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BCO-DMO
Biological & Chemical Oceanography Data Management Office

The Frictionless Data Package: Data Containerization for Addressing Big Data Challenges

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Big Data Challenges

VERACITY VARIETY VOLUME

for specs: https://frictionlessdata.io/
for tooling: https://frictionlessdata.io/software/

OPEN KNOWLEDGE INTERNATIONAL With support from Alfred P. Sloan Foundation Google.org ODI open data institute

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Abstract

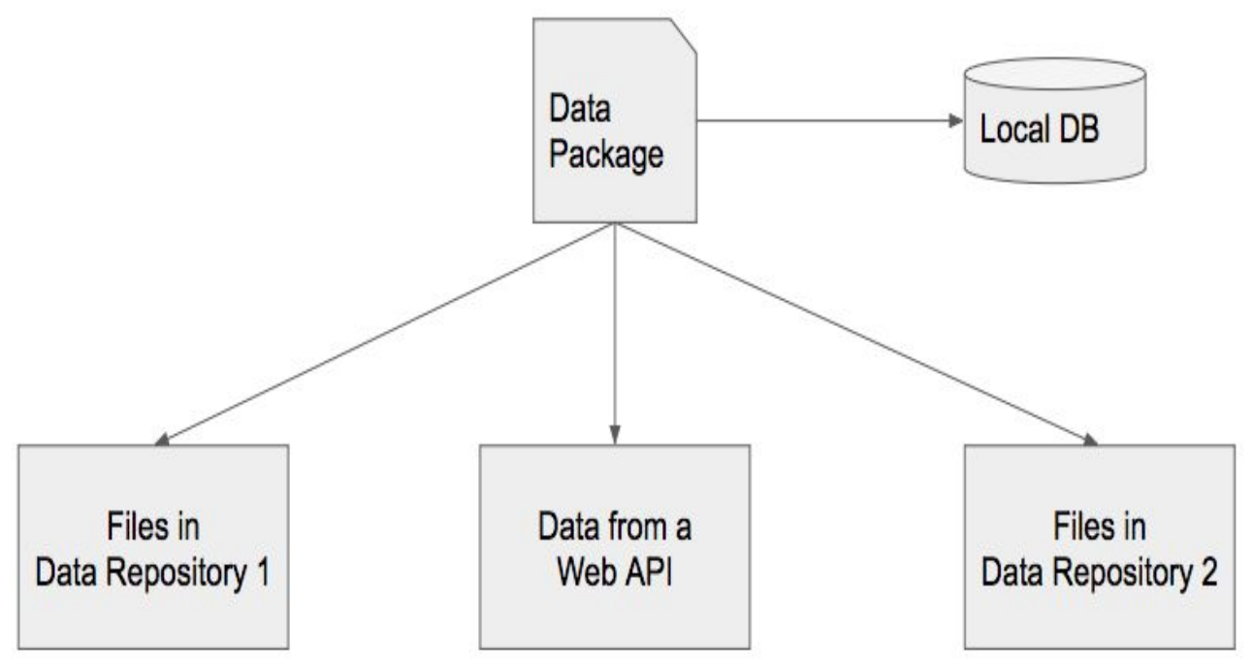
At the Biological and Chemical Oceanography Data Management Office (BCO-DMO) Big Data challenges have been steadily increasing. The sizes of data submissions have grown as instrumentation improves. Complex data types can sometimes be stored across different repositories. This signals a paradigm shift where data and information that is meant to be tightly-coupled and has traditionally been stored under the same roof is now distributed across repositories and data stores. For domain-specific repositories like BCO-DMO, a new mechanism for assembling data, metadata and supporting documentation is needed.

Traditionally, data repositories have relied on a human's involvement throughout discovery and access workflows. This human could assess fitness for purpose by reading loosely coupled, unstructured information from web pages and documentation. Distributed storage was something that could be communicated in text that a human could read and understand. However, as machines play larger roles in the process of discovery and access of data, distributed resources must be described and packaged in ways that fit into machine automated workflows of discovery and access for assessing fitness for purpose by the end-user. Once machines have recommended a data resource as relevant to an investigator's needs, the data should be easy to integrate into that investigator's toolkits for analysis and visualization.

BCO-DMO is exploring the idea of data containerization, or packaging data and related information for easier transport, interpretation, and use. Data containerization reduces not only the friction data repositories experience trying to describe complex data resources, but also for end-users trying to access data with their own toolkits. In researching the landscape of data containerization, the Frictionlessdata Data Package (https://frictionlessdata.io/) provides a number of valuable advantages over similar solutions. This presentation will focus on these advantages and how the Frictionlessdata Data Package addresses a number of real-world use cases faced for data discovery, access, analysis and visualization in the age of Big Data.

What is Data Containerization?

