Real-time acquisition of plasmaspheric electron densities by a global network for space weather investigations

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Plasmasphere
why is it important?

Density variations in

Plasmasphere

=> wave-particle interaction

with

Radiation Belts' particles =>

acceleration and precipitation

of high (relativistic) energy

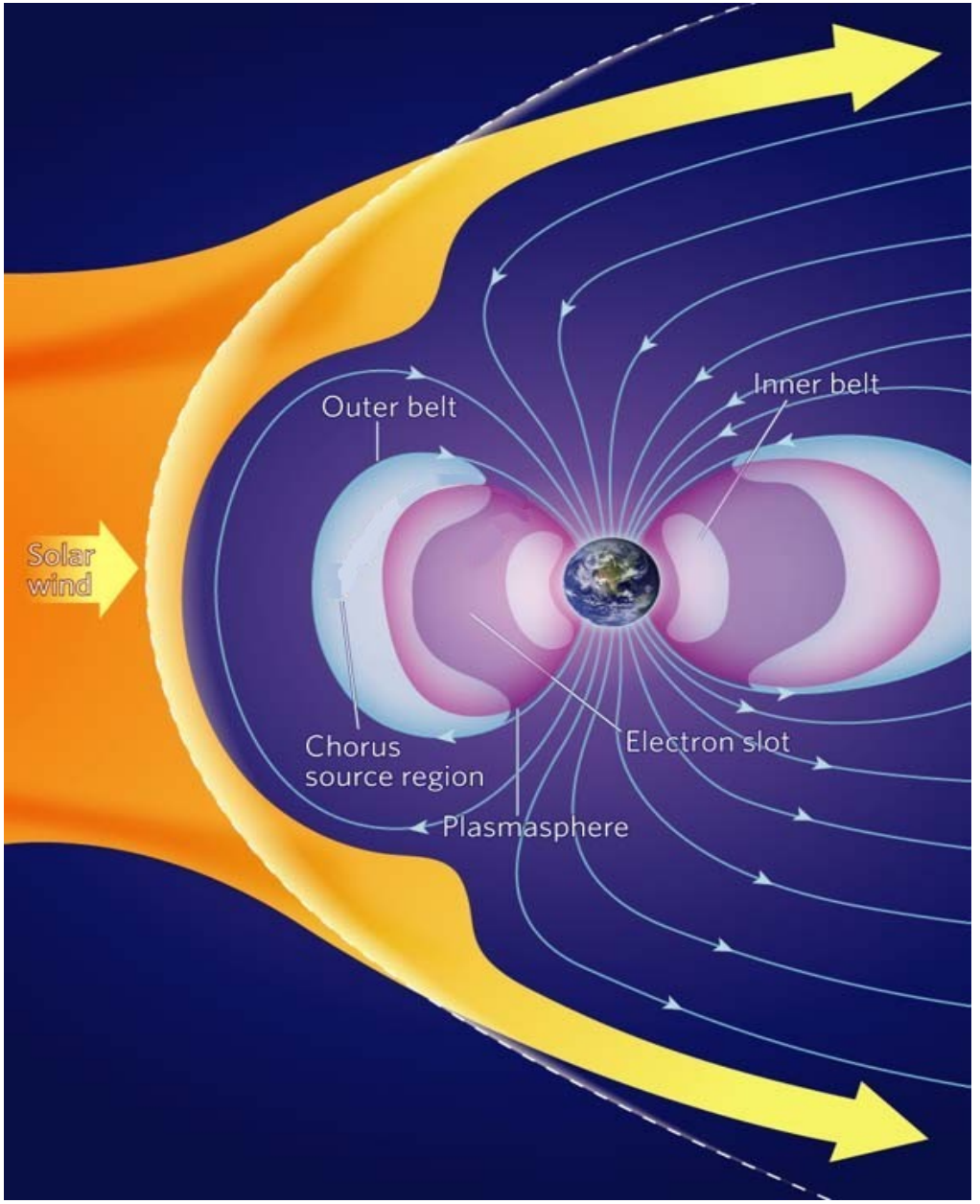
particles =>

- damage of satellites' solar

cells and electronics

