

# Interfaces, Discovery and Intelligence in Digital Earth Observation

14 March 2024, ACAT

**Stefanie Lumnitz**

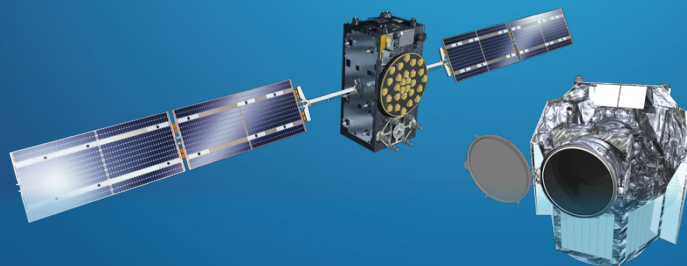
*Climate Action, Sustainability  
and Science Department, ESA*

ESA UNCLASSIFIED – For ESA Official Use Only



# What is the European Space Agency?

Make Space  
for Europe



Promoting cooperation among participating States in space research, technology and applications, for exclusively peaceful purposes



5 500+

ESA Workforce

22

Member States

2024 Budget

€ 7.79 billion =  
10.5 per European



# The Explorers and Their Challenge



1. EXPLORE THE UNIVERSE

2. IMPROVE LIFE ON EARTH



...WHILE SERVING

PEACEFUL PURPOSES...

.. AND STRENGTHENING THE SPACE INDUSTRY



A large, semi-transparent image of the Earth as seen from space, showing the Western Hemisphere with North and South America visible. The image is centered behind the main title.

