Magnetism and applications
Monday 7.6.2021

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Kangerlussuaq
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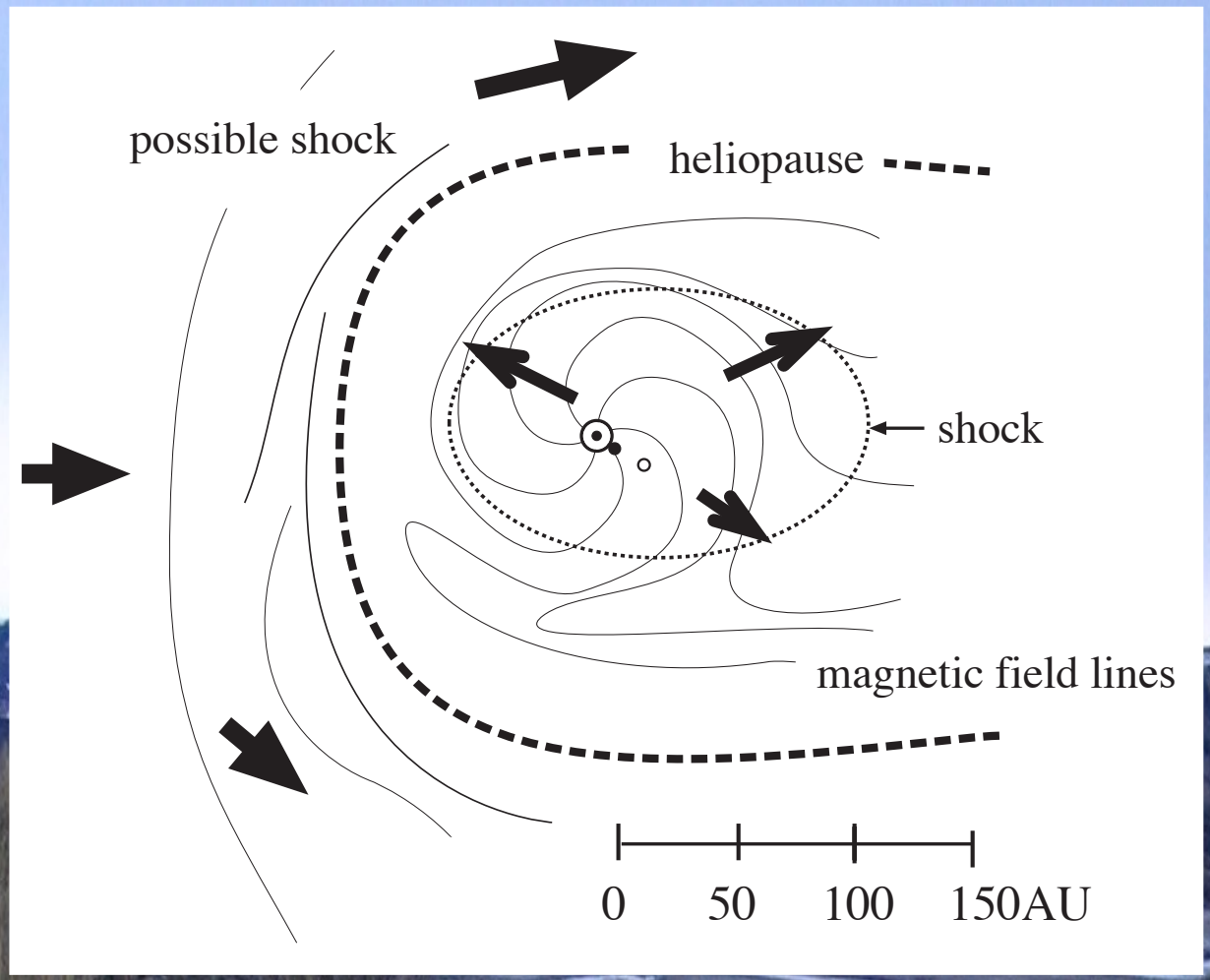
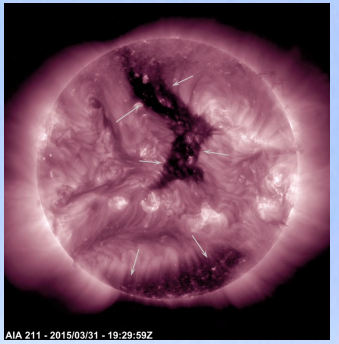
Magnetism in heliosphere and beyond

