Detection of Ionospheric Scintillation in GNSS Data over the Faroe Islands During a Solar-Min

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SUMMARY

During the 7 October 2018, a visible aurora borealis was witnessed over the Faroe Islands (62°N) at 20:00 for a period of around 30 minutes. GNSS data from a CORS GNSS receiver in Tórshavn, gathering data at a rate of 1Hz was investigated on the 6, 7 and 8 October in order to study the effect during this event on GNSS carrier phase and code measurements. Two approaches were used, these being the Time Differenced Code Minus Carrier and the Time Differenced Phase Ionospheric Residual techniques. The first technique predominately identifies noise in the code measurements, whilst the second identifies relative noise in carrier phase observables. The results illustrate that the carrier phase measurements are affected by the event, but not the code measurements. Not all the satellites were affected, and individual satellites were affected at disparate time instances as the plasma cloud passed across the ionosphere. The results illustrate that the location of the cloud can be calculated at any time using all 31 GNSS satellites observed during the 30-minute period, which give a relatively dense product. These approaches can be used to eliminate satellites that are affected at specific instances in a positioning solution. Comparisons are made between the GNSS results and 1Hz geomagnetic readings taken at Suðuroy in the Faroe Islands, illustrating correlations.

The GPS data were positioned using both AUSPOS and CSRS-PPP. The results illustrate that the positional error during the aurora borealis event reached over 1m when using AUSPOS and 0.8m using CSRS-PPP.

This occurrence was during a solar-min. In 5 years', we will reach a solar-max, where ionospheric activities and scintillation will increase in number and magnitude. Such phenomena will greatly affect high latitudes and equatorial regions, and techniques are required to detect how individual GNSS satellites' data are affected in real time. In addition, other electromagnetic signals will be

affected, and knowing the real time location of a plasma cloud causing scintillation will be useful.