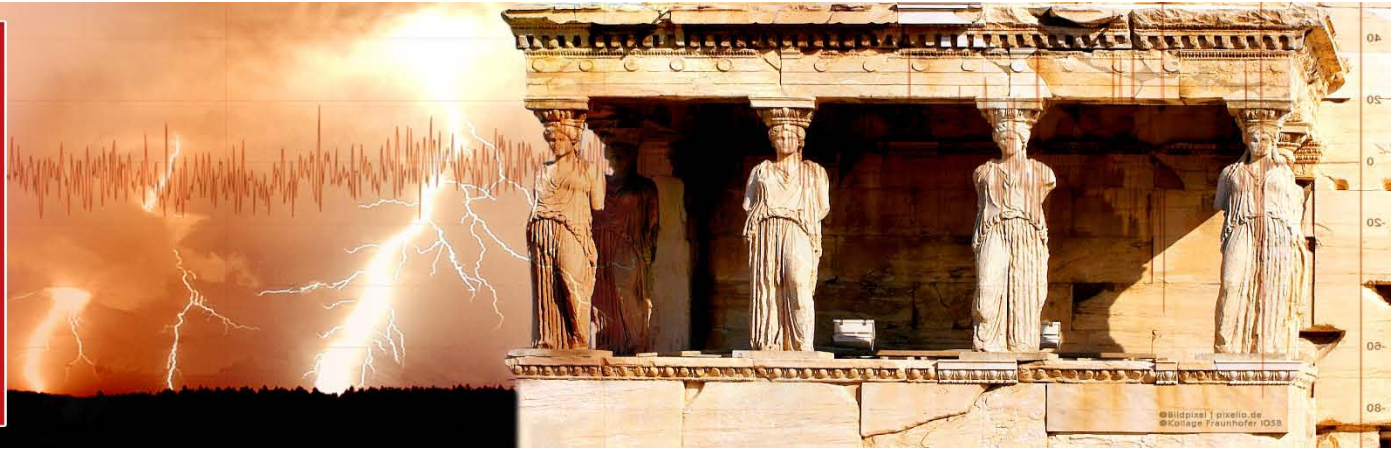
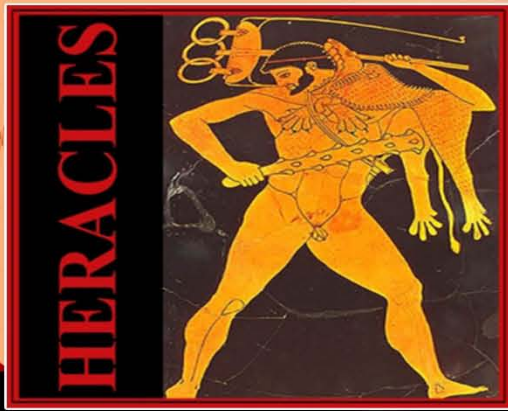

Sensordata for Crisis Management



Dr. Jürgen Moßgraber
Geospatial Sensor Webs – Münster 2018



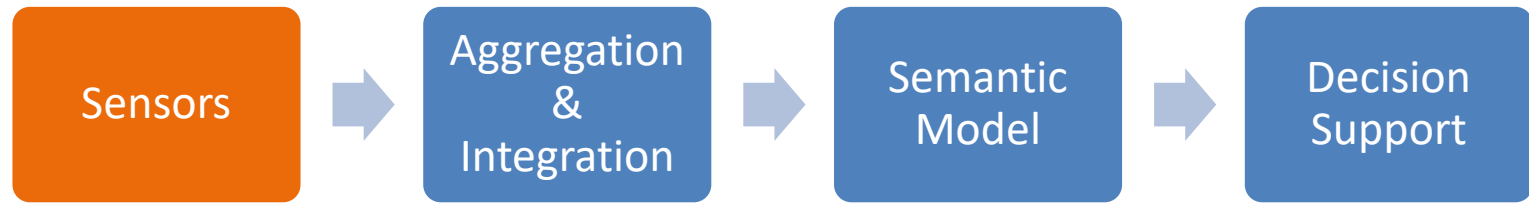
- EU-Project in Horizon 2020 framework
- **Integrated solution** to support forecasting, early warnings, transmission and routing of the emergency data, **aggregated analysis of multimodal data** and management the **coordination** between the **first responders** and the **authorities**
- <http://beaware-project.eu/>



- EU-Project in Horizon 2020 framework
- Goal: **Design**, validate and promote responsive **systems/solutions** for **effective resilience** of **Cultural Heritage** (buildings) against climate change effects
- Semantic Modeling of cultural heritage, risks climate effects, materials, sensors, simulation models, ...
- <http://www.heracles-project.eu/>

Process chain „from Sensor to the decision“





SENSORS AND SENSOR DATA

Internet of Things (IoT)

■ Interdomain topic

■ IoT

- Network between heterogeneous sensors, devices and software systems
- Goal: New functionalities

■ Semantic Interoperability ?

- Understanding the meaning of the exchanged data

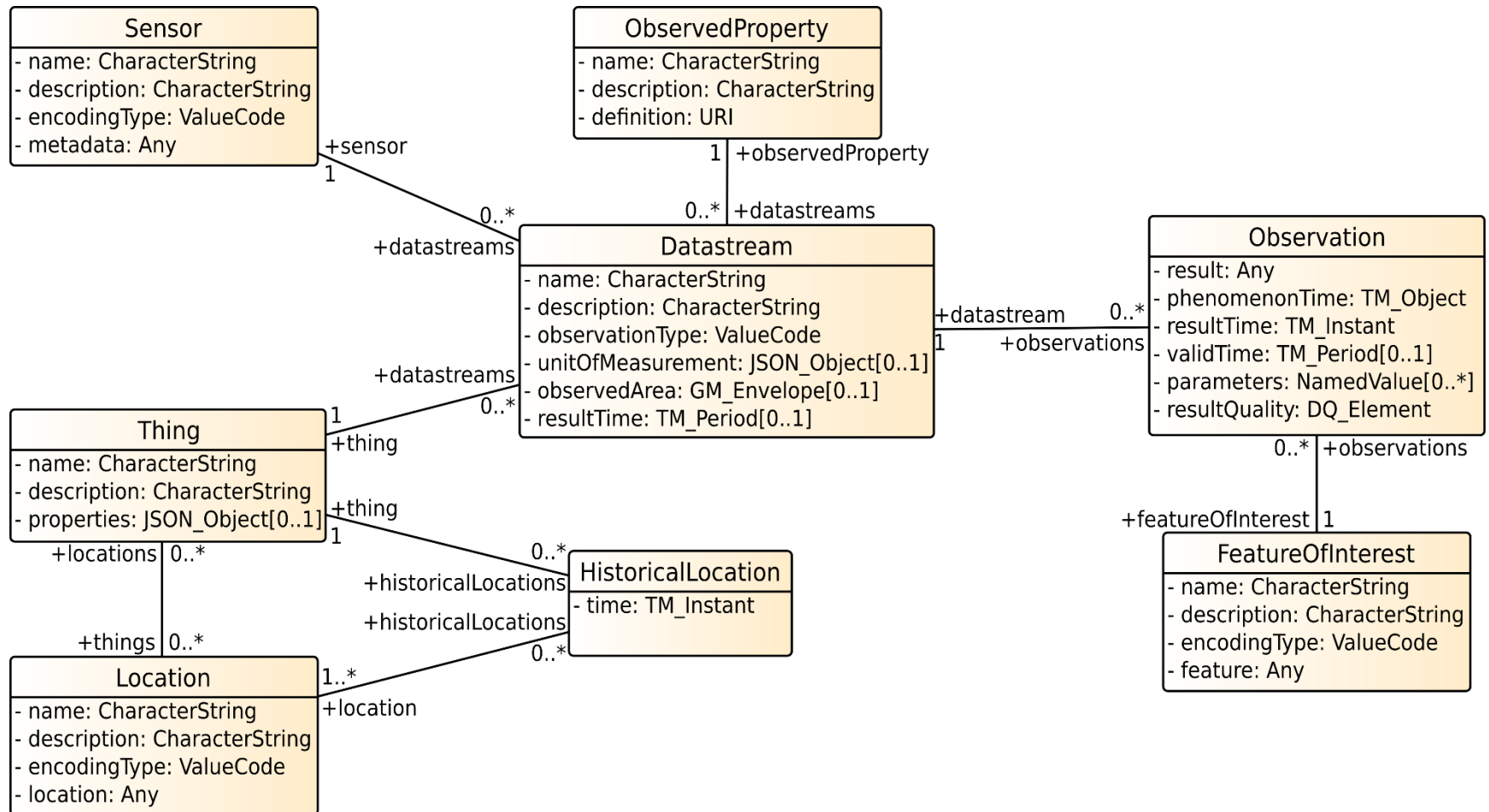
OGC SensorThings API



Standard for the exchange of Sensordata and Metadata.

