# Open Data Cubes and related technology
## upcoming data revolution for sustainable development

Nils Hempelmann[1,2] et. al[2]

[1] GIZ - Regional Project Central Africa, COMIFAC
[2] FOSS4G Community (OpenDataCubes, birdhouse, PAVICS, etc...)

21. Juni 2018

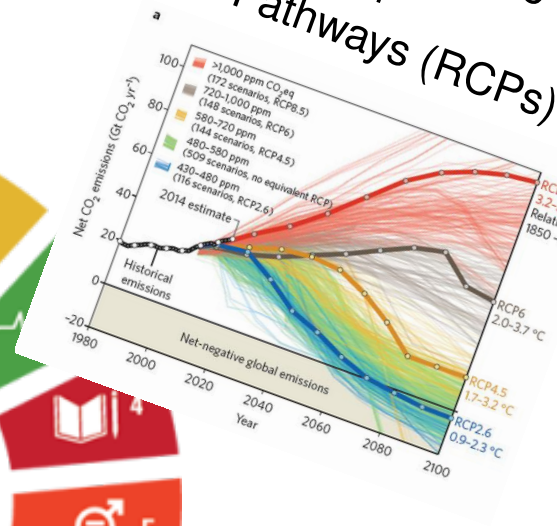
# Content



# Need of action

nasa.gov/effects

Representative Carbon Pathways (RCPs)



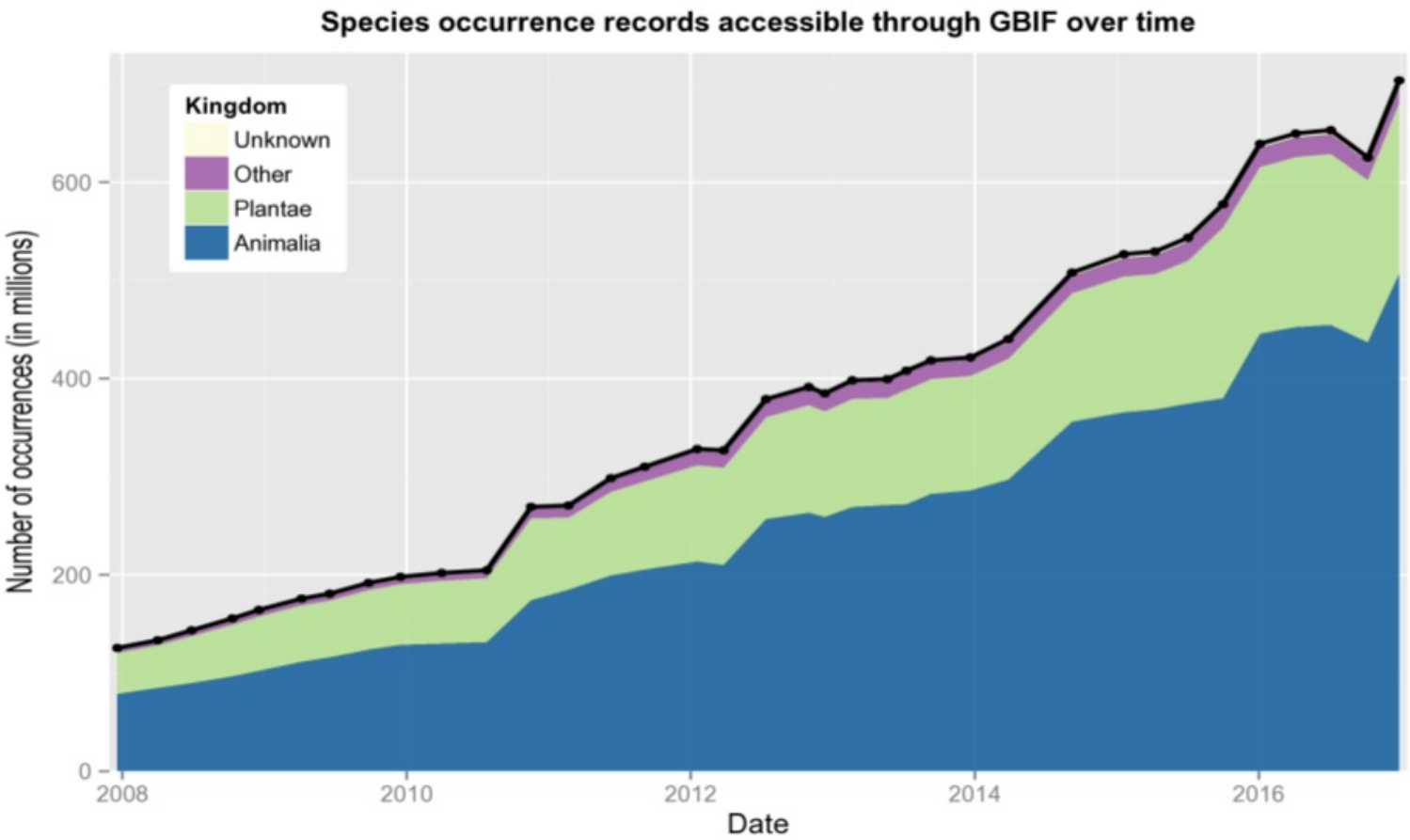

Cameroon Flood at 27.02.2018


Sustainable Development Goals (SDGs)