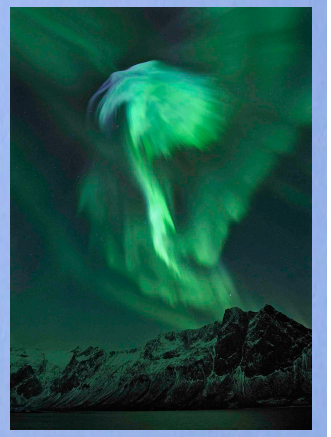
Magnetic forces act in many spatial scales from nanometers to light years.

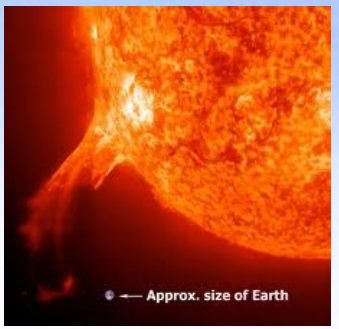


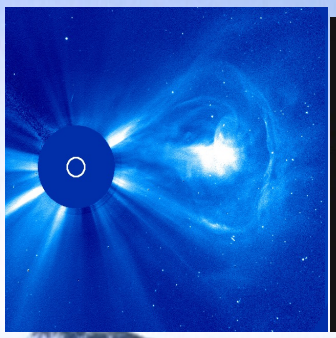
The Sun – Earth magnetic coupling

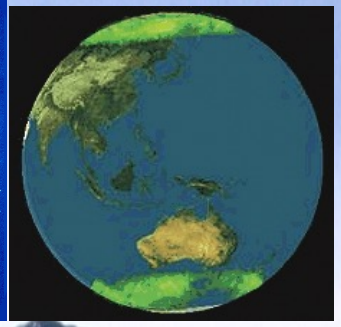


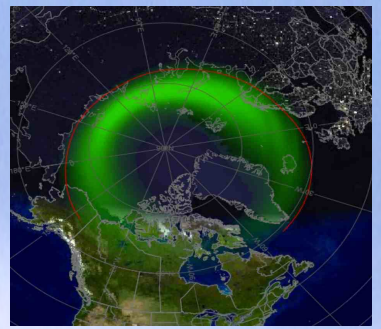
Goal is to examine and better understand geomagnetic activity and its drivers from above and below in time-scales of seconds, hours, decades and centuries.