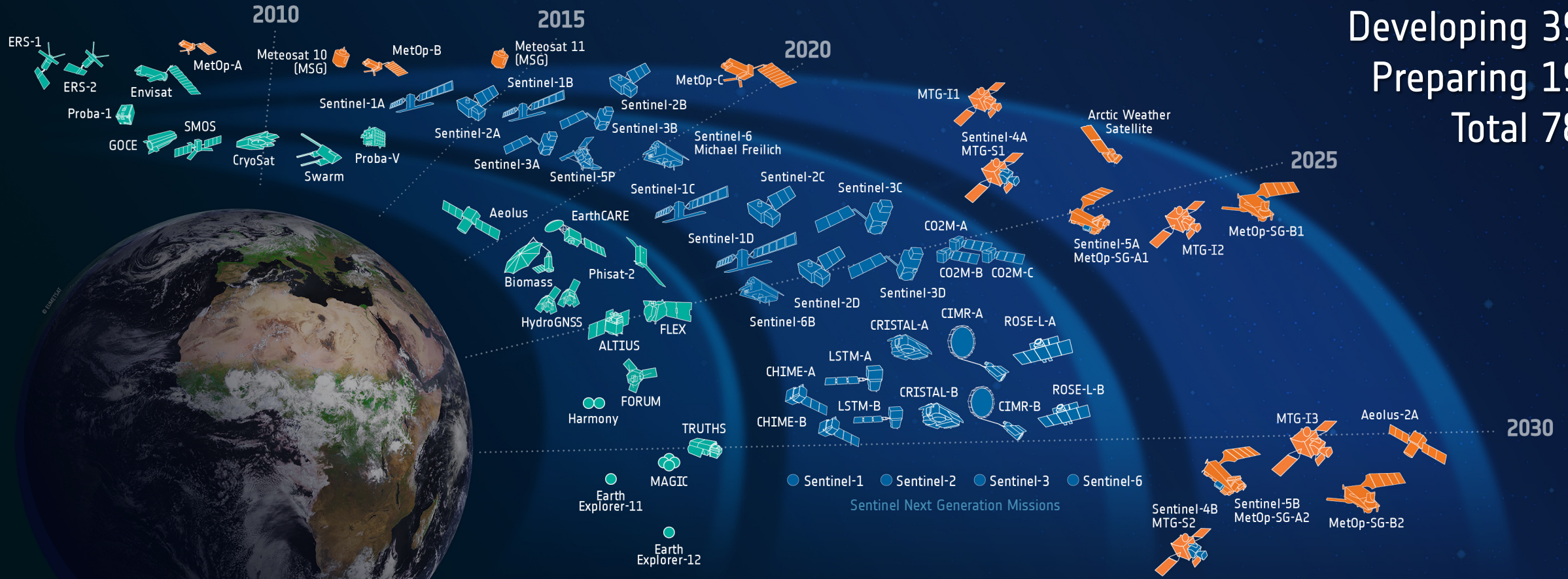
# ESA's Earth Observation Vision

## Taking the Pulse of our Planet

# ESA's Earth Observation Missions



Heritage 06  
Operational 14  
Developing 39  
Preparing 19  
Total 78



Science



Copernicus



Meteorology



> **750.000**

registered users  
= tip of the iceberg



All global landmass is observed every **5 days at 10m** resolution



**350 TB** satellite data  
distributed per day



**30 TB** Sentinel data  
produced per day



**full, free & open**  
data policy

## Next Generation missions

CO2M



LSTM



CHIME



ROSE-L

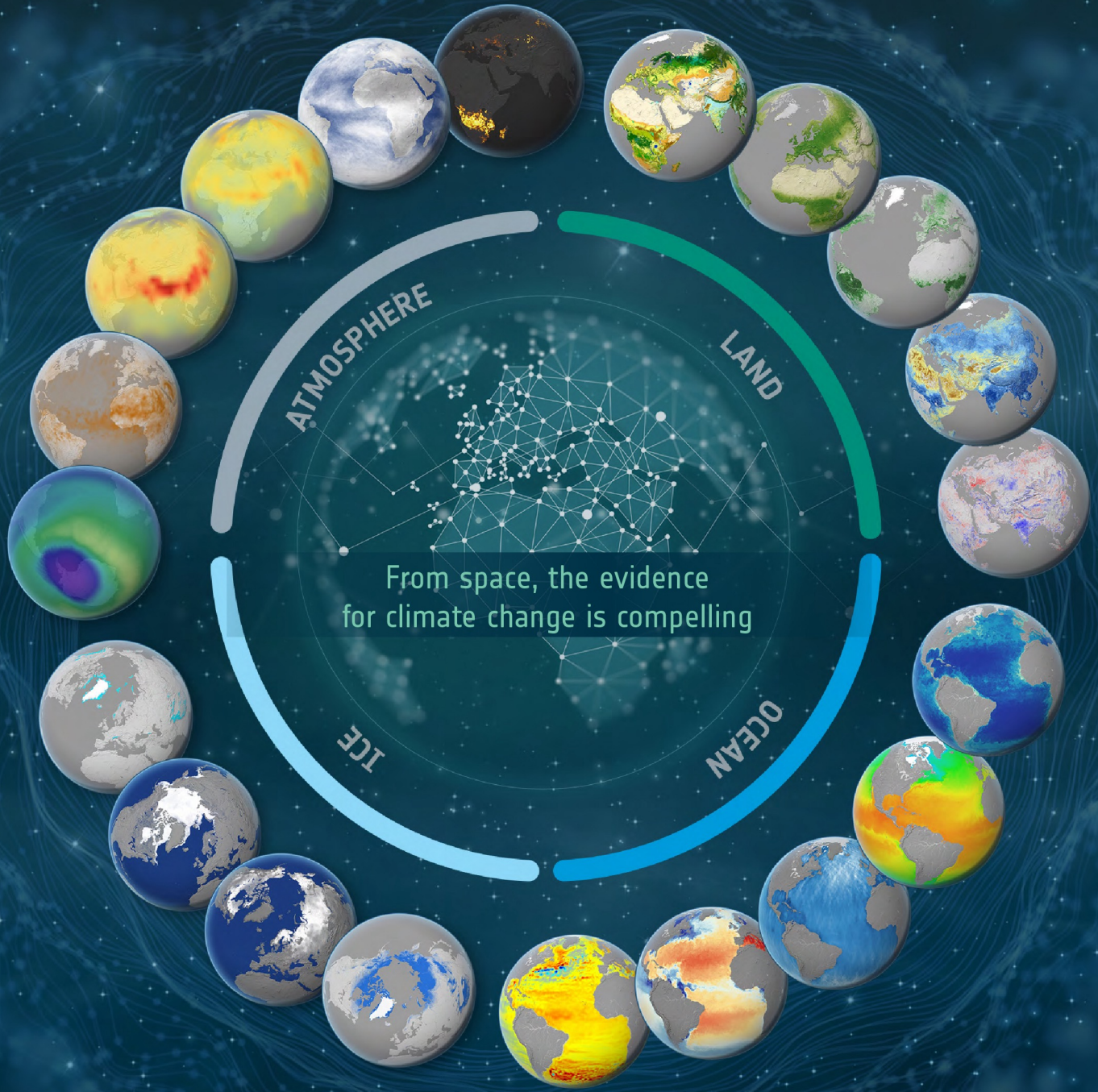


CIMR



CRISTAL





**Space helps to  
bend the curve..**

In Colombia

21.3%

decrease of burned area in 2019 compared to the 2001-2018 average

In Venezuela

43.5%

increase of burned area in 2019 compared to the 2001-2018 average

In Brazil

1.7%

increase of burned area in 2019 compared to the 2001-2018 average

In Bolivia

51.4%

increase of burned area in 2019 compared to the 2001-2018 average

In Paraguay

1.8%

increase of burned area in 2019 compared to the 2001-2018 average

In Argentina

49.4%

decrease of burned area in 2019 compared to the 2001-2018 average

Space helps to bend the curve..

.. through the global stocktake (IPCC) ..

Data sources:  
Percentages derived from Lizundia-Loiola et al., (2020)  
Temporal anomalies in burned area trends: Satellite estimations of the Amazonian 2019 fire crisis  
Above ground biomass ranges from 0 to >350 tons/ha (dark green). Dataset from Santoro, Maurizio (2018): GlobBiomass - global datasets of forest biomass. PANGAEA



