GROUND-BASED GEOMAGNETIC SIGNATURE OF THE 7-8 SEPTEMBER MAGNETIC STORM AS A FAREWELL GIFT FROM SOLAR CYCLE 24

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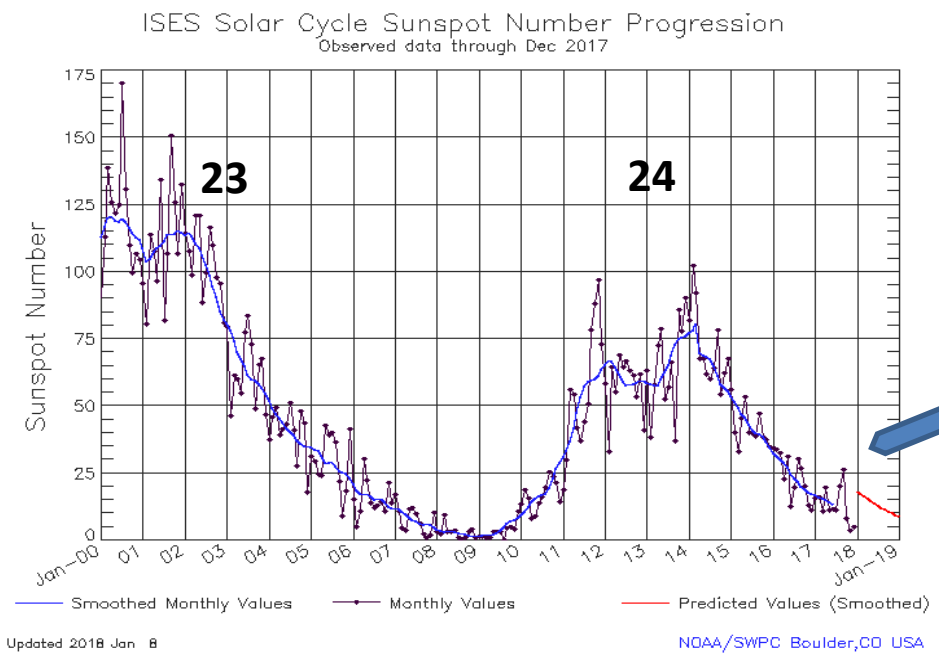
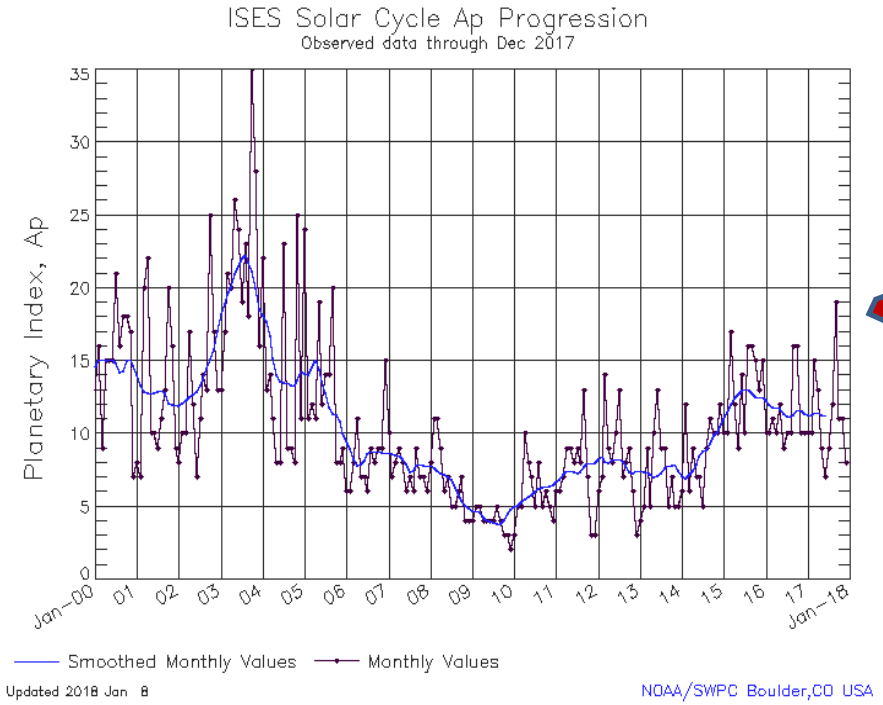
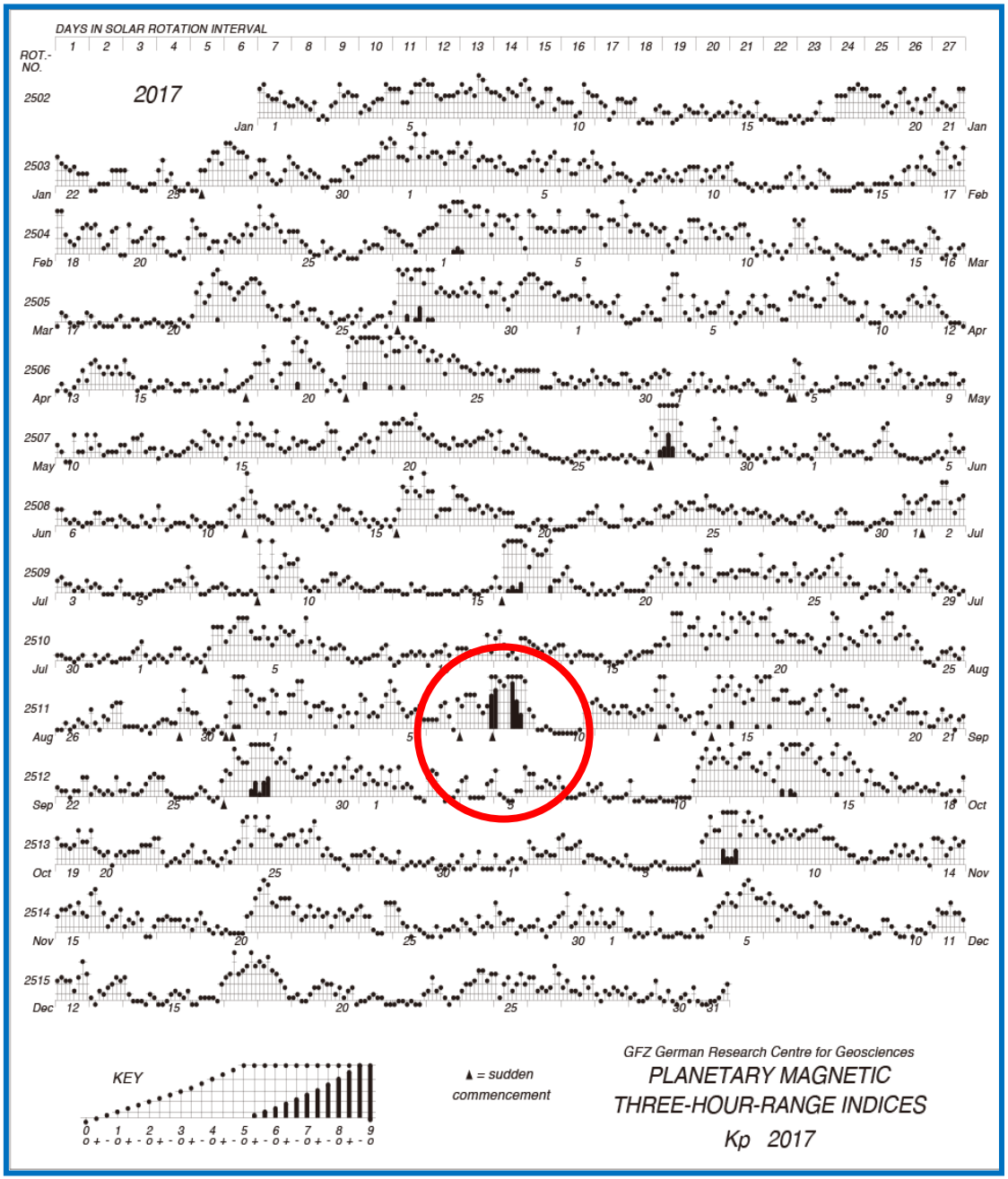


The Sunspot number progression in the Solar Cycles 23 and 24.



