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# Developing semantic interoperability in ecology and ecosystem studies

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1. INRAE URM 228 route de l'Aérodrome 84914 Avignon

2. CNRS UMS BBES 55 rue Buffon 75005 Paris

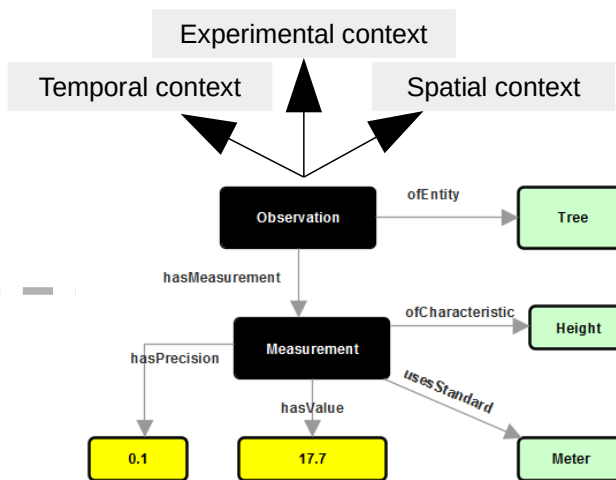
3. INRA UMR EMMAH 228 route de l'Aérodrome 84914 Avignon

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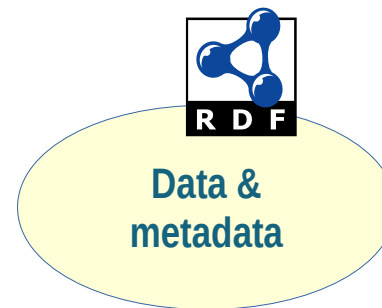
5. INRA UMR CARRTEL 75 avenue de Corzent 74200 Thonon-les-bains



Obs. & exp. on ecosystems

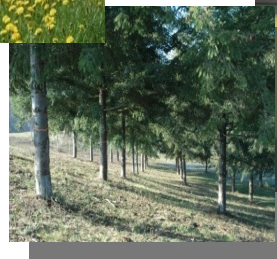
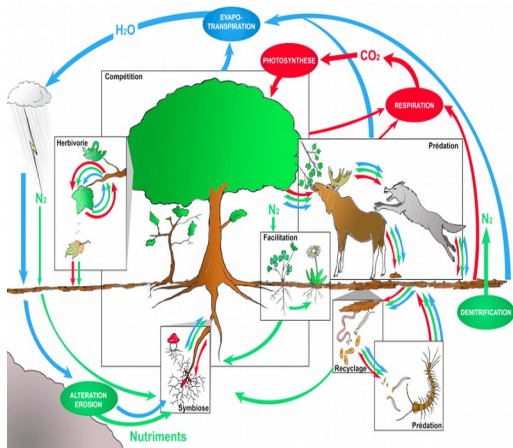


Graph data modeling



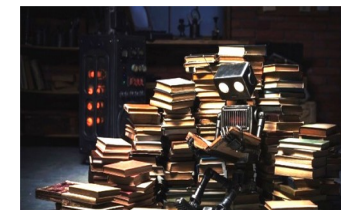
Semantic interoperability

Rationale



Ecosystem study requires complex research and deals with heterogeneous, varied and widespread data.

