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GRADUATE THESIS

Constructing INSPIRE Compliant Ontologies for Geospatial Data

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ΠΤΥΧΙΑΚΗ ΕΡΓΑΣΙΑ

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Επιβλέποντες: Μανώλης Κουμπαράκης, Καθηγητής
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ABSTRACT

Since 2007, the INSPIRE directive has been aiming to create a European Union spatial data infrastructure. This will enable the sharing of environmental spatial information among public sector organizations and better facilitate public access to spatial information across Europe. The spatial information considered under the directive is extensive and includes a great variety of topical and technical themes.

The objective of this thesis is to develop INSPIRE compliant ontologies for datasets that belong to the following INSPIRE themes: Greek Administrative Geography, Public Transport, Public Buildings and Land Use. The first task was to construct four ontologies that contain all information needed to represent data related to each of the themes. The next step was to study each existing ontology, import it to its INSPIRE equivalent and proceed to making changes or expansions wherever it was necessary. Following that process, the Geotriples tool was used to convert the shapefile data to RDF form, again using each ontology. Finally, in order to demonstrate the results the four datasets have been stored in the spatiotemporal RDF store Strabon, and indicative queries where performed against each dataset.

SUBJECT AREA: Semantic Web, AI, Knowledge Technologies

KEYWORDS: Linked open data, Linked Geospatial Data, INSPIRE, RDF/OWL Metadata, SPARQL, GeoSPARQL

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1. INTRODUCTION

The Resource Description Framework (RDF) is a directed, labeled graph data format for representing information (especially metadata) about resources in the Web. Resources can be anything, including documents, people, physical objects, and abstract concepts.

RDF is based on the idea of identifying resources using Web identifiers and describing resources in terms of simple properties and property values. To identify resources, RDF uses Uniform Resource Identifiers (URIs) and URI references (URIrefs). The resources being described have properties which have values, and that resources can be described by making statements, that specify those properties and values.

SPARQL Protocol and RDF Query Language (SPARQL) can be used to express queries across diverse data sources, whether the data is stored natively as RDF or viewed as RDF via middleware. SPARQL contains capabilities for querying required and optional graph patterns along with their conjunctions and disjunctions. SPARQL also supports extensible value testing and constraining queries by source RDF graph. The results of SPARQL queries can be results sets or RDF graphs. The SPARQL query language is designed to meet the use cases and requirements identified by the RDF Data Access Working Group in RDF Data Access Use Cases and Requirements.

Linked data is a new research area which studies how one can make RDF data available on the Web, and interconnect it with other data with the aim of increasing its value for users. The resulting ”Web of data” has recently started being populated with geospatial data. Ordnance Survey is the first national mapping agency that has made various kinds of geospatial data from Great Britain available as open linked data1. Another representative example of such efforts is LinkedGeoData2 where OpenStreetMap data is made available as RDF and queried using the declarative query language SPARQL. Finally, a similar effort is GeoLinked Data3 where geospatial data from Spain is made public using RDF. With the recent emphasis on open government data, some of it encoded already in RDF4, these efforts demonstrate that the development of useful Web applications utilizing geospatial data might be just a few SPARQL queries away.

This recent, pragmatic emphasis on linked geospatial data continues the vision of the Semantic Geospatial Web, first articulated by Max Egenhofer invited GIS researchers to pay special attention to geospatial information on the Web, and contribute to the Semantic Web effort by developing geospatial ontologies, query languages and query processing techniques for geospatial information on the Web, etc.

The Web of data has recently started being populated with geospatial data. A representative example of this trend is project LinkedGeoData where OpenStreetMap data is made available as RDF and queried using SPARQL. Using the same technologies, Ordnance Survey makes available various geospatial datasets from the United Kingdom. The availability of geospatial data in the linked data “cloud” has motivated research on geospatial

extensions of SPARQL. These works have formed the basis for GeoSPARQL, an Open Geospatial Consortium (OGC) standard. In addition, a number of papers have explored implementation issues for such languages.

In the last few years, linked geospatial data has received attention as researchers and practitioners have started tapping the wealth of geospatial information available on the Web. As a result, the linked open data (LOD) cloud has been rapidly populated with geospatial data. For example, Great Britain's national mapping agency, Ordnance Survey, has been the first national mapping agency that has made various kinds of geospatial data from Great Britain available as open linked data.

In Europe a major recent development has been the entering in force of the INSPIRE Directive in May 2007, establishing an infrastructure for spatial information in Europe to support Community environmental policies, and policies or activities which may have an impact on the environment. INSPIRE is based on the infrastructures for spatial information established and operated by the 28 Member States of the European Union. The Directive addresses 34 spatial data themes needed for environmental applications, with key components specified through technical implementing rules. This makes INSPIRE a unique example of a legislative "regional" approach. In this thesis, four INSPIRE-compliant have been created to model datasets that belong to the respective INSPIRE themes:

- Administrative Units
- Transport Networks
- Buildings
- Land Use

Previous work related to this purpose includes the paper "Beyond INSPIRE: an ontology for biodiversity metadata records"[1], written for the Faculdade de Engenharia da Universidade do Porto. In this paper, a preliminary experiment on the use of ontologies for the description of biodiversity datasets is presented. In Geospatial World Forum a presentation is found titled "INSPIRE and Linked Data: Bridging the Gap Part II: Tools for linked INSPIRE data"[2]. Its objective is to expose INSPIRE via GeoSPARQL endpoints, thus making transformation to RDF triples possible with less human effort. Finally, the tool HUMBOLDT Alignment Editor[3] of the HUMBOLDT Harmonisation Toolkit utilizes a user interface that takes as input gml/xml schemata describing datasets, in order to convert them to INSPIRE-compliant.

The rest of this thesis is structured as follows. In Chapter 2 I present the scientific background of this thesis, with a brief reference to elements like RDF and SPARQL, Linked Geospatial Data, GeoSPARQL and INSPIRE. Chapter 3 is dedicated to the implementation of the project, meaning the process of creating INSPIRE-compliant ontologies for linked geospatial data, INSPIRE-compliant datasets and presenting the results. In Chapter 4 there are some conclusions and propositions for future extensions of this work. Finally, the Appendix contains the mapping files used during the implementation.

[1] See `http://dendro.fe.up.pt/pdf/papers/ontocontent2014.pdf`
[2] See `http://www.geospatialworldforum.org/speaker/SpeakersImages/Kostas%20Patroumpas.pdf`
[3] See `http://community.esdi-humboldt.eu/projects/hale/wiki`

2. BACKGROUND

2.1. RDF and SPARQL

RDF is intended for situations in which information about Web resources needs to be processed by applications, rather than being only displayed to people. RDF provides a common framework for expressing this information so it can be exchanged between applications without loss of meaning. Since it is a common framework, application designers can leverage the availability of common RDF parsers and processing tools. The ability to exchange information between different applications means that the information may be made available to applications other than those for which it was originally created [2].

The following illustrates various different uses of RDF, aimed at different communities of practice.

- Adding machine-readable information to Web pages using, for example, the popular schema.org vocabulary, enabling them to be displayed in an enhanced format on search engines or to be processed automatically by third-party applications.
- Enriching a dataset by linking it to third-party datasets. For example, a dataset about paintings could be enriched by linking them to the corresponding artists in Wikidata, therefore giving access to a wide range of information about them and related resources.
- Interlinking API feeds, making sure that clients can easily discover how to access more information.
- Using the datasets currently published as Linked Data, for example building aggregations of data around specific topics.
- Building distributed social networks by interlinking RDF descriptions of people across multiple Web sites.
- Providing a standards-compliant way for exchanging data between databases.
- Interlinking various datasets within an organisation, enabling cross-dataset queries to be performed using SPARQL.

RDF allows us to combine triples from any source into a graph and process it as legal RDF. A large amount of RDF data is available as Linked Data. Datasets are being published and interlinked on the Web using RDF, and many of them offer a querying facility through SPARQL. Examples of such datasets used in the examples above include:

- Wikidata[1], a free, collaborative and multilingual database and ran by the Wikimedia Foundation.
- DBpedia[1], publishing data extracted from Wikipedia infoboxes.
- WordNet[2], a lexical database of English terms, grouped in sets of synonyms, with a range of semantic interrelations. Similar databases exist for other languages.
- Europeana[3], publishing data about cultural objects from a large number of European institutions.
- VIAF[4], publishing data about people, works and geographic places from a number of national libraries and other agencies.

RDF also allows us to make statements about resources. The format of these statements is simple. An RDF statement expresses a relationship between two resources. The subject and the object represent the two resources being related; the predicate represents the nature of their relationship. The relationship is phrased in a directional way (from subject to object) and is called in RDF a property. Because RDF statements consist of three elements they are called triples. Figure 2.1 shows a simple example of triples.

```
1  <Charlemagne> <is a> <emperor>.
2  <Leo III> <is a> <pope>.
3  <Leo III> <has crowned> <Charlemagne>.
4  <Charlemagne> <was crowned on> <Christmas Day, 800>.
```

Figure 2.1: Sample Triples

The same resource is often referenced in multiple triples. In the example above, Leo III is the subject of two triples, and Charlemagne is the subject of two and the object of one triple. This ability to have the same resource be in the subject position of one triple and the object position of another makes it possible to find connections between triples, which is an important part of RDF's power. Three types of RDF data occur in triples: IRIs, literals and blank nodes.

The abbreviation IRI is short for "International Resource Identifier". An IRI identifies a resource. The URLs (Uniform Resource Locators) that people use as Web addresses are one form of IRI. Other forms of IRI provide an identifier for a resource without implying its location or how to access it. The notion of IRI is a generalization of URI (Uniform Resource Identifier), allowing non-ASCII characters to be used in the IRI character string. IRIs can appear in all three positions of a triple.

Literals are basic values that are not IRIs. Examples of literals include strings such as "Charlemagne", dates such as "Christmas Day, 800" and numbers such as "3.14159". Literals are associated with a datatype enabling such values to be parsed and interpreted correctly. Literals may only appear in the object position of a triple. The RDF Concepts

[1]See https://www.wikidata.org/wiki/Wikidata:Main_Page
[1]See http://wiki.dbpedia.org/
[2]See https://wordnet.princeton.edu/
[3]See http://www.europeana.eu/portal/
[4]See https://viaf.org/

document provides a (non-exhaustive) list of datatypes. This includes many datatypes defined by XML Schema, such as string, boolean, integer, decimal and date.

IRIs and literals together provide the basic material for writing down RDF statements. In addition, it is sometimes handy to be able to talk about resources without bothering to use a global identifier. Blank nodes are like simple variables in algebra; they represent something without saying what their value is. Blank nodes can appear in the subject and object position of a triple. They can be used to denote resources without explicitly naming them with an IRI.

A number of different serialization formats exist for writing down RDF graphs. However, different ways of writing down the same graph lead to exactly the same triples, and are thus logically equivalent. Here, the format used for every dataset is the N-Triples. N-Triples is often used for exchanging large amounts of RDF and for processing large RDF graphs with line-oriented text processing tools.

N-Triples provides a simple line-based, plain-text way for serializing RDF graphs. A segment of the land use dataset is represented in N-Triples as shown in figure 2.2:

```
539000 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30300> <http://data.linkedeodata.eu/ontology#region> "01"^^<http://www.w3.org/2001/XMLSchema#string> .
539001 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30301> <http://data.linkedeodata.eu/ontology#region> "85"^^<http://www.w3.org/2001/XMLSchema#string> .
539002 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30302> <http://data.linkedeodata.eu/ontology#region> "01"^^<http://www.w3.org/2001/XMLSchema#string> .
539003 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30303> <http://data.linkedeodata.eu/ontology#region> "85"^^<http://www.w3.org/2001/XMLSchema#string> .
539004 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30304> <http://data.linkedeodata.eu/ontology#region> "04"^^<http://www.w3.org/2001/XMLSchema#string> .
539005 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30305> <http://data.linkedeodata.eu/ontology#region> "04"^^<http://www.w3.org/2001/XMLSchema#string> .
539006 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30306> <http://data.linkedeodata.eu/ontology#region> "07"^^<http://www.w3.org/2001/XMLSchema#string> .
539007 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30307> <http://data.linkedeodata.eu/ontology#region> "01"^^<http://www.w3.org/2001/XMLSchema#string> .
539008 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30308> <http://data.linkedeodata.eu/ontology#region> "01"^^<http://www.w3.org/2001/XMLSchema#string> .
539009 <http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/30309> <http://data.linkedeodata.eu/ontology#region> "01"^^<http://www.w3.org/2001/XMLSchema#string> .
```

Figure 2.2: Sample N-Triples

SPARQL is based on matching graph patterns against RDF graphs. Most forms of SPARQL query contain a set of triple patterns called a basic graph pattern. Triple patterns are like RDF triples except that each of the subject, predicate and object may be a variable. A basic graph pattern matches a subgraph of the RDF data when RDF terms from that subgraph may be substituted for the variables and the result is RDF graph equivalent to the subgraph.

The common query consists of two parts: the SELECT clause identifies the variables to appear in the query results, and the WHERE clause provides the basic graph pattern to match against the data graph. The basic graph pattern in this example consists of a single triple pattern with a single variable (?name) in the object position. Graph pattern matching produces a solution sequence, where each solution has a set of bindings of variables to RDF terms. SPARQL FILTERs restrict solutions to those for which the filter expression evaluates to TRUE [3]. Figure 2.3 shows a simple example of a SPARQL Query.

```
1 PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
2 SELECT ?name
3 WHERE{
4   ?x inspire:nationalLevelName ?name.
5 }
```

Figure 2.3: SPARQL Query Sample

2.2. Linked Geospatial Data, GeoSPARQL

In the context of the open data effort of the UK Government, Ordnance Survey (the national mapping agency for Great Britain) is committed to making publicly available various UK geospatial datasets. Some of these datasets have been made available as linked data (the 1:50,000 Scale Gazetteer, Code-Point Open, and the Administrative geography gazetteer for Great Britain) and can be queried through a SRARQL Endpoint. As an example, the Administrative geography of Great Britain describes the hierarchy of administrative units and the topological relations among them. The corresponding ontology includes classes that represent the administrative units of Great Britain, and properties that describe qualitative topological relations. Two ontologies, the Geometry Ontology and the Spatial Relations Ontology, are used to provide geospatial vocabulary. These ontologies describe abstract geometries and topological (equivalent to RCC-8) relations respectively. Boundary-Line, a polygon dataset of areas defined by electoral and administrative boundaries, has been used to generate the topological relations among the covered areas based on the provided names and boundary information. The resulting dataset has been then combined with addresses, roads, land use, height and other datasets available in RDF.

There has been a number of interesting mashups that have been produced using the above linked data sets. GeoNames[1] is a gazetteer that collects both spatial and thematic information for various placenames around the world. GeoNames data is available through various Web services and is also published as linked data. The placenames in GeoNames are interlinked with each other defining regions that are inside other placenames, neighboring countries or placenames that have certain distance with the underlined placename. GeoNames data is linked to the DB-pedia data and other linked data sources. Beyond names of places in various languages, data stored include latitude, longitude, elevation, population, administrative subdivision and postal codes [4].

Recently, the geospatial semantic web has started to be populated with EO products (e.g., CORINE Land Cover and Urban Atlas published by project TELEIOS3). In general, open EO data that are currently made available by space agencies such as ESA and NASA are not following the linked data paradigm. Therefore, EO data and other kinds of geospatial data that are necessary for a user to satisfy her information needs can only be found in different data silos, where each silo may contain only part of the needed data. Publishing the content of these silos as RDF graphs, enables the development of data analytics applications with great environmental and financial value. With the recent emphasis on open government data in many countries, the development of useful Web applications utilizing EO data and geospatial data in general is just a few SPARQL queries away.

Geospatial data in general and EO data in particular, can come in vector or raster form and are usually accompanied by metadata. Vector data, available in formats such as ESRI shapefiles, KML, and GeoJSON documents, can be accessed either directly or via Web Services such as the OGC Web Feature Service[2] or the query language of a geospatial DBMS. Raster data, available in formats such as GeoTIFF, Network Common Data Form (netCDF), Hierarchical Data Format (HDF), can be accessed either directly or via Web Services such as the OGC Web Coverage Processing Service (WCS) or the query language of an array DBMS, e.g., the array-query language SciQL4. Metadata about EO data are encoded in various formats ranging from custom XML schemas to domain

[1] See `http://www.geonames.org/`

[2] See `http://www.opengeospatial.org/standards/wfs`

specific standards like the OGC GML Application schema for EO products and the OGC Metadata Profile of Observations and Measurements. Figure 2.4 shows the GeoNames, as a part of the Linked Open Data cloud diagram.

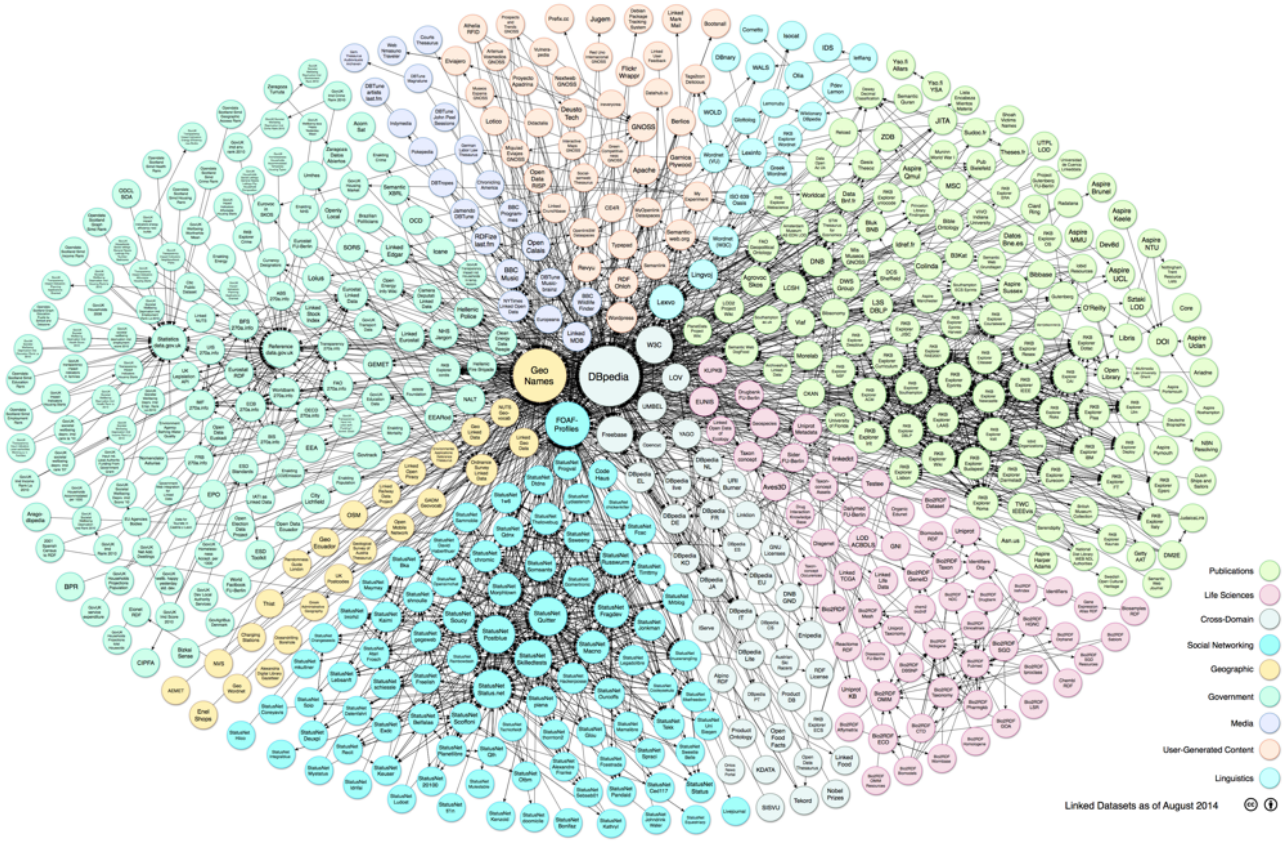

Figure 2.4: The Linking Open Data cloud diagram [1]

The query language stSPARQL is an extension of SPARQL1.1 with functions that take as arguments spatial terms and can be used in the SELECT, FILTER, and HAVING clause of a SPARQL 1.1 query. A spatial term is either a spatial literal (i.e., a typed literal with datatype strdf:geometry or its subtypes), a query variable that can be bound to a spatial literal, the result of a set operation on spatial literals (e.g., union), or the result of a geometric operation on spatial terms (e.g., buffer). In stSPARQL we use functions from the OpenGIS Simple Feature Access standard (OGC-SFA) for querying stRDF data. This standard defines relational schemata that support the storage, retrieval, query and update of sets of simple features using SQL.

GeoSPARQL is a recently proposed OGC standard for a SPARQL-based query language for geospatial data expressed in RDF. GeoSPARQL defines much of what is required for such a query language by providing vocabulary (classes, properties, and functions) that can be used in RDF graphs and SPARQL queries to represent and query geospatial data. GeoSPARQL follows the modular design typical of OGC standards and consists of the following components:

- Core. This component defines top level classes that provide users with vocabulary for modeling geospatial information. The classes offered by this component are geo:SpatialObject and geo:Feature. geo:SpatialObject is the top class defined by

GeoSPARQL and has as instances everything that can have a spatial representation. geo:Feature is the class of all the features and is the superclass of all classes of features users might want to define. geo:SpatialObject is a superclass of geo:Feature and geo:Geometry.

- Geometry extension. This component provides vocabulary for asserting and querying information about geometries. A crucial design decision of GeoSPARQL is to use literal values to encode geometries as a single unit (similar to stSPARQL), and introduce two RDF datatypes geo:wktLiteral and geo:gmlLiteral for these literals. The extension is parameterized by the serialization standard of OGC to be used for encoding geometry literals (WKT[1] or GML[2]) and the version of the relevant standard. Literals of type geo:wktLiteral consist of an optional URI identifying the coordinate reference system followed by the WKT encoding of a geometry. Similarly, literals of type geo:gmlLiteral consist of a valid GML element that implements a subtype of type GM Object. The geometry extension defines the class geo:Geometry as the superclass of all geometry classes. It also defines properties for representing metadata of geometries (e.g., geo:dimension that captures the topological dimension), for associating features with geometries (e.g., geo:hasGeometry) and for associating geometries with their literal serializations (geo:asWKT and geo:asGML). In addition, this extension defines functions for performing non-topological operations on geometries.

- Topology vocabulary extension. This component provides vocabulary for asserting and querying topological relations between spatial objects. The extension is parameterized by the family of topological relations supported. These can be the topological relations for simple features (e.g., geo:sfTouches), the Egenhofer relations (e.g., geo:ehMeet), or the RCC-8 relations (e.g., geo:rcc8ec). An important point here is that these topological relations can relate not just geometries but also features. They can be asserted by a triple of an RDF graph (e.g., dbpedia:Athens geo:sfWithin dbpedia:Greece) but also used in a triple pattern of a SPARQL query (e.g., ?x geo:sfWithin dbpedia:Greece). The query rewriting extension discussed below provides a mechanism to derive topological relations between features from the relationships that are satisfied by their corresponding geometries. In this way GeoSPARQL caters to users that are more interested in qualitative spatial reasoning applications but also to more traditional GIS or DBMS users interested in geospatial computations.

