First Experience in Operationally Monitoring and Assessing the Space Weather Impact on GNSS based Positioning


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SWIPPA

Space Weather Impact on Precise Positioning Applications

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SWIPPA is a pilot project, jointly supported by the German Aerospace Centre (DLR) and the European Space Agency (ESA) via contract ESTEC-16952/02/NL/LvH.
The space weather can induce adverse effects on GNSS-based communication, navigation, and positioning applications. Permanent **ionosphere/space weather monitoring service should be established** and specific products, based on GNSS and space weather observations, should be generated and distributed to GNSS reference network operators in order to help them **deliver a more reliable, precise and secure positioning service** and to eventually reduce the operation, production, and other business costs. **Relevant information and support** to be regularly **exchanged** with SWENET (Space Weather European Network).

Objectives achieved by:

- Operational provision of GPS data
- Operational provision of ionospheric and space weather observations
- Pre-processing and calibration of GPS data
- Generation of TEC maps (and derivative products) over Europe
- Post-processing and analysis of ionospheric / space weather information
- Analysis of ionospheric / space weather effects
- Analysis of benefits for the service users
Nowcast TEC maps
Nowcast TEC spatial and temporal gradients
Warning geophysical messages
Forecast TEC maps

Spatial mapping coverage – regional:

Mapping area:
Longitude: - 5° to + 25°E
Latitude: + 35° to + 60°N

Grid resolution (depending on the ‘visibility’ of GNSS satellites):
Longitude: 1° (best option)
Latitude: 1° (best option)

Temporal coverage
Availability: 24-hour service
Update rate: 15 min
Latency: 1 min
Service reliability. The periods of service unavailability (planned or otherwise) decreased steadily during the project (see the figure).

Spatial and temporal resolution particularly good, higher and better than originally requested by users.

Quality of forecast products good, but can be further improved.

The service evaluation was performed by consortium members and external users.

Increased awareness of space weather-related problems.

Improved likelihood of successful measurements and consequent processing.

improved SAPOS-based imaging.

About €1500 per day saved during each space weather event by avoiding repeated measurements/processing.

About €250 per day per surveying team saved during each SpWe event by avoiding re-initialisation procedure(s) on the field.
Further improve the spatial and temporal resolution of the nowcast service.

Improve the quality of the short-term ionospheric forecast, diversify the forecast products.

Utilise additional space-based measurements for plasmasphere reconstruction.

Extend the current regional mapping towards local and global coverage.

Develop novel techniques/products to be directly used in GNSS algorithms.

Develop new improved service to address a larger set of professional GNSS users.
Experience gained by the SWIPPA developers and users would help improving the services

New services should address the needs/requirements of a wider GNSS user community

Forecast products needed by GNSS users:
- TEC disturbance, forecast needed from 3h to 24h in advance
  (requires comprehensive fundamental research)
- Scintillations local, forecast
  (requires data processing on site)

Service operational costs (estimated):
Service operation/upgrade: 1 person/year
Equipment maintenance
(GNSS/IT equipment maintenance, data archiving, etc.): 1 person/year

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