- Sensor-Web-Enablement-Light: SWE for IoT
- Similar to Sensor Observation Service (SOS), but:
 - RESTful
 - JSON
 - Adapts OASIS OData URL patterns and queries
 - Supports ISO MQTT

The OGC SensorThings API data model



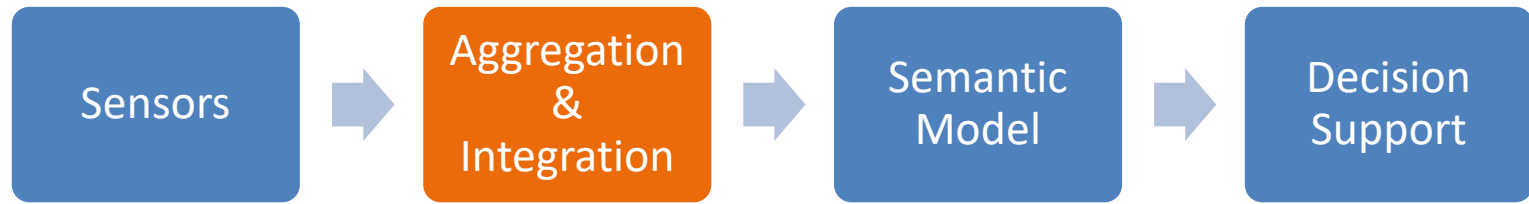
FROST Server



- „**Fraunhofer Open Source SensorThings API Server**“.

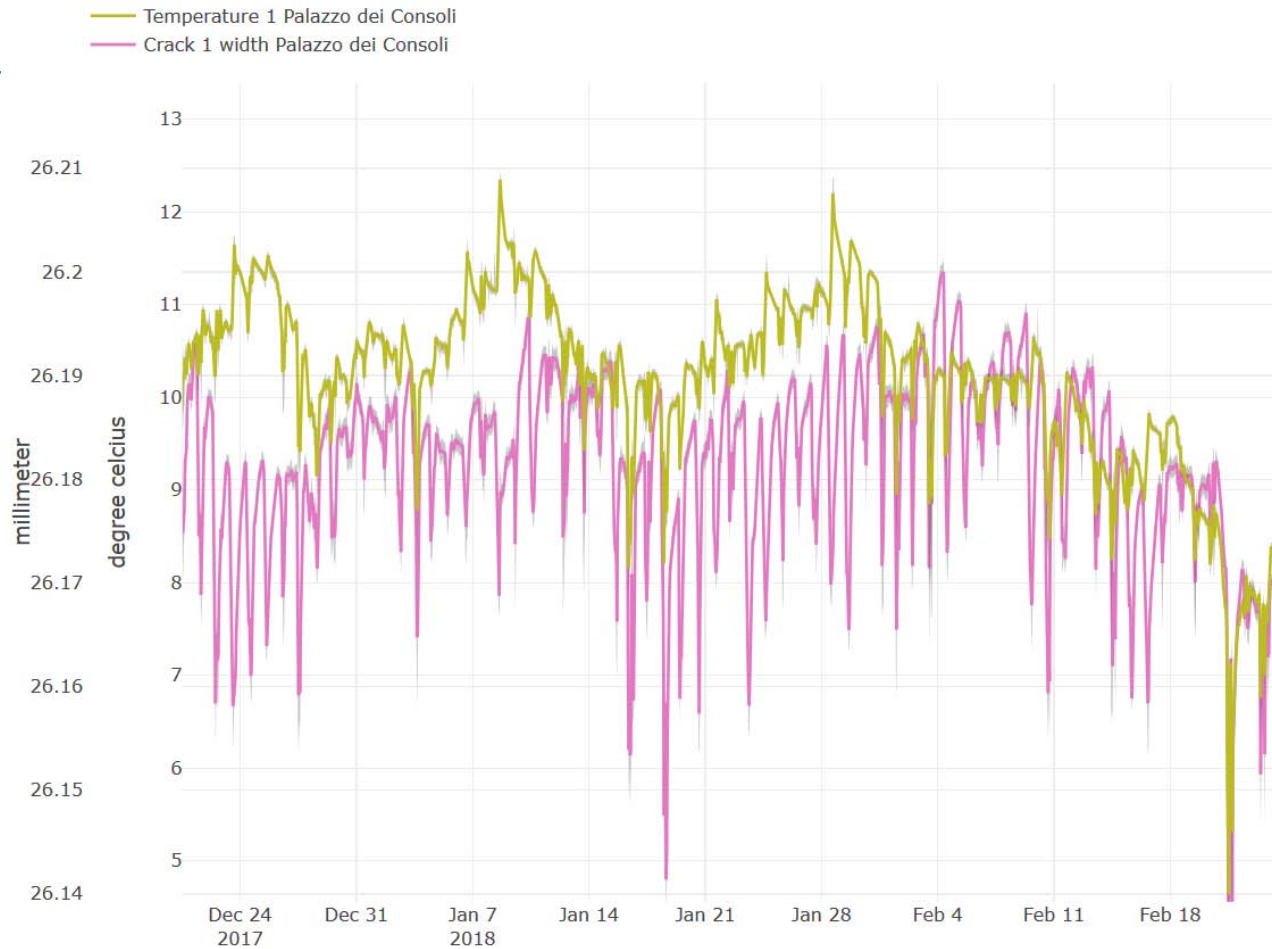


- First Open Source (GNU Lesser General Public License 3.0) implementation
- <https://github.com/FraunhoferIOSB/FROST-Server>
- <https://www.iosb.fraunhofer.de/?80113>