# Growing amount of available data

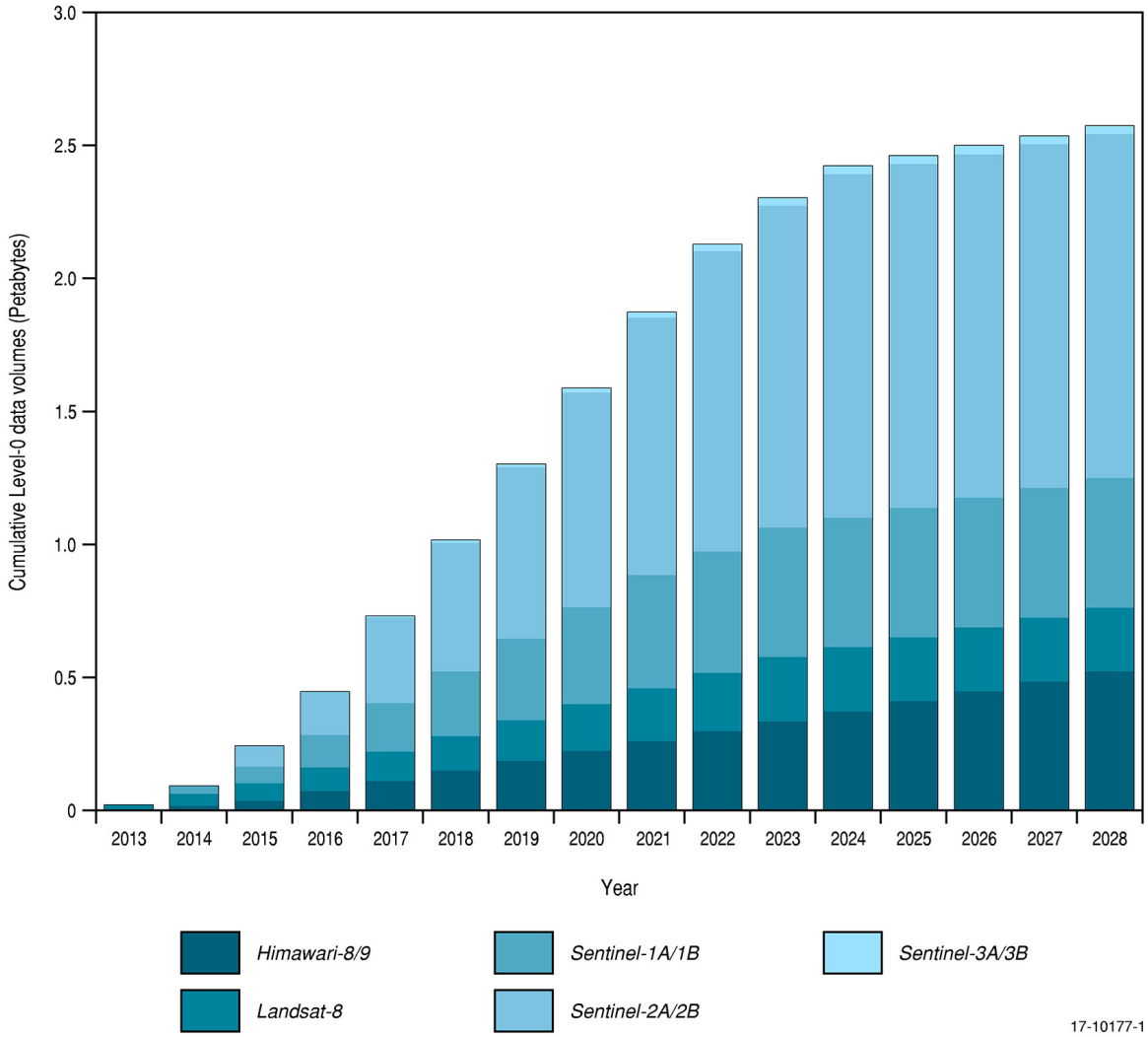
data availability

## DATA PUBLISHED THROUGH GBIF.ORG



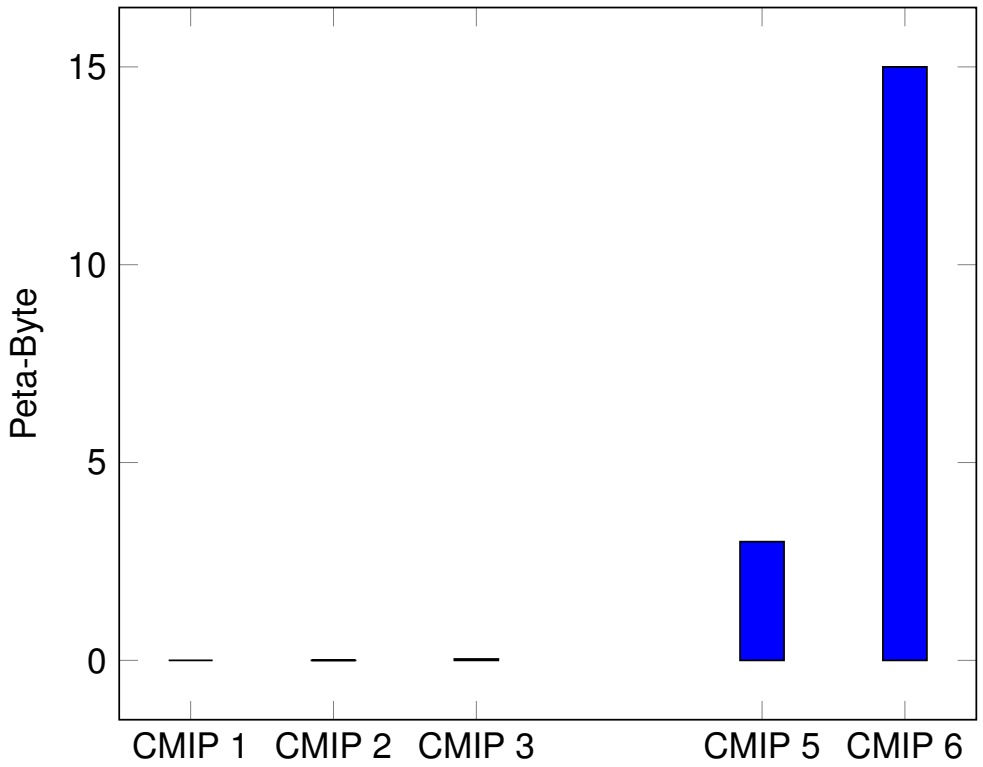

www.gbif.org/analytics/global

# Predicted EO-data availability for Australia




Australian Geoscience Data Cube

# Global Climate Model Data Availability




**CMIP 1 :** 1 GB
**CMIP 2 :** 500 GB
**CMIP 3 :** 35 TB
**CMIP 4 :** Not existing
**CMIP 5 :** 3.5 PB (multi-model archive)
**CMIP 6 :** currently 10-20 PB as "ESGF" Data (real existing 10time more)

**********

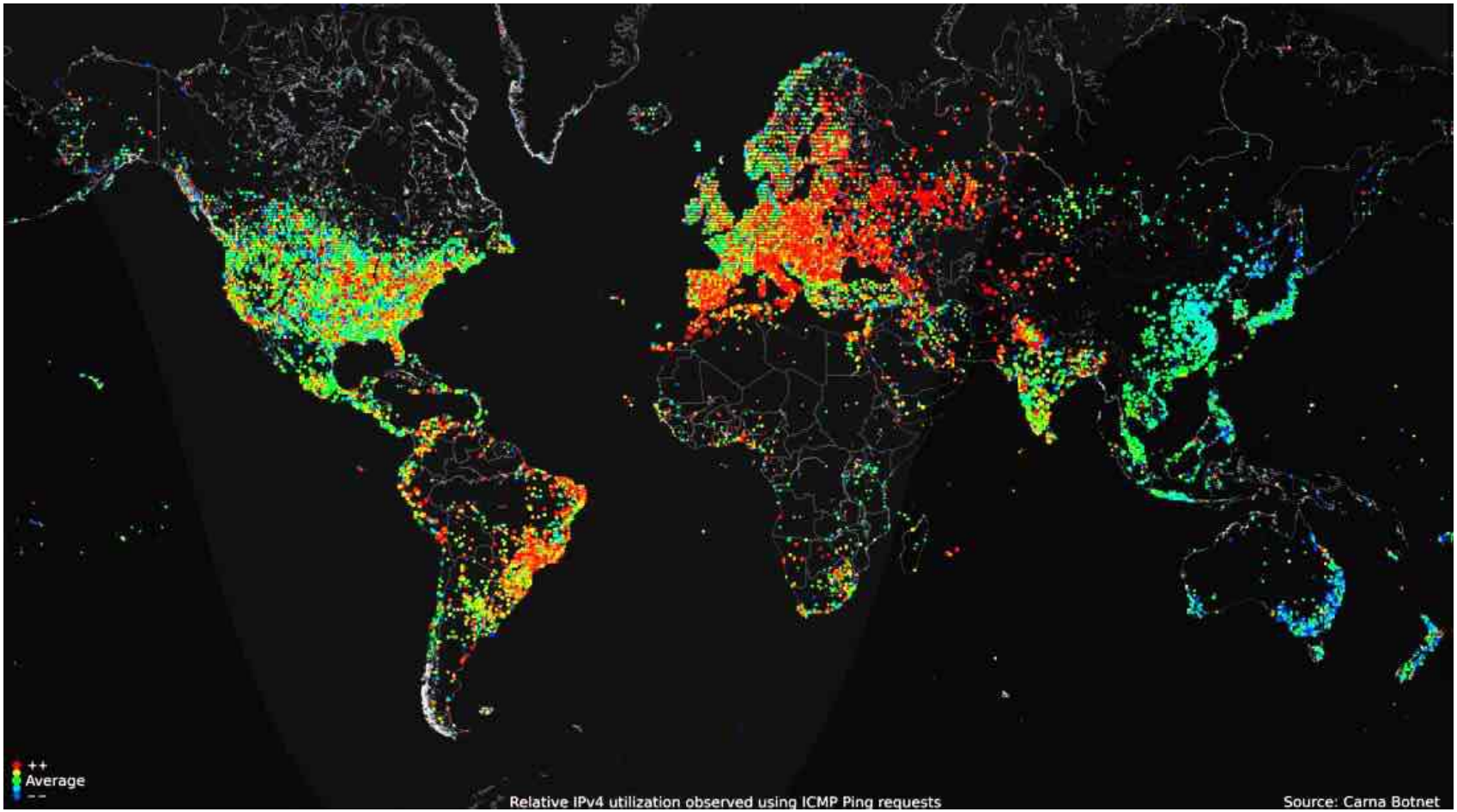
IPCC 1 : 1990
IPCC 2 : 1995
IPCC 3 : 2001
IPCC 4 : 2007
IPCC 5 : 2014
IPCC 6 : –> $\sim$ 2019

**********

Global Land Outlook : 2017 (Report UNCCD)

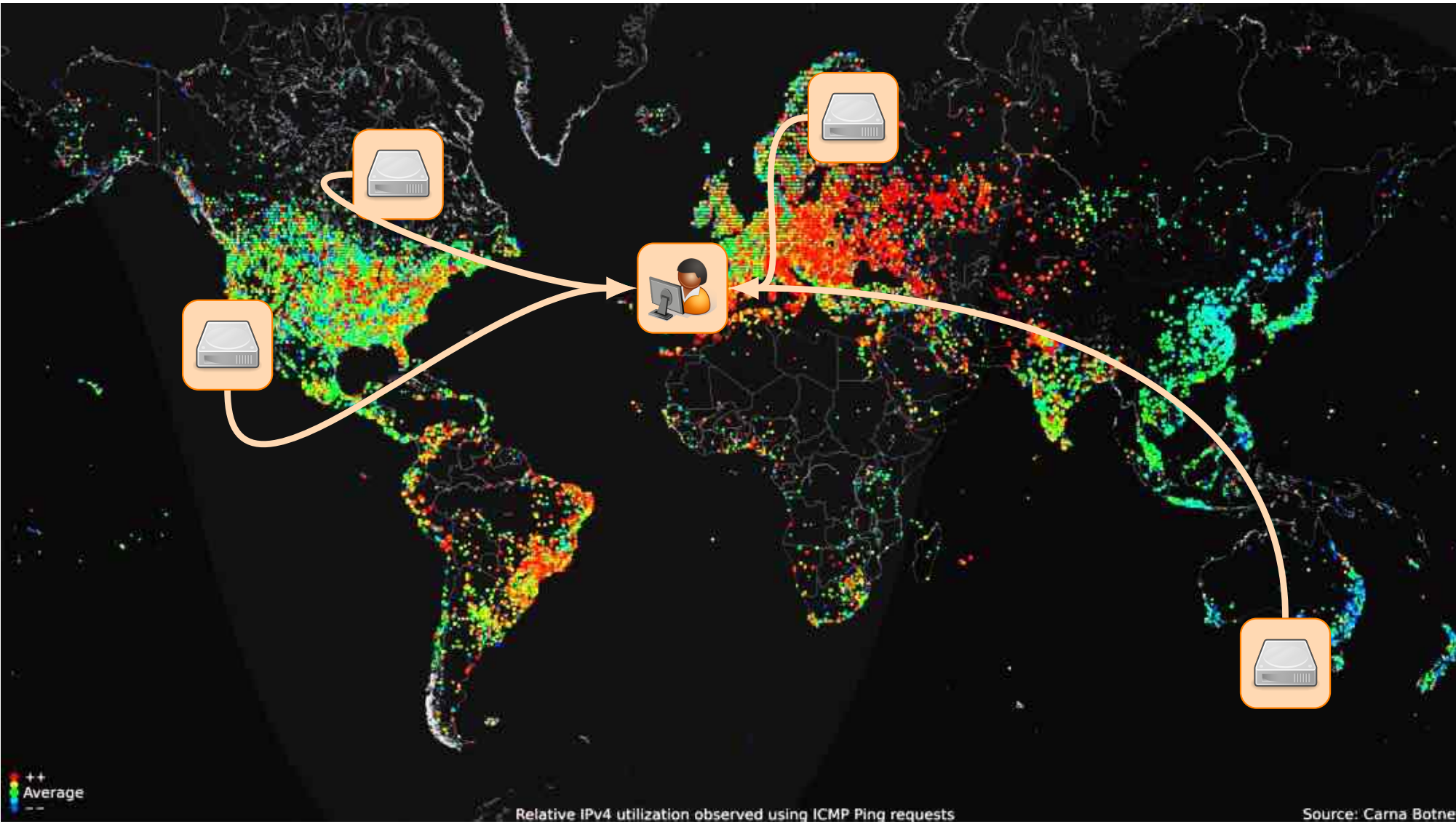
CMIP = Coupled Model Inter-comparison Project
IPCC = Intergovernmental Panel of Climate Change