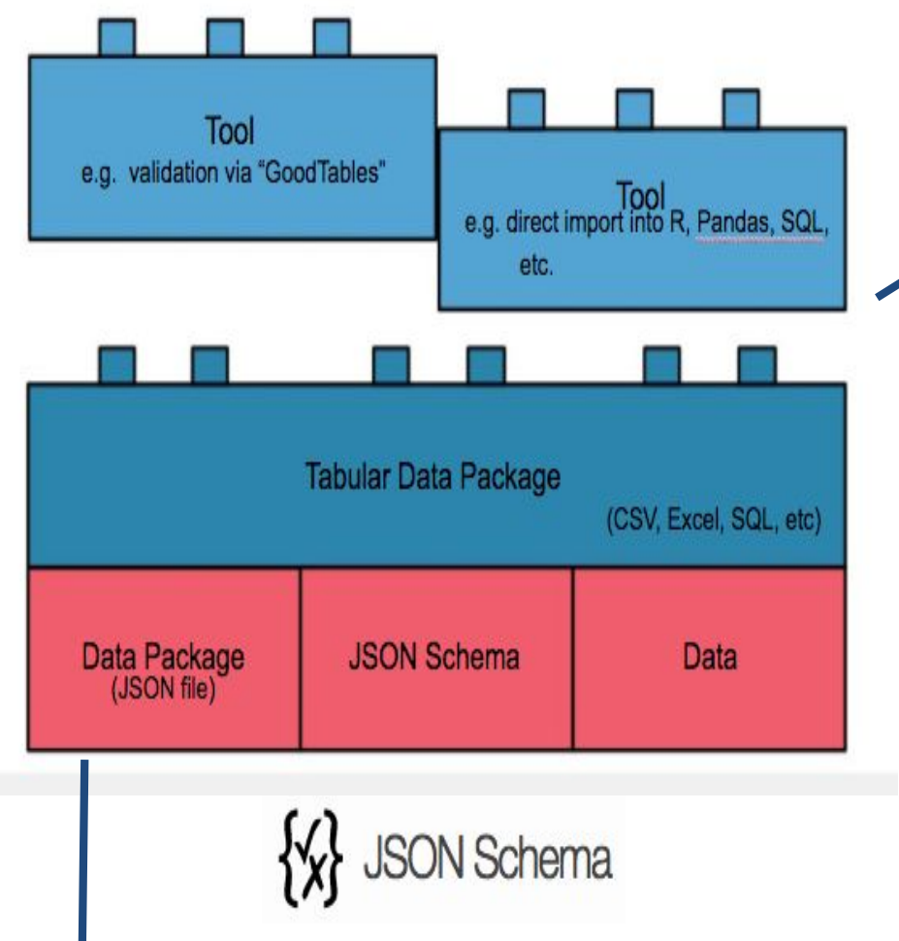
Problem: Data can be distributed across multiple locations - databases, files on a server, files on the web, or available from web APIs, etc.

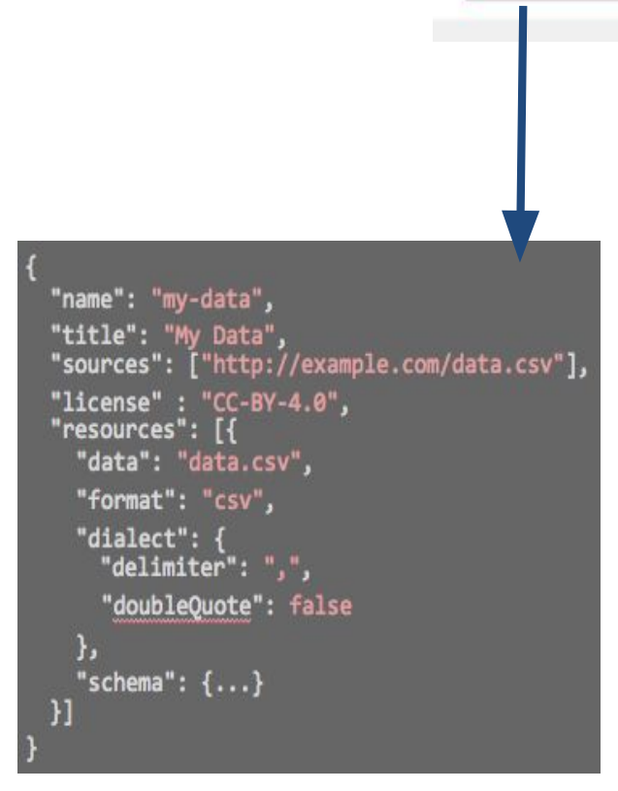


Problem: Data can be large so that traditional packages (TAR, ZIP, BagIt) are inefficient transports.

Q: How do we package data to handle these various locations and sizes?

The Frictionless Data Package is a set of extendible, lightweight formats for packaging data and metadata.