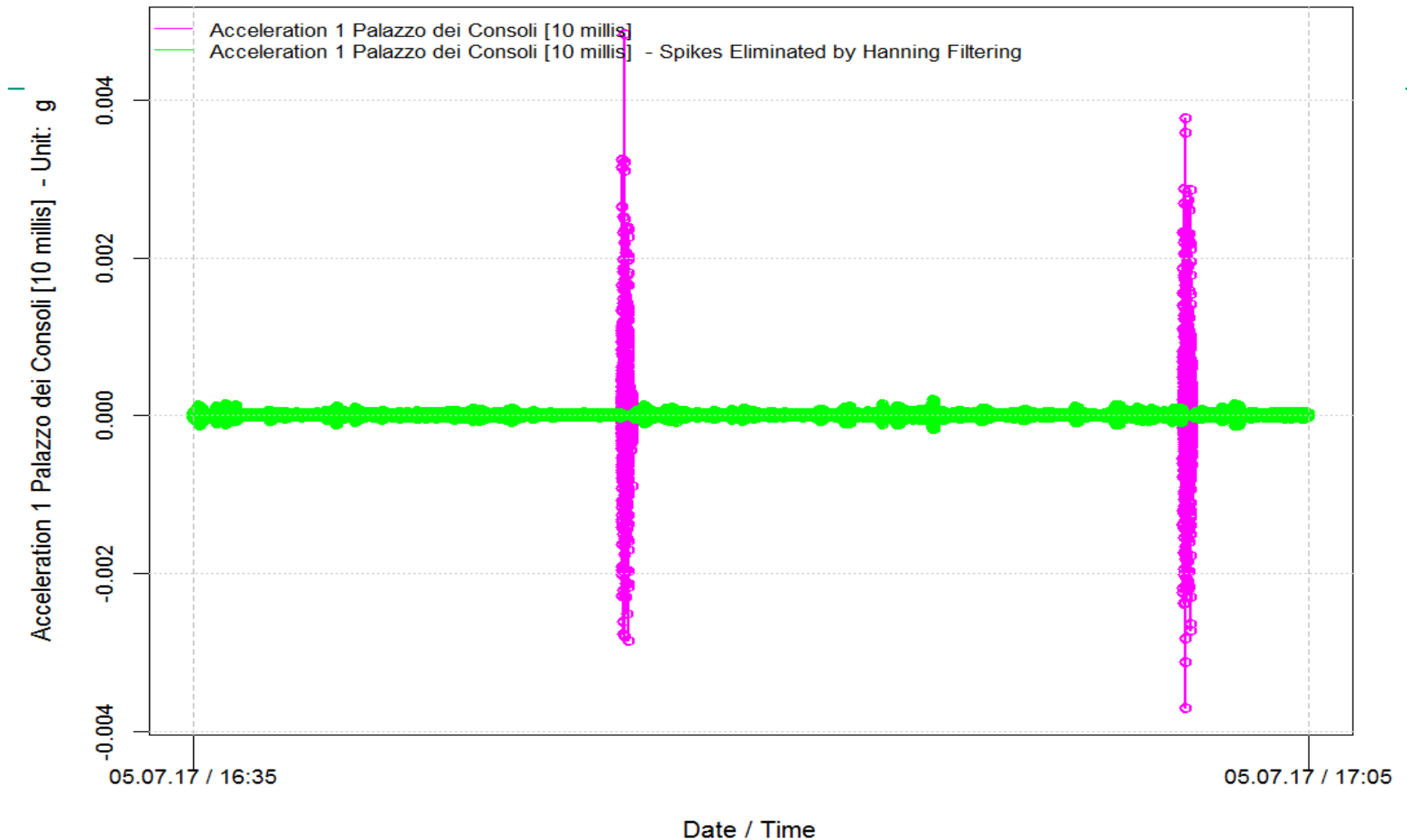


AGGREGATION AND INTEGRATION

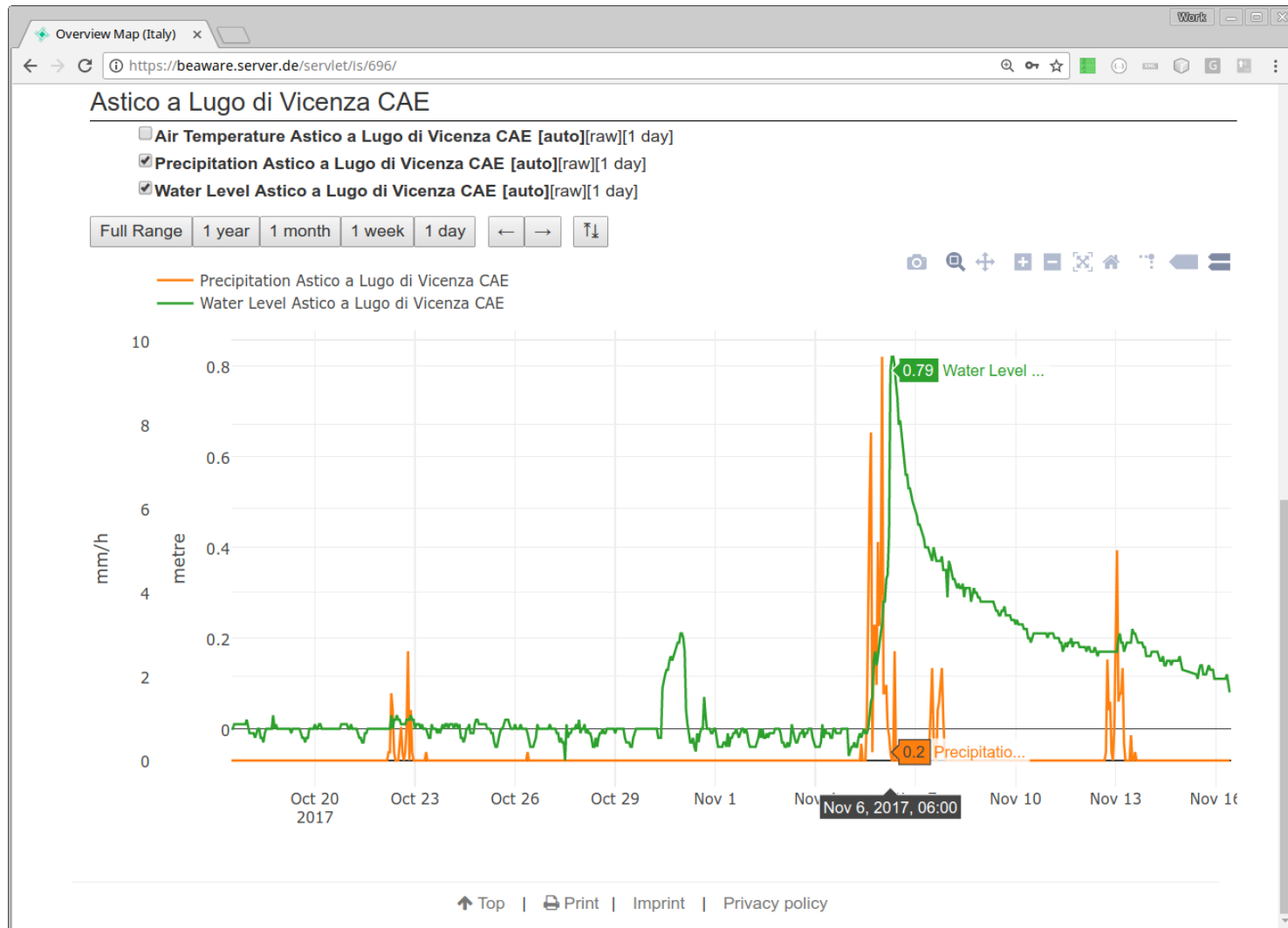
Visualizing Sensordata



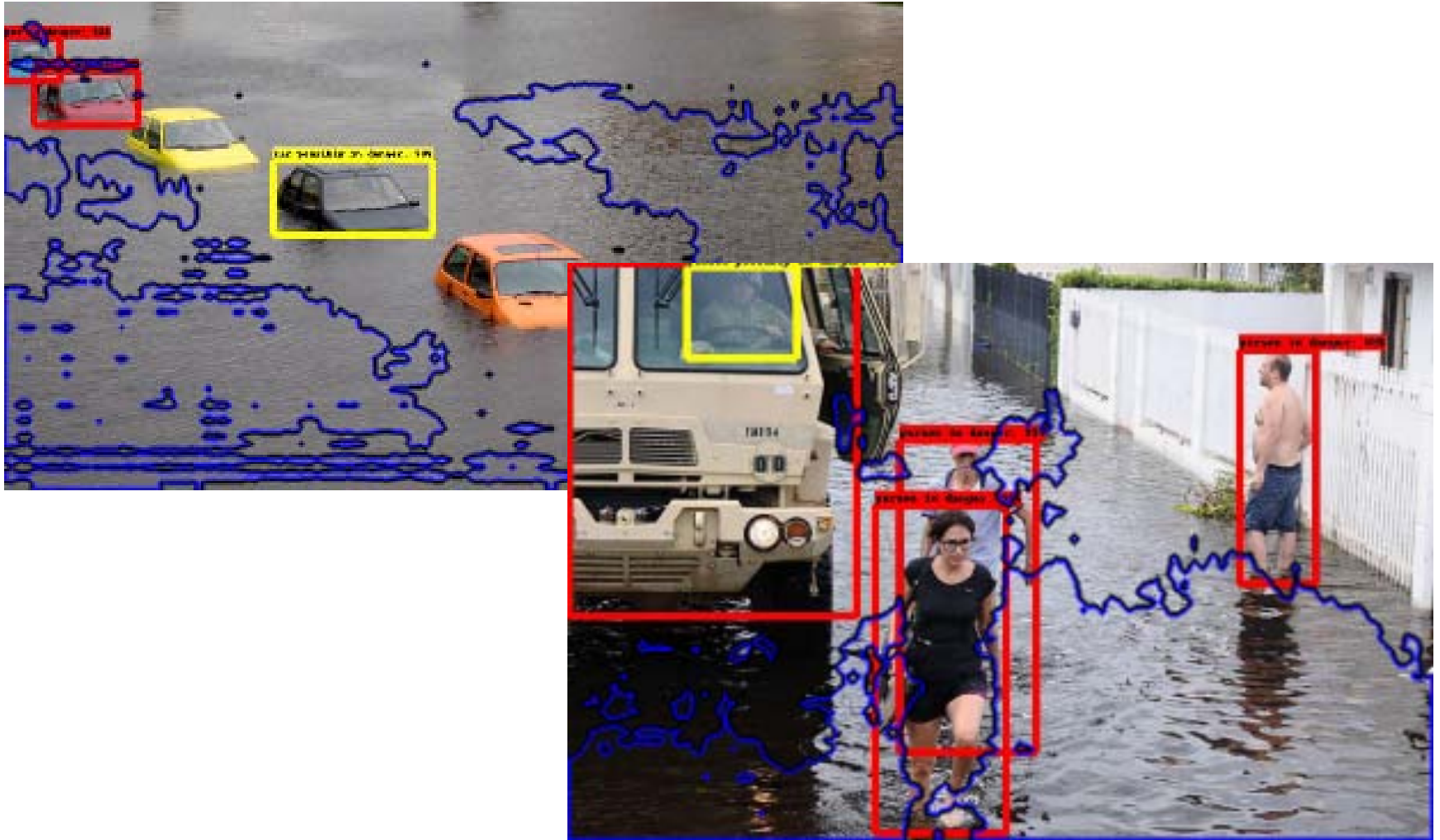
Integrating analysis algorithms

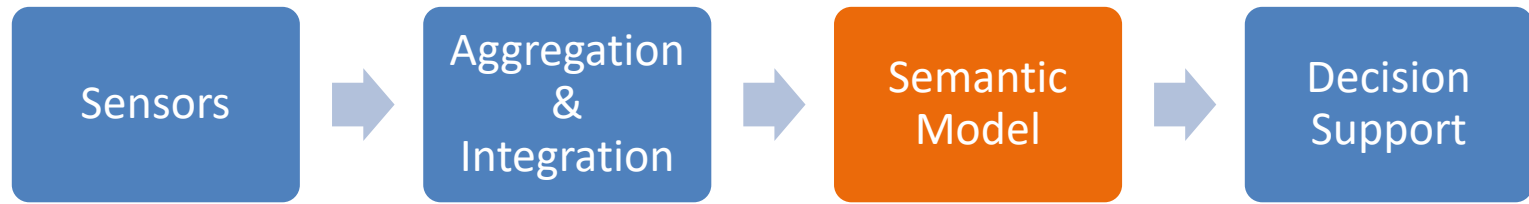


Visualizing Sensordata



