ENVRI Common Operations of Environmental Research Infrastructures

Data discovery and basic access

Massimo Argenti
massimo.argenti@esa.int

SEVENTH FRAMEWORK PROGRAMME

Goal

Enable multidisciplinary scientists to **access** and **study** data from **multiple domains** for "system level" research

by providing solutions and guidelines for the RIs common needs

Multiple data producers

Multiple data consumers

Discovery and Basic Access with ENVRI

- Discover heterogeneous data at different places and in different catalogues
  - Distributed measurements and monitoring
    - physical, chemical and biological parameters
  - Laboratories and experimental facilities
    - in fixed monitoring stations
    - on research vehicles, ships, floats and buoys
    - from aircraft and satellites
  - A variety of data
    - heterogeneous in format
    - primary and processed data
  - Analytical and modeling platforms
    - data exchange and integration
    - high performance computing and Grid services
    - e-Laboratories

Behind the data discovery-access

- A federation of catalogues:
  - One at the level of the portal/client containing the metadata at series collection level
  - Many catalogues at the level of the federated resources containing the metadata at dataset product level
- All the catalogues can be accessed using OGC OpenSearch protocol, a collection of technologies allowing websites and search engines to publish search results in a standard and accessible format (http://www.opensearch.org/)
- Data/products remain at their original location, i.e., where the Data Provider stores them; the Catalogues provide the user with the link to directly access the data

Outline

- Syntactic Discovery
  - A discovery and basic access example
  - What's behind: high level architecture and basic flow
  - Demo
- Semantic Discovery
  - A discovery and basic access example
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  - Demo
- Notes for the developer
  - OpenSearch and the RDF model
  - Machine-to-machine syntactic demo
  - The semantic framework in depth

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- Discovery and Access with ENVRI: an introduction
- Syntactic Discovery
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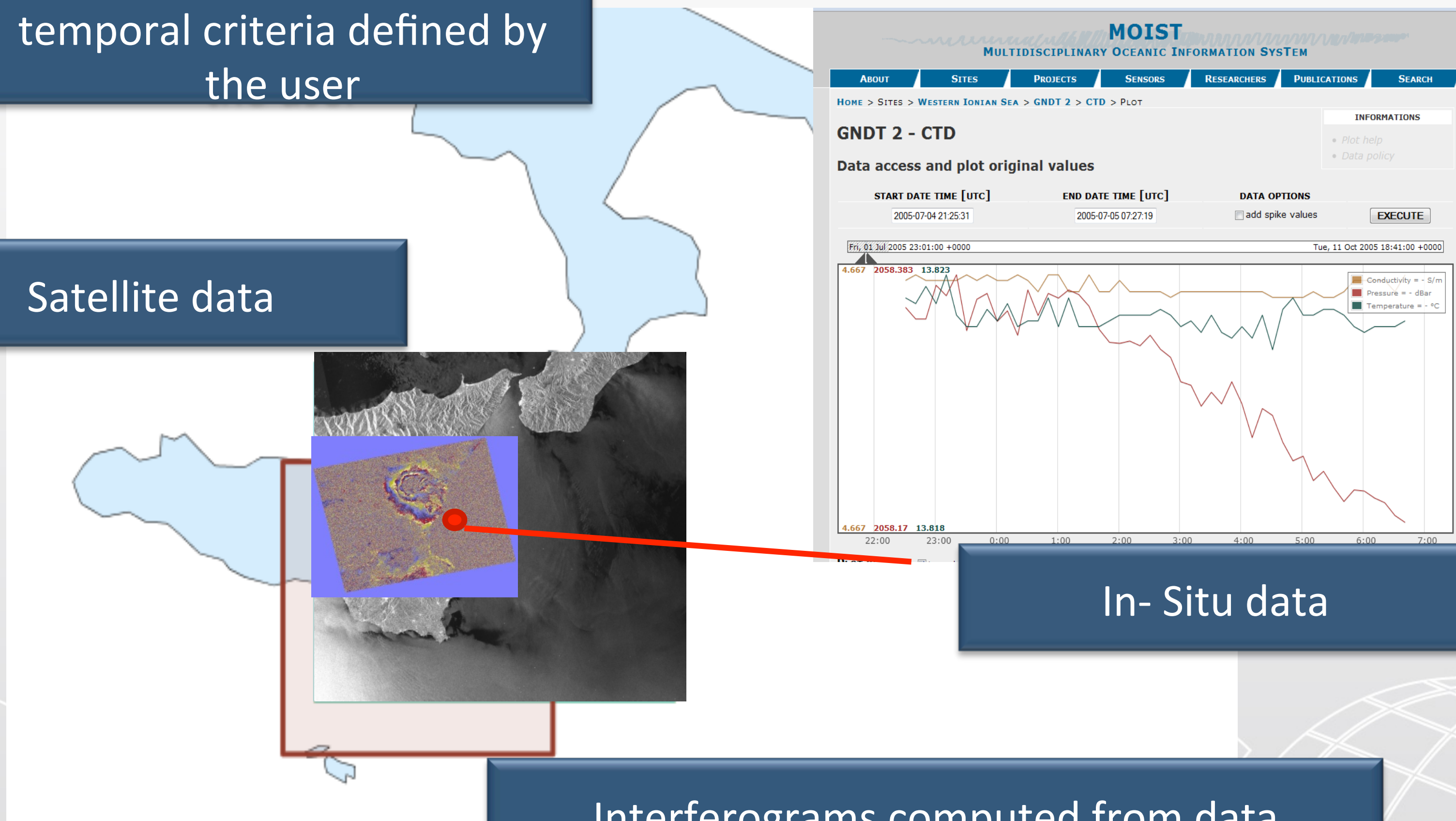
Syntactic Discovery – a discovery and basic access example

Query of heterogeneous data based on geo-spatial and temporal criteria defined by the user

Satellite data

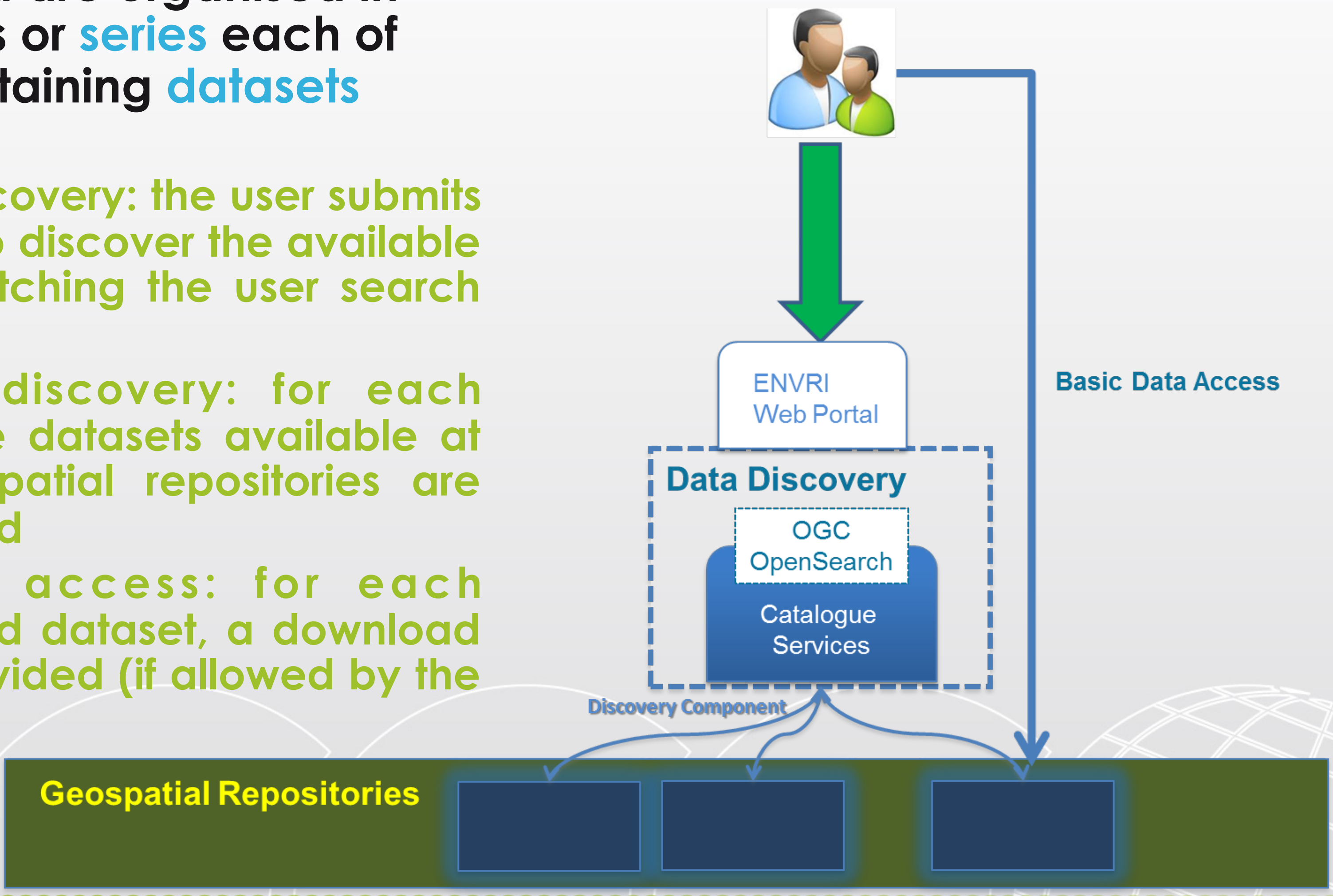


In- Situ data

Interferograms computed from data (either on demand computation or discovery of previously generated products)

Syntactic Discovery – a discovery and basic access example

- ENVRI data are organised in collections or series each of which containing datasets (products)
  - Series discovery: the user submits a query to discover the available series matching the user search criteria
  - Dataset discovery: for each series, the datasets available at the Geospatial repositories are discovered
  - Dataset access: for each discovered dataset, a download link is provided (if allowed by the provider)



Syntactic Discovery – a discovery and basic access example

Select the catalogue

Insert the **search text** string

Search text
ETNA

Start date 6/25/06
End date 7/31/13

Search in 2 catalogues
Search

Insert **Start Date** and **Stop Date**

Click on **Search** to start the query

Series matching criteria: 5

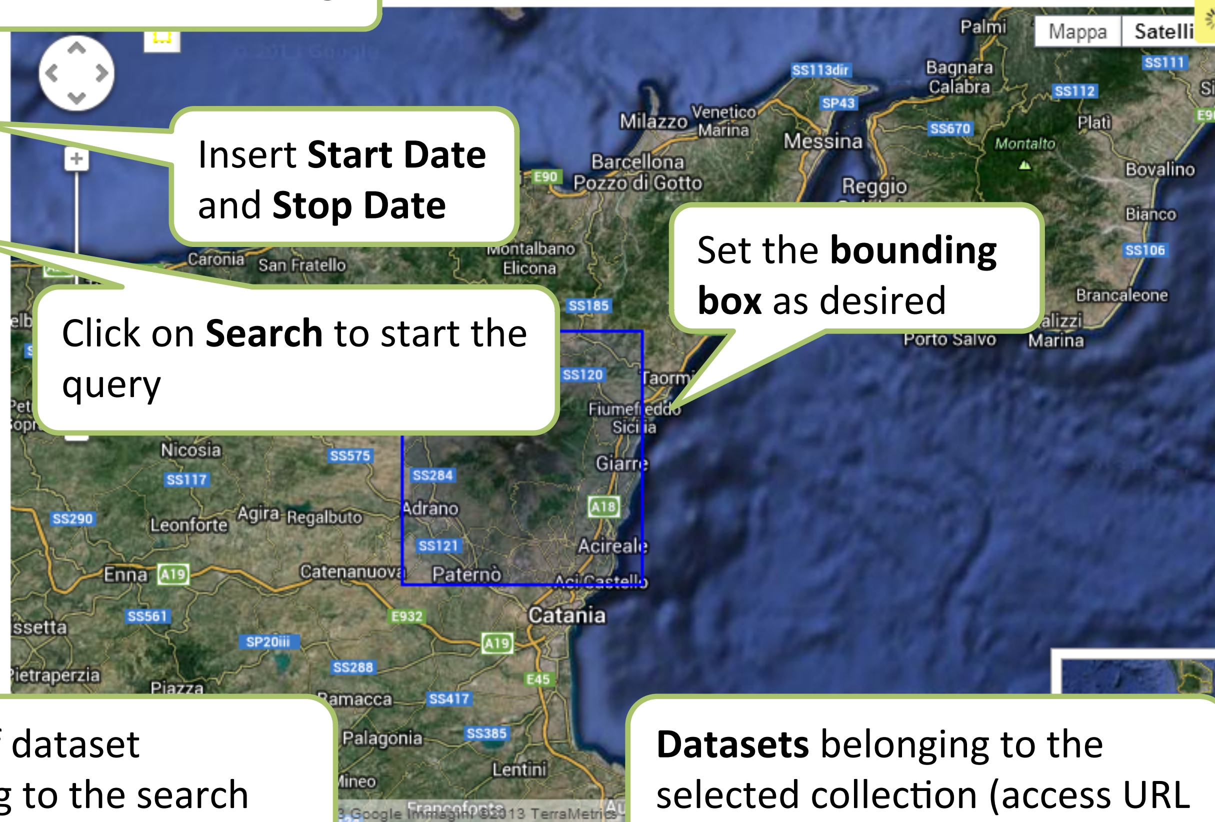
SAR analysis

SAR analysis

- Title: SAR analysis
- Subject: Vulcanology
- Date: 2007-01-03 to 2010-12-29
- Number of Records: 12

Rights
Free Usage with Rights

GPS Network
Etna breathing
Etna Interferograms
Etna Volcanic Ash Campaign



Set the **bounding box** as desired

Collections of dataset corresponding to the search criteria are listed here

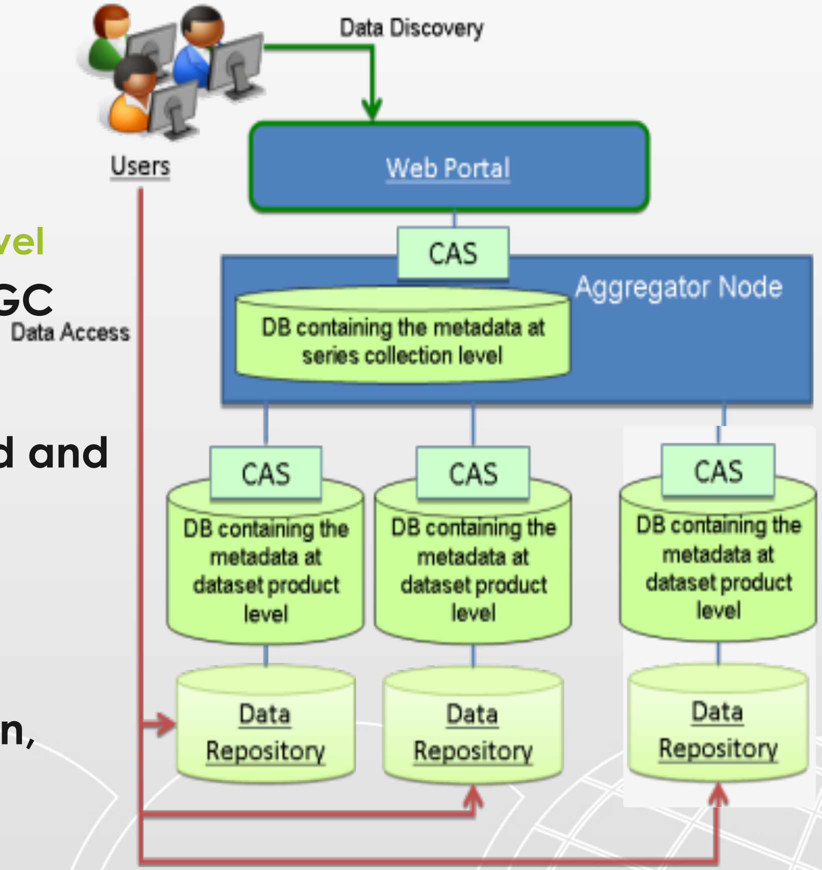
Datasets belonging to the selected collection (access URL is also provided)

Dataset from 1 to 12 of 12 belonging to the serie 'SAR analysis'.

