Iron deposit effect observed in Kiruna geomagnetic fluctuations:

Indications for an improved approach of magnetotellurics searching methods

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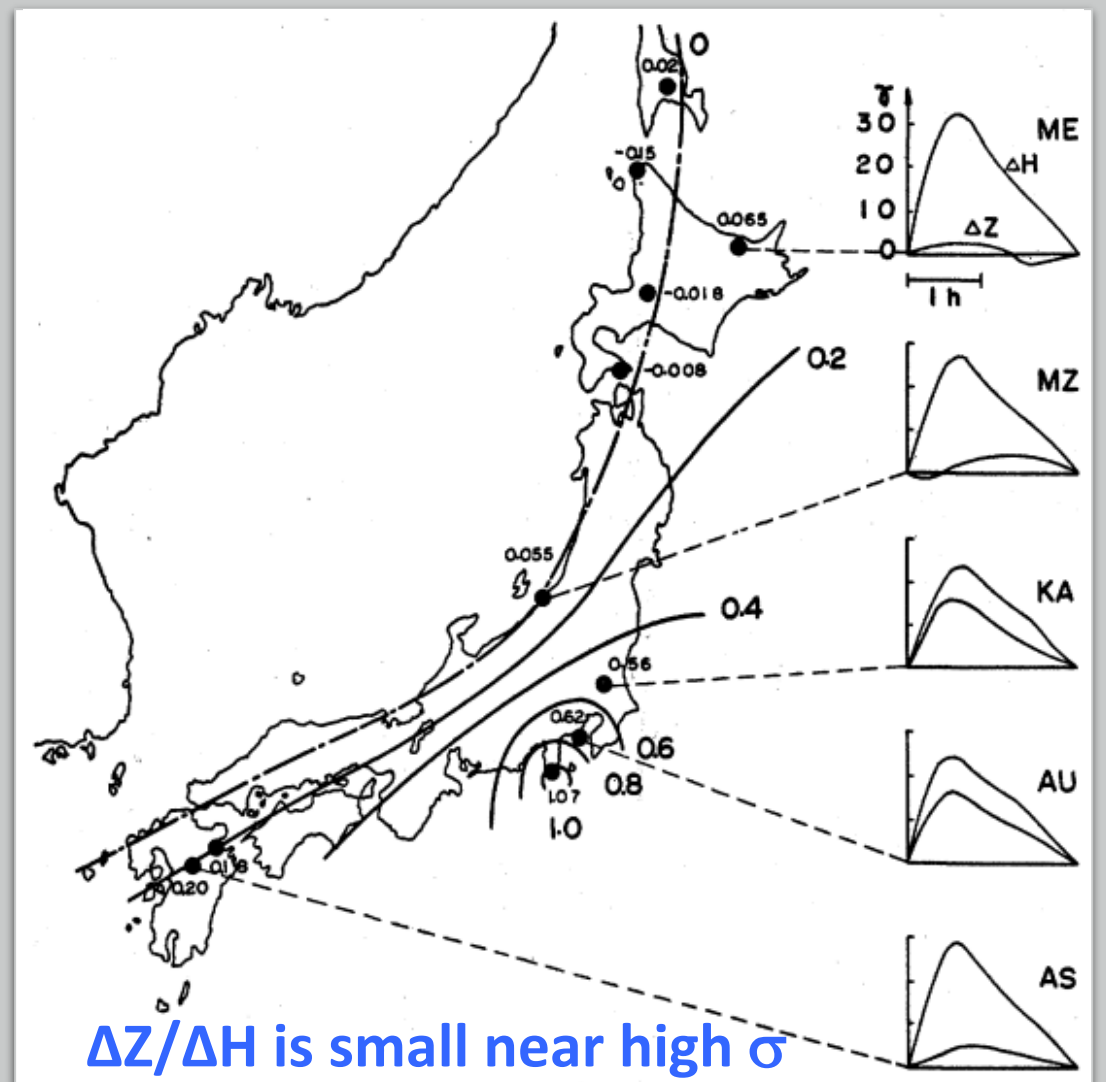
Magnetotellurics (MT)

