



Met Office

Publishing Linked Data

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November 2014

OGL

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Why do we care about Linked Data?



DATA.GOV.UK^{Beta}
Opening up Government



Home

Data

Apps

Interact

🏠 / Library / Open data White Paper

Open data White Paper

Submitted on Wed, 27/06/2012 - 17:56 | Updated on Wed, 19/09/2012 - 12:01

2.41 The Commission believes that adopting Open Data principles and removing barriers to re-use can generate economic benefits in the order of £33 billion a year.

(9) Release data quickly, and then work to make sure that it is available in open standard formats, including **linked data** forms .

2.51 [...] there is a growing realisation of the power of linked data for exposing, sharing and connecting pieces of data and information [...] to realise efficiencies in the public sector.

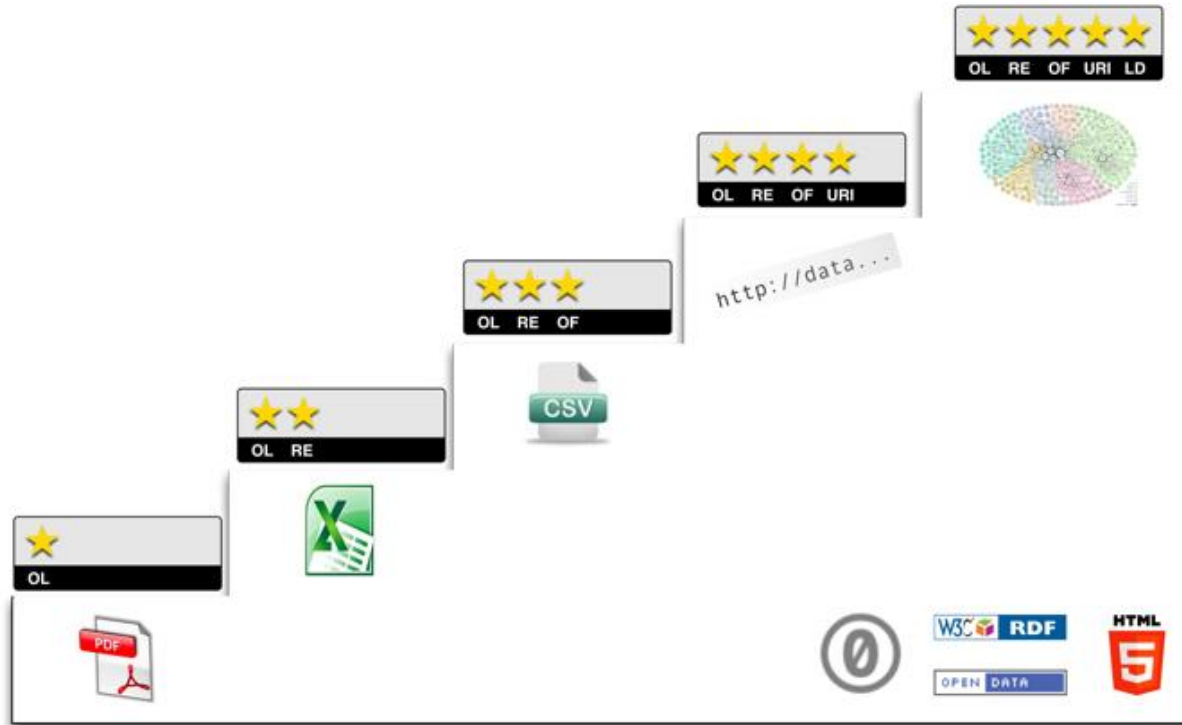
Disclaimer

Met Office URIs used in this presentation
are illustrative and will not resolve.

Does your data look like this?