Dataset name	Start time	End time		
geo_filt_070620-070725-sim_HDR_4rlks.tif	Wed Jun 20 00:00:00 CEST 2007	Wed Jul 25 00:00:00 CEST 2007		
geo_filt_070620-070829-sim_HDR_4rlks.tif	Wed Jun 20 00:00:00 CEST 2007	Wed Aug 29 00:00:00 CEST 2007		
geo_filt_070620-071003-sim_HDR_4rlks.tif	Wed Jun 20 00:00:00 CEST 2007	Wed Oct 03 00:00:00 CEST 2007		
geo_filt_070620-071107-sim_HDR_4rlks.tif	Wed Jun 20 00:00:00 CEST 2007	Wed Nov 07 00:00:00 CET 2007		
geo_filt_070620-071212-sim_HDR_4rlks.tif	Wed Jun 20 00:00:00 CEST 2007	Wed Dec 12 00:00:00 CET 2007		

Syntactic Discovery - What's behind: high level architecture

- ENVRI uses a federation of distributed catalogues inherited from GENESI-DEC
- 2-steps discovery:
  - One or more Aggregator Nodes contain the metadata at series collection level
  - Each federated resources exposes a catalogue containing the metadata at dataset product level
- All the catalogues can be accessed using OGC OpenSearch protocol, a collection of technologies allowing websites and search engines to publish search results in a standard and accessible format
- User can directly query the Catalogues using OpenSearch or through Clients, as the ENVRI webportal
- Data/products remain at their original location, i.e., where the Data Provider stores them; the Catalogues provide the user with the link to directly access the data



Syntactic Discovery - What's behind: the RDF metadata model

- The metadata model is based on RDF (Resource Description Framework)
- The RDF model:
  - A "Series" section: includes information shared by all the datasets belonging to that series.
  - One or more "Dataset" sections: includes information shared by all the data of the dataset (a dataset represents an identifiable collection of data)
  - Can be expanded as needed according to the specific needs of the communities

Syntactic Discovery – What's behind: Catalogues in ENVRI

- **Data Providers should:**
  - Provide online access to their data/products (restricted access if needed)
  - Create a metadata catalogue for these data/ products – at least metadata useful/needed for discovery – domain specific metadata can be added
  - Set up OpenSearch Interfaces for the catalogues
  - Register the catalogues endpoints to the ENVRI aggregator nodes

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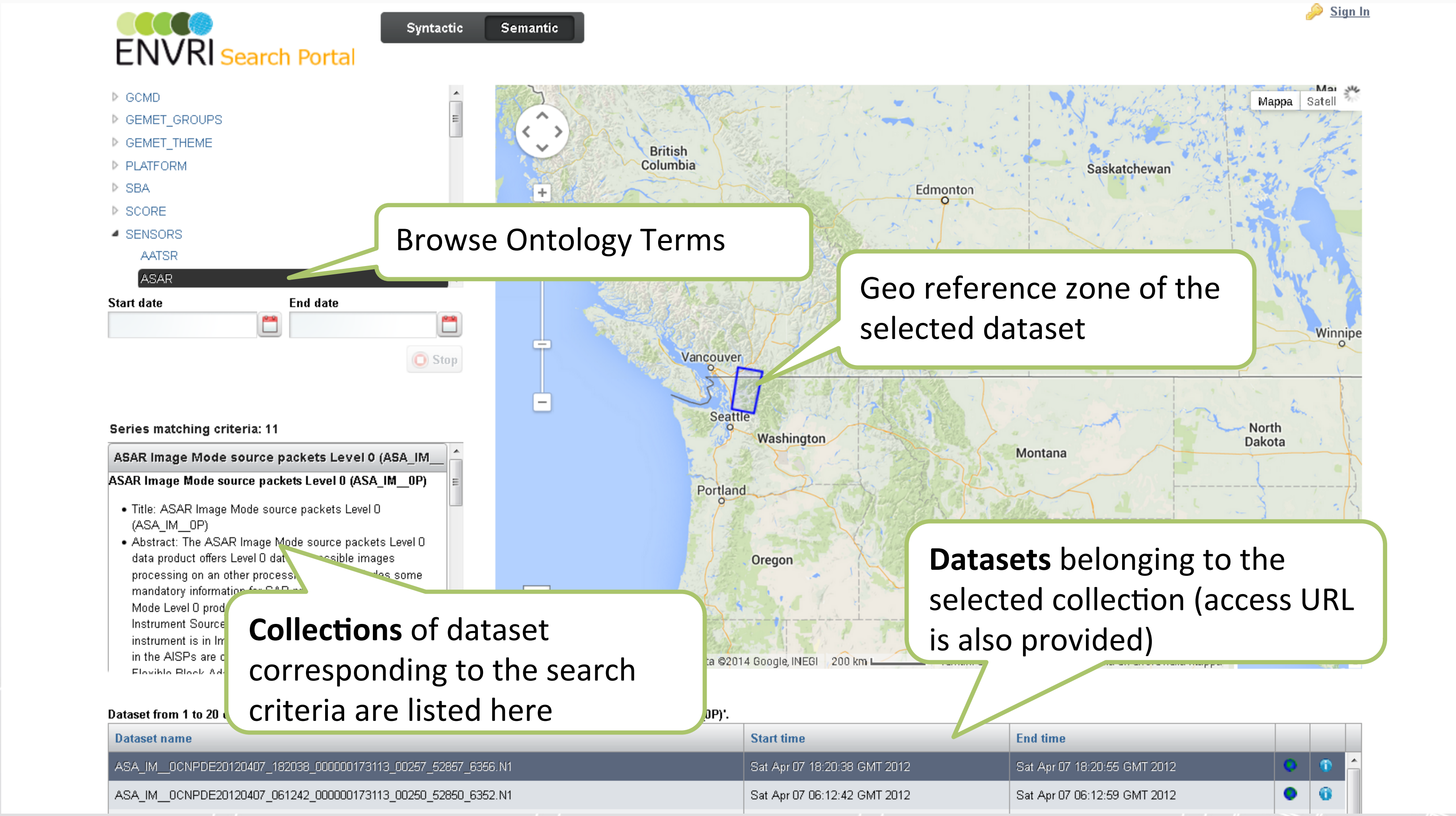
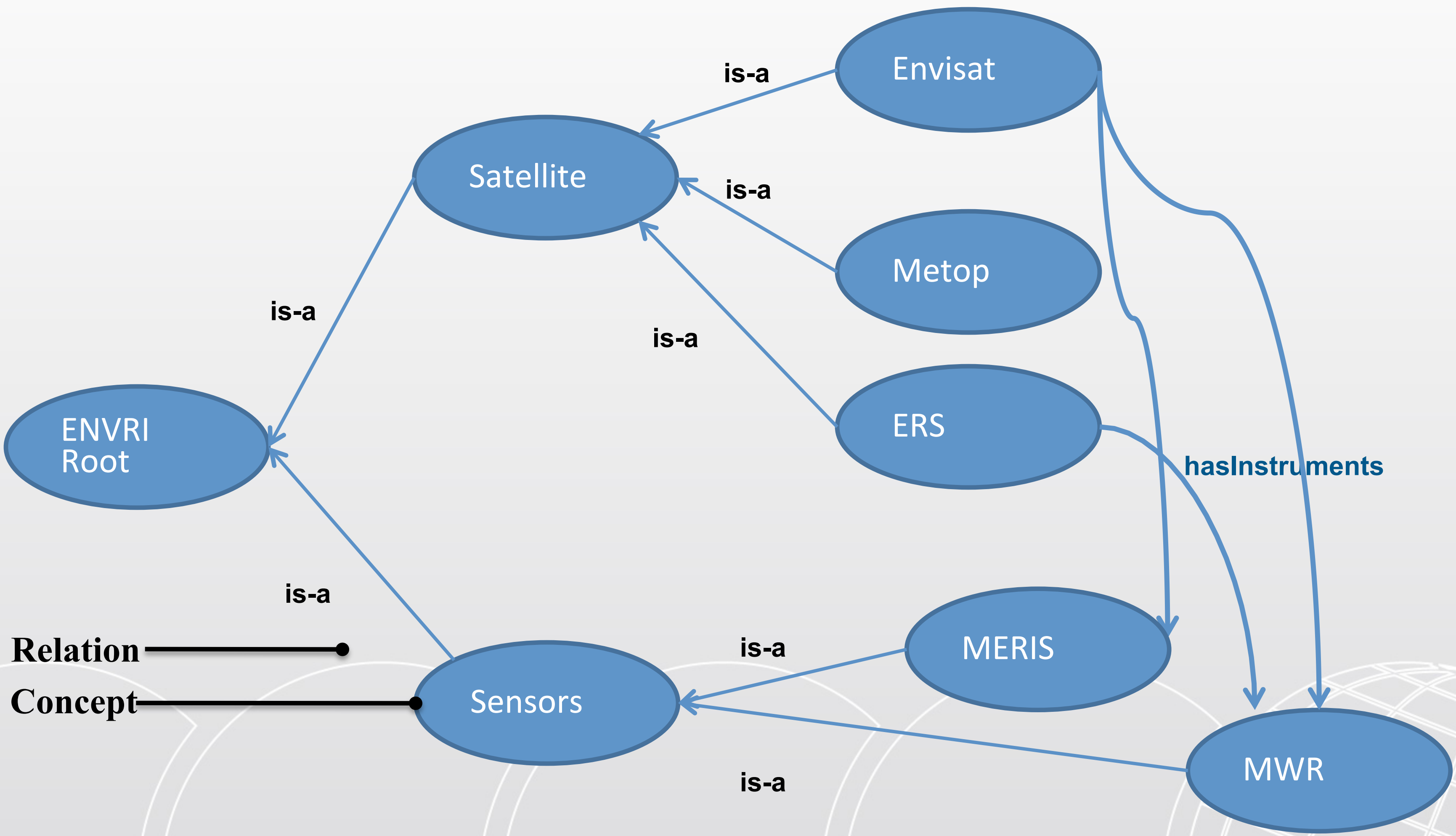
  - Demo

Semantic Discovery – A discovery and basic access example



Semantic Discovery – what's behind: Ontology Example



Semantic Discovery – what's behind: Ontologies-Knowledgbase

- An Ontology is a formal and explicit description of concepts (or classes) in a specific domain. An ontology is made of:
  - Concepts (classes)
  - Relations between concepts (e.g. 'is-a' or 'instanceOf')
  - Concepts attributes (slots or roles or properties) describing properties of classes or instances
  - Restrictions on attributes (facets or role restrictions)
- A Knowledge Base is an ontology together with a set of individual instances of classes
- The big task in ENVRI will be the creation of an Ontology that should merge the concepts and relations of different domains like DRs and new Infrastructure

Semantic Discovery – what's behind: Semantic Web

Tim Berners-Lee originally expressed the vision of the semantic web as follows:

"I have a dream for the Web [in which computers] become capable of analysing all the data on the Web – the content, links, and transactions between people and computers. A 'Semantic Web', which should make this possible, has yet to emerge, but when it does, the day-to-day mechanisms of trade, bureaucracy and our daily lives will be handled by machines talking to machines. The 'intelligent agents' people have touted for ages will finally materialize."