- Effect of the surface/subsurface conductivity (σ) on the geomagnetic variation (e.g., $\Delta Z/\Delta H$) has long been known as the coast effect

  $\Rightarrow$ it can be applied to interior structure and conductivity anomaly

- Estimate σ by measuring geomagnetic response to natural and artificial input

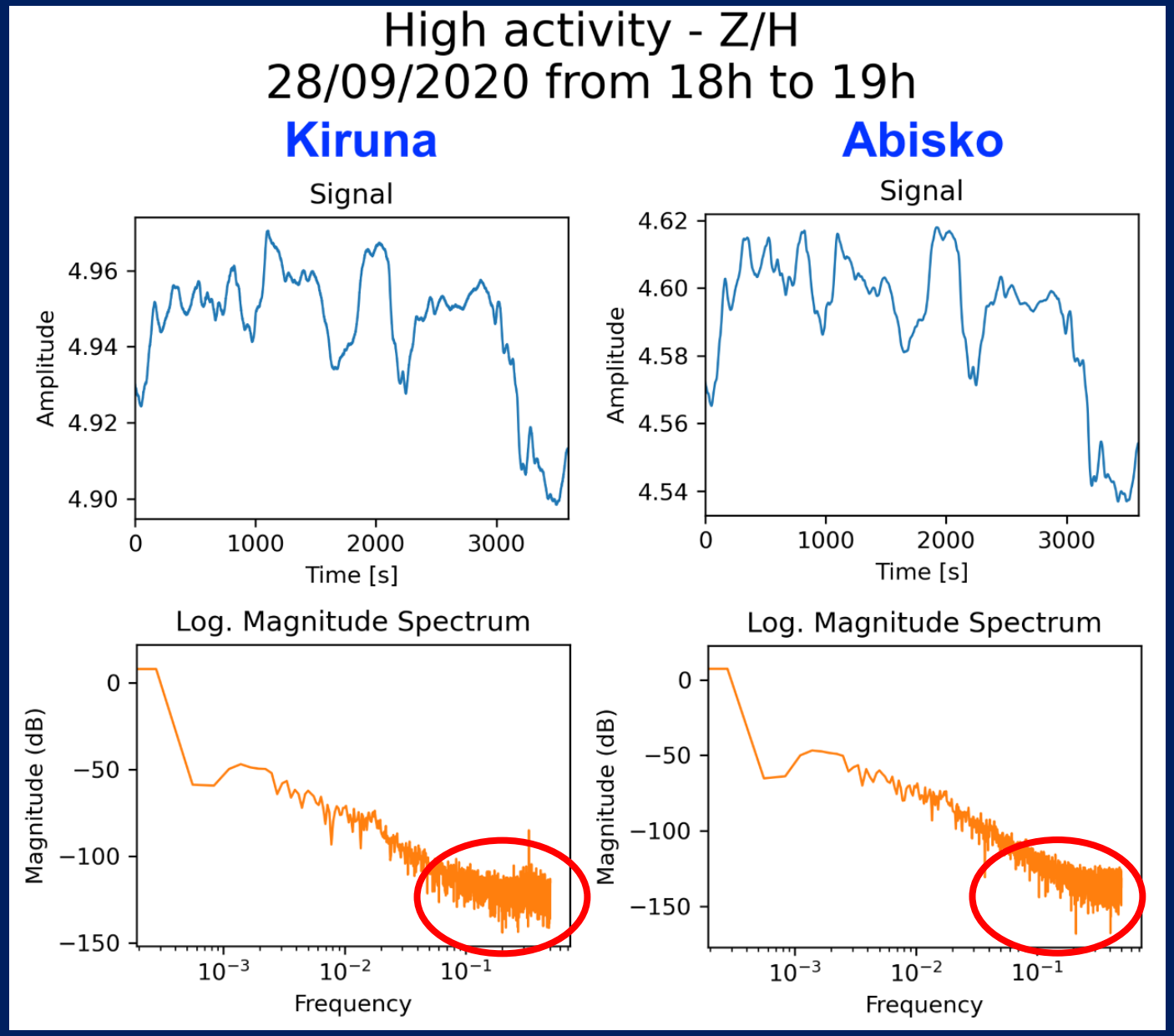
- The method is established as the magnetotellurics method (MT) in the frequency domain



$\Delta Z/\Delta H$ is small near high σ

Distribution of the statistical value of ΔZ and ΔH (Rikitake & Yokoyama, 1953)

Does Kiruna mine influences Kiruna DC magnetometer?



