An interface for Exploiting Spatio-temporal Heterogeneous Data (Environmental data, Ship Trajectory)

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Outline

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4. Exploitating heterogeneous spatio-temporal data through a Web interface
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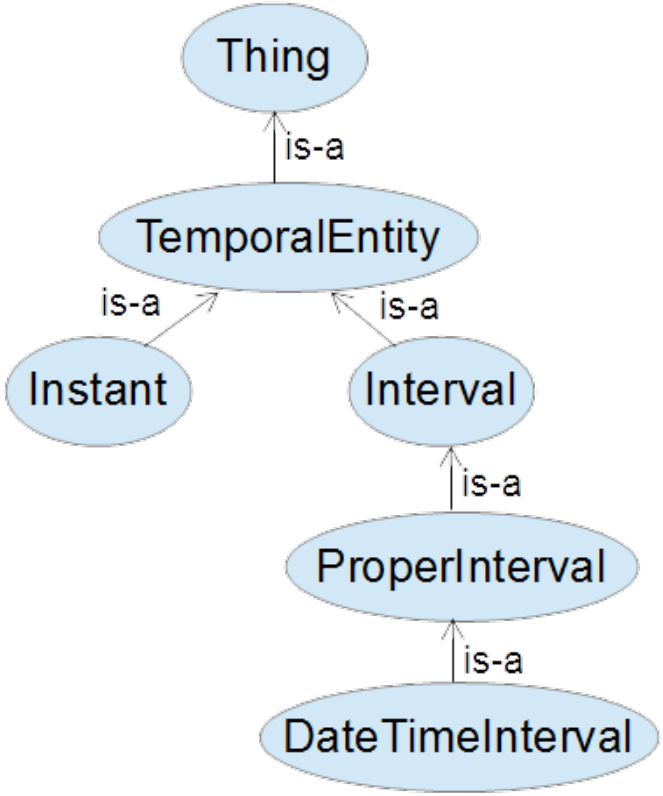
    2. DéAIS (Detection of faked AIS messages)
6. Conclusion & perspectives &future work

Introduction

- **Environmental data (spatio-temporal)**
  - Data Integration
  - A semantic web approach (RDF, OWL)
  - A web interface

Semantic integration

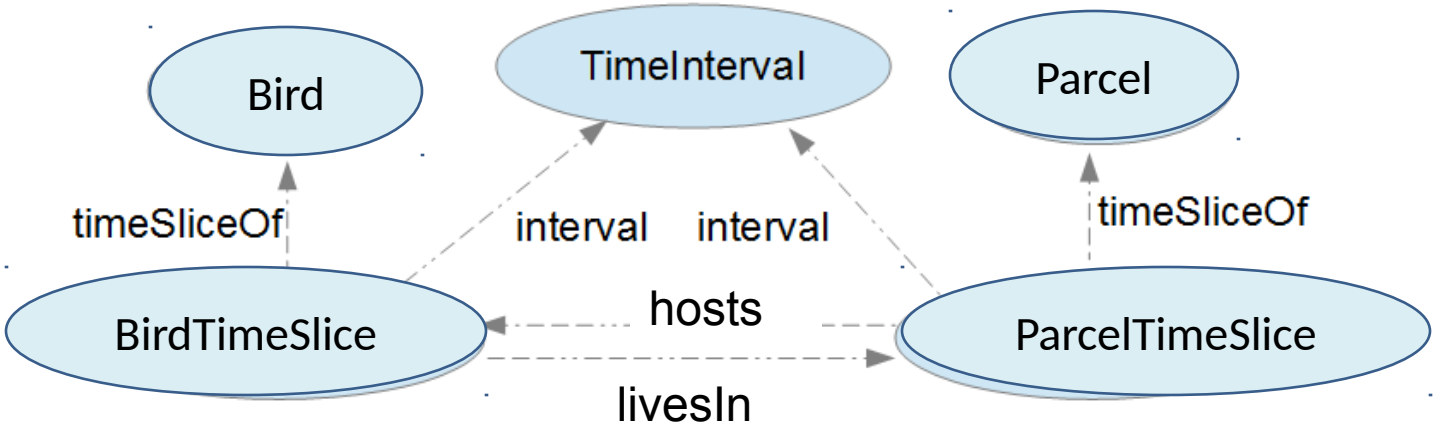
- **Ontology of time & ontology of fluent**
  - OWL-Time
    - Formalized in OWL
    - Recommended by the W3C
    - Dedicated to the concepts and temporal relationships as defined in the theory of Allen
      - intervalBefore
      - intervalMeets
      - intervalDuring
      - **inside**
      - …



An extract of OWL-Time

Semantic integration

- **Ontology of time & ontology of fluent**
  - Ontology of fluent
    - Represents properties of an entity over time as fluents
    - *4D-fluent:*
      - Introduces the TimeSlice classe
      - Enables diachronic relations in the Semantic Web



