16/04/2022

Observation JSON Format

Présentation

Environmental Sensing

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1 INTRODUCTION

ObsJSON is a text format for the ES-Observation data.

This format is an application of the JSON format (RFC 8259), GeoJSON format (RFC 7946), Date and Time format (RFC 3339).

A binary version is also defined (Appendix) with CBOR format (RFC 8949)

1.1 CONVENTIONS USED

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 BCP14 [RFC2119] [RFC8174] when, and only when, they appear in all capitals, as shown here.

The grammatical rules in this document are to be interpreted as described in [RFC5234].

1.2 TERMINOLOGY

The terms Json-Text, Json-Value (Value), Object, Member, Array, Number, String, False, Null, True are define in the JSON grammar.

The terms Geometry-type, Point, MultiPoint, LineString, MultiLineString, Polygon, MultiPolygon, GeometryCollection, GeoJSON-Types are defined in GeoJSON grammar.

Timestamp is defined in Date and Time format.

1.3 RULES

A Value in an ESValue SHOULD be unambiguous (i.e., parsers CAN deduce the Value type).

An ObsJSON-Text CAN contains all the ESObservation information (i.e., the ESObservation build from the ObsJSON-Text is identical to the initial ESObservation).

Values in Array are ordered and independent from the other Values.

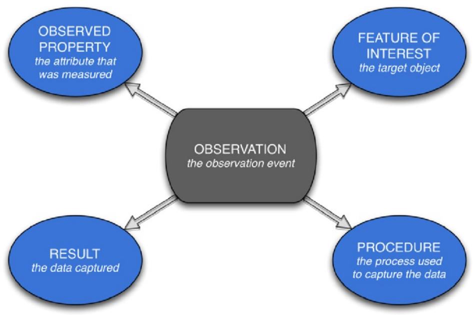
Elements in Objects are not ordered.

2 ENVIRONMENTAL SENSING – OBSERVATION

The concept of "Observation" is defined in the ISO19156 Standard. It allows to represent for example:

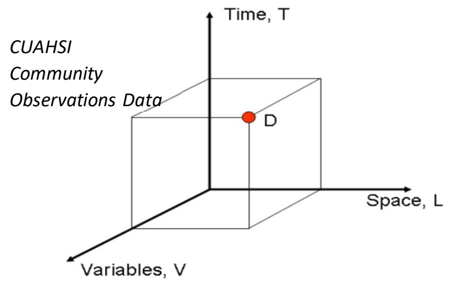
- Unit data from sensors,
- Modeling results,
- Geographical distributions,
- Temporal or trip histories,

In this Standard, an Observation is characterized by:



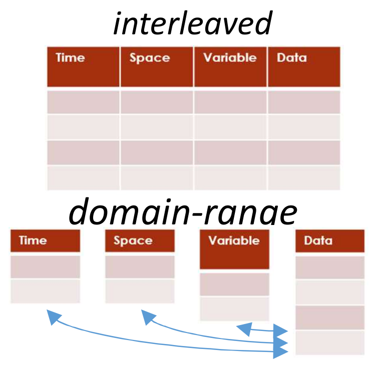
- "Observed property": the observed property,
- "Feature of interest": the object (usually a place) of the observation,
- "Procedure": the information acquisition mode (sensor, model, etc.)
- "result": result of the observation or measurement

The result is a set of values referenced according to the 3 dimensions:



- Temporal,
- Spatial,
- Physical (observed property)

It can be converted into a 3-dimensional matrix, with each result indexed by temporal, spatial and physical values.



Note: This "domain range" indexed representation is preferred to an "interleaved" tabular representation which associates temporal, spatial and physical values with each result value.

Common properties (flags) are associated with each Observation. They make it possible to perform processing on the Observations without having to know their composition (e.g., bounding boxes, type of observation, volumetry, etc.).

