# Weather Data Publication on the LOD using SOSA/SSN Ontology

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**Abstract.** This paper presents an RDF dataset of meteorological measurements. The measurements come from one weather station at the Irstea experimental farm located in Montoldre. The measurements have been made from August 2018 until now. They have been transformed and published as Linked Open Data (LOD). The data schema is based on the new version of the Semantic Sensor Network ontology. This ontology version integrates the Sensor, Observation, Sample, and Actuator pattern . We first present the network of ontologies used to organize the data. Then, the transformation process for publishing the dataset is detailed. To conclude we present some use cases of queries related to Irstea research projects.

Keywords: Semantic Sensor Ontology, Sensor, Observation, Sample, and Actuator, Climate Linked Data, meteorological observation

## 1. Introduction

The AgroTechnoPôle of Irstea contains an experimental farm where researchers and engineers can test their prototypes, such as robots or automatic systems. A weather station is located on the experimental farm. Weather data are useful for farmer activities but also for research experiments. We want to facilitate access to these weather measurements. Thus, we decided to test the publication of our meteorological dataset on the LOD.

In our previous work [1], we published meteorological observations using the Semantic Sensor Network (SSN) ontology [2]. This first work was based on previous publications of meteorological measurements using the SSN ontology : [3] presented a Linked Data weather archive of data from AEMET, the Spanish Meteorological Office. SSN was used as a central

node to connect a network of ontologies. SSN is still used to publish AEMET weather archives [4]. Note that [5] presented a Linked Data weather archive of date from the Australian Bureau of Meteorology. This work is different from the previous one because it joins the SSN ontology with the RDF Data Cube vocabulary : the meteorological measurements were aggregated and saved in a data cube [6].

The SSN ontology has been updated and has become a W3C recommendation in 2017 [7]. Now, SSN integrates the Sensor, Observation, Sample, and Actuator (SOSA) pattern. This paper describes a new meteorological dataset based on the SOSA/SSN ontology. To the best of our knowledge, this work is the first to publish meteorological data with the new version of the SOSA/SSN ontology. We published measurements from the Vantage Pro 2 weather station that is in use at our experimental farm. We have followed the usual steps in the Linked Data publication, as discussed in [8]. We have reused as much as possible existing on-

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tologies or thesauri related to meteorological observations and phenomena.

This paper is organized as follows: Section 2 describes our weather station and its measurements. Section 3 briefly presents the network of ontologies. Some examples of the organization of the data using these ontologies are described in section 4. Section 5 describes the populating processes and the links to other datasets. Section 6 presents some use cases of queries with this dataset. Finally we conclude by presenting an analysis of our work and perspectives.

## 2. Montoldre's Weather Station Description and Data Sources

Irstea has a research and experimentation site located in Montoldre. This experimental farm is part of the innovation lab of AgroTechnoPôle. One of the goals of the site is to run research experiments. One of these experiments is the "RObotics and Sensors serving the Ecophyto plan" (ROSE) challenge [9]. The goal of the ROSE challenge is to evaluate autonomous robots for use as weeding solutions for crops. This farm has its own weather station, a Vantage Pro 2 [1] from Davis Instruments. According to the documentation of the Vantage Pro 2, the station contains the following sensors: a barometer, two temperature sensors (inside and outside), two humidity sensors (inside and outside), an anemometer, a wind direction sensor, a rain collector to measure the amount of precipitation and the precipitation rate, a solar radiation sensor and a clock. These external sensors use wireless communication to send their measurements to a console located inside a building. The console is connected to a computer to store the measurement values. The storage of the measurements is automatically performed according to the user parameters (intervals of time, units, etc.). These data are extracted once per day to generate a Comma-Separated Values (CSV) file as shown in Table 1. This daily file is used to update a table in a PostgreSQL database. The structure of the table is similar to that of the CSV file.

This table stores the meteorological measurements from August 2018 until now. The table contains the following measures: outside temperature (in degrees Celsius), atmospheric pressure (in hectopascals), outside relative humidity (in percentages), wind direction

(east, north, south, west, ...), wind speed (in kilometers per hour), precipitation quantity (in millimeters), precipitation rate (in millimeters per hour) and solar radiation (in watts per square meter). The frequency of the measurements was fixed to 10 minutes.

