



INSPIRE and Multi-Disciplinary Interoperability

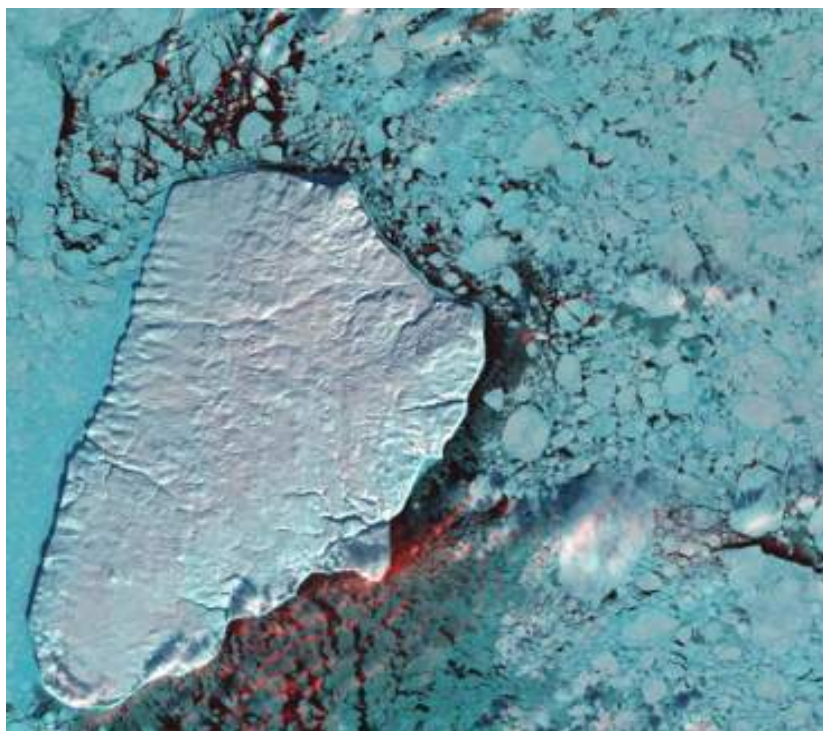
Max Craglia
European Commission
Joint Research Centre

www.jrc.ec.europa.eu

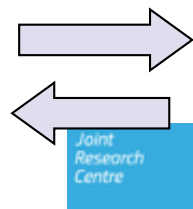


*Serving society
Stimulating innovation
Supporting legislation*

Earth system science needs to model the interactions between nature and society



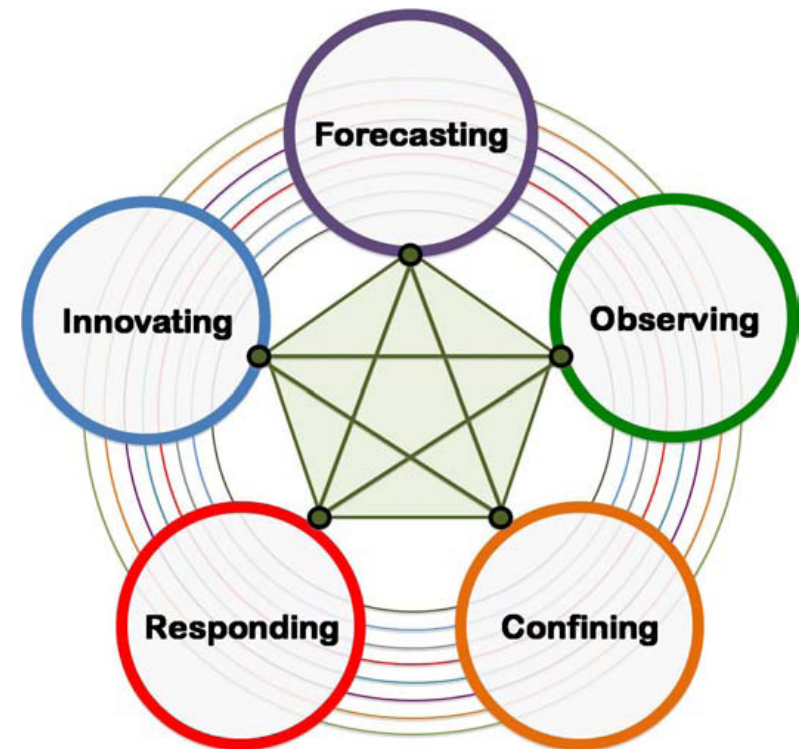
Nature: Physical equations
Describe processes



Society: Decisions on how to
Use Earth's resources

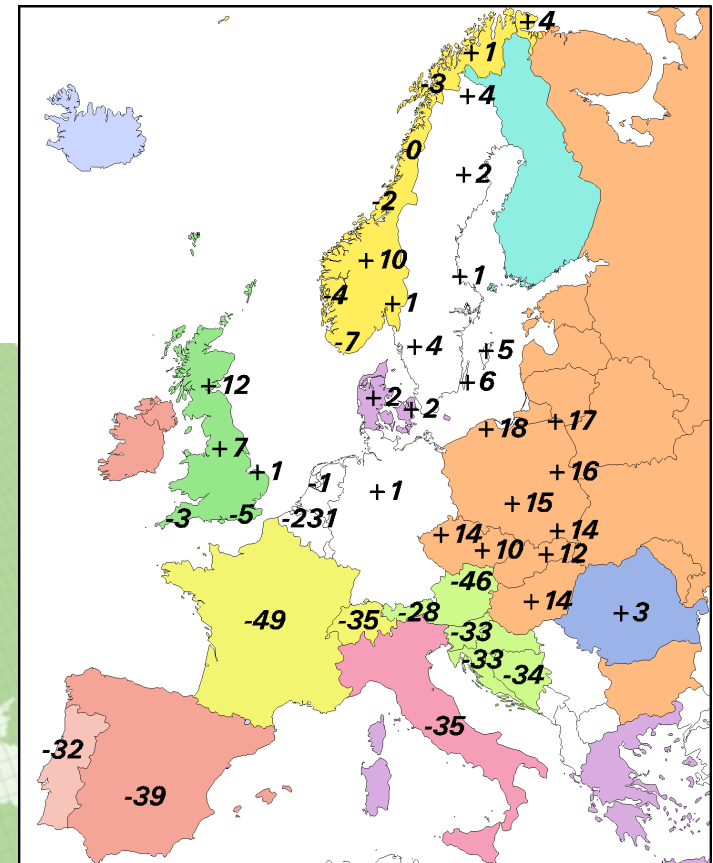
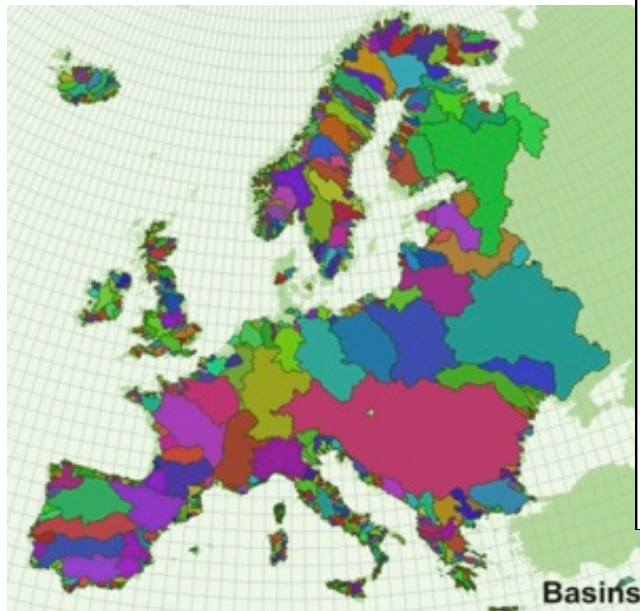
Key challenges for sustainability research

- Develop the information infrastructures necessary for policy based on sound knowledge;
- Foster the multi-disciplinary research necessary to improve our understanding of the relationships environment-society;
- Communicate science more effectively to decision makers and European citizens;
- Engage the public in the scientific process (e.g. help monitor the environment they live in).



Information Infrastructures: INSPIRE = European SDI

- Needed because natural disasters do not stop at national borders,
- 70% of all fresh water bodies in Europe are part of a trans-boundary river basin
- We could not even agree on how to measure "Height"!