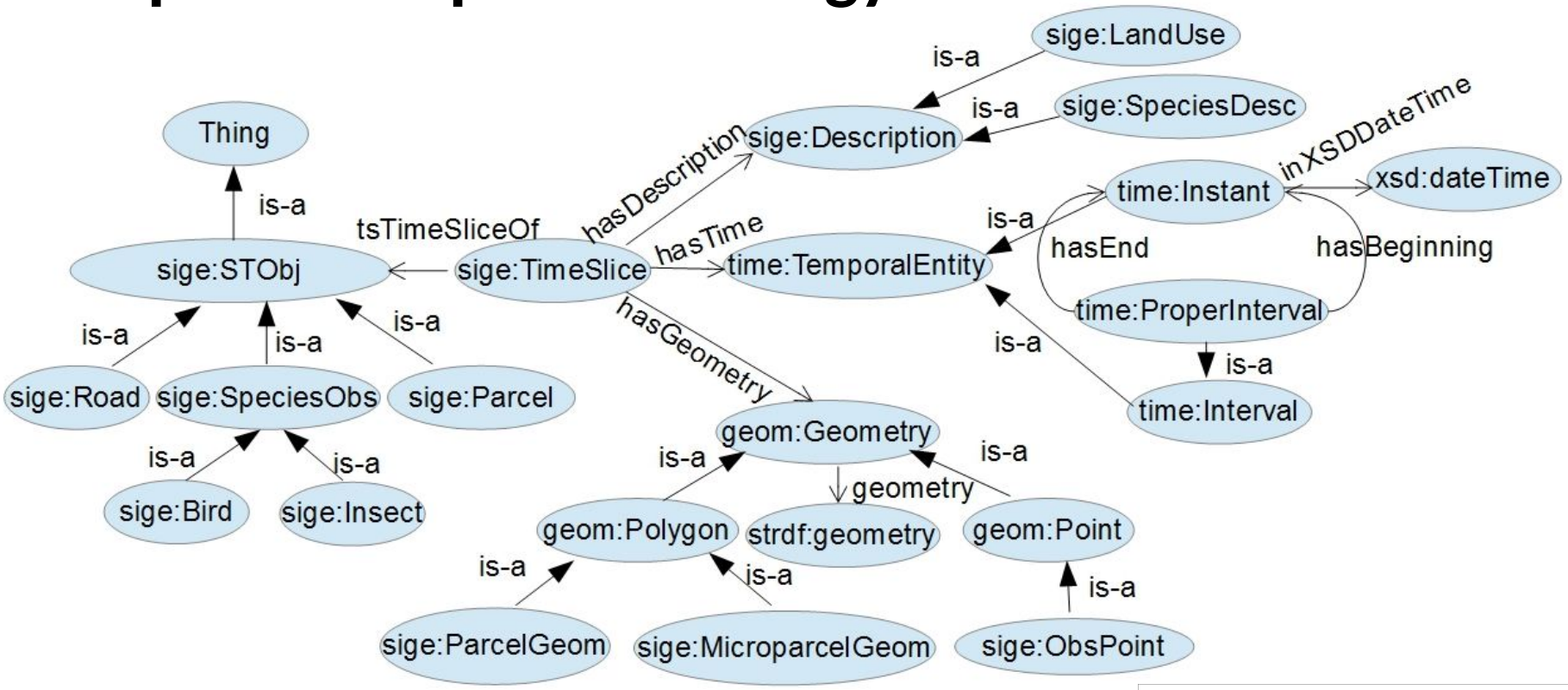
An example of the 4D-fluent approach

Semantic integration

- **A spatio-temporal ontology for environment**
  - Based on the *4-D fluent* approach
  - Inspired by the *Continuum* model
  - As a semantic mediator to integrate data sets
  - Generalizing the *Interval* class to the *TemporalEntity* class of OWL-Time
  - Spatio-temporal reasoning mechanism: temporal SWRL rules and spatial functions of the triplestore, sparql update