# Global internet speed (access to information)

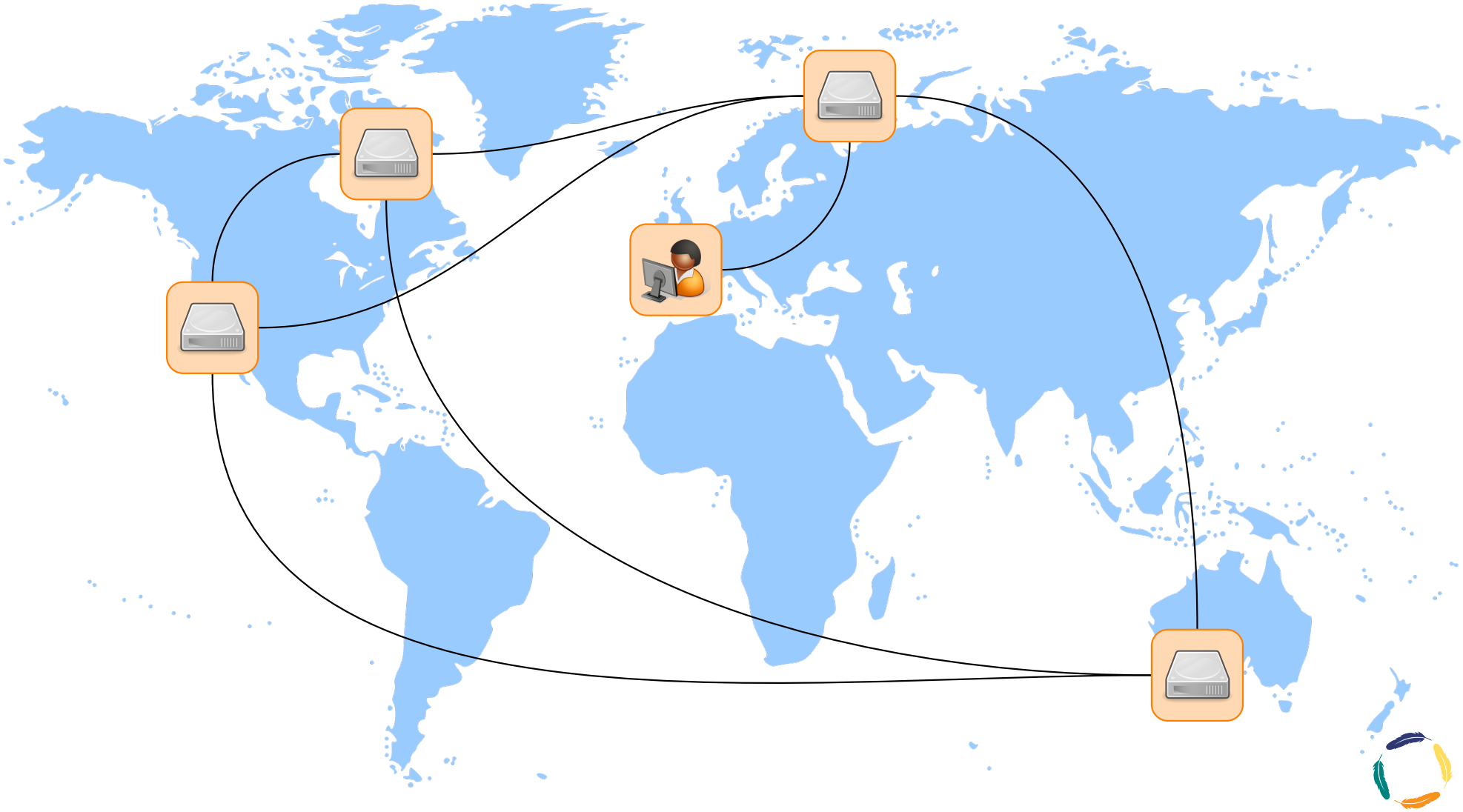



Global Internet Speed (fossbytes.com)

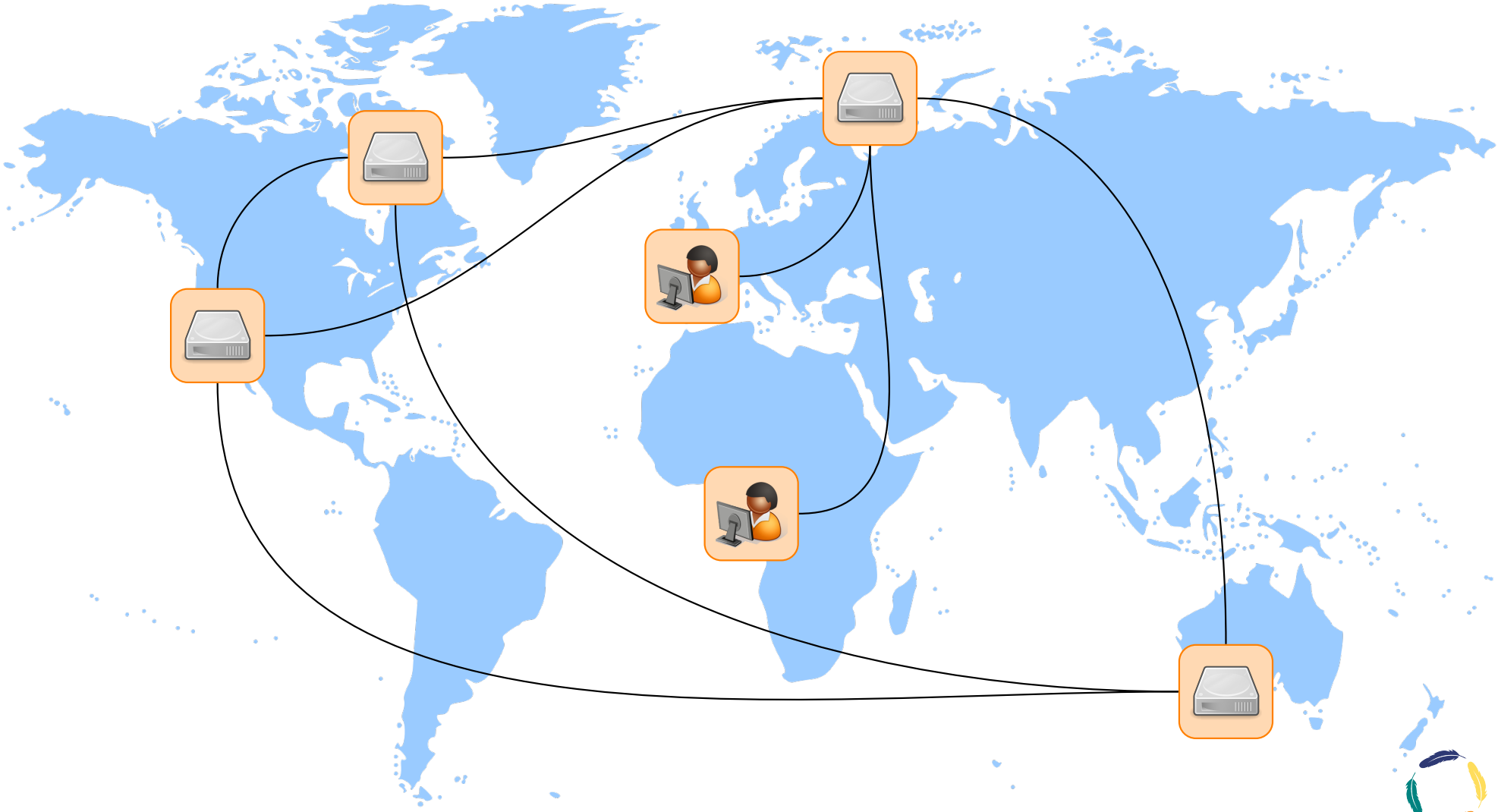
# The Big Data Problem - Download and Process at home



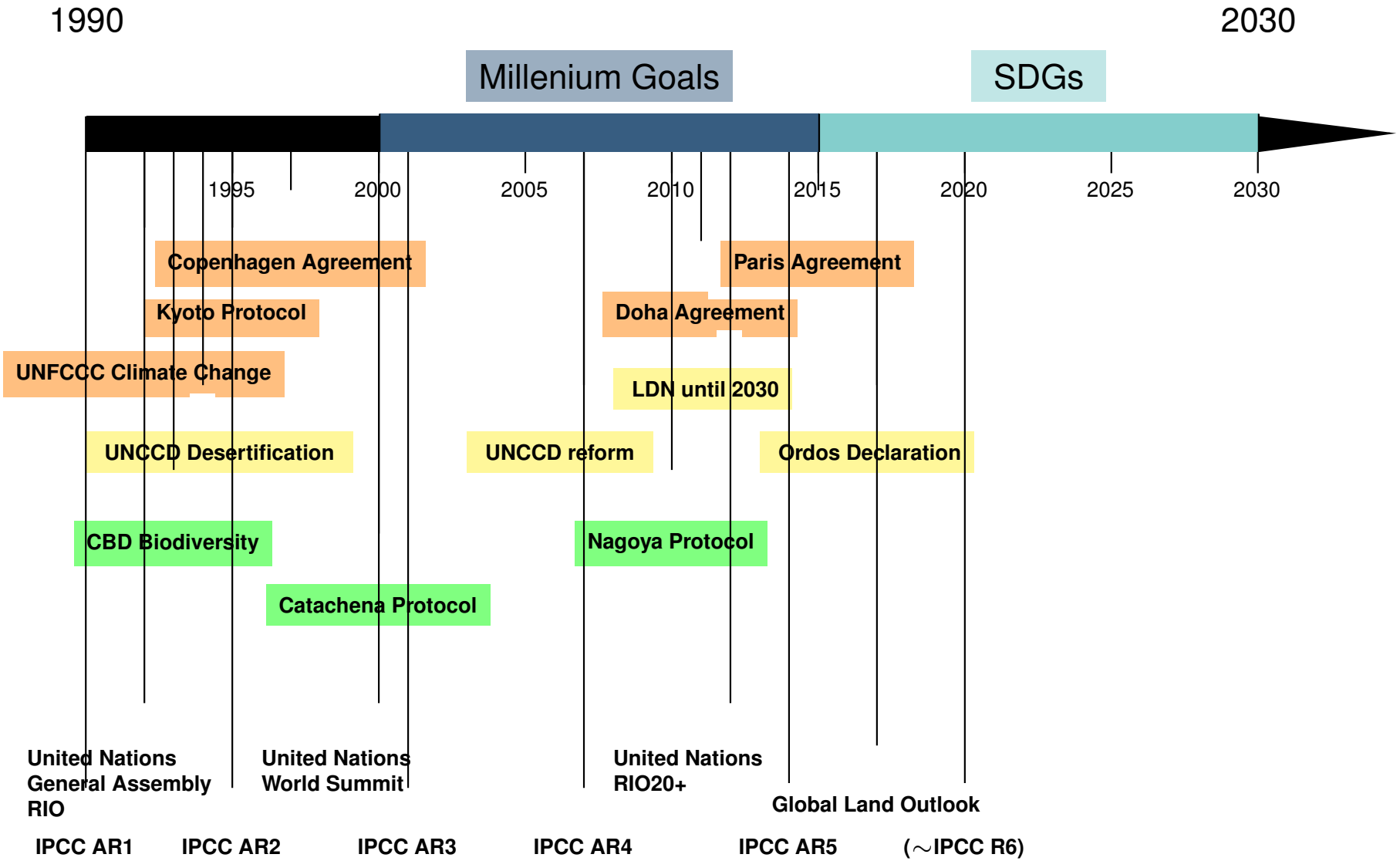
# The Big Data Problem - Process in federated Networks



# Big opportunity less/least developed countries



# Political discourse



# Cherry Picking aspects of the Paris Agreement (COP21)

**Article 6 Paragraph 2 :**
'Parties shall, where engaging on a voluntary basis in cooperative approaches ...'
**Article 6 Paragraph 8. :**
'Parties recognize the importance of integrated, holistic and balanced non-market approaches being available to Parties to assist in the implementation of their nationally determined contributions,...'
**Article 7 Paragraph 7 :**
Parties acknowledge that adaptation action should follow a country-driven, gender-responsive, participatory and fully transparent approach, ...'
**Article 10 Paragraph 1 :**
'Parties share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions.
**Article 10 paragraph 2 :**
'Parties, noting the importance of technology for the implementation of mitigation and adaptation actions under this Agreement and recognizing existing technology deployment and dissemination efforts, shall strengthen cooperative action on technology development and transfer.'