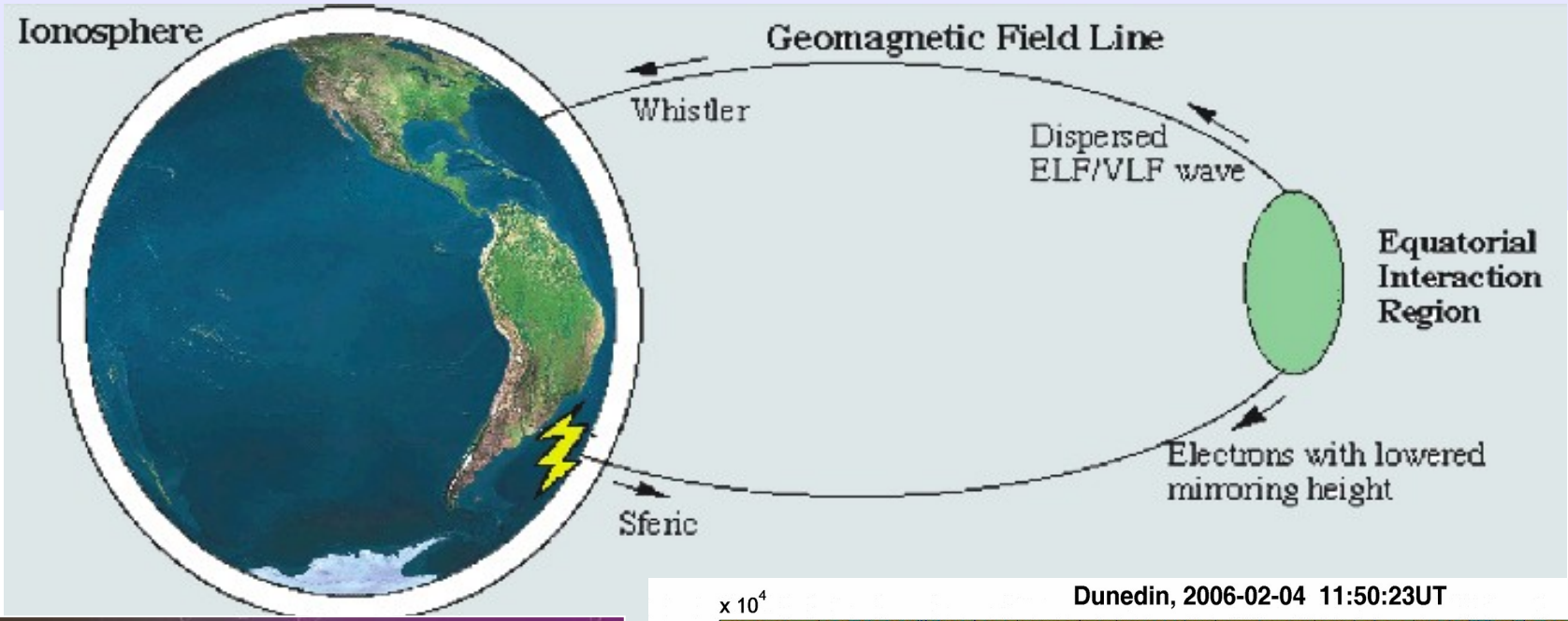
- energy transfer into the neutral

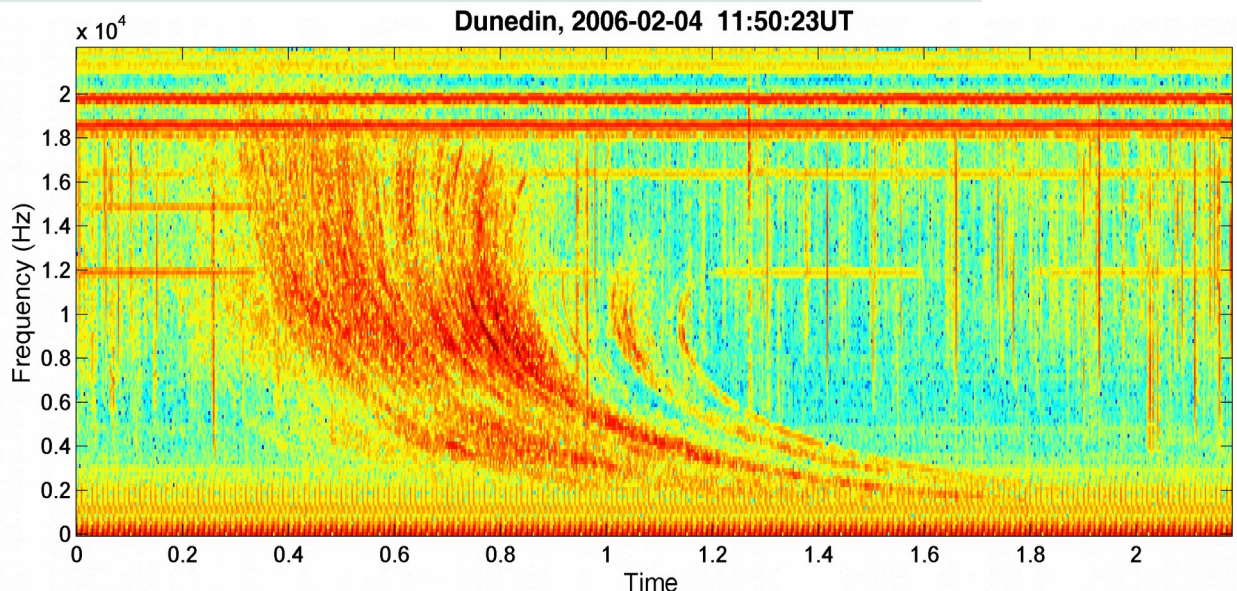
atmosphere



Automatic Whistler Detector and Analyzer Network
AWDANet

It detects and analyze (invert) lightning whistlers automatically in real-time → plasmaspheric electron densities, key parameter in wave particle interaction





What are the *whistlers* good for?

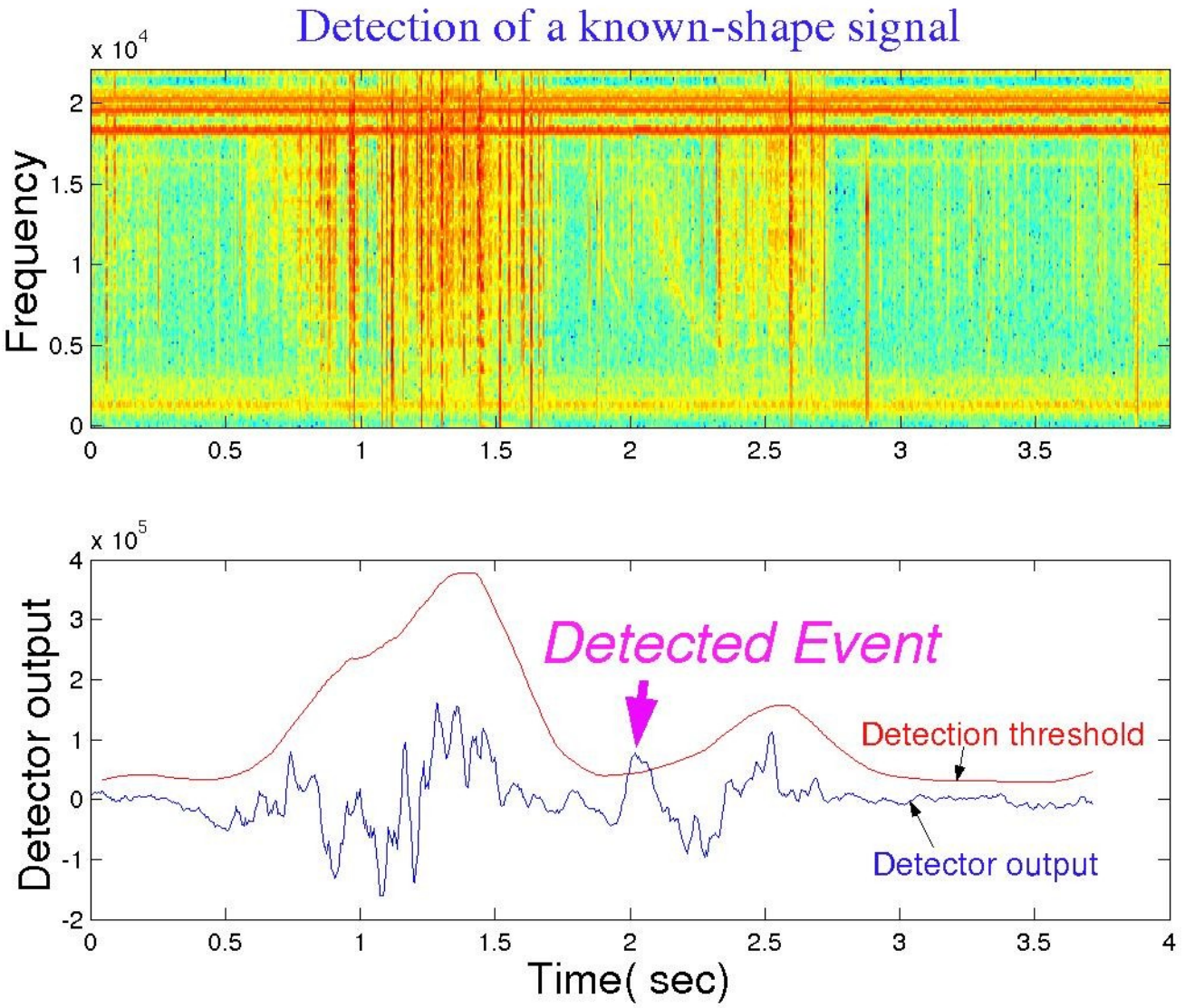
1. ***Nose*** frequency
2. ***Dispersion***

