

Operational space weather service for regional GNSS based applications

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SWIPPA (Space Weather Impact on Precise Positioning Applications) is a project initiated by the German Aerospace Center (DLR) and co-sponsored by the European Space Agency (ESA). The project aims at establishing, operating, and evaluating a specific space-weather monitoring service that can possibly lead to improving the precise positioning applications based on Global Navigation Satellite Systems (GNSS). Reported here is the current status of SWIPPA, detailed are the products and services that are currently available in a high resolution operational mode.

The established SWIPPA service centre at DLR operates a powerful data processing system working, in both real-time and post-processing modes, to provide the project consortium members with essential expert information delivered in the form of several products.

Generated are real-time products based on data from the reference network *ascos*[®], a reliable network which is typically operated at a sampling rate of 1 measurement per second (1Hz sampling rate). Primary measurements are formatted and transferred to the DLR processing facility where new value-added products based on these measurements are produced and distributed immediately. For example, produced are regional maps of the Total Electron Content (TEC), maps of the TEC spatial and temporal gradients. For the mapping process, the achieved spatial resolution is 1 degree and the temporal resolution is 5 minutes.

Simultaneously, collected are several important ground and space based observations of the current space weather conditions, including: solar wind parameters, geomagnetic field's horizontal component, percentage deviation of currently measured critical frequencies from monthly medians, and others. By regularly analysing and synthesising the incoming geophysical information, short messages are prepared, summarising the current conditions and warning for ongoing/upcoming ionosphere disturbances.

A strict evaluation of the service is currently under way, including reliability and applicability of the service, benefits, and possible future improvements.

Space Weather Impact on Precise Positioning Applications

Operational Space Weather Service for Regional GNSS-based Applications

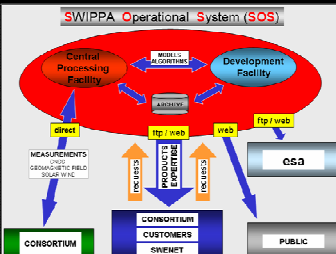
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The Space Weather is defined as the set of all conditions – on the Sun, in the solar wind, magnetosphere, ionosphere and in the geospace – that can influence the performance and reliability of ground-based or space-based technological systems and can endanger human health and life. SWIPA is a pilot project, initiated by the German Aerospace Center (DLR) and co-sponsored by the European Space Agency (ESA) via contract ESTEC-1955202/MLU/ML, which aims at the establishment of a specific space weather service for the GNSS-based applications. The main objective of SWIPA is to develop a space weather service for the GNSS-based applications, which is based on the operational space weather service for the GNSS-based applications, which is based on the operational space weather service for the GNSS-based applications.

Service

The project provides a specific space weather information to GNSS network operators in order to help them deliver a precise positioning service and to help them to solve any problem in the operation, post-processing, and other services. SWIPA is a pilot project, initiated by the German Aerospace Center (DLR) and co-sponsored by the European Space Agency (ESA) via contract ESTEC-1955202/MLU/ML, which aims at the establishment of a specific space weather service for the GNSS-based applications. The main objective of SWIPA is to develop a space weather service for the GNSS-based applications, which is based on the operational space weather service for the GNSS-based applications, which is based on the operational space weather service for the GNSS-based applications.



Consortium

German Aerospace Center (DLR)
 Institute of Communications and Navigation,
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 (http://www.dlr.de/ncn)

Aerialist network services,
 4th Floor, Unter den Eichen 10,
 D-10117 Berlin, Germany
 (http://www.aerialist.de)

IEEA International Electrotechnical Commission,
 3, rue de la Woluwe, 1200 Brussels, Belgium
 (http://www.iea.ch)

SENZIS – Sensor and Systematic Analysis of GNSS Data,
 Bad Godesberg, Germany
 (http://www.senzis.de)

LYM – Land Surveying Office of Mecklenburg-Vorpommern,
 Schwerin, Germany
 (http://www.lym.de)

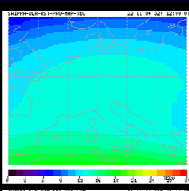
Swiss Reinsurance, Zurich, Switzerland
 (http://www.swissre.com)

Geoforschungszentrum (GFZ), Potsdam, Germany
 (http://www.gfz-potsdam.de)

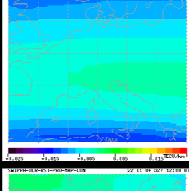
University of Applied Sciences, Neubrandenburg, Germany
 (http://www.haw.de)

Products

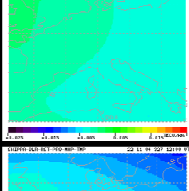
TTC
 DLR operates a system for regularly monitoring ground-based GPS data and processing maps of the ionospheric conditions over the European region. These maps are generated from the ground-based GPS data and from other geophysical data. The maps are generated from the ground-based GPS data and from other geophysical data. The maps are generated from the ground-based GPS data and from other geophysical data.



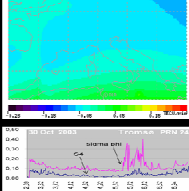
TEC gradients - latitude
 Using gradients to be forecasted, TEC values as well as small-scale structures of the ionosphere can be forecasted. The forecasted TEC values are used to predict the ionospheric conditions over the European region. The forecasted TEC values are used to predict the ionospheric conditions over the European region.



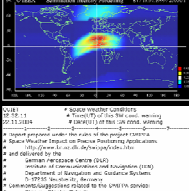
TEC gradients - longitude
 Using gradients to be forecasted, TEC values as well as small-scale structures of the ionosphere can be forecasted. The forecasted TEC values are used to predict the ionospheric conditions over the European region. The forecasted TEC values are used to predict the ionospheric conditions over the European region.



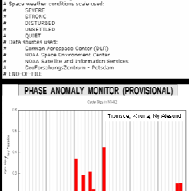
TEC gradients - time
 Using gradients to be forecasted, TEC values as well as small-scale structures of the ionosphere can be forecasted. The forecasted TEC values are used to predict the ionospheric conditions over the European region. The forecasted TEC values are used to predict the ionospheric conditions over the European region.



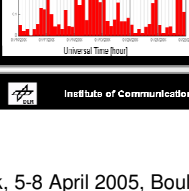
Scintillation Monitoring
 This product is a regularly generated map of the ionospheric conditions over the European region. The map is generated from the ground-based GPS data and from other geophysical data. The map is generated from the ground-based GPS data and from other geophysical data.



Space Weather Warning
 This product is a regularly generated map of the ionospheric conditions over the European region. The map is generated from the ground-based GPS data and from other geophysical data. The map is generated from the ground-based GPS data and from other geophysical data.



Cycle Slip Monitoring
 This product is a regularly generated map of the ionospheric conditions over the European region. The map is generated from the ground-based GPS data and from other geophysical data. The map is generated from the ground-based GPS data and from other geophysical data.



Case Study

Several geomagnetic storms took place in January 2005 during one of the most active periods of the solar cycle. The geomagnetic storm on 13 January 2005 was the most intense. The storm was caused by a coronal mass ejection (CME) from the Sun. The CME was directed towards Earth and caused a geomagnetic storm. The storm was caused by a coronal mass ejection (CME) from the Sun. The CME was directed towards Earth and caused a geomagnetic storm.