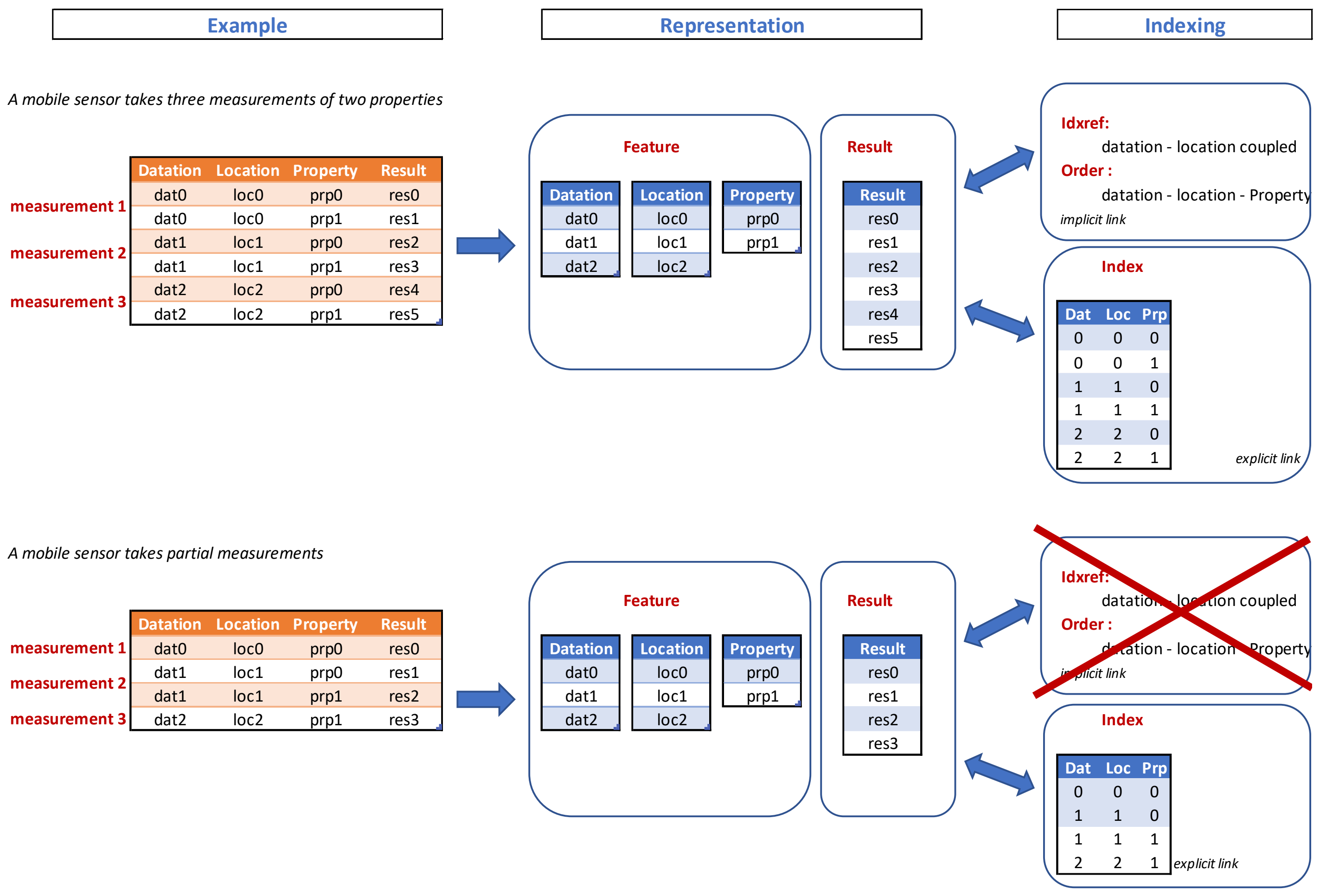
Note: If the indexed representation is identical to the original, the "domain range" representation is equivalent to the "interleaved" tabular representation.