Integrating analysis algorithms

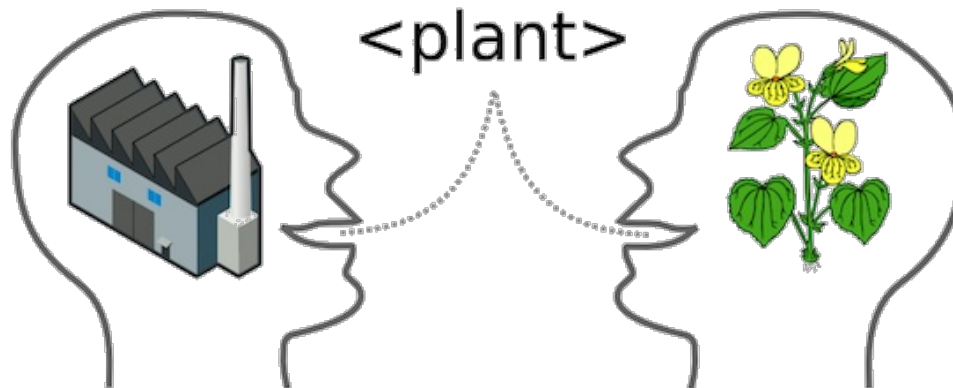




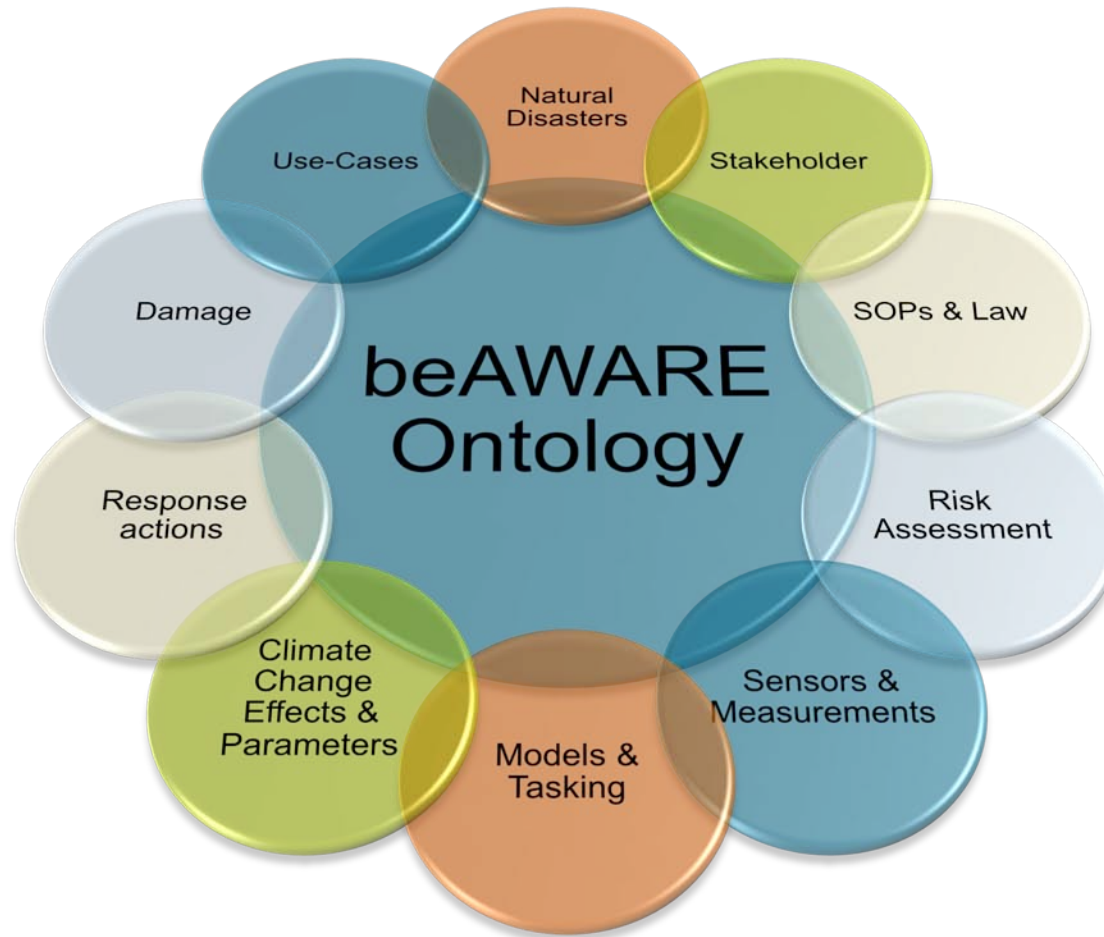
SEMANTIC MODEL

What are Semantics?

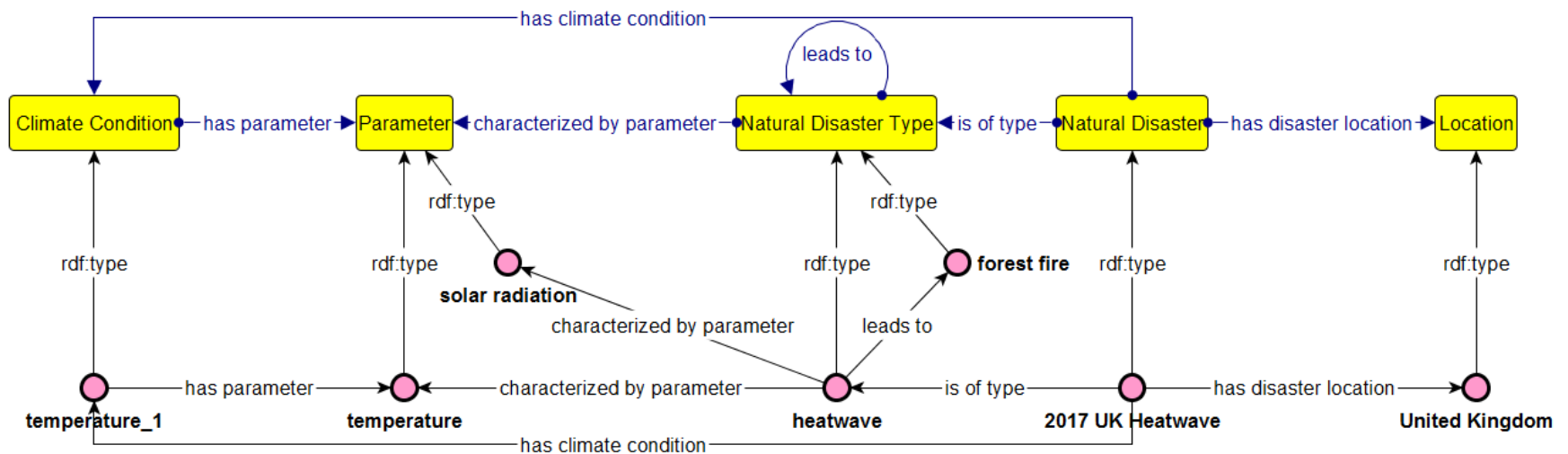
Semantics (*from Ancient Greek: sēmantikos, "significant"*) is the linguistic and philosophical study of meaning.



