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Detecting and forecasting ionospheric irregularities using a cross-correlation method applied to the belgian dense gnss network

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Nowadays, the ionospheric effect remains one of the main precision-limiting factor in GPS applications. In order to assess the ionospheric activity effect on GPS accuracy, a software has been developed at the Royal Observatory of Belgium (ROB) to detect the ionospheric irregularities (Travelling Ionospheric Disturbances (TIDS) and scintillations) in the Total Electron Content (TEC). This software applied to the dense GPS network in Belgium (about 70 permanent GPS stations with a typical distance of 20 km between 2 neighbour stations) and combined with a cross-correlation method allows to extract more information about the propagation and the type of the small-scale structures in the TEC. In summary, the philosophy used in the study consists in comparing the TEC behaviour (temporal evolution of the vertical TEC variations) recorded in the neighbour stations in order to find the highest level of correlation between these behaviours to compare it with a fixed threshold above of which we consider that the 2 stations are affected by the same ionospheric irregularity. Thus, by working by couple of stations, we are able to make vectorial maps of the TID(s) propagation across the dense network and to make the distinction between the different types of ionospheric irregularities. For future work, an extension of the cross-correlation method should allow us to model the real propagation of the small-scale structures in the TEC to make prediction about ionospheric activity for a specific location and to detect the local anomalies inside ionospheric structures as the TID(s).