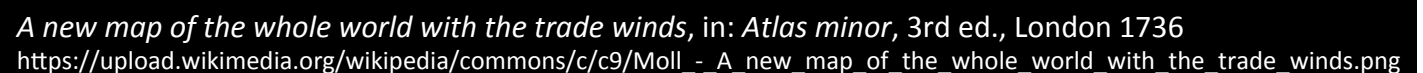# Data management within Spatial Data Infrastructures

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Scuola di Architettura Urbanistica Ingegneria delle Costruzioni
Landscape Architecture. Land Landscape Heritage
ENVIRONMENTAL ANALYSIS AND LANDSCAPE MAPPING
Politecnico di Milano – 19/11/2018

Sharing geospatial data

The historic phase
(till XIX century)

Aims:
Commerce, navigation, land
ownership…

Producers:
individuals, corporations, …

Data sharing model:
Not organized at all, for sale or
through libraries

A new map of the whole world with the trade winds, in: *Atlas minor*, 3rd ed., London 1736
https://upload.wikimedia.org/wikipedia/commons/c/c9/Moll_-_A_new_map_of_the_whole_world_with_the_trade_winds.png

Sharing geospatial data

The "enlightened" phase
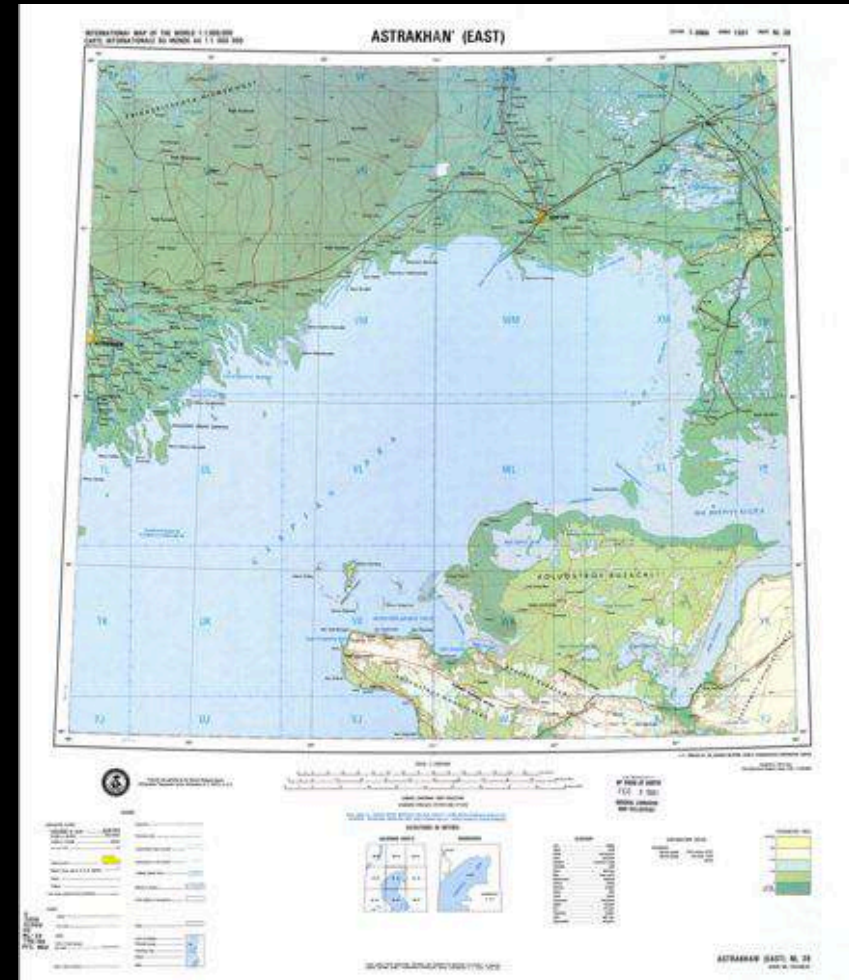(late XIX–XX century)

Producers:
National mapping agencies (often military branches)

Aims:
Establish and maintain dominion; exhaustive representation of the world (with accuracy and scale). Mapping stable phenomena

Data sharing model:
Simple radial model. Geoinformation is produced and distributed by NMPs

U. S. National Geospatial-Intelligence Agency - International Map of the World 1:1,000,000 – North-East part of Caspian Sea (1975)
https://commons.wikimedia.org/wiki/File:North-East_part_of_Caspian_Sea_(IMW_NL39).jpg

Sharing geospatial data

The contemporary phase
(late XX century - today)

The digital Earth (Al Gore, 1998)

Producers:
Geographic information become a distributed
enterprise (lower cost due to ICT evolution:
more providers). Central government, but
also local, and private business is new actor

Aims:
Value added products for the market.
Mapping transitory phenomena becomes
possible (e.g. weather, traffic reports, …).

