

Magnetometer

M.Yamauchi <at> irf.se

Daria Mikhaylova

Mats Luspa

Lars-Göran Vanhainen

Peter Dalin

Csilla Szasz

Peje Nilsson (Umeå)

Fredrik Rutqvist (Umeå)

Urban Braendström

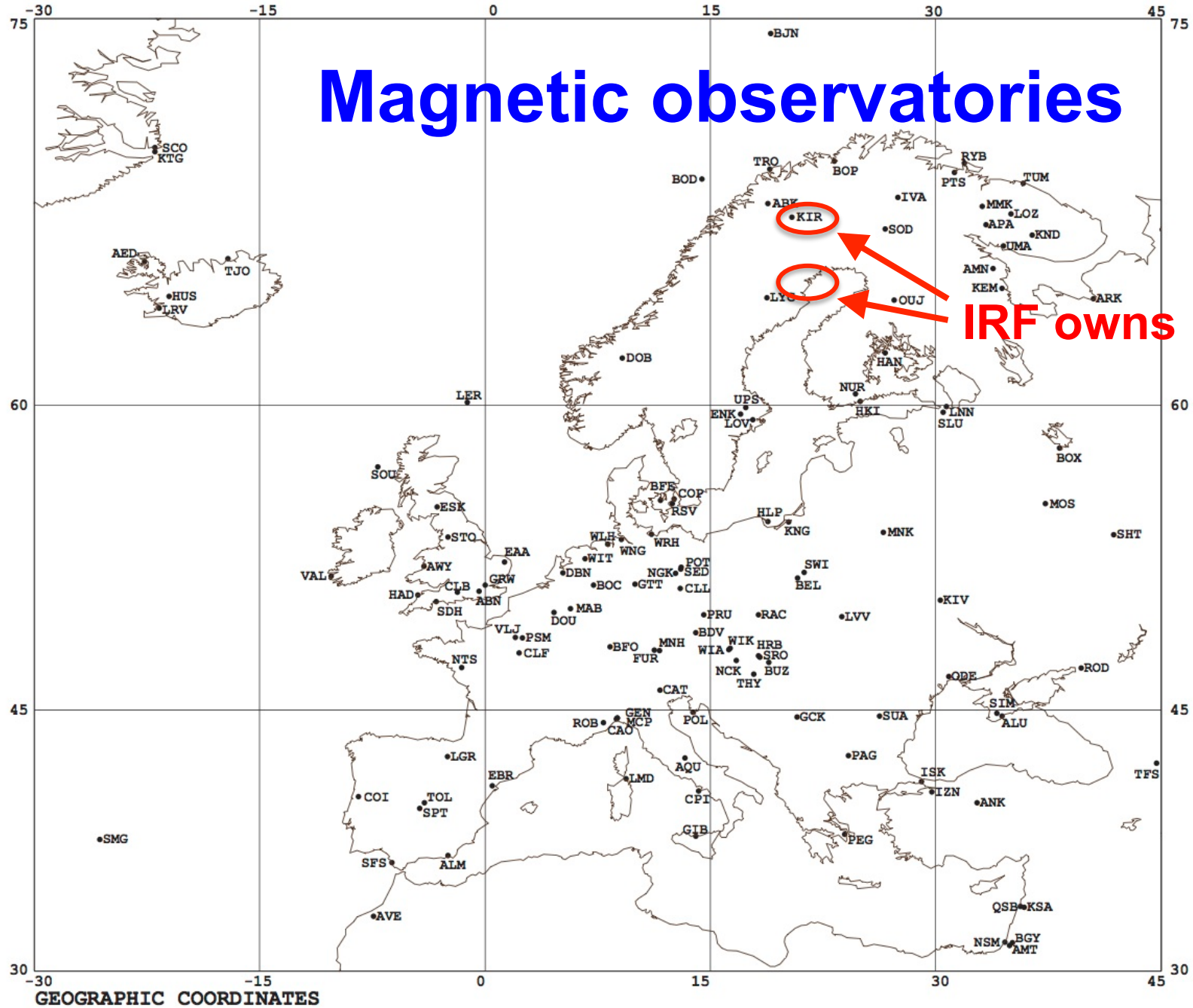


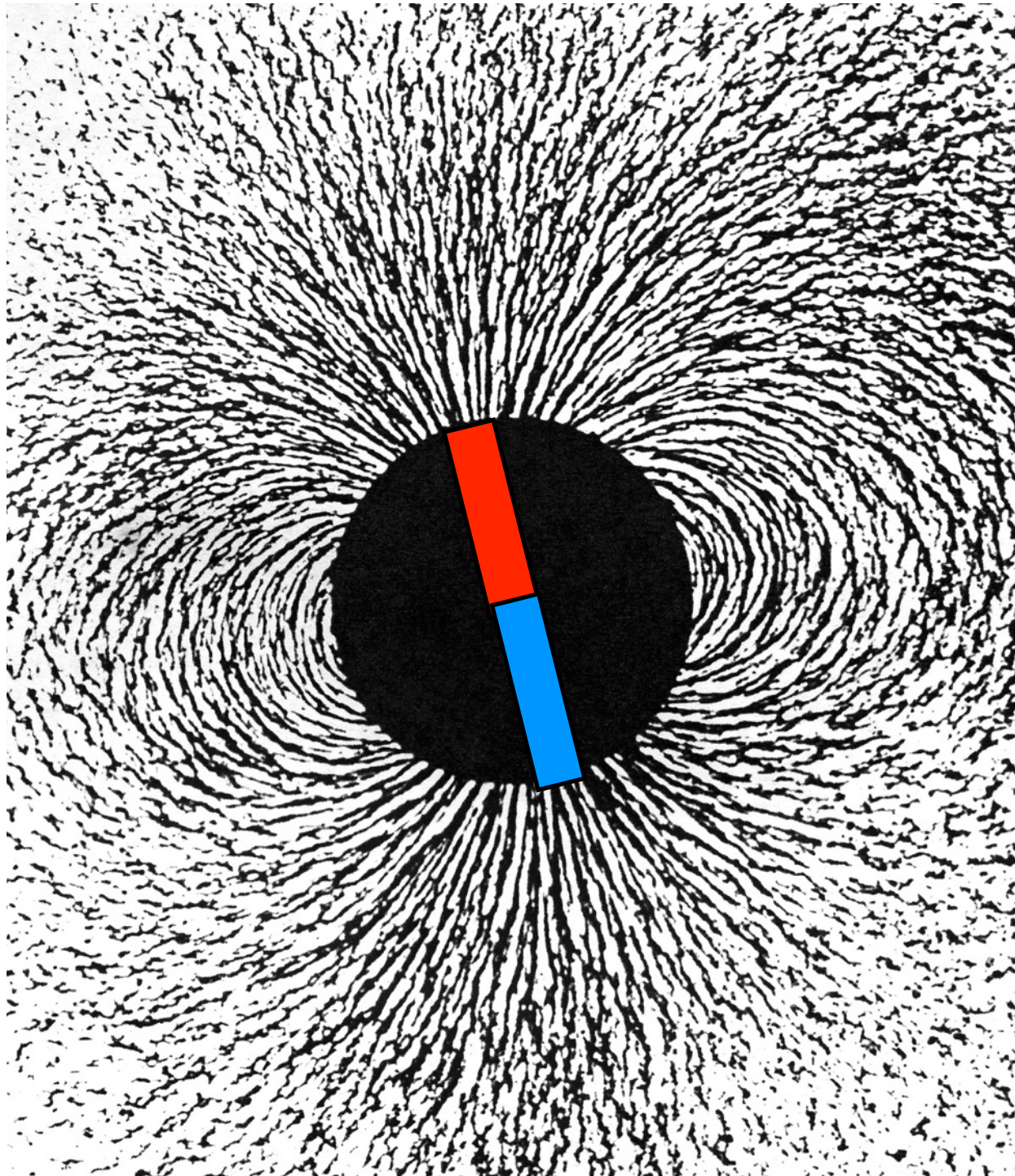
Kiruna Observatory (IAGA: KIR)

The Absolute Measurement building on the left contains a scalar magnetometer and a DI-flux theodolite. The building on the right contains the variometer.

Swedish Institute of Space Physics (IRF): <http://www.irf.se>

EUROPEAN STATIONS





Why do we measure

Ionospheric activity

- aurora
- ~ current
- ~ conductivity etc.

