Web Processing Service

Deploying a WPS for Copernicus Climate Data Store

Copernicus CORDEX4CDS Meeting
DMI, Copenhagen, 23-24 September 2019

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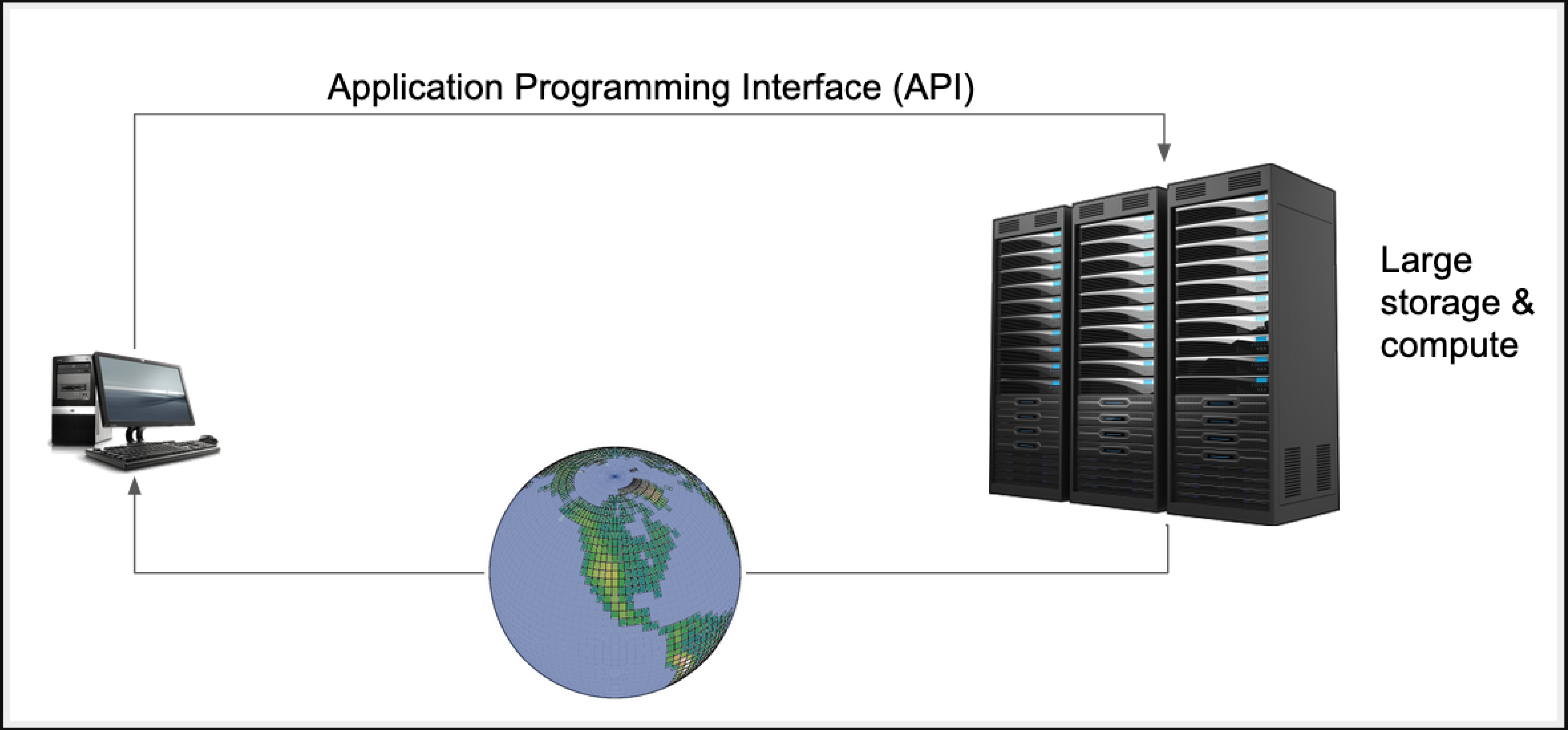
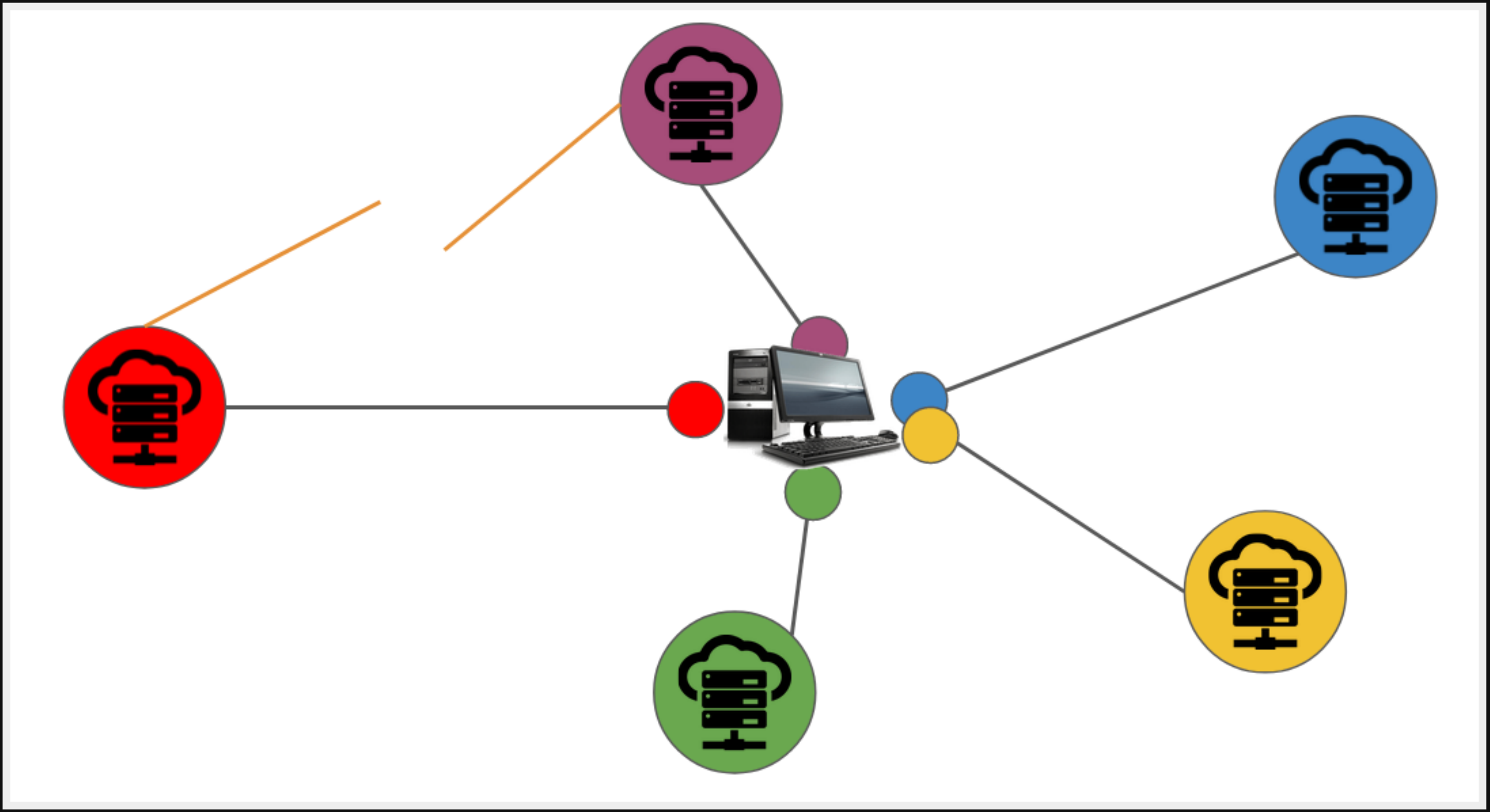
What is a WPS?