Data sharing model:
Federated, multitenanted. Each actor
contribute to part of a larger "patchwork"
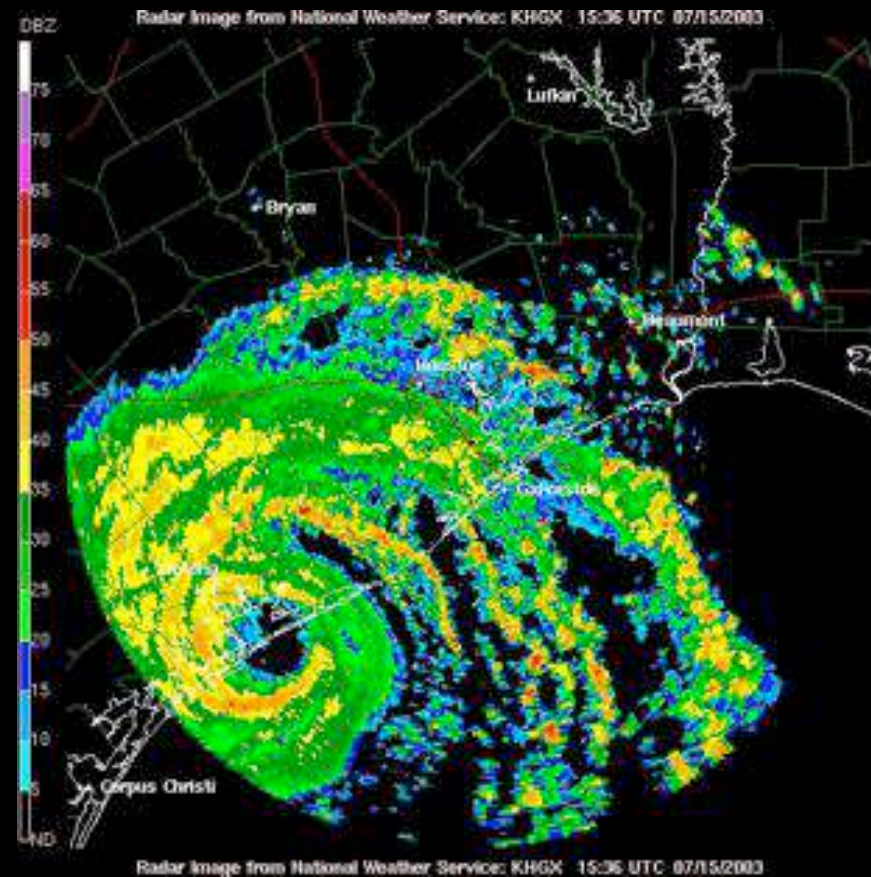
Radar image from National Weather service - 2011

Sharing geospatial data

1994 First Spatial Data Infrastructure : NSDI (USA)

A network of producers -> a maintained patchwork coverage

Standards are in place: for interoperation of the various parts

Spatial data infrastructure (SDI)