Semantic integration

- **A spatio-temporal ontology for environment**

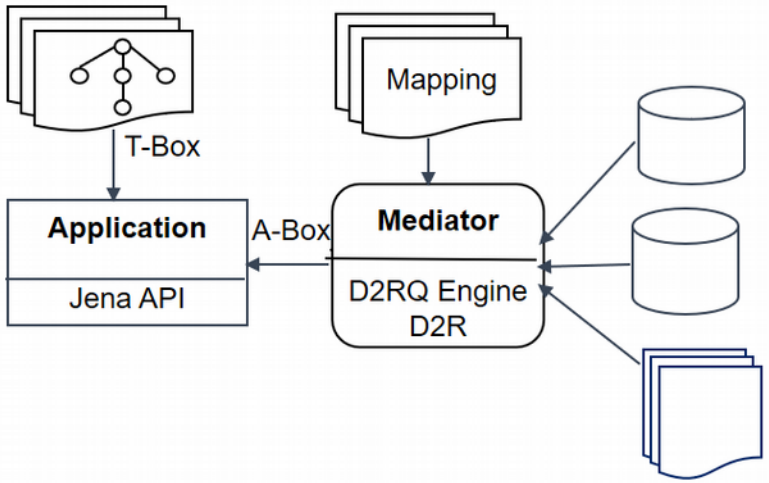


A spatio-temporal ontology for environment

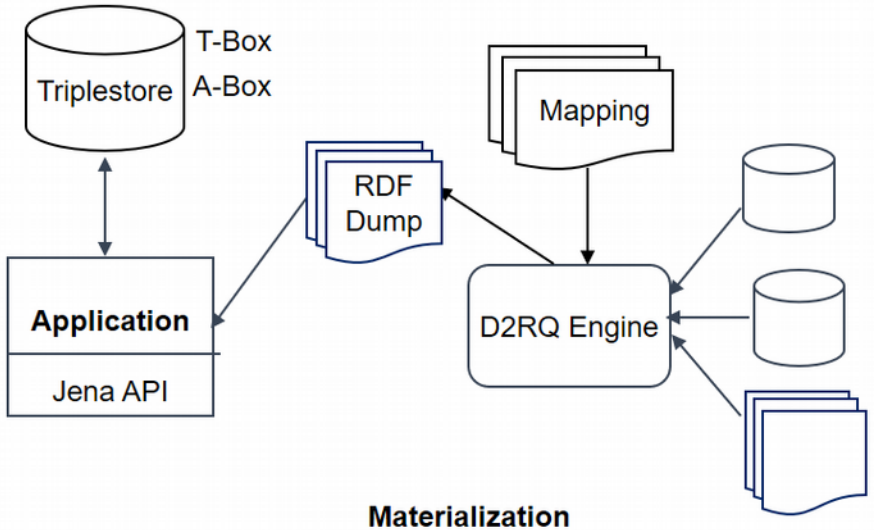
sige	http://gemina.univ-lr.fr/owlSigE#
geo	http://geovocab.org/spatial#
time	http://www.w3.org/2006/time#
strdf	http://strdf.di.uoa.gr/ontology#

Semantic integration

- **Mapping**
  - On-demand mapping
  - Materialization
  - Materialization best query performance / update



