GI4.5 | Arctic observations: data collection, management, and user engagement

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

The INGV Arctic Ionospheric data management system and its synergy with the Italian NADC

DOI: 10.5194/egusphere-egu2020-22424

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The polar regions are a privileged place for the ionospheric monitoring and the scientific research in the field of the Space Weather. The INGV permanent observatories in the Svalbard (and soon in the Thule airbase, Greenland) provide near real-time information to constantly monitor the ionosphere in the northern hemisphere and contribute, with the other observatories of the INGV network, to the Space Weather services realized in the framework of international collaborations like the PECASUS* consortium.

* http://pecasus.eu/
The Space Weather Information Technology (SWIT) system

- **ACQUISITION AND TRANSMISSION LAYER**: real-time processing, near real-time data transmission (15 minutes or less).
- **DATABASE MANAGEMENT SYSTEM LAYER**: data storing and preservation; allows to easily retrieve, analyse and compare spatially and temporally distributed ionospheric data.
- **POST-PROCESSING LAYER**: higher-level data and ionospheric space weather targeted products.
- **ACCESS AND DISSEMINATION LAYER**: open and unrestricted access to data and services.
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Access and dissemination layer

- **SWIT DBMS**
  - DB query
- **VISUALIZATION AND ANALYSIS ENGINE** (Grafana**)
- **RESTful WEB-SERVICE** (based on php-crud-api project***)
  - HTTP APIs requests
  - Machine-readable JSON data
- **ESWUA WEBSITE***
  - HTTP APIs
  - Image rendering
- **DOWNLOAD TOOL**
  - HTTP APIs
- **DATA VISUALIZATION AND ANALYSIS TOOL**
  - Direct and unrestricted access

**END USERS AND STAKEHOLDERS**

- Advanced, script-based access
- Simplified, user-friendly access
- Data visualization

* The new eSWua website will be online soon ** https://github.com/mevdschee/php-crud-api *** https://grafana.com/
eSWua website: near real-time data visualization and access

This example shows the near real-time scintillation data (in the image are visible the $S_4$ and $\sigma_\varphi$ scintillation index and the station parameters) for the Lyb0p instrument in Longyearbyen. The data can be filtered by area, station, time, GNSS constellation, etc. The GUI provides highly dynamic panels and make it possible to navigate the values of the represented data. Other tools allow to retrieve the datasets in the JSON interchange format and the rendering of static images.
eSWua website: the download tool and examples of visual alerts for scintillations monitoring over Arctic region
The path towards a FAIR ecosystem for the INGV Ionospheric data

A conceptual view of the SWIT-eSWua ecosystem and an abstraction of its FAIR components

Color legend
- **F**indable
- **A**ccessible
- **I**nteroperable
- **R**eusable
The Italian National Antarctic Data Center (NADC)

Besides the Arctic stations, the SWIT system also manages the data acquired by several INGV ionospheric instruments installed in the Antarctic region; this data will be also included in the Italian National Antarctic Data Center. The NADC is the ICT infrastructure designed to gather, handle, publish and provide access to the large amount of scientific data collected by several projects in the framework of the Italian Antarctic National Research Program (PNRA). Aim of the infrastructure is to provide a single integrated system that allows the final users to easily access and share data wherever they are stored. The Infrastructure is adopting the ISO 19115-3/INSPIRE standard for the metadata and will rely on the GeoNetwork opensource software as catalog application.
Final remarks

- Regular ionospheric observations in the Arctic region can provide timely information for the monitoring, forecasting and mitigation of the effects on modern technologies (such as telecommunication systems, power networks and in general systems relying on satellite navigation) during Space Weather events.

- The SWIT (Space Weather Information Technology) system coupled with the eSWua (electronic Space Weather upper atmosphere) web-platform enable the management of the near real-time ionospheric data collected by the INGV network and allow the open access to this information.

- A FAIR-oriented development approach is adopted, aimed at Open Science principles. FAIR Digital Objects can only exist in a FAIR ecosystem which includes services that provide persistent identifiers, metadata specifications, stewardship, actionable policies, etc.

- The experience gained with the Italian National Antarctic Data Center is essential to improve the interoperability of the SWIT-eSWua system and to foster new collaborations with the Arctic data centers.