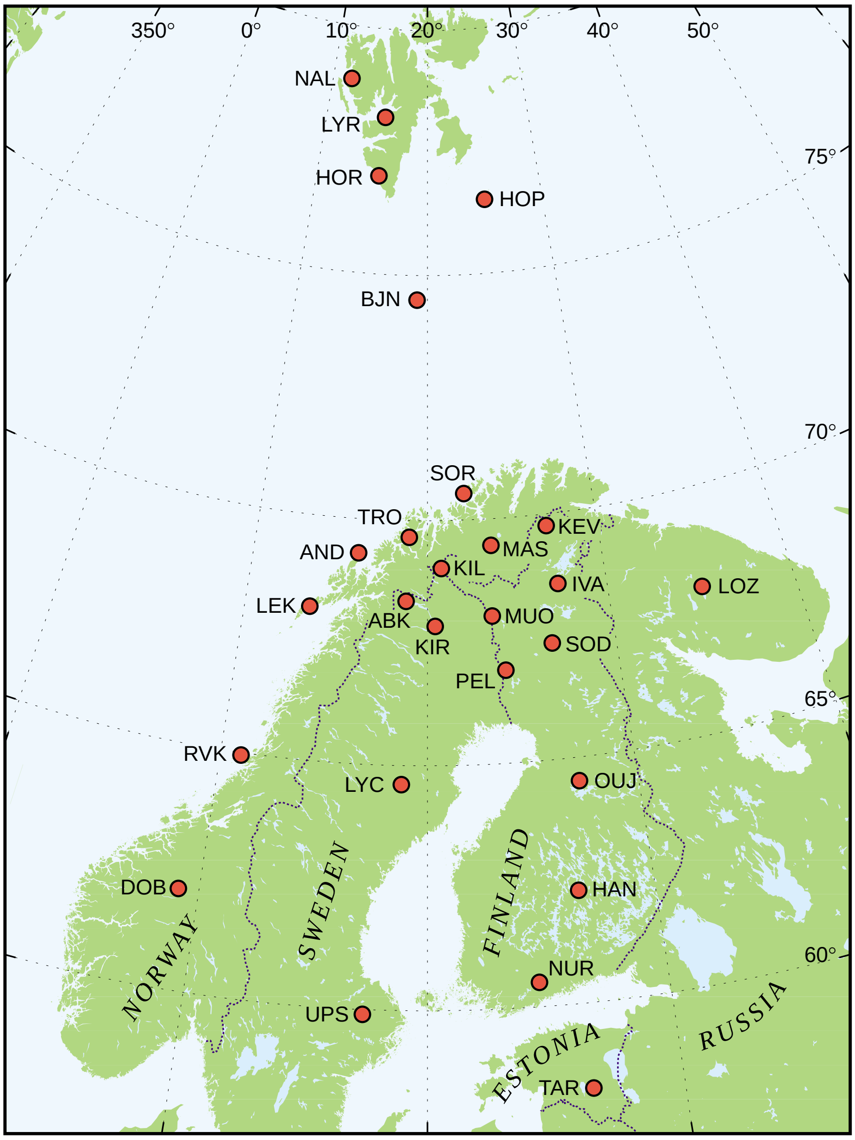


Fig. 2. Ionospheric equivalent currents on June 26, 1998, 02:30 UT, determined with the method of spherical elementary current systems. The input data comprises IMAGE and the temporary BEAR magnetotelluric array, which operated in summer 1998 in Fennoscandia.

Further information of these analysis tools is available on http://www.geo.fmi.fi/MIRACLE/MIRACLE_analysis_tools_main_00.html.

IMAGE magnetometer stations



New stations at Ivalo and Tartu

The Finnish Meteorological Institute and the Sodankylä Geophysical Observatory installed a magnetometer in Ivalo (68.56 N, 27.29 E) in autumn 2000, and data have been added in the IMAGE database since February 2001. The station supplements the dense part of the array inside the fields of view of the all–sky cameras in Kevo, Muonio and Sodankylä.

