

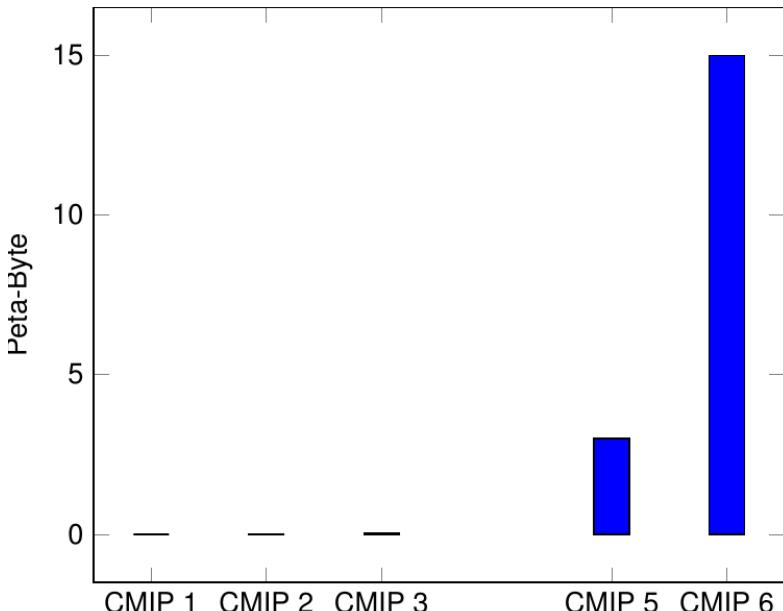
Projects based on the Web Processing Service framework birdhouse

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Growing Amount of Data (Example Climate Model data)



CMIP 1	1 GB	IPCC AR 1 1990
CMIP 2	500 GB	IPCC AR 2 1995
CMIP 3	35 TB	IPCC AR 3 2001
	Not existing	IPCC AR 4 2007
CMIP 5	3,5 PB	IPCC AR 5 2014
CMIP 6	10-20 PB (in ESGF)	IPCC AR 6 12-16 April 2021

CMIP = Coupled Model Inter-comparison Project

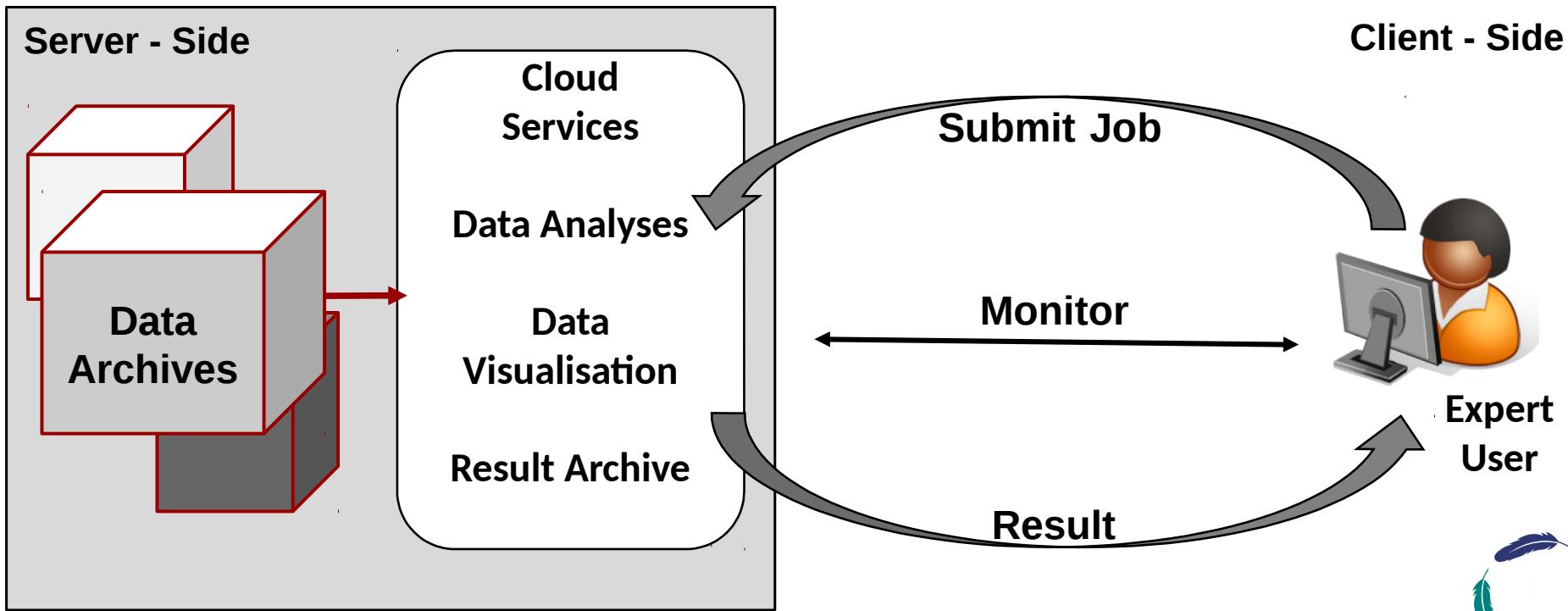
IPCC = Intergovernmental Panel of Climate Change

ESGF = Earth System Grid Federation



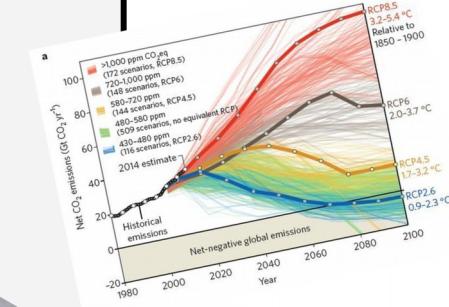
high performance environment

(low internet bandwidth)



Advantage of Server-Side Services

- Avoiding of double work
- Decrease difficulties for accessing raw / processed data
- Improved quality (continuous testing by the user community)
- Increased visibility of Developers/Researchers
- Sharing:
 - methods
 - compute resources
 - storage space
 - result data
- Standardized way of producing results (Monitoring)
- Enable multidisciplinary projects with synergies between groups
- low cost