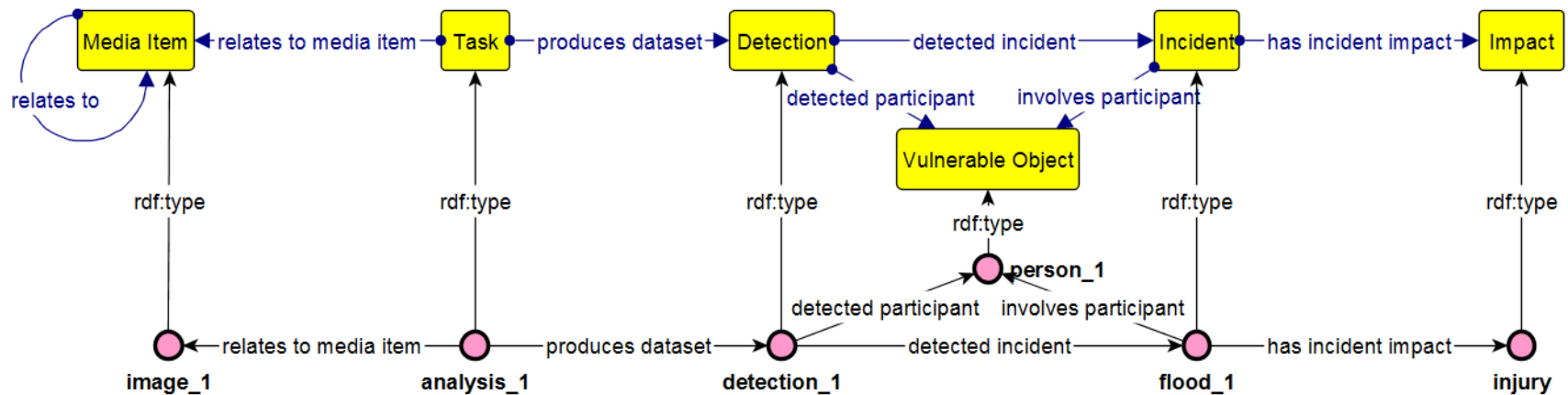
Domains of the beAWARE Ontology



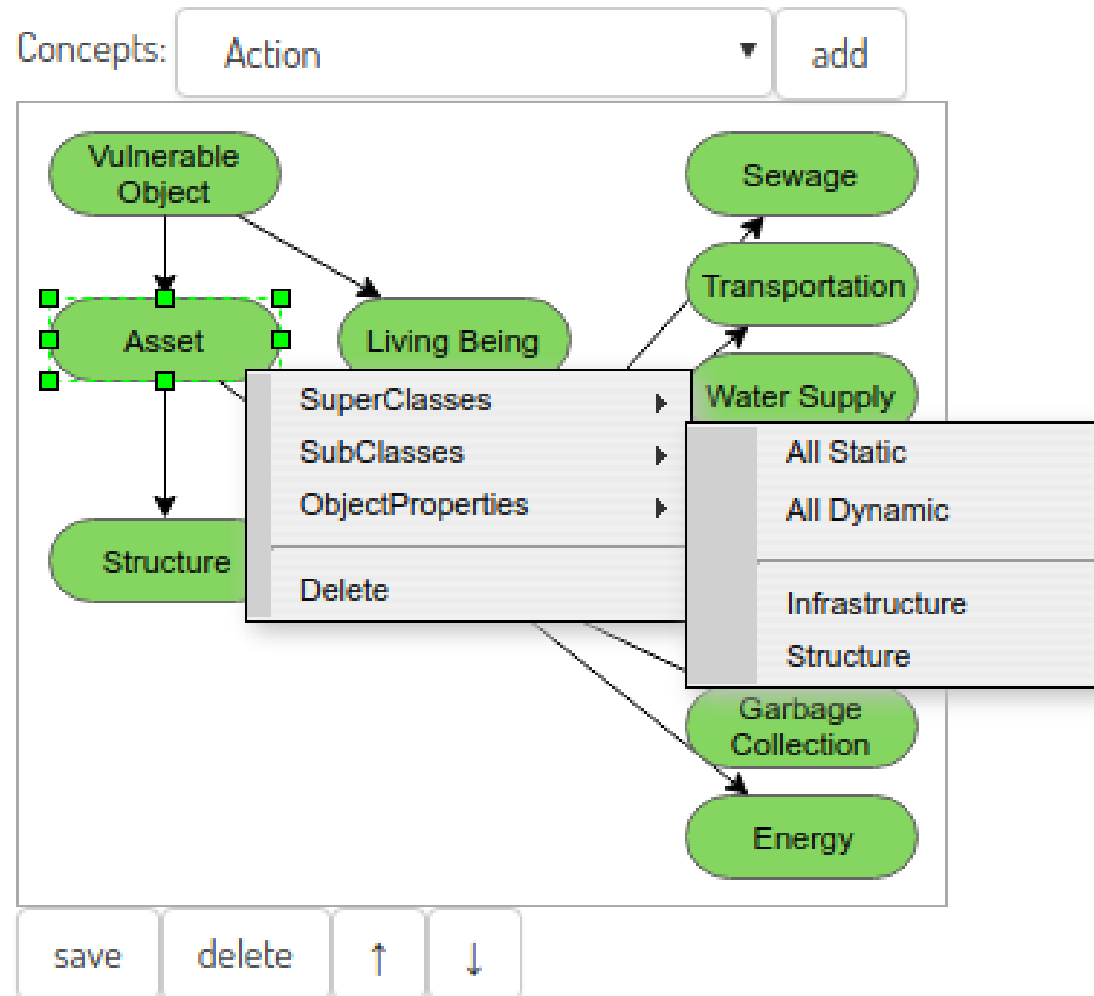
Representing natural disasters in the beAWARE ontology



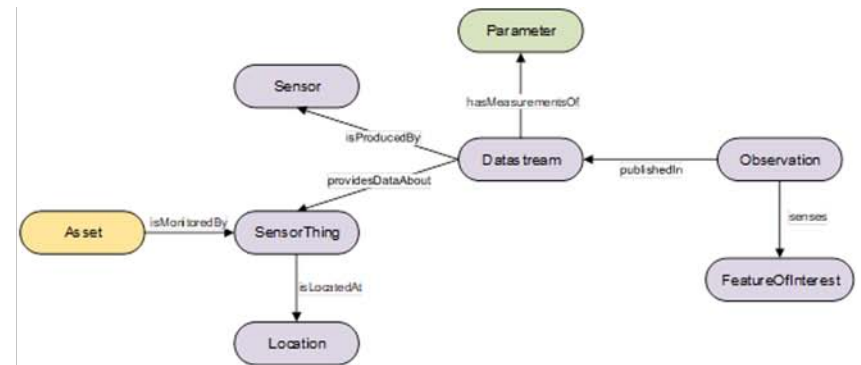
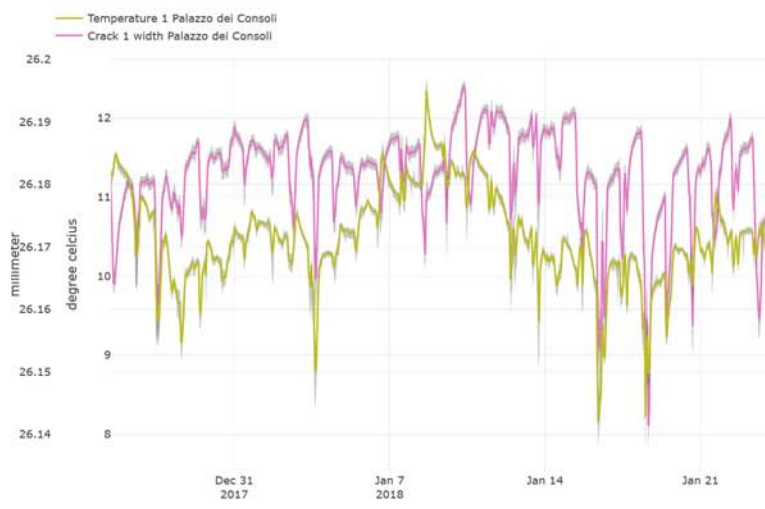
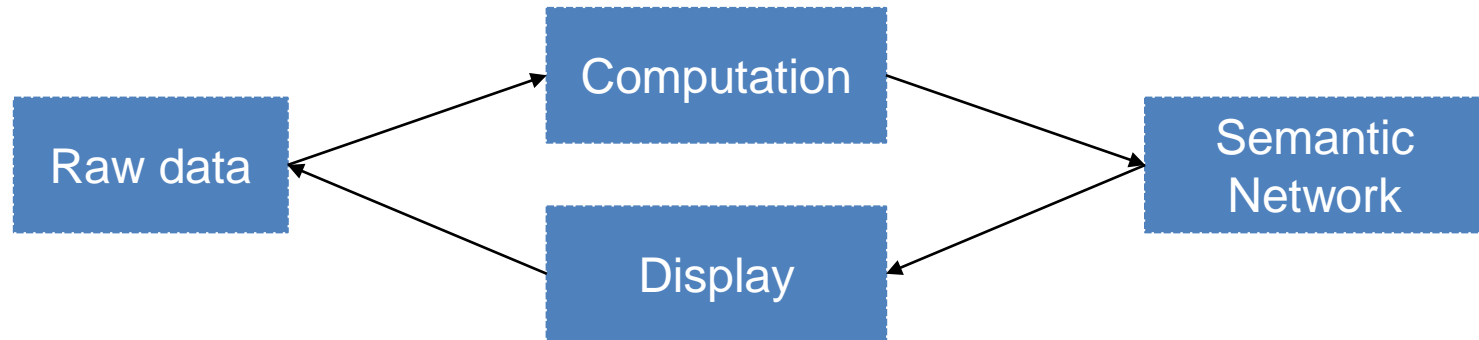
Representing natural disasters in the beAWARE ontology