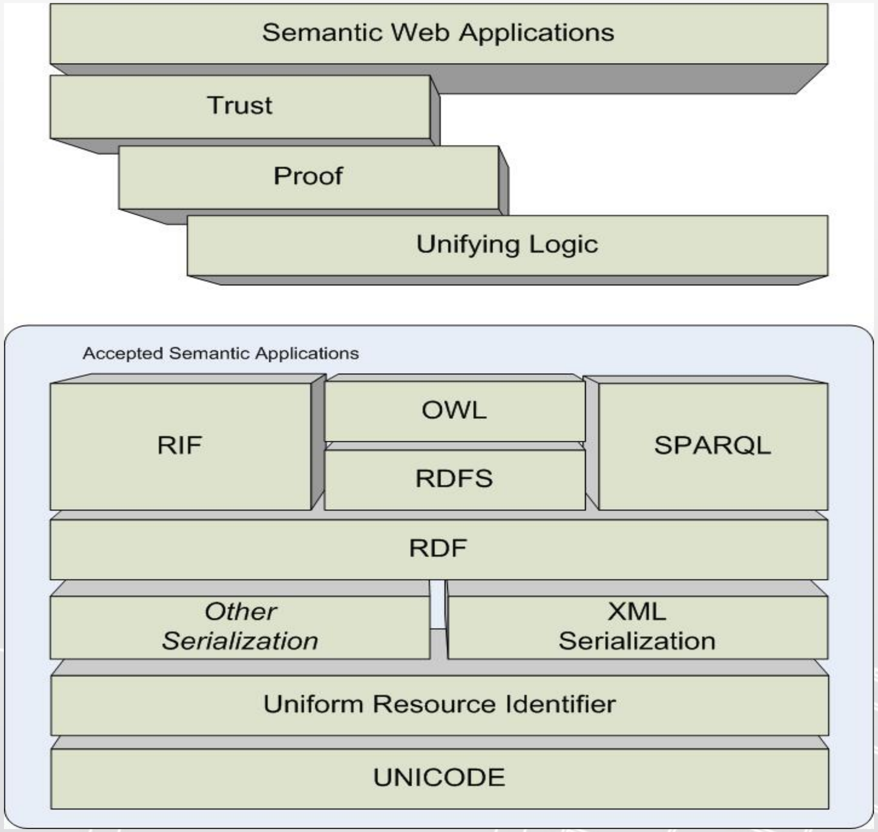
- The Semantic Web is an extension of the current web in which information is given well-defined meaning, better enabling computers and people to work in cooperation.

- The Semantic Web is a vision of data that is understandable by machines, so computers can perform more of the tedious work involved in finding, combining, and acting upon data on the web.

Semantic Discovery – what's behind: Semantic Web Stack

The Semantic Web Stack is a hierarchy of languages and technologies used to create the Semantic Web:

- the lower layers comprise well-known technologies from the classical hypertext web (e.g. Unicode and XML)
- the middle layers comprise technologies for enabling semantic we applications to be built (e.g. RDF and OWL)
- the top layers contain those technologies required to bring the semantic web to full fruition.



Semantic Discovery – what's behind: RDF & OWL

- RDF and OWL are relatively simple things compared to AI and they offer:
  - a simple way to express and store metadata
  - a way to "structure" and characterize the terms
  - means to make some inference within a restricted framework

and that is it!

- The atomic element in an RDF description is the triple
- An (s,p,o) triple can be viewed as a labeled edge in a graph (Subject, Predicate, Object)
  - i.e., a set of RDF statements is a directed, labeled graph
    - both "objects" and "subjects" are the graph nodes
    - "properties" are the edges

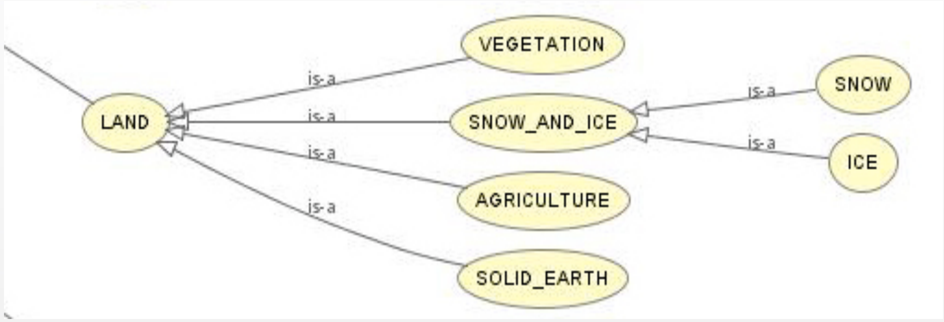
Semantic Discovery – what's behind: Inference

- Inference is the process of deriving new knowledge starting from the relevant (domain) ontology and the available knowledge (available from the knowledge base).The process is performed by a Reasoner.

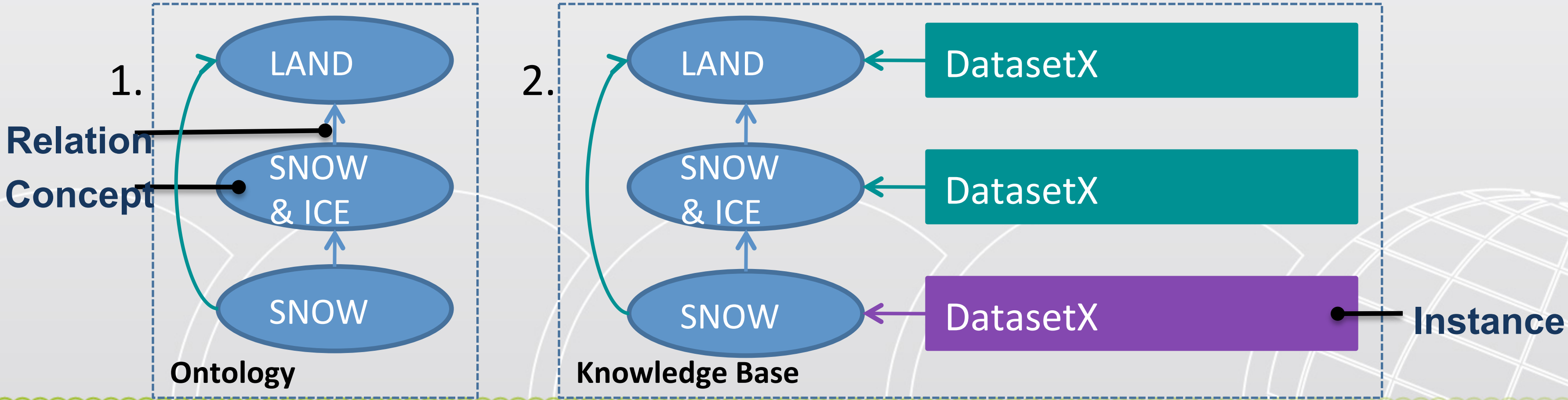
- The inference should be performed when new semantic information's are inserted in the tag repository or on the fly as first step in a discovery operation.

- Global inference process should be centralised taking into account the new tagged information.

Semantic Discovery – what's behind: Inference



From the ontology we can infer →SNOW is a Land, →ICE is a Land
From the statement 'The datasetX is-a SNOW', looking at the ontology we can infer → 'The datasetX' is-a SNOW & ICE → 'The datasetX' is-a LAND



Semantic Discovery – what's behind: Semantic in Envri

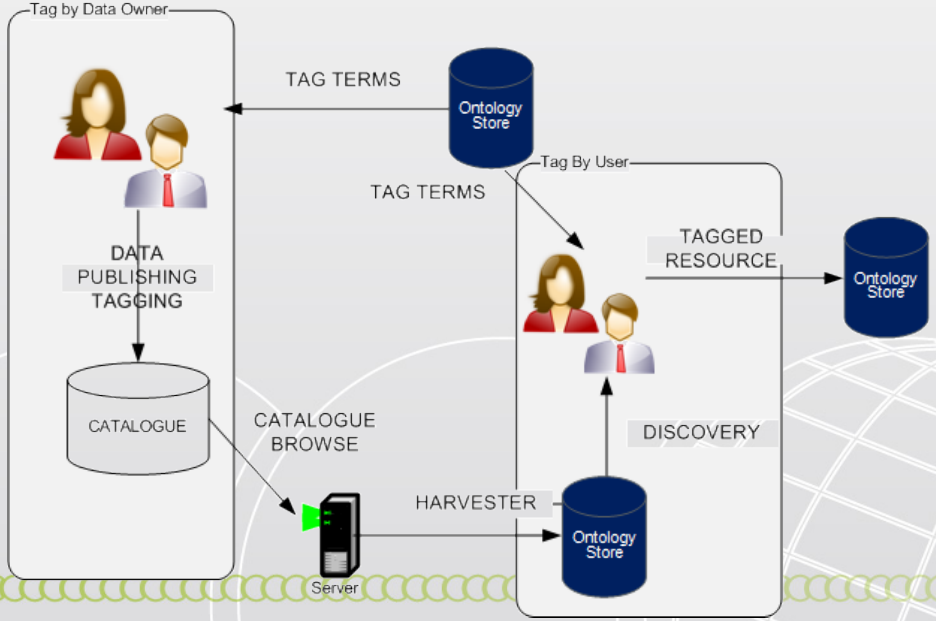
- Set up a Semantic solution to close the resource discovery gap.
- Adding Semantics considering:
  - Different domain ontologies (i.e. with the new External Infrastructure)
  - Multi-domain and multilingual context
  - Semantic links between data resources (possibly of different owners - from different domains)
- The ENVRI User Community must play a proactive role with data owner tagging their own data or data user consumer tagging after the data use.
- Users are normally tagging resources belonging to their domain of interest, so they are domain expert users

Semantic Discovery – what's behind: Semantic in Envri

- The following thesaurus have been introduced to describe, annotate and discover the ENVRI resources :
  - GEMET (GEneral Multilingual Environmental Thesaurus) provides a user friendly parameter discovery interface for the European Environment Information and Observation Network (EIONET). It makes use of SKOS, (Simple Knowledge Organisation System) and also the metadata registries standard, ISO 11179.
  - SBA (Social Benefit Areas) GEO Group and observation is constructing GEOSS on the basis of a 10-year implementation plan for the period 2005 to 2015.
  - GCMD (Global Change Master Directory) science keywords list is a comprehensive directory of information about Earth science data, including the oceans, atmosphere, hydrosphere, solid earth, biosphere and human dimensions of global change. (NASA)

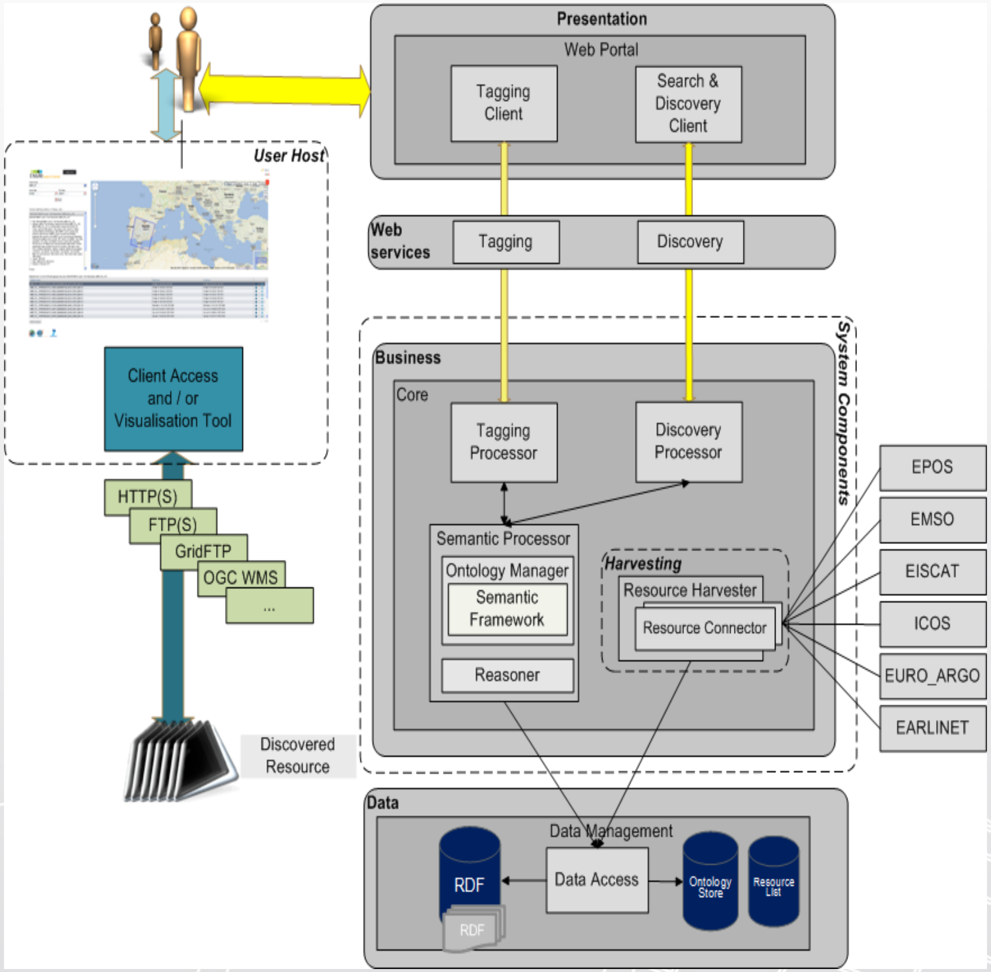
Semantic Discovery – what's behind: ENVRI tagging

- In addition to data discovering, a user in ENVRI can:
  - Provide a data resource URI and associate semantic metadata to the resource
- Semantic metadata are supposed to be represented by concepts from an ontology
- Users are normally tagging resources belonging to their domain of interest, so they are domain expert users



Semantic Discovery – what's behind: high level architecture

- Tagging Client and Discovery Client are the portal UI where the user interacts with the semantic framework
- Discovery Processor is the component devoted to discovery resources using a predefined set of ontology terms
- Tagging Processor is the component devoted to tag a resource discovered linking the tag to the user logged
- Harvester is the component devoted to populate the knowledge base extracting the information from catalogues repositories
- Semantic Processor is the component that manage the interface with the ontology DB and all the semantic operations



Syntactic Demo

- A syntactic query from the portal
  - Access http://portal.envri.eu
  - Insert “SAR Etna” in the free text field, select Sicily area as the bounding box and press “Search”
  - Select one of the tiff files from the result list and download it locally
  - Insert “GPS” in the free text field, select Sicily area as the bounding box and press “Search”
  - Select one of the text files from the result list and download it locally

Semantic Demo

- A semantic query from the portal
  - Select the “Semantic” option and browse the categories to identify data of interest.
  - Show discovery, access and positioning of data for generic terms
  - Browse specific semantic term like *TEST_CASE→ISLAND_VOLCANO*
  - Select one of the files from the result list and download it locally
  - Browse specific semantic term like *GCMD→SOLID_EARTH→VOLCANOES→VOLCANIC ASH/DUST*
  - Select one of the files from the result list and download it locally

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Notes for the developer – OpenSearch

- The catalogues of the different repositories expose an OpenSearch-based interface by which data can be discovered and accessed through external applications
- OpenSearch is a collection of technologies allowing websites and search engines to publish search results in a standard and accessible format
- Search engines are described through OpenSearch Description Documents