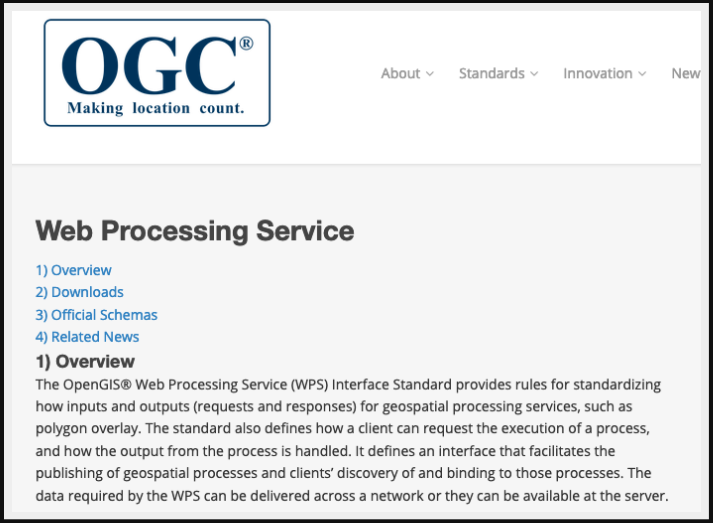
Scientific number-crunching is moving into the cloud



But we could get stuck with multiple APIs and clients



WPS is an OGC standard for remote processing



Web Processing Service

1) Overview
2) Downloads
3) Official Schemas
4) Related News

1) Overview

The OpenGIS® Web Processing Service (WPS) Interface Standard provides rules for standardizing how inputs and outputs (requests and responses) for geospatial processing services, such as polygon overlay. The standard also defines how a client can request the execution of a process, and how the output from the process is handled. It defines an interface that facilitates the publishing of geospatial processes and clients' discovery of and binding to those processes. The data required by the WPS can be delivered across a network or they can be available at the server.

- Define inputs and outputs of your *processes* ("functions")
- Like *"Function as a Service"*

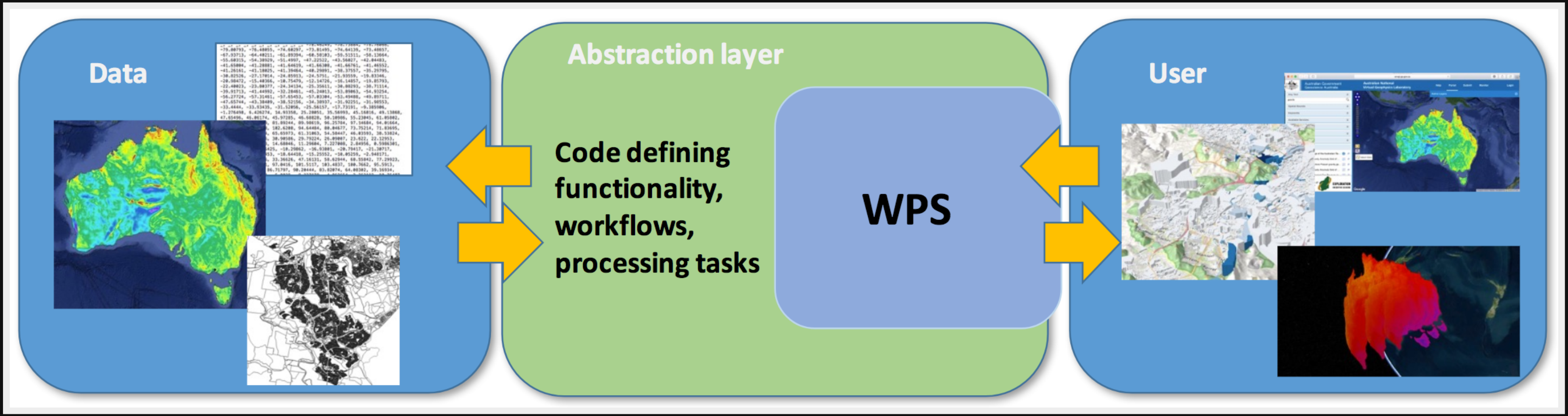
WPS operations

- **GetCapabilities** – List available processes
- **DescribeProcess** – Inputs and outputs of a process
- **Execute** – Launch a process

Usually it looks like this

```
http://localhost:5000/wps?
  service=WPS&
  version=1.0.0&
  request=Execute&
  identifier=hello&
  DataInputs=name=Stranger
```

Mostly used by user-friendly clients



Like portals, Jupyter notebooks, ...

