

Ontology-Based Search for Earth Observation Products:

The RARE System

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- The RARE System
- Prod-Trees Extensions
- LEO Extensions
- Conclusion

The RARE Software

- Main development performed in ESA project RARE since 2011

- With  epistematica®
knowledge engineers

- Main Objective

Develop an ontology-based resolving service usable by users with no specific EO knowledge,

RARE User Interface



The screenshot displays the RARE User Interface. At the top left is the "spaceapplications SERVICES" logo. To its right is the "epistematica" logo, which includes a red square icon with the text "ROTAS OPERATI ARREPO SATOR" and the tagline "knowledge engineers". In the top right corner, there is a "Sign In" button with a key icon. Below the logos is a dark grey "Welcome" button. A breadcrumb trail shows "RARE Public Portal" followed by "Welcome". A "RARE FAQ" link is visible. The search section features a "Search" label, an "Advanced ..." link, a large yellow search input field, and a blue "Search" button with a magnifying glass icon. Below the input field, two dropdown menus show "7 out of 8 types selected" and "10 out of 11 providers selected", followed by the text "Insert application term". At the bottom of the search area, there is a footer with the text: "RARE - Rapid Response Support Server • June 2013 • Space Applications Services S.A./N.V. • Epistematica S.r.l. The RARE Platform is being developed under the European Space Agency contract 1-6453/10/I/NB." In the bottom right corner of the interface, it says "Powered By Liferay".

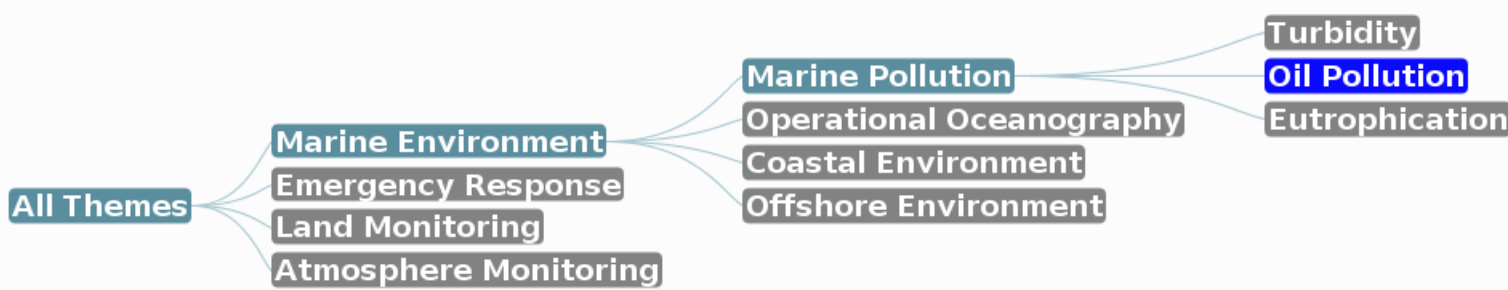
RARE User Interface

The screenshot displays the RARE Public Portal interface. At the top, there are logos for 'spaceapplications SERVICES' and 'epistematica knowledge engineers'. A 'Sign In' button is located in the top right corner. Below the logos is a dark 'Welcome' banner. A breadcrumb trail shows 'RARE Public Portal > Welcome'. A 'RARE FAQ' link is visible. The main search area includes a search bar with a yellow border, a 'Search' button, and two filter panels. The left filter panel, titled '7 out of 8 types selected', includes a 'Select all types' checkbox and a list of checked items: 'Map Layers (WMS)', 'Feature Types (WFS)', 'Coverage (WCS)', 'Processors (WPS)', 'EO Products (EOP)', and 'Data Records (ISO/CIM)'. The right filter panel, titled '10 out of 11 providers selected', includes a 'Select all providers' checkbox and a list of checked items: 'Cryoland', 'Disasters Charter', 'Enviro SDI', 'G-POD', 'MyOcean', and 'RDC-SNSF'. A text input field contains 'Insert application term' and 'epistematica S.r.l.'. A 'Powered By Liferay' watermark is present in the bottom right of the interface.