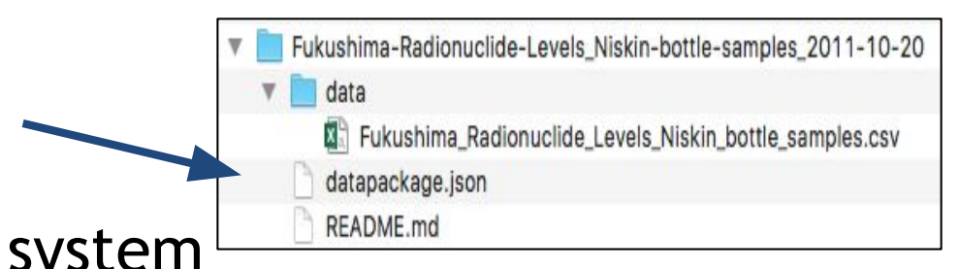




```
{
  "name": "my-data",
  "title": "My Data",
  "sources": ["http://example.com/data.csv"],
  "license" : "CC-BY-4.0",
  "resources": [{
    "data": "data.csv",
    "format": "csv",
    "dialect": {
      "delimiter": ",",
      "doubleQuote": false
    },
    "schema": {...}
  }]
}
```

datapackage.json

- can be added to traditional packaging formats (BagIt, TAR, ZIP) for describing local files
- can point to data resources that aren't local to the package or file system
- for data accessible by URL, can be the only file needed to be passed in transport



```
▼ Fukushima-Radionuclide-Levels_Niskin-bottle-samples_2011-10-20
    ▼ data
        Fukushima_Radionuclide_Levels_Niskin_bottle_samples.csv
    datapackage.json
    README.md
```

BCO-DMO wants:

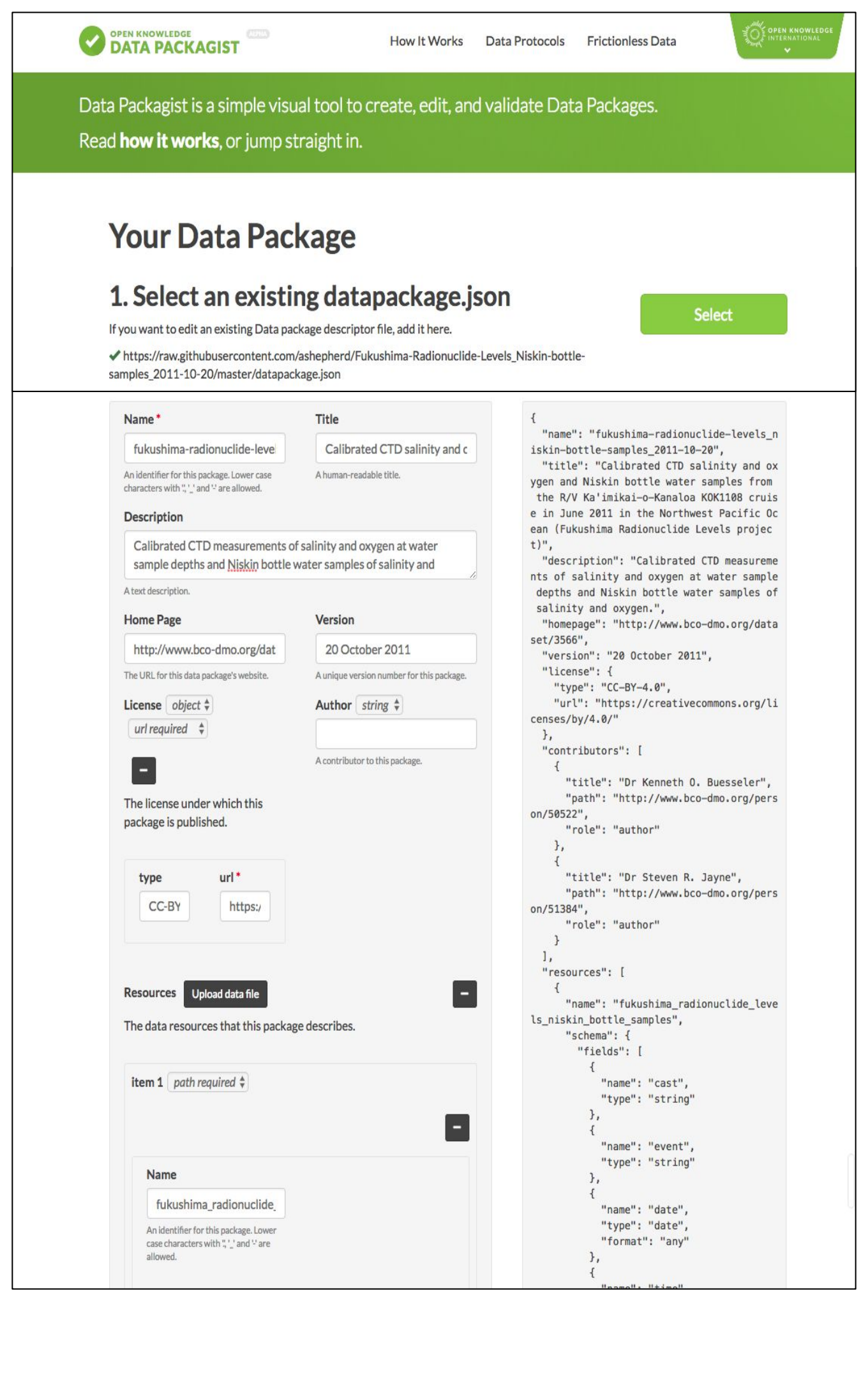
- Simpler, expedited data ingest for submitters
- Data transformation that captures provenance
- Continuous integration testing of data holdings

Simpler, expedited data ingest for submitters

DataPackagist - A web service for creating Data Packages.

https://github.com/frictionlessdata/datapackagist

Data Submitters: login, describe submission, get immediate feedback



Data Packagist is a simple visual tool to create, edit, and validate Data Packages.
Read **how it works**, or jump straight in.