# Shift of principles for knowledge management

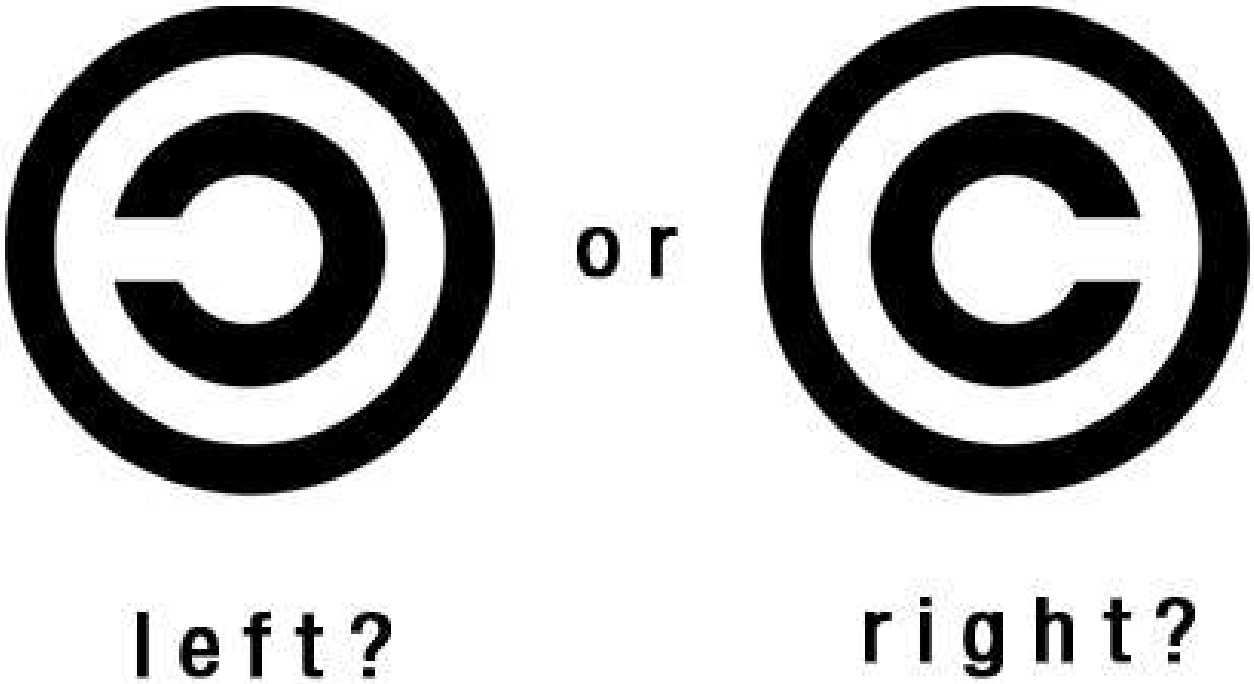
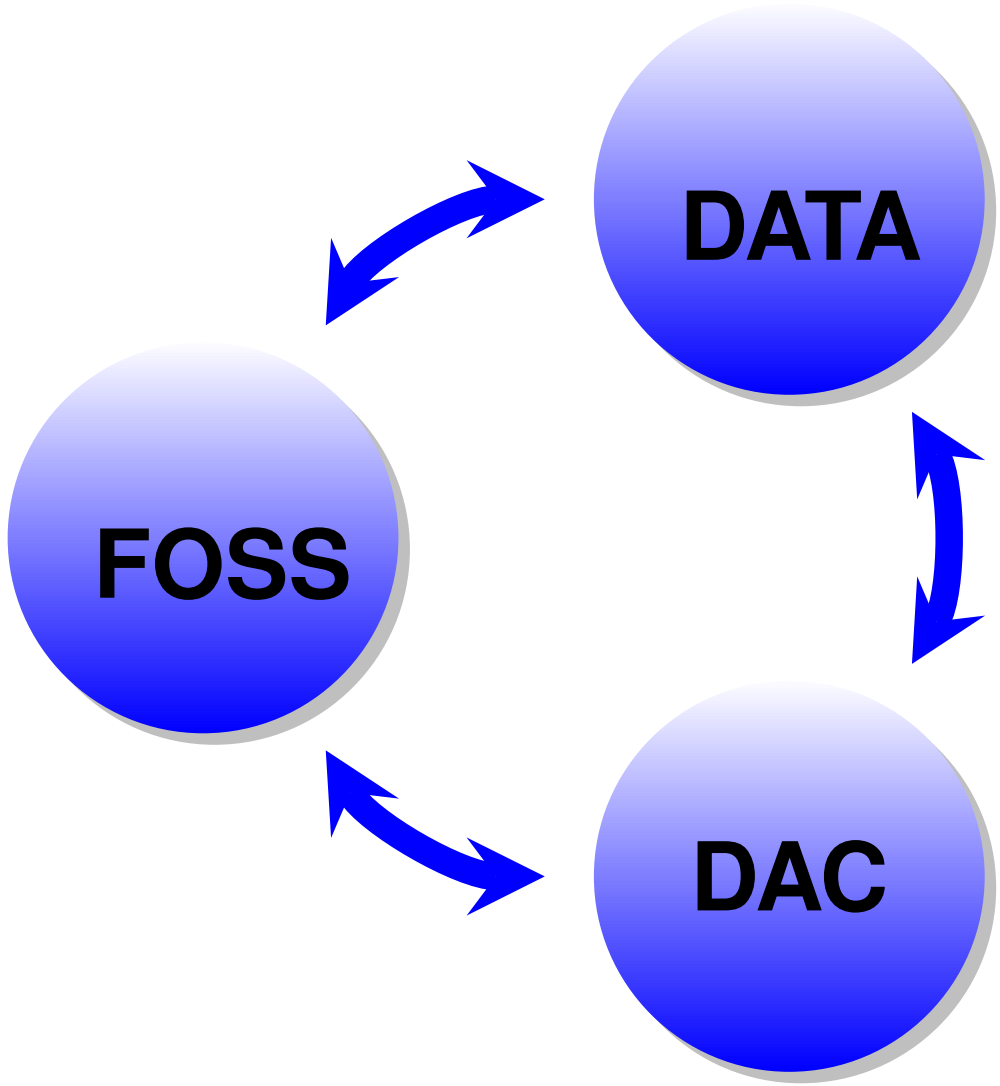



FIGURE – copyleft

# Organizations Landscape




Group of Earth observation

Open Spatial Consortium

Development Agencies Community

# High Performance Computation for Sustainable Development


FIGURE – High Performance Computer


FIGURE – Sustainable Development Goals

Further reading :

Cyber-structures for sustainable development

The IT Landscape for Climate Services

# Examples 2



# COPERNICUS C3S

## C3S seasonal charts

### Filters

Show All

### Parameters

- [ ] MSLP (0/4)
- [ ] SST (0/8)
- [x] T2m (4)
- [ ] T850 (0/4)
- [ ] geopotential height 500hPa (0/
- [ ] precipitation (0/4)

### Centres

- [x] C3S multi-system (1/7)
- [x] ECMWF (1/7)
- [x] Met Office (1/7)
- [x] Meteo-France (1/7)

Base time | Map type (forecasts and skill measures) | Area | Product results

C3S multi-system T2m (Produced by the Copernicus C
ECMWF T2m (Produced by the Copernicus C
Met Office T2m (Produced by the Copernicus C
Meteo-France T2m (Produced by the Copernicus C

C3S multi-system seasonal forecast
Mean 2m temperature anomaly
Nominal forecast start: 01/12/16
Variance-standardized mean

<-2.0°C | -2.0..-1.0 | -1.0..-0.5 | -0.5..-0.2 | -0.2..0.2

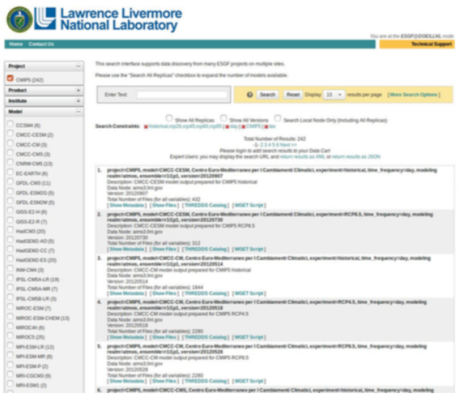
VT: Feb 2017

(Produced by the Copernicus Climate Change Service, using Copernicus data.)
These products are under development, in a proof of concept phase. The quality control of input data and outputs is not guaranteed.

