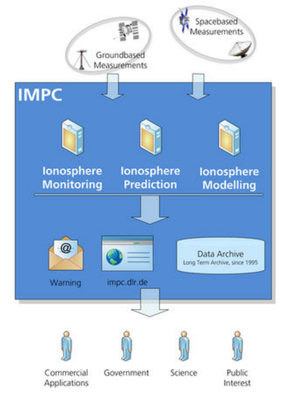
Ionosphere Monitoring and Prediction Center

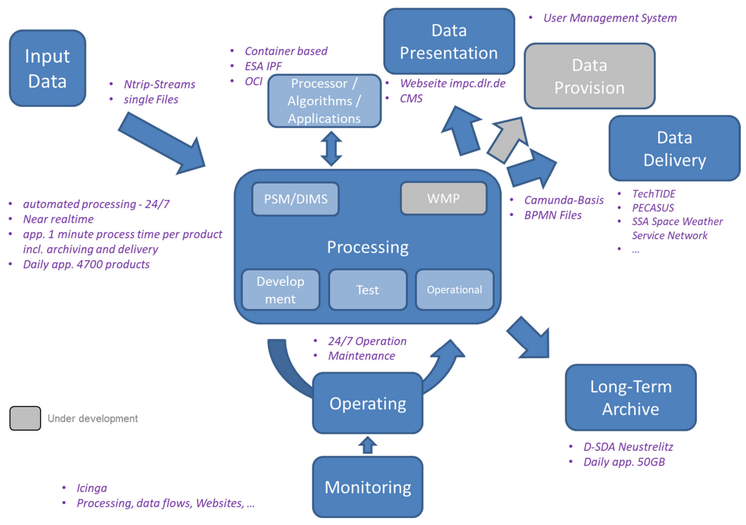
Background

The IMPC - evolved from the predecessor projects SWIPPA (Space Weather Impact on Precise Positioning Applications of GNSS) and SWACI (Space Weather Application Center - Ionosphere) - processes more than 50 gigabytes of ionosphere-related data daily, generating 2888 ROTI products and 288 TEC products as well as 1588 other products for GNSS users. This flexibly extensible and building block platform for data processing, archiving and delivery relies on the use of standards such as OCI (for container applications), BPMN (Business Process Model and Notation) and ESA IPF and is oriented towards the latest methods of data processing and orchestration. Both near-real-time product delivery and secure long-term archiving are applied here. The IMPC can be used and adapted for various projects in the field of space weather and thus currently offers, among other things, within the framework of the ESA Space Safety Programme (https://swe.ssa.esa.int/), as well as the ICAO PECASUS project (https://pecasus.eu/), as one of the four ICAO global space weather centers, and for the continuous provision of ionospheric products, which are being developed by the Institute for Solar-Terrestrial Physics in Neustrelitz.



IMPC as a processing platform

The development and continuous operation of efficient infrastructures based on excellent research, established standards and modern open source data processing and container technologies is the basic prerequisite for the operation of highly available and value-adding space weather services. This allows a wide range of products to be computed and delivered on time with very high cadence and very low latency, and ultimately to support internal and global research activities in space weather science and related applications.

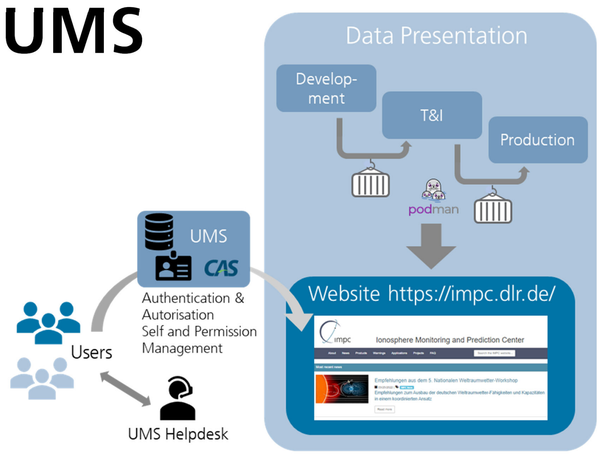


The IMPC as a platform for automated processing of ionospheric products with a 24/7 near real-time basis.

The IMPC needs around 1 minute processing time per product including archiving and delivery time. Approximately 4700 products are created daily. The platform gets data from NTRIP streams or single files and uses a 3 step processing environment from development over test zone to the operational world. The operational service is accompanied by the IMPC User Help Desk (impc-uhd@dlr.de) for technical, functional or thematic issues and requests from registered users, project partner or any ionospheric weather interested persons. Furthermore it is monitored by an automatic system. The IMPC platform provides three different ways for data distribution to users, projects and networks. The first and easiest way is data presentation via the IMPC website (https://impc.dlr.de/) with near real-time products. The second way is the data delivery directly to projects and users via sftp or other individually defined ways. The third data distribution approach is currently under development and will give users an opportunity to retrieve customized data packages from the IMPC product data archive.

Website and UMS

The IMPC website (https://impc.dlr.de/) offers information about the IMPC background and about the current state of the ionosphere, related forecasts and warnings. It offers also graphs and data from current near real-time products.