PyWPS - Server

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PyWPS

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PyWPS

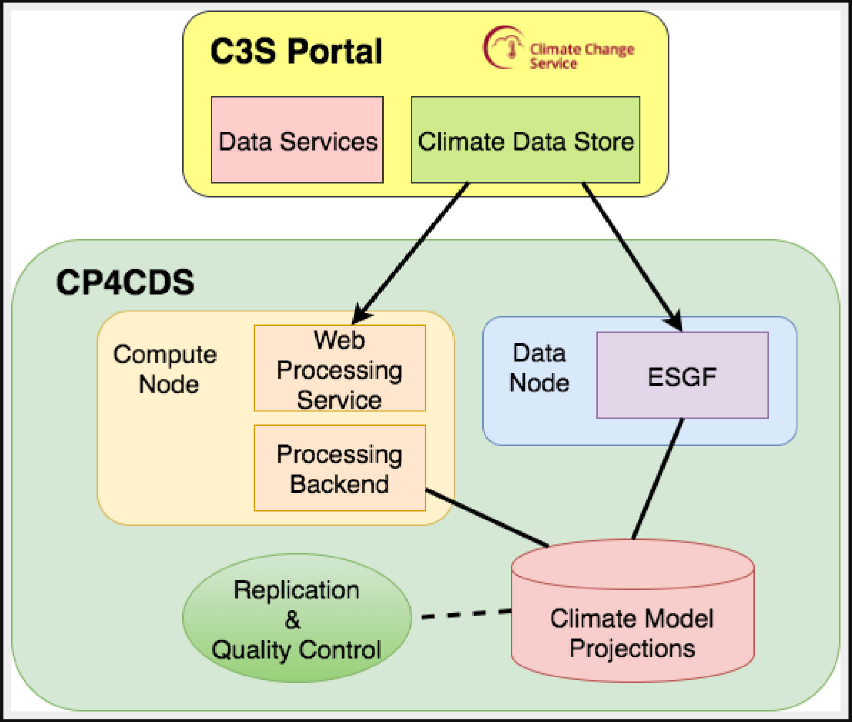
PyWPS is an implementation of the Web Processing Service standard from the Open Geospatial Consortium on the server side. PyWPS is written in Python. PyWPS enables integration, publishing and execution of Python processes via the WPS standard.

- Python implementation of WPS
- Like a bicycle easy to use
- Open Source and active community

What is the Goal?

- Make climate data accessible to a wide audience
- Use a standards based compute service
- Example: data-reduction as a service next to a large data pool (CORDEX)

WPS for Climate Data Store



- Climate projections for Climate Data Store
- ESGF data nodes for CMIP5, CORDEX
- WPS for compute nodes

Build your own WPS

Use a Cookiecutter Template

- Cookiecutter: Python tool to create projects from templates
- We have a cookiecutter template for a PyWPS project
- Generated PyWPS project works out of the box

https://cookiecutter-birdhouse.readthedocs.io/en/latest/

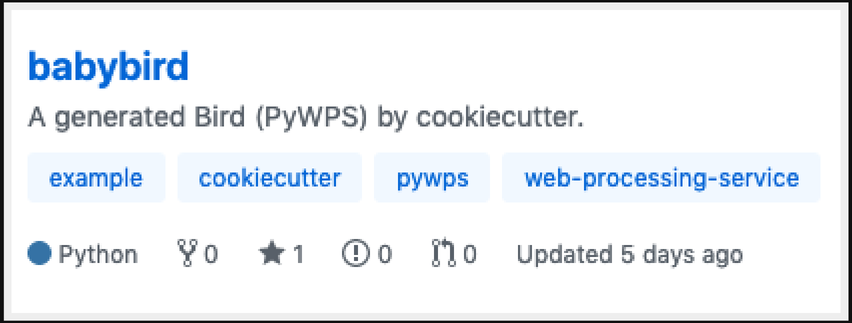
Example

```
# Install cookiecutter
$ conda install -c conda-forge cookiecutter

# Run cookiecutter with PyWPS template
$ cookiecutter https://github.com/bird-house/cookiecutter-birdhou

full_name [Full Name]: Daphne du Maurier
github_username [bird-house]: bird-house
project_name [Babybird]: Babybird
project_slug [babybird]: babybird
project_short_description [Short description]: A Web Processing S
version [0.1.0]: 0.1.0
http_port [5000]: 5000
```

Creates a PyWPS project named *babybird*.

Babybird

Add your new WPS service to GitHub



babybird

A generated Bird (PyWPS) by cookiecutter.

example cookiecutter pywps web-processing-service

https://github.com/bird-house/babybird

Working with the new WPS

Install your WPS

```
# Get source from GitHub
$ git clone https://github.com/bird-house/babybird.git
$ cd babybird

# Create a conda environment
$ conda env create -f environment.yml
$ source activate babybird

# Run Python installation
$ pip install -e .[dev]
OR
$ make develop
```

- Use Conda to manage dependencies
- Normal Python installation

Start the Service

```
# start service with custom config
$ make start -c custom.cfg

# run GetCapabilities request
$ curl -o caps.xml \
  "http://localhost:5000/wps?service=WPS&request=GetCapabilities"

# check logs
$ tail -f pywps.log
```

No additional installation steps necessary to run service (using Werkzeug library)