Your Data Package

1. Select an existing datapackage.json

If you want to edit an existing Data package descriptor file, add it here.

✓ https://raw.githubusercontent.com/ashepherd/Fukushima-Radionuclide-Levels_Niskin-bottle-samples_2011-10-20/master/datapackage.json

Name*: fukushima-radionuclide-leve
An identifier for this package. Lower case characters with '.', '_' and '-' are allowed.

Title: Calibrated CTD salinity and c
A human-readable title.

Description: Calibrated CTD measurements of salinity and oxygen at water sample depths and Niskin bottle water samples of salinity and
A text description.

Home Page: http://www.bco-dmo.org/dat
The URL for this data package's website.

Version: 20 October 2011
A unique version number for this package.

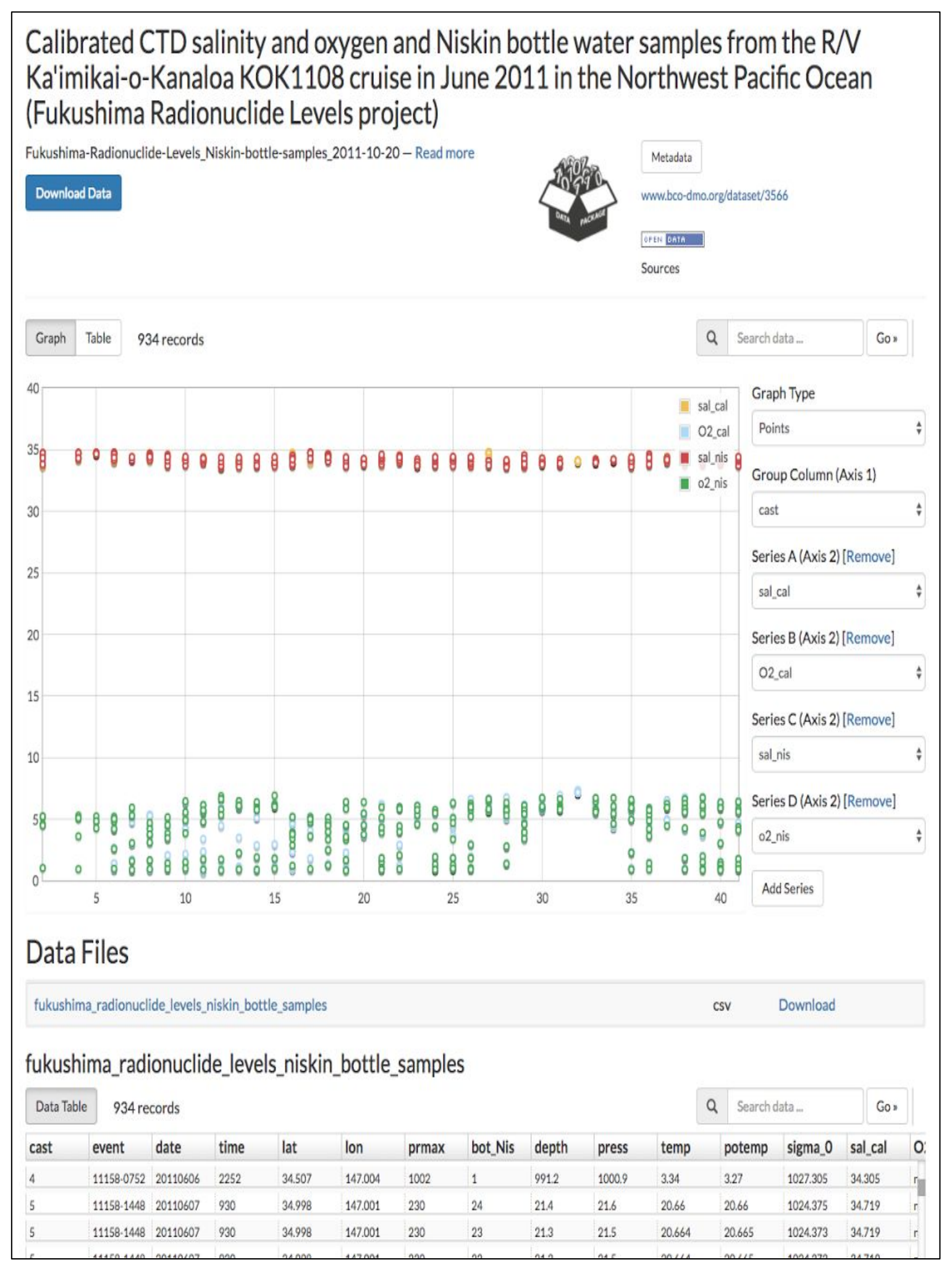
License: object; url required
The license under which this package is published.
type: CC-BY; url*: https:/

Author: string
A contributor to this package.

