High-resolution measurements of plasma entry into the polar cap: indication of plasma structuring

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Polar cap patches/tongue of ionization are believed to be the dominant space weather phenomena in the high-latitude ionosphere as they are associated with significant plasma irregularities. These irregularities can greatly degrade satellite-based communication and navigation systems that rely on trans-ionospheric signals. Due to the practical need for a more reliable space weather forecasting system, the plasma structuring of these phenomena are an active area of research in recent years. In the study, we present a case of a tongue of ionization that was formed due to the transport of the high-density plasma from the dayside sunlit ionosphere into the dark polar cap. The tongue of ionization was probed by the first Norwegian scientific satellite NorSat-1 in noon-midnight orbits. Among other payloads, NorSat-1 carries the multi-needle Langmuir probe (m-NLP) system that is capable of measuring electron density at a rate up to 1 kHz. The electron density measurement shows significant irregularities at all scales along the profile of the tongue of ionization. In the dayside auroral oval, the electron density is associated with clear mesoscale (20-80 km) density enhancements, which are likely caused by structured auroral precipitations. We also use data from other satellites (e.g., Swarm and DMSP) to support observations from NorSat-1.