Automated processing of geomagnetic data from the INTERMAGNET international network and the first observational results of the solar eclipse on February 17, 2026.

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The rapid supersonic transit of the Moon's shadow creates a localized area in ionospheric conductivity. This forcing distorts global electric current systems, which are compelled to reroute around the low-conductivity shadow. These electrical reconfigurations manifest at the surface as distinct bursts of fast geomagnetic variations, with periods from several minutes to several seconds. As well as a series of AGW packets from the region of the lunar shadow and penumbra, travelling ionospheric irregularities that can propagate over a large distance both within the penumbra and beyond it.

A solar eclipse is a natural laboratory for investigating the Earth's ionosphere and magnetosphere. The sudden reduction in solar radiation creates rapid shifts in ionospheric conductivity, triggering anomalous scintillations of cosmic radio sources and modulating global electric current systems. These perturbations manifest as distinct bursts and phase variations in geomagnetic pulsations, particularly across the Pc4 - Pc6 bands, providing direct insight into the dynamic processes of the near-Earth space environment.

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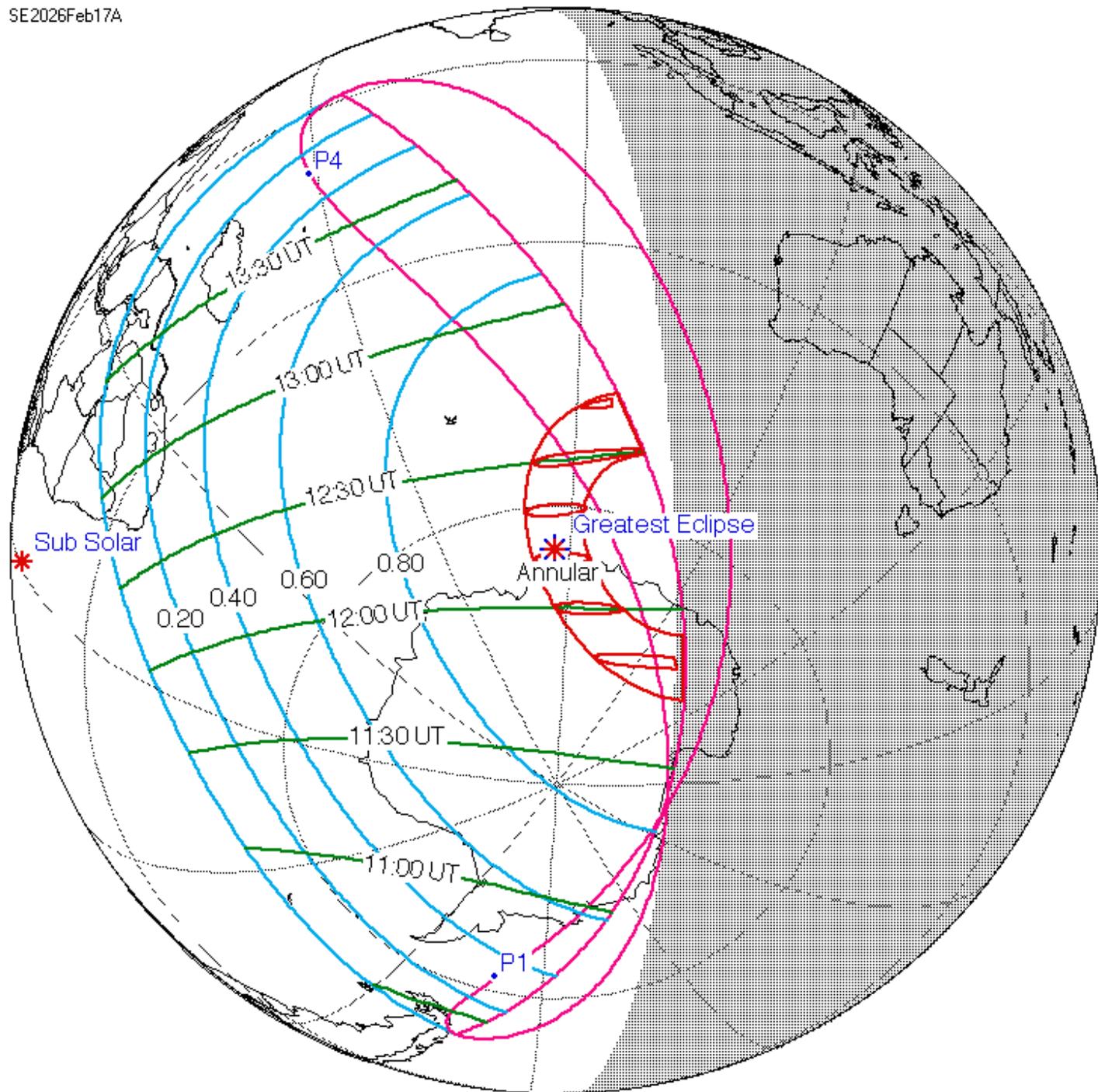
The eclipse of February 17, 2026, was annular, making it one of the most significant astronomical events of the year for South Hemisphere.

The Moon covered approximately 92% of the solar disk at its peak.

The central band of the annular phase passed through Antarctica and the southern Indian Ocean.

The eclipse was also observed as a partial eclipse in South Africa, southern South America, and parts of Australia.

This eclipse greatest point was in Antarctica, which provides an amazing opportunity to detect the geomagnetic response to "shake-up" of the "magnetosphere-ionosphere" system, practically without interference and distortion.

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Location of the Antarctic research stations (magnetometers):

Akademik Vernadsky (Ukraine): Located on Galindez Island in the Argentine Islands archipelago, near the Antarctic Peninsula. Its geographic coordinates are 65°14'44" S and 64°15'28" W.