Resources
The data resources that this package describes.

item 1: path required
Name: fukushima_radionuclide_
An identifier for this package. Lower case characters with '.', '_' and '-' are allowed.

```
{
  "name": "fukushima-radionuclide-levels_niskin-bottle-samples_2011-10-20",
  "title": "Calibrated CTD salinity and oxygen and Niskin bottle water samples from the R/V Ka'imikai-o-Kanaloa KOK1108 cruise in June 2011 in the Northwest Pacific Ocean (Fukushima Radionuclide Levels project)",
  "description": "Calibrated CTD measurements of salinity and oxygen at water sample depths and Niskin bottle water samples of salinity and oxygen.",
  "homepage": "http://www.bco-dmo.org/dataset/3566",
  "version": "20 October 2011",
  "license": {
    "type": "CC-BY-4.0",
    "url": "https://creativecommons.org/licenses/by/4.0/"
  },
  "contributors": [
    {
      "title": "Dr Kenneth O. Buesseler",
      "path": "http://www.bco-dmo.org/person/50522",
      "role": "author"
    },
    {
      "title": "Dr Steven R. Jayne",
      "path": "http://www.bco-dmo.org/person/51384",
      "role": "author"
    }
  ],
  "resources": [
    {
      "name": "fukushima_radionuclide_levels_niskin_bottle_samples",
      "schema": {
        "fields": [
          {
            "name": "cast",
            "type": "string"
          },
          {
            "name": "event",
            "type": "string"
          },
          {
            "name": "date",
            "type": "date",
            "format": "any"
          },
          {
```



Calibrated CTD salinity and oxygen and Niskin bottle water samples from the R/V Ka'imikai-o-Kanaloa KOK1108 cruise in June 2011 in the Northwest Pacific Ocean (Fukushima Radionuclide Levels project)

Fukushima-Radionuclide-Levels_Niskin-bottle-samples_2011-10-20 – Read more

934 records

Graph Type: Points
Group Column (Axis 1): cast
Series A (Axis 2) [Remove]: sal_cal
Series B (Axis 2) [Remove]: O2_cal
Series C (Axis 2) [Remove]: sal_nis
Series D (Axis 2) [Remove]: o2_nis

Data Files

fukushima_radionuclide_levels_niskin_bottle_samples csv Download

fukushima_radionuclide_levels_niskin_bottle_samples

Data Table 934 records

cast	event	date	time	lat	lon	prmax	bot_Nis	depth	press	temp	potemp	sigma_0	sal_cal
4	11158-0752	20110606	2252	34.507	147.004	1002	1	991.2	1000.9	3.34	3.27	1027.305	34.305
5	11158-1448	20110607	930	34.998	147.001	230	24	21.4	21.6	20.66	20.66	1024.375	34.719
5	11158-1448	20110607	930	34.998	147.001	230	23	21.3	21.5	20.664	20.665	1024.373	34.719