Earth evolution

- dynamo
- ~ polarity change

Ground current

- spaceweather
- & conductivity



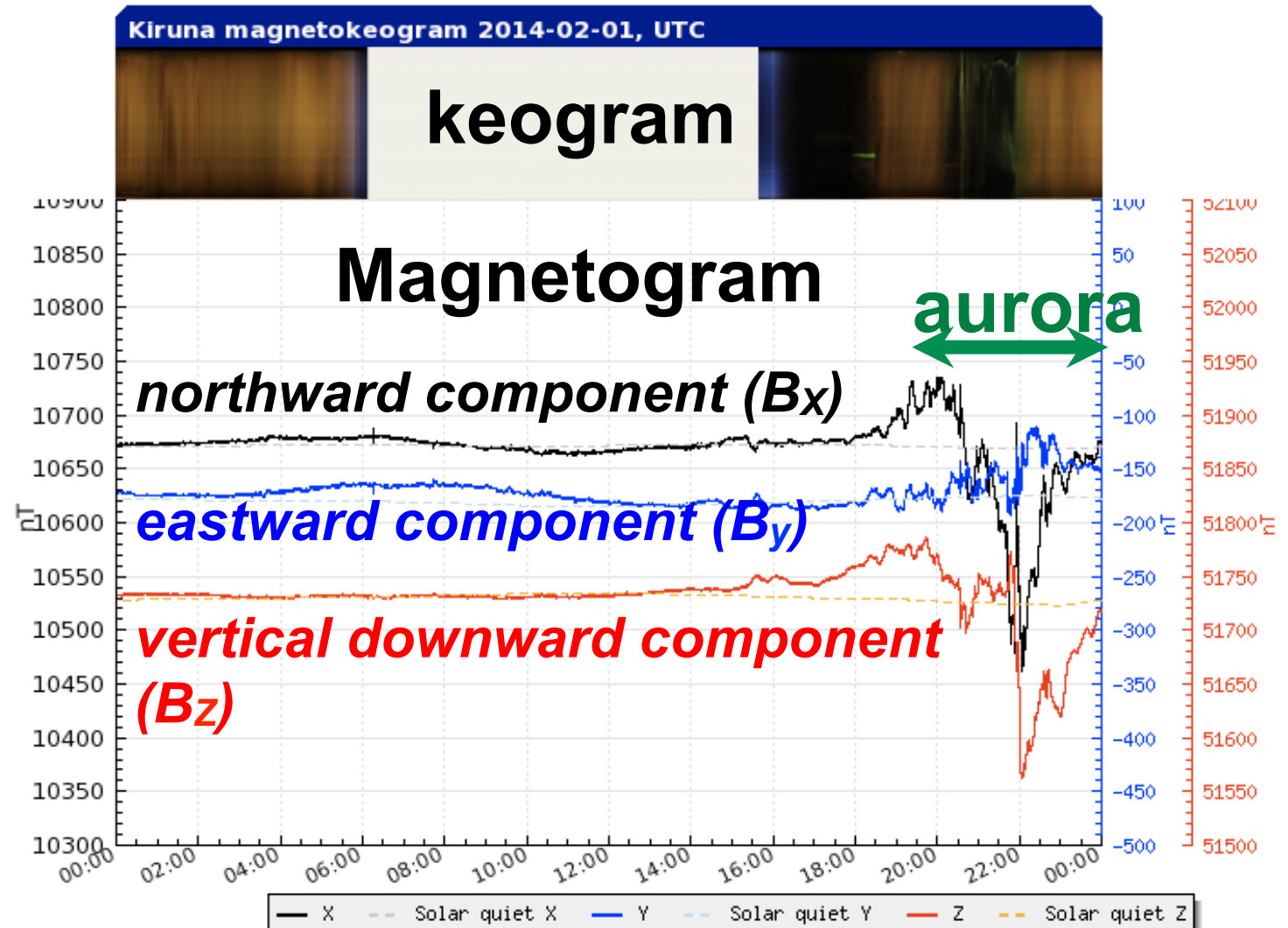
Overview
Topical
Vacancies
Popular Science
Research
Observatory
Data
Publications
Library
Education
SEARCH
Contact

IRF Kiruna
IRF Umeå
IRF Uppsala
IRF Lund

MAP

Real-time page

Get Kiruna plot in pdf format



<http://www.irf.se/mag>

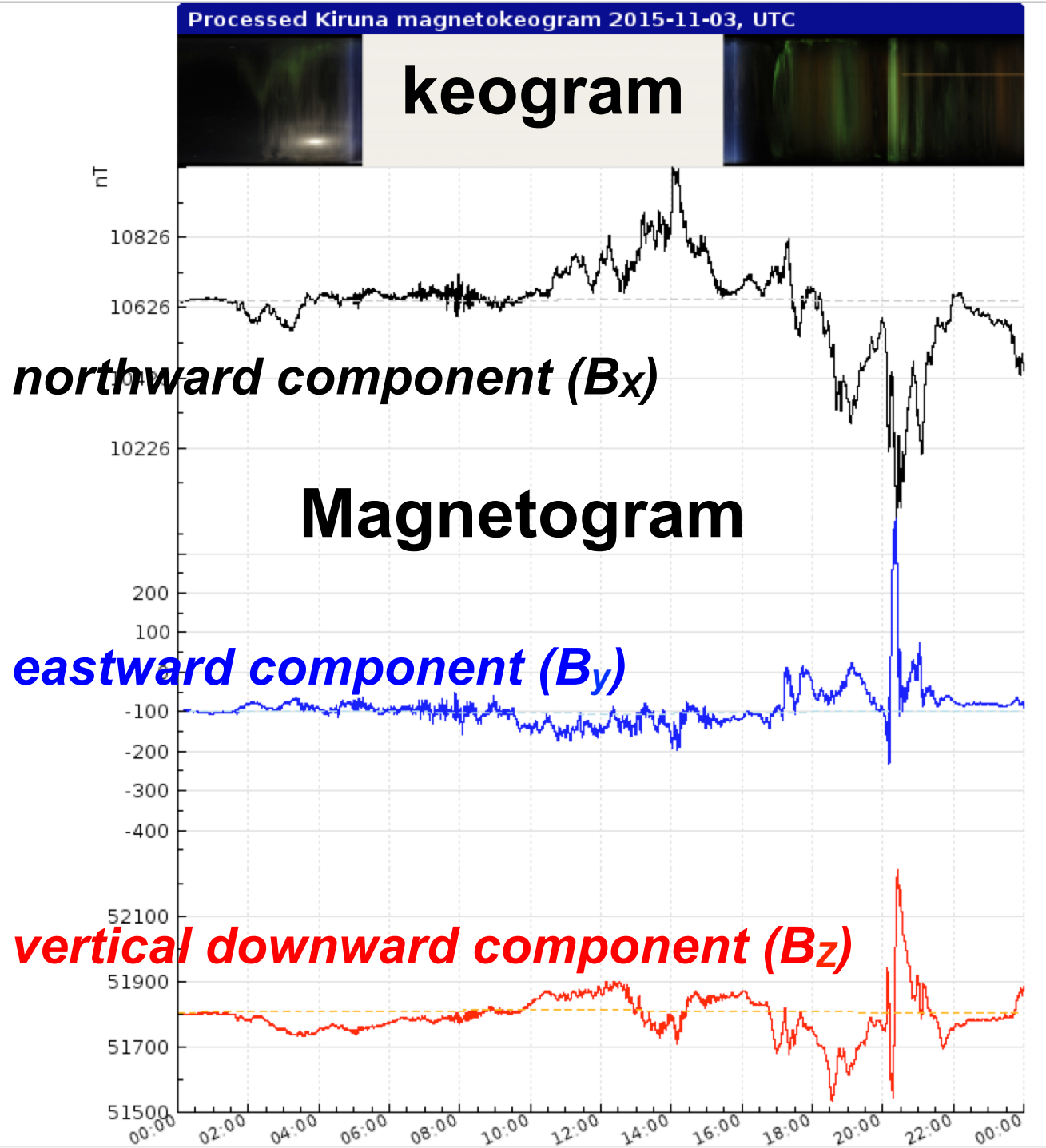
<http://www.irf.se/mag>



Overview
Topical
Vacancies
Popular Science
Research
Observatory
Data
Publications
Library
Education
SEARCH
Contact

