Weather on the WEB
&
APIs based on Rest Pattern

EGOWS
ECMWF 2018

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The Main Messages(1)

- Show how the MetOcean Application Profile may be implemented by a specific profile that uses WFS3.0.
  - ➢These slides are a starting point and show only very limited detail.
- Show how the MetOcean Profile may be utilized to access and extract common meteorological and oceanographic coverage types via ***RESTful API's***.
- These RESTful API patterns:
  - Are harmonized with the WFS3.0 specification, as much as possilbe, for consistency within the OGC.
  - Will make MetOcean data more interoperable to the wider geospatial world.

When is a Feature not a Feature

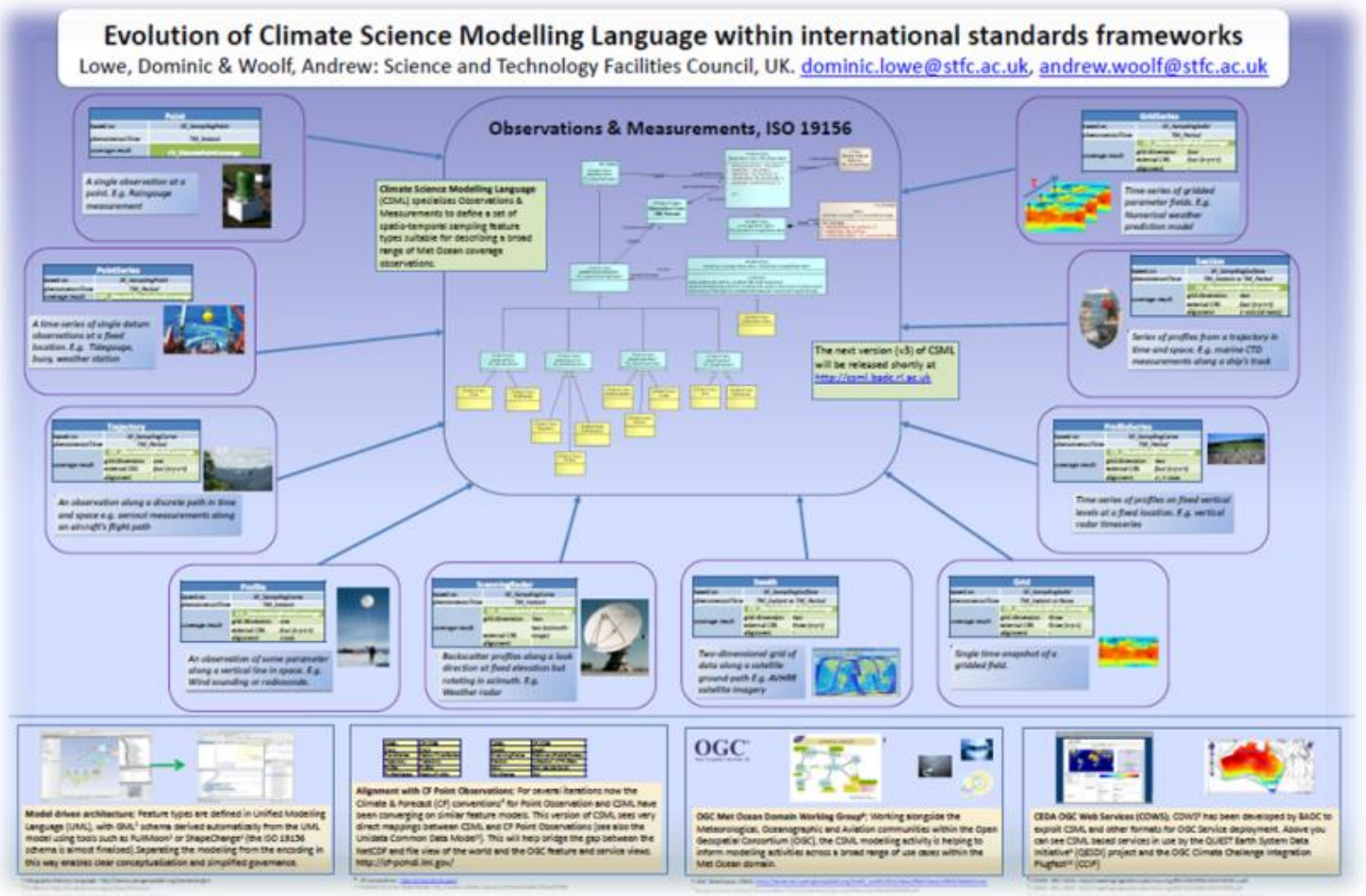
- The first thing is that the MetOcean community use a specialised form of a feature known as a coverage.
- So why not make use of this relationship.
- Well there is a bit difference:-
- To start at the beginning, what are Met Ocean features:-

When is a Feature not a Feature

- The first thing is that the MetOcean community use a specialised form of a feature known as a coverage.
- So why not make use of this relationship.
- Well there is a bit difference:-
- To start at the beginning, what are Met Ocean features:-

A Variety of Coverages Used in MetOcean Today!

