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TEC and Scintillations in the Ionosphere above Greenland

Sarah Beeck¹, Anna Jensen², and Per Knudsen¹

¹National Space Institute, Technical University of Denmark, Kgs. Lyngby, Denmark

²Division of Geodesy and Satellite Positioning, KTH Royal Institute of Technology, Stockholm, Sweden

Global Navigation Satellite System (GNSS) signals are affected by the media of the ionosphere when traversing it. Therefore, near real-time monitoring of the ionosphere and its scintillation can be an advantage for GNSS users. There can be strong phase scintillation in the Arctic region, however, there is no continuous real-time monitoring of the ionosphere above Greenland at the moment. This project investigates possibilities for real-time monitoring of the ionosphere above Greenland, based on data from geodetic GNSS stations. The novelty of the work is the application of the kriging method as basis for rate of total electron content index (ROTI) maps in the Arctic.

The GNSS data analyzed in this project is from seven selected GNSS receivers that are part of the Greenland GPS Network (GNET). The data is used for computing the phase scintillation index ROTI, which is then used for mapping the scintillation activity. First the spatial data coverage was examined to investigate the possibility of visualizing the ROTI values spatially. Further, the kriging and natural neighbor methods were tested for interpolating ROTI above Greenland.

In the project there were some large spatial data gaps, caused by the sparse distribution of the GNSS receiver stations. A relation between high ROTI values and low elevation angles was shown, and this relation was more prominent at geomagnetically quiet times. This indicated that a higher elevation cut-off angle might have been useful for the mapping if more data had been available. The test of the interpolation methods lead to the conclusion that kriging provided slightly better maps than the natural neighbor method at geomagnetically active times, while natural neighbor might be preferable at geomagnetically quiet times. Finally, it was found that receivers at all of the tested latitudes were affected by ionospheric phase scintillation, this was seen as an increase in the amount of cycle slips.

The conclusions drawn from this project can help indicate what the next step should be on the path towards real-time monitoring the ionosphere above Greenland. The general recommendation for future work is to install a network of GNSS Ionospheric Scintillation and TEC Monitor (GISTM) receivers in Greenland which can provide near real-time scintillation indices.