Ontology Visualization



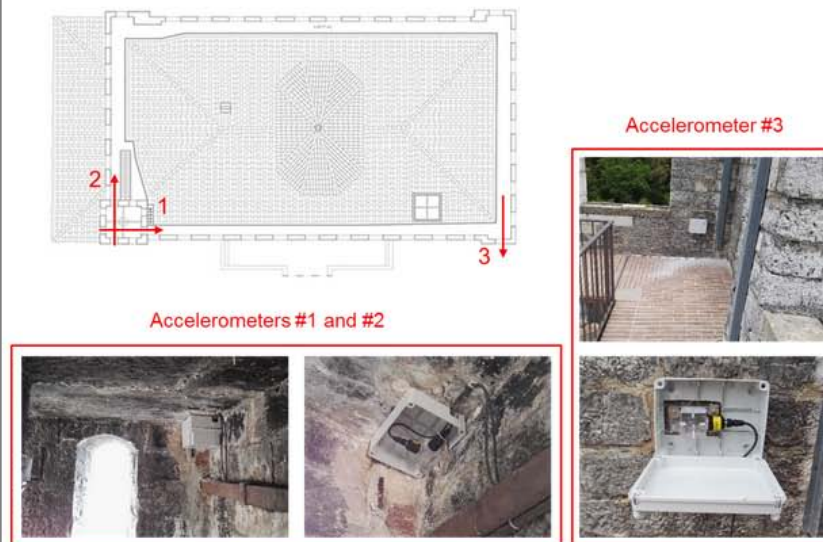
The gap between raw data and Semantics



From the Metadata of a Sensor...

Accelerometer

Accelerometer measure acceleration caused by shocks or structural influences. The sensors can identify individual frequencies and their impact on the observed object. The picture below shows the accelerometers on the roof of the Gubbio Palace.



In the pictures below sample charts of possibly obtained data is shown. The left picture shows the accelerometer amplitudes (positive values). The right picture shows a frequency analysis and depicts the occurrence of specific frequencies and their distribution. In the right column sample data in text files is provided as content.

Concept

Sensor

Sensor endpoint

Endpoint for Accelerometer

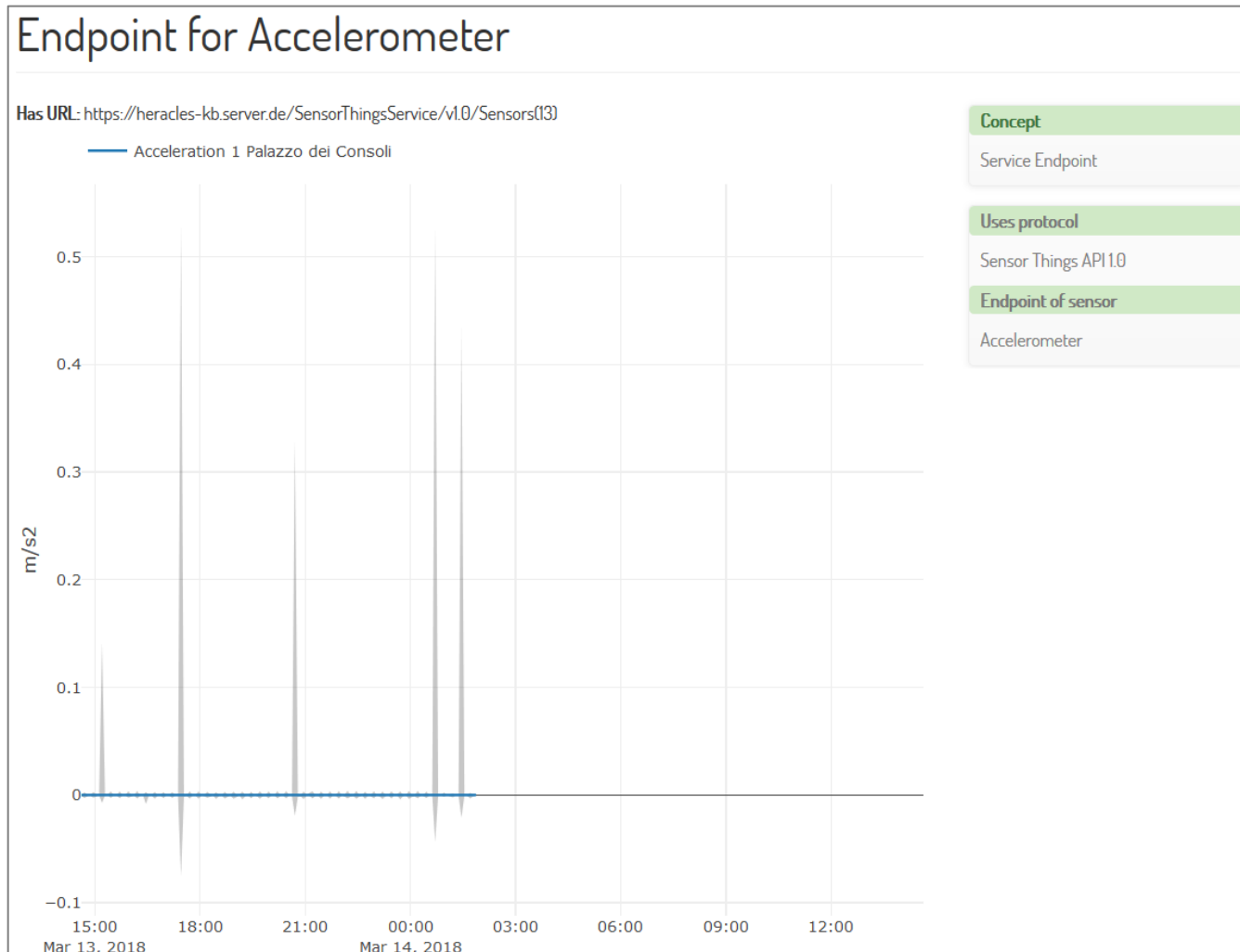
Sensor monitors

Palace of Gubbio

Sensor produces dataset

Acceleration Data Set

... to the Rawdata of the Sensor



Semantic Queries

Q CQ11 - What is the priority of a specific incident?

Q CQ12 - Which is the type of a specific incident?

Q CQ14 - Which humans are involved in a specific incident?

Q CQ15 - Are humans involved in an incident?

Q CQ16 - Location with most people at risk?

Q [CQ17 - Which location suffers a specific impact?](#)

Q CQ21 - What is the task assignment of a specific FR?

Q CQ22 - What is a FR's location?

Q CQ25 - Traffic Situation

Q CQ5 - Which location is the origin of a specific media item?

Q CQ6 - Which location does a specific incident relate to?

Q CQ7 - Location with most incidents

Q CQ8 - When did a specific incident occur?

Semantic Data Fusion – Competency Questions

- Resulting Ontology can be queried via SPARQL
- Some predefined queries (Competency Questions) are running on top of ontology and the results are included into the ontology.
- Example: Retrieve all incidents which affect humans

```
1 SELECT ?incident
2 WHERE
3 { ?incident a <#Incident> .
4   ?impact <#isCausedByIncident> ?incident .
5   ?human <#suffersImpact> ?impact .
6   ?human a <#Human> .
7   ?human <#participantIsDetectedBy> ?detection .
8   ?detection <#hasDetectionConfidence> ?detectionConfidence .
9   FILTER ( ?detectionConfidence > 80)
10 }
11 GROUP BY (?incident)
```

Semantic Queries

CQ14 - Which humans are involved in a specific incident?

