**ESA Summer School 2012**

**Week 1: August 3**

# Cyberinfrastructures in Earth Sciences

Stefano Nativi

National Research Council of Italy

*Earth and Space Science Informatics-laboratory (ESSI-lab) of the Institute of Atmospheric Pollution Research (IIA)*

stefano.nativi@cnr.it


# Cyber(e)Infrastructure

- .. Research environr
  acquisition, data sto
  integration, data mir
  other computing and
  processing services
  the scope of a singl
- Technological and s
  efficiently connectin
  people with the goa
  scientific theories a

(Wikipedia)

# AuScope Mission Statement
# (A national Earth Science Infrastructure Program)

"*Many of these problems can only be solved on a national, if not global scale. No single researcher, research institution, discipline or jurisdiction can provide the solutions. We increasingly need to embrace e-Research techniques and use the internet not only to access nationally distributed datasets, instruments and compute infrastructure, but also to build online, 'virtual' communities of globally dispersed researchers*."

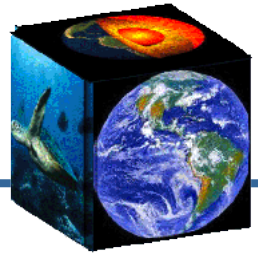
AuScope
An organisation for a national earth science infrastructure program

www.auscope.org.au/



stefano.nativi@cnr.it

# US NSF EarthCube

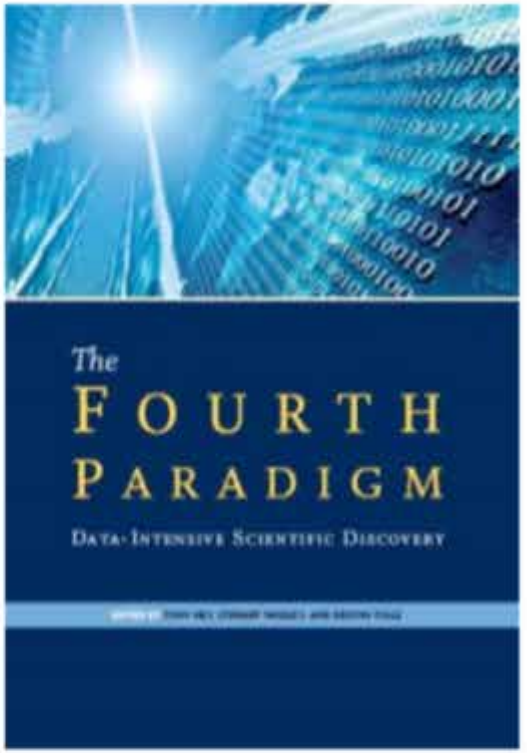


- … recognize the multifaceted challenges of modern, data-intensive science and education and envision an environment where low adoption thresholds and new capabilities act together to greatly increase the productivity and capability of researchers and educators working at the frontiers of Earth system science …

http://www.nsf.gov/geo/earthcube/

# Dealing with Data






http://www.sciencemag.org/site/special/data/ http://www.economist.com/node/15579717


# AUSTRALIAN NATIONAL DATA SERVICE (ANDS) -

http://www.ands.org.au/


# AUSCOPE -

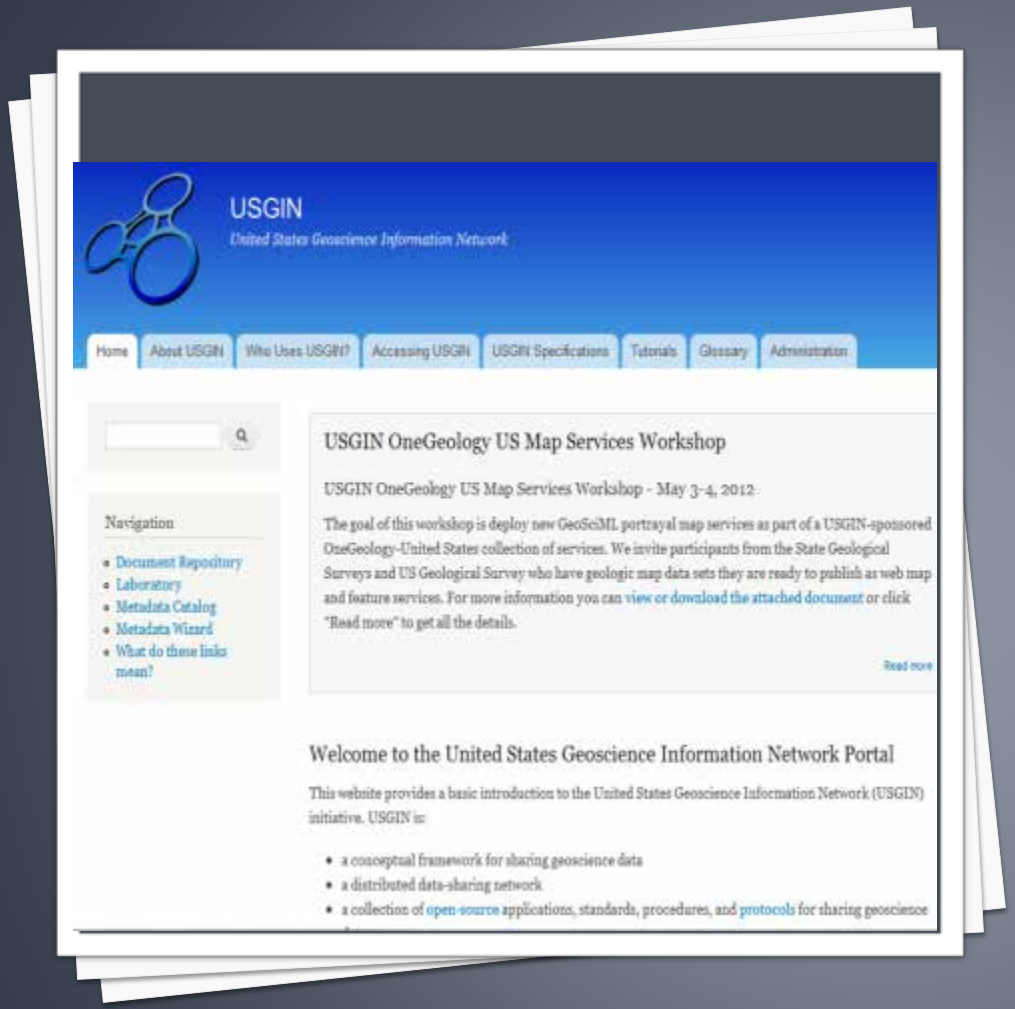
http://auscope.org.au


# ONEGEOLOGY

# AND

# ONEGEOLOGY-EUROPE

http://www.onegeology.org/
http://www.onegeology-europe.eu




# U.S. GEOSCIENCE INFORMATION NETWORK (USGIN) –

http://usgin.org


# EU INSPIRE -

http://inspire.jrc.ec.europa.eu/


# EU GLOBAL MONITORING FOR ENVIRONMENT AND SECURITY: GMES -

http://www.gmes.info/


# EU SHARED ENVIRONMENTAL INFORMATION SYSTEM: SEIS -

http://ec.europa.eu/environment/seis/index.htm

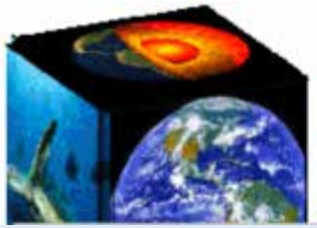

GROUP ON EARTH OBSERVATIONS

# GEOSS COMMON INFRASTRUCTURE -

http://www.earthobservations.org/geoss.shtml


# UNEP-LIVE

http://www.uneplive.org/uneplive/catalog/maps/home.page



EarthCube

To transform the conduct of research in geosciences by supporting community-based cyberinfrastructure to integrate data and information for knowledge management across the Geosciences.

# EARTHCUBE

http://earthcube.ning.com/


# EYE ON EARTH

http://www.eyeonearth.org

eye on earth
ABU DHABI 2011 SUMMIT
CONVENE | CONVERGE | COLLABORATE
12-15 December 2011

# Cyber(e)infrastructure Objectives

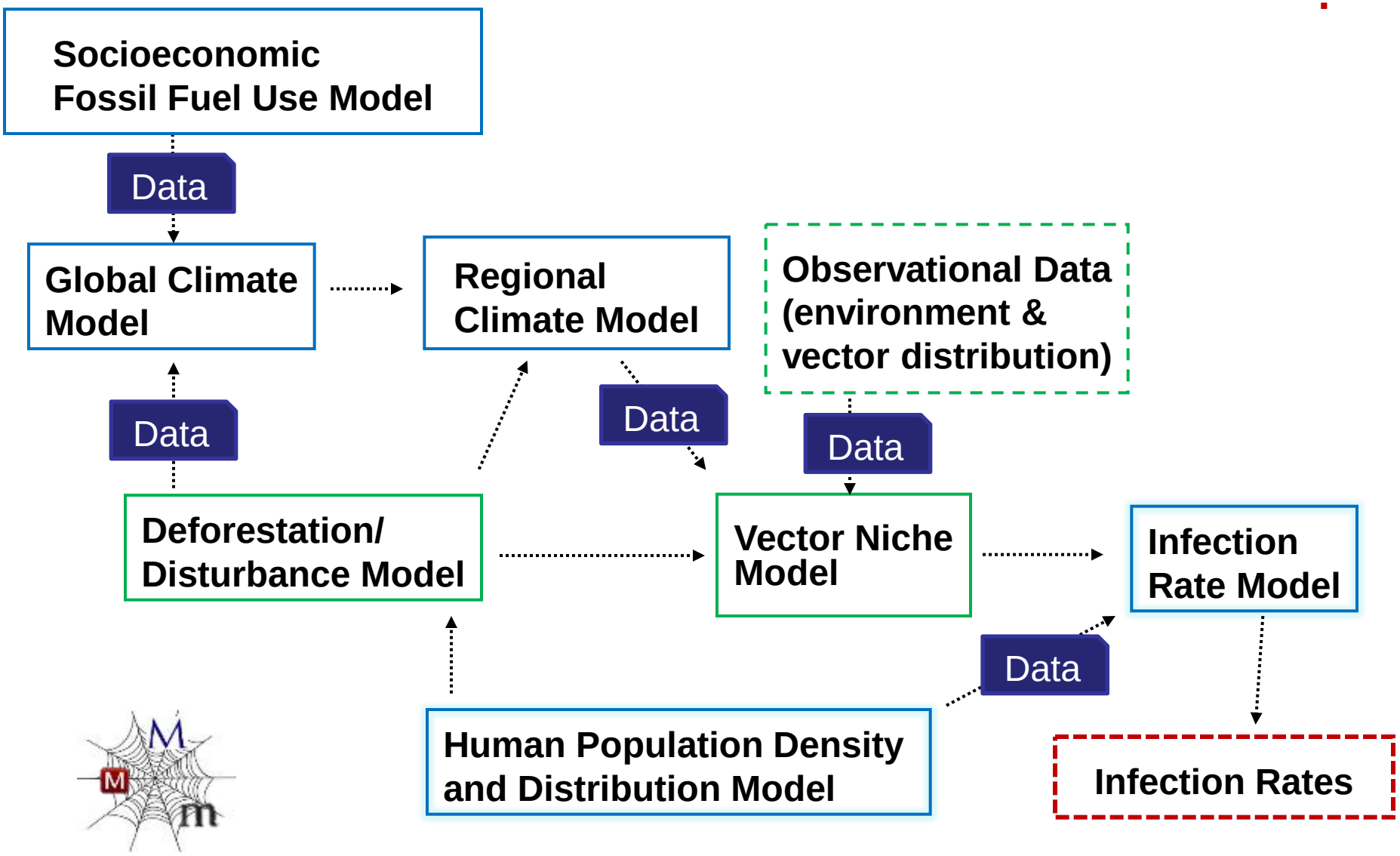
- leverage and share resources, and developments
- Facilitate multi and cross-disciplinarity (e.g. ESS)
- support new applications/tool development and existing application/tool use
- enhance knowledge transfer not only across the community, but into the domain sciences
- lower existing entry barriers for users and data producers

- facilitate and enhance emerging technologies and methodologies
- support the promulgation and institutionalization of agreed-upon standards, protocols, and practice