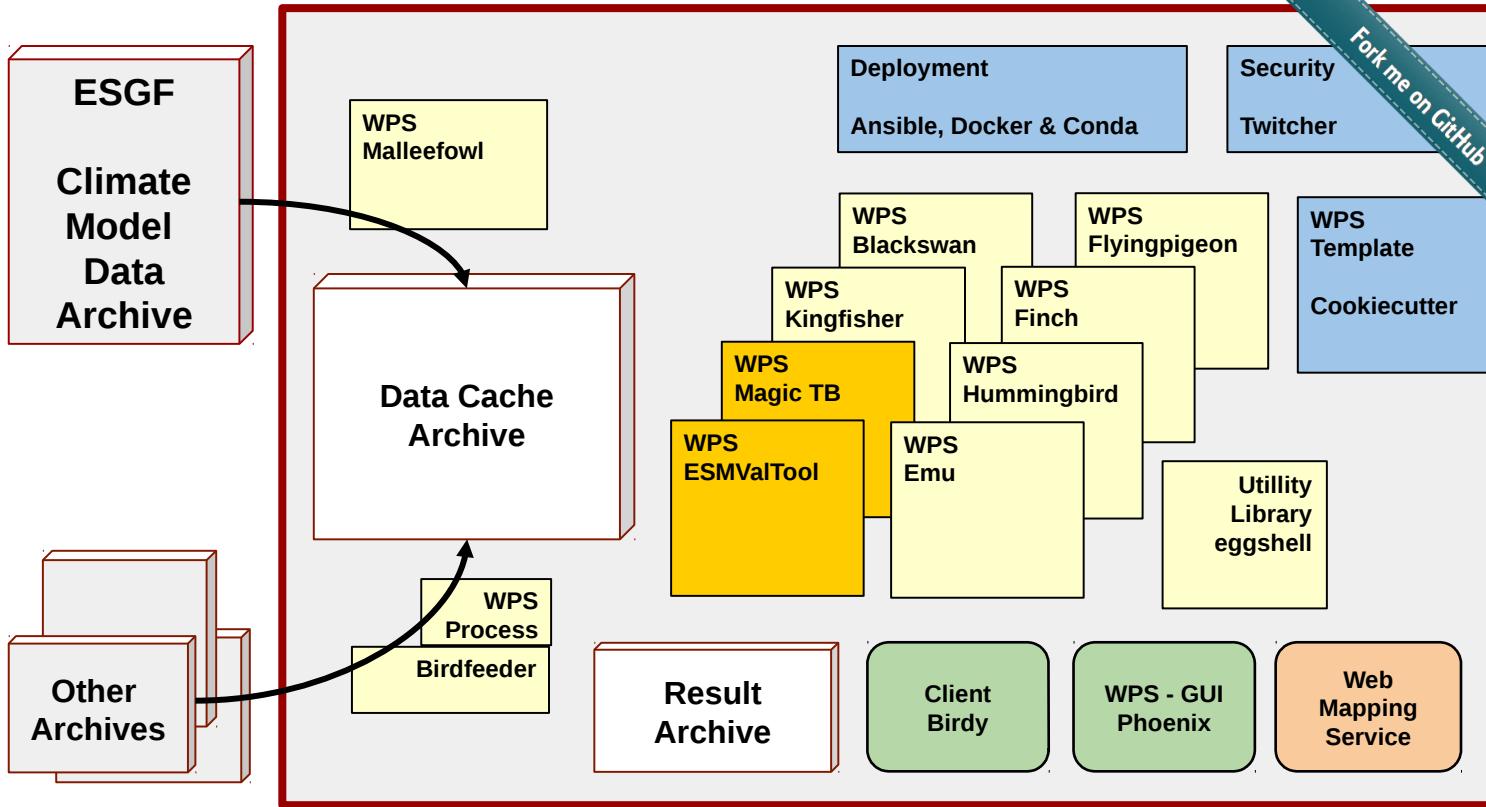


Birdhouse Ecosystem

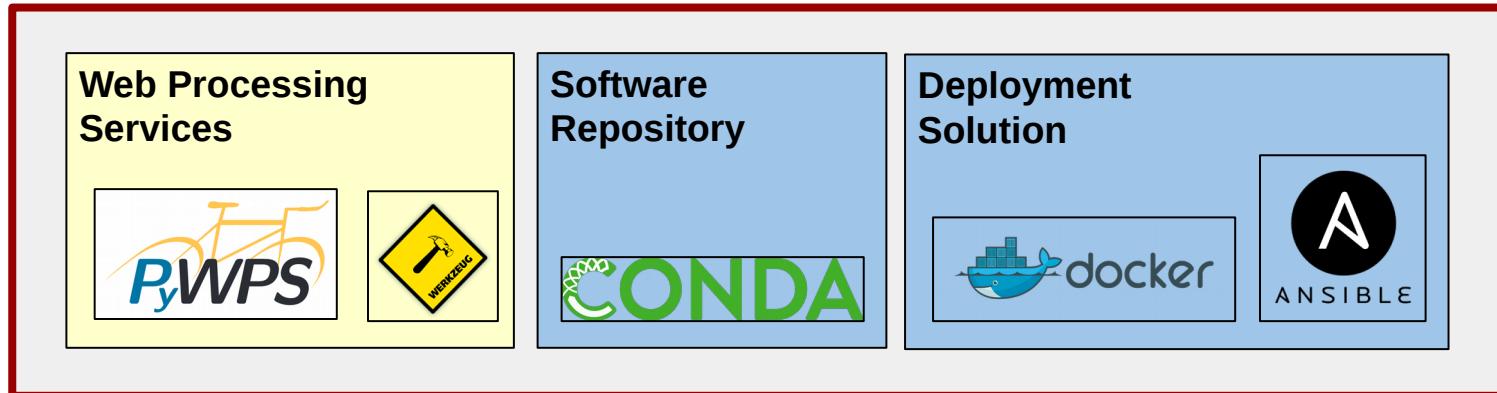


Fork me on GitHub

EMU	Test suite
Flyingpigeon	Sandbox
Malleefowl	ESGF search&fetch
Blackswan	Extreme Event assessment
Kingfisher	EO-Data
Hummingbird	Data Quality Control
Finch	Climate Impact
ESMValTool	EarthSystem Validation
Magic Toolbox	Climate indices



Server Side: Deployment



Setup WPS Project



Client Side: Many Views on WPS

```
usage: birdy [<options>] <command> [<args>]

Copernicus Demo: WPS processes for testing and demos.

optional arguments:
  -h, --help            show this help message and exit
  --debug              enable debug mode
  --version             show program's version number and exit
  --sync, -s             Execute process in sync mode. Default: async mode.
  --token TOKEN, -t TOKEN
                        Token to access the WPS service.

command:
```

PHOENIX Processes Help ▾

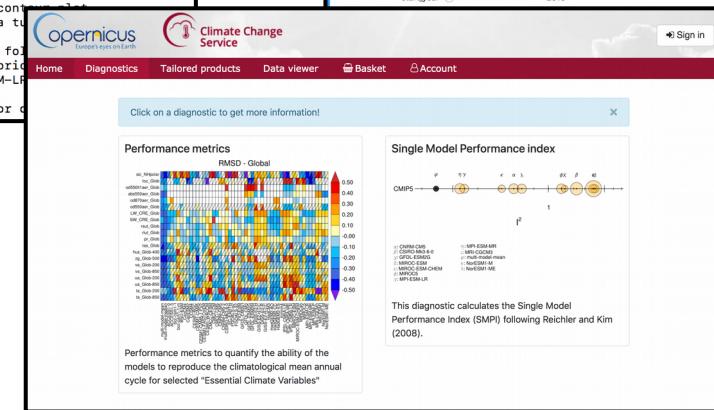
Copernicus Demo

Please choose one of the processes to submit a job.

WPS processes for testing and demos.

Birdhouse/Copernicus Demo

- Simple plot 1.1.0**
Generates a plot for temperature using ESMValTool. It is a diagnostic used in the ESMValTool tutorial doc/toy-diagnostic-tutorial_cmip5.html#simple-plot. Following CMIP5 data: project=CMIP5, experiment=historical, ensemble=r1i1p1, variable=ta, model=MPI-ESM-LR, time_frequency=mon.
- Surface contour plot 1.1.0**
Generates a surface contour plot for precipitation using ESMValTool. It is a tutorial diagnostic used in the ESMValTool tutorial doc/toy-diagnostic-tutorial_cmip5.html#surface-contour-plot. Following CMIP5 data: project=CMIP5, experiment=historical, ensemble=r1i1p1, variable=pr, model=MPI-ESM-LR, time_frequency=mon.
- Cloud Taylor Diagram 1.1.0**
Creates a cloud Taylor diagram using ESMValTool. Expected execution time: 30 seconds. The default run uses the following: experiment=historical, ensemble=r1i1p1, variable=tas, model=MPI-ESM-LR, time_frequency=mon. In addition the calculation Tier3/ERA-Interim.



