XII International Conference “Solar-terrestrial relations and physics of earthquakes precursors”

Mid-latitude effects of “expanded” geomagnetic substorms: a case study

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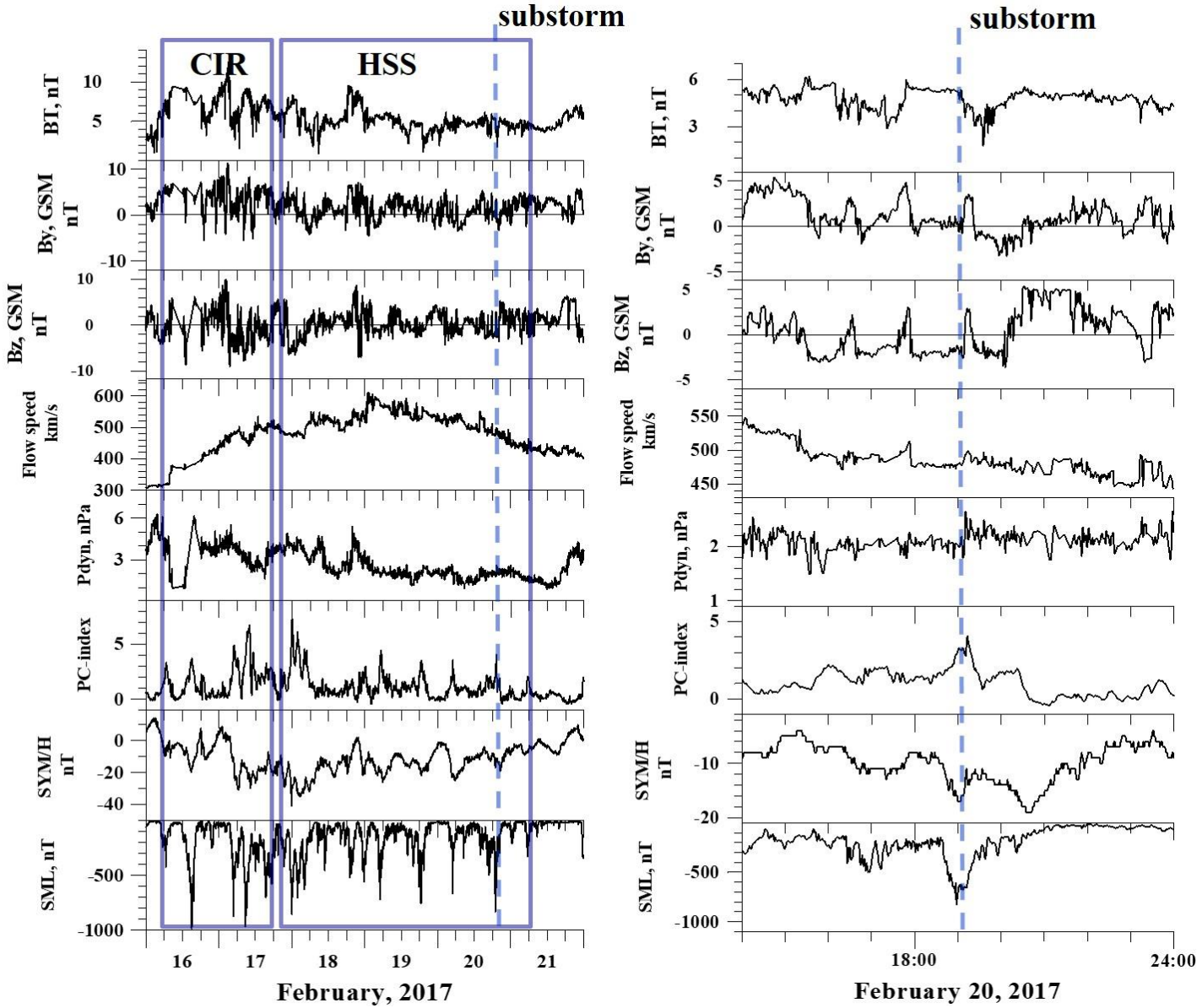
Goal: to examine the effects of the “expanded” or “high-latitude” substorms at midlatitudes.



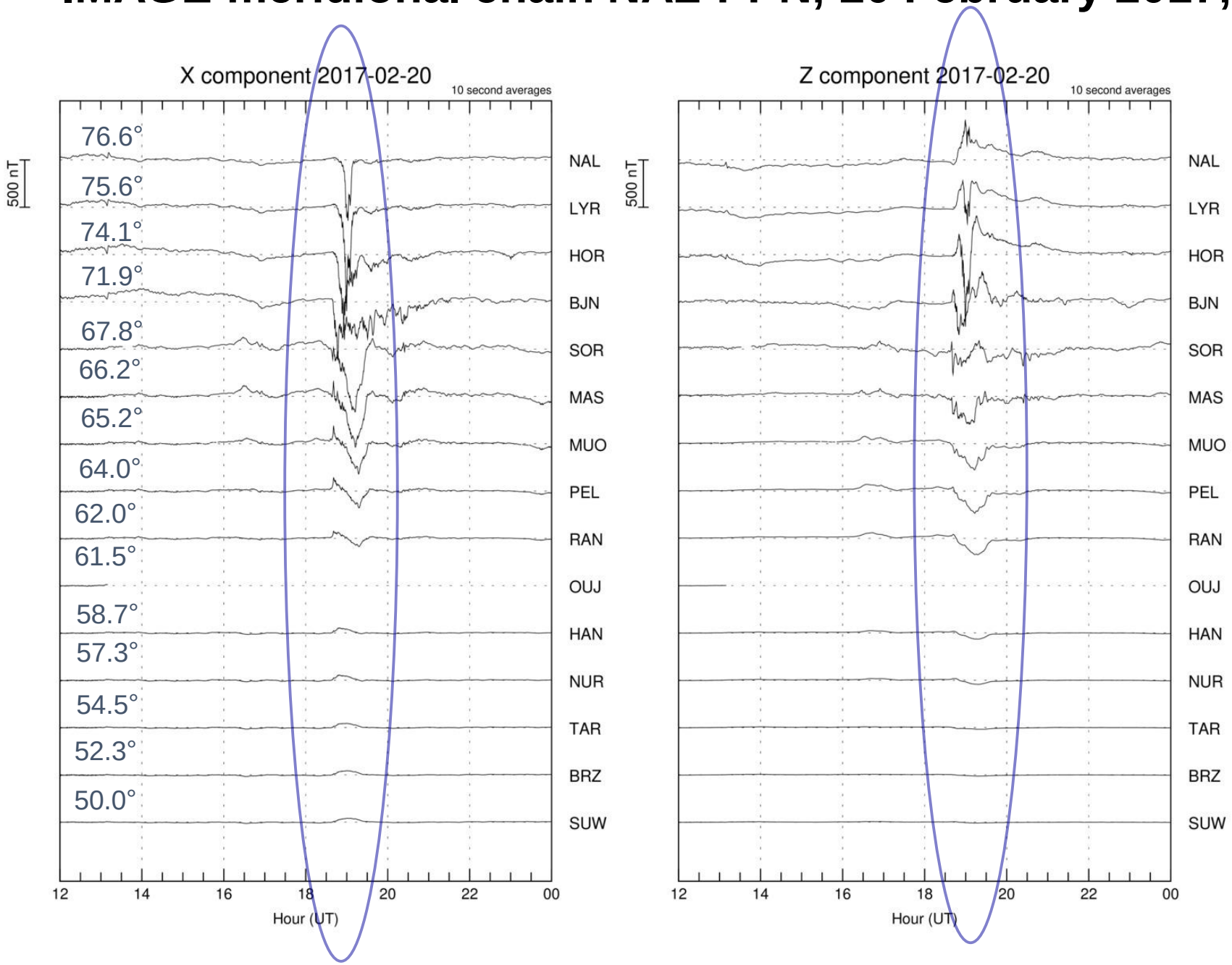
Example: the substorm at 18:40 UT on 20.02.2017.