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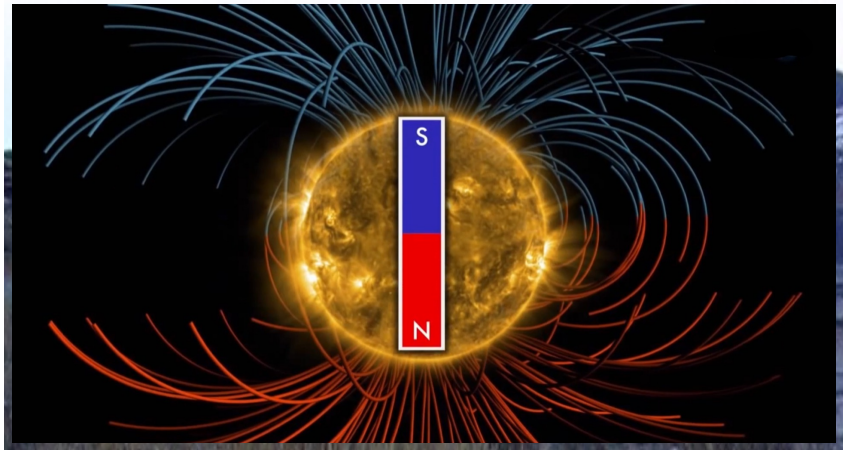
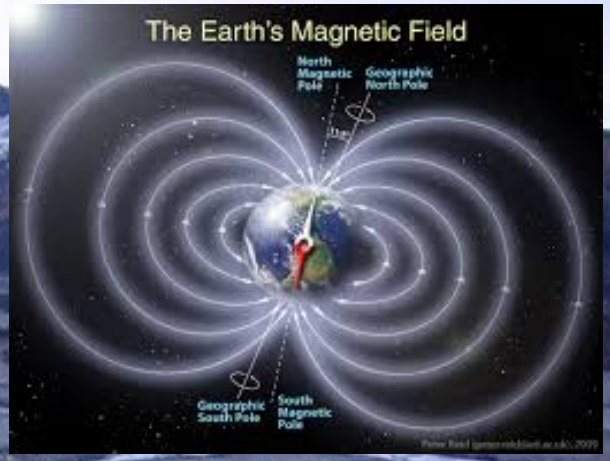
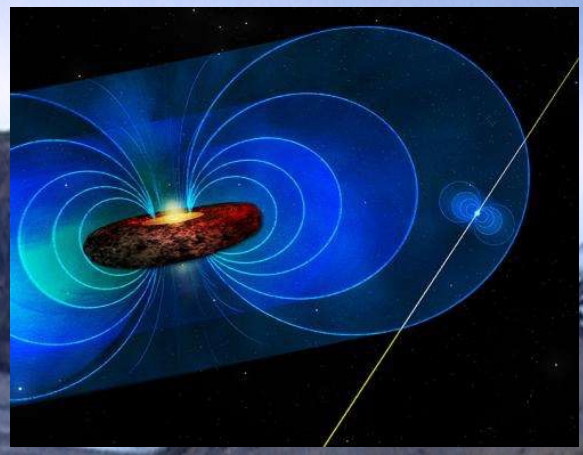
The Sun is a magnet. The Earth is a magnet. The Milky Way is a magnet.

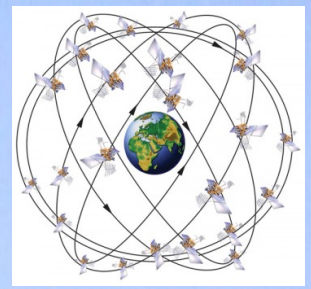
We live in an electromagnetic world almost without noticing the forces that have an influence on us, on our environment and on the basic functions of our society.

Our lives and homes are filled with devices used every day, which are based on magnetic forces, including cars, computers, microwave ovens, credit cards and cell phones.









Telecommunication

Satellite safety

Space safety

Aviation, navigation

Transportation

Electric cars

IMPACT

Nuclear power safety

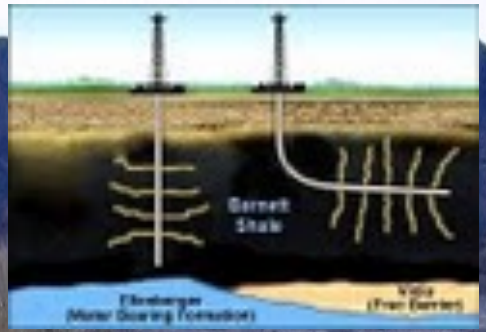
Energy supply

Electricity

Food and water supply

Synchronized data systems

Oil drilling, mining



Content of the course

During the course you will …

* Learn how to count sunspots, measure terrestrial magnetic field, and understand how space weather varies over decades and centuries.