MT spectral does not show any particularity < 0.5 Hz

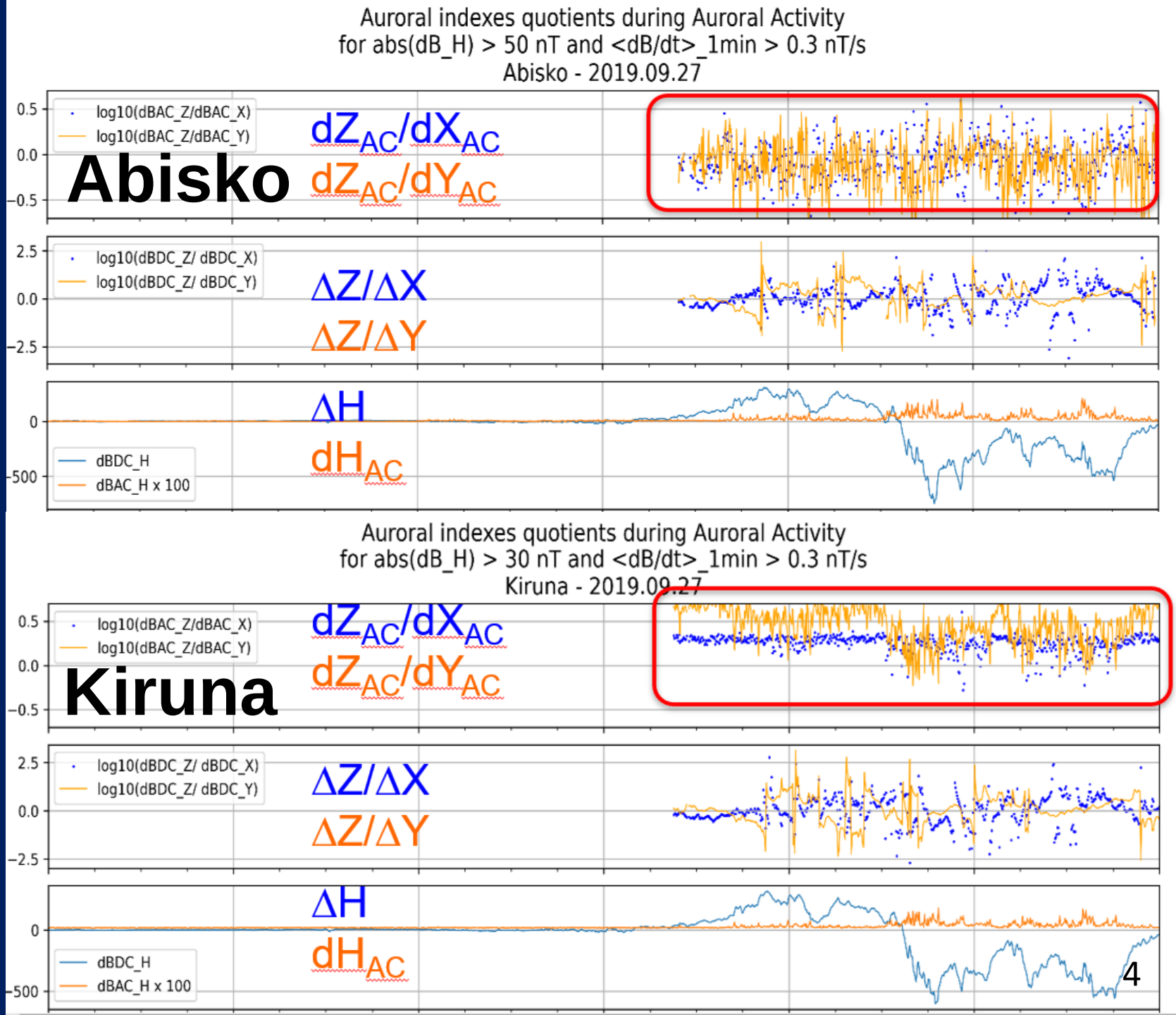
We try a different approach : Time-domain analysis