Scott Base (New Zealand): Located on Ross Island in the Weddell Sea (near the American McMurdo Antarctic base). Its coordinates are 77°50'57" S and 166°46'06" E.
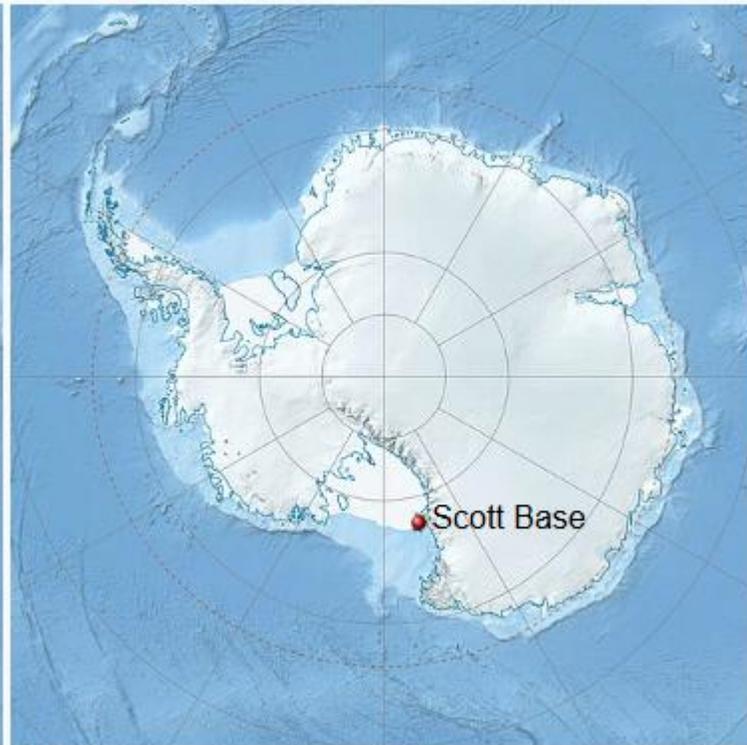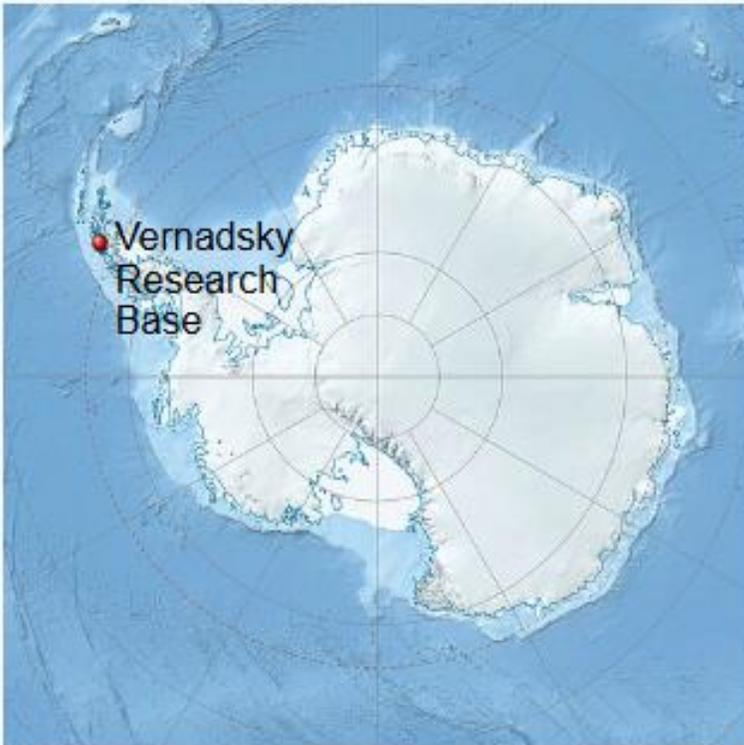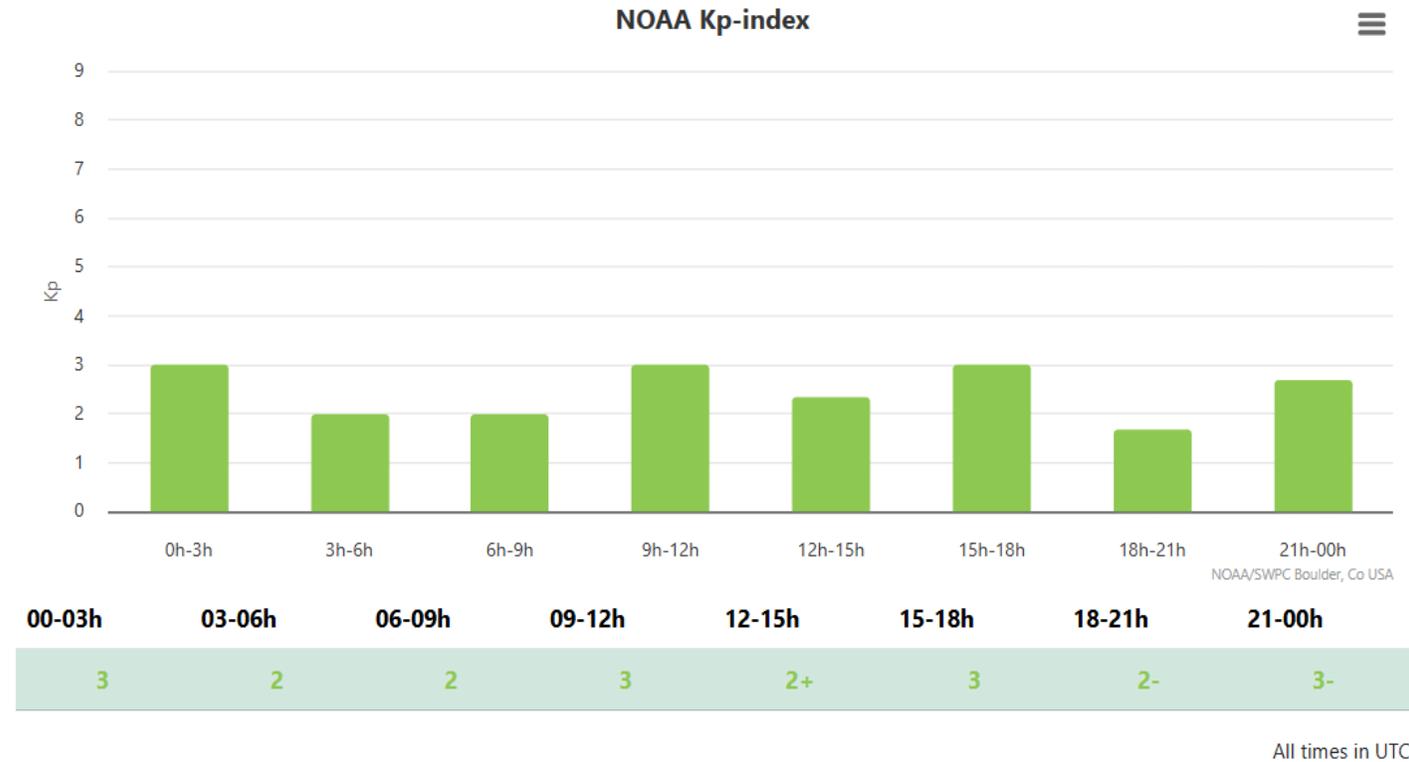

