



Geographical Linked Data: a Spanish Use Case

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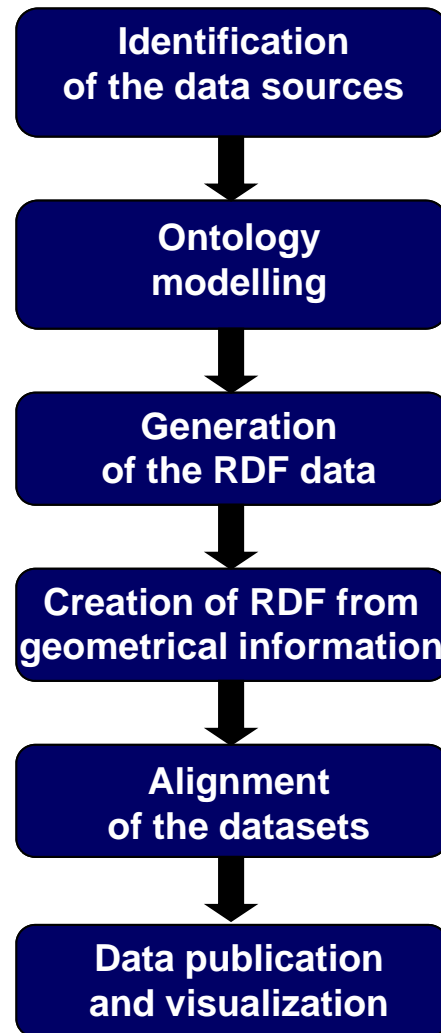
- Motivation
- A Process for Publishing Linked Government Data
 - Identification of the data sources
 - Ontology modelling
 - Generation of the RDF data
 - Creation of RDF from geometrical information
 - Alignment of the datasets
 - Data publication and visualization
- Demo
- Future Work

- **GeoLinkedData** is an open initiative whose aim is to enrich the Web of Data with Spanish geospatial data.
- It has started off by publishing diverse information sources, such as National Geographic Institute of Spain (IGN).



- <http://geo.linkeddata.es>
- Recently, National Statistics Institute (INE)