From ***1.*** + ***2.*** => where & what

Where did it travel in *plasmasphere*

What was the *plasma density* there

Automatic Whistler Detector



Whistler inversion method

1. wave propagation model,
2. plasma density distribution model (along the propagation path).
3. magnetic field model,

=> to obtain plasma and propagation parameters

Automatic Whistler Detector and Analyzer (AWDA) system

Whistlers are searched in the broad-band VLF signal without human interaction

Automatic whistler analyses yields plasma and propagation parameters → electron density distribution → *Space Weather*

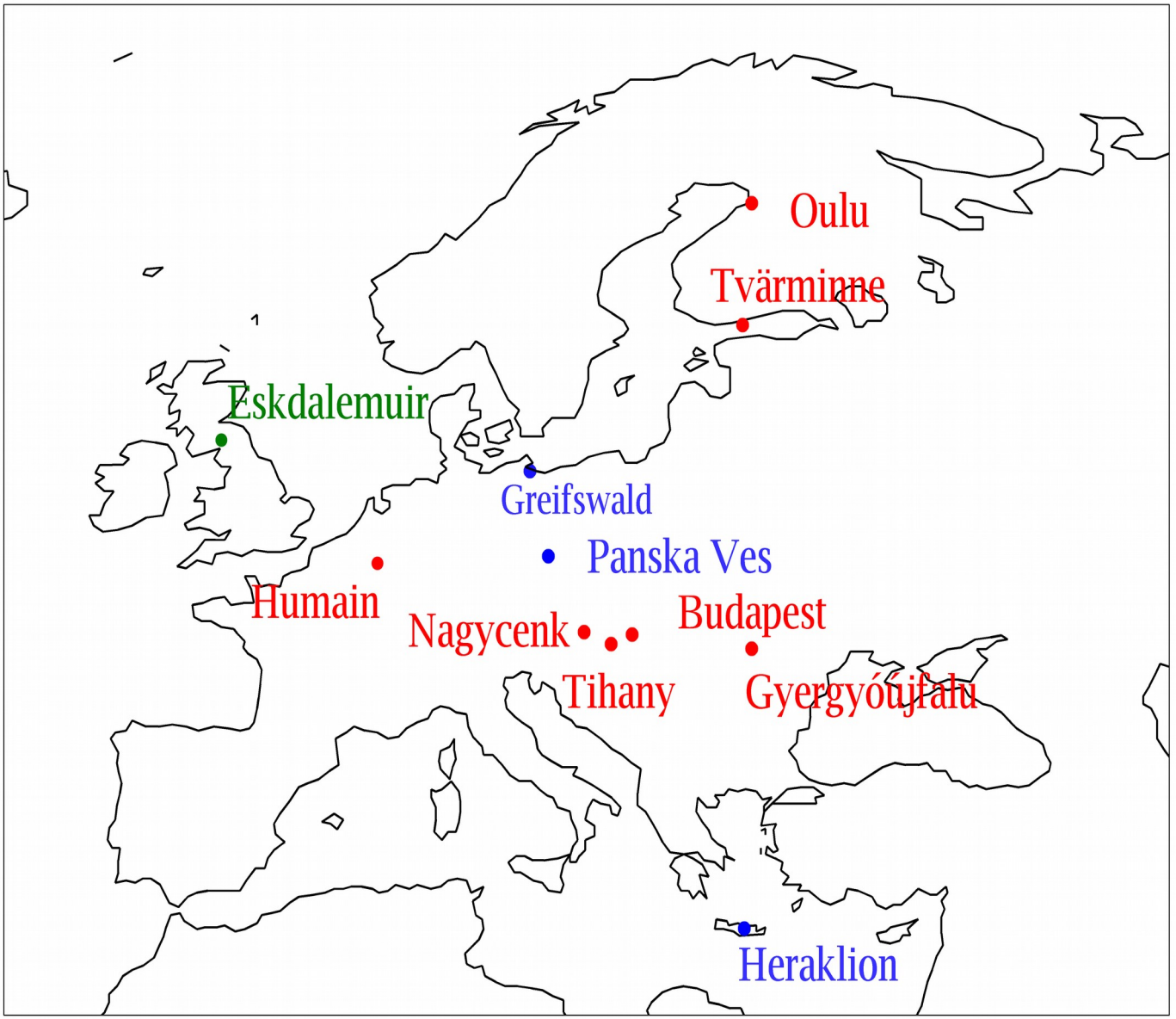
AWDANet

Extending network of AWDA systems covering low-, mid- and high (magnetic) latitudes since 2002 including conjugate locations