# DRIVEN by the GREEN TRANSITION



leveraging 50 years of public and private investment in space



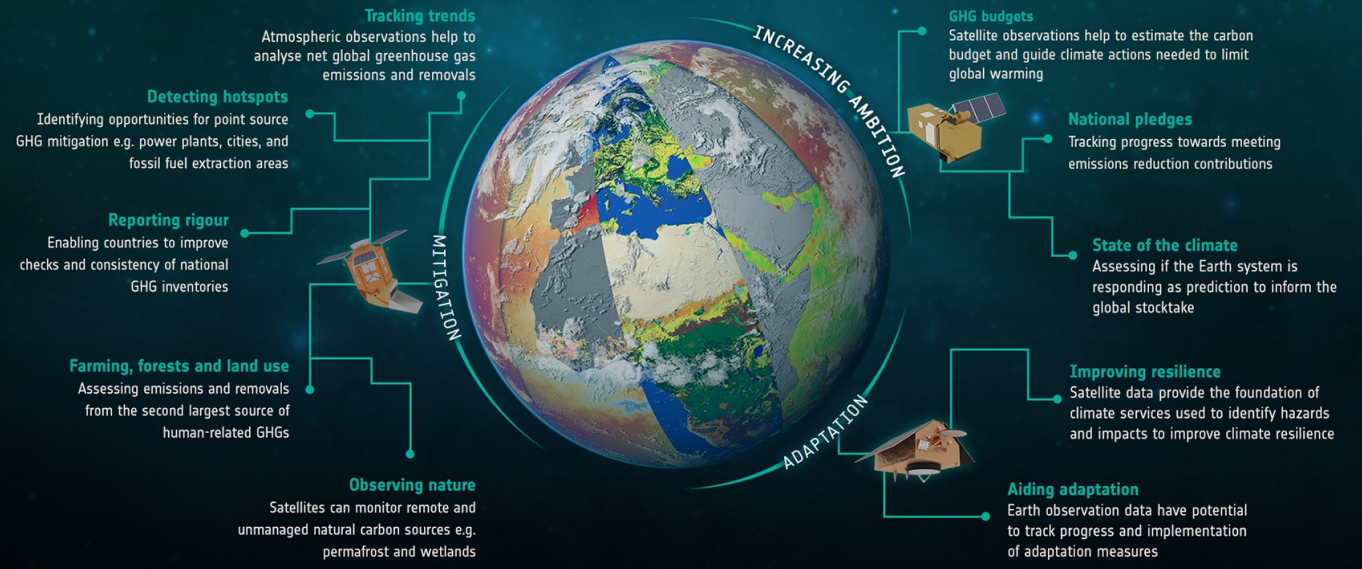
Space plays a significant role

Still far below strategic and societal potential

## Supporting the Paris Agreement from Space



The Paris Agreement aims to keep global temperatures well below 2°C and ideally 1.5°C relative to the pre-industrial period and reduce climate change vulnerability. Satellite observations are increasingly contributing to national mitigation and adaptation progress to meet these objectives.



[climate.esa.int](https://climate.esa.int)

References: [1] Deng, Z et al (2022) Earth Syst. Sci. Data, <https://doi.org/10.5194/essd-14-1639-2022>. [2] Heggin M (2021) <https://unfccc.int/documents/307696>



ENERGY TRANSITION



MOBILITY TRANSITION



SUSTAINABLE CITIES



CARBON ACCOUNTING



EO ADAPTATION SERVICES

# Space for a Green Future

Collaborative  
Interfaces

Open  
Discovery

Intelligence in  
Innovation

# Space for a Green Future

Collaborative  
Interfaces

# EARTH EXPLORERS

Pioneering scientific and technical excellence



**cryosat**

ICE



**goce**

GRAVITY FIELD



**smos**

WATER



**swarm**

MAGNETIC FIELD



**aeolus**

WIND



**earthcare**

CLOUD AND AEROSOL



**biomass**

FOREST CARBON



**flex**

PHOTOSYNTHESIS



**forum**

THERMAL RADIATION

**harmony**

SURFACE DYNAMICS



# BioPAL

## BIOMASS Product Algorithm Laboratory



- = Open Source Software Project  python™
- = official BIOMASS algorithms
- = first time that official algorithms are made publicly accessible

biopal@esa.int



biopal.org



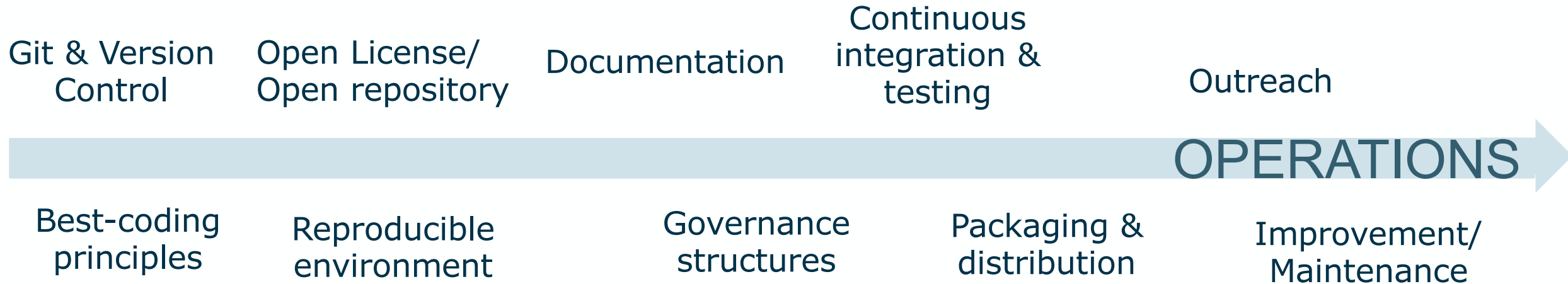
github.com/BioPAL



*Banda, F.; Giudici, D.; Le Toan, T.; Mariotti d'Alessandro, M.; Papathanassiou, K.; Quegan, S.; Riembauer, G.; Scipal, K.; Soja, M.; Tebaldini, S.; Ulander, L.; Villard, L. "The BIOMASS Level 2 Prototype Processor: Design and Experimental Results of Above-Ground Biomass Estimation" Remote Sensing, 2020, 12, 985. [doi.org/10.3390/rs12060985](https://doi.org/10.3390/rs12060985)*