Interplanetary and geomagnetic conditions

Left panel: CIR and HSS in the solat wind were observed, no geomagnetic storm developed. The time of the substorm onset is marked by the dashed vertical line.

The behavior of the solar wind parameters before the substorm onset is shown in more detail in the right panel.

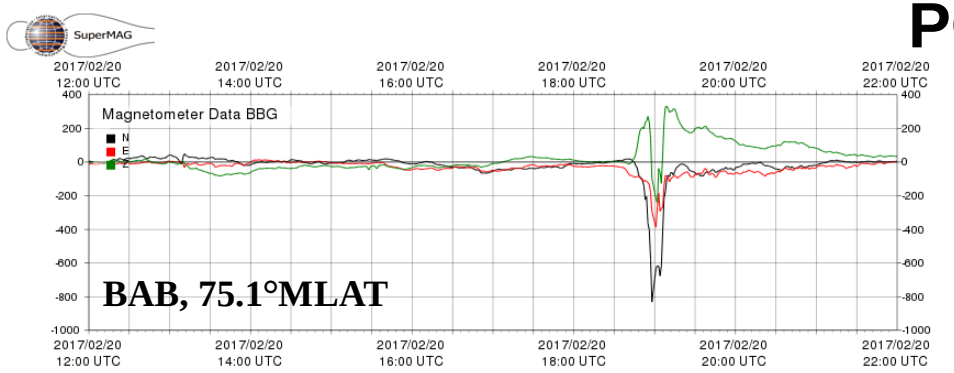
IMAGE meridional chain NAL-PPN, 20 February 2017, 12-24 UT

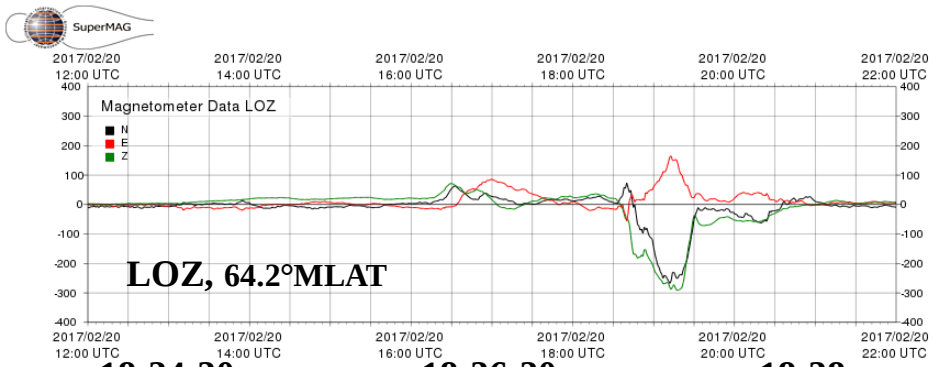


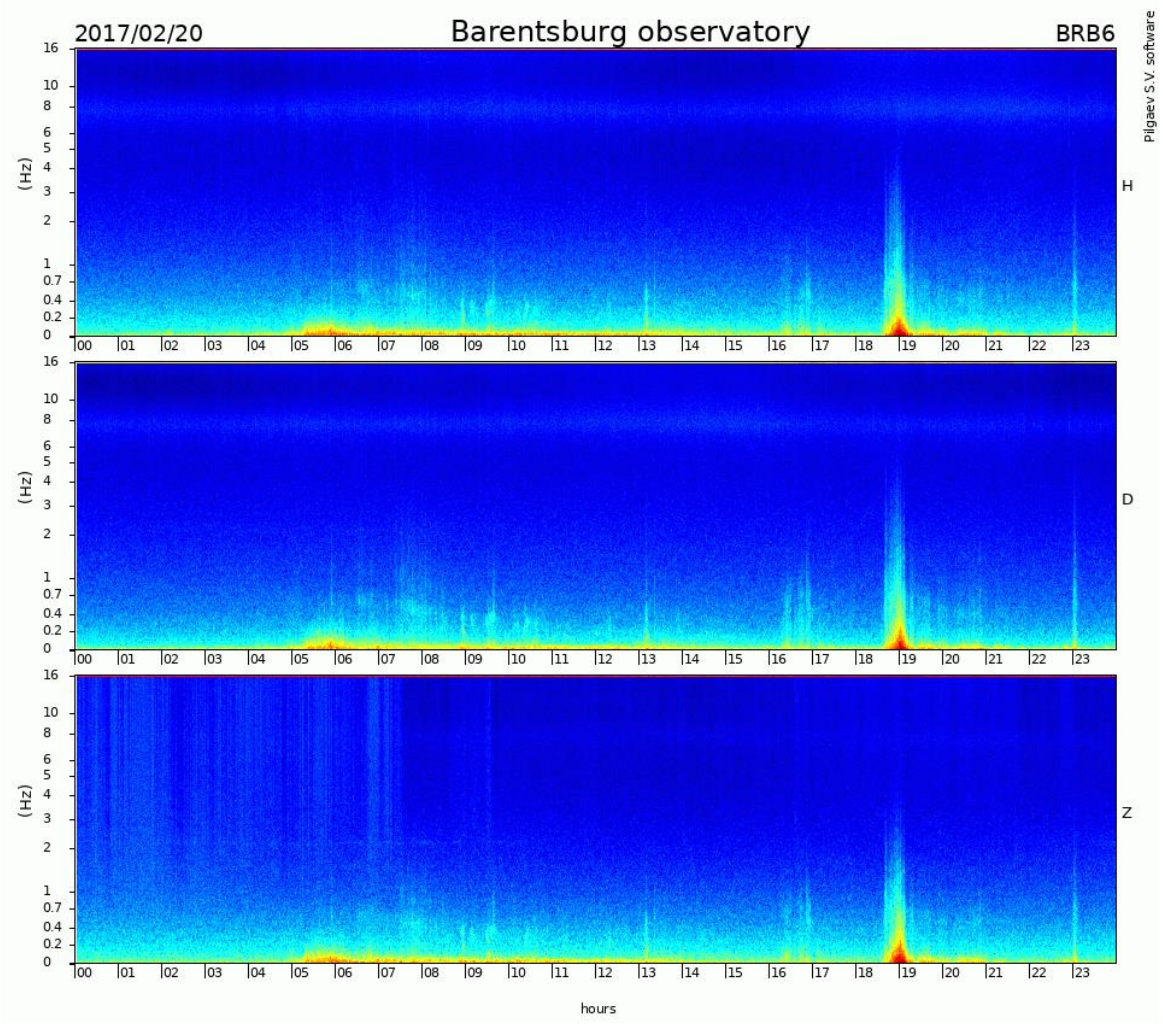
The substorm at 18:40 UT on 20.02.2017 is a typical example of isolated high latitude or “expanded” substorm: origin at auroral latitudes and propagation to very high latitudes – above ~70° GMlat.