Geomagnetic data from the Akademik Vernadsky station were with a 1-second and 1-minute time resolution, data from the Scott Base station were with a 1-second time resolution, obtained from February 16 to 18, 2026.
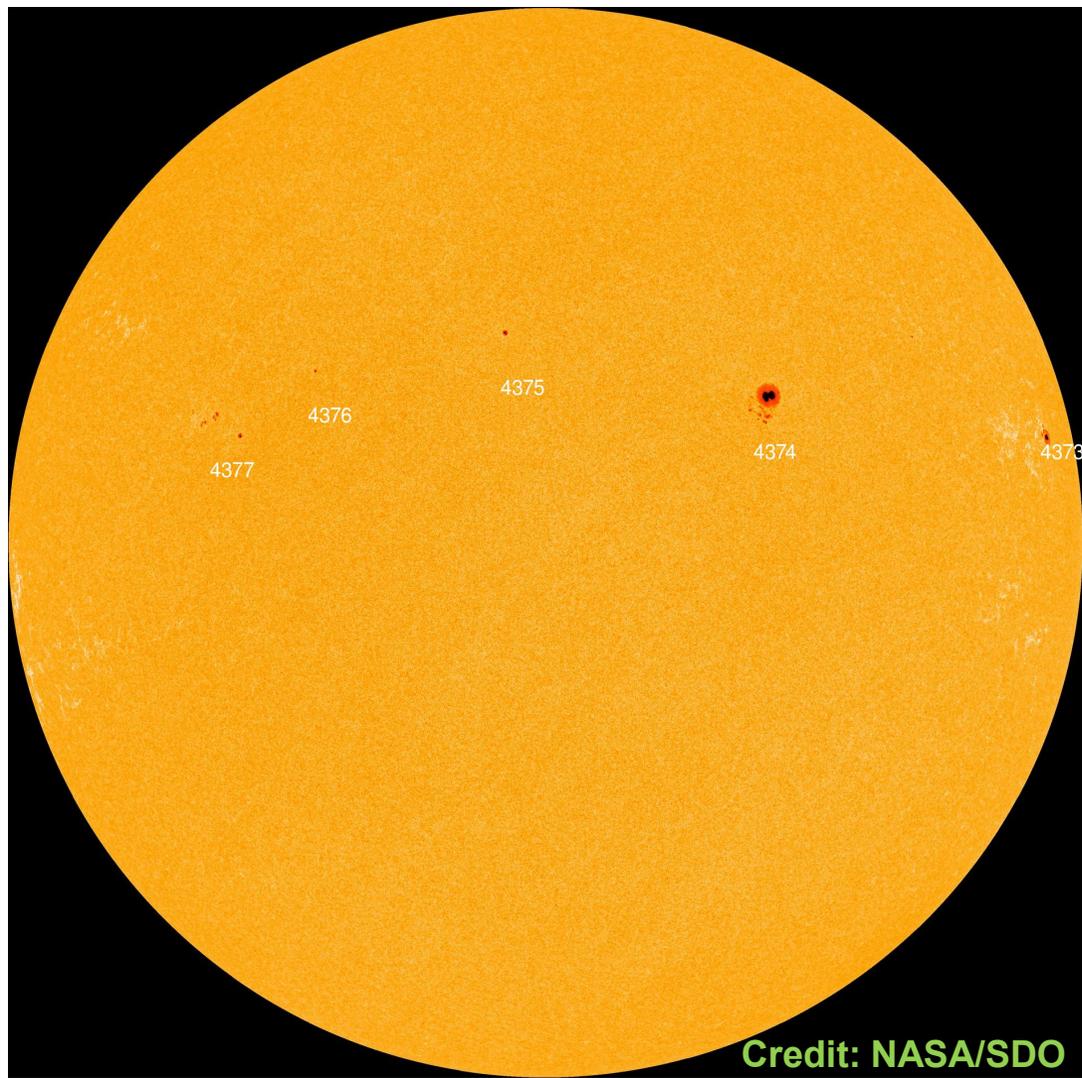
Credit: NASA/SDO

On the day of the solar eclipse, five active regions were located on the solar disk, but their geoeffective influence was weak. However, on February 20, 2026, geomagnetic disturbances began.

NOAA estimated Kp-index

NOAA Kp-index

00-03h	03-06h	06-09h	09-12h	12-15h	15-18h	18-21h	21-00h
3	2	2	3	2+	3	2-	3-

NOAA/SWPC Boulder, Co USA

All times in UTC

On February 17, 2026, the geomagnetic conditions were relatively calm, which is very important for recording fast geomagnetic variations that would otherwise be suppressed by a magnetic storm. There were also no major solar flares.

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The geomagnetic data were in the IAGA-2002 standard (text file with header). A linear script in Matlab was written to read and automatically process them, allowing for basic data processing and obtaining information on fast geomagnetic variations on the day of the solar eclipse.

|	
First Penumbral External Contact	2026 February 17 at 09:57:35.9 UTC
First Umbral External Contact	2026 February 17 at 11:44:00.0 UTC
Greatest Eclipse	2026 February 17 at 12:13:05.8 UTC
Last Umbral External Contact	2026 February 17 at 12:42:41.3 UTC
Last Penumbral External Contact	2026 February 17 at 14:28:51.0 UTC

Solar Eclipse Timing

Large geomagnetic data sets, which will be used in the IONIX project, are no longer suitable for manual analysis, even using specialized spectrum analyzer software. Therefore, automated data processing is an important element that will make grant implementation more effective and productive.

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Station: Vernadsky, Agentine Islands | IAGA: AIA | Date: 2026-02-16 - 2026-02-18
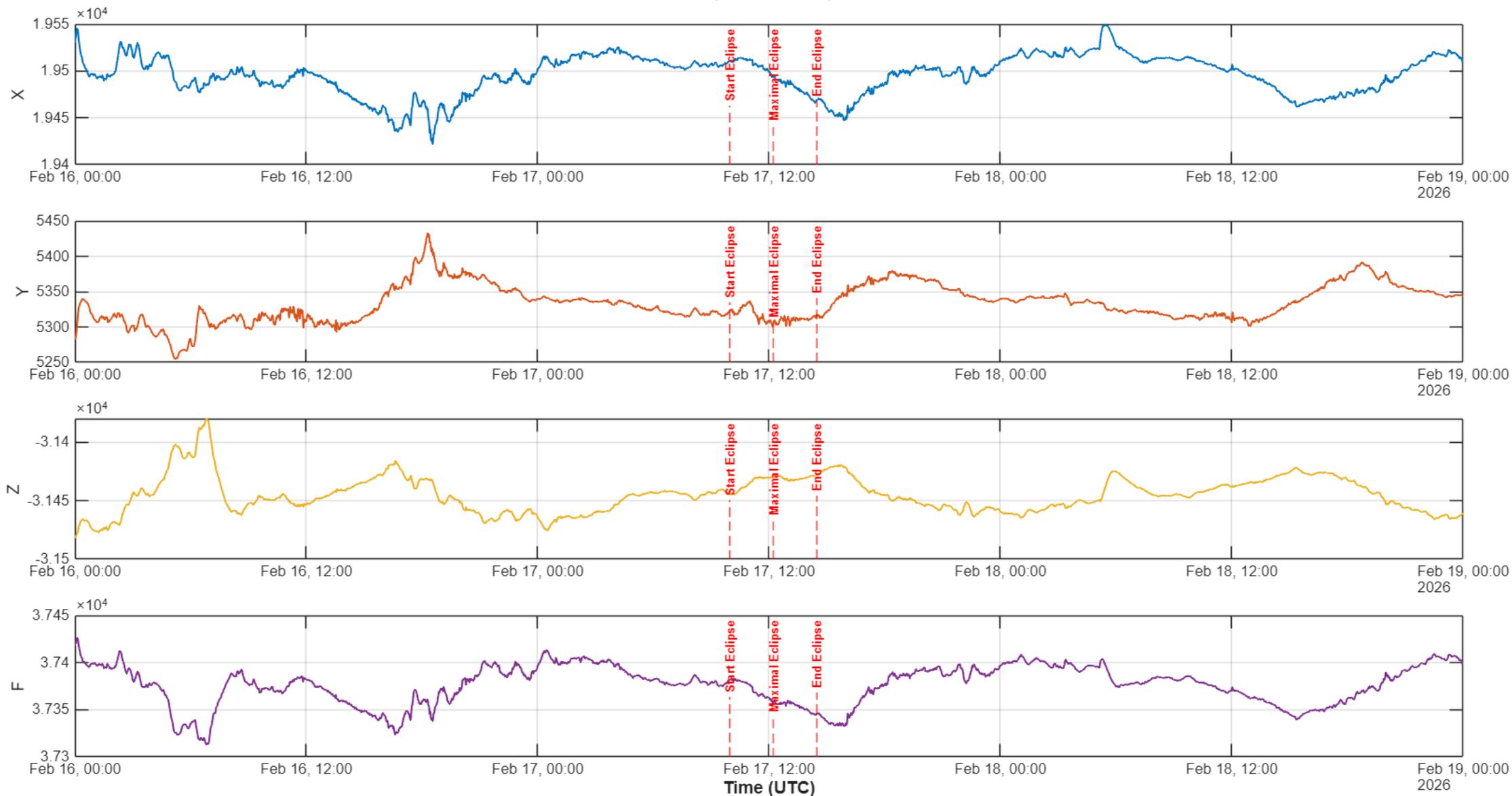
Data for three days, February 16-18, 2026, clearly shows the trending daily variation of the magnetic field.

