Multimapping Design of Complex Sensor Data in Environmental Observatories

Hicham Hajj-Hassan, Nicolas Arnaud, Arnaud Castelltort, Laurent Drapeau, Anne Laurent, Olivier Lobry, Carla Khater

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H.Hajj-Hassan, N.Arnaud, A.Castelltort, L.Drapeau, *A.Laurent*, O.Lobry, C.Khater

National Council for Scientific Research

Institut de recherche pour le développement

LIFE Observatoire Libano-Français de l'Environnement

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MINES Alès

Environmental resources

- air quality, water quantity, birds,...
- need for data to understand fundamental questions such as **global change**
- collecting data: sensors + human as a sensor (HaaS)
- need for data sharing, data publishing
- data models and formats have emerged
- need for data crossing

O-Life

- The **Mediterranean basin** is a priority area and a leading area for the **analysis of environmental data**
- **shared observatory** between France and Lebanon
- with the aim of **collecting, perpetuating, sharing, and valorizing environmental information**
- creation of an ambitious **Circum-Mediterranean observatory network**

Objectives of O-Life

- Conduct simultaneously: Observation, Research, Training and Valorization
- Federate skills through common tools and objects
- **Organize, share, sustain and enhance environmental data**

Priorities

- **Build environmental databases** of the critical zone in consideration
- Conduct **monitoring services**: Provide instruments, equipment, assist in the operation and monitoring of sites
- **Enhance environmental data** and research among scientists, public policy makers, and the public in general, to promote a coordinated approach to sustainable development
- **Facilitate the prospective approach and exchange through innovative web services**
- Be a force of exploration and proposal for relevant calls for projects

Building environmental databases

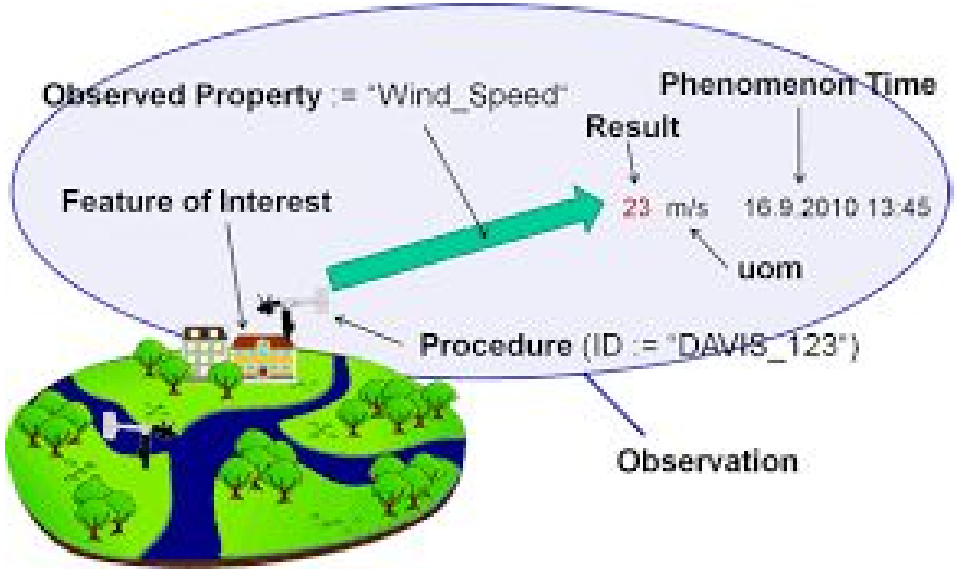
- crossing heteregeneous data
  - formats
  - context
- collected for a primary goals and not for publication