The sign conversion latitude is between RAN and HAN stations, 62°-58.7° GMlat.

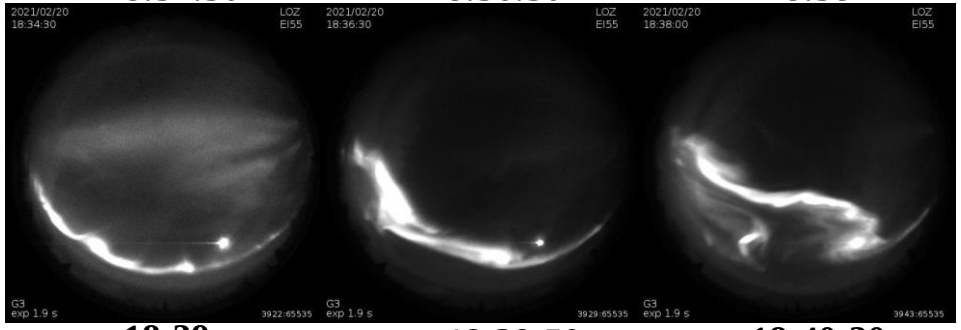
PGI data



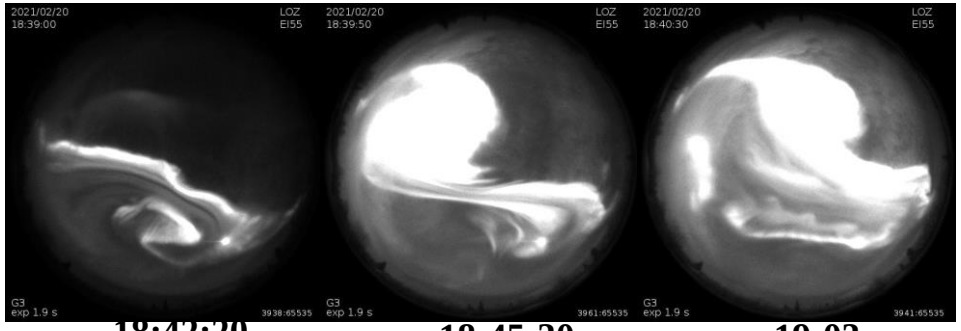




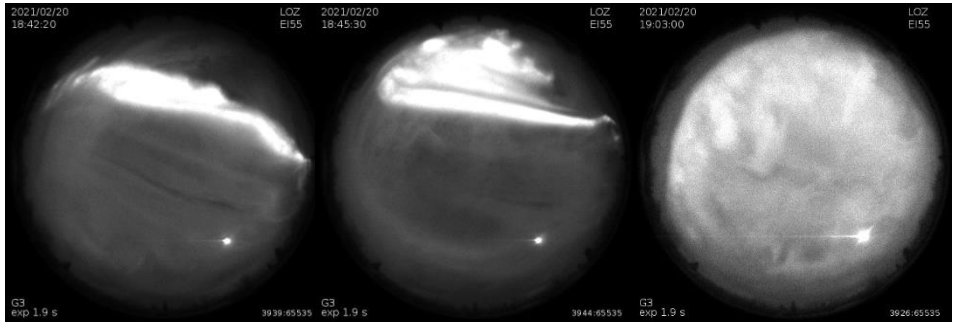