INSPIRE is a legal framework

- The INSPIRE Directive lays down general rules to establish an **Infrastructure for Spatial Information in Europe** for environmental policies and policies which may affect the environment
- INSPIRE is built on the SDIs established and operated by the Member States
- JRC is the technical coordinator
- Implementing Rules (i.e. legislation)
 1. Metadata
 2. Interoperability of spatial data sets and services
 3. Services (discovery, view, download, transform, invoke)
 4. Data and Service sharing (policy)
 5. Monitoring & reporting

INSPIRE in a nutshell

- Comprehensive **data inventory**
- **Facilitate data discovery** through standardised discovery services & metadata
- **Data sharing**
- **Facilitate data access** by allowing view, download and transformation
- **Facilitate data use and interoperability** by adopting common cross-domain models to exchange data



INSPIRE thematic scope

Annex I

1. Coordinate reference systems
2. Geographical grid systems
3. Geographical names
4. Administrative units
5. Addresses
6. Cadastral parcels
7. Transport networks
8. Hydrography
9. Protected sites

Annex II

1. Elevation
2. Land cover
3. Ortho-imagery
4. Geology

Annex III

1. Statistical units
2. Buildings
3. Soil
4. Land use
5. Human health and safety
6. Utility and governmental services
7. Environmental monitoring facilities
8. Production and industrial facilities
9. Agricultural and aquaculture facilities
10. Population distribution – demography
11. Area management/ restriction/regulation zones & reporting units
12. Natural risk zones
13. Atmospheric conditions
14. Meteorological geographical features
15. Oceanographic geographical features
16. Sea regions
17. Bio-geographical regions
18. Habitats and biotopes
19. Species distribution
20. Energy Resources
21. Mineral resources



INSPIRE Geoportal

INSPIRE metadata from EU Member States are available online starting from November 2011, and harvested by the INSPIRE Geoportal

Some 250k datasets currently available through the multilingual geoportal developed and managed by the JRC, more to come.

Contact | Search | Legal notice

English (en) ▼



INSPIRE GEOPORTAL

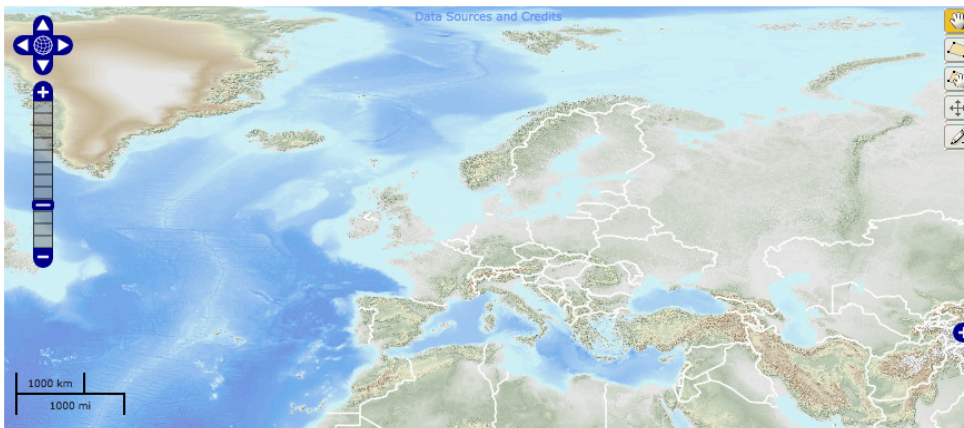
Enhancing access to European spatial data

EUROPEAN COMMISSION > INSPIRE > INSPIRE GEOPORTAL > Discovery / Viewer

What's new

Find a place in: Europe

Powered by GeoNames



Search: Enter your query in any language of the European Union

Advanced Search

sorted by relevance | most relevant

displaying 1 to 10 out of 283167 results

< 1 2 3 ... 28316 28317 >

[dataset] Saved Local Plan Policy A1 - Allocated Employment Sites

Sites allocated for employment under the Saved Local Plan po ... (show more)

[dataset] GeoIndex UK Onshore Geophysical Library (UKOGL)

The UK Onshore Geophysical Library was established in 1994 i ... (show more)

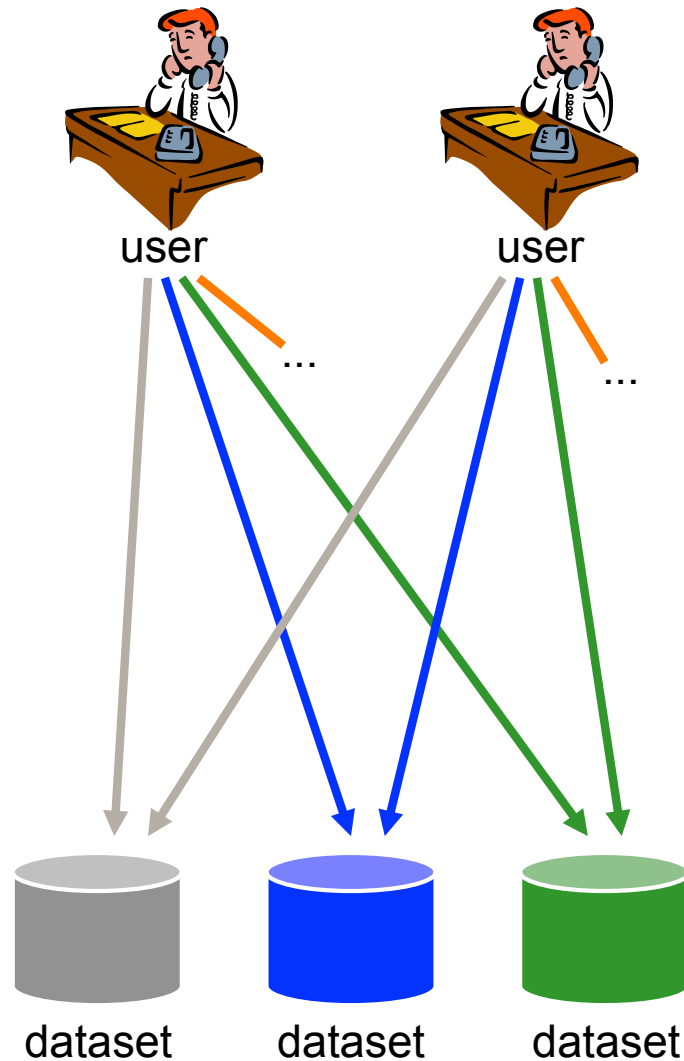
[dataset] Saved Local Plan Policy D26 - Urban Open Spaces

Dataset showing Urban Open Spaces under Policy D26 of the Sa ... (show more)

[dataset] Polling Districts

Statutory Polling Districts within Borough Borough Council Ad ... (show more)

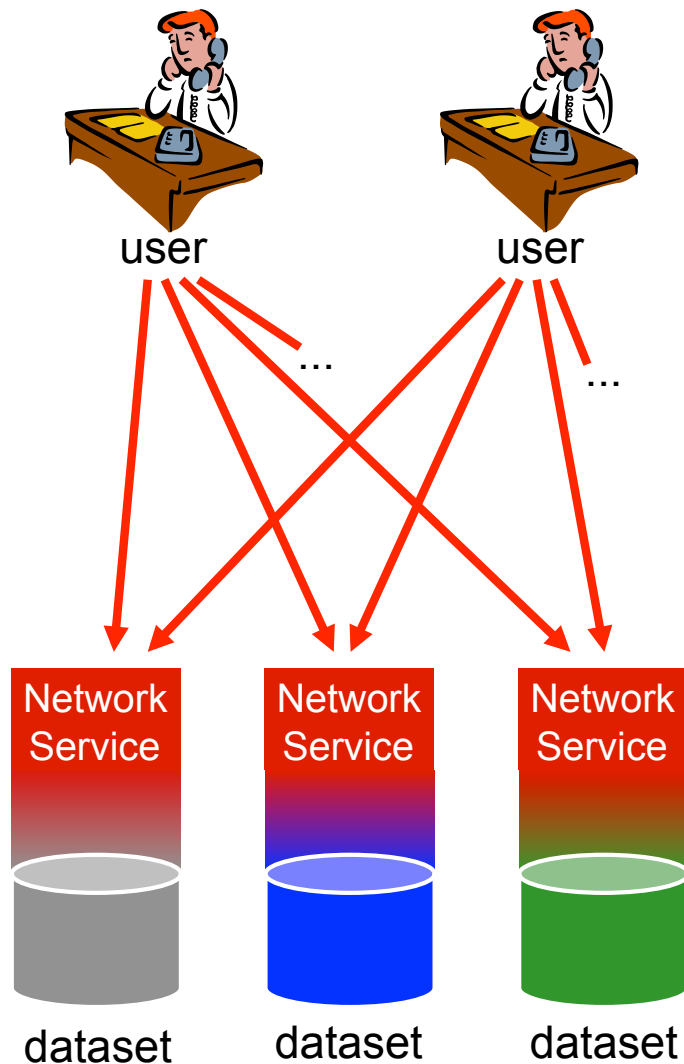
Data interoperability



The starting point ...