Sensor Data

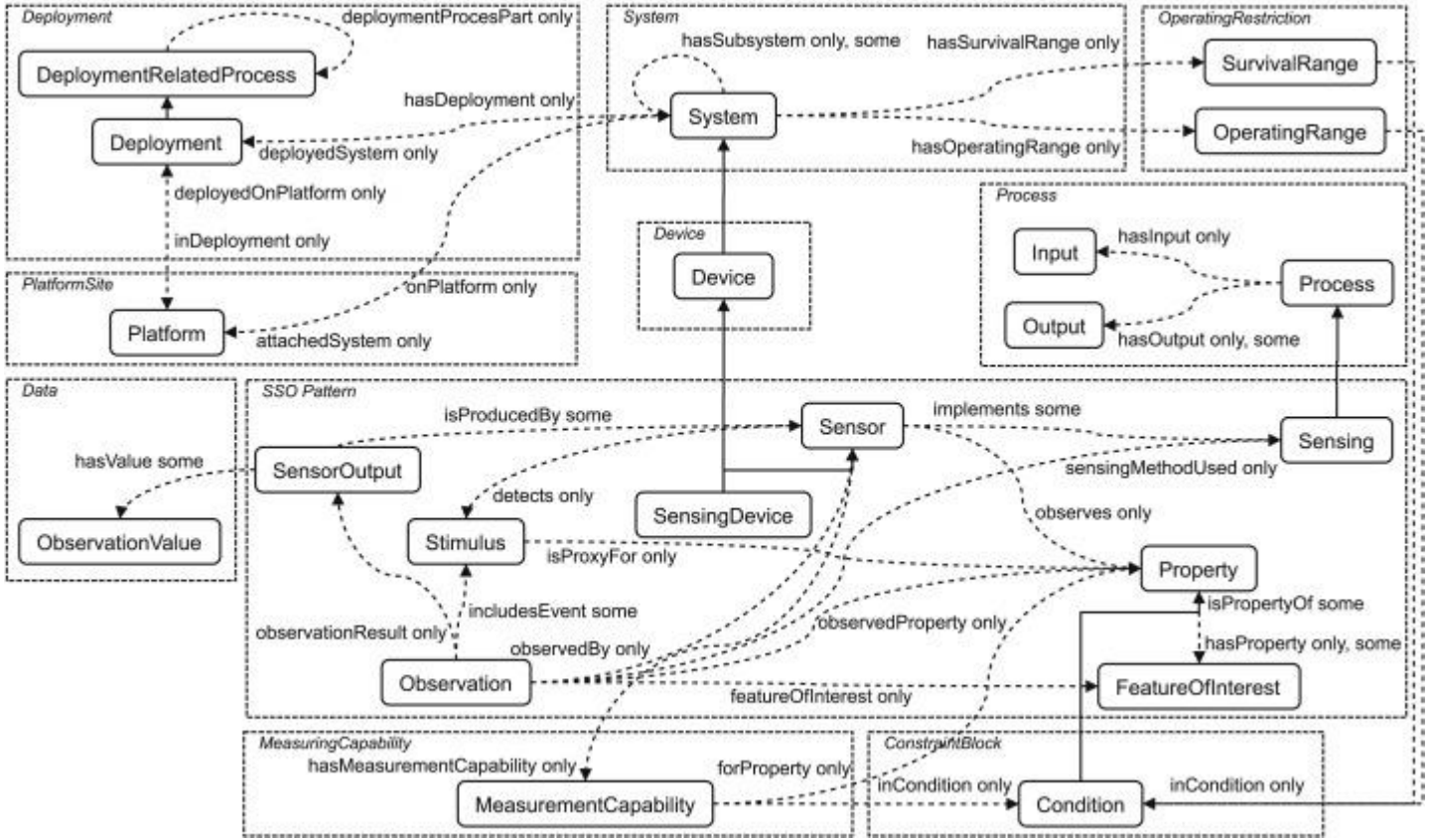
- Observations and Measurements (O&M) framework
- SOS: Sensor Observation Service
- proposed by the OGC (Open Geospatial Consortium) within the Sensor Web Enablement (SWE)
- Several frameworks, our choice: 52°North

Concepts

- **Feature of interest**
- Phenomenon time.
- Result time
- Procedure
- **Observed property**
- Result
- Unit of Measure



