



# STUDY ON THE EFFECTS OF SPACE WEATHER BY COMPLEX MEASUREMENTS AT YAKUTSK MERIDIONAL CHAIN STATIONS

Baishev D.G., Mullayarov V.A., Samsonov S.N.,  
Moiseyev A.V., Boroyev R.N., Stepanov A.E.  
Yu.G.Shafer Institute of Cosmophysical Research  
and Aeronomy SB RAS, Yakutsk, Russia

Yoshikawa A., Yumoto K.  
International Center for Space Weather Science  
and Education, Kyushu University, Fukuoka, Japan

UN/Japan Workshop on Space Weather, Fukuoka, Japan, 2 March 2015

# Milestones of IKFIA and STEL/SERC/ICSWE cooperation

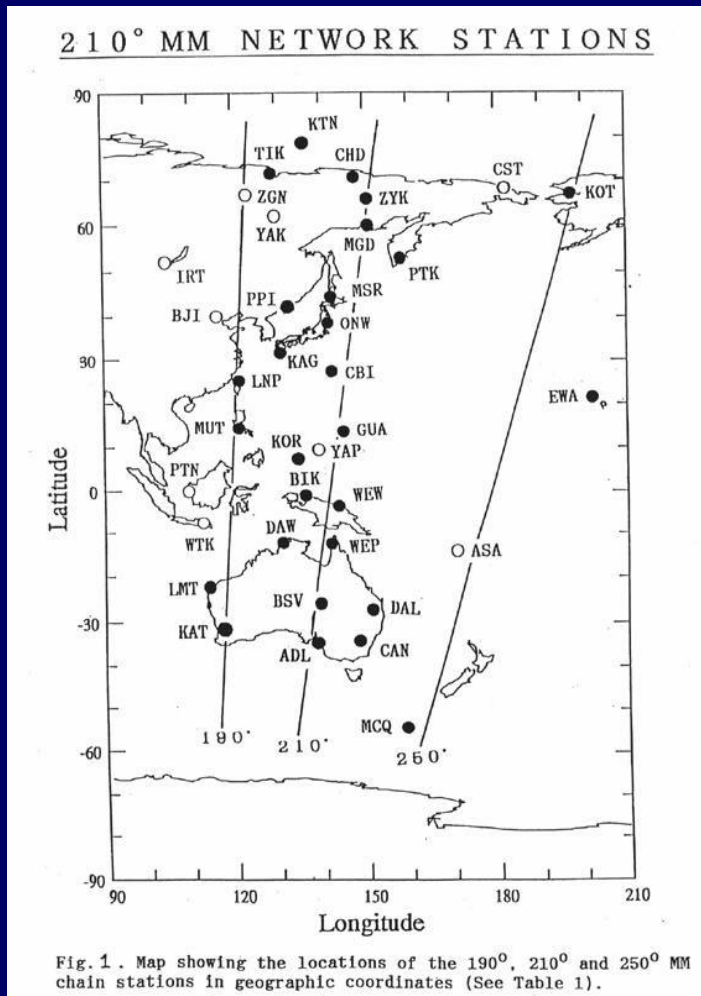
IKFIA collaborates in  
international projects:

- 210 magnetic meridian network project (1991-1995);
- CPMN - Circum-pan Pacific Magnetometer Network (1996-2005);
- MAGDAS (2006-present time)



Meeting of Prof. K. Yumoto with Prof. E. Berezhko (Director) and Prof. S. Solovyev at IKIFIA in January 2005.

# Milestones of IKFIA and STEL/SERC/ICSWE cooperation



**Prof. K. Yumoto at IKFIA (2003)**

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# Milestones of IKFIA and STEL/SERC/ICSWE cooperation



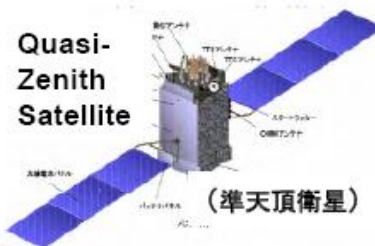
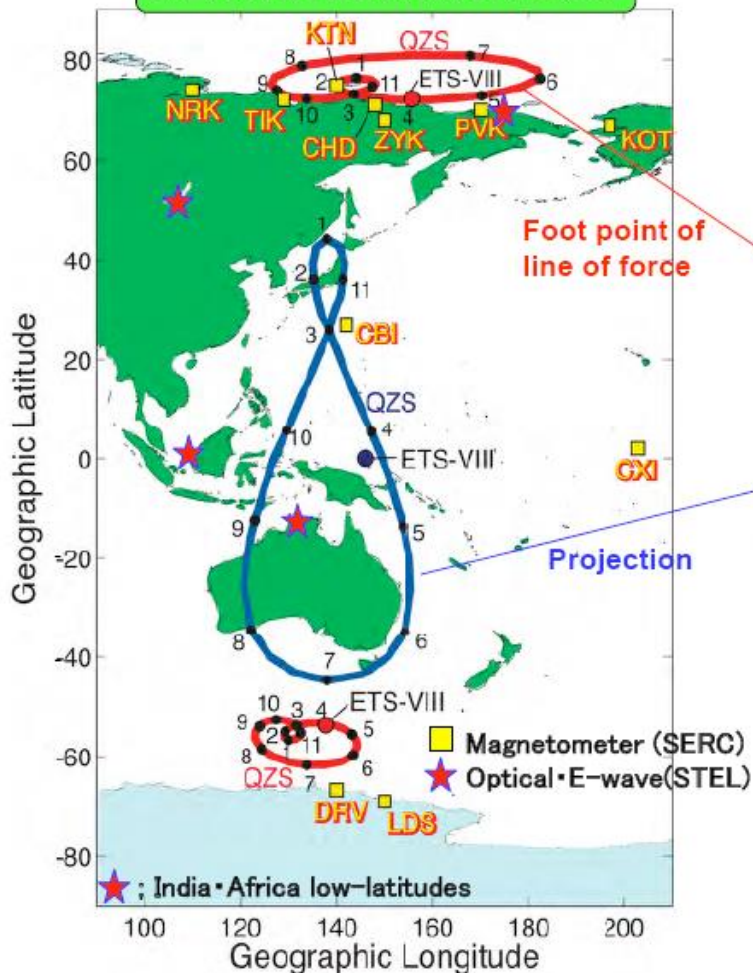
**Prof. K.Yumoto presented MAGDAS project at IKFIA (March 2011)**