- Access to spatial data in various ways
- User has to deal with interpreting **heterogeneous data** in different formats, identify, extract and post-process the data he needs
→ **lack of interoperability**

Data interoperability



And what INSPIRE aims at....

- Provide access to spatial data via **network services** and according to a harmonised data specification to achieve **interoperability of data**
- ! Datasets used in Member States may stay as they are
- ! Data or service providers have to provide a transformation between their internal data model and the harmonised data specification

Example: HY – The World



Example: HY – Complete Data Specification





Coordination

- Transparency and inclusiveness
- Stakeholder consultations
- **Support to Member States** on the implementation
- Extend INSPIRE to and ensure consistency of **different policy domains**
- Promote INSPIRE in **international standardisation**



Key pillars of data interoperability

Conceptual data models

- objects types, properties & relationships
- cross-domain harmonization
- based on a common modelling framework
- managed in a common UML repository

Encoding

- conceptual models independent of concrete encodings
- standard encoding: GML, but also possible to derive other encodings (e.g. based on RDF)

Harmonised vocabularies

- to overcome interoperability issues caused by free-text and/or multi-lingual content
- allow additional terms from local vocabularies

Registers

- provide unique and persistent identifiers for reference to resources
- allow their consistent management and versioning

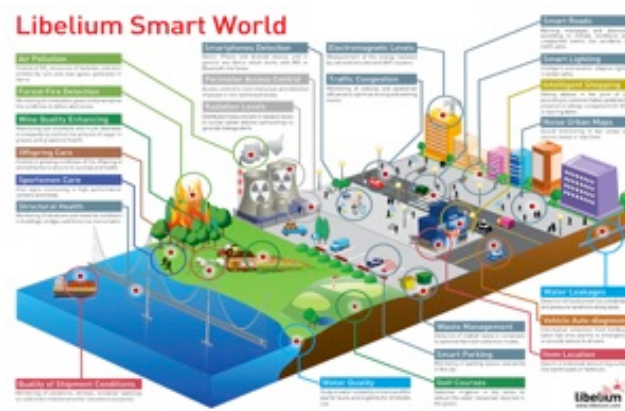
Moving towards Big Data

- 2 Terabytes per day once in operations
- Raises issues of where and how to store the data, how to provide easy and rapid access, how to process and analysis, and maintain over time.
- Australia's DataCube and public research cloud are very interesting models for us.



The screenshot shows the Copernicus website interface. At the top, the Copernicus logo is displayed with the tagline 'The European Earth Observation Programme'. A search bar is located on the right. A navigation menu on the left includes links for Overview, Services, Infrastructure, Applications, Projects, Library, Events, News, Newsletters, Publications, and Links. The main content area features a grid of six images: a landscape, clouds, a city, a glacier, a wave, and a refugee camp. Below the images, a text block states: 'Copernicus, previously known as GMES (Global Monitoring for Environment and Security), is the European Programme for the establishment of a European capacity for Earth Observation. The views expressed on this website are those of the authors and do not necessarily represent those of the European Commission.' The bottom right corner contains a 'FOCUS EVENT' section for the 'European Space Expo' held from 05 November 2013 to 10 November 2013 in Munich, Germany. A 'Newsletter' sign-up button is visible in the bottom left corner.

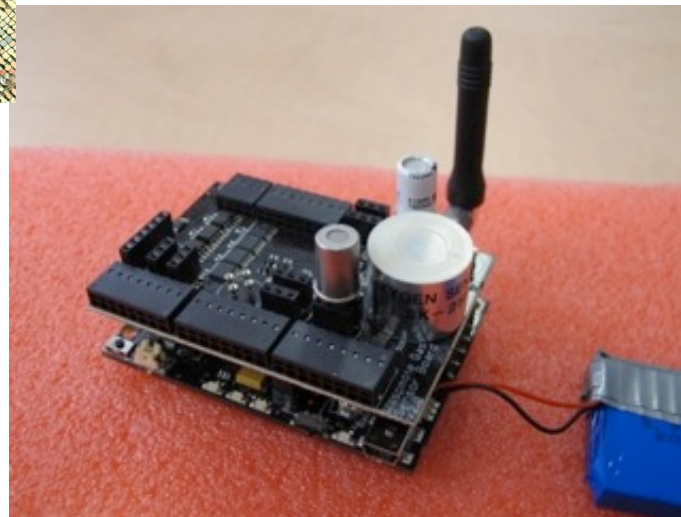
Massive diffusion of cheap sensors providing new opportunities and challenges



- Mobile phones as increasingly useful sensor platforms
- Drones = highly detailed mapping at low cost
- Waspnotes need programming and issues of calibration and response time but opportunities high..

App Store

Play Store



Sensing society.....

500 million Tweets per day (Aug 2013)

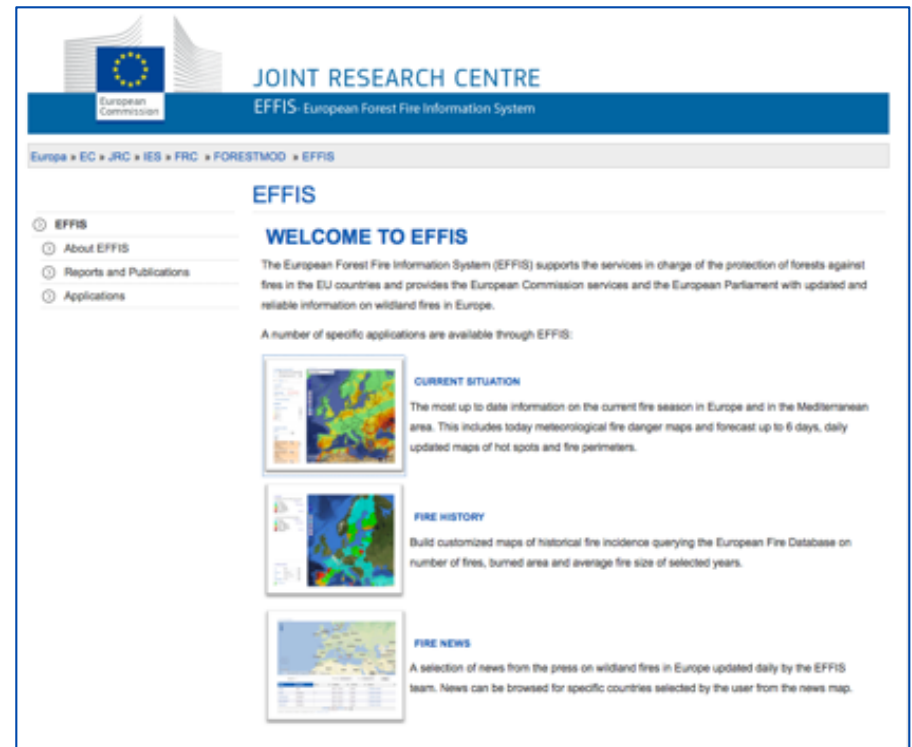
140 characters but complex semantics for data mining
Looking for forest fire in Athens, Greece.



- "New blog posting, Sure-**Fire** Christian drug rehab Health Recovery Services Inc Bassett House, **Athens** (OH)"
- @**Athens**PIO: National Pet **Fire** Safety Day is July 15
- "@Sade_vs_Lex XXX XXXXing by a bon **fire** screamin like **heathens!**"
- Back at hotel in **Athens**. **Fire** skirted village. Little evidence of significant damage. Helicopters still overhead damping scrub. **Beer unaffected.**
- Is quality a **BIG** issue?