stefano.nativi@cnr.it

# What if…

**How will CC affect infection rate of dengue fever in Vietnam?**




*[GEO Model Web, Geller, Nativi, Mazzetti,]*

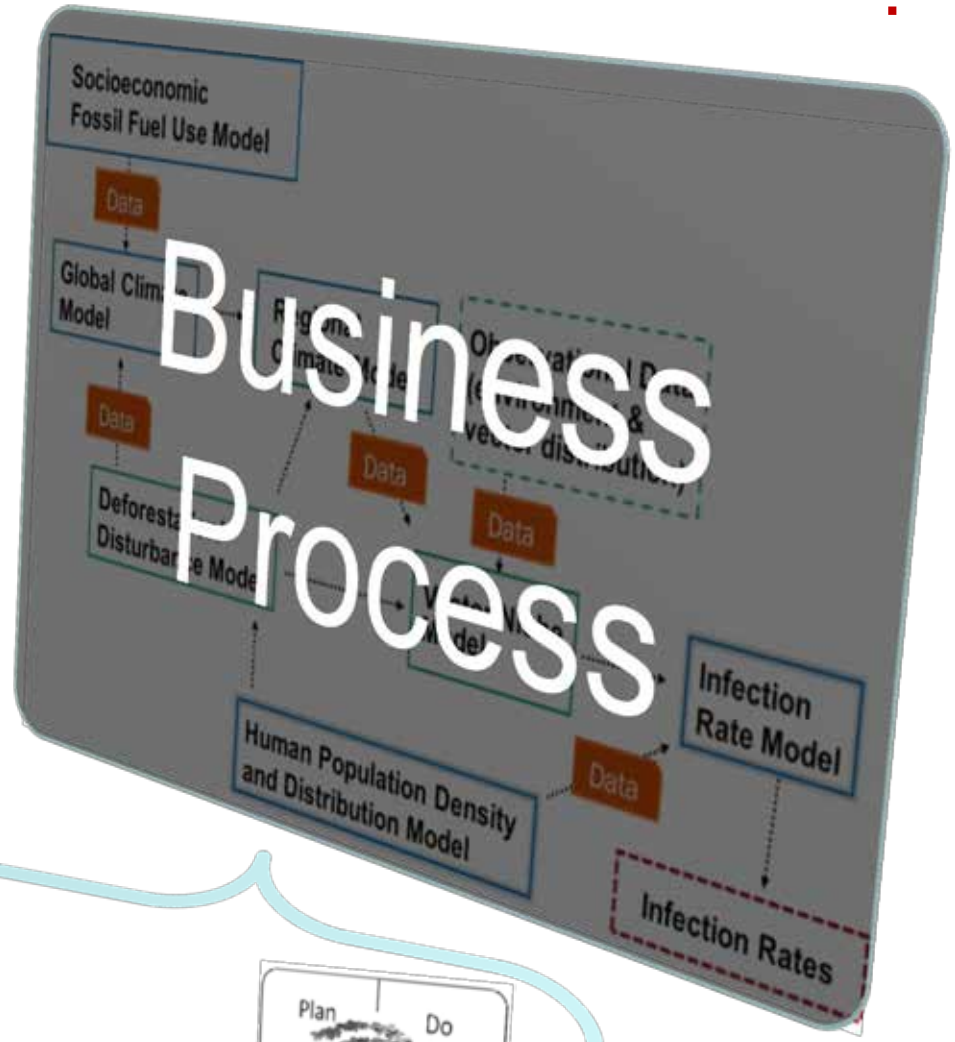
# Elements …

**How will CC affect infection rate of dengue fever in Vietnam?**

Data

**Model**

Link/Interface ▪▪▪▪▪▪▪▶





Vocabularies

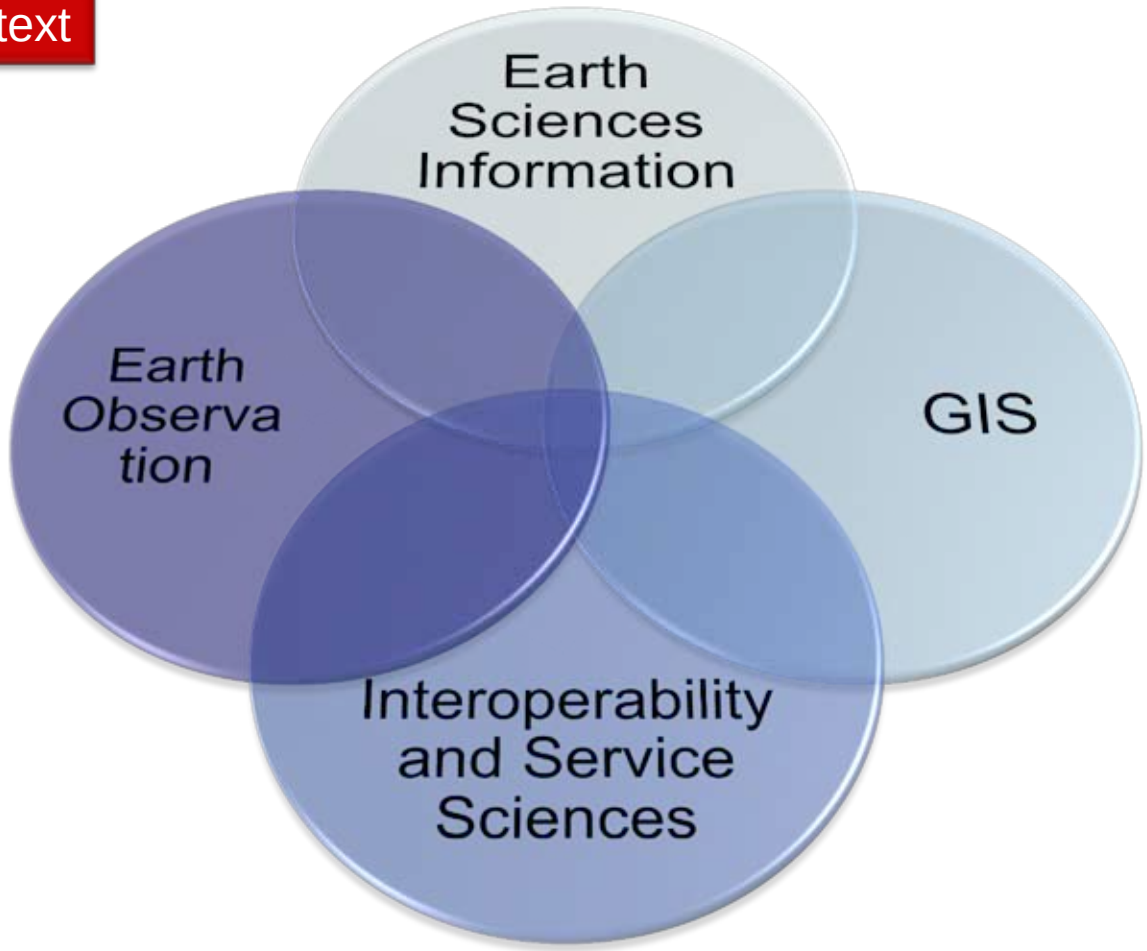

Knowledge Base

*Let's go in order …*


stefano.nativi@cnr.it

# Earth Sciences cyber(e)-Infrastructure

Context

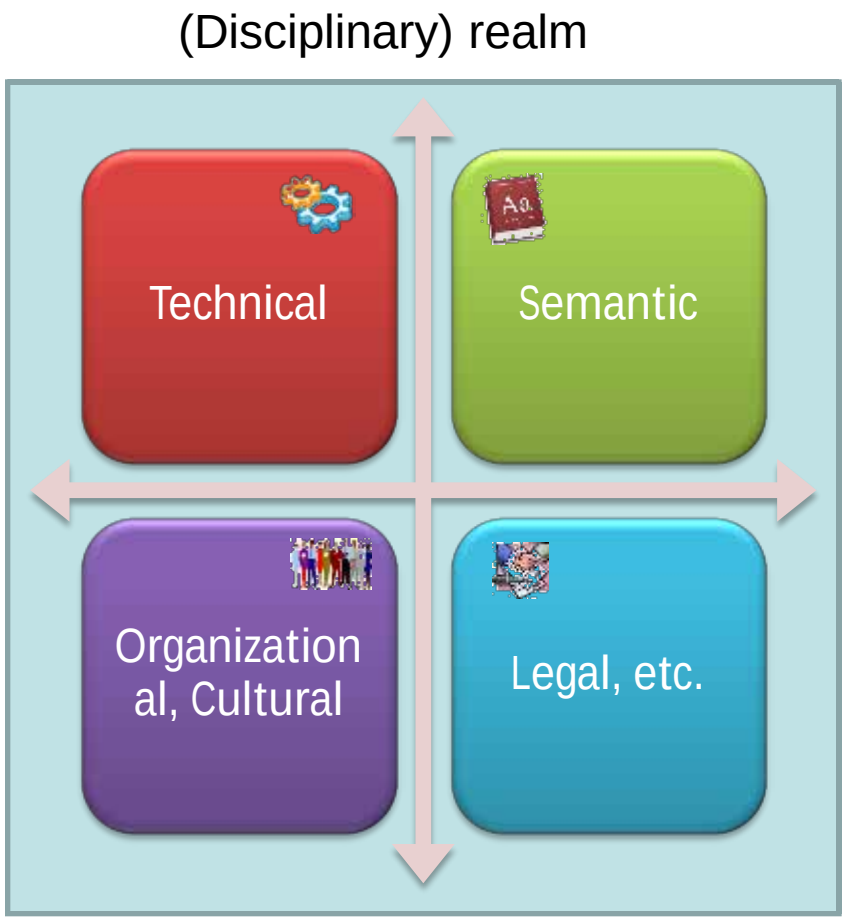





stefano.nativi@cnr.it

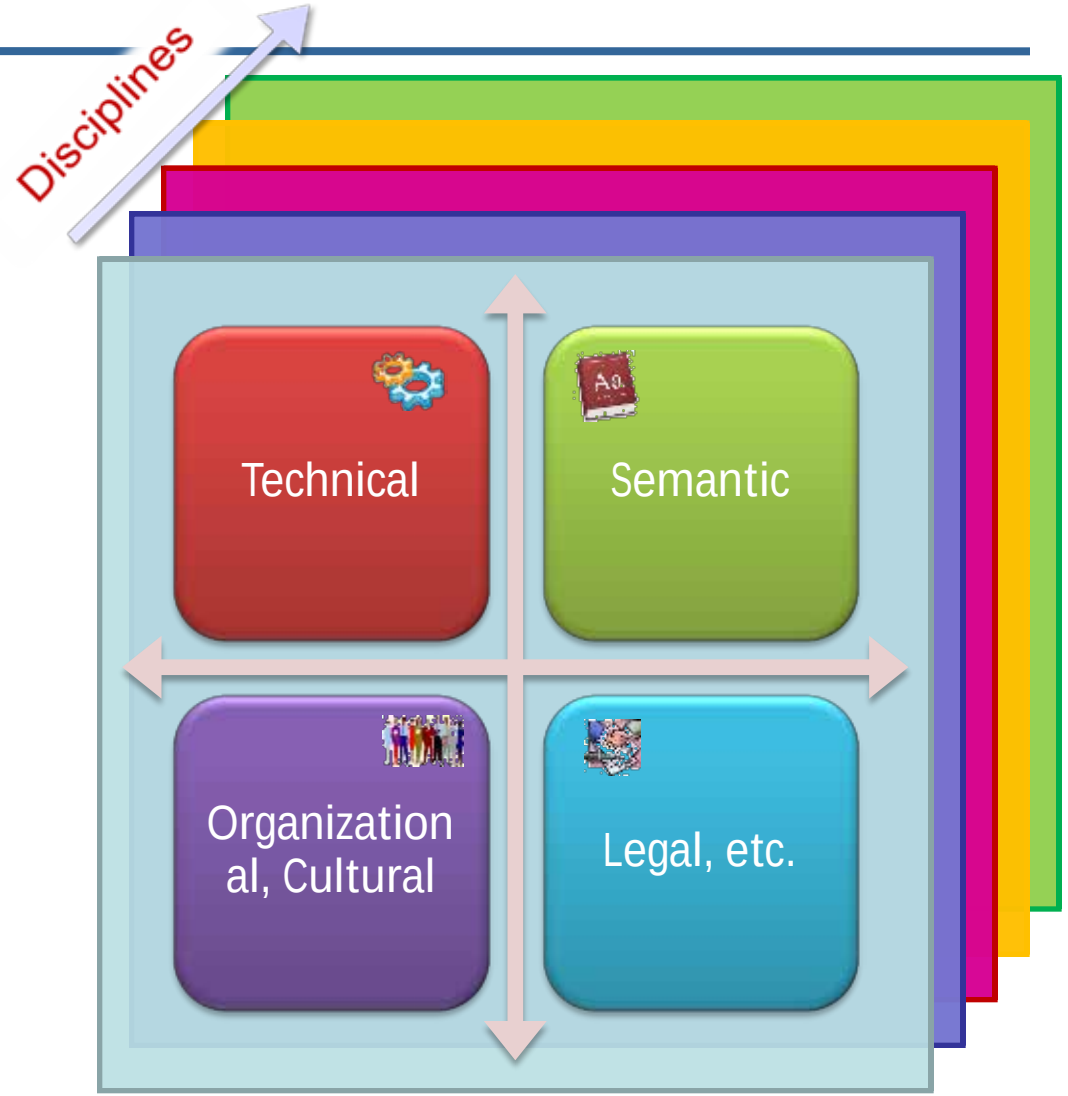
# (Disciplinary) Interoperability types

- Cyber(e)-Infrastructures must address **Interoperability**
  - Technical
  - Semantic
  - Organizational
  - Cultural,
  - Legal,
  - ..



# Multi-disciplinary Interoperability

- Address **Heterogeneity across (disciplinary) realms**
  - Technical
  - Semantic
  - Organizational
  - Cultural,
  - Legal,
  - ..





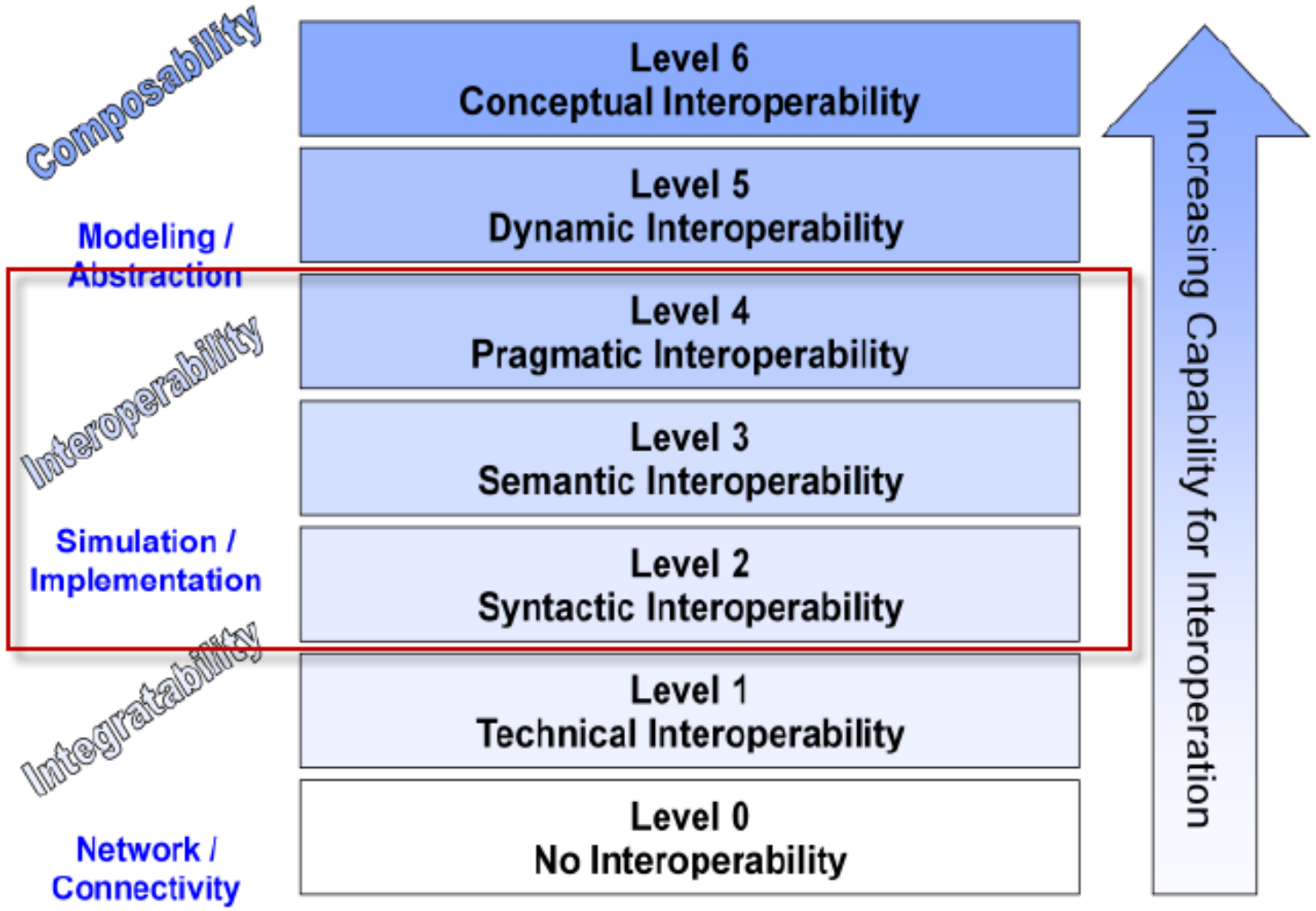
stefano.nativi@cnr.it

# Interoperability for people

*Increased coordination of development activities (technical, organizational, social) among leaders and practitioners in national and international efforts across the geosciences to foster commonalities across disparate networks*.

"*Before you make the data and systems interoperable you have to make the people interoperable*"
[Ian Jackson, OneGeology]

# Interoperability levels






*[source Ilya Zalavsky, UCSD]*

stefano.nativi@cnr.it

# Earth Sciences

- Fields of science (**disciplines**)
  - **Geology**
    - mineralogy and petrology, geochemistry, geomorphology, paleontology, stratigraphy, structural g… …engineering geology, sedimentology
  - **Physical geography**
    - geomorphology, oceano…
  - **Geophysics and geodes…**
  - **Soil science**
    - edaphology, pedology
  - **Oceanography**
    - physical, chemical, biol…
  - **Hydrology**
    - limnology
  - **Glaciology**
  - **Atmospheric sciences**
    - meteorology, climatology, atmospheric chemistry, atmospheric physics.




stefano.nativi@cnr.it

# Earth Sciences (geosciences)

- Basic earth science **topics**

**Atmosphere**

- Atmospheric chemistry
- Climatology
- Meteorology
  - Hydrometeorology
- Paleoclimatology

**Biosphere**

- Biogeography
- Paleontology
  - Palynology
  - Micropaleontology
- Geomicrobiology
- Geoarchaeology

**Hydrosphere**

- Hydrology
  - Geohydrology
- Limnology (freshwater science)
- Oceanography (marine science)
  - Chemical oceanography
  - Physical oceanography
  - Biological oceanography (marine biology)
  - Geological oceanography (marine geology)

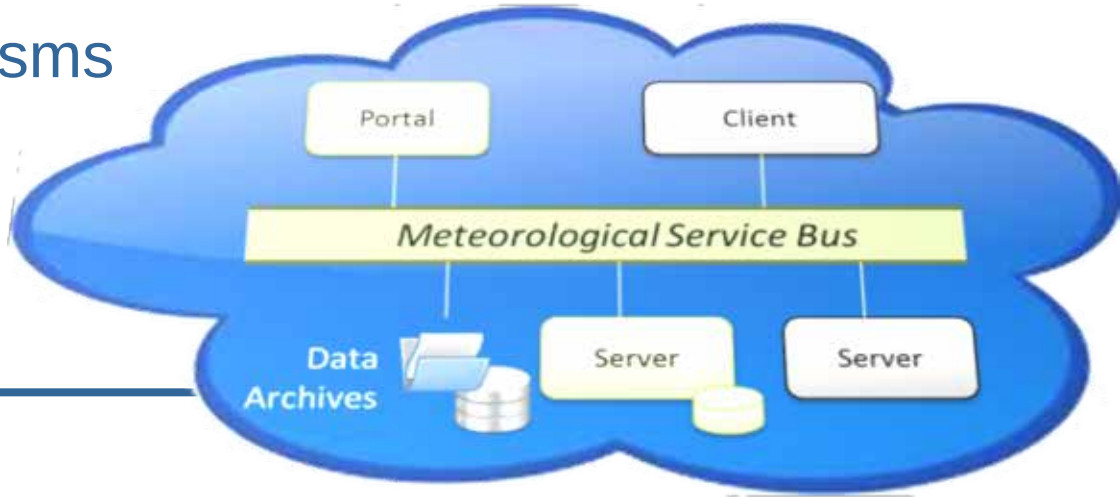
**Lithosphere or geosphere**

- Geology
  - Economic geology
  - Engineering geology
  - Environmental geology
  - Historical geology
    - Quaternary geology
  - Planetary geology
  - Sedimentology
  - Stratigraphy
  - Structural geology
- Geography
  - Physical geography
- Geochemistry
- Geomorphology
- Geophysics
  - Geochronology
  - Geodynamics (see a
  - Geomagnetism
  - Gravimetry (also part
  - Seismology
- Glaciology
- Hydrogeology
- Mineralogy
  - Crystallography
  - Gemology
- Petrology
- Speleology
- Volcanology