Typical Architecture of a SDI
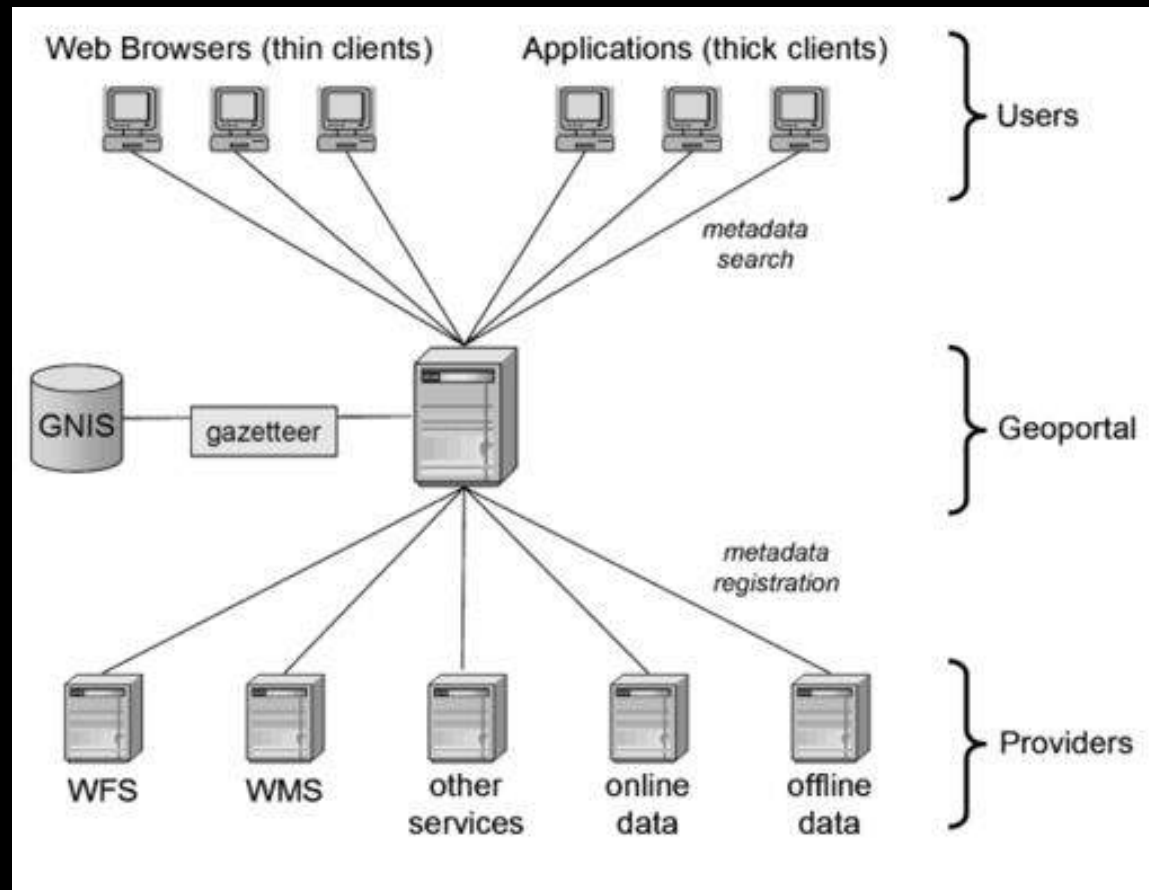
Sharing Geographic Information: An Assessment of the Geospatial One-Stop
Michael F. Goodchild, Pinde Fu and Paul Richz, 2007

Presentation/application

Desktop applications (GIS, …)

Web browser (Web App)

Mobile App

Service bus (HTTP, MQTT)

Service

OGC Server
(maps, features, coverage, observations, catalogues)

Application server
(charts, …)

Ad Hoc Middleware

Processing chains

Data & Metadata

ETL / data ingestion, normalisation, filtering

EO data repositories with API/web services

Other data repository with API
(Open Data, Social networks, VGI)

SQL DB
(PostGRES, PostGIS)

NOSQL DB
(Mongo DB)

Triple Store
(Fuseki, Virtuoso)

Metadata Repository

Structured File system

Standards involved in current SDI

- Standardization bodies: Main International Standardization bodies:
  - W3C: http, semantic web (RDF, SPARQL, SKOS, …)
  - ISO: 19115/19139 Metadata for geospatial objects
    - Technology: XML <- validation - gatekeeping
  - OGC: geospatial services

Standards involved in current SDI

OGC services - Visualization

– Map service for the web (WMS): images of data

- Operations of WMS

Operation	Description
GetCapabilities	Retrieves metadata about the service, including supported operations and pa
GetMap	Retrieves a map image for a specified area and content.
GetFeatureInfo (optional)	Retrieves the underlying data, including geometry and attribute values, for a
DescribeLayer (optional)	Indicates the WFS or WCS to retrieve additional information about the layer.
GetLegendGraphic (optional)	Retrieves a legend for a map.

Standards involved in current SDI

OGC services – data access
– Web Feature Service (WFS) – vector data
  • Operations of WFS

GetCapabilities Returns a document that describes the functionality and resources offered by the WFS service that is provided by the server.

DescribeFeatureType Returns a description of the structure of feature types and feature properties offered or accepted by an instance of a WFS.