$$\Delta B = < B >_{1\text{min}} - B_0$$

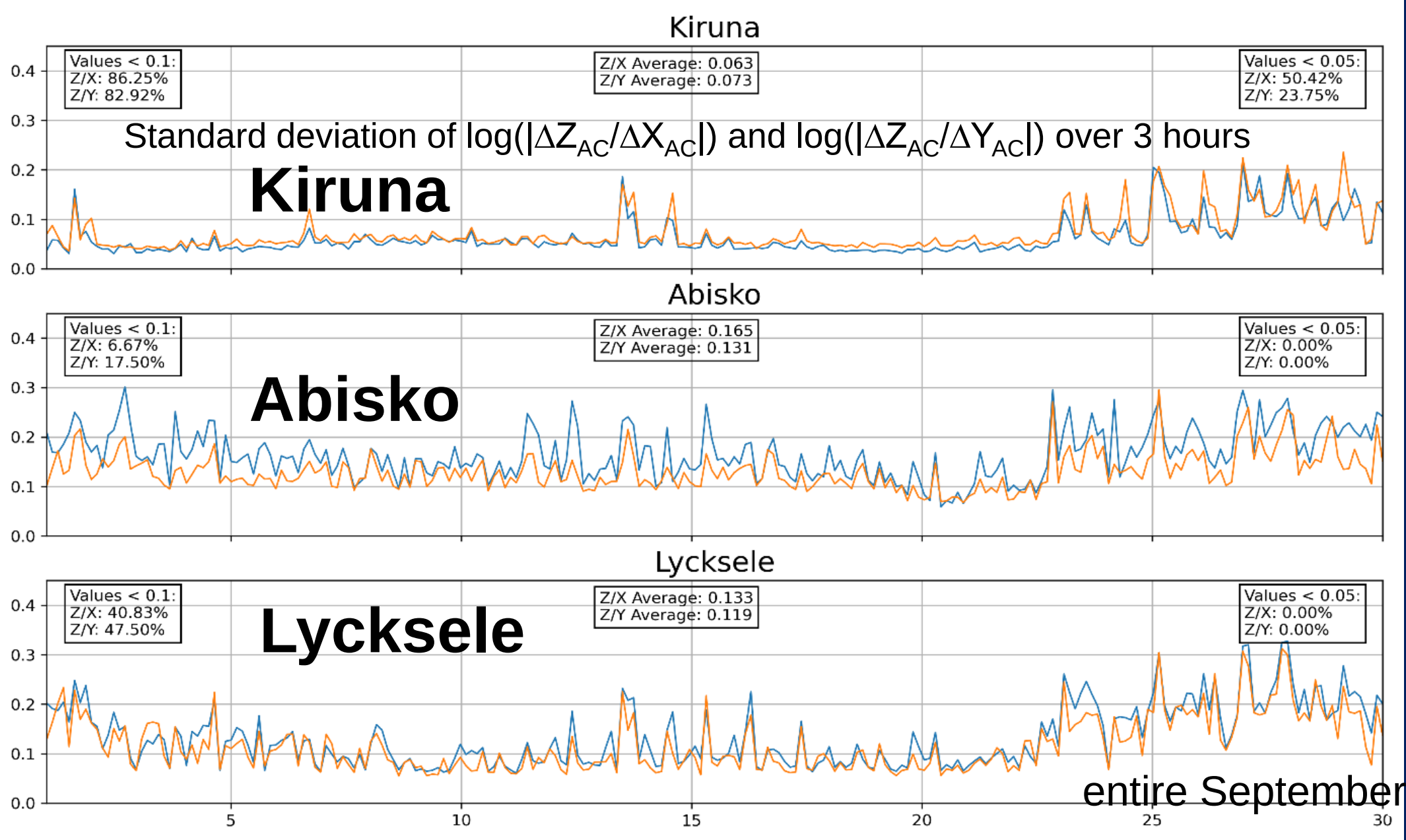
$$dB_{AC} = < \left| \frac{dB}{dt} \right|_{1\text{sec}} >_{1min}$$

$$\log(\left|\frac{\Delta Z_{AC}}{\Delta X_{AC}}\right|) \text{ and } \log(\left|\frac{\Delta Z_{AC}}{\Delta Y_{AC}}\right|)$$