Large scale experiment at JRC to assess quality of social network data

- Project at JRC 2010-12 to develop automatic workflow and extract and assess data from Flickr and Twitter related to forest fires and compare to official data from European Forest Fire Information System managed by JRC.



The screenshot shows the homepage of the European Forest Fire Information System (EFFIS). The header includes the European Commission logo and the text "JOINT RESEARCH CENTRE" and "EFFIS - European Forest Fire Information System". A navigation menu lists "Europe", "EC", "JRC", "IES", "FRC", "FORESTMOD", and "EFFIS". The main content area is titled "EFFIS" and "WELCOME TO EFFIS". It provides a brief description of the system's purpose and lists three main applications: "CURRENT SITUATION", "FIRE HISTORY", and "FIRE NEWS". Each application is accompanied by a small thumbnail image representing its data visualization.



European Commission

FOREST FIRE CASE STUDY

RETRIEVAL

Collect the volunteered information from data publicly available on social media platforms as text messages and photo tags.

GEOCODING

Only a fraction of the VGI is explicitly geocoded with coordinates, while the majority is implicitly geocoded with place names. We extract the place names and their spatial reference and geocode them to make these available for analysis.

QUALITY ASSESSMENT

The crucial aspect for using volunteered information in the context of crisis management is to assess its quality. For this task, we explore several methods, including:

- Syntactical validation of the data
- Cross-referencing with other data
- Spatial and temporal clustering

The two main metrics for assessing the quality will be the **credibility** and the **relevance** of data with respect to a specific event.



INTEGRATION

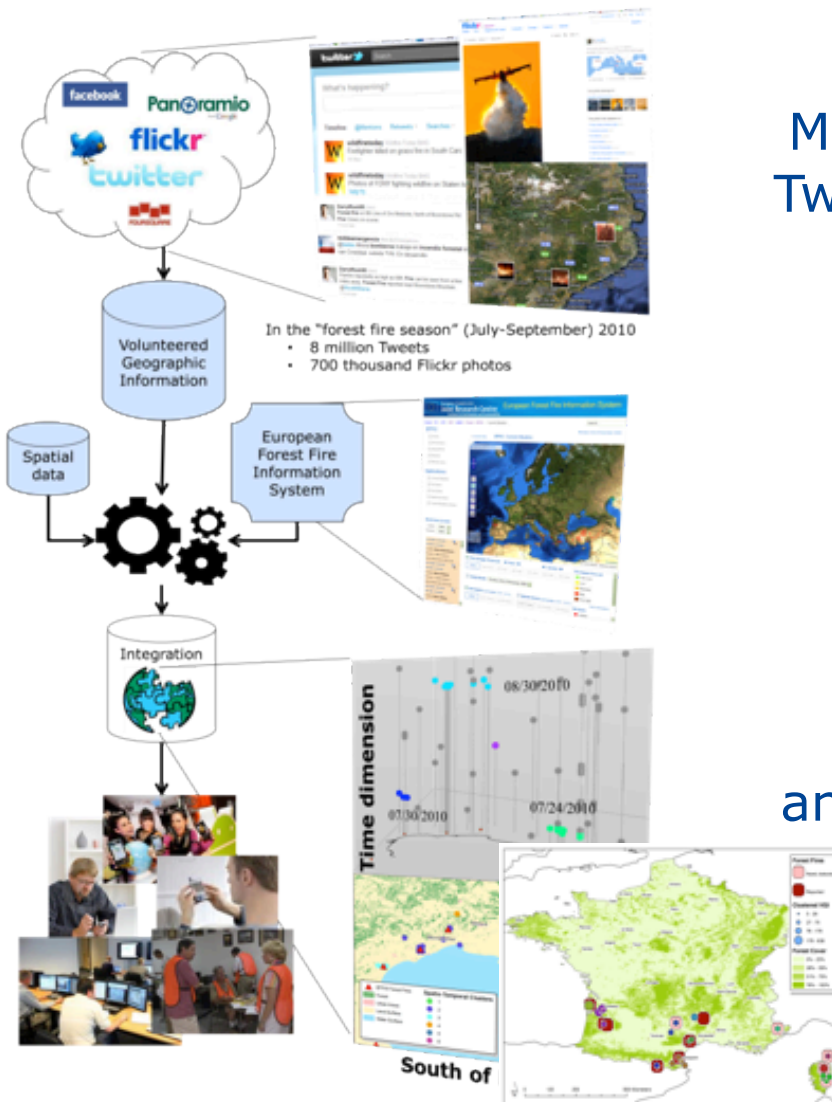
The quality-assessed VGI needs to be integrated within the disaster management process and other official data such as remote sensing images and spatial data infrastructures.

DISSEMINATION & EVALUATION

The two main target audiences for the results are:

1. The general public
2. Decision makers

They have very different needs, that will be addressed in a final step, a task- and user-centered design process. The added value of the VGI will be rigorously evaluated.



More than 20million Tweets and 1 million Flickr images retrieved and analysed for fires South of France

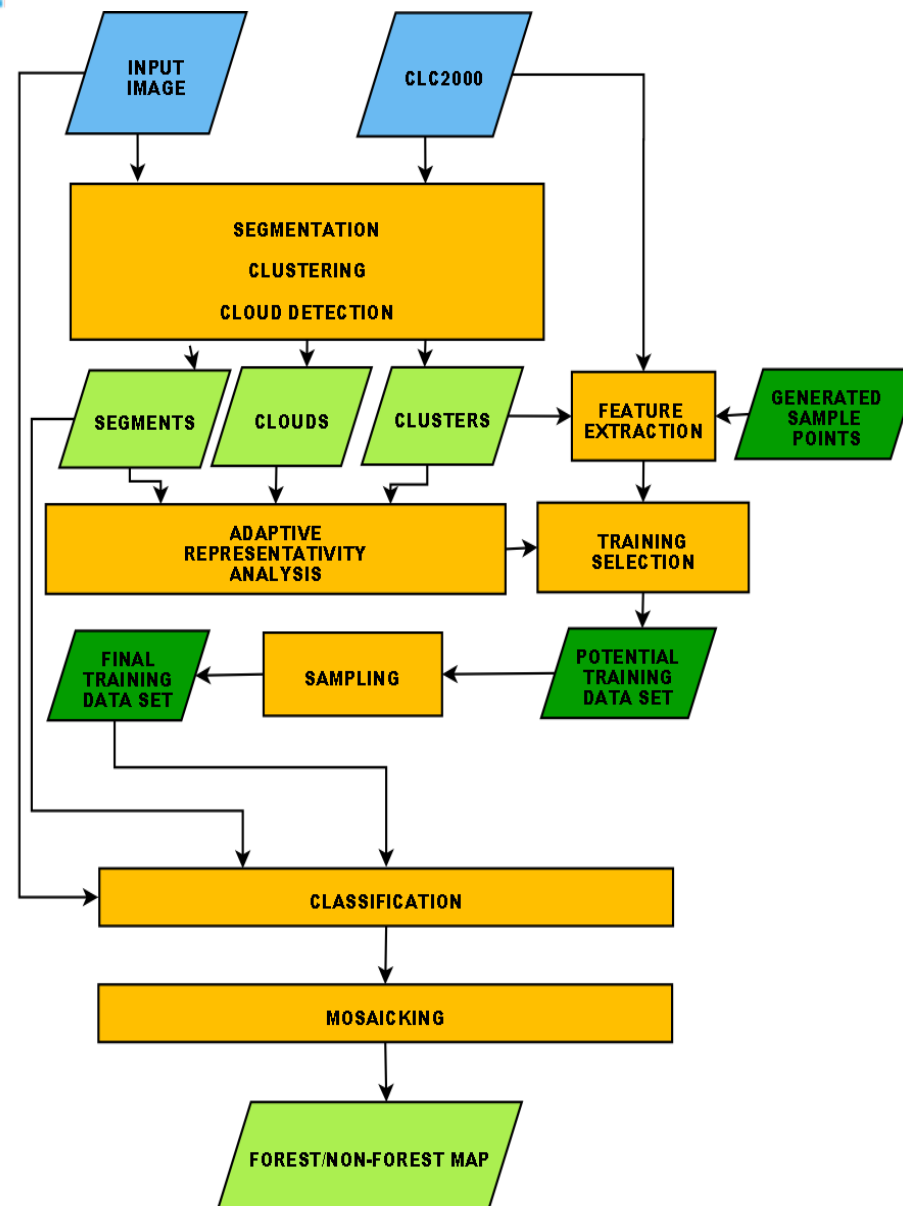
Spatio-temporal clustering and analysis shows 80% of fires correctly detected