Try with Birdy as WPS client

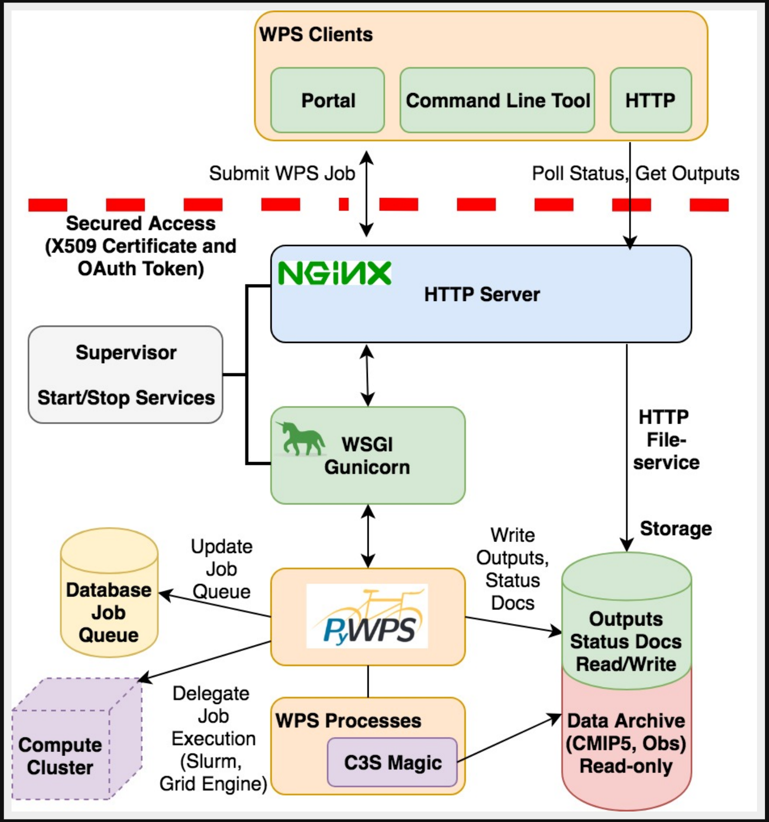
```
from birdy import WPSClient
babybird = WPSClient(url='http://localhost:5000/wps')
output = babybird.hello(name='Stranger')
print(output.get())
'Hello Stranger'
```

- Can be used in Jupyter Notebooks
- WPS functions feel like normal Python functions

https://birdy.readthedocs.io

Deploy your WPS

PyWPS full-stack



Need several other components to run in production: Nginx, Postgres, ...

Deploy with Ansible

```
# Get Ansible playbook
$ git clone \
  https://github.com/bird-house/ansible-wps-playbook.git
$ cd ansible-wps-playbook

# Edit config: point it to your WPS on GitHub
$ vim custom.yml

# Run playbook
$ ansible-playbook -c local playbook.yml
```

- Use Ansible playbook for full-stack deployment of PyWPS
- Ansible: language for IT automation

Test with Vagrant

Deploy with Ansible into a test virtual machine set-up by Vagrant

```
# Use Ansible playbook
$ cd ansible-wps-playbook

# use vagrant config
$ cp etc/sample-vagrant.yml custom.yml

# Vagrant starts a VM and deploys with Ansible
$ vagrant up
```

Summary

- WPS is standard interface for remote processing
- Use Cookiecutter template to create a new WPS project
- New WPS is ready to use without extra installation steps
- Ansible can be used for production deployment

Links

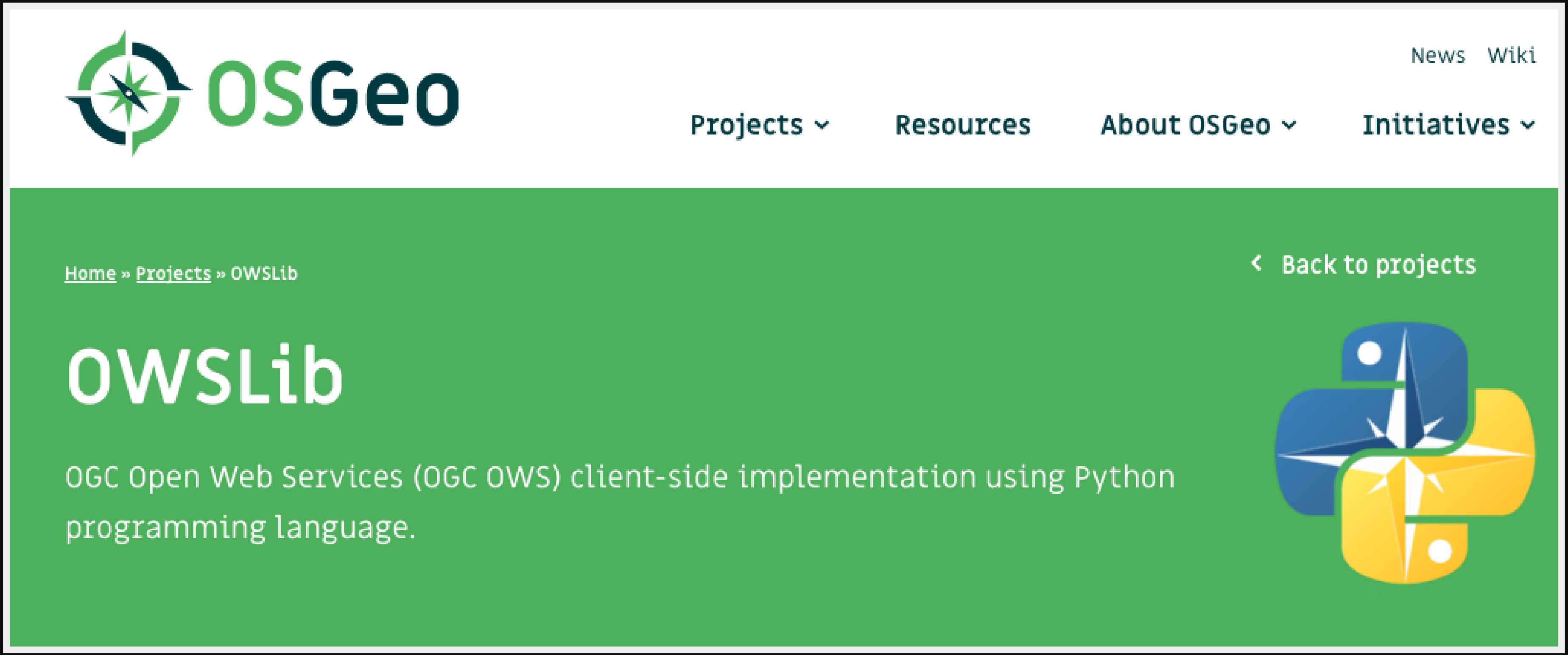
- Website: http://bird-house.github.io/
- Development: https://github.com/bird-house
- CP4CDS: https://cp4cds.github.io/
- Presentation: https://github.com/cehbrecht/wps-talk-copernicus-cordex-dmi-meeting-2019
- Poster: https://github.com/cehbrecht/copernicus-poster-egu-2018/blob/master/copernicus-poster-egu-2018.pdf