- Geometry topology extension. This component provides a collection of Boolean functions that operate on geometries and check whether given topological relationships hold for these geometries. The extension is parameterized by the family of topological relations used, the serialization standard for the geometries and the version of the serialization standard. The extension defines Boolean functions that correspond to each of the topological relations of the topology vocabulary extension presented above (simple features, Egenhofer, and RCC-8) and can be applied to geometry literals encoded in WKT or GML (e.g., the Boolean function geof:ehMeet that corresponds to the Egenhofer topological relation geo:ehMeet mentioned above). In addition, the extension defines the general function geof:relate that can be used to specify any topological relationship one might be interested in that can be expressed using the dimensionally extended 9-intersection model.

[1] See `http://www.geoapi.org/3.0/javadoc/org/opengis/referencing/doc-files/WKT.html`
[2] See `http://www.opengeospatial.org/standards/gml`

- RDFS entailment extension. This component provides a mechanism for realizing the RDFS entailments that follow from the geometry class hierarchies that are defined by the WKT and GML standards used as serializations of geometry literals, and the properties introduced by GeoSPARQL. If this extension is supported by a system then the system should use an implementation of RDFS entailment to allow the derivation of new triples from those already in a graph. An example is the triple ex:f1 rdf:type geo:Feature that follows from the triples ex:f1 geo:hasGeometry ex:g1 and geo:hasGeometry rdfs:domain geo:Feature. This extension is parameterized by the family of topological relations used, the serialization standard for the geometries and the version of the serialization standard.

- Query rewrite extension. This component provides a collection of RIF rules that derive any of the topological relations of the topology vocabulary extension between two pairs of spatial objects (features or geometries), whenever the corresponding Boolean function of the geometry topology extension holds between the corresponding geometry literals. As an example, the component has a RIF rule named geor:sfWithin that can be used to derive the triple dbpedia:Athens geo:sfWithin dbpedia:Greece from the fact that the Boolean function geof:sfWithin returns true when evaluated with arguments the WKT encodings of the geometry literals corresponding to features dbpedia:Athens and dbpedia:Greece. The extension is parameterized by the family of topological relations used, the serialization standard for the geometries and the version of the serialization standard. The name of the extension (query rewrite) comes from one of its possible implementations which would be to re-write a given SPARQL query with a triple pattern involving, e.g., a topological relation between two features, into one that checks whether the corresponding Boolean function holds between the geometry literals corresponding to the features.

2.3. INSPIRE

2.3.1. Administrative Units

Administrative units are included in Annex I, which means that they are considered as reference data, i.e. data that constitute the spatial frame for linking to and/or pointing at other information that belong to specific thematic fields such as the environment and socio-economic statistics, alongside many others.

The core element of the AdministrativeUnits application schema is the administrative unit represented by a surface geometry. In accordance with the Directive, each administrative unit carries a unique identifier. Administrative units are further described by their geographical name, the country of location, the national administrative code, and the hierarchical level within the administrative structure of the country. This information is completed, if available, with the life cycle information (when the administrative unit has been inserted or changed in the dataset, and when it has been (if ever) superseded or retired in the spatial data set), the name of the corresponding national level and the residence of the administrative authority.

The administrative division of the Members States follows a hierarchical structure where the lowest level units (often communes) are united in higher level units (like provinces, counties, etc) that compose other units at a higher level. It must be ensured that an administrative unit of an upper level is composed of one or more administrative units of a lower level. Lowest level administrative units are further characterised by their geometry and, where available, by the corresponding local administrative unit code. A special spatial object type called condominium has been introduced for describing independent administrative areas that are administered by two or more countries.

Administrative units are separated by administrative boundaries that are specified as lines. As mandatory properties they carry a unique identifier, information on the country, the administrative hierarchic level and their own geometry. These are complemented, when available, with the legal and technical status of the boundary and the life cycle information [5].

2.3.2. Transport Networks

INSPIRE Directive (2007/2/EC, 14.03.2007) defines the spatial data theme Transport Networks as:

> “Road, rail, air and water transport networks and related infrastructure. Includes links between different networks. Also includes the trans-European transport network as defined in Decision 1692/96/EC of the European Parliament and of the Council of 23 July 1996 on Community guidelines for the development of the trans-European transport network and future revisions of that Decision.”

The transport component should comprise of an integrated transport network, and related features, that are seamless within each national border. In accordance with Article 10 of the INSPIRE Directive, national transport networks may also be seamless at European level, i.e. connected at national borders. Transportation data includes topographic features that are related to transport by road, rail, water, and air. It is important that the

features form networks where appropriate, and that links between different networks are established, i.e. multi-modal nodes, especially at the local level, in order to satisfy the requirements for intelligent transport systems such as location based services (LBS) and telematics. The transport network should also support the referencing of transport flows to enable the navigation services.

The elements in the network are handled as nodes, links, aggregated links, areas and points. In addition, the individual transport links can be combined to form transport link sequences or further – the combination of both can be used to form the transport link sets.

The data specification includes three types of geometry: (a) (topographic) area objects, (b) centerline objects and (c) point objects. The types (a) and (b) may be alternative representations of the same real world phenomena about which the user can associate their own information (objects). The type (c) is, apart from network nodes, only included in the specification for marker posts. The basic spatial representation type is 2D vector [6].

2.3.3. Buildings

Building data is a key theme for environmental studies. On one hand, buildings are the places where people live, work and spend more of their time and where they should be ensured good quality of habitat and protection from risks (flood, fire, earthquake, …) and from pollutions (noise, air pollution, …). Buildings by themselves may deserve protection because of their historical or architectural interest. On the other hand, buildings and their inhabitants are consuming natural resources (heating, land, transport, construction material) and there is clear need to promote more sustainable buildings and to control urban spreading. This data specification addresses requirements related to European reporting, such as the Noise Directive, the Air Quality Directive, the Energy Performance of Building Directive and the Population and Housing Census Directive. The Flood Directive and the project of Soil Directive have also been taken into account.

Building data exist with various levels of detail both in geometry and in semantics. For example, there are representations of buildings and constructions as points, surfaces or solids. The 2D surface representation is the most frequent, the building having been captured e.g. by its foot print or roof edge or envelope. The 3D representations of buildings are generally described using the well-defined levels of detail of the CityGML OGC standard.

All these various representations have their interest and their limits. For instance, 3D data offer a wonderful tool to design and to communicate about urbanism projects but are far from being accepted by any kind of software. Another example is about the level of detail of the geometric representation: whereas detailed geometry of buildings may be necessary for local use, a more generalised geometry that implies smaller volume of data and so shorter time for computation is generally more suitable for larger areas of interest.

The data model offers a flexible approach by allowing multiple representations of buildings and constructions, through a set of four profiles with different levels of detail both in geometry and semantics.

The core profiles contain the requirements to be included in the implementing rule. They

contain feature types building and building part and a limited set of attributes mainly related to temporal aspects (construction, renovation and demolition dates), physical information (height, number of floors, elevation) and the classification of buildings according to their physical aspect and current use [7].

- The Buildings2D profile includes various geometrical representations of buildings as 2D or 2,5D data.
- The Buildings3D profile has same semantic content as the Buildings2D profile and allows in addition, the geometric representation of buildings in any of the four levels of detail of City GML.

The extended profiles contain the recommendations to provide more detailed information about theme buildings. In addition to building and building part, the main features represented are other constructions, building units and installations.

- The BuildingsExtended2D profile is a semantic extension of Buildings2D profile with additional thematic attributes (material of construction, official area or value, connection to utility networks…), classes (building units, installations, other constructions) and references to other data (like cadastral data and addresses).
- The BuildingsExtended3D profile is an extension of the Buildings3D profile for rich 3D representations at different levels of details. It includes the possibility to represent many building components, such as the building boundaries (wall, roof …), the openings (doors – windows) and building interior (rooms, internal installations) and the textures associated with the main feature types. It also contains all the semantic information of extended 2D profile.

2.3.4. Land Use

In the INSPIRE directive, Land Use is defined as Territory characterised according to its current and future planned functional dimension or socio-economic purpose (e.g. residential, industrial, commercial, agricultural, forestry, recreational). It is the description of land in terms or its socio-economic and ecological purpose. The inland water bodies as well as coastal waters are considered within the connected piece of land and planning of the use of sea and the use of seabed has been taken into consideration.

Land Use is itself split up into two different types:

The Existing Land Use (current land use in the above definition), which objectively depicts the use and functions of a territory as it has been and effectively still is in real life. Geographical data-sets that provide Land Use information, at the time of observation, are modeled according to three application schemas:

(a) organized as a partition (in the mathematical sense) of a given area. Each element of the partition is homogeneous regarding the functional use of land. (ExistingLandUse application schema),

(b) organized as a set of discrete observation points informing on the functional use at the exact location and/or at its surrounding at the time of observation, (SampledExistingLandUse application schema),

(c) organized as a set of pixels informing on the functional use (GriddedExistingLandUse application schema)

The Planned Land Use or PLU (future planned land use in the above definition), which corresponds to spatial plans, defined by spatial planning authorities, depicting the possible utilization of the land in the future. Planned land use is regulated by spatial planning documents elaborated at various levels of administration. Land Use regulation over a geographical area is in general composed of an overall strategic orientation, a textual regulation and a cartographic representation. Spatial planning documents result from the spatial planning process, once adopted and therefore which third parties must conform with. The scope of the INSPIRE Land Use Data Specification is giving the exact spatial dimension of all the elements a spatial plan is composed of. Planned Land Use application schema is mainly based on ZoningElement that depicts the zoning defined by spatial planners and SupplementaryRegulation that enables to inform on regulations that superimpose on the zoning [8].

3. IMPLEMENTATION

3.1. Creating INSPIRE-compliant Ontologies for linked geospatial data

In this section, I present the procedure of constructing INSPIRE-compliant ontologies. In each subsector, one of the four ontologies is thoroughly explained, using figures and description to demonstrate the existing INSPIRE properties used and the new ones added. Every property is mentioned with its name and role, as well as derivation. I also provide some UML diagrams to present the various class extensions.

3.1.1. Greek Administrative Geography Ontology

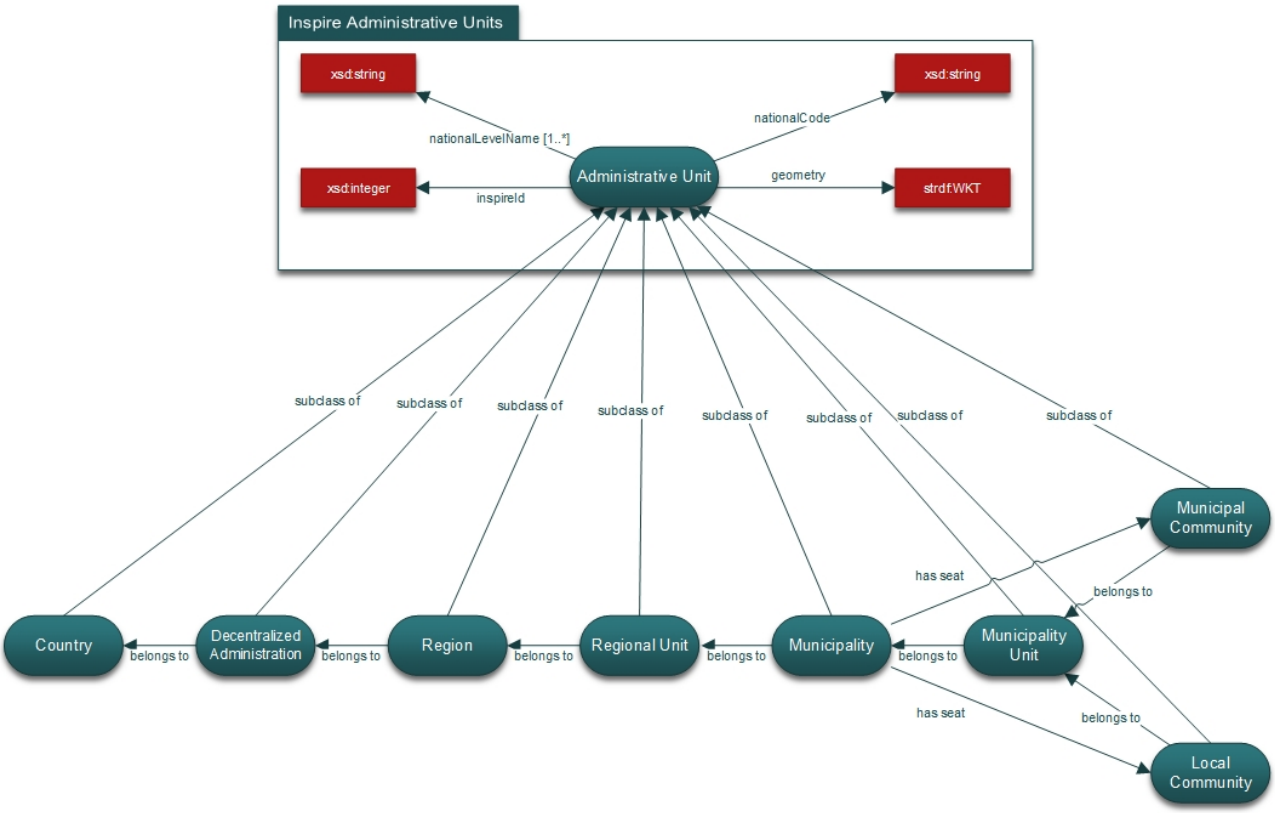

Figure 3.1: GAG Ontology

The Administrative Units Inspire data specification establishes two application schemas: AdministrativeUnits and MaritimeUnits. The spatial object types in the AdministrativeUnits schema use the GeographicalName type from the Geographical Names package and refers to the Base Types package to use the Identifer type from the GCM.

AdministrativeUnit is the key spatial object type for representing the units of division at all levels of the administrative hierarchy. Each single unit (i.e. instance of AdministrativeUnit spatial object type) belongs to exactly one level of the respective national hierarchy.

Usually, administrative units from a higher level aggregate the units at lower level of administrative hierarchy. As this division of territory is not always strictly hierarchical and can be derived from the geometry, semantic relationships between the units of subsequent upper and lower levels were introduced.

Here, the feature type class “AdministrativeUnit” of the AdministrativeUnits schema has been extended, as shown in Figure 3.1, in order to describe the administrative system of Greece, according to an OWL ontology for the Kallikratis plan [9].

Classes

Every administrative unit is represented by a subclass of AdministrativeUnit:

- Country
- Decentralized Administration
- Region
- Regional Unit
- Municipality
- Municipal Unit
- Municipal Community
- Local Community

The above list of administrative units gives us also the hierarchical organization of these units except for Municipal Community and Local Community which belong to the same administrative level.

Properties

Object Properties

The basic property for describing the hierarchical administrative organization of Greece is:

- *belongs to*
  For example, we can say that a region belongs to a decentralized administration, which in turn belongs to Greece. This property is irreflexive, asymmetric and transitive.

Another object property is:

- *has seat*
  This property connects a municipality with a municipal or local community.

Data Properties

The Kallikratis ontology provides the official name of each unit, its population and its geographical boundaries. So, the following properties are included:

- *has geometry*
  This property is covered by the object property “geometry” provided by the Inspire data specification which contains the geometric representation of border line.
- *has official name*
  This property is covered by the data property “nationalLevelName” provided by the Inspire data specification which contains an official national geographical name.
- *has code*
  This property is covered by the object property “nationalCode” provided by the Inspire data specification which contains a thematic identifier corresponding to the national administrative codes defined in each country.
- *inspireId*
  This property is used as proposed by the Inspire theme as a unique object identifier.
- *has population*
  This property has been added as a functional attribute with a non-negative integer as value type.

3.1.2. Public Transport Ontology

The Common Transport Elements application schema covers elements that are shared by subthemes Road, Rail, Cable, Water and Air. These subthemes have been modelled as separate application schemas within the Transport Networks theme.

Many of the common transport elements are specializations of common definitions for networks and network elements available in the GNM. Elements in networks are handled as nodes, links, aggregated links, areas and points. Road Node class represents a point spatial object that is used to either represent connectivity between two road links or to represent a significant spatial object such as a services station or roundabout. A collection of transport link sequences and or individual transport links that has a specific function or significance in a transport network is represented by Transport link set.

Transport Property is a reference to a property that falls upon the network. This property can apply to the whole of the network element it is associated with or - for linear spatial objects - be described using linear referencing.

Here, the feature type classes “RoadNode” and “TransportProperty” of the Common Transport Elements schema have been extended, as shown in Figure 3.2. Also, various enumerations have been added [10].

Classes

RoadNode class has been extended by Stop. Under class Stop the following classes have been added:

- MetroStop
- SuburbanRailwayStop
- TramStop
- TrolleyBusStop

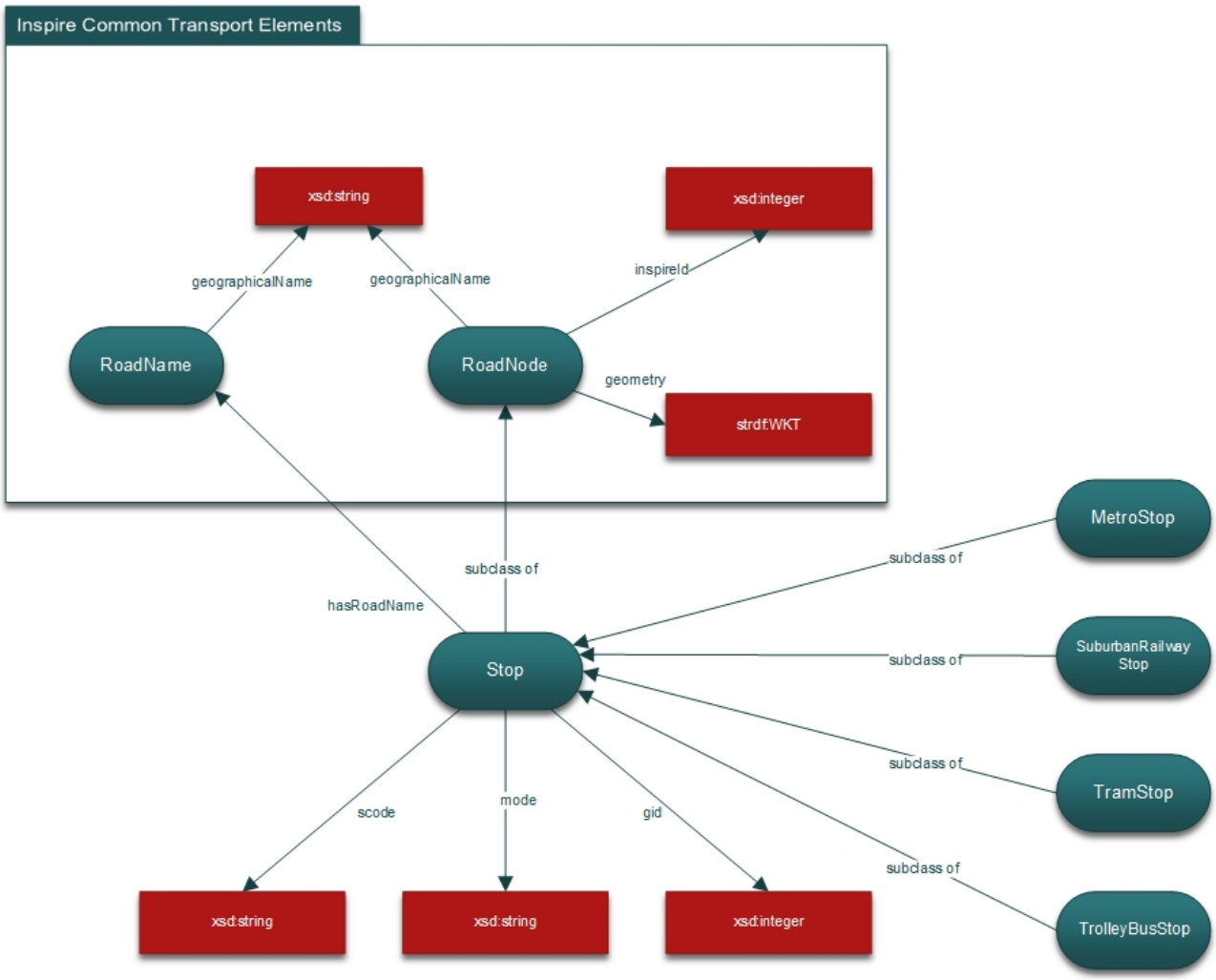

Figure 3.2: Public Transport Ontology 1

Properties

Object Properties

- *street*
  In order to access the name of a stop's street an object property has been added, called "hasRoadName", connecting the class Stop with the existing class RoadName, which in turn has a "geographicalName" data property with the official geographical street name.

Data Properties

The Public Transport ontology provides the official name and the geographical point of each stop. So, the following properties are included:

- *has geometry*
  This property is covered by the object property “geometry” provided by the Inspire data specification which contains the geometric representation of a stop.
- *full name*
  This property is covered by the data property “geographicalName” provided by the Inspire data specification which contains an official geographical name.
- *gid*
  This property has been added as an attribute with a non-negative integer as value type, representing the geographical id.
- *inspireId*
  This property is used as proposed by the Inspire theme as a unique object identifier.
- *mode*
  This property has been added as an attribute with a string as value type, representing the type of the stop (one of the four subclasses of class Stop).
- *scode*
  This property has been added as an attribute with a string as value type.

