

## Executive Summary



Ground European Network for Earth Science Interoperations - Digital Earth Communities (GENESI-DEC) (<http://www.genesi-dec.eu/>) is a project, co-funded by the European Community's Seventh Framework Programme FP7/2007-2013 under grant agreement n° 261623 addressing work programme topic "INFRA-2010-1.2.3: Virtual Research Community" and implemented by a consortium led by the European Space Agency, aimed at providing reliable, easy, long-term access to Earth Science data via the Internet. The project kicked off on the first of May 2010 and its duration is 29 months. The contact person is Roberto Cossu ([roberto.cossu@esa.int](mailto:roberto.cossu@esa.int)).

**Introduction: Digital Earth** is a visionary concept for the virtual representation of the Earth that is spatially referenced, interconnected with the world's digital data repositories, and encompassing all its systems and forms, including Earth Sciences, Natural Resources Management, Environmental Monitoring system and human society dimensions. GENESI-DEC will establish open data and services access, allowing European and worldwide Digital Earth Communities to seamlessly access, produce and share data, information, products and knowledge. This will create a multi-dimensional, multi-temporal, and multi-layer information facility of huge value in **addressing global challenges such as biodiversity, climate change, pollution and economic development**. GENESI-DEC evolves and enlarges the platform developed by the predecessor GENESI-DR project by federating to and interoperating with existing infrastructures.

GENESI-DEC involves key partners of ESFRI projects and collaborates with key actors of Digital Earth and Earth Science initiatives, including the International Society of Digital Earth and GEO-GEOSS. Thus efficient use of already existing and planned developments is guaranteed.

**Objectives:** The objectives of GENESI-DEC are:

- *Enlarge the Infrastructure:* To enlarge the existing GENESI-DR infrastructure in terms of data, resources availability and geographical extent.
- *Guarantee Service:* To provide guaranteed, reliable, easy, effective access to a variety of data, facilities, tools and services to an ever increasing number of Digital Earth users from all disciplines.
- *Harmonise Federation:* To harmonise operations at selected key Digital Earth infrastructures limiting fragmentation of solutions.
- *Enable User Collaboration:* To enable multidisciplinary collaboration among Digital Earth users as well as the creation of user-configured virtual research facilities/test-beds.
- *Respond to Innovation:* To integrate new scientific and technological derived paradigms in operational infrastructures in response to the latest Digital Earth requirements.
- *Promote Virtualisation:* To stimulate, educate and support the creation of virtual Digital Earth research communities.

**Digital Earth Communities:** GENESI-DEC pays a great attention to all the aspects related to User Communities and in particular to Digital Earth Communities. To this end a dedicated activity (WP3) is in charge of:

- liaising with the wide Digital Earth community and relevant infrastructures projects,
- analysing and eliciting the needs and functionalities required by the Digital Earth Communities, also by defining high level use cases;
- documenting the community requirements and passing them to the technical activities of the project which undertake the infrastructure design and development work;
- identify and develop specific applications matching the community needs;
- once the upgraded system is deployed, validate GENESI-DEC to assure that the community needs are correctly addressed by the infrastructure.

WP3 significantly contributes to the main goals of the project by both guiding the enlargement of the GENESI-DEC infrastructure via interoperation with other e-infrastructures and building multidisciplinary services and customised Digital Earth facilities.

At the beginning of the project, GENESI-DEC has started considering a predefined set of specific Digital Earth Communities within specific Earth Science domains/disciplines. For each of the Digital Earth Community, e-infrastructures and/or digital repositories of interest have been identified and specific Use Cases defined. These have been analysed and used to derive user requirements, which have been documented and transferred to the technical activities.

Five applications have been implemented in the first project phase, which enrich GENESI-DEC with joint visualization capabilities of surface and seafloor data as well as aircraft and satellite data, and also with orthorectification and land cover mapping capabilities. The successful validation of the newly developed GENESI-DEC functionalities against the user requirements has been carried out.

**In the second project phase** new communities have been identified and analysed and collaborations established with new FP7 projects. Thirteen new use cases have been devised (and corresponding requirements specified): these use cases, while serving the needs of the identified communities, fully address the challenging Project objectives, from discovery and access of heterogeneous data, to discovery and usage of processing services and applications to multidisciplinary and inter-user collaboration.

New applications have been designed and implemented, as needed from the new use cases. They add up to the five already developed in the first project phase and provide GENESI-DEC with new capabilities, including ship detection services, disaster management support services that allow e.g. earthquakes damages assessment and analysis; services for the Calibration and Validation of data.

Moreover, two of the applications delivered in the first project phase (the Visualization Tool and Near real Time Orthorectification Service) have been further improved.

As of this writing, WP3 is planning the validation activities on the final GENESI-DEC infrastructure: they are aimed at verifying the compliance with the elicited user requirements.

**The GENESI-DEC Platform:** GENESI-DEC evolves from the predecessor GENESI-DR project, which has given a significant and recognized contribution in designing and implementing a multidisciplinary platform. The platform developed by GENESI-DR provides discovery capabilities of scattered and heterogeneous data, easy and fast access to such data, on demand computing resources, and makes easier the dissemination of newly generated results. The GENESI-DR Architecture is realized by existing and newly developed services, interacting through SOAP and REST interfaces. GENESI-DEC has inherited a

federative infrastructure hosting more than 166 dataset series. Dataset series include satellite data, in situ data, images acquired by airborne sensors, digital elevation models and model outputs. At the end of the first year of activity, the number of dataset series has increased to 440. **During this second year of activities**, the number of series has increased from 440 to more than 1500. The work done in the past year aimed at increasing and guaranteeing the refreshing and updating of the catalogue with the acquisition of new data (for all the series of satellite data acquired by ESA and available online) and has also led to a significant increase of available products within the series.