The figure shows a screenshot of a RESTClient interface. At the top, there are tabs for File, Authentication, Headers, View, and a dropdown for Favorite Requests and Setting. The main area shows a "Request" section with Method set to POST, URL set to http://localhost:5000/wps, and a "SEND" button. The "Body" section contains XML code for a WPS execute request:

```
<wps:Execute service="WPS" version="1.0" xmlns:wps="http://www.opengis.net/wps/1.0.0" xmlns:xlink="http://www.w3.org/1999/xlink" xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" xsi:schemaLocation="http://www.opengis.net/wps/1.0.0/wpsExecute_request.xsd">
  <wps:Identifier>simple_plot</wps:Identifier>
  <wps:DataInputs>
    <wps:Input>
```

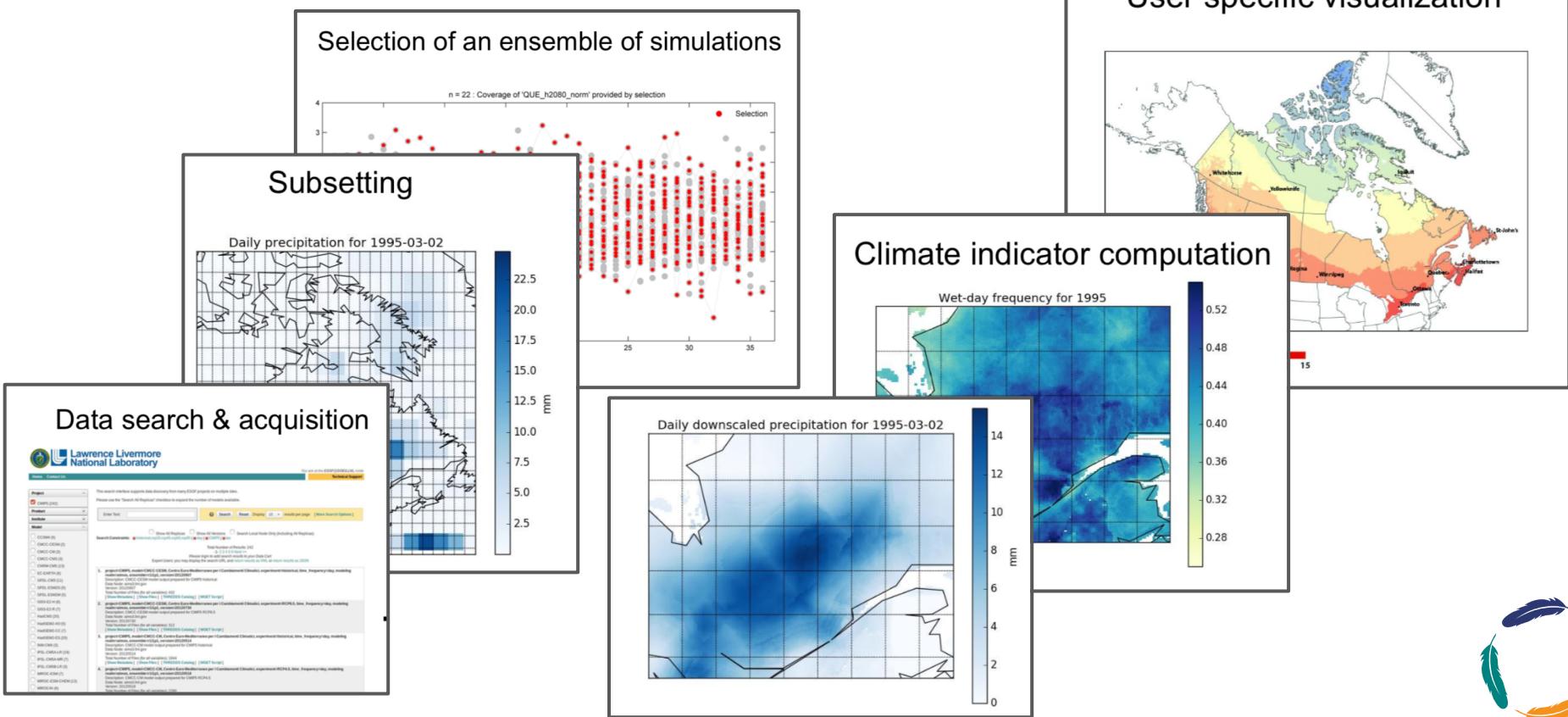
Below the request, there is a "Help" section for "wpsdemo.ipynb" containing Jupyter notebook code:

```
In [15]: def f(model, start_year, end_year):
    return Image(climf.tsplot(model=model, start_year=start_year, end_year=end_year), width=500, height=500)

In [16]: interact_manual(f,
    model=['HadGEM2-ES', 'MPI-ESM-LR'],
    start_year=(2010, 2100, 10),
    end_year=(2010, 2100, 10))
```

The "model" dropdown is set to "MPI-ESM-LR" and the "start_year" slider is set to 2010.