**Modernization by MAGDAS-9 magnetometers was started in Yakutia from Autumn 2011: Yakutsk (YAK, Aug.2011), Zhigansk (ZGN, Aug.2011), Tixie (TIX, Sept.2011), Isl.Kotelny (KTN, Oct.2011), Chokurdakh (CHD, Oct.2011), Zyryanka (ZYK, Oct.2013)**

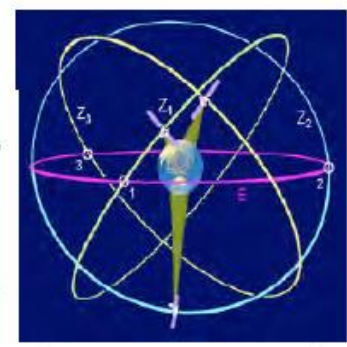
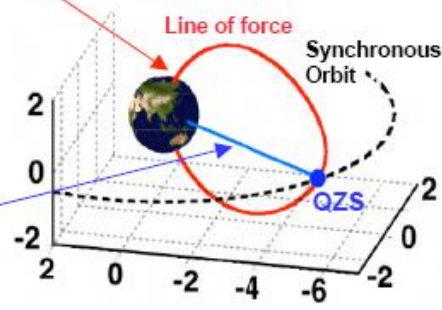
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## 1. MAGDAS-QZS Substorm Observation Project

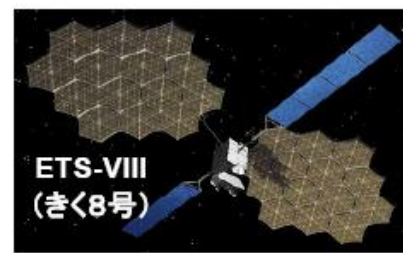
SERC/STEL Network Obs.



JAXA Satellite Space Environment Measurement



(Synchronous Orbit)





# Yakutsk meridional chain of geophysical stations



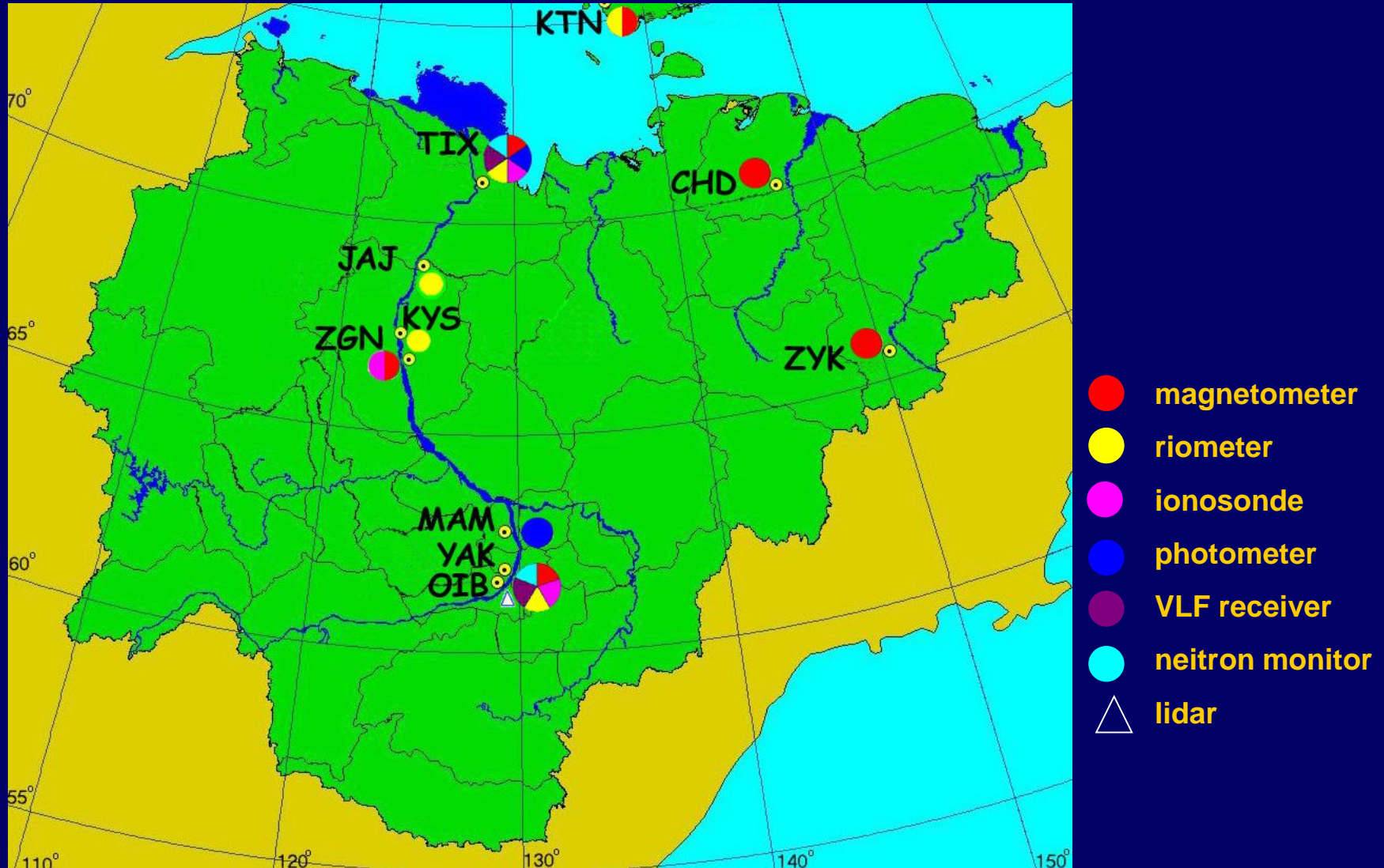
## Yakutsk meridional chain stations:

- map of stations in Yakutia governed by IKFIA;
- buildings;

Observational stations

Study on the effects of space weather

# Yakutsk meridional chain of geophysical stations



# Yakutsk meridional chain of geophysical stations



Building and sensors at KTN



Тикси (Россия·Саха) [ИКФИА]

Tixi(Russia, Saha) [ operated by IKFIA]

Tixi is one of the 12 AE stations. This picture shows geomagnetic house, aurora video house and riometer antennas seen from the geomagnetic sensor house in spring. This polar station also makes observations of Ionosphere and Cosmic Rays.



Building at Zhigansk



VLF station  
at Oybenkel





# Yakutsk meridional chain of geophysical stations

Yakutsk meridional chain stations

## Observational stations:

- all-sky TV camera;
- digisonde DPS-4;
- riometer chain;
- registration of VLF emission;
- magnetic observatory Yakutsk;

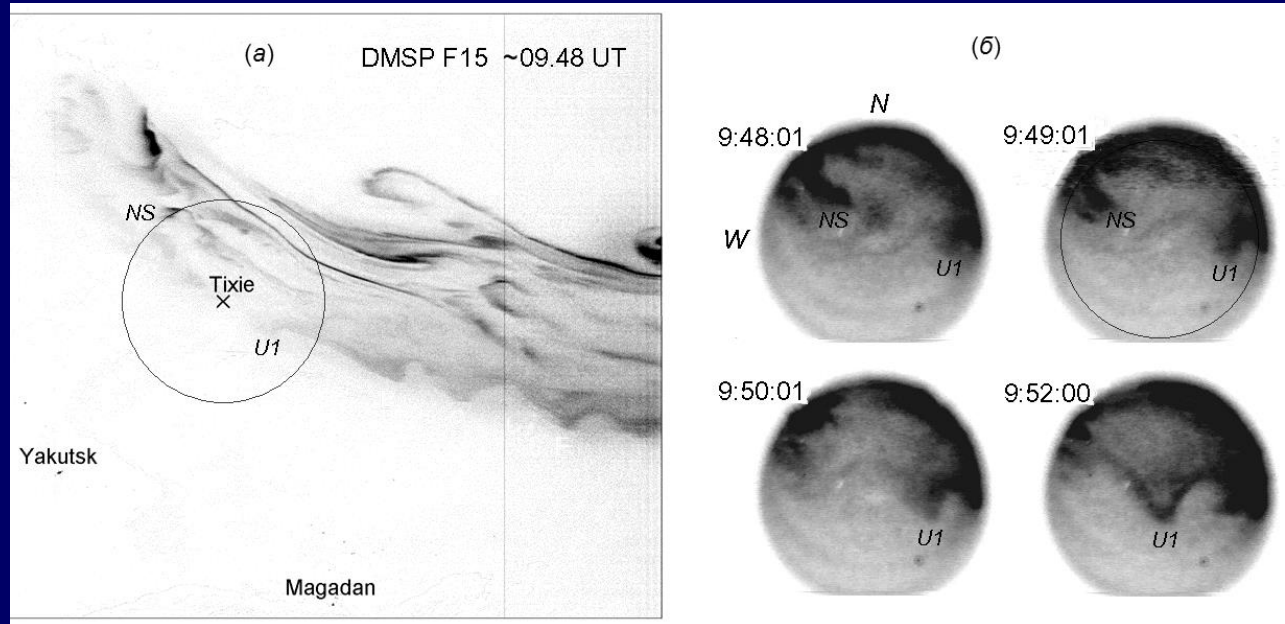
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# Yakutsk meridional chain of geophysical stations



All-sky TV camera at Tixie.