Significant improvements in interfacing the CEOS WGISS Integrated Catalogue (CWIC) have been obtained, thus it is now possible to seamlessly discover data from US, Chinese and Brazilian providers. The metadata related to the Italian Ministry of Environment have been consolidated so to be fully compliant to the INSPIRE directive.

The first operations needed to make the Web Portal interoperating/interface with the services and tools developed by WP6 and WP7 have started (and will be concluded in the next reporting period). A new processing environment, based on OGC WPS standard, has been prepared and an aggregator node has been prepared to store and publish the information related to the available WPS services, so that these will be discoverable in the same way as dataset series are.

**Research activities:** The two major GENESI-DEC deliveries, as described while presenting the meaning and the products of the virtuous cycle of innovation, will include the outcomes of the two joint research activities (JRAs) identified by the consortium.

The first JRA (WP6- Geosemantics, Ontology and Workflows) is concerned with the use of semantics and ontologies in assisting data discovery and geospatial services composition. **During the second year** of the project, the semantic framework developed in the first year has been also enhanced by enriching the content and quality of the knowledge database and by developing new services that allows not only an easier data discovery, but also processing services discovery, data and services tagging, and workflow composition (e.g. identification and selection of data to be used for a particular processing service for a specified time period and over a specific geographic area).

The second JRA (WP7 – Security Frameworks Interoperability) is tackling the security in heterogeneous federated repositories. The outcomes of WP7 are expected to allow users to log in once to the system and gain access to the resources and services available in the federation without being prompted to log in again, despite the physical location and ownership of the different data and/or resources selected. **In the second year of activity**, WP7 has improved the components developed during the first year. The main developments include a Shibboleth/OpenID bridge, which is planned to be used in the ESA SSO operational environment, and an OpenLDAP attribute mapper, to provide the users with an easier access to secured data. Furthermore a test repository using OpenID and the LDAP attribute mapper is also planned to be deployed. Security requirements in processing services have also been extensively analysed and addressed.

**Standardisation and dissemination activities:** Since the beginning of the project, GENESI-DEC has established key collaborations in the frame of **Global Environmental initiatives**, such as the **Global Earth Observation System of System (GEOSS)**, which will provide decision-support tools to a wide variety of users, being a global and flexible network of content providers allowing decision makers to access an extraordinary range of information at their desk. This ‘system of systems’ will proactively link together existing and planned observing systems around the world and support the development of new systems where gaps currently exist. Another major key collaboration is in the frame of environmental Research Infrastructures, and more specifically with **ESFRI** projects.

GENESI-DEC integration in the GEO Portal has demonstrated how it can contribute to the enhancement of the GEOSS Common Infrastructure with new data access and processing capabilities. A number of successful demonstrations of GENESI-DEC capabilities in easily discovering and accessing heterogeneous data have been made included the one at the GEO Plenary, in November 2011. The enhancement of the GEOSS Common Infrastructure will be addressed by the EC-FP7 GEOWOW project starting from the GENESI-DEC achievements.

Within the frame of the GEO-GEOSS work plan 2012-2015 GENESI-DEC is contributing in providing data access and supported the GEOWOW project to prepare a common vision towards the GEOSS Common Infrastructure.

GENESI-DEC has also established successful collaborations with several **Environmental ESFRI projects**, in addition to the ones represented in the consortium. INGV has developed OpenSearch interfaces to the MOIST catalogues, which contained data that will be included in the EMSO RI. DLR, partner in IAGOS, is now using OpenSearch to cataloguing its flight data. The ENVRI project which has among its goals to achieve interoperability among Environmental ESFRI infrastructures, considers GENESI-DEC as the basis for the technical development to be done for achieving this challenging objective.

Furthermore MARIS has developed OpenSearch interfaces on top of the SeaDataNet CDI catalogue which contains over 1 million marine in-situ datasets.

GENESI-DEC is proactive in several **Open GeoSpatial Consortium (OGC)** working groups on the following topics: Catalogue Services for the Web, Web Processing Service, Ordering Services for Earth Observation Products Standard , OpenSearch GeoSpatial Standard, Publish/Subscribe Standard, Web Map Context Implementation.

**Highlights and Conclusions:** **During its second year of activity**, GENESI-DEC has significantly enhanced the operational platform resulting from the first innovation cycle. This platform is aimed at offering Earth scientists reliable, easy, long-term access to Earth Science data via the Internet. In particular, GENESI-DEC has increased the number of products discoverable and accessible through the platform, has consolidated the set of metadata for the already registered series, has improved the reliability and freshness of data available. Research Activities have started delivering and updating a large set of components that will be fully integrated in the platform. These will allow a semantically enriched search of data and processing services, the automatic identification of processing services available for the discovered data, data tagging and workflow chaining as well as a single-sign-on experience that will simplify data access for authorised users.

Many of these features are the response to the needs of the different Digital Earth Communities identified within the project that have allowed the definition of several challenging use cases that will be used in the next reporting period to validate the platform.

Several collaborations with projects and external bodies have been established with the aim of educating user communities to the use of Research Infrastructures, gathering user requirements. Particular attention has been given to GEO-GEOSS and to Environmental ESFRI projects.