## 3. A Network of Ontologies for Meteorological Data Publication

The SOSA/SSN ontology [7] can be used as a core ontology for the publication of meteorological data. This ontology should be linked with other ontologies to create a network. Our network of ontologies is composed of the following:

- Ontology to describe the different types of sensors.
- Ontology to describe the units of measurement.
- Ontologies to describe the geographical places and their locations.
- Ontology to describe the temporal entities.

In this section, we briefly describe the ontologies used for the publication of our meteorological data. We indicate the elements that we have reused from the ontology.

### 3.1. The W3C Semantic Sensor Network (SSN) Ontology

The Semantic Sensor Network (SSN) ontology is a generic ontology related to sensor observations [2]. The first version of this ontology was created by the W3C Semantic Sensor Network Incubator Group. Since then, this ontology has been updated to become a W3C recommendation. The new ontology is lightweight and is dedicated to sensor and actuator description. It was named the Sensor, Observation, Sample, and Actuator (SOSA) pattern. The link between SSN and SOSA is described as follows in [7]: "SOSA provides a lightweight core for SSN and aims at broadening the target audience and application areas that can make use of Semantic Web ontologies. At the same time, SOSA acts as minimal interoperability fall-back level, i.e., it defines those common classes and properties for which data can be safely exchanged across all uses of SSN, its modules, and SOSA."

The classes we have reused from the SOSA/SSN ontology are as follows:

- *sosa*:*Observation* to describe the measurement context,

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[1]https://www.davisinstruments.com/solution/vantage-pro2/

| Date | Time | Temp Out | Out Hum | Wind Speed | Wind Dir | Bar | Rain | Rain Rate | Solar Rad. |
|------|------|----------|---------|-----------|----------|------|------|-----------|------------|
| 08/01/19 | 23:30 | 3.3 | 89.0 | 6.4 | WNW | 1025.1 | 0.25 | 1.5 | 0 |
| 08/01/19 | 23:40 | 3.3 | 89.0 | 6.4 | WNW | 1025.0 | 0.25 | 1.5 | 0 |
| 08/01/19 | 23:50 | 3.2 | 89.0 | 6.4 | WNW | 1025.0 | 0.25 | 1.5 | 0 |

Table 1

Example of a CSV file

| Prefix | Name | URI |
|--------|------|-----|
| ssn | Semantic Sensor Network Ontology | <http://www.w3.org/ns/ssn/> |
| sosa | Sensor, Observation, Sample, and Actuator Ontology | <http://www.w3.org/ns/sosa/> |
| geo | OGC GeoSPARQL 1.0: A Geographic Query Language for RDF Data | <http://www.opengis.net/ont/geosparql> |
| locn | ISA Programme Location Core Vocabulary (Second version) | <http://www.w3.org/ns/locn> |
| qudts | Quantities, Units, Dimensions and Types Ontology (version 1.1) schema | <http://qudt.org/1.1/schema/qudt> |
| qudt | Quantities, Units, Dimensions and Types Ontology (version 1.1) vocabulary | <http://qudt.org/1.1/vocab/unit> |
| aws | Ontology for Meteorological sensors | <http://purl.oclc.org/NET/ssnx/meteo/aws> |
| time | Time Ontology in OWL | <http://www.w3.org/2006/time#> |

Table 2

Reused vocabularies and ontologies

- *sosa*:*FeatureOfInterest* to specify the observed phenomena (e.g., wind),
- *sosa*:*ObservableProperty* to specify the measured property of the observed phenomena (e.g., wind speed),
- *sosa*:*Platform* to describe the weather station,
- *sosa*:*Sensor* to describe the sensors of the weather station, and
- *sosa*:*Result* to provide the sensor measurement value.

We have also used the main properties associated with these classes: *sosa*:*observedProperty*, *sosa*:*madeBy-Sensor*, *sosa*:*hosts*, *sosa*:*hasFeatureOfInterest*, *sosa*:*hasResult*, etc.