3 DATA MODEL

An Observation is composed of (domain range representation):

- A list of results data
- A list of datation data
- A list of location data
- A list of property data
- Several lists of variable data
- A link between result value and datation / location / property / variable value (indexing)

Example:



	Datation	Location	Property	Result
measurement 1	dat0	loc0	prp0	res0
	dat0	loc0	prp1	res1
measurement 2	dat1	loc1	prp0	res2
	dat1	loc1	prp1	res3
measurement 3	dat2	loc2	prp0	res4
	dat2	loc2	prp1	res5

Datation	Location	Property
dat0	loc0	prp0
dat1	loc1	prp1
dat2	loc2	

Result
res0
res1
res2
res3
res4
res5

Dat	Loc	Prp
0	0	0
0	0	1
1	1	0
1	1	1
2	2	0
2	2	1

	Datation	Location	Property	Result
measurement 1	dat0	loc0	prp0	res0
measurement 2	dat1	loc1	prp0	res1
	dat1	loc1	prp1	res2
measurement 3	dat2	loc2	prp1	res3

Datation	Location	Property
dat0	loc0	prp0
dat1	loc1	prp1
dat2	loc2	

Result
res0
res1
res2
res3

Dat	Loc	Prp
0	0	0
1	1	0
1	1	1
2	2	1

The representation of data is optimized (no duplication).

The indexing of the results can be done implicitly (ordered data) or explicitly with the rank of each index.

Note: If the data is not complete, implicit indexing is not available

4 OBSJSON OBJECTS

An ObsJSON -Text is a JSON-text and consists of a single object ObsJSON

ObsJSON objects define in this document are:

- ESObservation,
- ESAtt (key /value Member),
- ESOrder,
- ESIdxref,
- ESFeature (ESDatation, ESLocation, ESProperty, ESResult, ESVariable),
- ESValue (DatationValue, LocationValue, PropertyValue, ResultValue),
- ESIndex,
- ESData (ESInformation, ESParameter, ESUserData),

4.1 ESATT

ESAtt are terminal key/value Members. The value SHALL not be another ObsJSON object.

Two kinds of ESAtt are defined:

- Defined ESAtt where the Key and the format of the Value are specified,
- User ESAtt where both Key and Value are unconstrained.

User ESAtt MAY be included in ESParameter or ESUserData Object.

4.2 ESOBSERVATION

Description

ESObservation is an Object. The Members included SHALL be:

- ESAtt
- ESIdxref
- ESOrder
- ESFeature,
- ESIndex
- ESData

The Members are:

Class	Member	Key	Value
ESAtt	ESName	« name »	String
ESAtt	ESType	« type »	« observation »
ESAtt	ESId	« id »	String
ESIdxref	ESIdxref	« idxref »	Object
ESOrder	ESOrder	« order »	Array
ESFeature	ESDatation	« datation »	Array or DatationValue
ESFeature	ESLocation	« location »	Array or LocationValue
ESFeature	ESProperty	« property »	Array or PropertyValue
ESFeature	ESResult	« result »	Array or ResultValue
ESFeature	ESVariable	String	Array or Object
ESIndex	ESIndex	« index »	Array or ESIdx
ESData	ESInformation	« information »	Object
ESData	ESParameter	« parameter »	Object
ESData	ESUserData	String	Object

Validity

An ESObservation is valid if:

- it contains at least the ESType Member,
- it contains at most one ESDatation, one ESLocation, one ESProperty, one ESResult Member
- each Member is valid.

Example

```
{“type”: “observation”, “datation”: “morning”, “location”: “paris”, “property”: “air quality”, “result”: “good”}

{“type”: “observation”, “datation”: “2021-01-05T22:18:26”, “location”: [2.4, 48.9], “property”: {“prp”: “PM10”, “unit”: “µg/m3”}, “result”: 51.3}
```

4.3 ESATT

4.3.1 ESType

Description

ESType is a single key/value Element :

- Key: “type”
- Value: “observation”

Validity

ESType is valid if key and value are as defined.

4.3.2 ESId

Description

ESId is a single key/value Element:

- Key: “id”

The value is a string (e.g., Database Id or filename)

Validity

ESId is valid if key and value are as defined.

4.3.3 ESName

Description

ESName is a single key/value Element:

- Key: “name”

The value is a string.

Validity

ESName is valid if key and value are as defined.

4.4 ESIDXREF

Description

ESIdxref is an Object. The members are key/value and represent coupled ESFeature:

- Key: ESFeature key
- Value: ESFeature key

If no one ESFeature is coupled, ESIdxref is not present.

Validity

ESIdxref is valid if at least one member is present and if ESFeature keys are present in ESObservation.