On-demand mapping



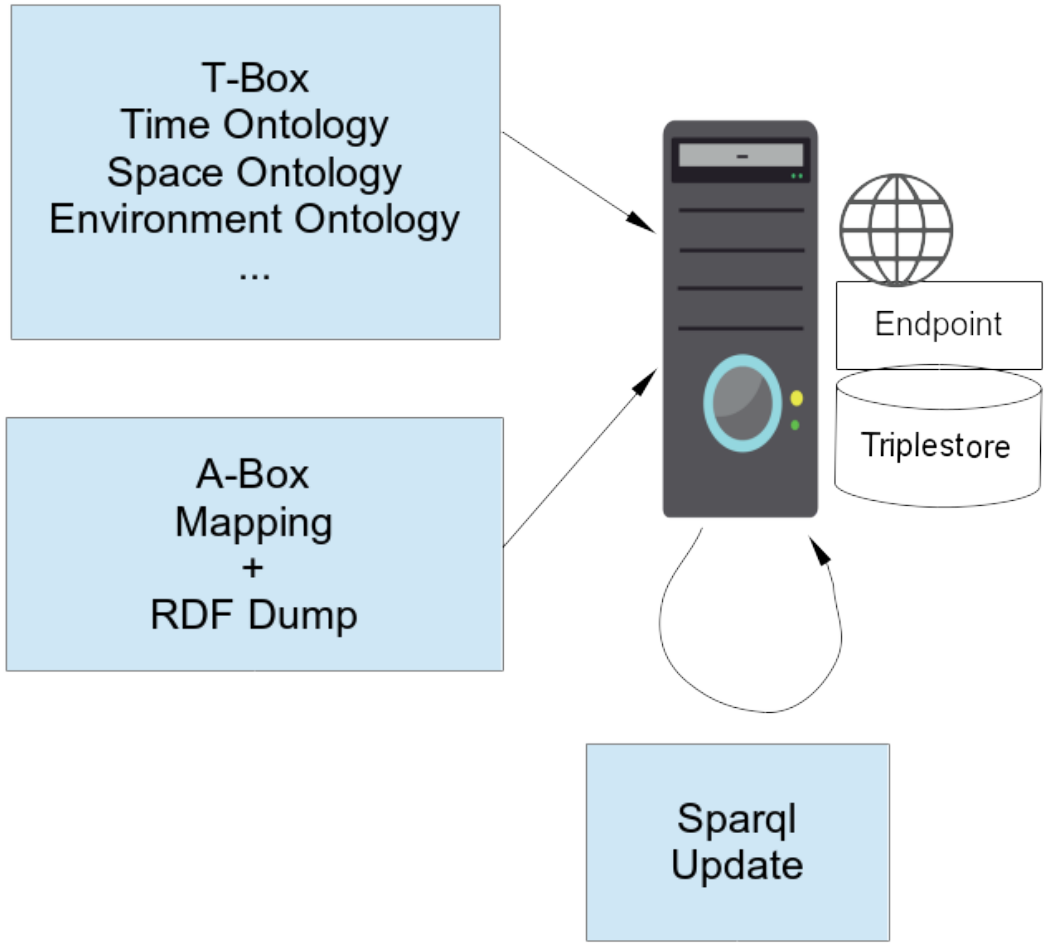
Materialization

Geospatial knowledge base

- **A geospatial-triplestore-based knowledge base**
  - Knowledge base (T-Box,A-Box)
  - Geospatial triplestore (Strabon)
    - Sesame – PostgreSQL/Postgis
    - Web Interface
  - SPARQL Construct or SPARQL Update are used to enrich data with expert knowledge

Geospatial knowledge base

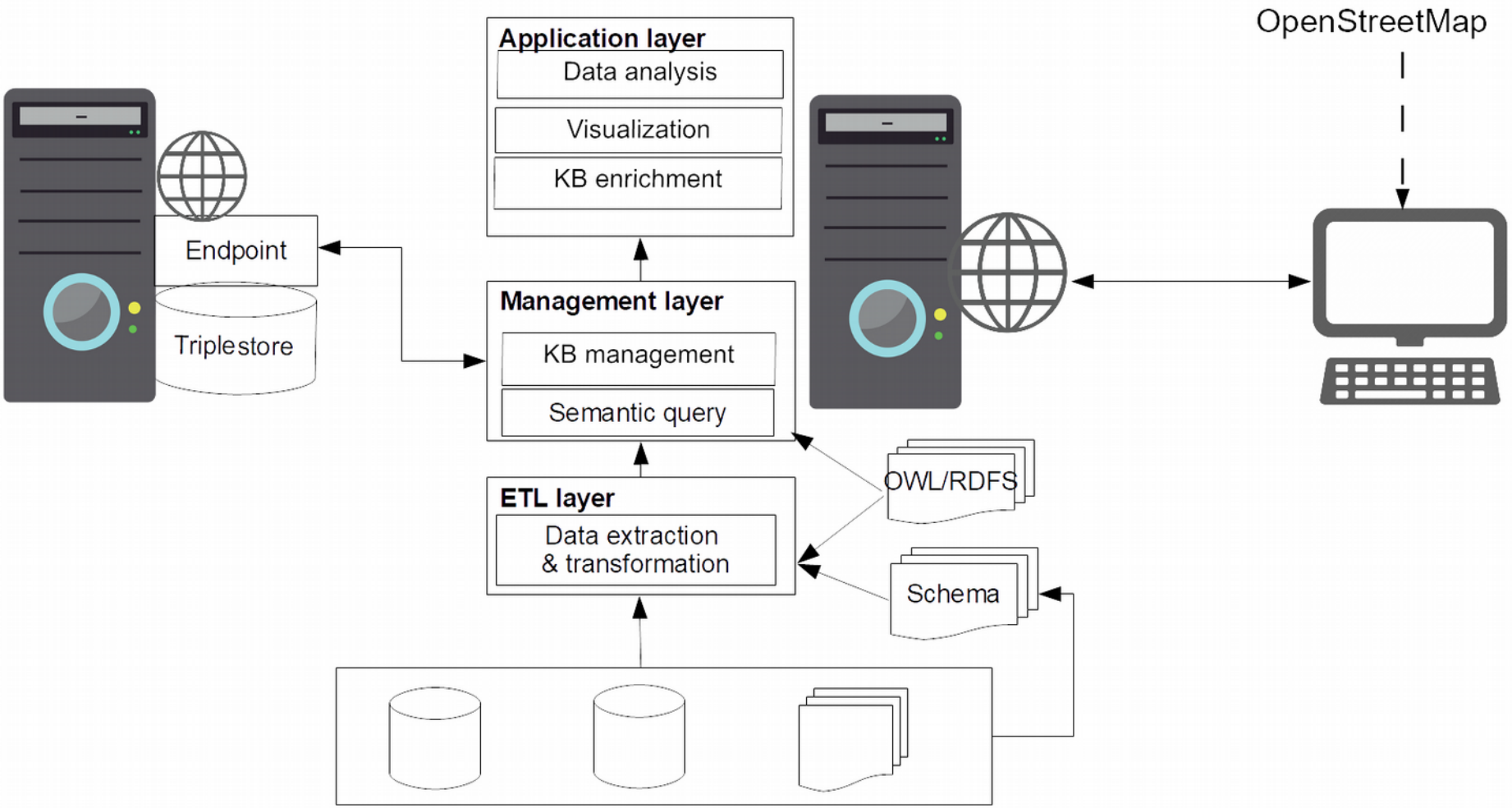
knowledge base



Heterogeneous spatio-temporal data

- **Exploiting heterogeneous spatio-temporal data**
  - Web Interface
  - 3 layers
    - ETL (Extract, Transform, Load)
    - Management layer
      - semantic query module
      - KB management module
    - Application layer
      - Visualization module
      - Knowledge base enrichment module
      - Data analysis module