A Process for Publishing Linked Government Data

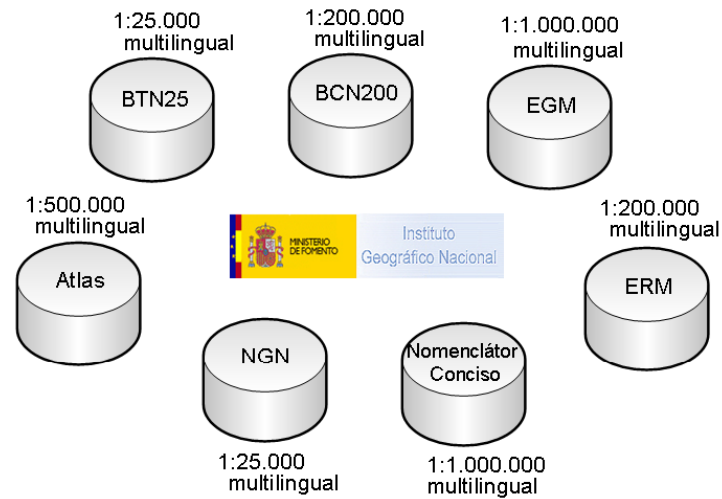


1. Identification of the data sources

IGN

National Geographic Institute of Spain

Oracle & MySQL

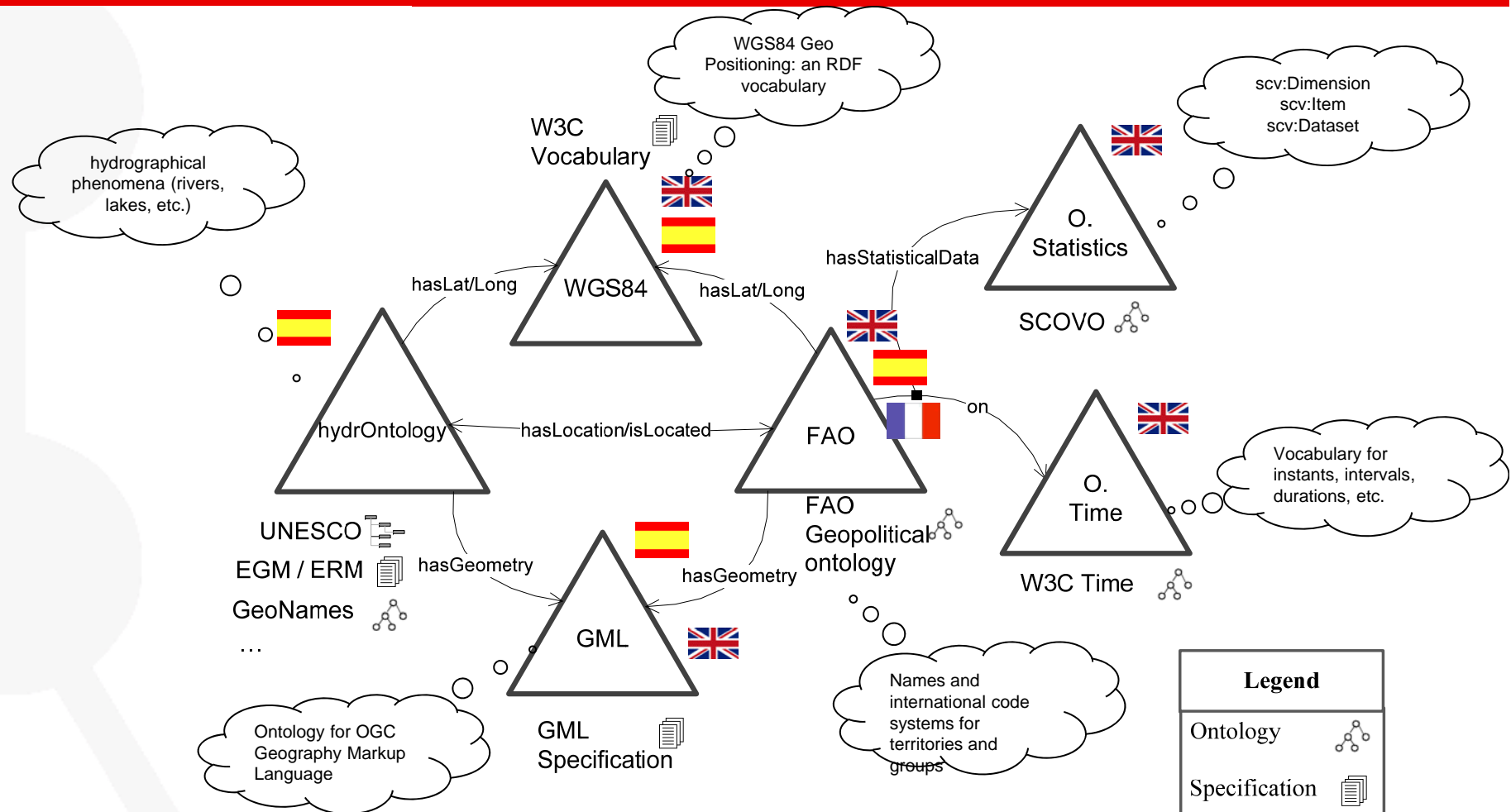


INE

National Statistic Institute of Spain



2. Ontology modelling

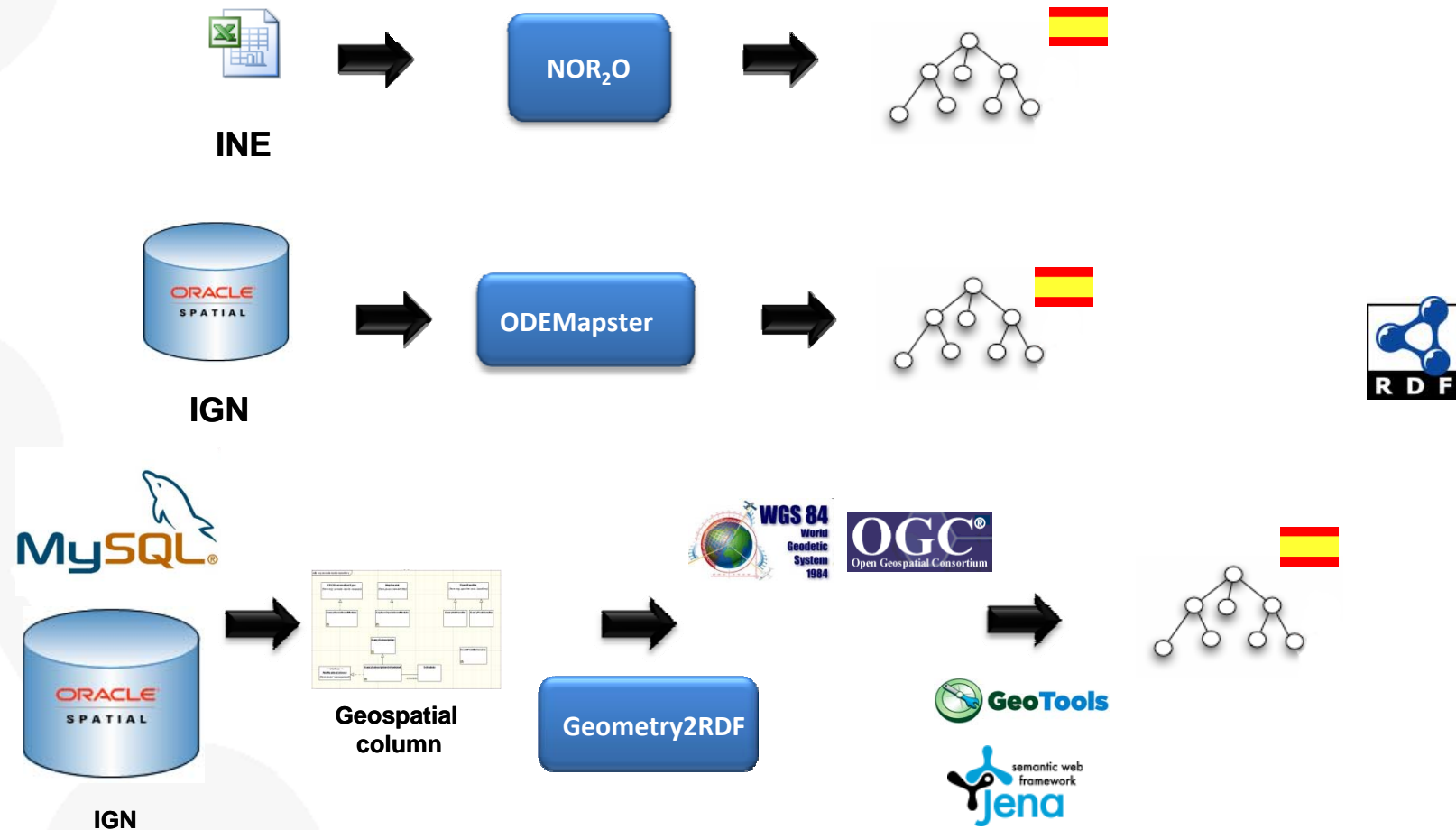


Classes	33	33
Object Properties	44	44
Data Properties	318	318



Following the INSPIRE (INfrastructure for SPatial InfoRmation in Europe) recommendation. hydrOntology, SCOVO, FAO Geopolitical, WGS84, GML, and Time