Community of Practices (CoP)

# Disciplinary (CoP) cyber(e)Infrastructures

- Client-Server (C-S) architectures
- Pursue Disciplinary interoperability by pushing standards
  - Open Geospatial Consortium (OGC)
  - ISO specifications
  - Web 2.0
  - Standardized data interchange mechanisms (Community de-facto standards)



Meteorology cyberInfrastructure

Portal

Client

*Meteorological Service Bus*

Data Archives

Server

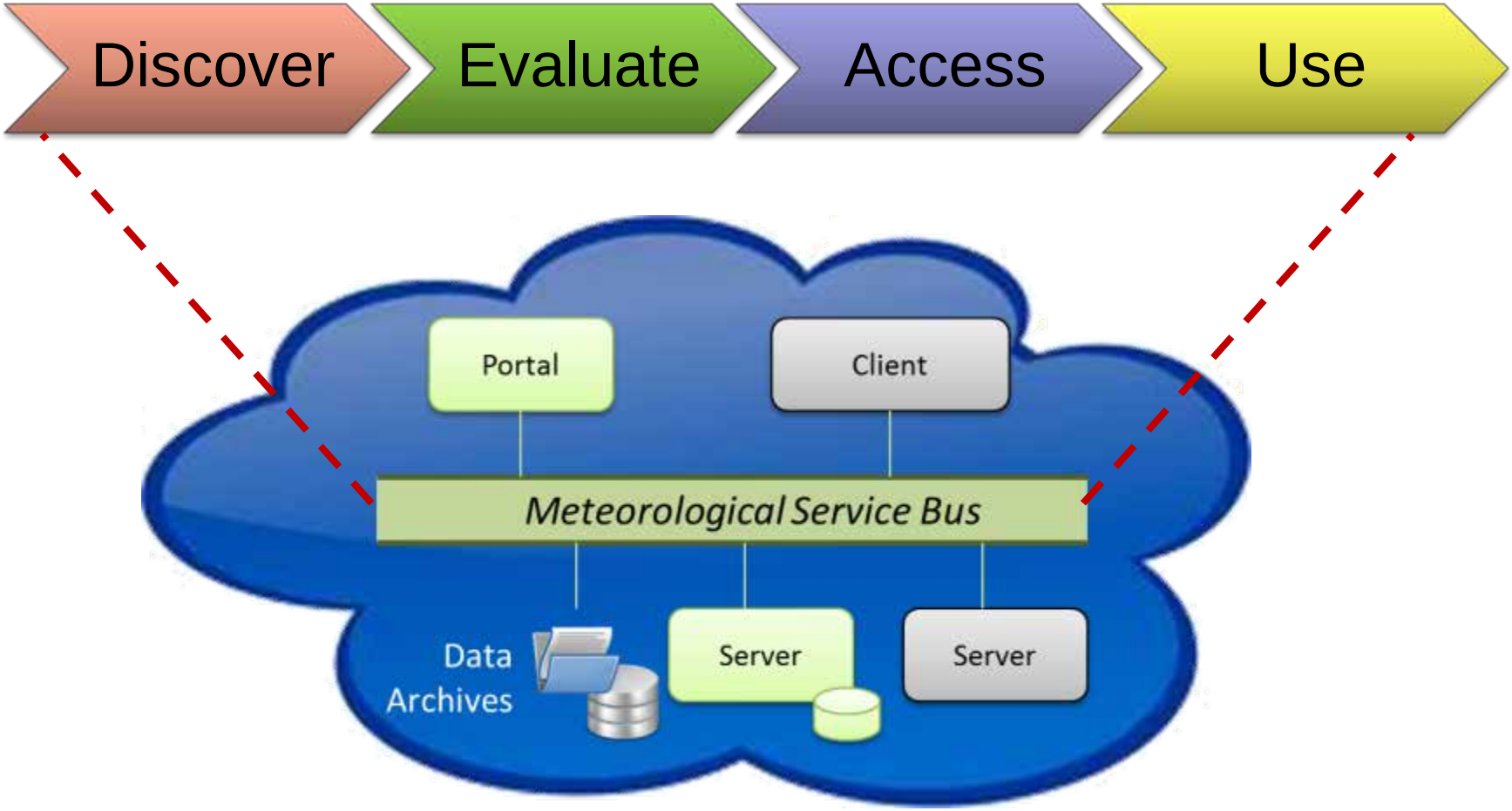
Server

- Best practices
- Data policy
- ….

- Metadata model(s)
- Data Model(s)
- Encoding Format(s)/Language(s)
- Controlled Vocabulary(ies)
- ….

- Discovery protocol(s)/interface(s)
- Access protocol(s)/interface(s)
- Visualization protocol(s)/interface(s)
- Semantic protocol(s)/interface(s)
- …

# Functionalities supported by a Service Bus





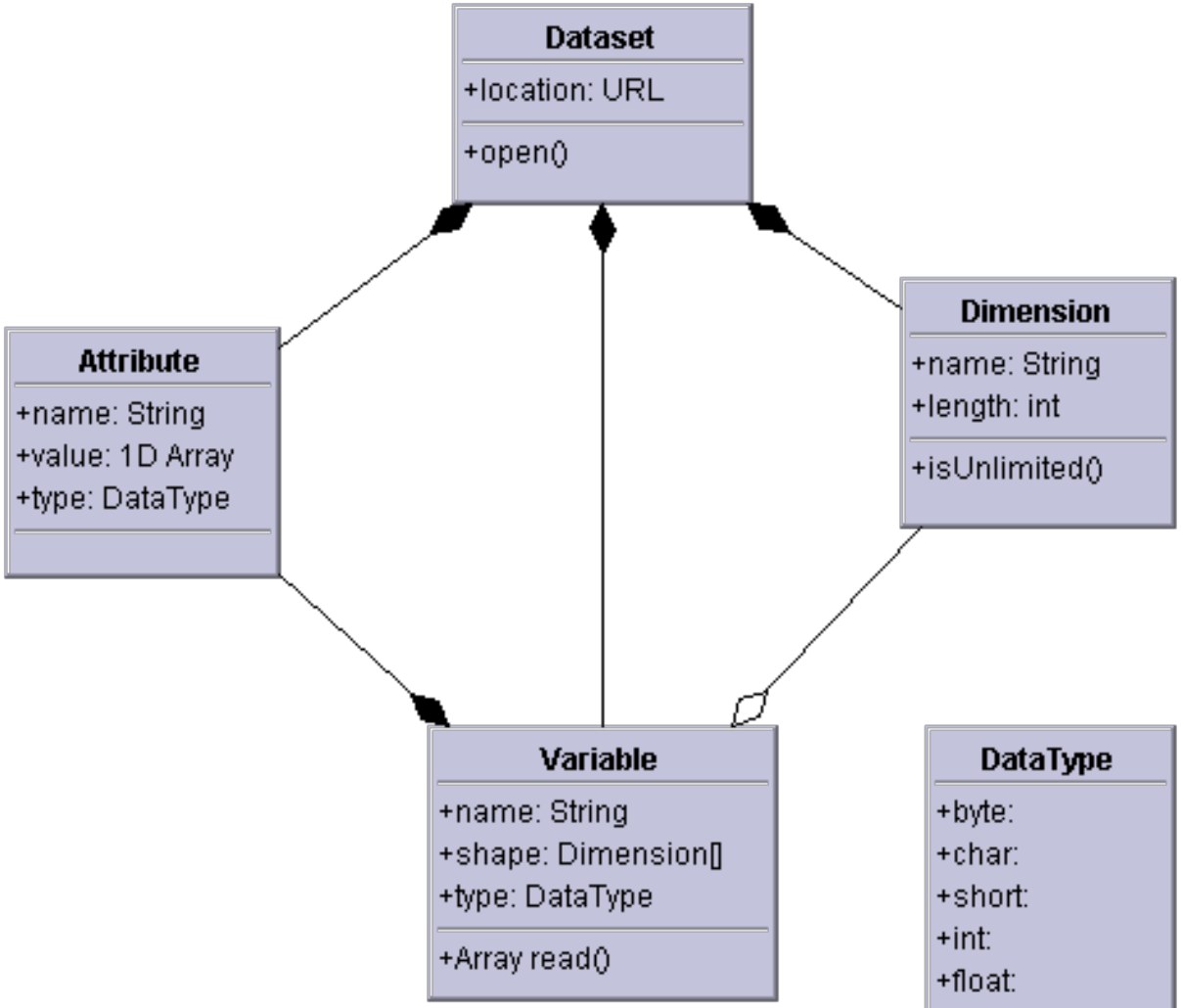

stefano.nativi@cnr.it


# … and what about the next technologies?

# Atmospheric Science Community

| | |
|---|---|
| **Data model** | Array oriented; Profiles; Model outcomes; Sensor outcomes; … |
| **Metadata model** | ISO 19115 profiles; CF; THREDDS; O&M; … |
| **Web protocols** | REST; OGC profiles; OPeNDAP; … |
| **Encoding languages/Schemas /Formats** | netCDF; GRIB; HDF; ncML; XML schemas; BUFR; CDM; CSML;… |
| **Thesauri** | CF; UDUNITS; .. |
| **Tools** | IDV; GEMPACK; McIDAS; AWIPS II; THREDDS; GI-cat.. |
| **Data Systems** | WIS; UNIDATA Motherlode; TIGGE; GCMD; ECMWF; … |

# NetCDF Core Data Model



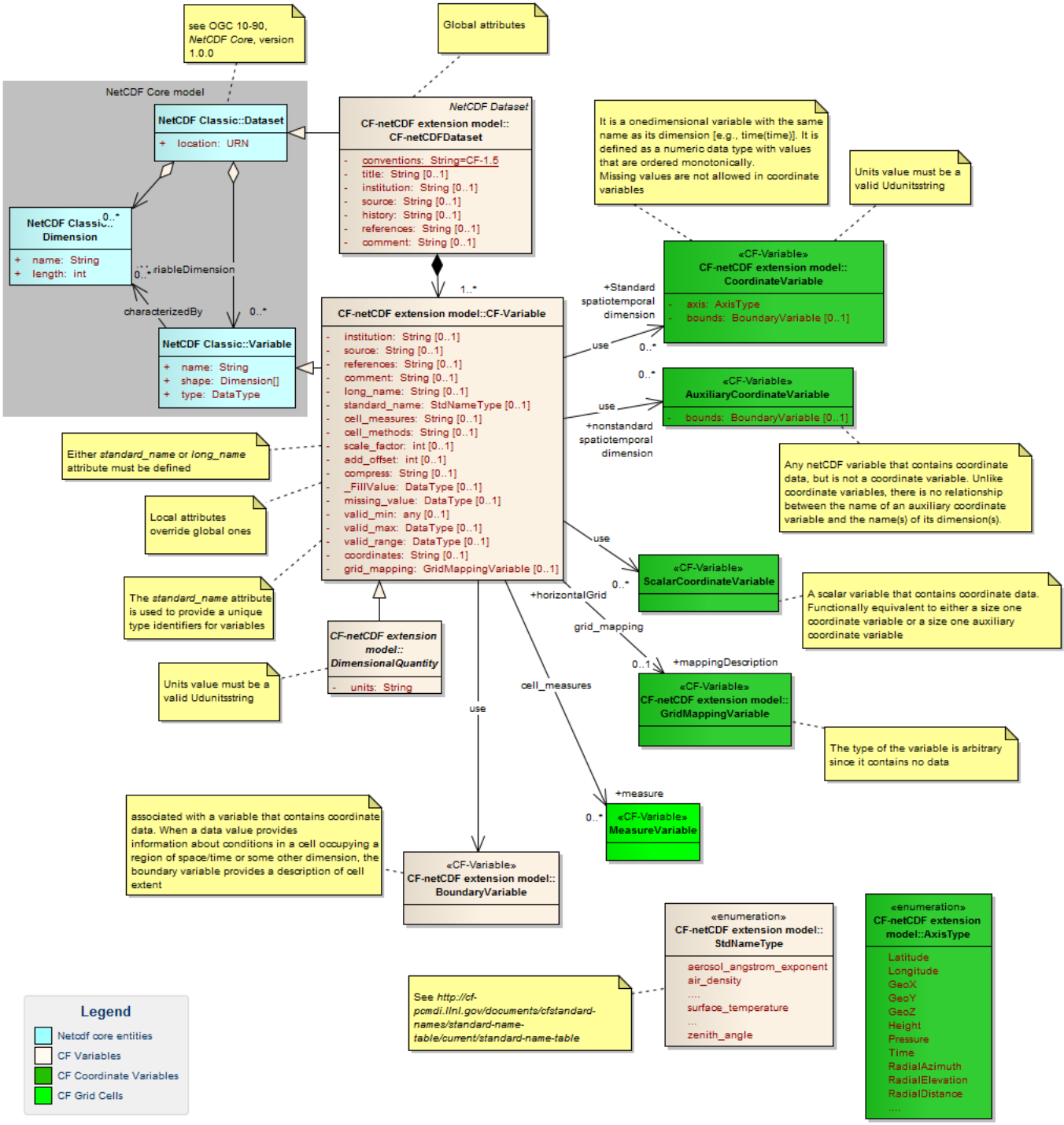

*[from J. Caron]*

# NetCDF Conventions

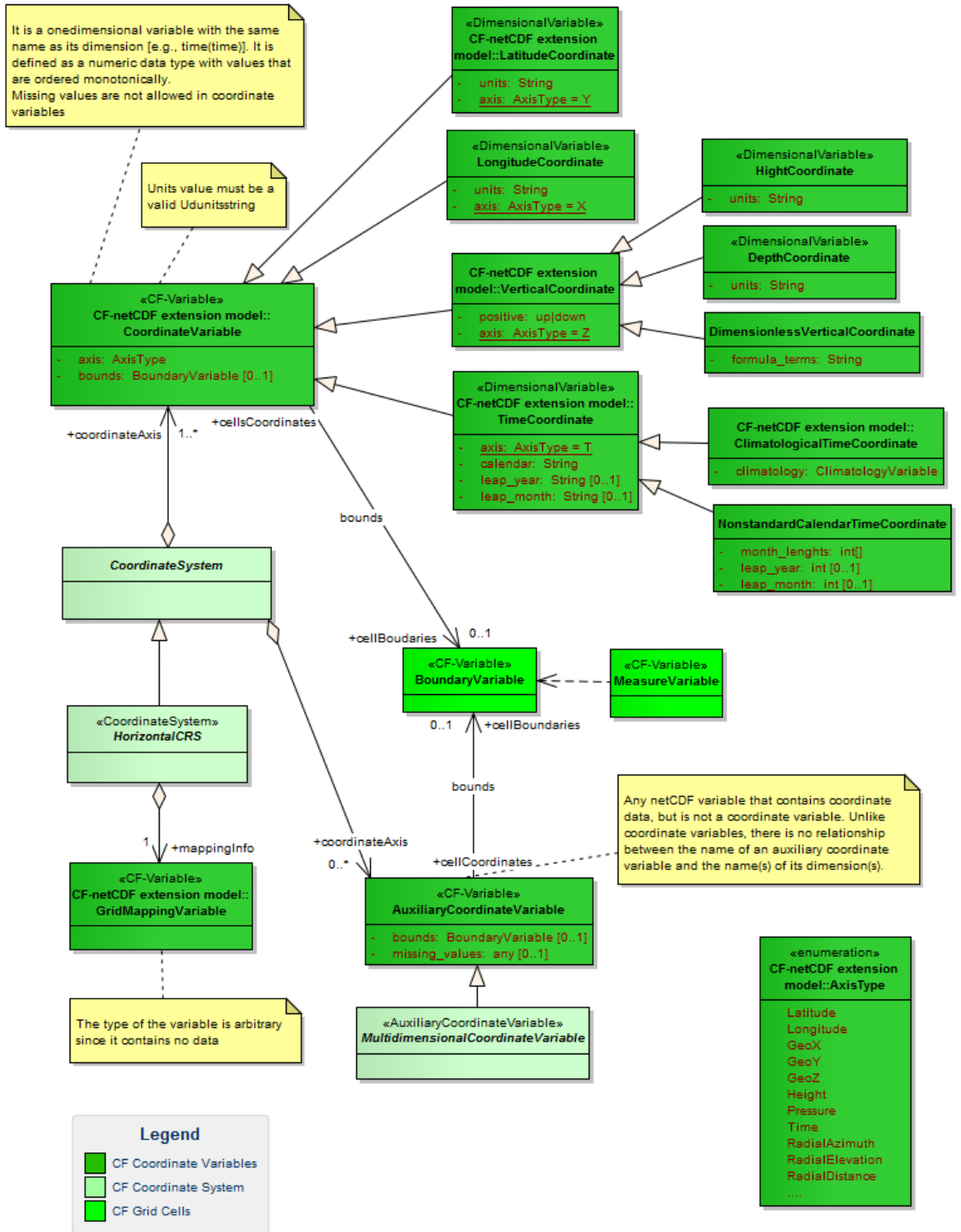
## NetCDF data model extensions

- **CF Conventions (Recommended, if applicable)**
- COARDS Conventions (1995 standard that CF Conventions extends and generalizes)
- GDT Conventions (1999 standard that CF Conventions extends and generalizes)
- CDC Conventions (for gridded data, compatible with but more restrictive than COARDS)
- NCAR-RAF Conventions for Aircraft Data
- AMBER Trajectory Conventions for molecular dynamics simulations
- NUWG Conventions (1992-1995 effort to create some observational data conventions)
- PMEL-EPIC Conventions
- GDV Conventions (deprecated)

