

# Climate VTEC maps in cooperation of IGS' GNSS and GIRO sensor networks – ionospheric events detection possibilities – case study

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## ABSTRACT

IGS Iono Working Group and International Reference Ionosphere (IRI), following the International Reference Ionosphere 2017 Workshop held on 6-17 November 2017 in Taoyuan City, Taiwan recommendation, are cooperating in order to assimilate empirical VTEC data from broad IGS GNSS sensor network into IRI model. This work presents the ionospheric events detection capabilities of a near-real-time ionosphere mapping system combining ionospheric data from two separate sensor networks: IGS permanent GNSS receivers providing VTEC measurements and GIRO high-frequency ionosonde sounders providing data for 3D mapping of the bottomside ionospheric plasma density in the frame of GAMBIT Explorer (<http://giro.uml.edu/GAMBIT/>).

Since 1998, the International GNSS Service (IGS) Ionosphere Working Group has been continuously releasing global maps of vertical total electron content (VTEC) in rapid, final, and predicted schedules. The IGS Ionosphere Combination and Validation Center (ICVC) at University of Warmia and Mazury is responsible for an ensemble analysis of the global VTEC maps synthesized independently by several ISG Associate Analysis Centres by applying the observation uncertainty weights determined by validating the VTEC data against the original slant TEC measurements.

Comparison of the ICVC-released “weather” VTEC maps to their quiet-time “climate” counterpart allows rapid evaluation of the anomalous near-space plasma dynamics as it

responses to a wide variety of effects in the Sun-Earth system, ranging from the forces acting in the outer space to the processes on the surface and even underneath the Earth's crust. Our approach to the task of building a reference for the deviation maps is to compute daily empirical 30-day running average VTEC. Such averaging is expected to smooth out effects from any ongoing events (that would otherwise distort the presentation of ionospheric/plasmaspheric climate) while still preserving the specifics of the annual cycle. This should allow near-real time detection of ionospheric events in the near future.

That multi-sensor data is currently being processed and shared in a frame of GAMBIT Explorer software on daily basis and based on the experience already gained during the span of this project and previously performed empirical data assimilations into IRI we expect to fully and successfully assimilate IGS ionospheric products into IRI model soon.

**Keywords:** climate TEC, GAMBIT Explorer, IGS, IRI, TEC anomalies detection