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# Characterizing ionospheric turbulence on the poleward side of the cusp using sounding rocket observations and modelling work

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The dayside auroral region is known to be subject to density irregularities and turbulence with "Space weather impacts", meaning that the fluctuations may for instance perturb Global Navigation Satellite Systems (GNSS) and/or high frequency (HF) radio signals. During their flight through the cusp/dayside aurora above Svalbard, the Twin Rockets to Investigate Cusp Electrodynamics-2 (TRICE-2) encountered regions of both strong GNSS phase scintillations and enhanced spectral width from HF radar, evidence of the presence of such irregularities with scale-sizes between a few meters and a few kilometers [1].

In this work, we combine the in-situ observations of plasma density irregularities from the sounding rockets with numerical simulations using Geospace Environment Model of Ion-Neutral Interactions (GEMINI) [2] to study the formation and characteristics of the fluctuations in detail. From the high-resolution rocket data, we investigate how the energy is distributed across the scales during an interval where large-scale density gradients and flow channels were observed, and which corresponded to the region where the ground-based phase scintillations appeared strongest. The rocket data is then used as input parameters to GEMINI to investigate the development of instabilities such as the Kelvin-Helmholtz Instability and the Gradient Drift Instability, and to compare the spectral features obtained from the model with those extracted from the rocket observations, expanding previous analysis about the density irregularities encountered by TRICE-2 [e.g., 1,3]. Combined, the high-resolution measurements from the rocket and the modelling work help better understand the formation of irregularities and to characterize the multi-scale nature of the plasma fluctuations in the cusp/dayside auroral region.

[1] Spicher, A., LaBelle, J., Bonell, J. W., Roglans, R., Moser, C., Fuselier S. A., et al. "Interferometric study of ionospheric plasma irregularities in regions of phase scintillations and HF backscatter," *Geophys. Res. Lett.*, 49, 12, 2022, e2021GL097013. https://doi.org/10.1029/2021GL097013
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[3] Spicher A., Kvammen A, LaBelle J., Zettergren, M., Bonnell J., Roglans R. et al. "Examining the relevance of different instability mechanisms in causing ionospheric cusp irregularities based on sounding rocket data and numerical simulations", August 2023, URSI GASS, https://doi.org/10.46620/URSIGASS.2023.3015.YTWB1455