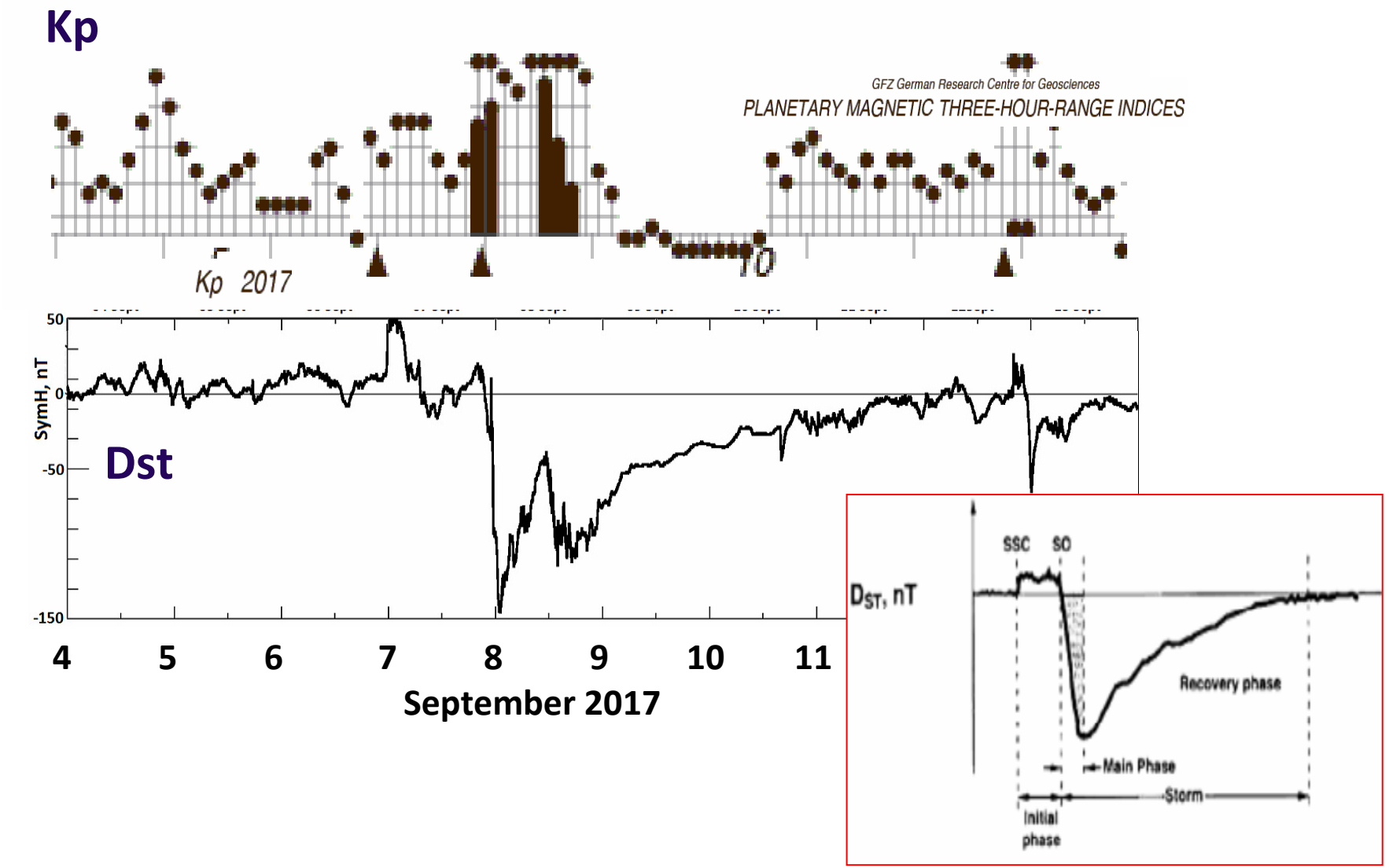
The correspondent variations of the geomagnetic activity



Kp-index 2017

There was only one strong magnetic storm – in September 2017

Magnetic storm on 7-8 September 2017

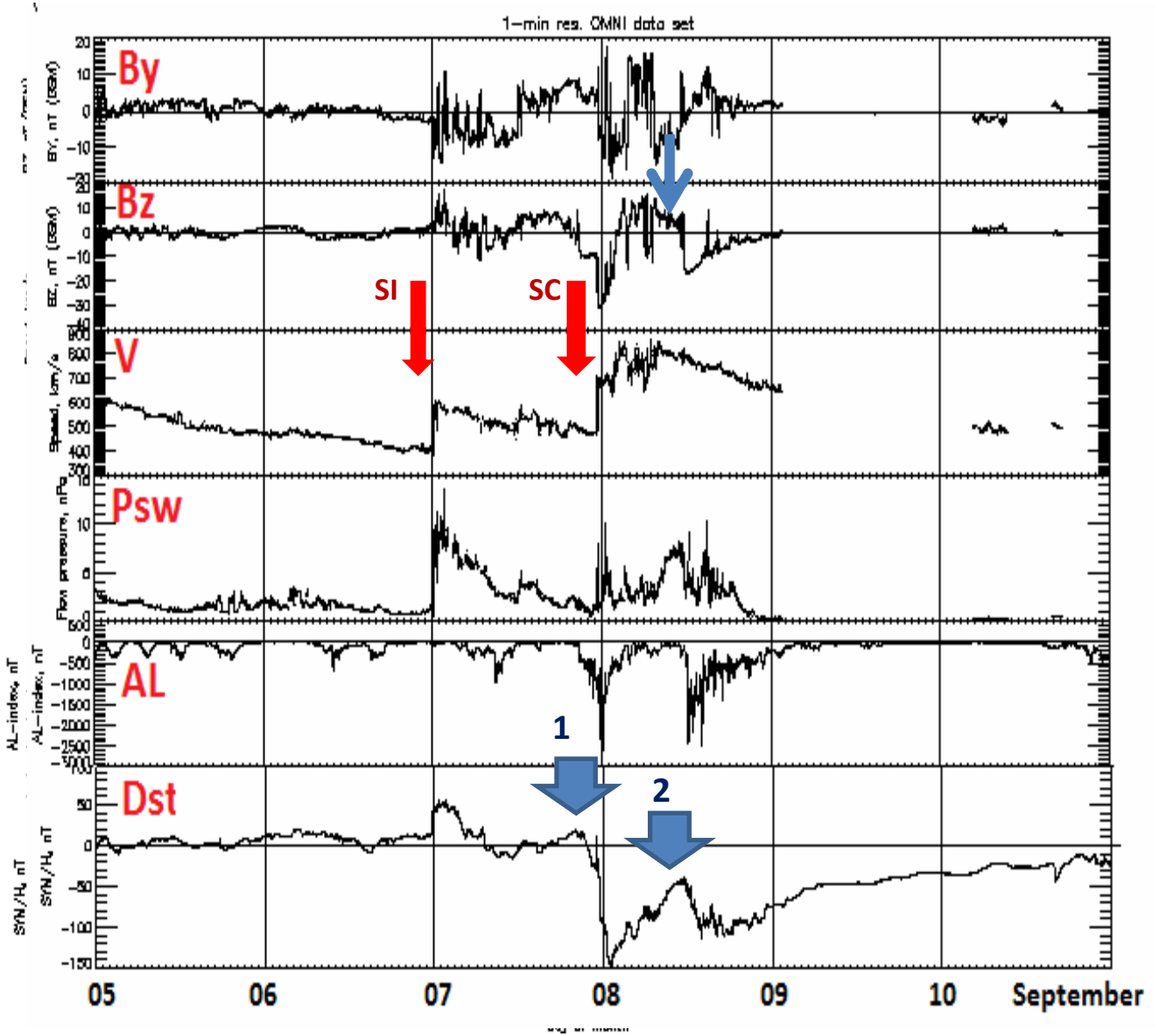


Standard storm observatories

- Four storm observatories located around the Earth's magnetic equator:

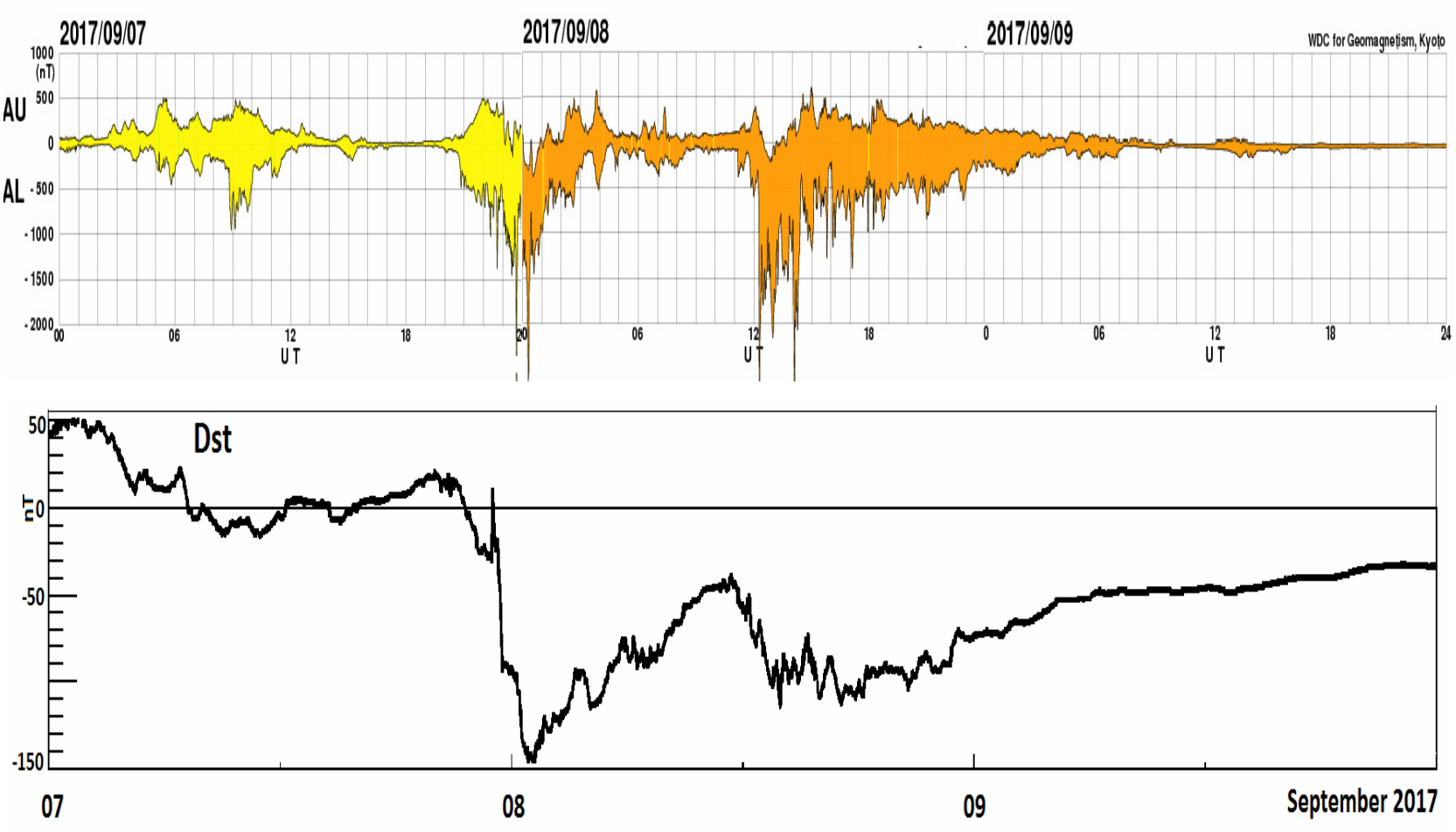
  Kakioka, San Juan, Hermanus and Honolulu.

Solar wind and Interplanetary magnetic field parameters



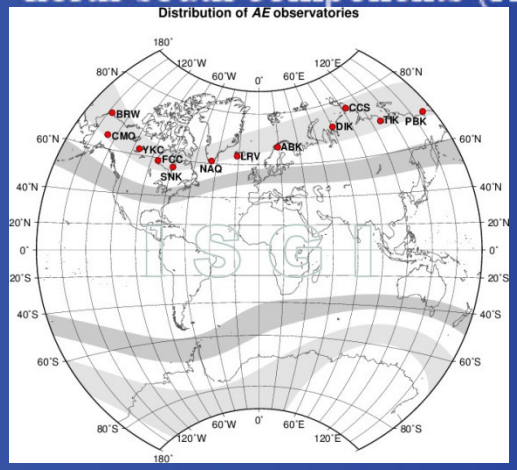
The arrival of the coronal mass ejection associated with the 6 September X-9 flare produced severe geomagnetic storming on 7 and 8 September.

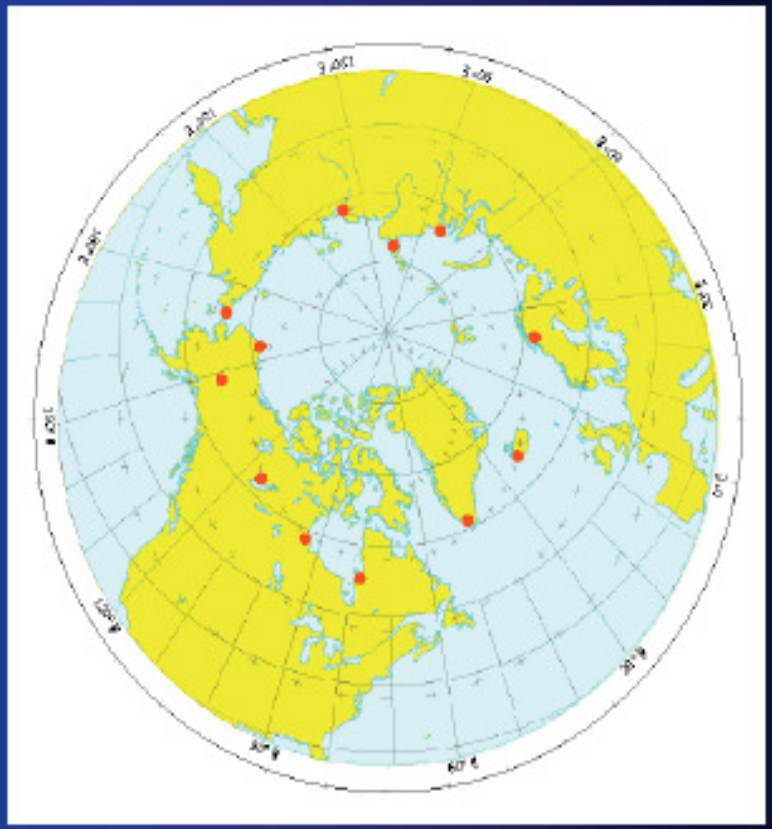
Global substorm activity



Substorm observatories

- 12 standard observatories
- Substorms identified from AL/AE index, which is an envelope curve of measured north-south components (X_{GSM}).

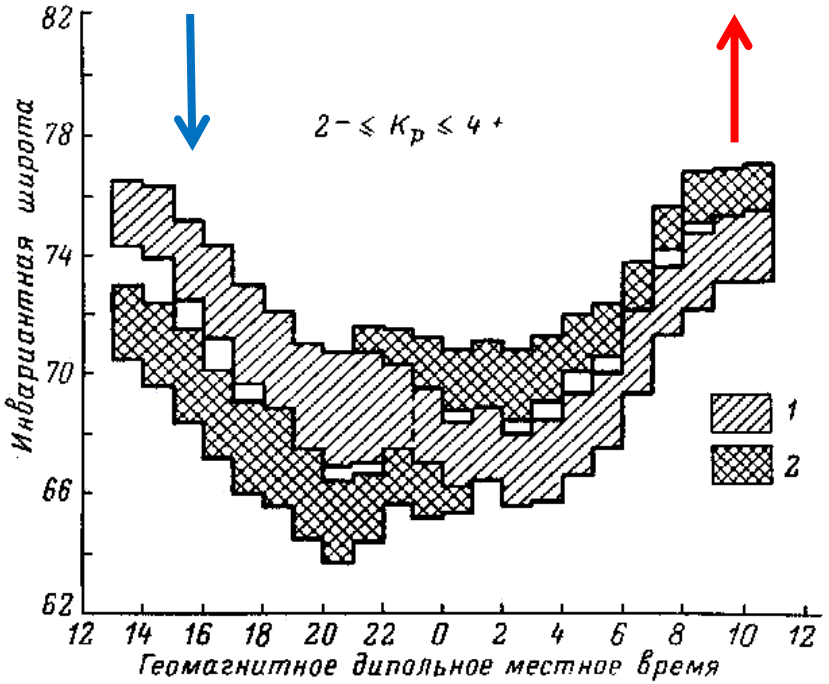




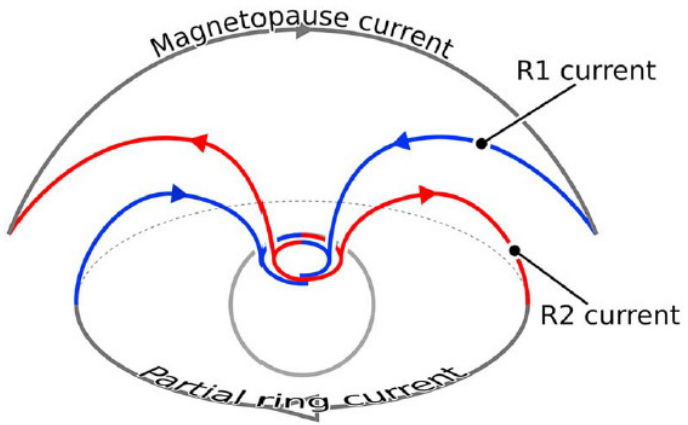
Field aligned currents (FAC) or Birkeland currents