Every enumeration (except Day) is represented by a subclass of TransportInformation, as shown in Figure 3.3:

- Accessibility
- Administration Direction
- Disembarking Type
- Embarking Type
- Exception Type
- Fare Type
- Itinerary Type
- Payment Method
- Precision
- PWSN Boarding
- Stop Type
- Transport Type
- Transportation Clearance

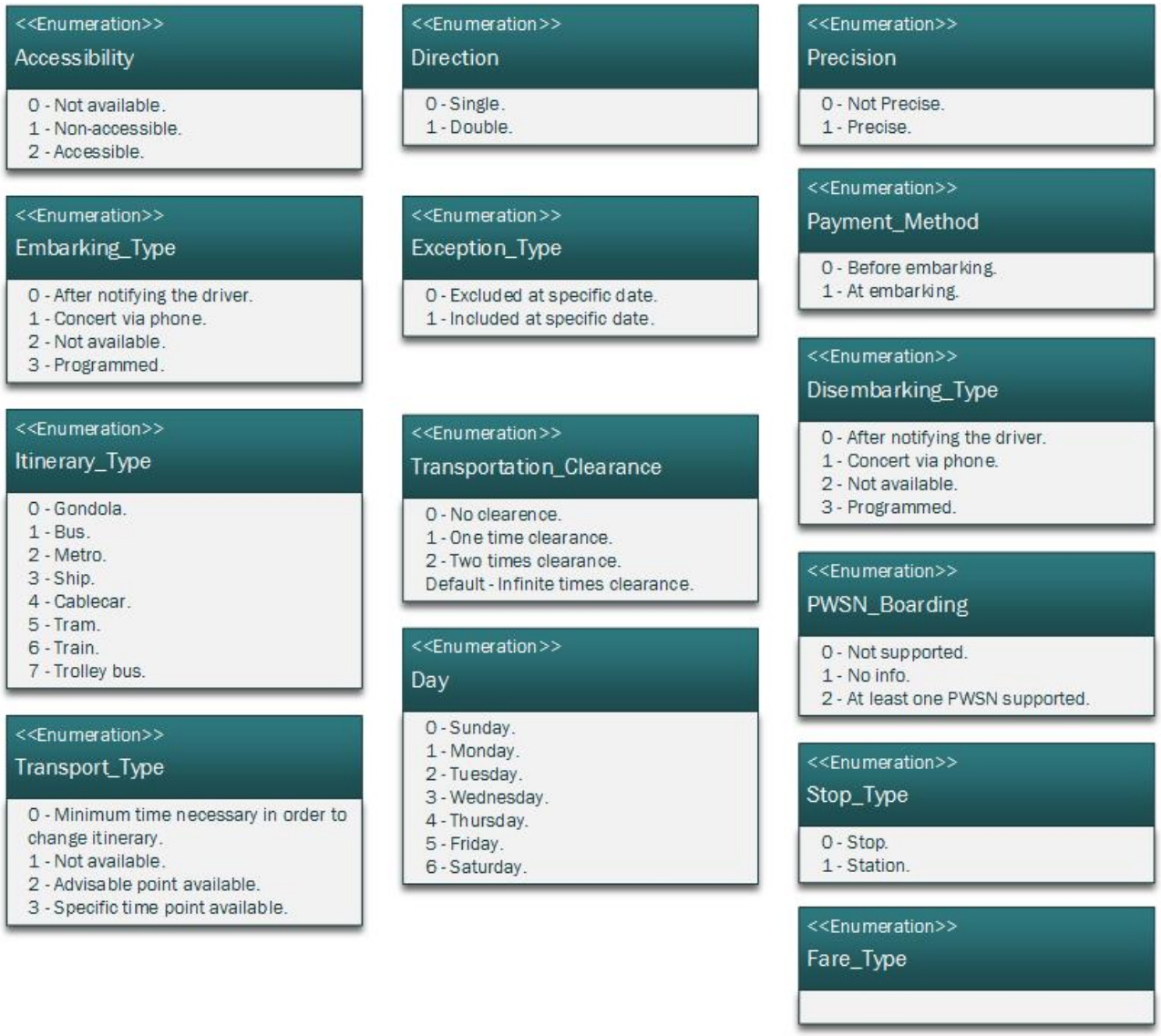

Figure 3.3: Public Transport Enumeration UML Diagram

Finally, class TransportProperty has been extended, as shown in Figure 3.4, by the following classes:

- Calendar
- CalendarException
- Entity
- Fare
- Frequency
- Itinerary
- Programme
- Route
- StopTime

- Transfer
- Zone

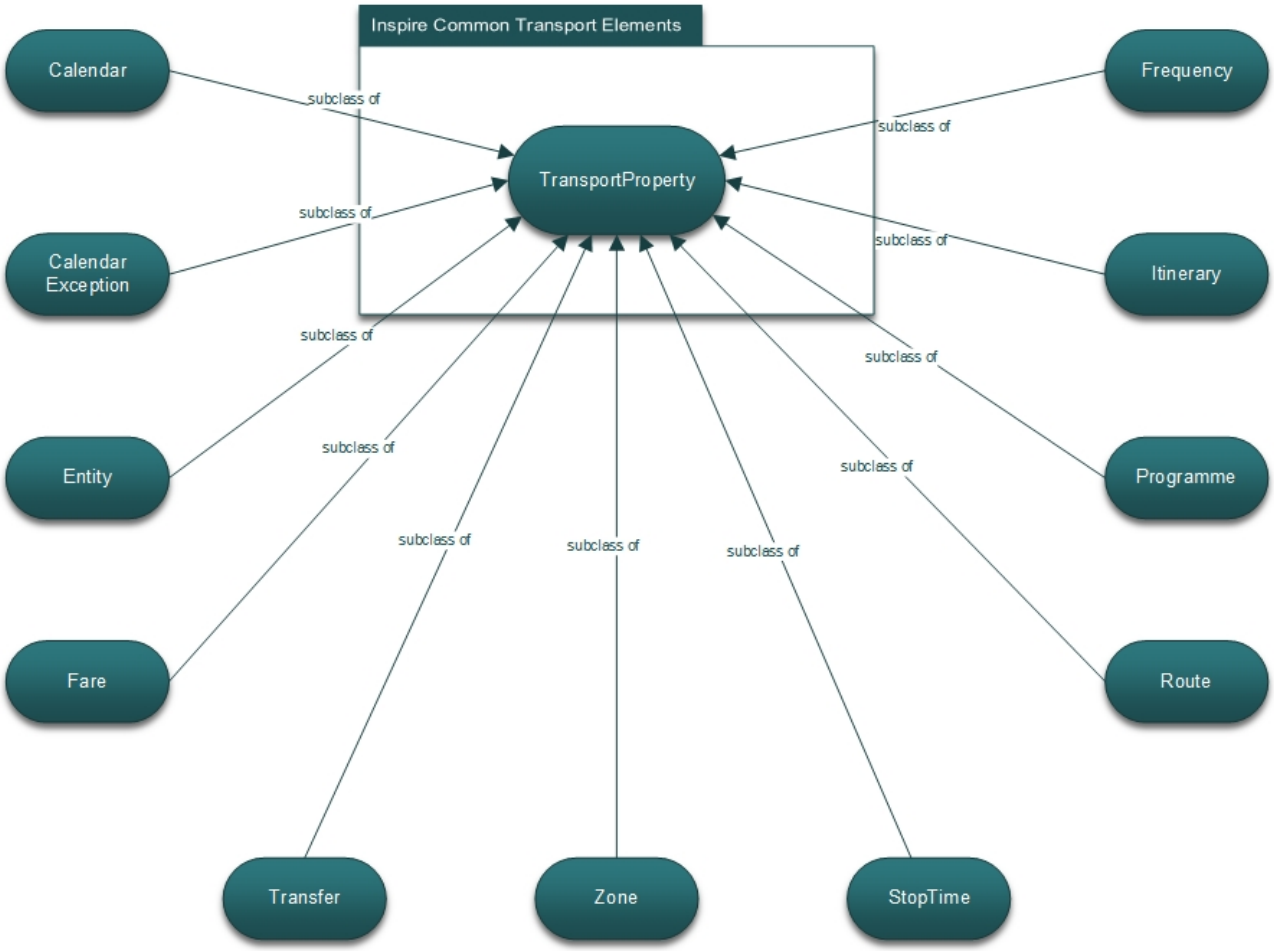

Figure 3.4: Public Transport Ontology 2

3.1.3. Public Buildings Ontology

Buildings Base application schema is an abstract application schema that describes the feature types, data types and code lists that are common to all the four instantiable application schemas, namely 2D, 3D, extended2D and extended3D.

It addresses mainly the basic normative semantics and includes in addition a data type about the 2D geometric representation of buildings that is used by all the four instantiable application schemas.

Here, the code list class “CurrentUseValue” of the main types of the Building Base schema has been extended in order to describe the various Greek public services, according to an OWL ontology for public buildings [11].

Every public service is represented by a subclass of Service, which extends the code list CurrentUseValue, as shown in Figure 3.5:

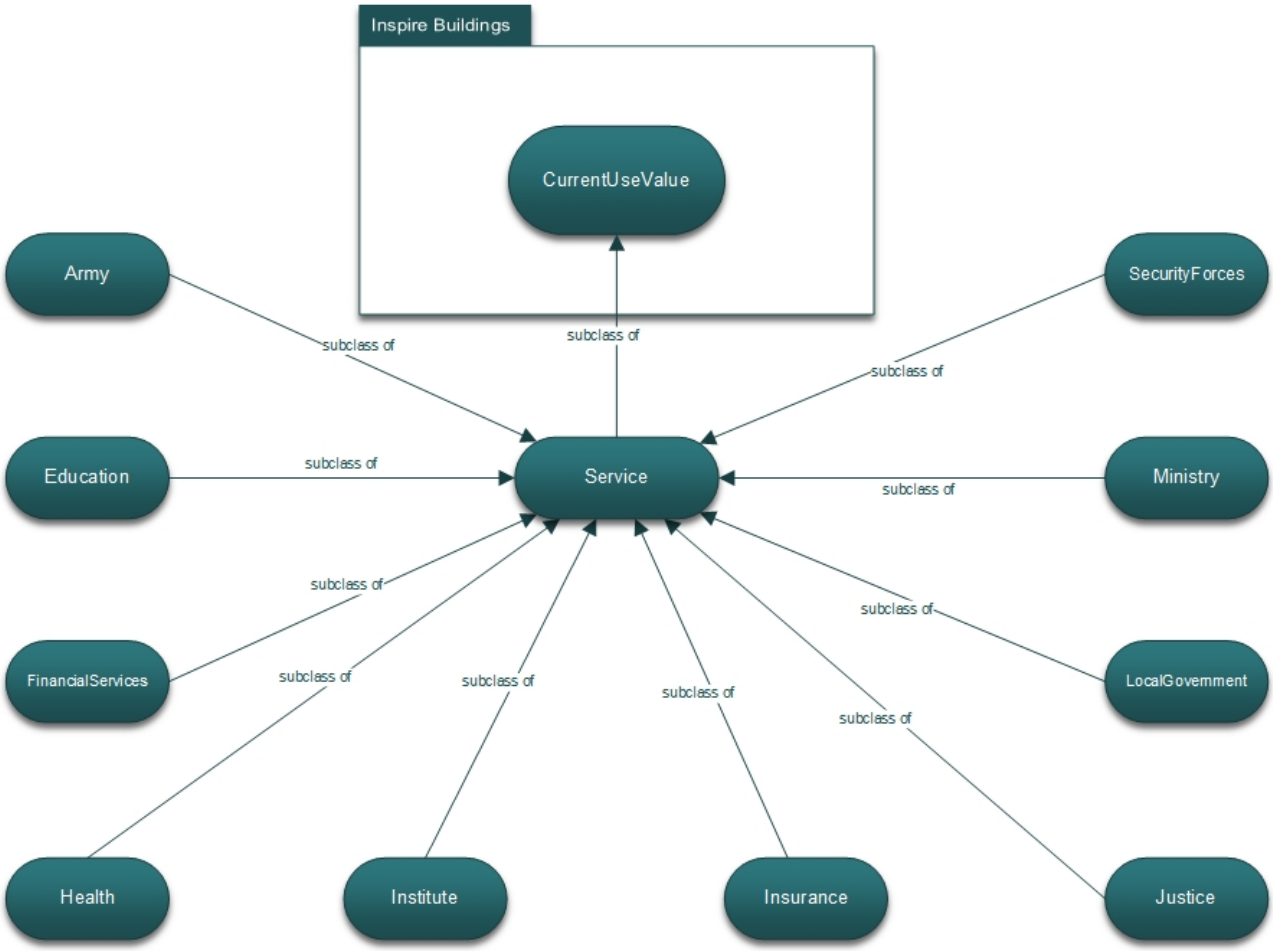

Figure 3.5: Public Buildings Ontology 1

- Army
- Education
- Financial Services
- Health
- Institute
- Insurance
- Justice
- Local Government
- Ministry
- Security Forces

Abstract Construction is an abstract spatial object type grouping the semantic properties of buildings, building parts and of some optional spatial object types that may be added in order to provide more information about the theme Buildings.

Abstract Building is an abstract spatial object type grouping the common semantic properties of the spatial object types Building and BuildingPart. A Building is an enclosed

construction above and/or underground, used or intended for the shelter of humans, animals or things or for the production of economic goods. A building refers to any structure permanently constructed or erected on its site.

Building and Building Unit Info is an abstract spatial object type grouping the additional properties that are common to Building, Building Part and BuildingUnit. Here, the class “Public Building” has been added as an extension of both feature types Building2DExtended and Building3DExtended, in order to describe Greek public buildings specifically, as shown in Figure 3.6.

Properties

Data Properties

The Buildings ontology provides the official name of each unit and its location details. So, the following properties are included:

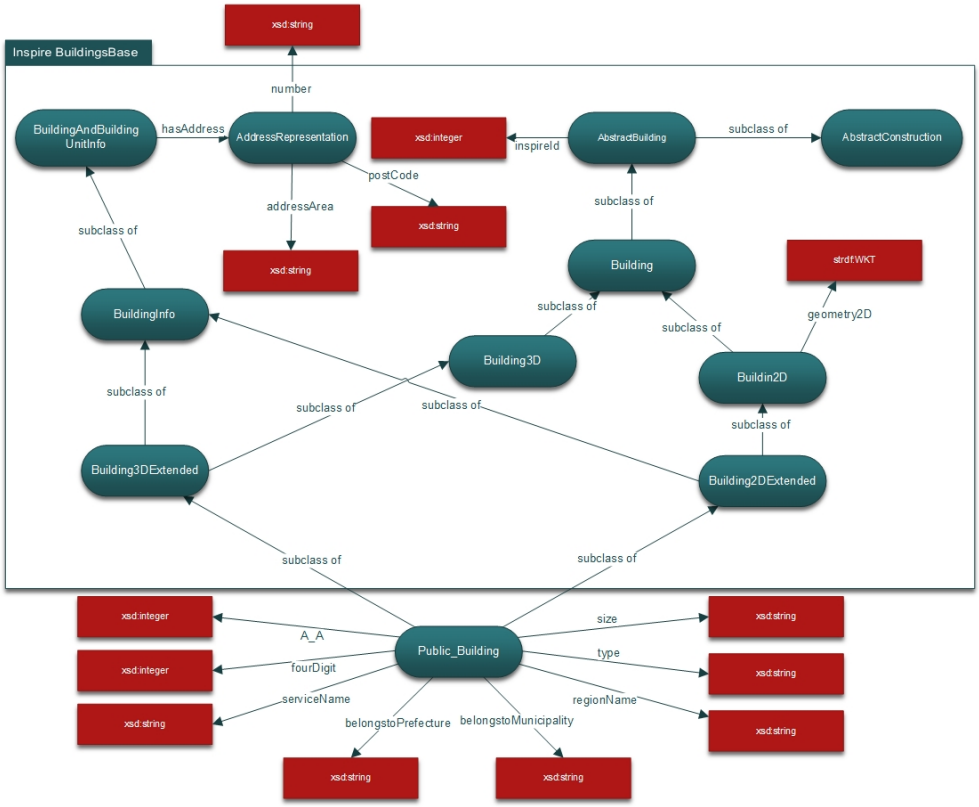

Figure 3.6: Public Buildings Ontology 2

- *address, number, pc*
  These properties are covered by the object property “hasAddress” provided by the Inspire data specification, in the Building and Building Unit Info feature type. hasAddress connects the building with the “AddressRepresentation” class, which includes the attributes “addressArea” and “postCode”. An extra attribute “number” have been added in order to store the address number separately.
- *has geometry, LAT, LNG*
  These properties are covered by the object property “geometry2D” provided by the Inspire data specification which contains the geometric representation of a building.
- *inspireId*
  This property is used as proposed by the Inspire theme as a unique object identifier.
- *size, type*
  These two properties had been added as data attributes with a string as value type, in order to store the extra information about the size of a building and the type of service it currently provides.
- *region name, service name, belongs to municipality, belongs to prefecture*
  These four properties had been added as data attributes with a string as value type, in order to store the extra information about a public building.
- *A A, fourDigit*
  These two properties had been added as data attributes with an integer as value type.

3.1.4. Land Use Ontology

In this INSPIRE data specification creates an application schema (named Land Use) that defines feature types but is as open ended as possible with respect to particular classification systems. This approach assures that a wide range of data based on different land use classification systems can co-exist in INSPIRE, as long as these systems are sufficiently well documented. The application schema provides mechanisms to document several classification systems [12]. Figures 3.7, 3.8 and 3.9 shows the extention of the classes Gridded Land Use, Sampled Land Use and Existing Land Use.

Properties

Object Properties

- *hasGeometry*
  This property is covered by the object property “geometry” provided by the Inspire data specification which contains the geometric representation of border line.

Data Properties

- *CODE, hasCode Level1, hasCode Level2, hasCode Level3*
  These properties are added so that each instance can be recognized as one of the subclasses of code list Land Use Classification Value. CODE includes a three digit code with that purpose and each digit has been attributed at its corresponding code level.

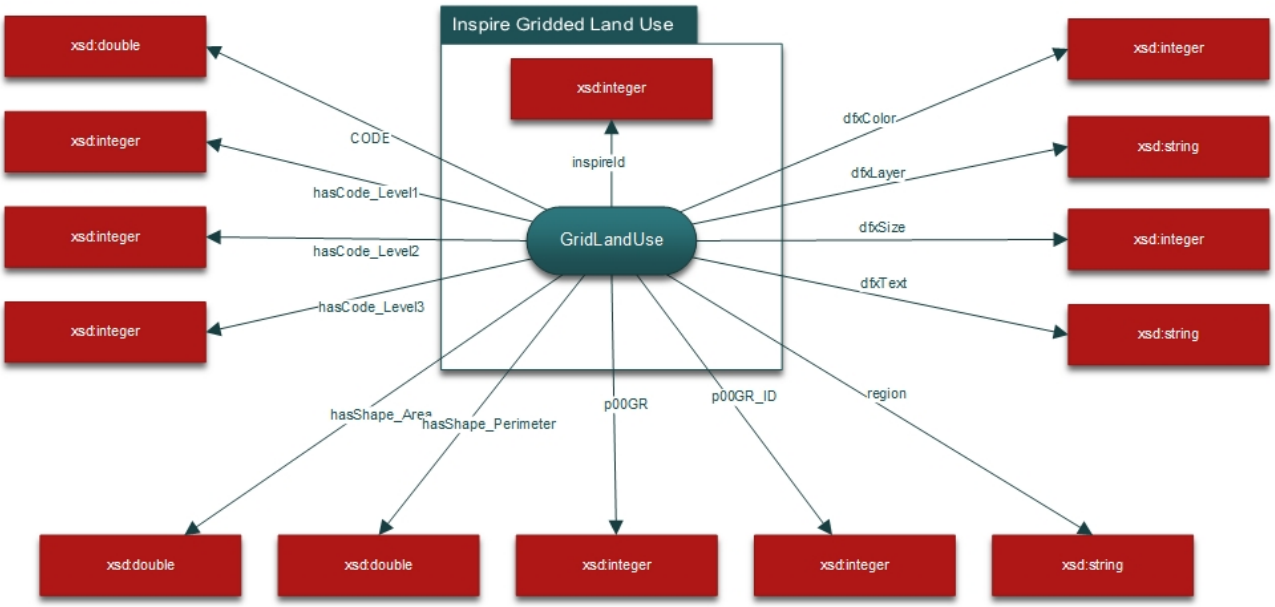

Figure 3.7: Gridded Land Use Ontology

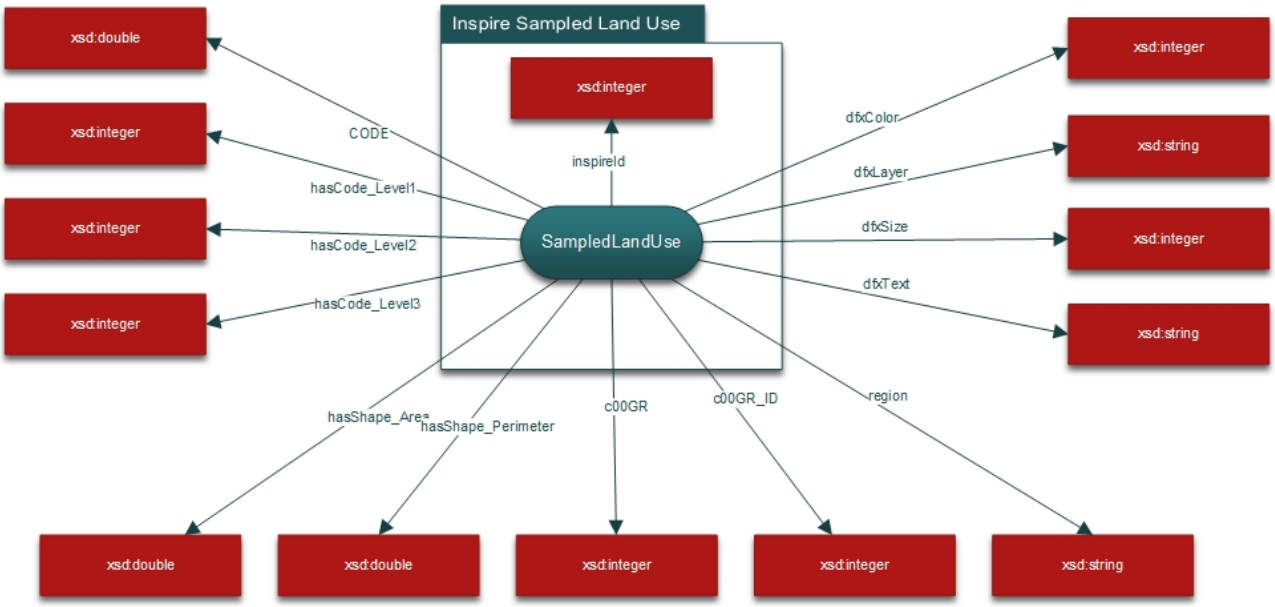

Figure 3.8: Sampled Land Use Ontology

- *hasShape Area, hasShape Length, hasShape Perimeter*
  These properties have been added in order to access specific geographical information explicitly.
- *inspireId*
  This property is used as proposed by the Inspire theme as a unique object identifier.
- *dfxColor, dfxLayer, dfxSize, dfxText*
  These properties have been added in order to store dfx information.
- *c00GR, c00GR ID, p00GR, p00GR ID, fNode, tNode, lPoly, rPoly*
  These properties had been added as data attributes with an integer as value type.