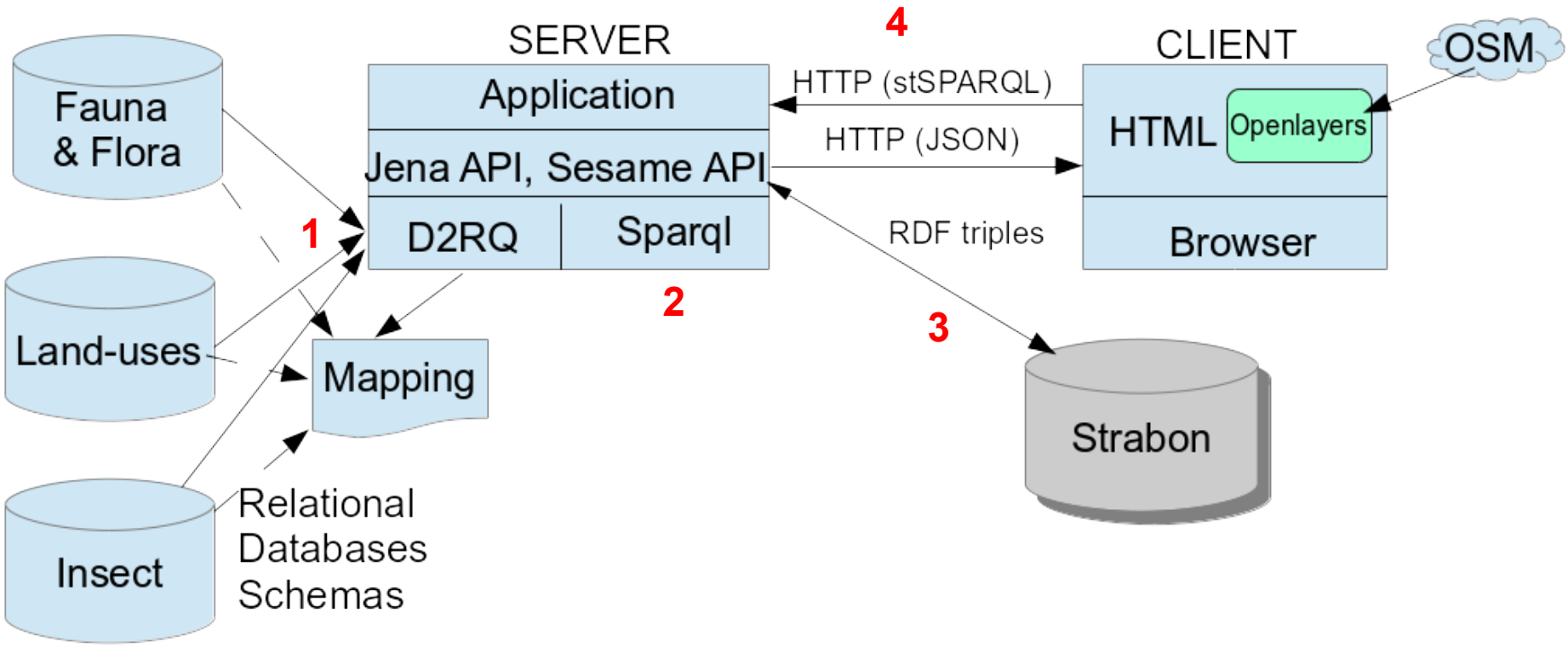
Heterogeneous spatio-temporal data



Heterogeneous spatio-temporal data

The framework consists of:

1. Data translation
2. Temporal relation inference
3. Triplestore load
4. data preparation and visualization.



Application

- **Application**

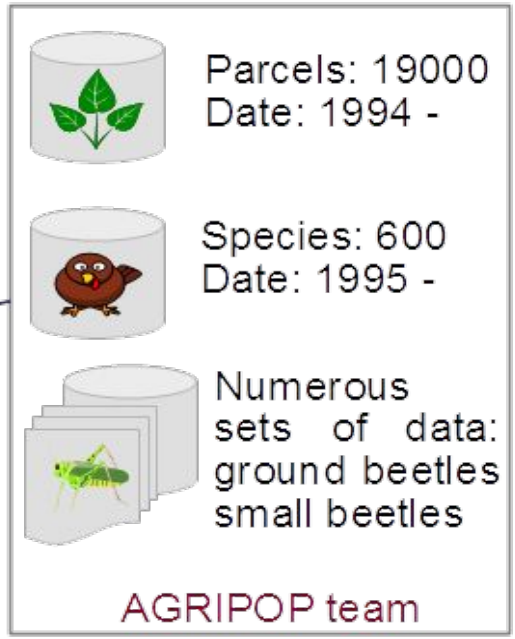
  in two different use cases

  - “GEMINAT” (Environment and landscape geo-knowledge)