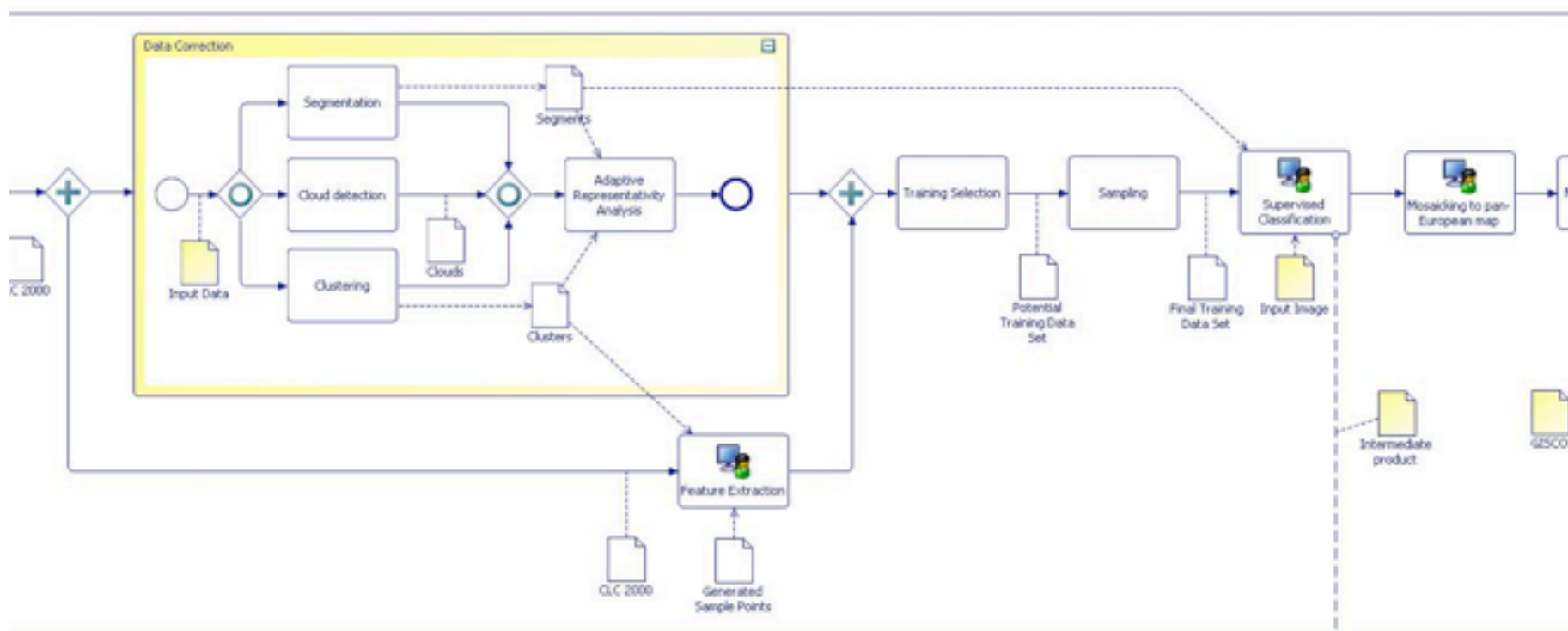
From Data to Processes

- If you have BIG Data from multiple sources, you cannot move the data for processing, need to move the analysis and processing to the data.
- Beyond Search and Access, we need also to develop a shared understanding of *what do you do with the data?*
- How do you frame a problem and possible solution according to different disciplinary approaches.
- This quest requires to describe not just the data, but also processes or workflows, leading to new executable web services that are understood across disciplines.

Example: how to make a forest map



Workflows described in formal modelling language



Executable workflows and models can then be integrated and interfaced with other services to develop chains.

JRC Model inventory and infrastructure



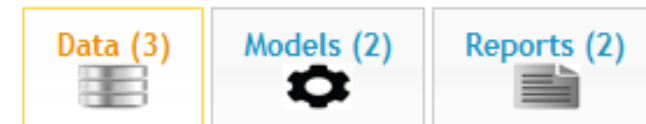
The screenshot shows the MIDAS PORTAL interface. At the top, there is a navigation bar with 'Contact | Search | Legal notice' and a language dropdown set to 'English (en)'. The main header features the European Commission logo and the text 'MIDAS PORTAL Modelling Inventory Database & Access Services'. Below this is a breadcrumb trail: 'EUROPEAN COMMISSION > JRC > RDSI > MIDAS Discovery'. The main content area is titled 'Point Of Contact' and includes a 'Back to model' button. The primary entry is 'Natura 2000 (vector) 100 k - end 2009'. To the left of the main text are several sections: 'Responsible Organization' (European Environment Agency), 'Conditions For Access And Use', 'intellectual property rights', and 'Limitations On Public Access'. The main text describes Natura 2000 as a key instrument for biodiversity protection. Below this are sections for 'Lineage' (Member States update data), 'Resource Locator' (a URL to the data), and 'Unique Resource Identifier' (EEA_Natura2000_100k_DataSet).

Inventory of JRC models:

- Point of Contact
- Description of the model
- Policy Area
- Property Rights
- Links to input and output data

Related Resources (Data)

Related Resources



Input - Natura 2000

vector 100k - end 2009

Input - Corine Land Cover 2006

raster 100m - version 15, Aug. 2011

Output - Land Use Map

Simulated map of land use/cover

Ensures:

- Reproducibility
- Transparency



[Contact](#) | [Search](#) | [Legal notice](#) | [English \(en\)](#)


MIDAS PORTAL
 Modelling Inventory Database & Access Services

EUROPEAN COMMISSION > JRC > RDSI > MIDAS Discovery

Point Of Contact
 eea.enquiries@eea.europa.eu
 European Environment Agency

Responsible Organization
 eea.enquiries@eea.europa.eu
 European Environment Agency

[Conditions For Access And Use](#)
 intellectual property rights
[Limitations On Public Access](#)

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[Back to model](#)