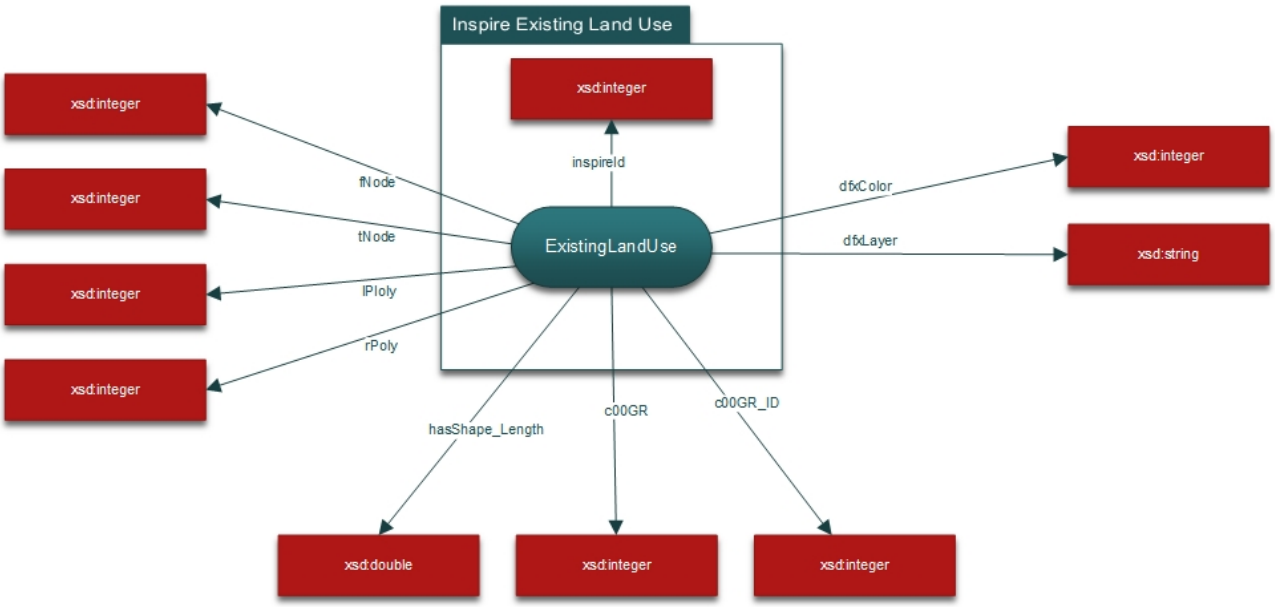

Figure 3.9: Existing Land Use Ontology

Land Use Classification Value is a list of land use categories to be used in INSPIRE Land Use and agreed at a national or local level. This CodeList is empty in the INSPIRE context and here has been extended, according to an OWL ontology intended to cover Greek land use specifications, as shown in the UML diagrams below, in Figures 3.10, 3.11, 3.12, 3.13 and 3.14:

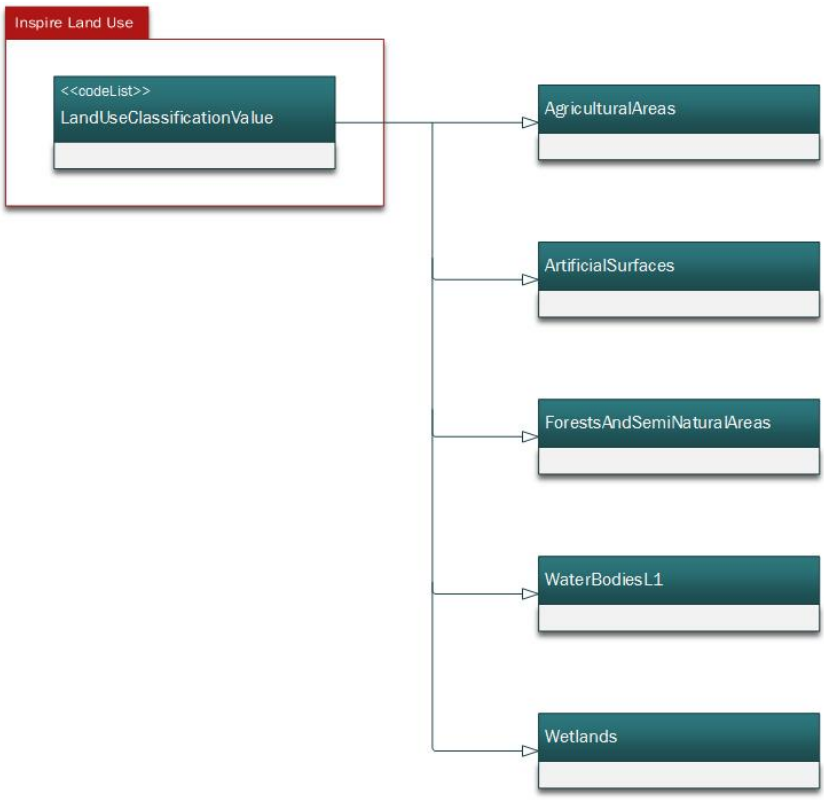

Figure 3.10: Land Use UML Diagram 1

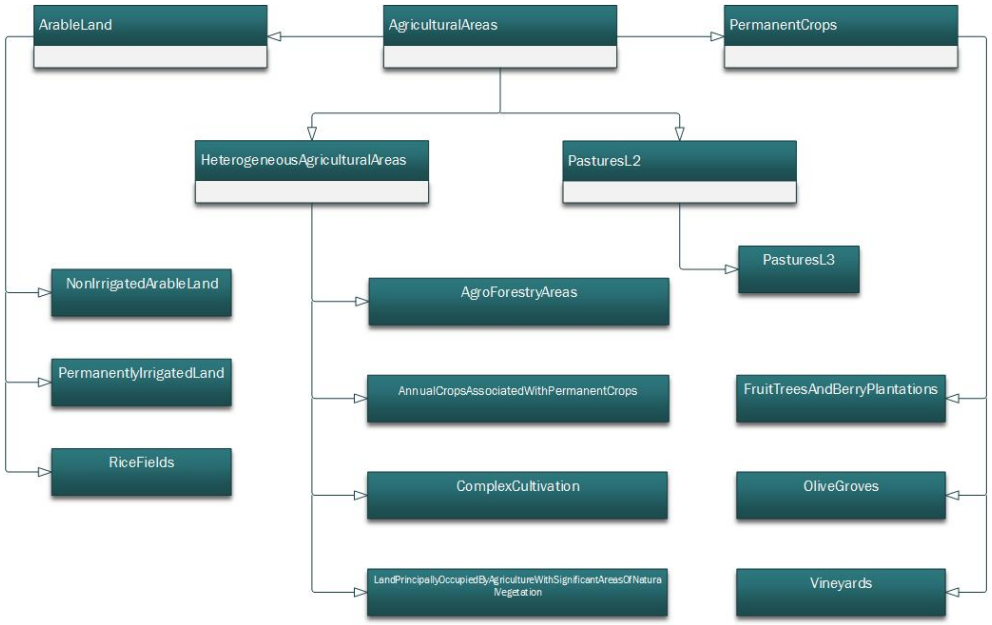

Figure 3.11: Land Use UML Diagram 2

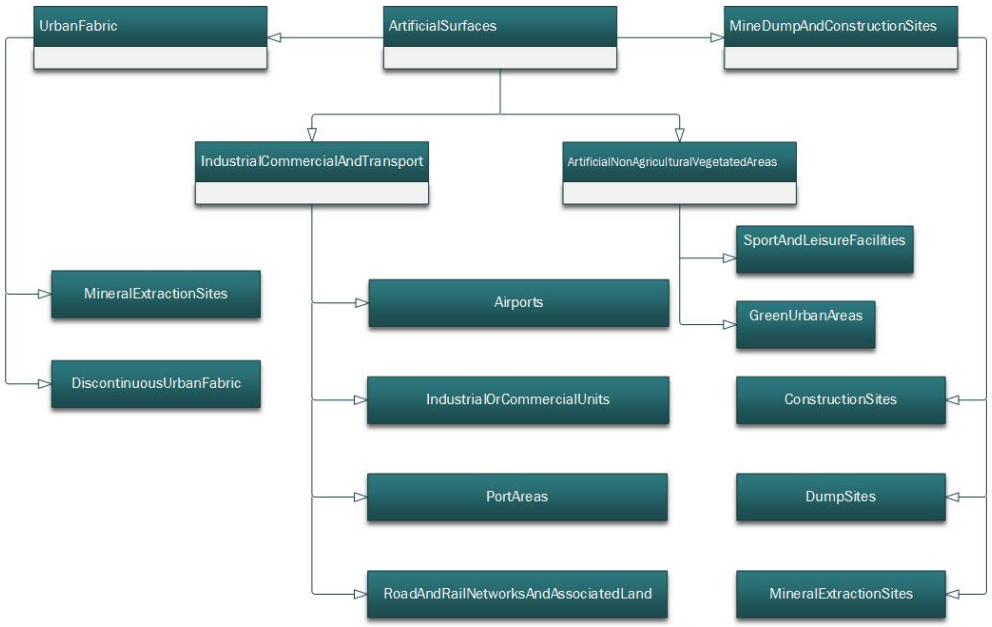

Figure 3.12: Land Use UML Diagram 3

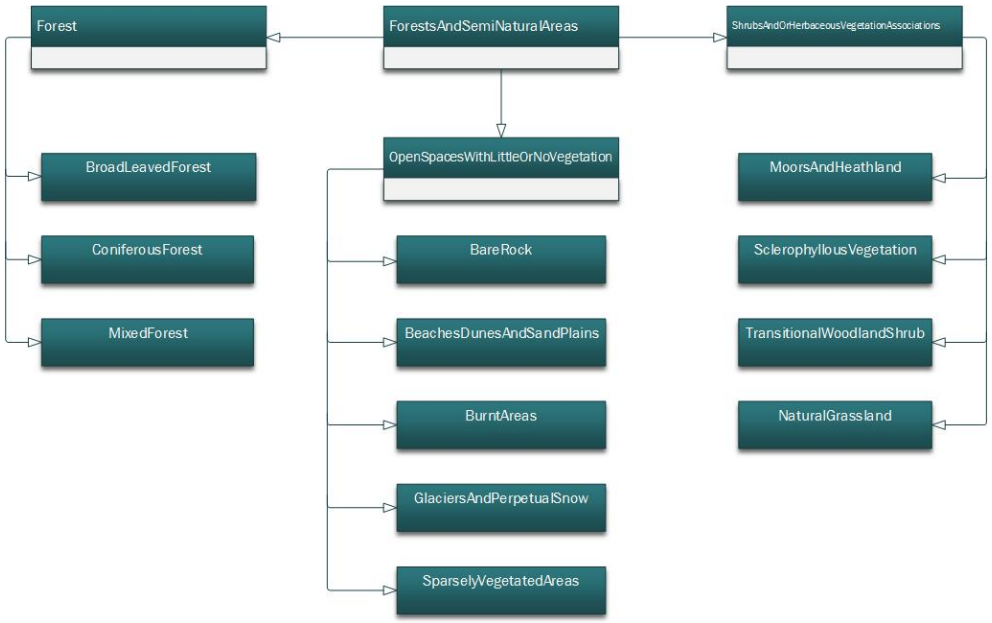

Figure 3.13: Land Use UML Diagram 4

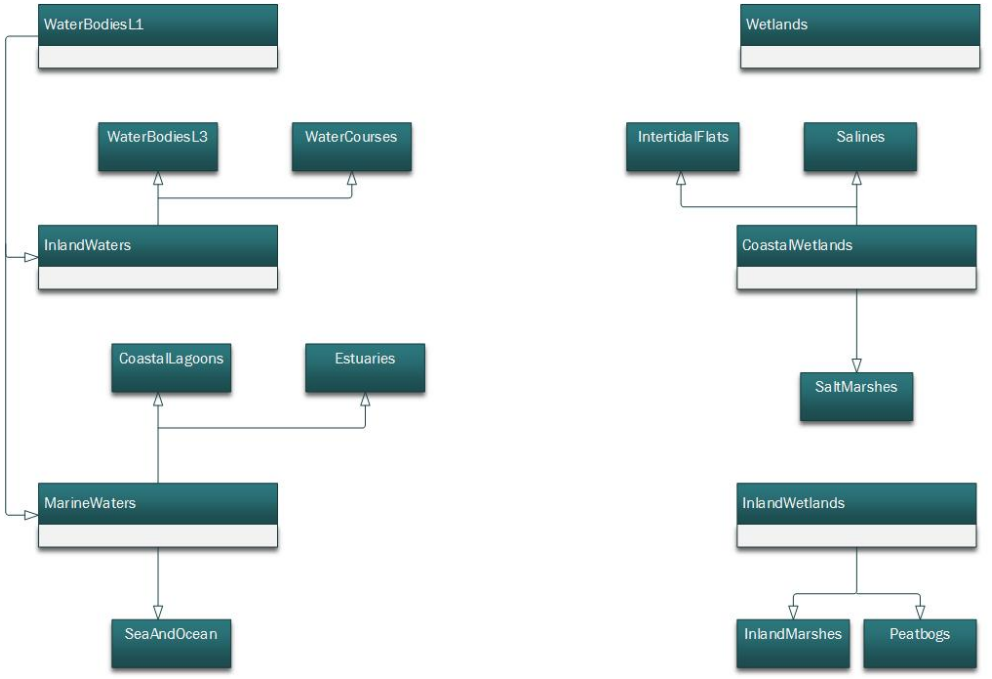

Figure 3.14: Land Use UML Diagram 5

3.2. Creating INSPIRE-compliant datasets

Automating the process of publishing linked geospatial data has not been addressed yet. For example, in the wildfire monitoring and management application that was developed in TELEIOS, custom Python scripts were used for publishing all necessary data as linked data. For this reason, the tool GeoTriples[1] was designed and implemented, in the context of the EU FP7 project LEO5.GeoTriples allows for the transformation of EO data and geospatial data in various formats, such as data stored in spatially-enabled relational databases and raw files, into RDF graphs. GeoTriples goes beyond the state of the art by extending the R2RML mapping language to be able to deal with the specificities of geospatial data. GeoTriples is a semi-automated tool that allows for the publication of geospatial information into an RDF graph using the state of the art vocabularies like GeoSPARQL, but at the same time it is not tightly coupled to a specific vocabulary. The publishing process comprises three steps. First, GeoTriples generates automatically R2RML mappings for publishing data that reside in spatially-enabled databases and raw files(e.g., ESRI shapefiles). Afterwards, the user may edit these mappings according to her needs (e.g., utilize a different vocabulary) and finally GeoTriples processes these mappings for producing an RDF graph [13].

Strabon 3.0[2] is a fully-implemented, open-source, storage and query evaluation system for stRDF/stSPARQL and the corresponding subset of GeoSPARQL. We concentrate on stSPARQL only, but given the similarities with GeoSPARQL, the applicability to it is immediate. Strabon has been implemented by extending the widely-known RDF store Sesame[3]. Sesame was chosen because of its open-source nature, layered architecture, wide range of functionalities and the ability to have PostGIS, a spatially enabled DBMS, as a backend to exploit its variety of spatial functions and operators. Strabon is implemented by creating a layer that is included in Sesame's software stack in a transparent way so that it does not affect its range of functionalities, while benefitting from new versions of Sesame.

Strabon 3.0 uses Sesame 2.6.3 and comprises three modules: the storage manager, the query engine and PostGIS. The storage manager utilizes a bulk loader to store stRDF triples using the "one table per predicate" scheme of Sesame and dictionary encoding. For each redicate table, two B+ tree two-column indices are created. For each dictionary table a B+ tree index on the id column is created. All spatial literals are also stored in a table with schema geo values (id int, value geometry, srid int). Each tuple in the geo values table has an id that is the unique encoding of the spatial literal based on the mapping dictionary. The attribute value is a spatial column whose data type is the PostGIS type geometry and is used to store the geometry that is described by the spatial literal. The geometry is transformed to a uniform, user-defined CRS and the original CRS is stored in the attribute srid. Additionally, a B+ tree index on the id column and an R-tree-over-GiST spatial index on the value column are created.

Query processing in Strabon is performed by the query engine which consists of a parser, an optimizer, an evaluator and a transaction manager. The parser and the transaction manager are identical to the ones in Sesame. The optimizer and the evaluator have been implemented by modifying the corresponding components of Sesame as described below.

[1] See `http://sourceforge.net/projects/geotriples/`
[2] See `http://www.strabon.di.uoa.gr/`
[3] See `http://rdf4j.org/`

The query engine works as follows. First, the parser generates an abstract syntax tree. Then, this tree is mapped to the internal algebra of Sesame, resulting in a query tree. The query tree is then processed by the optimizer that progressively modifies it, implementing the various optimization techniques of Strabon. Afterwards, the query tree is passed to the evaluator to produce the corresponding SQL query that will be evaluated by PostgreSQL. After the SQL query has been posed, the evaluator receives the results and performs any post-processing actions needed. The final step involves formatting the results. Besides the standard formats offered by RDF stores, Strabon offers KML and GeoJSON encodings, which are widely used in the mapping industry [14].

The process that took place in order to produce Inspire-compliant Datasets, using the existing ones(GAG [15], Public Transpot [16], Public Buildings [17], Land Use [18]) was as shown in Figure 3.15:

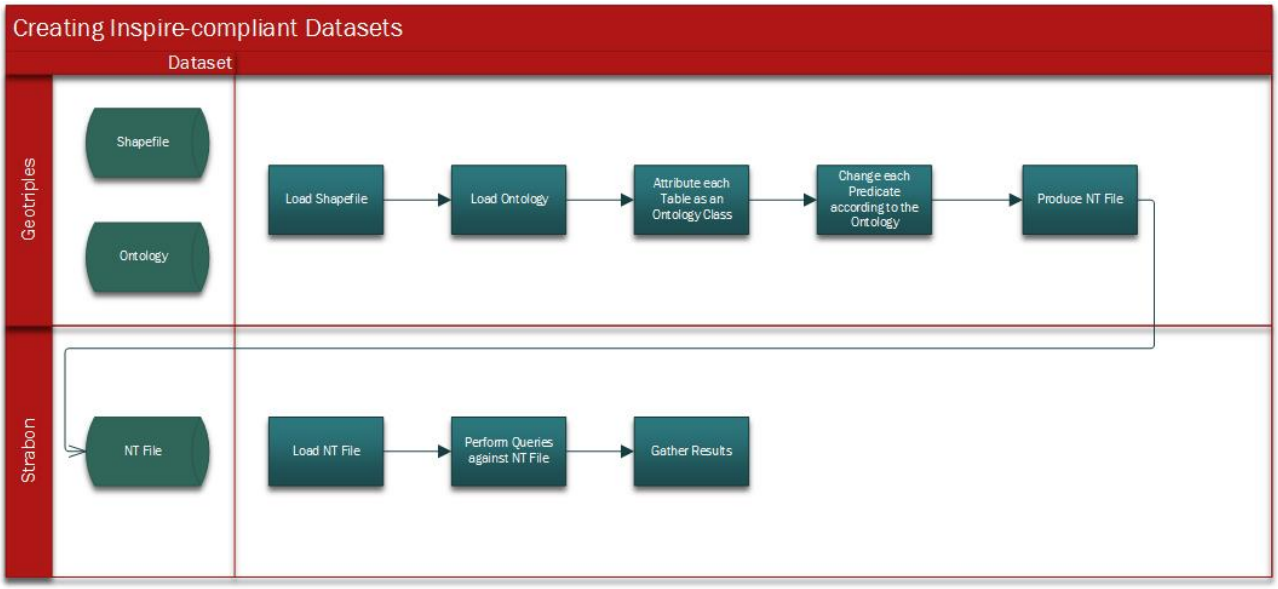

Figure 3.15: Creating INSPIRE-compliant Datasets WorkFlow Diagram

- Load the shapefile, which includes two tables, the first one concerning the records of each dataset and the second the corresponding Geometry.
- Load the Ontology.
- Define the first table's records as the equivalent class in each Ontology and the second's as Geometry.
- Change each predicate of the first table according to the Ontology.
- Produce the mapping and the NT file.
- Load the NT file to Strabon.
- Perform indicative queries against the NT file.
- Gather the results.