ListStoredQueries Returns a list of the queries that have been stored inside the WFS instance.

DescribeStoredQueries Returns a description of the queries that have been stored inside the WFS instance.

GetFeature Returns a selection of feature instances from a data store published through the WFS.

Standards involved in current SDI

OGC services – data access
– Web Coverage Service (WCS) – raster data
  • Operations of WCS
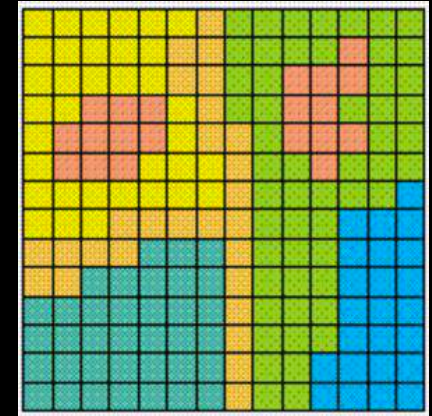
GetCapabilities Retrieves a list of the server's data, as well as valid WCS operations and parameters	
DescribeCoverage Retrieves an XML document that fully describes the request coverages.	
GetCoverageReturns a coverage in a well known format. Like a WMS GetMap request, but with several extensions to support the retrieval of coverages.	

Standards involved in current SDI

OGC services – data access
– Sensor Observation Service (SOS) – (sensor)
  observation data
  - Operations of SOS

GetCapabilities Returns a document that describes the functionality and resources offered by the SOS service that is provided by the server.
DescribeSensor Returns a description of the procedures or sensors associated with an SOS.
GetObservation Returns observation data that has been collected by the procedure or sensor.

Standards involved in current SDI

OGC services – metadata
– Catalog service for the web (CSW) –
  metadata documents
  - Operations of CSW

GetCapabilities allows CSW clients to retrieve service metadata from a server
DescribeRecord: "allows a client to discover elements of the information model supported by the target catalogue service. The operation allows some or all of the information model to be described"
GetRecords: search for records, returning record Ids
GetRecordById: "retrieves the default representation of catalogue records using their identifier"

INSPIRE and SOS

- Presentation of INSPIRE

http://inspire.ec.europa.eu/about-inspire/563

Technological solutions: GET-IT

- Presentation of get-it: enabling nodes of SDI

What is GET-IT?

- Aims to enable research groups/institutes to become leaders in the creation of an interoperable Spatial Data Infrastructures (SDI).

www.get-it.it
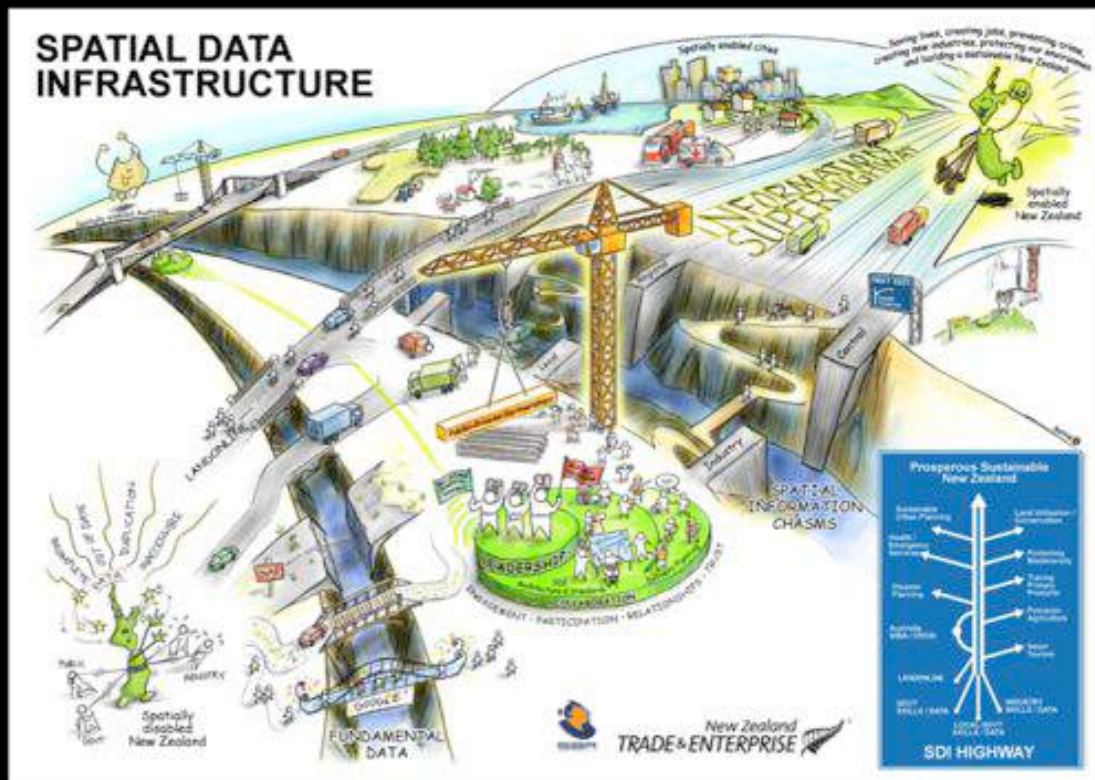
What is GET-IT?

