Open Source in Environmental Sustainability

2023

Natural Resources

Food and Agriculture

Land and Soil

Photovoltaics
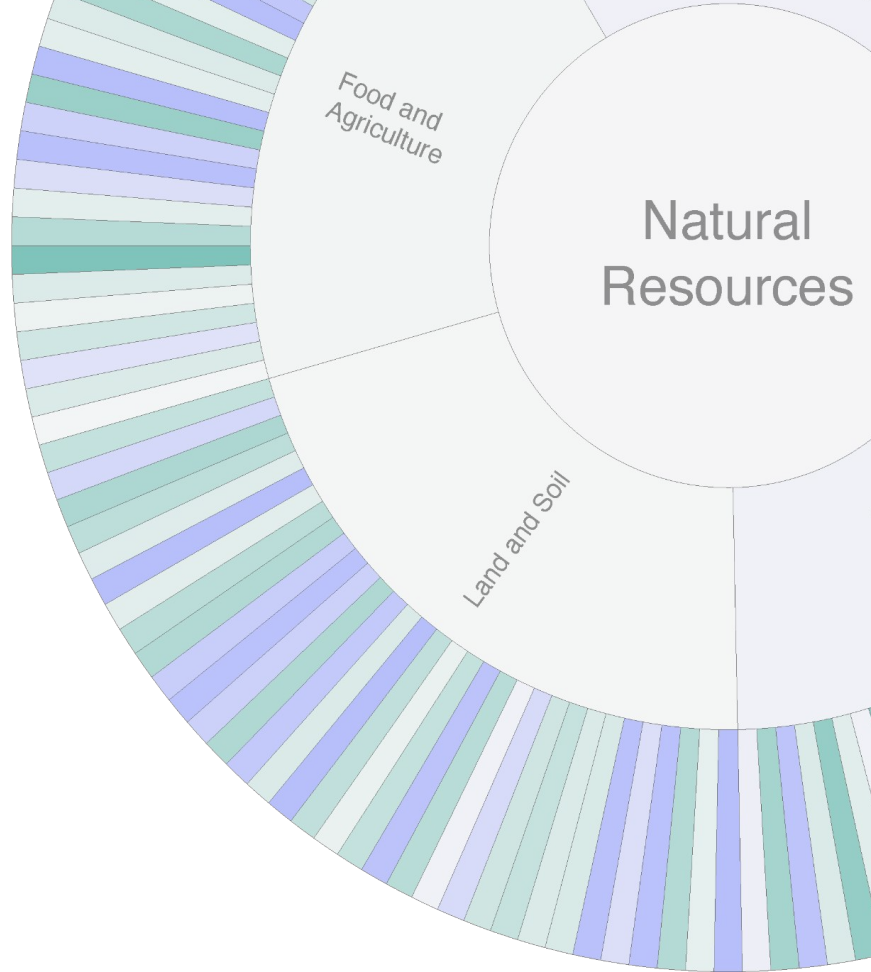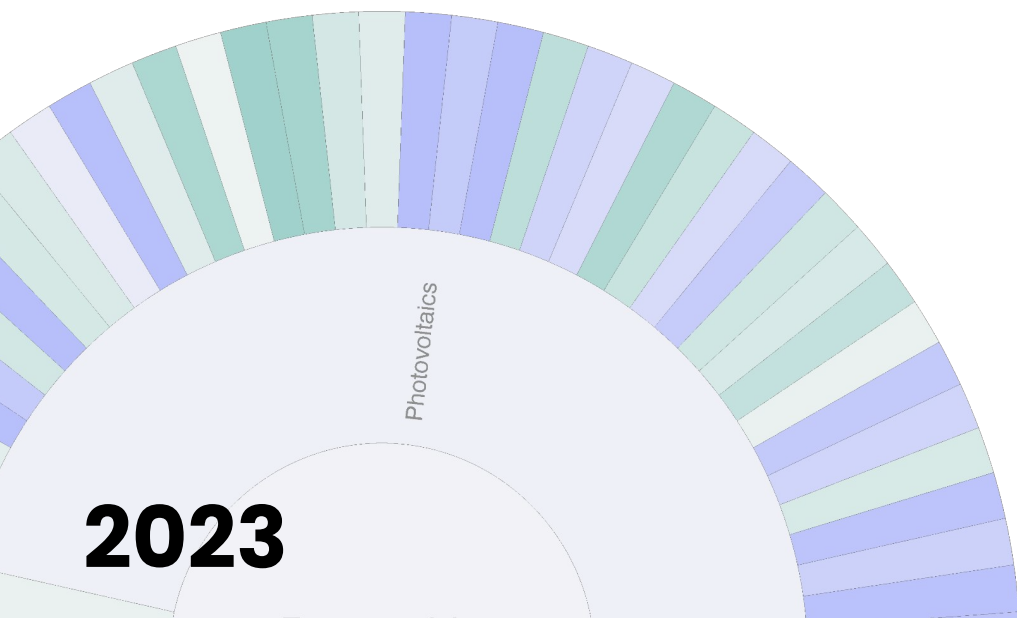
Project by