Downward current

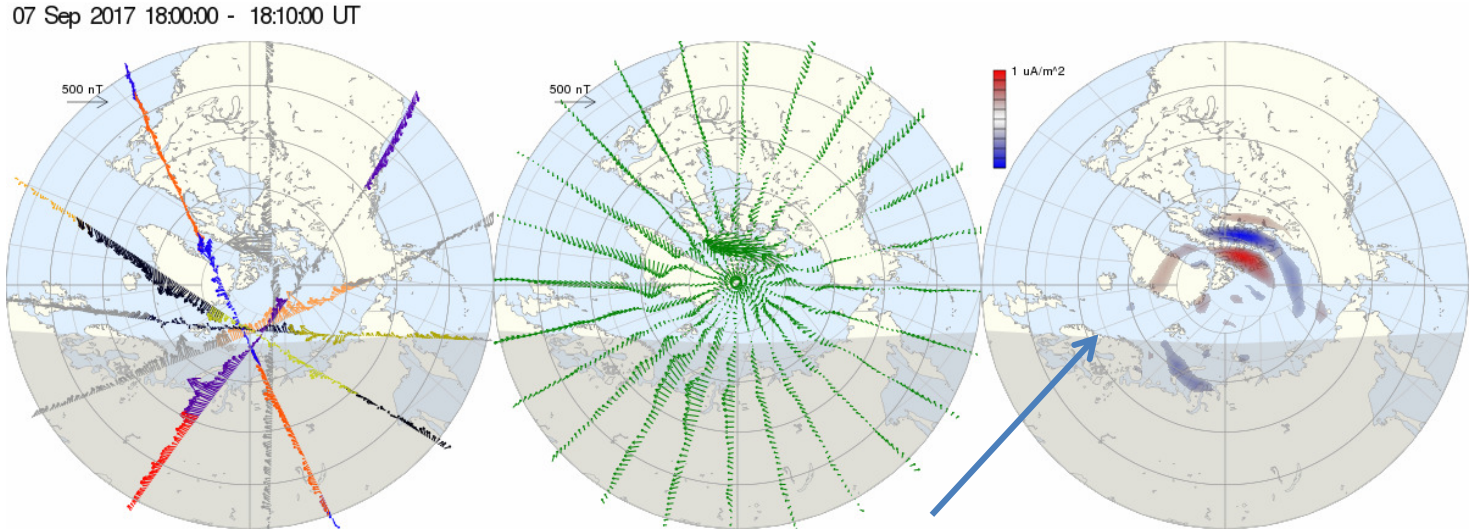
Upward current



The higher latitude currents are called "Region 1" and the lower latitude currents - "Region 2"

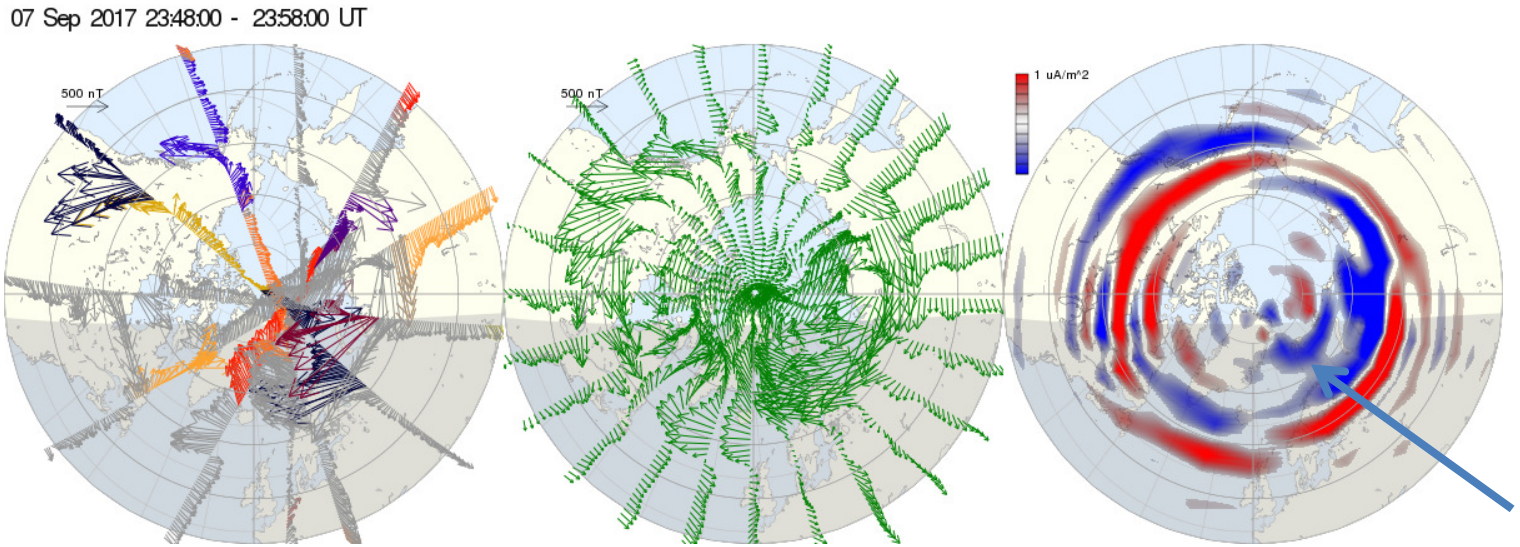


AMPERE (Active Magnetosphere and Planetary Electrodynamics Response Experiment) project consists of 66+ commercial satellites in 780 km polar circular orbits distributed over 6 orbital planes to provide global telephone service.