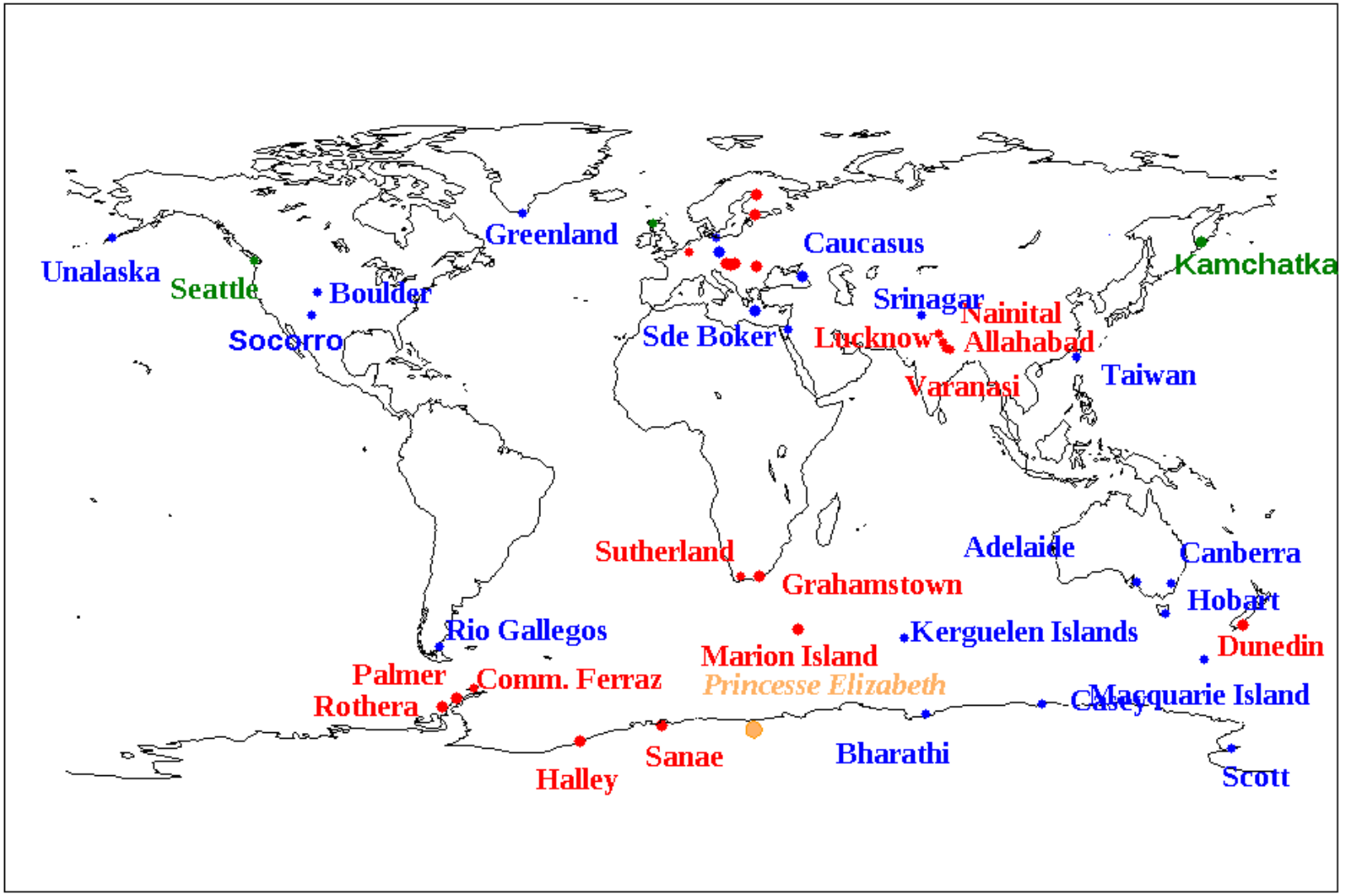
~50 000-10 000 000 traces/year/station

Real time operation since *mid 2014*

Automatic Whistler Detector and Analyzer Network
AWDANet - Europe



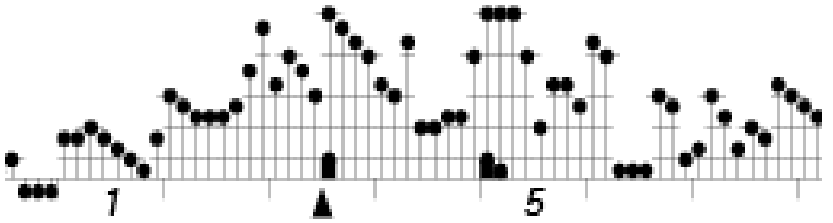
Automatic Whistler Detector and Analyzer Network
AWDANet