Ontology

beAWARE Ontology (1932) Load C 115 Q 81 D 53 6

Semantic Query

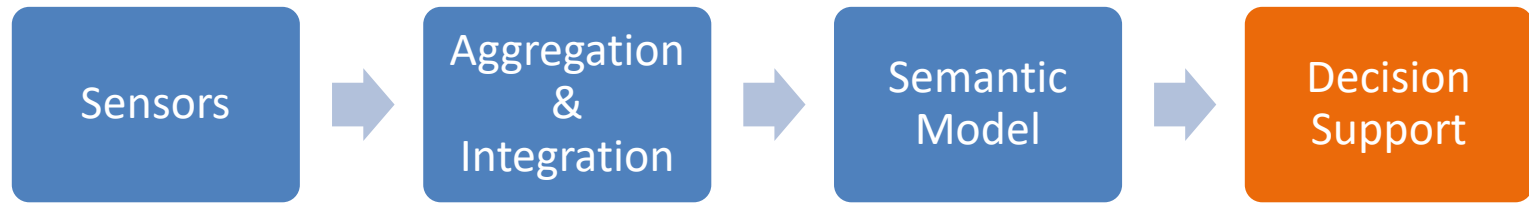
impact	type	Impact	-
impact	is caused by incident	incident	-
			+

Alternative Query

Create from stored Semantic Query

```
BASE    <http://beaware-project.eu/beAWARE/#>

SELECT ?human
WHERE
{
  ?incident a                <#Incident> .
  ?impact <#isCausedByIncident> ?incident .
  ?human <#suffersImpact> ?impact .
  ?human a <#Human> .
}
```



DECSION SUPPORT

Understanding the Situation



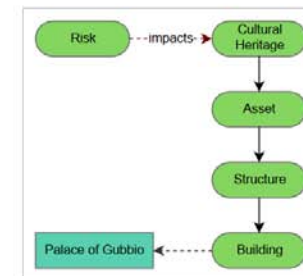
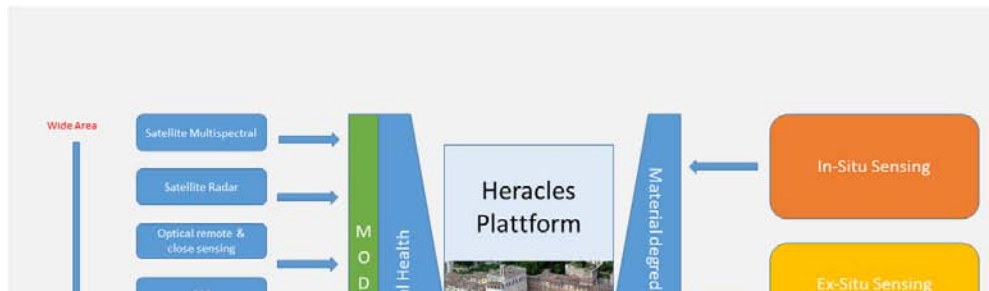
[HERACLES KNOWLEDGE BASE](#) |
 [USE-CASE CRETE \(GREECE\)](#) |
 [USE-CASE GUBBIO](#) |
 [WEBGENESIS](#) |
 [LOGOUT](#)

[HERACLES](#) > [HERACLES Knowledge Base](#) > [Instances](#) > [BuildingIndividuals](#) > [GubbioPalace](#)

Palace of Gubbio



The Consoli Palace was built between 1332 and 1343. The Palace has a rectangular shape, and a very articulated distribution of volumes divided into 9 levels. The main façade overlooking the square is made of ashlar stone and it stands for over 44 meters up to the top of the bell tower. The entryway is through a fan-shaped staircase leading to the "Arengo". This hall has two mullioned windows positioned on the two sides of the Gothic style portal, decorated with a XVI-century fresco in the lunette. In the main floor, six windows with round centre in pairs, divided by pillars, are present, while the battlement is supported by small pointed arches.



☐ Edit Images

Concept

Building

Has representation

3D- Model
 Anthropogenic pressure model
 Finite Element Models for structural analysis
 SAR Interferometry for structural analysis
 Structural monitoring by inverse velocity techniques
 Structural statistical models for the analysis of monitoring data

Located in

Gubbio

Asset endpoint

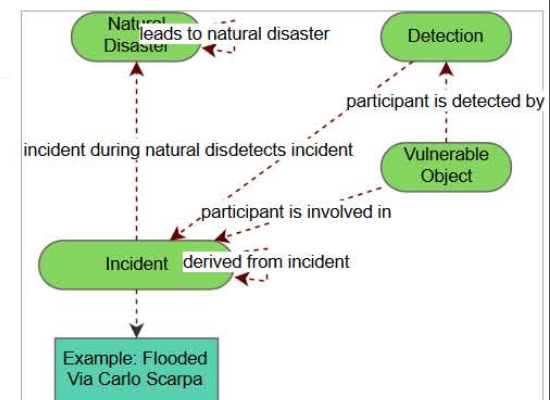
Understanding the Situation

Flooded Via Carlo Scarpa

The Via Carlo Scarpa is flooded.



The Via Carlo Scarpa was flooded due to heavy rains. The powerhouse was suffered water damages and was shut down for safety reasons.