As a co–operation between the Estonian Meteorological and Hydrological Institute, the University of Tartu and the Finnish Meteorological Institute, the first Estonian magnetic observatory was founded in September 2001 in the area of the Tartu Observatory in Tõravere (58.26 N, 26.46 E). It also extends the length of the south–north magnetometer profile from Tartu to Ny Ålesund up to about 2300 km, and improves possibilities to observe exceptionally southern geomagnetic storms.

The updated IMAGE map is available on
http://www.geo.fmi.fi/image/stations.html
as gif, PostScript and PDF files.

Geographic and geomagnetic coordinates (CGM in 2001) are listed on
http://www.geo.fmi.fi/image/coordinates.html

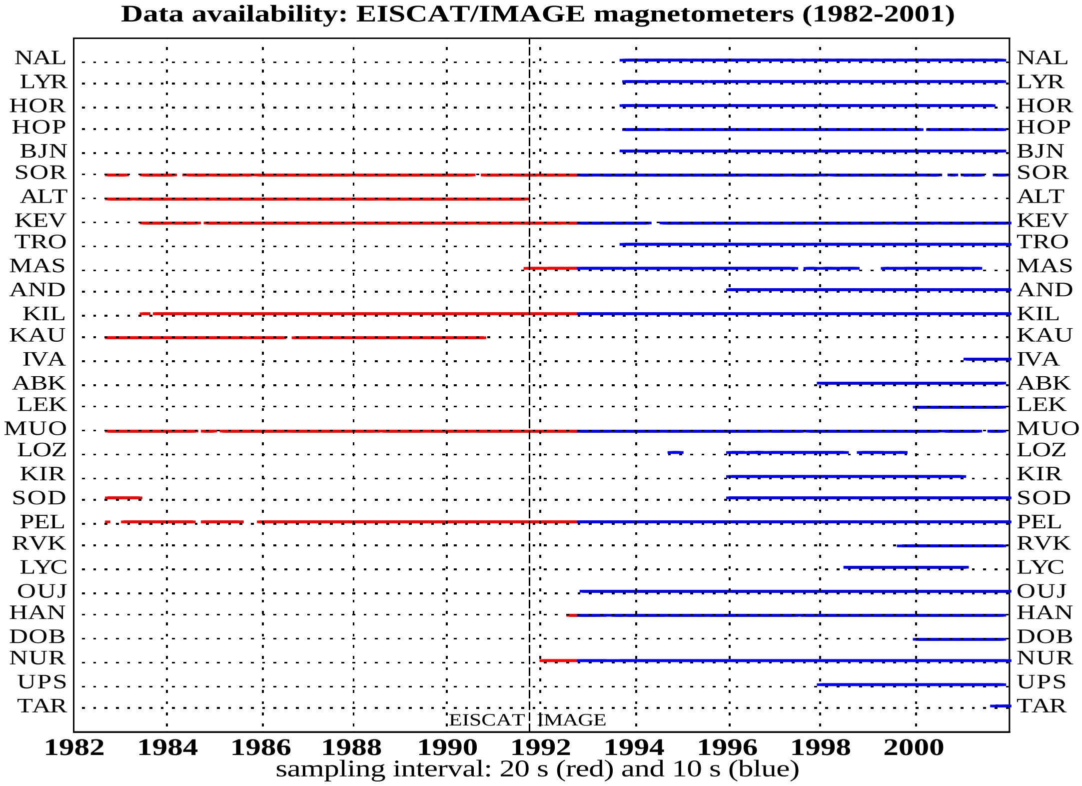


IMAGE WWW pages

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

Some improvements have been made on our WWW pages for an easier use:

Permanently stored daily X magnetograms can now be navigated with “previous” and “next” day buttons. Data files are distributed in 6 formats: IAGA, column, WDC, GADF, PostScript and jpg. We have also removed some clearly erroneous data especially of 1980's, and this work will continue.

Combined quick–look plots of the IRIS instrument (Imaging Riometer for Ionospheric Studies) and IMAGE are provided by the Lancaster University at http://www.dcs.lancs.ac.uk/iono/summary/.

The homepage of MIRACLE is

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

This Newsletter is available as a colour copy (PDF file) at URL http://www.geo.fmi.fi/image/newsletter/news8.pdf

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