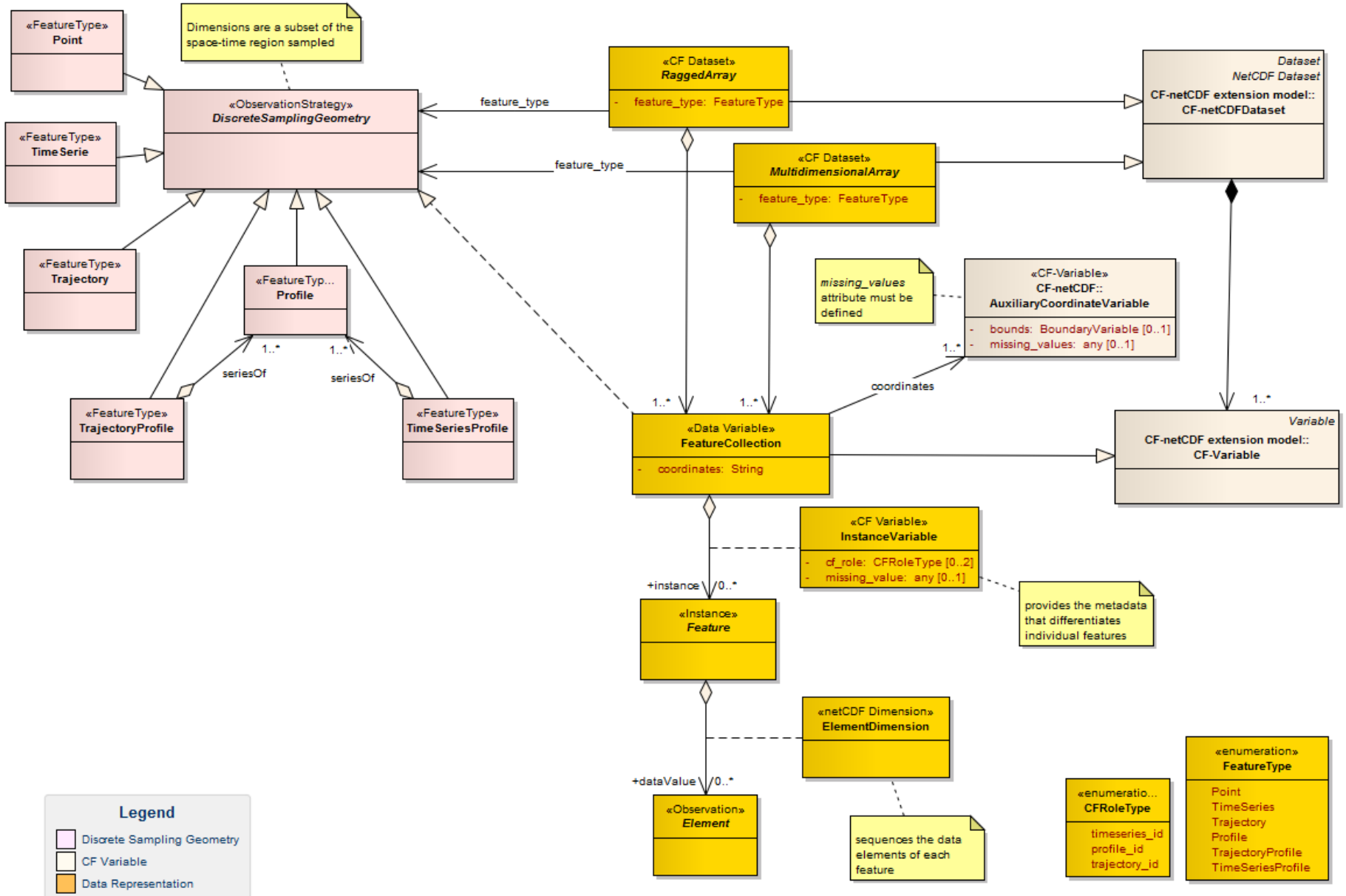
# CF-netCDF specification (OGC)



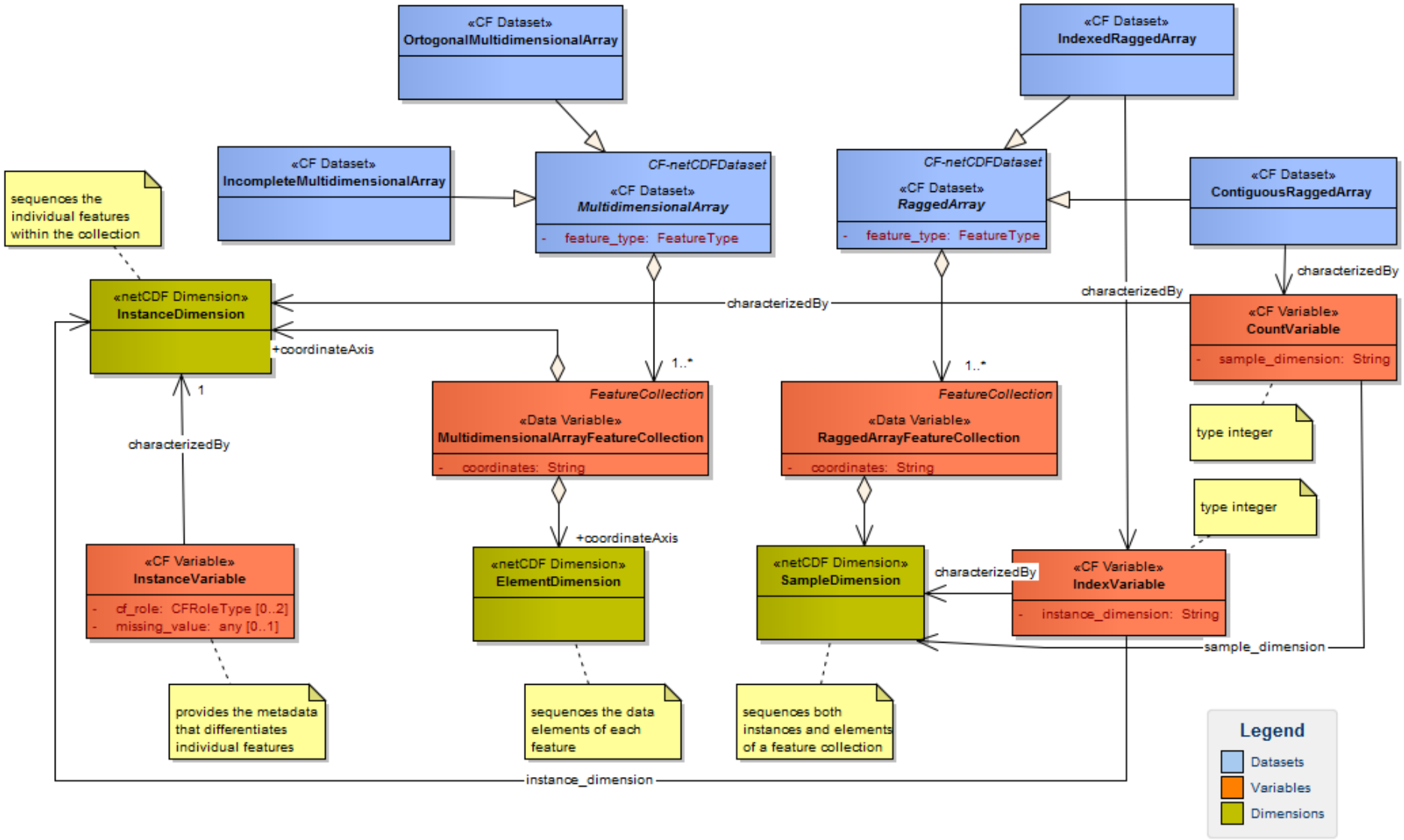
# CF-netCDF specification (OGC)



# CF-netCDF specification (OGC)



# CF-netCDF specification (OGC)

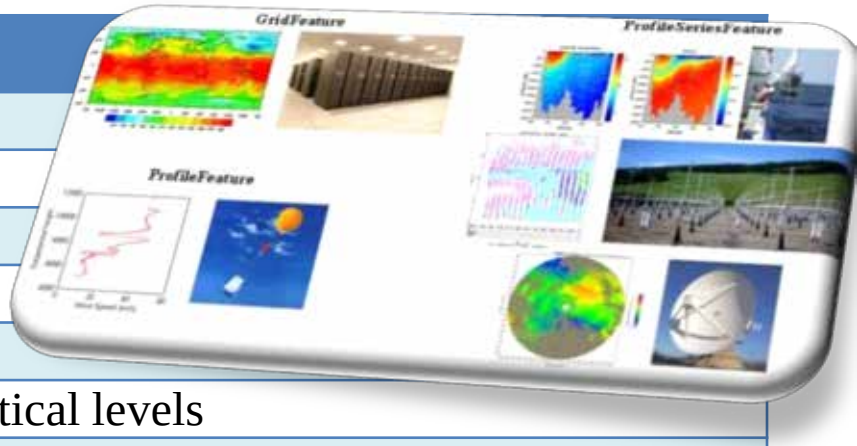


# Marine/Oceanography Community

| | |
|---|---|
| **Data model** | Array oriented; Profiles; Model outcomes; Sensor outcomes; Ragged array; .. |
| **Metadata model** | ISO 19115 profiles (CDI; EDMED) CF; THREDDS; O&M;… |
| **Internet protocols** | REST; OGC profiles; OPeNDAP; .. |
| **Encoding languages/Schemas/ Formats** | netCDF; GRIB; HDF; ncML; XML schemas; BUFR; … |
| **Thesauri** | SeaDataNet Vocabulary; CF; UDUNITS; .. |
| **Tools** | ODV; MIKADO; NEMO; THREDDS; GI-cat; DIVA; ... |
| **Data Systems** | SeaDataNet; MGDS; UNIDATA Motherlode; MyOcean; GCMD; PANGAEA; … |

# Data Model (Coverage/Feature types)

- Multiple coverage and/or Feature types exist
  - mainly, they are related to the Observation&Measurement approach
- The **Common Data Model** will support all these types in netCDF-CF




| CDM Feature Type |
|---|
| PointFeature |
| StationFeature |
| TrajectoryFeature |
| StationFeature at fixed time |
| ProfileFeature |
| StationProfileFeature at one location and fixed vertical levels |
| StationProfileFeature at one location |
| SectionFeature with fixed number of vertical levels |
| SectionFeature |
| RadialFeature |
| GridFeature at a single time |
| GridFeature |
| SwathFeature |


stefano.nativi@cnr.it

# International Oceanographic Data and Information Exchange (IODE)

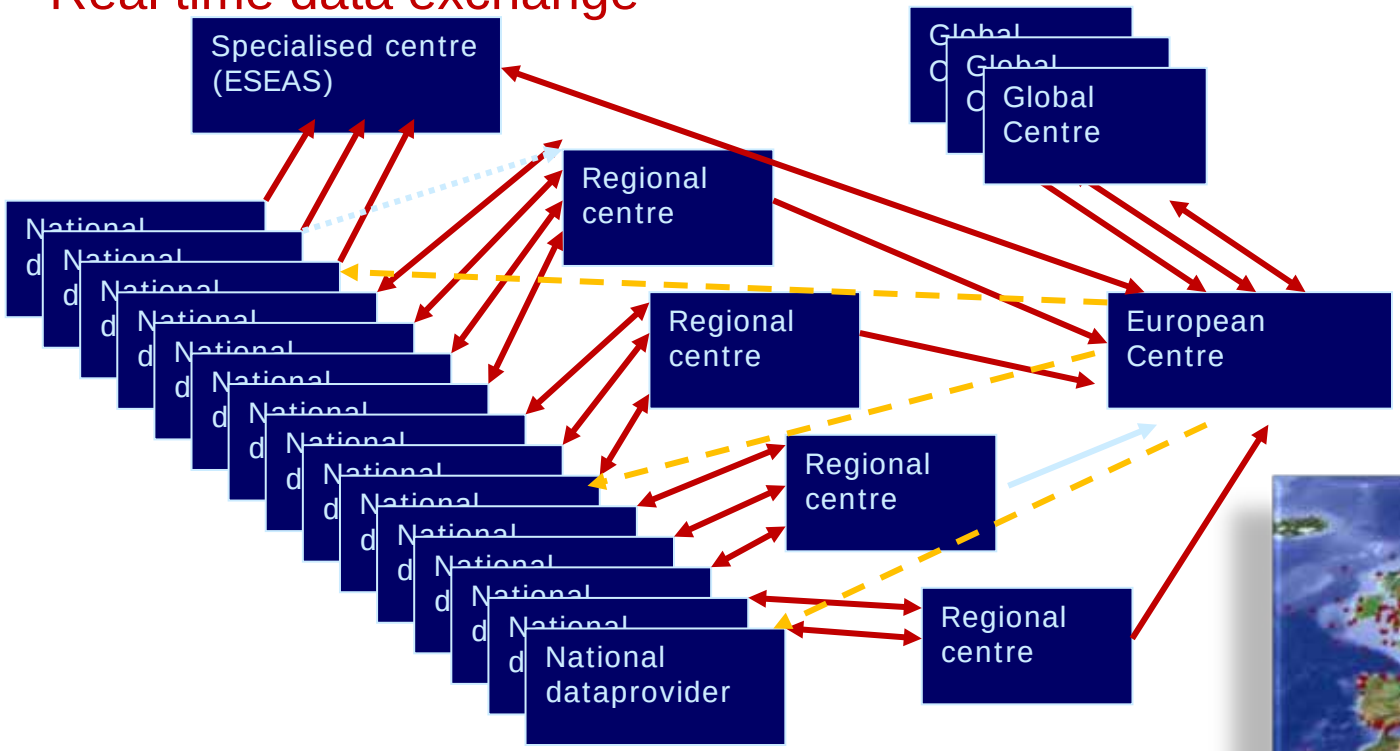
- The IODE programme of the "Intergovernmental Oceanographic Commission" (IOC) of UNESCO was established in 1961.
- To enhance marine research by facilitating the exchange of oceanographic data and information between participating Member States
- IODE publishes technical Manuals and Guides
- Standards
  - In the past decades IODE has made a number of attempts to agree on data management standards (e.g. MEDI and mXML for marine metadata).
    - However these attempts were not successful, possibly due to insufficient coordination with other similar initiatives.
  - Reasons why now IODE recognizes the opportunity to achieve success in developing international standards