3.2.1. Greek Administrative Geography Demo

Query 1
“Return the first 40 Greek municipality names.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?name
WHERE{
?x a inspire:AdministrativeUnit.
?x inspire:nationalLevelName ?name.
}
LIMIT 40
```

The results of this Query are shown in Figure 3.16 bellow:

name
"Áìõíóáßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"¶èùò"^^<http://www.w3.org/2001/XMLSchema#string>
"¶êôéïõ - Âûíéôóáò"^^<http://www.w3.org/2001/XMLSchema#string>
"¶íäñïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"¶ñãïõò - Ìõêçíþí"^^<http://www.w3.org/2001/XMLSchema#string>
"¸äåóóáò"^^<http://www.w3.org/2001/XMLSchema#string>
"¹éëäáò"^^<http://www.w3.org/2001/XMLSchema#string>
"Éëßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"¾äñáò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áßãéíáò"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁâàÞñùí"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãßáò ÂáñâÜñáò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãßáò ÐáñáóêåõÞò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãßïõ Âáóéëåßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãßïõ Äçìçôñßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãßïõ Âóóôñáôßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãßïõ Íéêïëüïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãßùí Áíáñãýñùí - Êáíáðåñßïý"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãáèïçóßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁãéÜò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãêéóôñßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁãñÜòùí"^^<http://www.w3.org/2001/XMLSchema#string>
"Áãñéíßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"Áèçíáßùí"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁéãÜëåò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áéãéáëåßáò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áëßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁëåîÜíäñåéáò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áëåîáíäñïýðïçò"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁëéÜñðïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁëïíïÞóíõ"^^<http://www.w3.org/2001/XMLSchema#string>
"Áëìõñïý"^^<http://www.w3.org/2001/XMLSchema#string>
"Áëìùðßáò"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁìÜñéïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"Áìáñïõóßïõ"^^<http://www.w3.org/2001/XMLSchema#string>
"Áìïñãïý"^^<http://www.w3.org/2001/XMLSchema#string>
"Áíðåëïêþðùí - ÌåíåìÝíçò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áìößêëåéáò - ÁëÜòåéáò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áìößðïëçò"^^<http://www.w3.org/2001/XMLSchema#string>
"Áìöéëï÷ßáò"^^<http://www.w3.org/2001/XMLSchema#string>

Figure 3.16: GAG Query 1

Query 2
“Show all Greek municipalities on the map.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?name ?wkt
WHERE{
?x a inspire:AdministrativeUnit.
?x inspire:nationalLevelName ?name.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
}
```

The results of this Query are shown in Figure 3.17 bellow:

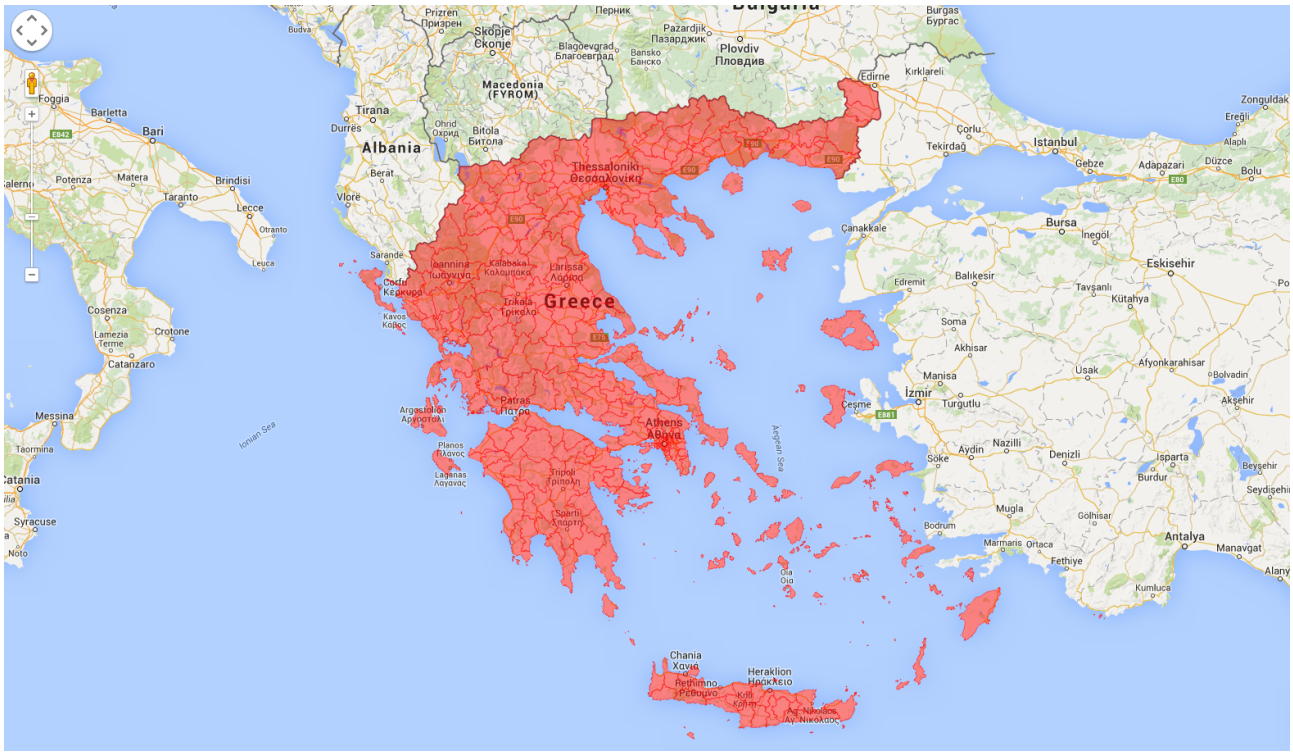

Figure 3.17: GAG Query 2

Query 3
“Show on the map all the fourth zone municipalities.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?name ?code ?wkt
WHERE{
?x a inspire:AdministrativeUnit.
?x inspire:nationalLevelName ?name.
?x inspire:nationalCode ?code.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
FILTER ( ?code > ”9301”).
}
```

The results of this Query are shown in Figure 3.18 bellow:

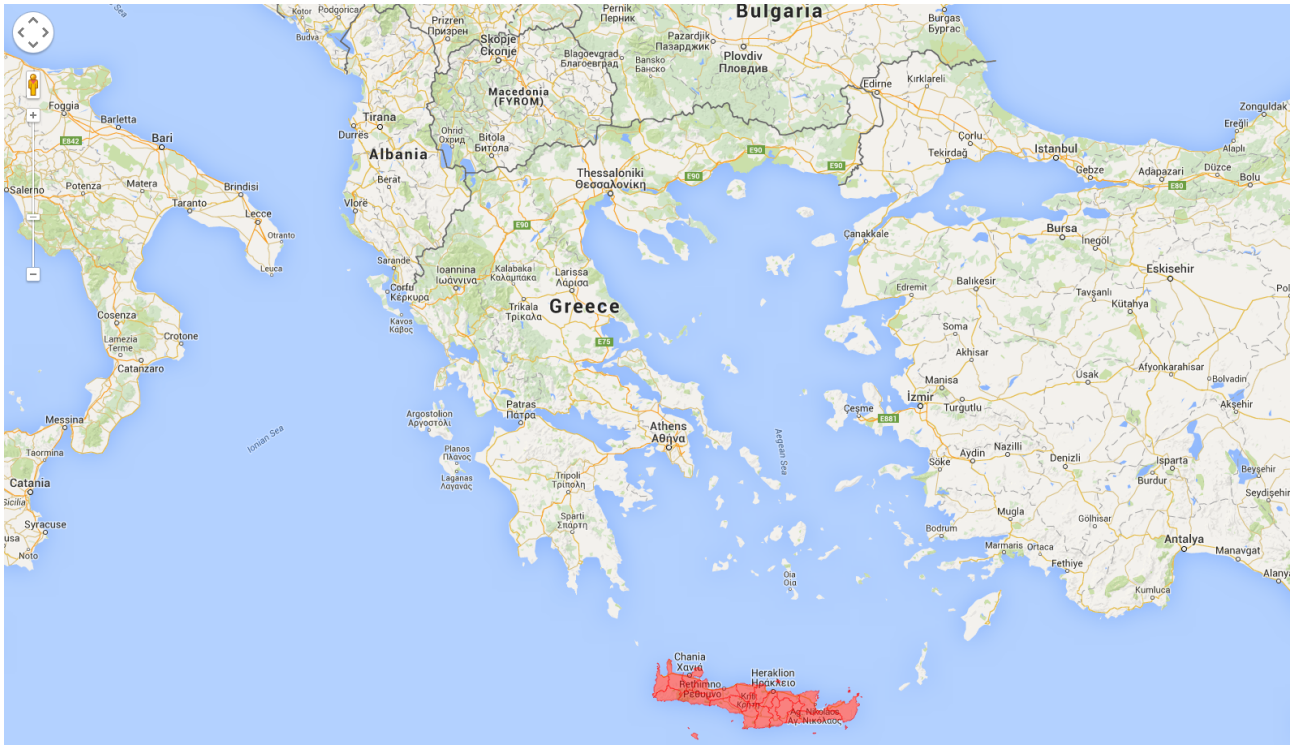

Figure 3.18: GAG Query 3

3.2.2. Public Transport Demo

Query 1
“Return the first 30 stops with their name and mode.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?name ?mode
WHERE{
?x a inspire:Stop.
?x inspire:geographicalName ?name.
?x inspire:mode ?mode.
}
LIMIT 30
```

The results of this Query are shown in Figure 3.19 bellow:

x	name	mode
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/1	"ÑÁÍÔÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/2	"ÁÈÇÍÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/3	"ÓÔ.ÁÍÙ ÊËÍÓÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/4	"ÁÓÐÑÏÐÕÑÃÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/5	"ÓÉÁÇÑ/ÊÍ ÈÁÍÔÑÏ Á×ÁÑÍÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/6	"ÇÑÁÊËÁÉÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/7	"ÌÁÔÁÌÏÑÒÙÓÇ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/8	"ÉÁÕÊÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/9	"ÐÁÉÑÁÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/10	"ÑÏÕÖ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/11	"ÌÁÃÏÕÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/12	"ÓÔ.ÄÁÖÍÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/13	"ÓÉÓÎÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÉÁÙÖÏÑÁÉÏ/ ÓÑÏËÉÁÕ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/14	"ÓÔ.ÁÃ.ÄÇÌÇÔÑËÏÔ-ÁË.ÐÁ/ ÉÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/15	"2ç Í.ÆÙÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÉÁÙÖÏÑÁÉÏ/ ÓÑÏËÉÁÕ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/16	"ÁÃ.ÁÍÁÑÃÕÑÏÉ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÑÏÁÓÔÉÁÊÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/17	"ÓÔ.ÓÁÐÏËÉÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/18	"ÓÔ.ÁÊÑÏÐÏËÇ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/19	"ÓÔ.ÓÕÃÃÑÏÕ-ÖÉÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/20	"ÓÔ.ÍÁÍÓ ÊÍÓÌÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/21	"ÓÔ.ÁÃ.ÉÙÁÍÍÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/22	"ÊÁÊÕÍÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÉÁÙÖÏÑÁÉÏ/ ÓÑÏËÉÁÕ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/23	"ÓÔ.ÊÁÑÁÌÁÉÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/24	"ÓÔ.ËÁÑÉÓÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/25	"ÓÔ.ÌÁÔÁÌÏÕÑÃÁÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/26	"ÓÔ.ÐÁÍÁÐÉÓÓÇÌÉÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/27	"ÓÔ.ÓÕÍÔÁÃÀÌÁÔÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/28	"ÓÔ.ÄÕÁÃÃÄËÉÓÌÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/29	"ÓÔ.ÌÁÃ.ÌÍÕÓÉÈÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/30	"ÓÔ.ÁÌÐÁËÏÊÇÐÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÔÑÏ (ÇÓÁÐ/ ÁÌÁÉ)"^^<http://www.w3.org/2001/XMLSchema#string>

Figure 3.19: Public Transport Query 1

Query 2
“Return the first 40 stops sorted with scode.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?scode
WHERE{
?x a inspire:Stop.
?x inspire:scode ?scode.
}
ORDER BY (?scode)
LIMIT 40
```

The results of this Query are shown in Figure 3.20 bellow:

x	scode
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/59	"010001"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/60	"010002"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/61	"010003"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/62	"010004"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/64	"010005"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/66	"010006"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/67	"010007"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/68	"010008"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/69	"010009"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/70	"010010"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/71	"010011"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/72	"010012"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/74	"010013"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/75	"010014"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/76	"010015"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/78	"010016"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/81	"010017"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/85	"010018"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/86	"010019"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/87	"010020"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/89	"010021"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/90	"010022"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/91	"010023"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/93	"010024"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/94	"010025"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/95	"010026"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/96	"010027"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/98	"010028"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/99	"010029"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/100	"010030"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/101	"010031"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/102	"010032"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/103	"010036"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/104	"010037"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/105	"010040"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/106	"010041"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/107	"010042"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/111	"010043"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/112	"010044"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/115	"010045"^^<http://www.w3.org/2001/XMLSchema#string>

Figure 3.20: Public Transport Query 2

Query 3
“Return the first 40 stops with the street they are on.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?name ?street
WHERE{
?x a inspire:Stop.
?x inspire:geographicalName ?name.
?x inspire:hasRoadName ?roadname.
?roadname inspire:geographicalName ?street.
}
LIMIT 40
```

The results of this Query are shown in Figure 3.21 bellow:

name	street
"ÑÁÍÔÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÍÔ.ÄÇÏÏÕ ÁÃ.ÉÙÁÍ.ÑÅÍÔÇ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁÈÇÍÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÓÉÄÇÑÏÄÑÏÌÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁÍÙ ËËÏÓÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÏÌÄÏÓ ÁÔÔÉÊÇ ÏÄÏÓ-ÓÕËÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁÓÐÑÏÐÕÑÃÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÍÍÔ.ÐÁÑ.ÏÄÏÕ.ÁÓÐÑÏÐÕÑÃÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÉÄÇÑ/ÊÏ ÊÁÍÔÑÏ Á×ÁÑÍÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇ ÏÄÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÇÑÁÊËÁÉÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÏÌÂ.ÁÔÔÉÊ.ÏÄ.Ë.ÇÑÁÊËÁÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÌÁÔÁÏÑÕÙÓÇ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇ ÏÄÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ËÁÕÊÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÍÔÏÓ ÄÇÏÏÕ ÐÁÉÑÁÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÐÁÉÑÁÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÍÔÏÓ ÄÇÏÏÕ ÐÁÉÑÁÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÑÏÕÖ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÙÍÓÔÁÍÔÉÍÏÕÐÏËÁÙÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÌÁÃÏÕËÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"ËÏÌÂ.ÁÔÔ.ÏÄÏÓ-ÈÑÉÁÓ.ÐÂÄ."^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÄÄÓÍÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐË.ÊÁËÏÃÇÑÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÉÓÏÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÑ.ÁÍÔÕÐÁ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁÃ.ÄÇÌÇÔÑÉÏÓ-ÁË.ÐÁ/ÉÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÉÁÙÖ.ÂÏÕËÉÁÃÌÁÍÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"2ç Í.ÆÙÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÇÐÂÉÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁÃ.ÁÍÁÑÃÕÑÏÉ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÙÍÓÔÁÍÔÉÍÏÕÐÏËÁÙÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÓÐÐÏËÉÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÍÔÉÃÏÍÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁÊÑÏÐÏËÇ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÓÔÑ\ÃÏÕ ÌÁÊÑÕÃÉÁÍÇ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÓÕÃÃÑÏÕ-ÓÉÎ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÉÁÙÖ.ÓÕÃÃÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÍÁÏÖ ËÏÓÏÏÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐË.ÊÁÑÁÉÓÊÁÊÇ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁÃ.ÉÙÁÍÍÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÌÂÑ.ÕÑÁÍÔÆÇ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÈÁËÕÌÏÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁËÕÌÏÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÊÁÑÁÌÁÉÊÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÃÍÙÓÔÇ ÐËÁÔÁÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ËÁÑÉÓÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÄÇËÇÃÉÁÍÍÇ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÌÁÔÁÍÏÕÑÃÁËÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐË.ÁÃ.ÊÙÍÓÔÁÍÔÉÍÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÐÁÍÅÐÉÓÔÇÌÉÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÁÍÅÐÉÓÔÇÌÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÓÕÍÔÁÃÌÁÓÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐË.ÓÕÍÔÁÃÌÁÔÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁÕÁÃÃÁËÉÓÏÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÉÁÙÖ.ÂÁÓ.ÓÏÕÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÌÁÃ.ÏÕÓÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÉÁÙÖ.ÂÁÓ.ÓÏÕÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁÌÐÅËÏÊÇÐÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÉÁÙÖ.ÁËÂÍÁÍÄÑÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÐÁÍÑÏÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÁÍÑÏÏ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÊÁÔÅ×ÁÊÇ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÓÏÃÄÉÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÊÁÔÙ ÐÂÔÑÁËÙÍÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁÉÑÇÍÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÍÂÑÁÔÆÉÙÔÉÓÓÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁÌÁÑÏÕÓËÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÍÂÑÁÔÆÉÙÔÉÓÓÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.Í.ÇÑÁÊËÁÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"Ì.ÁÍÓÕÐÁ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÊÁËËÉÈÁÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÁÓÑ.ÃÑÇÃÏÑÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÐÉ.ÐÁÐÁÄÉÁÌÁÍÓÇ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÌÁÑÊÏÑÁ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÁÖÂÓÇÑÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÁÊÊÏÊÏÍÁÕËÇ"^^<http://www.w3.org/2001/XMLSchema#string>
"ÓÔ.ÁË.ÂÁÍÉÆÄÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÐÁÓÑ.ÃÑÇÃÏÑÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>

Figure 3.21: Public Transport Query 3

Query 4
“Show all stops on the map with their names.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?name ?wkt
WHERE{
?x a inspire:Stop.
?x inspire:geographicalName ?name.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
}
```

The results of this Query are shown in Figure 3.22 bellow:

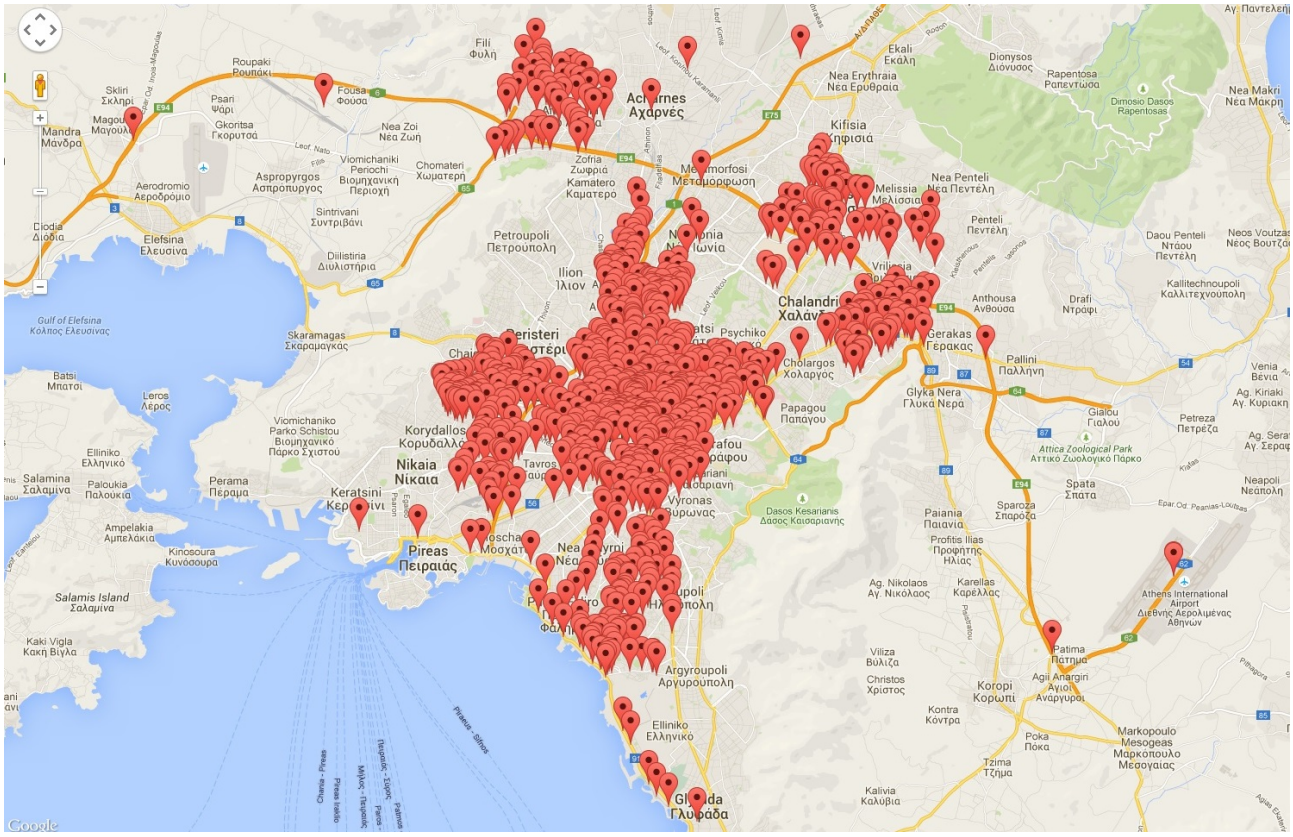

Figure 3.22: Public Transport Query 4

Query 5
“Show on the map all the stops at Aghios Dimitrios.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?name ?scode ?wkt
WHERE{
?x a inspire:Stop.
?x inspire:geographicalName ?name.
?x inspire:scode ?scode.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
FILTER ( ?scode <= ”050000”).
FILTER ( ?scode >= ”040000”).
}
```

The results of this Query are shown in Figure 3.23 bellow:

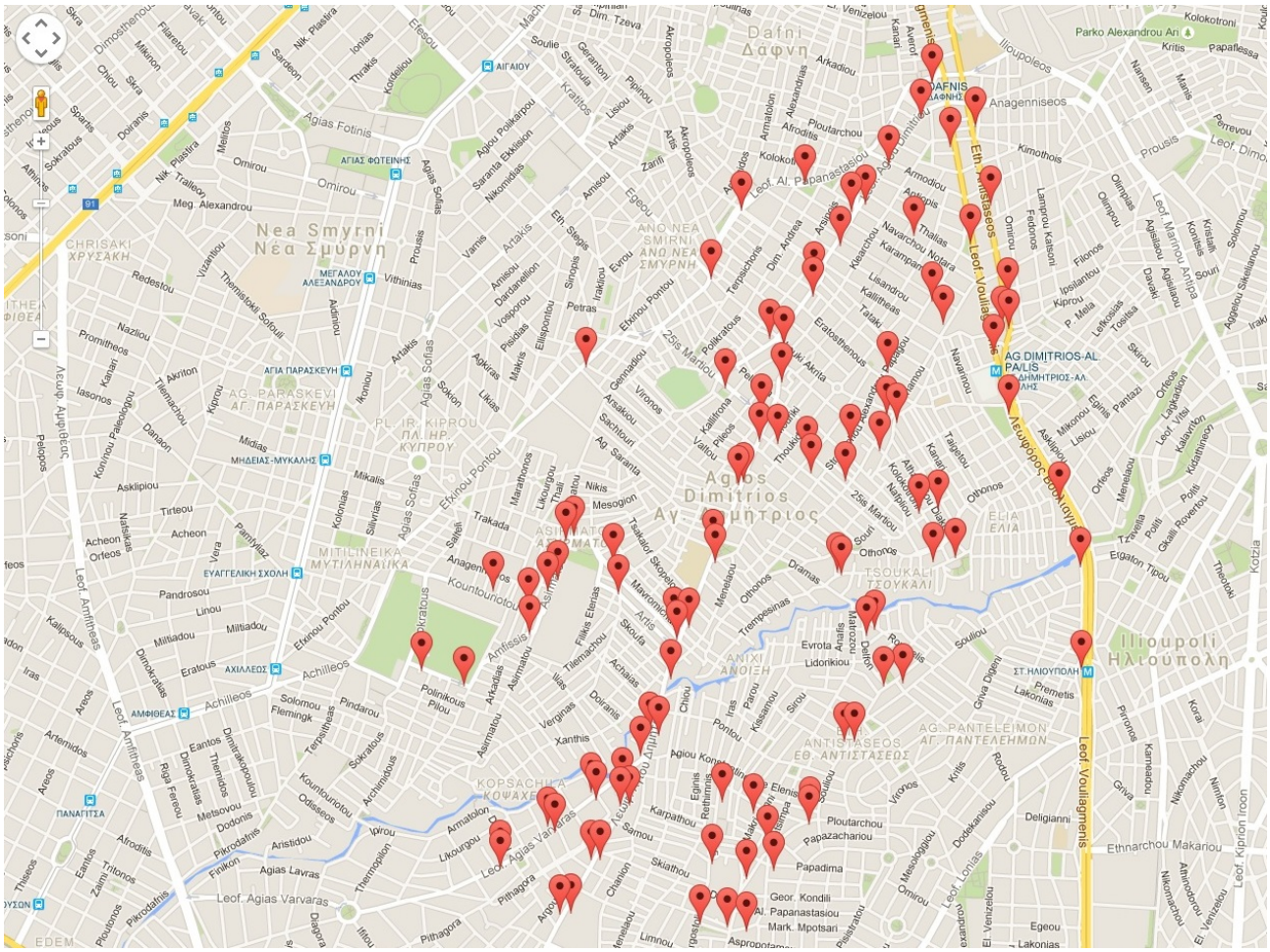

Figure 3.23: Public Transport Query 5

3.2.3. Public Buildings Demo

Query 1
“Return the first 40 buildings with A_A and four Digit attributes.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?A_A ?fourDigit
WHERE{
?x a inspire:Public_Building.
?x inspire:fourDigit ?fourDigit.
?x inspire:A_A ?A_A.
}
LIMIT 40
```

The results of this Query are shown in Figure 3.24 bellow:

x	A_A	fourDigit
http://data.linkedeodata.eu/dhmosia_kthria/id/29939	"5786"^^<http://www.w3.org/2001/XMLSchema#integer>	"0"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/29322	"5131"^^<http://www.w3.org/2001/XMLSchema#integer>	"0"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/24801	"325"^^<http://www.w3.org/2001/XMLSchema#integer>	"423"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/27090	"2759"^^<http://www.w3.org/2001/XMLSchema#integer>	"2937"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28203	"3913"^^<http://www.w3.org/2001/XMLSchema#integer>	"4882"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/25335	"905"^^<http://www.w3.org/2001/XMLSchema#integer>	"1005"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/25770	"1371"^^<http://www.w3.org/2001/XMLSchema#integer>	"1471"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26248	"1873"^^<http://www.w3.org/2001/XMLSchema#integer>	"1994"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28013	"3724"^^<http://www.w3.org/2001/XMLSchema#integer>	"4691"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26314	"1938"^^<http://www.w3.org/2001/XMLSchema#integer>	"2059"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26995	"2659"^^<http://www.w3.org/2001/XMLSchema#integer>	"2837"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28968	"4752"^^<http://www.w3.org/2001/XMLSchema#integer>	"0"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28131	"3842"^^<http://www.w3.org/2001/XMLSchema#integer>	"4809"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26734	"2380"^^<http://www.w3.org/2001/XMLSchema#integer>	"2558"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/25912	"1522"^^<http://www.w3.org/2001/XMLSchema#integer>	"1623"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28385	"4107"^^<http://www.w3.org/2001/XMLSchema#integer>	"5085"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/27418	"3103"^^<http://www.w3.org/2001/XMLSchema#integer>	"4043"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28246	"3957"^^<http://www.w3.org/2001/XMLSchema#integer>	"4926"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28215	"3925"^^<http://www.w3.org/2001/XMLSchema#integer>	"4894"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26311	"1935"^^<http://www.w3.org/2001/XMLSchema#integer>	"2056"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26621	"2262"^^<http://www.w3.org/2001/XMLSchema#integer>	"2440"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26711	"2357"^^<http://www.w3.org/2001/XMLSchema#integer>	"2535"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/25288	"853"^^<http://www.w3.org/2001/XMLSchema#integer>	"953"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26344	"1972"^^<http://www.w3.org/2001/XMLSchema#integer>	"2149"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/29303	"5112"^^<http://www.w3.org/2001/XMLSchema#integer>	"0"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/27903	"3615"^^<http://www.w3.org/2001/XMLSchema#integer>	"4577"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28065	"3776"^^<http://www.w3.org/2001/XMLSchema#integer>	"4743"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/27679	"3376"^^<http://www.w3.org/2001/XMLSchema#integer>	"4328"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/29515	"5338"^^<http://www.w3.org/2001/XMLSchema#integer>	"0"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/27567	"3257"^^<http://www.w3.org/2001/XMLSchema#integer>	"4200"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/27809	"3522"^^<http://www.w3.org/2001/XMLSchema#integer>	"4479"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26091	"1710"^^<http://www.w3.org/2001/XMLSchema#integer>	"1831"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/29821	"5664"^^<http://www.w3.org/2001/XMLSchema#integer>	"0"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/25864	"1471"^^<http://www.w3.org/2001/XMLSchema#integer>	"1572"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28672	"4430"^^<http://www.w3.org/2001/XMLSchema#integer>	"2127"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/29769	"5609"^^<http://www.w3.org/2001/XMLSchema#integer>	"0"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/28356	"4076"^^<http://www.w3.org/2001/XMLSchema#integer>	"5054"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/26371	"2004"^^<http://www.w3.org/2001/XMLSchema#integer>	"2181"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/24505	"5"^^<http://www.w3.org/2001/XMLSchema#integer>	"6"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/dhmosia_kthria/id/25113	"670"^^<http://www.w3.org/2001/XMLSchema#integer>	"768"^^<http://www.w3.org/2001/XMLSchema#integer>

Figure 3.24: Public Buildings Query 1

Query 2
“Return the first 30 buildings with their address information.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?addressArea ?number ?postCode
WHERE{
?x a inspire:Public_Building.
?x inspire:hasAddress ?address.
?address inspire:addressArea ?addressArea.
?address inspire:number ?number.
?address inspire:postCode ?postCode.
}
LIMIT 30
```

The results of this Query are shown in Figure 3.25 bellow:

x	addressArea	number	postCode
http://data.linkedeodata.eu/dhmosia_kthria/id/29939	"ÐÕÑÃÏÓ ÔÑÉÖÕÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"0"^^<http://www.w3.org/2001/XMLSchema#string>	"24400"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/29322	"ÁÑÏÓÉÁ ÉÀÑÏÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/24801	"70003, ÁÃÉÁ ÁÁÑÁÁÑÁ ÇÑÁÉÉÁÉÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/27090	"ÍÀÍÓ ÉÃÏÀÍÀÙÓ 22, ÇÑÁÉÉÁÉÏ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28203	"25ÇÓ ÍÁÑÕÉÍÕ 24. ÀÓÁÍÕÍÕ ÔÉ 85103"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/25335	"ÐÉÀÒÁÉÁ ÁÉÃÕÉÀÑÉÁÓ 7, 62300, ÓÉÁÇÑÍÉÁÓÓÑÍ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/25770	"ÊÍÊÉÉÍÉ, 49100 ÉÀÑÉÔÑÁ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26248	"ÄÇÌÇÔÑÀÓ 19, ÁÉÁÍÁÍÁÑÍÔÐÌÉÇ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28013	"ÕøçëÚíóç 1, ÉáíßáÿÁ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26314	"ÁÍÁÑÁÁ ÐÁÐÁÍÁÑÁÍÕ 37 ÍÀÑÍÓÖÉ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26995	"ÓÇÉÍÕ 4 ÑÍÀÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28968	"ÁÉÍ ÁÍÔÉÓÓÁÓÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#string>	"36100"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28131	"ÉÁÂÊÀÄËÙÍ 1, ÉÁÂÊÀÄËÁ ÔÊ 22003"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26734	"ÇÉÉÍÀÙÑÏÕ 10 ÉÃÑÉÓÁ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/25912	"ÓÉÉÉÁÔÑÀ ÍÁÓÇÍÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28385	"ÃÕÁÃÃÁÉÉÓÓÑÉÁÓ 17 ÔÇÍÍÕ ÔÊ 84200"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/27418	"ÁÉÍÉÊÇÓ ÁÍÔÉÓÔÁÓÁÙÓ 53, ÁÑÕÉÑÁÓ 19008"^^<http://www.w3.org/2001/XMLSchema#string>... more	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28246	"Á. Ñþíá (Íáíßá), ÆÚéõíéíó"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28215	"ÃÉÁÉÍÓ ÕÕÍÇ ÔÊ 85600"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26311	"ÔÔÁÁÉÍÕ 27 ÁÉÇÍÁ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26621	"ÉÓÓÉÁÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26711	"ÍÁÓÓÁÐÉÙÍ 4"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/25288	"ÍÁÃÁÉÍ ÉÁÓÁÉÍÁÑÕÖÍ ÔÑÉÊÁÉÙÍ 42100"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26344	"ÍÁÑÏÃÍÕÑÏÕ 290, ×ÁÍÉÁ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/29303	"ÍÁÕÐÂÉÔÍÕ 29 ÁÑÍÇ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/27903	"ÐÀÕÓÉÉÕÐÏÕ 9 ÊÍÉÉÍÁÑÍÓ ÔÊ 60061"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28065	"ÓÕÉÉÁ ÔÊ 63072"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/27679	"Ãáíçíáóú 22, ÍÚïõóá 59200"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/29515	"ÍÍÕÊÉÉ"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	"20200"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/27567	"Ãáýãïó ×áíßùí ÔÊ 73001"^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>	""^^<http://www.w3.org/2001/XMLSchema#string>

Figure 3.25: Public Buildings Query 2

Query 3
“Return the first 30 buildings with their national level information.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?belongstoMunicipality ?belongstoPrefecture ?regionName
WHERE{
?x a inspire:Public_Building.
?x inspire:belongstoMunicipality ?belongstoMunicipality.
?x inspire:belongstoPrefecture ?belongstoPrefecture.
?x inspire:regionName ?regionName.
}
ORDER BY DESC(?belongstoMunicipality)
LIMIT 30
```

The results of this Query are shown in Figure 3.26 bellow:

x	belongstoMunicipality	belongstoPrefecture	regionName
http://data.linkedeodata.eu/dhmosia_kthria/id/34225	"ÚÑÙÐÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/41285	"ÚÑÙÐÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/40301	"ÚÑÙÐÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/47175	"ÚÑÙÐÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/38475	"ÚÑÙÐÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/34623	"ÚÑÙÐÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÔÔÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/45450	"ÚÑÀÙÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÓÓÁÑÀÁÓ ÁÉÊÁÀÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÕÀÏÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/33503	"ÚÑÀÙÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÓÓÁÑÀÁÓ ÁÉÊÁÀÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÕÀÏÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/46265	"ÚÑÀÙÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÓÓÁÑÀÁÓ ÁÉÊÁÀÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÕÀÏÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/37215	"ÚÑÀÙÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÓÓÁÑÀÁÓ ÁÉÊÁÀÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÕÀÏÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/45756	"ÚÑÀÙÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÓÓÁÑÀÁÓ ÁÉÊÁÀÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÕÀÏÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/45930	"ÚÑÀÙÏ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÓÓÁÑÀÁÓ ÁÉÊÁÀÏÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÁÕÀÏÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/32271	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/31434	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/31938	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/45569	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/47253	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/31743	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/31513	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/47704	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/47705	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/31333	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/32529	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/32843	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/39019	"ÚÑÁÉÏÊÁÓÔÑÏÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÊÁÍÓÑÉÊÇÓ ÍÀÊÁÀÏÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÈÁÓÓÁËÏÍÉÊÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/34230	"ÚÉÁÍÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÄÕÔÉÊÇÓ ÁÉÊÁÀÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"Á×ÁÚÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/31872	"ÚÉÁÍÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÄÕÔÉÊÇÓ ÁÉÊÁÀÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"Á×ÁÚÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/42072	"ÚÉÁÍÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÄÕÔÉÊÇÓ ÁÉÊÁÀÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"Á×ÁÚÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/42360	"ÚÉÁÍÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÄÕÔÉÊÇÓ ÁÉÊÁÀÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"Á×ÁÚÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/29247	"ÚÉÁÍÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÄÕÔÉÊÇÓ ÁÉÊÁÀÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"Á×ÁÚÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>

Figure 3.26: Public Buildings Query 3

Query 4
“Return the first 25 buildings with their type and service name and a specific size.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?serviceName ?type
WHERE{
?x a inspire:Public_Building.
?x inspire:serviceName ?serviceName.
?x inspire:type ?type.
?x inspire:size ?size.
FILTER (?size=”ADSL”^^xsd:string)
}
ORDER BY DESC(?type)
LIMIT 25
```

The results of this Query are shown in Figure 3.27 bellow:

x	serviceName	type
http://data.linkedeodata.eu/dhmosia_kthria/id/27003	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ×ÉÎÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26265	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÁÄÑÏÉÊÌÁÍÁ ÓÐÄÔÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26538	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÉÍÆÉÁÍÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26539	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÓÉÙÑÉÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28673	"Á' ×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÈÄÓÓÁËÍÍÉÊÇÓ (Éá÷áíáâäïñÙ)"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28674	"Á' ×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÈÄÓÓÁËÍÍÉÊÇÓ (ÁâñïëéíÝíáò Êáóóáëïíßêçó)"^^<http://www.w3.org/2001/XMLSchema#... more	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28678	"Á' ×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÈÄÓÓÁËÍÍÉÊÇÓ ÊÉÉÍÁÊÉÏ ÄÉÐÁ-ÁÉÈÄ (Áéõëéóôþñêí)"^^<http://www.w3.org/2001/XMLS... more	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26677	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÈÇÄÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26360	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÁÄ. ÍÉÉÍÉÄÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26363	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÑÄÉÕÍÍÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26860	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÍÄÓÍÉÏÄÄÉÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26836	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÇÄÎÓÍÁÍÉÓÓÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26885	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÐÓÑÄÍÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26907	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÁÑÍÍÕÐÍÉÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26913	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÍÄÕÐÉÉÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26923	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÓÑÉÐÍÉÇÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26419	"×ÇÍÉÊÇ ÕÐÇÑÄÓÉÁ ÁÑÁÍÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>	"×ÇÍÉÊÄÓ ÕÐÇÑÄÓÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/28492	"ÊÄÍÓÑÏ ÕÃÄÉÁÓ ÁÍÙÃÄÉÙÍ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÖÏÑÁÁÓ ÕÃÄÉÁÓ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/49000	"ÁÑ×ÁÉÍÉÍÃÉÊÍ ÍÍÕÓÁÉÍ ÇÑÄÉÊÁÉÍÕ"^^<http://www.w3.org/2001/XMLSchema#string>	"ÕÐ.ÐÏ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26997	"ÁÉÊÄÓÕÊÉÍ ÃÑÁÓÁÉÍ ÓÕÑÏÕ (ÔÑÁÐÅÆÁ ÍÍÍÉÊÙÍ ÐÉÇÑÏÓÍÑÉÙÍ)"^^<http://www.w3.org/2001/XMLSchema#stri... more	"ÔÍÐ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/27000	"ÁÉÊÄÓÕÊÉÍ ÃÑÁÓÁÉÍ ÁÃÑÉÍÉÍÕ (ÔÑÁÐÅÆÁ ÍÍÍÉÊÙÍ ÐÉÇÑÏÓÍÑÉÙÍ)"^^<http://www.w3.org/2001/XMLSchema#s... more	"ÔÍÐ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26308	"ÕÐÍÕÑÃÄÉÍ ÁÍÙÕÁÑÉÊÙÍ (ÔÑÁÐÅÆÁ ÍÍÍÉÊÙÍ ÐÉÇÑÏÓÍÑÉÙÍ)"^^<http://www.w3.org/2001/XMLSchema#string&... more	"ÔÍÐ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26309	"ÕÐÍÕÑÃÄÉÍ ÁÐÁÓ×ÍÇÇÓÇÓ & ÊÍÉÍÙÍÉÊÇÓ ÐÑÏÓÓÁÓÉÁÓ (ÓÑÁÐÅÆÁ ÍÍÍÉÊÙÍ ÐÉÇÑÏÓÍÑÉÙÍ -ÔÍÐ)"^^<http://... more	"ÔÍÐ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26310	"ÕÐÍÕÑÃÄÉÍ ÁÐÁÓ×ÍÇÇÓÇÓ & ÊÍÉÍÙÍÉÊÇÓ ÐÑÏÓÓÁÓÉÁÓ (Ã. Ã. Ê. Á.) (ÓÑÁÐÅÆÁ ÍÍÍÉÊÙÍ ÐÉÇÑÏÓÍÑÉÙÍ -ÔÍÐ)... more	"ÔÍÐ"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/dhmosia_kthria/id/26458	"ÁÉÊÄÓÕÊÉÍ ÃÑÁÓÁÉÍ ÁÁÑÏÉÁÓ (ÔÑÁÐÅÆÁ ÍÍÍÉÊÙÍ ÐÉÇÑÏÓÍÑÉÙÍ)"^^<http://www.w3.org/2001/XMLSchema#st... more	"ÔÍÐ"^^<http://www.w3.org/2001/XMLSchema#string>

Figure 3.27: Public Buildings Query 4

Query 5
“Show all buildings on the map.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?wkt
WHERE{
?x a inspire:Public_Building.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
}
```

The results of this Query are shown in Figure 3.28 bellow:

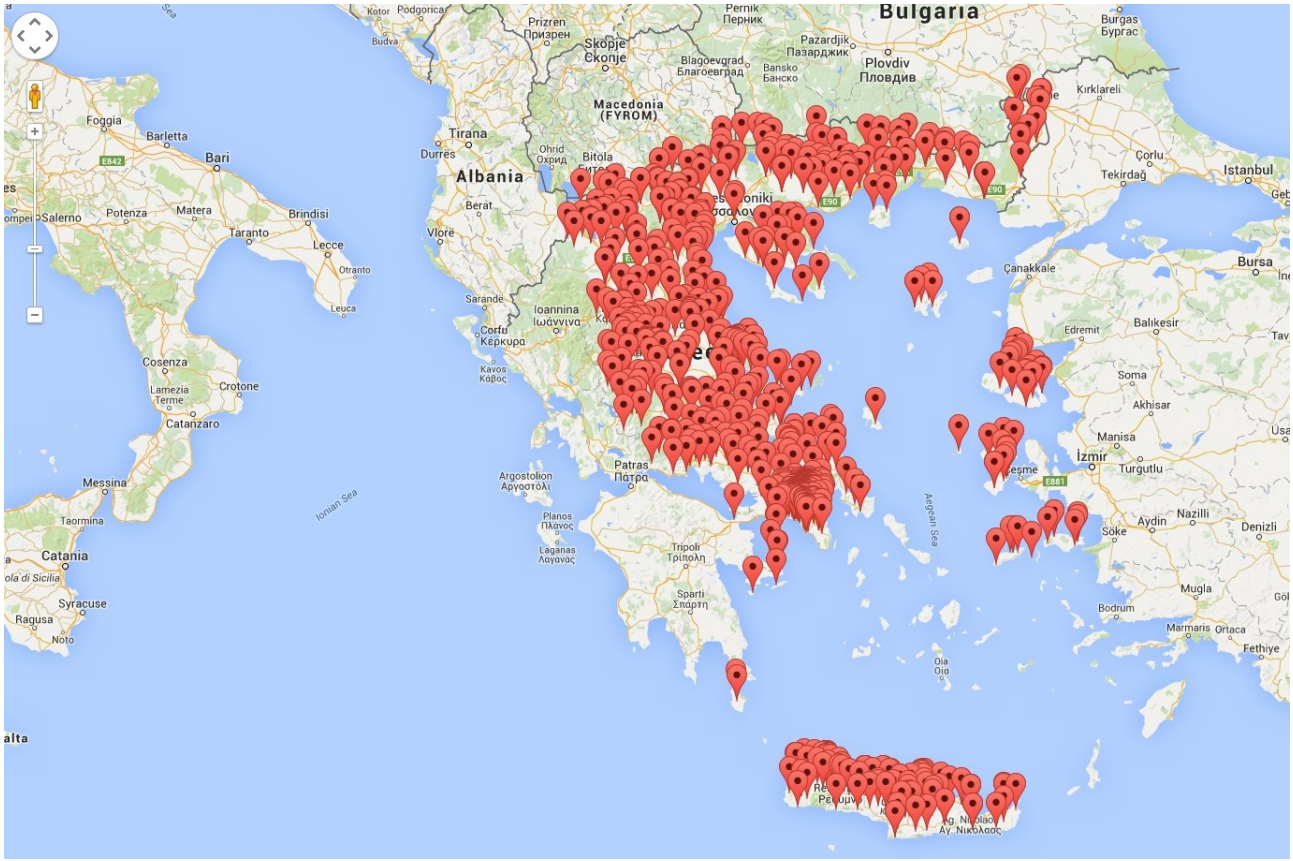

Figure 3.28: Public Buildings Query 5

Query 6
“Show on the map all buildings of Chania region.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?wkt ?region
WHERE{
?x a inspire:Public_Building.
?x inspire:regionName ?region.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
FILTER (?region=”×ÁÍÉÙÍ”^^xsd:string)
}
```

The results of this Query are shown in Figure 3.29 bellow:

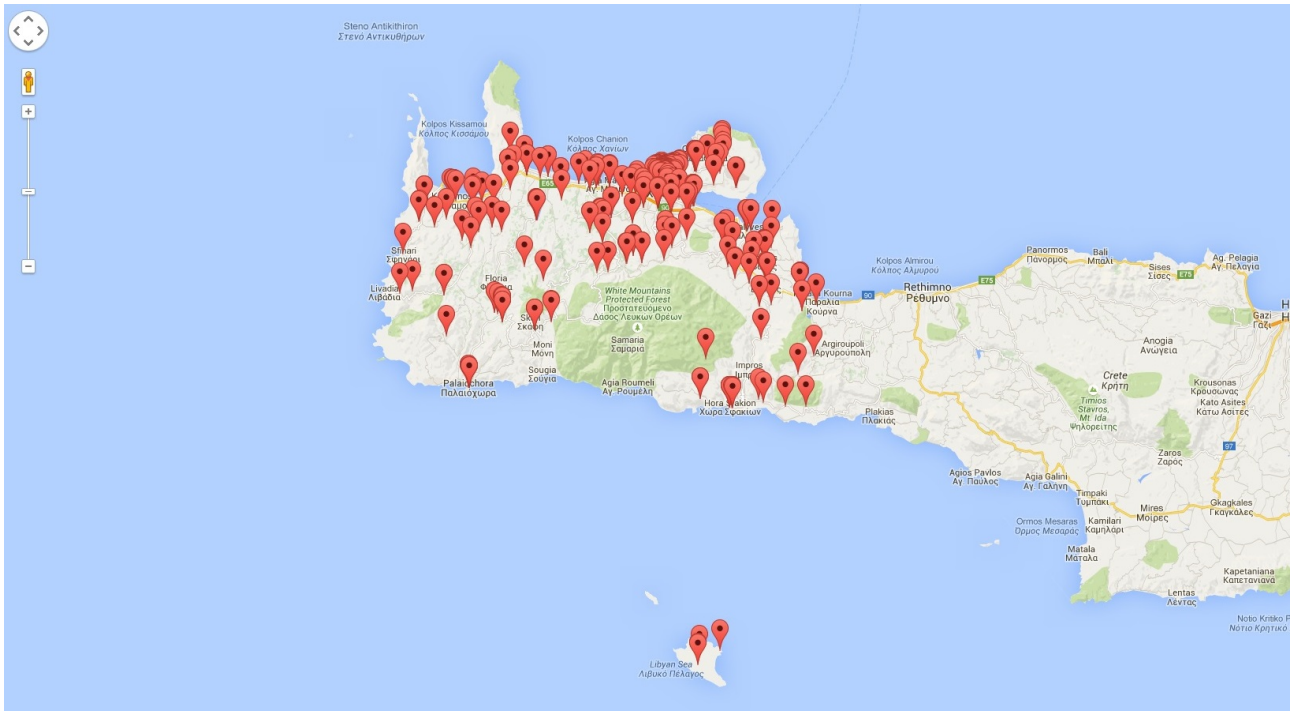

Figure 3.29: Public Buildings Query 6

3.2.4. Land Use Demo

Query 1
“Return the first 45 samples with their dfx attributes.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?dfxLayer ?dfxColor ?dfxText ?dfxSize
WHERE{
?x a inspire:SampledLandUse.
?x inspire:dfxLayer ?dfxLayer.
?x inspire:dfxColor ?dfxColor.
?x inspire:dfxText ?dfxText.
?x inspire:dfxSize ?dfxSize.
}
LIMIT 45
```

The results of this Query are shown in Figure 3.30 bellow:

x	dfxLayer	dfxColor	dfxText	dfxSize
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1532	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"211"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6945	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"323"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5412	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"411"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2218	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"321"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2074	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"112"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7983	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"324"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7640	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"324"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4782	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"321"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7135	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"211"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6726	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"231"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4386	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"231"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7131	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2403	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"211"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1752	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/987	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1008	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4603	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"211"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4806	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"212"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7992	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"211"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7904	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"222"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2086	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4221	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"311"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6277	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"323"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2062	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"323"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6730	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"313"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4153	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7746	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"212"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1948	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"324"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/901	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7798	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"211"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1085	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"324"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1717	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"333"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5721	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"324"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5931	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"222"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6717	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1458	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"213"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5235	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"323"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/147	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"324"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3411	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"112"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3556	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"121"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6817	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"321"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5147	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"243"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3320	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"321"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/549	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"511"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2931	"CODE-00"^^<http://www.w3.org/2001/XMLSchema#string>	"2"^^<http://www.w3.org/2001/XMLSchema#integer>	"141"^^<http://www.w3.org/2001/XMLSchema#string>	"150"^^<http://www.w3.org/2001/XMLSchema#integer>

Figure 3.30: Land Use Query 1

Query 2
“Return the first 45 samples with their geographic information.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?area ?perimeter ?region
WHERE{
?x a inspire:SampledLandUse.
?x inspire:hasShape_Area ?area.
?x inspire:hasShape_Perimeter ?perimeter.
?x inspire:region ?region.
}
LIMIT 45
```