IRF Kiruna
IRF Umeå
IRF Uppsala
IRF Lund

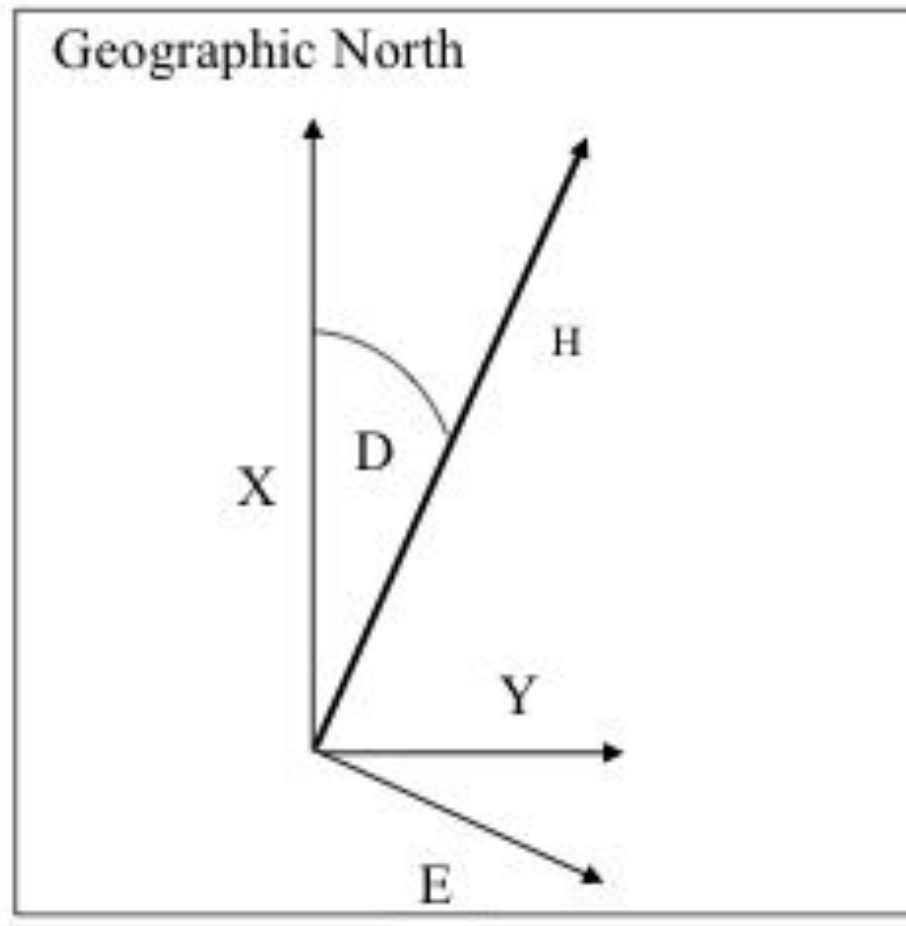
MAP



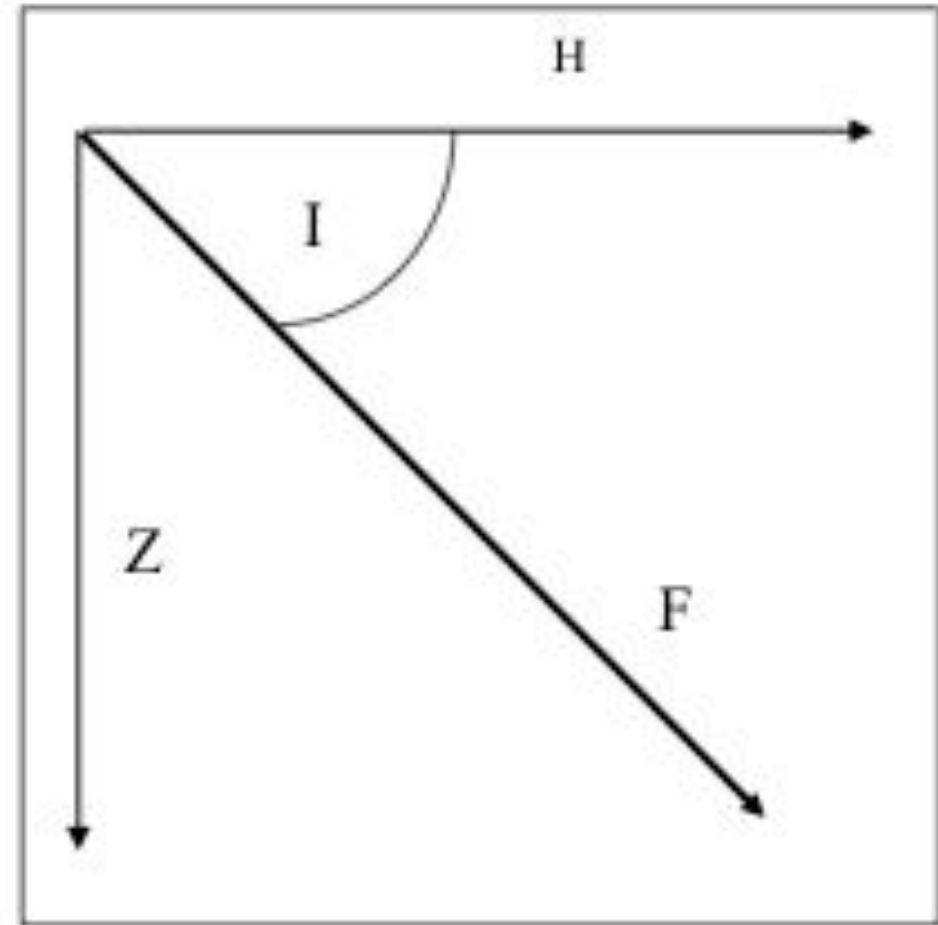
Processed page

Coordinate System

Measurement: Horizontal-Declination-Inclination $\Rightarrow$ Convert to XYZ



Horizontal plane



Vertical plane



Magnetiska

Abs Hus

How to measure (equipment)

What do we have at Kiruna?

Vector field (1 sec): Flux gate magnetometer

- # Primary

- # Secondary (but just call “backup”)