3. Generation of the RDF Data



3. Generation of the RDF Data – NOR₂O

Industry Production Index

Year

	2009	2008	2007	2006	2005	2004	2003
Total Nacional	3356830	3422239	3336657	3174393	3064129	2942593	2831199
Alava	21988	22318	20670	19638	19638	19779	19638
Albacete	27380	27647	27068	25531	24035	23550	22547
Alicante	136239	142307	140145	133016	123333	113852	111805
Almería	43501	45130	43970	40871	38766	36260	33947
Ásturias	71853	73124	72276	70115	68175	67009	65062
Avila	11455	11708	11434	10900	10611	10319	10211
Badajoz	40874	41358	40168	38045	37052	34972	34866
Illes Balears	9182	93335	91254	88027	87024	85425	75951
Barcelona	467235	477942	469432	444410	436294	417425	37693
Burgos	25367	25891	25372	24504	23733	22882	21159
Cáceres	25307	26494	26064	25039	24846	20596	23140
Cádiz	52817	64505	63338	61691	58986	57138	54432
Cantabria	39611	40393	39560	37690	36561	35649	34017
Castellón	42122	43855	42476	39749	37865	37214	3421
Ciudad Real	32046	33011	31881	30446	29521	29011	26778
Córdoba	48979	50057	49302	47155	45405	43394	41964
Coruña, A	83748	84220	82673	79170	77023	74809	71746
Cuenca	14747	14928	14741	13822	13336	12829	12546
Girona	58404	51467	50108	47169	46827	45145	52482
Granada	60016	62269	61055	57223	54341	50508	4966
Guadalajara	13507	13735	12874	11825	10438	10120	942
Guipúzcoa	62034	63569	59546	58486	57193	56498	55933
Huelva	2783	27463	27063	25487	24777	24270	22347
Huesca	11837	17109	16694	16025	15390	15078	14283
Jaén	36157	37368	36962	35383	34675	33157	32444
León	33584	34012	33563	32359	31664	30992	30256
Llrida	36920	37638	36065	33956	32739	31515	29605
Lugo	24861	25035	24609	23780	23122	22479	22396
Madrid	511804	519307	503000	478202	456175	43607	407655
Málaga	113662	116683	114547	108713	102382	96387	88257
Murcia	95636	100070	97374	90698	85110	82484	75973
Navarra	43282	43847	43142	41083	40730	39679	38936
Ourense	23304	23711	23520	22843	22452	22118	21560
Palencia	10664	11114	11060	10694	10576	10390	10297

Province

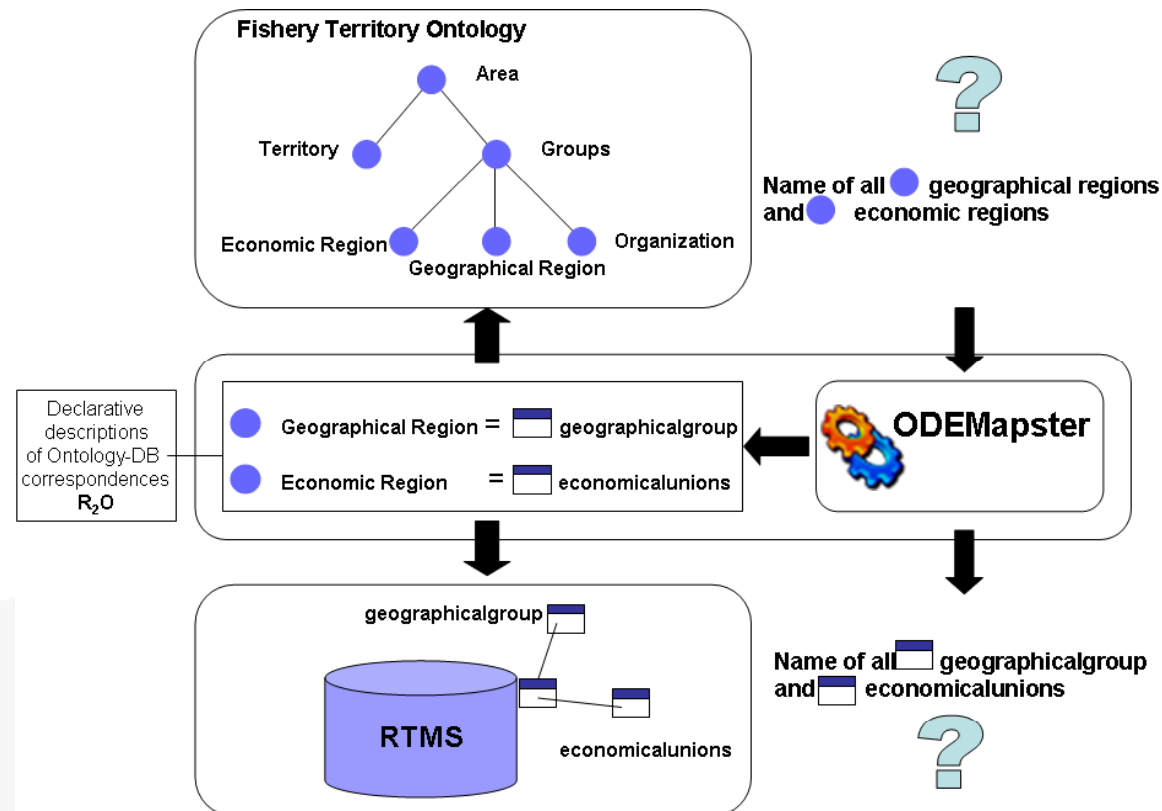
```
<?xml version="1.0" encoding="UTF-8"?>
<!-- <nor xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:noNamespaceSchemaLocation="http://www.w3.org/2001/XMLSchema-instance" -->
<Nor type="GenericSpreadSheet" name="Spanish Employment">
  <Schema>
    <SchemaEntities>
      <SchemaEntity name="Location">
        <Attribute name="Name" valueFrom="pcaxis.[A11:A62]" type="string"/>
      </SchemaEntity>
      <SchemaEntity name="Dataset">
        <Attribute name="Name" valueFrom="pcaxis.[B6:H6]" type="string"/>
      </SchemaEntity>
      <SchemaEntity name="Year">
        <Attribute name="Name" valueFrom="pcaxis.[B9:H9]" type="string"/>
      </SchemaEntity>
      <SchemaEntity name="IndustryProductionIndex" type="Nary">
        <Attribute name="hasValue" valueFrom="pcaxis.[B10:H62]" type="string"/>
        <Relation name="inArea" usingSpreadSheetColumn="A" destination="Location"/>
        <Relation name="inPeriod" usingSpreadSheetRow="9" destination="Year"/>
        <Relation name="dataset" usingSpreadSheetRow="6" destination="Dataset"/>
      </SchemaEntity>
    </SchemaEntities>
  </Schema>
  <DataModel>
    <GenericDataModel/>
  </DataModel>
  <Implementation>
    <Spreadsheet type="ms" file="Empresas.xls"/>
  </Implementation>
</Nor>
```