SSN


Deployment
deploymentProcesPart only
DeploymentRelatedProcess
hasDeployment only
Deployment
deployedSystem only
deployedOnPlatform only
inDeployment only
PlatformSite
onPlatform only
Platform
attachedSystem only
System
hasSubsystem only, some
hasSurvivalRange only
System
hasOperatingRange only
OperatingRestriction
SurvivalRange
OperatingRange
Device
Device
Process
Input
hasInput only
Process
Output
hasOutput only, some
Data
hasValue some
ObservationValue
SSO Pattern
isProducedBy some
Sensor
implements some
Sensing
SensorOutput
sensingMethodUsed only
detects only
SensingDevice
observes only
Stimulus
isProxyFor only
Property
isPropertyOf some
includesEvent some
observationResult only
observedProperty only
hasProperty only, some
observedBy only
Observation
featureOfInterest only
FeatureOfInterest
MeasuringCapability
hasMeasurementCapability only
forProperty only
MeasurementCapability
ConstraintBlock
inCondition only
Condition
inCondition only

The need for crossing points of view

- one observation model is meant as to correspond to one feature of interest
- however, it may be the case that several points of view can be considered
- Example
  - following species

Species	Observators	Date of observation (dd/mm/yyyy)	Common name English	Village	Phenology at time of observation	Nb_of_individuals	Sex	Description
Dama	A.A.	1/1/2015	Fallow deer	Faraya	Adulte	4	M & F	Gray
Panthera pardus tulliana	C.K.	4/3/2015	Anatolian leopard	Ehden	Young	1	F	Hairy
Dama	S.C.	5/12/2015	Fallow deer	Bsharre	Young	3	M	Long Tail

Multi-mappings

- with the goal to consider alternative features of interest
- some parts of the SSN ontology are refined in order to be able
  - to represent multiple mappings and
  - to point out the existence of multimapping to the users

Example: Mapping 1

A	B	C	D	E	F	G	H	I
Species	**Observators**	**Date of observation (dd/mm/yyyy)**	**Common name English**	**Village**	**Phenology at time of observation**	**Nb_of_individuals**	**Sex**	**Description**
Dama	A.A.	1/1/2015	Fallow deer	Faraya	Adulte	4	M & F	Gray
Panthera pardus tulliana	C.K.	4/3/2015	Anatolian leopard	Ehden	Young	1	F	Hairy
Dama	S.C.	5/12/2015	Fallow deer	Bsharre	Young	3	M	Long Tail
Mapping _1								
ObservedProperty	Procedure	samplingTime	phenomenon_description	*featureOfInterest*	propertyValueProvider	propertyValueProvider	propertyValueProvider	propertyValueProvider

Example: Mapping 2

Species	Observators	Date of observation (dd/mm/yyyy)	Common name English	Village	Phenology at time of observation	Nb_of_individuals	Sex	Description
Dama	A.A.	1/1/2015	Fallow deer	Faraya	Adulte	4	M & F	Gray
Panthera pardus tulliana	C.K.	4/3/2015	Anatolian leopard	Ehden	Young	1	F	Hairy
Dama	S.C.	5/12/2015	Fallow deer	Bsharre	Young	3	M	Long Tail
Mapping _2								
featureOfInterest	Procedure	samplingTime	phenomenon_description	propertyValueProvider	propertyValueProvider	*ObservedProperty*	propertyValueProvider	propertyValueProvider