DMSP F15 image and TV frames at TIX on 25 Dec. 2005



# Yakutsk meridional chain of geophysical stations

## Digisonde DPS-4 at ZGN

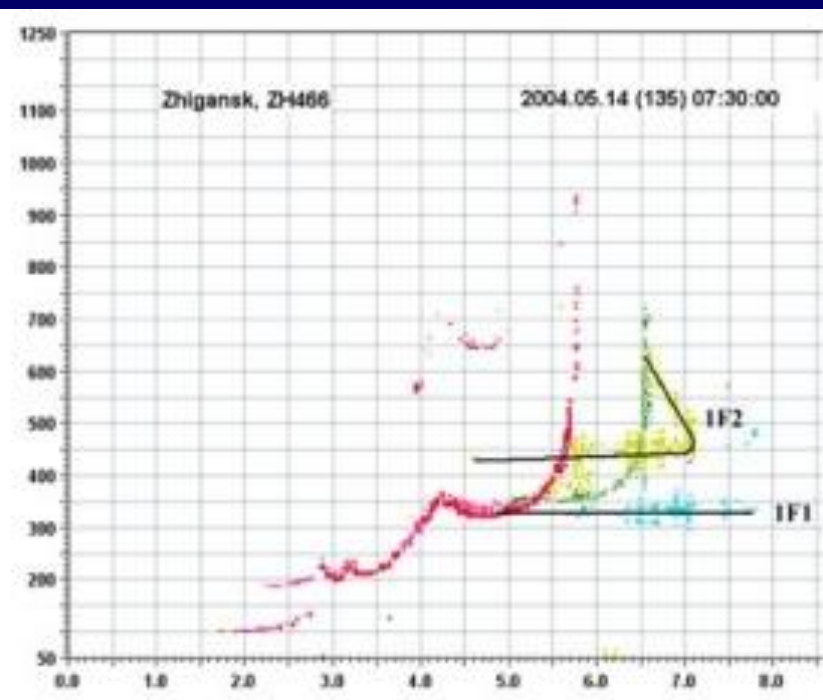
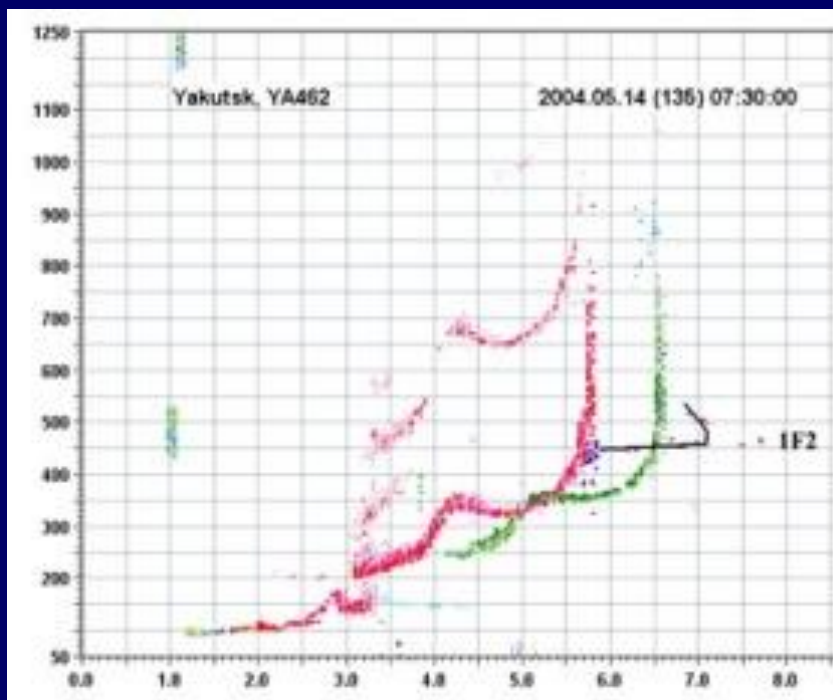


Locations of digisondes (ionosonde at TIX) in Russia and China (stars).