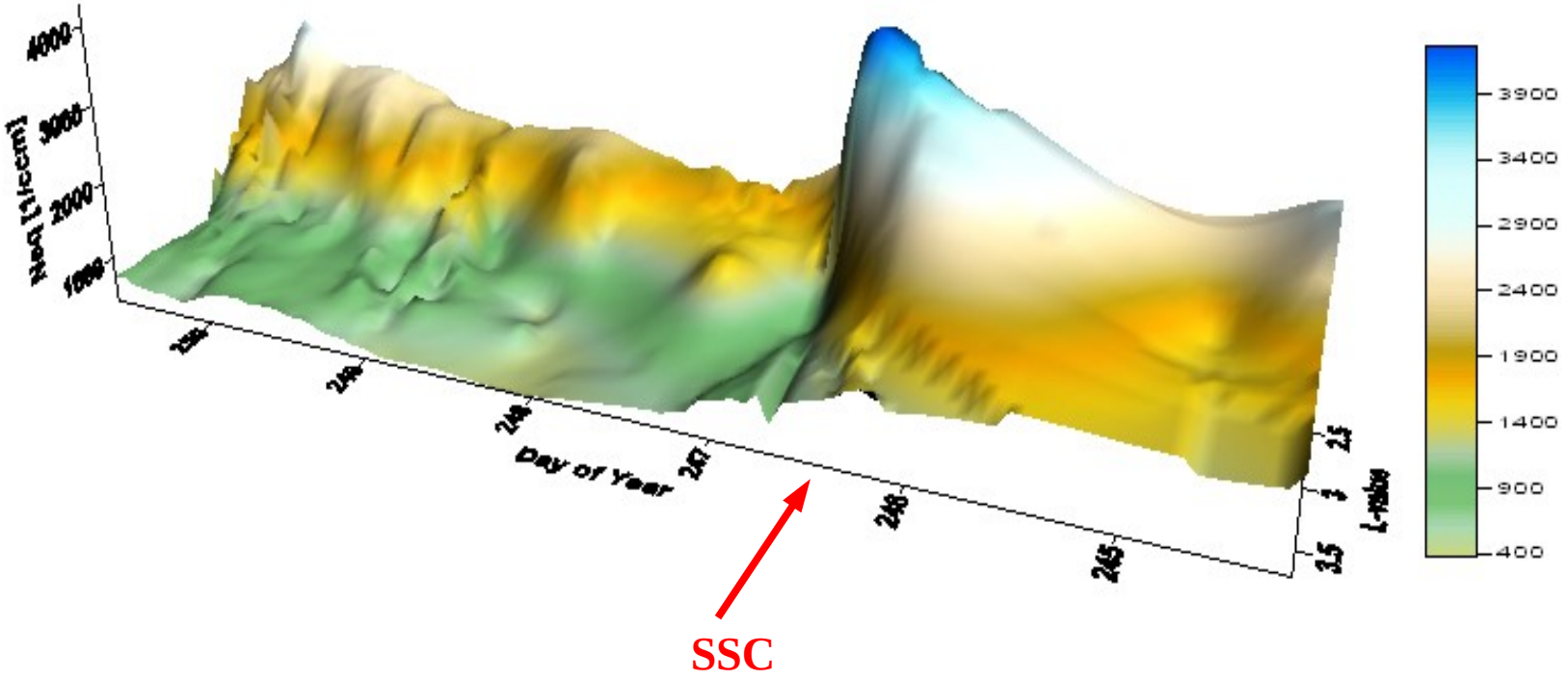


Disturbed period

Magnetic Storm on 3 September 2012

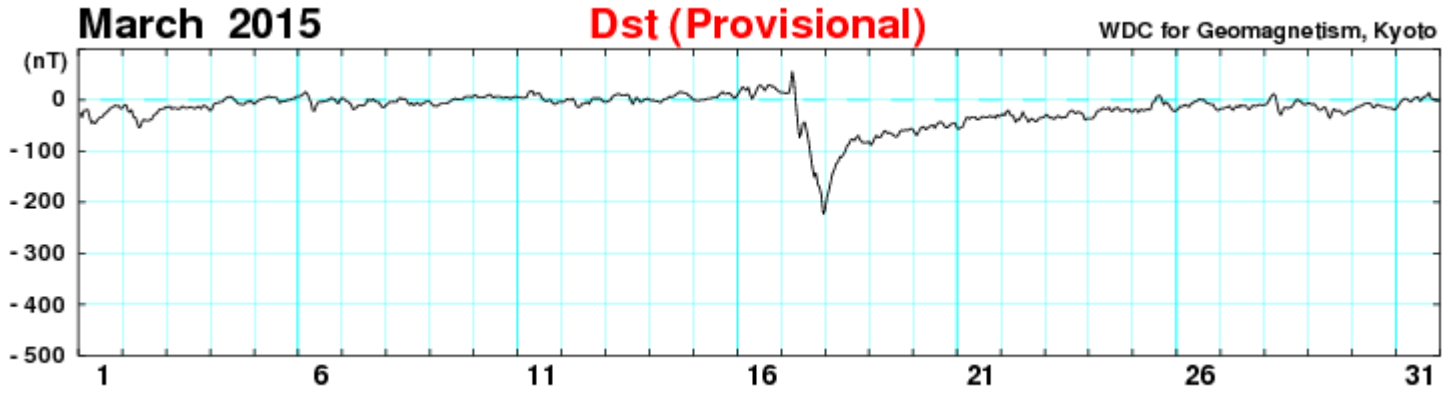
1110 whistler events recorded at Karymshina (Kamchatka, Russia)