# Open Source Algorithms



# Open Source Software Projects





Enhancing the  
Biomass  
Processor  
collaboratively

biopal@esa.int



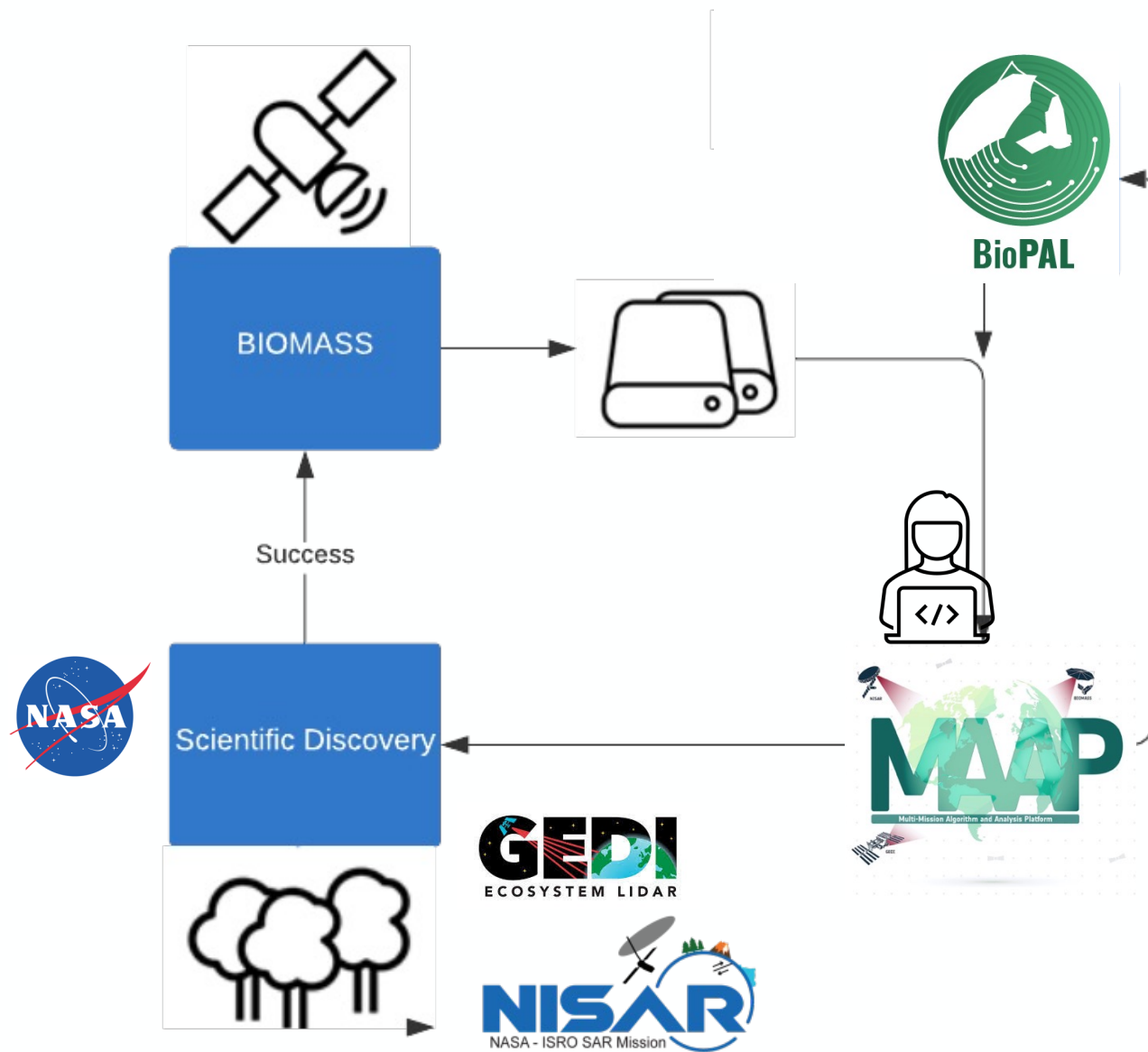
biopal.org



github.com/BioPAL

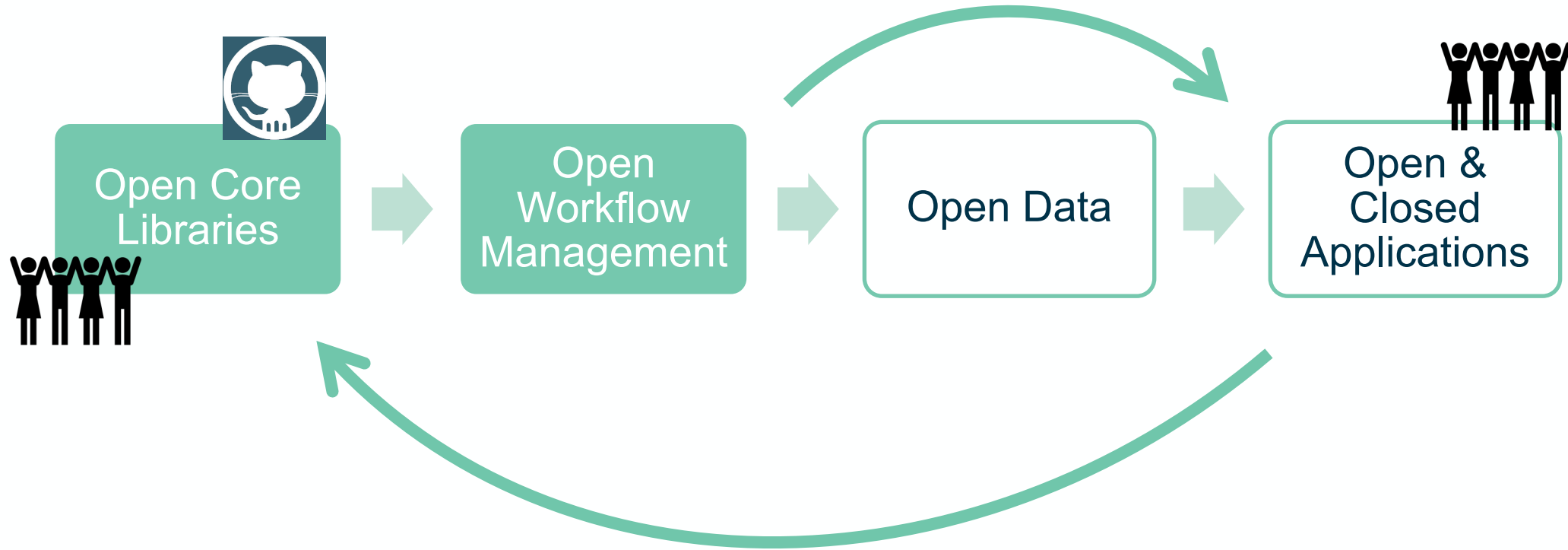


Bringing User  
activities closer to  
the data





# From open data towards open innovation



# Space for a Green Future

Open  
Discovery

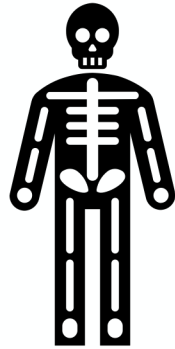
# Open Source Geospatial – A Mature Ecosystem

## The State of Open Source GIS



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Last Revised: September 15, 2007