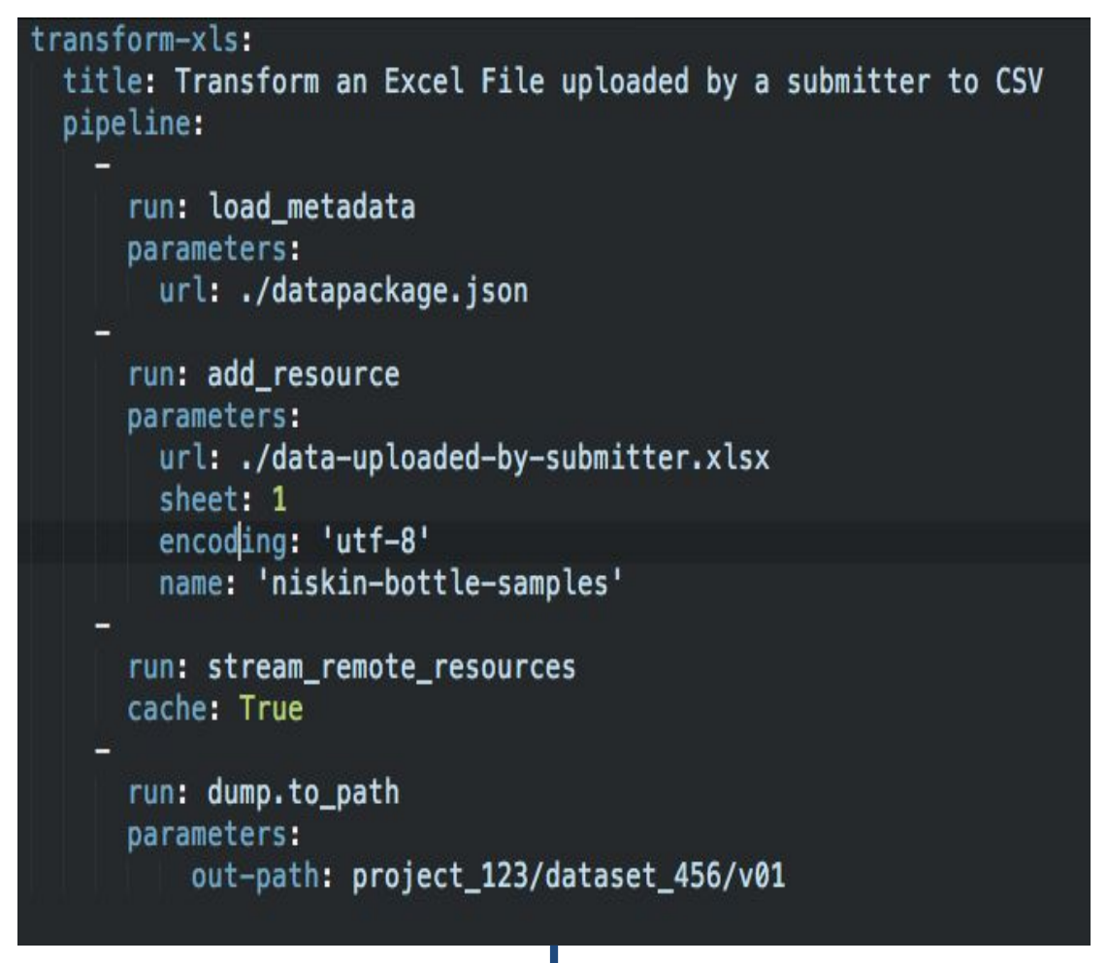
Data Package View Tool by Open Knowledge Foundation
http://data.okfn.org/tools/view?url=https%3A%2F%2Fraw.githubusercontent.com%2Fashepherd%2FFukushima-Radionuclide-Levels_Niskin-bottle-samples_2011-10-20%2Fmaster%2Fdatapackage.json

What about the work of a data manager?

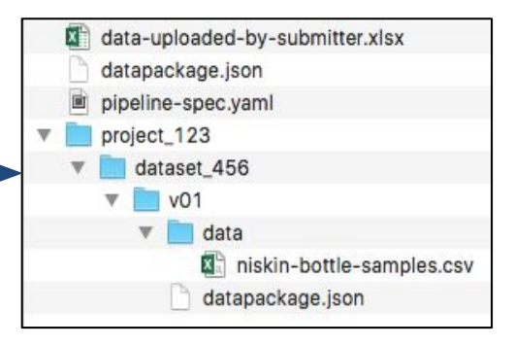
Data Package Pipelines - Framework for processing data packages in pipelines of modular components.

https://github.com/frictionlessdata/datapackage-pipelines

- A pipeline has a list of processing steps, and it generates a single data package as its output.
- A pipeline is defined in a declarative way, not in code, stored in a file named *pipeline-spec.yaml*.
- Data Package Pipelines define some common processors, custom processors can be created.