# Yakutsk meridional chain of geophysical stations



Example of synchronous observations by DPS-4 digisondes on path YAK-ZGN

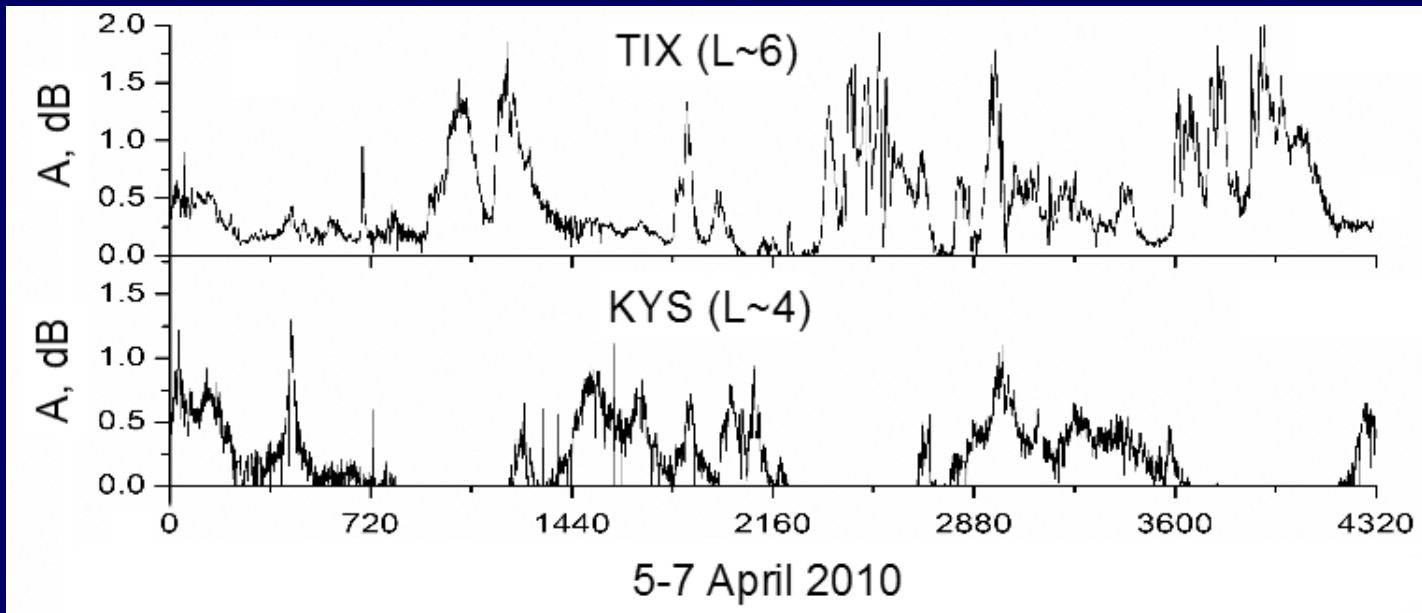


# Yakutsk meridional chain of geophysical stations

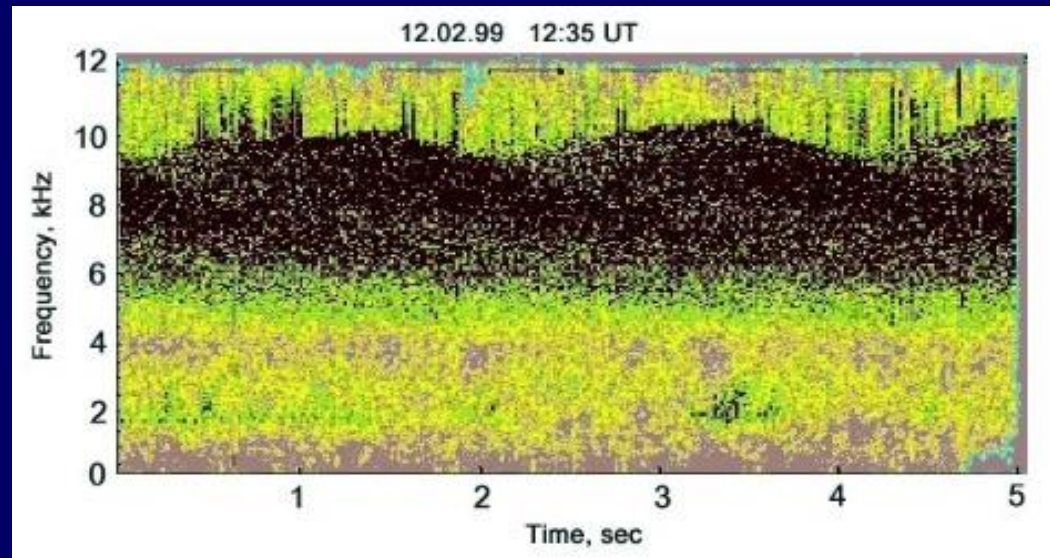
Examples of raw data  
for the cosmic noise  
absorption at TIX (L~6)  
and KYS (L~4)



Riometer  
parts



# Yakutsk meridional chain of geophysical stations



## VLF receiver

*A signals at the station are received with three antennae: vertical electrical one (monopole) and two orthogonal magnetic antennae (loops with an effective area of 180 m<sup>2</sup>). The error in measuring the azimuth of incoming signals does not exceed 2°.*

## Variations of VLF emissions

*Spectrogram of magnetospheric quasiperiodic (QP) VLF emissions observed at Yakutsk. A rare type of emissions has noise character (VLF hiss) at frequencies above 5 kHz with a total dispersion from the upper to the lower frequencies.*

- In 1932 magnetic station was founded at Yakutsk.
- Since 1964 magnetic observatory situated at present location, namely ~10 km to the south from Yakutsk.
- In 2008 observatory was equipped by modern instruments in the frames of cooperation between IIFIA and GFZ (Potsdam, Germany).
- Since 2011 observatory is a member of international project MAGDAS.



Three wooden buildings and logo of magnetic observatory Yakutsk

## Measurements:

- (i) Magnetic variations measurements;
- (ii) Absolute measurements of Earth magnetism elements: X, Y, Z, H, D, I, F;
- (iii) Continuous registration of magnetic pulsations in different frequency ranges.