	A	B	C	D	E	F	G	H	I	J	K	L
1	Site Code	Site Name	Latitude	Longitude	Region	Observation Time	Observation Date	Wind Direction	Wind Speed	Wind Gust	Visibility	Screen Temperature
96	3684	ANDREWS FIELD (3684)	51.896	0.453	East of England	12:00	27/06/2014	SSW	14		17000	18.6
97	3647	LITTLE RISSINGTON (ESAWS) (3647)	51.86	-1.692	South West England	12:00	27/06/2014	SW	9		17000	13.4
98	3743	LARKHILL (3743)	51.201	-1.805	South West England	12:00	27/06/2014	SSW	7		30000	15.9
99	3809	CULDROSE (3809)	50.085	-5.257	South West England	12:00	27/06/2014	W	11	24	20000	16.6
100	3840	DUNKESWELL AERODROME (3840)	50.86	-3.239	South West England	12:00	27/06/2014	S	15		23000	15.1
101	3649	BRIZE NORTON (3649)	51.758	-1.576	London & South East England	12:00	27/06/2014	SW	3		30000	14.4
102	3749	MIDDLE WALLOP (3749)	51.15	-1.57	London & South East England	12:00	27/06/2014	WSW	9		30000	16.9
103	3772	HEATHROW (3772)	51.479	-0.449	London & South East England	12:00	27/06/2014	SW	11		25000	20.3
104	3866	ST CATHERINES PT. (3866)	50.577	-1.297	London & South East England	12:00	27/06/2014	WSW	9			16.6
105	3002	BALTASOUND (3002)	60.749	-0.854	Orkney & Shetland	12:00	27/06/2014	NNE	18		30000	11.3
106	3023	SOUTH UIST RANGE (3023)	57.358	-7.397	Highland & Eilean Siar	12:00	27/06/2014	ENE	22		28000	14.3
107	3037	SKYE/LUSA (SAMOS) (3037)	57.257	-5.809	Highland & Eilean Siar	12:00	27/06/2014	E	11		21000	14.9
108	3047	TULLOCH BRIDGE (3047)	56.867	-4.708	Highland & Eilean Siar	12:00	27/06/2014	NE	9		35000	11.4
109	3065	CAIRNGORM SUMMIT (3065)	57.12	-3.64	Grampian	12:00	27/06/2014	NE	18			1
110	3080	ABOYNE (3080)	57.077	-2.836	Grampian	12:00	27/06/2014	NNE	8		40000	11.9
111	3105	ISLAY/PORT ELLEN (3105)	55.681	-6.256	Strathclyde	12:00	27/06/2014	E	15		29000	15.3
112	3155	DRUMALBIN (3155)	55.627	-3.735	Strathclyde	12:00	27/06/2014	ENE	13		24000	11.9
113	3132	WEST FREUGH (ESAWS) (3132)	54.859	-4.936	Dumfries, Galloway	12:00	27/06/2014	S	5		40000	14.7
114	3166	EDINBURGH/GOGARBANK (3166)	55.928	-3.343	Dumfries, Galloway	12:00	27/06/2014	ESE	13		20000	12.6
115	3911	LOUGH FEA (3911)	54.72	-6.82	Northern Ireland	12:00	27/06/2014	E	7		25000	12.6
116	3923	GLENANNE (3923)	54.237	-6.502	Northern Ireland	12:00	27/06/2014	E	6		23000	12.3
117	3313	RHYL (3313)	53.259	-3.509	Wales	12:00	27/06/2014	E	3		11000	14.2
118	3410	LAKE VYRNWY SAWS (3410)	52.757	-3.464	Wales	12:00	27/06/2014	ENE	5		10000	12.3
119	3604	MILFORD HAVEN C.B. (3604)	51.708	-5.055	Wales	12:00	27/06/2014	S	10		25000	15.7

5★ (Linked) Open Data



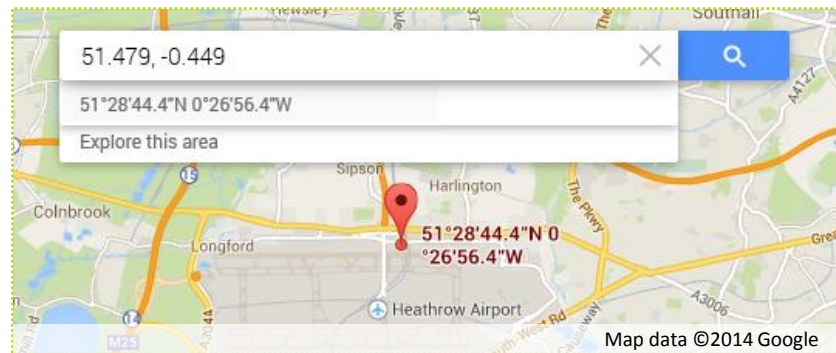
- ★ on the web published with an open license* ✓
OL
- ★★ structured data ✓
OL RE
- ★★★ non-proprietary format ✓
OL RE OF