# GOOS (Global Ocean Observing System) Pilot Projects

- GOOS is a/the oceanographic component of GEOSS
- GOOS provides the ocean component of the Global Climate Observing System (GCOS)
- Programmes and Projects which are demonstrating the next generation of Global Ocean Observation System technologies, techniques and applications
  - ChloroGIN (Chlorophyll Global Integrated Network)
    - Chloro-GIN Africa, ANTARES (ChloroGIN Latin American Regional branch)
  - Ferry Box: environmental monitoring systems
  - GODAE (Global Ocean Date Assimilation Experiment)
  - MOON (Mediterranean Operational Oceanography Network)
  - Ocean Tracking Network: track thousands of marine animals around the world
  - QUIJOTE: monitor the coastal ocean of Argentina, Uruguay and Brazil
  - MILAC (Marine Impacts on Lowland Agriculture and Coastal Resources)

# EuroGOOS

- EuroGOOS is an Association of Agencies to further the goals of GOOS
- Promote Operational Oceanography fostering a sustained production of services at a Regional scale
- Real time data exchange

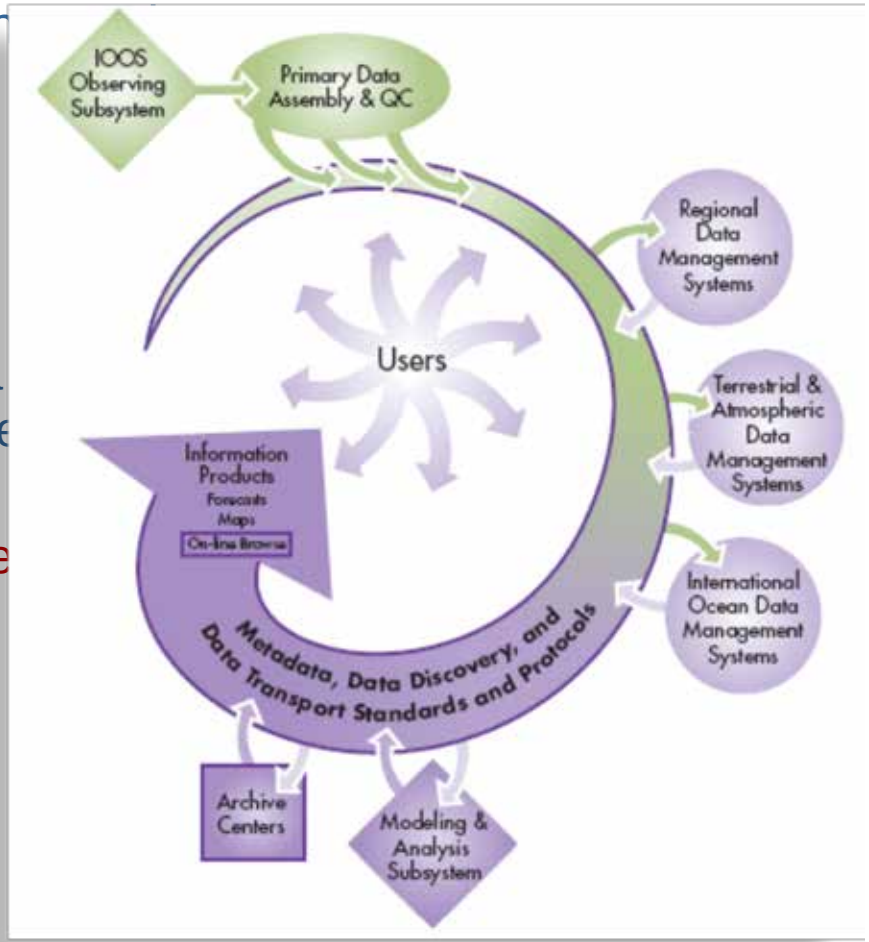



[source: Hans Dahlin, EuroGOOS ]

# U.S. IOOS® (Integrated Ocean Observing System)

- IOOS is a federal, regional, and private-sector partnership working to enhance US ability to collect, deliver, and use ocean information
- IOOS helps Decision Makers taking action to improve safety, enhance the economy, and protect th

- DMAC (Data Management and Communications) Team
  - identifies technologies, formats, and protocols needed to support the data management and communications ne of IOOS
  - manages a standards adoption proce



# OOI (OCEAN OBSERVATORIES INITIATIVE)

- NSF-funded initiative
  - The OOI is envisioned as a research-based counterpart to the U.S. Integrated Ocean Observing System (IOOS)
  - The OOI's networked sensor grid will collect ocean and seafloor data at high sampling rates for decades
- OOI Cyberinfrastructure (OOI CI)
  - Start: Oct 2009
  - End: summer 2014

# Russian World Ocean Subprogram ESIMO

- “Creating a Unified System of Information on the World Ocean Condition”
  - creation of unified normative and methodological, organizational and technological basis for developing and maintaining information resources on the condition of the World Ocean;
  - formation and maintaining the State data holdings on condition of the World Ocean;
  - development and standardization of monitoring technologies of condition and pollution of the World Ocean and coastal areas;
  - integration of departmental information systems and providing an access to overall state information resources on the World Ocean;
  - organization of exchange of the similar systems on the World Ocean within the frames of international Cupertino as well as participation in the international programs.

# EC FP7 Projects

- Mersea/MyOcean
  - Monitors and forecasts the global and regional ocean
  - Provides a service for application providers (oil spill monitoring, ship routing, …) and policy makers
  - Information flows are federated through standards back-end services and central facilities (catalogue, viewing portal, system monitoring)
- SeaDataNet
  - An network infrastructure for managing the large and diverse data sets collected by the oceanographic fleets and the automatic observation systems.
  - Sets up reference services (vocabularies, catalogues, users directory…) before setting up a federating infrastructure for European marine observation data sharing.

# Biodiversity/Ecosystems Community

| | |
|---|---|
| **Data model** | Feature oriented; Sensor outcomes; Model outcomes; .. |
| **Metadata model** | EML; ISO 19115 profiles; GBIF Global Biodiversity Resources Discovery System; NBII; O&M; … |
| **Internet protocols** | REST; OGC profiles; OAI-PMH; TAPIR; DiGiR; UDDI; RSS; … |
| **Encoding languages/Schemas/ Formats** | Darwin Core; ABCD; GML; TDWG XML schemas; … |
| **Thesauri** | Life Science Identifiers Vocabularies; .. |
| **Tools** | GBIF; DOPA; OpenModeller; BioCatalog; Mercury; ... |
| **Data Systems** | OBIS; GBIF; LTER/ILTER, NBII; NASA GCMD; LIFE-WATCH; IUCN; GCMD; … |

OPEN ARCHIVES TDWG Taxonomic Databases WORKING GROUP FAO GBIF GEO OBIS OCEAN BIOGEOGRAPHIC INFORMATION SYSTEM

# GEO-BON

GROUP ON EARTH OBSERVATIONS | GEO BON

Table 3. Standards for metadata, data exchange and transfer protocols.

| *Name* | *Brief Description* |
|---|---|
| ABCD | "ABCD Schema is a common data specification for biological collection units, including living and preserved specimens, along with field observations that did not produce voucher specimens. It is intended to support the exchange and integration of detailed primary collection and observation data." http://www.tdwg.org/activities/abcd |
| BioCASe | The BioCASe protocol is based on DiGIR but adapted for use with ABCD encoded data. Its main user is the Biological Collection Access Service for Europe (BioCASE - http://search.biocase.org/). http://www.biocase.org/products/protocols |
| CSDGM | The Content Standard for Digital Geospatial Metadata (CSDGM), (FGDC-STD-001-1998), the US Federal Metadata standard, "provides a common set of terminology and definitions for the documentation of digital geospatial data." http://www.fgdc.gov/standards/projects/FGDC-standards-projects/metadata/base-metadata/index_html |
| CSDGM<br>- Biological Data Profile | Biological Data Profile of the Content Standard for Digital Geospatial Metadata "broadens the application of the CSDGM so that it is more easily applied to data that are not explicitly geographic (laboratory results, field notes, specimen collections, research reports) but can be associated with a geographic location. The profile changes the conditionality and domains of CSDGM elements, requires the use of a specified taxonomical vocabulary, and adds elements." http://www.fgdc.gov/metadata/geospatial-metadata-standards |
| CSDGM<br>– Profile for Shoreline Data | Metadata Profile of CSDGM for Shoreline Data "addresses variability in the definition and mapping of shorelines by providing a standardized set of terms and data elements required to support metadata for shoreline and coastal data sets. The profile also includes a glossary and bibliography." http://www.fgdc.gov/metadata/geospatial-metadata-standards |



stefano.nativi@cnr.it

# GEO-BON

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| | |
|---|---|
| Darwin Core | The Darwin Core is a set of standards including a glossary of terms intended to facilitate the sharing of information about biological diversity. It is based primarily on taxa, their occurrence in nature as documented by observations, specimens, and samples, and related information. http://rs.tdwg.org/dwc/index.htm |
| DiGIR | Distributed Generic Information Retrieval is a protocol that provides unified access to distributed databases allowing clients to retrieve information from distributed servers. It uses HTTP as transport mechanism with messages and data encoded in XML (Darwin Core). http://digir.sourceforge.net/ |
| Dublin Core | "The Dublin Core metadata standard is a simple yet effective element set for describing a wide range of networked resources. The Dublin Core standard includes two levels: Simple and Qualified. Simple Dublin Core comprises fifteen elements; Qualified Dublin Core includes three additional elements (Audience, Provenance and RightsHolder), as well as a group of element refinements (also called qualifiers) that refine the semantics of the elements in ways that may be useful in resource discovery." (http://dublincore.org/documents/usageguide/). http://dublincore.org/documents/dcmi-terms/ |
| EML | "Ecological Metadata Language (EML) is a metadata specification developed by the ecology discipline and for the ecology discipline. It is based on prior work done by the Ecological Society of America and associated efforts... EML is implemented as a series of XML document types that can be used in a modular and extensible manner to document ecological data. Each EML module is designed to |



stefano.nativi@cnr.it

# GEO-BON

GROUP ON EARTH OBSERVATIONS

| | |
|---|---|
| | describe one logical part of the total metadata that should be included with any ecological dataset." http://knb.ecoinformatics.org/software/eml/ |
| MIENS | MIENS – Minimum Information about an Environmental Sequence, an extension to the minimum information about a genome/meta-genome sequence (MIGS/MIMS) specification of the Genomics Standard Consortium is a proposal for documenting the environmental parameters in the extraction environment associated with a sequence. http://gensc.org/gc_wiki/index.php/MIGS/MIMS/MIENS |
| Natural Collections Descriptions | Natural Collections Descriptions (NCD) is a standard for facilitating the exchange of information on all kinds of collections of natural history material including specimens, original artwork, photographs, archives, published material. http://www.tdwg.org/activities/ncd/ |
| OAI-PMH | The Open Archives Initiative Protocol for Metadata Harvesting (OAI-PMH) provides a "low-barrier" mechanism for interoperability across distributed metadata repositories. Data providers expose metadata and service providers, in turn, consume the metadata through a client application known as a harvester that issues OAI-PMH service requests over HTTP. http://www.openarchives.org/pmh/ |
| OGC CSW | The Open Geospatial Consortium Catalogue Services for the Web (CSW) specification defines "the interfaces, bindings, and a framework for defining application profiles required to publish and access digital catalogues of metadata for geospatial data, services, and related resource information". Note that, from an interoperability perspective, this is not a single standard as it encompasses several non-interoperable search technologies. http://www.opengeospatial.org/standards/cat |
| OGC WCS | The Open Geospatial Consortium Web Coverage Service (WCS) "supports electronic retrieval of geospatial data as "coverages" – that is, digital geospatial information representing space-varying phenomena." http://www.opengeospatial.org/standards/wcs |
| OGC WMS | "The OpenGIS® Web Map Service (WMS) Implementation Specification provides three operations (GetCapabilities, GetMap, and GetFeatureInfo) in support of the creation and display of registered and superimposed map-like views of information that come simultaneously from multiple remote and heterogeneous sources." http://www.opengeospatial.org/standards/wms |



stefano.nativi@cnr.it

# GEO-BON

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| | |
|---|---|
| OGC WFS | "The OpenGIS® Web Feature Service (WFS) Implementation Specification allows a client to retrieve and update geospatial data encoded in Geography Markup Language (GML) from multiple Web Feature Services. The specification defines interfaces for data access and manipulation operations on geographic features, using HTTP as the distributed computing platform. " http://www.opengeospatial.org/standards/wfs |
| ISO 19115 | "ISO 19115:2003 defines the schema required for describing geographic information and services. It provides information about the identification, the extent, the quality, the spatial and temporal schema, spatial reference, and distribution of digital geographic data." http://www.iso.org/iso/iso_catalogue/catalogue_tc/ catalogue_detail.htm? csnumber=26020 . Countries that are members of ISO are required to provide metadata in a profile of ISO 19115. The INSPIRE initiative in the European Union is recommending use of ISO 19115, and a North American Profile (NAP) for the USA and Canada is under development. The new ANZLIC metadata standard used in Australia and New Zealand complies with ISO 19115. |
| ISO 19139 | "ISO/TS 19139:2007 defines Geographic MetaData XML (GMD) encoding, an XML Schema implementation derived from ISO 19115." http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=32557 |
| TAPIR | Designed as a generic tool that can be applied to domains other than biodiversity and natural science collections data, the TDWG Access Protocol for Information Retrieval (TAPIR) is a specification for accessing structured data on distributed databases using HTTP for transport and XML for encoding messages and data. It combines and extends the features of DiGIR and BioCASe protocols. http://www.tdwg.org/activities/tapir/ |
| Taxon Concept Schema | "The Taxon Concept Schema (TCS) provides a standard for taxon names and taxon concepts in the exchange and integration of biodiversity and natural history data." http://www.tdwg.org/activities/tnc/ |



stefano.nativi@cnr.it

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BETA

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- Materials, Physics and Nanosciences (MPNS)
- Transport and Urban Development (TUD)

ESSEM COST Action ES1101

# Harmonizing Global Biodiversity Modelling (HarmBio)

Descriptions are provided by the Actions directly via e-COST.

Global biodiversity is declining rapidly, largely as a result of human activities. Effective policy and adaptive management strategies in the face of global change require anticipation of future changes. Mid- to long-term planning will therefore depend, at least in part, on model-based projections. Unlike the well-coordinated climate modelling community, the biodiversity modelling community is currently disparate and largely uncoordinated. Hence, there are no agreed metrics of biodiversity produced as standard output from models, nor are there common datasets used for calibration and validation by modelling efforts. This Action facilitates the harmonization of current models and datasets of terrestrial, freshwater and marine biodiversity to improve the reliability of future projections of biodiversity change. This cross-community initiative aims to accelerate the development of transparent and scientifically robust biodiversity models, through validation, calibration and intercomparison of models and data, and ultimately to enable environmental decision making based on state-of-the-art

**Earth System Science and Environmental Management COST Action ES1101**

- Description
- Parties
- Management Committee

## General Information*

Chair of the Action:
Dr Jorn SCHARLEMANN (UK)

Vice Chair of the Action:
Prof. Paul LEADLEY (FR)

DC Rapporteurs:
Dr Emil FULAJTAR (SK)

Science officer of the Action:
Dr Basak KISAKUREK

Administrative officer of the Action:
Chandrasa SJAMSUDIN


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Toward a Global Virtual Environment for Biodiversity Research
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Global Biodiversity Information Facility (World)
GEOSS / GEOBON
CAS
Chinese Academy of Sciences (China)
Lifewatch
Europe
SANBI
South Africa National Biodiversity Institute (South Africa)
DataOne
(USA)
CRIA
Reference Centre on Environmental Information (Brazil)
ALA
Atlas of Living Australia
CREATIVE-B
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# Geology Community

| | |
|---|---|
| **Data model** | Feature oriented; Field oriented; Sensor outcomes; Model outcomes; … |
| **Metadata model** | Dataless SEED; ASCII schemas; ISO 19115 profiles; O&M; … |
| **Internet protocols** | REST; OGC profiles; FTP; WAF; … |
| **Encoding languages/Schemas/ Formats** | GeoSciML; GML; ESRI Grid; ESRI Grid ASCII; GeoTIFF; XYZ ASCII; netCDF; ESRI File Geodatabase ArcGis 9.3; ESRI shapefile; Mapinfo mif/mid; SEED; miniSEED; Receiver Independent Exchange Format; IRIS StationML and QuakeML;… |
| **Thesauri** | EuroGEONames; USGS vocabulary; SWEET;.. |
| **Tools** | GPlates; GeoMappApp; GoogleEarth; EuroGEONames MatLab; IDV; OPAL; ... |
| **Data Systems** | EPOS; OpenTopography; UNAVCO; CHRONOS; GEON; EuroGeographics; IRIS; … |

IRIS eurogeographics ESRI UNAVCO OGC Open GIS Consortium, Inc.