Station: Scott Base | IAGA: SBA | Date: 2026-02-16 - 2026-02-18
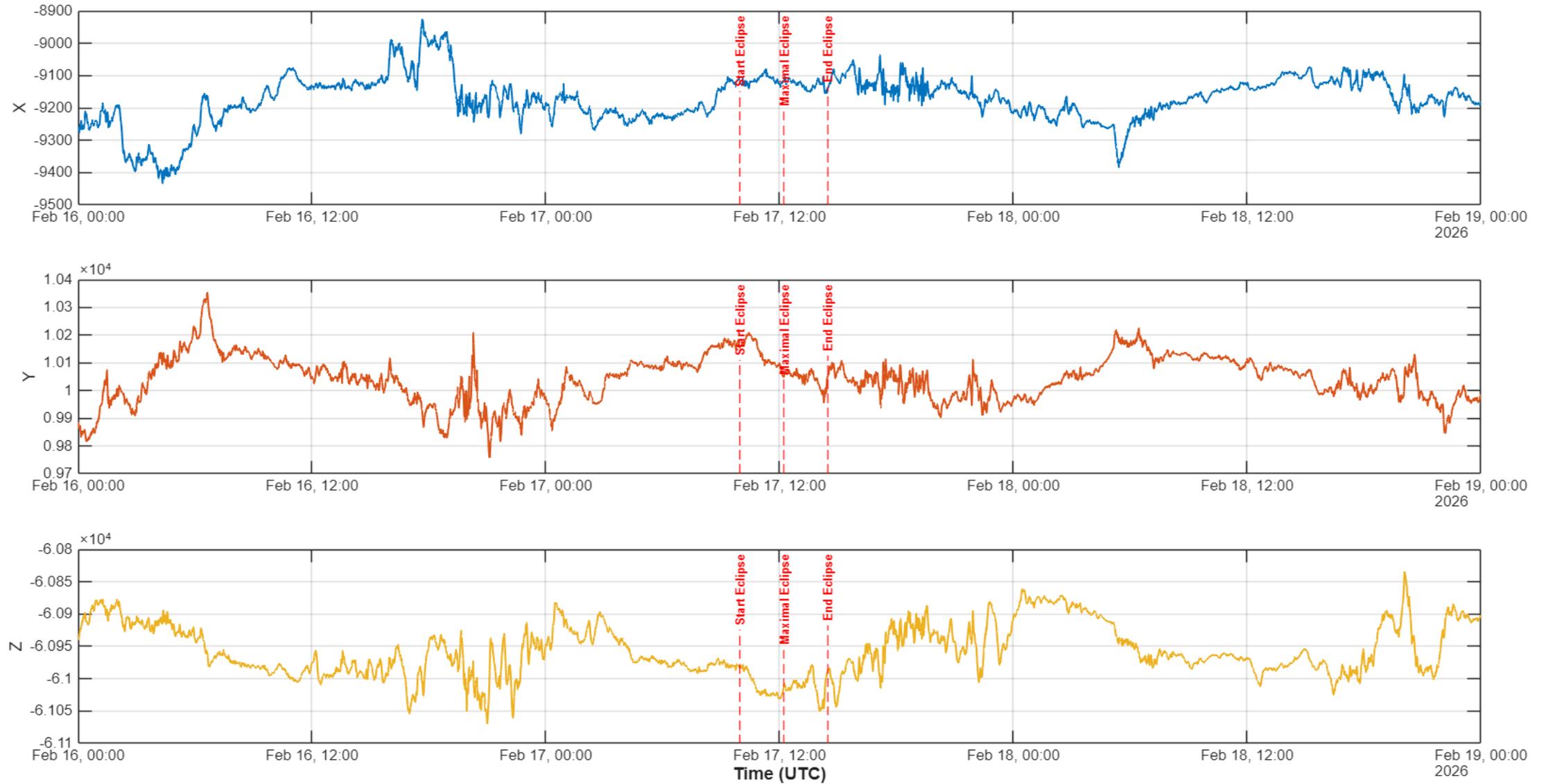
Scott Base was much closer to the lunar shadow (the Moon's coverage of the Sun is about 86%) and it is interesting to compare the geomagnetic response with the Academik Vernadsky station.

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Station: Akademic Vernadsky | IAGA: AIA | Date: 2026-02-17
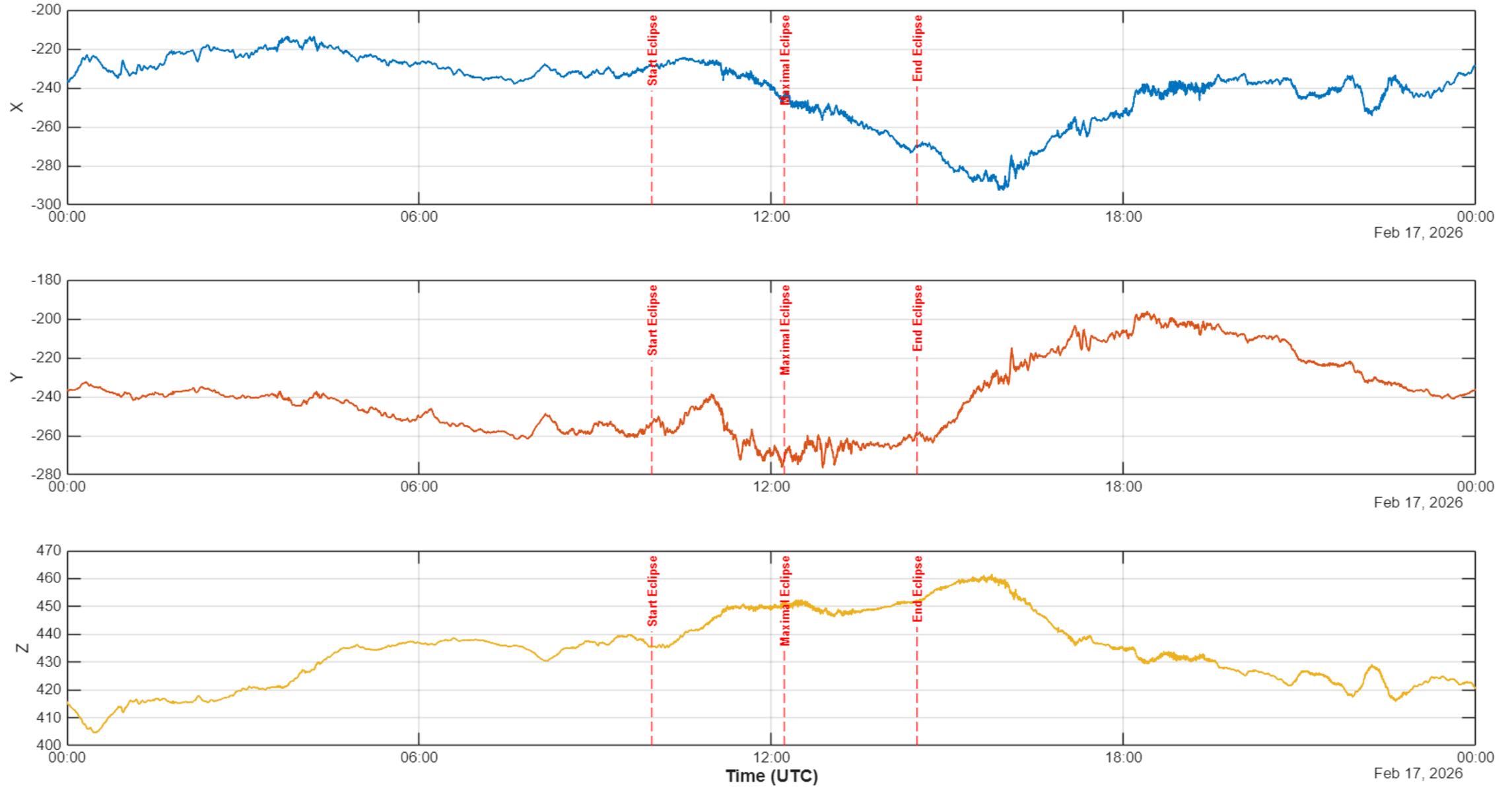
On the day of the solar eclipse, at the Akademik Vernadsky station, weak ripples of rapid geomagnetic variations are visible in the time of the eclipse.