OPEN CORRIDOR

SUBAK

protontypes

Tobias Augspurger, Eirini Malliaraki and Josh Hopkins

Environmental Sustainability

Requires:

The intelligence and intention to understand, predict and manage the stability of natural resources.
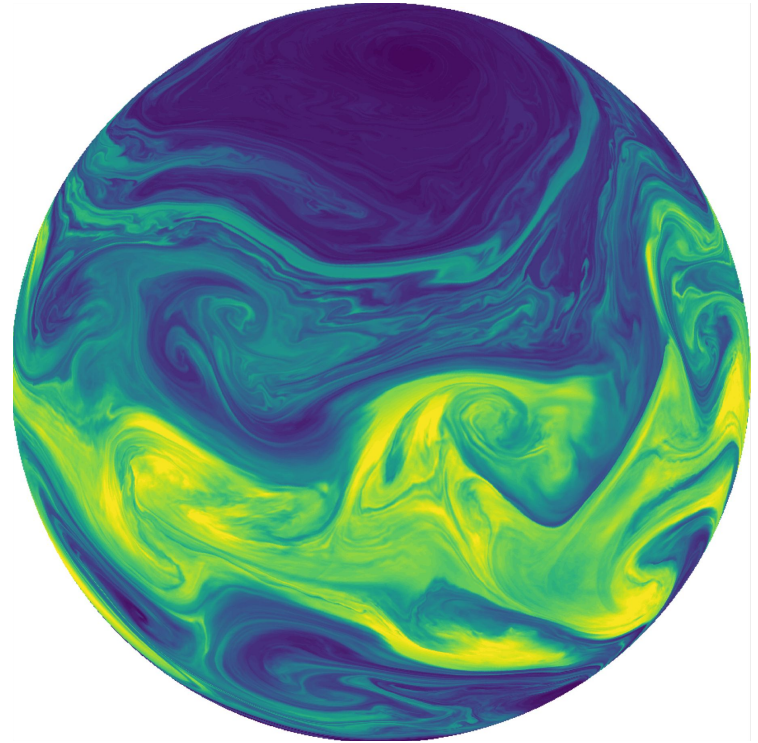
Turbulent eddies in water vapour from a 3 km horizontal resolution using the Exascale global atmosphere model SCREAM

What enables Open Source Software in Environmental Sustainability?