Absolute measurement (weekly): DI flux magnetometer

- # in operation

- # spair

Total field = scalar value (every 4 sec): Proton magnetometer

- # in operation

- # spair

Higher frequency than 1 Hz: Pulsation magnetometer

- # 3 sensors (XYZ) in operation

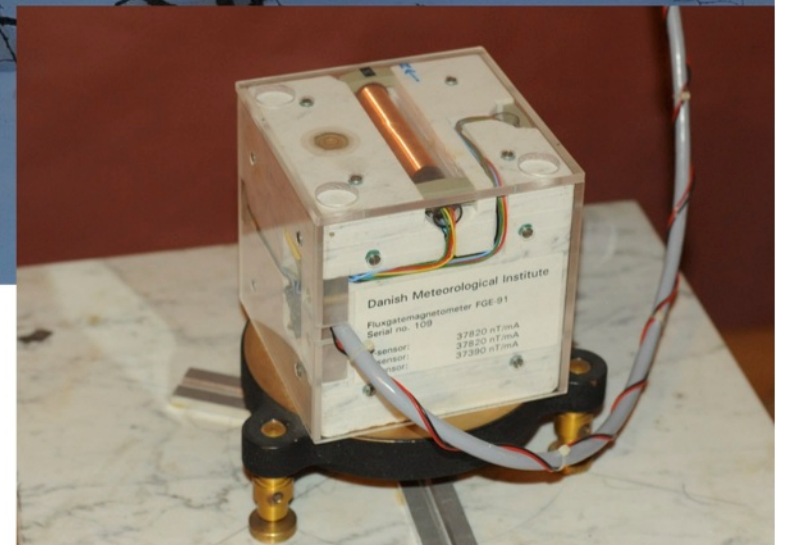
- # one spair

We also have a set at Lycksele, which is operated in collaboration with SGU

Main building



Variometer FGE 91 DMI



Absolute House



Backup GemSys och MinGeo



**Proton magnetometer
GSM-90 Gem Sys**

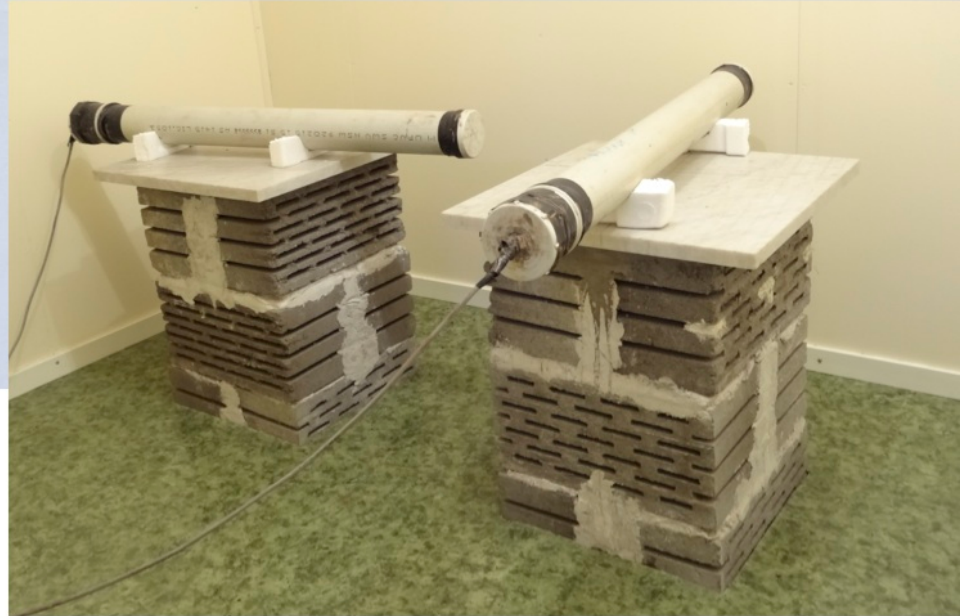


**DI-flux
DMI Zeiss Jena**

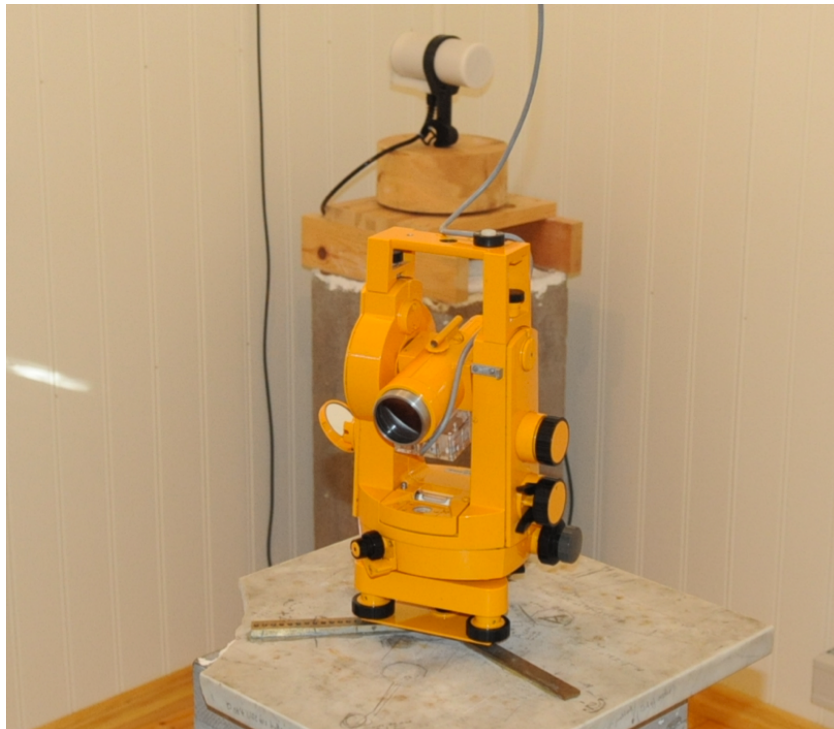
Other magnetometers



Backup EDA 85B/94B UiT

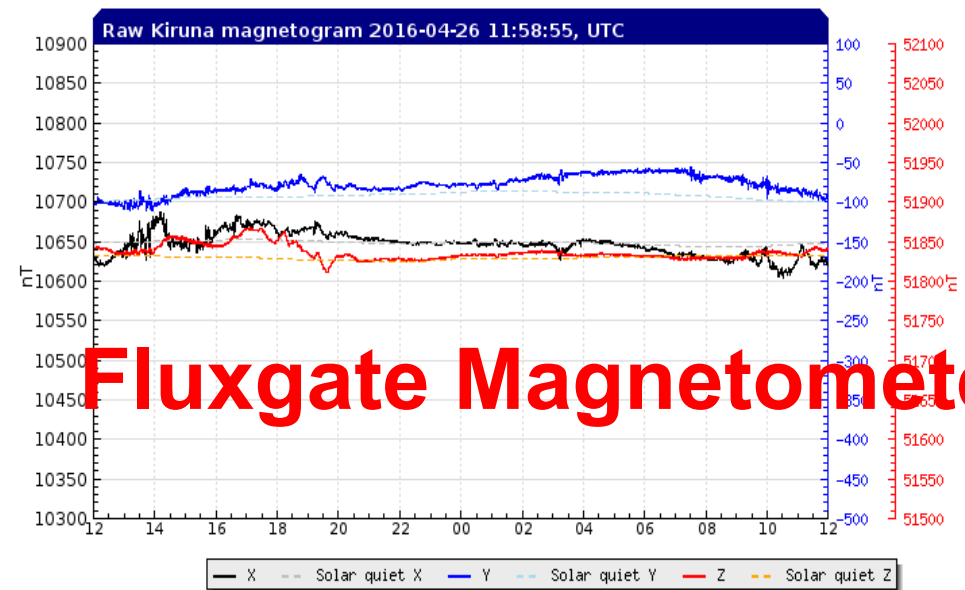
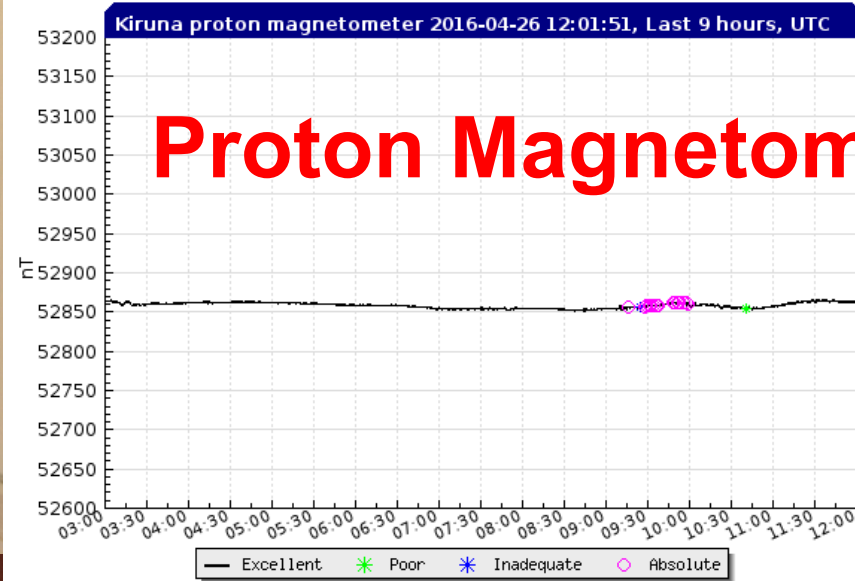


Pulsations Magnetometer



Proton magnetometer

2016 04 26 get day as graphs
 <<<<<< >>>>>>



Fluxgate Magnetometer

Why do we measure

Ionospheric activity

aurora ~ current ~ conductivity etc.

Earth evolution

dynamo ~ polarity change

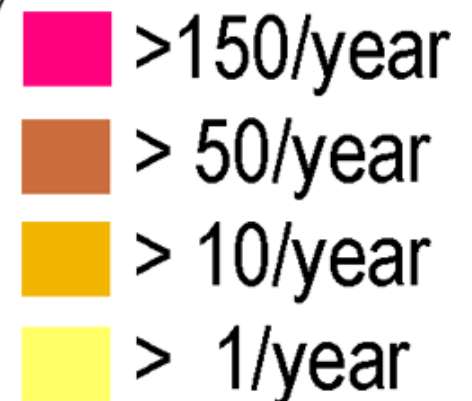
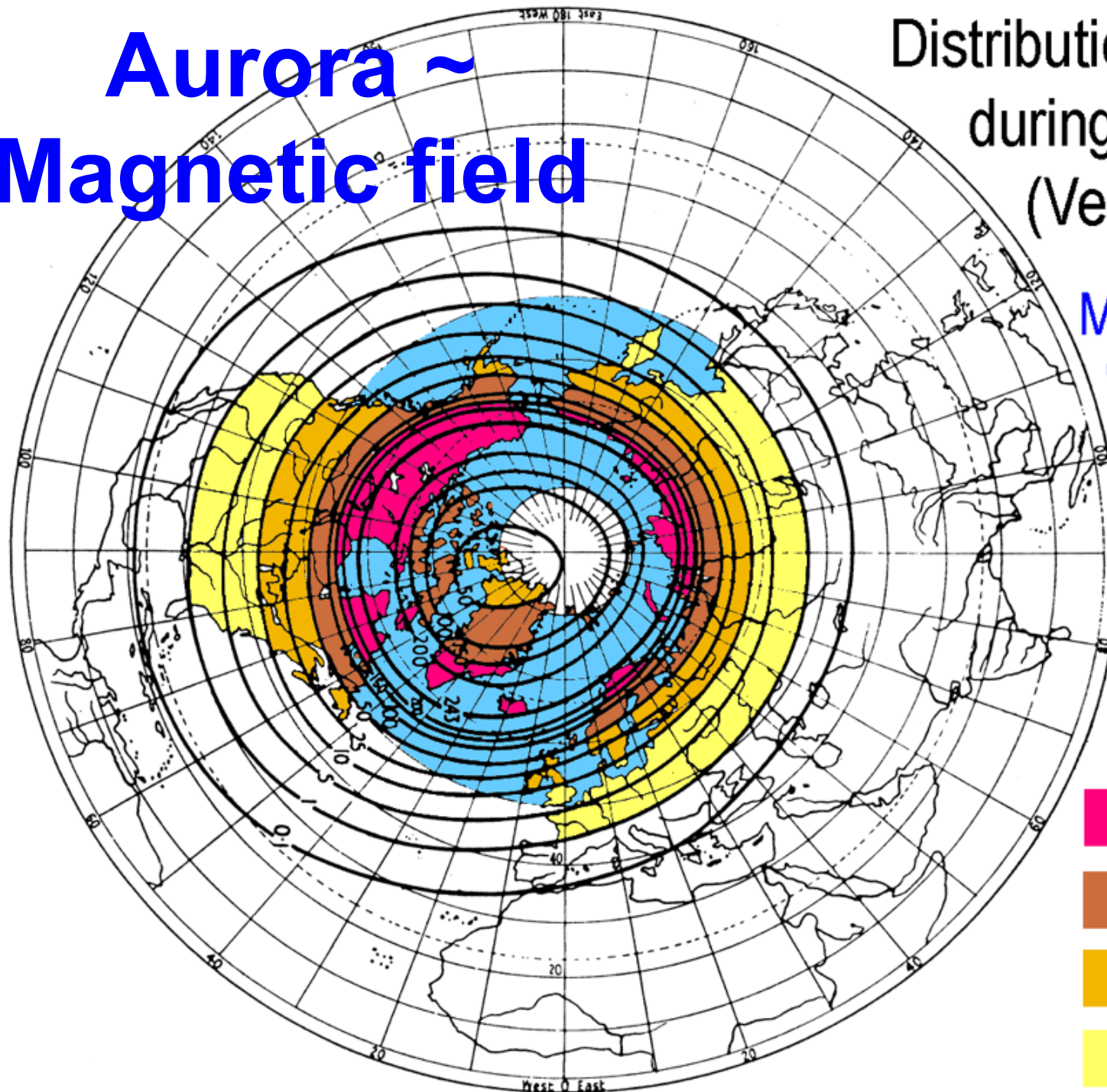
Ground current