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For further analysis, it is necessary to remove the strong diurnal trend from the data. For this purpose, it is convenient to use clearly defined bands of geomagnetic pulsation periods (Pc3, Pc4, Pc5, Pc6) for each geomagnetic field component, rather than abstract data filtering bands.

To filter geomagnetic data, a 3rd order Butterworth bandpass filter is used with the zero-phase delay method, which provides a good balance between the steepness of the cutoff and the stability of the filter (no artificial distortions or edge effects).

Figure example for Scott Base – Y geomagnetic component, 17.02.2026
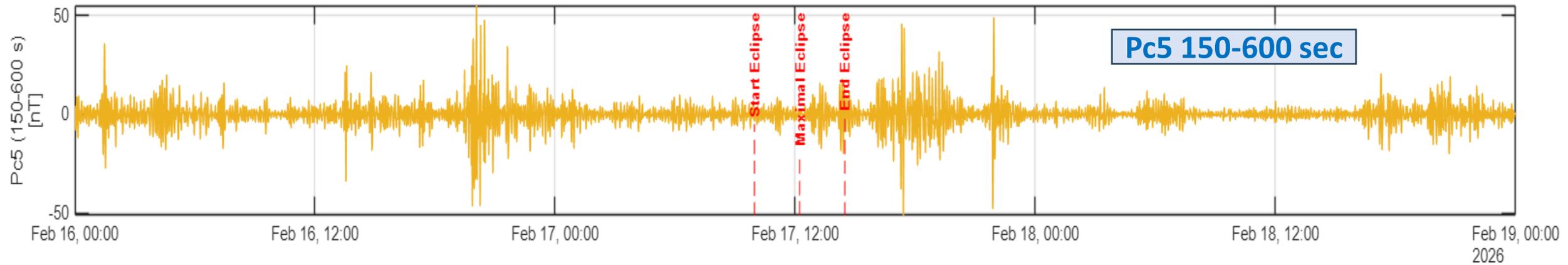
Decomposition into Pc3–Pc6 bands was performed for all analyzed time series with a 1-second time resolution. This allowed for a detailed understanding of the evolutionary dynamics of variations over time for each X, Y, or Z component of the geomagnetic field.
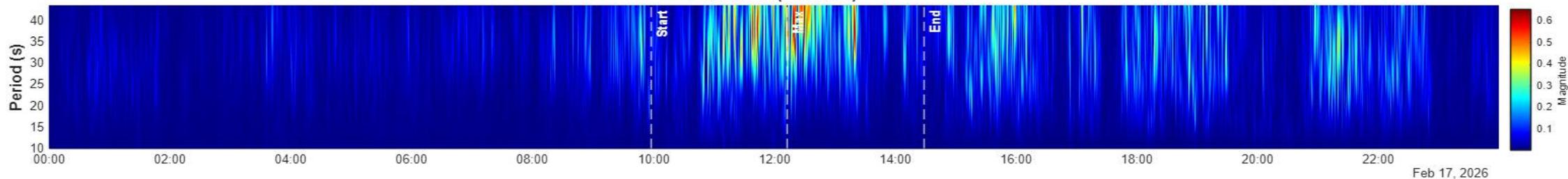
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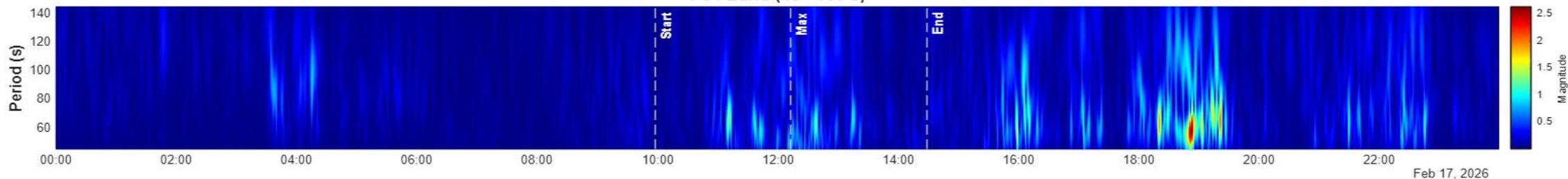**Station: Akademic Vernadsky | Filtered X-component | Date: 2026-02-17**
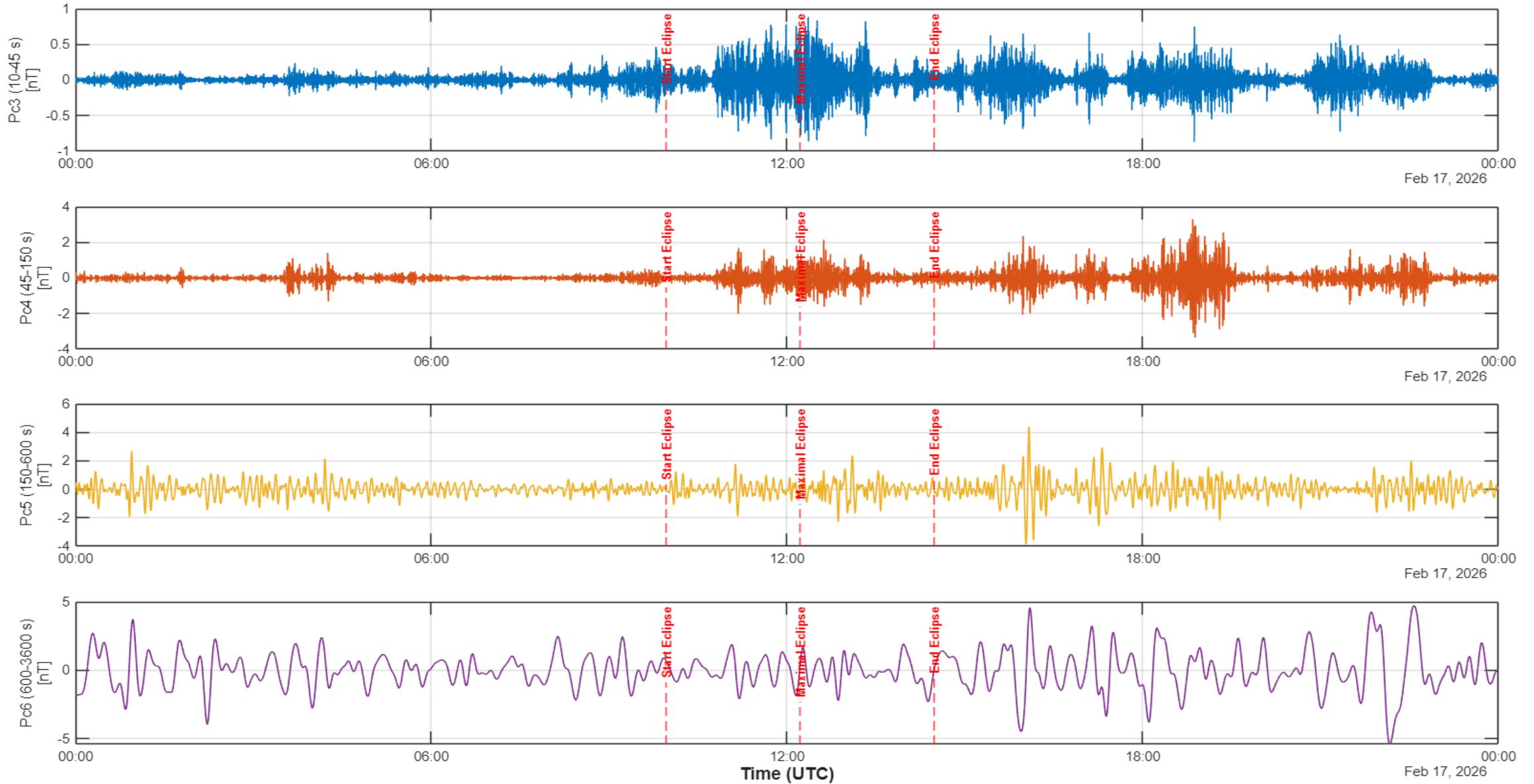
It is clear that on the day of the solar eclipse there was a strong burst of very fast geomagnetic variations in the X-component of the geomagnetic field.