Thank You

- Pierre Logerais, IPSL
- Katharina Berger, DKRZ
- Carsten Ehbrecht, DKRZ

Extra slides

OWSLib - Client



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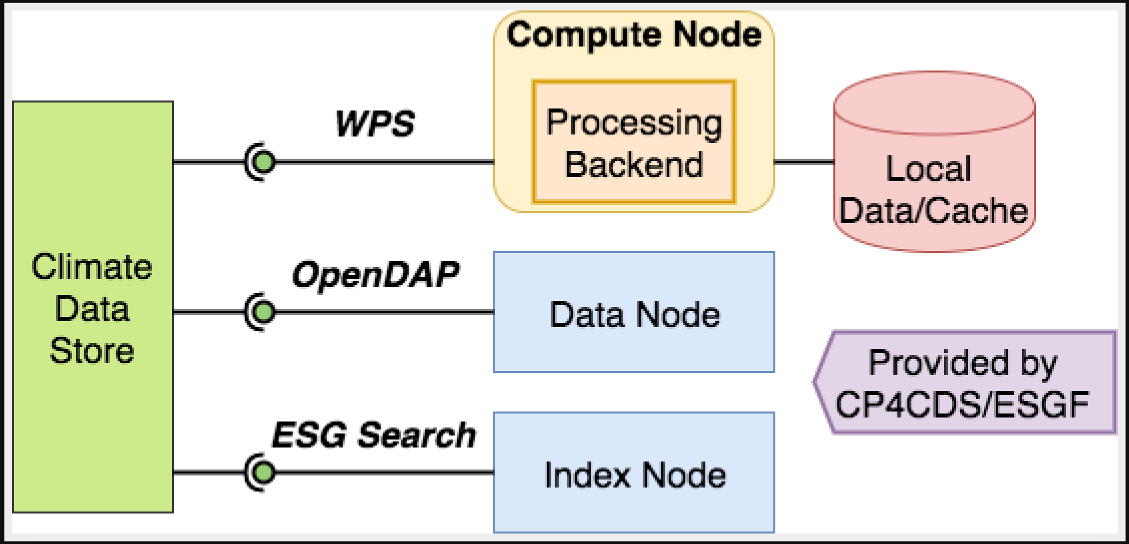
OWSLib

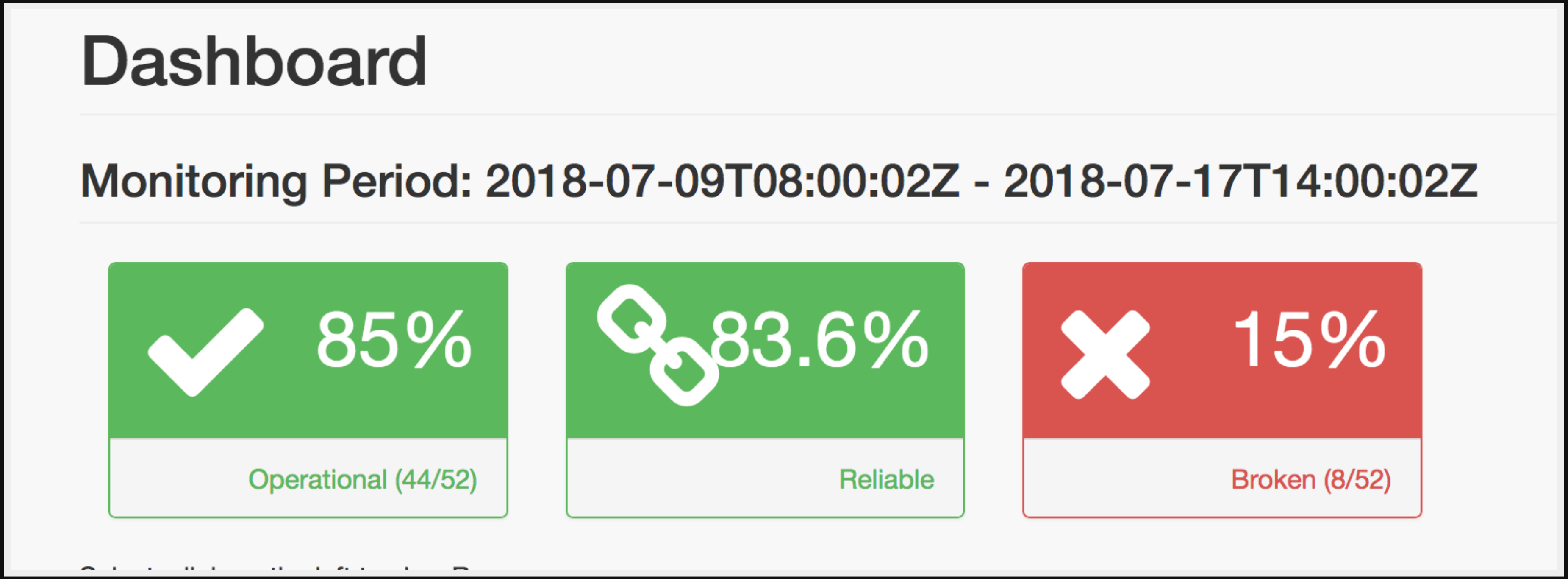
OGC Open Web Services (OGC OWS) client-side implementation using Python programming language.