NOR₂O

```
<!-- http://geo.linkeddata.es/resource/Estad%C3%ADstica/Madrid_ipi_2003 -->
<scv:Item rdf:about="Estad%C3%ADstica/Madrid_ipi_2003">
  <rdfs:label xml:lang="es">&#205;ndice de Producci&#243;n Industrial de Madrid en el a&#241;o 2003</rdfs:label>
  <rdf:value rdf:datatype="xsd:double">407655.0</rdf:value>
  <scv:dimension rdf:resource="A%C3%B1o/2003"/>
  <scv:dataset rdf:resource="Estad%C3%ADstica/%25C3%258DndiceDeProducci%25C3%25B3nIndustrial"/>
  <onto:inProvincia rdf:resource="Provincia/Madrid"/>
</scv:Item>
<!-- http://geo.linkeddata.es/resource/Estad%C3%ADstica/Madrid_ipi_2004 -->
<scv:Item rdf:about="Estad%C3%ADstica/Madrid_ipi_2004">
  <rdfs:label xml:lang="es">&#205;ndice de Producci&#243;n Industrial de Madrid en el a&#241;o 2004</rdfs:label>
  <rdf:value rdf:datatype="xsd:double">436074.0</rdf:value>
  <scv:dimension rdf:resource="A%C3%B1o/2004"/>
  <scv:dataset rdf:resource="Estad%C3%ADstica/%25C3%258DndiceDeProducci%25C3%25B3nIndustrial"/>
  <onto:inProvincia rdf:resource="Provincia/Madrid"/>
</scv:Item>
```

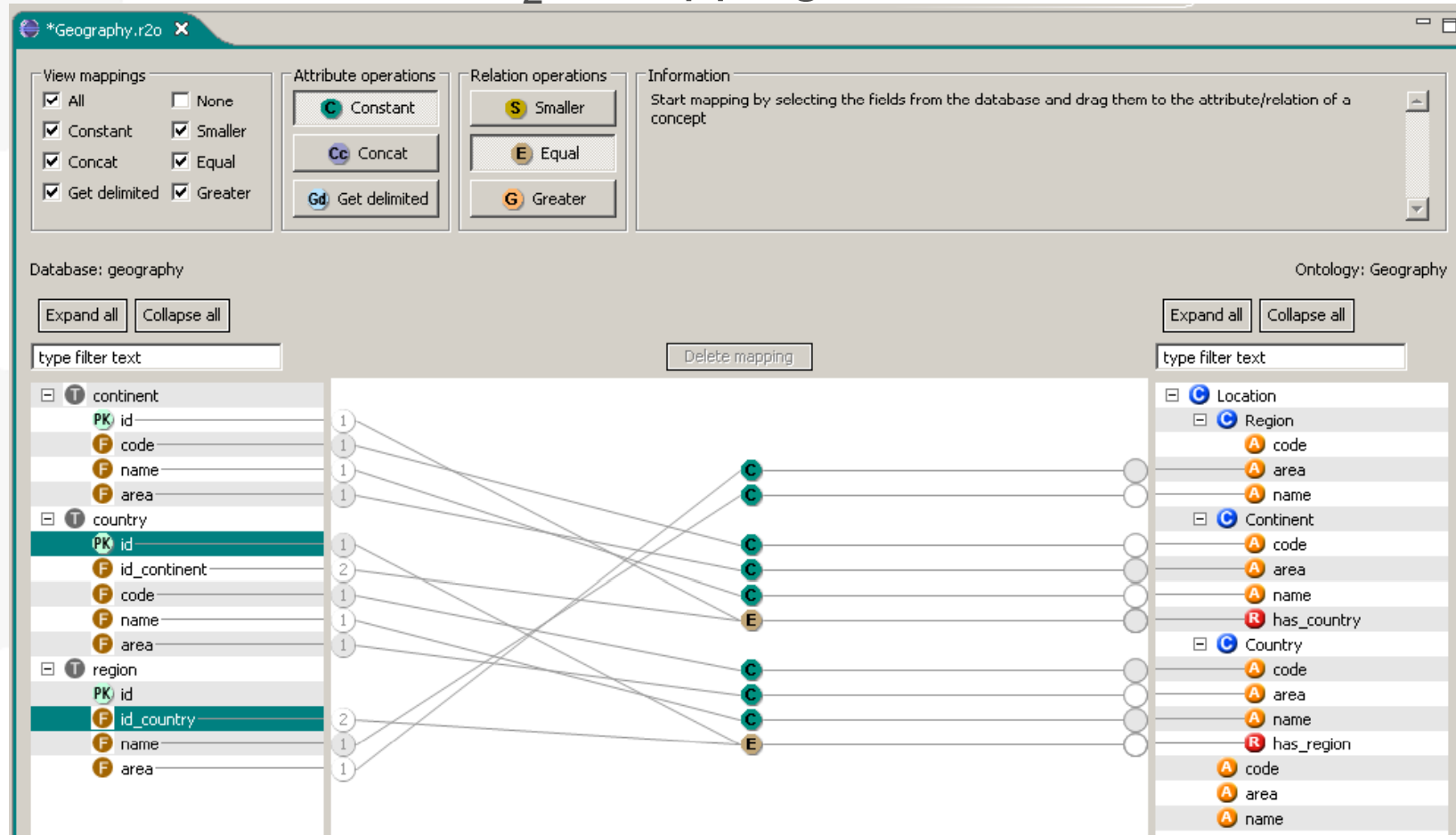

3. Generation of the RDF Data – R₂O & ODEMapster

- R₂O is an extensible, fully declarative language to describe mappings between relational database schemas and ontologies.
- The ODEMapster processor generates Semantic Web instances from relational instances based on the mapping description expressed in the R₂O document



3. Generation of the RDF Data – R₂O & ODEMapster

- Creation of the R₂O Mappings



3. Generation of the RDF Data – R₂O & ODEMapster

```
<conceptmap-def name="http://mccarthy.dia.fi.upm.es/Geography#Region">
  <uri-as>
    <operation oper-id="concat">
      <arg-restriction on-param="string1">
        <has-value>http://mccarthy.dia.fi.upm.es/Geography#Region</has-value>
      </arg-restriction>
      <arg-restriction on-param="string2">
        <has-column>region.id</has-column>
      </arg-restriction>
    </operation>
  </uri-as>
</conceptmap-def>
```

Excerpt of the R₂O document

The screenshot shows the R2O (R2O2) web application interface. The window title is "Geography.r2o". The interface is divided into three main sections:

- Concepts:** A tree view showing the hierarchy of concepts. Under "Location", "Region", "Continent", and "Country" are listed. "Region" is selected.
- Attributes and Relations:** A section for selecting attributes and relations. Under "Selection", "Instances only", "Instances with attributes", "Instances with relations", "Instances with both", and "Custom selection" are listed. "Custom selection" is selected. Under "Attributes and Relations", "code", "area", "name", and "has_region" are listed. "code", "area", "name", and "has_region" are selected.
- RDF output:** A section for the RDF output. It includes an "Execution" section with "Execute query" and "Save output" buttons. Below this, the generated RDF output is displayed in XML format, showing various instances of the "Region" concept, including their area, code, and name.