Example of Processes & Workflows



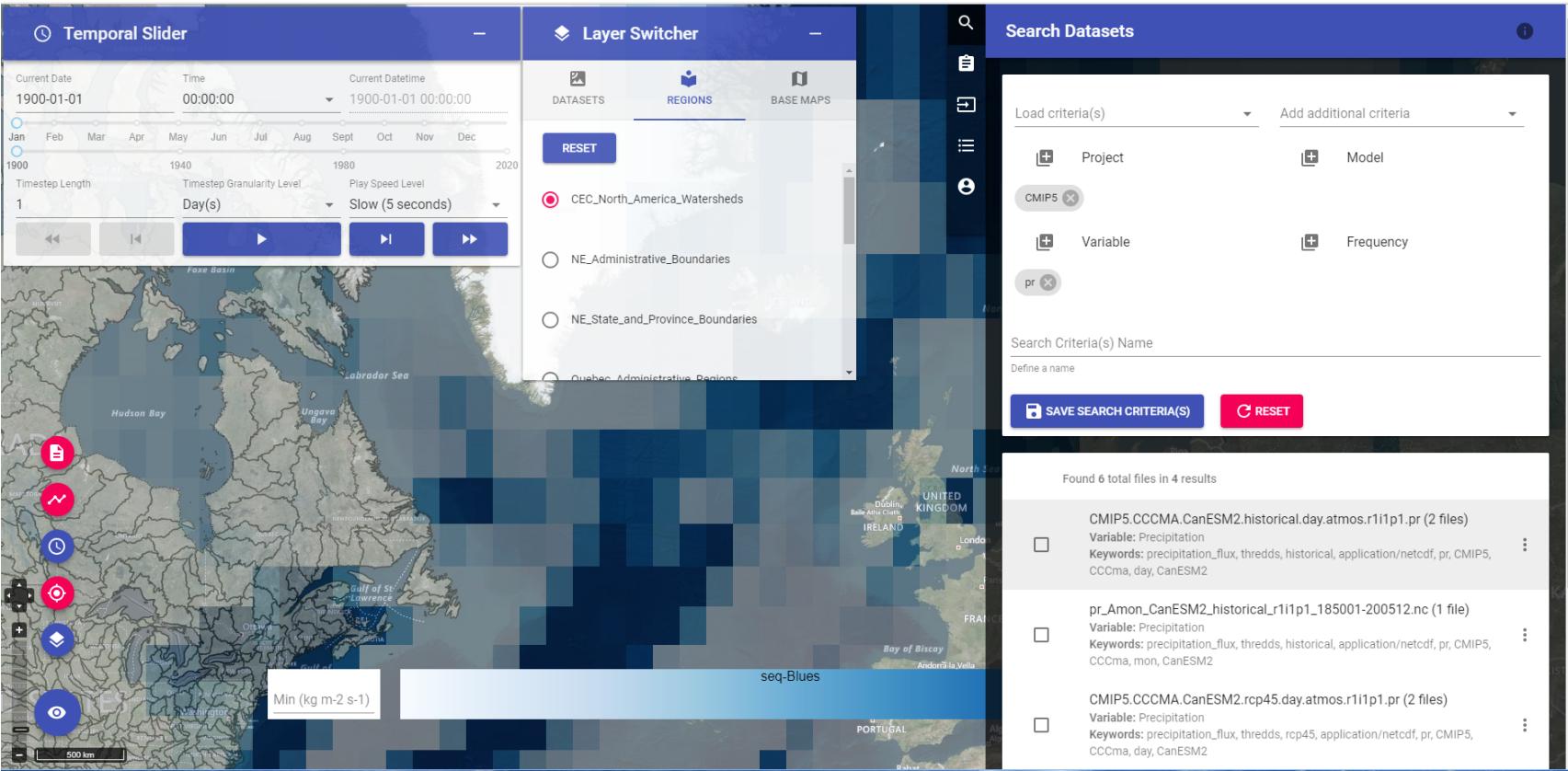
Project: PAVICS



ICRIM

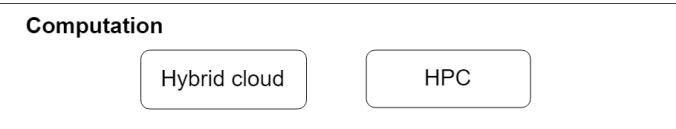
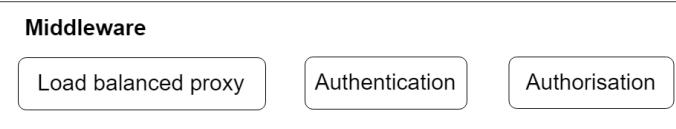
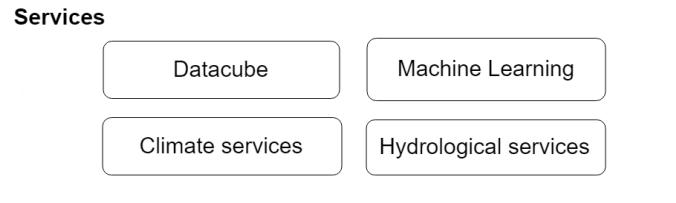
OURANOS

canarie



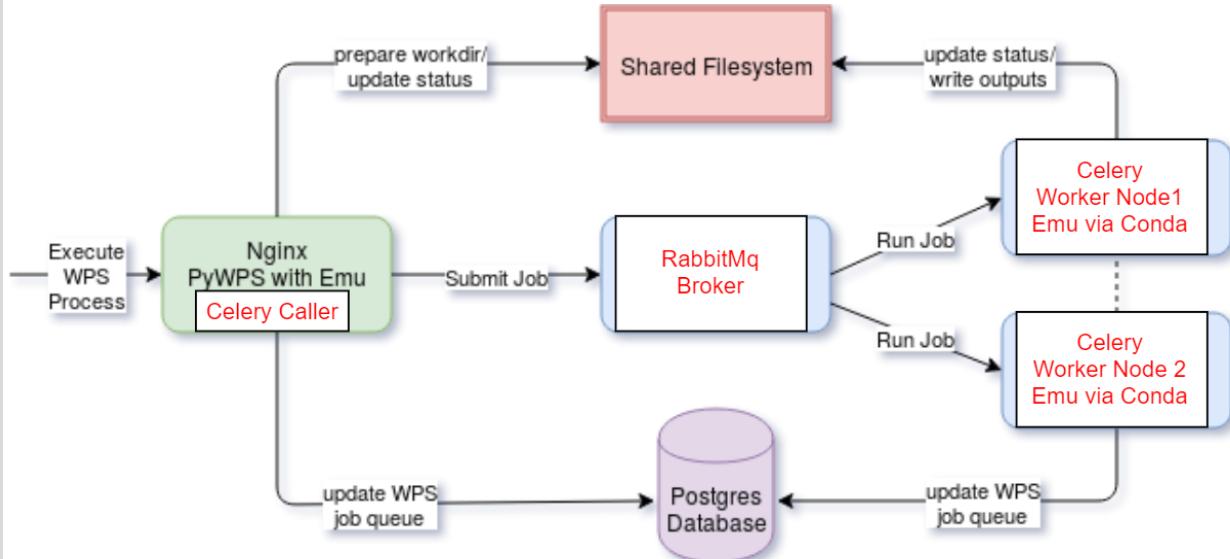
Project: PAVICS NexGen

- Canadian-led Science Gateway
- Will provide a federated cyberinfrastructure
- Advanced hydro & climate services, Machine Learning and Earth Observation tools
- Geospatial Interoperability through OGC Web Services

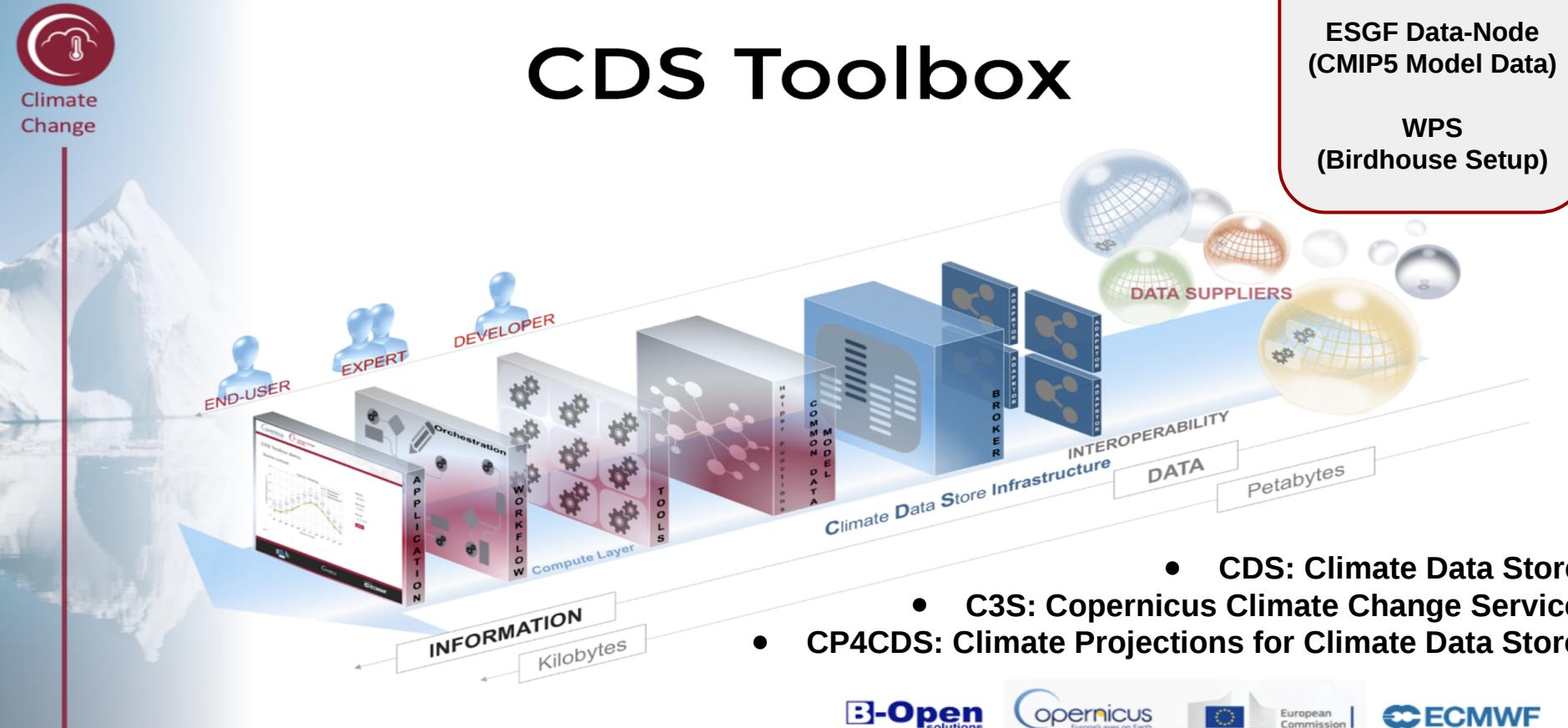


Project: OGC Testbeds

- **OGC Testbeds:**
 - Collaborative efforts to define, design, develop, and test candidate interface specifications.
- **Testbed-13:**
 - Builds on Birdhouse and PyWPS HPC scheduler
 - Implements cloud computing & application packaging (Docker)
- **Testbed-14:**
 - Extends Birdhouse security and job processing (OpenAPI)
 - Implements interoperable workflows (CWL, OWS Context)