RARE GSCDA Ontology Browser

View All Occurrences Cancel Use Selected Term

Oil Pollution (4 occurrences)

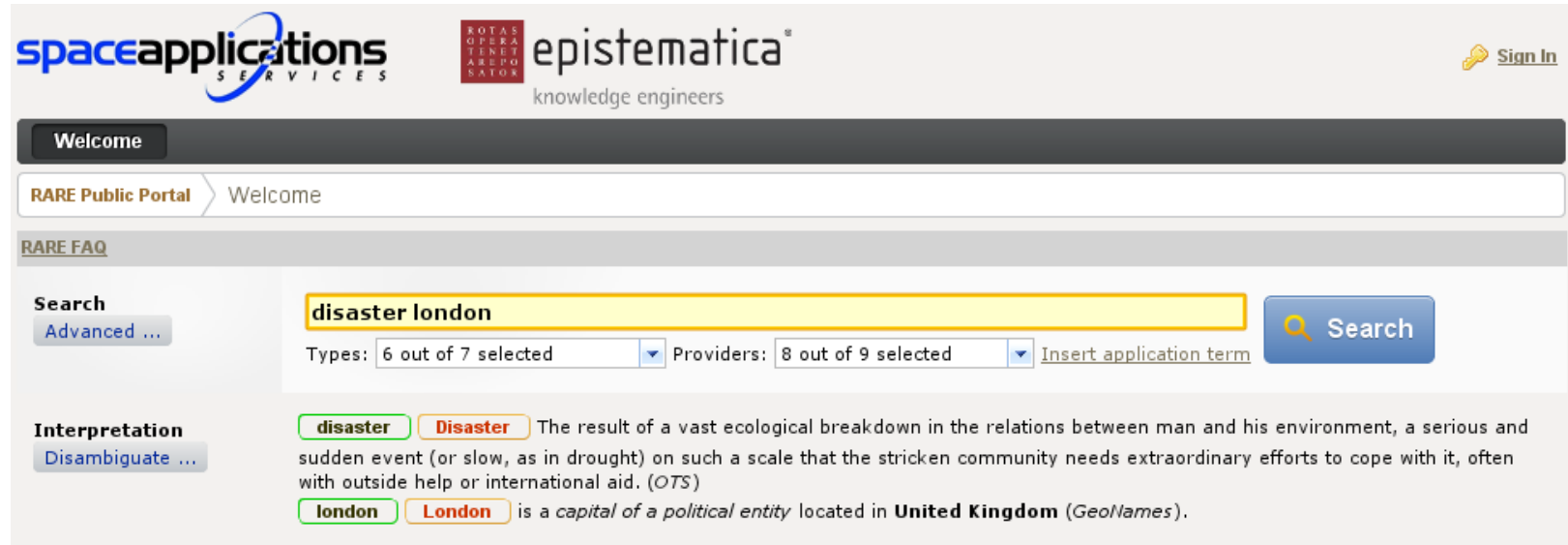


```
graph LR; AllThemes[All Themes] --- MarineEnvironment[Marine Environment]; AllThemes --- EmergencyResponse[Emergency Response]; AllThemes --- LandMonitoring[Land Monitoring]; AllThemes --- AtmosphereMonitoring[Atmosphere Monitoring]; MarineEnvironment --- MarinePollution[Marine Pollution]; MarineEnvironment --- OperationalOceanography[Operational Oceanography]; MarineEnvironment --- CoastalEnvironment[Coastal Environment]; MarineEnvironment --- OffshoreEnvironment[Offshore Environment]; MarinePollution --- Turbidity[Turbidity]; MarinePollution --- OilPollution[Oil Pollution]; MarinePollution --- Eutrophication[Eutrophication]; style OilPollution fill:#0070C0,color:#fff
```

Focus On

Oil Pollution
Contamination of any ecosystem, but usually of freshwater or marine ecosystems, by oil or other petroleum products.

RARE User Interface



The screenshot displays the RARE Public Portal interface. At the top, there are logos for 'spaceapplications SERVICES' and 'epistematica® knowledge engineers', along with a 'Sign In' button. A 'Welcome' message is shown in a dark bar. Below this, a breadcrumb trail reads 'RARE Public Portal > Welcome'. A 'RARE FAQ' section is also visible. The main content area features a search bar with the query 'disaster london'. Below the search bar, there are filters for 'Types: 6 out of 7 selected' and 'Providers: 8 out of 9 selected', with a link to 'Insert application term'. A blue 'Search' button is positioned to the right of the filters. Underneath the search bar, there are two search results displayed as colored boxes: a green box for 'disaster' and an orange box for 'Disaster'. The text for 'Disaster' reads: 'The result of a vast ecological breakdown in the relations between man and his environment, a serious and sudden event (or slow, as in drought) on such a scale that the stricken community needs extraordinary efforts to cope with it, often with outside help or international aid. (OTS)'. Below this, another result is shown: a green box for 'london' and an orange box for 'London', with the text: 'is a capital of a political entity located in **United Kingdom** (GeoNames)'. On the left side of the search results, there are sections for 'Search' with an 'Advanced ...' link, and 'Interpretation' with a 'Disambiguate ...' link.

RARE User Interface

EO Resources

Select ...