- *Time Series*
- *Vertical Profiles*
- *Radar*
- *Wind Profiles*
- *Radiosondes*
- *Satellite Data*
- *NWP model output*
- *Etc*



MetOcean coverages are Not Restricted to Grids!

So What's the Issue with "Coverages" ?

- A typical NWP simulation is comprised of a ***large number of "coverages"*** each with a ***unique vertical coordinate reference system***, *e.g. :*

  - ***pressure***
  - ***height above MSL***
  - ***height above GL*** →
  - ***ground (surface)***
  - ***max wind level*** →
  - ***etc.***

- For meteorological/oceanic grids, the typical dimensionality of a coverage is ***4D (x,y,z,t)***.
- However, this is often treated as a ***set of 2D (x,y) "fields"***
- This unfortunately requires a large number of GetCoverage requests to access the whole cube ***(possibly 1000's)***

So What's the Issue with "Coverages" (cont) ?

- Bottom line is a GetCoverage request needs to support ***multidimensionality*** to reduce the amount of coverages we are dealing with.
- But this is only functional if the coverage itself is multidimensional!
- For example, a ***GetCoverage operation is much easier*** if the geospatial object is 4D with only one identifier. This ensures one request. The task with many 2D coverages is much more complicated.
- MultiDimensionality is a key aspect MetOcean addresses!

MetOcean Features

- This operation will list all the available extraction patterns the following call.
- The all have proper names

Point Features	Point	PointCollection	PointTimeSeries	PointCollectionTimeSeries
Profile Features	Profile	ProfileCollection	ProfileTimeSeries	ProfileCollection TimeSeries
Section Features	Section	SectionTime		
Grid Features	Grid	GridLayer	GridLayerTimeSeries	
Polygon Features	Polygon	PolygonCollection	PolygonTimeSeries	
Trajectory Features	2D Trajectory	2D TrajectoryTime	3D Trajectory	3D TrajectoryTime

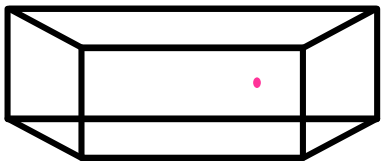
Table 1

Point Features

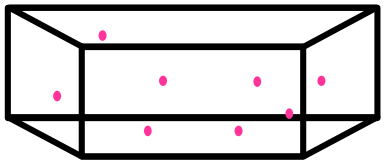
- *For Points, the general Point_Feature grouping consists of 4 Domain Types:*

- *Point*
- *PointTimeSeries*
- *PointCollection*
- *PointCollectionTimeSeries*

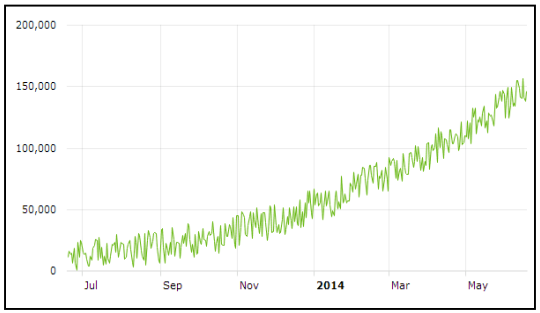
X=1	Y=1	Z=[1]	T=[1]	Composite=no
X=1	Y=1	Z=[1]	T=+	Composite=no
X=+	Y=+	Z=[1]	T=[1]	Composite=yes
X=+	Y=+	Z=[1]	T=+	Composite=yes



Point



Point Collection



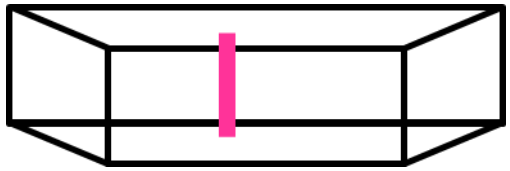
PointTimeSeries

Profile Features

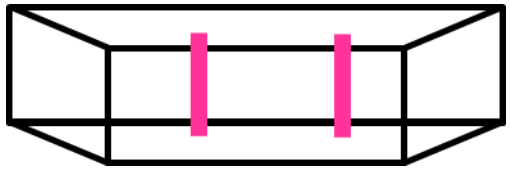
- *For Profiles, the general Profile_Feature grouping consists of 4 Domain Types:*