Concept

Incident

Derived from incident

Example: Rain In Bacchiglione Basin Area

Is of incident type

Flood

Heavy Precipitation

Has incident impact

House Damaged in East Vicenza

Power Breakdown in East Vicenza

Involves participant

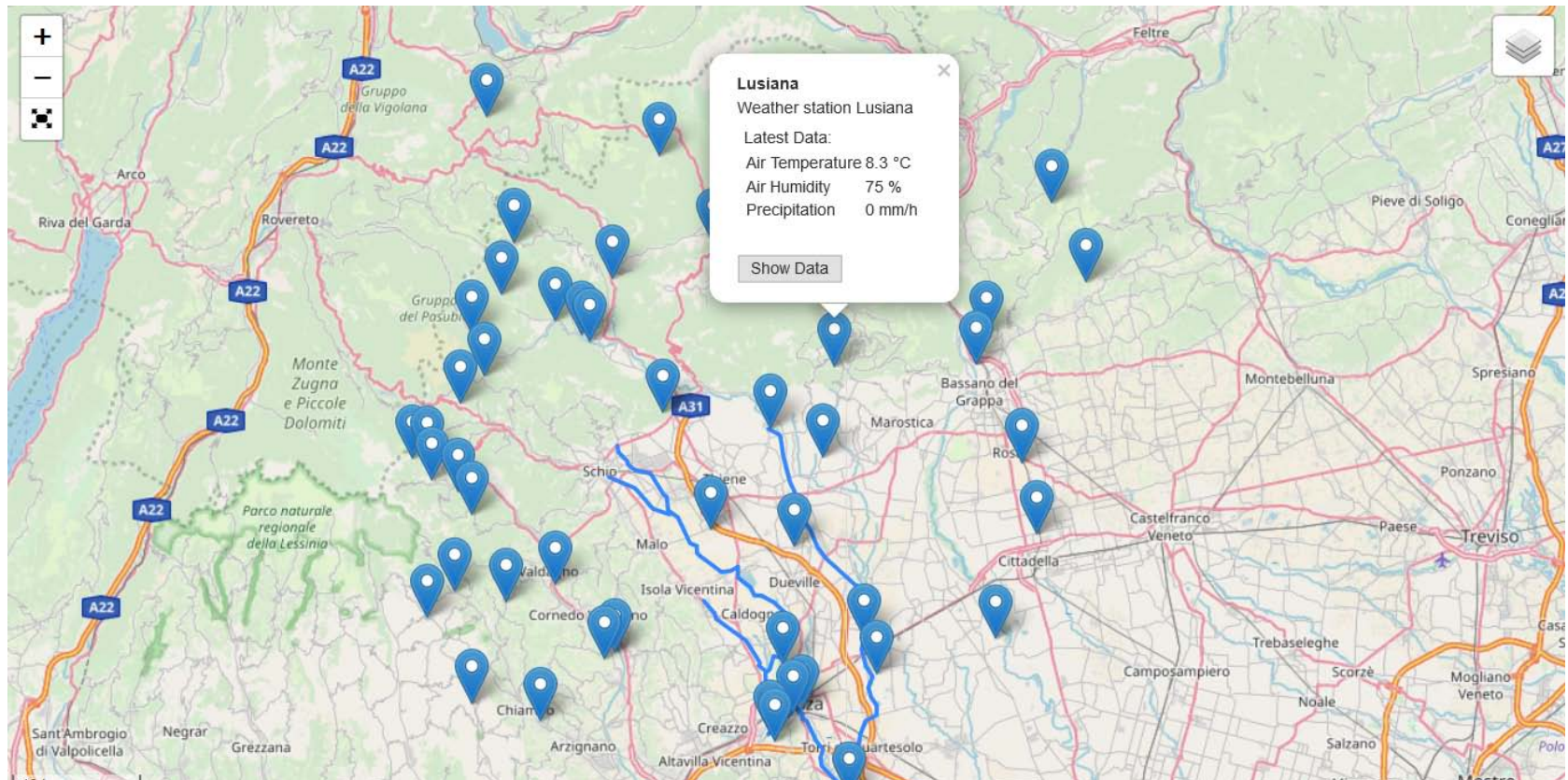
A. P. E. C. Powerhouse

Electrical Energy Supply of East Vicenza

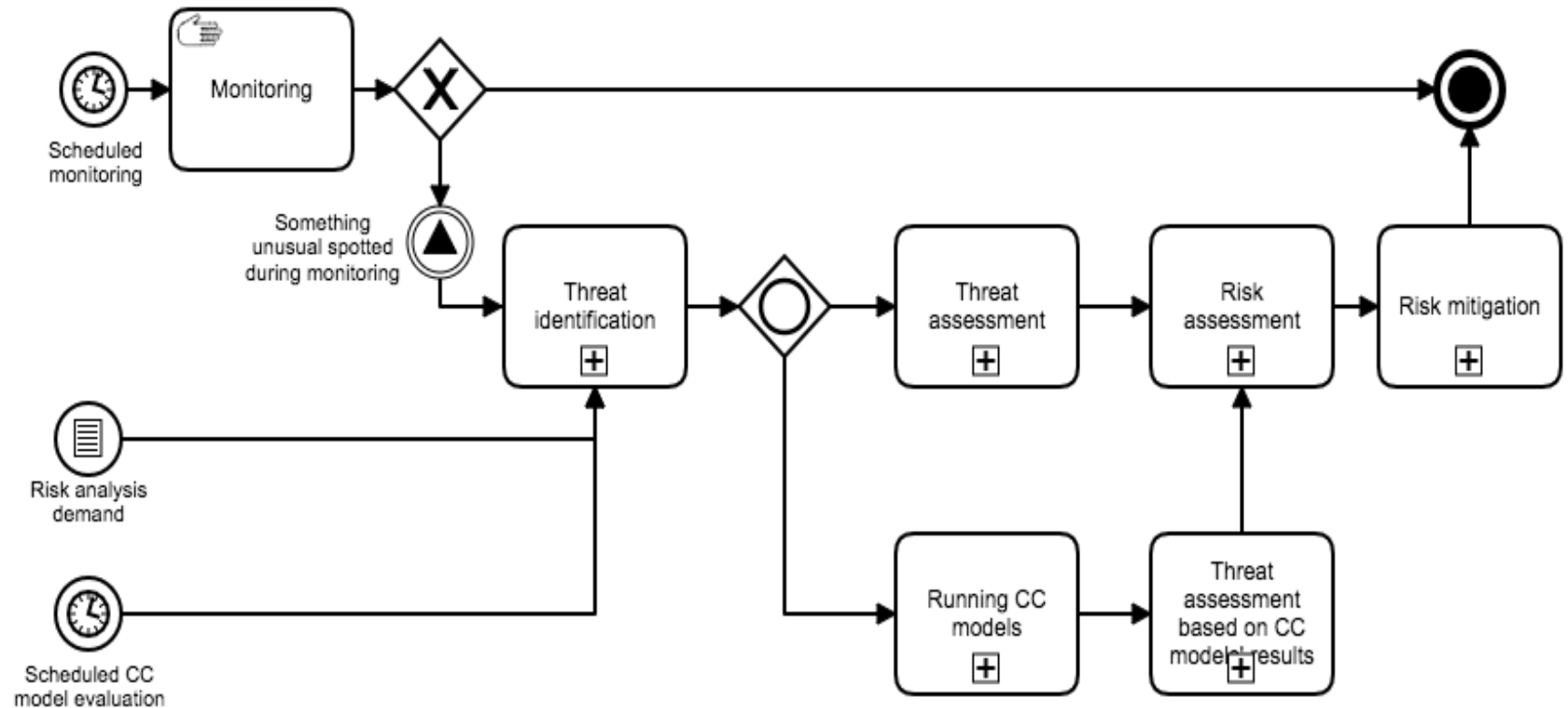
Human 08

Human 09

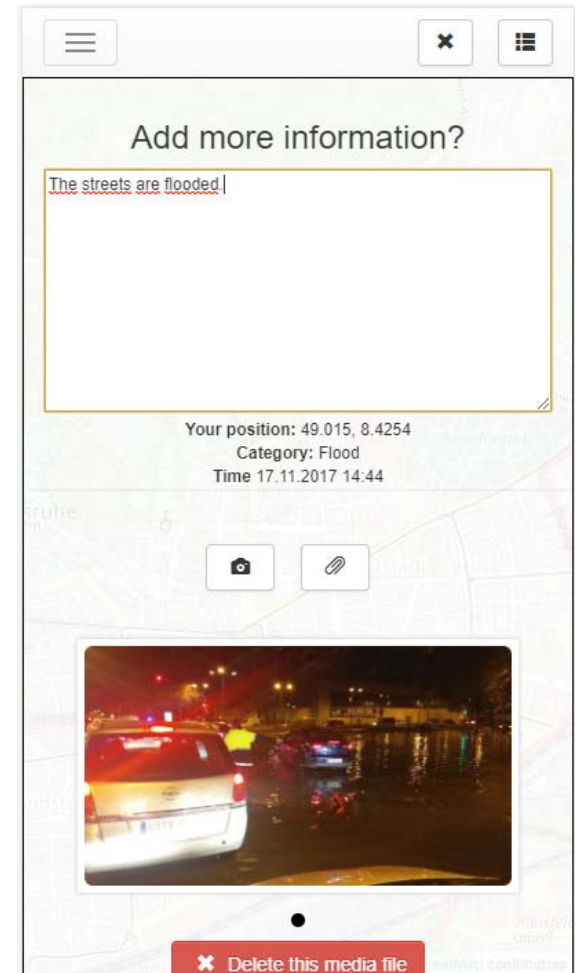
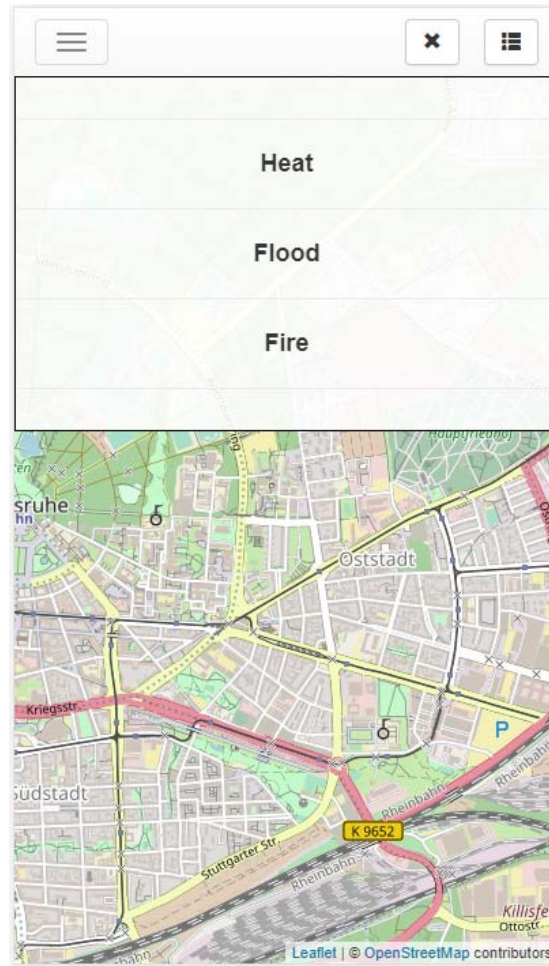
Spatial understanding



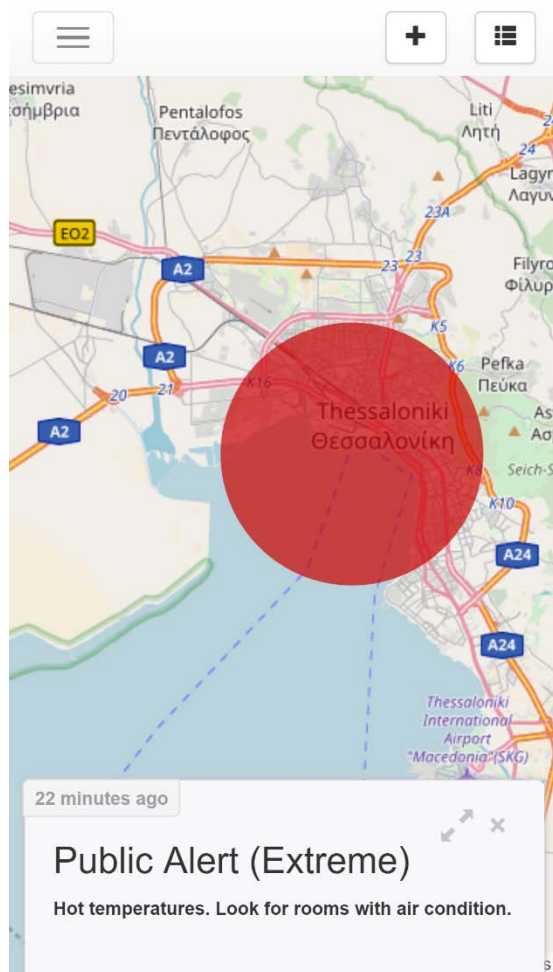
Support for SOPs by using Workflows - BPMN



Send a report



Public Alerts



Receive public alert from authority
Notification on new alert



Questions?

