

## 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 two years. 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 Infrastructure:* To enlarge the existing GENESI-DR infrastructures 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 both the main goals of the project by 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. In fact, thanks to the fact that GENESI-DEC is strongly built on the success of GENESI-DR, several liaison with external heterogeneous Digital Communities were already established at the project kick-off. These liaisons are mainly made via representative projects in the European and international scenario, relevant in the context of the Earth Sciences or research data infrastructures. For each of the Digital Community, e-infrastructures and/or digital repositories of interest have been identified and specific Use Cases defined. These been analysed and used to derive system requirements, which have been documented and transferred to the technical activities. A set of applications to be developed in the first project phase have been selected according to user priorities and technical constraints. Five applications have been implemented: they 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.

**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 multi-disciplinary 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 inherited a federative infrastructure made up of 19 different Digital Repositories hosting more than 166 dataset series. Dataset series refer to heterogeneous and 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. The scalability of GENESI-DEC has been enhanced substituting the single central site with several Aggregator Nodes that can be specialised to contain the metadata of community specific dataset series. A new Web Portal has been designed and deployed providing new features that makes easier the discovery of the data and the develop of highly customizable services. Part of these features derived from the analysis of user requirements has gathered by WP3. The project has also consolidated the set of metadata based on the feedback of User Communities (e.g., satellite atmospheric data) and has successfully worked to increase and guarantee 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). Furthermore, WP5 has worked to solve some open issues identified at the end of GENESI-DR and this has led to a

new release of the GENESI SW. In particular, the Catalogue Access Service SW has been improved in terms of performances (e.g., time to response), features (e.g. querying capabilities), management (e.g., more user friendly interface to register new data, based REST interface).

**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 service composition. In the first year of the project, requirements for geospatial data and services semantic interoperability were identified and guidelines for the data and services annotation in a context of collaborative development of data descriptions were defined. A prototype of the metadata annotation component was implemented semantically enabling search and discovery service for GENESI-DEC. The first domain used to model the GENESI-DEC Ontology has been the Earth and Observation one. Different ontology model published over the net have been studied and tailored in the GENESI environment. Several already consolidated ontologies have been imported in our ontology to reuse them. Specific terms and concepts strictly linked with the needs of GENESI-DEC project have been integrated. The first integration tests between the ontology and the semantic framework have been performed to test the process. The Semantic framework has been also installed in a public IP machine to allow all other partners to reach it and interact with it. The Harvester components has been finalised being also prepared for the other external infrastructures. The customization of the connector to map concepts of the ESA central catalogue with the ontology terms has been consolidated and finalised. Also the integration with the semantic framework has been performed transforming metadata tag and value retrieved from the catalogue in sets of triple with ontology terms.

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 first year of activity, WP7 has analysed the security interoperability requirements of the GENESI-DEC stakeholder communities and defined an architecture allowing them to be federated. It has developed components that allow any standard Apache repository to be integrated into this security framework. The attribute provider allows mapping of attributes between communities where desired, while still allowing individual repository owners the final say in access decisions at their repositories. A demonstration portal and two test repositories have been deployed to demonstrate how the system works. The password manager component allows integration with legacy password-based repositories. WP7 has provided solutions to improve the usability of GENESI-DEC by allowing repositories to provide a custom error page when authorisation is denied that allows users to submit a request for access easily, with the user ID and resource filled in automatically.

**Standardisation and dissemination activities:** 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.

Within the frame of the GEO-GEOSS work plan 2009-2011 and its DA-09-02a GEO task for effective management of large volumes and diverse types, an Alliance has been proposed

among selected data centres/projects (in particular DIAS, GIOVANNI and GENESI-DR/GENESI-DEC) to promote a common vision towards the GEOSS Common Infrastructure.

GENESI-DEC has been recently integrated in the GEO Portal to demonstrate 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 has paved the way to the integration of GENESI-DEC in GEO-GEOSS and its use for the next GEO-GEOSS demo to be done at the GEO Plenary, November 2011. The enhancement of the GEOSS Common Infrastructure will be addressed by the EC-FP7 GEOWOW project starting from GENESI-DEC achievements.

GENESI-DEC has also established successful collaborations with several **Environmental ESFRI projects**, in addition to the ones represented in the consortium. EMSO has already developed OpenSearch interfaces to their catalogues. DLR, partner in IAGOS, is now using OpenSearch to cataloguing its flight data. The SeaDataNet CDI system (with around 1 million in situ observations) is on the edge of having an OpenSearch interface to its catalogue. A new project ENVRI has been approved by EC for interoperations among Environmental ESFRI infrastructures. GENESI-DEC will be the basis of the technical development to be done for achieving this interoperability.

GENESI-DEC is proactive in several **OpenGeoSpatial 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 first year of activity, GENESI-DEC has inherited and enhanced the operation platform set-up and deployed by GENESI-DR. 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, has developed new SW for an easier registration and management of data and a new portal with an enhanced set of features for data discovery and highly customisable services design. Many of these features are the response to the needs of several Digital Earth Communities as identified within the project.

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, validating the GENESI-DEC system during the second year of activity via an increased number of validation applications. Particular attention has been given to GEO-GEOSS and to Environmental ESFRI projects.

A particular focus on industry involvement will be considered as well, given the project's infrastructure provides them with new opportunities to introduce services in the Earth Science domain from a scientific and commercial viewpoint fruiting from the state-of-the-art technologies such as Grid and Web Services and standards that are at the basis of the infrastructure.