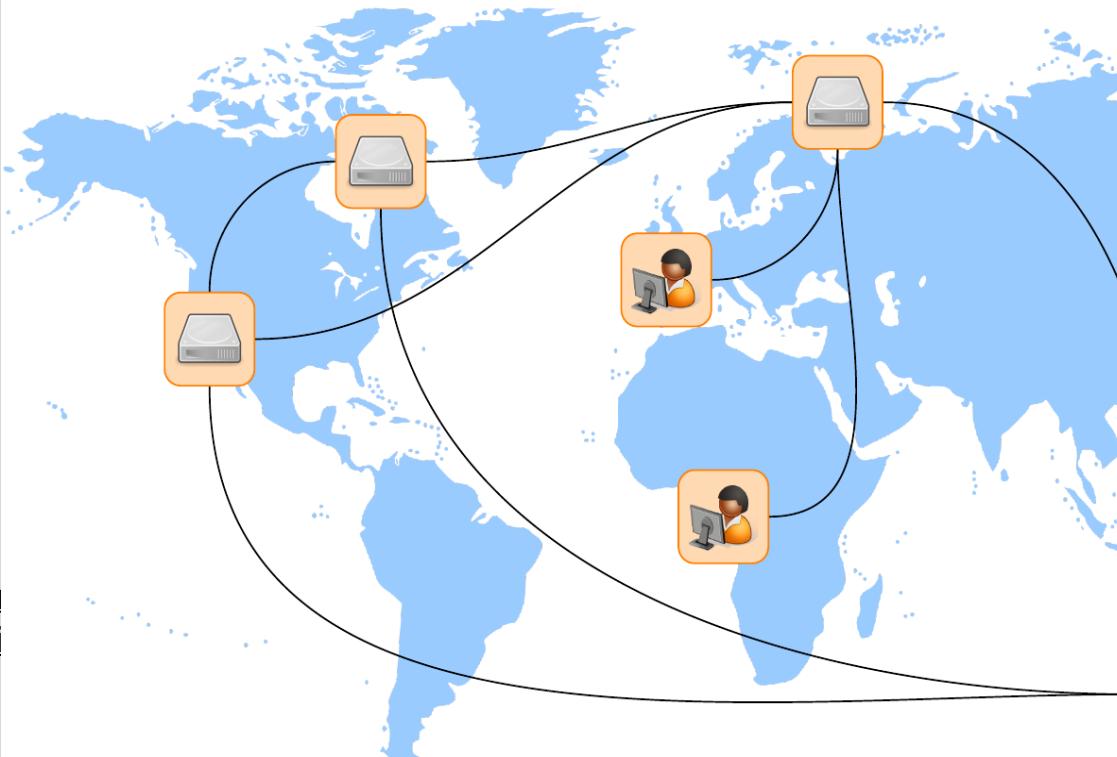
CDS Toolbox



Harnessing WPS for Sustainable Development

- Indicators for the Sustainable development Goals (SDGs)
- Monitoring and Reporting required from UNFCCC, UNCCD and CBD
- non binding Sendai Framework for Disaster Risk Reduction - UNISDR
- etc ...

Leave no one behind



Outlook

- **EU COPERNICUS**
 - C3S with CP4CDS ready for production use in 2019.
(based on CMIP5 data)
 - extended for CORDEX (regional model data) in 2019/2020
 - extended for CMIP6 ... ?
- **Canada**
 - Govt of Canada: Canadian Center for Climate Services (CCCS)
 - Pan-Canadian federated cyberinfrastructure
 - Earth Observation support, integration of ML/DL
- WPS on **ESGF Nodes**
- **A2C2** Service for Extreme Weather Assessment
- etc.



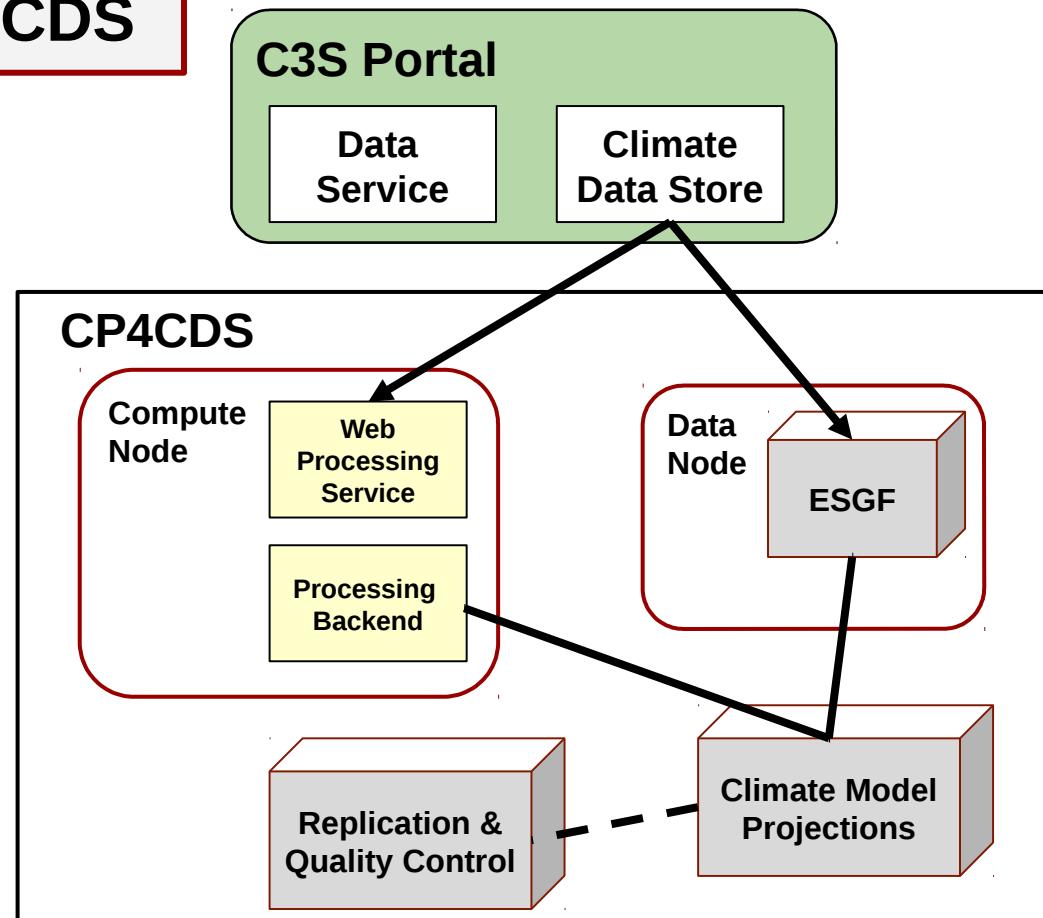
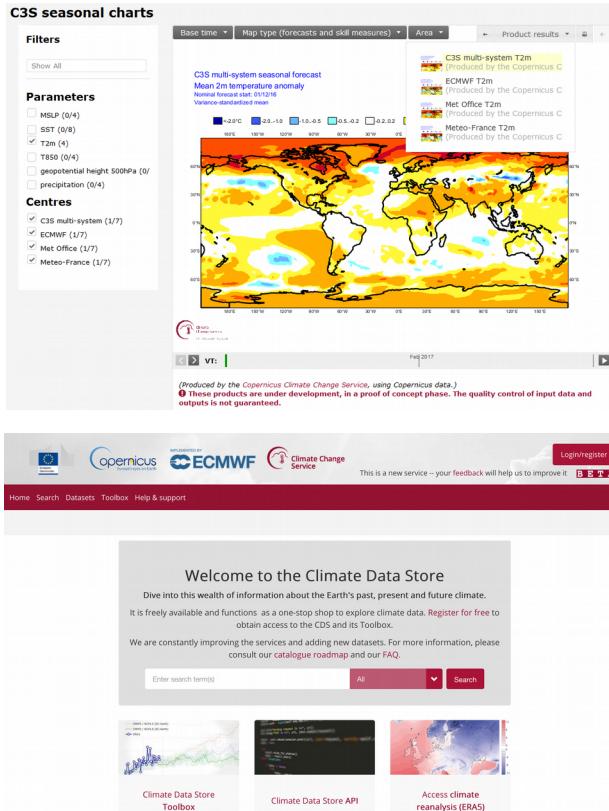
<http://bird-house.github.io/>