MAGDAS-9 magnetometer at YAK

## Equipment of INTERMAGNET observatory:

### Variations:

- Triaxial fluxgate magnetometer FGE (Danish Meteorological Institute)
- Overhauser effect proton precession magnetometer GSM 90

### Absolutes:

- DI-fluxgate magnetometer (Theo 020B DMI sensor)
- Overhauser effect proton precession magnetometer GSM 19T

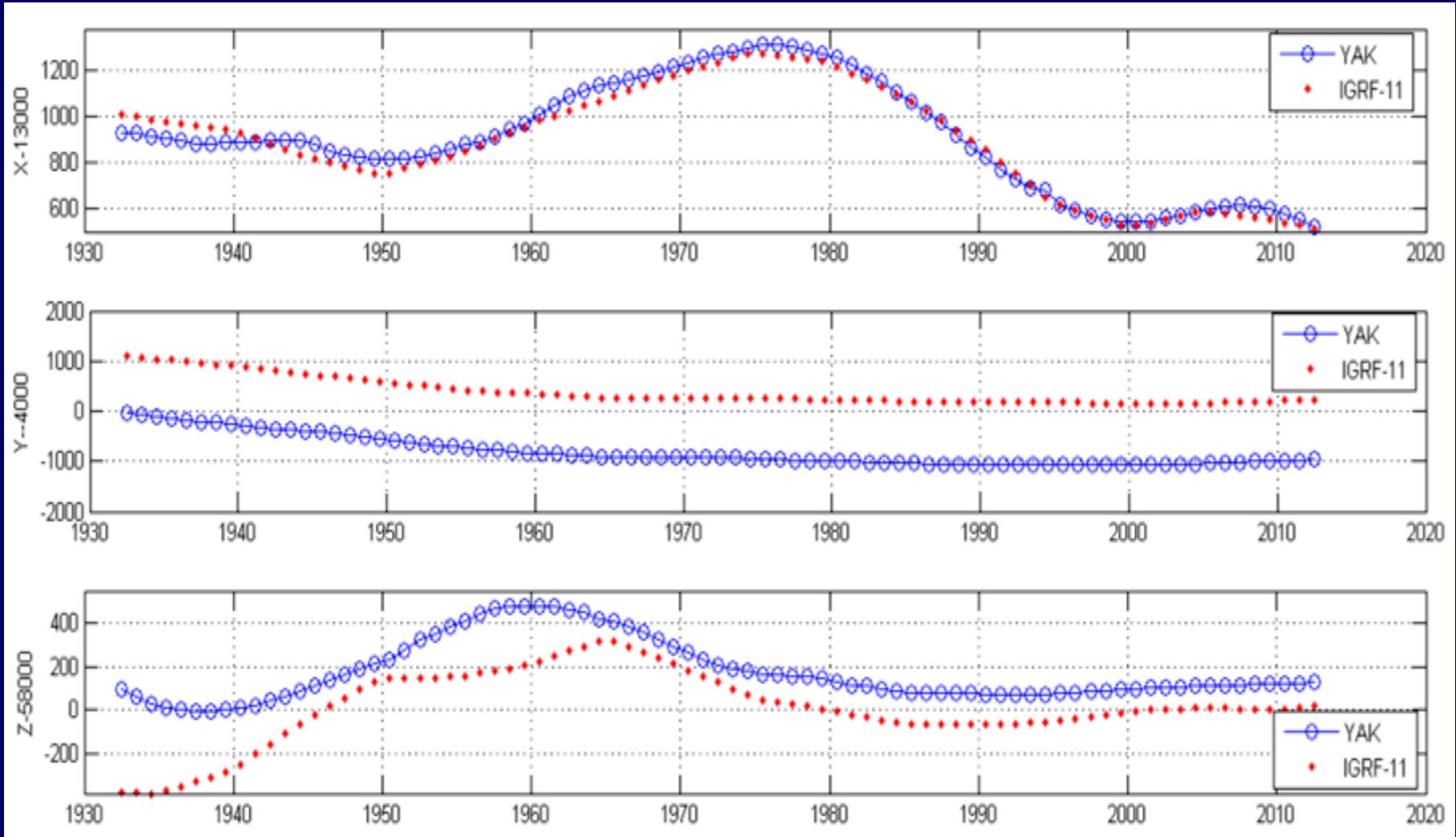
[http://www.intermagnet.org/imos/imos-list/imos-details-eng.php?iaga\\_code=YAK](http://www.intermagnet.org/imos/imos-list/imos-details-eng.php?iaga_code=YAK)







# Magnetic observatory Yakutsk



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# Yakutsk meridional chain of geophysical stations