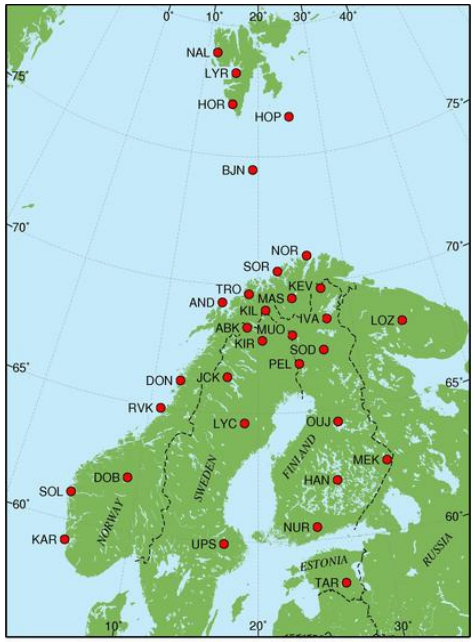


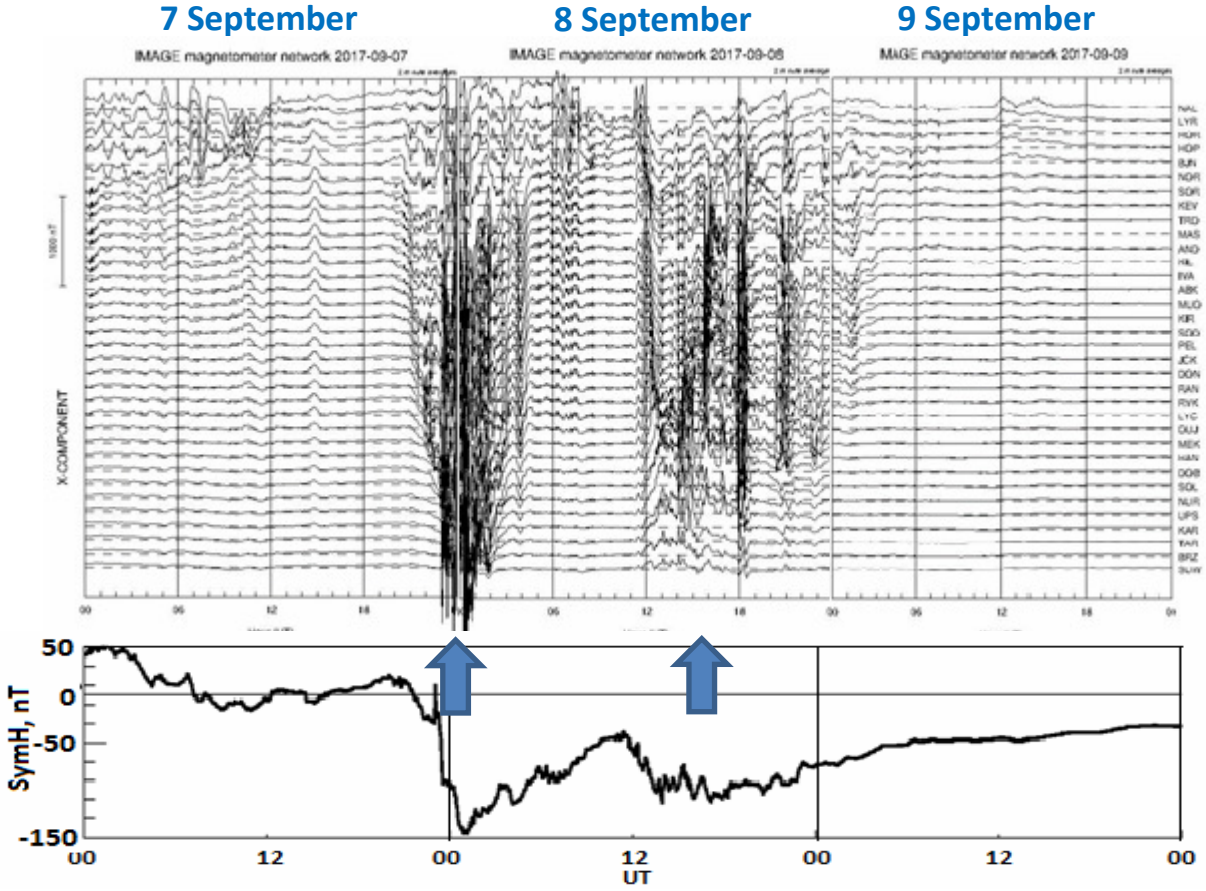
Before the magnetic storm on 7 September