Example

```
“idxref”: {“datation”: “location”}                    datation and location are coupled
```

4.5 ESDTYPE

Description

ESDtype is an Object. The members are key/value and represent the format of ESVariable data:

- Key: ESVariable key
- Value: ESValue used for the ESVariable

If ESDtype is not present, the default value ResultValue `is used.`

Validity

ESDtype is valid if ESFeature keys are present in ESObservation.

Example

```
“dtype”: {“campaign”: “datationvalue”}        the campaign is defined by datationvalue
```

4.6 ESORDER

Description

ESOrder is a String Array. The strings in the Array are the ESFeature keys ordered according to indexing.

If ESOrder is not present, the default value [`“datation”, “location”, “property”, “first ESVariable key”] is used.`

Validity

ESOrder is valid if:

- The values are present in ESFeature list,
- The length of the array equals the number of ESFeature.

Example

```
“order”: [“datation”, “property”, “location”}
```

4.7 ESFEATURE

Description

ESFeature is an Array. Value is specific for each ESFeature:

Member	Key	Value
ESDatation	« datation »	Array of DatationValue
ESLocation	« location »	Array of LocationValue
ESProperty	« property »	Array of PropertyValue
ESResult	« result »	Array of ResultValue

ESVariable	String	Array of value

Note:

If the Array contains only one value, the square brackets MAY be omitted in the JSON String.

The value of ESVariable is unconstrained.

Validity

An ESFeature Member is valid if:

- it contains at least one value
- each value is valid

Example

```
“location”: “paris”                                         one ESValue
“location”: [[2.4, 48.9], [4.8, 45.8], [5.4, 43.3]]         three ESValue
“location”: [“paris”, “lyon”, “marseille”]                  three ESValue
```

4.8 ESVALUE

Description

An ESValue contains two information: A Name, a Value

One of the three formats SHALL be used for ESValue (where Name is a String):

• Object format:	{Name: Value}
• Value format:	Value
• Name format:	Name

Validity

An ESValue Member is valid if:

- One of the three formats is used,
- it contains at least a Value or a Name
- each Value is valid compared to ESFeature

Note:

The Name string MAY be used to represent:

- *detailed information (e.g., “beginning of the observation”),*
- *link to external information (e.g., “https://loco-philippe.github.io/ES.html”),*

- *id to link internal information (e.g., "res003" where "res003" is a key in a ESData Object),*

Example

```
"morning"                                                  Name format
{"morning": "2021-01-05T10:00:00"}                         Object format
[["2021-01-05T08:00:00", "2021-01-05T12:00:00"]]           Value format
```

4.8.1 LocationValue

Description

The Value of a LocationValue is a representation of a Point or a Polygon. It is defined by a Coordinates Array (as specified in GeoJSON).

Validity

A Value is valid if the Coordinates Array is valid and represents a Point or a Polygon.

Value example

```
[2.4, 48.9]                                                Point
[[[2.4, 48.9], [4.8, 45.8], [5.4, 43.3], [2.4, 48.9]]]     Polygon
[[[0,0], [0,5], [5,5], [0,0]], [[1,1], [1,2], [2,2], [1,1]]]   Polygon with a hole
```

Note:

The other Geometry-type are not allowed because the Coordinates Array is ambiguous:

- *LineString, Multipoint and Array of Point have the same representation*
- *Polygon and Array of LineString have the same representation*
- *MultiPolygon and Array of Polygon have the same representation*

The LineString in a Polygon MAY be open (without the last Point)

4.8.2 DatationValue

Description

A Date is defined by a Timestamp (as specified in RFC 3339).

The Value of a DatationValue is a representation of a single Date or a Slot (MultiInterval):

- Date: String
- Slot: Array of one or multiple Interval (an Interval is an Array of two Date)

Validity

A Value is valid if the Date or Slot is valid.

Value example

```
"2021-01-05T10:00:00"                                   Date
[["2021-01-05T08:00:00", "2021-01-05T12:00:00"]]        Interval
[["2021-01-05", "2021-01-10"], ["2021-01-20", "2021-01-25"]]   Slot
```

Note:

Intervals MUST be represented by a Slot to avoid ambiguities with an array of Dates

If the DatationValue consists of a unique String, and if the String represents a Date, the parser SHALL assign the String to the Date, otherwise to the Name.