- Developed by a joint research group of CNR IREA – ISMAR is based on GeoNode open source software.

New contribute:
- *Metadata Editor (EDI)*
- *Import observation tool*
- *Web client for visualization of map, layers and observations*
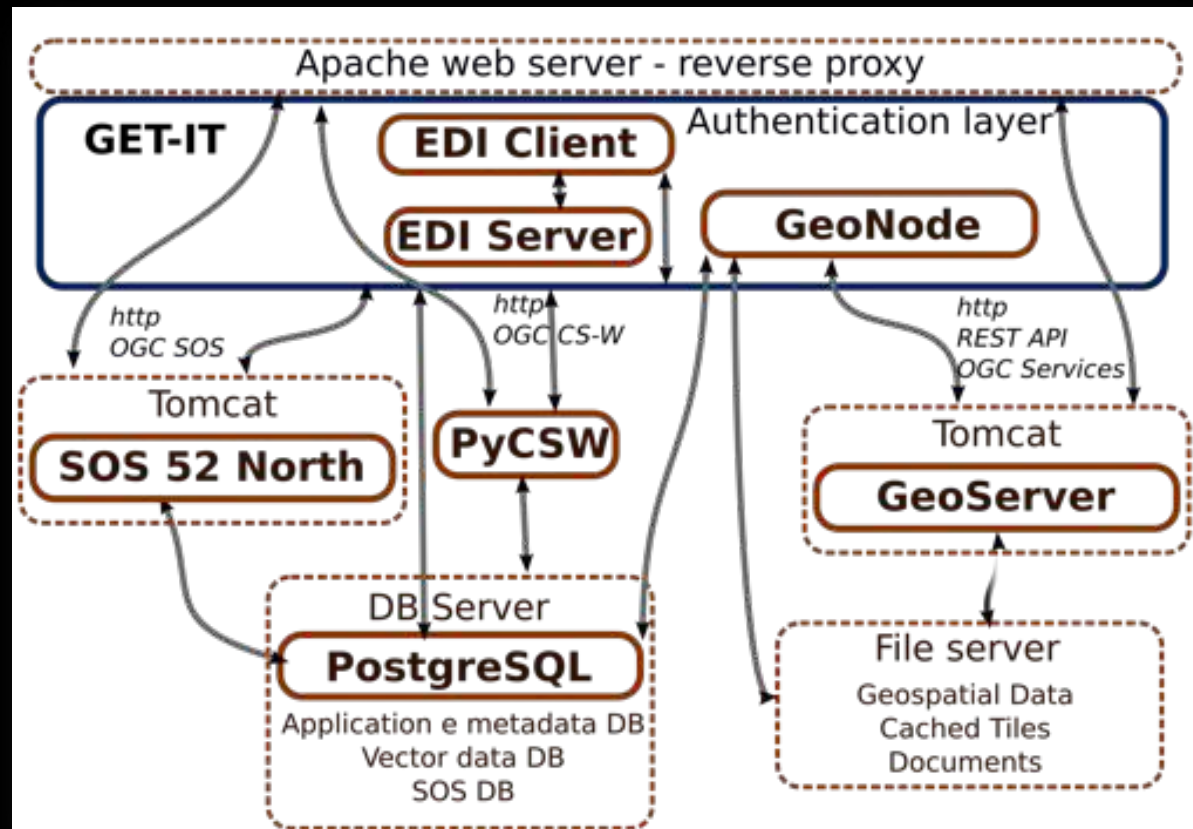
What is GET-IT?

