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Performance of ROB's near real-time ionospheric product during normal and disturbed space weather periods.

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Several agencies are routinely monitoring the vertical Total Electron Content (vTEC) using GNSS data. Derived maps are available with different latencies, area extents, and grid/time resolutions. However, no high-resolution maps are publically available over Europe in near real-time.

In this frame, the Royal Observatory of Belgium (ROB) developed the ROB-IONO software which takes advantage of the dense EUREF Permanent GNSS Network (EPN) to monitor the ionosphere. The main ROB products consist of ionospheric vTEC maps over Europe and their variability estimated in near real-time every 15 min on 0.5° x 0.5° grids using GPS observations. The maps are available online with a latency of ∼3 min in the IONEX format at ftp://gnss.oma.be and as interactive web pages at www.gnss.be.

During normal ionospheric activity, the ROB-TEC maps show a good agreement with widely used post-processed global products from IGS, CODE and ESA, with mean differences of 1.3 ± 0.9, 0.6 ± 0.7 and 0.4 ± 1.6 TECu respectively for the period 2012 to mid-2013. For a disturbed period, such as the 2003 Halloween ionospheric storm, the mean differences with IGS, CODE and ESA maps are respectively 0.9 ± 2.2, 0.1 ± 2.0 and 0.6 ± 6.8 TECu, with maximum differences (>38 TECu) occurring during the major phase of the storm. These differences are due to the lower resolution of global products in time and space compared to the ROB-TEC maps.

A description of two recent events, on March 17, 2013 and February 27, 2014 highlights the capability of the method adopted to detect in near real-time abnormal ionospheric behaviour over Europe. The potential of the variability maps as an indicator of rapid ionospheric variations during the 15 min of observations is also highlighted. More than 30 ionospheric events associated with Space weather were detected during the period 2012–2014. The ionospheric perturbations are associated with Coronal Mass Ejections (CMEs, ∼70% of the time), active geomagnetic conditions (∼20% of the time) or unidentified phenomena (∼10% of the time). Each event is reported a few days after with a summary of the origin of the disturbances and their effect on the vTEC over Europe.