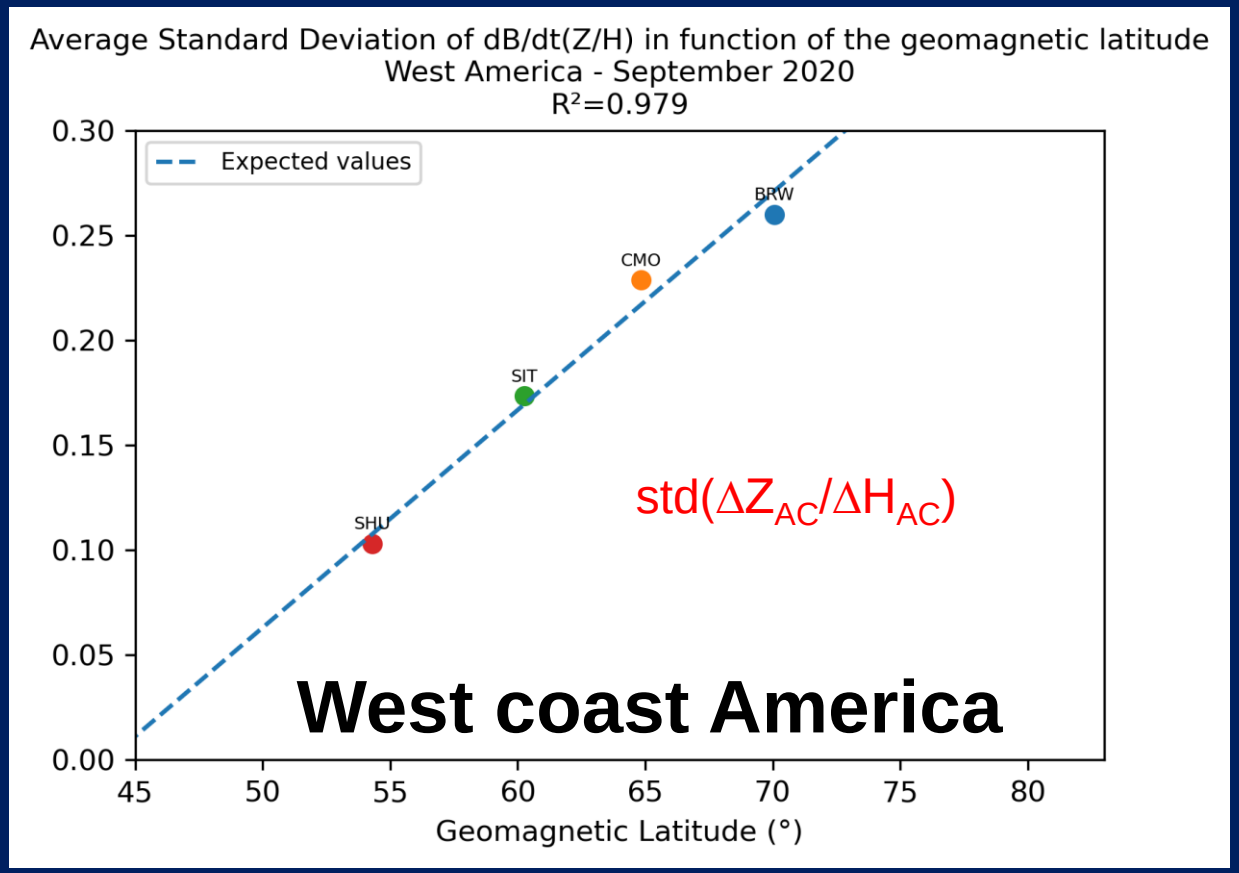
⇒ "Kiruna ≠ Abisko" whereas the two stations are 90km away