The results of this Query are shown in Figure 3.31 bellow:

x	area	perimeter	region
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1532	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"62"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6945	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"00"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5412	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"57"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2218	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"73"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2074	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"57"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7983	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"53"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7640	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"56"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4782	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"71"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7135	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"58"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6726	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"63"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4386	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"57"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7131	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"55"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2403	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"52"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1752	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"73"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/987	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"52"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1008	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"52"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4603	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"55"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4806	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"71"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7992	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"63"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7904	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"56"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2086	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"73"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4221	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"71"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6277	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"54"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2062	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"72"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6730	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"59"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4153	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"57"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7746	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"54"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1948	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"52"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/901	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"52"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7798	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"54"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1085	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"72"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1717	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"73"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5721	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"59"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5931	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"59"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6717	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"54"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1458	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"00"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5235	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"59"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/147	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"00"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3411	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"52"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3556	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"72"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6817	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"59"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5147	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"71"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3320	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"52"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/549	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"52"^^<http://www.w3.org/2001/XMLSchema#string>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2931	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"0.0"^^<http://www.w3.org/2001/XMLSchema#double>	"55"^^<http://www.w3.org/2001/XMLSchema#string>

Figure 3.31: Land Use Query 2

Query 3
“Return the first 45 samples with p00GR and p00GR_ID.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?p00GR ?p00GR_ID
WHERE{
?x a inspire:SampledLandUse.
?x inspire:p00GR ?p00GR.
?x inspire:p00GR_ID ?p00GR_ID.
}
LIMIT 45
```

The results of this Query are shown in Figure 3.32 bellow:

x	p00GR	p00GR_ID
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1532	"1532"^^<http://www.w3.org/2001/XMLSchema#integer>	"1532"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6945	"6945"^^<http://www.w3.org/2001/XMLSchema#integer>	"6945"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5412	"5412"^^<http://www.w3.org/2001/XMLSchema#integer>	"5412"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2218	"2218"^^<http://www.w3.org/2001/XMLSchema#integer>	"2218"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2074	"2074"^^<http://www.w3.org/2001/XMLSchema#integer>	"2074"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7983	"7983"^^<http://www.w3.org/2001/XMLSchema#integer>	"7983"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7640	"7640"^^<http://www.w3.org/2001/XMLSchema#integer>	"7640"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4782	"4782"^^<http://www.w3.org/2001/XMLSchema#integer>	"4782"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7135	"7135"^^<http://www.w3.org/2001/XMLSchema#integer>	"7135"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6726	"6726"^^<http://www.w3.org/2001/XMLSchema#integer>	"6726"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4386	"4386"^^<http://www.w3.org/2001/XMLSchema#integer>	"4386"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7131	"7131"^^<http://www.w3.org/2001/XMLSchema#integer>	"7131"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2403	"2403"^^<http://www.w3.org/2001/XMLSchema#integer>	"2403"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1752	"1752"^^<http://www.w3.org/2001/XMLSchema#integer>	"1752"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/987	"987"^^<http://www.w3.org/2001/XMLSchema#integer>	"987"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1008	"1008"^^<http://www.w3.org/2001/XMLSchema#integer>	"1008"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4603	"4603"^^<http://www.w3.org/2001/XMLSchema#integer>	"4603"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4806	"4806"^^<http://www.w3.org/2001/XMLSchema#integer>	"4806"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7992	"7992"^^<http://www.w3.org/2001/XMLSchema#integer>	"7992"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7904	"7904"^^<http://www.w3.org/2001/XMLSchema#integer>	"7904"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2086	"2086"^^<http://www.w3.org/2001/XMLSchema#integer>	"2086"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4221	"4221"^^<http://www.w3.org/2001/XMLSchema#integer>	"4221"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6277	"6277"^^<http://www.w3.org/2001/XMLSchema#integer>	"6277"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2062	"2062"^^<http://www.w3.org/2001/XMLSchema#integer>	"2062"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6730	"6730"^^<http://www.w3.org/2001/XMLSchema#integer>	"6730"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/4153	"4153"^^<http://www.w3.org/2001/XMLSchema#integer>	"4153"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7746	"7746"^^<http://www.w3.org/2001/XMLSchema#integer>	"7746"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1948	"1948"^^<http://www.w3.org/2001/XMLSchema#integer>	"1948"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/901	"901"^^<http://www.w3.org/2001/XMLSchema#integer>	"901"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/7798	"7798"^^<http://www.w3.org/2001/XMLSchema#integer>	"7798"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1085	"1085"^^<http://www.w3.org/2001/XMLSchema#integer>	"1085"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1717	"1717"^^<http://www.w3.org/2001/XMLSchema#integer>	"1717"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5721	"5721"^^<http://www.w3.org/2001/XMLSchema#integer>	"5721"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5931	"5931"^^<http://www.w3.org/2001/XMLSchema#integer>	"5931"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6717	"6717"^^<http://www.w3.org/2001/XMLSchema#integer>	"6717"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/1458	"1458"^^<http://www.w3.org/2001/XMLSchema#integer>	"1458"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5235	"5235"^^<http://www.w3.org/2001/XMLSchema#integer>	"5235"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/147	"147"^^<http://www.w3.org/2001/XMLSchema#integer>	"147"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3411	"3411"^^<http://www.w3.org/2001/XMLSchema#integer>	"3411"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3556	"3556"^^<http://www.w3.org/2001/XMLSchema#integer>	"3556"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/6817	"6817"^^<http://www.w3.org/2001/XMLSchema#integer>	"6817"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/5147	"5147"^^<http://www.w3.org/2001/XMLSchema#integer>	"5147"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/3320	"3320"^^<http://www.w3.org/2001/XMLSchema#integer>	"3320"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/549	"549"^^<http://www.w3.org/2001/XMLSchema#integer>	"549"^^<http://www.w3.org/2001/XMLSchema#integer>
http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/2931	"2931"^^<http://www.w3.org/2001/XMLSchema#integer>	"2931"^^<http://www.w3.org/2001/XMLSchema#integer>

Figure 3.32: Land Use Query 3

Query 4
“Show all Land Use samples on the map.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?wkt
WHERE{
?x a inspire:SampledLandUse.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
}
```

The results of this Query are shown in Figure 3.33 bellow:

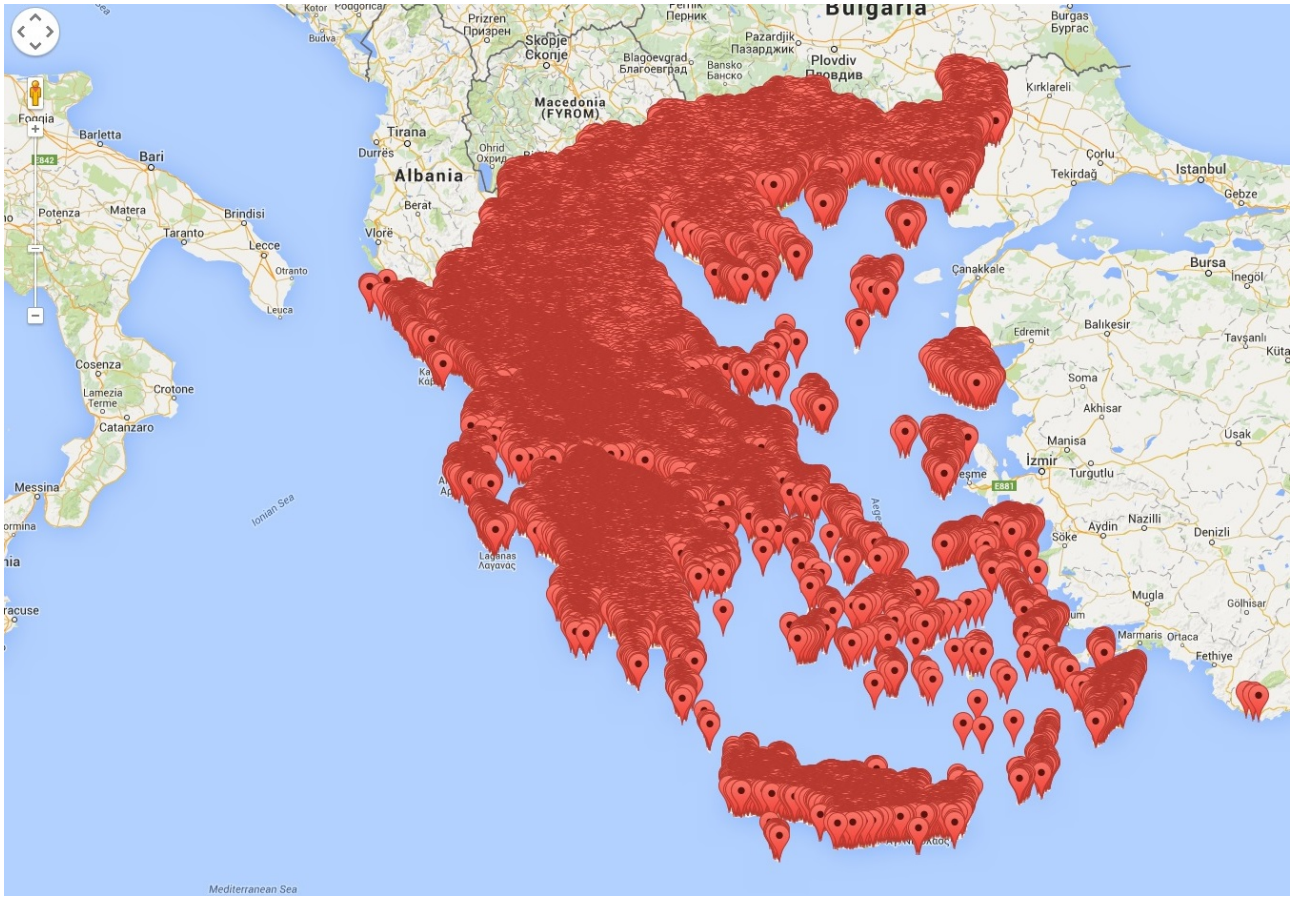

Figure 3.33: Land Use Query 4

Query 5
“Show on the map all the landscapes of mineral extraction.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?wkt
WHERE{
?x a inspire:SampledLandUse. ?x inspire:hasCode_Level1 ?level1.
?x inspire:hasCode_Level2 ?level2.
?x inspire:hasCode_Level3 ?level3.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
FILTER (?level1=”1”^^xsd:integer)
FILTER (?level2=”3”^^xsd:integer)
FILTER (?level3=”1”^^xsd:integer)
}
```

The results of this Query are shown in Figure 3.34 bellow:

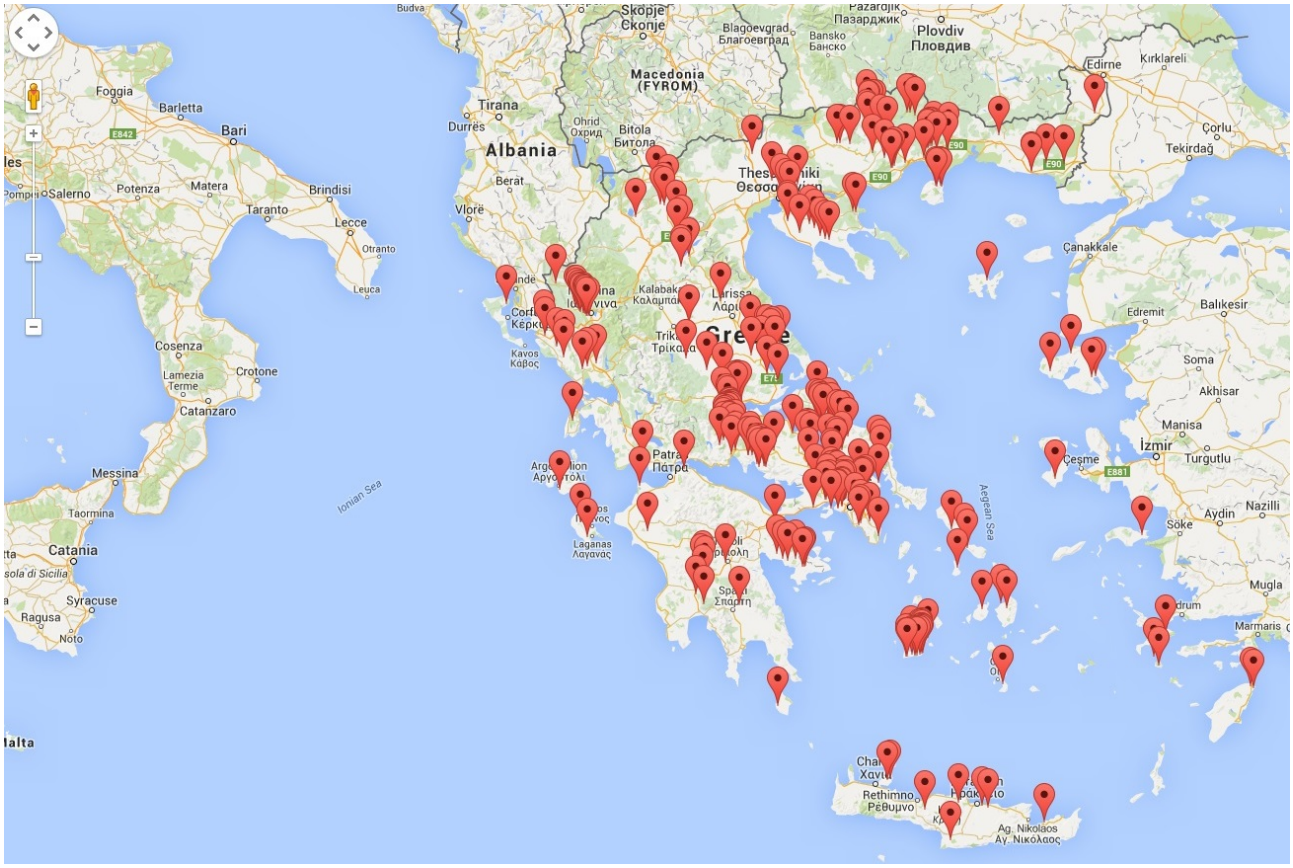

Figure 3.34: Land Use Query 5

Query 6
“Show on the map all coastal marshlands of Aitoloakarnania region.”

```
PREFIX strdf: <http://strdf.di.uoa.gr/ontology#>
PREFIX rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>
PREFIX rdfs: <http://www.w3.org/2000/01/rdf-schema#>
PREFIX xsd: <http://www.w3.org/2001/XMLSchema#>
PREFIX inspire: <http://data.linkedeodata.eu/ontology#>
PREFIX opengis: <http://www.opengis.net/ont/geosparql#>
SELECT ?x ?wkt ?region
WHERE{
?x a inspire:SampledLandUse.
?x inspire:hasCode_Level1 ?level1.
?x inspire:hasCode_Level2 ?level2.
?x inspire:hasCode_Level3 ?level3.
?x inspire:region ?region.
?x opengis:hasGeometry ?geometry.
?geometry opengis:asWKT ?wkt.
FILTER (?level1=”1”^^xsd:integer)
FILTER (?level2=”2”^^xsd:integer)
FILTER (?level3=”4”^^xsd:integer)
FILTER (?region=”01”^^xsd:string)
}
```

The results of this Query are shown in Figure 3.35 bellow:

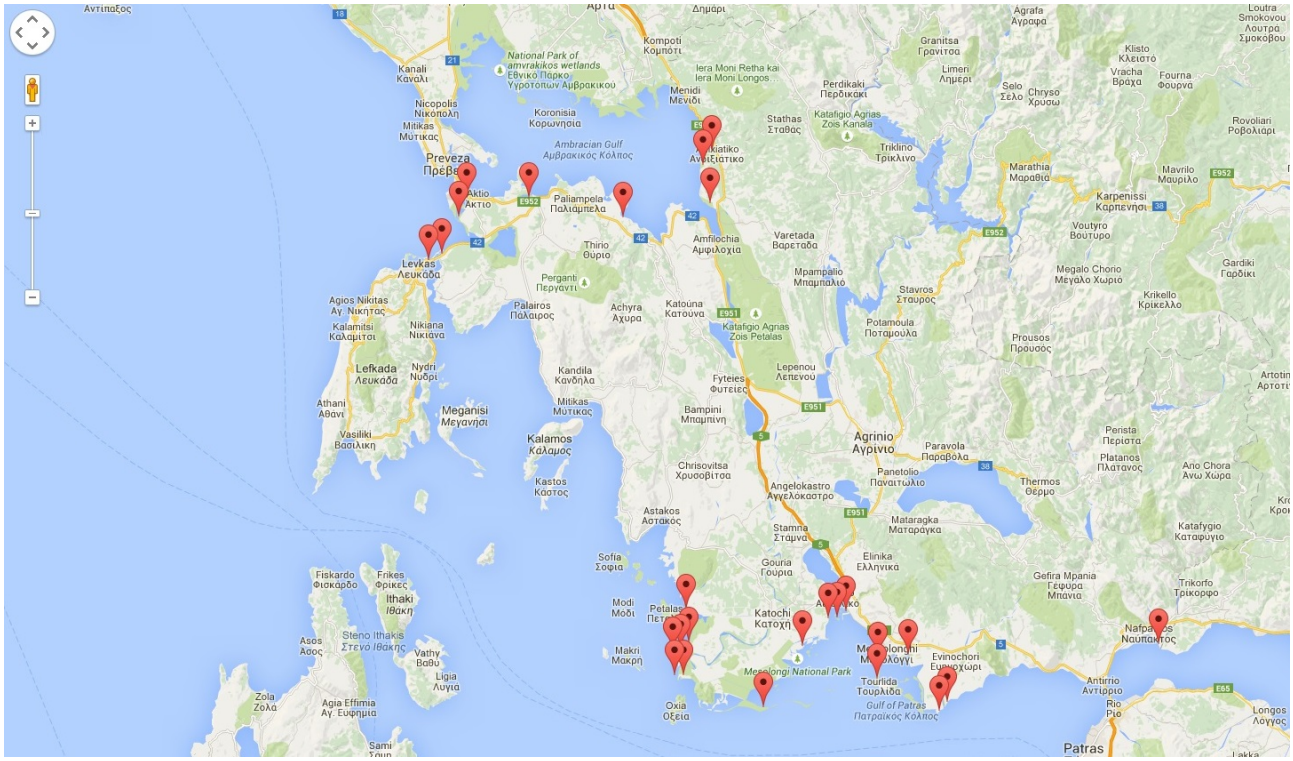

Figure 3.35: Land Use Query 6

4. CONCLUSIONS AND FUTURE WORK

In this work I demonstrated how four existing ontologies for geospatial data (Greek Administrative Geography, Public Transport, Public Buildings and Land Use), are constructed in order to become INSPIRE-compliant. Having as a basis the four INSPIRE Data Specification and Technical Guidelines packages, I constructed ontologies that contain all information needed to represent data related to each of the themes. These ontologies have been reshaped and extended, wherever it was necessary, after they were closely studied. This was the greatest challenge of this project, considering the various incompatibilities between the INSPIRE and the preexisting ontologies. Following that process, the Geotriples tool was used to convert the shapefile data to RDF form, again using each ontology. Finally, in order to demonstrate the results the four datasets have been uploaded to Strabon Server where indicative queries were performed against each dataset. The result was a study of the procedure of converting existing geospatial datasets, so they become compliant with the INSPIRE Directive.

There are various ways to expand this project and ameliorate the process of converting a geospatial dataset to become INSPIRE-compliant. Firstly, the most crucial future extension would be the use of the methodology presented in this thesis to convert the datasets of other INSPIRE themes. The further atomization of the methodology using a user interface, would also be an important next step. In addition, more data could be collected in the future, with the purpose of providing more detailed results. For example, Public Transport ontology could include information about the various itineraries or Land Use could provide expected output per year for a field. Moreover, datasets could be combined, to support for example queries about land usage in a specific municipality. Of course, this would become possible when the country's public sector acquire a program dedicated to that purpose. Finally, a semi-automated tool like geotriples could be more Greek-oriented, in order to avoid encoding issues with Greek data.

Table 4.1: LIST OF ABBREVIATIONS

AI	Artificial Intelligence
OWL	Web Ontology Language
RDF	Resource Description Framework
stRDF	space time Resource Description Framework
LOD	Linked Open Data
OGC	Open Geospatial Consortium
WKT	Well Known Text
SPARQL	SPARQL Protocol and RDF Query Language
stSPARQL	space time SPARQL Protocol and RDF Query Language
GeoSPARQL	Geospatial SPARQL Protocol and RDF Query Language
URI	Universal Resource Identifier
INSPIRE	Infrastructure for Spatial Information in the European Community
GAG	Greek Administrative Geography
XML	Extensible Markup Language

APPENDIX I

Mapping files (R2RML)

A.1 Greek Administrative Geography

```
@prefix geof: <http://www.opengis.net/def/function/geosparql/>.
@prefix map: <#>.
@prefix ogc: <http://www.opengis.net/ont/geosparql#>.
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix rr: <http://www.w3.org/ns/r2rml#>.
@prefix rrx: <http://www.w3.org/ns/r2rml-ext#>.
@prefix rrxf: <http://www.w3.org/ns/r2rml-ext/functions/def/>.
@prefix vocab: <ontology#>.
@prefix xsd: <http://www.w3.org/2001/XMLSchema#>.