* Learn basics on the magnetism and large-scale infrastructures

* Write a scientific report from the own selected topic

* Learn to give short oral presentations and evaluate fellow students

Schedule of the course 2021

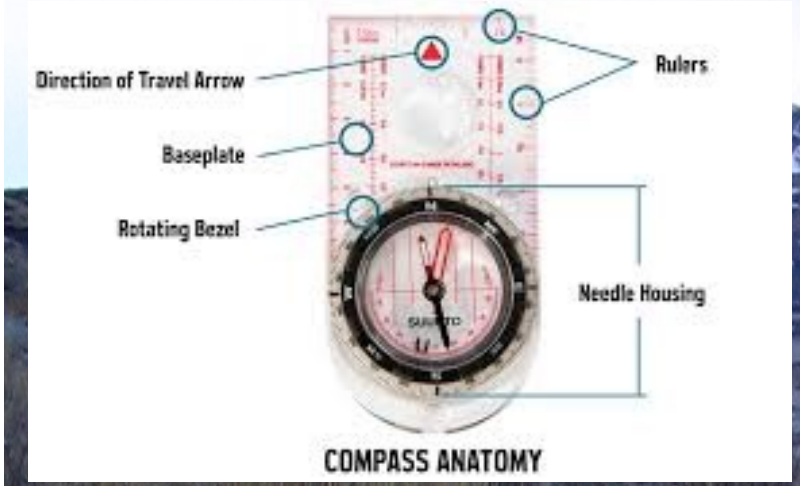
Venue: Zoom

- Monday 7th June at 12:15 – 14:30. Basics of heliospheric magnetism by Eija Tanskanen
- Tuesday 8th June at 12:15 – 14:30. Virtual tours to Sodankylä Geophysical Observatory+ sunspot computing, Shabnam Nikbakhsh, Jouni Envall and Otto Kärhä
- Monday 14th June: Sun-Earth coupling, report writing, Eija Tanskanen
- Tuesday 15th June: Preparing oral presentations and final report
- Monday 21st June: Space weather, observatory tour, Pyry Peitso & Tero Raita
- Tuesday 22nd June: Aurora and VLF emissions by Jyrki Manninen
- Monday 28th: Oral presentations by students.
- Tuesday 29th: Supervised report writing

Compass

Research of magnetism has a long history starting over 4000 years ago when compass was invented for orientation purposes. Compass is a floating magnetic needle that points toward the magnetic north pole.