Yakutsk meridional chain stations

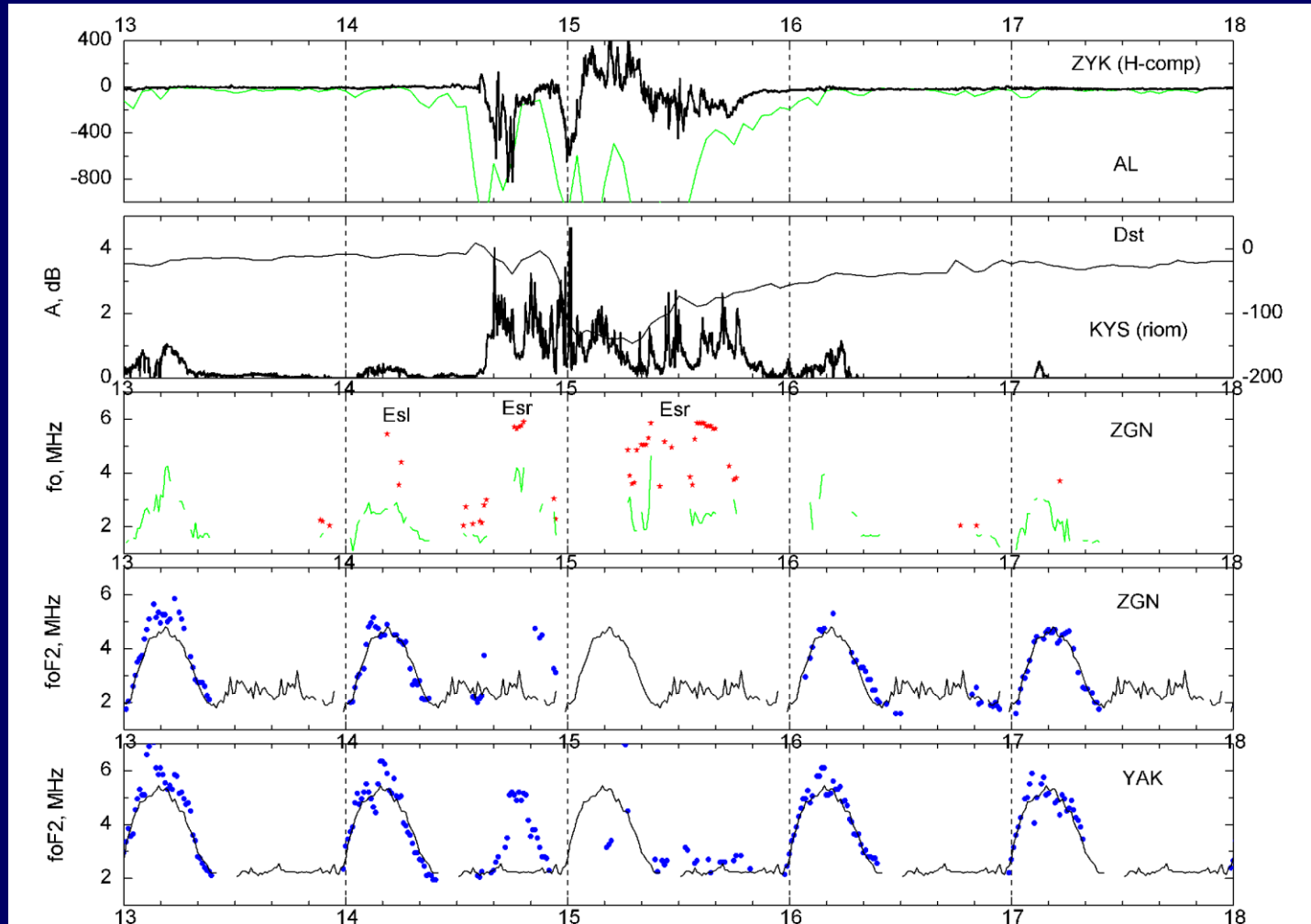
Observational stations

Study on the effects of space weather:

- Effects of strong magnetic storm on 14-16 December 2006
- Effects of moderate magnetic storm on 6-8 December 2006
- HILDCAA (high-intensity long-duration continuous auroral activity) event on 19-23 December 2006

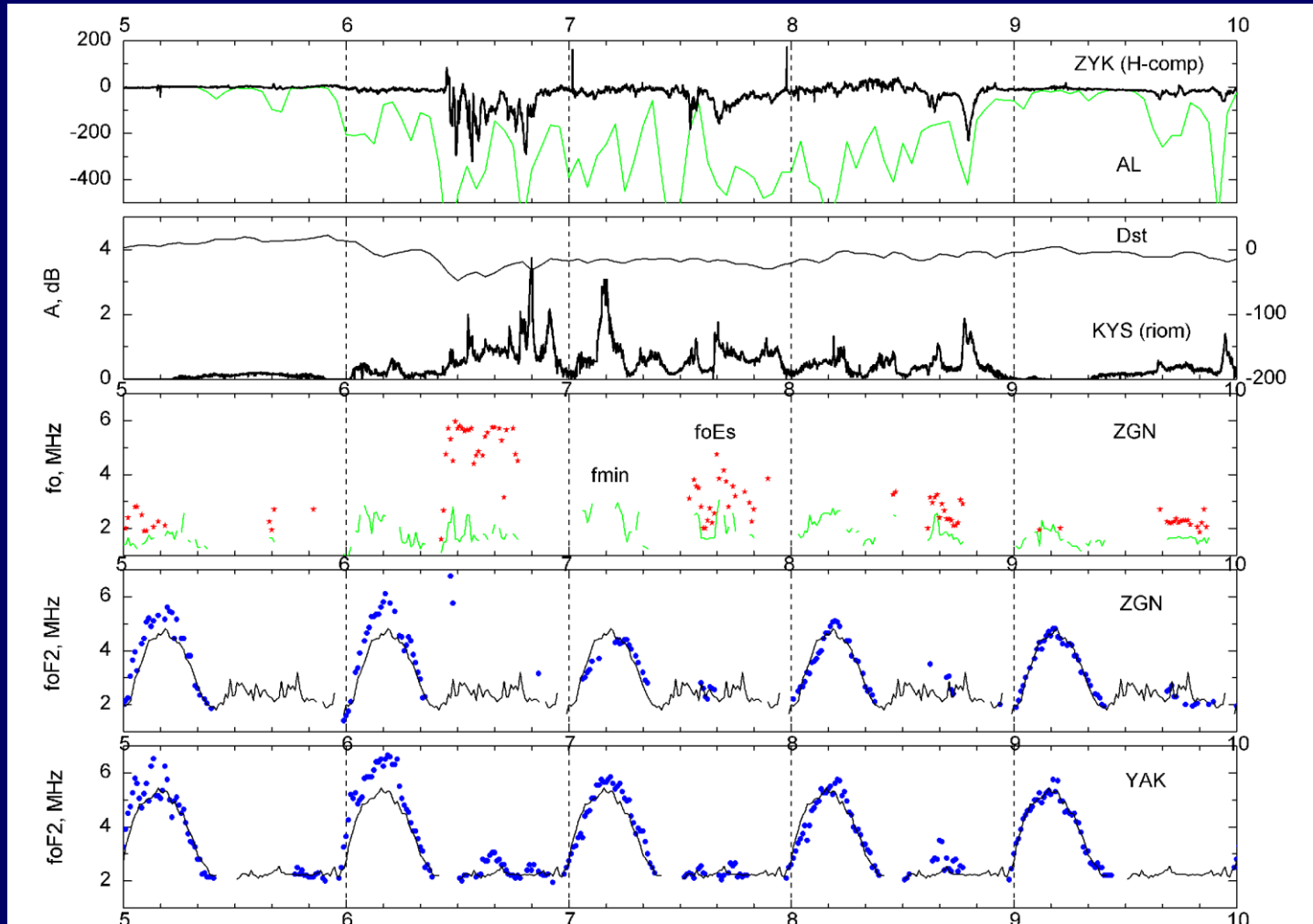
# Yakutsk meridional chain of geophysical stations