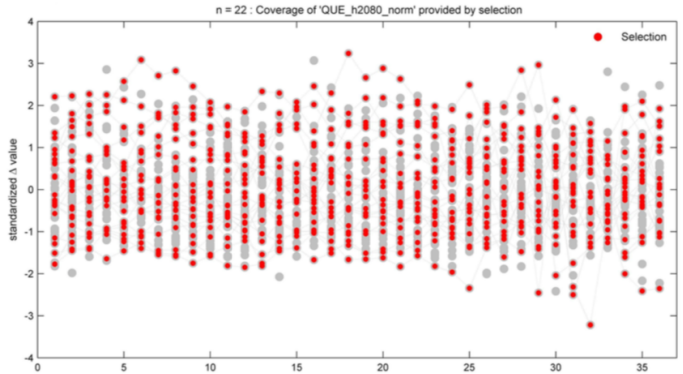
Copernicus Climate Change Service

# PAVICS :
# A Platform for the Analysis and Visualization of Climate Science

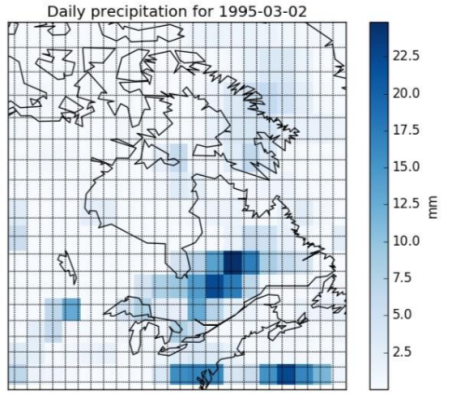
Data search & acquisition



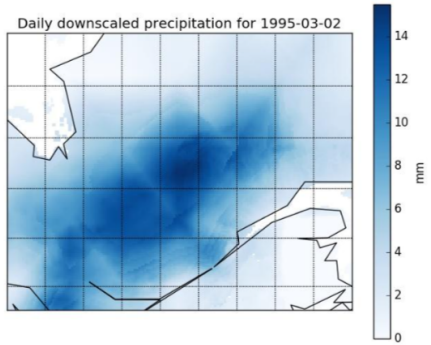

Selection of an ensemble of simulations



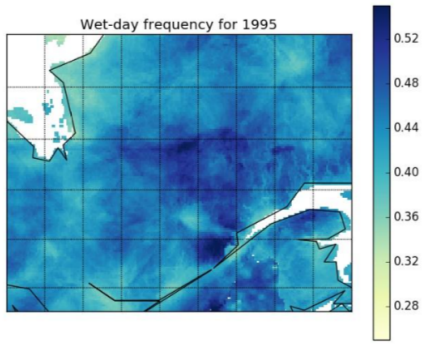

Subsetting



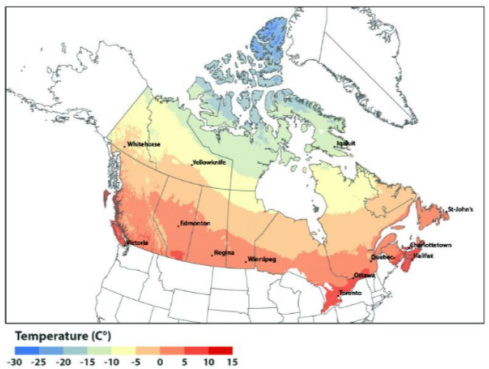