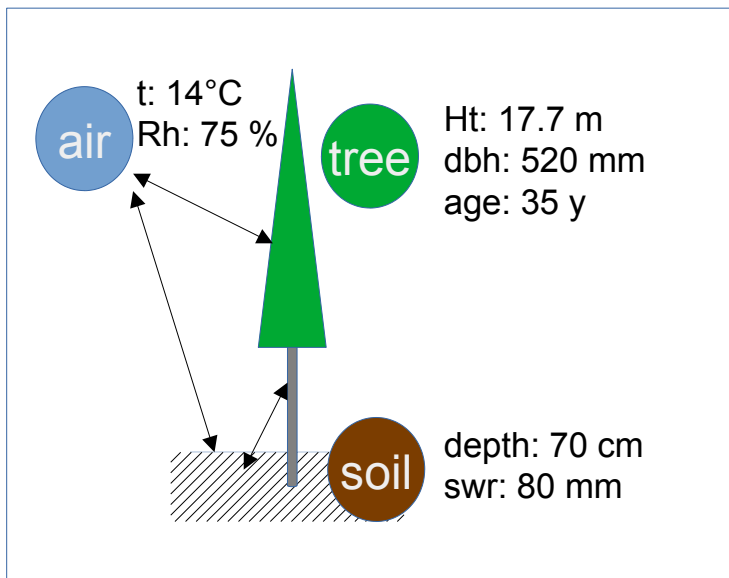
The proper understanding and interoperability of the information sources remains one of the greatest challenges



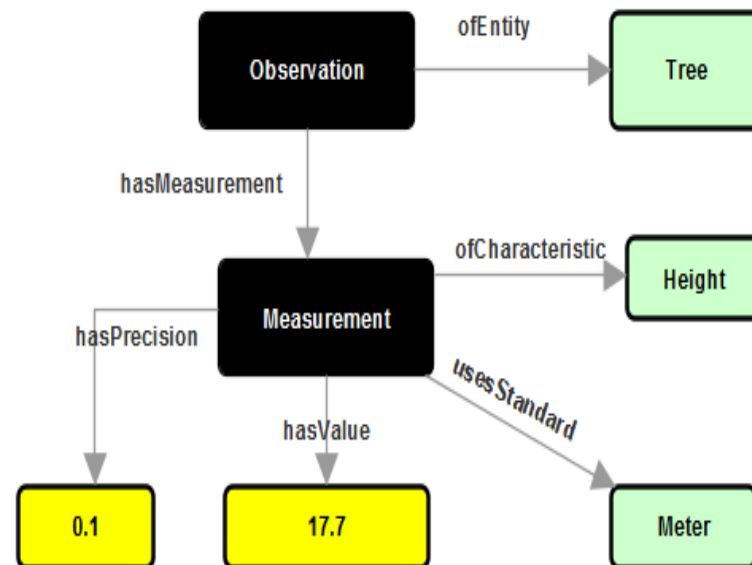
## Method

### 1) Identify

- the components of the system
- and their relationships

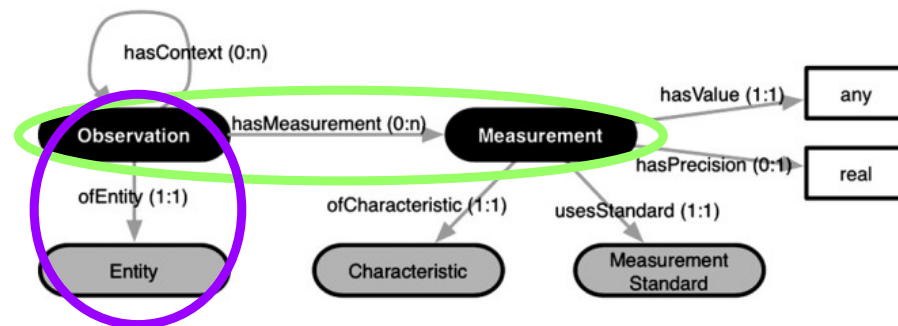


### 2) Model the system using semantic vocabularies



AnaEE\* RI as scientific context:  
The Research Infrastructure offers services for experimentation on continental ecosystems