2,409 codebases in total were audited by Synopsys in 2021, of which 97% contained open source.
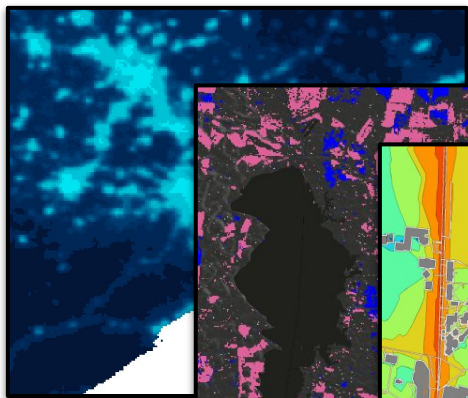
State

Insights

Principles

Visions

Strategies

Potential

Environmental Intelligence
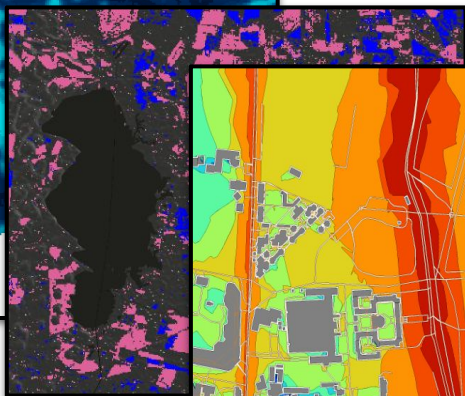
Air Quality   Forest Change   Noise   Emission   Biodiversity   Urban Vegetation   Heat Islands
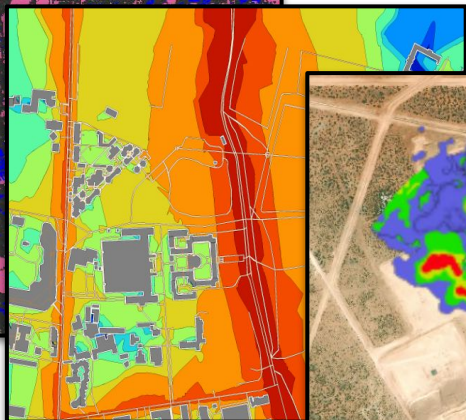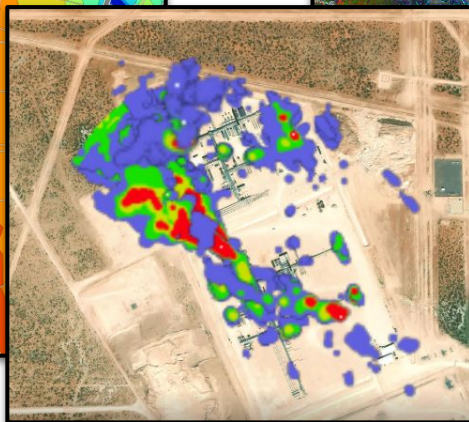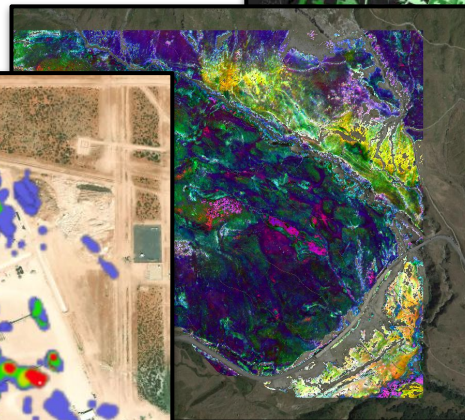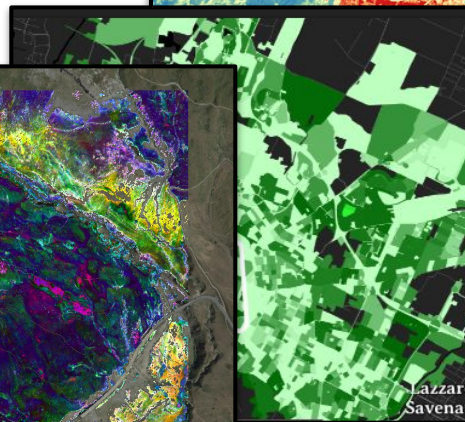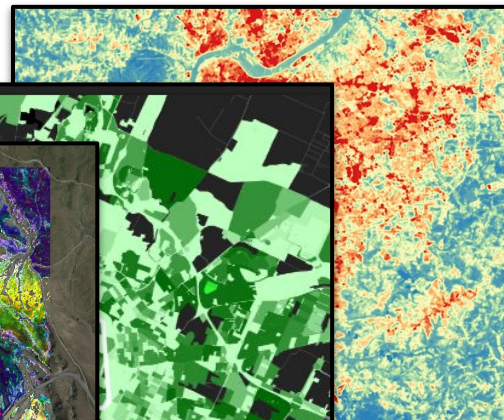
Environmental Technology
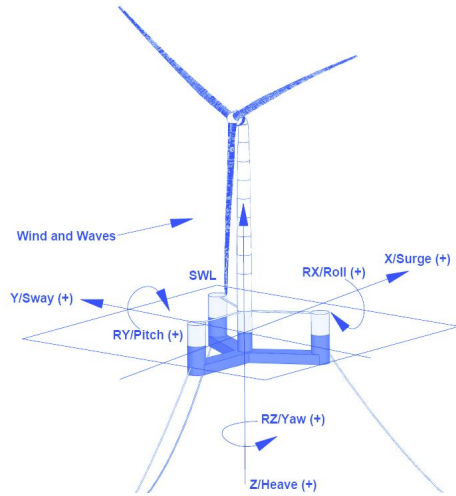
State-of-the-art 15MW reference wind turbine:
IEA-15-240-RWT