  - “DéAIS” (Detection of faked AIS messages)

Application-“GEMINAT”

- **The ”Plaine & Val de Sèvre” workshop observatory**
  - Established by the UMR Chizé in 1994
  - Seeks for relationships between agricultural practices and ecological processes

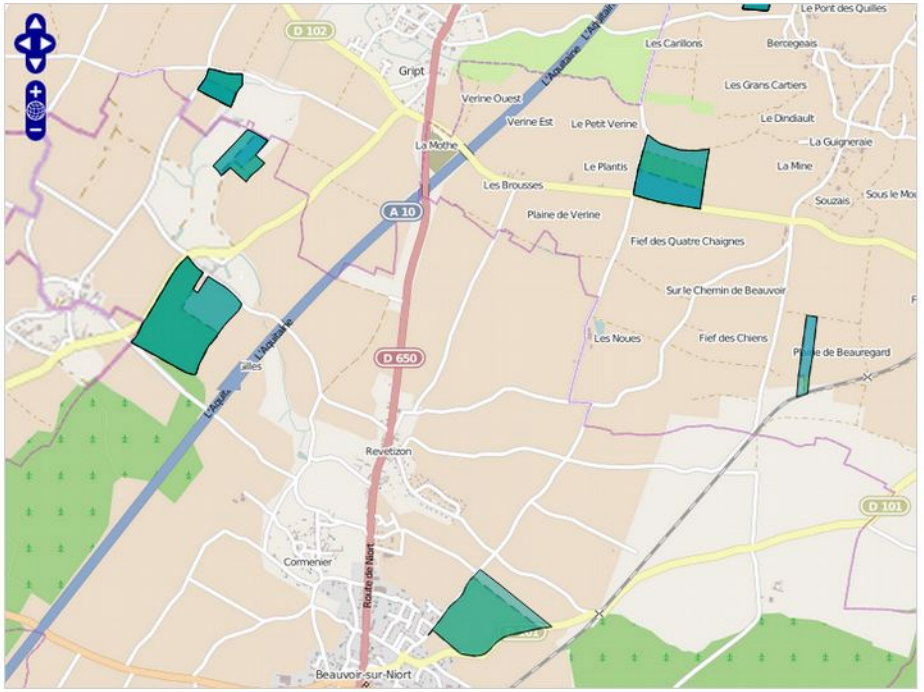


More on : http://www.za.plainevalsevre.cnrs.fr/

Application-“GEMINAT”

- Search for correlations between crop rotations and biodiversity
- Changes of limits discovery
- Data anomalies detection

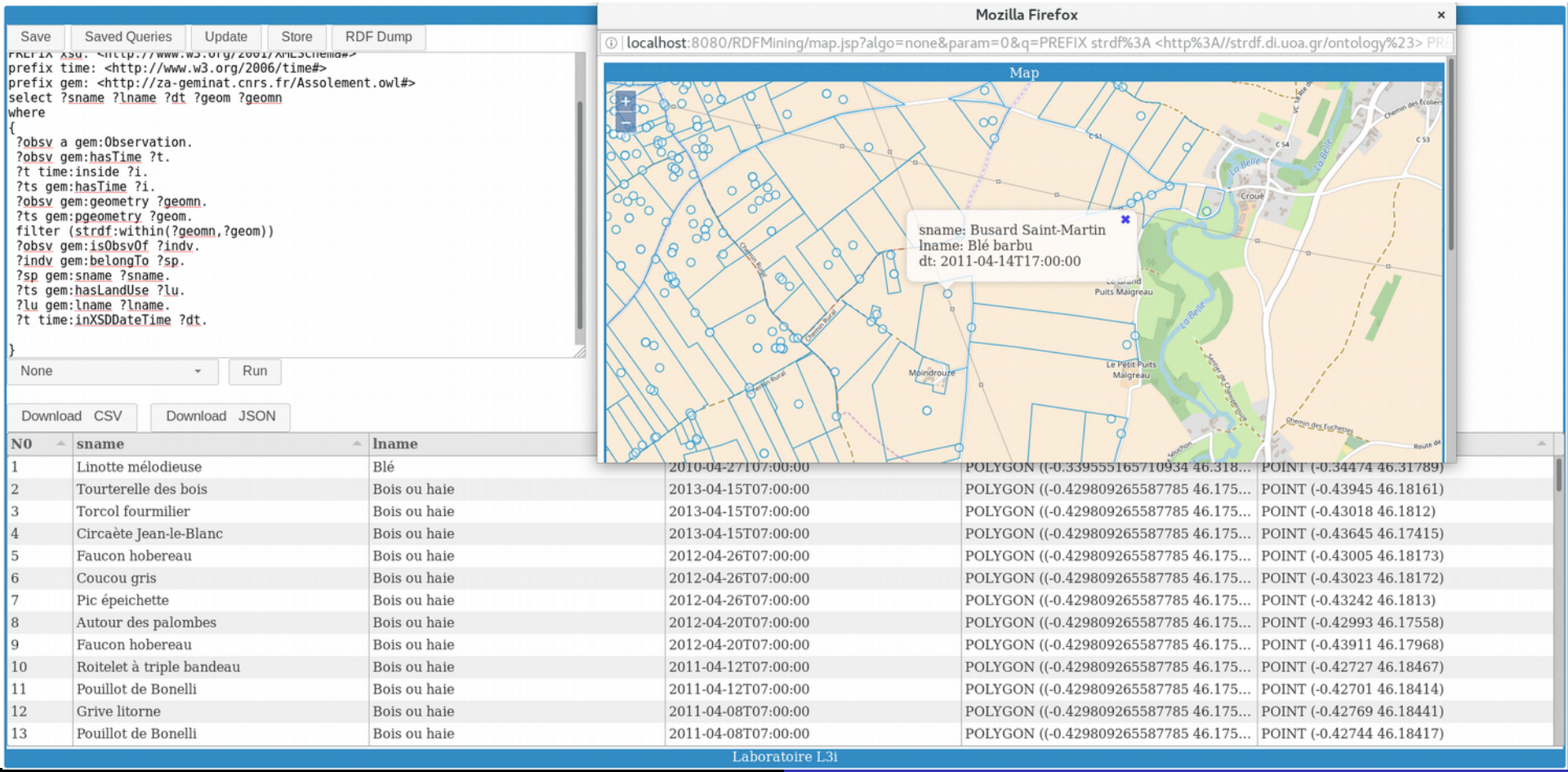
A search for correlation between the positions of Montagu's Harrier and grassland parcels in 2012