Notes for the developer – OpenSearch Description Document

```xml
<?xml version="1.0" encoding="UTF-8"?>
 <OpenSearchDescription xmlns="http://a9.com/-/spec/opensearch/1.1/">
   <ShortName>Web Search</ShortName>
   <Description>Use Example.com to search the Web.</Description>
   <Tags>example web</Tags>
   <Contact>admin@example.com</Contact>
   <Url type="application/rss+xml"
        template="http://example.com/?q={searchTerms}&amp;pw={startPage?}"/>
 </OpenSearchDescription>
```

- The URL element:
  - provides in the template attribute the URL and format to be used by clients to query the search engine. OpenSearch-defined parameters are used as placeholders (i.e. searchTerms, startPage)
  - can occur more than once, since there is one for each format in which the results are returned: the type attribute is the MIME type of such format.
- In ENVRI, the Aggregator Nodes as well as each geospatial repository site search engines are described as OpenSearch Description Documents
  - http://catalogue.genesi-dec.eu/search/description
  - http://catalogue.envri.eu/catalogue/envri/description

Notes for the Developer – the RDF metadata model

- The metadata model is based on RDF - Resource Description Framework
- The RDF model:
  - A “Series” section: includes information shared by all the datasets belonging to that series.
  - One or more “Dataset” sections: includes information shared by all the data of the dataset (a dataset represents an identifiable collection of data)
  - Can be expanded as needed according to the specific needs of the communities

Example RDF: series section

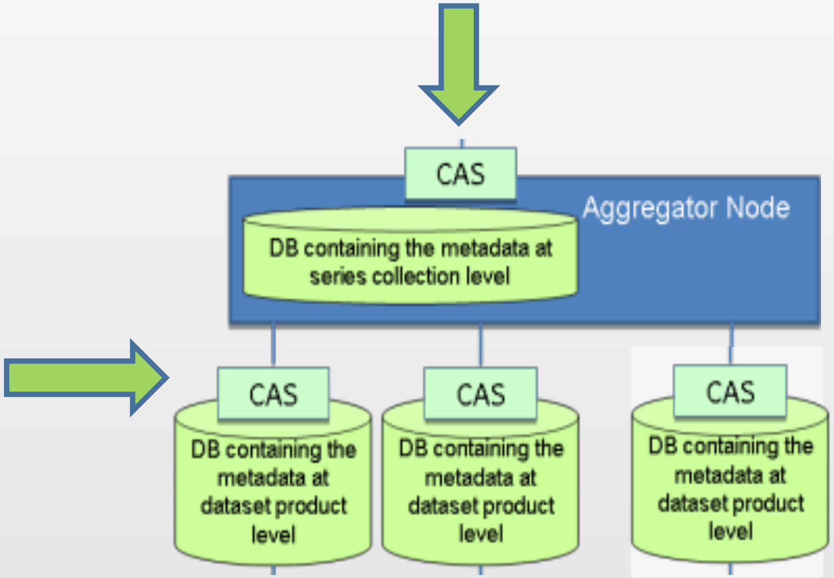

```
- <dclite4g:Series rdf:about="http://dr-site.esrin.esa.int/catalogue/genesi/CultureMERIS/rdf">
    <dc:identifier>CultureMERIS</dc:identifier>
    <atom:link atom:rel="search" atom:type="application/opensearchdescription+xml" atom:title="Search the CULTUREMERIS" atom:href="http://dr-site.esrin.e
    /description/"/>
    <dc:title>Culture MERIS </dc:title>
  - <dct:abstract>
      Culture-MERIS products are targeting particular land activities in Europe and Africa, for which a quick and updated overview of the land.s state is needed. To ac
      on the processing chain that has been established during the ESA.s DUE GlobCover project by MEDIAS-France (see RD-1, RD-2). Culture-MERIS project us
      on-line archive (Rolling Archive) of ESRIN (PDHS-E) and Kiruna (PDHS-E) stations. Every week (on Wednesdays) an updated MERIS FR (300 m.) bottom-
      provided, based on data that have been acquired during the previous week (Monday to Sunday acquisitions). Therefore Culture-MERIS provides weekly (Mon
      cloud-free spectral reflectance composites as derived from MERIS FR (300 m.) data acquired over Europe and Africa and processed using the GlobCover proc
    </dct:abstract>
    <eop:platform>Envisat</eop:platform>
    <ical:dtstart>2011-03-06T23:00:00.000Z</ical:dtstart>
    <ical:dtend>2011-04-09T22:00:00.000Z</ical:dtend>
    <dct:spatial>POLYGON((-25 -35,-25 75,65 75,65 -35,-25 -35))</dct:spatial>
    <dc:subject>Land</dc:subject>
    <dc:rights>Free Usage with ESA Credits</dc:rights>
    <dc:format>HDF</dc:format>
    <dclite4g:resolution>300 meters</dclite4g:resolution>
    <eop:processingLevel>Level 3</eop:processingLevel>
    <dct:extent>1135</dct:extent>
    <dct:created>2011-04-18T08:11:39.243Z</dct:created>
    <dct:modified>2012-02-17T15:10:30.786Z</dct:modified>
    <eop:sensorType>OPTICAL</eop:sensorType>
    <dc:publisher rdf:resource="http://www.esa.int"/>
</dclite4g:Series>
```

Example RDF: dataset section


```
– <dclite4g:DataSet rdf:about="http://dr-site.genesi-dr.eu/catalogue/genesi/MER_RR__2P_CALVAL/MER_RR__2PRBCG20110501_103708_000000543102_0
  – <dc:identifier>
      MER_RR__2PRBCG20110501_103708_000000543102_00080_47939_0001.N1
    </dc:identifier>
    <dclite4g:series rdf:resource="http://dr-site.genesi-dr.eu/catalogue/genesi/MER_RR__2P_CALVAL/rdf"/>
  – <dclite4g:onlineResource>
      <ws:HTTP rdf:about="http://teststorage.terradue.com/academic/MERIS_CALVAL_DATA/2011/05/MER_RR__2PRACR20110501_102221_000263031
      ws:preference="50"/>
    </dclite4g:onlineResource>
  – <dclite4g:onlineResource>
      <ws:HTTPS rdf:about="https://dr-site.genesi-dr.eu/data/MERIS_CALVAL_DATA/2011/05/MER_RR__2PRACR20110501_102221_000026303102_000
      ws:preference="50"/>
    </dclite4g:onlineResource>
    <eop:processingCenter>F-ACRI</eop:processingCenter>
    <eop:orbitNumber>47939</eop:orbitNumber>
    <eop:wrsLongitudeGrid>80</eop:wrsLongitudeGrid>
    <ical:dtstart>2011-05-01T10:37:08.053Z</ical:dtstart>
    <ical:dtend>2011-05-01T10:38:01.553Z</ical:dtend>
    <eop:processingDate>2011-08-23T03:29:17.000Z</eop:processingDate>
  – <dct:spatial>
      POLYGON((-6.79854 47.2926,7.74396 44.5975,6.2564 41.5242,-7.56024 44.1351,-6.79854 47.2926))
    </dct:spatial>
    <dct:created>2012-06-01T15:59:51.574Z</dct:created>
    <dct:modified>2012-06-01T15:59:51.574Z</dct:modified>
  </dclite4g:DataSet>
+ <dclite4g:DataSet rdf:about="http://dr-site.genesi-dr.eu/catalogue/genesi/MER_RR__2P_CALVAL/MER_RR__2PRBCG20110501_103424_000000563102_0
```

Notes for the developer – Querying ENVRI-like systems programatically

- **Querying ENVRI-like systems programatically**
  - First level query towards the Aggregator Node(s)
  - Second level query towards the geospatial repositories macthing the search criteria in the first level query
  - Both queries are enabled by a Catalogue Access Service based on OpenSearch



Notes for the developer – Querying ENVRI-like systems programatically

```xml
<AdultContent>false</AdultContent>
<Language>en-us</Language>
<OutputEncoding>UTF-8</OutputEncoding>
<InputEncoding>UTF-8</InputEncoding>
<Url type="application/rdf+xml" indexOffset="0" pageOffset="0" template="http://catalogue.genesi-dec.eu/search/rdf/?count={count?}&startPage={startPage?}&startIndex={startIndex?}&q={searchTerms?}&uid={geo:uid?}&bbox={geo:box?}&start={time:start?}&stop={time:end?}&modified={dct:modified?}"/>
<Url type="application/vnd.taverna.t2flow+xml" indexOffset="0" pageOffset="0" template="http://catalogue.genesi-dec.eu/search/t2flow/?q={searchTerms?}"/>
<Url type="application/atom+xml" indexOffset="0" pageOffset="0" template="http://catalogue.genesi-dec.eu/search/atom/?count={count?}&startPage={startPage?}&startIndex={startIndex?}&q={searchTerms?}&uid={geo:uid?}&bbox={geo:box?}&start={time:start?}&stop={time:end?}&modified={dct:modified?}"/>
/OpenSearchDescription>
```

1. Aggregator Node description request

http://catalogue.genesi-dec.eu/search/description

2. Aggregator Node **OpenSearch Description Document**

in the **template** attributes shows **how to query the Aggregator Node,** so you can:

3. Submit query to the Aggregator Node

e.g. http://catalogue.genesi-dec.eu/search/rdf/?q=ETNA

Notes for the developer – Querying ENVRI-like systems programatically

– <dclite4g:Series rdf:about="http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/rdf">
<dc:identifier>Etna_SAR</dc:identifier>
<atom:link atom:rel="search" atom:type="application/opensearchdescription+xml" atom:title="Search the ETNA_SAR" atom:href="http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/description/"/>
<dc:title>SAR analysis</dc:title>
<ical:dtstart>2007-01-03T00:00:00.000Z</ical:dtstart>
<ical:dtend>2010-12-29T23:59:59.000Z</ical:dtend>
<dct:spatial>POLYGON((14 38,15.5 38,15.5 37,14 37,14 38))</dct:spatial>
<dc:subject>Vulcanology</dc:subject>
<dc:rights>Free Usage with Rights</dc:rights>
<dc:format>ASCII</dc:format>
<dclite4g:resolution>NA</dclite4g:resolution>
<dct:extent>12</dct:extent>

1. Aggregator Node description request
http://catalogue.genesi-dec.eu/search/description

2. Aggregator Node **OpenSearch Description Document**
in the **template** attributes shows **how to query the Aggregator Node**, so you can:

3. Submit query to Aggregator Node
e.g. http://catalogue.genesi-dec.eu/search/rdf/?q=ETNA

4. **Series metadata** file
in the **atom:href** attribute provides the **URL** of the OpenSearch Description Document of the series at issue

Notes for the developer – Querying ENVRI-like systems programatically


```
<OutputEncoding>UTF-8</OutputEncoding>
<InputEncoding>UTF-8</InputEncoding>
<Url type="application/rdf+xml" indexOffset="0" pageOffset="0" template="http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/rdf/?count={count?}&startPage={startPage?}&startIndex={s
q={searchTerms?}&uid={geo:uid?}&bbox={geo:box?}&start={time:start?}&stop={time:end?}&modified={dct:modified?}"/>
<Url type="application/vnd.google-earth.kml+xml" indexOffset="0" pageOffset="0" template="http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/kml/?count={count?}&startPage={startPag
{startIndex?}&q={searchTerms?}&uid={geo:uid?}&bbox={geo:box?}&start={time:start?}&stop={time:end?}&modified={dct:modified?}"/>
<Url type="application/atom+xml" indexOffset="0" pageOffset="0" template="http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/atom/?count={count?}&startPage={startPage?}&startInde
q={searchTerms?}&uid={geo:uid?}&bbox={geo:box?}&start={time:start?}&stop={time:end?}&modified={dct:modified?}"/>
/OpenSearchDescription>
```


1. Opensearch description request for the series of interest

e.g. http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/description/

2. **OpenSearch Description Document for the series of interest**

in the **template** attributes shows how to query datasets from the series of interest

3. Submit (refined) dataset query

e.g. http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/rdf/?start=2007-06

Notes for the developer – Querying ENVRI-like systems programatically


```
+<dclite4g:DataSet rdf:about="http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/geo_filt_070620-070725-sim_HDR_4rlks.tif/rdf"></dclite4g:DataSet>
-<dclite4g:DataSet rdf:about="http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/geo_filt_070620-070829-sim_HDR_4rlks.tif/rdf">
   <dc:identifier>geo_filt_070620-070829-sim_HDR_4rlks.tif</dc:identifier>
   <dclite4g:series rdf:resource="http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/rdf"/>
  -<dclite4g:onlineResource>
     <ws:HTTP rdf:about="http://dr-ext.genesi-dec.eu/downloads/Etna_SAR/geo_filt_070620-070829-sim_HDR_4rlks.tif" ws:preference="50"/>
   </dclite4g:onlineResource>
   <ical:dtstart>2007-06-20T00:00:00.000Z</ical:dtstart>
   <ical:dtend>2007-08-29T00:00:00.000Z</ical:dtend>
  -<dct:spatial>
     POLYGON((14.7816248 37.9186147,15.2203952 37.9186147,15.2203952 37.5509574,14.7816248 37.5509574,14.7816248 37.9186147))
   </dct:spatial>
   <dct:created>2013-02-04T13:54:07.806Z</dct:created>
   <dct:modified>2013-02-04T13:54:07.806Z</dct:modified>
</dclite4g:DataSet>
```


2. **OpenSearch Description Document for the series of interest**

in the **template** attributes shows how to query datasets from the series of interest

3. Submit (refined) dataset query

e.g. http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/rdf/?start=2007-06

4. **Result metadata file**

also provides the **URL** of the **dataset** itself

Notes for the developer – Example of queries

- OpenSearch queries
  - http://catalogue.genesi-dec.eu/search/description
  - http://catalogue.genesi-dec.eu/search/rdf/?q=Etna&bbox=14,36,16,38
- SAR OpenSearch queries
  - http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/description/
  - http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/rdf/?startIndex=0&start=2007-05-01&stop=2013-01-01
  - http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_SAR/rdf/?startIndex=0&start=2008-11-01&stop=2008-12-31
- GPS OpenSearch queries
  - http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_GPS/description/
  - http://dr-ext.genesi-dec.eu/catalogue/genesi/Etna_GPS/rdf?startIndex=0&start=2008-11-01&stop=2008-12-31&station=EFAR