C tribe



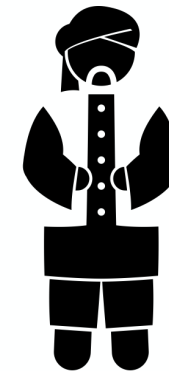
Java tribe



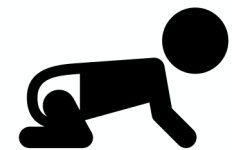
Python tribe



Web wild card



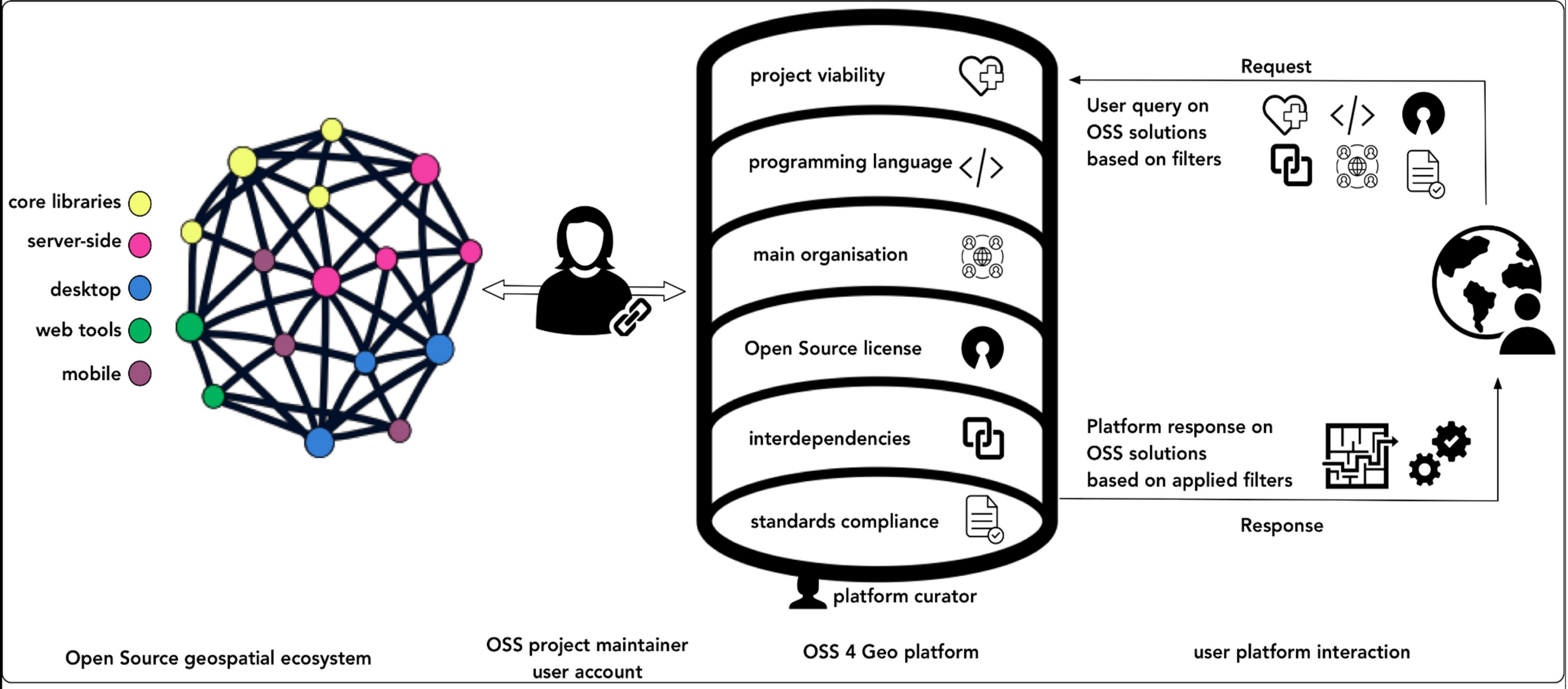
R tribe




Julia tribe



# OSS4gEO – The How



qgis/QGIS



docker build manual Azure Pipelines succeeded  
DOI 10.5281/zenodo.5869837

QGIS is a full-featured, user-friendly, free-and-open-source (FOSS) geographical information system (GIS) that runs on Unix platforms, Windows, and MacOS.