272 results
(13.39 seconds)

Footprints

Thumbnails

Details

Types

EO products (4)

Map layers (71)

Feature layers (57)

Coverage layers (140)

Providers

Not defined (227)

Disasters Charter (3)

Enviro SDI (34)

Disaster Charter (2)

MyOcean (6)

Sort

▲ Relevance

Resource Type

Area of Interest



Time of Interest

Harvesting Date

[EO Product] UK-DMC → OPTICAL - Sun Nov 18 2012 09:57:59 GMT+0100 (CET) XML


Acquisition information

- Product type: DMCII
- Platform: UK-DMC
- Instrument:
- Sensor type: OPTICAL
- Begin position: Sun Nov 18 2012 09:57:59 GMT+0100 (CET)
- End position: Sun Nov 18 2012 09:58:03 GMT+0100 (CET)
- Orbit type: LEO


[Coverage] Atmospheric Infrared Sounder (AIRS) data from NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) → TotCldLiqH2O_A XML

Mean total integrated column cloud liquid water in kg/m2, for ascending orbits.




[Coverage] Atmospheric Infrared Sounder (AIRS) data from NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) → AIRX3STD:ascending:TotH2OVap_A XML

Total integrated column water vapor burden, in kg/m2, for ascending orbits.



[Coverage] Atmospheric Infrared Sounder (AIRS) data from NASA Goddard Earth Sciences Data and Information Services Center (GES DISC) → Total Ozone for Ascending Orbit XML

The total integrated column ozone burden parameter (in Dobson Units), from the AIR IR and AMSU without HSB level 3 daily gridded product. The values cover a temporal period of



RARE Example Workflow: *Disaster London 2009*

Interpreted Query

disaster »»» Ontology Concept:
The result of a vast ecological
breakdown

london »»» Toponym:
capital of UK (GeoNames)
»»» bounding box

2009 »»» Time Expression:
between 1-Jan-2009 and
31-Dec-2009 »»» time range

Search terms:

disaster **london** **2009**

AT

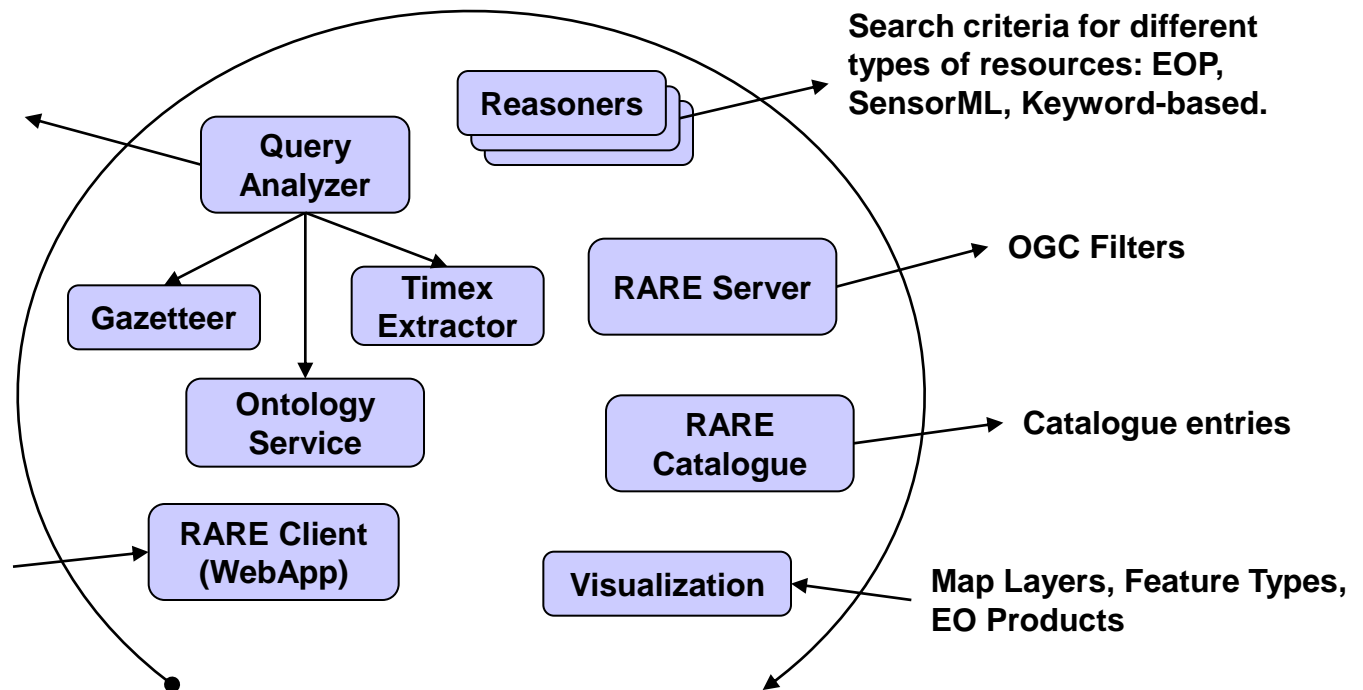
GT

TE

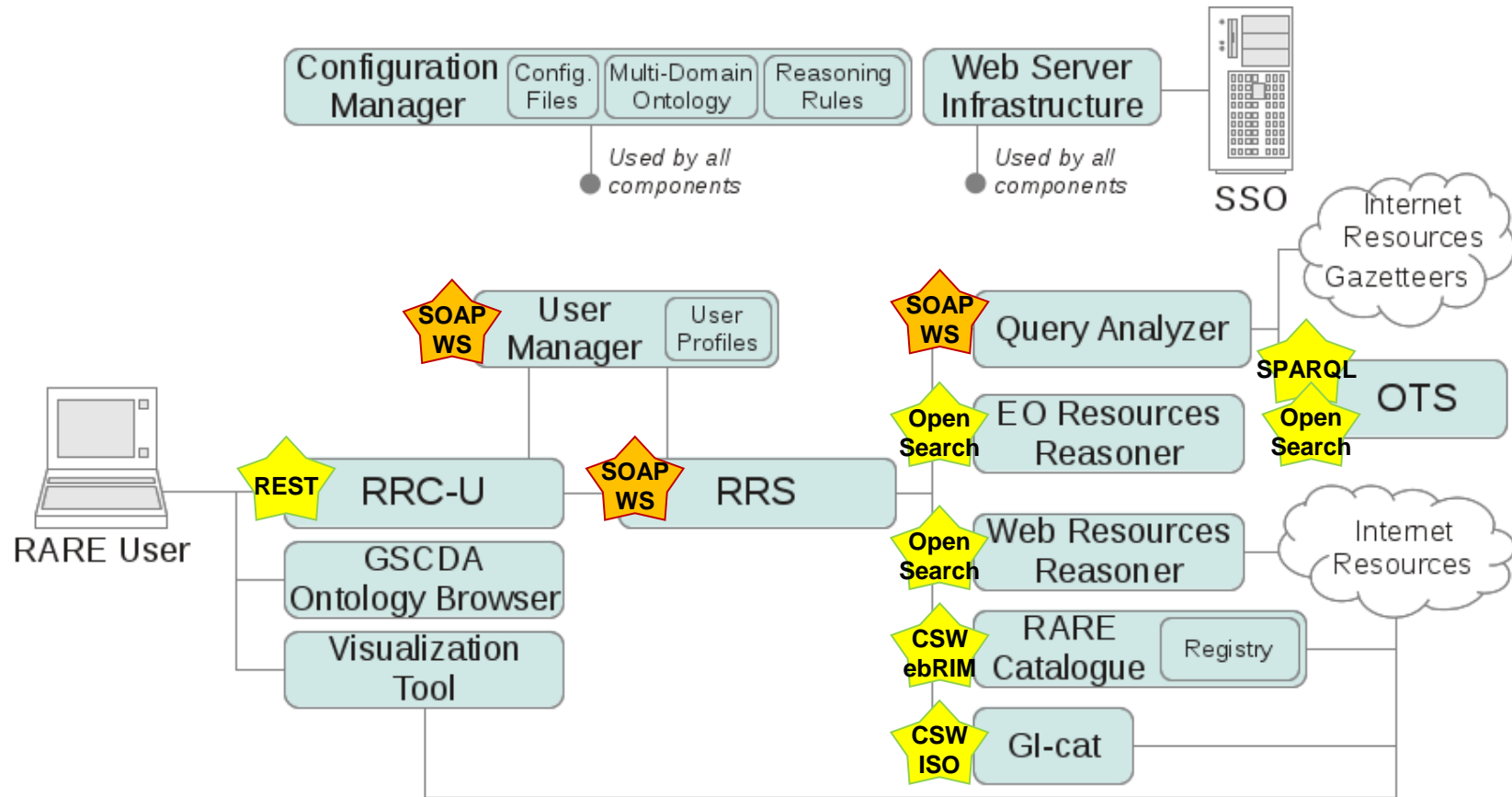
AT: Application Term

GT: Geographical Term / Toponym



TE: Time Expression



RARE – Architecture (User View)



Prod-Trees Demonstrator

- On-going ESA project with NKUA  National and Kapodistrian University of Athens and CNR-IIA 
- Main Objective
 - Specify an EO convention for the netCDF standard: "EO-netCDF"
- Demonstrate in a semantically-enabled EO products search platform
- Implementation
 - Demonstrator based on the RARE system
 - Cross-Ontology Browser: GSCDA, GEOSS, GEMET, GCMD
 - New EO-netCDF Reasoner to generate netCDF search criteria
 - Dynamic Multi-Criteria Search Page for experts

Prod-Trees Demonstrator Main Search Page

Prod-Trees

Liferay > Prod-Trees

[Prod-Trees FAQ](#)

Search
[Multi-Criteria ...](#)

Interpretation
[Disambiguate ...](#)

EO Resources
[Select ...](#)

1 result
(3.44 seconds)

[Footprints](#)

[Thumbnails](#)

[Details](#)

[Insert application term](#)

london London is a capital of a political entity located in **United Kingdom** (*GeoNames*).