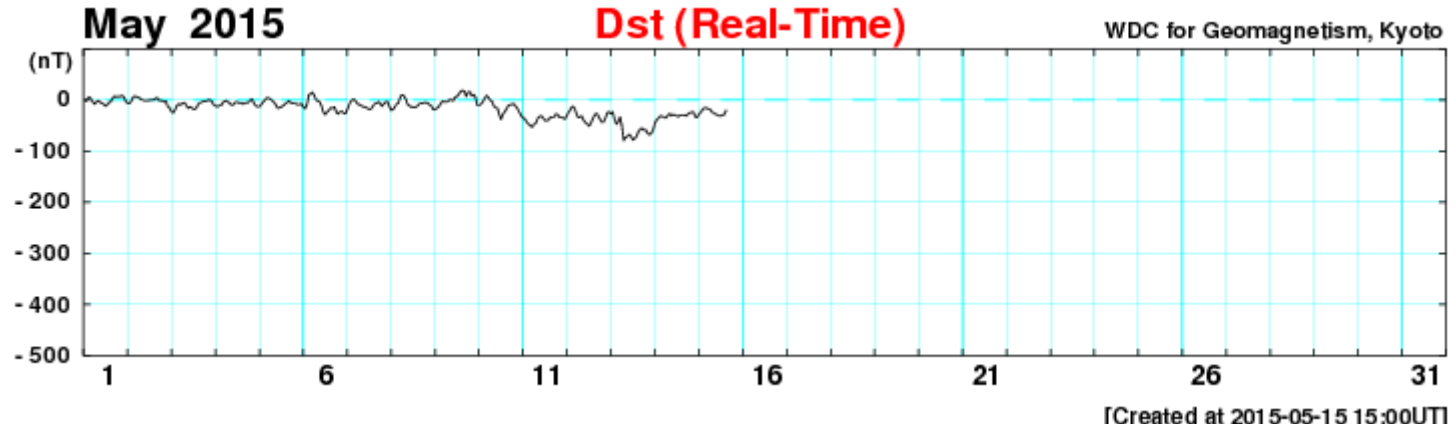




Quiet - moderately disturbed period

26 March – 12 May 2015

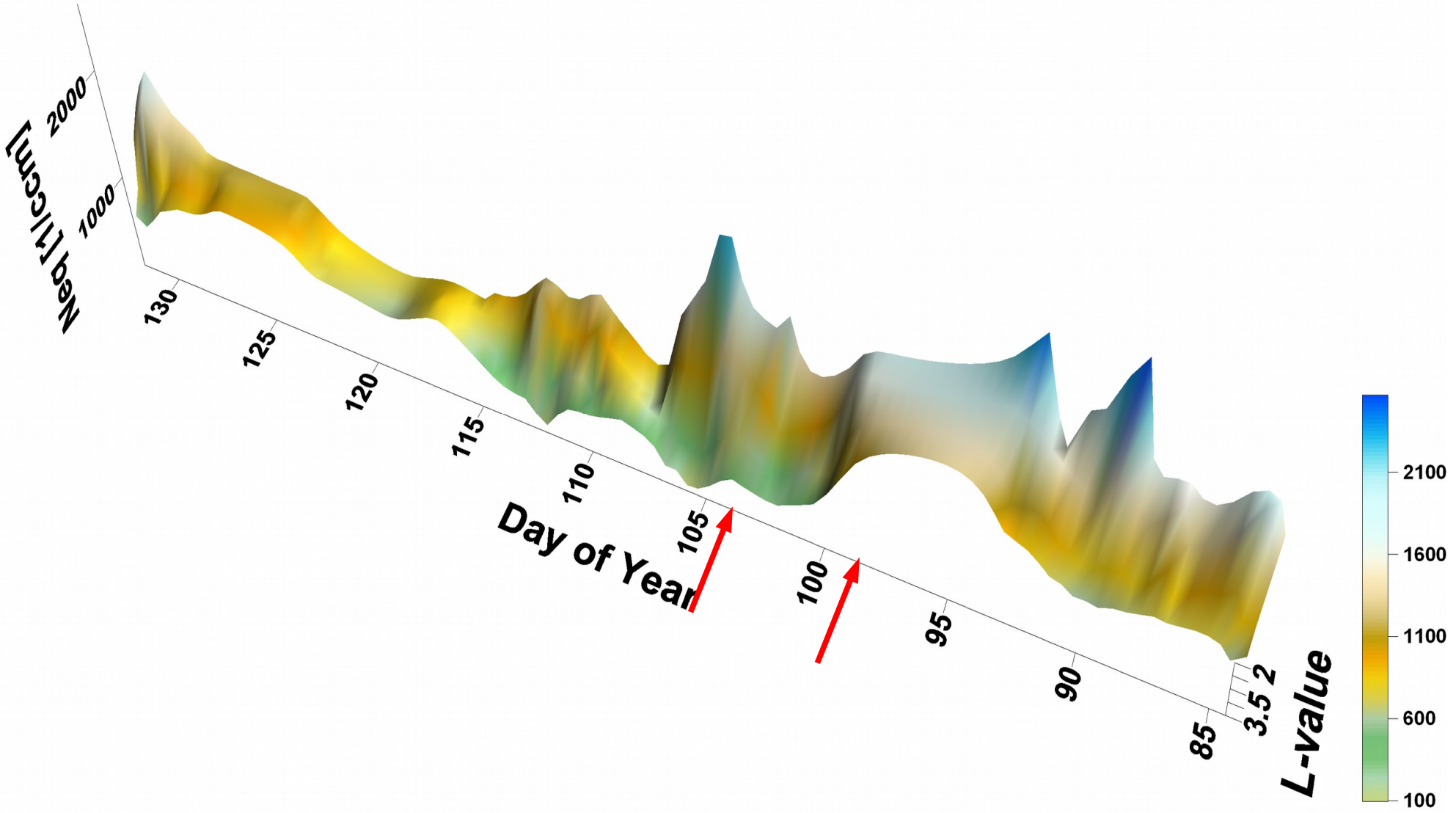




Quiet - moderately disturbed period

26 March – 12 May 2015

2172 whistler events recorded at Rothera (Antarctica)



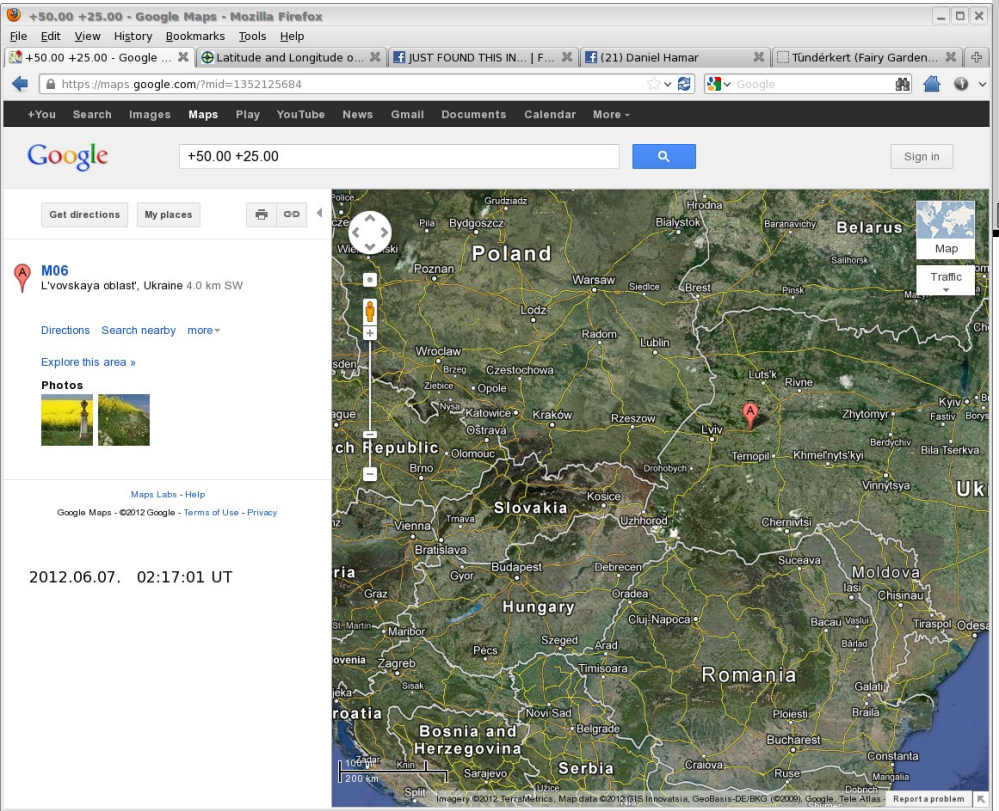
In-situ measurements of Space Wetaher effects

