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Data Assimilation Techniques for Ionospheric Reference Scenarios – project overview and achieved outcomes

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The ionosphere is the upper part of the Earth's atmosphere, where sufficient free electrons exist to affect the propagation of radio waves. Therefore, the treatment of the ionosphere is a critical issue for many applications dealing with trans-ionospheric signals such as GNSS positioning, GNSS related augmentation systems (e.g. EGNOS and WAAS) and remote sensing.
The European Geostationary Navigation Overlay Service (EGNOS) is the European Satellite Based Augmentation Service (SBAS) that provides value added services, in particular to safety critical GNSS applications, e.g. aviation and maritime traffic. In the frame of the European GNSS Evolution Programme (EGEP), ESA has launched several activities, supporting the design, development and qualification of the operational EGNOS infrastructure and associated services. Ionospheric Reference Scenarios (IRSs) are used by ESA in order to conduct the EGNOS performance simulations and to assure the capability for maintaining accuracy, integrity and availability of the EGNOS system, especially during ionospheric storm conditions.
The project Data Assimilation Techniques for Ionospheric Reference Scenarios (DAIS) – aims the provision of improved EGNOS IRSs. The main tasks are the calculation and validation of time series of IRSs by a 3D assimilation approach that combines space borne and ground based GNSS observations as well as ionosonde measurements with an ionospheric background model. The special focus thereby is to demonstrate that space-based measurements can significantly contribute to fill data gaps in GNSS ground networks (particularly in Africa and over the oceans) when generating the IRSs.
In this project we selected test periods of perturbed and nominal ionospheric conditions and filtered the collected data for outliers. We defined and developed an applicable technique for the 3D assimilation and applied this technique for the generation of IRSs covering the EGNOS V3 extended service area. Afterwards the generated 3D ionosphere reconstructions as well as the final IRSs are validated with independent GNSS slant TEC (Total Electron Content) data, vertical sounding observations and JASON 1 and 2 derived vertical TEC. This presentation gives an overview about the DAIS project and the achieved results. We outline the assimilation approach, show the reconstruction and the validation results and finally address open questions.