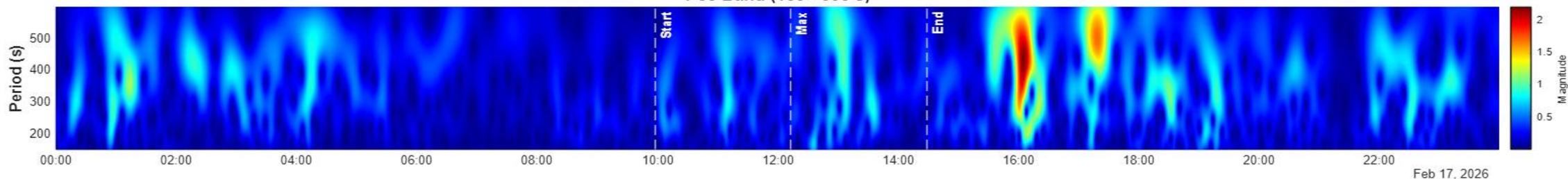**CWT Spectrograms | Station: Akademic Vernadsky | Comp: X | Date: 2026-02-17**
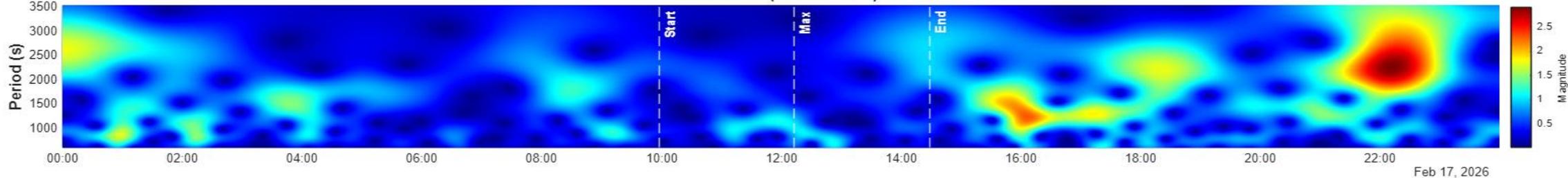
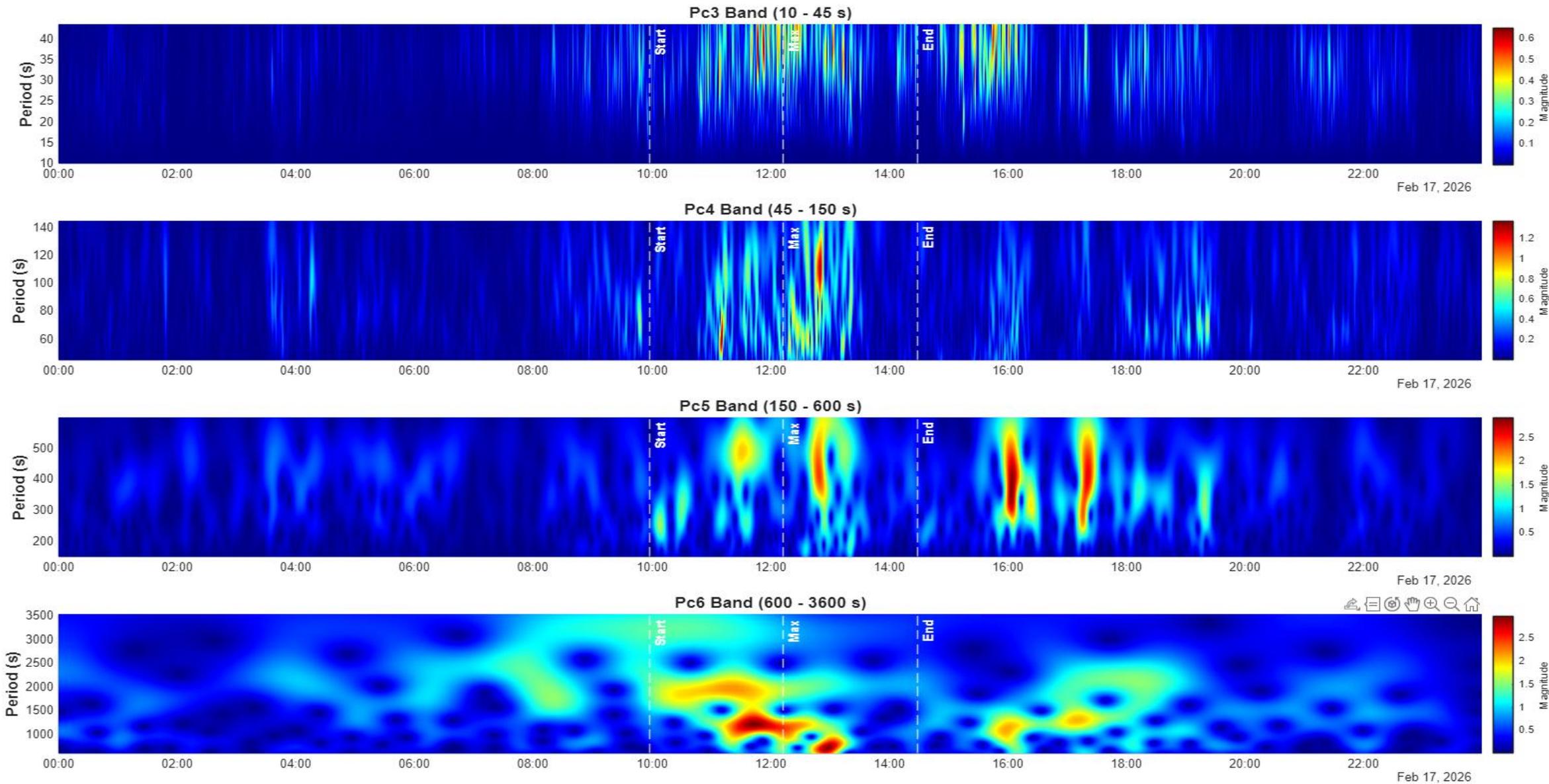Pc3 Band (10 - 45 s)

