Service Template Specification

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**The "sensor\_data" Service Template**

Abstract

This document describes the specifications for the sensor\_data service whose purpose is to make available environmental data from remote field sensors to authorized ATLAS network consumers.

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# Introduction

Environmental sensor data is key to a great number of services and platforms in the ATLAS network. Services implementing the sensor\_data service template will benefit from the historical information collected by physical sensors.

The sensor\_data service template is designed with the idea to provide discrete measurements of sensors located within a boundary region and during a time interval. For outdoors sensors, the boundary region is typically that of a field which clients can retrieve from a field\_data service. In the case of indoor sensors, the boundaries would typically be that of barns.

# Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](https://datatracker.ietf.org/doc/html/rfc2119) and indicate requirement levels for compliant implementations.

The notation "[xxx]" (xxx in square brackets) is equivalent to "array of xxx".

When used alone, the term "sensor\_data" refers to "sensor\_data service template". Instead, "sensor\_data service" is equivalent to "a service implementing the sensor\_data service template".

# Pre-requisites

A thorough understanding of the following is required for both service consumers and service implementors:

* GeoJSON specifications (<https://geojson.org/>)
* ISO8601 representation of dates and times (<https://www.iso.org/iso-8601-date-and-time-format.html>)

# sensor\_data Use Scenarios

The following sections describe some aspects of the use of sensor\_data. The examples were chosen to illustrate the basic operation of applications using sensor\_data, not to limit what sensor\_data may be used for.

## Irrigation

The aim is to optimize water usage based on several data sources from sensor\_data. The irrigation decisions taken by a sensor\_data service could use a sensor\_data service to retrieve the historical data related to a specified region.

When an irrigation prediction needs to be done, the sensor\_data service would update the latest data concerning a boundary.

## Disease forecast

Crop growers can benefit from a sensor\_data service using the weather and the field data available on the sensor\_data for a specific field boundaries.

A service could be implemented to build a risk map and determine if fungicides should be applied on the field, helping the farmer to control the possible diseases.

## Animal monitoring

sensor\_data may be used to retrieve information from sensors located in a barn, to monitor the wellbeing of animals using information such as temperature, light, noise levels, etc.

An animal monitoring system might combine such sensor data with behavioural analysis to alert farmers on unusual conditions.

# Service Template structure

The template is divided into two endpoints. One to retrieve the data and another two show the available measurements (capabilities).

The data endpoint is used to get the measures within a boundary region, provided in time series and during a time interval.

For each parameter with available data at the specified boundary, a time series per aggregation is returned. Note that null values may be returned as part of a time series when no measurements are available.

Therefore, those three parameters should be provided in the request, as it is shown below.

+--------------------------------------------+

| data |

+-------------+------------------------------+

| Inputs | Boundary |

| | Time interval |

| | Required parameters |

+-------------+------------------------------+

| Outputs | Sensor data available |

+-------------+------------------------------+

On the other hand, the capabilities endpoint contains all the parameters available for each sensor\_data service implementor. It also contains the aggregations defined for each parameter.

A query to the capabilities endpoint returns an array of strings representing the parameters supported by the implementor, given the availability of physical sensors within the requested boundaries.

+--------------------------------------------+

| capabilities |

+-------------+------------------------------+

| Inputs | Boundary |

+-------------+------------------------------+

| Outputs | Supported parameters |

+-------------+------------------------------+

Please refer to the openAPI sensor\_data specification for details about data schemas and formats returned by the capabilities endpoint, as well as to ANNEX 1 for a list of normalized measurements that may be offered by a sensor\_data service.

sensor\_data services are not required to handle intense traffic from a single client, such as the one that may result from being directly invoked on user interface interactions in an FMIS, for instance. Implementors MAY generate a 429 TOO MANY REQUESTS error response if the rate of calls exceeds some pre-defined quota. Clients requiring more intense field information are advised to implement a mirroring mechanism using the subscription functions.

## Queries with no data available

It could happen that there is no data available for the requested parameters at the specified boundary and time interval. A common example for that could be that sensors for the requested parameters were never installed within the boundaries, or they were not online during the time interval.

In those cases, an error message will be returned to the request.

## Invalid time interval

Sometimes the requested time interval may be invalid according to the available sensor data. For example, if the time interval is 7 minutes and only time series of 1 hour are available.

In all those cases an error would be returned to the request.

To solve the most common requests, the next default time intervals should be covered by the sensor\_data service implementor: 1 Hour, 1 day, 1 week, 1 month and their multiples.

# Access and Authentication

Farmers MUST have an account setup on a sensor\_data service in order to authenticate and access API endpoints. The service implementor is responsible for the creation of accounts; it is not covered in the service template specifications.

Unless specifically documented in the OpenAPI specifications, all operations must include credentials in form of Bearer authentication (also called token authentication). Clients can obtain an access token on behalf of their user from the service's authorization server (see ATLAS service pairing).

Some of the information held by sensor\_data services are considered to be sensitive from a GDPR perspective. The service's authorization server MUST request the client's end-user consent at service pairing time in order to deliver an access token.

# ANNEX 1 – Sensor Service Parameters

The current list of standardized measurement parameters that may be returned by sensor\_data services is listed below. Newer versions of the sensor\_data template are likely to extend this list.

|  |  |  |  |
| --- | --- | --- | --- |
| Parameter | Unit | Description | Mandatory aggregations |
| ATMO\_\_T | ºC | Atmospheric temperature | min, max, avg |
| ATMO\_\_RH | % | Atmospheric relative humidity | min, max, avg |
| ATMO\_\_P | hPa | Atmospheric pressure | min, max, avg |
| ATMO\_\_WIND\_SPEED | m/s | Wind speed | min, max, avg |
| ATMO\_\_IRRADIATION | W/m2 | Solar irradiation | min, max, avg |
| ATMO\_\_SSR | W/m2 | Surface Solar Radiation (incoming solar radiation on soil surface) | min, max, avg |
| ATMO\_\_WIND\_GUSTINESS | m/s | Wind gusts | min, max, avg |
| ATMO\_\_RAINFLOW | mm/h | Precipitation intensity | min, max, avg |
| ATMO\_\_RAINFALL | mm | Accumulated precipitation | sum |
| SOIL\_\_VMC | % | Soil volumetric moisture content | min, max, avg |
| SOIL\_\_T | ºC | Soil temperature | min, max, avg |
| CANOPY\_\_WETNESS | % | Canopy wetness index (free water on sensor surface) | min, max, avg |
| SOIL\_\_WETNESS | % | Soil wetness index (free water on soil surface) | min, max, avg |

It should be taken into account that some parameters could represent a measurement at any height, due to some uncontrolled offset on the location descriptor.