spaceweather
& conductivity

Aurora ~ Magnetic field

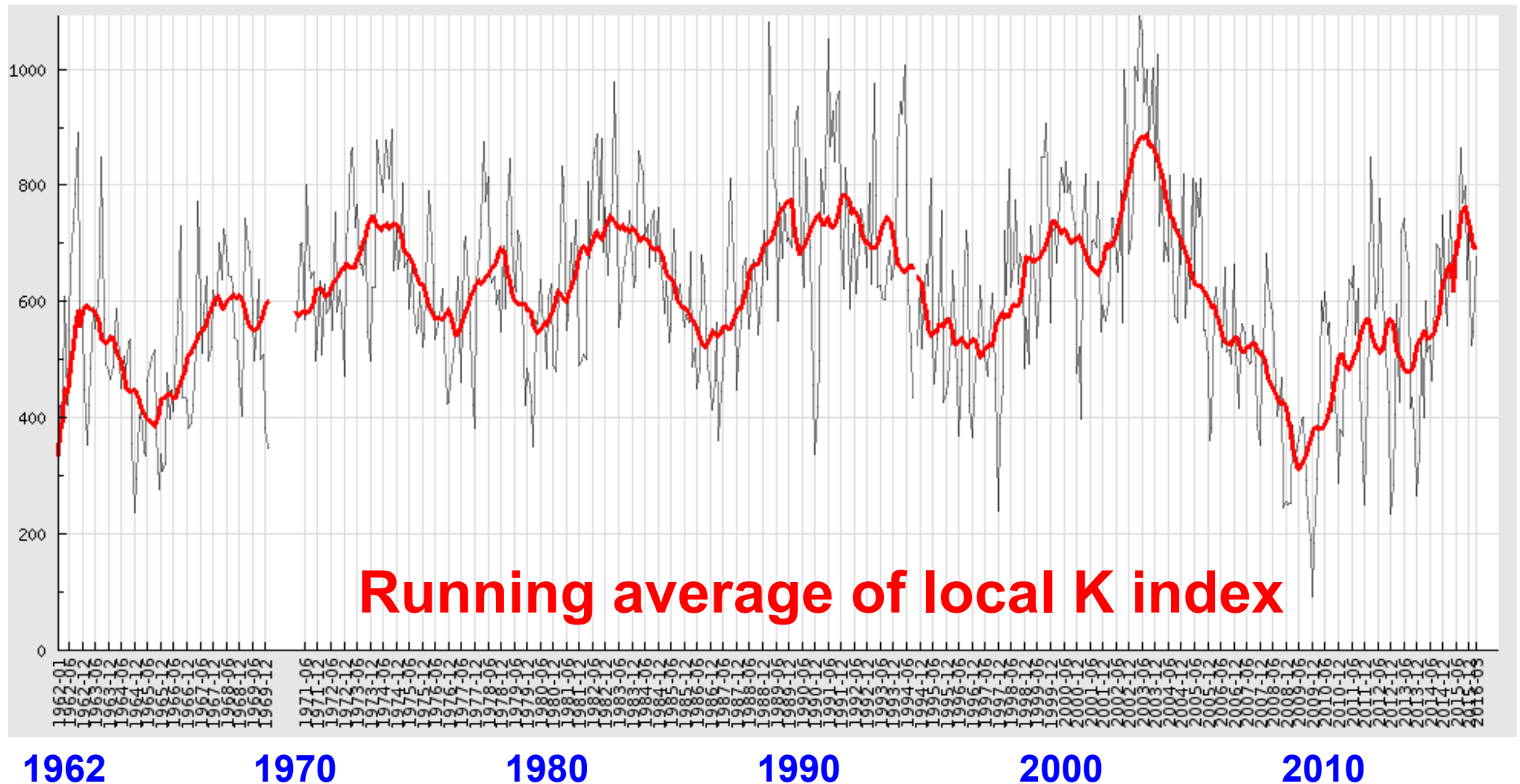
Distribution of aurora
during 1700-1942
(Vestine, 1944)

Match with
Geomagnetic
field

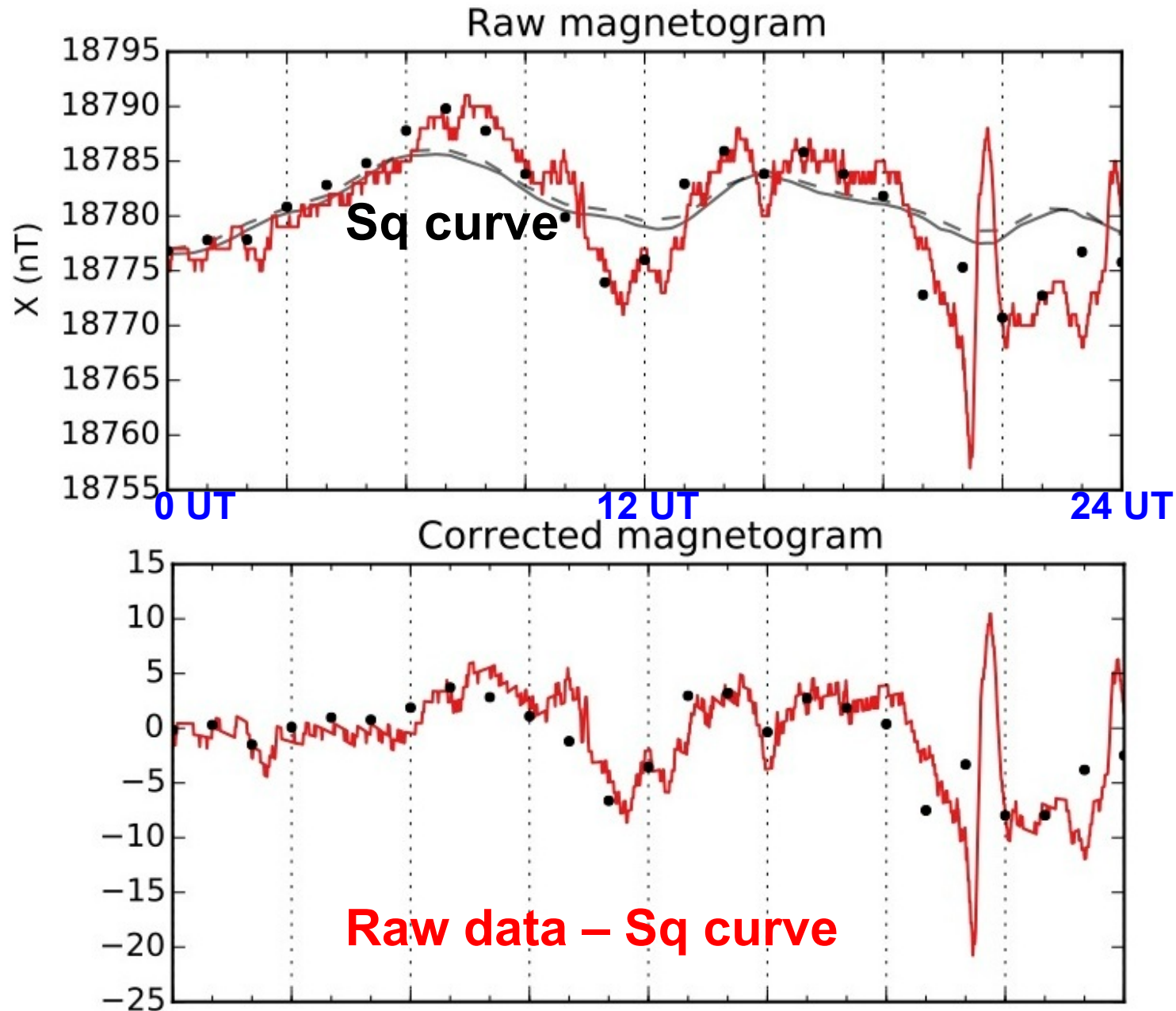


Old time without digital archive

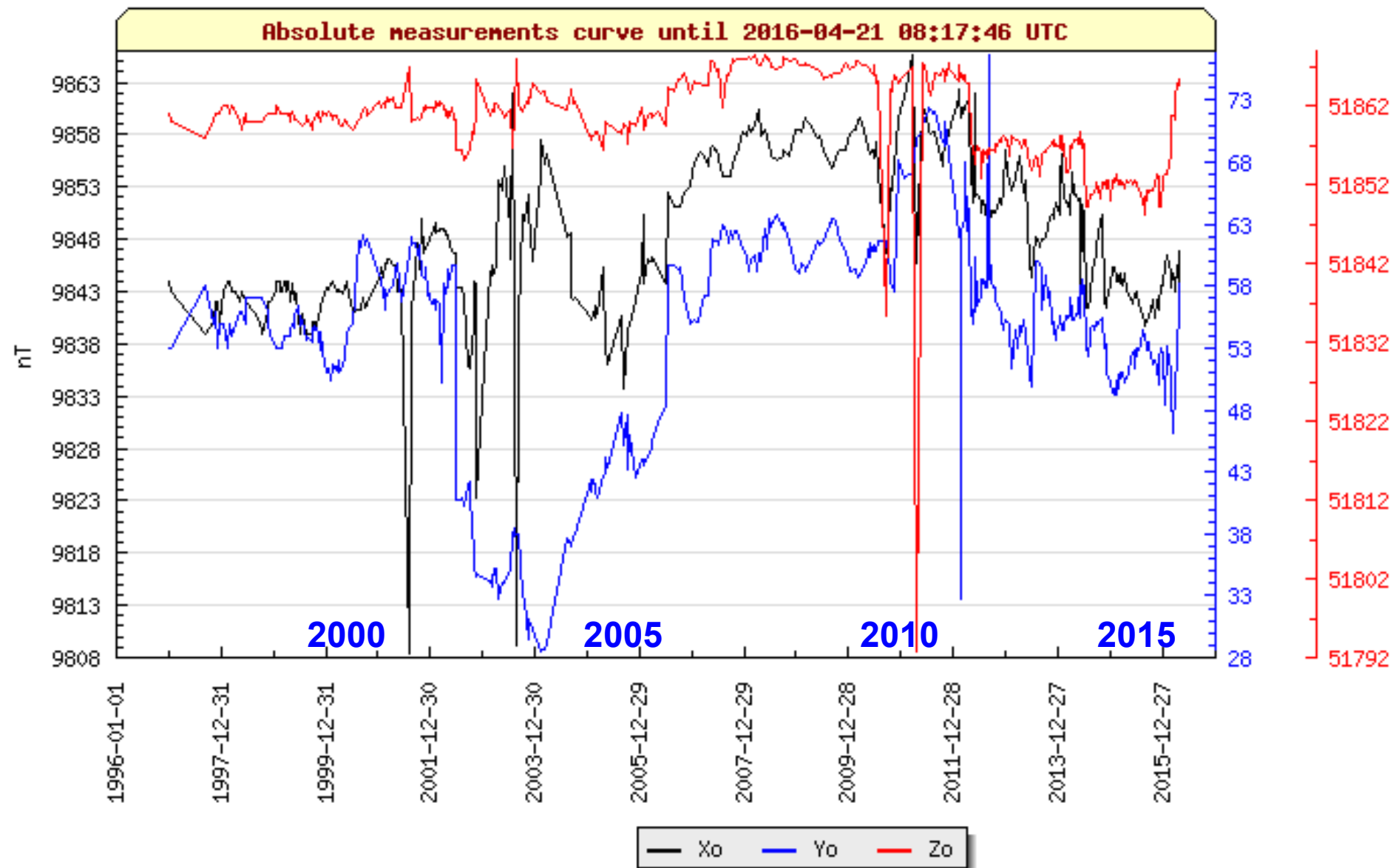
1-hour values or 3-hour range index (**K**) for “digital data”
 $K \sim \log(\Delta B)$