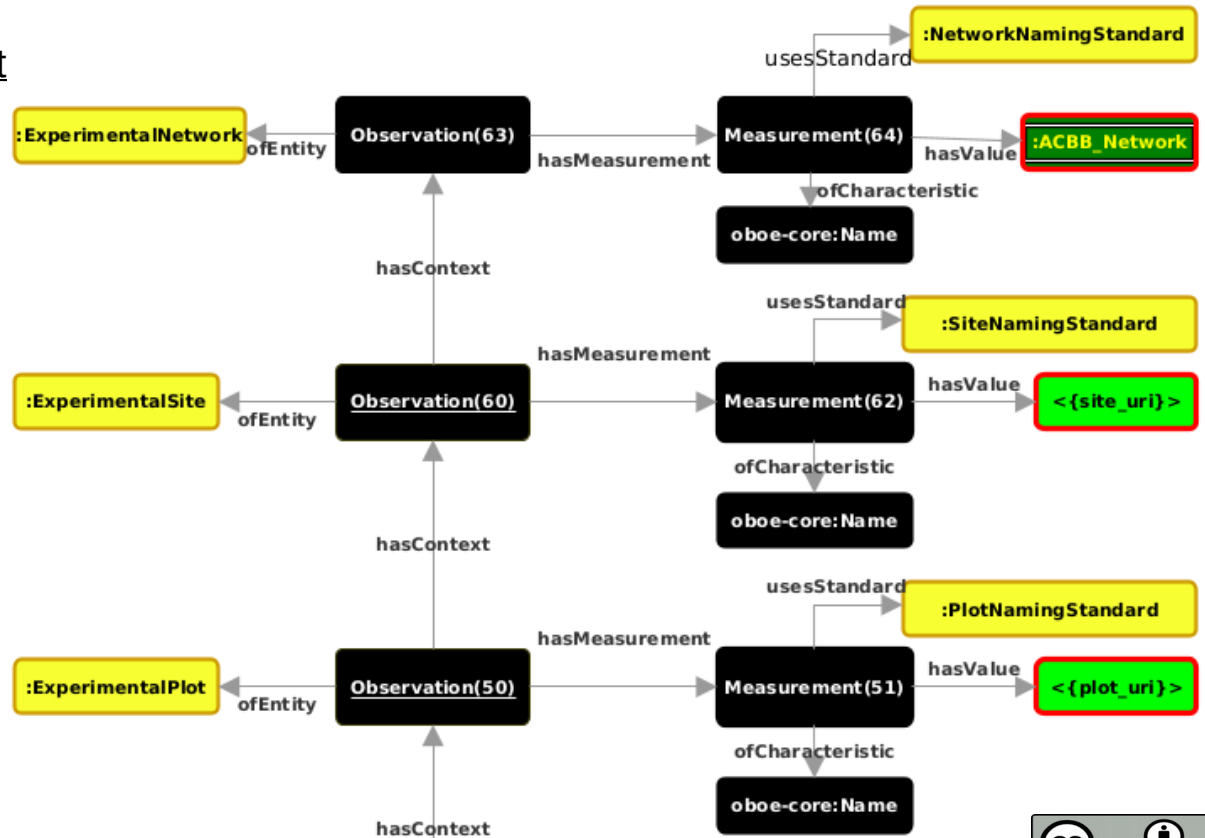
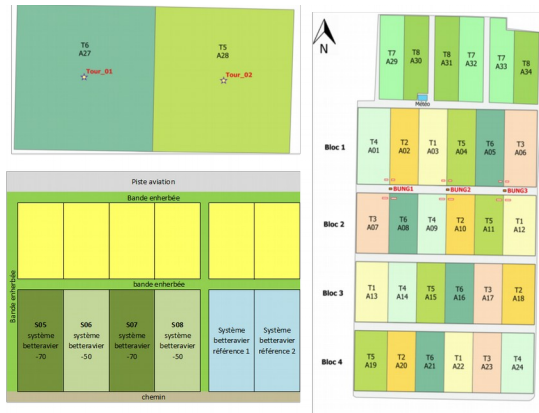
OBOE\* as ontological framework:  
The ontology provides the atomic elements for modeling observations