OneGeology

*Making Geological Map Data for the Earth Accessible*

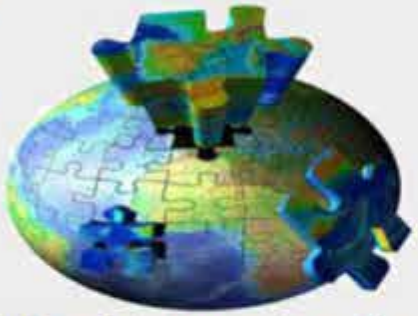
Home

العربية 中国 English Français Русский Español

- What is OneGeology +
- Participants +
- Organisation +
- Getting involved
- Technical overview +
- Technical detail for participants +
- Meetings +
- Portal
- OneGeology eXtra +
- Press information

OneGeology Europe


## Welcome to OneGeology



OneGeology is an international initiative of the geological surveys of the world. This ground-breaking project was launched in 2007 and contributed to the 'International Year of Planet Earth', becoming one of their flagship projects.

Thanks to the enthusiasm and support of participating nations, the initiative has progressed rapidly towards its target - creating dynamic geological map data of the world, available to everyone via the web. We invite you to explore the website and view the maps in the OneGeology Portal.

Fill in our online form to be kept informed of the OneGeology initiative progress and receive our regular newsletters.

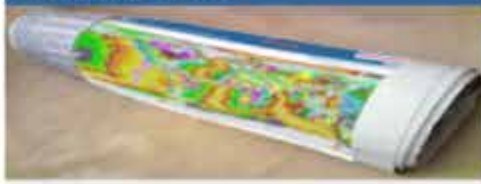
**portal.OneGeology.org**

## Happy 5th birthday OneGeology!

OneGeology celebrated its 5th anniversary in March 2012. The initial start-up workshop was held in Brighton, UK on March 12-16, 2007. Thank you to everyone who has supported the OneGeology initiative over this time.

## OneGeology at the 34th International Geological Congress

### Monthly news



OneGeology Newsletter Issue 13 is now available

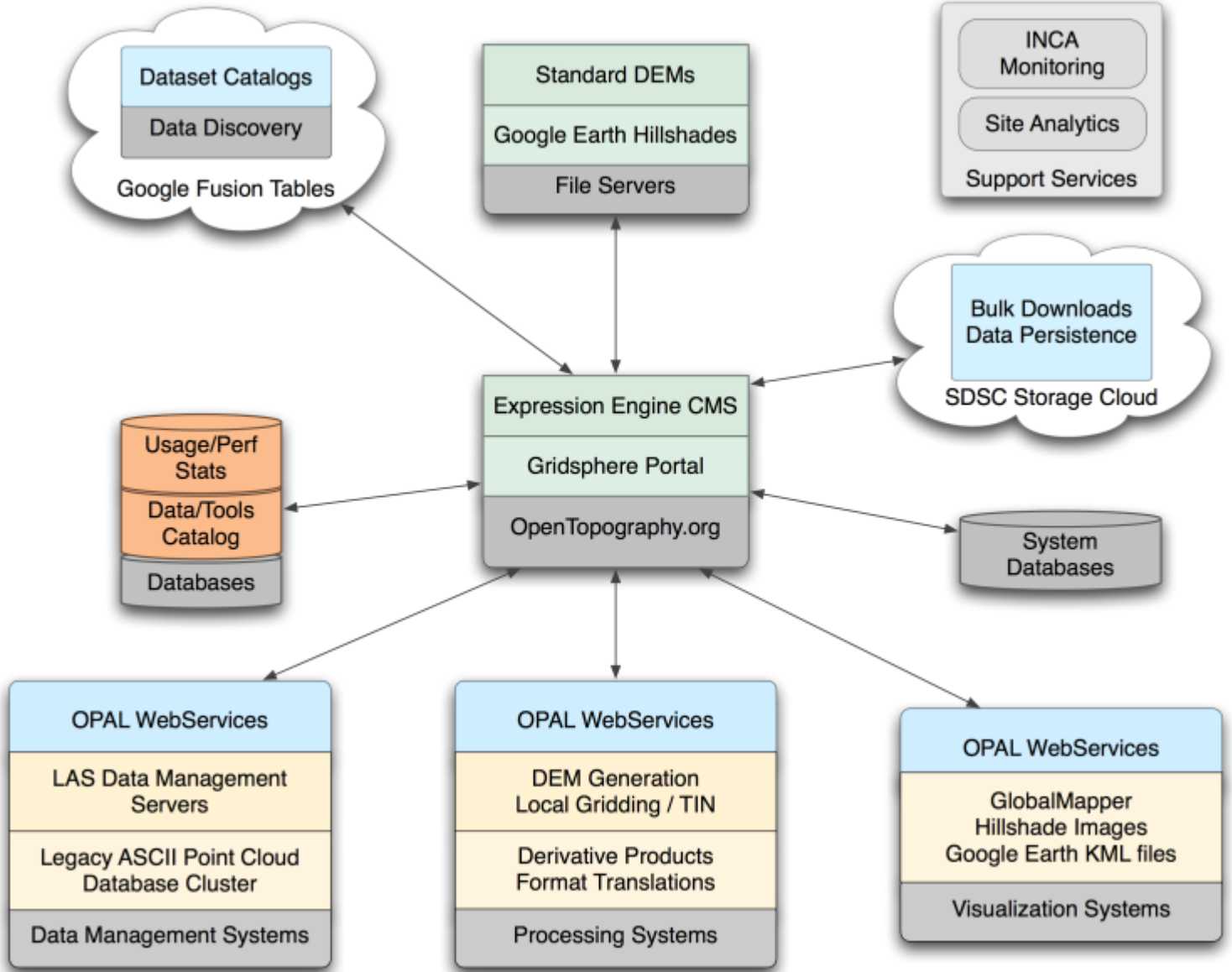
### Geodiversity

View Geoparks and World Heritage sites linked to geology on a Google map.

### Accreditation Scheme

View scheme details and how

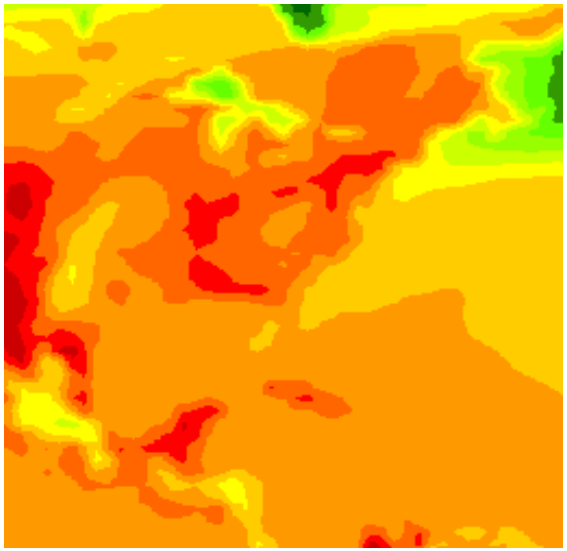
# OpenTopography



# Hydrology Community

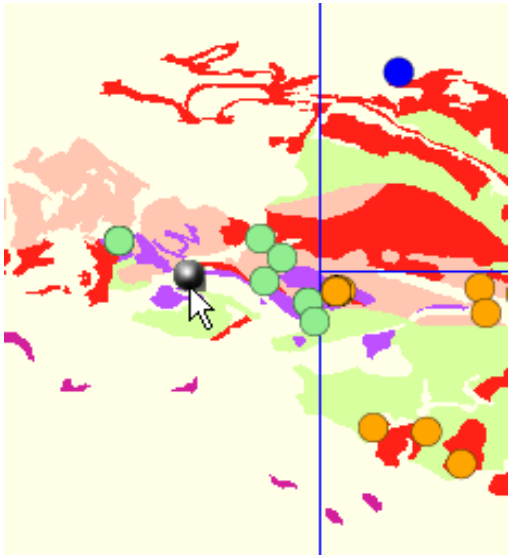
| | |
|---|---|
| **Data model** | Feature oriented; Sensor outcomes; Model outcomes; Ragged array; .. |
| **Metadata model** | ISO 19115 profiles; O&M; … |
| **Internet protocols** | REST; OGC profiles; … |
| **Encoding languages/Schemas/ Formats** | GML; WaterML; … |
| **Thesauri** | CUAHSI vocabulary; CF; UDUNITS; .. |
| **Tools** | ArcHydro; HydroServer; HydroDesktop; HIS central; ... |
| **Data Systems** | HIS; |

# Summary: Different Data Models



**classic earth-observations: “field” or “coverage”**

Fields
vs.
Objects
vs.
Specimens



**classic geology: “feature”**

| Specimen | Au (ppm) | Cu-a (%) | Cu-b (%) | As (ppm) | Sb (ppm) |
|---|---|---|---|---|---|
| ABC-123 | 1.23 | 3.45 | 4.23 | 0.5 | 0.34 |
| | | | | | |
| | | | | | |
| | | | | | |

- A Cell reflects the result of a single observation

[source: S. Cox]

# Summary: Different Metadata Model

- Mostly ISO 19115 profiles
  - part 2 is important, as well
- Dublin Core Metadata Initiative
- Extensions are introduced by specific CoP
  - Satellite Remote Sensing community
    - ebRIM; EO;
  - Biodiversity/ecosystems
    - Taxonomies
  - Modelers
    - Uncertainty (propagation)
  - ….

# Summary: Different Web protocols

- OGC Web protocols are well used
  - Discovery and access
- Internet protocols are well used
  - HTTP-based protocols; ….
- Community de-facto standards
  - OPeNDAP; IDD; TAPIR; …
- Content agnostic protocols
  - FTP; WAF; …
- Web 2.0 protocols are gaining popularity
  - OpenSearch; RSS; SKOS; …


stefano.nativi@cnr.it

# Summary: Different Encoding languages/Schemas/Formats

- Plethora of technologies
  - OGC languages
  - Community de-facto standards
  - Internet MIME types
  - Legacy products
  - Web 2.0 languages
- Different types
  - Binary; ASCII; XML; Video; Imagery; Streams; ….

# Summary: Different Thesauri

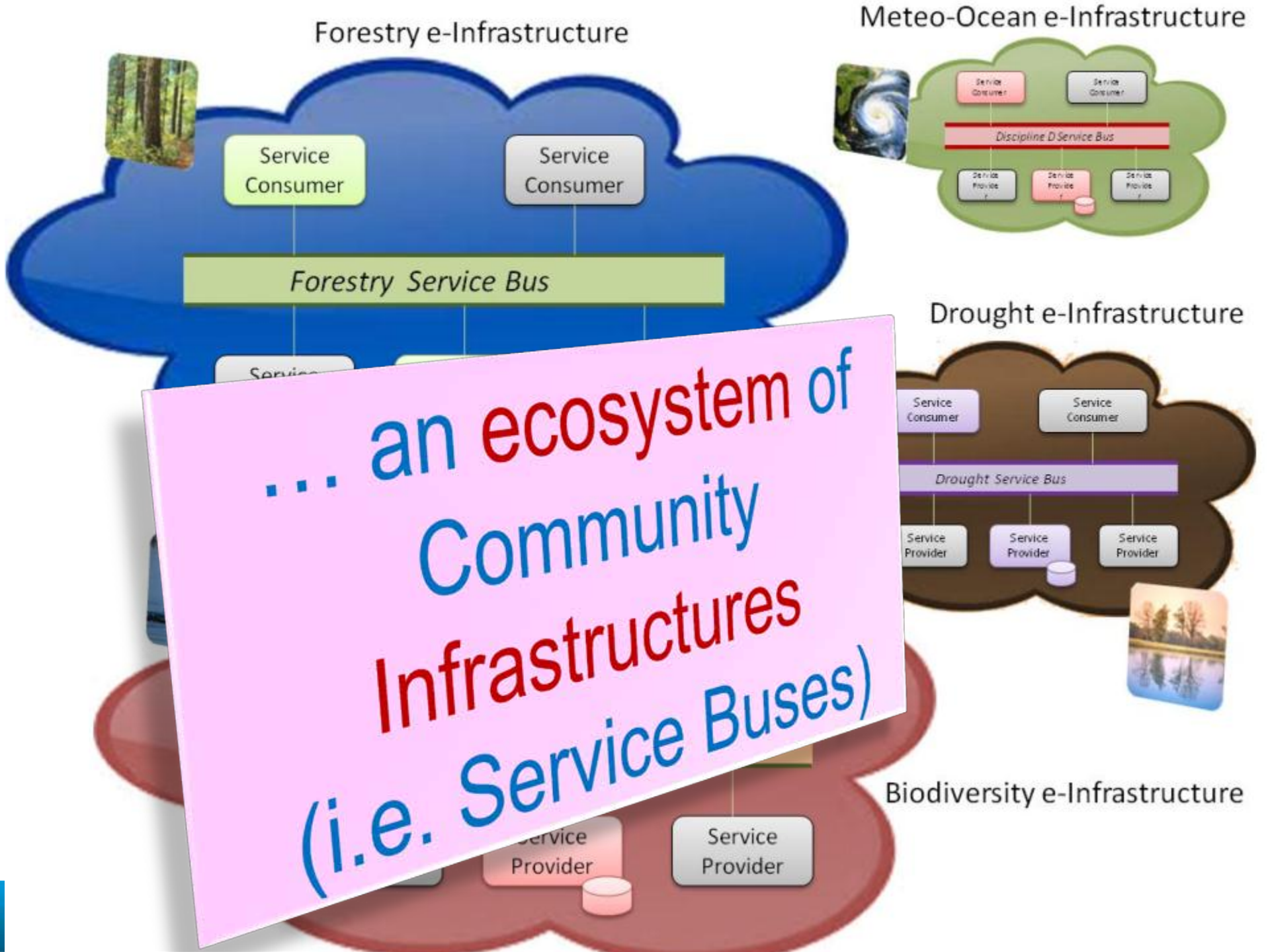
- Controlled vocabularies exists for most of the Disciplines
  - Many are accessible and re-usable (e.g. SKOS, RDF, etc.)
- Interconnection and alignment is still a challenge

# Summary: Different Tools and Data Systems

- Many different portals
  - Almost a portal for each significant application
- Often such portals do not allow to access data with one/few clicks


stefano.nativi@cnr.it

# What about multidisciplinarity interoperability?

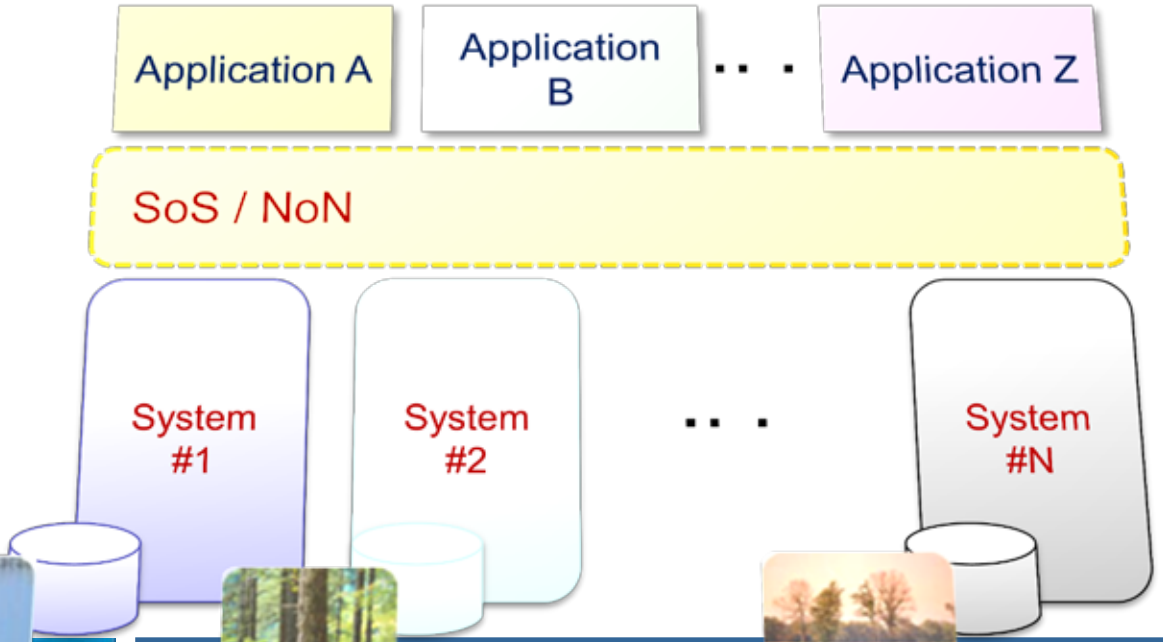

Forestry e-Infrastructure
Service Consumer
Service Consumer
Forestry Service Bus
Meteo-Ocean e-Infrastructure
Discipline D Service Bus
Drought e-Infrastructure
Service Consumer
Service Consumer
Drought Service Bus
Service Provider
Service Provider
Service Provider
Biodiversity e-Infrastructure
Service Provider
Service Provider
… an ecosystem of Community Infrastructures (i.e. Service Buses)