4★: use URIs to denote things

	A	B	C	D	E	F	G	H	I	J	K	L	
1	Site Code	Site Name	Latitude	Longitude	Region	Observation Time	Observation Date	Wind Direction	Wind Speed	Wind Gust	Visibility	Screen Temperature	Pre
103	3772	HEATHROW (3772)	51.479	-0.449	London & South East England	12:00	27/06/2014	SW	11		25000	20.3	

```
{  
  "Site Code": "3772",  
  "Site Name": "HEATHROW (3772)",  
  "Latitude": "51.479",  
  "Longitude": "-0.449",  
  "Region": "London & South East England",  
  "Observation Time": "12:00",  
  "Observation Date": "27/06/2014",  
  "Wind Direction": "SW",  
  "Wind Speed": "11",  
  "Wind Gust": "",  
  "Visibility": "25000",  
  "Screen Temperature": "20.3",  
  "Pressure": "1012",  
  "Significant Weather": "Partly cloudy (day)"  
}
```



(16-point compass)
(mph)
(mph)
(m)
(degrees Celsius)
(hPa)
([code](#))

Referencing code list terms

Canonical labels don't work well as identifiers as their use is error prone ...

```
{  
  ...  
  "Significant Weather": "Partly cloudy (day)"    (code)  
}
```

Referencing code list terms

Canonical labels don't work well as identifiers as their use is error prone ...

So use an unambiguous global unique identifier to refer to the term ... a URI

```
{  
  ...  
  "Significant Weather": {"@id": "http://data.metoffice.com/datapoint/def/weather-type/3"}  
}
```


Referencing code list terms

```
{  
  "@id": "http://data.metoffice.com/datapoint/def/weather-type/3",  
  "notation": "3",  
  "label": [  
    {"@language": "en", "@value": "Partly cloudy (day)"},  
    {"@language": "cy", "@value": "Rhannol gymylog (dydd)"}  
  ]  
}
```

A URI allows the definition can be reconciled with usage ...
A URI doesn't have to resolve on the web – but it helps; a
URI is just as useful as an identifier within a closed system.

```
{  
  ...  
  "Significant Weather": {"@id": "http://data.metoffice.com/datapoint/def/weather-type/3"}  
}
```

CHALLENGE: How do I get my URIs to resolve?

URIs don't have to resolve – but Linked Data is predicated on the idea that they *do* resolve to provide useful info.

The trouble is: URIs are hard.

Publishers need to have control over some suitable web domain and the ability to publish data there. Yet they:

- frequently lack the authority to manage parts of their organisation's namespace, and
- may be required to submit pages for publication via a content management system that neither allows control over the resulting URIs nor supports content negotiation required for data publication.

UKGovLD Registry software

Funded by the UK Government, [UKGovLD](#) and partners [Epimorphics](#), have developed an open source software solution: the UKGovLD Registry.

- A register is a controlled list; governance is explicit
- Provides authoritative point of reference
- Container pattern; hackable URIs allow enable traversal from member to containing register ...

<http://data.metoffice.com/datapoint/def/weather-type/3>

- Validation service: check that a term is valid member
- Simple Linked Data publication platform
- Not limited to SKOS Collections or Concept Schemes

Deployment example: WMO Codes

WMO Codes Registry Check URI Datasets Admin Sparql About Search Not logged in

[http://codes.wmo.int / bufr4 / codeflag / 0-22-061](http://codes.wmo.int/bufr4/codeflag/0-22-061)


Register: State of the sea Stable

WMO No. 306 Vol I.2 FM 94 BUFR (edition 4) Code-table 0 22 061 'State of the sea'.