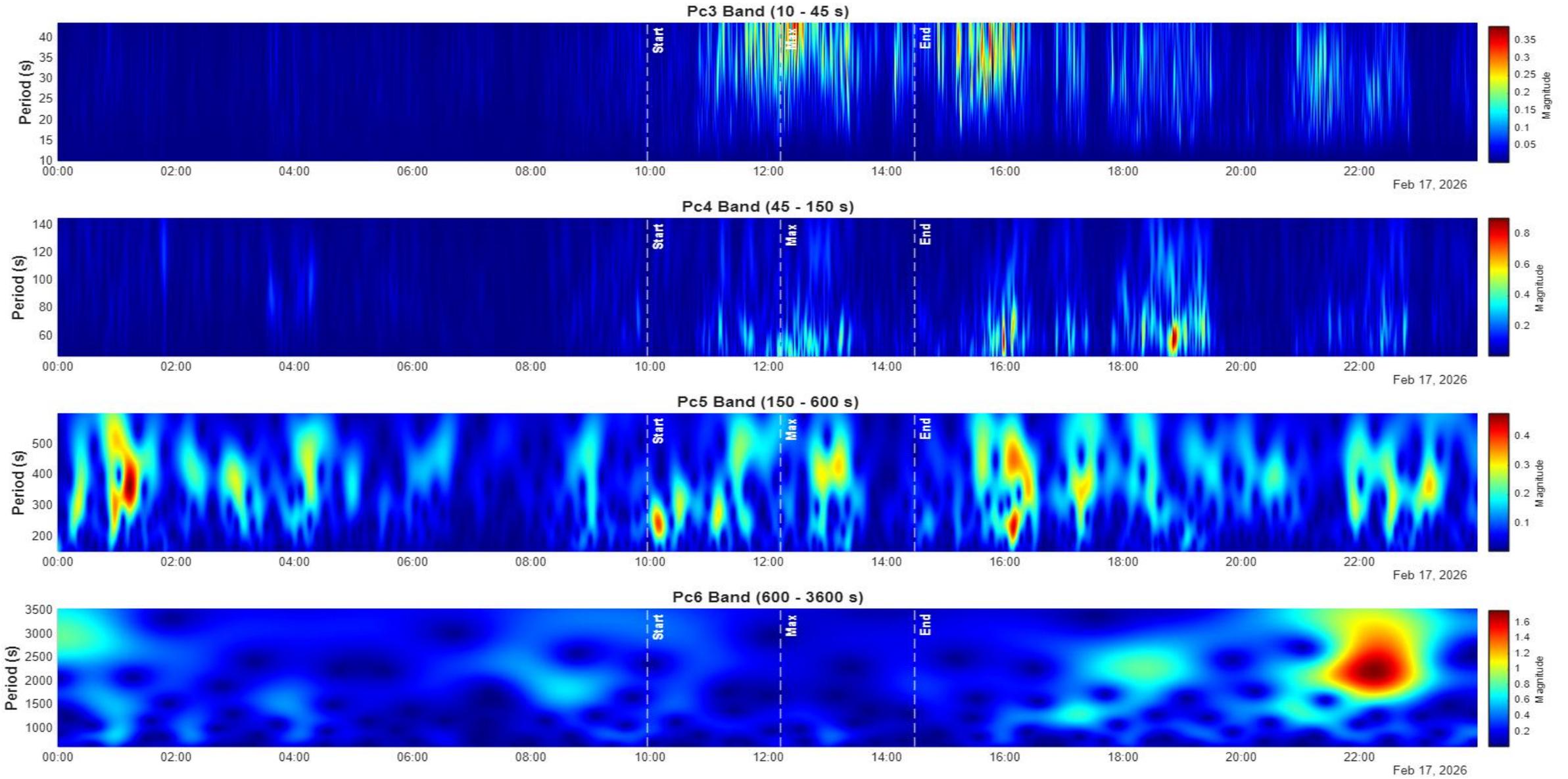Pc4 Band (45 - 150 s)

Pc5 Band (150 - 600 s)

Pc6 Band (600 - 3600 s)

Wavelet spectrum for the Pc3 - Pc6 bands for the X component of the geomagnetic field. It is evident that pulsations intensified after the onset of the eclipse and within the eclipse time interval.

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Wavelet spectrum for the Pc3 - Pc6 bands for the Y component of the geomagnetic field

Wavelet spectrum for the Pc3 - Pc6 bands for the Z component of the geomagnetic field

Pc-type geomagnetic pulsations are low-frequency oscillations of the Earth's magnetic field that arise from the interaction of the solar wind with the magnetosphere and resonant processes within it.
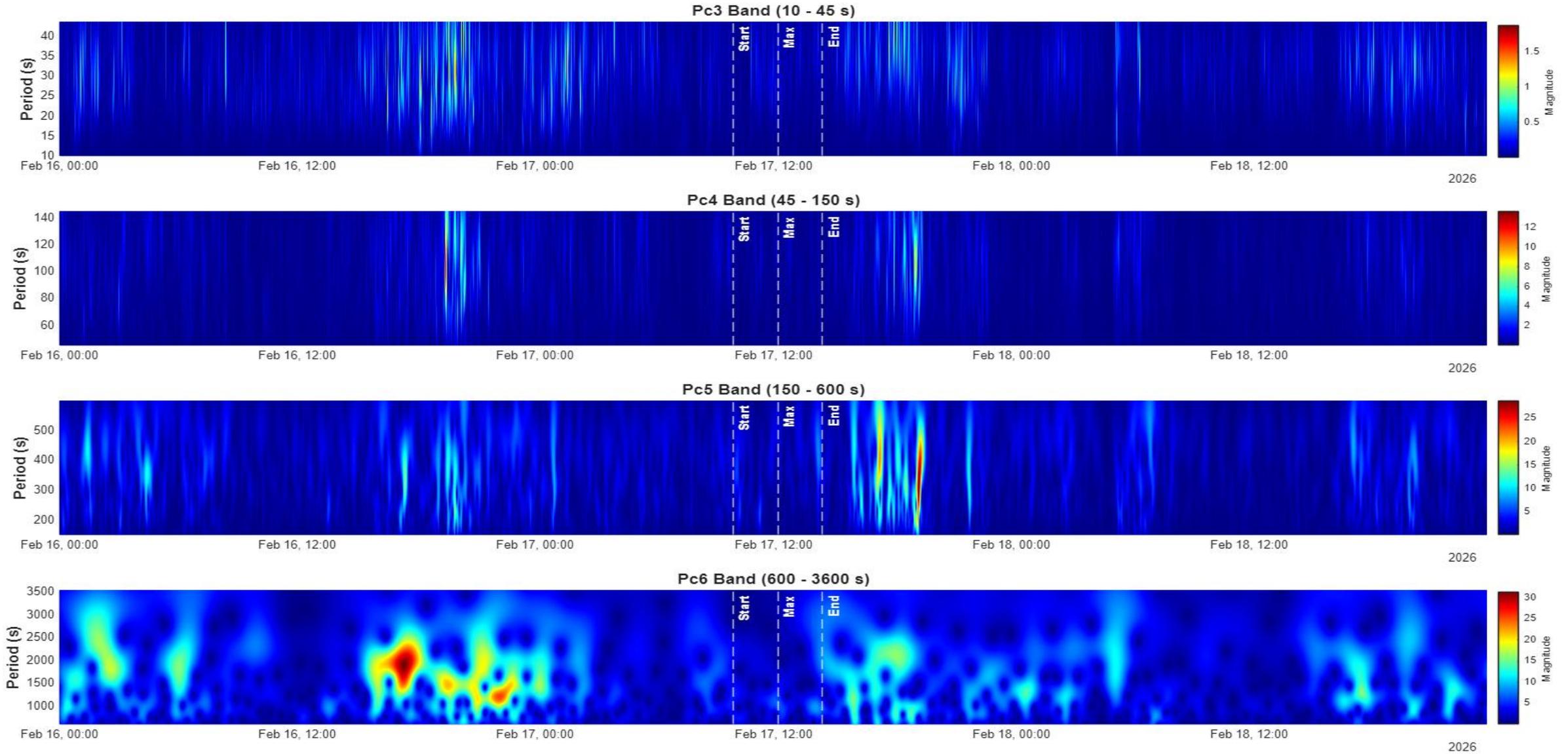
Pc3–Pc4 (10–150 s): These oscillations are typically associated with resonances of magnetic fields in the inner magnetosphere. They are often initiated by waves generated in the solar wind ahead of the magnetopause and serve as an indicator of the state of the interplanetary medium.