- Python client-side implementation of WPS, WMS, WCS and more

CP4CDS Interfaces



Uptime 99%

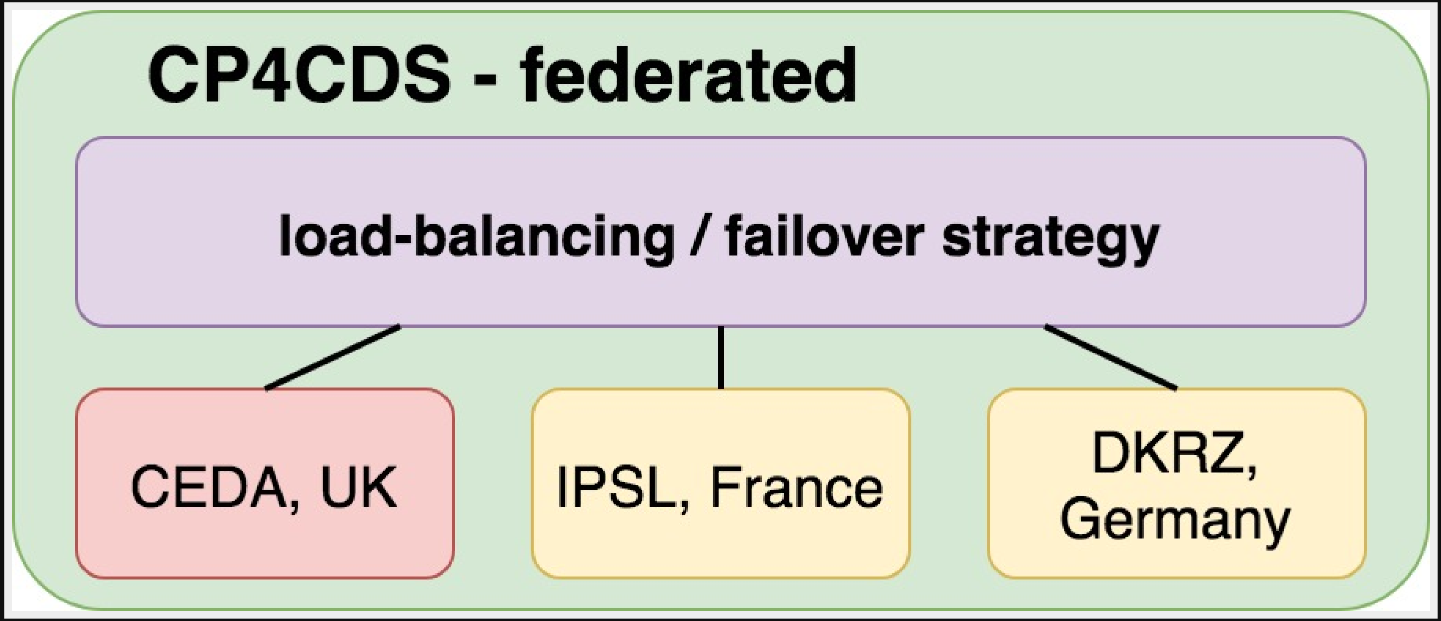


Dashboard

Monitoring Period: 2018-07-09T08:00:02Z - 2018-07-17T14:00:02Z

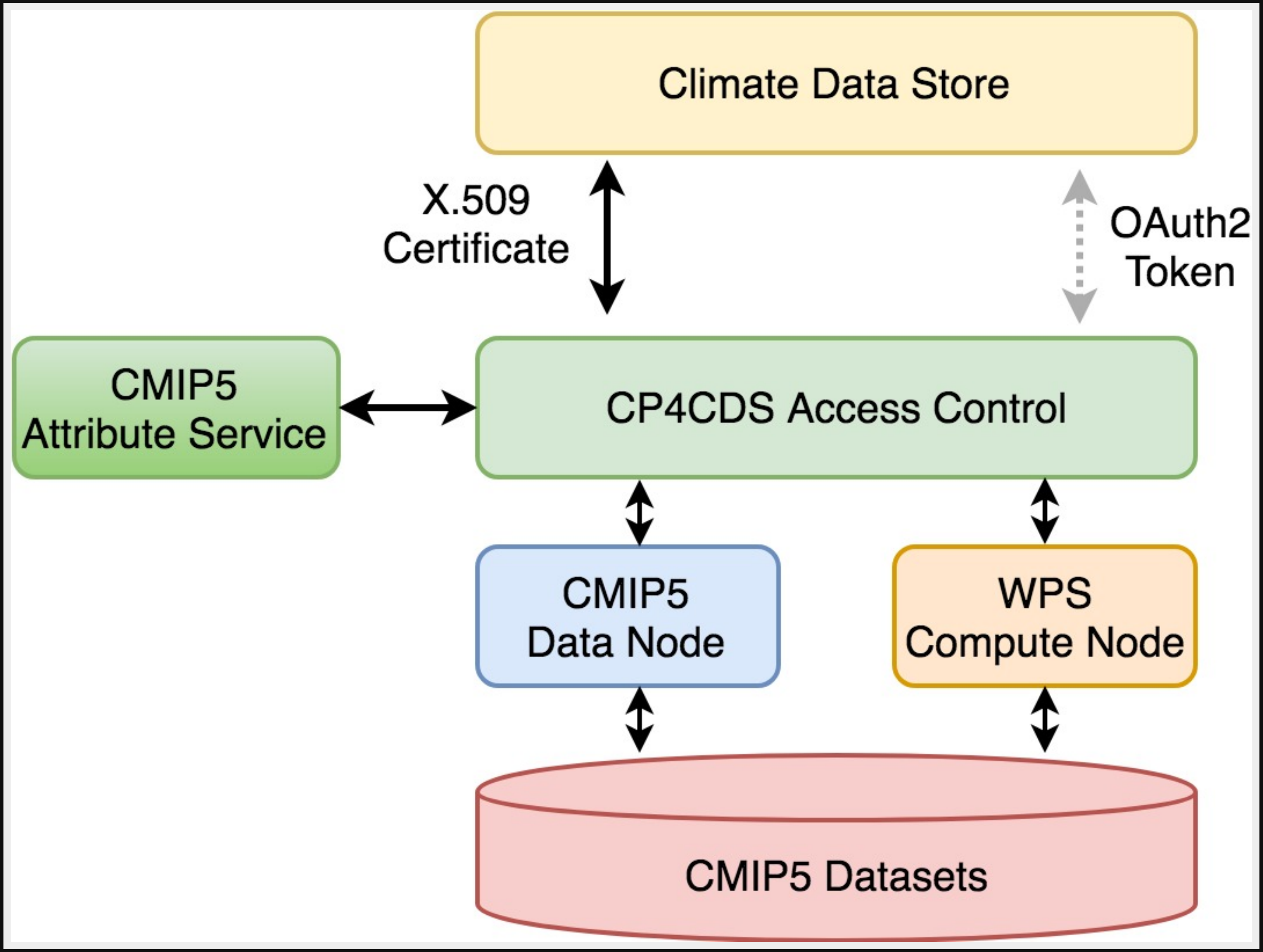
85%	83.6%	15%
Operational (44/52)	Reliable	Broken (8/52)