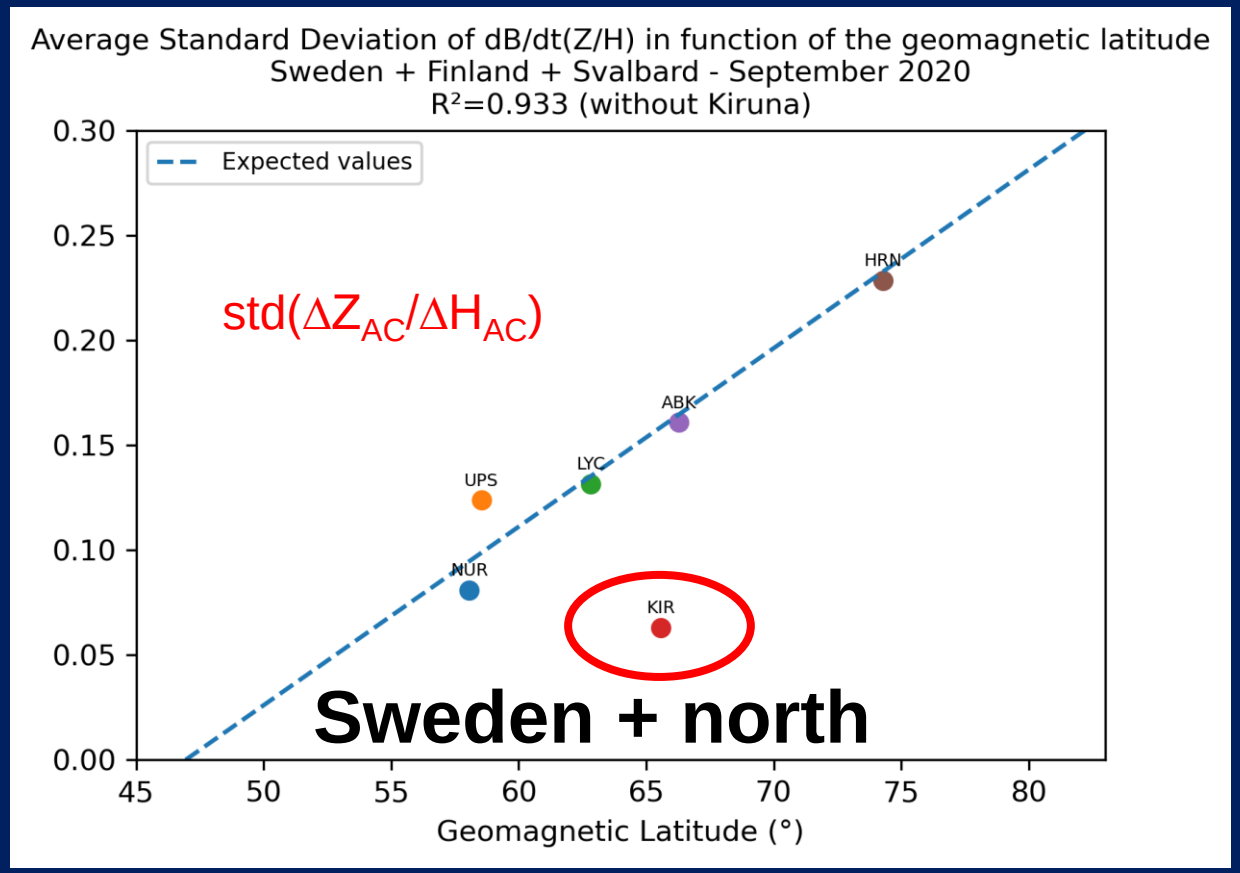


Towards a new parameter to compare auroral stations: The Standard Deviation



Result: Linear relation with geomagnetic latitude except for Kiruna

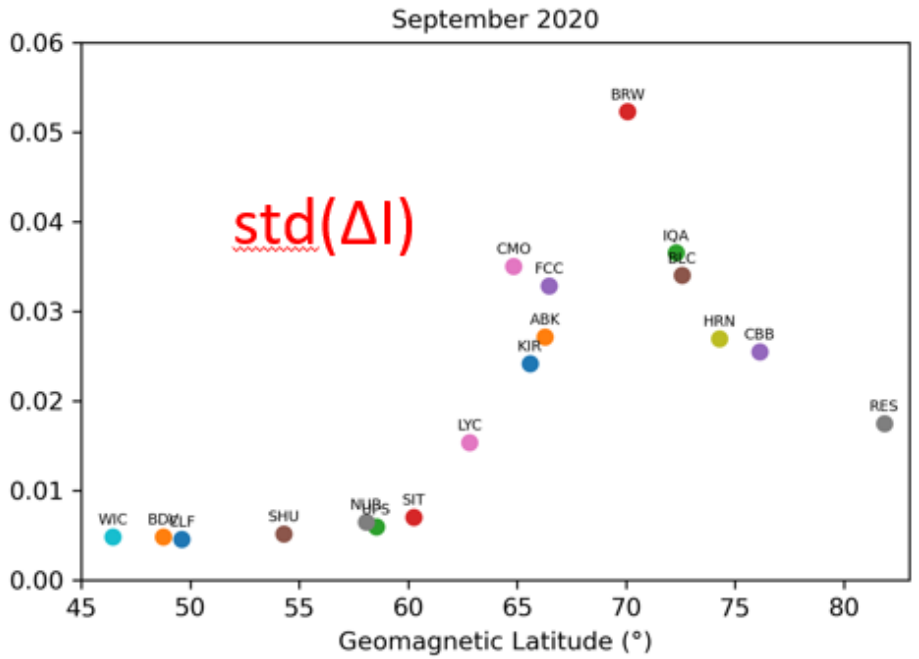


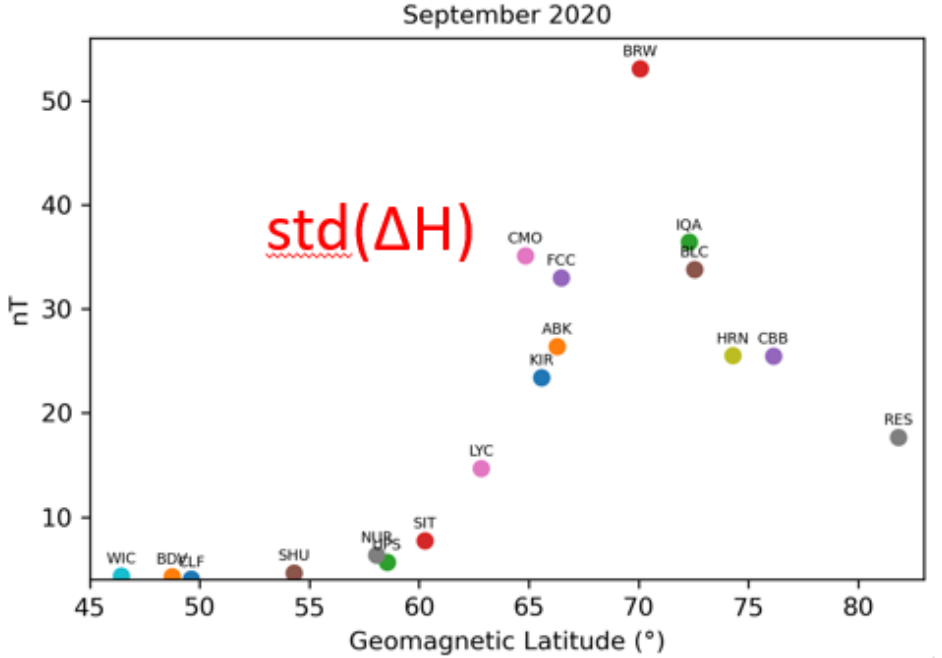


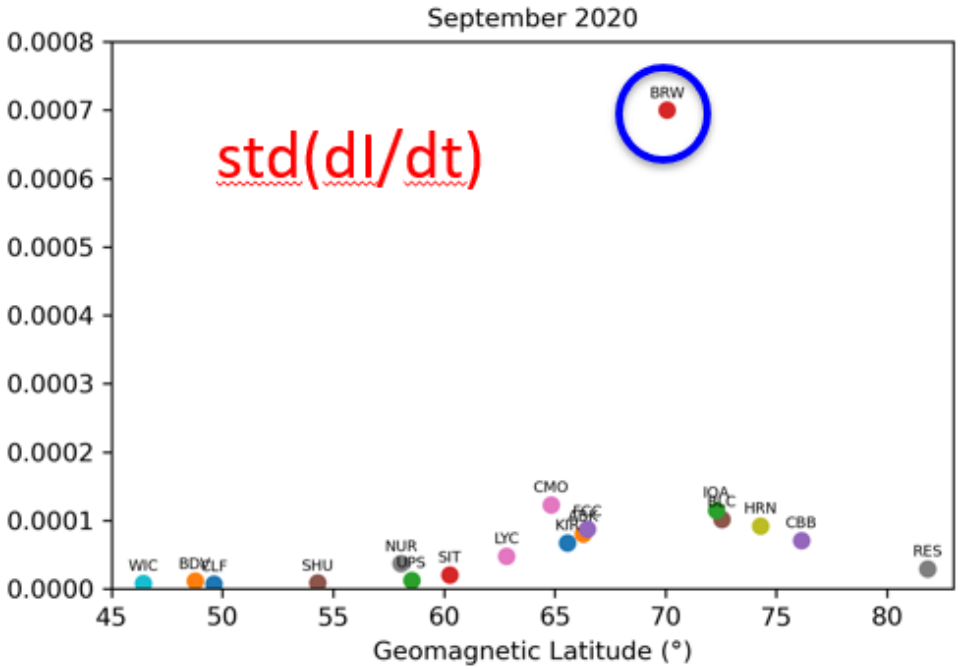
This result is valid across ten years for both old DMI and new DTU magnetometer