4. Creation of RDF from geometrical information

NOMBRE	GMLGEOMETRY
Abengibre	(HUGECLOB)
Alatoz	(HUGECLOB)
Albatana	(HUGECLOB)
Balsa de Ves	(HUGECLOB)
Ballester, El	(HUGECLOB)
Alborea	(HUGECLOB)
Alcadozo	(HUGECLOB)
Alcalá del Júcar	(HUGECLOB)

Oracle STO UTIL package

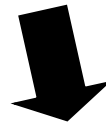


```
SELECT TO_CHAR(SDO_UTIL.TO_GML311GEOMETRY(geometry))
      AS Gml311Geometry
FROM "BCN200"."BCN200_0301L_RIO" c
WHERE c.Etiqueta='Arroyo'
```

```
<gml:Polygon srsName="SDO:8223" xmlns:gml="http://www.opengis.net/gml">
  <gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="," ts=" ">-1.48374108,39.23127677,0 -1.48404
  -1.48480765,39.22531695,0 -1.48544493,39.2231538,0 -1.4858725,39.22212319,0 -1.48608465,39.22141415,0 -1.4860584:
  -1.48421128,39.21319056,0 -1.48390698,39.21064575,0 -1.48429166,39.2094524,0 -1.48529268,39.20490629,0 -1.492506:
  -1.49590016,39.20383639,0 -1.49905691,39.20405732,0 -1.50256876,39.20446292,0 -1.50338941,39.20453654,0 -1.50483:
  -1.51378498,39.2047147,0 -1.51398161,39.20472622,0 -1.5171434,39.20471246,0 -1.51894734,39.20373528,0 -1.5196271:
  -1.52344981,39.20108038,0 -1.52699007,39.19901681,0 -1.5284903,39.19815278,0 -1.53151867,39.19619073,0 -1.532086:
  -1.5329951,39.19479473,0 -1.53398595,39.19503246,0 -1.53537021,39.19528414,0 -1.53607317,39.19544615,0 -1.536914:
  -1.53953498,39.19602121,0 -1.54099994,39.19629185,0 -1.54110394,39.19630216,0 -1.54231647,39.19646151,0 -1.54461:
  -1.54957924,39.19633592,0 -1.55131402,39.1964386,0 -1.55382202,39.19666799,0 -1.55798564,39.19690882,0 -1.559800:
  -1.56633376,39.19750743,0 -1.5703604,39.19765603,0 -1.57231502,39.19777011,0 -1.57278711,39.19790204,0 -1.573636:
  -1.57633787,39.19982863,0 -1.57807687,39.20087703,0 -1.57814542,39.20092292,0 -1.57871557,39.20136237,0 -1.57915:
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  -1.5819531,39.20563664,0 -1.58191475,39.20581637,0 -1.58194513,39.20603299,0 -1.58285235,39.20756676,0 -1.584270:
  -1.58512212,39.21073162,0 -1.58612224,39.21073712,0 -1.58732734,39.211122,0 -1.58732734,39.211122,0 -1.58834122
```