Effects of strong magnetic storm on 14-16 December 2006



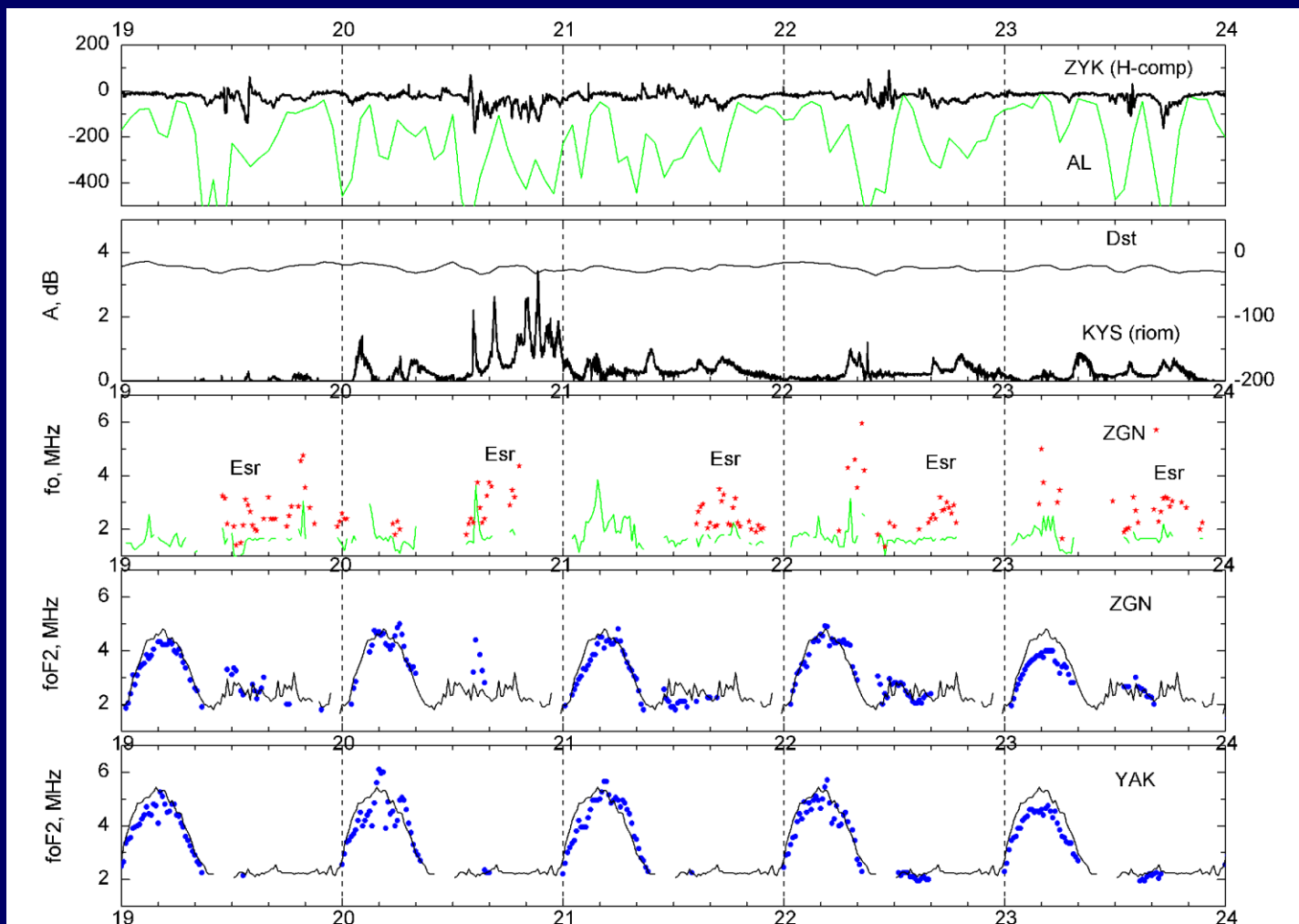
# Yakutsk meridional chain of geophysical stations

Effects of moderate magnetic storm on 6-8 December 2006



# Yakutsk meridional chain of geophysical stations

## HILDCAA event on 19-23 December 2006





Thanks for your attention

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