### 3.2. The AWS Ontology for Meteorological Sensors

The Ontology for Meteorological Sensors [10] (AWS) extends the old version of the SSN ontology by specializing its class *ssn*:*SensingDevice*. It focuses on the description of the different types of sensors that can be used to measure the meteorological phenomena. Note that *ssn*:*SensingDevice* and *sosa*:*Sensor* have one common parent class *ssn*:*System*. The definition of *sosa*:*Sensor* does not mention any *rdfs*:*subClassOf* relation between *sosa*:*Sensor* and *ssn*:*Sensor*. Nevertheless their definitions are compatible. There is no logical incoherence between them. More specifically, we mostly reused the following classes:

- *aws*:*AtmosphericPressureSensor* to define the barometer;
- *aws*:*CapacitiveThinFilmPolymer* to define the outside humidity sensor;
- *aws*:*Pyranometer* to define the solar radiation sensor;
- *aws*:*Thermistor* to define the outside temperature sensor;
- *aws*:*TippingBucketRainGaugeTbrgWithout Correction* to define the precipitation collector sensor; this sensor is able to produce two separate measurements: the quantity of precipitation regardless of the precipitation type (snow, rainfall, hail), and the precipitation rate;
- *aws*:*WindVane* to define the wind direction sensor; and
- *aws*:*CupAnemometer* to define the anemometer (wind speed sensor).

We noticed that AWS proposes many meteorological sensor types. In our case, AWS provides all the sensor descriptions needed for our purpose.

### 3.3. Quantity, Unit, Dimension and Type

The Quantity, Unit, Dimension and Type (QUDT) is a collection of OWL ontologies and vocabularies. We used version 1.1 [2]. The QUDT schema defines the base

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[2] the version 2.0 of this collection is available on the website http://qudt.org.

classes, properties, and restrictions used for modeling the physical quantities, units of measure, and their dimensions in various measurement systems. QUDT also contains a set of vocabularies to define the units for different domains. We reused the *unit* vocabulary that categorizes units into different classes. This vocabulary also provides individuals of those classes to identify units such as *qudt*:*Millimeter* or *qudt*:*Percent*.

### 3.4. The ISA Location Core Vocabulary (LOCN) and GeoSPARQL

Currently, several ontologies exist for the publication of spatial data. We decided to use the GeoSPARQL vocabulary [11]. GeoSPARQL is the result of a standardization process at the Open Geospatial Consortium (OGC). It first focuses on querying the geographical data. It also proposes a model to describe the geometries of spatial objects: through the object property *hasGeometry* and the data properties *hasGML* or *hasWKT*. GeoSPARQL extends the WGS84 vocabulary and proposes different types of geometries, such as point, polygon, multipolygon, etc. It also allows the definition of the topological relationships between spatial objects.

The ISA Core Location vocabulary [12] (LOCN) was released in November 2013, and has recently been given a W3C-owned namespace, although it was initially generated outside the consortium. This RDFS vocabulary focuses on the description of places and their address. It provides a set of three classes and several properties. This ontology was used to describe the address of the experimental farm.

### 3.5. The W3C Time Ontology

The W3C Time ontology [13] enables the description of instants and intervals in time. Hence it may be useful when we need to describe the timestamps or the time period associated with the measurements made by the weather station. We reused the classes *time*:*Interval* and *time*:*Instant*, and the associated properties *time*:*inXSDDateTimeStamp*, *time*:*hasBe--ginning*, *time*:*hasEnd*, etc.

## 4. Populating the Network of Ontologies

Based on the network of ontologies described in the previous section, we were now able to create a dataset containing all the individuals describing mea-

surements of our weather station. Now we explain the decisions made to create the resource URIs (section 4.1), and we provide examples of the resource descriptions (section 4.2).

### 4.1. Resource URIs for our Weather Station Data

The URIs were designed with several principles in mind, such as simplicity, stability and manageability. We followed the common guidelines and recommendations [3]. This section presents the main URI design decisions and the conventions used. Table 3 provides a summary of the main types of URIs that we generated. The first column presents the type of resources. The second column indicates the associated class that types the resources. The last column contains the name pattern used to generate the resource URIs.