4. Creation of RDF from geometrical information

```
<gml:Polygon srsName="SDO:8223" xmlns:gml="http://www.opengis.net/gml">
  <gml:outerBoundaryIs><gml:LinearRing><gml:coordinates decimal="." cs="," ts=" ">-1.48374108,39.23127677,0 -1.48404
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  -1.48421128,39.21319056,0 -1.48390698,39.21064575,0 -1.48429166,39.2094524,0 -1.48529268,39.20490629,0 -1.492506
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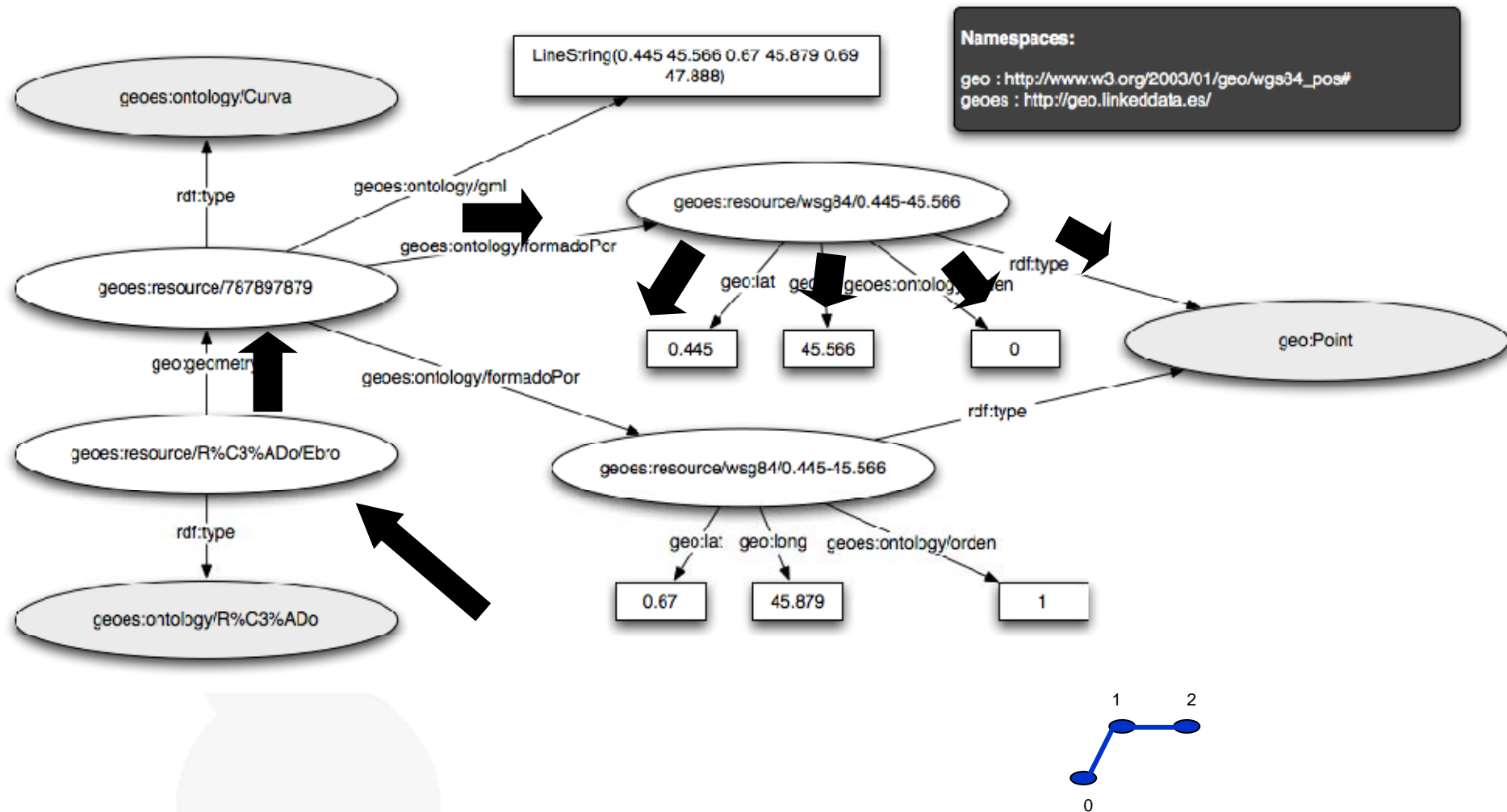


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<rdf:Description rdf:about="http://geo.linkeddata.es/resource/wgs84/39.158523176194414_-1.6341427210305737">
  <geontology:order rdf:datatype="http://www.w3.org/2001/XMLSchema#int">205</geontology:order>
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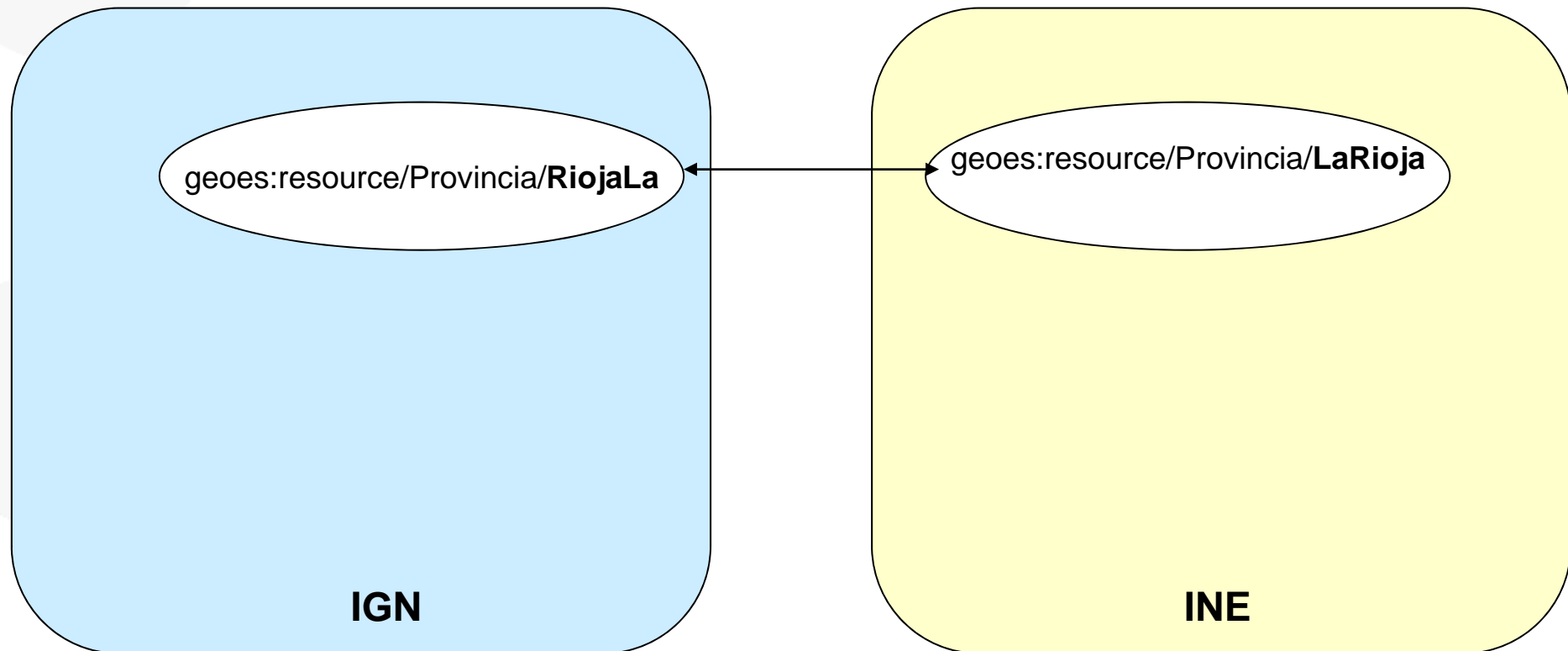
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  <geo:long rdf:datatype="http://www.w3.org/2001/XMLSchema#decimal">-2.6158910085778153</geo:long>
  <geo:lat rdf:datatype="http://www.w3.org/2001/XMLSchema#decimal">38.65501872007066</geo:lat>
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</rdf:Description>

<rdf:Description rdf:about="http://geo.linkeddata.es/resource/wgs84/38.37015012539368_-1.6964507982671462">
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```

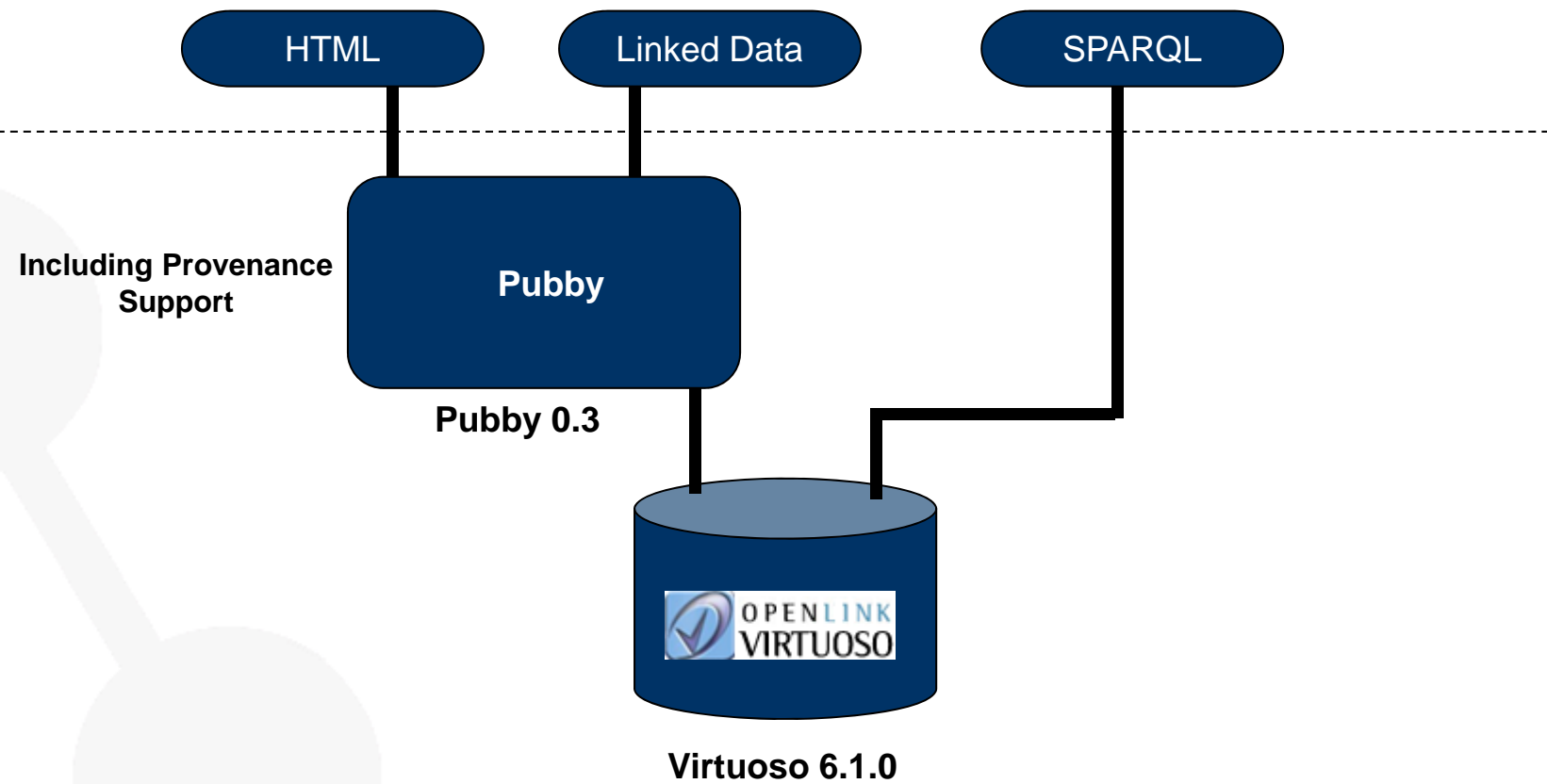
4. Creation of RDF from geometrical information



5. Alignment of the datasets