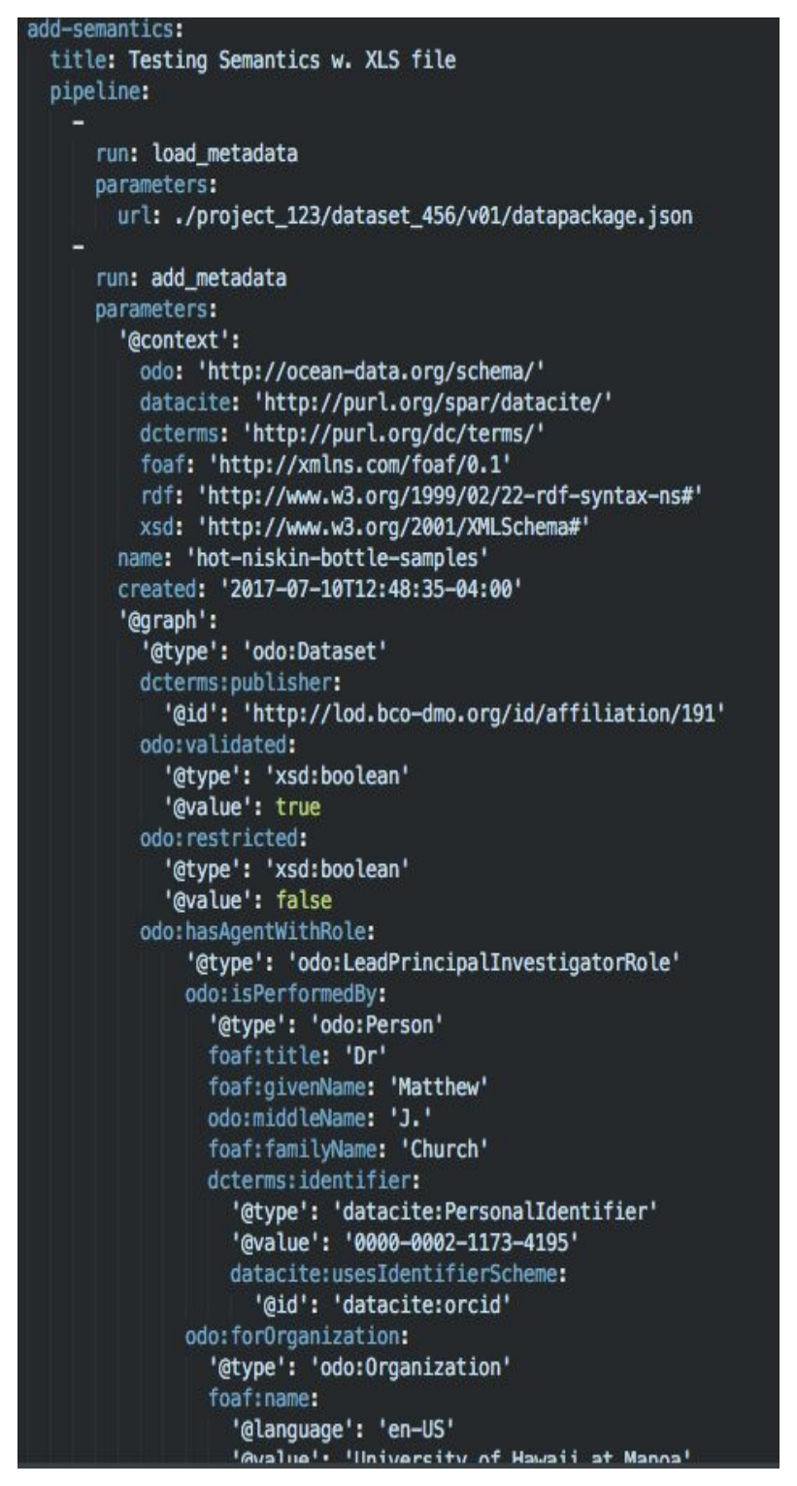
```
transform-xls:
  title: Transform an Excel File uploaded by a submitter to CSV
  pipeline:
    -
      run: load_metadata
      parameters:
        url: ./datapackage.json
    -
      run: add_resource
      parameters:
        url: ./data-uploaded-by-submitter.xlsx
        sheet: 1
        encoding: 'utf-8'
        name: 'niskin-bottle-samples'
    -
      run: stream_remote_resources
      cache: True
    -
      run: dump.to_path
      parameters:
          out-path: project_123/dataset_456/v01
```



```
data-uploaded-by-submitter.xlsx
datapackage.json
pipeline-spec.yaml
▼ project_123
    ▼ dataset_456
        ▼ v01
            ▼ data
                niskin-bottle-samples.csv
            datapackage.json
```

Data Managers can extend the datapackage.json to add semantic markup.

The resulting datapackage.json can then be used to populate repository metadata catalog.



```
add-semantics:
  title: Testing Semantics w. XLS file
  pipeline:
    -
      run: load_metadata
      parameters:
        url: ./project_123/dataset_456/v01/datapackage.json
    -
      run: add_metadata
      parameters:
        '@context':
          odo: 'http://ocean-data.org/schema/'
          datacite: 'http://purl.org/spar/datacite/'
          dcterms: 'http://purl.org/dc/terms/'
          foaf: 'http://xmlns.com/foaf/0.1'
          rdf: 'http://www.w3.org/1999/02/22-rdf-syntax-ns#'
          xsd: 'http://www.w3.org/2001/XMLSchema#'
        name: 'hot-niskin-bottle-samples'
        created: '2017-07-10T12:48:35-04:00'
        '@graph':
          '@type': 'odo:Dataset'
          dcterms:publisher:
            '@id': 'http://lod.bco-dmo.org/id/affiliation/191'
          odo:validated:
            '@type': 'xsd:boolean'
            '@value': true
          odo:restricted:
            '@type': 'xsd:boolean'
            '@value': false
          odo:hasAgentWithRole:
              '@type': 'odo:LeadPrincipalInvestigatorRole'
              odo:isPerformedBy:
                '@type': 'odo:Person'
                foaf:title: 'Dr'
                foaf:givenName: 'Matthew'
                odo:middleName: 'J.'
                foaf:familyName: 'Church'
                dcterms:identifier:
                  '@type': 'datacite:PersonalIdentifier'
                  '@value': '0000-0002-1173-4195'
                  datacite:usesIdentifierScheme:
                    '@id': 'datacite:orcid'
              odo:forOrganization:
                '@type': 'odo:Organization'
                foaf:name:
                  '@language': 'en-US'
                  '@value': 'University of Hawaii at Manoa'
```