List **Table** Properties Metadata

Members

Item: 0 - Calm (glassy) <i>Wave height in metres: 0</i>	Type: seaState	Stable
Item: 1 - Calm (rippled) <i>Wave height in metres: 0 - 0.1</i>	Type: seaState	Stable
Item: 2 - Smooth (wavelets) <i>Wave height in metres: 0.1 - 0.5</i>	Type: seaState	Stable
Item: 3 - Slight <i>Wave height in metres: 0.5 - 1.25</i>	Type: seaState	Stable
Item: 4 - Moderate <i>Wave height in metres: 1.25 - 2.5</i>	Type: seaState	Stable

 plain: [ttl](#) | [rdf/xml](#)
with metadata: [ttl](#) | [rdf/xml](#)

About the Register

owned by	wmo
managed by	www-dm
submitted on	25 Sep 2013 12:56:34.824
submitted by	bootstrap

Deployment example: Environment Registry

Environment Registry (alpha)

Browse

About

Advanced ▾

Search

Submit

List all registers

Filters

Category









- Marine and Coast [1]
- Organizations_and_sectors [1]
- System [12]
- Water [5]

Owner

- Department for Environment, Food & Rural Affairs [6]
- Environment Agency [7]
- Marine Management Organisation [3]

Entity

- Abstract [7]
- Organizations and sectors [2]
- Regions and Habitats [1]

Name	Notation	Description	Status
 root		Register representing the root of the registry tree.	Stable
 Structure	structure	Code lists used to aid organizing and presenting the Environment re...	Stable
 UI	ui	Codes and concepts used to guide the presentation of the registry u...	Stable
 Definitions	def	Code lists, concept schemes and other collections in the registry	Stable
 System register	system	Internal registers which are used to control system operation	Stable
 bulk collection types	bulkCollectionTypes	System register describing the data types which can be uploaded as ...	Stable
 Link definitions	links	A system register which lists all link definitions which the UI sho...	Stable
 prefixes	prefixes	System register containing the prefix mappings used in serializations	Stable



4★: use URIs to denote code-list terms

```
{
  "@context": {"skos": "http://www.w3.org/2004/02/skos/core#"},
  "Site Code": "3772",
  "Site Name": "HEATHROW (3772)",
  "Latitude": "51.479",
  "Longitude": "-0.449",
  "Region": "London & South East England",
  "Observation Time": "12:00",
  "Observation Date": "27/06/2014",
  "Wind Direction": {
    "@id": "http://location.data.gov.uk/def/direction/compass-point/SW",
    "skos:notation": "SW" },
  "Wind Speed": "11",
  "Wind Gust": "",
  "Visibility": "25000",
  "Screen Temperature": "20.3",
  "Pressure": "1012",
  "Significant Weather": {
    "@id": "http://data.metoffice.com/datapoint/def/weather-type/3",
    "skos:prefLabel": "Partly cloudy (day)" }
}
```

CHALLENGE: How do determine the entities in my data?

```
{
  "@context": {"skos": "http://www.w3.org/2004/02/skos#"},
  "Site Code": "3772",
  "Site Name": "HEATHROW (3772)",
  "Latitude": "51.479",
  "Longitude": "-0.449",
  "Region": "London & South East England",
  "Observation Time": "12:00",
  "Observation Date": "27/06/2014",
  "Wind Direction": {
    "@id": "http://location.data.gov.uk/def/direction/compass-point/SW",
    "skos:notation": "SW" },
  "Wind Speed": "11",
  "Wind Gust": "",
  "Visibility": "25000",
  "Screen Temperature": "20.3",
  "Pressure": "1012",
  "Significant Weather": {
    "@id": "http://data.metoffice.com/datapoint/def/weather-type/3",
    "skos:prefLabel": "Partly cloudy (day)" }
}
```

What's the subject? There are two entities described in each row ...

- site (location); and
- observation event



4★: use URIs to denote resources

```
{
  "@context": {"skos": "http://www.w3.org/2004/02/skos/core#"},
  "site": {
    "@id": "http://data.metoffice.com/uk/locations/obs/site/3772#id",
    "Site Code": "3772",
    "Site Name": "HEATHROW (3772)",
    "Latitude": "51.479",
    "Longitude": "-0.449",
    "Region": "London & South East England"
  },
  "@id": "http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z",
  "Observation Time": "12:00",
  "Observation Date": "27/06/2014",
  "Wind Direction": {
    "@id": "http://location.data.gov.uk/def/direction/compass-point/SW",
    "skos:notation": "SW"
  },
  "Wind Speed": "11",
  "Wind Gust": "",
  "Visibility": "25000",
  ...
}
```