18:34:30 18:36:30 18:38



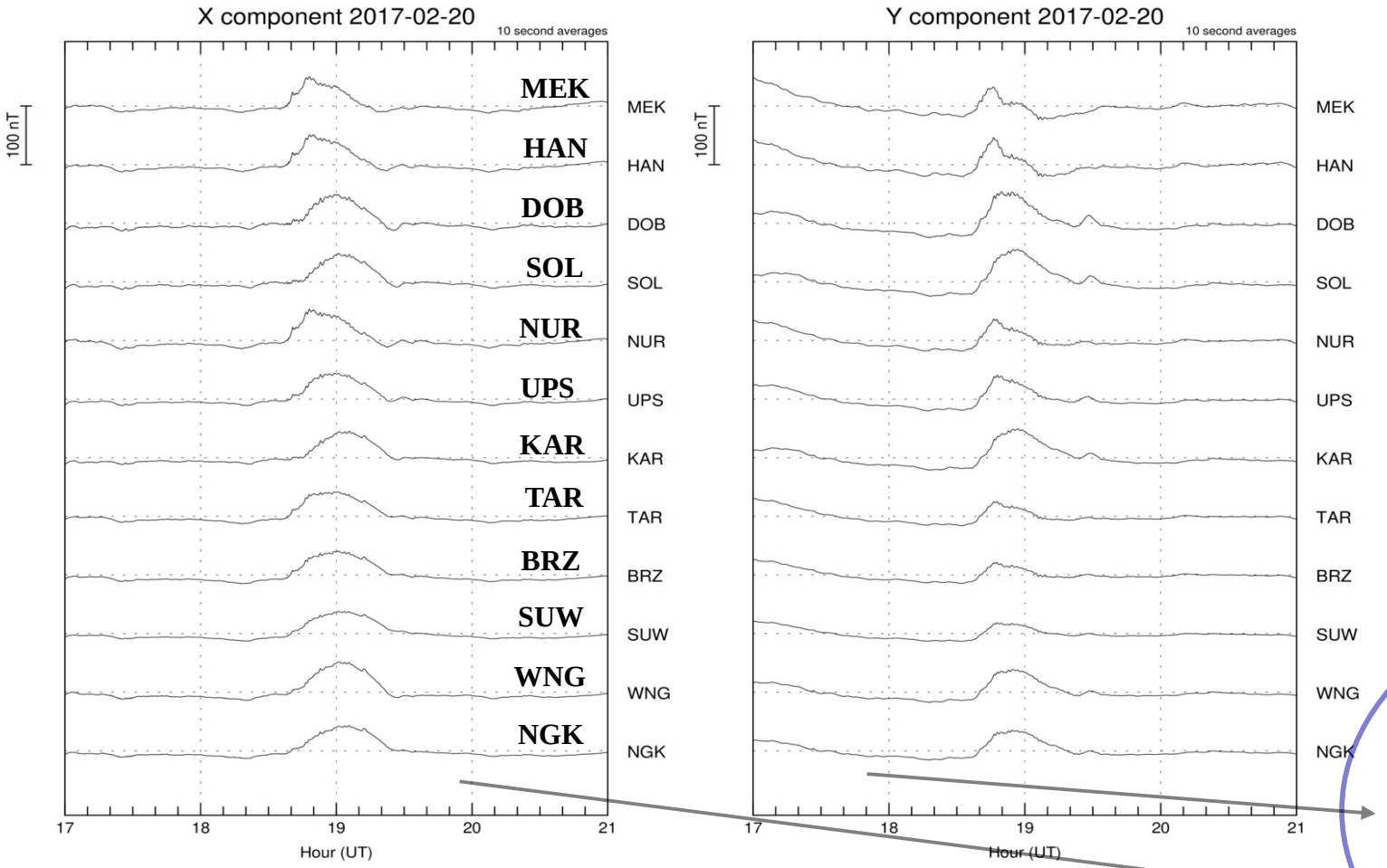
18:39 18:39:50 18:40:30

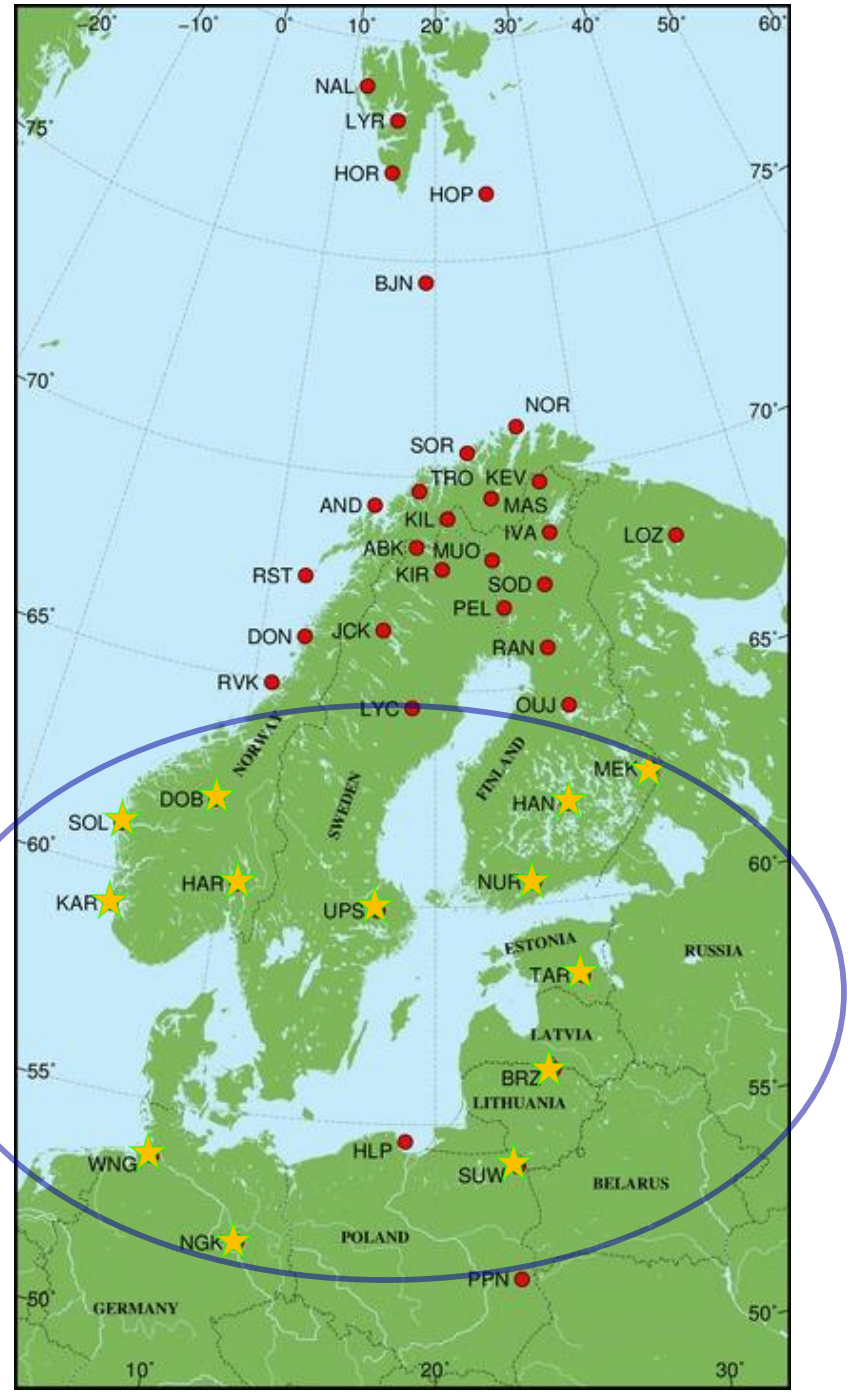


18:42:20 18:45:30 19:03



Positive bays by data of the IMAGE magnetometers network:



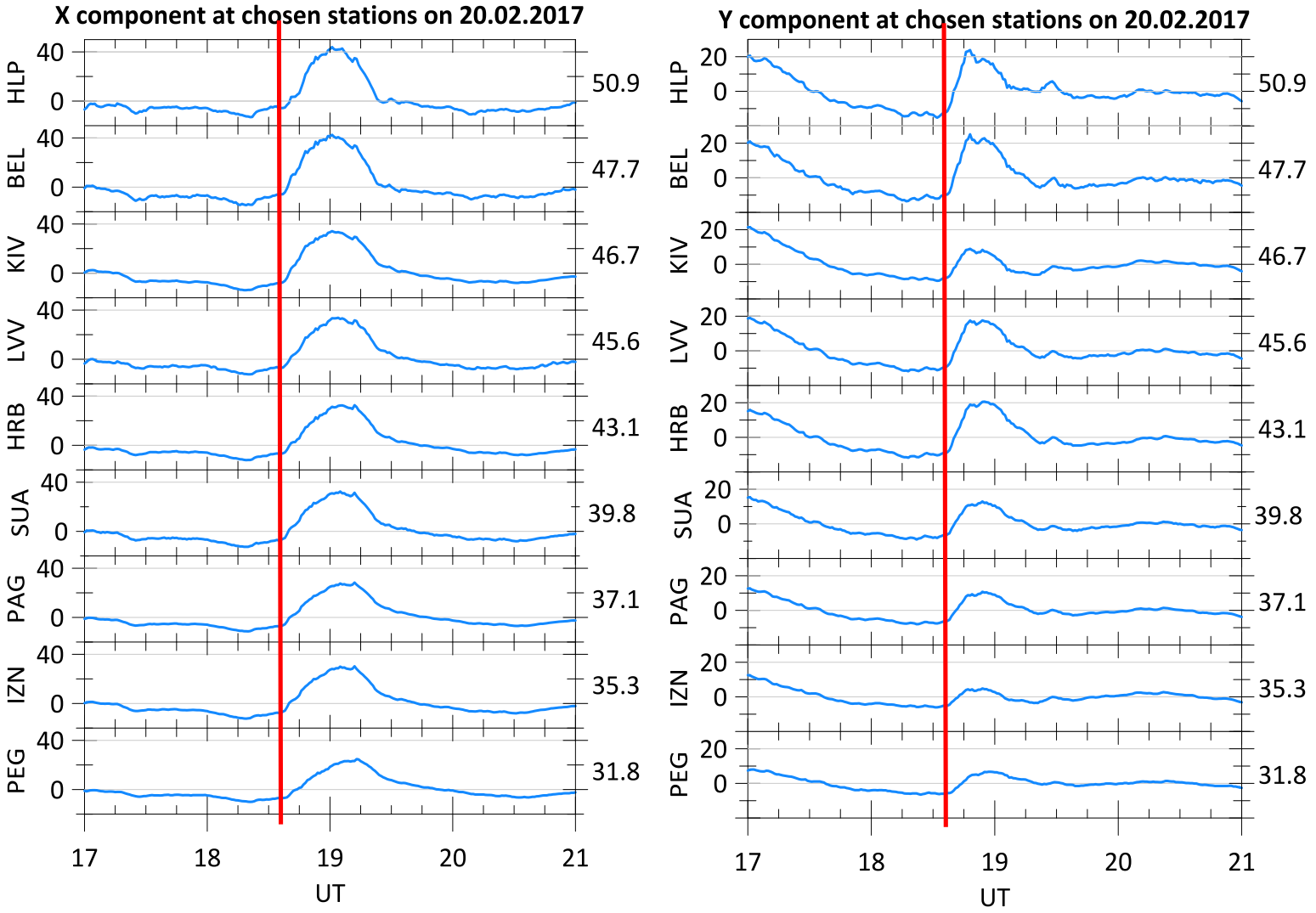


The positive bays are observed down from MEK (58.7°) and DOB (59.6°).

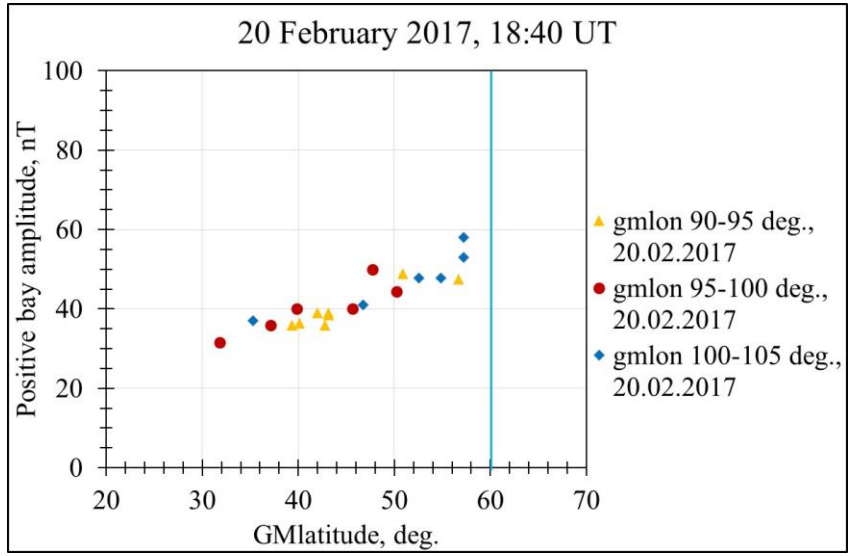
Sign conversion latitude: ~60° GMlat

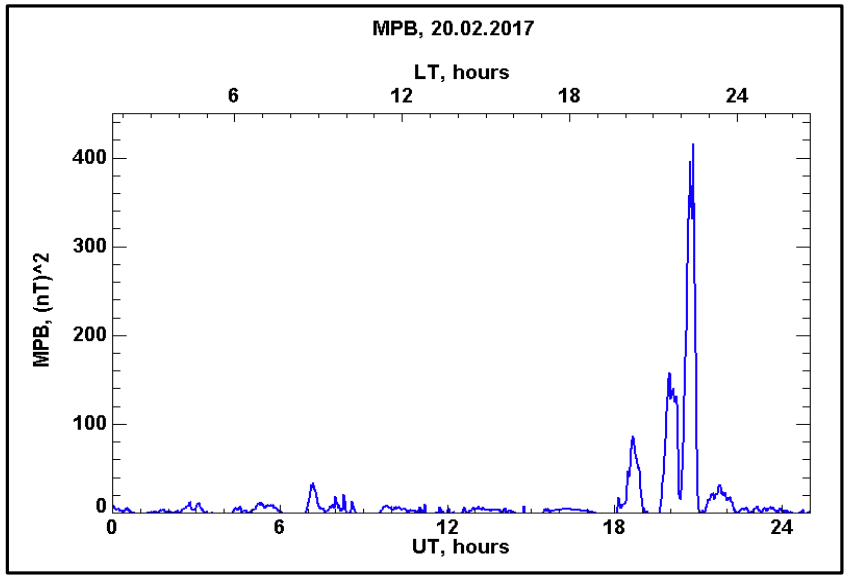
Positive Y component: therefore IMAGE network was located to the West from the “center” of electrojet