2002 from 1 January to 31 December 2002.

[NetCDF Product] tcw

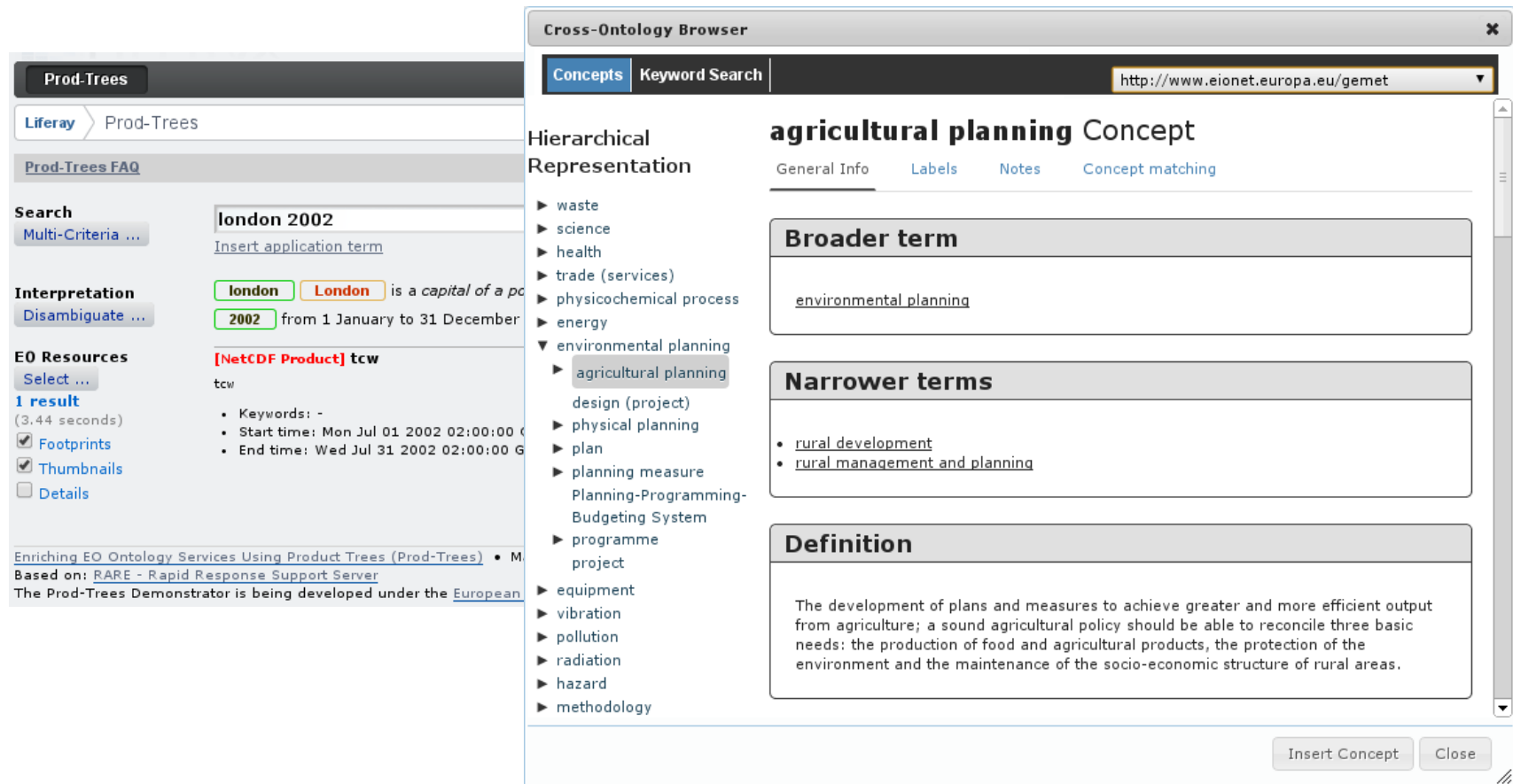
tcw

- Keywords: -
- Start time: Mon Jul 01 2002 02:00:00 GMT+0200 (CEST)
- End time: Wed Jul 31 2002 02:00:00 GMT+0200 (CEST)



[Enriching EO Ontology Services Using Product Trees \(Prod-Trees\)](#) • [March 2014](#) • [Space Applications Services S.A./N.V.](#) • [CNR](#) • [UoA](#)
 Based on: [RARE - Rapid Response Support Server](#)
 The Prod-Trees Demonstrator is being developed under the [European Space Agency](#) contract 1-7196/12/I-NB.