6. Data publication and visualization



6. Data publication and visualization

Granada at geo.linkdata.es

<http://geo.linkdata.es/resource/ProvinciaGranada>



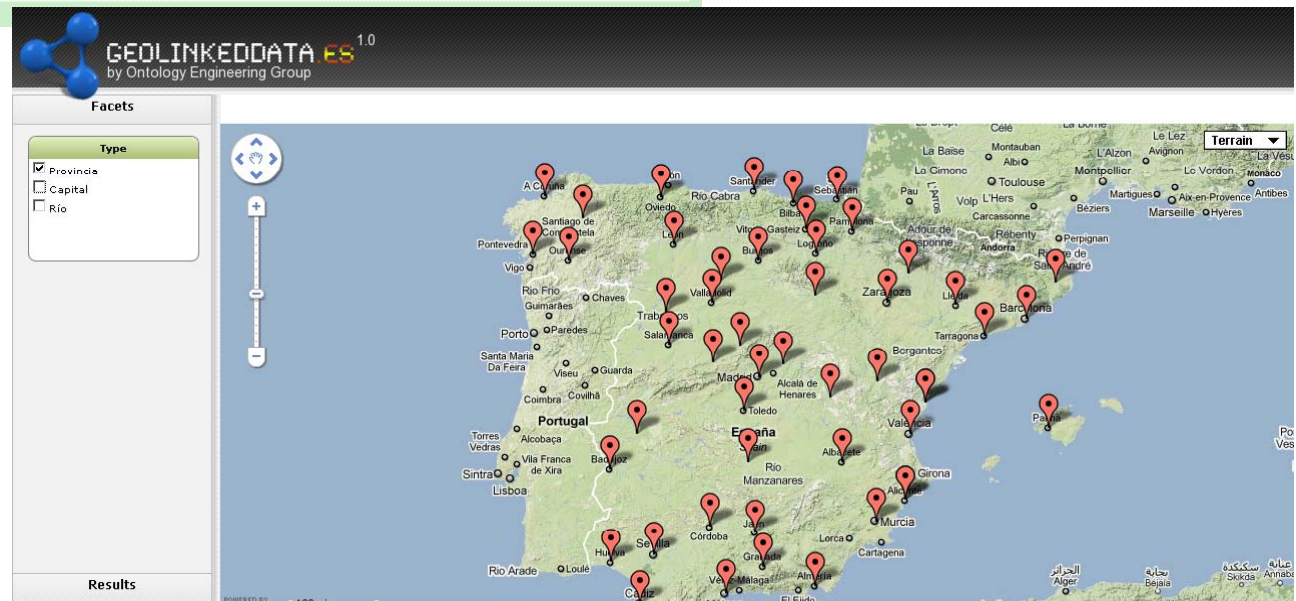
Property	Value
is geoes:esCapitalDe of	■ http://geo.linkdata.es/resource/CapitalGranada
is geoes.formadaPor of	■ http://geo.linkdata.es/resource/Comunidad_AutonomiaAndaluc%C3%ADa
geo:geometry	■ http://geo.linkdata.es/wgs84/37.1793252620624_-3.59704135514161
rdfs:label	■ Granada (en string)
geoes.perteneceA	■ http://geo.linkdata.es/resource/Comunidad_AutonomiaAndaluc%C3%ADa
geoes.tieneCapital	■ http://geo.linkdata.es/resource/CapitalGranada
rdfs:type	■ geoes:Provincia

Metadata

<http://geo.linkdata.es/data/ProvinciaGranada>

rdfs:type	< http://www.w3.org/2004/03/trix/rdfg-1/Graph >
foaf:primaryTopic	< http://geo.linkdata.es/resource/ProvinciaGranada >
dcterms:creator	< http://geo.linkdata.es/provider/ign-e > (more)
dcterms:publisher	< http://geo.linkdata.es >
dc:rights	La información geográfica digital comprendida en el Equipamiento Geográfico de Referencia Nacional (artículo 1.1 de la Orden FOM/956/2008) así como los Metadatos de los datos geográficos y servicios del IGN-CNIG, no requieren la aceptación de licencia y su uso será, en cualquier caso, libre y gratuito, siempre que se mencione al Instituto Geográfico Nacional como propietario de los datos.
dcterms:spatial	< http://geo.linkdata.es/resource/Espa%C3%B1a >
prov:createdBy	Anon_0 (more)

[expand all](#)