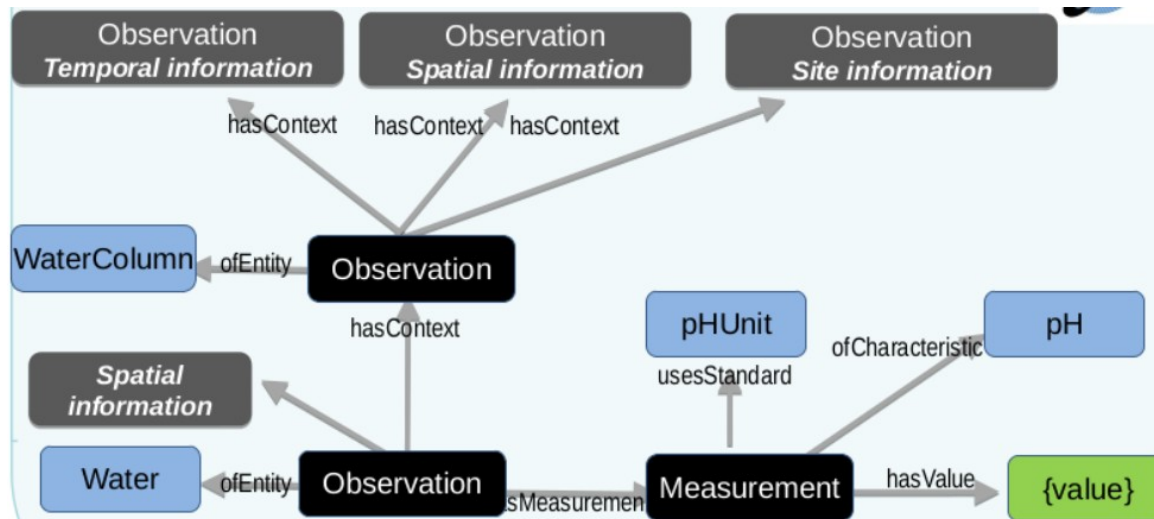
\*Mark Schildhauer, Matthew B. Jones, Shawn Bowers, Joshua Madin, Serguei Krivov, Deana Pennington, Ferdinando Villa, Benjamin Leinfelder, Christopher Jones, and Margaret O'Brien. 2016. OBOE: the Extensible Observation Ontology, version 1.2. KNB Data Repository. doi:10.5063/F1125R0F

Implementation

Modeling the experimental context



Modeling the measured variables




### Implementation

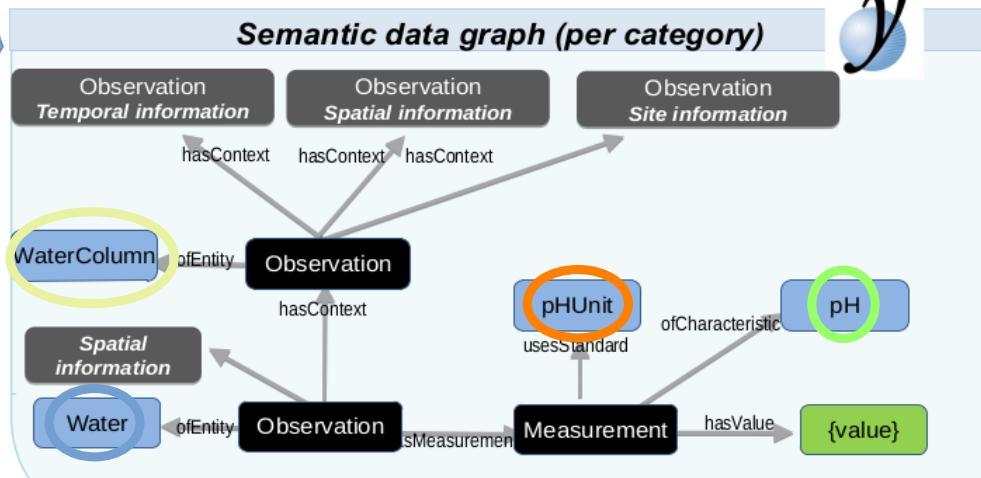
Graph pattern approach:

Design parametric graphs suitable for a set of variables



**Variable semantic description** 

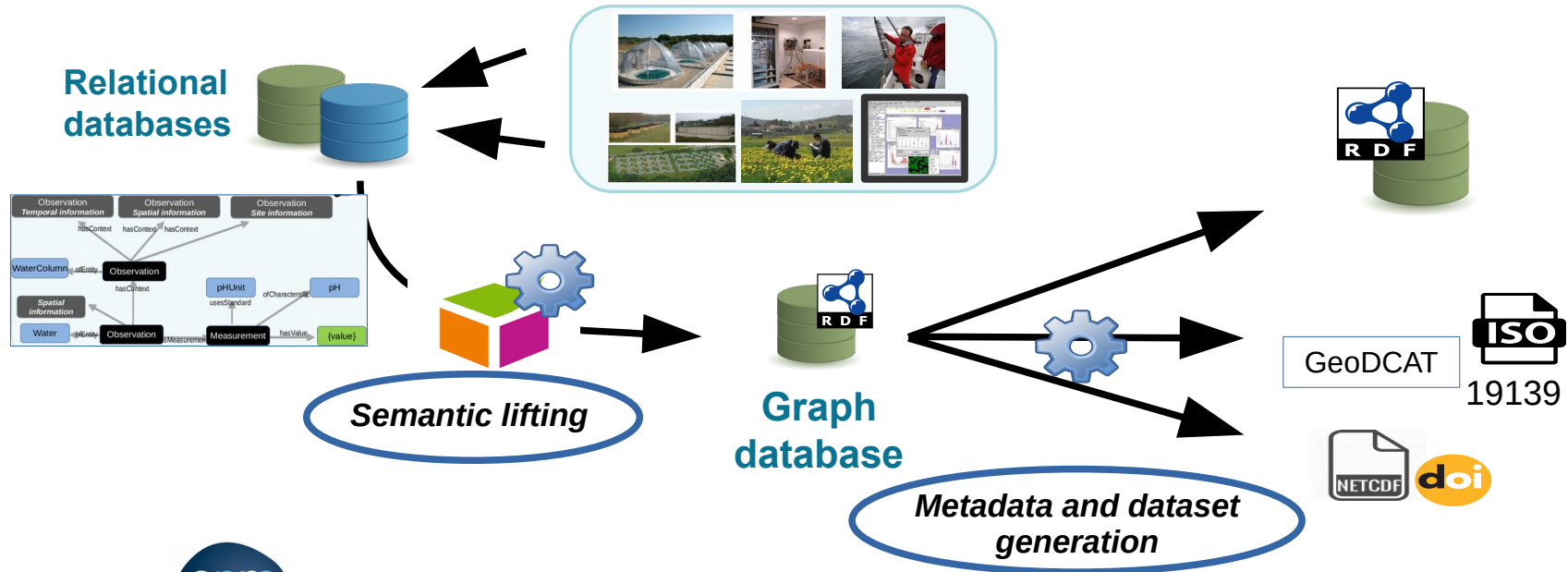
| AnaEE standard | Category           | Context      | Entity        | Characteristic    | Unit                           |
|----------------|--------------------|--------------|---------------|-------------------|--------------------------------|
| Phytoplankton  | Biodiversity       | Water        | Phytoplankton | Volume Per Volume | MicroMeterCubed Per Millimeter |
| WaterPH        | Physical Chemistry | Water Column | Water         | pH                | pHUnit                         |
| ...            | ...                | ...          | ...           | ...               | ...                            |





## Semantic lifting and data exploitation

Graph patterns and variable semantic descriptions are processed by a pipeline for semantic lifting of the data before their exploitation



## Lessons from this work

- The OBOE generic ‘observation model’ allows for efficient atomic modeling of the components of the system and of their nested or crossed relationships.
- In addition to the provided OBOE extensions (characteristics, spatial, temporal, standards), the unique identification of the system components is ensured through new classes and individuals especially for Entity (e.g experimental entities) and Standards (e.g lists of variable names or of experimental facilities).
- A graph pattern approach for the modeling of the variables leads to a more efficient investment at greatly reduced cost
- When data are initially managed in structure databases, the data modeling is directly exploitable by pipelines for mass lifting to rdf graphs
- The whole process produces syntactically and semantically interoperable data, contributing to FAIR sharing and data reuse