Pc5 (150–600 s): Global magnetospheric oscillations characteristic of the outer regions of the magnetosphere. The main causes of their generation are instabilities at the magnetopause boundary (e.g., the Kelvin-Helmholtz instability) and abrupt changes in solar wind pressure.

Pc6 (600–3600 s): Ultra-long-period pulsations that are closely associated with large-scale changes in ionospheric current systems. They reflect global restructuring of the ionosphere in response to extreme events, such as the passage of a solar eclipse shadow, which "turns off" ionospheric conductivity.

All Pc3-Pc5 wavelet spectra (Akademik Vernadsky Antarctic station) show a sharp increase in geomagnetic pulsations after the onset of the solar eclipse, while pulsations were very weak before the eclipse. This is a sign of a major restructuring of the ionospheric current system in response to the passage of the lunar shadow and penumbra. The ionosphere acts as a shield for ultra-low-frequency (ULF) waves coming from the geospace. The lunar shadow creates a sharp local dip in ionospheric conductivity. The "shield" thins, and magnetospheric waves are intensely recorded by magnetometers.

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CWT Spectrograms | Station: Scott Base | Comp: X | Date: 2026-02-16

Pc3 Band (10 - 45 s)

Pc4 Band (45 - 150 s)
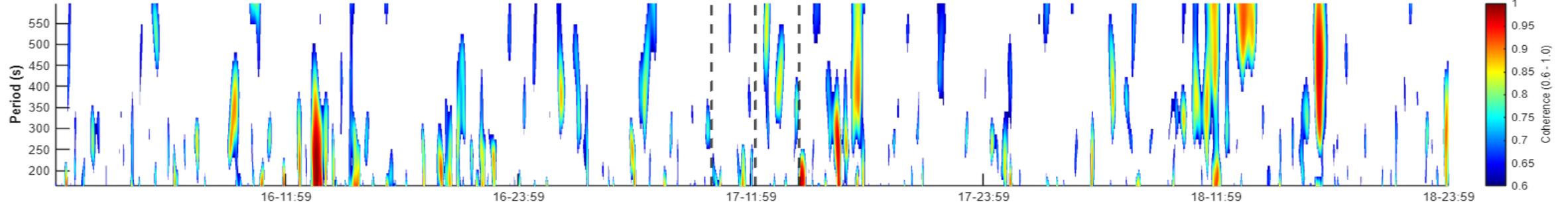
Pc5 Band (150 - 600 s)

Pc6 Band (600 - 3600 s)

The picture is completely different at Scott Base, where there were no geomagnetic pulsations during the eclipse, but they flared up immediately after the eclipse.

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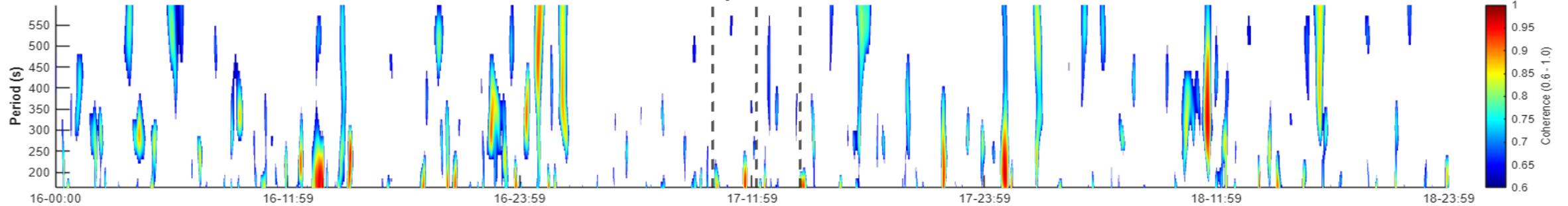# Cross-Wavelet Coherence > 0.6 (Pc5: 150-600 s)
Akademik Vernadsky vs Scott Base
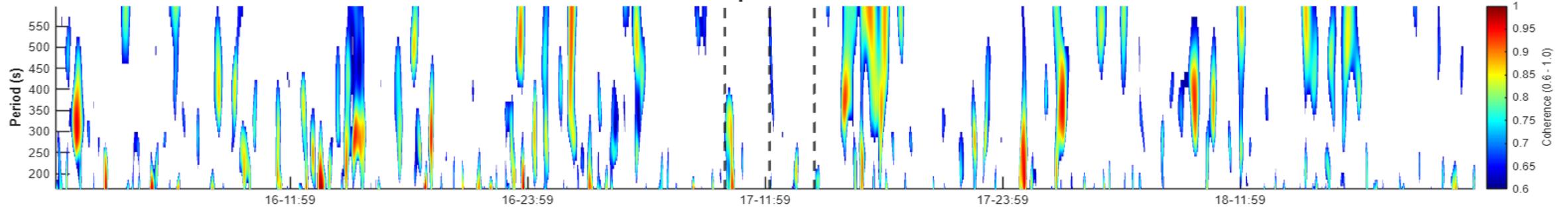
Wavelet-Coherence between Akademik Vernadsky and Scott Base.

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The solar eclipse disrupted the correlation between geomagnetic variations at the Vernadsky and Scott Base stations, in the X and Z components of the geomagnetic field. Partial correlation remained between the Y components (when an eclipse's shadow creates a spot with a sharp drop in conductivity over Antarctica, any zonal current flowing at that moment go around this obstacle. Electric currents cannot pass through the "gap" and are forced to bend around it along the meridians).

Based on preliminary data analysis, it can be assumed that a direct physical connection between the solar eclipse of February 17, 2026, and geomagnetic pulsation dynamics has been established. The eclipse acted as a global electromagnetic trigger, causing a cascading response in the ionosphere and magnetosphere.

To analyze geomagnetic data from the INTERMAGNET catalog, a Matlab-script was written. It reads files and performs comparative data analysis in geomagnetic pulsation period bands using Butterworth filters, and calculates cross-wavelet coherence and phase spectra. This will also be useful for studying and comparing the local development of magnetic storms in Antarctica and in mid-latitude and Northern circumpolar regions.

This is a preliminary version, pending further development of a more in-depth analysis.

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Scott Base

Akademik Vernadsky

Thank you for your attention !

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