- By exploiting standards from the OGC it enables the interoperable distribution of geospatial data, sensors, measurements and metatada.

Service	Version	Software
OCG Web Map Service	1.1.1, 1.3.0	GeoNode (GeoServer)
OGC Web Feature Service	1.0.0, 1.1.0, 2.0	GeoNode (GeoServer)
OGC Web Coverage Service	1.0, 1.1	GeoNode (GeoServer)
OSGeo WMS Tile Caching		GeoNode (GeoServer/GWC)
OGC Web Map Tile Service		GeoNode (GeoServer/GWC)
OSGeo Tile Map Service		GeoNode (GeoServer/GWC)
OGC Catalogue Services for the Web	2.0.2	GeoNode (pycsw)
INSPIRE Discovery Services	3.0	GeoNode (pycsw)
OGC SOS	1.0.0, 2.0	52°North SOS
OGC Sensor Model Language (SensorML)	2.0.0	52°North SOS
OGC Observation and Measurement (O&M)	2.0.0	52°North SOS
OGC Geography Markup Language (GML)	3.1.1	52°North SOS
Service	Version	Software
OCG Web Map Service	1.1.1, 1.3.0	GeoNode (GeoServer)

What is GET-IT?

- Completely free and open-source.
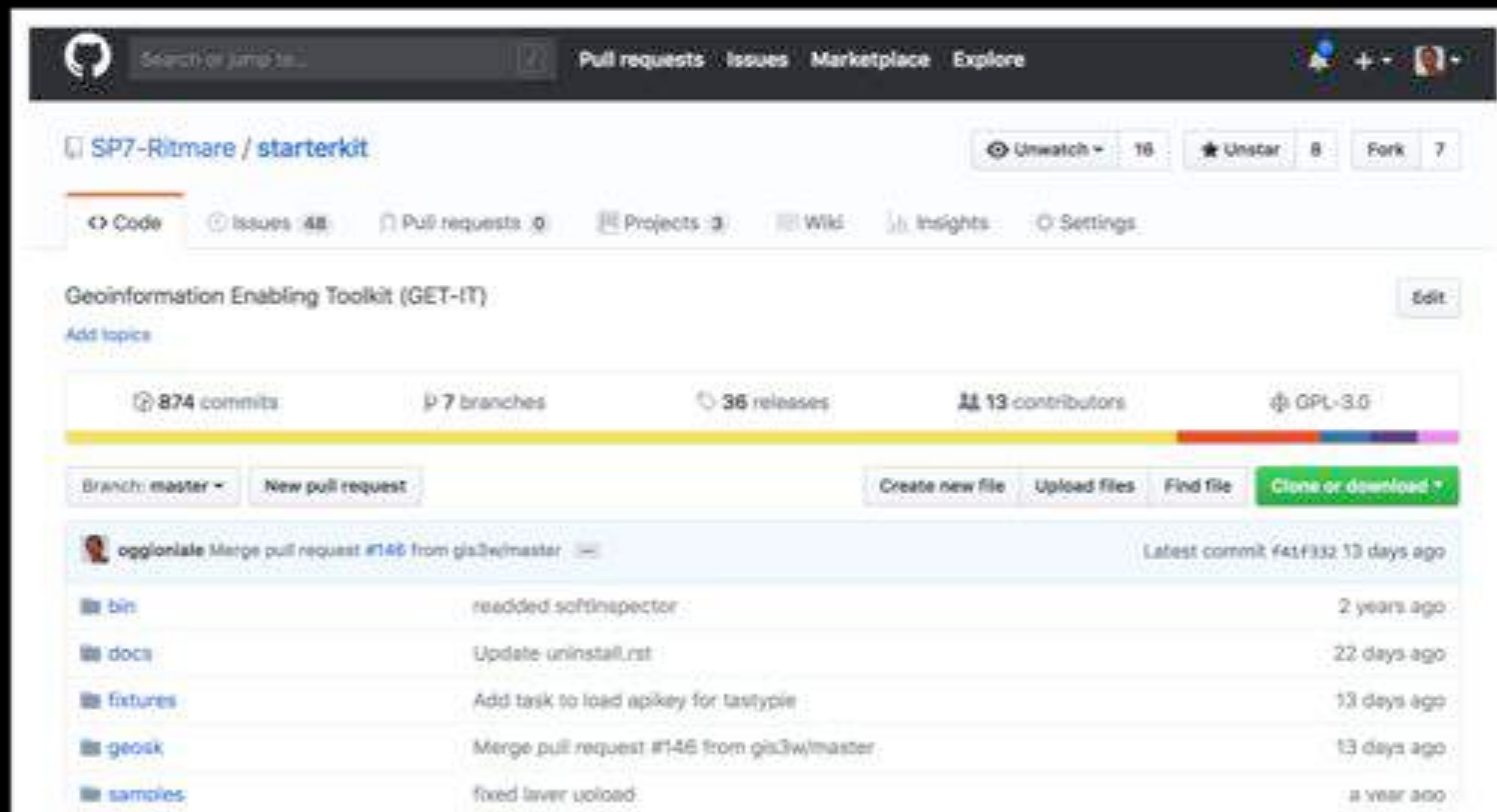
GET-IT functions