The base URI for our new meteorological dataset is located at http://ontology.irstea.fr/weather/resource/. Its prefix is atpw. We have another base URI for generic information shared between several datasets called http://ontology.irstea.fr/society/resource/. Its prefix is irstea.

Our generic name pattern to produce URIs for each object is {Base URI} +'/'+ {nameOfClass} +'/'+ {objectIdentifier}. The object identifiers and class names are written in the camel case. The '_' character is used between two object identifiers. For example, the URI that represents the barometer named 'barometer01' of the weather station named 'VP2lesPalaquins01' is as follows: http://ontology.irstea.fr/weather/resource/ sensor/VP2lesPala- -quins01_barometer01. Note that all the URIs about time description are compliant with the ISO 8601 format [14] except that the '/' character is replaced by the '_' character .

### 4.2. Excerpts from our Weather Dataset

The following subsections provide some examples to illustrate the use of our network of ontologies.

### 4.2.1. Weather Station Description

In this section we provide a general overview of the weather station description. The individual that represents the weather station is an instance of the *sosa*:*Platform* class. The GeoSPARQL vocabulary is used to describe the precise location of the weather station. As shown in figure 1, the geometry of the weather station is a point expressed by a WKT string. This string is linked to a *geo*:*Geometry* instance

| Object | Class | local ID pattern |
|---|---|---|
| Weather Station | *sosa:Platform* | *atpw:platform/{stationType}{locationName}{stationID}* |
| Sensor | *sosa:Sensor* | *atpw:sensor/{stationType}{locationName}{stationID}_{sensorType}{sensorID}* |
| Feature of Interest | *sosa:FeatureOfInterest* | *atpw:featureOfInterest/{NaturalPhenomenonLabel}* |
| Observable Property | *sosa:ObservableProperty* | *atpw:observableProperty/{NaturalPhenomenonLabel}_{propertyLabel}* |
| Instant | *time:Instant* | *atpw:instant/{date}T{time}{timeZone}* |
| Duration | *time:Duration* | *atpw:duration/P{duration}* |
| Interval | *time:Interval* | *atpw:interval/P{duration}_{endInstant}* |
| Observation | *sosa:Observation* | *atpw:observation/at_{time}_of_{sensor}_on_{NaturalPhenomenonLabel}_{propertyLabel}* |
| Result value | *sosa:Result* | *atpw:result/value_{measurementValue}_{unit}* |
| Geometry | *geo:Geometry* | *{Base}/geometry/{geometryType}_{objectName}* |

Table 3

URI generation templates for resources

by the *geo:asWKT* property. The *geo:hasGeometry* property links the *sosa:Platform* instance to the *geo:Geometry* instance. The ISA Core Location Vocabulary (LOCN) is used to define the address of the Montoldre experimental farm. The *locn:address* property links *geo:Feature* instance to the *locn:Address* instance. As shown in figure 1, the *geo:sfContains* and *geo:sfWithin* properties express the spatial inclusion relationship between *geo:Feature* instances.

#### 4.2.2. Sensor Description

Each sensor of the weather station is represented by an instance of the class *sosa:Sensor*. Figure 2 presents a description of the barometer. The barometer is identified by a URI ending with *barometer*01. This URI is typed by two classes *aws:AtmosphericPressureSensor* and *sosa:Sensor*. The *sosa:host* property links the *sosa:Platform* instance to the barometer URI. The *sosa:observes* property links the barometer URI to an instance of *sosa:ObservableProperty* that is labeled by the string "air pressure".

#### 4.2.3. Observation Description

An observation describes the context of a measurement made by a sensor. Figure 3 represents an observation made by the barometer of the air pressure at a given point in time. The properties *sosa:observedProperty*, *sosa:hasFeatureOfInterest*, *sosa:madeBySensor* and *sosa:hasResult* link our specific observation with the corresponding observed property, natural phenomenon, sensor and measurement value. Note that we created an individual, instance of the *sosa:FeatureOfInterest* class that represents the air phenomenon.