Simulating the performance of photovoltaic energy systems with **pvlib**
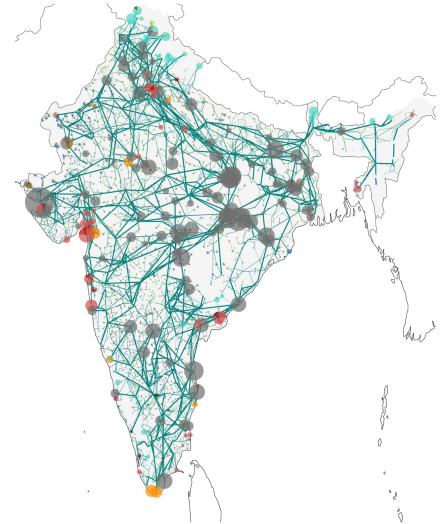
PyPSA is an open source toolbox for simulating and optimising modern power and energy systems

Methodology

Compilation and curation of all active projects that primarily aim at environmental sustainability

Automated collection of repository metadata and targeted interviews with developers

Collaborative report cross-validation between qualitative and quantitative insights
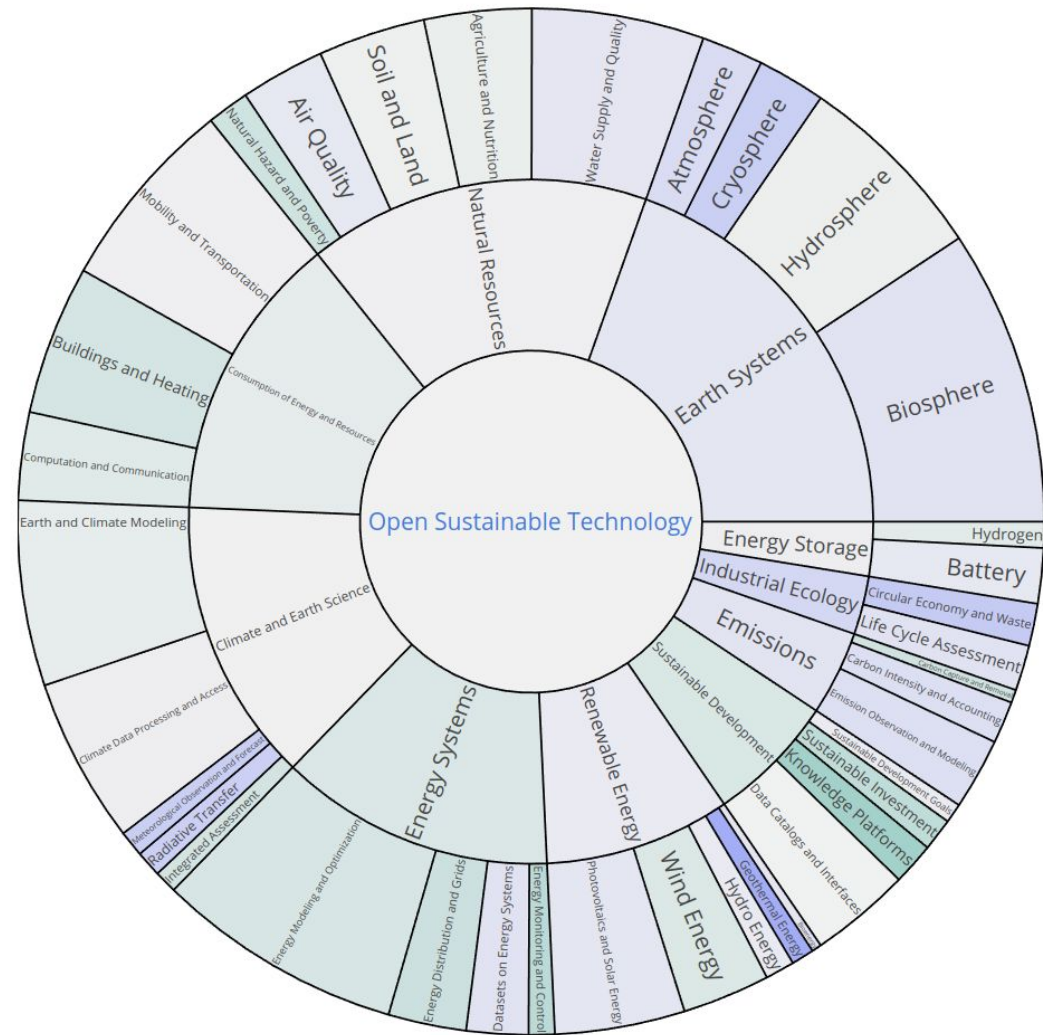
Overview on the dataset

Dimension	Value
Total number of projects	1339
GitHub projects	1187
GitLab projects	27
Other platforms	125
Number of projects in personal namespace	547
Number of projects in community namespace	792
Total stars of all projects	126568
Total contributors in all projects	14628
Active GitHub projects	995
Inactive GitHub projects	192
Projects with contribution guide in %	30.58
Projects with code of conduct in %	13.98
Projects accepting donations in %	3.71
Median number of commits	481
Median stargazers	42
Median stars last year	11
Median Development Distribution Score	0.3043
Median number of contributors	6
Median closed issues last year	8
Median commits last year	23
Median age in years	4.45

Popularity

38,851 Projects with more than 1000 ⭐ on GitHub

3 project in this ecosystem

Left chart — Stars:

Project	Stars
A/B Street	~6800
Electricity Maps	~2500
Emoncms	~1050
MetPy	
OpenFarm	
openfoodnetwork	
WRF	
WoBike	
EVCC	
Scaphandre	
Transportr	
sentinelsat	
Farmbot	
EnergyPlus	
pvlib-python	
Oceananigans.jl	
PyPSA	
palmerpenguins	
NILM	
Earthdata Search	
transitfeed	
gbfs	
sentinelhub-py	
WhiteboxTools	
netcdf-python	
pangeo	
mobility-data-specification	
CityFlow	
Streetmix	
Energy-Languages	

Stars

Right chart — Contributors (DDS color scale):

