# GNSS MEASUREMENTS IN HIGH SUN ACTIVITY MALPILS CASE

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GNSS measurements are widely used in determining coordinates and surveying objects in field conditions. It is a fast and effective measuring tool for determining coordinates in open areas. The accuracy and reliability of measurements are influenced by the activity of solar spots. The cycle of solar activity is eleven years and in 2025 activity reaches its peak.

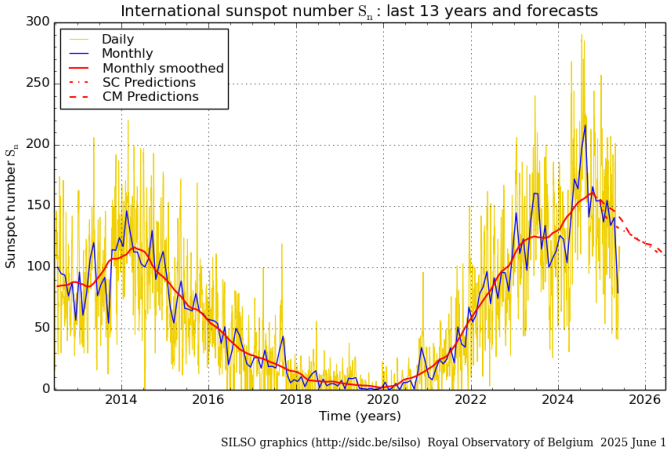


**Fig. 1.** Source: https://www.sidc.be/SILSO/dayssnplot

On a daily basis, coordinate measurements are carried out by surveyors with instruments from different manufacturers and various types of correction in real-time measurement. The overall goal is to obtain geodetic coordinates within permissible error limits, regardless of the instrument and the time of measurement. To check the operation of GNSS in conditions of high solar activity, the determination of coordinates took place in the middle of the day in good weather. On the day the measurements were taken, the sun's activity significantly increased the number of electrons in the ionosphere.

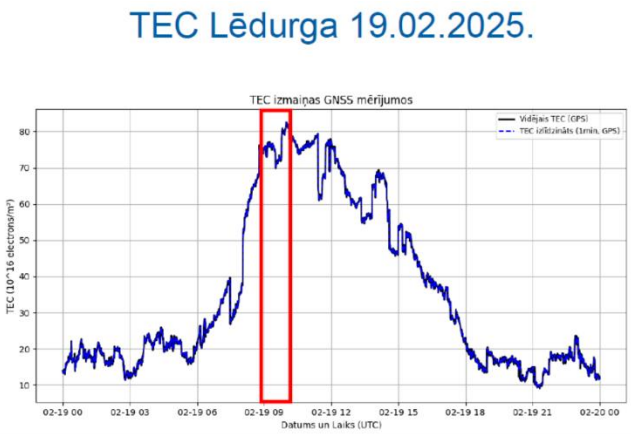


**Fig. 2.** Source: A.Vallis

The number of electrons in the ionosphere was four times higher than under normal conditions. Two types of coordinate measurement methods were used to detect GNSS malfunctions: stationary measurement with repeated achievement of a fixed position and GNSS measurements on geodetic points located in some locations. The GNSS tools used were with the latest firmware to have the latest coordinate calculation methods. Measurements were also made with a GNSS RTK instrument that is at least 10 years old.

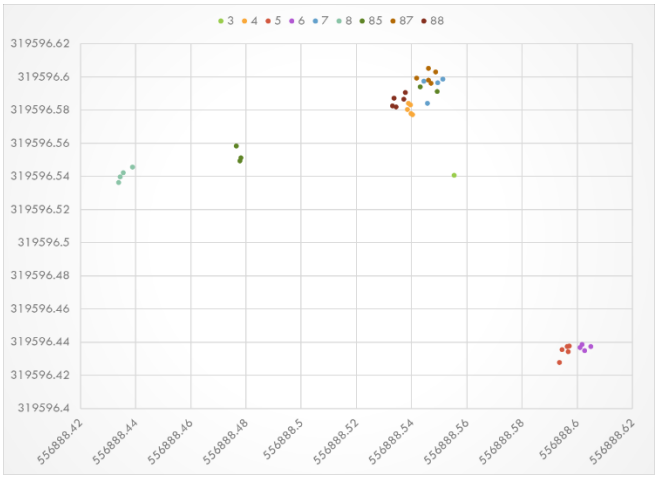


**Fig. 3.** Results of divergent fixations of different corrections

A statistical examination of the obtained data and grouping by type of correction demonstrates that the difference in fixed coordinates exceeds both the values given by the manufacturer and the accuracy to be achieved in regulatory enactments.

*Conclusions*

When analysing the data, no regularities were found when performing repeated measurements. This proves that solar activity and Total Electron Content affect GNSS measurement results and reduce their reliability.

**Keywords:** GNSS; GNSS accuracy; Real Time Kinematic (RTK); Radio modules; Global position measurements.