**Features**

1. Flexible and powerful spatial data management
2. Beautiful cartography
3. Advanced and robust geospatial analysis
4. Powerful customization and extensibility
5. QGIS Server

**Under the hood**

- Versions and release cycle
- Free and Open Source

**Installing and using QGIS**

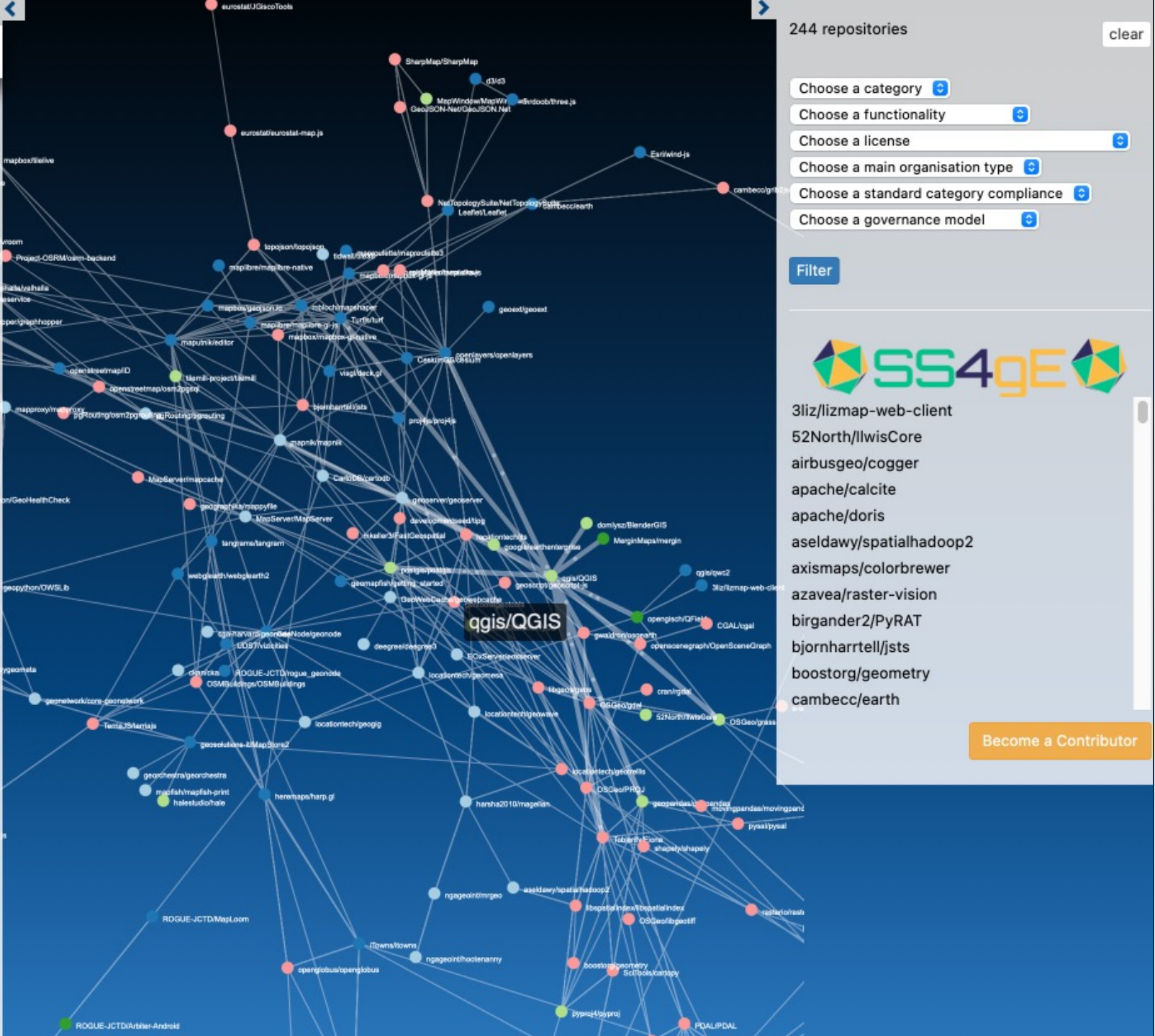
- Documentation
- Help and support channels

**Get involved with the community**

- Bug reporting and bug fixing
- New features and enhancements
- Translations
- Other ways to contribute

## Features


### 1. Flexible and powerful spatial data management



244 repositories

Choose a category  
Choose a functionality  
Choose a license  
Choose a main organisation type  
Choose a standard category compliance  
Choose a governance model

Filter



3liz/lizmap-web-client  
52North/IlwisCore  
airbusgeo/cogger  
apache/calcite  
apache/doris  
aseldawy/spatialhadoop2  
axismaps/colorbrewer  
azavea/raster-vision  
birgander2/PyRAT  
bjornharrtell/jsts  
boostorg/geometry  
cambecc/earth