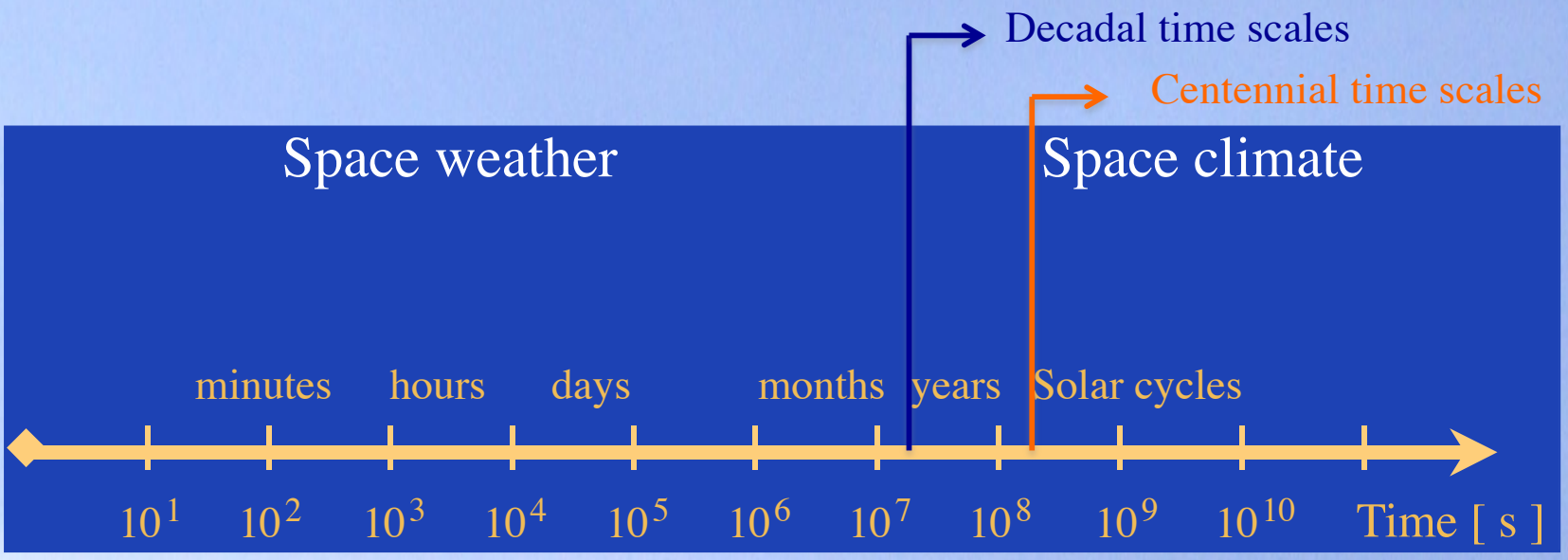
Classical compass



1927 English pocket compass

Modern compass

Time-scales



Pulsations

Substorms

Storms

High-speed streams

Seasonal variation

Year-to-Year variation

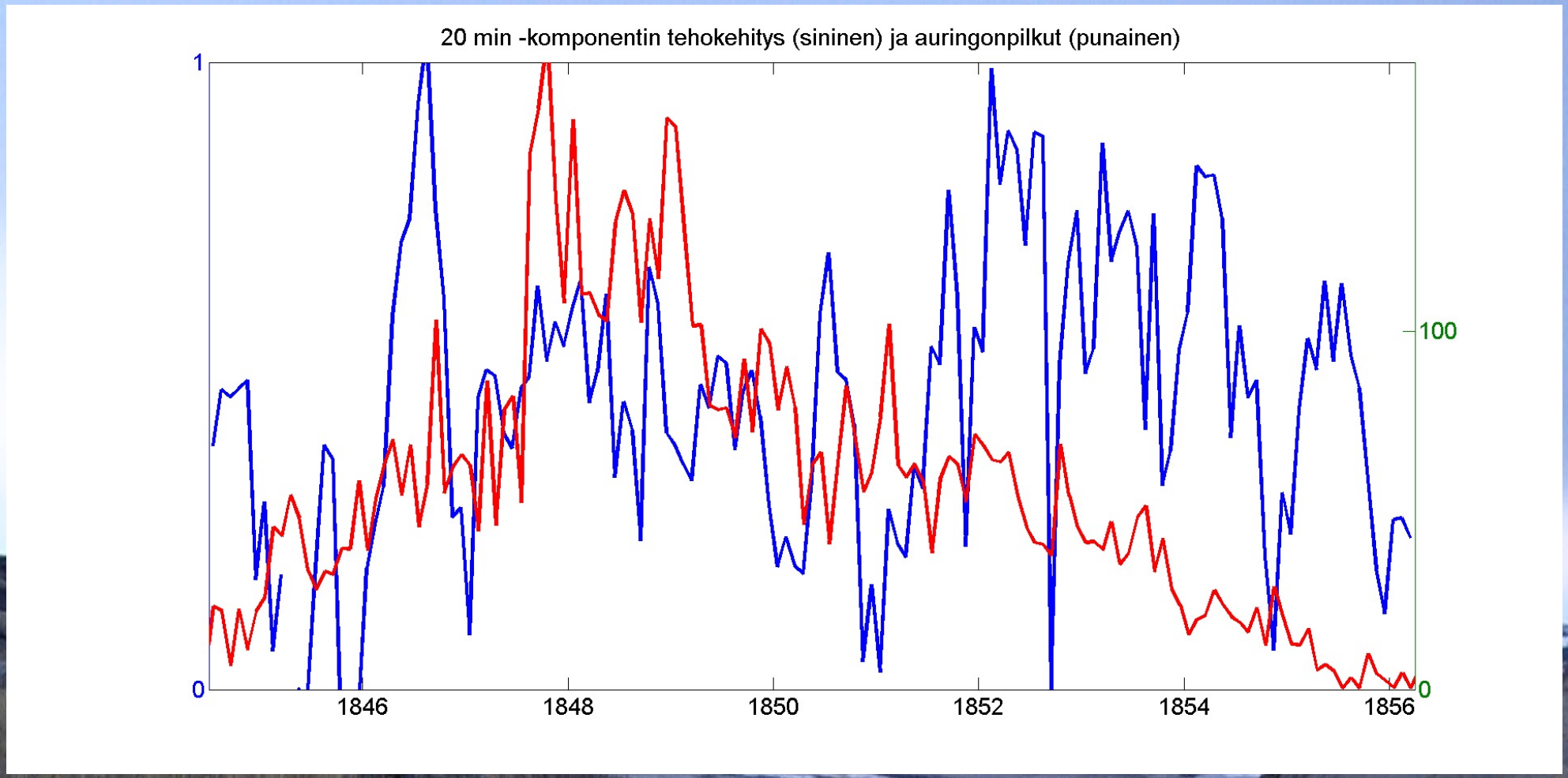