4.8.3 PropertyValue

Description

The Value of a PropertyValue is an Object made up of ESAtt. The Defined ESAtt are:

Member	Key	Value
PropertyType	« prp »	String (mandatory)
Unit	« unit »	String
SamplingFunction	« sampling »	String
Application	« application »	String
SensorType	« sensor »	String
UpperValue	« uppervalue »	Float
LowerValue	« lowervalue »	Float
Period	« period »	Float
UpdateInterval	« updateinterval »	Float
Uncertainty	« uncertainty »	Float

Note:

If the PropertyValue consists of a single Member (the PropertyType), it's not allowed to replace the Object by a string (the PropertyType value).
If the ESAtt PropertyDict is not defined, the default PropertyDict is used

Validity

A Value is valid if it contains at least the PropertyType ESAtt.

The PropertyType value MAY be present in a propertyDict how's define the Unit value

Example

```
{"prp": "Temp"}                                          Minimal Value
```

`{“prp”: “Temp”, “unit”: “°c”}`	*Defined Member*
`{“prp”: “Temp”, “unit”: “°c”, “operation”: “phase 1”}`	*User Member*

Note:

> *UserAtt MAY be used in the PropertyValue*
>
> *For PropertyValue, the Name format is allowed (i.e., if the PropertyValue consists of a single string, this SHOULD be interpreted as the name).*

4.8.4 ResultValue

Description

The Value of a ResultValue CAN be any JSON Object.

Note:

> *For ResultValue, the Name format is not allowed (i.e., if the ResultValue consists of a single string, this SHOULD be interpreted as a Value).*

Validity

A Value is valid if it contains at least one Result.

Example

`21.8`	*Value format*
`{“low temperature”: 2.4}`	*Object format*
`“https://loco-philippe.github.io/ES.html”`	*Value format*
`[21.8, {“test”: true}]`	*Value format*

Note:

> *If the ResultValue is composed by a unique String, the parser SHALL assign the String to the Result.*

4.9 ESIndex

Description

ESIndex is an “indexed” ESResult Array. It’s a two-dimensional array following the order defined in ESOrder:

- One row for each ESFeature,
- One column for each ResultValue

The values in Array are integer.

Note:

If the ESObservation contains only one ESFeature, the square brackets for row MAY be omitted.
If the ESObservation contains only one ResultValue, the square brackets for column MAY be omitted.
If only one level of square brackets is present, the parser must decide if columns or rows are present

Validity

An ESIndex Value is valid if:

- it contains at least one integer value
- the number of rows equals the number of ESFeature
- the number of columns equals the number of ResultValue
- the integer values are positive and lower than the length of ESFeature

Example

```
“index”: [[0,2,1], [0,0,0]]              two ESFeature, three ResultValue

“index”: [0,2,1]                 one ESFeature, three ResultValue (or the opposite)
```

4.10 ESDATA

ESData are elements where the Value MAY be an Object.

The Object is made up of Defined ESAtt and User ESAtt.

4.10.1 ESInformation

Description

The Defined ESAtt are:

Member	Key	Value
ObservationType	« typeobs »	String
LocationType	« typeloc »	String
DatationType	« typedat »	String
PropertyType	« typeprp »	String
ResultType	« typeres »	String
nValLocation	« nvalloc »	Integer
nValDatation	« nvaldat »	Integer
nValProperty	« nvalprp »	Integer
nValResult	« nvalres »	Integer
BoundingBox	« bbox »	Array (4 Float)
IntervalBox	« tbox »	Array (2 String)

Complet	« complet »	True / false
Score	« score »	Integer
Rate	« rate »	Float
Dimension	« dimension »	Integer
Axes	« axes »	Array (1 to 3 integers)

Validity

An ESInformation is valid if the Value contains at least one ESAtt.

All the ESAtt are optional.

Example

```
{"typeobs": "areaObsrecord"}                                          Minimal Value
{"typeobs": "areaObsrecord", "complet": false, "score": 226}          Defined Member
```

Note:

That information come from the other ESObervation elements.

A parser MAY ignore The ESInformation to build an ESObservation (User ESAtt are lost).

