**International Beacon Satellite Symposium BSS-2016**
**Trieste, Italy**

# Three-Dimensional Modeling of High-Latitude Scintillation Observations

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## ABSTRACT

Global Navigation Satellite Systems (GNSS) signals exhibit rapid fluctuations at high and low latitudes, believed to be caused by ionospheric refraction and diffraction. This study focuses on the high-latitude problem, where the ionospheric irregularity region cannot be approximated to a thin layer in the direction of signal propagation. The nature of the high-latitude problem necessitates the use of a fully three-dimensional multiple phase screen modeling approach, based on the work of *Rino* [1979]. This study takes advantage of the fortuitous conjunction of EISCAT Incoherent Scatter Radar (ISR) observations and a scintillation monitor viewing the same line-of-sight during an auroral E-region enhancement just after 20:00 UT on 17 October 2013. The scintillation observations are explained using ISR measurements to specify the macroscale environment within which *Deshpande et al.'s* [2014] scintillation model, *Sigma*, is operated. A geometry change is introduced to that model that greatly reduces computation times. Excellent agreement is achieved with the observations, indicating that a plausible irregularity distribution has been identified. The distribution contains a kilometer-scale irregularity superimposed on an anisotropic irregularity spectrum of varying intensity and high spectral index (-4.2). The altitude extent is 95 - 175 km and the intensity varies between 5 – 25% of the background density.

**Key words:** Ionosphere, GNSS, Scintillation, Modeling, Incoherent Scatter Radar

## References

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**Acknowledgements**

This EISCAT experiment was led by PI Biagio Forte. Data can be retrieved from https://www.eiscat.se/madrigal/. Scintillation data were collected by PI Cathryn Mitchell on EPSRC grant EP/H003304/1 GNSS scintillation: detection, forecasting and mitigation and can be obtained by contacting her.