Prod-Trees Demonstrator Main Search Page



The image shows a screenshot of the Prod-Trees Demonstrator Main Search Page and a Cross-Ontology Browser window.

Prod-Trees Main Search Page:

- Prod-Trees** (Header)
- Liferay** > Prod-Trees
- Prod-Trees FAQ**
- Search:** Search box contains "london 2002". Below it, "Insert application term" is visible.
- Interpretation:** "london" and "London" are highlighted. Text: "London is a capital of a po". "2002" is highlighted. Text: "from 1 January to 31 December".
- EO Resources:** "[NetCDF Product] tcw" is highlighted. Text: "tcw".
- 1 result** (3.44 seconds):
 - Keywords: -
 - Start time: Mon Jul 01 2002 02:00:00 G
 - End time: Wed Jul 31 2002 02:00:00 G
- Options: Footprints, Thumbnails, Details.
- Footer: "Enriching EO Ontology Services Using Product Trees (Prod-Trees) • M", "Based on: RARE - Rapid Response Support Server", "The Prod-Trees Demonstrator is being developed under the European".

Cross-Ontology Browser:

- URL: <http://www.eionet.europa.eu/gemet>
- Tab: **Concepts** | Keyword Search
- Hierarchical Representation:**
 - ▶ waste
 - ▶ science
 - ▶ health
 - ▶ trade (services)
 - ▶ physicochemical process
 - ▶ energy
 - ▼ environmental planning
 - ▶ agricultural planning
 - design (project)
 - ▶ physical planning
 - ▶ plan
 - ▶ planning measure
 - Planning-Programming-Budgeting System
 - ▶ programme
 - project
 - ▶ equipment
 - ▶ vibration
 - ▶ pollution
 - ▶ radiation
 - ▶ hazard
 - ▶ methodology

- agricultural planning Concept:**
- General Info | Labels | Notes | Concept matching
- Broader term:**
 - [environmental planning](#)
- Narrower terms:**
 - [rural development](#)
 - [rural management and planning](#)
- Definition:**

The development of plans and measures to achieve greater and more efficient output from agriculture; a sound agricultural policy should be able to reconcile three basic needs: the production of food and agricultural products, the protection of the environment and the maintenance of the socio-economic structure of rural areas.
- Buttons: **Insert Concept**, **Close**

Prod-Trees Demonstrator Multi-Criteria Search Page

Prod-Trees

Liferay > Prod-Trees


[Prod-Trees FAQ](#) | [Search Prod-Trees](#)