Machine to machine (syntactic) Demo

- A machine to machine example
  - The following steps are executed via script:
    - search the same data used in the portal (syntactic)
    - download them locally
    - plots a graph from the GPS text file
    - creates a kmz file containing the downloaded tiff file and the generated plot
    - Open the two kmz files using Google Earth

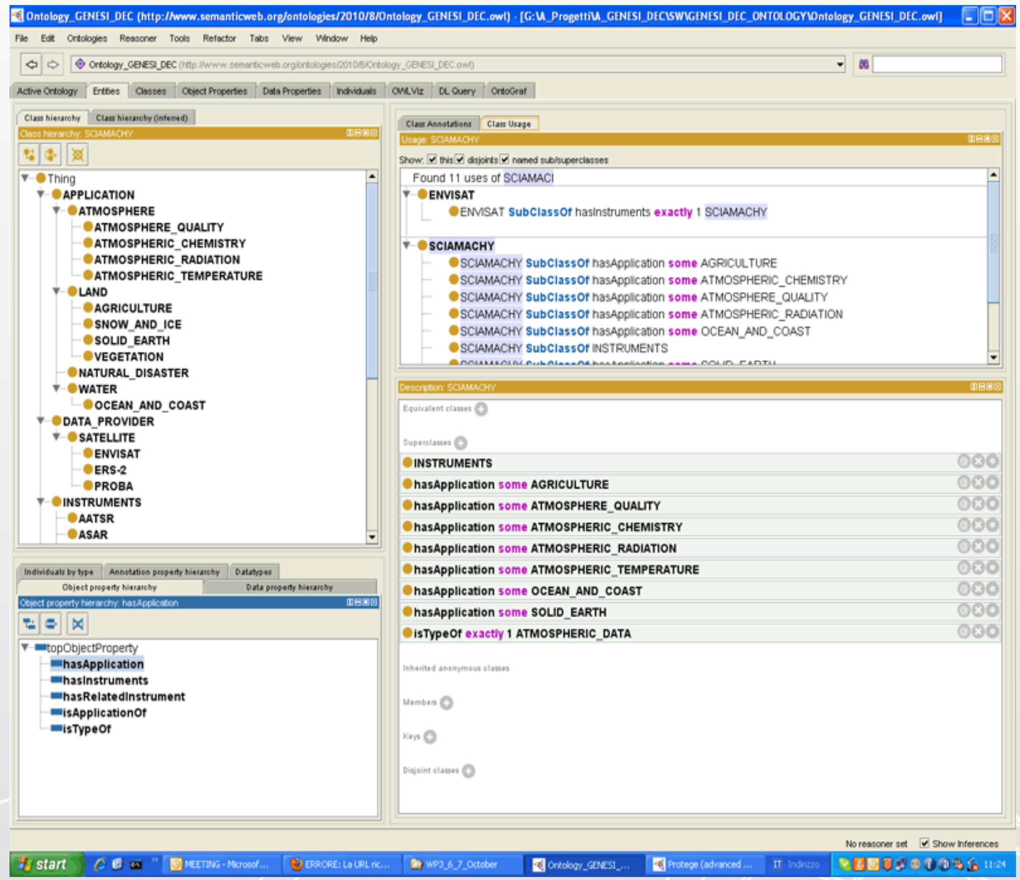
Notes for the developer – technologies/products

- Semantic Framework (editor)
  - Jena
  - Protegè
  - Redland
  - RDFSuite
  - ARQ
  - RDF2GO
  - Semantic Web Client
- Storage (triplestore)
  - Sesame
  - Virtuoso
  - AllegroGraph
  - YARS
- Reasoner
  - Pellet
  - RacerPRO
  - KAON2
  - OWLIM
  - OntoBroker
- SPARQL Endpoint
  - Openlink Virtuoso
  - D2RQ Server
  - Semantic Discovery System
  - Sesame

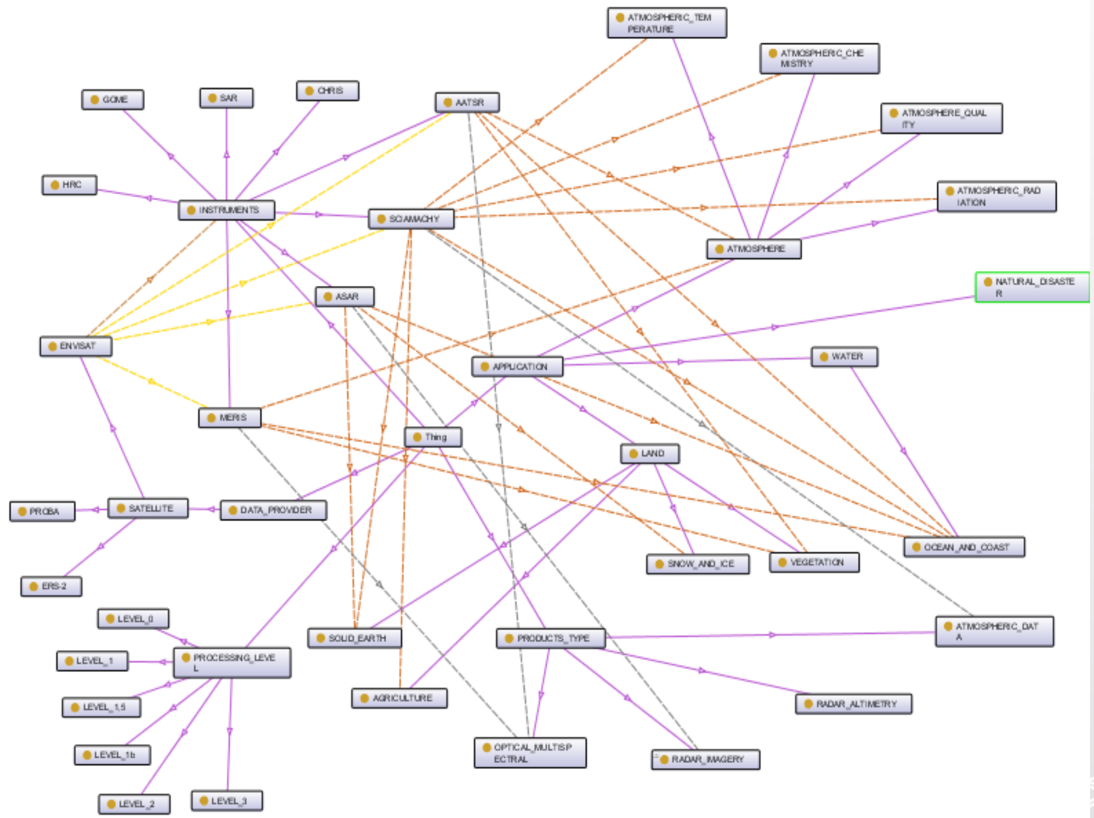
Notes for the developer – Modelling with Protegè

- Protégé is a free, open-source platform that provides a growing user community with a suite of tools to construct domain models and knowledge based applications with ontologies.

- The is-a objects relationship comes from the objects domain ierarchy
- New relationship should be created by means of specific operation
- Different kind of relationship should be used: direct, inverse, functional, transitive etc
- The full Ontology graph with all the relationship sould be created by the Ontograph tool (plug-in of Protégé)

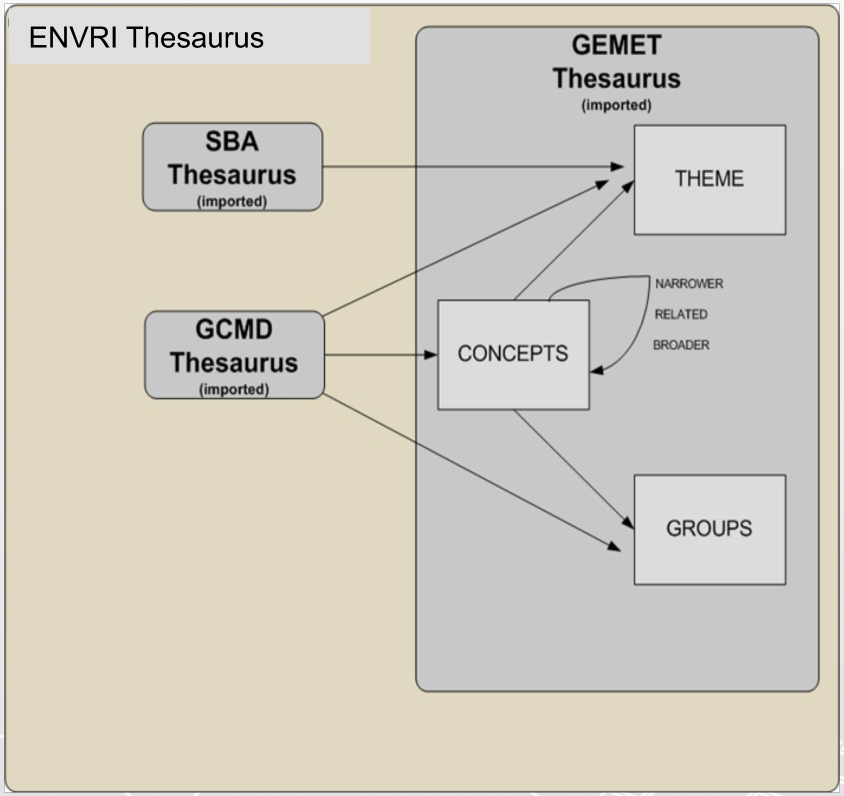


Notes for the developer – Ontology graph



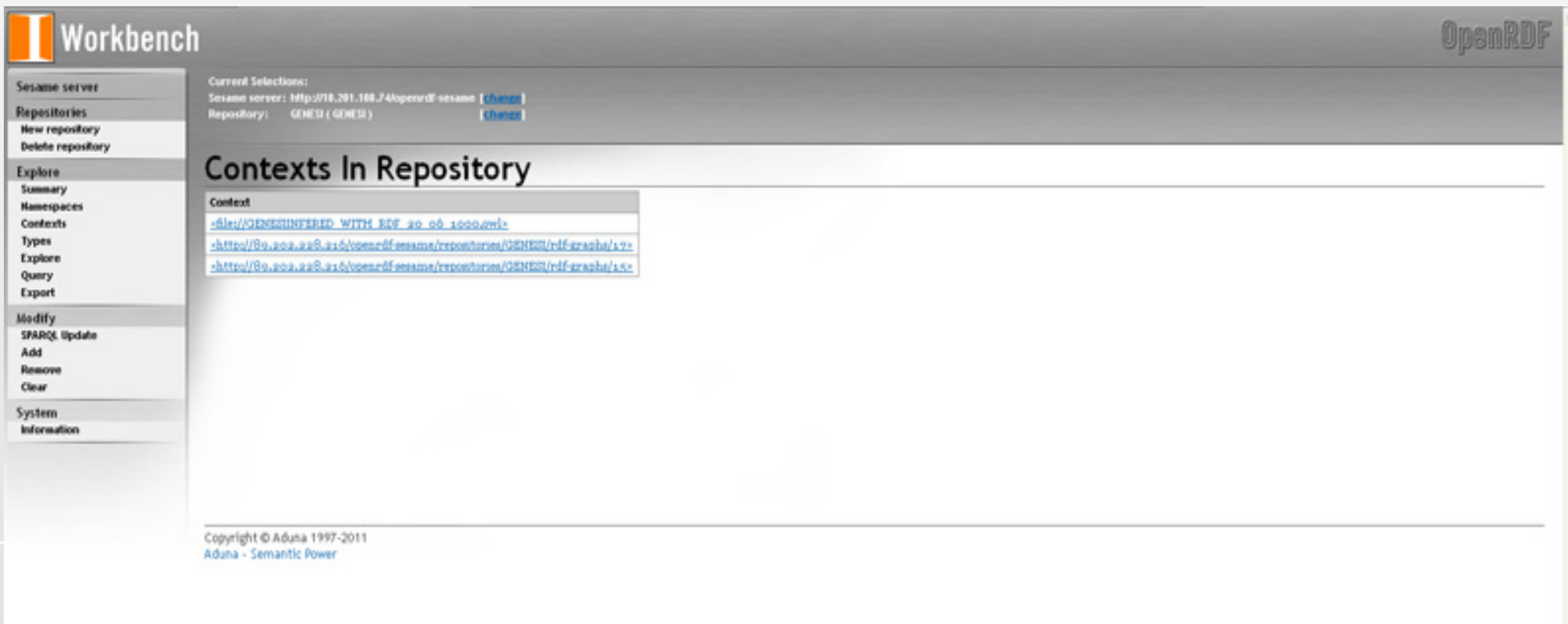
Notes for the developer – The semantic framework

- ENVRI Ontology has been consolidated with GEMET thesaurus integration
- Two different navigation path implemented to reach the GEMET concepts has been implemented
  - Theme
  - Groups and SuperGroup
- Categories rdf description files to integrate GEMET has been used from the Eionet (www.eionet.europa.eu/gemet/)