Deleted slides

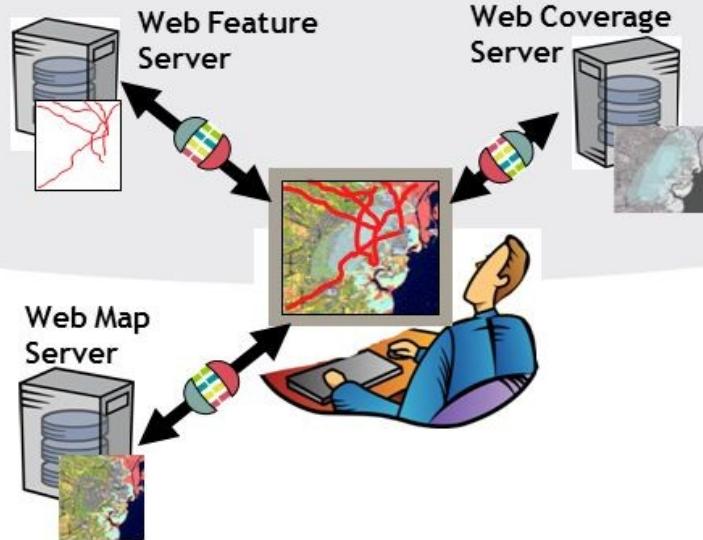


Projects: C3S and CP4CDS



Open Geospatial Consortium

The geospatial web is enabled by OGC standards:



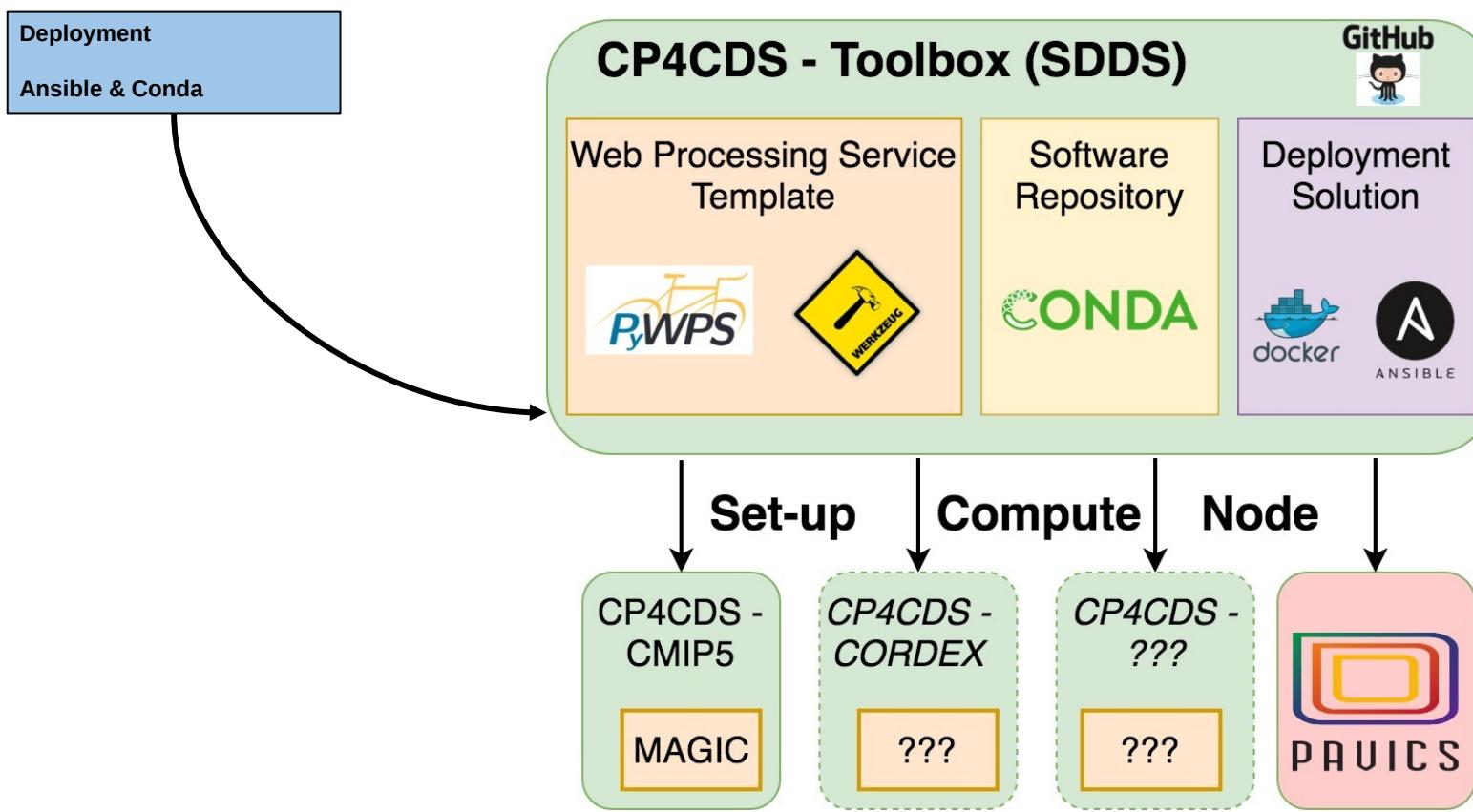
- Web Map Service (WMS)
- Web Map Tile Service (WMPS)
- Web Feature Service (WFS)
- Web Coverage Service (WCS)
- Catalogue (CSW)
- Geography Markup Language (GML)
- KML
- Others...

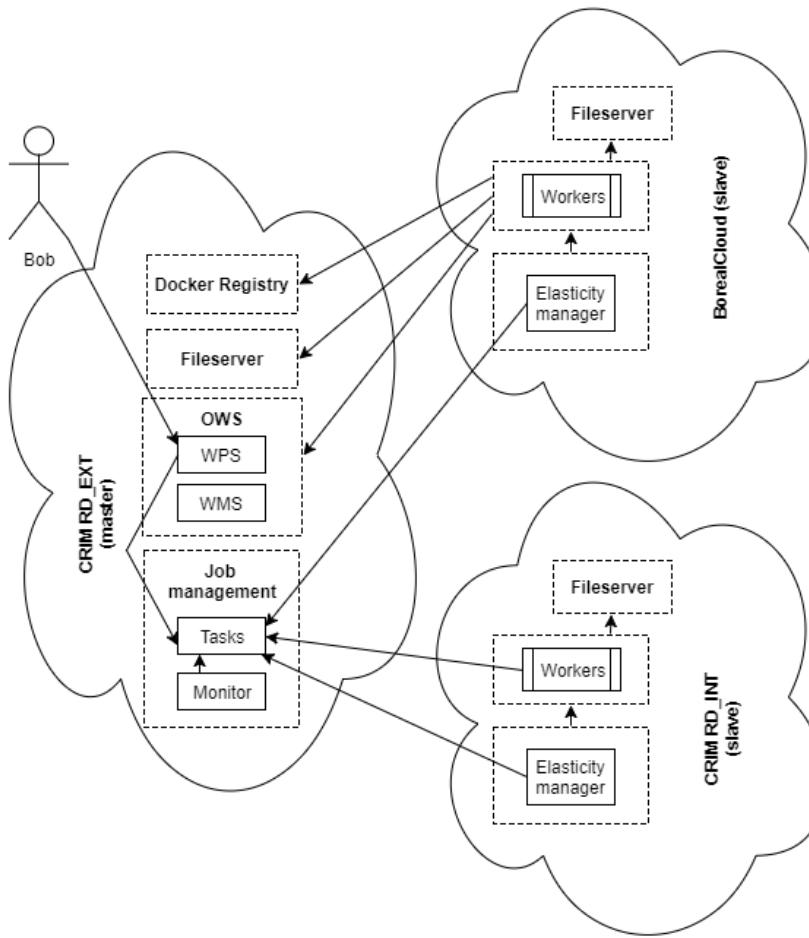
Relevant to geospatial applications: Critical Infrastructure, Emergency Management, Weather, Climate, Homeland Security, Defense & Intelligence, Oceans Science, etc