#### 4.2.4. Phenomenon Time Description

A measurement can be instantaneous. For example, the barometer measures the air pressure in an instan-

| Measured property | Time entity |
|---|---|
| outside temperature | instant |
| atmospheric pressure | instant |
| outside humidity | instant |
| wind direction | interval |
| wind speed | interval |
| quantity of precipitation | interval |
| rain rate | interval |
| solar radiation | interval |

Table 4

Measured properties and related time entities

taneous manner. Figure 3 presents an observation produced by the barometer. The *sosa:phenomenonTime* property points to an instance of the class *time:Instant*. The property *time:inXSDDateTimeStamp* connects the *time:Instant* instance to an *xsd:dateTime* value. This value is expressed in the ISO 8601 format.

Sometimes a measurement is related to a period of time. For example, the rain collector measures the quantity of precipitation that falls during a time period. Figure 4 presents an observation made by the rain collector sensor. The property *ssn:phenomenonTime* links the *sosa:Observation* instance to an instance of the class *time:Interval*. The properties *time:hasBeginning*, *time:hasEnd* and *time:hasDuration* specify the beginning, the end and the duration of the interval, respectively. Table 4 summarizes the time entities associated with types of measurement.

### 5. Data Transformation Process

This section briefly describes the processes involved in the RDF dataset generation. As explained in section 1, the measurements produced by the weather station
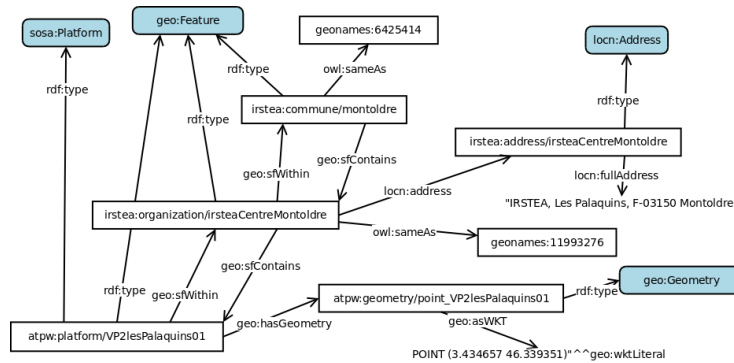
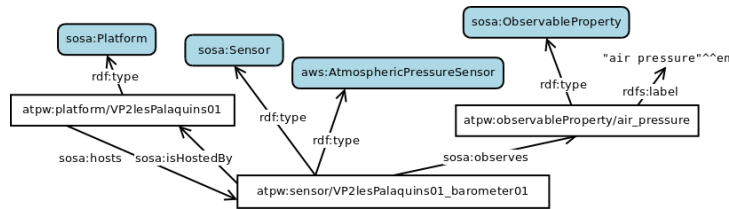Fig. 1. Location of the weather station
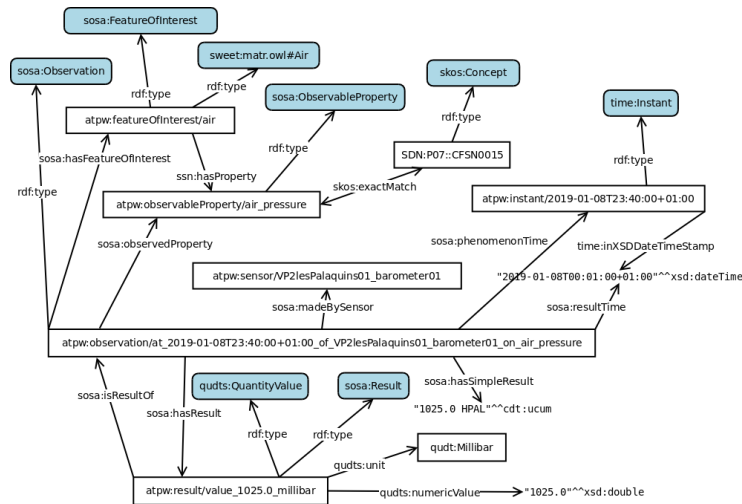
Fig. 2. Barometer description

Fig. 3. Example of observation made by the barometer

sensors are stored in the PostgreSQL table. The measurements are performed every 10 minutes. The transformation process is performed by a program written in Python. The goal of the program is to update an RDF triplestore available on a Jena Fuseki server. This program uses three main libraries :

- *requests* to communicate with the triplestore using the HTTP protocol,
- *psycopg2* to query the PostgreSQL database,

- *datetime* to process the datetime objects in order to compute the time duration or time instant and write them in the ISO 8601 format, and
- *arrow* to extract the current timezone.