Upload layers/maps (OGC WMS, WFS & WCS)

GET-IT functions

**Register INSPIRE
MetaData
(ISO 19115)**

EDI

doi:

GET-IT functions

**Register sensor
information
(OGC SensorML v2.0.0)**

EDI

doi:

GET-IT functions

**Describe sensor
(OGC SensorML v2.0.0)**
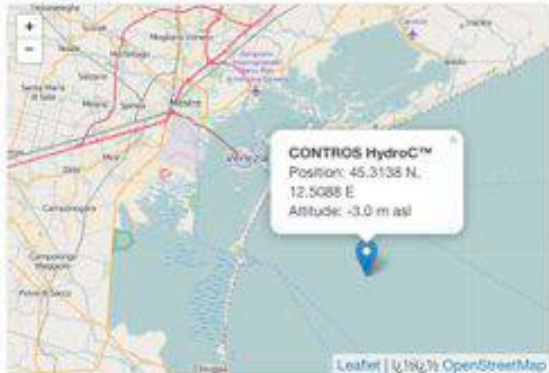
CONTROS HydroC™ (Piattaforma Acqua Alta - CONTROS HydroC)

The CONTROS HydroC™ CO2 sensor is a unique underwater dioxide sensor for in-situ and online measurements of dissolved CO2. The versatile HydroC™ CO2 is suitable for platform installations (e.g. ROV s or AUV s), long-term deployments (e.g. buoys and moorings) as well as for profiling applications (e.g. water sampling rosettes). Fields of application include: ocean acidification research, climate studies, air-sea gas exchange, limnology, fresh water control, aquaculture/fish farming, carbon capture and storage – monitoring, measurement and verification (CCS-MMV).

Manufacturer Name
CONTROS
☎ tel:+49-431-2609-5900
▥ Wischhofstrasse 1-3 Geb.
Kiel - Seefischmarkt
D-24148
DE
✉ mailto:contact@contros.eu
🔗 http://www.contros.eu

Model Number
HydroC

Parameters
Partial_pressure_of_carbon_dioxide_{pCO2}_in_the_atmosphere_by_infra-red_gas_analysis
Unit of measure: uatm
Partial pressure of carbon dioxide {pCO2} in the atmosphere by infra-red gas analysis

Position

CONTROS HydroC™
Position: 45.3138 N,
12.5088 E
Attitude: -3.0 m asl

Leaflet | ¿½¿½ OpenStreetMap

Contact

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Documentation
Documentazione Stazione dal sito ufficiale
🔗 application/pdf

History

Today

Update

GET-IT functions

Insert observations from monitoring and experimentation activities (OGC SOS v2.0)

GET-IT functions

Explore layers/maps (OGC WMS, WFS & WCS) and observations (OGC SOS)

GET-IT LADeC
http://ladec.get-it.it

Follow us

SP7-Ritmare/starterkit

@GETITSK

Standards involved in current SDI

- Data and Metadata Standards do not suffice
  - Several communities
  - Only syntactic interoperability is granted
- "profiles" are needed
  - Each community can define its own profile
  - Profiles specify:
    - Additional Constraints (e.g. mandatory fields)
    - Value ranges
  - Semantic technologies can be of help

Semantics

- Examples:
- Thesauri: eurovoc, agrovoc, NERC vocabulary service
- For:
  - Keywords (cfr. INSPIRE metadata)
  - O&M observed properties
  - Place names

