

Annual ISES Report 2014

Regional Warning Center Sweden

Swedish Institute of Space Physics in Lund (IRF-Lund)

The research project “Solar storms and space weather” is funded by the Swedish Civil Contingencies Agency (MSB). The continuation will be focused on daily warnings of severe to extreme solar storms. IRF-Lund has been asked to participate in two EU H2020 applications: “Predictive Magnetosphere-Ionosphere Coupling Simulations” led by FMI, Finland and “Prediction of geospace radiation environment and solar wind parameters” led by University of Sheffield, UK. IRF-Lund has also been asked to participate in two ESA SSA applications: “Space weather ESCs definition and development”, led by ASTRUM and “Space weather services in Arctic regions”, led by DTU, Denmark.

1. Recent accomplishments

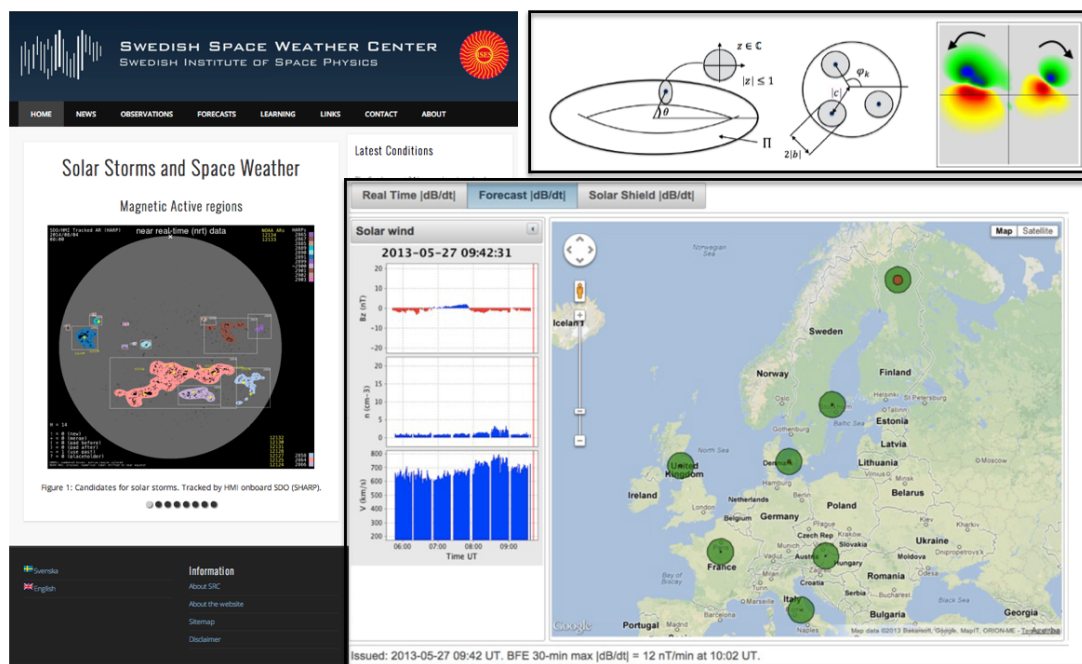


Figure 1. A new RWC-Sweden web service, a solid torus model with simulated magnetogram of May 1921 and real-time $|dB/dt|$ forecasts based on ACE solar wind data.

1.1 A complex solid torus as a model of an extreme solar storm

A complex solid torus model (Fig 1.) was developed in order to be able to study an extreme solar storm, the so-called “Great Storm” or “New York Railroad Storm” of May 1921, when neither high spatial and time resolution magnetic field measurements, solar flare nor coronal mass ejection observations were available. We suggest that a topological change happened in connection with the occurrence of the extreme solar storm. The solar storm caused one of the most severe space weather

effects ever.

We have now continued by studying more recent extreme solar storms; on 4 November 2003 and on 23 July of 2012.

1.2 dB/dt forecast system for Europe

The EU EURISGIC project has just been finished. The goal was to develop a dB/dt forecast system for Europe (Fig. 1).

1.3 A new web service – “Swedish Space Weather Center”

A new web site “Swedish Space Weather Center” is under development (Fig 1). The new address is <http://src.irf.se> (password: solilund). The website has been developed using WordPress, a content management system (CMS). It contains both static pages as well as news articles (posts). The website is both in Swedish and English.

The home page will contain the latest data for solar storms and space weather as well as a short, but descriptive, forecast of solar storms and space weather. In the News section we will publish short articles of general interest about current and past solar and space weather events. This will act as a space weather blog.

In the Observations section we will show data in three categories: Solar magnetic activity, Coronal response and Solar Wind. The Forecast section is the main part of the site and will be updated continuously to reflect new research results and new forecast models.