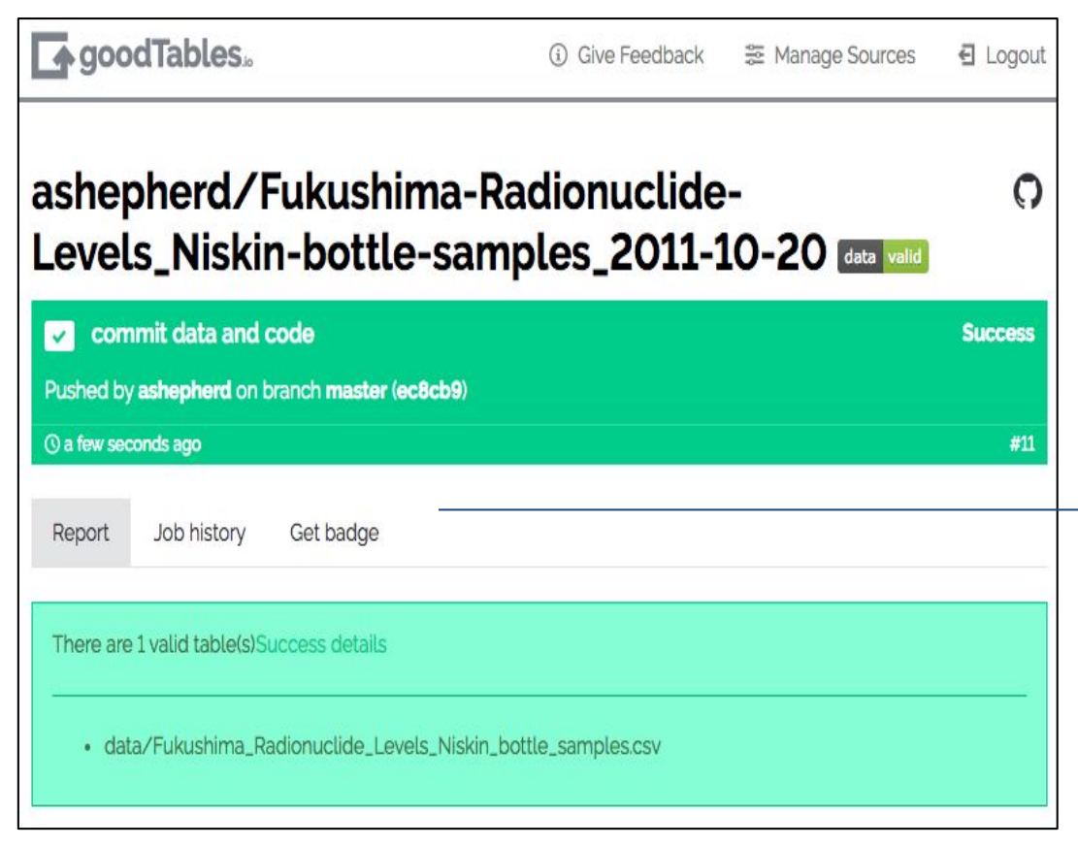
Continuous Integration Testing for Data

Goodtables.io - Continuous data validation as a service.

https://github.com/frictionlessdata/goodtables.io

Because Data Package Pipelines are declarative, *pipeline-spec.yaml* files are **provenance** records.

- Pipelines can be re-run to verify that the workflow is reproducible
- Data Packages can be validated
  - Is the datapackage.json well-formed ?
  - Does it meet the JSON schema specification ?
- Tabular Data Packages have deeper validation
  - Column header checking vs. datapackage.json defined fields
  - Methods for handling missing data values
  - Regex processing of a data cell for conforming to a pattern



ashepherd/Fukushima-Radionuclide-Levels_Niskin-bottle-samples_2011-10-20

☑ commit data and code — Success
Pushed by **ashepherd** on branch **master (ec8cb9)**
a few seconds ago #11

There are 1 valid table(s)Success details

- data/Fukushima_Radionuclide_Levels_Niskin_bottle_samples.csv

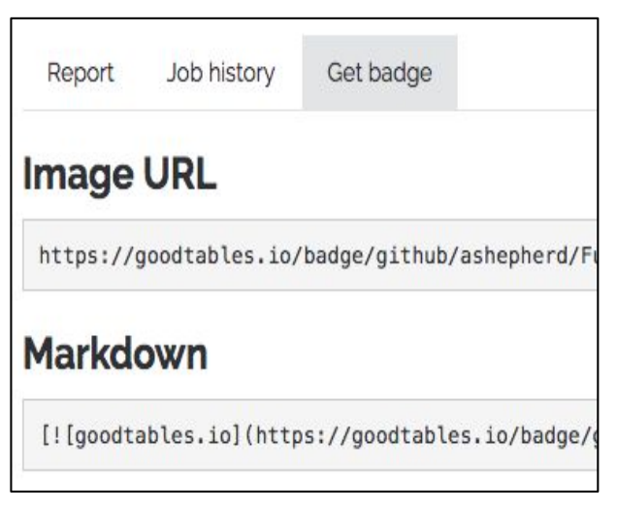


Image URL
https://goodtables.io/badge/github/ashepherd/F

Markdown
[![goodtables.io](https://goodtables.io/badge/