Downscaling




Climate indicator computation

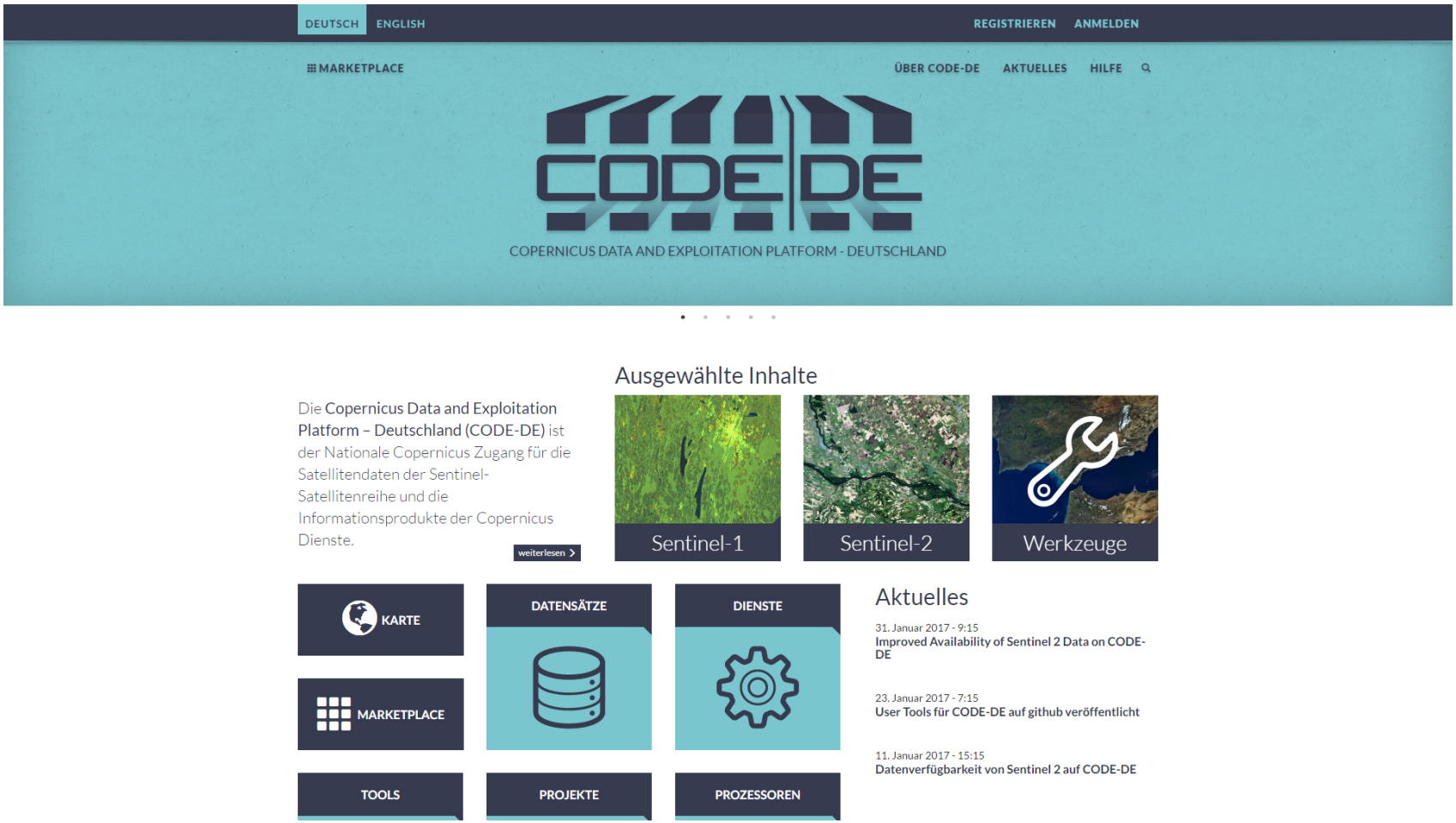



User specific visualization



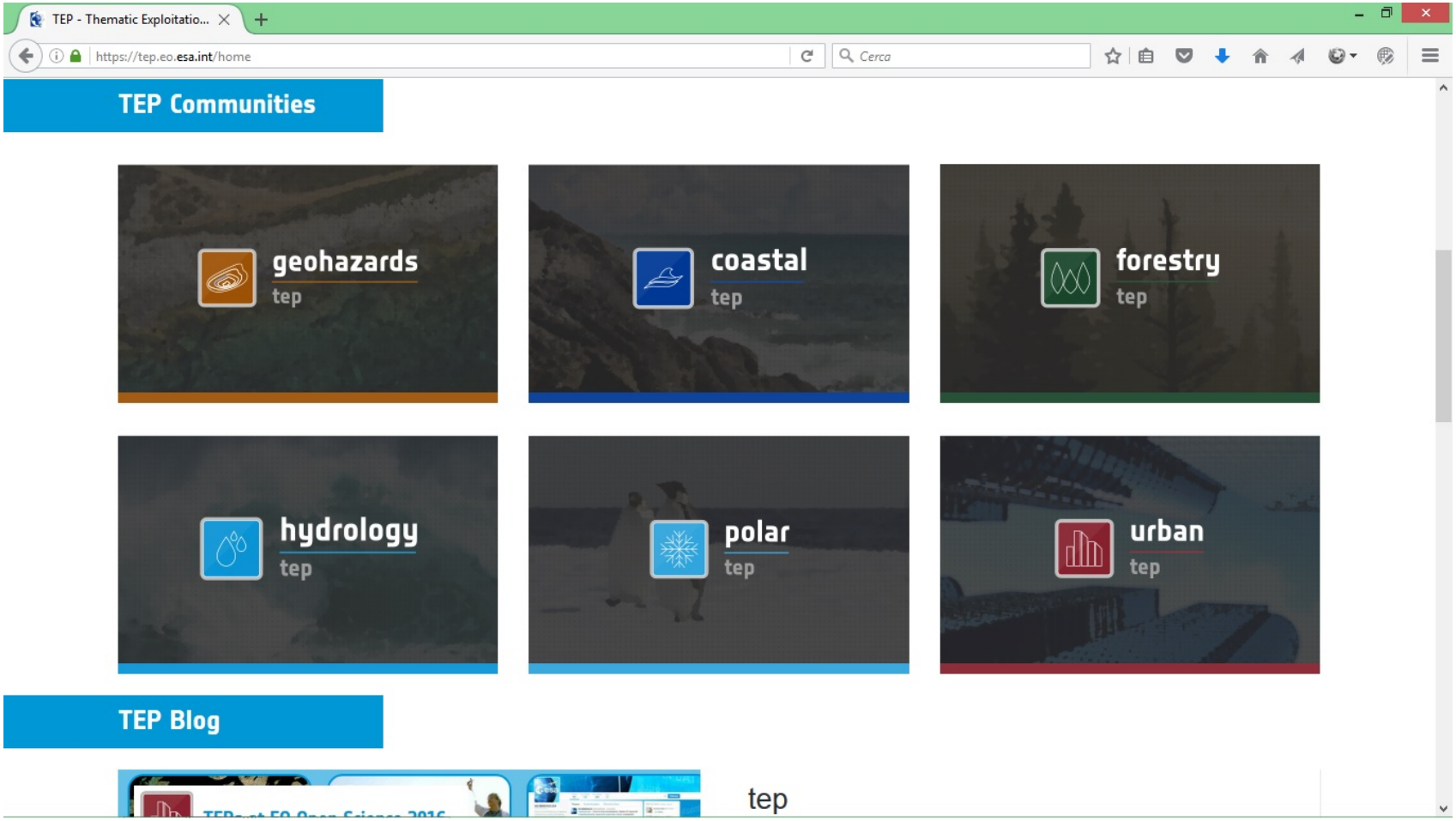

https://www.researchgate.net/project/PAVICS

# CODE-DE



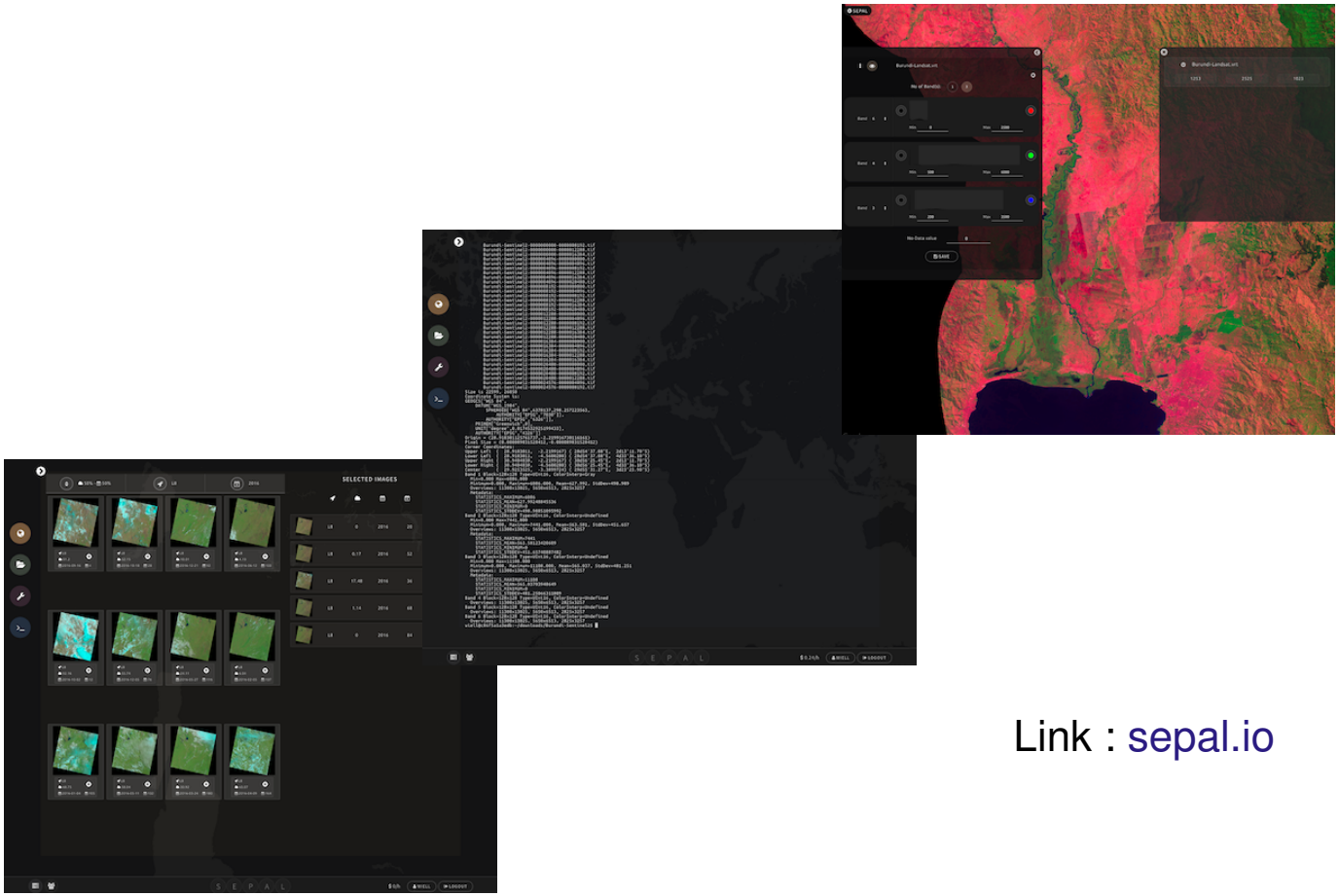

code-de.org

# TEP ESA



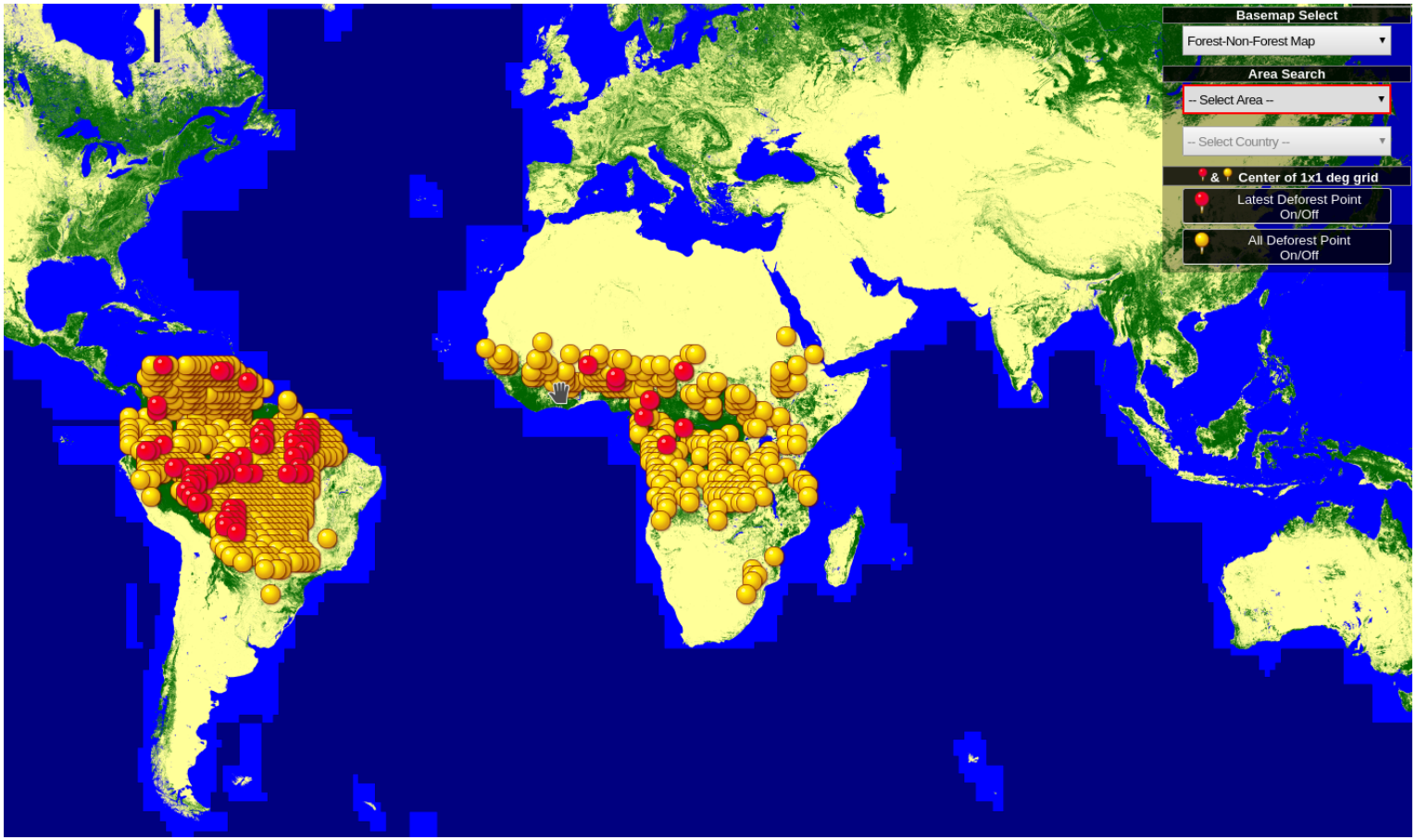

ESA Thematic Exploitation Platforms (TEPs)