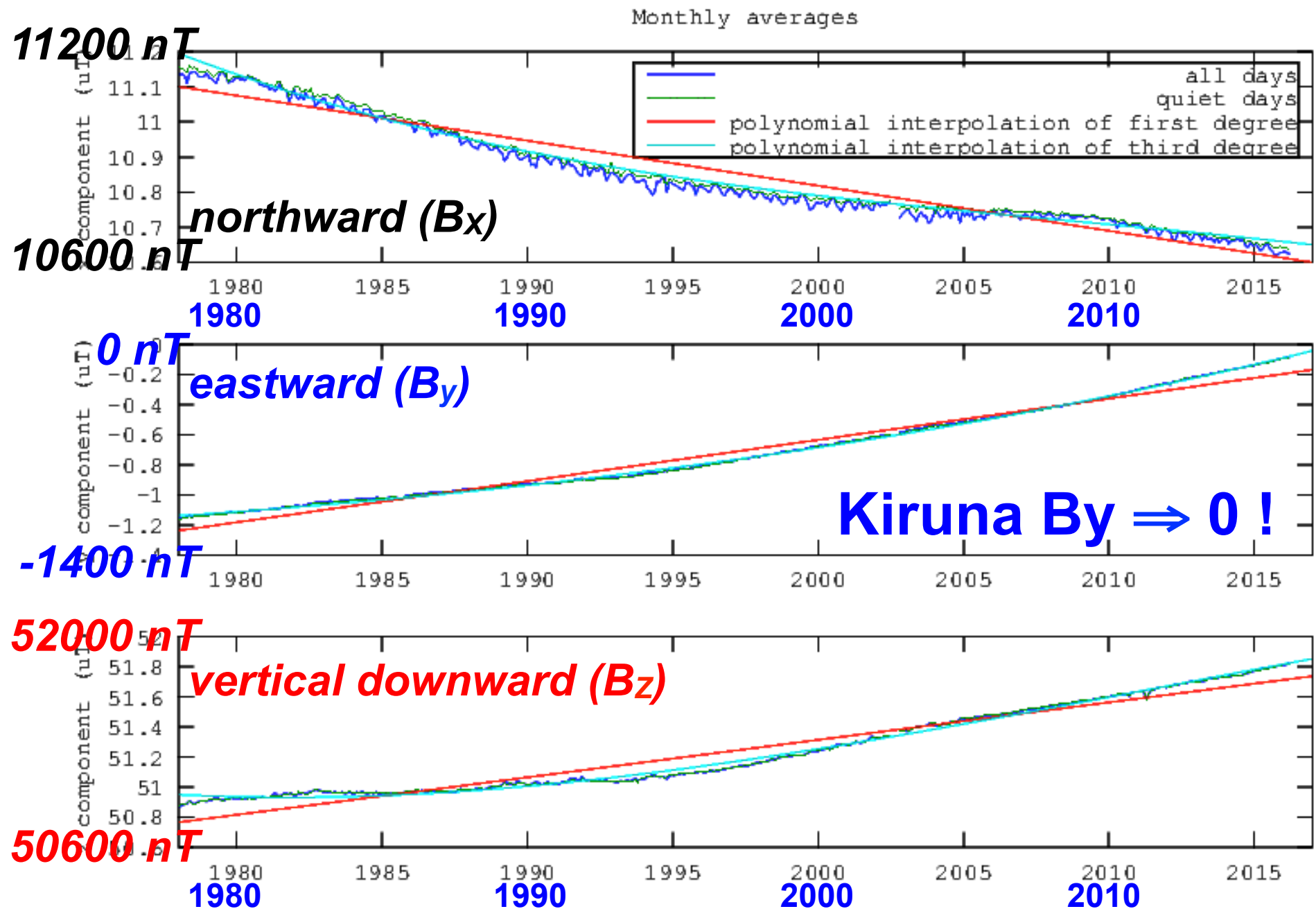
Problem is baseline (due to convection)

