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The VARION algorithm for moving GNSS receivers: preliminary tests and results

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The VARION (Variometric Approach for Real-Time Ionosphere Observation) algorithm is a valid instrument to analyse TIDs (Travelling ionospheric disturbances), since it is able to estimate slant TEC (sTEC) variations in real-time [1]. In this work, the first application of VARION to moving GNSS
receivers is presented. This usage is made possible since VARION algorithm is based on the geometry-free combination: the receiver motion does not affect the sTEC estimation process. In particular, GNSS observations coming from a ship, moving in the Greenland sea, were used. They were then compared to observations from GNSS permanent receivers both situated in Greenland [2] and in Iceland [3], which served as reference.
The GNSS permanent receivers were chosen in a such way the distance between the ship and the stations was within 200-300 km. In detail, sTEC time series related to the nearest IPP tracks are compared.
The first results show a good agreement both with the selected permanent stations and with the ship-based GNSS receiver. The noise level is also similar and well below the threshold chosen to highlight significant perturbations, like those induced by earthquakes and tsunamis. Furthermore, a passband filter was adopted to cut frequencies ranging from 0.5 to 3.3 mHz, corresponding to wave periods of 5 to 30 seconds. These frequencies were selected to consider only variations in sTEC with periods similar to that of the ocean tsunami itself. The filter was applied both to ship-based GNSS data and to GNSS permanent stations. The reference and the ship data display a better coherence also in this case. The developed methodology, although preliminary, can thus represent a new real-time and costeffective ionosphere monitoring tool, which does not require the installation of complex infrastructures in open sea, but leverages the ships already present in the seas. In conclusion, ship-based GNSS receivers could also be used to increase the ionosphere monitoring coverage over the oceans and, hence, to enhance tsunami early warning system.

References

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