4.10.2 ESParameter

Description

The Defined ESAtt are:

Member	Key	Value
Reference	« reference »	String
ResultTime	« resulttime »	Timestamp
PropertyDict	« pdict »	String
UniqueIndex	« unicindex »	True/false

Validity

An ESParameter is valid if the Value contains at least one ESAtt.

All the ESAtt are optional.

Example

```
{“unicindex”: true, “approbation”: true}
```

4.10.3 ESUserData

The structure of ESUserData is totally free.

It MUST not contain any Defined ESAtt.

The keys used in ESUserData MUST be different from those defined in the Reserved list name (see Appendix.)

5 APPENDIX : RESERVED VALUES

« type »
« id »
« datation »
« location »
« property »
« result »
« information »
« parameter »
« observation »
« prp »
« unit »
« sampling »
« application »
« sensor »
« uppervalue »
« lowervalue »
« period »
« updateinterval »
« uncertainty »
« typeobs »
« typeloc »
« typedat »
« typeprp »
« typeres »
« nvalloc »
« nvaldat »
« nvalprp »
« nvalres »
« bbox »
« tbox »
« complet »
« score »
« rate »
« dimension »
« axes »
« reference »
« resulttime »
« order »
« propdict »
« unicindex »

6 Appendix : Examples

- {“type”: “observation”, “datation”: “morning”, “location”: “paris”, “property”: “air quality”, “result”: “good”}

- {“type”: “observation”, “datation”: “2021-01-05T22:18:26”, “location”: [2.4, 48.9], “property”: {“prp”: “PM10”}, “result”: 51.3}

- {“type”: “observation”, “datation”: [“2021-01-05T22:18:26”, “2021-01-05T22:18:26”], “property”: [“air quality PM10”, “air quality PM2.5”], “result”: [10.2, 21.5, 51.3, 48]}

- {“type”: “observation”, “name”: “example4”, “id”: “example4.obs”,

```
 “parameter”: {“pdict”: “official”, “example”:4},
 “datation”:
      [“2021-01-04T10:00:00”,[[“2021-01-05T08:00:00”,“2021-01-05T12:00:00”]]],
 “location”:
      [[2.4, 48.9], [[[2.4, 48.9], [4.8, 45.8], [5.4, 43.3], [2.4, 48.9]]]],
 “property”:
      [{“prp”: “PM10”, “unit”: “µg/m3”}, {“prp”: “Temp”, “unit”: “°c”}]
 “result”: [51.3, {“low temperature”: 2.4}, 20.8, “high temperature”]
 “idxref”: {“datation”: “location”}}
```

Note: another solution is to include index instead of idxref:

```
        “index”: [[0,0,1,1], [0,0,1,1], [0,1,0,1]]
```

7 APPENDIX : CBOR FORMAT

The Concise Binary Object Representation (CBOR – RFC8949) is a data format whose design goals include the possibility of extremely small code size, small message size, and extensibility without the need for version negotiation.

CBOR is based on the JSON data model: numbers, strings, arrays, maps (called objects in JSON), and a few values such as false, true, and null.

The CBOR format can be used with different options to minimize length:

- The precision of float values is adjustable from half precision (two bytes) to double precision (eight bytes),
- The datetime can be described by a standard text string (RFC3339) or by a numerical value (Epoch-based: six bytes).
- The ESFeature name can be represented with code value instead of string value
- The coordinates value can be described with integer instead of float (val_int = round(val_float)*10**7 : for bytes).

Example :

```
{"type": "observation",
"datation":["2021-01-04T10:00:00",[["2021-01-05T08:00:00","2021-01-5T12:00:00"]]],
"location":[[2.4123456, 48.9123456], [[[2.4123456, 48.9123456], [4.8123456, 45.8123456], [5.4123456, 43.3123456], [2.4123456, 48.9123456]]]],
"property": [{"prp": "PM10"}, {"prp": "Temp"}],
"result": [51.348, {"low": 2.457}, 20.88, "high"],
"idxref": {"datation": "location"}}
```

```
Length (bytes):

    •  JSON:           388
    •  CBOR:           298
    •  CBOR optimized: 123
```