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Variability of ionosphere studied and modelled based on data from the Swarm satellites

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Dynamic processes in the Earth's ionosphere, which often include different instabilities and turbulence, can result in plasma density irregularities at various scales. The variability of ionospheric plasma is an important aspect of the space weather system. Its understanding is crucial for modelling of the state of ionosphere and building the capability of predicting and mitigating severe space weather effects. One example of such impacts is the influence of ionospheric irregularities on the propagation of radio signals, and hence degradation of communication or positioning with the Global Navigation Satellite Systems (GNSS).

In the project *Swarm-VIP*, *Variability of Ionospheric Plasma*, we provide spatiotemporal characteristics of ionospheric plasmas and uncover the dynamical coupling between different scales in response to geomagnetic conditions. The study is based on data from the Swarm satellites, such as the IPIR dataset [1,2], and auxiliary datasets, to which we apply complementary analysis techniques and signal decomposition tools. Taking advantage of the orbital characteristics of the Swarm satellites, we ascertain the dominant scales at given geomagnetic conditions at different latitudes. Our focus is primarily on the characteristics of ionospheric plasma, i.e., plasma density and total electron content as measured respectively by the Langmuir probes and GPS receivers onboard Swarm satellites, as well as variations in the magnetic field measured by Swarm.

The result of *Swarm-VIP* is a semi-empiric model for the ionosphere that can determine the probability of occurrence of different structure scales in ionospheric plasmas with respect to geomagnetic conditions and magnetosphere-ionosphere coupling. It also gives insight into ionospheric structuring and coupling between scales, and it can be understood in the context of space weather effects, such as scintillations of trans-ionospheric radio signals. The *Swarm-VIP* products will be provided globally, along the whole orbits of the Swarm satellites, and a special emphasis will be put on high latitudes, Arctic and Antarctica, and the European sector, where the validation study will be done with a network of ground-based instruments. Here, controlling parameters can also include the dynamics of the ionospheric current systems and aurora. *Swarm-VIP* is carried out as a response to the European Space Agency's EO Science for Society *Swarm+ 4DIonosphere* initiative. In this presentation we also show how the wider scientific community can contribute to the project.

References

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