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Dr. Fusco has more than 30 years experience in Earth Observation (EO) system and application domain. His present position in ESA-ESRIN is: Senior Advisor for Earth Observation Applications - EO Science and Application Department - ESA ESRIN.

He has continued to be involved in the planning and in the management of projects dealing with different aspects of EO Payload Data Systems, EO Applications and related innovation technologies. Since the last few years he is leading the ESA participation to the development and utilisation of GRID, Open GIS, emerging Web based and e-collaboration technologies for EO and Environmental applications throughout ESA and EC funded projects.

In the ESA participation to EC active FP6 and FP7 activities he is the coordinator of the GRID based Research Infrastructure project GENESI-DR (Ground European Network for Earth Science Interoperations – Digital Repositories) and he leads the ESA participation to the following projects: Grid support action for Earth Science – DEGREE; Digital Libraries in GRID environment – D4SCIENCE; Testbed for Long Term Digital Data and Knowledge Preservation – CASPAR; and Collaborative Working Environment – Collaboration@Rural.

GRL2020 Position Paper

This position paper gives a quick overview and vision on the key directions that research digital libraries should undertake in the specific domain of *Earth Science and Earth Observation*.

Earth Observation refers to images and data that allow for the observation of large-scale environmental phenomena with the appropriate time and space accuracy. Space-based data acquisitions are complemented by other ground-based data collection systems (e.g. buoys) to meet Earth Science community research and application requirements for generation of information; knowledge as expressed in detailed scientific results and publications; and operational applications for monitoring the earth's environment.

ICT services supporting the earth science domain like web portals or client applications have to deal with continuous streams of very different types of data sources, which need to be collected, organized and presented to their consumers. The management of this data must take into account not only the huge volumes of information, but also the different scenarios that can use and re-use such content together with the different categorization schemas possibly applicable to them. So far, the Earth Science community has concentrated large efforts in developing and using very advanced standards for metadata specification and services for data handling, such as those promoted by the Open Geospatial Consortium[1] (OGC) and the INSPIRE[2] initiative. Providers of

[1] http://www.opengeospatial.org/standards
[2] http://www.ec-gis.org/inspire/

geospatial and Earth Science related information maintain their data archives and derived knowledge in huge databases supported by sophisticated user access services via web sites and portals with rich and navigable descriptions of their content, such as the community EO portal[3] and data access directory and catalogue services[4].

State-of-the-art in research libraries targeting the earth science domain, shows a total lack of digital instruments to access and retrieve the above information and then manipulate and share it. This is especially true in a virtualised and personalised environment. Although attempts to put in place digital library dedicated services (e.g. the DLESE and ALEXANDRIA[5] projects) in this particular domain exist, what is lacking the most from the majority of current services and access points to earth science information, is a *user-centric approach.* This is because limits are usually imposed by few restricted search functionalities and fixed representation which is produced automatically from standard templates with content being regularly fed from databases. Such limitations are restrictive as Earth Science Representations can be dynamic, changing according to different contexts/scenarios of work and based on systems dedicated to collecting data on-demand from different sources and for different exigencies (working much like today RSS aggregators) according to users' preferences.

A concrete reference example which involved the participation of ESA/ESRIN in the exploitation and integration of digital libraries and Grid technologies is the DILIGENT project[6]. The integration of such technologies goes in the direction of enabling end-users to gain from distributed computing and large storage spaces; as well as, from typical high level services to access and retrieve information. Under the Earth Science domain perspective, the main directions in which research libraries activity should move have been identified as:

a) being based on unlimited hw resources (disk space, processing power, network capacity etc);
b) enabling full-text and geospatial search and browsing;
c) offering facilities to enable: the collaboration in virtual spaces built on-demand following users requests, the definition of personalised views via selection of content of interest, the semantic annotation of information to enrich customized views, the retrieval of annotations and, the *inclusion* of information;
d) being interoperable, offering facilities to plug-in user defined algorithms and applications to manipulate and processing contents;
e) being easy to reach use and possibly to host.

In particular, point e is too often not taken into consideration by researchers and developers in the ICT research field. This has an enormous impact in the domain of Earth Science where a number of everyday and also emergency applications involve the collaboration of scientists spread around the globe and coming from slightly different cultures who need easiness of use, fast access to information and accuracy of the software instruments at their disposal.

The DILIGENT test-bed demonstrated the usefulness of concepts like virtual organization, user workspace, collection, compound service and living documentation with the aim of creating on-demand ad hoc transient digital libraries and then aggregating pertained information into report documents (e.g. on the environment status), browsing, searching and managing users' workspaces from within virtual research environments. The user interface which is delivered is based on relatively recent technologies. These are essentially dynamic html and features interaction modalities for content objects; such as, moveable interactive knowledge units which are generated upon queries submitted by the user. These can be inspected, annotated towards user defined ontology, aggregated and saved into users' baskets, as well as being re-accessible on a per-user basis.

[3] http://www.eoportal.org
[4] http://earth.esa.int/, http://gcmd.nasa.gov/
[5] http://www.dlese.org/library/index.jsp, http://www.alexandria.ucsb.edu/
[6] http://www.diligentproject.org/