CHALLENGE: How do I get my URIs to resolve?

```
{
  "@context": {"skos": "http://www.w3.org/2004/02/skos/core#"},
  "site": {
    "@id": "http://data.metoffice.com/uk/locations/obs/site/3772#id",
    "Site Code": "3772",
    "Site Name": "HEATHROW (3772)",
    "Latitude": "51.479",
    "Longitude": "-0.449",
    "Region": "London & South East England"
  },
  "@id": "http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z",
  "Observation Time": "12:00",
  "Observation Date": "27/06/2014",
  "Wind Direction": {
    "@id": "http://location.data.gov.uk/def/direction/compass-point/SW",
    "skos:notation": "SW"
  },
  "Wind Speed": "11",
  "Wind Gust": "",
  "Visibility": "25000",
  ...
}
```

!Click!



Resolve to a dataset description page?

🏠 / Datasets / 3 hourly weather forecast and observational data - UK locations

3 hourly weather forecast and observational data - UK locations



Published by Met Office. Licensed under **OGL** Open Government Licence.
Openness rating: ★★★★★

Nil

Provider: Met Office

The interface gives access to three datasets, hourly observations for approximately 150 UK observing stations, daily site specific and 3 hourly site specific forecasts for approximately 5000 UK locations.

Environment

Both the 3 hourly and daily forecast datasets provide forecasts out to 5 days with updates issued hourly.

Daily forecasts provide data for day and night using the following data time intervals.


· Weather symbols: Day - Sunrise to sunset, Night Sunset to Sunrise

· Temperature: Max - Maximum during 0600-18:00, Minimum during 18:00-06:00

· All other parameters are calculated for midday or midnight. ...

Read More

DATA RESOURCES (1)

 HTML	DataStore interface	▼
---	---------------------	---

ADDITIONAL INFORMATION

Added to data.gov.uk	29/11/2011
Theme	Environment
Geographic coverage	Great Britain (England, Scotland, Wales)
Precision	As supplied by Met Office
Update frequency	Hourly
Temporal granularity	hour
Taxonomy URL	http://www.metoffice.gov.uk/weather/uk/guide/key.html
Secondary Theme(s)	No value
Mandate	No value
Temporal coverage	No value
Date added computed	No value
Date updated computed	No value

Resolve to a dataset description page?

Home / Datasets / 3 hourly weather forecast and observational data - UK locations

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· Weather symbols: Day - Sunrise to sunset, Night Sunset to Sunrise

· Temperature: Max - Maximum during 0600-18:00, Minimum during 18:00-06:00

· All other parameters are calculated for midday or midnight. ...

In fact, you should *always* publish a data description page to allow folks to discover and evaluate your data.

Publishing metadata descriptions for datasets should be familiar to those of you already publishing INSPIRE datasets.

Resolve each data item ...

HM Government

Linked Data API

csv | html | json | rdf | text | ttl | xml

HEATHROW (3772) weather observation for 27th June 2014 at 12:00

<http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z>

Show Search Form

★ observation time	12:00	🔍
★ observation date	27 June 2014	🔍
★ screen temperature	20.3 Celsius	🔍
★ visibility	25000 m	🔍
★ wind speed	11 mph	🔍
★ wind direction	South west	🔍
	★ notation SW	🔍
★ significant weather	Partly cloudy (day)	🔍
	★ notation 3	🔍
★ site	Observation site at HEATHROW	🔍
	★ easting 507500	🔍
	★ northing 177500	🔍
	★ lat 51.479	🔍
	★ long -0.449	🔍
	★ site 3772	🔍
	★ notation	🔍
★ dataset	uk weather observations	

