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Earth Sciences Multi-disciplinary Interoperability role in Distributed Research Infrastructures

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Earth scientists are engaged in integrating knowledge stemming from different disciplines about the constituent parts of the complex Earth system with the objective of understanding its properties as a whole system and mitigate the effects of the global changes. Earth system and global changes analysis is a real challenge for scientists as well as for information technology experts.
In fact, the scope and complexity of Earth system investigations demand the formation of distributed, Multi-disciplinary, collaborative teams. Indeed, advanced digital infrastructures, or cyber(e)-Infrastructures, are important to support the formation and operation of an Earth system science Community that is based on Multi-disciplinary knowledge integration. These distributed infrastructures must support Multi-disciplinary information sharing and interoperability. This requires to combine the scientific perspective and the technological perspective.
Considerable intellectual innovation is occurring due to data, information, and knowledge sharing across traditional disciplinary boundaries. The growing area of Multi-disciplinary Interoperability is concerned with providing integrated access to a range of advanced information and processing resources for the environment and the policy-makers support.
Multi-disciplinary interoperability is essential to achieve and effective and flexible integration of information systems from different geoscience disciplines, addressing the heterogeneity that characterizes the disciplines' data, metadata, processing models, services protocols and interfaces, semantics, and embedded knowledge.
In the Internet era, there is a clear demand to discover and access geosciences resources using Internet technologies. There is an irreversible trend away from data- centric architectures and toward service- oriented architectures (SOA) and systems. Data-centric architectures consider interactions and interoperability at the data level, sharing common data models, while service-oriented architectures allow interoperability among information systems at the enterprise level, sharing common functional interfaces.
This can be achieved by enabling spatial data infrastructures (SDI) to "understand" and serve valuable and useful geosciences resources. Recent Web 2.0 applications are required by Users to lower the entry barrier addressing some of the present SOA interoperability drawbacks (e.g. semantic issues and the proliferation of "standard" interfaces). Distributed Computing Infrastructures (DCIs) are needed to provide the necessary capabilities implementing the scalability required to integrate complex environmental models and manage large Earth Observation data and model forecasts.
Recent and promising experimentations have considered holistic and flexible approaches applying the System of Systems (SoS) and the Internet of Services (IoS) principles.
Important European and international initiatives (e.g. INSPIRE, GMES, and GEO/GEOSS) served as virtual intellectual commons for the geosciences community for discussing and sharing ideas and knowledge on advanced technologies that are of interest to the geospatial science community.