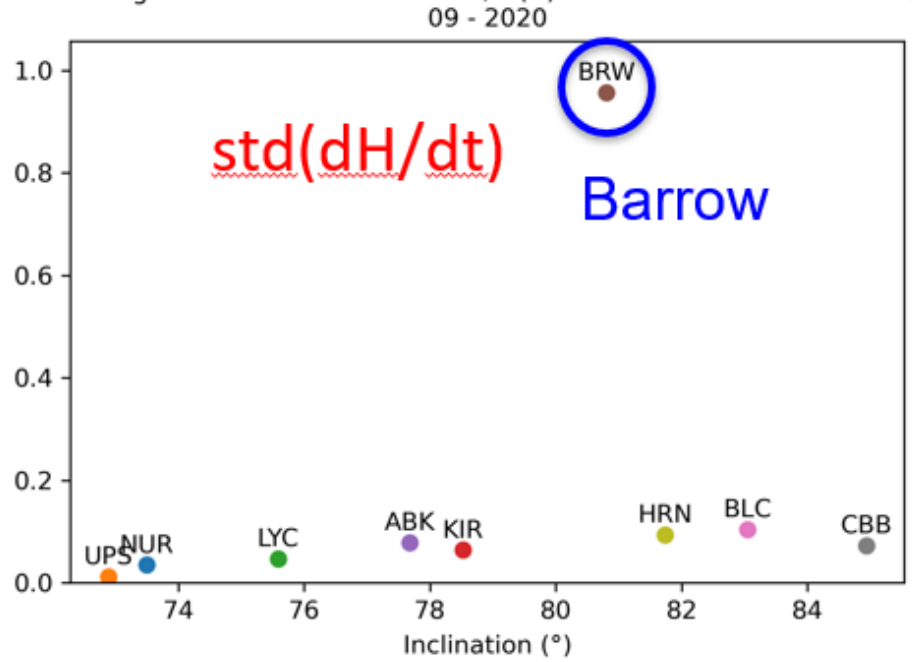
⇒ Difficult to attribute to KIR magnetometer filtering

Is Barrow also abnormal?









Summary

Kiruna anomaly is clear in d/dt method, while magnetotellurics (MT) spectrum method did not show any clear anomaly at 0.1 - 0.5 Hz (sampling 1 Hz)

We believe that this anomaly is not due to the 1-sec filtering of the magnetometer because it is seen in only in one parameter: $\Delta Z_{AC}/\Delta H_{AC}$ across ten years and two different magnetometers

We believe that the time-domain method is more sensitive due to the fact that natural variation under auroral zone is more step-like rather than sinusoidal

⇒ If so, d/dt method is promising in detecting σ anomaly at high-latitudes

THANK YOU!