11 and 22-year periodicities

Solar cycle-to-cycle variation

Grand minima and maxima

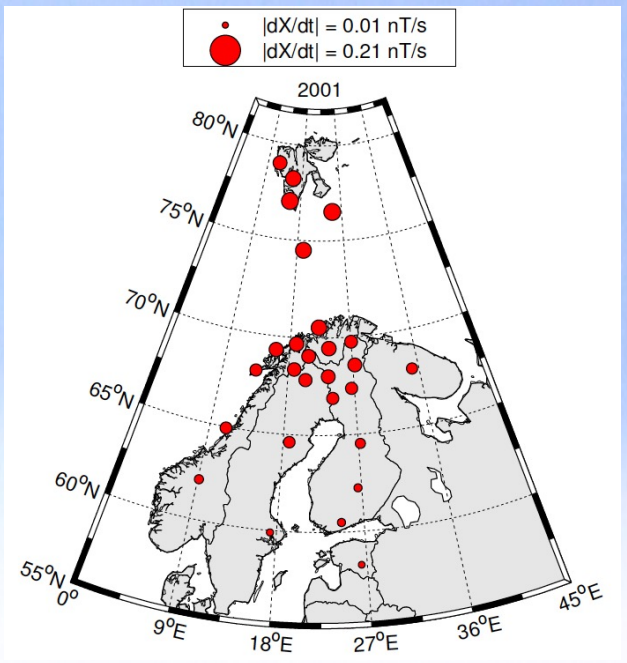
Scientific quality geomagnetic data

Scientific quality geomagnetic data has been recorded in Finland since 1844.