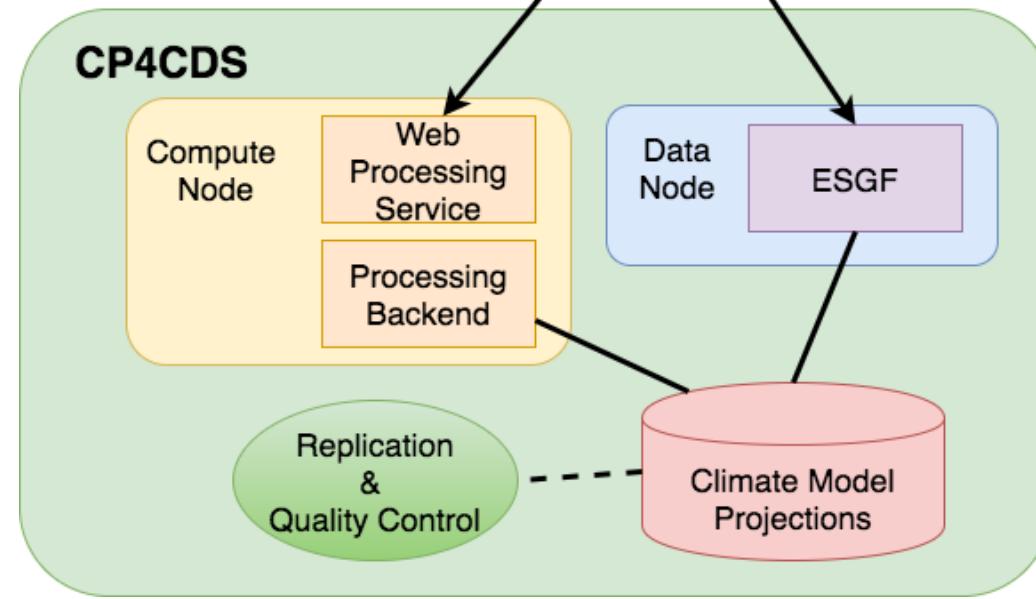
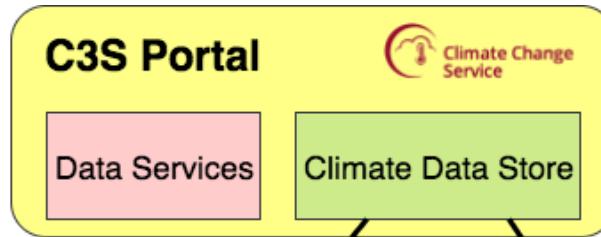
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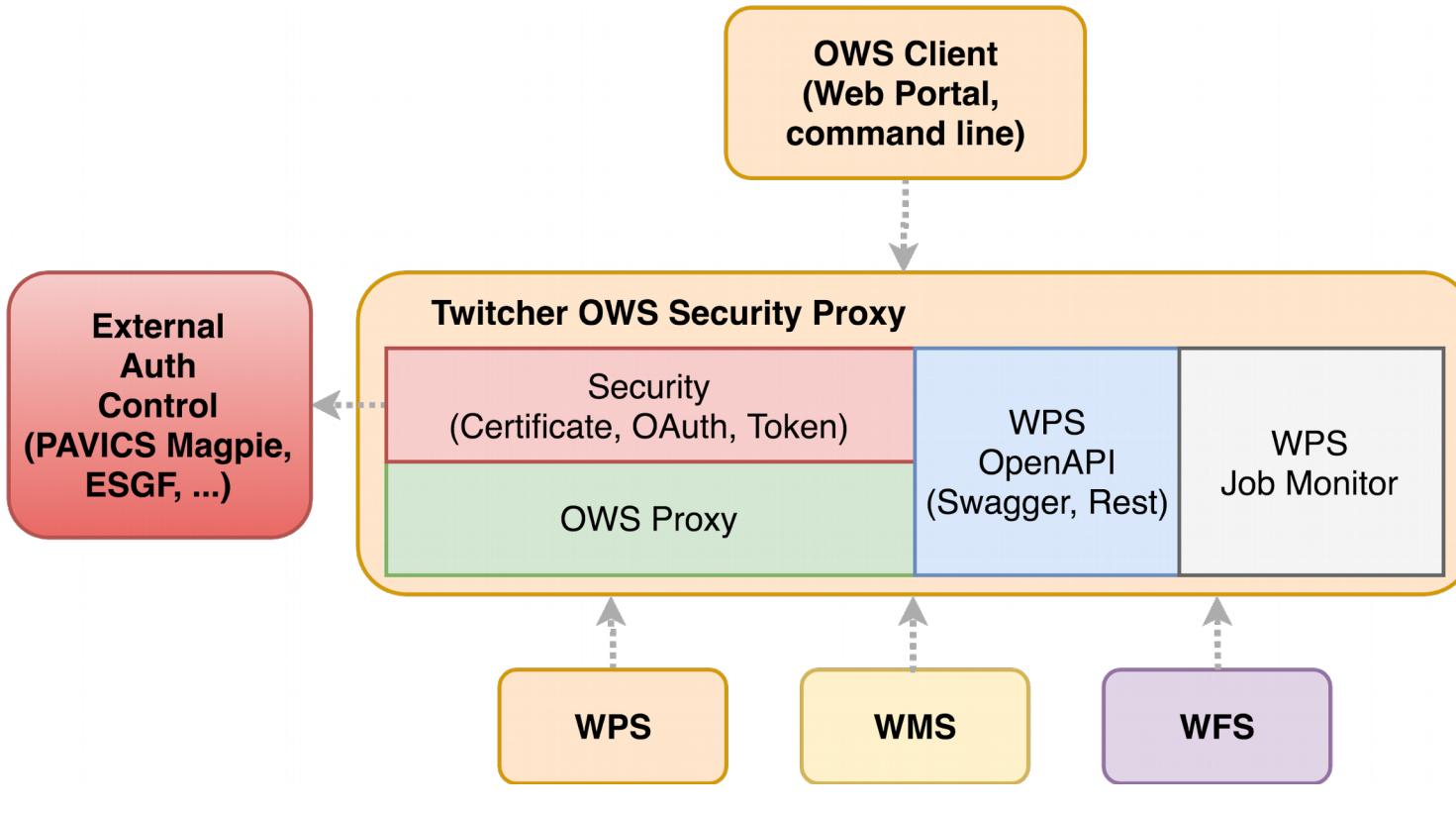
Server Side: Deployment