A search for fusion event between parcels in 2009

Application-“GEMINAT”

- Web Interface
  - An example of use



N0	sname	lname			
1	Linotte mélodieuse	Blé	2010-04-27T07:00:00	POLYGON ((-0.339555165710934 46.318...	POINT (-0.34474 46.31789)
2	Tourterelle des bois	Bois ou haie	2013-04-15T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.43945 46.18161)
3	Torcol fourmilier	Bois ou haie	2013-04-15T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.43018 46.1812)
4	Circaète Jean-le-Blanc	Bois ou haie	2013-04-15T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.43645 46.17415)
5	Faucon hobereau	Bois ou haie	2012-04-26T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.43005 46.18173)
6	Coucou gris	Bois ou haie	2012-04-26T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.43023 46.18172)
7	Pic épeichette	Bois ou haie	2012-04-26T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.43242 46.1813)
8	Autour des palombes	Bois ou haie	2012-04-20T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.42993 46.17558)
9	Faucon hobereau	Bois ou haie	2012-04-20T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.43911 46.17968)
10	Roitelet à triple bandeau	Bois ou haie	2011-04-12T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.42727 46.18467)
11	Pouillot de Bonelli	Bois ou haie	2011-04-12T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.42701 46.18414)
12	Grive litorne	Bois ou haie	2011-04-08T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.42769 46.18441)
13	Pouillot de Bonelli	Bois ou haie	2011-04-08T07:00:00	POLYGON ((-0.429809265587785 46.175...	POINT (-0.42744 46.18417)

Application-“DéAIS”

- **The goal of the project “DéAIS” is to detect whether ship’s AIS reports have been falsified (or spoofed)**

  (Ecole Navale-IRENav, Mines ParisTech-CRC, CEREMA, Université de La Rochelle-l3i)