The data transformation algorithm is composed of the following steps :

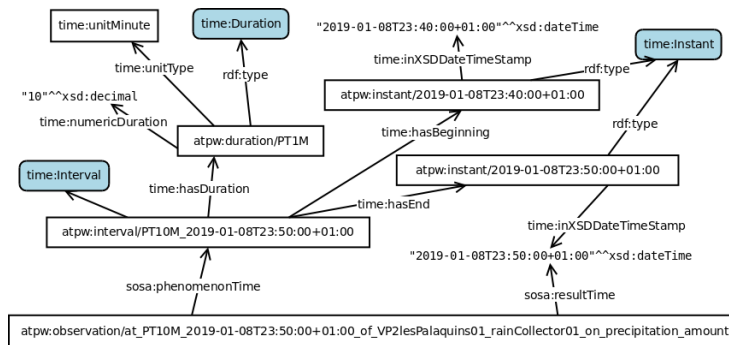- query the triplestore to obtain the time of its newest measurement, and

Fig. 4. Example of interval

– based on this time, query the PostgreSQL table to retrieve the new measurements ordered by time;
– for each measurement of the query results, compute its duration,
– extract the measurement values,
– convert the wind direction into degrees, and
– write an *"INSERT DATA"* SPARQL query and send it to the triplestore through an HTTP POST frame.

During this process, the new `sosa:Result` individuals are stored in a stack. The process tests if an individual URI already exists in the stack, and then it sends the INSERT query to the triplestore. Note that the Jena Fuseki server has an internal duplicate testing procedure that slows its execution.

Our dataset characteristics are listed in Table 5. The statistics presented in Table 6 were computed in July 2019. Note that the number of observations was 46.648 for precipitation rate, precipitation amount, air pressure and wind speed. There were only 25.274 wind direction measurements. When the wind sensor does not detect wind events, this type of measurement does not occur. The number of observations for the relative humidity, flux density and air temperature were close to 45.170. Indeed the data transfer from the weather station to the PostgreSQL table sometimes fails.

### 5.1. Interlinking

As shown in Table 6, we manually aligned our dataset to several resources as follows:

– the SWEET network of ontologies: the Semantic Web for Earth and Environmental Terminology [15],
– the CF thesaurus: the Climate and Forecast Standard Names [16],

| URL | http://ontology.irstea.fr/weather |
|---|---|
| Documentation | http://ontology.irstea.fr/pmwiki.php/Site /WeatherSOSA |
| SPARQL endpoint | http://ontology.irstea.fr/weather/snorql/ |
| Datahub name | datahub.ckan.io/fr/dataset/irstea-weather -dataset-of-the-montoldre-experimental-farm |
| VoID | http://ontology.irstea.fr/weather/page/metadata |
| Licensing | https://www.etalab.gouv.fr/licence -ouverte-open-licence |
| 5 star rating | ***** |

Table 5
Technical details

| Category | Resources |
|---|---|
| Total Nr. of triples | 3.789.344 |
| Nr. of classes | 26 |
| Nr. of properties | 57 |
| Nr. of platform | 1 |
| Nr. of sensors | 8 |
| Nr. of observations | 347.383 |
| Nr. of observations per observed property | Max 46.648 |
| Nr. of result | 2.309 |
| Nr. of temporal entities | 93.320 |
| Nr. of links to SWEET | 4 |
| Nr. of links to CF thesaurus | 8 |
| Nr. of links to GeoNames | 2 |
| Nr. of links to INSEE | 1 |
| Nr. of links to DBpedia | 2 |

Table 6
Key statistics

– Geonames: the GeoNames geographical database[3],

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[3] https://www.geonames.org/

– INSEE: the SPARQL endpoint of the National Institute of Statistics and Economic Studies [4], and
– the DBpedia: a dataset extracted from the Wikipedia InfoBox [17].