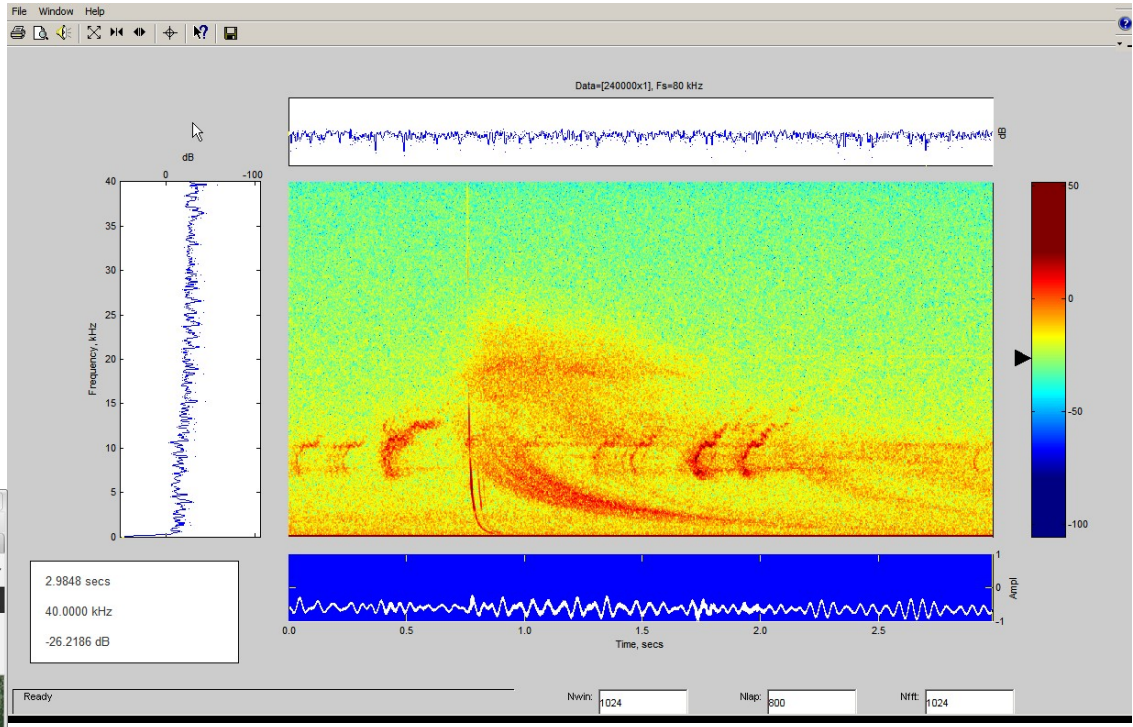
Preliminary results:

E *channel*

7th June 2012, 02.17.01 UT;