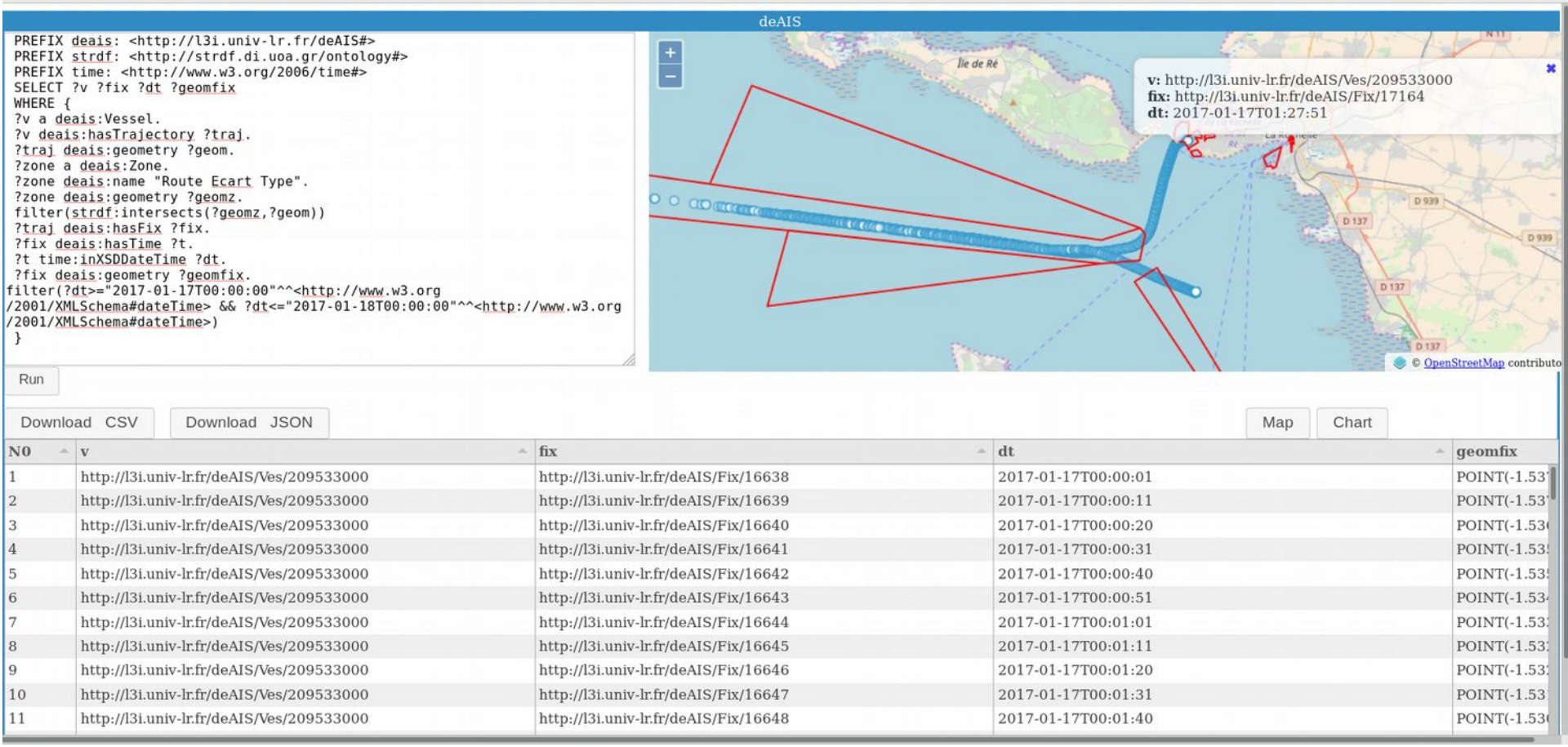
  - We have at the University – AIS Automatic identification system
  - We have in our knowledge base ship trajectory and some other data in La Rochelle Area (3 ports)
  - We have use our approach for data analysis

More on :

https://www.researchgate.net/project/ANR-DEAIS-Data-Management-Processing-and-Mining-for-an-Integrity-Assessment-of-AIS-Messages

Application-“DéAIS”

- Web Interface
  - An example of use



N0	v	fix	dt	geomfix
1	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16638	2017-01-17T00:00:01	POINT(-1.53
2	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16639	2017-01-17T00:00:11	POINT(-1.53
3	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16640	2017-01-17T00:00:20	POINT(-1.53
4	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16641	2017-01-17T00:00:31	POINT(-1.53
5	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16642	2017-01-17T00:00:40	POINT(-1.53
6	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16643	2017-01-17T00:00:51	POINT(-1.53
7	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16644	2017-01-17T00:01:01	POINT(-1.53
8	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16645	2017-01-17T00:01:11	POINT(-1.53
9	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16646	2017-01-17T00:01:20	POINT(-1.53
10	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16647	2017-01-17T00:01:31	POINT(-1.53
11	http://l3i.univ-lr.fr/deAIS/Ves/209533000	http://l3i.univ-lr.fr/deAIS/Fix/16648	2017-01-17T00:01:40	POINT(-1.53

Conclusion & perspectives

- Conclusion
  - A framework is introduced to exploit environmental data through semantic web technologies
  - The proposed ontology and framework can fulfill the need of spatio-temporal analysis of these heterogeneous data
  - The approach is used for 2 use cases
  - https://gitlab.univ-lr.fr/abouju/STRDFMining
- Perspectives
  - Use this approach for other use case and integrate other datasets
  - Enrich and qualify the data sources through the framework
  - Publish a portion of these data as linked data

Future works

- Future works
  - An ANR Portic (2018-2022)
    The Digital Revolution: relationship to knowledge and culture

    PORTs & Information and Communication Sciences and Technology

    Querying and visualizing eighteenth-century shipping and trade dynamics in the digital era
  - A local project DYPOMAR (Port Dynamics, Urban and Maritime Environments), a project funded through a French CPER/FEDER planning agreement between the French State and the Nouvelle-Aquitaine region (2014-2020).

Future works

- Unmanned surface vehicle
  - heterogeneous spatio-temporal data

Thank you!

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