  - *Profile*
  - *ProfileTimeSeries*
  - *ProfileCollection*
  - *ProfileCollectionTimeSeries*

X=1	Y=1	Z=+	T=[1]	Composite=no
X=1	Y=1	Z=+	T=+	Composite=no
X=+	Y=+	Z=+	T=[1]	Composite=yes
X=+	Y=+	Z=+	T=+	Composite=yes



Profile



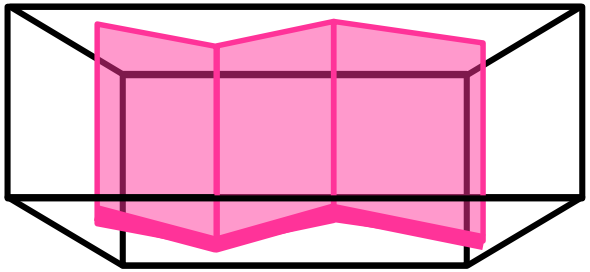
Profile Collection

Profile TimeSeries

Profile Features

- *For Sections, the general Section_Feature grouping consists of 2 Domain Types:*

Section	X=no	Y=no	Z=+	T=1	Composite=yes
SectionTime	X=no	Y=no	Z=+	T=+	Composite=yes



Extracting vertical profile data for a composite axis

Grid Features

- For Grids, the general Grid_Feature grouping consists of 3 Domain Types:

  - *Grid*
  - *GridLayer*
  - *GridLayerTimeSeries*

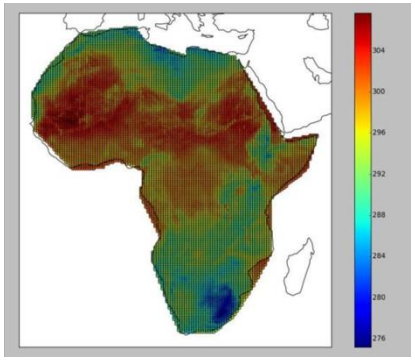
X=+	Y=+	Z=[+]	T=[+]	Composite=no
X=+	Y=+	Z=1	T=1	Composite=no
X=+	Y=+	Z=1	T=+	Composite=no

Horizontal slice (layer) from a data cube.

Polygon Features

- For Polygons, the general Polygon_Feature grouping consists of 3 Domain Types:

• *Polygon*	X=no	Y=no	Z=[1]	T=1	Composite=yes
• *PolygonTimeSeries*	X=no	Y=no	Z=[+]	T=+	Composite=yes
• *PolygonCollection*	X=no	Y=no	Z=[1]	T=1	Composite=yes

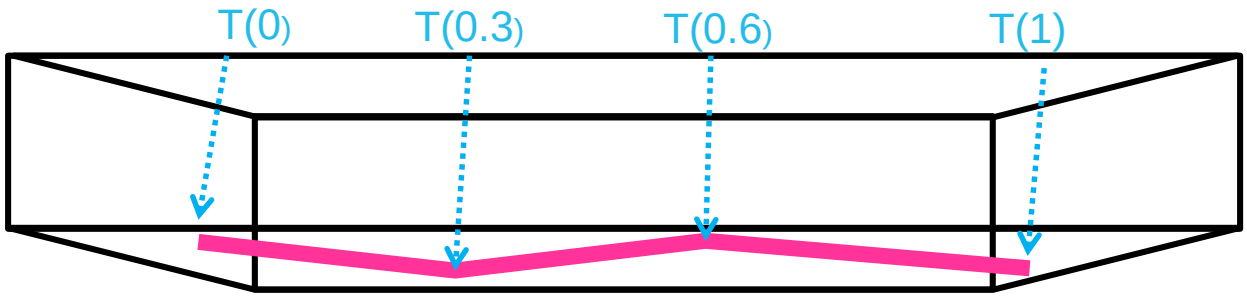


Simple Polygon

Trajectory Features

- For Trajectories, the general Trajectory_Feature grouping consists of 4 Domain Types:

	X	Y	Z	T	Composite
2DTrajectory	no	no	[1]	1	yes
2DTrajectoryTime	no	no	[1]	+	yes
3DTrajectory	no	no	[+]	+	yes
3DTrajectoryTime	no	no	[+]	+	yes



Trajectory (surface)

WFS for MetOcean Coverages

- Many of the WFS conformance classes will be applicable, but may need some new interpretation.
- The world of WFS is concerned with already existing feature e.g. roads, rivers, towns etc., but in the MetOcean world we create features on the fly:
  - e.g. times series of a point data source, vertical profile for a specific point, cross sections, trajectories etc.