Blue - downward , red - upward currents

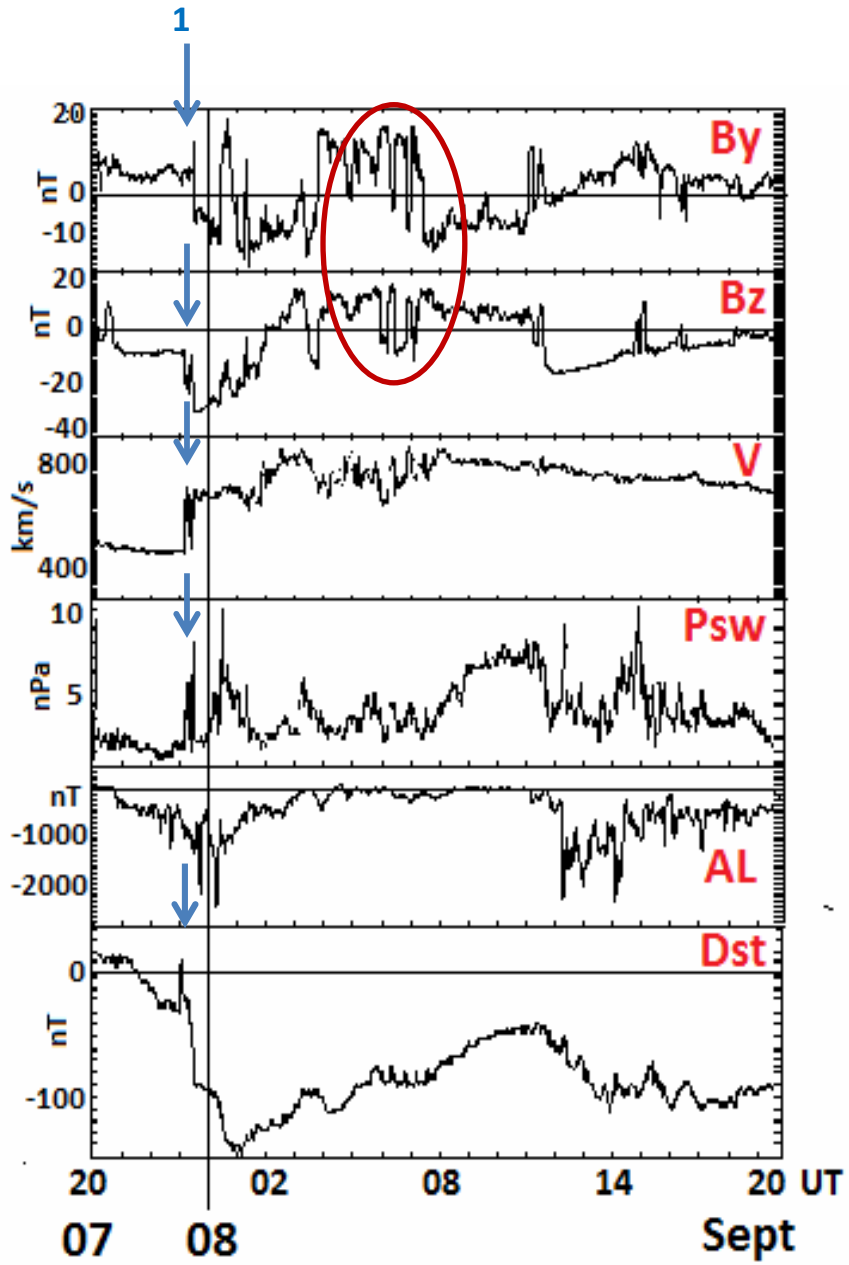


In the storm main phase beginning





Magnetograms from the Scandinavian IMAGE set included 39 ground stations


1
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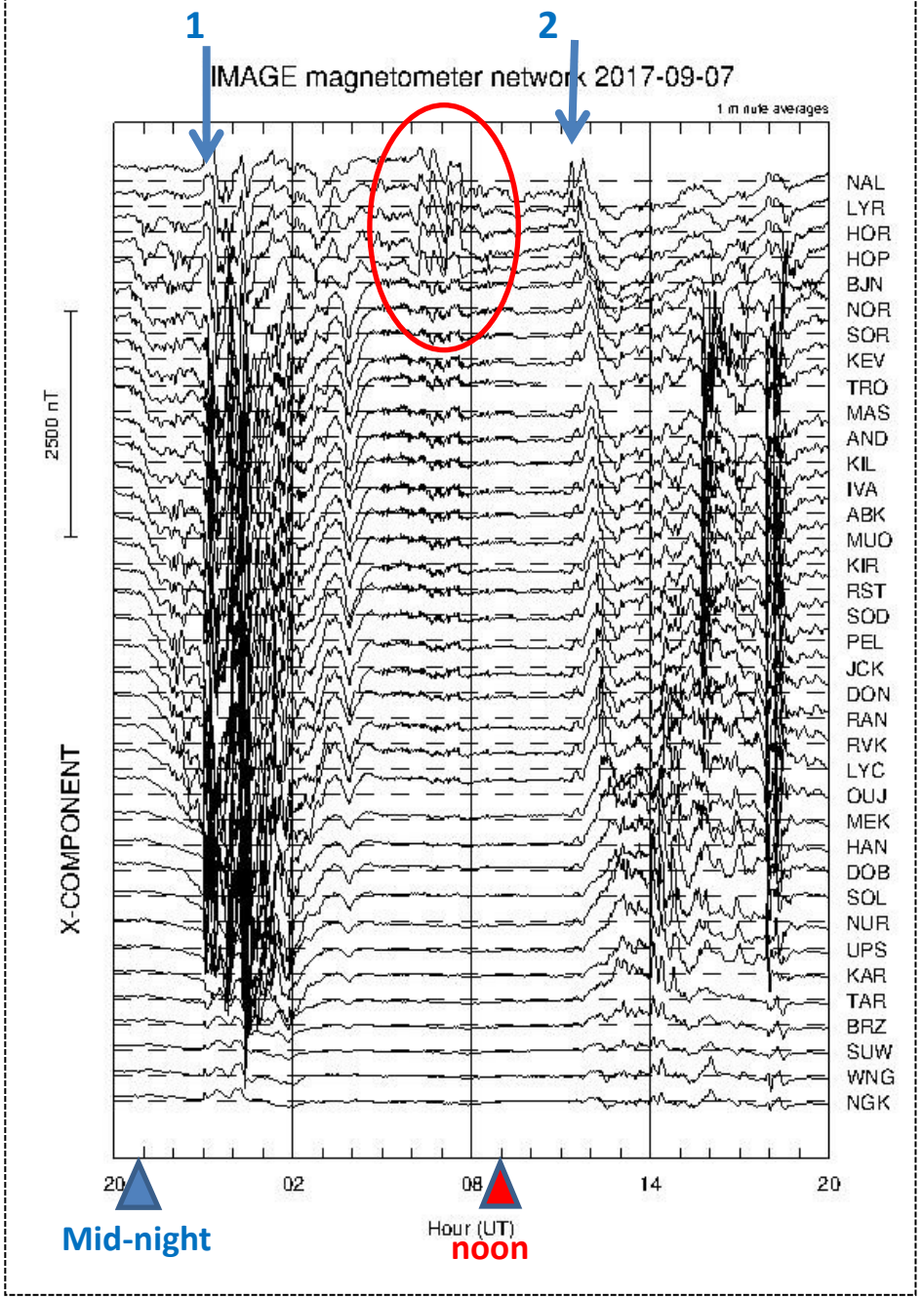
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IMAGE magnetometer network 2017-09-07
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20
02
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14
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Hour (UT)
Mid-night
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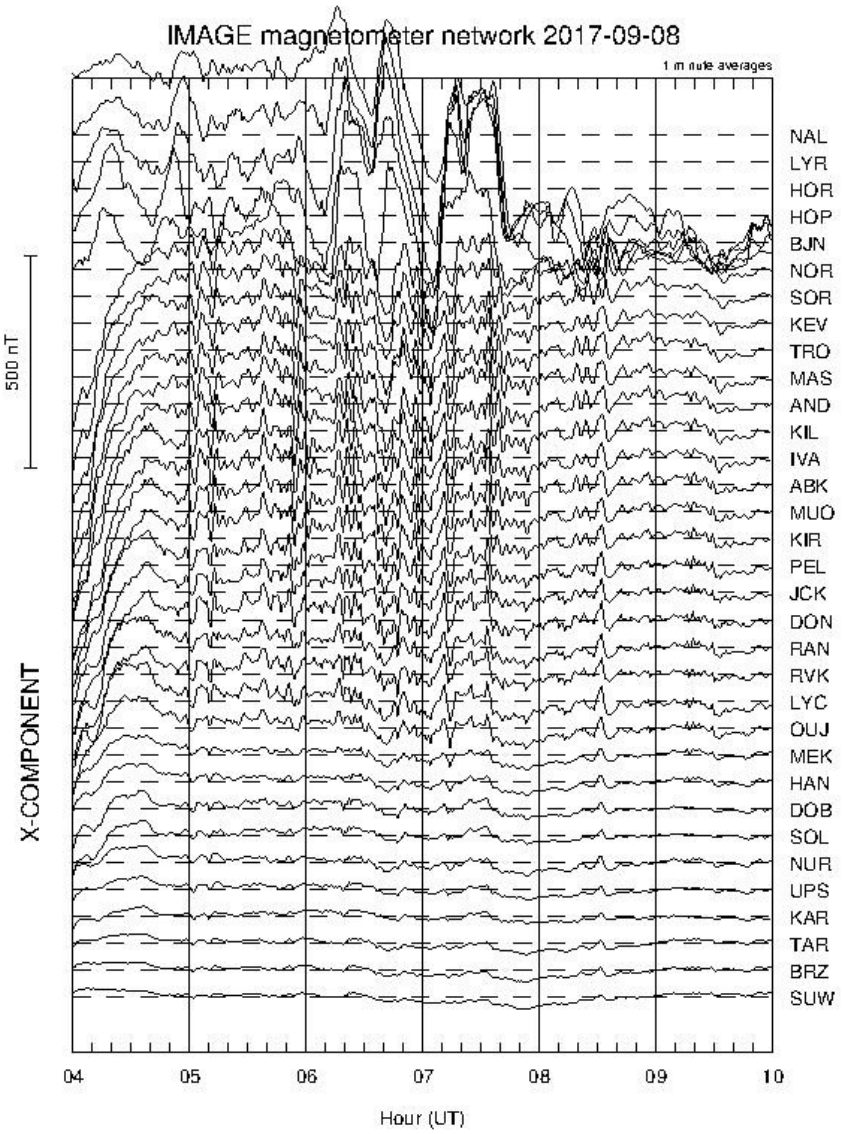
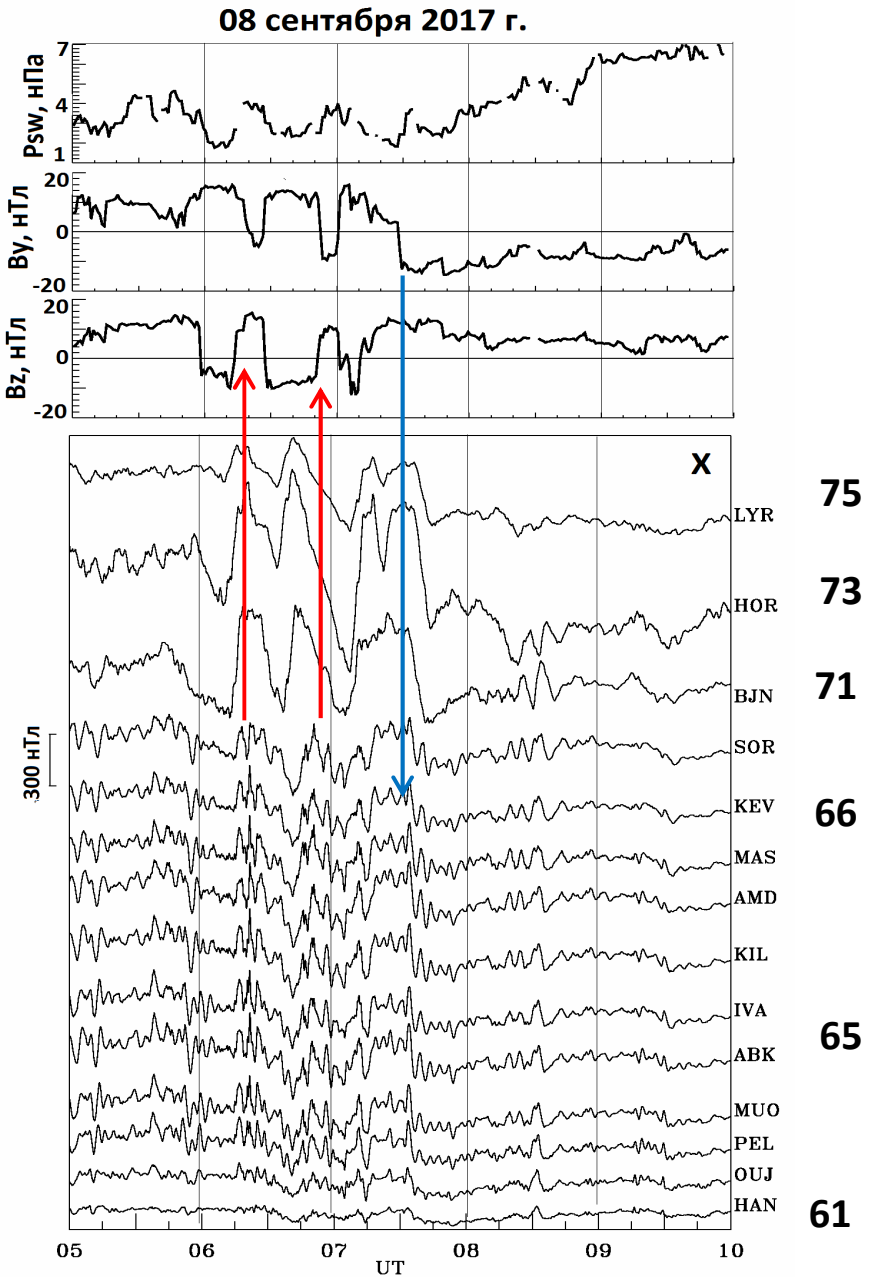
Storm recovery phase