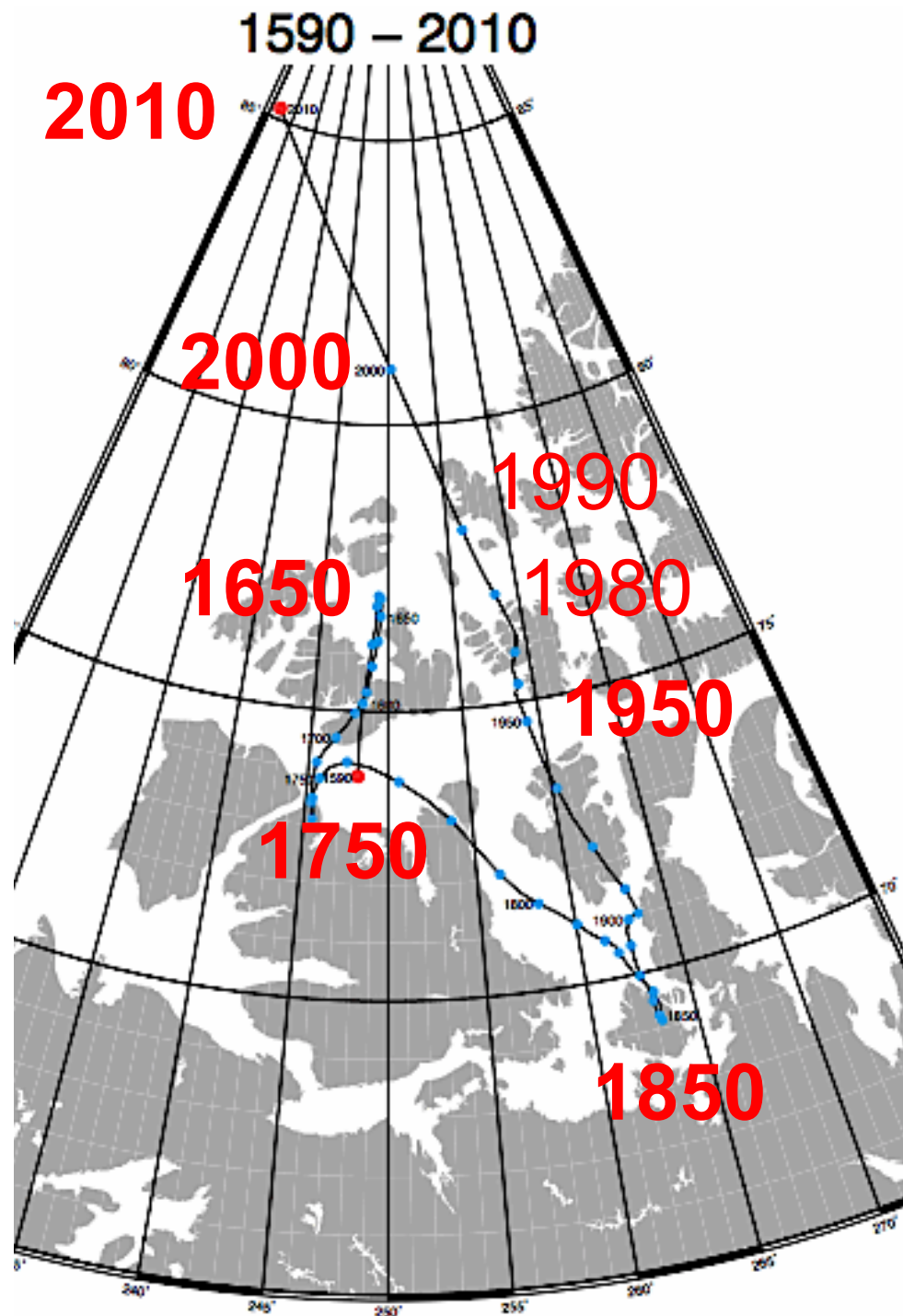


**But, absolute measurement is difficult
because we must measure the offset !**

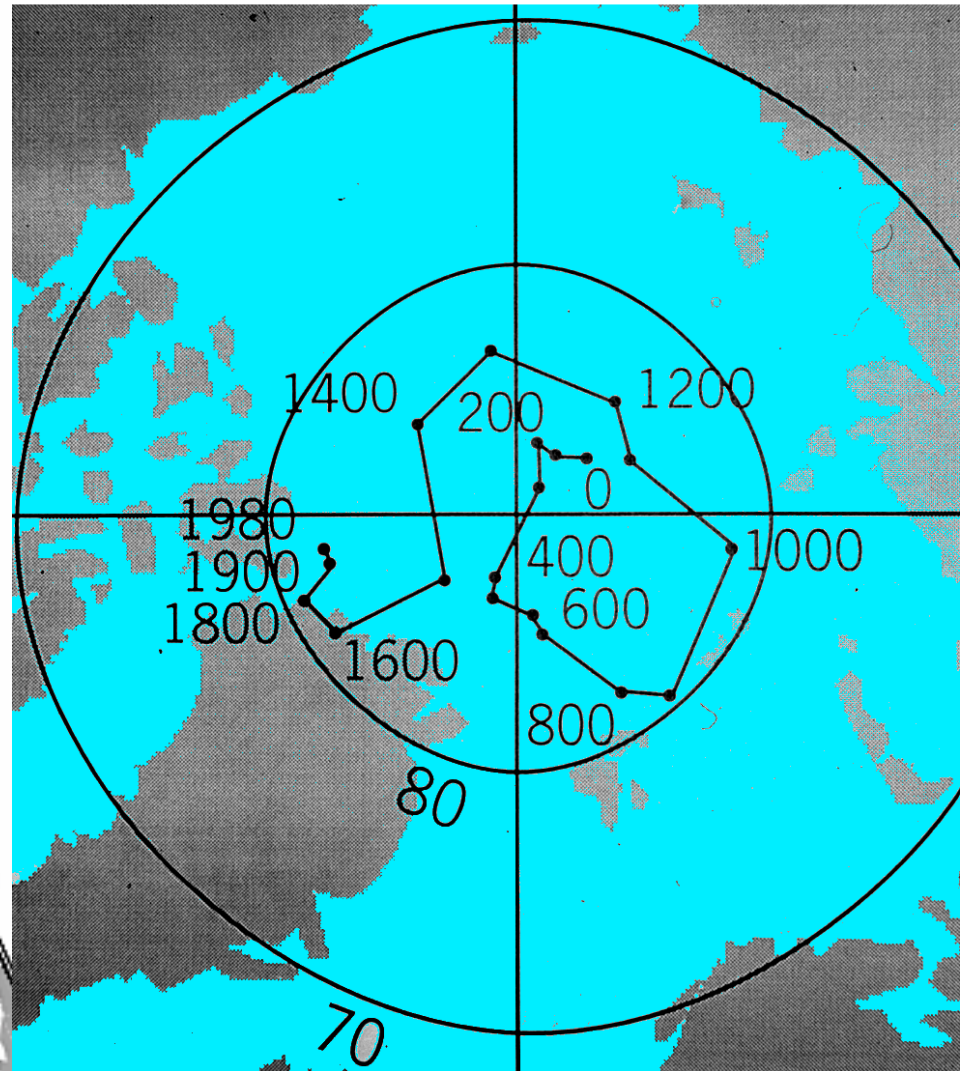


Another reason for absolute measurement





Motion of Magnetic Pole (磁極の動き)

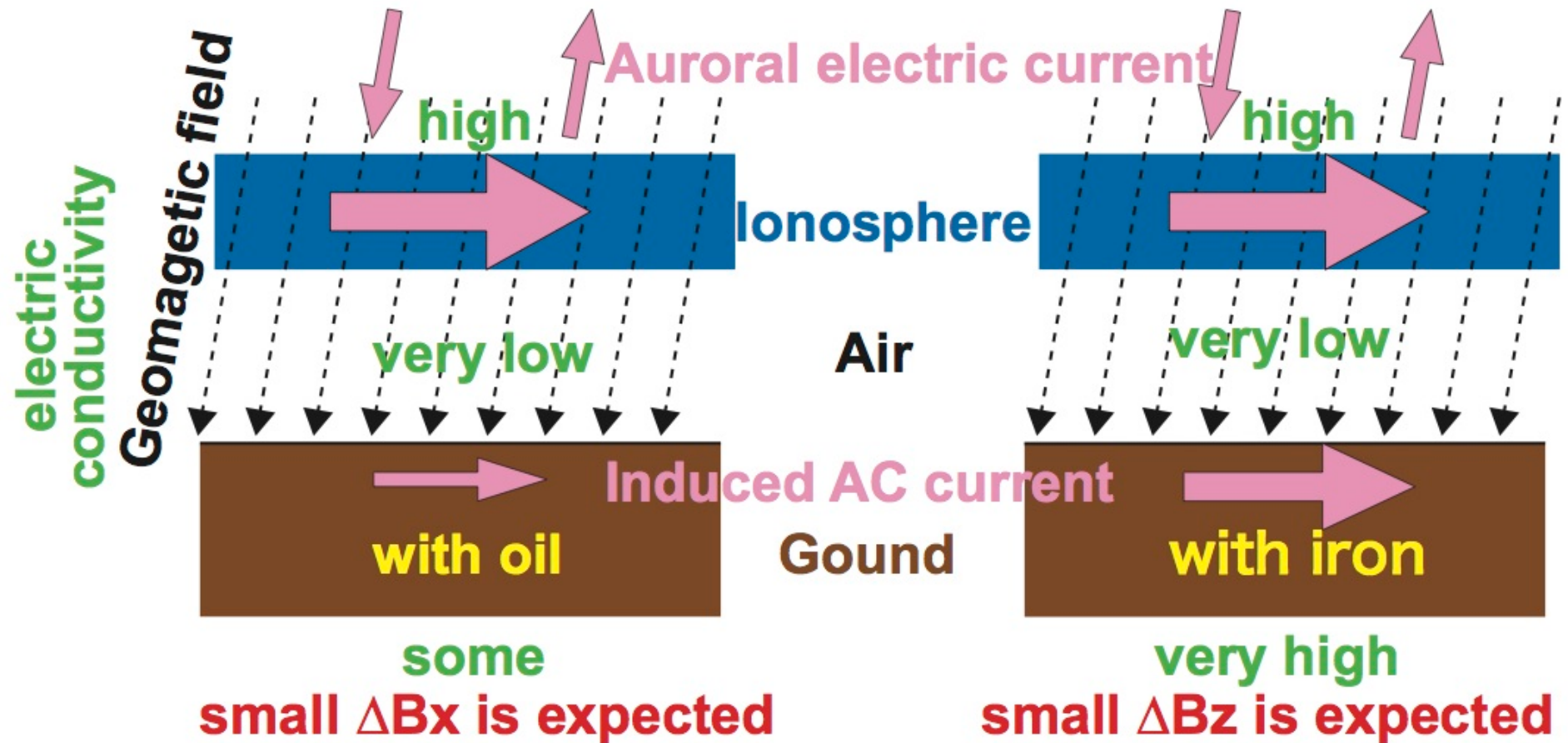


Earth evolution

[illegible]

with Invariant Latitude counter (h=200km)