# ESS Cyberinfrastructure Challenges

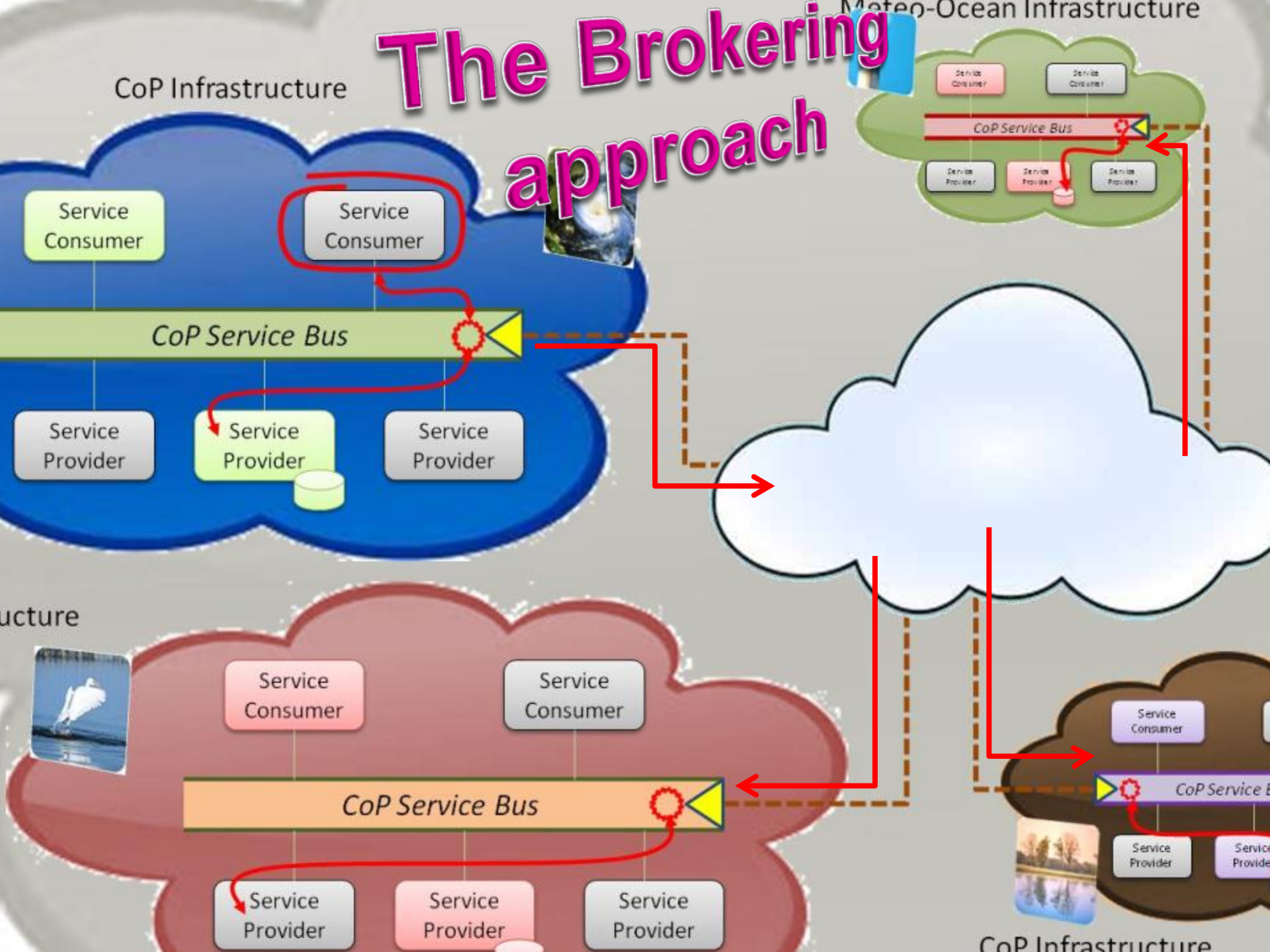
- un-controlled (technological) environment
  - global dimension
  - multi-disciplinary
  - multi-organizational
  - based on voluntary contributions
  - fast-growing
  - etc.
- almost impossible to "impose" and "preserve" specific technological solutions (e.g. standard interfaces)
- apply System of Systems (SoS) or Network of Networks (NoN) principles to build interoperability cyberinfrastructures

# System of Systems / Network of Networks principles

- **Build** on existing (community) system/network infrastructures
- **Supplement** but **not supplant** system/network mandates and governance arrangements
- Address heterogeneity to **lower** User/Data Provider **entry barriers** avoiding to impose a federal approach



# The Brokering approach



# Brokering benefits

- Lowers barriers to participation in distributed systems for both users and resource providers
  - minimal burden or cost impact on existing systems;
- Accelerates interconnection of disparate systems;
- Facilitates sustainability, reusability, extensibility, and flexibility of the infrastructure
- Enhances multi-disciplinary interoperability via introduction of new capabilities across multiple domains;
- Removes need to impose common (e.g. federal, “top-down”) specifications and software components enabling a more adaptive “bottom-up” evolution of the infrastructure

# Broker types

- Discovery Broker

- Access Broker

- Semantic Broker

- Service composition Broker

- Quality Broker

- Policy Brokers

- …

Implement **Discovery Interoperability** Arrangements

Evaluate

## Authoritative Data Providers

**Service Providers (Resource Servers)**

- + CSW2.0.2-Core
- + CSW2.0.2-ebRIM/CIM0.1.9
- + CSW2.0.2-ebRIM/EO0.2.5
- + CSW2.0.2-ISO1.0
- + Deegree2.2
- + GBIF
- + GDACS
- + GeoNetwork2.2.0
- + GeoNetwork2.4.1
- + GeoRSS2.0
- + GI-cat6.x
- + GI-cat7.x
- + NetCDF-CF1.4
- + OAI-PMH2.0
- + OpenSearch1.1
- + THREDDS1.01-1.0.2
- + WCS1.0
- + WCS1.1.2
- + WFS1.0.0
- + WFS1.1.0
- + WMS1.1.1
- + WMS1.3.0
- + WPS1.0.0
- + CDI

. . .

Discovery Broker

**«CatalogInterface» Published Interfaces**

- + CSW2.0.2-ebRIM/CIM0.1.9
- + CSW2.0.2-ebRIM/EO0.2.5
- + CSW2.0.2-ISO1.0
- + GI-cat Extended interface 7.x
- + OAI-PMH2.0
- + OpenSearch-GENESI-DR
- + OpenSearch1.1

Users

Implements Multi-disciplinary Interoperability Arrangements

Discover → Evaluate

## Non-authoritative Data Providers

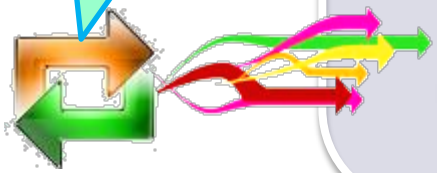
What about Citizen Science ?



Implements Web 2.0 Interoperability Arrangements

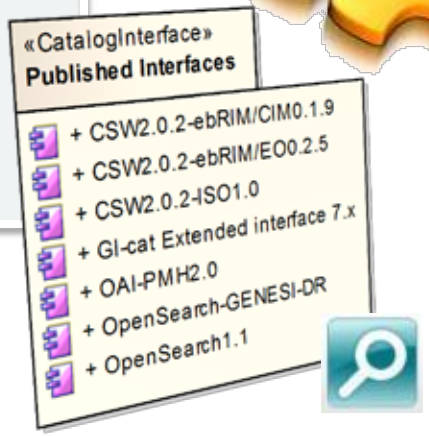
Discovery Broker





Web 2.0 mediator

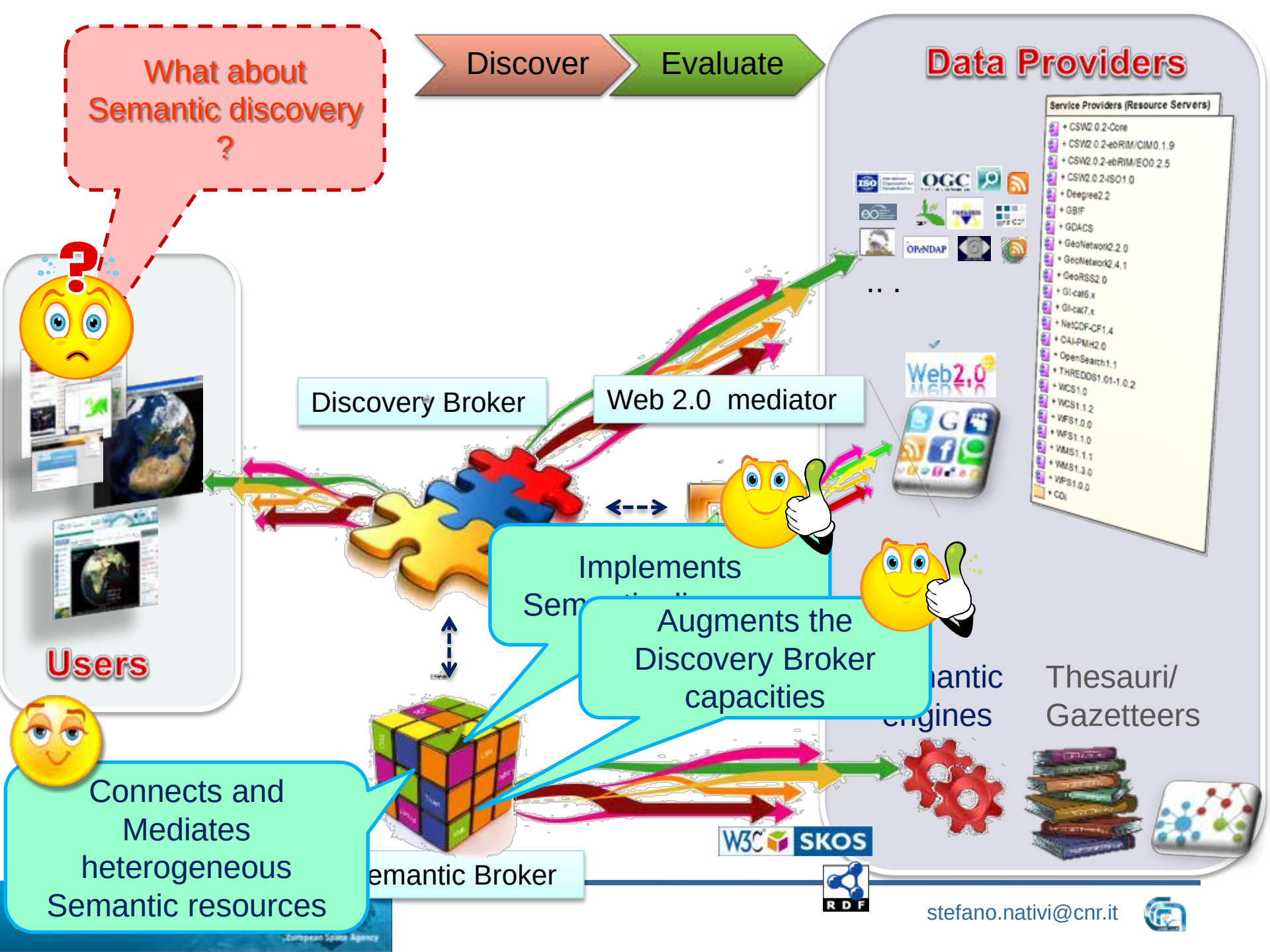
Users




Implements Web 2.0 discovery Interfaces



stefano.nativi@cnr.it

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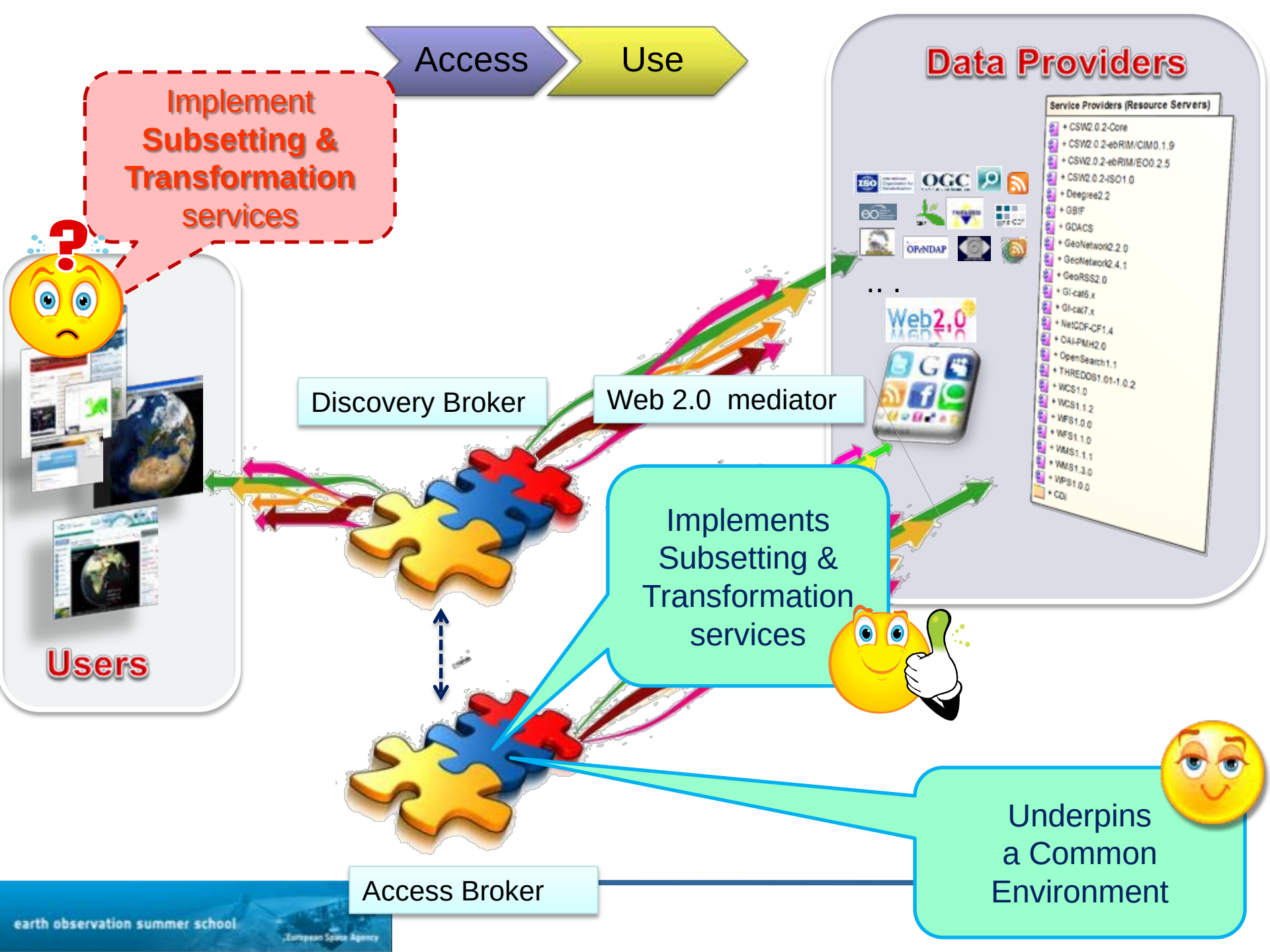
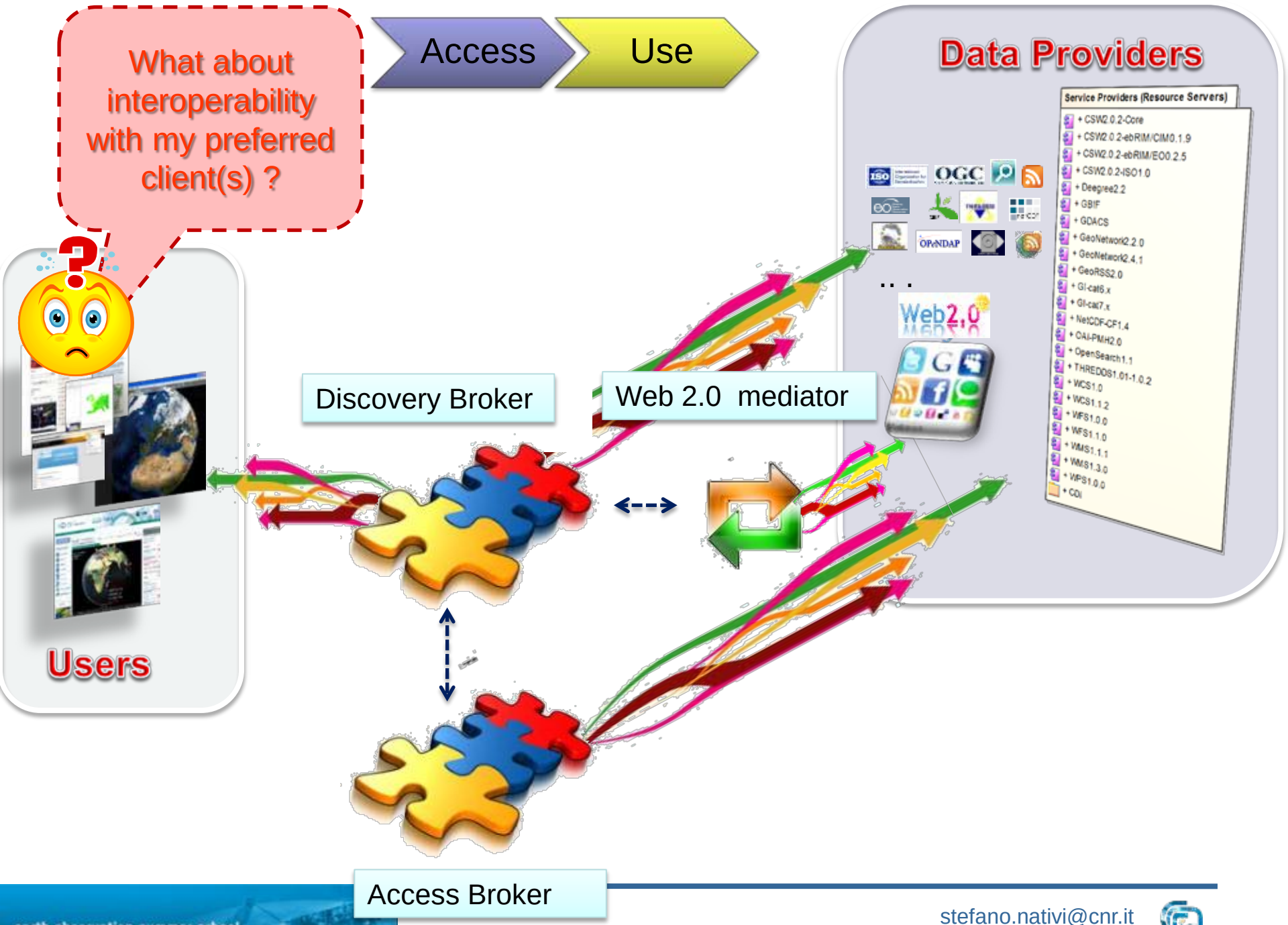