Pc5 pulsations

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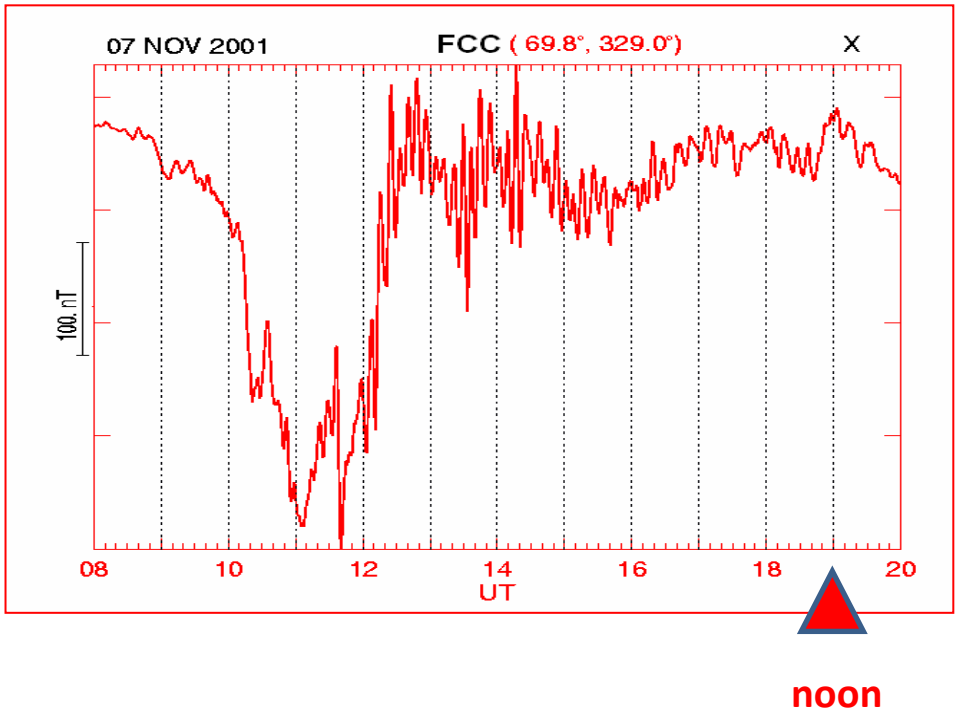
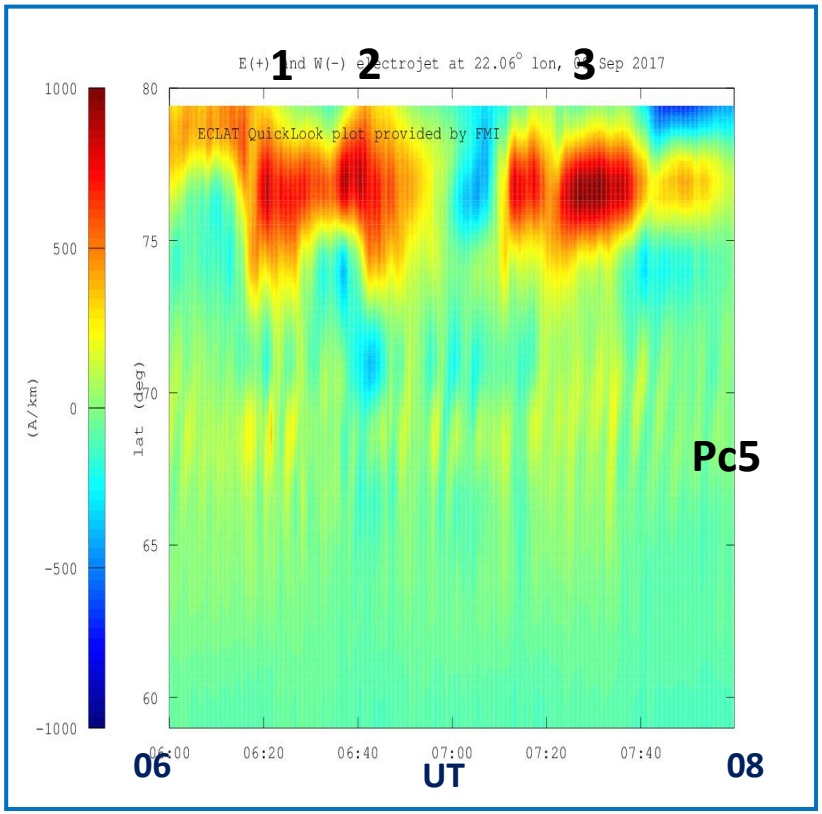
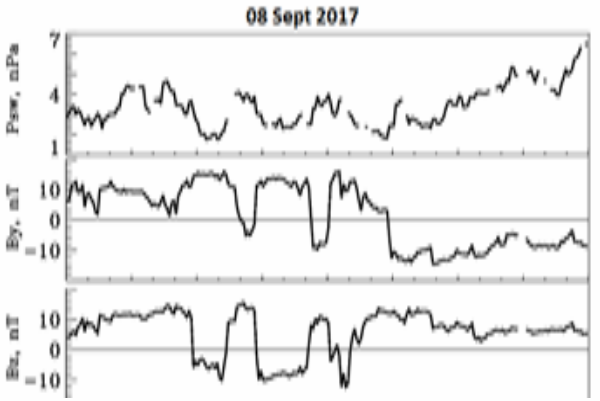
Typical Pc5 pulsations

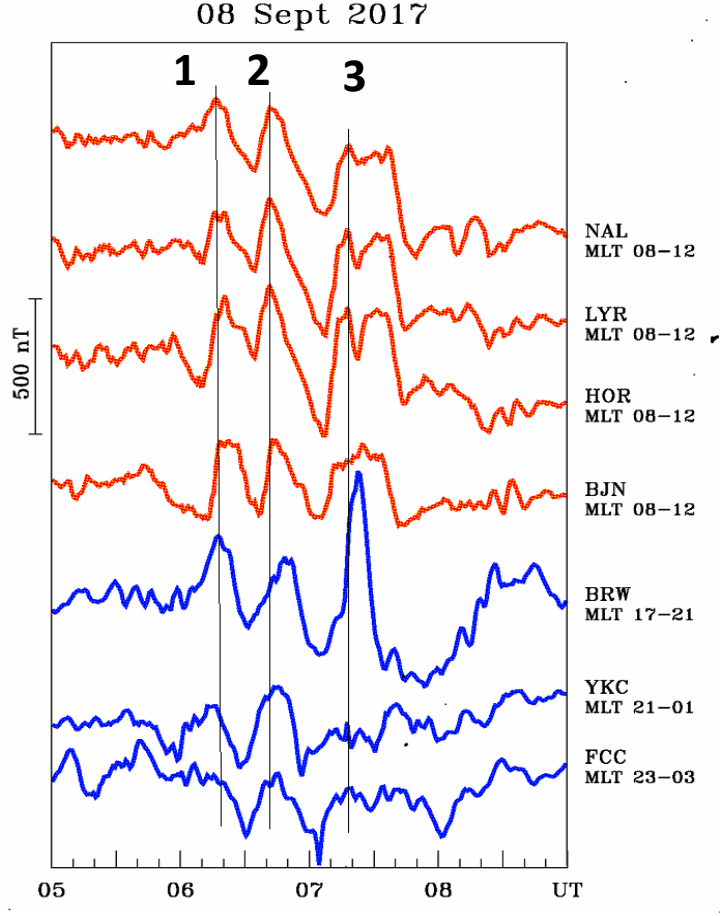


Typical Pc5 pulsations (T= 150-600 s) are attributed to the field line resonances driven by magnetopause shear-flow instability, developing preferentially on the dawn flank of the magnetosphere.