Natura 2000 (vector) 100 k - end 2009

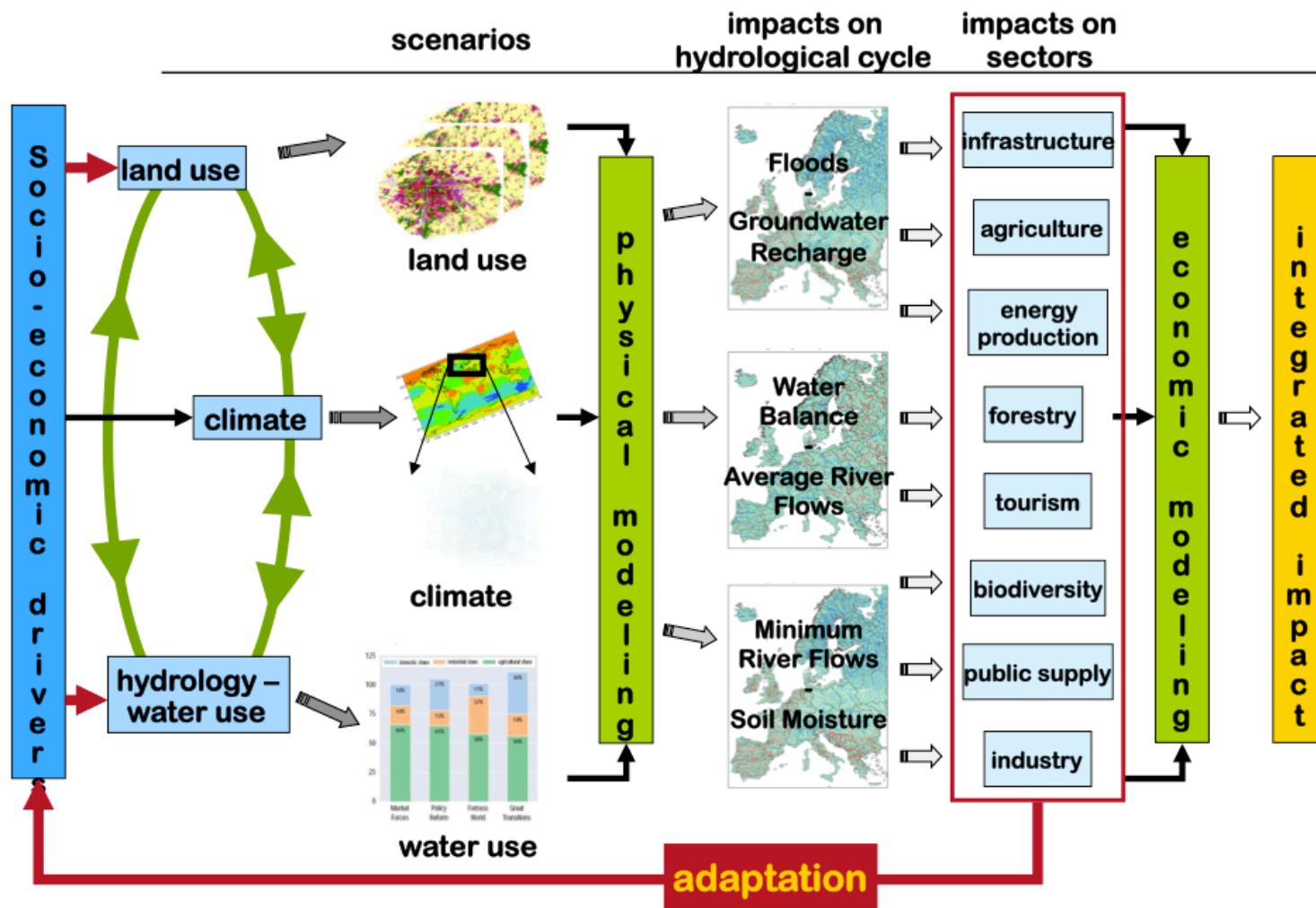
Natura 2000 is the key instrument to protect biodiversity in the European Union. It is an ecological network of protected areas, set up to ensure the survival of Europe's most valuable species and habitats. Natura 2000 is based on the 1979 Bird's Directive and the 1992 Habitat's Directive. The green infrastructure it provides safeguards numerous ecosystem services and ensures that Europe's natural systems remain healthy and resilient.

[Lineage](#)
 Member States update Natura 2000 spatial data continuously. The EEA integrates and validates the data, producing two releases a year.

[Resource Locator](#)
<http://www.eea.europa.eu/data-and-maps/data/natura-2000>

[Unique Resource Identifier](#)
 EEA_Natura2000_100k_DataSet
 eea.europa.eu

Moving towards integrated modelling



Multidisciplinary Interoperability Challenges

- ✓ Different communities have different theoretical approaches, analytical practices, and multiple layers of knowledge;
- ✓ Different terminologies and ontology, formats and standards;
- ✓ We need have a framework for interoperability that bridges across different disciplines and e-infrastructures



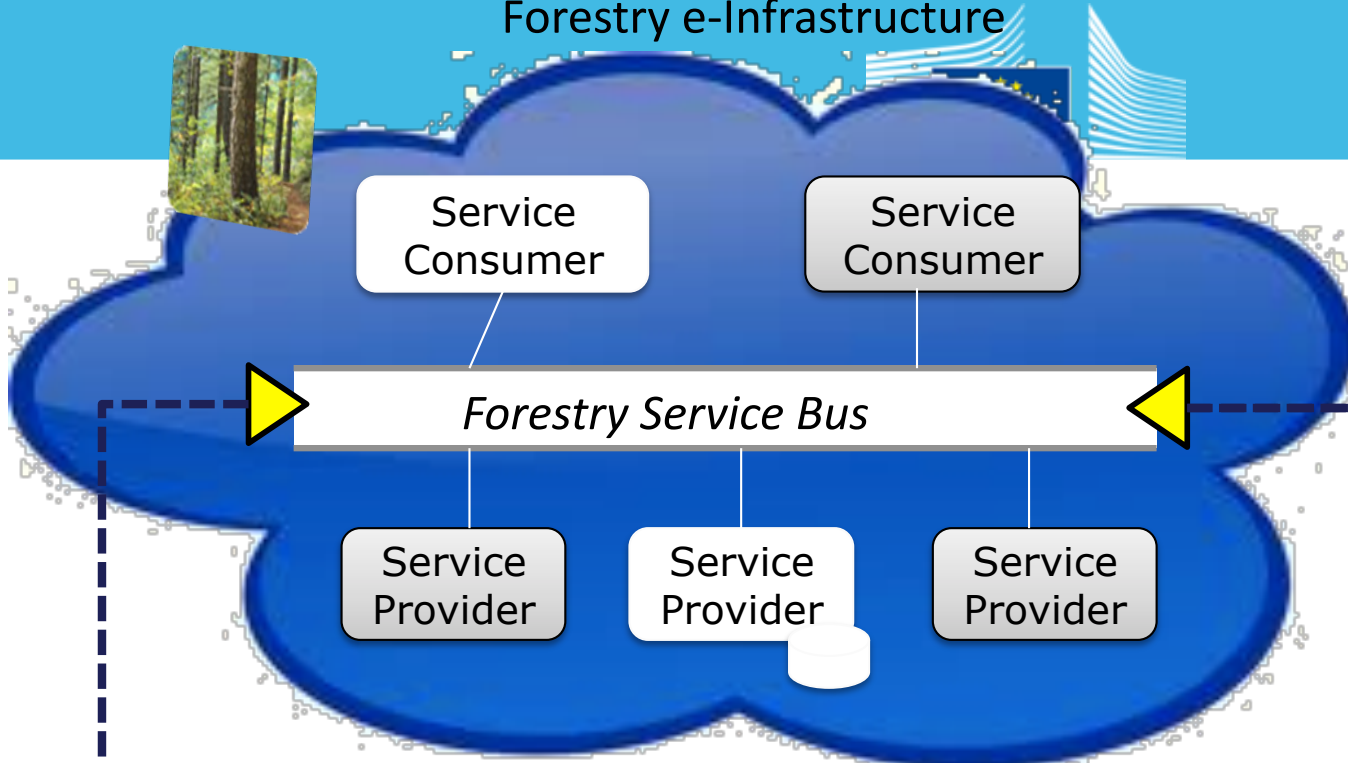
Interoperability Approaches

Federating means connecting systems that agree to a single set of standards
INSPIRE good example backed by law

In a global voluntary framework it is not possible to get agreement on a single set of standards **Brokering** introduces a middle layer of components that build the necessary bridges.