Positive bays in the 90°-105° GMlon interval by INTERMAGNET chosen stations

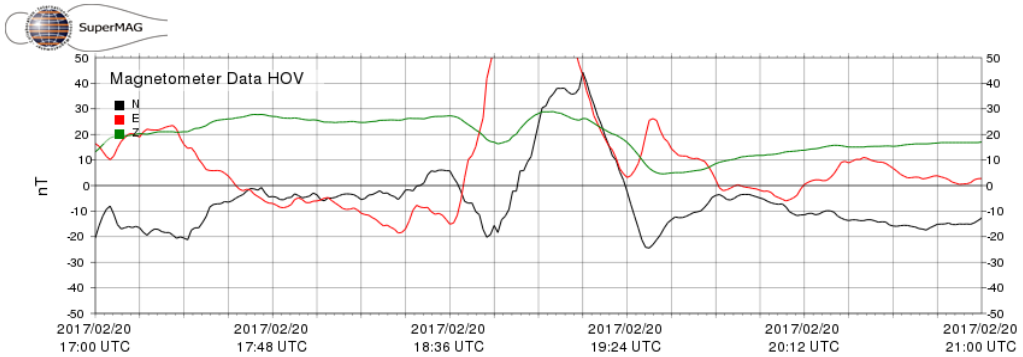


Dependance of the MPB amplitudes on the GM latitude (up), horizontal power of the magnetic field at Panagjurishte station (down)

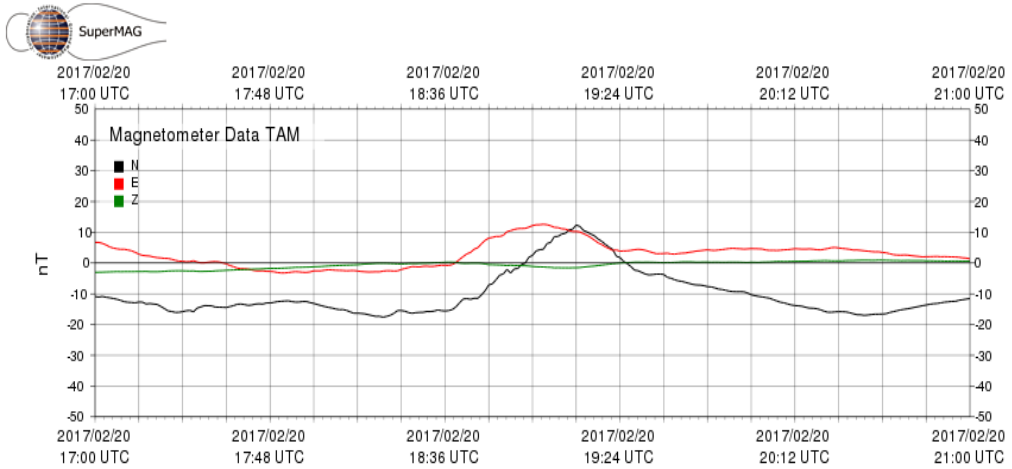




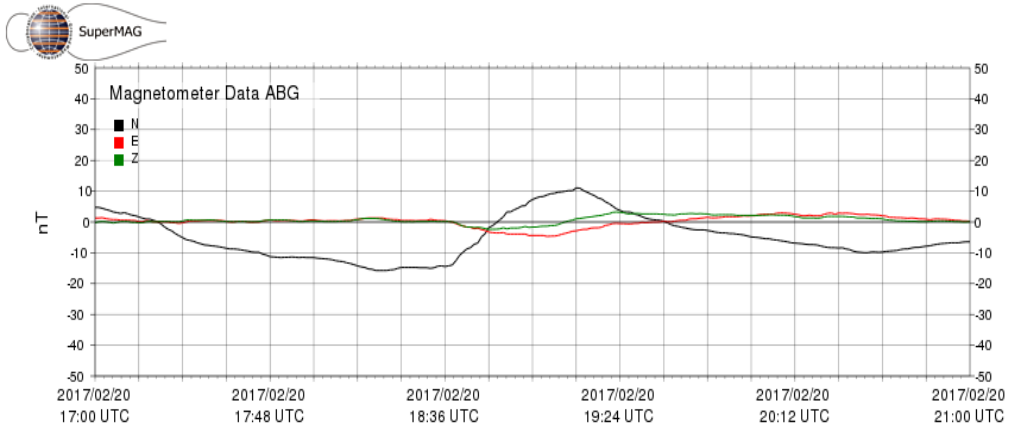
Latitudinal extent of the positive bays: from the sign conversion latitude, ~60° GMlat, to the equatorial stations, e.g. TAM and ABG



HOV (Faroe Island, Denmark)
GMlat=60.3°
GMlon=77.2°



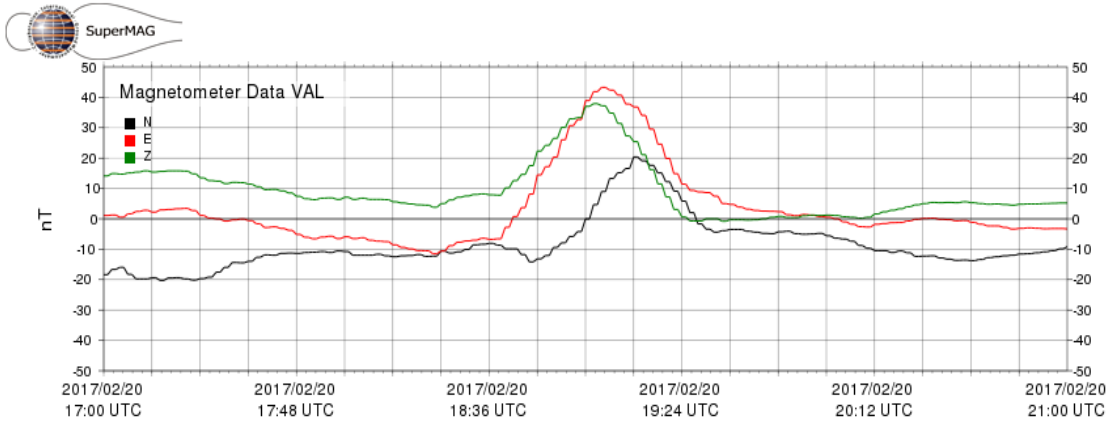
TAM (Tamanrasset, Alzir)
GMlat=8.9°
GMlon=78.9°