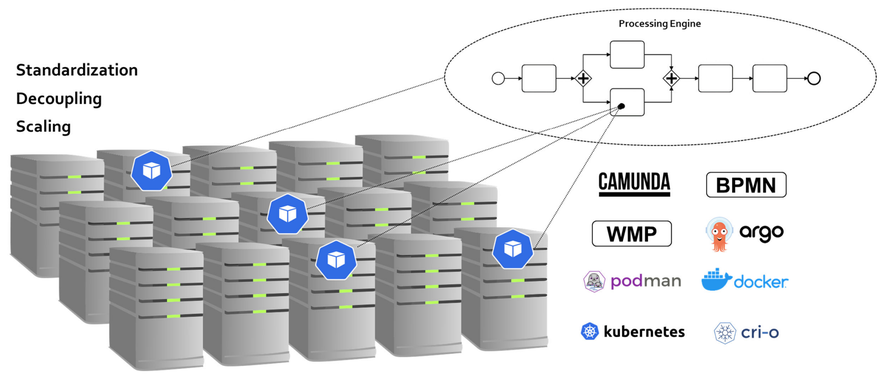
The EOC User Management System IMPC connection.

For the IMPC user management the EOC UMS (User Management System) is used. Connection to the EOC UMS enables Single Sign-On (SSO) with centralized user and group management. The system is compliant with the German Satellite Data Security Act (SatDSiG) and has a well-established science user support. The IMPC website is compliant to the General Data Protection Regulation (GDPR).

The development and operation of the IMPC web server environment is also protected through the use of three levels of development (development – test & integration - production). For the convenient operation of the website security and its different versions, containerization is implemented. Thus root rights on the server are not required and network communication between the containers is possible.

Processing and Archiving

The IMPC processing system is in a state of transition. Established processing chains have been integrated by using components from the Data and Information Management System (DIMS). This is a functionally as well as geographically distributed system that offers standardized interfaces for access management, production management and long-term archiving. Upcoming processing chains will be implemented by using container for a standardization, the Workflow Management Platform (WMP) and the Business Process Model and Notation (BPMN) for defining the workflows. Our partner for the development of DIMS and WMP is WERUM (https://www.werum.de/).

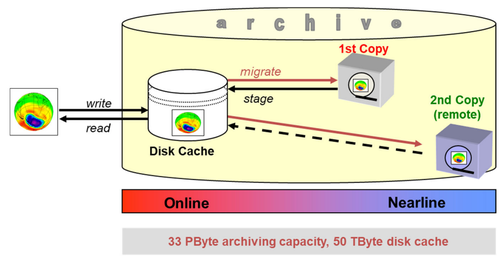


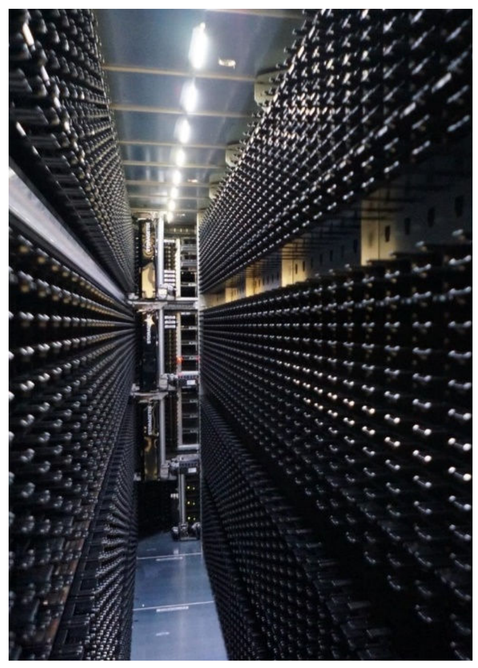
Great importance is attached to standardization by using a uniform format for all components (containers) and to facilitate deployments, interchangeability and upgrades. Also decoupling of all components from the actual runtime environment (executable in all compatible container runtime environments) has an extremely high priority.

DLR's German Satellite Data Archive (D-SDA) in Neustrelitz and Oberpfaffenhofen is one of the most modern long-term archives in the world. It serves to archive all of the Earth Observation Center's remote sensing data and products in both the short- and long-term, as well as providing access for users. Long-term archiving is used to ensure sustainable availability and usability of Earth observation data. The D-SDA currently is containing app. 135 million files and 25 Pbyte of data.

DLR has more then 20 years of experience with the SAM-FS in 365 days/24 hours operations with ~47.000 product transfers per day.

For IMPC data and products the permanent archiving is an important component without time limitation, fast data delivery to users and a high availability.





DLR's German Satellite Data Archive (D-SDA) – the archive for all of the Earth Observation Center's remote sensing data and products in both the short- and long-term.

Deutsches Zentrum für Luft- und Raumfahrt

Henrike Barkmann, Galina Voinov, Daniel Risch, Sven Stönner, Max Wegner and Mirco Tegler [1] on behalf of the IMPC team[1,2]

[1] DLR Earth Observation Center, Neustrelitz, Germany
[2] DLR Institute for Solar-Terrestrial Physics, Neustrelitz, Germany

Contact: impc-uhd@dlr.de

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