Forestry e-Infrastructure

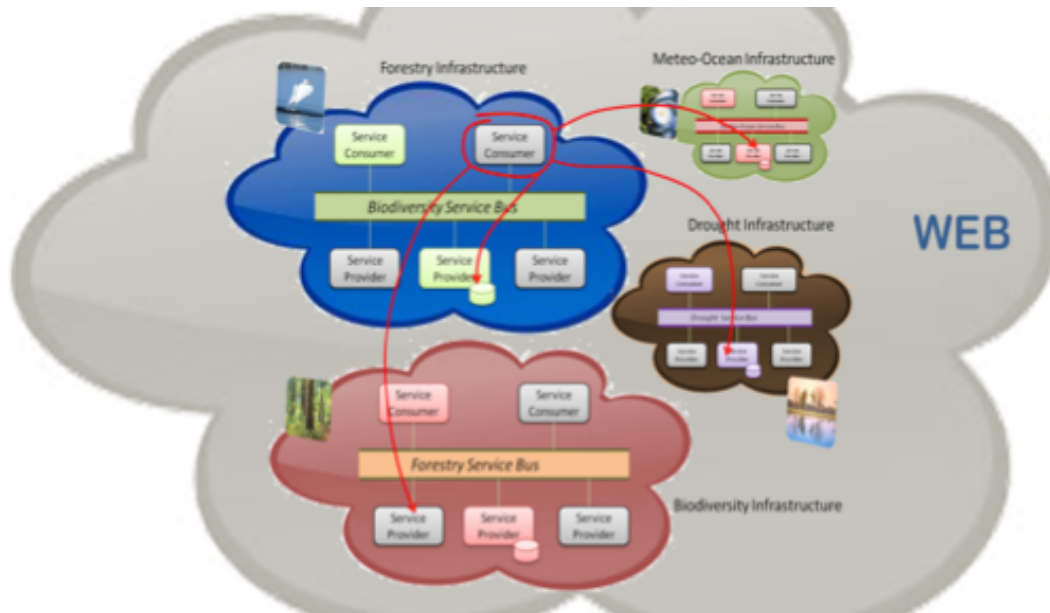


- Best practices
- Data policy
-

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

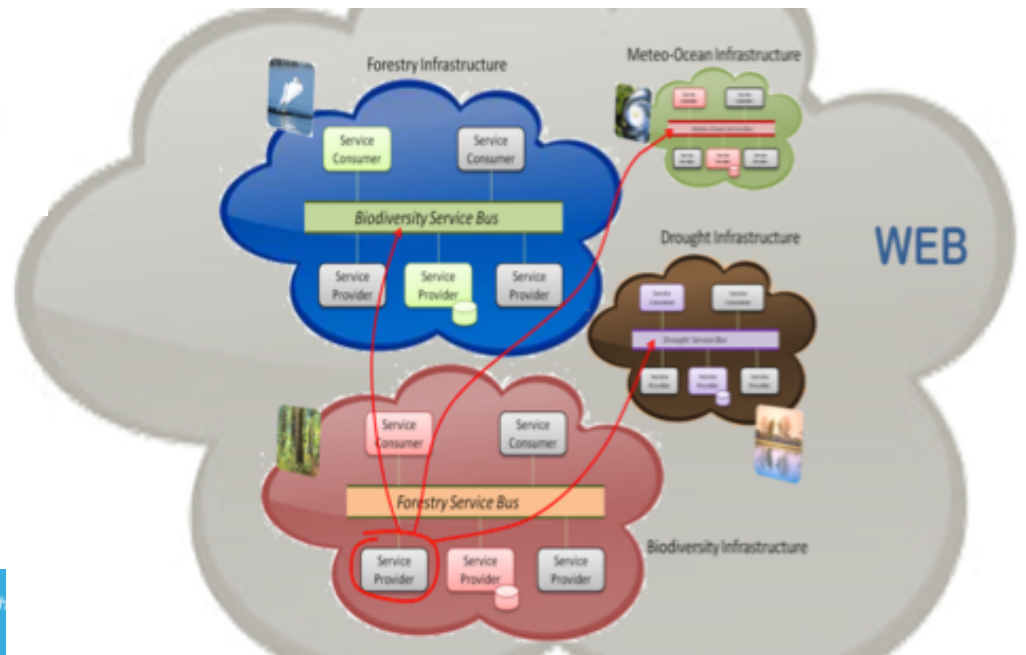
- Discovery protocol(s)/interface(s)
- Access protocol(s)/interface(s)
- Visualization protocol(s)/interface(s)
- Semantic protocol(s)/interface(s)
- ...

Traditional approaches

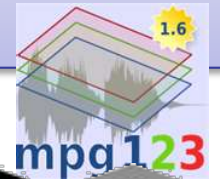
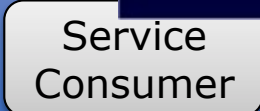


The providers publish in the multiple standards of the users = Heavy on providers

The consumers deal with the great variety of standards in each discipline = Heavy on users



Forestry e-Infrastructure



Forestry Service Bus



Geographic Information



Metadata model(s), Data model(s), Encoding Format(s), Language, Intergovernmental, International



WORLD WIDE WEB CONSORTIUM



OpenSearch



Controlled

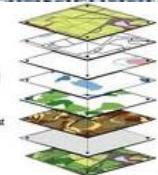


GML

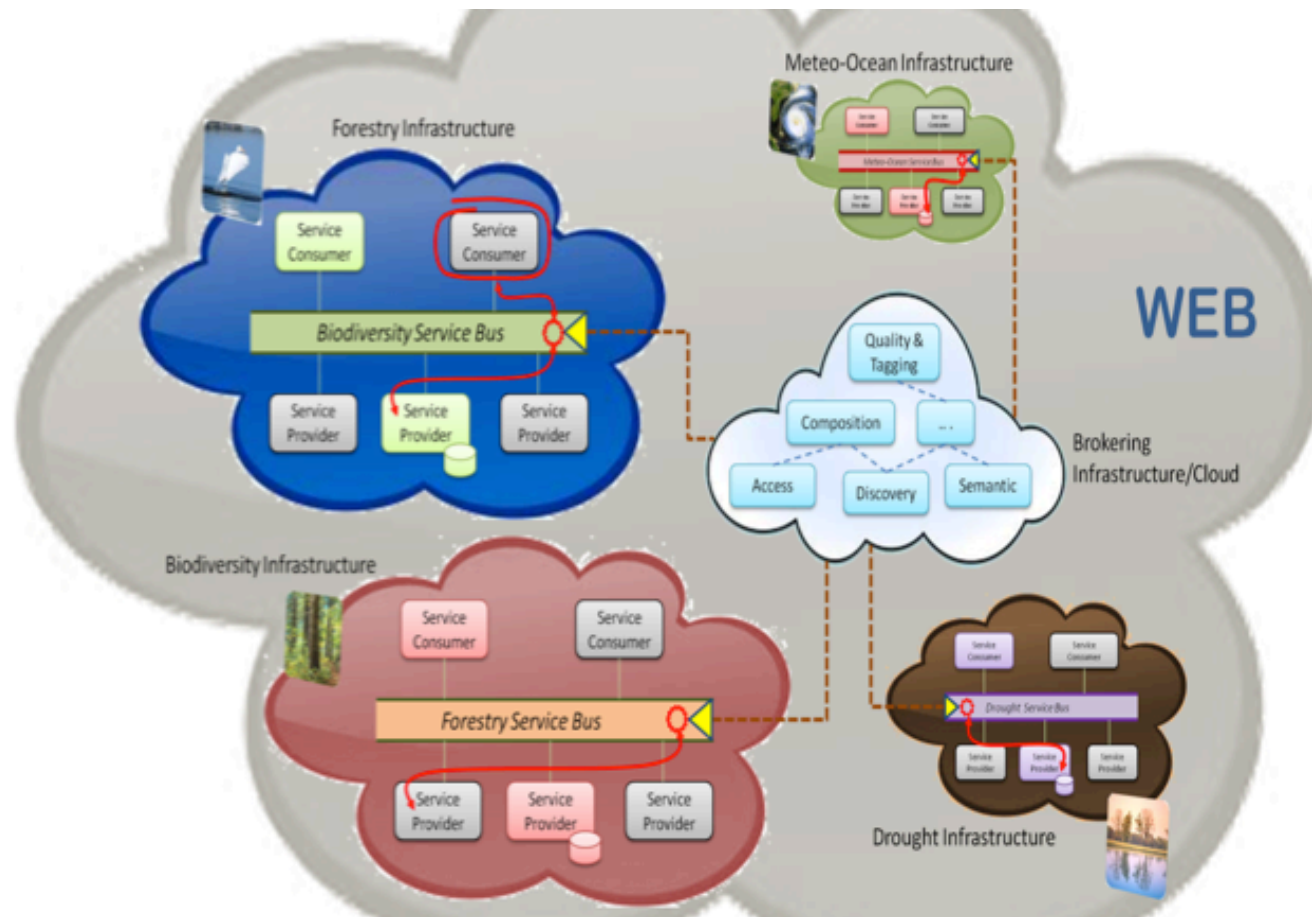
Visualization protocol(s)