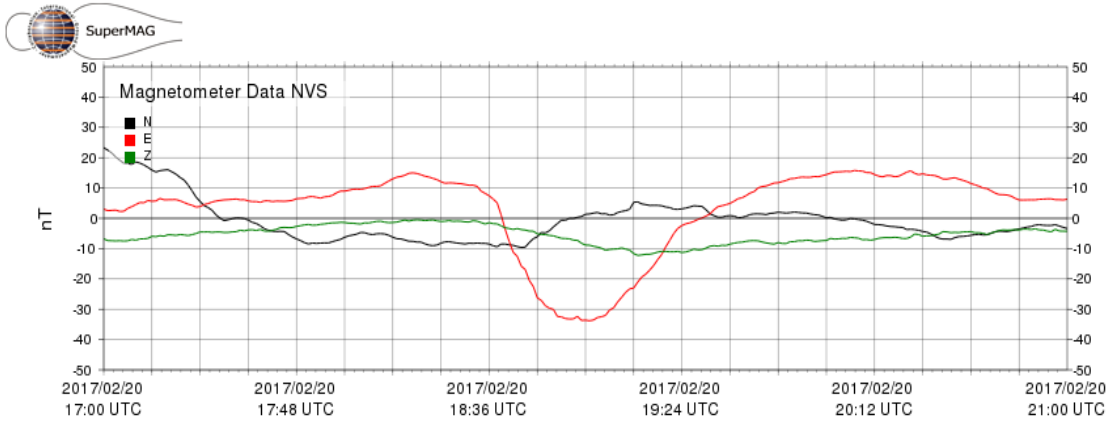
ABG (Alibag, India)
GMlat=12°
GMlon=149.2°

Lat. extent: ~51°

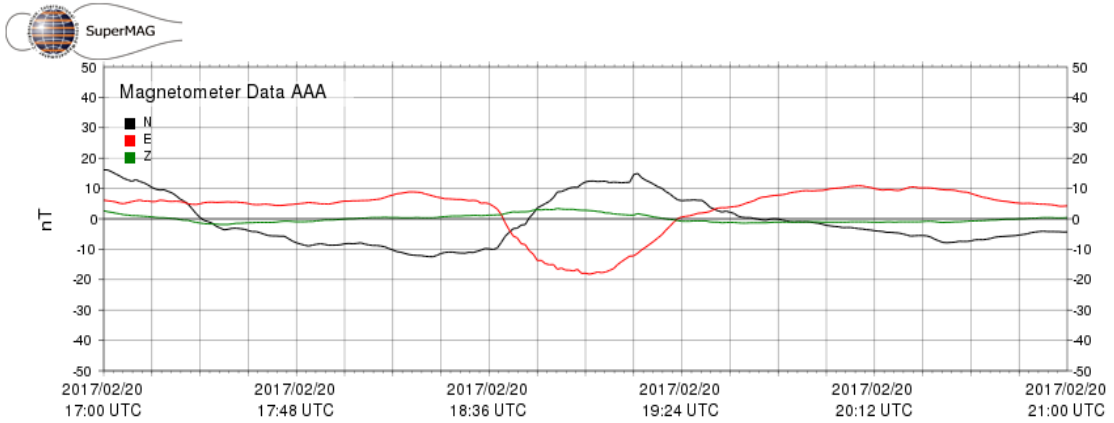
Longitudinal extent of the positive bays:



VAL (Valentia, Ireland)
GMlat=49.5°
GMlon=70.3°



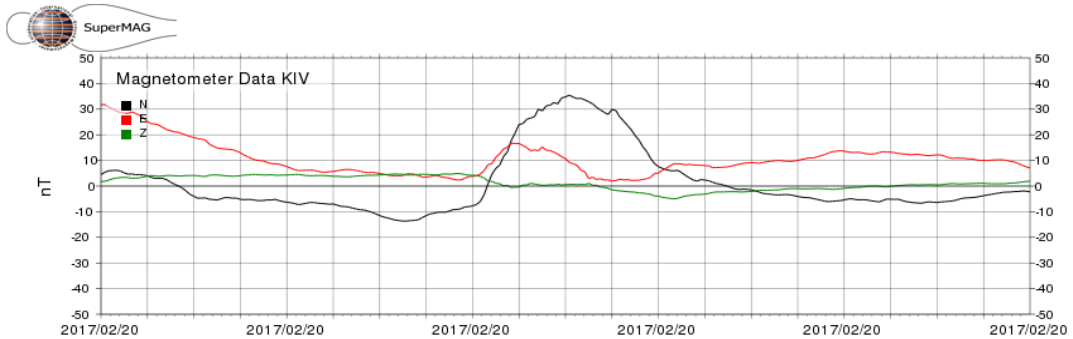
NVS (Novosibirsk, Russia)
GMlat=50.9°
GMlon=155.7°



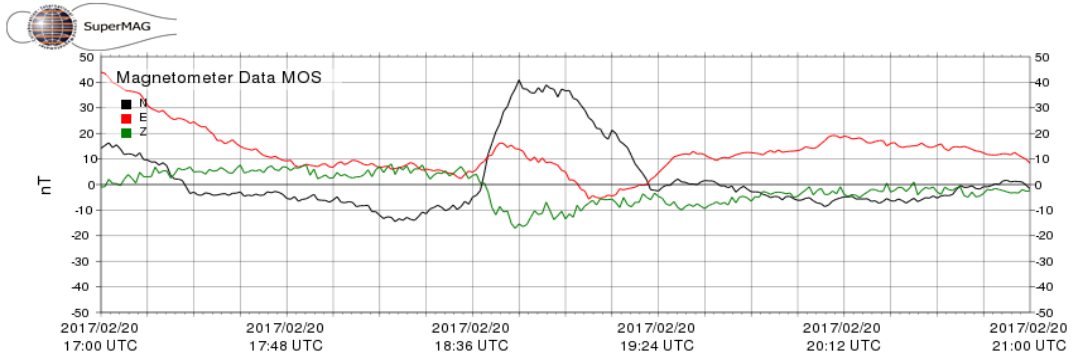
AAA (Alma Ata, Kazakhstan)
GMlat=38.8°
GMlon=150.2°