map:oria_dhmwn_kallikraths_geometry
  rr:logicalTable [ rr:tableName "'oria_dhmwn_kallikraths'"; ];
  rr:subjectMap [ rr:class ogc:Geometry; rr:template "http://data.linkedeodata.eu/oria_dhmwn_kallikraths/Geometry/'gid'"; ];
  rr:predicateObjectMap [
      rr:predicate rdfs:label;
      rr:objectMap [
            rr:termType rr:Literal;
            rr:template "oria_dhmwn_kallikraths_geometry #'gid'";
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:asGML;
      rr:objectMap [
            rr:datatype <http://opengis.net/ont/geosparql#gmlLiteral>;
            rrx:transformation [ rrx:function rrxf:asGML; rrx:argumentMap [
                        rr:column "'the_geom'";
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:hasSerialization;
      rr:objectMap [
            rr:datatype ogc:wktLiteral;
            rrx:transformation [ rrx:function rrxf:hasSerialization; rrx:argumentMap [
                        rr:column "'the_geom'";
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:asWKT;
      rr:objectMap [
            rr:datatype ogc:wktLiteral;
            rrx:transformation [ rrx:function rrxf:asWKT; rrx:argumentMap [
                        rr:column "'the_geom'";
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:isSimple;
      rr:objectMap [
            rr:datatype xsd:boolean;
            rrx:transformation [ rrx:function rrxf:isSimple; rrx:argumentMap [
                        rr:column "'the_geom'";
                  ]; ];
      ];
  ];
```

```
  rr:predicateObjectMap [
      rr:predicate ogc:dimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:dimension; rrx:argumentMap [
                        rr:column "‘the_geom‘";
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:is3D;
      rr:objectMap [
            rr:datatype xsd:boolean;
            rrx:transformation [ rrx:function rrxf:is3D; rrx:argumentMap [
                        rr:column "‘the_geom‘";
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:spatialDimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:spatialDimension; rrx:argumentMap [
                        rr:column "‘the_geom‘";
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:coordinateDimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:coordinateDimension; rrx:argumentMap [
                        rr:column "‘the_geom‘";
                  ]; ];
      ];
  ];
  .
map:oria_dhmwn_kallikraths
  rr:logicalTable [ rr:tableName "‘oria_dhmwn_kallikraths‘"; ];
  rr:subjectMap [ rr:class vocab:AdministrativeUnit; rr:template "http://data.linkedeodata.eu/oria_dhmwn_kallikraths/id/‘gid‘"; ];
  rr:predicateObjectMap [
      rr:predicate ogc:hasGeometry;
      rr:objectMap [
            rr:parentTriplesMap map:oria_dhmwn_kallikraths_geometry;
            rr:joinCondition [ rr:child "gid"; rr:parent "gid"; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate rdfs:label;
      rr:objectMap [
            rr:termType rr:Literal;
            rr:template "oria_dhmwn_kallikraths #‘gid‘";
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate vocab:nationalLevelName;
      rr:objectMap [
            rr:datatype xsd:string;
            rr:column "‘NAME‘";
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate vocab:nationalCode;
      rr:objectMap [
            rr:datatype xsd:string;
            rr:column "‘KWD_YPES‘";
      ];
  ];
  .
```

A.2 Public Transport

```
@prefix geof: <http://www.opengis.net/def/function/geosparql/>.
@prefix map: <#>.
@prefix ogc: <http://www.opengis.net/ont/geosparql#>.
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix rr: <http://www.w3.org/ns/r2rml#>.
@prefix rrx: <http://www.w3.org/ns/r2rml-ext#>.
@prefix rrxf: <http://www.w3.org/ns/r2rml-ext/functions/def/>.
@prefix vocab: <ontology#>.
@prefix xsd: <http://www.w3.org/2001/XMLSchema#>.

map:stathmoi_k_staseis_oasa_geometry
  rr:logicalTable [ rr:tableName ”‘stathmoi_k_staseis_oasa‘”; ];
  rr:subjectMap [ rr:class ogc:Geometry; rr:template ”http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/Geometry/‘gid‘”; ];
  rr:predicateObjectMap [
      rr:predicate rdfs:label;
      rr:objectMap [
            rr:termType rr:Literal;
            rr:template ”stathmoi_k_staseis_oasa_geometry #‘gid‘”;
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:asGML;
      rr:objectMap [
            rr:datatype <http://opengis.net/ont/geosparql#gmlLiteral>;
            rrx:transformation [ rrx:function rrxf:asGML; rrx:argumentMap [
                        rr:column ”‘the_geom‘”;
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:is3D;
      rr:objectMap [
            rr:datatype xsd:boolean;
            rrx:transformation [ rrx:function rrxf:is3D; rrx:argumentMap [
                        rr:column ”‘the_geom‘”;
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:spatialDimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:spatialDimension; rrx:argumentMap [
                        rr:column ”‘the_geom‘”;
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:coordinateDimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:coordinateDimension; rrx:argumentMap [
                        rr:column ”‘the_geom‘”;
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:asWKT;
      rr:objectMap [
            rr:datatype ogc:wktLiteral;
            rrx:transformation [ rrx:function rrxf:asWKT; rrx:argumentMap [
                        rr:column ”‘the_geom‘”;
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:hasSerialization;
      rr:objectMap [
            rr:datatype ogc:wktLiteral;
            rrx:transformation [ rrx:function rrxf:hasSerialization; rrx:argumentMap [
                        rr:column ”‘the_geom‘”;
                  ]; ];
      ];
```

```
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:isSimple;
      rr:objectMap [
            rr:datatype xsd:boolean;
            rrx:transformation [ rrx:function rrxf:isSimple; rrx:argumentMap [
                        rr:column "‘the_geom‘";
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:dimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:dimension; rrx:argumentMap [
                        rr:column "‘the_geom‘";
                  ]; ];
      ];
  ];
  .
map:stathmoi_k_staseis_oasa
  rr:logicalTable [ rr:tableName "‘stathmoi_k_staseis_oasa‘"; ];
  rr:subjectMap [ rr:class vocab:Stop; rr:template "http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/id/‘gid‘"; ];
  rr:predicateObjectMap [
      rr:predicate vocab:geographicalName;
      rr:objectMap [
            rr:datatype xsd:string;
            rr:column "‘name‘";
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate vocab:hasRoadName;
      rr:objectMap [
            rr:template "http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/RoadName/id/‘gid‘";
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:hasGeometry;
      rr:objectMap [
            rr:parentTriplesMap map:stathmoi_k_staseis_oasa_geometry;
            rr:joinCondition [ rr:child "gid"; rr:parent "gid"; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate rdfs:label;
      rr:objectMap [
            rr:termType rr:Literal;
            rr:template "stathmoi_k_staseis_oasa #‘gid‘";
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate vocab:mode;
      rr:objectMap [
            rr:datatype xsd:string;
            rr:column "‘mode‘";
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate vocab:scode;
      rr:objectMap [
            rr:datatype xsd:string;
            rr:column "‘scode‘";
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate vocab:inspireId;
      rr:objectMap [
            rr:datatype xsd:integer;
            rr:column "‘id‘";
      ];
  ];
  .
map:dromoi
  rr:logicalTable [ rr:tableName "‘stathmoi_k_staseis_oasa‘"; ];
  rr:subjectMap [ rr:class vocab:RoadName; rr:template "http://data.linkedeodata.eu/stathmoi_k_staseis_oasa/RoadName/id/‘gid‘"; ];
  rr:predicateObjectMap [
```

```
        rr:predicate vocab:geographicalName;
        rr:objectMap [
                rr:datatype xsd:string;
                rr:column "‘street‘";
        ];
  ];
.
```

A.3 Public Buildings

```
@prefix geof: <http://www.opengis.net/def/function/geosparql/>.
@prefix map: <#>.
@prefix ogc: <http://www.opengis.net/ont/geosparql#>.
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix rr: <http://www.w3.org/ns/r2rml#>.
@prefix rrx: <http://www.w3.org/ns/r2rml-ext#>.
@prefix rrxf: <http://www.w3.org/ns/r2rml-ext/functions/def/>.
@prefix vocab: <ontology#>.
@prefix xsd: <http://www.w3.org/2001/XMLSchema#>.

map:dhmosia_kthria_geometry
  rr:logicalTable [ rr:tableName "‘dhmosia_kthria‘"; ];
  rr:subjectMap [ rr:class ogc:Geometry; rr:template "http://data.linkedeodata.eu/dhmosia_kthria/Geometry/‘gid‘"; ];
  rr:predicateObjectMap [
        rr:predicate ogc:coordinateDimension;
        rr:objectMap [
                rr:datatype xsd:integer;
                rrx:transformation [ rrx:function rrxf:coordinateDimension; rrx:argumentMap [
                                rr:column "‘the_geom‘";
                        ]; ];
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate ogc:is3D;
        rr:objectMap [
                rr:datatype xsd:boolean;
                rrx:transformation [ rrx:function rrxf:is3D; rrx:argumentMap [
                                rr:column "‘the_geom‘";
                        ]; ];
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate ogc:spatialDimension;
        rr:objectMap [
                rr:datatype xsd:integer;
                rrx:transformation [ rrx:function rrxf:spatialDimension; rrx:argumentMap [
                                rr:column "‘the_geom‘";
                        ]; ];
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate rdfs:label;
        rr:objectMap [
                rr:termType rr:Literal;
                rr:template "dhmosia_kthria_geometry #‘gid‘";
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate ogc:asGML;
        rr:objectMap [
                rr:datatype <http://opengis.net/ont/geosparql#gmlLiteral>;
                rrx:transformation [ rrx:function rrxf:asGML; rrx:argumentMap [
                                rr:column "‘the_geom‘";
                        ]; ];
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate ogc:dimension;
        rr:objectMap [
                rr:datatype xsd:integer;
                rrx:transformation [ rrx:function rrxf:dimension; rrx:argumentMap [
                                rr:column "‘the_geom‘";
                        ]; ];
```

```
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate ogc:isSimple;
        rr:objectMap [
            rr:datatype xsd:boolean;
            rrx:transformation [ rrx:function rrxf:isSimple; rrx:argumentMap [
                    rr:column "'the_geom'";
                ]; ];
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate ogc:hasSerialization;
        rr:objectMap [
            rr:datatype ogc:wktLiteral;
            rrx:transformation [ rrx:function rrxf:hasSerialization; rrx:argumentMap [
                    rr:column "'the_geom'";
                ]; ];
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate ogc:asWKT;
        rr:objectMap [
            rr:datatype ogc:wktLiteral;
            rrx:transformation [ rrx:function rrxf:asWKT; rrx:argumentMap [
                    rr:column "'the_geom'";
                ]; ];
        ];
    ];
    .
map:dhmosia_kthria
    rr:logicalTable [ rr:tableName "'dhmosia_kthria'"; ];
    rr:subjectMap [ rr:class vocab:Public_Building; rr:template "http://data.linkedeodata.eu/dhmosia_kthria/id/'gid'"; ];
    rr:predicateObjectMap [
        rr:predicate vocab:fourDigit;
        rr:objectMap [
            rr:datatype xsd:integer;
            rr:column "'TETRAPSIFI'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:type;
        rr:objectMap [
            rr:datatype xsd:string;
            rr:column "'TYPOS_1'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:serviceName;
        rr:objectMap [
            rr:datatype xsd:string;
            rr:column "'KTIRIO_YPI'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:belongstoMunicipality;
        rr:objectMap [
            rr:datatype xsd:string;
            rr:column "'DIMOS_1'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:regionName;
        rr:objectMap [
            rr:datatype xsd:string;
            rr:column "'NOMOS_1'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:A_A;
        rr:objectMap [
            rr:datatype xsd:integer;
            rr:column "'A_A_1'";
        ];
    ];
    rr:predicateObjectMap [
```

```
        rr:predicate ogc:hasGeometry;
        rr:objectMap [
                rr:parentTriplesMap map:dhmosia_kthria_geometry;
                rr:joinCondition [ rr:child ”gid”; rr:parent ”gid”; ];
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate vocab:size;
        rr:objectMap [
                rr:datatype xsd:string;
                rr:column ”‘MEGETHOS_1‘”;
        ];
  ];
rr:predicateObjectMap [
        rr:predicate vocab:hasAddress;
        rr:objectMap [
                rr:template ”http://linkedopendata.gr/public-buildings/Address/id/‘gid‘”;
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate vocab:belongstoPrefecture;
        rr:objectMap [
                rr:datatype xsd:string;
                rr:column ”‘PERIFEREIA‘”;
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate rdfs:label;
        rr:objectMap [
                rr:termType rr:Literal;
                rr:template ”dhmosia_kthria #‘gid‘”;
        ];
  ];
  .

map:dhmosia_kthria_diefthinseis
  rr:logicalTable [ rr:tableName ”‘dhmosia_kthria‘”; ];
  rr:subjectMap [ rr:class vocab:dhmosia_kthria; rr:template ”http://linkedopendata.gr/public-buildings/Address/id/‘gid‘”; ];
  rr:predicateObjectMap [
        rr:predicate vocab:addressArea;
        rr:objectMap [
                rr:datatype xsd:string;
                rr:column ”‘DIEFTHINSI‘”;
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate vocab:number;
        rr:objectMap [
                rr:datatype xsd:string;
                rr:column ”‘ARITHMOS‘”;
        ];
  ];
  rr:predicateObjectMap [
        rr:predicate vocab:postCode;
        rr:objectMap [
                rr:datatype xsd:string;
                rr:column ”‘TK_1‘”;
        ];
  ];
.
```

A.4 Land Use

```
@prefix geof: <http://www.opengis.net/def/function/geosparql/>.
@prefix map: <#>.
@prefix ogc: <http://www.opengis.net/ont/geosparql#>.
@prefix rdf: <http://www.w3.org/1999/02/22-rdf-syntax-ns#>.
@prefix rdfs: <http://www.w3.org/2000/01/rdf-schema#>.
@prefix rr: <http://www.w3.org/ns/r2rml#>.
@prefix rrx: <http://www.w3.org/ns/r2rml-ext#>.
@prefix rrxf: <http://www.w3.org/ns/r2rml-ext/functions/def/>.
@prefix vocab: <ontology#>.
@prefix xsd: <http://www.w3.org/2001/XMLSchema#>.

map:CLC2000_CENT_GREECE_geometry
  rr:logicalTable [ rr:tableName "'CLC2000_CENT_GREECE'"; ];
  rr:subjectMap [ rr:class ogc:Geometry; rr:template "http://data.linkedeodata.eu/CLC2000_CENT_GREECE/Geometry/'gid'"; ];
  rr:predicateObjectMap [
      rr:predicate ogc:hasSerialization;
      rr:objectMap [
            rr:datatype ogc:wktLiteral;
            rrx:transformation [ rrx:function rrxf:hasSerialization; rrx:argumentMap [
                        rr:column "'the_geom'"; 
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:asWKT;
      rr:objectMap [
            rr:datatype ogc:wktLiteral;
            rrx:transformation [ rrx:function rrxf:asWKT; rrx:argumentMap [
                        rr:column "'the_geom'"; 
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:isSimple;
      rr:objectMap [
            rr:datatype xsd:boolean;
            rrx:transformation [ rrx:function rrxf:isSimple; rrx:argumentMap [
                        rr:column "'the_geom'"; 
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:dimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:dimension; rrx:argumentMap [
                        rr:column "'the_geom'"; 
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:is3D;
      rr:objectMap [
            rr:datatype xsd:boolean;
            rrx:transformation [ rrx:function rrxf:is3D; rrx:argumentMap [
                        rr:column "'the_geom'"; 
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:spatialDimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:spatialDimension; rrx:argumentMap [
                        rr:column "'the_geom'"; 
                  ]; ];
      ];
  ];
  rr:predicateObjectMap [
      rr:predicate ogc:coordinateDimension;
      rr:objectMap [
            rr:datatype xsd:integer;
            rrx:transformation [ rrx:function rrxf:coordinateDimension; rrx:argumentMap [
                        rr:column "'the_geom'"; 
```

```
                    ]; ];
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate rdfs:label;
        rr:objectMap [
            rr:termType rr:Literal;
            rr:template "CLC2000_CENT_GREECE_geometry #'gid'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate ogc:asGML;
        rr:objectMap [
            rr:datatype <http://opengis.net/ont/geosparql#gmlLiteral>;
            rrx:transformation [ rrx:function rrxf:asGML; rrx:argumentMap [
                        rr:column "'the_geom'";
                    ]; ];
        ];
    ];
    .
map:CLC2000_CENT_GREECE
    rr:logicalTable [ rr:tableName "'CLC2000_CENT_GREECE'"; ];
    rr:subjectMap [ rr:class vocab:SampledLandUse; rr:template "http://data.linkedeodata.eu/CLC2000_CENT_GREECE/id/'gid'"; ];
    rr:predicateObjectMap [
        rr:predicate rdfs:label;
        rr:objectMap [
            rr:termType rr:Literal;
            rr:template "CLC2000_CENT_GREECE #'gid'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:p00GR_ID;
        rr:objectMap [
            rr:datatype xsd:integer;
            rr:column "'P00_GR_ID'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:CODE;
        rr:objectMap [
            rr:datatype xsd:double;
            rr:column "'CODE_00'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:dfxSize;
        rr:objectMap [
            rr:datatype xsd:integer;
            rr:column "'DXF_SIZE'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:dfxLayer;
        rr:objectMap [
            rr:datatype xsd:string;
            rr:column "'DXF_LAYER'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:region;
        rr:objectMap [
            rr:datatype xsd:string;
            rr:column "'NOMOS'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:hasShape_Area;
        rr:objectMap [
            rr:datatype xsd:double;
            rr:column "'AREA'";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:dfxColor;
        rr:objectMap [
            rr:datatype xsd:integer;
```

```
            rr:column "‘DXF_COLOR‘";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:hasShape_Perimeter;
        rr:objectMap [
            rr:datatype xsd:double;
            rr:column "‘PERIMETER‘";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:dfxText;
        rr:objectMap [
            rr:datatype xsd:string;
            rr:column "‘DXF_TEXT‘";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate vocab:p00GR;
        rr:objectMap [
            rr:datatype xsd:integer;
            rr:column "‘P00_GR_‘";
        ];
    ];
    rr:predicateObjectMap [
        rr:predicate ogc:hasGeometry;
        rr:objectMap [
            rr:parentTriplesMap map:CLC2000_CENT_GREECE_geometry;
            rr:joinCondition [ rr:child "gid"; rr:parent "gid"; ];
        ];
    ];
    .
```

REFERENCES

[1] The Linking Open Data cloud diagram, 2014. http://lod-cloud.net/.

[2] W3C. RDF 1.1 Primer, 2014. http://www.w3.org/TR/2014/NOTE-rdf11-primer-20140225/.

[3] W3C. SPARQL Query Language for RDF, 2008. http://www.w3.org/TR/rdf-sparql-query/#syntaxTerms/.

[4] Manolis Koubarakis, Manos Karpathiotakis, Kostis Kyzirakos, Charalampos Nikolaou, and Michael Sioutis. Data Models and Query Languages for Linked Geospatial Data. Technical report, Department of Informatics and Telecommunications, National and Kapodistrian University of Athens, 2012. http://strabon.di.uoa.gr/files/survey.pdf.

[5] INSPIRE Thematic Working Group Administrative Units, European Commission Joint Research Centre. D2.8.I.2 Data Specification on Administrative Units – Technical Guidelines, 2014. http://inspire.ec.europa.eu/cms/_code_5200.cfm?tn=Administrative%20units&tid=4&ABR=au.

[6] INSPIRE Thematic Working Group Transport Networks, European Commission Joint Research Centre. D2.8.I.7 Data Specification on Transport Networks – Technical Guidelines, 2014. http://inspire.ec.europa.eu/cms/_code_5200.cfm?tn=Transport%20networks&tid=5&ABR=tn.

[7] INSPIRE Thematic Working Group Buildings, European Commission Joint Research Centre. D2.8.III.2 INSPIRE Data Specification on Buildings – Technical Guidelines, 2013. http://inspire.ec.europa.eu/cms/_code_5200.cfm?tn=Buildings&tid=13&ABR=bu.

[8] INSPIRE Thematic Working Group Land Use, European Commission Joint Research Centre. D2.8.III.4 INSPIRE Data Specification on Land Use – Technical Guidelines, 2013. http://inspire.ec.europa.eu/cms/_code_5200.cfm?tn=Land%20use&tid=16&ABR=lu.

[9] Greek Linked Open Data: Greek Administrative Geography. http://www.linkedopendata.gr/dataset/greek-administrative-geography.

[10] Greek Linked Open Data: Public Transport. http://www.linkedopendata.gr/dataset/public-transport.

[11] Greek Linked Open Data: Public Buildings. http://www.linkedopendata.gr/dataset/public-buildings.

[12] Greek Linked Open Data: Corine Land Cover of Greece. http://www.linkedopendata.gr/dataset/corine-land-cover-of-greece.

[13] Kostis Kyzirakos, Ioannis Vlachopoulos, Dimitrianos Savva, Stefan Manegold, and Manolis Koubarakis. GeoTriples: a Tool for Publishing Geospatial Data as RDF Graphs Using R2RML Mappings. Technical report, Department of Informatics and Telecommunications, National and Kapodistrian University of Athens, 2014. http://linkedeodata.eu/publications/iswc-2014-terracognita.pdf.

[14] Kostis Kyzirakos, Manos Karpathiotakis, and Manolis Koubarakis. Strabon: A Semantic Geospatial DBMS. Technical report, Department of Informatics and Telecommunications, National and Kapodistrian University of Athens, 2012. http://www.strabon.di.uoa.gr/files/iswc-strabon.pdf.

[15] Οργανισμός Κτηματολογίου και Χαρτογραφήσεων Ελλάδας. Greek Linked Open GeoData: Municipality Borders (Kallikratis), 2010. http://geodata.gov.gr/geodata/index.php?option=com_sobi2&sobi2Task=sobi2Details&catid=16&sobi2Id=182&Itemid=.

[16] Οργανισμός Αστικών Συγκοινωνιών Αθηνών. Greek Linked Open GeoData: Stops and Stations of Athens Public Transport, 2011. http://http://geodata.gov.gr/geodata/index.php?option=com_sobi2&sobi2Task=sobi2Details&catid=29&sobi2Id=187&Itemid=.

[17] Greek Linked Open GeoData: Public Buildings, 2011. http://geodata.gov.gr/geodata/index.php?option=com_sobi2&sobi2Task=sobi2Details&catid=17&sobi2Id=29&Itemid=.

[18] Greek Linked Open GeoData: Corine 2000, 2010. http://geodata.gov.gr/geodata/index.php?option=com_sobi2&sobi2Task=sobi2Details&catid=16&sobi2Id=54&Itemid=.