Querying

- These are all created by the use of query patterns against the data source. The current WFS specification does not cover this aspect, for obvious reasons, it does not have to, they already exist.
- How we use the OpenAPI spec and the WFS patterns to our best advantage?
- The key aspect of this work is to make sure that the query patterns for each extraction pattern are clearly expressed in the applicable response document(s).

The Key Question?

- For the MetOcean community the resource may normally be described as a geospatial data cube.
- Not all the cubes are the same, they vary be the number of dimensions and the types of dimensions (particularly the vertical dimension.
- So how do we expose the geo-sampling patterns.
- In other words what operations may be performed against the resource and how do we advertise this.

Could we list the various services?

- https://www.proxy.met.uk/rest/services/
- This would list the various *available* services denoted in red.

Feature class	Feature identifiers			
Point Features	Point	PointCollection	PointTimeSeries	PointCollectionTimeSeries
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A separate API definition for each service

- https://www.proxy.met.uk/rest/services/PointTimeSeries/API

  - Would provide the OpenAPI specification for the specific service Points to include on document to support the following.

    - *PointTimeSeries*

Could we list the various services?

- https://www.proxy.met.uk/rest/services/PointTimeSeries/collections
  - This will list any resource that supports the PointTimeSeries query pattern.
    - For example
      - Radar
      - Satellite imagery
      - NWP models
      - Observations
  - This will mainly use the GetCapabilites file from WCS2.1.

Listing Models

- https://www.ldproxy.nrw.de/rest/services/PointTimeSeries/collections/NWPmodels
  - A list of all the available NWP models:
    - For example:
      - UK_Global_2018-09-15T00.00.00Z
      - UK_Global_2018-09-15T06.00.00Z
      - UKV_2018-09-15T00.00.00Z
      - UKV_2018-09-15T06.00.00Z
  - This will mainly use the GetCapabilites file from WCS2.1

- https://www.ldproxy.nrw.de/rest/services/Points/collections/UK_Global_2018-09-15T12.00.00Z/Items
  - This would list all coverage identifiers' for that model run.
    - For example:-
      - UK_Global_ISBL
      - UK_Global_MaxWind
  - This would list all coverage identifiers' for that model run using the response from DescribeCoverageCollection

- https://www.ldproxy.nrw.de/rest/services/PointTimeSeries/collections/UK_Global_2018-09-15T12.00.00Z/Items/UK_Global_ISBL/CoordinateDefn
  - This would list all defaults needed (per axis) to support the sampling geometry. To include units, coordinate definitions, interpolation, etc.
  - This would also provide a full description of the coverage, including the data mask if appropriate. (A trans copy of Describe Coverage response)

A full example

https://www.ldproxy.nrw.de/rest/services/Points/collections/UK_Global_2018-09-15T12.00.00Z/Items/UK_Global_ISBL*?*
&Point=-4.0,50.0
&Interpolation=No
&Level=1000.0&vert_uom=hPa
&Interpolation=No
&TimeExtractionPattern=Subset
&TimeBoundingBox=2017-07-21T00:00:00Z/2017-08-22T00:00:00Z
&Parameters=temperature/humidity
&Format=CovJSON

A full example

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&Format=CovJSON

MetOcean Profile Demmonstration (cont)

- **GetCapabilites** (http://ws-sandbox.iblsoft.com/wafc/kwbc?SERVICE=WCS&VERSION=2.1.0&REQUEST=GetCapabilities)
- **DescribeCoverageCollection** (http://ws-sandbox.iblsoft.com/wafc/kwbc?SERVICE=WCS&VERSION=2.1.0&REQUEST=DescribeCoverageCollection&COVERAGECOLLECTIONID=KWBC_2016-09-22T06.00.00Z)
- **DescribeCoverage** (http://ws-sandbox-ie.iblsoft.com/wafc/kwbc?SERVICE=WCS&VERSION=2.1.0&REQUEST=DescribeCoverage&COVERAGEID=KWBC_2018-10-15T06.00.00Z_ISBL)