Multi-Criteria Search

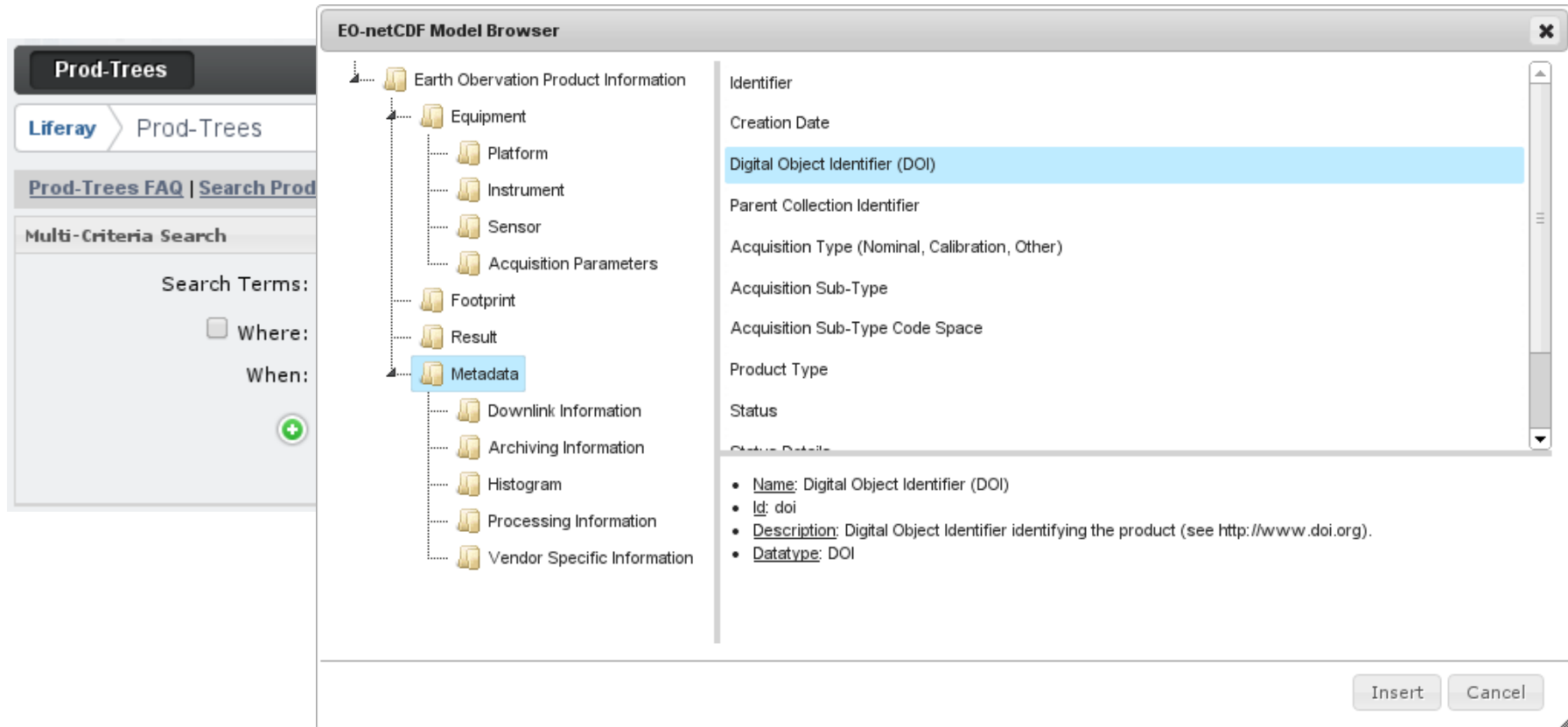
Search Terms:

Where:

When:

 [Add a NetCDF search criteria](#)

Prod-Trees Demonstrator Multi-Criteria Search Page



EO-netCDF Model Browser

Earth Observation Product Information

- Equipment
 - Platform
 - Instrument
 - Sensor
 - Acquisition Parameters
- Footprint
- Result
- Metadata**
 - Downlink Information
 - Archiving Information
 - Histogram
 - Processing Information
 - Vendor Specific Information

Identifier

Creation Date

Digital Object Identifier (DOI)

Parent Collection Identifier

Acquisition Type (Nominal, Calibration, Other)

Acquisition Sub-Type

Acquisition Sub-Type Code Space

Product Type

Status

Status Details

- Name:** Digital Object Identifier (DOI)
- Id:** doi
- Description:** Digital Object Identifier identifying the product (see <http://www.doi.org>).
- Datatype:** DOI

Insert Cancel

Prod-Trees Demonstrator Multi-Criteria Search Page

Prod-Trees

Liferay > Prod-Trees

[Prod-Trees FAQ](#) | [Search Prod-Trees](#)

Multi-Criteria Search

Search Terms:

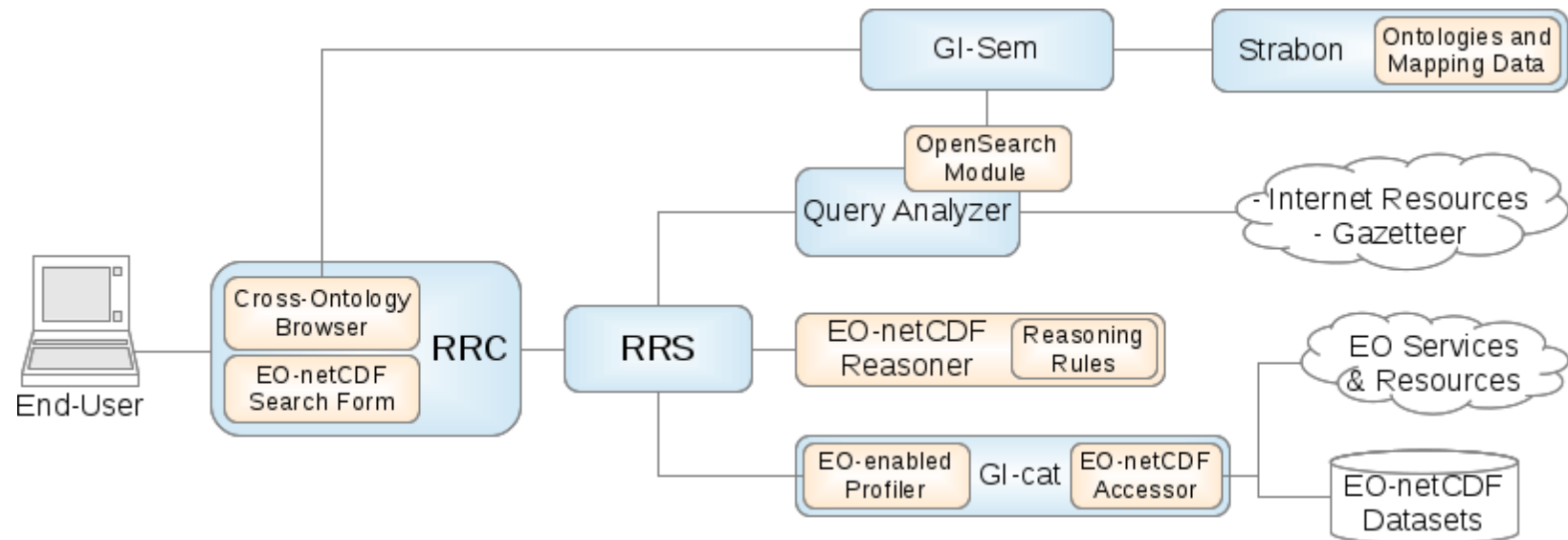
Where:

When:

NetCDF Variable: earth_observation_information >> earth_observation_metadata >> doi

Add a NetCDF search criteria

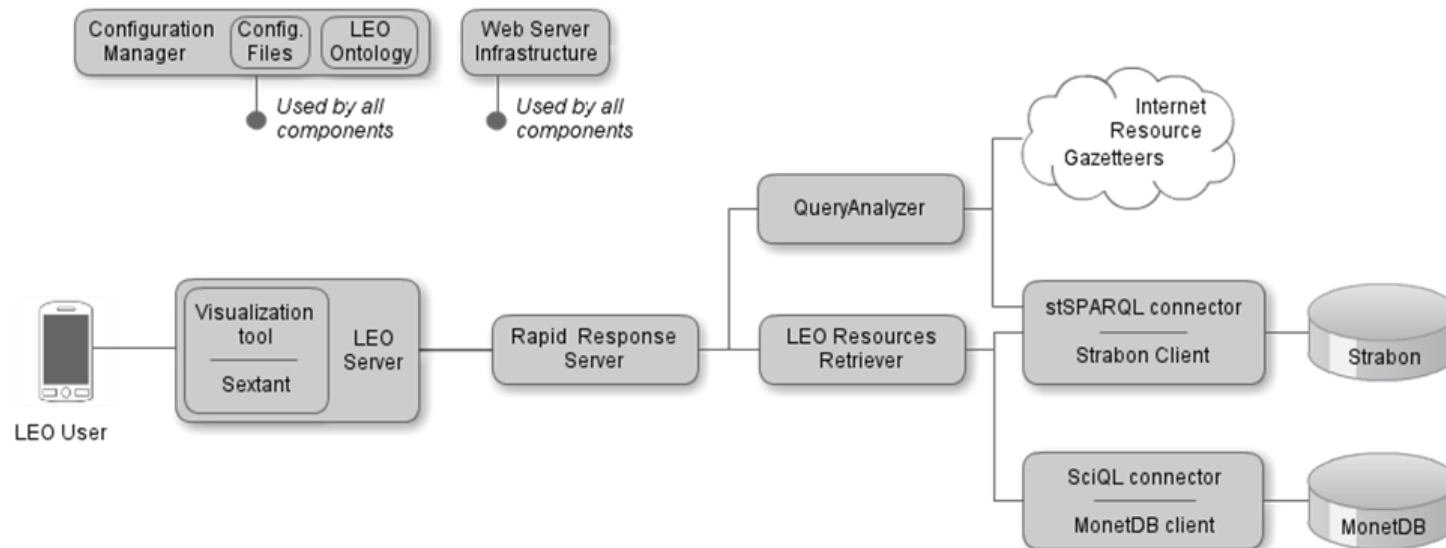
Prod-Trees Demonstrator Architecture



Searching, Browsing and Visualization Platform [WP4]

- RARE back-end services extended to communicate with Strabon for ontology navigation and search in Linked Open Data (including linked EO products)
- New Reasoner to support stSPARQL search criteria, allowing to query Strabon
- New User Interface adapted to mobile devices: search, browse and visualization of Linked Open Data
- [NKUA] Porting Sextant to mobile devices

LEO Platform Architecture



Conclusion

- RARE is a distributed system with re-usable components
- Modular components may be extended with new "connectors":
 - Originally: OGC CSW, W*S
 - In Prod-Trees and LEO: [EO-]netCDF, LOD
- New client applications may interact with the front-end REST interface
 - Originally: Web-based User Interface
 - In LEO: Android client application
- User Management
- Administration Interface (WebUI)

Thank you

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