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# Propagation disturbances in the auroral and polar ionospheres investigated through EISCAT/ESR and their effects on positioning

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Radio signals from Global Navigation Satellite Systems (GNSS) can be affected by disturbances introduced during the propagation through large-to-small scale plasma density irregularities in the Earth's ionosphere. Plasma density irregularities capable of disrupting GNSS mainly occur in the post-sunset equatorial ionosphere (where scintillation can be severe) and in the high latitude ionosphere (where phase temporal fluctuations tend to occur on GNSS signals). In particular, irregularities in the auroral and polar ionospheres form in the presence of particle precipitation as well as plasma patches and their disturbances on GNSS signals are a consequence of the propagation geometry.

The consequence of propagation disturbances on GNSS signals is a degradation in the positioning quality: this degradation manifests through enhancements in positioning errors as well as through outages (i.e., gaps in the availability of the positioning solution). A degradation in the positioning quality can limit the use of GNSS: disturbances occurring at equatorial and high latitudes can introduce severe limitations, for example, to safety-critical applications.

The origin of propagation disturbances occurring on GNSS signals in the auroral and polar ionospheres was investigated by combining observations from the European Incoherent SCATter (EISCAT), the EISCAT Svalbard Radar (ESR) and GNSS receivers. In the case of EISCAT observations, various geometries were utilized in the context of the propagation problem typical of GNSS signals propagating through irregularities in the auroral and polar ionospheres.

The origin of the degradation in the positioning quality was investigated as well, in view of the type of irregularities occurring in the auroral and polar ionospheres and of the propagation disturbances that they introduce. A possible mitigation strategy was suggested in these cases.