# REDD+ cloud computing tool



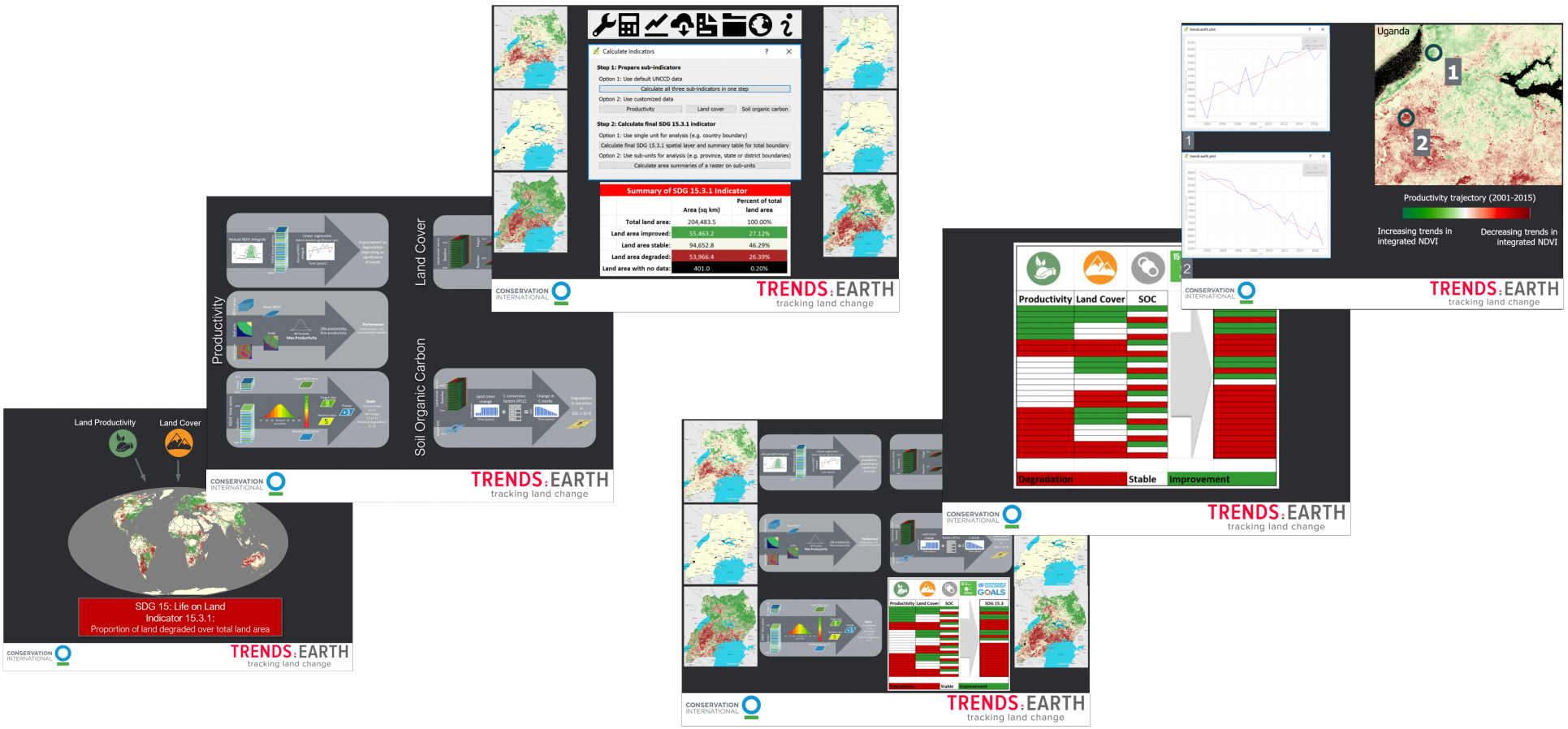
Link : sepal.io

# JICA-JAXA




JICA-JAXA Forest Early Warning System in the Tropics

# Trends.earth QGIS plugin (UNCCD LDN –> SDG 13.5.1)




link to Documentation Trends.Earth
link to Tutorial Trends.Earth

# ODC

## 20 data cubes by 2020 – (plus ARDC)


opendatacube
Link: African Regional Data Cube Announcement

Video Links :
Africa Regional Data Cube
How the Data Revolution is Shaping Africa's Future

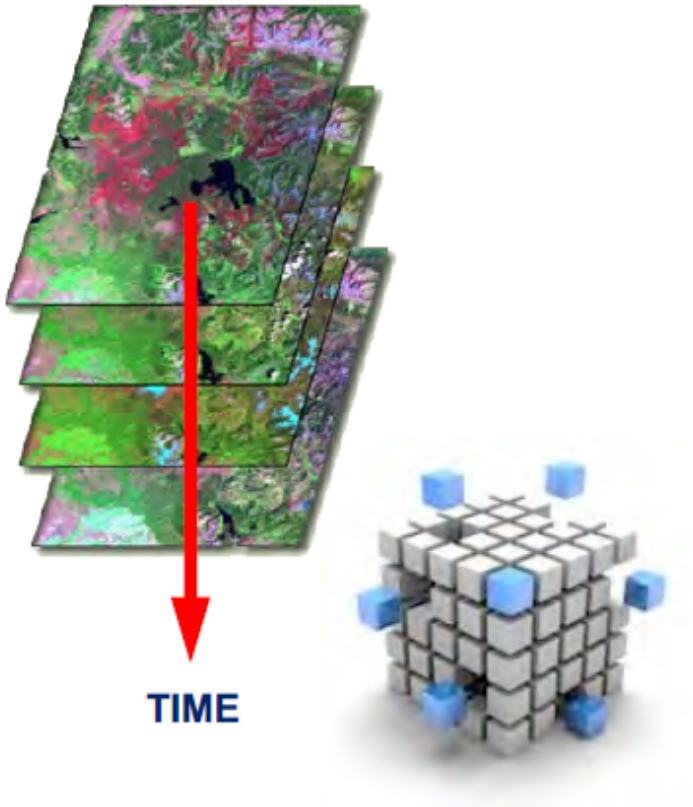
# Exmples 3



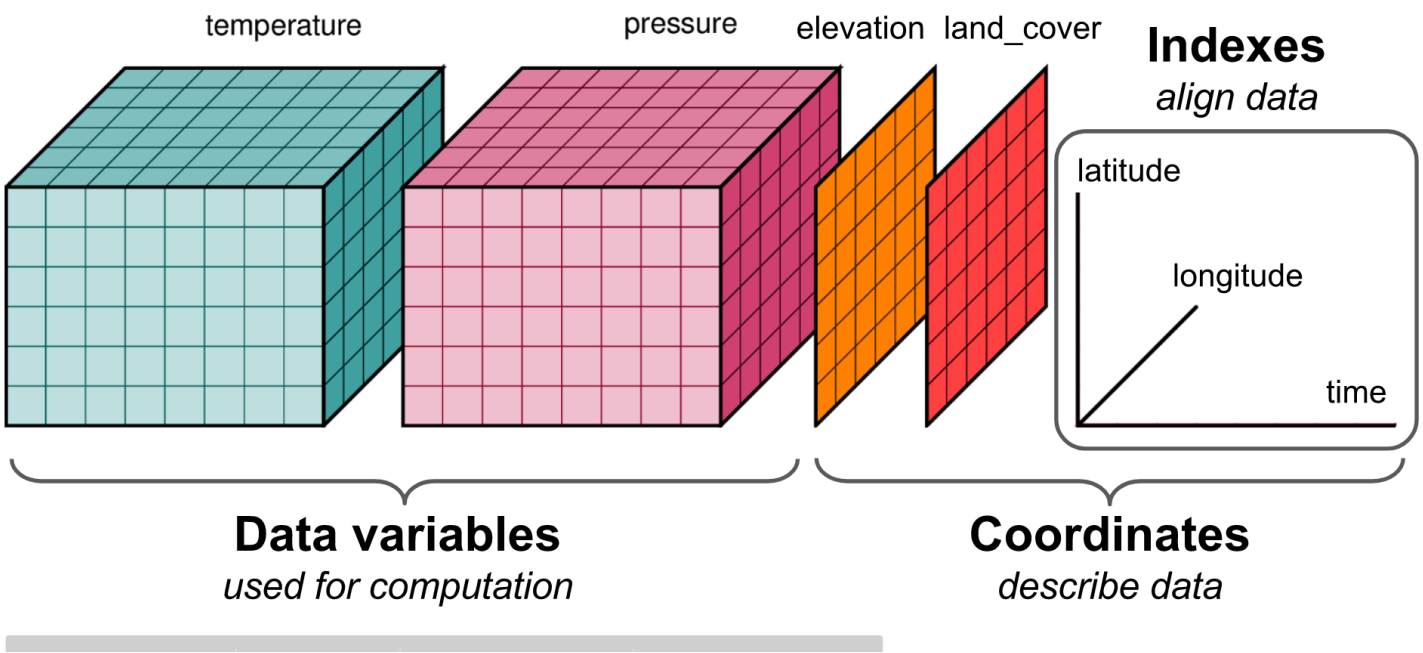
Open D

# What are Data Cubes?

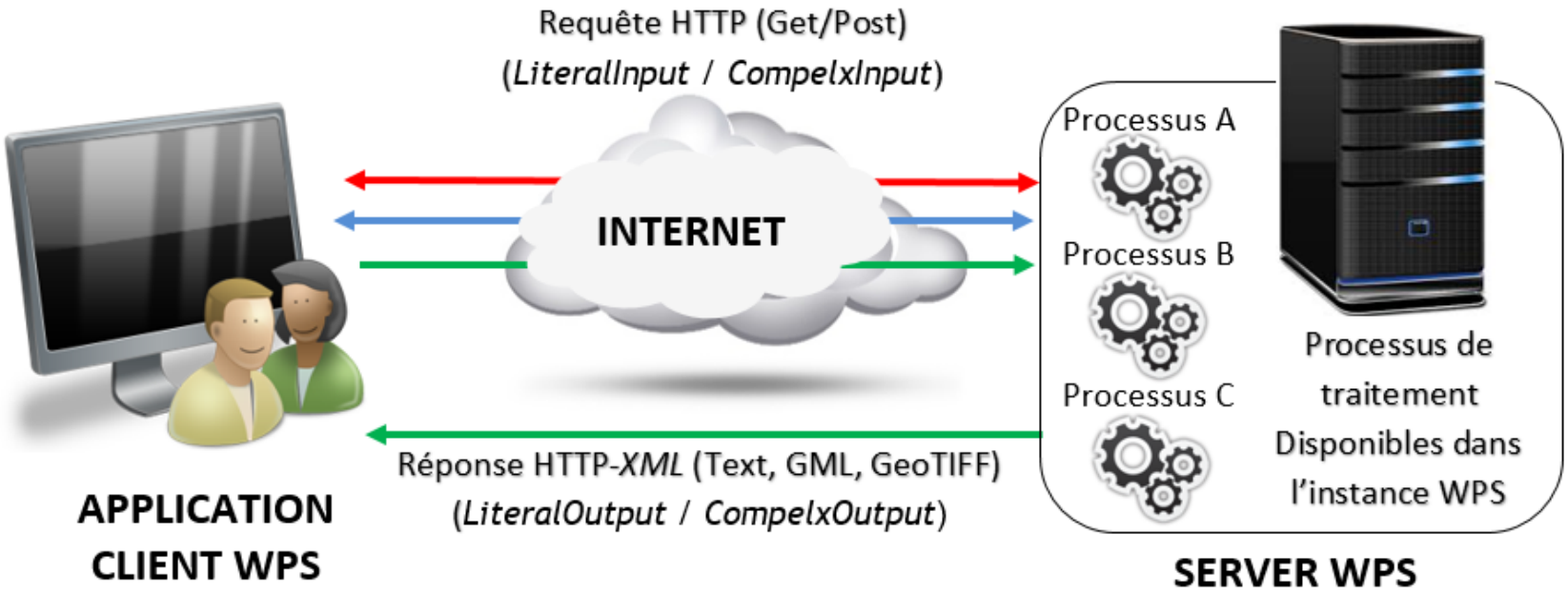
- **Data Cube** = Time-series multi-dimensional (space, time, data type) stack of spatially aligned pixels ready for analysis
- **Proven concept** by Geoscience Australia (GA) and the Australian Space Agency (CSIRO) and planned for the future USGS Landsat archive.
- **Analysis Ready Data (ARD)** ... Dependent on processed products to reduce processing burden on users
- **Open source** software approach allows free access, promotes expanded capabilities, and increases data usage.
- **Unique features:** exploits time series, increases data interoperability, and supports many new applications.