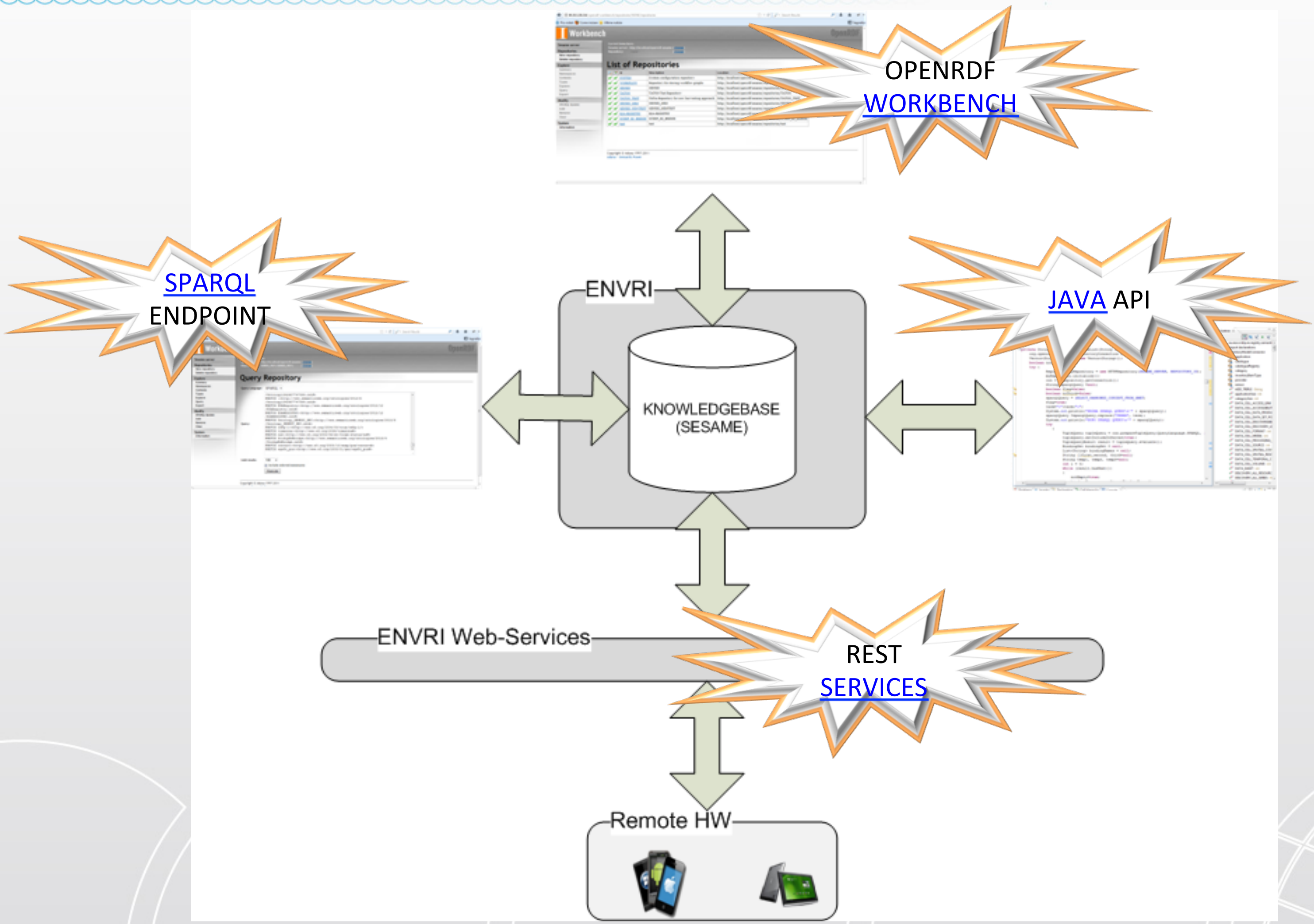


Notes for the developer – SESAME

- **Semantic SESAME latest framework has been installed in a new powerful server machine with a public IP.**



Notes for the developer – SESAME interfaces



Notes for the developer – ENVRI HARVESTING

- Resource Harvester: is the component devoted to harvest the metadata from a list of resources in order to initially populate the triple store mapping different data source formats with the needed triples.

- The creation of the knowledge base contents will be performed in different phases both as offline or runtime activities. The following schema will help to identify the phases:
  - Domain Harvesting at start-up (offline)
  - Domain Harvesting update (runtime)
  - Users tags provisioning (runtime)

- Use of a subset of metadata-model fields content to match ontology terms and tag the selected resource

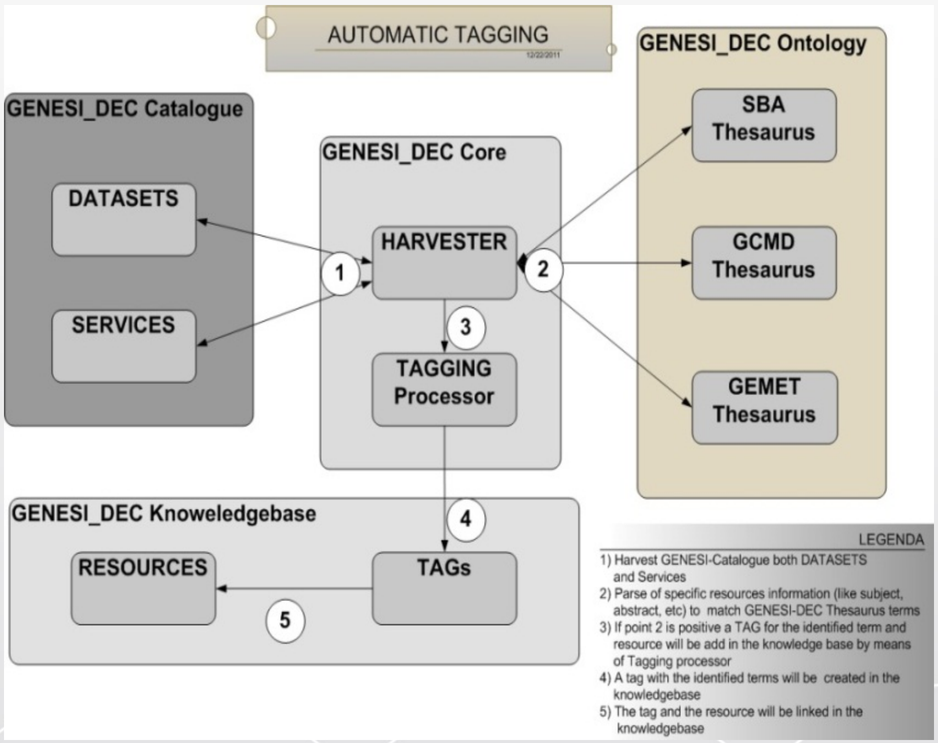
Notes for the developer – ENVRI DISCOVERY

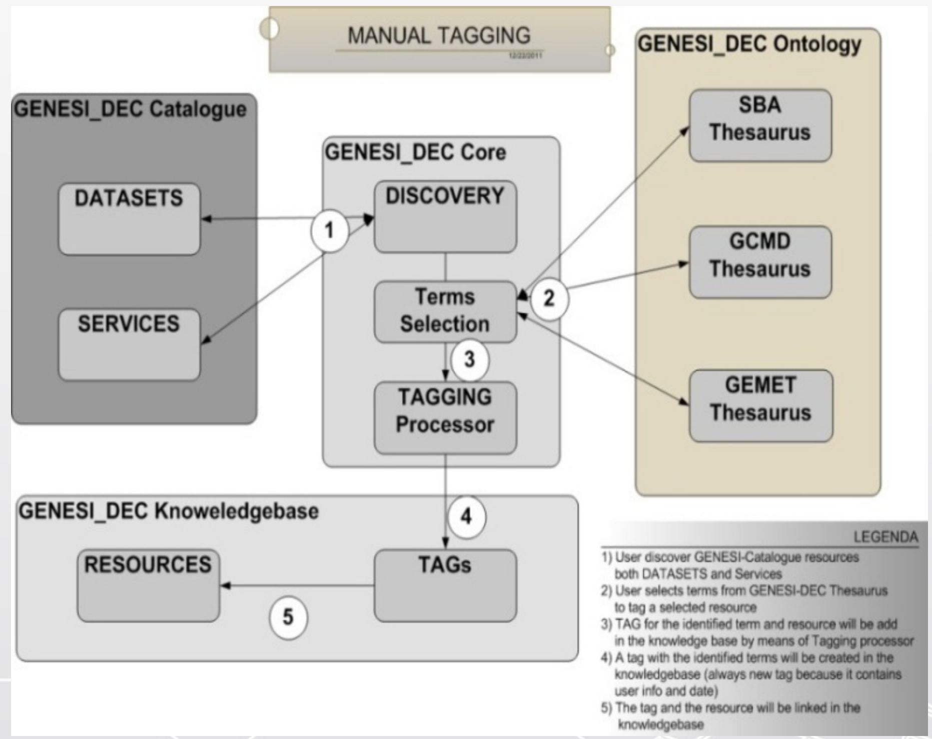
- Discovery operation involves data retrieving by querying the knowledge base. Being in RDF format, the knowledge base needs to be queried with specific languages. One of the most used is SPARQL.

- The discovery process allows the user to select a set of concepts from the Ontology application domain searching through the knowledge base.

- The semantic discovered results will be shown in the same way as the syntactic discovery operation, allowing the user consumer to find more results in respect to the syntactic search.