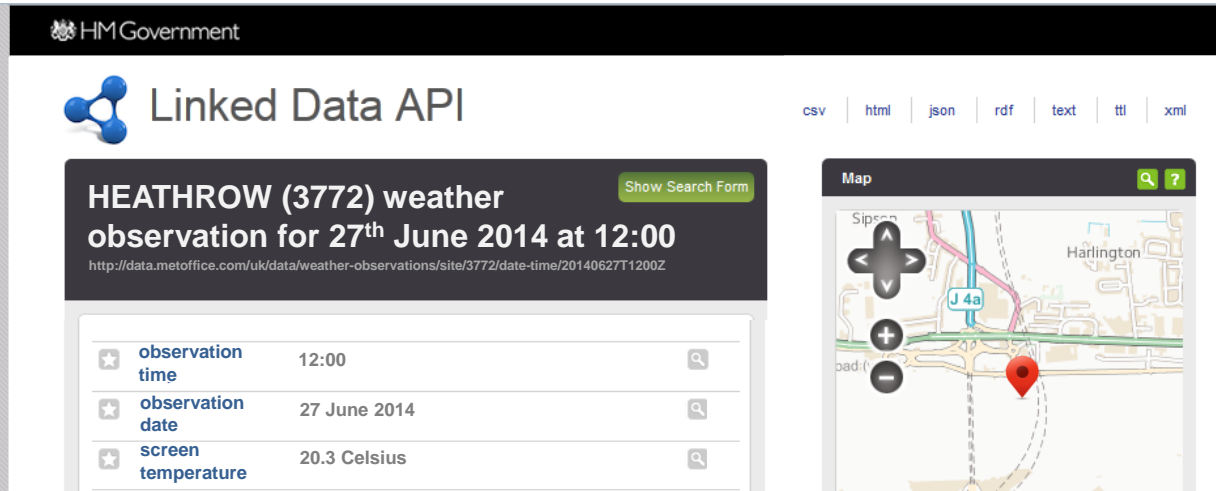
Map

Powered by Ordnance Survey

View

- ★ label
- ★ observation time
- ★ observation date
- ★ screen temperature
- ★ visibility
- ★ wind speed
- ★ wind direction > notation
- ★ significant weather > notation
- ★ site > name
- ★ site > notation
- ★ site > easting
- ★ site > northing
- ★ site > lat
- ★ site > lon
- ★ dataset

CHALLENGE: How do I deploy and configure item-level publication tools?



The screenshot displays the HM Government Linked Data API interface. At the top, the HM Government logo and the text "Linked Data API" are visible. Below this, there are navigation options for different data formats: csv, html, json, rdf, text, ttl, and xml. The main content area features a dark header for "HEATHROW (3772) weather observation for 27th June 2014 at 12:00" with a "Show Search Form" button. Below the header is a table of metadata:

★ observation time	12:00	🔍
★ observation date	27 June 2014	🔍
★ screen temperature	20.3 Celsius	🔍

To the right of the table is a "Map" section showing a map of the Heathrow area with a red location pin and navigation controls.

In addition to providing a dataset description page, one should publish information about each entity within the dataset.

Whilst the UKGovLD Registry provides a *simple* Linked Data publication platform, tools like [ELDA](#) are far more sophisticated. Yet with that sophistication comes the burden of complexity.

RDF triples

HEATHROW (3772) weather observation for 27th June 2014 at 12:00
<http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z>

★ site

Observation site at HEATHROW

★ easting	507500
★ northing	177500
★ lat	51.479
★ long	-0.449
★ site notation	3772

Powered by Ordnance Survey

Linked Data is almost always published in RDF (or something that can be *transformed* to RDF).

Each RDF statement is a triple:

subject-predicate-object.

```
{
S "@id": "http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z",
P "site": {
O   "@id": "http://data.metoffice.com/uk/locations/obs/site/3772#id"
}
}
```

RDF triples and graphs

Triples can be grouped together into graphs to convey complex information.

It is this ability that provides the *essence* of Linked Data.

HEATHROW (3772) weather observation for 27th June 2014 at 12:00
<http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z>

★ site

Observation site at HEATHROW	
★ easting	507500
★ northing	177500
★ lat	51.479
★ long	-0.449
★ site notation	3772

Powered by Ordnance Survey

```
{  
"@id": "http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z",
```

```
"site": {
```

```
  "@id": "http://data.metoffice.com/uk/locations/obs/site/3772#id",
```

```
  "notation": "3772",
```

```
  "label": "HEATHROW (3772)",
```

```
  "lat": "51.479",
```

```
  "lon": "-0.449"
```

```
}
```

```
}
```

... even linking data across organisation boundaries in 5★ data.