$\varphi = +50^{\circ}$, $\lambda = +25^{\circ}$





Signals with strange shapes systematically together with whistler groups

Chibis-M, SAS3-Ch

In-situ measurements of Space Wetaher effects

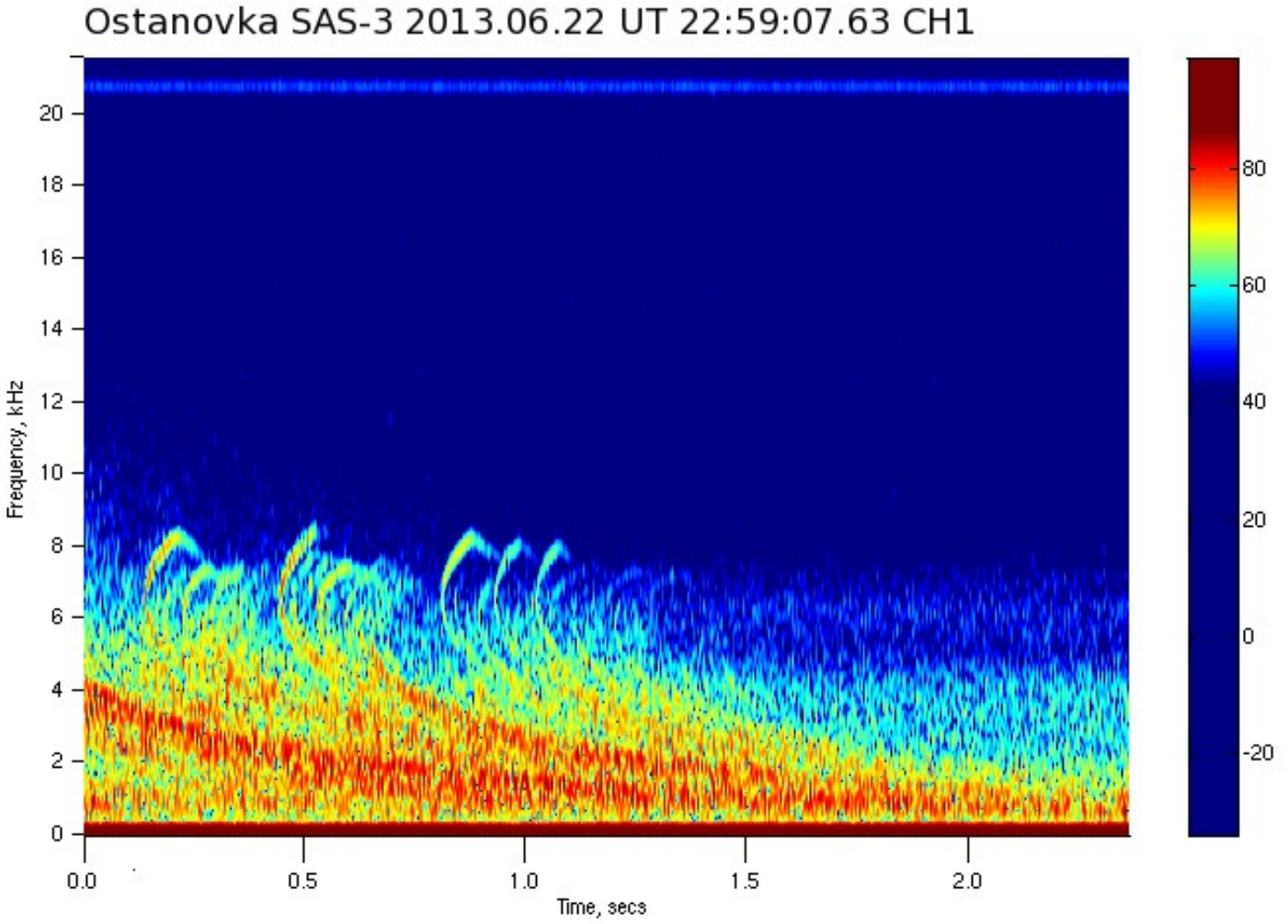
The Obstanovka mission

Unusual whistler triplets recorded by the SAS3-O: *2013*

- The environment of the ISS for this type of measurements is very good.

- The dispersion of the elements of the **triplets** slightly differs.

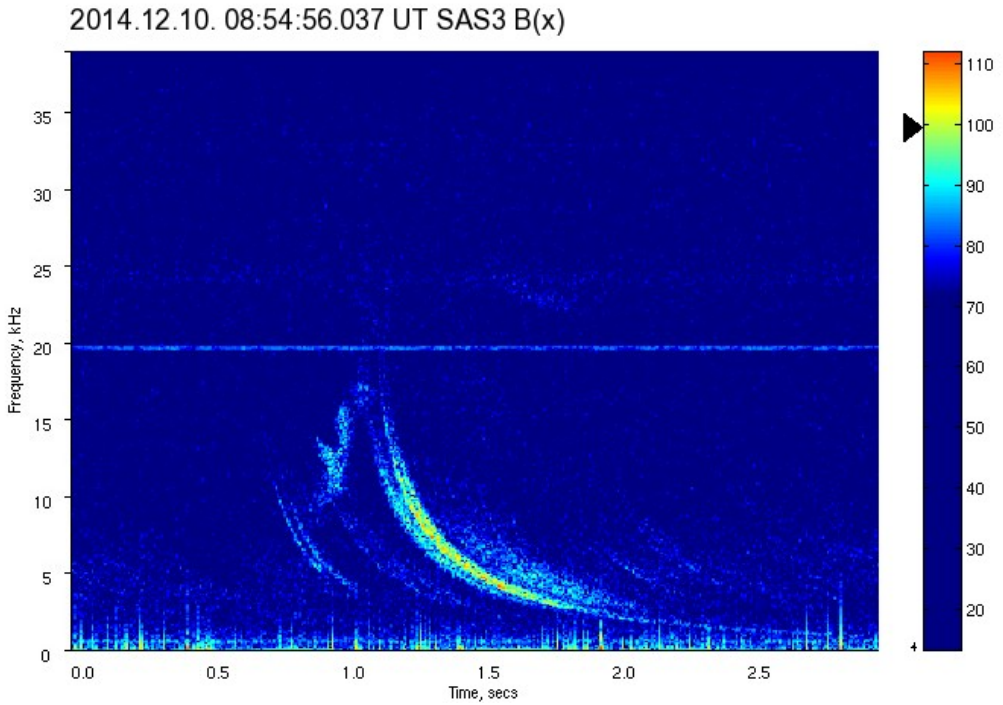
- What is the cause of the alias-like edge at the peak of these signals?

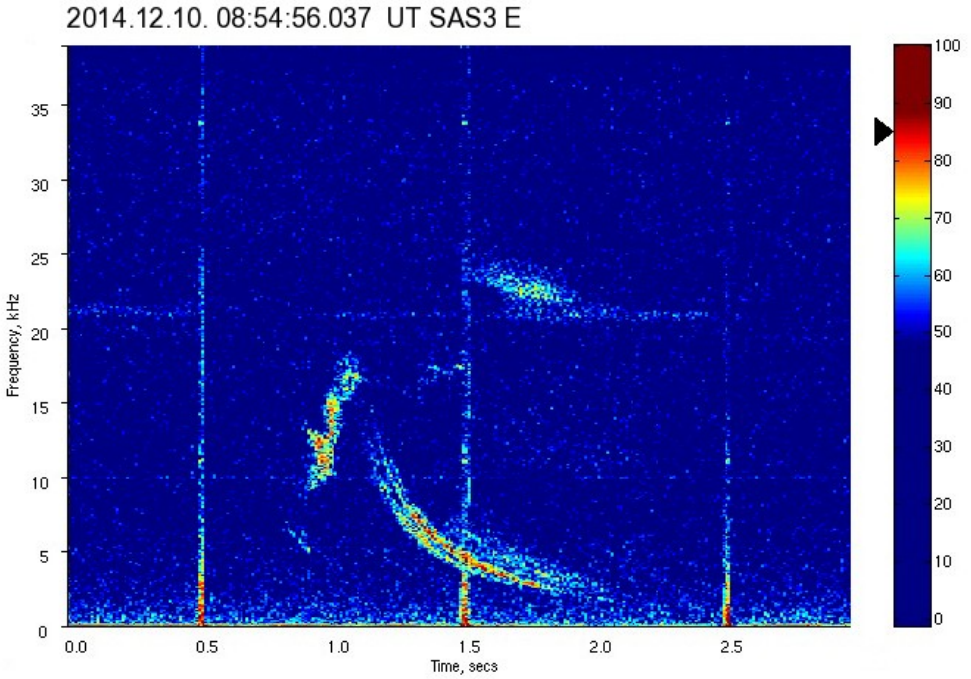


In-situ measurements of Space Wetaher effects

First results of Vernov (RELEK) SAS3-R mission:

Whistler triplets with slightly different dispersion,
and with simultaneous strange signals.





Conclusions

- AWDANet operates on 15 stations in quasi real-time mode since Jun 2014

- the processing of historical data recorded since 2002 has been started

- the global ground based network is complemented by satellite measurements