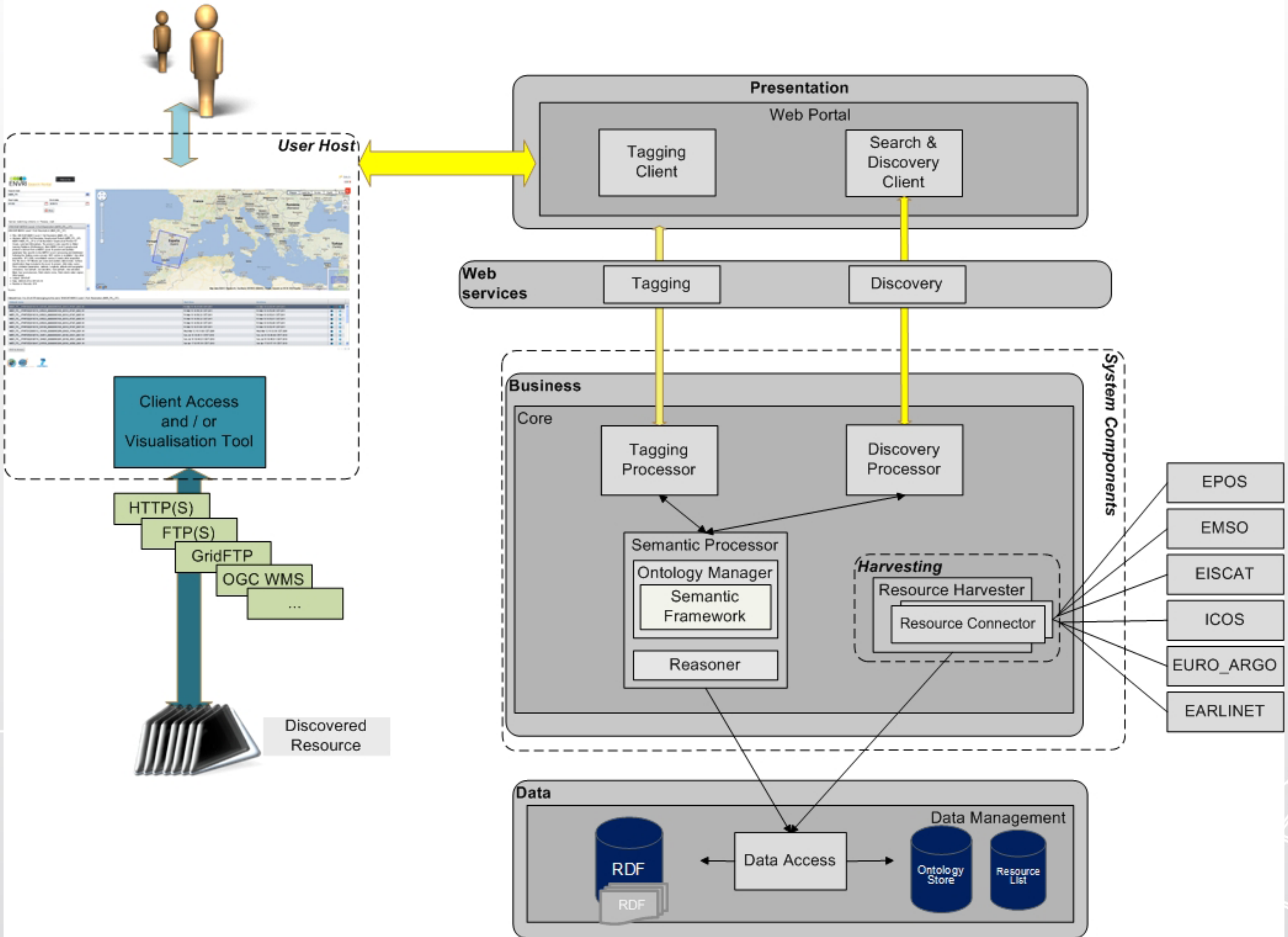
Notes for the developer – TAGGING



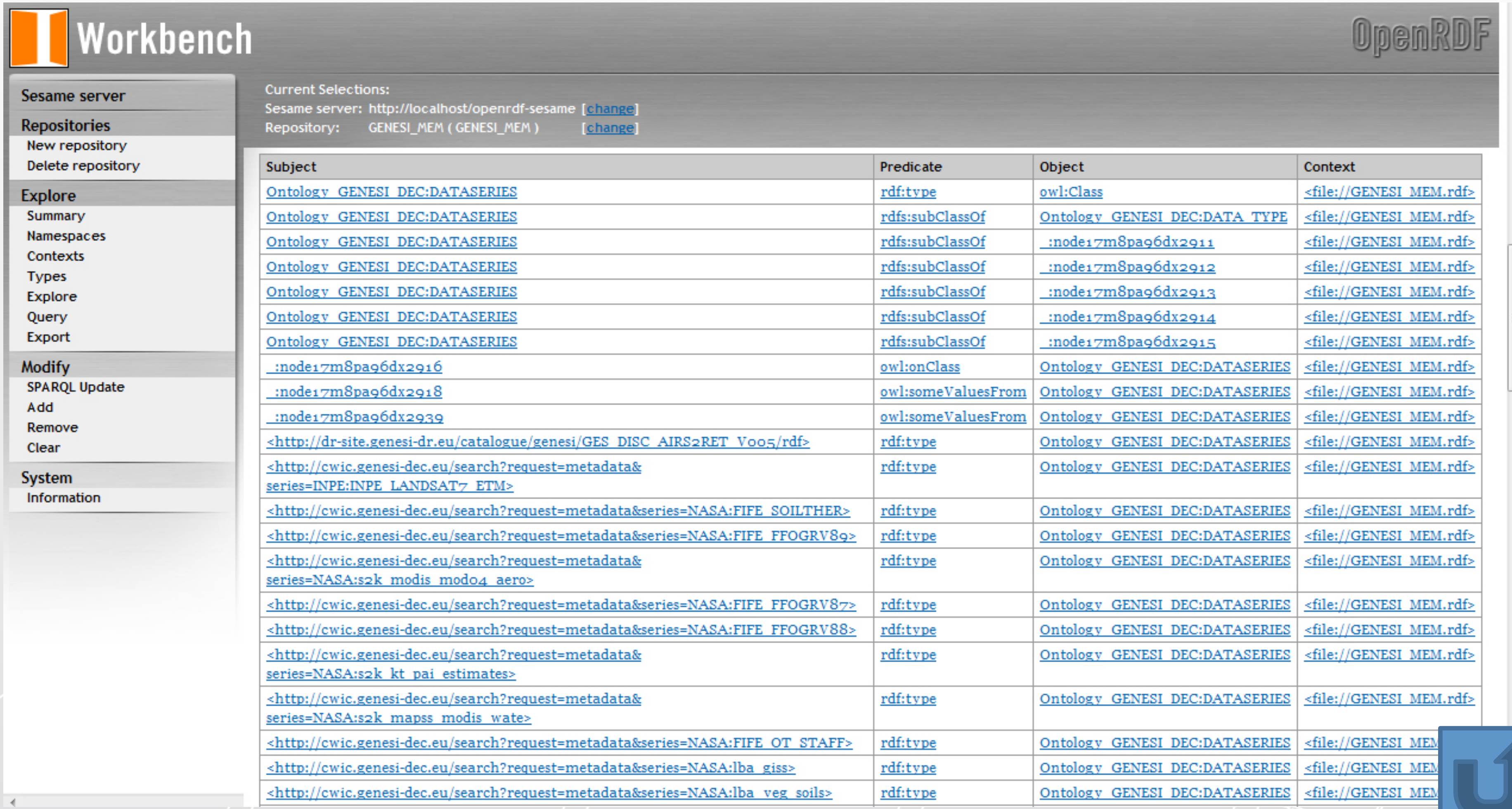


THANKS

Semantic Discovery – what's behind: high level architecture

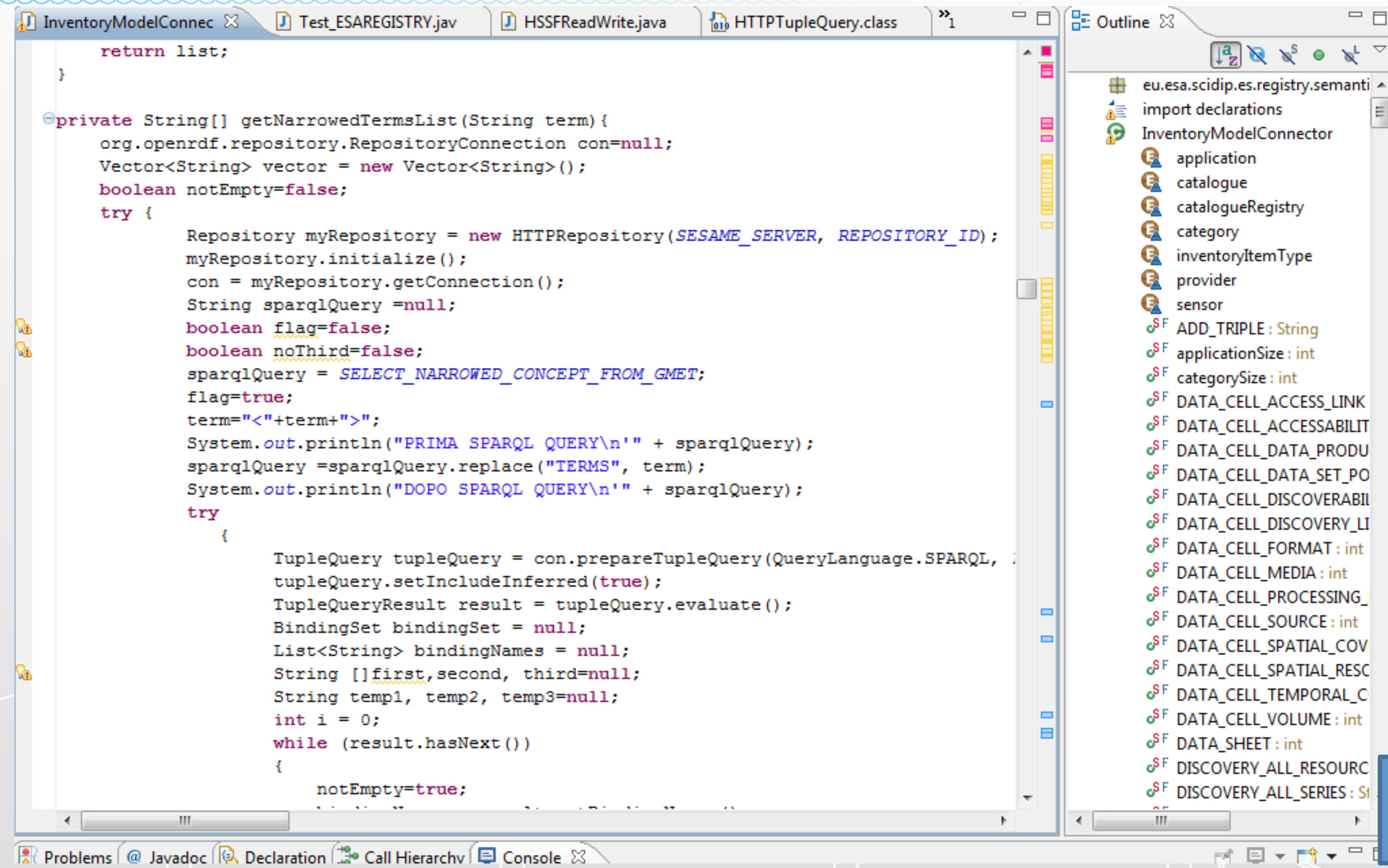


Notes for the developer – OPEN-RDF WORKBENCH



Subject	Predicate	Object	Context
Ontology_GENESI_DEC:DATASERIES	rdf:type	owl:Class	<file://GENESI_MEM.rdf>
Ontology_GENESI_DEC:DATASERIES	rdfs:subClassOf	Ontology_GENESI_DEC:DATA_TYPE	<file://GENESI_MEM.rdf>
Ontology_GENESI_DEC:DATASERIES	rdfs:subClassOf	_:node17m8pa96dx2911	<file://GENESI_MEM.rdf>
Ontology_GENESI_DEC:DATASERIES	rdfs:subClassOf	_:node17m8pa96dx2912	<file://GENESI_MEM.rdf>
Ontology_GENESI_DEC:DATASERIES	rdfs:subClassOf	_:node17m8pa96dx2913	<file://GENESI_MEM.rdf>
Ontology_GENESI_DEC:DATASERIES	rdfs:subClassOf	_:node17m8pa96dx2914	<file://GENESI_MEM.rdf>
Ontology_GENESI_DEC:DATASERIES	rdfs:subClassOf	_:node17m8pa96dx2915	<file://GENESI_MEM.rdf>
_:node17m8pa96dx2916	owl:onClass	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
_:node17m8pa96dx2918	owl:someValuesFrom	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
_:node17m8pa96dx2939	owl:someValuesFrom	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://dr-site.genesi-dr.eu/catalogue/genesi/GES_DISC_AIRS2RET_V005/rdf>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=INPE:INPE_LANDSAT7_ETM>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:FIFE_SOILTHER>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:FIFE_FFOGRV89>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:s2k_modis_mod04_aero>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:FIFE_FFOGRV87>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:FIFE_FFOGRV88>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:s2k_kt_pai_estimates>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:s2k_mapss_modis_wate>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM.rdf>
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:FIFE_OT_STAFF>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:lba_giss>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM
<http://cwic.genesi-dec.eu/search?request=metadata&series=NASA:lba_veg_soils>	rdf:type	Ontology_GENESI_DEC:DATASERIES	<file://GENESI_MEM

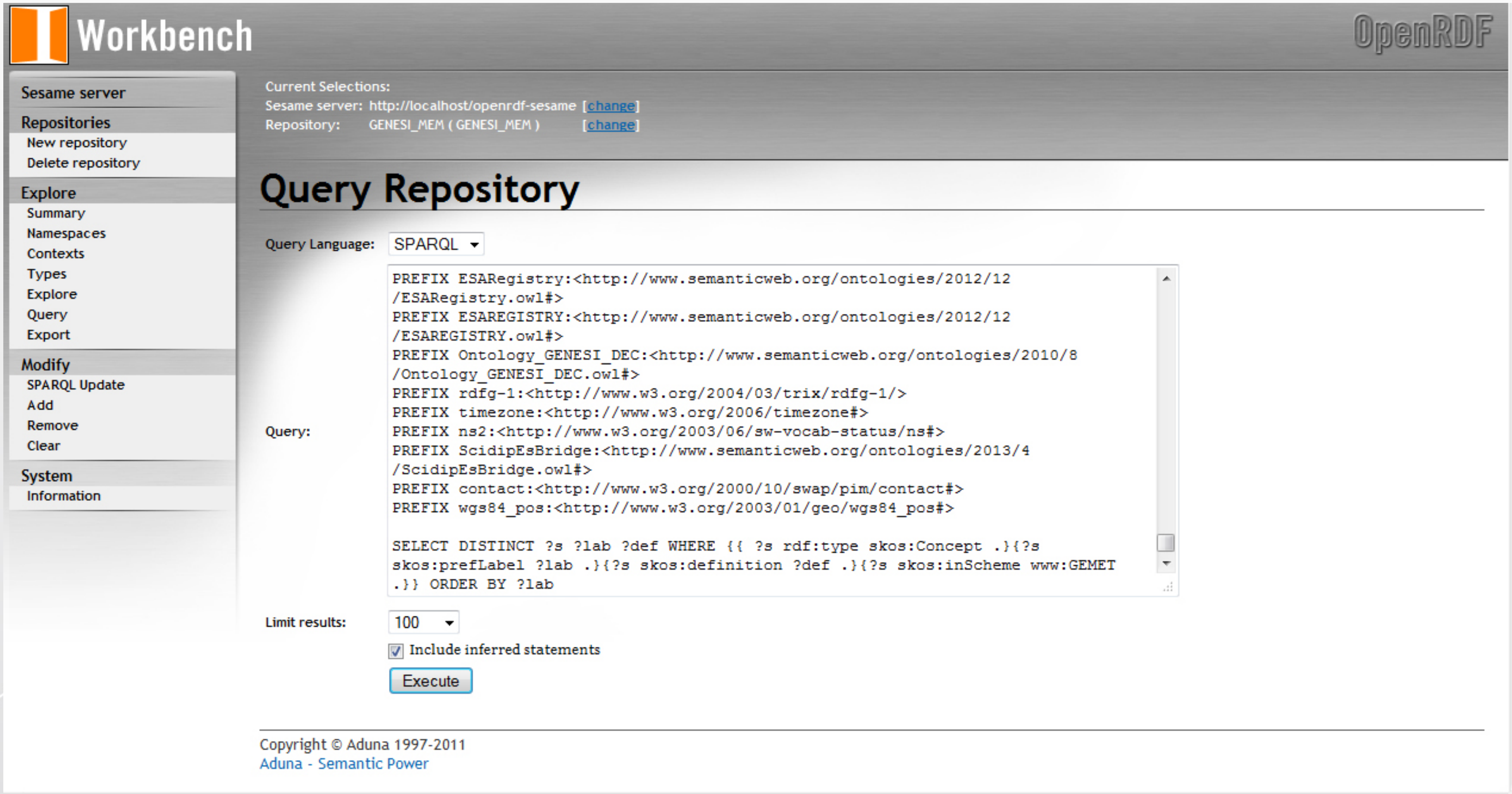
Notes for the developer – SESAME JAVA API



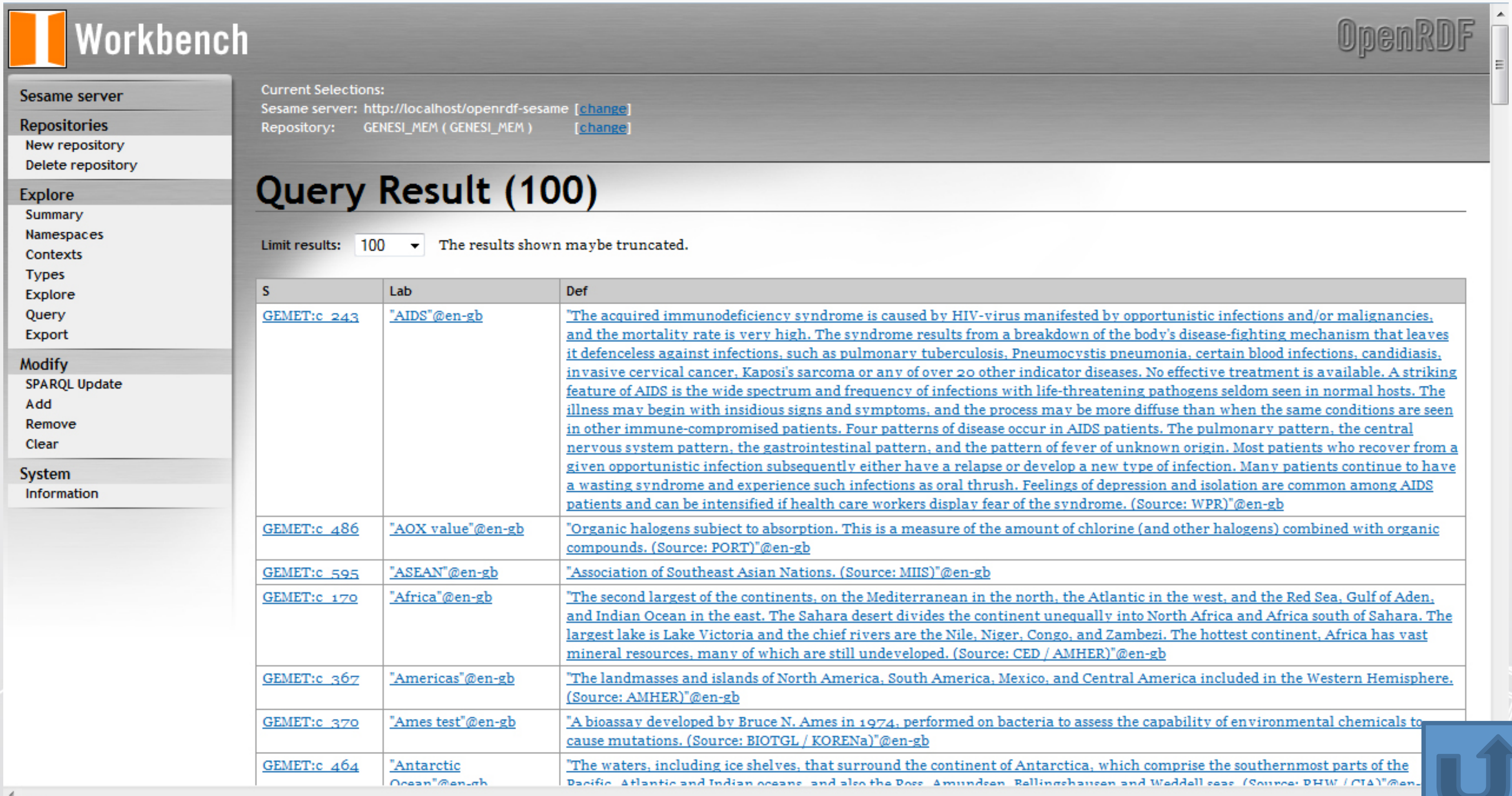
```java
        return list;
    }

    private String[] getNarrowedTermsList(String term){
        org.openrdf.repository.RepositoryConnection con=null;
        Vector<String> vector = new Vector<String>();
        boolean notEmpty=false;
        try {
                Repository myRepository = new HTTPRepository(SESAME_SERVER, REPOSITORY_ID);
                myRepository.initialize();
                con = myRepository.getConnection();
                String sparqlQuery =null;
                boolean flag=false;
                boolean noThird=false;
                sparqlQuery = SELECT_NARROWED_CONCEPT_FROM_GMET;
                flag=true;
                term="<"+term+">";
                System.out.println("PRIMA SPARQL QUERY\n'" + sparqlQuery);
                sparqlQuery =sparqlQuery.replace("TERMS", term);
                System.out.println("DOPO SPARQL QUERY\n'" + sparqlQuery);
                try
                    {
                        TupleQuery tupleQuery = con.prepareTupleQuery(QueryLanguage.SPARQL,
                        tupleQuery.setIncludeInferred(true);
                        TupleQueryResult result = tupleQuery.evaluate();
                        BindingSet bindingSet = null;
                        List<String> bindingNames = null;
                        String []first,second, third=null;
                        String temp1, temp2, temp3=null;
                        int i = 0;
                        while (result.hasNext())
                        {
                            notEmpty=true;
```