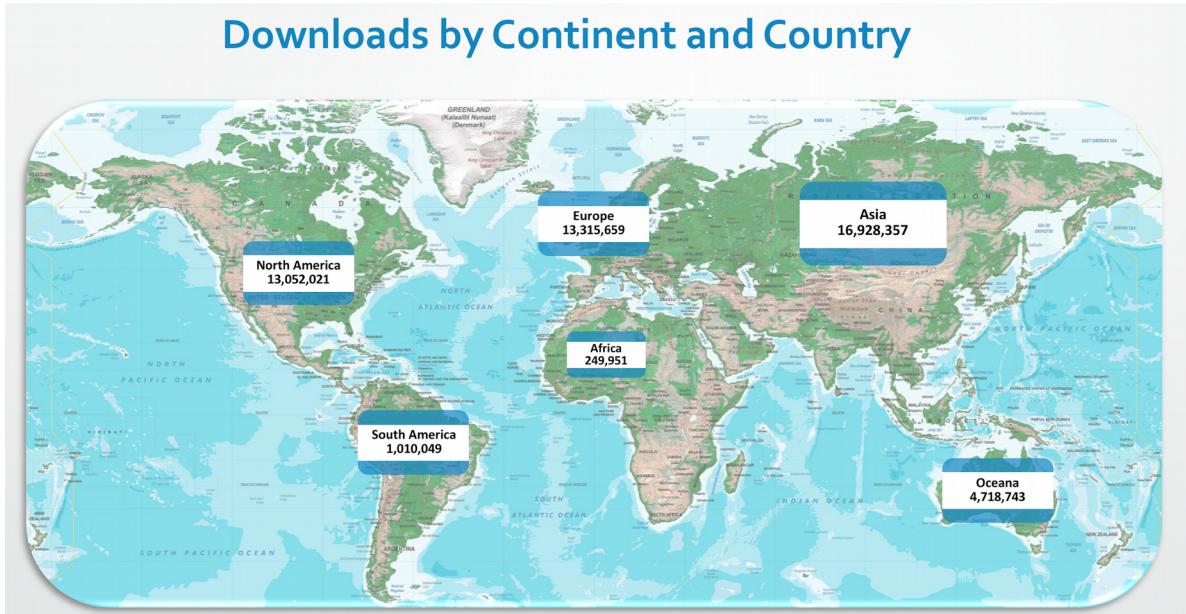
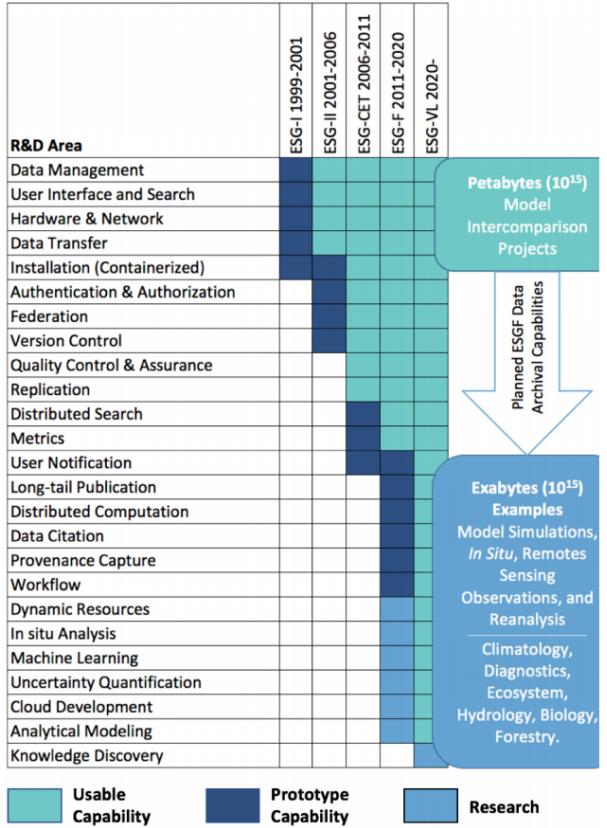




Security: Twitcher OWS Proxy



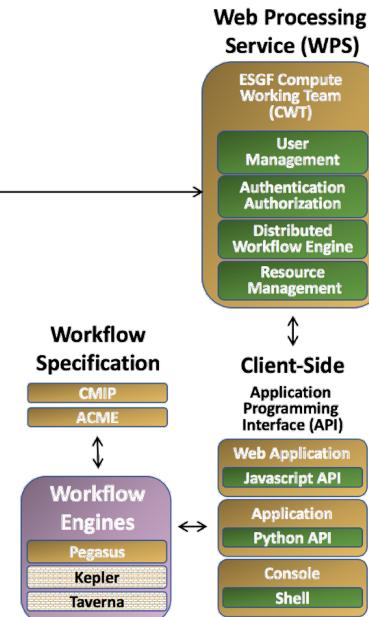
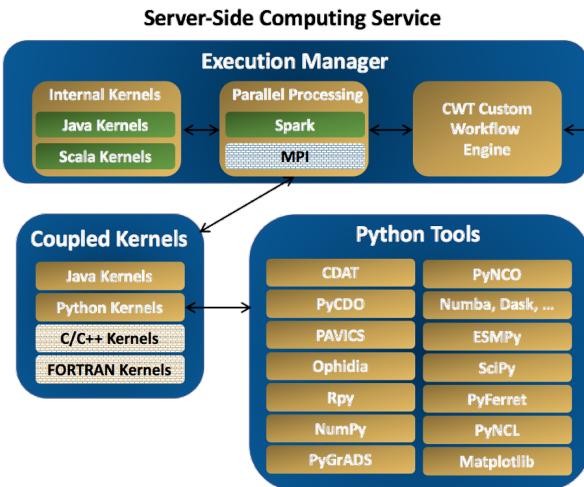
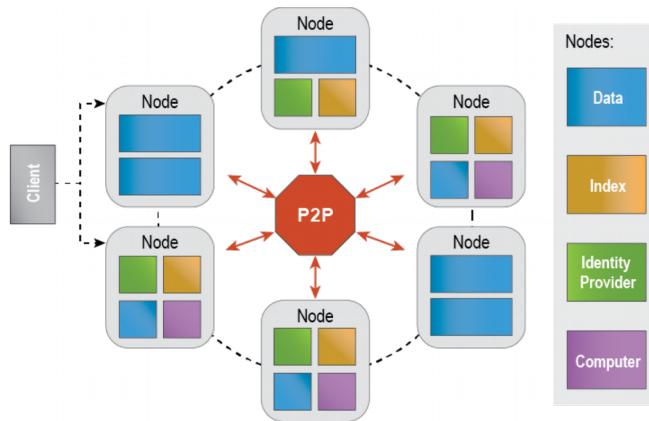
Earth System Grid Federation (ESGF)



<https://esgf.llnl.gov>



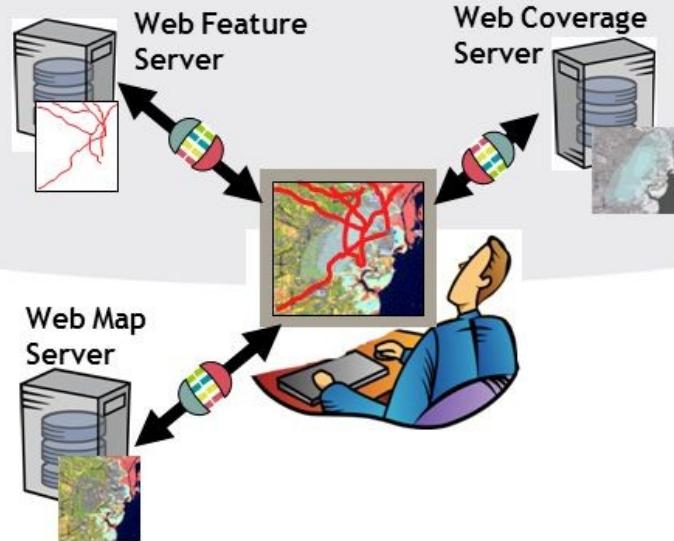
Project: Connectivity to ESGF



<https://esgf.llnl.gov>

Open Geospatial Consortium

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Web Map Service (WMS)
Web Map Tile Service (WMTS)
Web Feature Service (WFS)
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Geography Markup Language (GML)
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Others...

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