# Network Common Data Format (netCDF)



# Web Processing Services



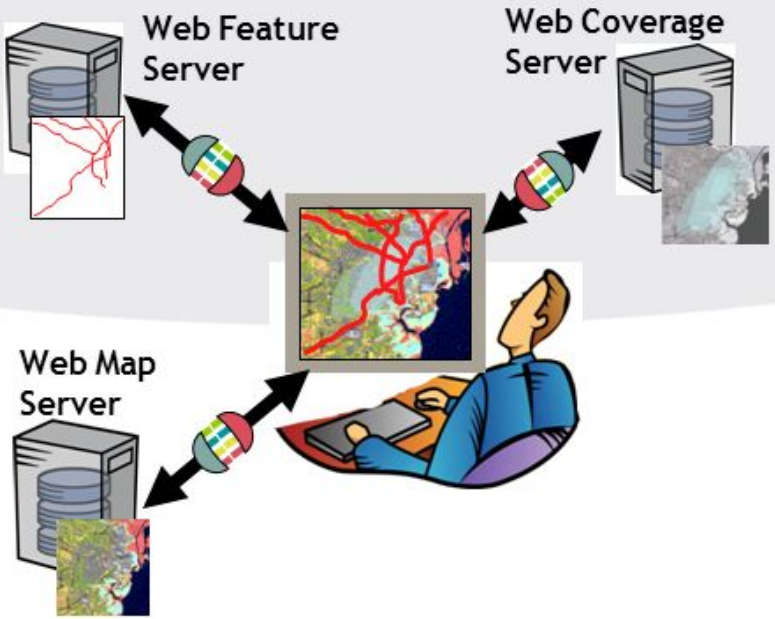

**Légende :**

- Le client envoi une requête ***GetCapabilities*** et le server répond (Liste des processus A, B, C)
- Le client sélectionne un traitement *processus C*, une requête ***DescribeProcess*** est envoyée et le server répand (Entrées & sorties du *processus C*)
- L'utilisateur choisie les entrées nécessaires et lance le traitement, une requête ***Execute*** est envoyé et le server répond par un document XML initial.

# OGC Standard

## OGC Web Services (OWS)

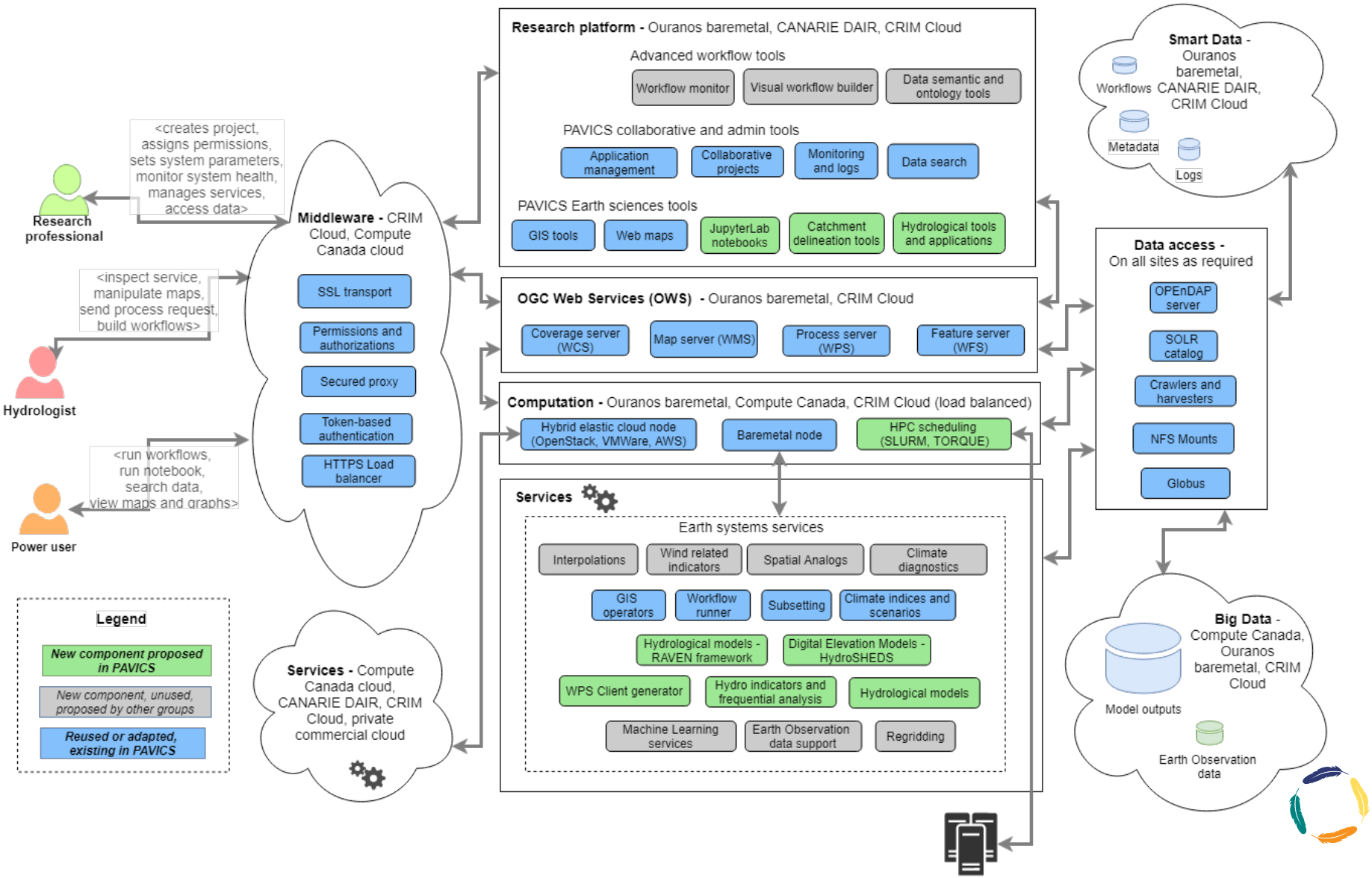
The geospatial web is enabled by OGC standards:



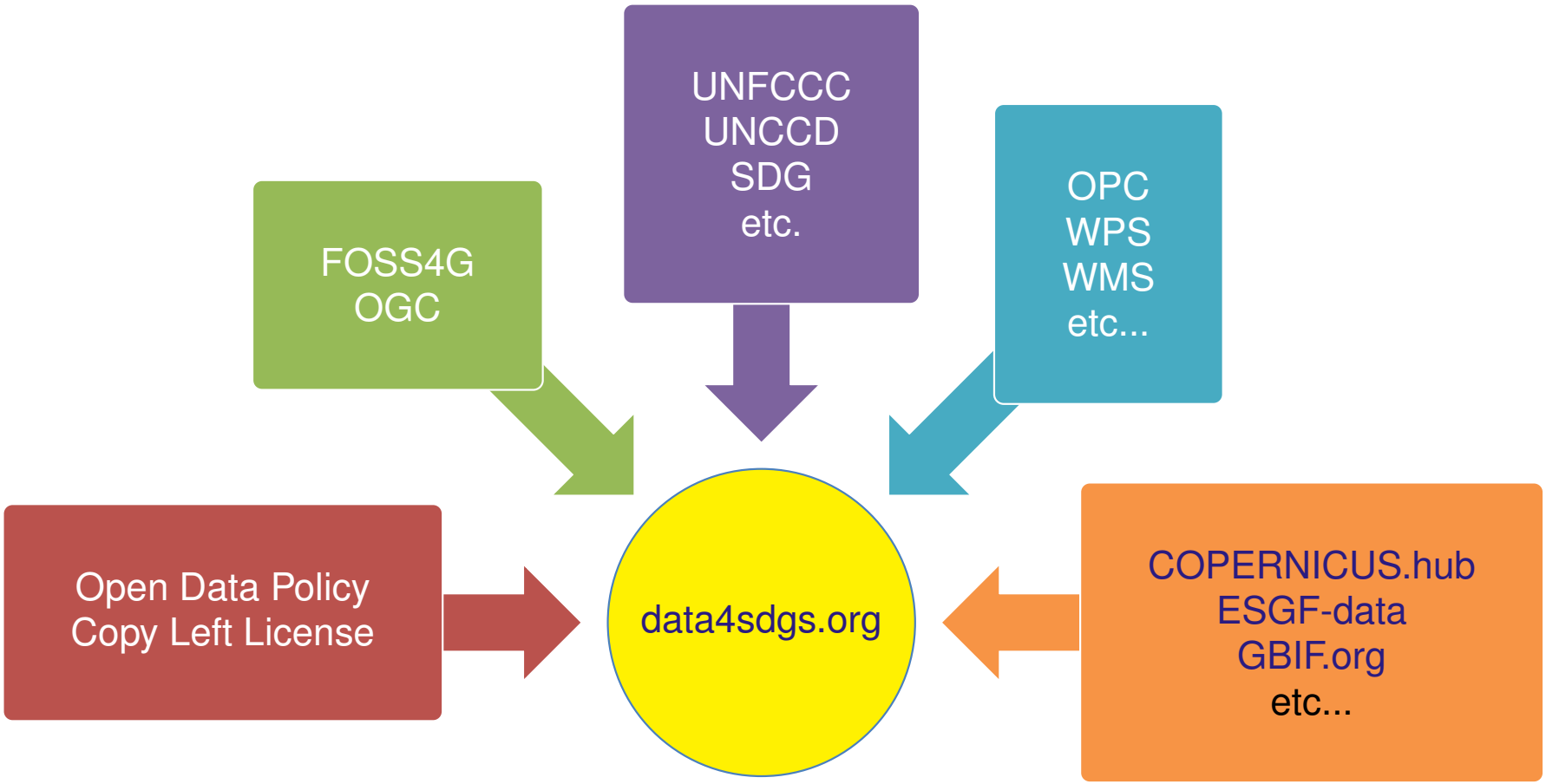

- Web Map Service (WMS)
- Web Map Tile Service (WMTS)
- Web Feature Service (WFS)
- Web Coverage Service (WCS)
- Catalogue (CSW)
- Geography Markup Language (GML)
- KML
- Others…

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

# Birdhouse-PAVICS framework



# Ingredients of the recipe for data for SDGs



# Technical Aspects 4



# DEMO

Platform Visualisation Climate Services

African Regional Data Cubes

WPS Workshop

REDD+ sepal.io/