Access
Use
Implement
Subsetting &
Transformation
services
Data Providers
Service Providers (Resource Servers)
+ CSW2.0.2-Core
+ CSW2.0.2-ebRIM/CIM0.1.9
+ CSW2.0.2-ebRIM/EO0.2.5
+ CSW2.0.2-ISO1.0
+ Deegree2.2
+ GBIF
+ GDACS
+ GeoNetwork2.2.0
+ GeoNetwork2.4.1
+ GeoRSS2.0
+ GI-cat6.x
+ GI-cat7.x
+ NetCDF-CF1.4
+ OAI-PMH2.0
+ OpenSearch1.1
+ THREDDS1.01-1.0.2
+ WCS1.0
+ WCS1.1.2
+ WFS1.0.0
+ WFS1.1.0
+ WMS1.1.1
+ WMS1.3.0
+ WPS1.0.0
+ CDI
Web2.0
Discovery Broker
Web 2.0 mediator
Users
Implements
Subsetting &
Transformation
services
Access Broker
Underpins
a Common
Environment
earth observation summer school
European Space Agency






stefano.nativi@cnr.it




stefano.nativi@cnr.it

# Brokering Framework

## Users Applications/ portals/Clients

## Web 2.0 Broker

## Discovery Broker

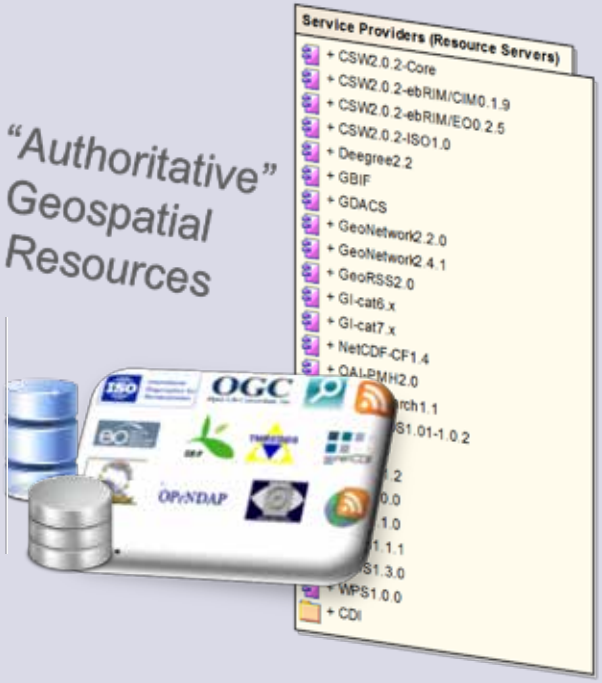
## Access Broker

## Semantic Broker

## Data Providers Resources

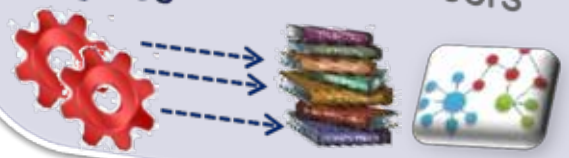
Web 2.0 Resources

"Authoritative" Geospatial Resources




Semantic engines

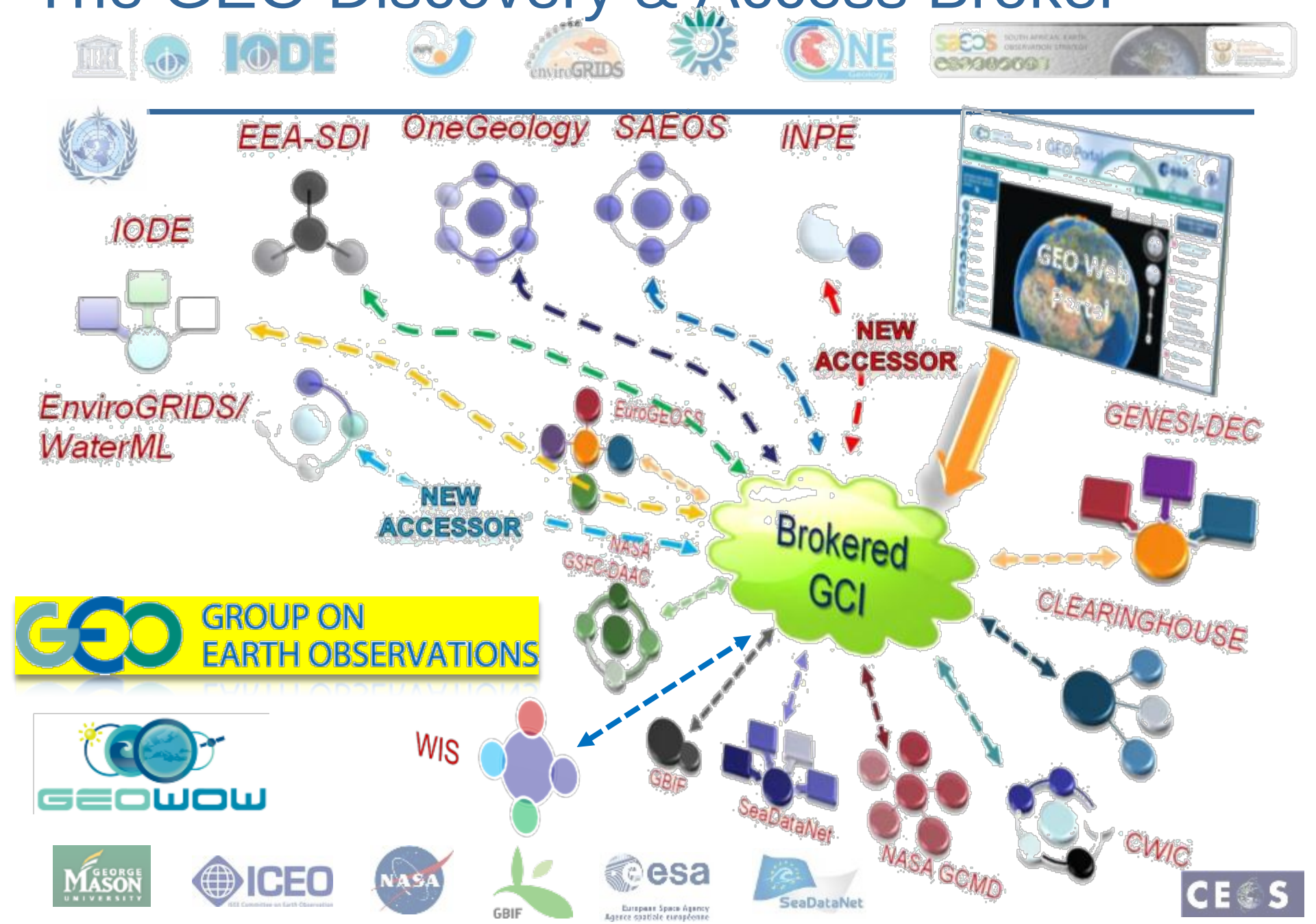
Thesauri/ Gazetteers





stefano.nativi@cnr.it

# The GEO Discovery & Access Broker



# Contributing to make accessible the GEOSS Data CORE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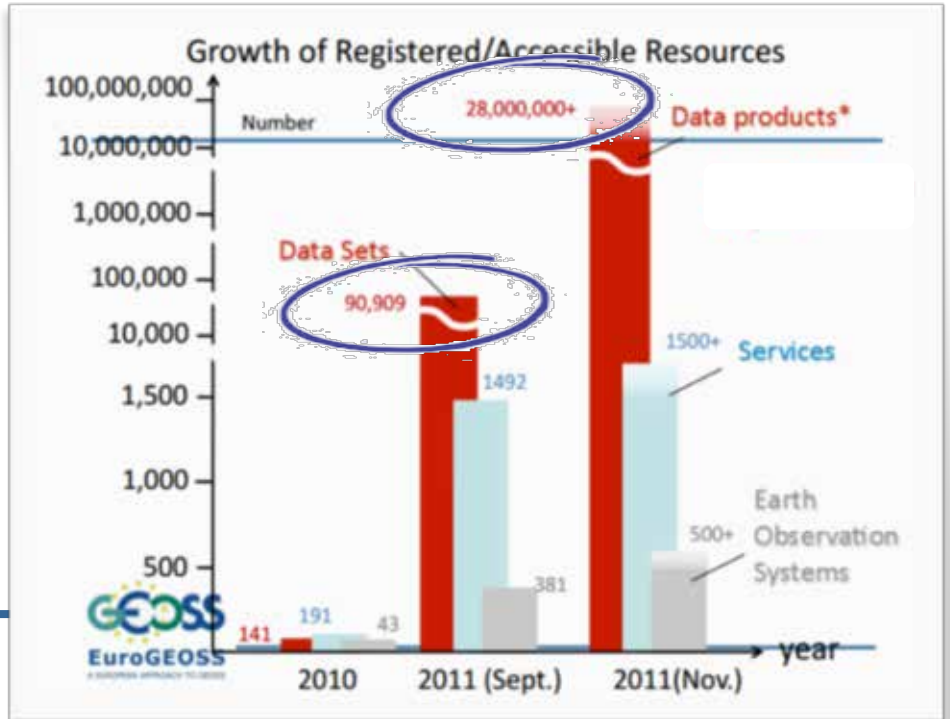
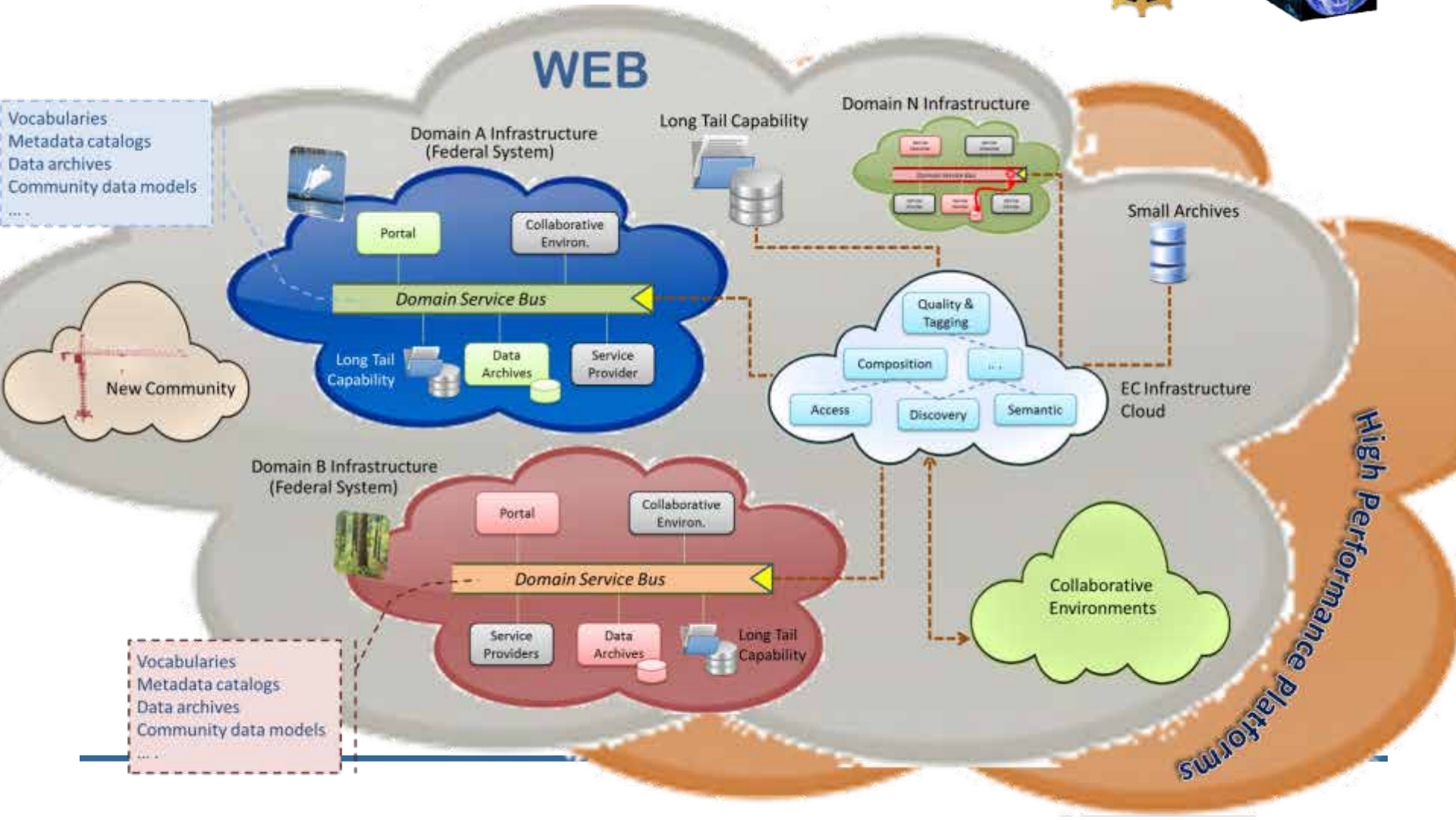
## Growth of Accessible resources




[source: 2012 GEO plenary, Istanbul]

# NSF Earth Cube Initiatives



# Thank you !

# Questions ?


stefano.nativi@cnr.it