All the instances of *sosa:FeatureOfInterest* were also typed according to the classes defined in SWEET. SWEET is a collection of OWL ontologies that include both orthogonal classes (space, time, earth realms, physical quantities, etc.) and integrative science knowledge classes (phenomena, events, etc.) [15]. As shown in Figure 3, the instance representing the air phenomenon is typed by the class named *sweet:Matr.owl#Air*. This class is defined in one of the ontologies of version 3.2.0 of the SWEET network[5]. Table 7 presents the correspondence between the *sosa:FeatureOfInterest* instances (*Air*, *Wind*, *Precipitation*, *SolarFlux*) and their *SWEET* classes. Note that instance labels are based on the SWEET class names.

All the instances of *sosa:ObservableProperty* were manually linked to the *skos:Concept* instances of the CF thesaurus using a *skos:exactMatch* or *skos:close-Match* property. The CF stores terms used to identify the measured properties of meteorological phenomena in climatic and forecasting conventions [16]. The thesaurus was published on the LOD using the SKOS vocabulary [18]. The labels of the *skos:Concept* instances are precise. Thus, the labels of our *sosa:Obser-vableProperty* instances were based on their associated *skos:Concept* labels. Figure 3 shows the *skos:exactMatch* link between a *sosa:Observable-Property* instance and a *skos:Concept* instance. Table 8 presents the links between our dataset and the CF thesaurus. The first column presents the measurement types of the Vantage Pro 2 station. The second column presents the URIs of the *sosa:ObservableProperty* instances. The last column presents the label and ID of the *skos:Concept* instances defined in the CF thesaurus.

The individuals that represent generic information (prefix *irstea*) were manually linked to their representations in other datasets with *owl:sameAs* links. For example, the individual that represents the Irstea institution is linked to its DBpedia representation. Individuals that represent the geographic feature (Irstea Center of Montoldre and Montoldre locality) are linked

to their representations in GeoNames. Figure 1 shows two *owl:sameAs* links with GeoNames individuals. The locality of Montoldre was also represented in the INSEE dataset. The number of links with other resources is presented in Table 6.

## 6. Meteorological Dataset Use Cases

Irstea is involved in farm robotic projects [9]. The robotic teams need to access precise weather conditions to determine the best times to carry out their field experiments. The weather data are useful for the analysis of their field experiments. The researchers need to understand the behavior of the electronic components. These components are sensitive to air humidity and temperature. Moreover, the robots need to adapt their speed depending on the soil humidity. Thus, robotic teams need to know how much rain has fallen in the days before their field experiments. To summarize, some robot parameters need to be adapted to the weather conditions. To query the meteorological dataset, we propose two SPARQL interfaces: the one proposed by SNORQL and the one presented in Figure 5. This new interface proposes some sample queries in a listbox. Moreover, the numeric results are visualized as a graph.

As far as we know, the meteorological dataset has only been queried by engineers to determine the parameter updates of their equipment. We expect in the future that this dataset will be queried by an automatic system. For example, an automatic irrigation system for maize crops is being developed [19]. The quantity of precipitation per day data is needed by the irrigation decision system to cancel or delay an irrigation. The quantity of water needed by the crop depends on its growth stage. Crop growth stages are evaluated automatically based on a formula that uses the minimal and maximal temperature per day measurements as input. The irrigation decision system will be connected to the SPARQL endpoint to automatically determine the crop growth stage and to adapt its decision accordingly.

This meteorological dataset can also be queried by the agronomists involved in crop modeling. Climatic events are correlated with the crop growth stage and crop yield. The agronomists are interested in studying the crop life cycle during climatic change. They need to know the minimal and maximal temperatures, the total amount of solar radiation and the total amount of precipitation per day. When our meteorological dataset is large enough, we will build some meteorological archives joined with the crop life cycle dataset.