Can’t do it alone



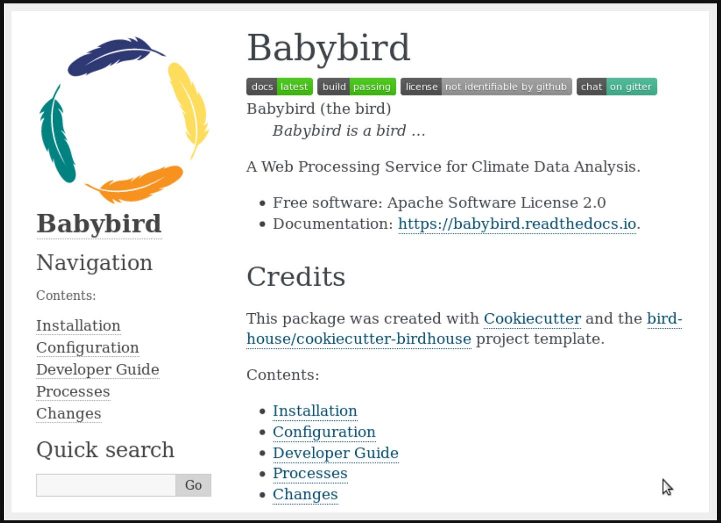
- Cloud based on Amazon Web Services
- Failover strategy for resilience

Security


Climate Data Store
X.509 Certificate
OAuth2 Token
CMIP5 Attribute Service
CP4CDS Access Control
CMIP5 Data Node
WPS Compute Node
CMIP5 Datasets

Documentation

Add your WPS documentation to ReadTheDocs



Babybird

Navigation

Contents:

- Installation
- Configuration
- Developer Guide
- Processes
- Changes

Quick search

Go

Babybird

docs latest | build passing | license not identifiable by github | chat on gitter

Babybird (the bird)

Babybird is a bird …

A Web Processing Service for Climate Data Analysis.

- Free software: Apache Software License 2.0
- Documentation: https://babybird.readthedocs.io.

Credits

This package was created with Cookiecutter and the bird-house/cookiecutter-birdhouse project template.

Contents:

- Installation
- Configuration
- Developer Guide
- Processes
- Changes

https://babybird.readthedocs.io/en/latest/index.html

Tests included

```
$ make test # quick
$ make test-all # slow, online
$ make lint # codestyle checks
```

Use the WPS with URL requests

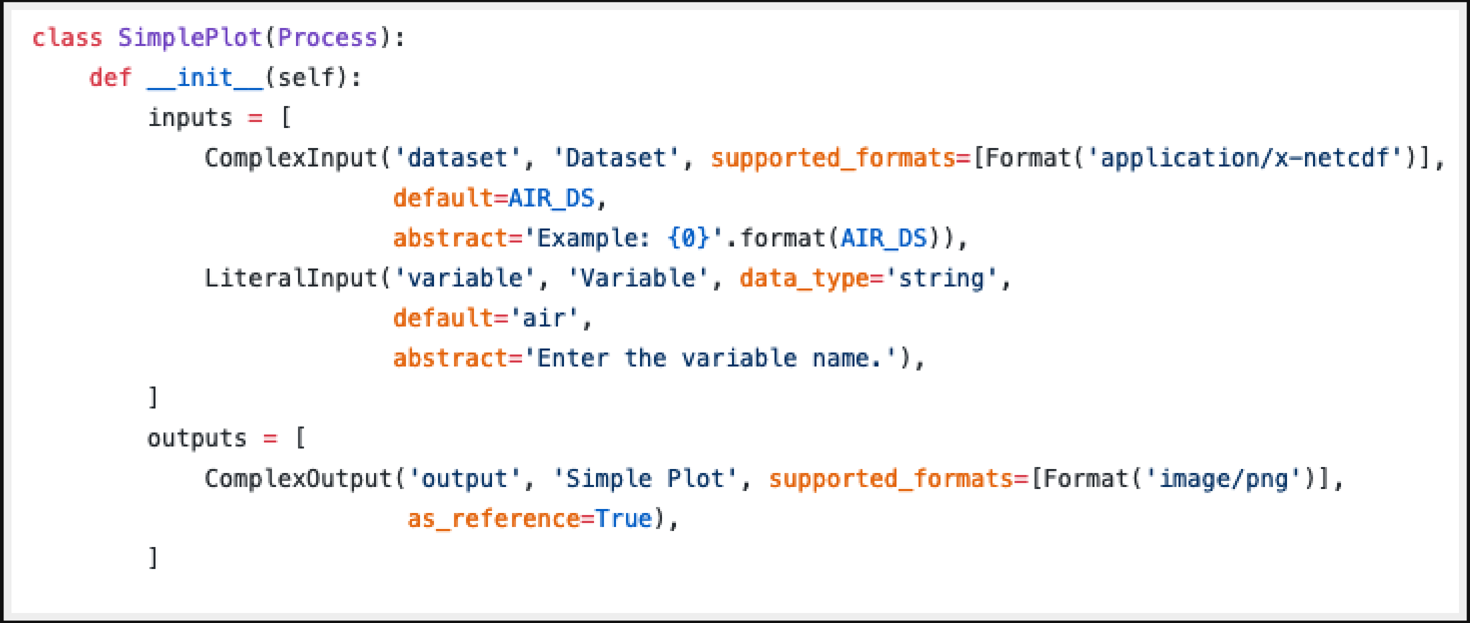
```
http://localhost:5000/wps?service=WPS&
  request=GetCapabilities

http://localhost:5000/wps?service=WPS&version=1.0.0&
  request=DescribeProcess&
  identifier=hello

http://localhost:5000/wps?service=WPS&version=1.0.0&
  request=Execute&
  identifier=hello&
  DataInputs=name=Stranger
```