Predicates: they are URIs too

Predicates provide the semantics for the links between *subject* and *object*. To ensure that those semantics are unambiguous, each predicate is identified with a URI.

```
{
  "@context": {
    "ex" : "http://data.metoffice.com/datapoint/def/observation-sites#",
    "rdfs" : "http://www.w3.org/2000/01/rdf-schema#",
    "skos" : "http://www.w3.org/2004/02/skos/core#",
    "geo" : "http://www.w3.org/2003/01/geo/wgs_84#"
  },
  "@id" : "http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z",
  "ex:site" : {
    "@id" : "http://data.metoffice.com/uk/locations/obs/site/3772#id",
    "skos:notation" : "3772",
    "rdfs:label" : "HEATHROW (3772)",
    "geo:lat" : "51.479",
    "geo:lon" : "-0.449"
  }
}
```

... often, we can reuse properties defined elsewhere – but you can't avoid creating your own; [ex:site](#).

RDF Vocabularies: data models by another name

A vocabulary (or ontology) is the collection of classes and properties needed to describe your data. To create a vocabulary, you need to do a bit of data modelling.

Data modelling is the same process undertaken to create Application Schema – as defined in the ISO 19100-suite of Geographic Information standards.

ISO/DIS 19150-2 Geographic information – Ontology – Part 2: Rules for developing ontologies in the Web Ontology Language (OWL) provides a mechanism to automatically convert your Application Schema to an RDF vocabulary.



5★: link to other people's data

By linking to other people's data, you increase the size of the *global graph*; it allows data consumers to easily reconcile your data with that from other publishers.

- By referencing (authoritative) definitions of common terminology, consumers comparing your data with that from other publishers can be sure that they are comparing like with like.
- By referencing definitions of places & regions, consumers can easily find information from multiple publishers relating to their place of interest.



5★: link to other people's data

```
{ "@id": "http://data.metoffice.com/uk/data/weather-observations/site/3772/date-time/20140627T1200Z",
  "ssn:observationSamplingTime": {"time:inXSDDateTime": "2014-06-27T12:00:00Z"},
  "ssn:featureOfInterest": {
    "@id": "http://data.metoffice.com/uk/locations/obs/site/3772#id",
    "skos:notation": "3772",
    "rdfs:label": "HEATHROW (3772)",
    "sam:shape": {"geo:asWKT": "Point(-0.449 51.479)"},
    "sam:sampledFeature": {
      "@id": "http://data.ordnancesurvey.co.uk/id/50kGazetteer/112605",
      "rdfs:label": "Heathrow London Airport"}},
  "ssn:observationResult": {
    "ssn:hasOutput": {
      "qudt:numericValue": "20.3",
      "qudt:unit": {
        "@id": "http://qudt.org/vocab/unit#DegreeCelsius",
        "rdfs:label": "Celsius"},
      "qudt:valueQuantity": {
        "qudt:quantityKind": {
          "@id": "http://codes.wmo.int/common/c-15/me/airTemperature",
          "rdfs:label": "Air temperature"}}}}
  ...
}
```

Click!

