The part of Earth's atmosphere extending from around 70 km to 1000 km is called the ionosphere. It is characterized by varying amount of ionization, and forms partially ionized plasma environment. The variation of Earth’s ionosphere is complex, as it has high temporal dynamic and spatial discrepancy under the influence of different phenomena. According to their origin, the ionospheric disturbances can be divided into two categories. The first one is related with the Sun’s activity causing sudden disturbances of ionosphere, while the second one origins from the anthropogenic activity and natural events. Compared with the ionospheric anomalies caused by the solar activity, the ionospheric disturbances caused by an incident, e.g., in the lithosphere have a smaller scale and duration time. These disturbances last for a few minutes to several hours and their scale is about hundreds to thousands of kilometers. Their examples may be seismic atmospheric disturbances (SID) that were observed in the pressure, temperature, electromagnetic field, and the ionosphere in the last decades.

An earthquake (EQ) is a tectonic process that happens in most cases due to collision of Earth tectonic plates. The ground shakes induce atmospheric waves that propagate right up to the ionosphere. These waves reach the ionosphere and cause detectable changes of the electron density (ED) and total electron content (TEC). The changes of ED and TEC can be measured by the signals from global navigation satellite systems (GNSS) transmitted through the ionosphere and received onboard the low-Earth orbit (LEO) satellite and on the ground by networks of GNSS stations. Substantially, the ionospheric anomalies caused by the local events such as EQ or volcano eruption are a solid Earth-ionosphere coupling.

GNSS data is an efficient tool for the observation of SIDs. TEC disturbances spread out to almost all directions from the EQ epicenter, with the speed of several hundreds of meters to several kilometers per second. Different SIDs have been observed from permanent ground GNSS observations. Different propagation velocities, which are related individually to the seismic Rayleigh waves, acoustic waves and tsunami-generated gravity waves were already discussed in several studies. Some authors have also presented evidences of SIDs even 5 days prior to the major EQs, which is key for the proposed research. Some regions of the Earth, having especially strong and permanent seismic activity, are equipped with dense ground GNSS networks (Japan, Chile, western USA), which enable local detailed observation of SIDs occurring before and after EQ and tsunami events.

The applicability of dense GNSS networks is local, but there are new satellite missions dedicated to the global observations of the ionosphere. Indeed, European Space Agency (ESA) Swarm mission includes three satellites equipped with Langmuir Probes (LP) and precise orbit determination (POD) GNSS receivers that can be used to observe ionospheric ED in situ and topside TEC, respectively. However, the recognition of SIDs from single-dimensional measurements along a single Swarm orbital track is not a trivial task, as their spatiotemporal correlation cannot be observed due to non-repeating orbit. Therefore, the proposed project aims at detailed spectral classification of different ionospheric disturbances and their local validation by dense ground GNSS data and global ionosphere maps (GIMs). Validated spectral patterns of different ionospheric disturbances can open a new way to observe composed systems of disturbances beyond the local areas of dense ground GNSS networks. Additionally, the analysis of spatiotemporal co-location of SIDs with respect to seismic data records and tectonic plate boundaries can bring a better answer about the solid Earth-ionosphere coupling. The orbital tracks of Swarm can reach all seismically active zones of the world, and therefore, the symbiosis of Swarm satellite observations with local ground GNSS networks and seismic data can become a powerful **system of global tracking of seismic ionospheric disturbances (GLOSID-S),** which aims at better understanding of solid Earth-ionosphere interactions, and brings us closer to the prediction of EQs.