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[4]http://rdf.insee.fr/sparql
[5]SWEET files are available on a github located in https://github.com/ESIPFed/sweet/tree/master/src

| FeatureOfInterest instance | | SWEET class |
| --- | --- | --- |
| label | URI | URI |
| air | *atpw:featureOfInterest/air* | sweet:matr.owl#Air |
| wind | *atpw:featureOfInterest/wind* | sweet:phenAtmoPrecipitation.owl#Wind |
| precipitation | *atpw:featureOfInterest/precipitation* | sweet:phenAtmoPrecipitation.owl#AtmosphericPrecipitation |
| solar flux | *atpw:featureOfInterest/solarFlux* | sweet:propEnergyFlux.owl#SolarFlux |

Table 7

Meteorological phenomena

| Measurement | Property | CF skos:Concept | |
| --- | --- | --- | --- |
| type | URI | label | ID |
| outside temperature | *atpw:observableProperty/air_temperature* | air_temperature | SDN:P07::CFSN0023 |
| atmospheric pressure | *atpw:observableProperty/air_pressure* | air_pressure | SDN:P07::CFSN0015 |
| outside humidity | *atpw:observableProperty/air_relativeHumidity* | relative_humidity | SDN:P07::CFSN0413 |
| wind direction | *atpw:observableProperty/wind_direction* | wind_from_direction | SDN:P07::CFSN0036 |
| wind speed | *atpw:observableProperty/wind_speed* | wind_speed | SDN:P07::CFSN0038 |
| quantity of precipitation | *atpw:observableProperty/precipitation_amount* | precipitation_amount | SDN:P07::CFSN0452 |
| rain rate | *atpw:observableProperty/precipitation_rate* | rainfall_rate | SDN:P07::CFSN0410 |
| solar radiation | *atpw:observableProperty/solarFlux_density* | downward_heat_flux_at _ground_level_in_soil | SDN:P07::CFSN0689 |

Table 8

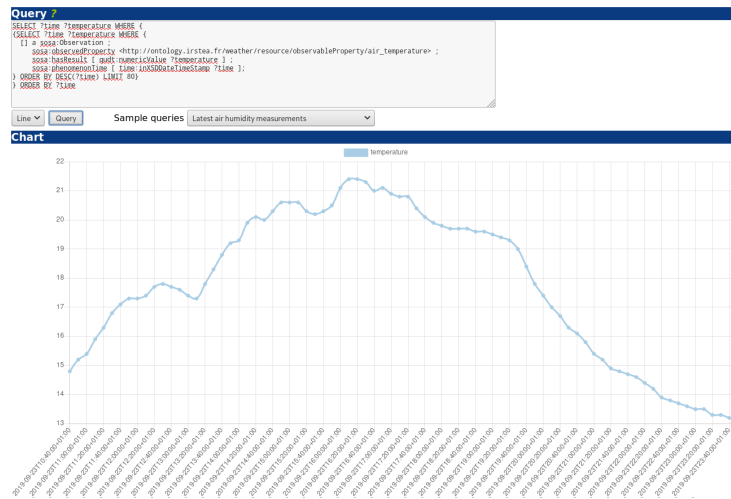Measured properties of meteorological phenomena



Fig. 5. Vizualisation of the latest air temperature measurements

## 7. Conclusion and Perspectives

The AgroTechnoPôle of Irstea contains an experimental farm where researchers and engineers can test their prototypes, such as robots or automatic systems. A weather station is located on the experimental farm. The weather data are useful for farming activities but also for research experiments. We want to facilitate access to weather measurements. Thus, we decided to test the publication of our meteorological dataset on the LOD.

This paper presents a meteorological dataset based on the new version of the SSN ontology, that is to say, the SOSA/SSN ontology. To do so, we selected a network of ontologies to describe our dataset. We built a dataset based on the measurements of the weather station from August 2018. It is updated daily. This dataset is accessible at a dedicated SPARQL endpoint.

The next step will be, to update the dataset with the meteorological observations of the two other weather stations in Irstea. AgroTechnoPôle has a mobile weather station located in one of the plots of the Montoldre farm and a weather station located near the university campus of Clermont-Ferrand.

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