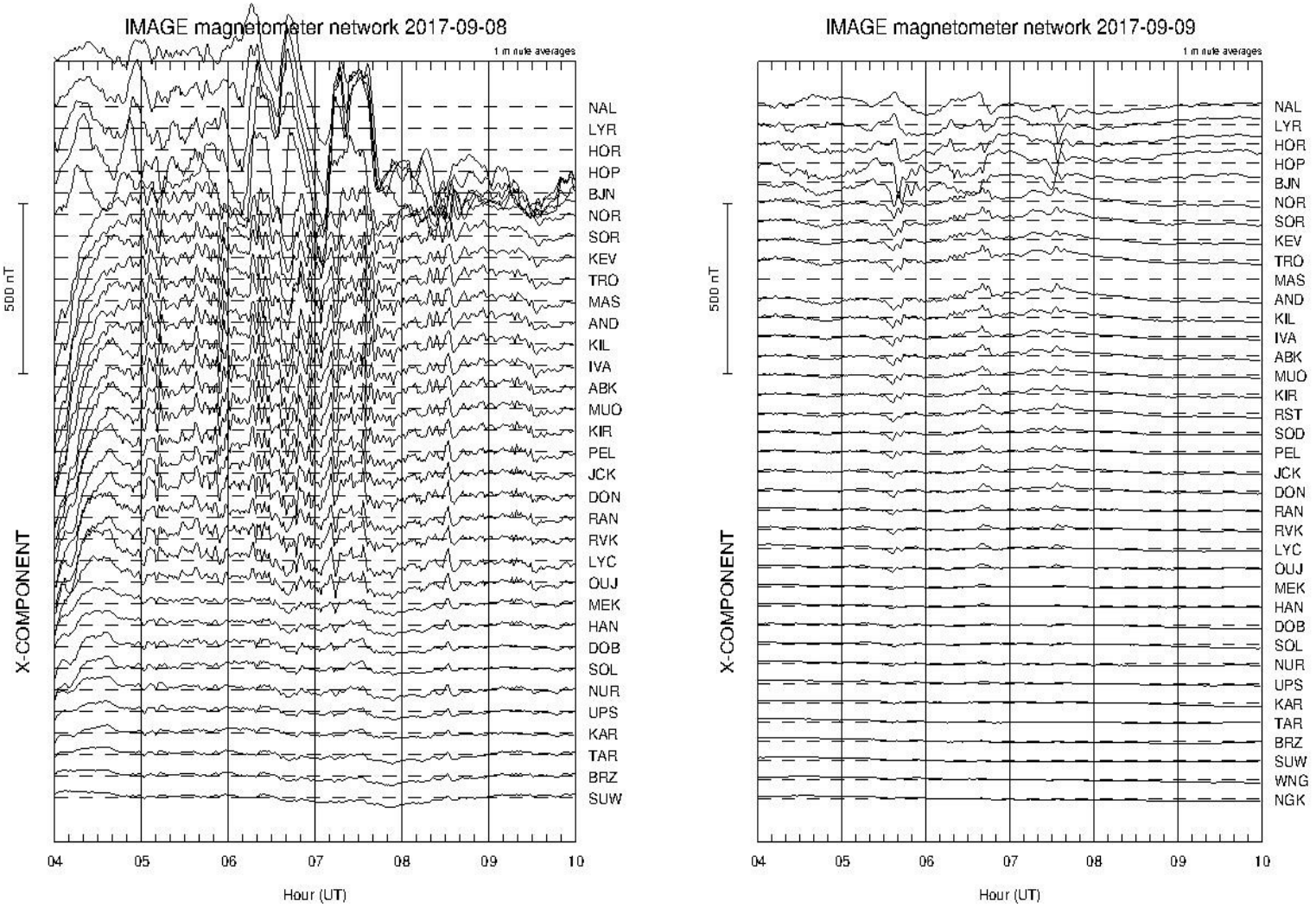
The 1D Ionospheric Equivalent Currents (assumed at 100 km altitude)

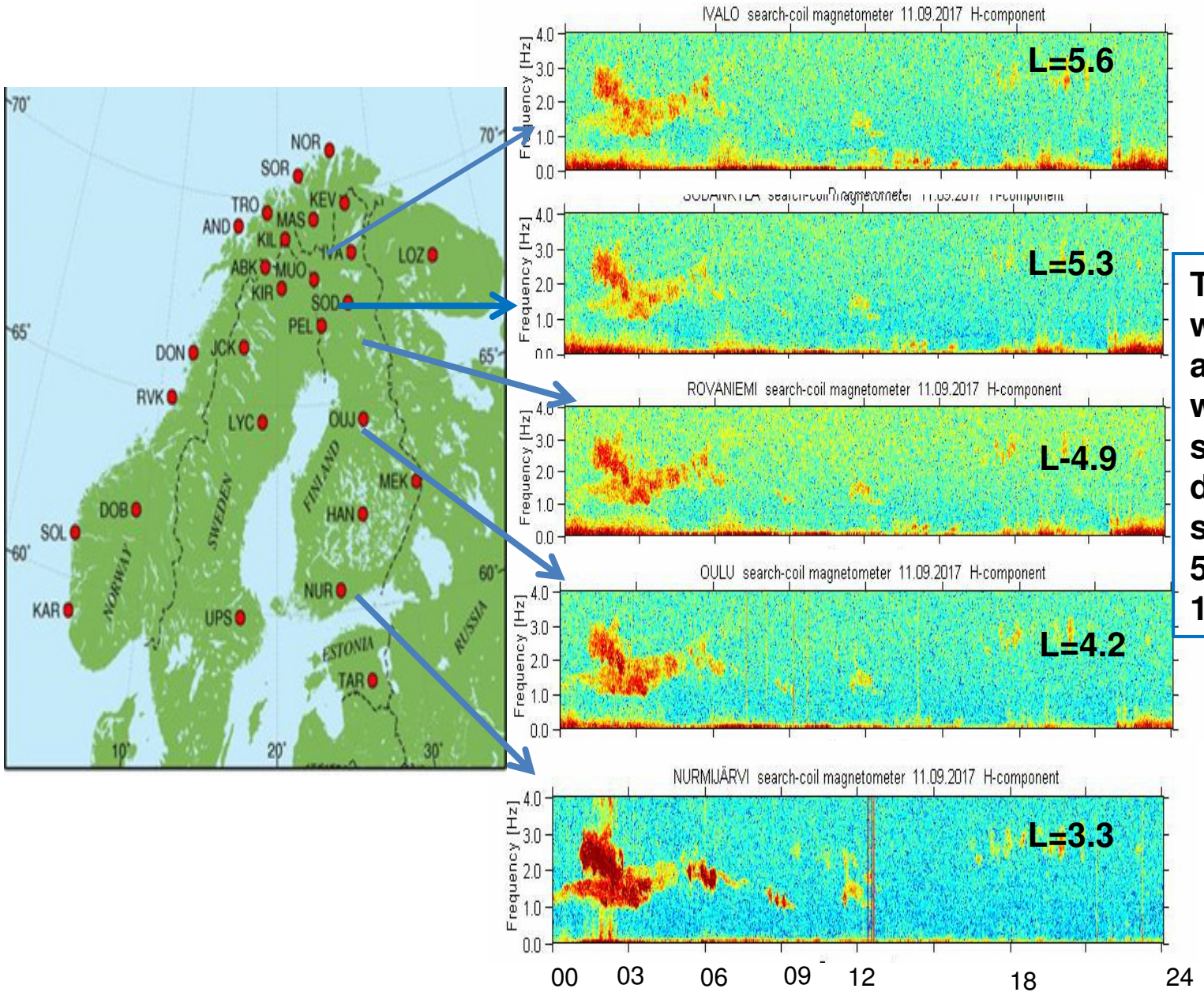






The recovery phase of the first storm demonstrates the daytime Pc5 geomagnetic pulsation generation. There were no Pc5 pulsations in the recovery phase of the second storm.





The Pc1 event was recorded at Scandinavia with the very similar dynamic spectrum at all 5 stations on 11 Sept 2017

Fig. 4. Pc1 spectrograms at Scandinavian stations

SUMMARY

- **The abrupt increase of the solar activity in September 2017 produced severe geomagnetic storming.**

- **The 7-8 September 2017 magnetic storm represents the two-step storm or two different successive storms. The sudden jump of the solar wind dynamic pressure (Psw) under negative values of the IMF Bz formed the Storm Sudden Commencement (SC) and resulted the rapid development of the first storm main phase.**

- **The second storm was caused by the change of the IMF direction (from positive to negative) which was accompanied by the Psw decrease.**

- **The IMF irregularity was observed in the first storm recovery phase as the 3 hours burst of the strong IMF By and Bz "dancing" values (up to 20 nT) which caused the very intense (up to 500 nT) magnetic variations at the polar latitudes both at day and night sides.**

- **Simultaneously with these polar variations, a long series of the Pc5 resonant geomagnetic pulsations have been generated in the inner magnetosphere. The sequence of Pc5 pulsation bursts were controlled by the IMF By and Bz variations.**
- **There were no Pc5 pulsations in the recovery phase of the second storm.**