XMLSchema

EDI Template
Language

is written following

Profiles

XMLSchema

Metadata
schema(s)
e.g. SensorML

XML

Profile specific
**EDI NG
Template**
**e.g. SensorML SOS
Lightweight Profile**

XPath SPARQL

Implements rules
defined by

Profile
documentation

XPath [UML]

web browser

Instructs

Javascript

**EDI NG
Client**

Produces

Valid and conformat with

User

Interacts with

HTML

WebForm

CSS

Posts user choices

application server

Java

**EDI NG
Server**

Produces

XML

Metadata
document
(e.g.
SensorML)

Performs runtime sparql
queries against

Answer with semantic resources
(e.g URIs for value ranges)

CNR

NVS

SPARQL
endpoints

CEH

→ http communication

--➤ action

····➤ relation

See http://edidemo.get-it.it
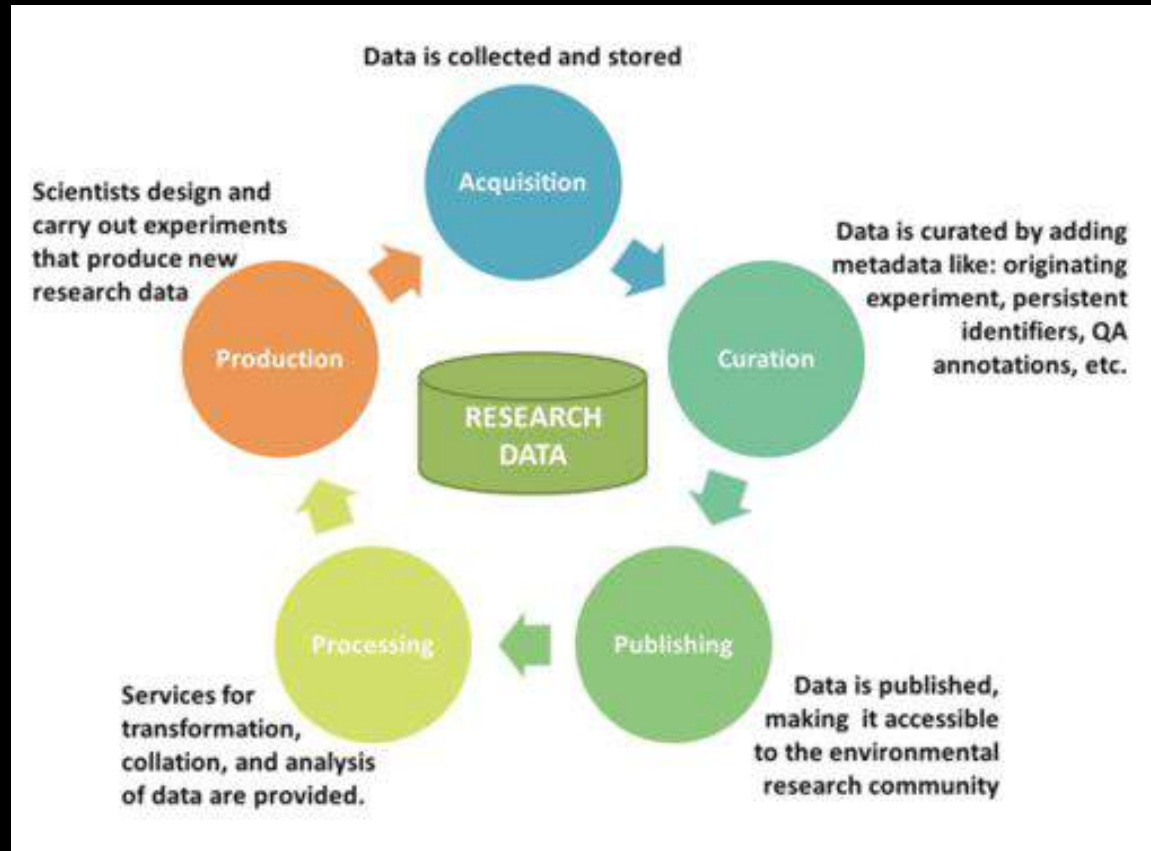
Data life cycle - recap

Figure from: Hardisty, Nieva de la Hidalga *How the ENVRI Reference Model helps to design research infrastructures*, ENVRIplus Newsletter, 2016

Hands on (proposal)

- demo2.get-it.it
- LADEC server
- Upload layer
- Open QGIS
- Install metasearch
- Use metasearch to add CSW of LADEC
- Alternatively add WMS/WFS layer

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