Tools for building the next generation of data-driven EO web applications

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Introduction

• Web browsers are becoming increasingly capable as visualisation and analysis platforms
• Lots of tools and libraries are built around images and “simple features”
  – GeoJSON, KML, OpenLayers, Leaflet ...
• Formats and tools for EO / scientific data are not always web-friendly
  – Complex, binary, desktop-oriented
• Lots of people building ad-hoc solutions

• We want to bring scientific data within the reach of more Web and app developers
  – Web-friendly formats (i.e. JSON)
  – More powerful and reusable visualisation/analysis tools
“Coverages”: a unifying concept

data = f(position, time, ...)

Vertical profile of POTM_CORRECTED
The CoverageJSON data format

- **Rich and efficient JSON** encoding of coverage data
- “As simple as possible but no simpler“
- Gridded and non-gridded data
- n-Dimensional data
- Continuous and categorical data
- Internationalisation
- Embedded semantics
  - (some interoperability with RDF through JSON-LD)
Skeleton Coverage JSON document

```
{
"domain": {
...,
"referencing": [...]
},
"parameters": {
"SST": {...},
"sea_ice": {...}
},
"ranges": {
"SST": {...},
"sea_ice": {...}
}
}
```

- Coordinates of data points and referencing information
- Metadata describing data values
- Data values as nD arrays
Metadata sample

```json
{
  "observedProperty": {
    "id": "http://vocab.nerc.ac.uk/standard_name/sea_surface_temperature/",
    "label": {
      "en": "Sea Surface Temperature",
      "de": "Meeresoberflächentemperatur"
    },
    "description": {...}
  },
  "unit": {
    "label": {
      "en": "Degree Celsius",
      "de": "Grad Celsius"
    },
    "symbol": {
      "value": "Cel",
      "type": "http://www.opengis.net/def/uom/UCUM/"
    }
  }
}
```
Scalability through tiling

- Large data files can be split into several JSON documents
- Each document holds part of the nD array
- Reduces need to run complex servers (cf. Web Map Tiling)
Interactive, in-browser reclassification of land cover maps
youtu.be/dxfmTkBdn90

- Data processed in-browser
- metadata is RDF “in disguise” using JSON-LD
In-browser intercomparison of models and observations
NASA (Web) World Wind
Web World Wind and CovJSON

https://webworldwind.org
Beyond visualisation: Big Data analytics over the Web

- Put CovJSON tiles on a web server
  - or content delivery network
- Write simple analysis script in Python
  - Use Dask to treat tiles as single virtual dataset
  - Dask automatically downloads only the required tiles

=> work on big datasets more easily, without the need for a complex server

Calculate mean sea surface temperature over certain region:

```python
dataset = getDataset("http://my.covjson.doc")
sst = dataset["sst"]
result = da.mean(sst[0,:450,:]).compute()
```
CoverageJSON Resources

The CoverageJSON Format Specification

Specification

Cookbook
(start here!)

Playground

https://covjson.org
Tools
(https://covjson.org/tools)

• JavaScript data-reading library
• Visualisation
  – Leaflet plugin
  – Web World Wind demos
• Conversion
  – Python library to convert from NetCDF to CovJSON
  – Java libraries
• Servers
  – Export CoverageJSON from ncWMS/THREDDS
Conclusions

• CoverageJSON is a simple but not simplified format
  – Handles many kinds of data, include satellite images, derived products, in situ observations, numerical model data ...
  – Friendly for web developers
  – Supported by documentation, tools and examples

• Discussed in OGC/W3C Spatial Data on the Web activity

• Potential output format for WCS etc
  – We need a mapping from CoverageJSON to Coverage Implementation Schama

• Web World Wind is a very powerful platform for visualisation and analysis (see Patrick Hogan’s talks!)

• We want to enable the community to generate new and exciting data-driven websites and apps!
Thank you!

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https://covjson.org
http://www.melodiesproject.eu