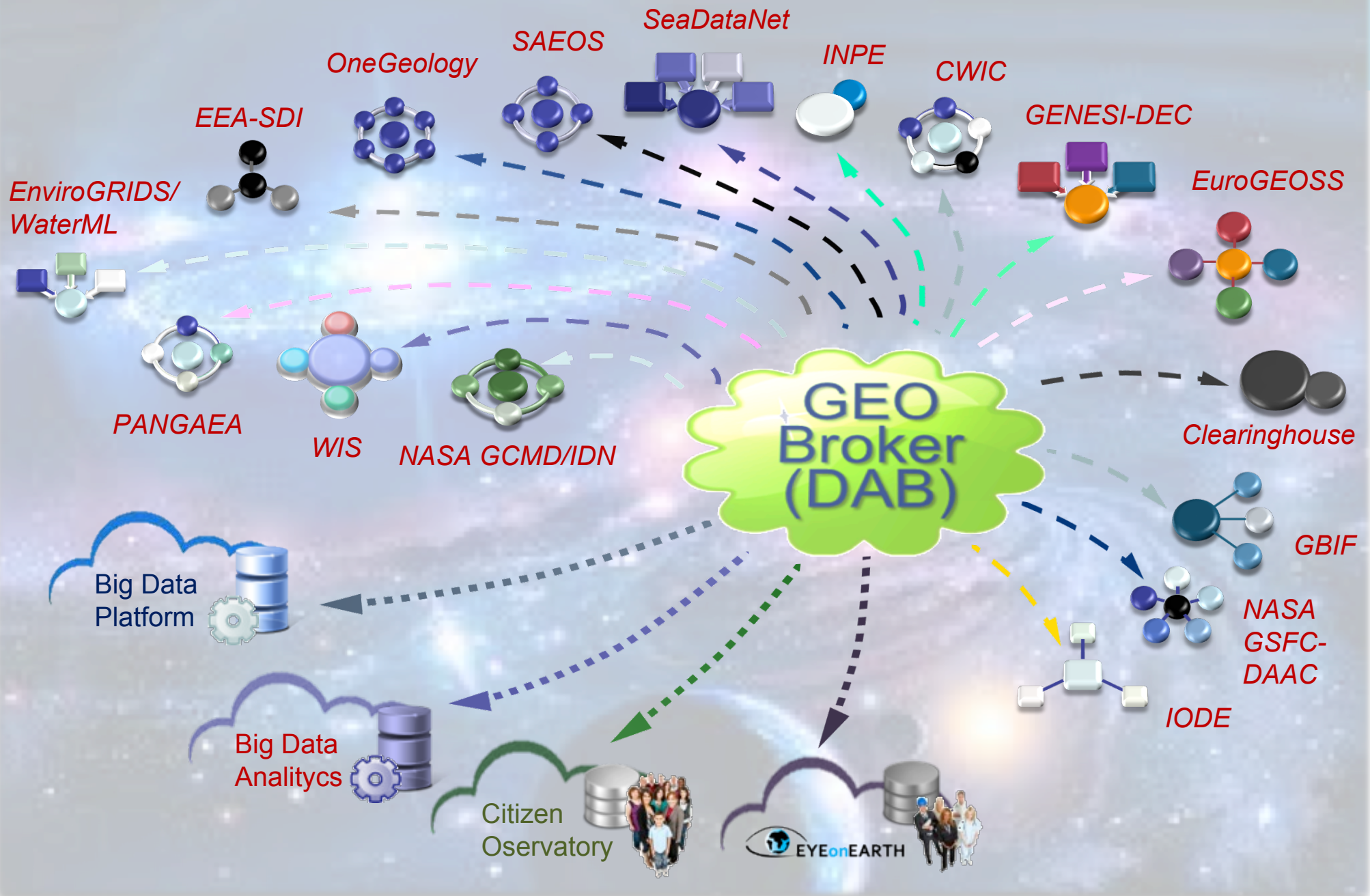


Most Common GIS Format



New approach: Brokering = middleware building the bridges across communities







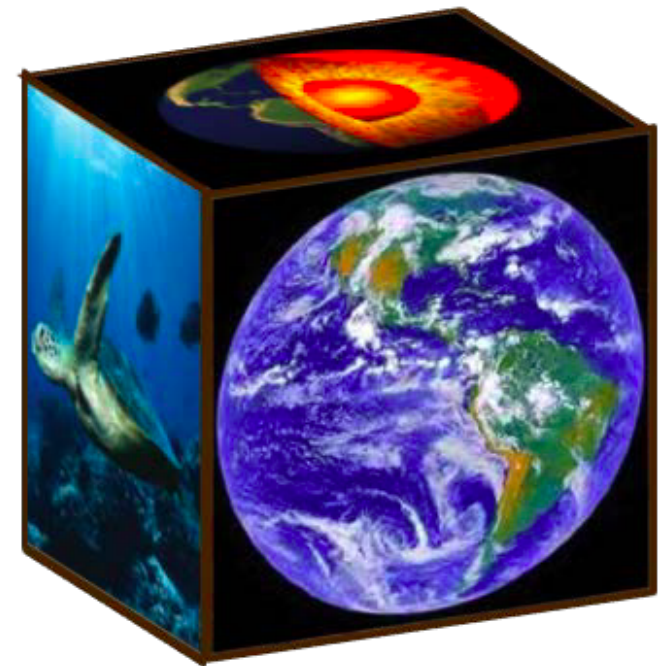
European
Commission

GEOSS Resources



NSF EarthCube

- To transform the conduct of research in geosciences by supporting the development of community-guided cyberinfrastructure to integrate data and information for knowledge management across the Geosciences
- JRC participating with Italian National Research Council to EarthCube pilots
- Brokering adopted as a principle given the range of existing data centres and large capacities



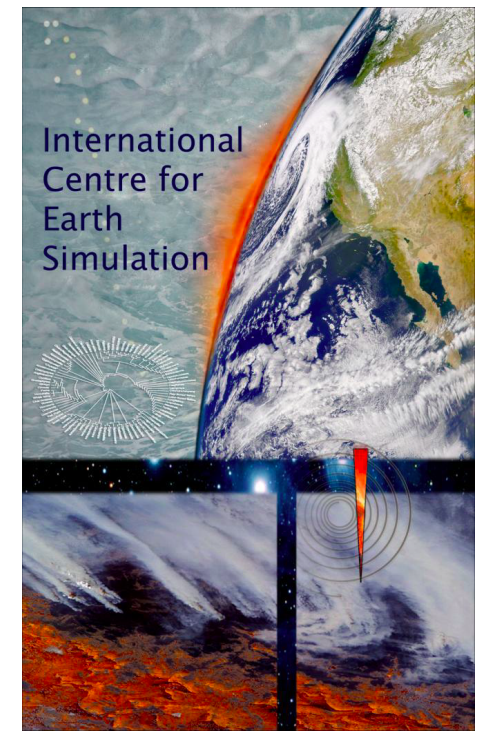
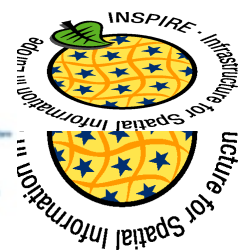
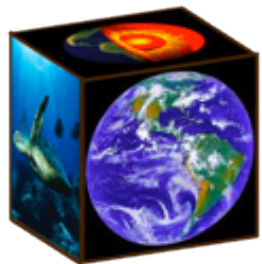
Digital Earth is the frame for our activities

- 3, 4, n-D: from the **global to local** (inside buildings, and under ground and under water) and everywhere on Earth.
- Visualize change through historical data and **integrated models**.
- Contribute to a **multi-disciplinary** shared understanding of how the Earth system works and impact of human activity.
- **Dynamic, interactive, participative**: synthesis of heterogeneous data from people, sensors, statistics, models. **Ubiquitous**, open and accessible for people and things on line at all times.
- Easy to use and **open**.



From Vision to Implementation

- Deepening and extending INSPIRE
- Researching the Observation Web = new data sources from citizens and sensors
- Researching multi-disciplinary interoperability linking data, models, outcomes
- Global collaborations (GEOSS, NSF EarthCube, ICES,



Digital Earth, a laboratory for Digital Science

- Develop in Horizon 2020 a prototype Digital Earth to test and show feasibility of DE vision
- Two new projects (2014-16) at JRC on Urban Quality of Life and Digital Earth Platform
- Connect the many pieces at our disposal data, models, scenarios, networks, citizen-generated content
- Contribute to turning the ICES vision into reality.



Right: Screenshot from *Spacefighter: The Evolutionary City* (game): a prototype video game system for interpreting global urban development behaviours, developed during two studios of postgraduate students from the Berlage Academy and MIT, led by Winy Maas and Arie Graafland. (MYRDEI05D)



Thank you for your kind attention



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