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Impact of ionospheric variability on the accuracy of Real Time GNSS applications

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The presence of small-scale structures in the ionosphere can strongly affect the reliability of GNSS high precision real time applications. In particular, small-scale structures in the ionosphere due to Travelling Ionospheric Disturbances or to geomagnetic storms can induce strong disturbances in high precision positioning. The goal of our research is to assess the effects of such ionospheric activity on relative GNSS positioning techniques based on carrier phase measurements.

We developed a software which allows the Determination of Ionospheric Positioning Error on RTK positioning (SoDIPE-RTK). The two main goals of SoDIPE-RTK are to reproduce the positioning conditions encountered by RTK users on the field and assess its positioning error due to the ionosphere. The approach is implemented on the Belgian dense network with a distance between the different reference stations ranging from 4 to about 30 km. In a first step, we assess the nominal RTK precision for each baseline during quiet ionospheric days (low TEC variability). The accuracy depend mainly on baseline length and satellite geometry observed at the two considered stations. In a second step, the impact of the occurrence of a strong ionospheric disturbance (i.e. a large amplitude Traveling Ionospheric Disturbance) and of a geomagnetic storm is tested in terms of positioning error.

The study demonstrates that the largest effects are observed during the occurrence of geomagnetic storms with a positioning error due to ionosphere reaching 80 cm. The maximal positioning errors observed for TID's is around 15 - 20 cm, depending on baseline orientation.