Notes for the developer – SPARQL Query



Notes for the developer – SPARQL Results



Workbench

OpenRDF

Sesame server

Repositories
- New repository
- Delete repository

Explore
- Summary
- Namespaces
- Contexts
- Types
- Explore
- Query
- Export

Modify
- SPARQL Update
- Add
- Remove
- Clear

System
- Information

Current Selections:
Sesame server: http://localhost/openrdf-sesame [change]
Repository: GENESI_MEM (GENESI_MEM) [change]

Query Result (100)

Limit results: 100 The results shown maybe truncated.

S	Lab	Def
GEMET:c_243	"AIDS"@en-gb	"The acquired immunodeficiency syndrome is caused by HIV-virus manifested by opportunistic infections and/or malignancies, and the mortality rate is very high. The syndrome results from a breakdown of the body's disease-fighting mechanism that leaves it defenceless against infections, such as pulmonary tuberculosis, Pneumocystis pneumonia, certain blood infections, candidiasis, invasive cervical cancer, Kaposi's sarcoma or any of over 20 other indicator diseases. No effective treatment is available. A striking feature of AIDS is the wide spectrum and frequency of infections with life-threatening pathogens seldom seen in normal hosts. The illness may begin with insidious signs and symptoms, and the process may be more diffuse than when the same conditions are seen in other immune-compromised patients. Four patterns of disease occur in AIDS patients. The pulmonary pattern, the central nervous system pattern, the gastrointestinal pattern, and the pattern of fever of unknown origin. Most patients who recover from a given opportunistic infection subsequently either have a relapse or develop a new type of infection. Many patients continue to have a wasting syndrome and experience such infections as oral thrush. Feelings of depression and isolation are common among AIDS patients and can be intensified if health care workers display fear of the syndrome. (Source: WPR)"@en-gb
GEMET:c_486	"AOX value"@en-gb	"Organic halogens subject to absorption. This is a measure of the amount of chlorine (and other halogens) combined with organic compounds. (Source: PORT)"@en-gb
GEMET:c_595	"ASEAN"@en-gb	"Association of Southeast Asian Nations. (Source: MIIS)"@en-gb
GEMET:c_170	"Africa"@en-gb	"The second largest of the continents, on the Mediterranean in the north, the Atlantic in the west, and the Red Sea, Gulf of Aden, and Indian Ocean in the east. The Sahara desert divides the continent unequally into North Africa and Africa south of Sahara. The largest lake is Lake Victoria and the chief rivers are the Nile, Niger, Congo, and Zambezi. The hottest continent, Africa has vast mineral resources, many of which are still undeveloped. (Source: CED / AMHER)"@en-gb
GEMET:c_367	"Americas"@en-gb	"The landmasses and islands of North America, South America, Mexico, and Central America included in the Western Hemisphere. (Source: AMHER)"@en-gb
GEMET:c_370	"Ames test"@en-gb	"A bioassay developed by Bruce N. Ames in 1974, performed on bacteria to assess the capability of environmental chemicals to cause mutations. (Source: BIOTGL / KORENa)"@en-gb
GEMET:c_464	"Antarctic Ocean"@en-gb	"The waters, including ice shelves, that surround the continent of Antarctica, which comprise the southernmost parts of the Pacific, Atlantic and Indian oceans, and also the Ross, Amundsen, Bellingshausen and Weddell seas. (Source: RHW / CIA)"@en-

Notes for the developer – Web Services

- **Migration of the webservices from SOAP (Simple Object Access Protocol) to REST (REpresentational State Transfer) protocol.**
  - http://earth2.cs.telespazio.it/rest/GenesiSemanticService.wsdl is the endpoint to retrieve the wsdl
  - http://earth2.cs.telespazio.it/rest/GenesiSemanticService/getSemanticTerms get semantic root elements
  - http://earth2.cs.telespazio.it/rest/GenesiSemanticService/getDetailedSemanticTerms?args0=XXX get detailed info of XXX element
  - http://earth2.cs.telespazio.it/rest/GenesiSemanticService/discoveryResourceByTerms?args0=SERIESTERM;http://gcmdservices.gsfc.nasa.gov/kms/concept/372b4016-80ab-4126-b6d1-e847bbf0b44f discover a resource tagged with the selected term
  - http://earth2.cs.telespazio.it/rest/GenesiSemanticService/addTag?args0=dec:genesidec_user;SERIES;seriesURI&args1=dec:average to a resource

Notes for the developer – Discovery Mapping

TYPE	TERM	DESCRIPTION
SERIES	Service URI	To retrieve all dataseries used by a selected service Returns resourceID list
SERVICES	Dataseries URI	To retrieve all services that uses the selected dataseries Returns resourceID list
RESOURCETAG	None	To discover all Resources with tags Returns resourceID list
SERIESTAG	None	To discover all Dataseries with tags Returns resourceID list
SERVICETAG	None	To discover all Services with tags Returns resourceID list
RESOURCETERM	Ontology TERM	To discover all resources tagged with the selected term. Returns resourceID list
SERIESTERM	Ontology TERM	To discover all Dataseries tagged with the selected term. Returns resourceID list
SERVICETERM	Ontology TERM	To discover all Services tagged with the selected term Returns resourceID list
SERIESDETAILTAG	seriesID	To discover all tags of a selected dataseries Returns (TermsID;TermsLabel;TermsDescription) List
SERVICEDETAILTAG	serviceID	To discover all tags of a selected service Returns (TermsID;TermsLabel;TermsDescription) List
USERTAG	userID	To discover all tags performed by a specified user Returns resourceID;Tag

Notes for the developer – Harvesting

```java
            try {

                taggingText=seriesTitle+"\n"+seriesAbstract+"\n"+seriesSubject;
                taggingText=taggingText.toLowerCase();
                // add triple of resource
                iter= res.listProperties();
                int counter=0;
                while (iter.hasNext())
                {
                    stmt = (Statement) iter.next();
                   if (stmt.getPredicate().toString().equals(xmlns_dc_identifier))
                   {
                       con = myRepository.getConnection();
                           org.openrdf.model.Statement statement1 = vf.createStatement(resourceURI,
                                RDF.TYPE, (URI)getURI(catalogue.DATASERIES));
                       org.openrdf.model.Statement statementTitle = vf.createStatement(resourceURI,
                               (URI)getURI(catalogue.TITLE),vf.createLiteral(seriesTitle) );
                       DateFormat dateFormat = new SimpleDateFormat("yyyy-MM-dd'T'HH:mm:ssZ");
                       String timestamp = Long.toString(System.currentTimeMillis());
                       Date currentDate = new Date(System.currentTimeMillis());
                       // Converting date to ISO8601
                       String javaDate = dateFormat.format(currentDate);
                       String isoDate = javaDate.substring(0, 22) + ":" + javaDate.substring(22);
                       URI dateResource = vf.createURI(statement1.getSubject()+"_Time");
                       org.openrdf.model.Statement statement5 = vf.createStatement(dateResource,
                                    RDF.TYPE, (vf.createURI(ontns_time_instant)));
                       org.openrdf.model.Statement statement6 = vf.createStatement(dateResource,
                                       vf.createURI(ontns_time_xsdTime), vf.createLiteral(isoDate));
                       org.openrdf.model.Statement statement7 = vf.createStatement(statement1.getSubject(),

                       con.add(statement1);
                       con.add(statementTitle);
                       con.add(statement5);
                       con.add(statement6);
                       con.add(statement7);
                       con.close();
```

Notes for the developer – Discovery

```java
private String[] discoveryResources(String sparqlQuery){
    org.openrdf.repository.RepositoryConnection con=null;
    Vector<String> vector = new Vector<String>();
    boolean notEmpty=false;
    try {
            Repository myRepository = new HTTPRepository(SESAME_SERVER, REPOSITORY_ID);
            myRepository.initialize();
            con = myRepository.getConnection();
            boolean flag=false;
            boolean noThird=false;
            flag=true;
        try
            {
                TupleQuery tupleQuery = con.prepareTupleQuery(QueryLanguage.SPARQL,
                        getRepositoryNamespaces(SESAME_SERVER,REPOSITORY_ID) +sparqlQuery);
                tupleQuery.setIncludeInferred(true);
                TupleQueryResult result = tupleQuery.evaluate();
                BindingSet bindingSet = null;
                List<String> bindingNames = null;
                String []first,second, third=null;
                String temp1, temp2, temp3=null;
                int i = 0;
                while (result.hasNext())
                {
                    notEmpty=true;
                    bindingNames = result.getBindingNames();
                    bindingSet = result.next();
                        temp1=bindingSet.getValue(bindingNames.get(0)).toString();
                        temp2=bindingSet.getValue(bindingNames.get(1)).toString();
                        vector.add(temp1+";"+temp2);
                        i++;
                }
                con.close();

            } catch (MalformedQueryException ex)
```

Notes for the developer – Tagging

```
private void addTermsTag(String user,String type,String resource, String category){
        org.openrdf.repository.RepositoryConnection con=null;
        ValueFactory vf=null;
        try {
                Repository myRepository = new HTTPRepository(SESAME_SERVER, REPOSITORY_ID);
                myRepository.initialize();
                vf = myRepository.getValueFactory();
                java.util.Date today = new java.util.Date();
                String randomString = "_" + new java.sql.Timestamp(today.getTime()).getTime();
                URI Annotation = vf.createURI(type+ randomString);
                org.openrdf.model.Statement statement1 = vf.createStatement(Annotation,
                        RDF.TYPE, (vf.createURI(type)));
               //Link the dataseries annotation with a Category found
                org.openrdf.model.Statement statement2 = vf.createStatement(Annotation,
                       vf.createURI(ontns_dec_hasCategory),vf.createURI(category));
               //Link the Resource with the created dataseries annotation
                org.openrdf.model.Statement statement3 = vf.createStatement(vf.createURI(resource),
                       vf.createURI(ontns_dec_hasAnnotation), Annotation);
                // User tag
                org.openrdf.model.Statement statement4 = vf.createStatement(Annotation,
                           vf.createURI(ontns_dec_hasCreator), vf.createURI(user));
                // Time tag
                org.openrdf.model.Statement statement5 = vf.createStatement(dateAnnotation,
                            RDF.TYPE, (vf.createURI(ontns_time_instant)));
                org.openrdf.model.Statement statement6 = vf.createStatement(dateAnnotation,
                              vf.createURI(ontns_time_xsdTime), vf.createLiteral(isoDate));
                org.openrdf.model.Statement statement7 = vf.createStatement(Annotation,
                              vf.createURI(ontns_dec_created), dateAnnotation);
                con = myRepository.getConnection();
                con.add(statement1);con.add(statement2);
                con.add(statement3);
                con.add(statement4);
                con.add(statement5);
                con.add(statement6);
                con.add(statement7);
                con.close();
```

Semantic direct access

- http://earth2.cs.telespazio.it/rest/GenesiSemanticService
- http://earth2.cs.telespazio.it/rest/GenesiSemanticService/getSemanticTerms
- http://earth2.cs.telespazio.it/rest/GenesiSemanticService/getDetailedSemanticTerms?args0=GCMD
- **Sparql Queries**
  - SELECT DISTINCT ?lab WHERE {{?s rdf:type dec:USABLE_TERMS .}UNION{?s rdfs:subClassOf dec:USABLE_TERMS .}{?s rdfs:label ?lab .}} ORDER BY ?lab
  - SELECT DISTINCT ?date ?usr ?var ?lab ?def WHERE {{ <http://dr-ext.genesi-dec.eu/catalogue/genesi/ICOS_Mace_Head_station/rdf> dec:hasAnnotation ?an . }{?an rdf:type dec:DATASERIES_ANNOTATION . }{ ?an dec:hasCategory ?var . }{?an dec:hasCreator ?usr . }{?an dec:created ?ant . }{ ?ant time:xsdDateTime ?date . }{ ?var skos:prefLabel ?lab . }{ ?var skos:definition ?def . }} ORDER BY ?date