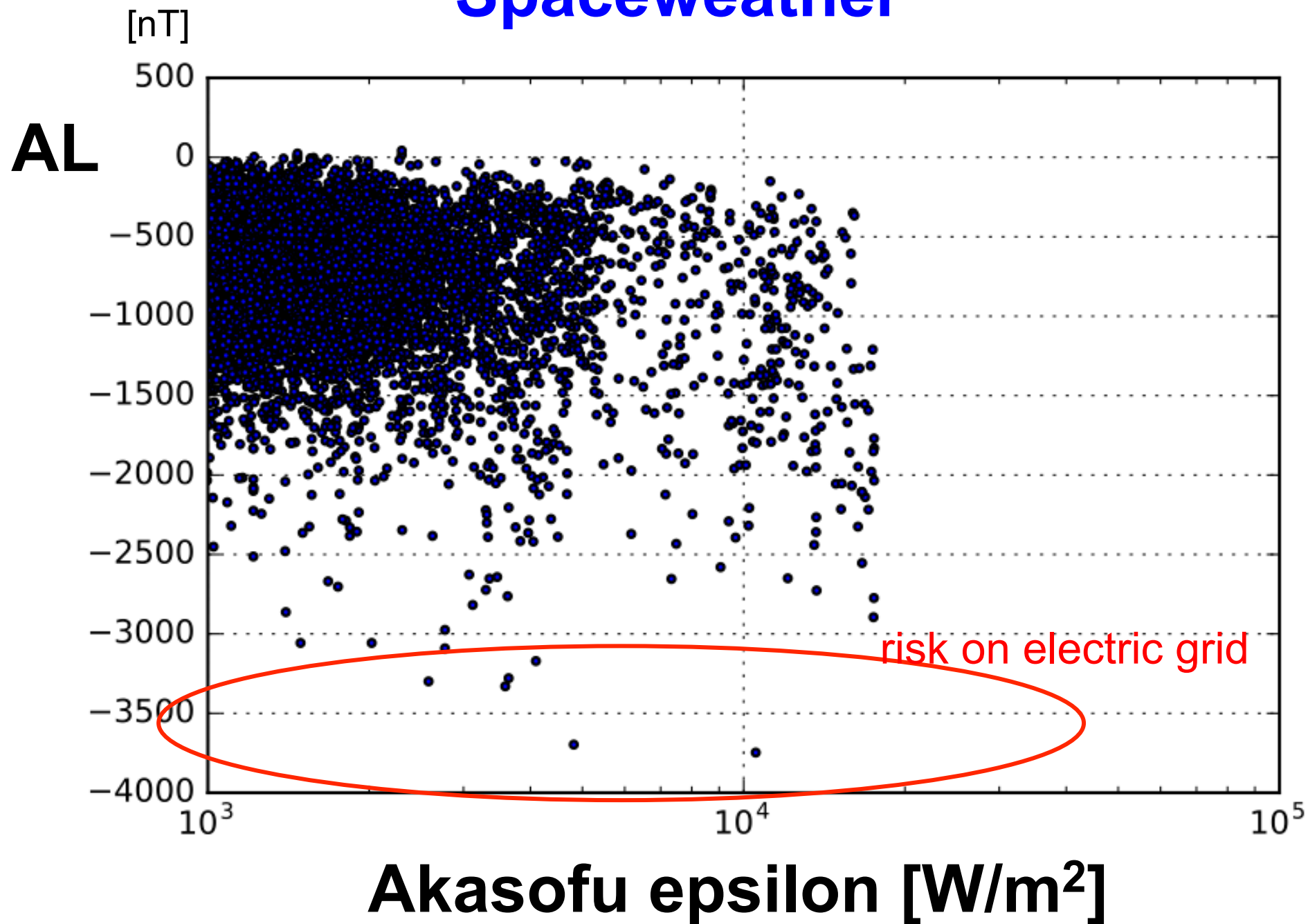
Large-scale induction current



> 100 km scale high conductance

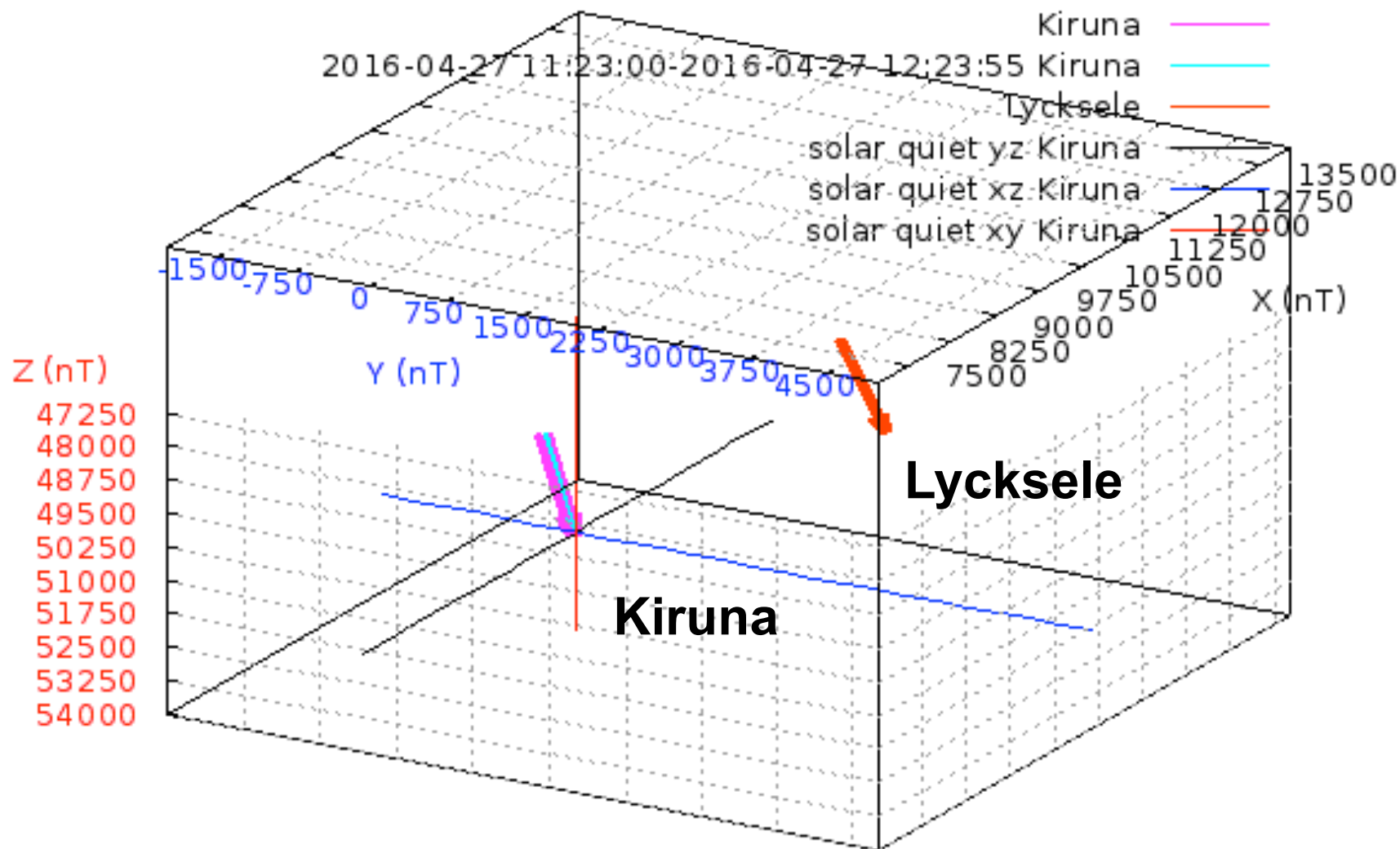
1. Electric power line $\Rightarrow$ high grid stress
2. Searching underground property using auroral energy

Spaceweather



3D plot (quiet day)

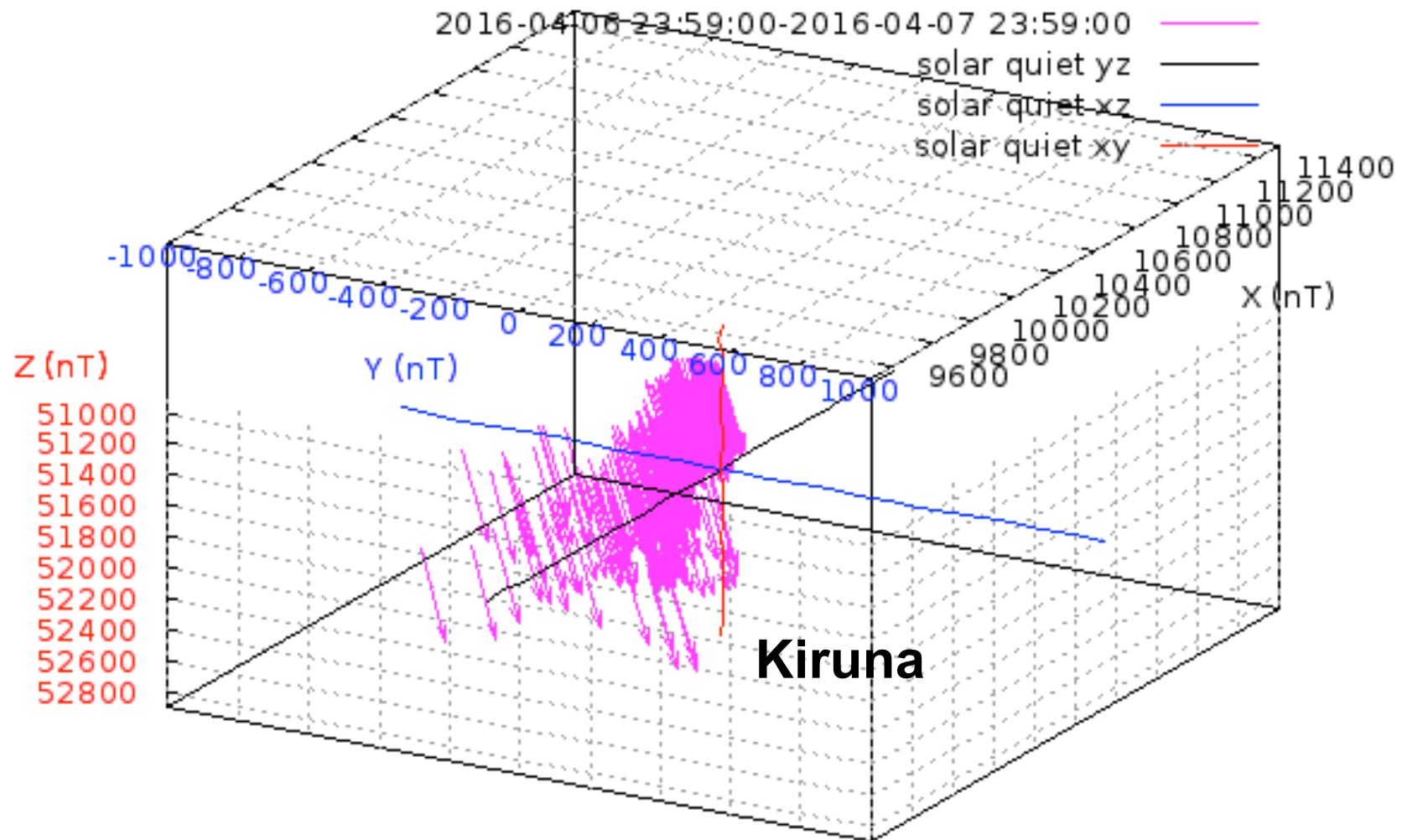
Kiruna and Lycksele 2016-04-26 12:23:00-2016-04-27 12:23:55 [UTC]



quiet day trajectories

3D plot (disturbed day)

Magnetic field in Kiruna 2016-04-06 23:59:00 [UTC]



disturbed day trajectory