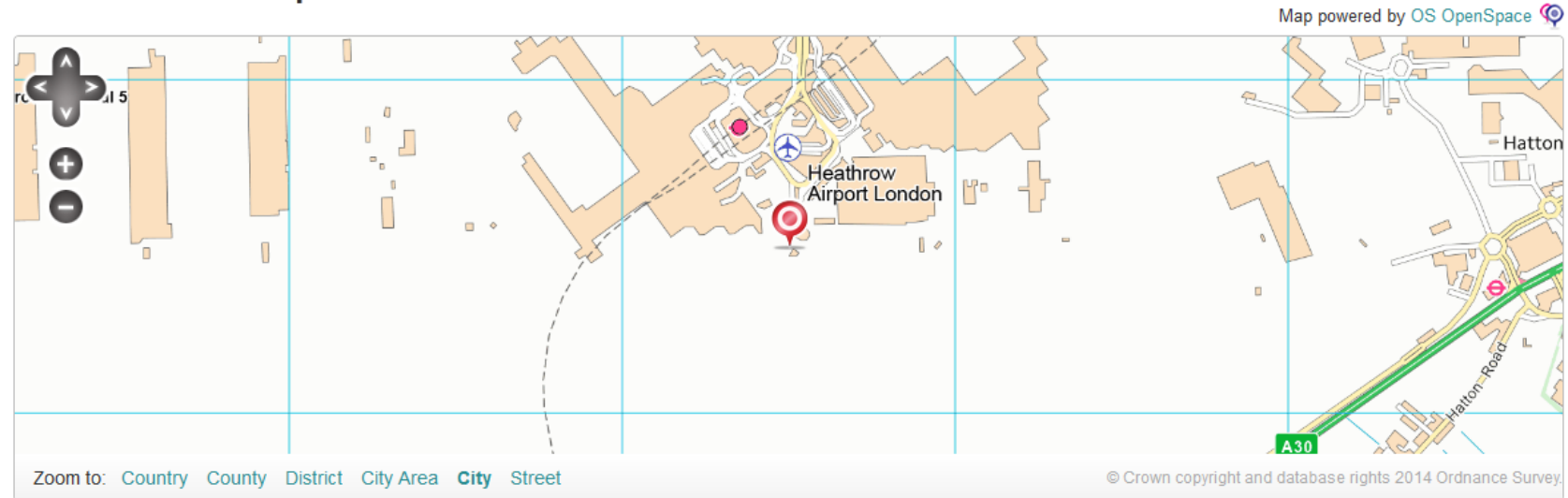


Heathrow London Airport (Named Place)



You are here: [linked-data](#) » [ordnance-survey-linked-data](#) » [heathrow-airport-london](#)

Heathrow Airport London



Heathrow Airport London is a Named Place.

Objects related to "Heathrow Airport London"

TwentyKMGrid Reference	TQ06
Feature Type	Other
OneKMGrid Reference	TQ0775

Core facts about "Heathrow Airport London"

Type	Named Place
Label	Heathrow Airport London
Name	Heathrow Airport London
Northing	175500
Easting	507500

Air temperature (Quantity kind)

WMO Codes Registry

Check URI

Datasets

Admin

Sparql

About

Search

Not logged in

<http://codes.wmo.int> / [common](#) / [quantity-kind](#) / [_airTemperature](#)

Entity: Air temperature

URI: <http://codes.wmo.int/common/quantity-kind/airTemperature>

Stable

Type: [Concept](#) , [QuantityKind](#) , [ThermodynamicsQuantityKind](#)

The temperature indicated by a thermometer exposed to the air in a place sheltered from direct solar radiation.

View [Properties](#) [Metadata](#) [History](#)

Description

The temperature indicated by a thermometer exposed to the air in a place sheltered from direct solar radiation.



plain: [ttl](#) | [rdf/xml](#)
with metadata: [ttl](#) | [rdf/xml](#)

About the Item

submitted on 3 Sep 2014 09:53:17.884

submitted by [marqh \(admin\)](#)

Developed by [Epimorphics Ltd](#)

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Standard level
self certified

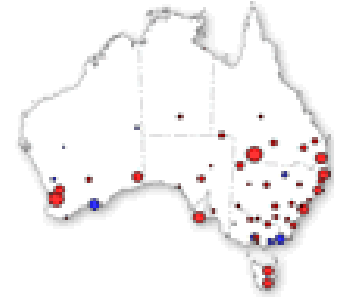
Embed this
on your site

A real example: ACORN-SAT



Australian Government
Bureau of Meteorology

Australian Climate Observations
Reference Network – Surface Air
Temperature (ACORN-SAT)



ACORN-SAT: Linked-data innovation area

Experimental Environmental Linked-data published by the Bureau of Meteorology

The screenshot shows the 'data.gov.au' Linked Data API interface. The 'Search Results' section displays details for series 023090, including the observation location 'Adelaide (023090/023000)' and coordinates (long: 138.622, lat: -34.921). A small map shows the location near Kent T. To the right, a larger map of Australia is populated with numerous green location markers. The interface includes navigation links for different data formats (html, json, plainhtml, rdf, text, ttl, xml) and a 'Show Search Form' button.



Met Office

Thank you

OGL

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