Become a Contributor

# Space for a Green Future

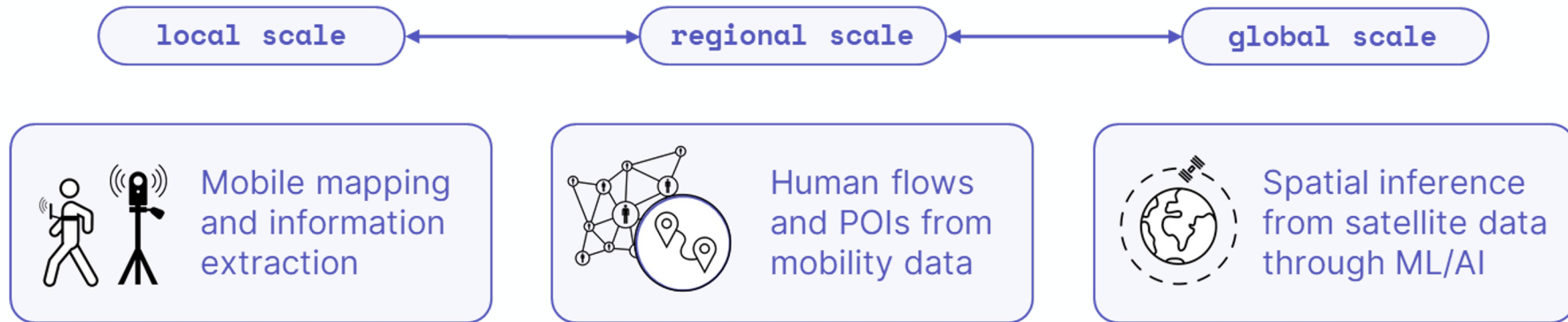
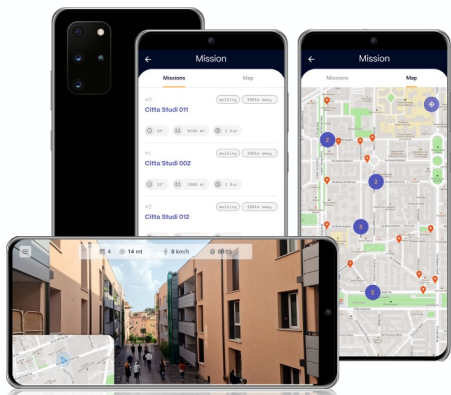
Intelligence in  
Innovation

# BEE.AI – Building energy efficiency estimation with Artificial intelligence



**WHAT:** Assessing buildings' energy performance and retrofiting potential by jointly leveraging Earth Observation and in-situ data.

**HOW:** Design, implement, and validate a multi-modal AI-based system able to automatically estimate the energy efficiency level of single buildings, ranking them from "A" (most energy-efficient) to "G" (least energy-efficient) and to generate recommendations for interventions.