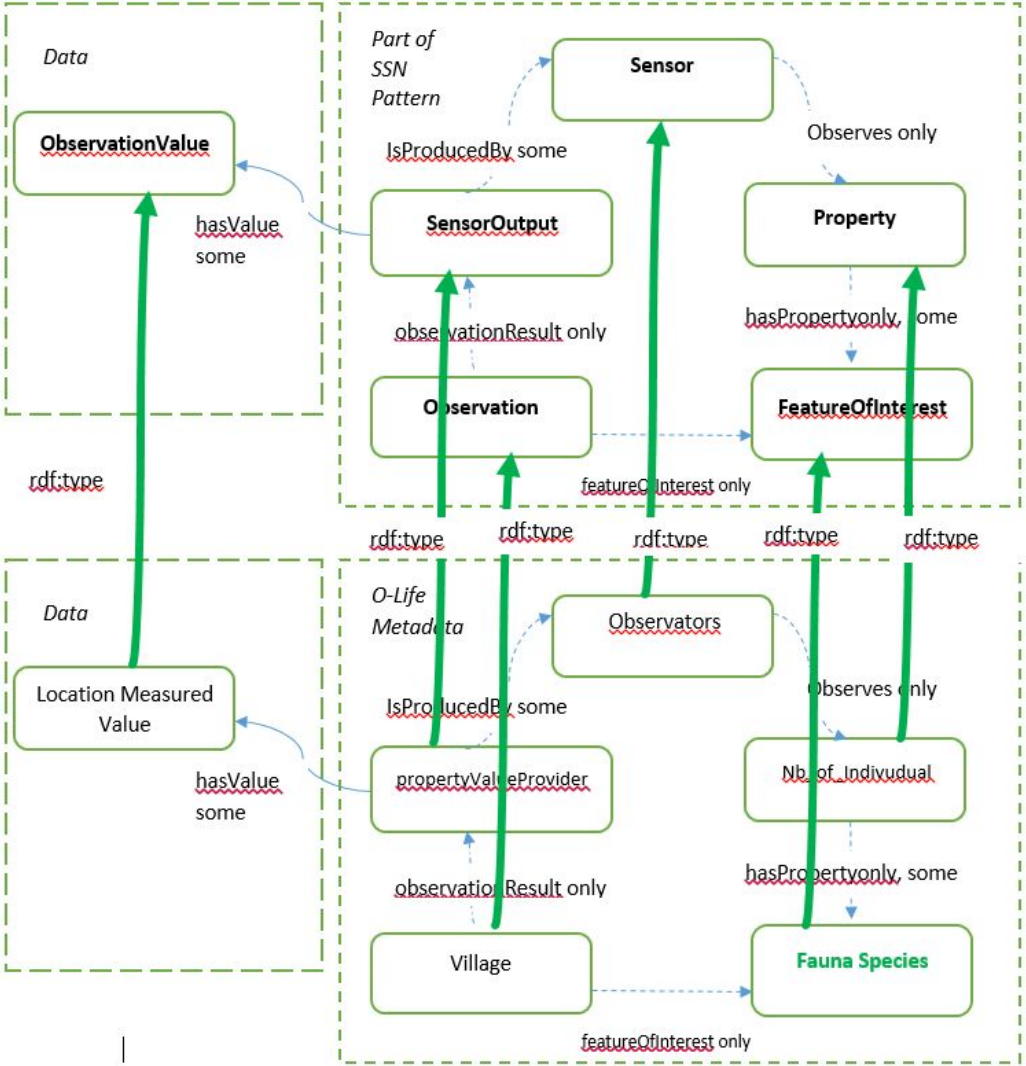
Representing multiple mappings

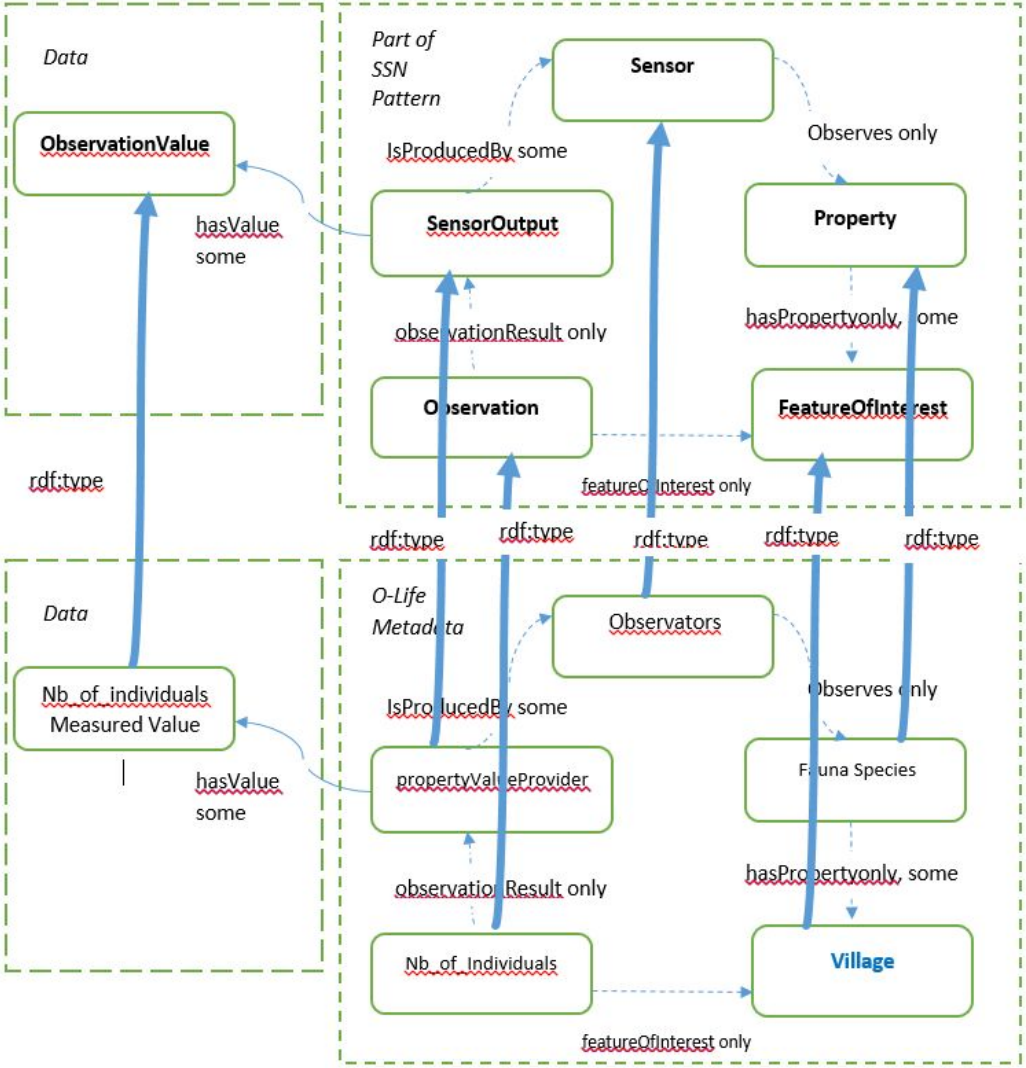
- introduction of ssn:alternative
- alternative observation
- alternative feature of interest
- alternative observed property

Description	Proposed Property
Alternative Observation	mssn:AltObservationDesign
Alternative Feature of Interest	mssn:altFeatureOfInterest
Alternative Observed Property	mssn:altObservedProperty
Alternative Observed By	mssn:altObservedBy

- introduction of RDF triplets like:

  fauna:species **mssn:altFeatureOfInterest** ssn:FeatureOfInterest


Data
ObservationValue
hasValue
some
Part of
SSN
Pattern
Sensor
IsProducedBy some
Observes only
SensorOutput
Property
observationResult only
hasPropertyonly some
Observation
FeatureOfInterest
featureOfInterest only
rdf:type
rdf:type
rdf:type
rdf:type
rdf:type
rdf:type
Data
Location Measured
Value
hasValue
some
O-Life
Metadata
Observators
IsProducedBy some
Observes only
propertyValueProvider
Nb_of_Indivudual
observationResult only
hasPropertyonly some
Village
Fauna Species
featureOfInterest only


Data
ObservationValue
hasValue
some
rdf:type
Data
Nb_of_individuals
Measured Value
hasValue
some
Part of
SSN
Pattern
Sensor
IsProducedBy some
Observes only
SensorOutput
Property
observationResult only
hasPropertyonly some
Observation
FeatureOfInterest
featureOfInterest only
rdf:type
rdf:type
rdf:type
rdf:type
rdf:type
O-Life
Metadata
Observators
IsProducedBy some
Observes only
propertyValueProvider
Fauna Species
observationResult only
hasPropertyonly some
Nb_of_Individuals
Village
featureOfInterest only

Conclusion and Perspectives

- importance of data crossing in the context of environemental data and climate change
- extension of the SSN ontology in order to make it possible to represent multiple mappings

- Need to offer a methodology
- Need to address other examples and frameworks