Every 11 years our Sun becomes more active than usually - it is so called the solar cycle maximum. The next solar maximum is rather close and it’s expected to begin at the end of 2023. More solar flares and geomagnetic storms can occur during the solar maximum period. These phenomena are called by term "Space Weather", similar to normal weather we observe beyond the windows. The Space Weather impacts the part of our atmosphere above 100 km, where significant part of medium is electrically charged, ionized in form of plasma. This ionized part of upper atmosphere called the ionosphere, and due to its plasma nature it can impact significantly on radio signals that traverse from satellites to the ground, in particular signals used for GPS/GNSS positioning and navigation. During geomagnetic storms driven by space weather, in the ionosphere there are developed different plasma structures, which can seriously disrupt navigation signals propagation.

We propose to investigate how these ionospheric structures develop during different phases of geomagnetic storms of various intensity and at different geographical locations, and to track temporal changes of their impact on accuracy of GPS positioning. The most well-known phenomenon during geomagnetic storm is polar lights or aurora borealis. Ionospheric structuring - plasma density irregularities at high latitudes often coincide to that aurora borealis locations, so called auroral oval in the polar region. During severe geomagnetic storms, these effects straightforwardly move from polar towards middle latitudes and can be observed up to latitudes of Poland or California. When we collect observations from multiple ground-based GPS receivers/stations, we can construct high-resolution maps of the ionosphere. These maps allow us to capture different types of ionospheric disturbances, structures and ionospheric plasma irregularities over our head, in the ionosphere. For the areas affected by ionospheric irregularities, we will analyze quality of GPS/GNSS positioning to understand how space weather driven structures will decrease navigation accuracy and what size and magnitudes of ionospheric plasma structures and irregularities should developed to produce significant errors in navigation. As the approaching solar maximum period will cover the years 2023–2026, we will have excellent opportunity to capture numerous strong space weather events, to specify ionospheric plasma structures and irregularities on a global scale during these events and to investigate comprehensively how space weather impact GPS/GNSS navigation systems.