Birdy command line tool

```
# Set URL to WPS
$ export WPS_SERVICE=http://localhost:5000/wps
# GetCapabilities
$ birdy -h
# DescribeProcess: hello
$ birdy hello -h
# Execute: hello
$ birdy hello --name Stranger
'Hello Stranger'
```

Using the Python OWSLib library for WPS

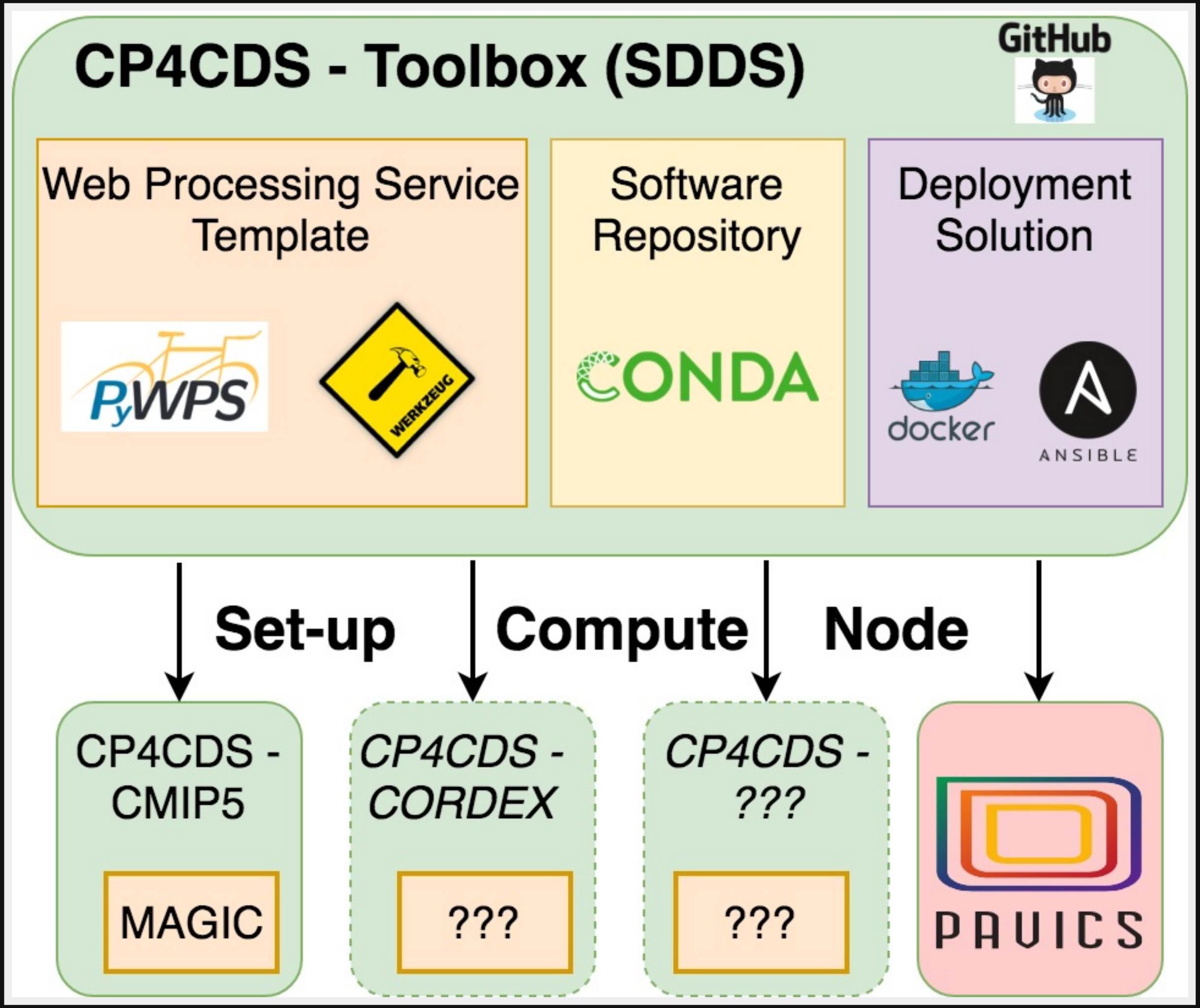
Modify your WPS



```
class SimplePlot(Process):
    def __init__(self):
        inputs = [
            ComplexInput('dataset', 'Dataset', supported_formats=[Format('application/x-netcdf')],
                         default=AIR_DS,
                         abstract='Example: {0}'.format(AIR_DS)),
            LiteralInput('variable', 'Variable', data_type='string',
                         default='air',
                         abstract='Enter the variable name.'),
        ]
        outputs = [
            ComplexOutput('output', 'Simple Plot', supported_formats=[Format('image/png')],
                          as_reference=True),
        ]
```

- Create a Python class
- Define the input and output parameters.
- Implement a *handler* method with the process code.

Sofware Deployment Solution



Deploy as docker container

Dockerfile was generated by the cookiecutter

```
# build
$ docker build -t bird-house/babybird .
# run
$ docker run -p 5000:5000 bird-house/babybird
# test it
http://localhost:5000/wps?request=GetCapabilities&service=WPS
```