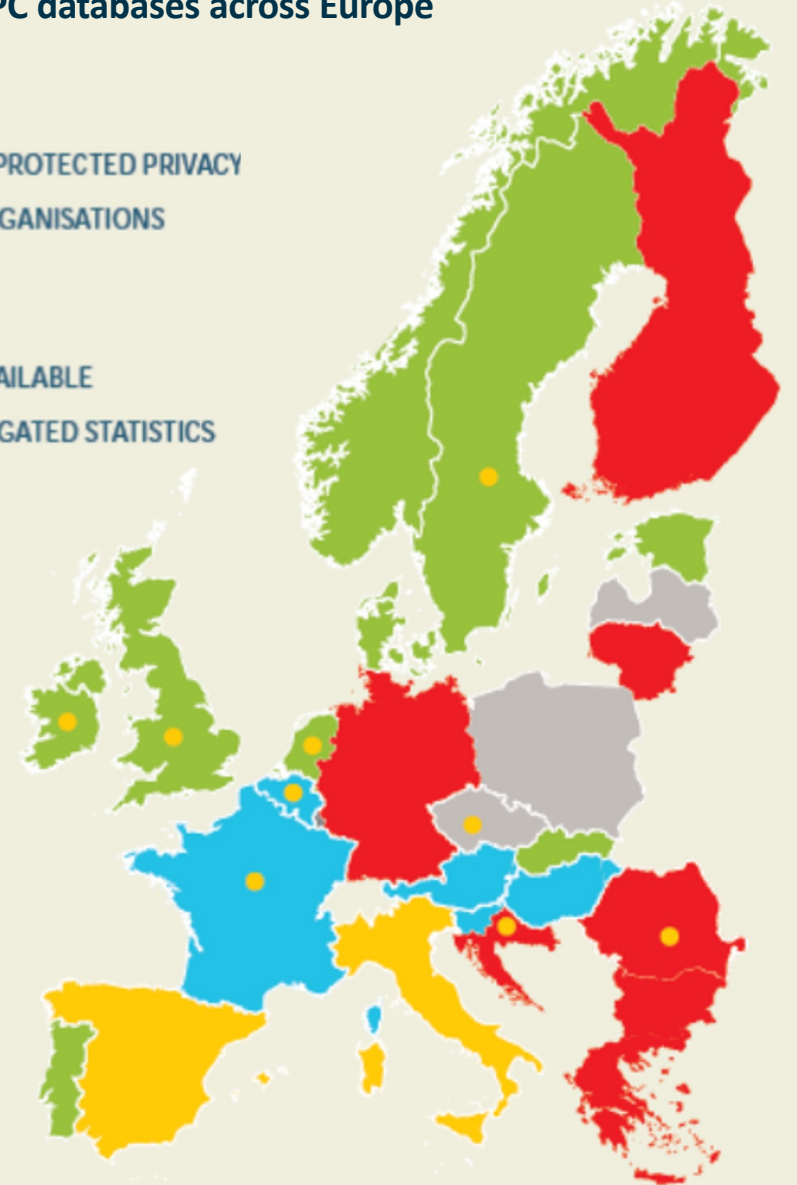


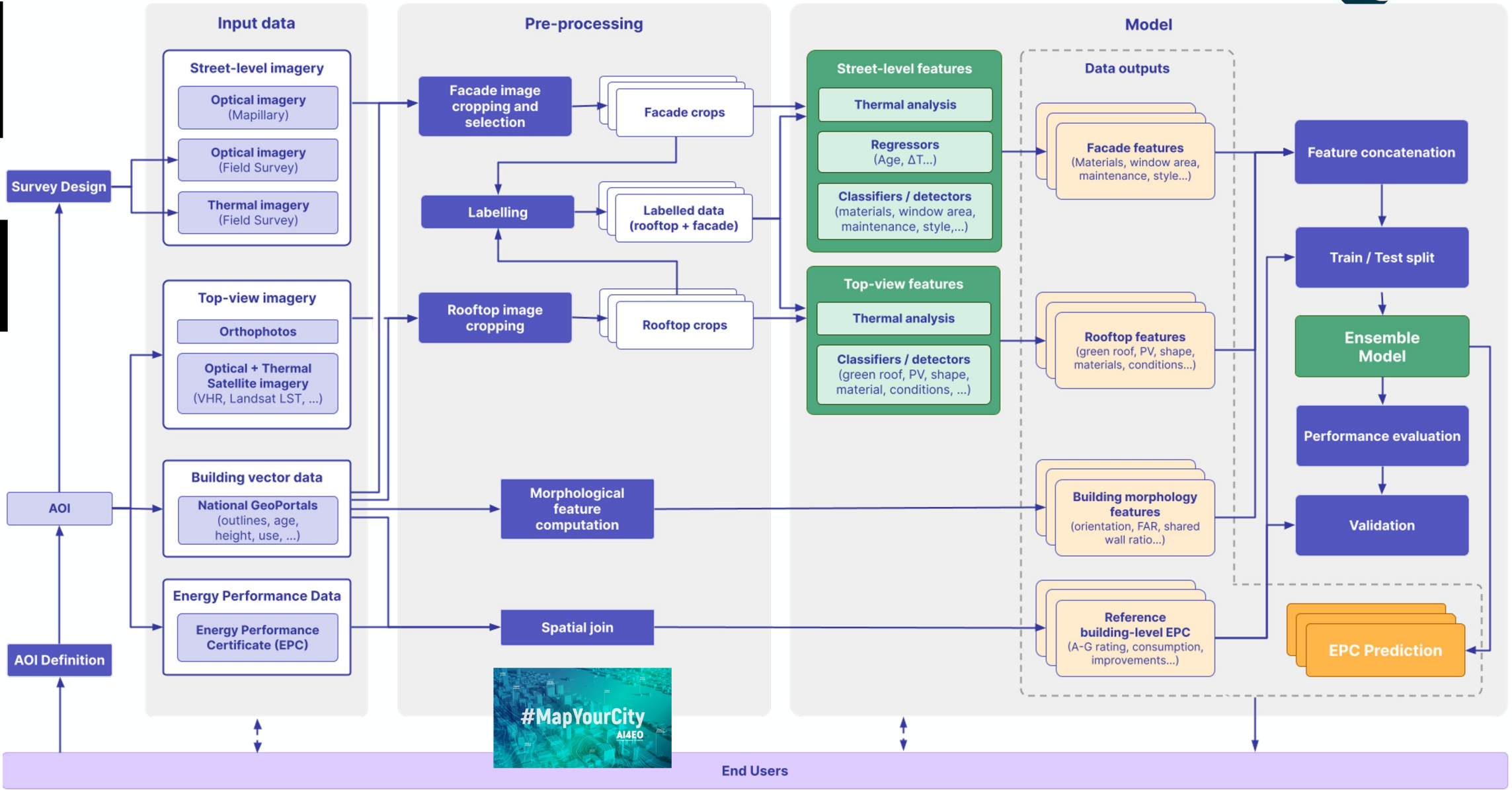
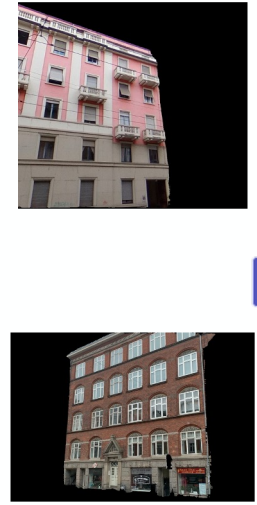


# Limitations of EPC Databases for Urban Planning

- Data Gaps and Incompleteness
- Lack of Standardisation
- Coverage Limitation
- Limited Public Access
- Highly labour intensive
- Lack of Update and Maintenance

Public access to EPC databases across Europe (BPIE, 2015)





# Space for a Green Future

Collaborative  
Interfaces

Open  
Discovery

Intelligence in  
Innovation

# WHAT NEXT?



*"We are on a highway to climate hell with our foot on the accelerator"*

António Guterres

We have a moral imperative to leverage 50+ years of public funding and private investment in space to address the greatest challenge of humanity.



*"Saving the climate is our generational task. It must unite & encourage us."*


Ursula von der Leyen

We have an obligation to  
**ACT NOW**

# Thank you!

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