Finally, we have started to build a small learning center on the site related to our research, forecast models and space weather effects.

2. Highest priority product goals

1. Warnings of severe to extreme solar storms.

The priority space weather goal of Swedish Civil Contingencies Agency (MSB) is to obtain early (days ahead), reliable warnings of extreme solar storms that can cause severe damages for the society. Our product goal is therefore to develop daily warnings of severe to extreme solar storms. First we have focused on solar flare forecasts based on solar magnetic field complexity. As input we have used SDO magnetic field data and complexity parameters available by the Stanford SHARP system. Next we will integrate what we have learned from earlier topological studies of extreme solar storms.

3. Highest priority data needs

As input to the forecast the most important data are:

- Solar magnetic field and velocity data observed with Solar Dynamics Observatory (SDO) and derived complexity parameters such as given by the SHARP system.
- Solar wind data available by ACE.
- Geomagnetic magnetic field data.

4. Recent information on user impacts

In a collaboration with the Swedish National Grid it was found that at times of the $|\text{dBh/dt}| > 500 \text{ nT/min}$ the transmission system was disturbed (Fig. 2).

It was also found that about 1 day per 10 years, a value of $|\text{dBh/dt}| > 1000 \text{ nT/min}$ is measured in Lovö or Uppsala.

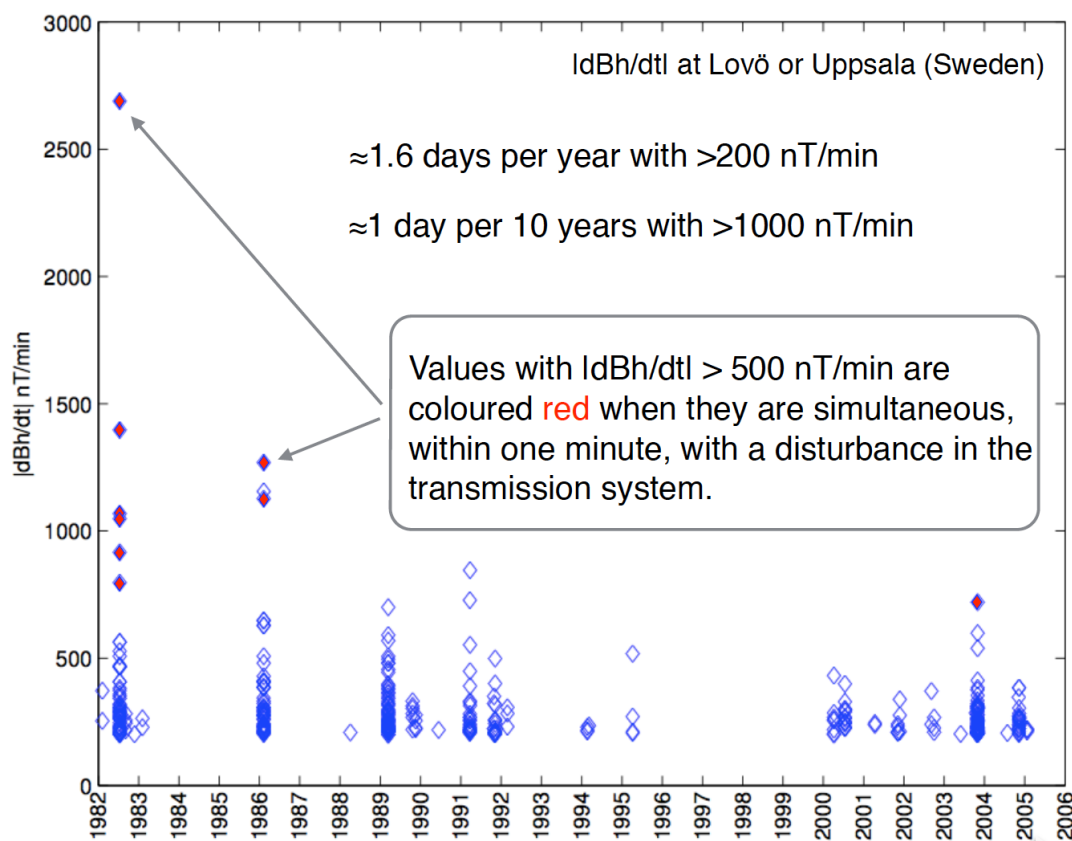


Figure 2. All events at Lovö or Uppsala in Sweden when dB/dt exceeded 200 nT/min between 1982 and 2006.

5. Forecast verification summary

The verification of the preliminary forecasts of severe solar flares, based on SDO complexity magnetic data, is in progress. During the EURISGIC project a study was completed of the verification.