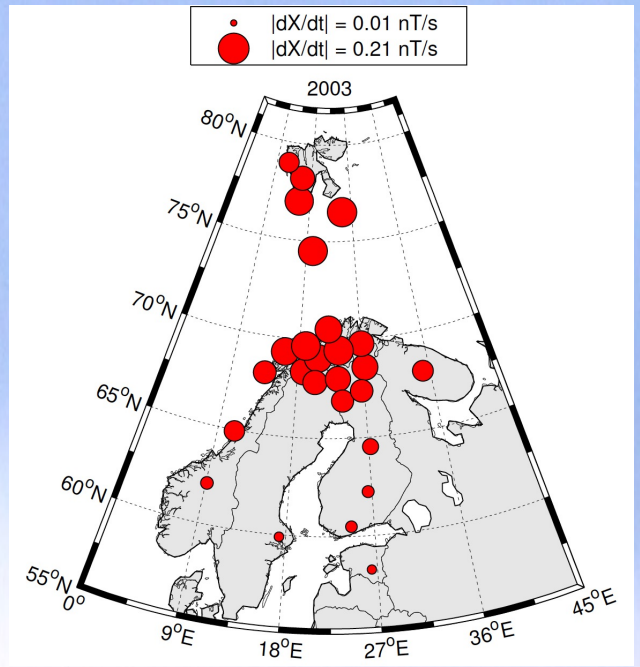


High-latitude geomagnetic activity

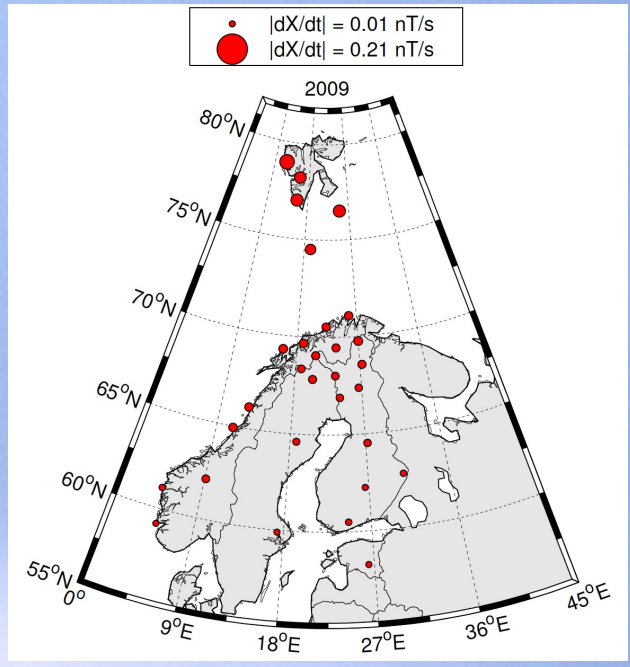
Largest geomagnetic disturbances in high-latitudes between 65 and 75° geom. lat during declining solar cycle phase. (Tanskanen et al., 2002; 2005; 2011 & Tanskanen, 2009.)



Solar maximum



Declining solar cycle phase



Solar minimum

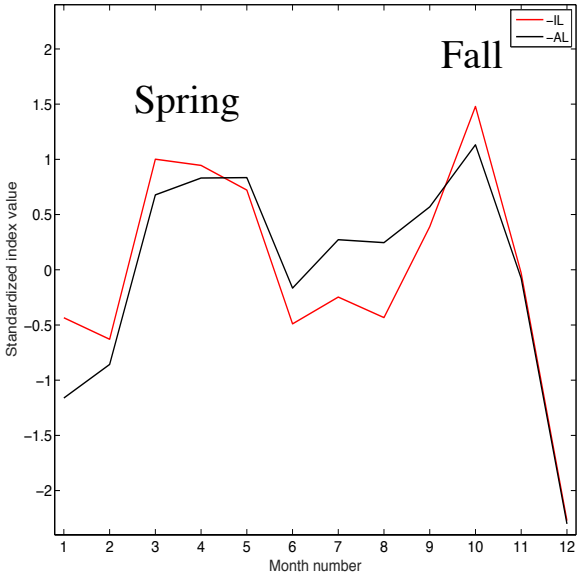
Seasonal variation

Old paradigm:
Geomagnetic activity maximizes in spring and fall.

New paradigm:
Geomagnetic activity can maximize at any solar cycle phase depending on the state of the Sun.

"While mechanisms leading to the classical two-equinox maxima pattern are in operation, the long-term change of solar wind speed tends to mask the effect of these mechanisms for individual years."

Multiyear averages



Close-to-classical semiannual variation

Fall-dominance

Entire year active

Solstice-dominance