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DEMO

<http://geo.linkeddata.es/browser>

Provinces



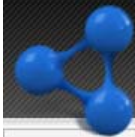

GEOLINKEDDATA.es^{1.0}
 by Ontology Engineering Group
 



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Capital of Province



GEOLINKEDDATA^{ES} 1.0
by Ontology Engineering Group

Beta

Facets

Capas



Estadísticas

Resultados



+

0

-

Estadísticas:

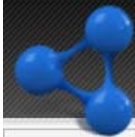
Indice de Producción Industrial
Indice de Producción Industrial
Indice de Desempleo

POWERED BY
Google

100 mi
200 km

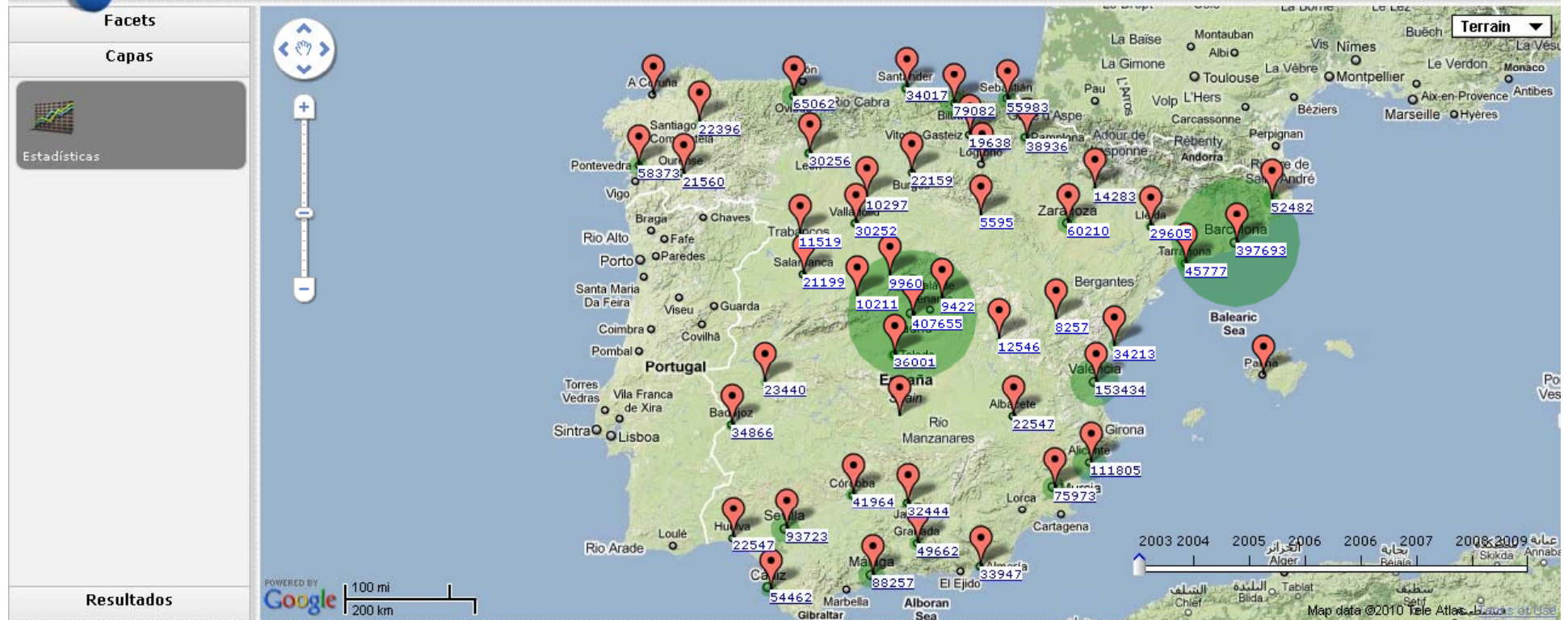
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Provinces – Industry Production Index



GEOLINKEDDATA^{ES} 1.0
by Ontology Engineering Group

Beta



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Beaches



GEOLINKEDDATA ^{ES} 1.0
by Ontology Engineering Group

Beta

Facets

Type

- ☐ Ojo
- ☐ Pantano
- ☐ Piscina
- ☒ Playa
- ☐ Ponor
- ☐ ...

Capas

Resultados



+

-

0

1

2

3

4

5

6

7

8

9

10

11

12

13

14

15

16

17

18

19

20

21

22

POWERED BY
Google

100 mi

200 km

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- Data cleansing
- Interlinking with DBpedia and Geonames
- Include other domains
- Improve faceted browser
- Cover complex geometrical information
 - Point
 - LineString
 - Polygons



Thank you



Geographical Linked Data: a Spanish Use Case

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