Positive bays were registered from ~70° GMlon (VAL) to ~155° GMlon (NVS)

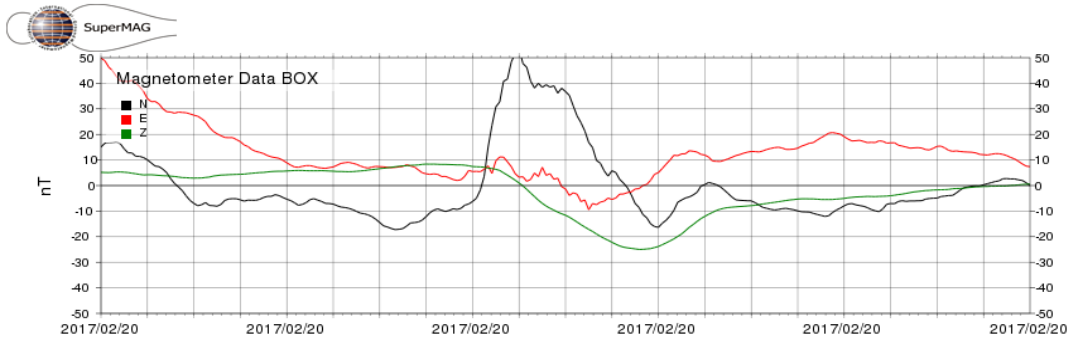
Longitudinal extent: ~85°



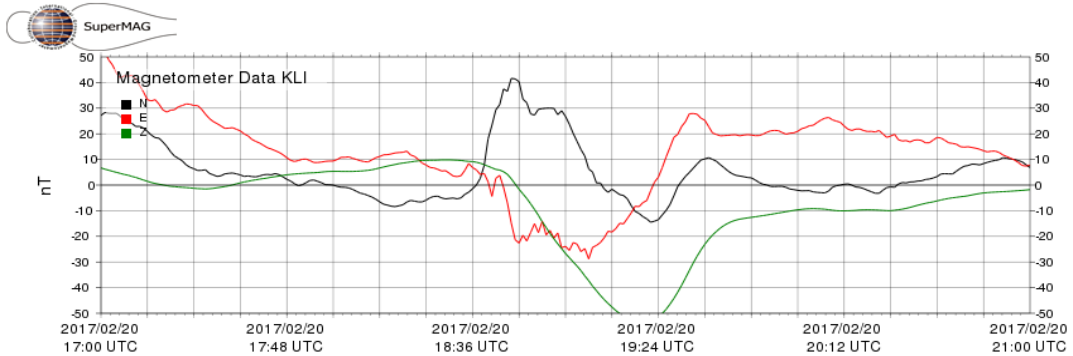
KIV (Kiev, Ukraine)
GMlat=46.7°
GMlon=104.0°



MOS (Moscow, Russia)
GMlat=51.9°
GMlon=112.1°



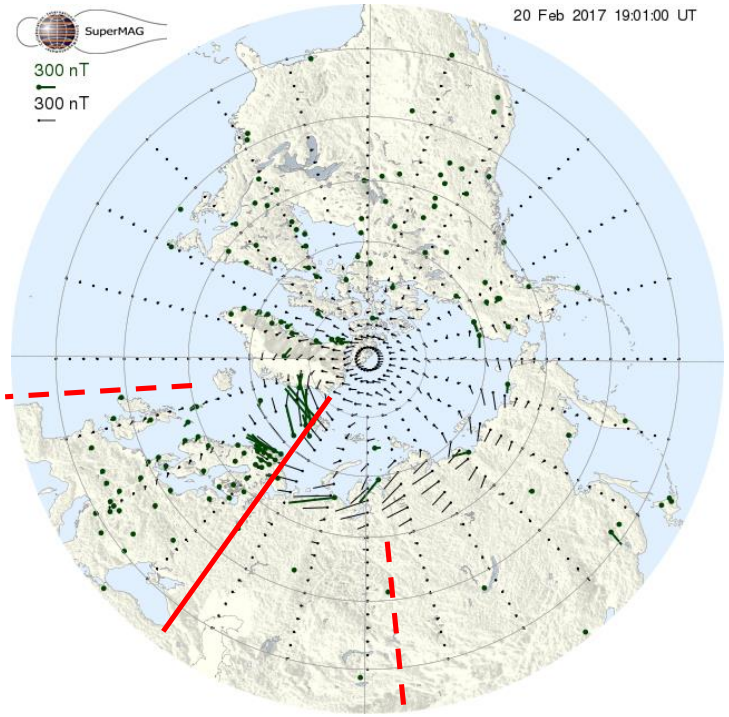
BOX (Borok, Russia)
GMlat=54.6°
GMlon=114.2°



KLI (Klimovskaya, Russia)
GMlat=58.5°
GMlon=115.5°

Central meridian of the substorm

The central meridian of the substorm was located at about 112°-114° GMlon



Conclusions

- Expanded substorms are accompanied by midlatitude positive bays, the maximum amplitude of which is observed in the midnight sector. The considered substorm at 18:40 UT on 20.02.2017 is a typical example of isolated high latitude or “expanded” substorm;
- For the considered substorm, the sign conversion latitude (~60°GMlat), the central meridian (~112°-114°GMlon), the latitudinal extent (~51°) and the longitudinal extent (~85°) of the positive bays were determined;
- The observed conversion latitude for the examined substorm is typical for “expanded” substorms (~60° GMlat) degrees, it is higher than for the storm-time substorms or usual substorms and lower than for polar substorms. Taking into account, that the different kind of substorms originate under different solar wind conditions, it is to be noted, that the more disturbed are the interplanetary conditions, the lower is the conversion latitude of the sign of the magnetic X bays.
- The amplitude of the positive bays as a whole, decreases with the latitude. A slight maximum at about 50° GM latitude is obtained;
- For “expanded” substorms the amplitude of the bays is higher than for usual or polar substorms;
- A difference of about 50% between the minimal and maximal positive amplitude at different latitudes in the interval 30°-60° GMlat and 95°-105° GMlon was obtained.

Thank You for your attention!

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