Project	Contributors
Electricity Maps	~255
openfoodnetwork	~195
SCREAM	~190
E3SM	~185
Digital Public Goods	~130
Emoncms	~115
WRF	~105
EnergyDataSimulationChallenge	~100
gbfs	~95
pvlib-python	~90
Iris	~85
EEA geospatial data catalogue	~85
pybikes	~80
netcdf-c	~80
mobility-data-specification	~80
Growstuff	~80
PEcAn	~75
pangeo	~75
ESMValTool	~72
EnergyPlus	~70
CoopCycle	~68
Karrot	~67
Open Smart Grid Platform	~65
EVCC	~65
Cloud Carbon Footprint	~65
navitia	~63
MetPy	~63
VOLTTRON	~62
PowSyBl	~62
Global Forest Watch	~62

DDS
0.8
0.7
0.6
0.5
0.4
0.3
0.2

Contributors

License and Language

Left chart (License):
- MIT 25.8%
- CUSTOM 24%
- GPL-3.0 17.3%
- Apache-2.0 11%
- BSD-3-Clause 7.98%
- AGPL-3.0 3.07%
- LGPL-3.0 2.46%
- GPL-2.0 1.74%
- CC0-1.0 1.64%
- CC-BY-4.0 1.43%
- MPL-2.0 1.23%
- BSD-2-Clause 0.91%

Right chart (Language):
- Python 39.8%
- R 16.7%
- Jupyter Notebook 9.35%
- Fortran 5.17%
- C++ 4.73%
- JavaScript 3.63%
- Julia 3.19%
- C 2.53%
- TypeScript 2.31%
- Java 2.31%
- HTML 2.09%
- Ruby 1.98%
- MATLAB 1.54%
- Modelica 1.49%

Origin and Form of Organisation

Left pie chart — Origin:
- Europe 33.1%
- North America 31.7%
- Global 28.7%
- Oceania 3.03%
- Asia 1.91%
- South America 0.955%
- Africa 0.637%

Right pie chart — Form:
- Community 25.8%
- Academia 23.4%
- Government Agency 15.9%
- For-Profit 14.3%
- Non-Profit 10.8%
- Collaboration 9.71%
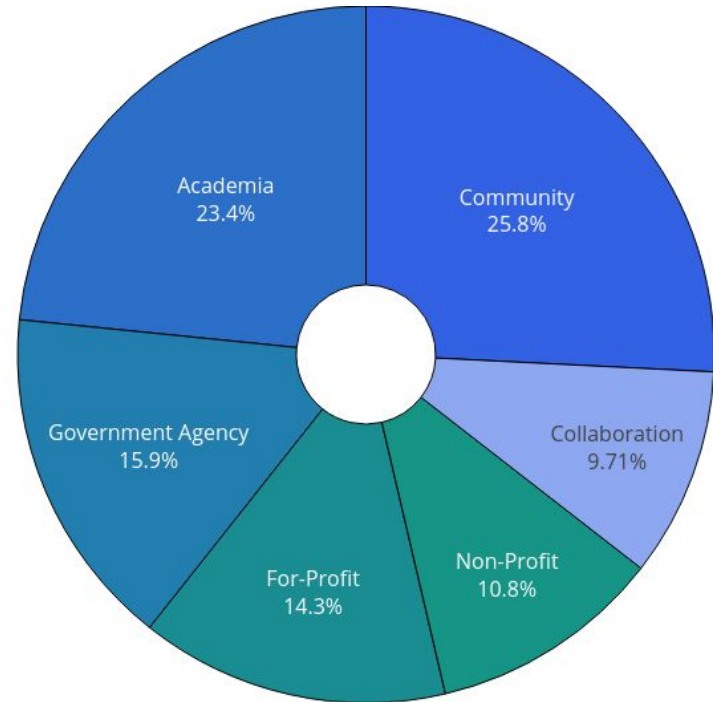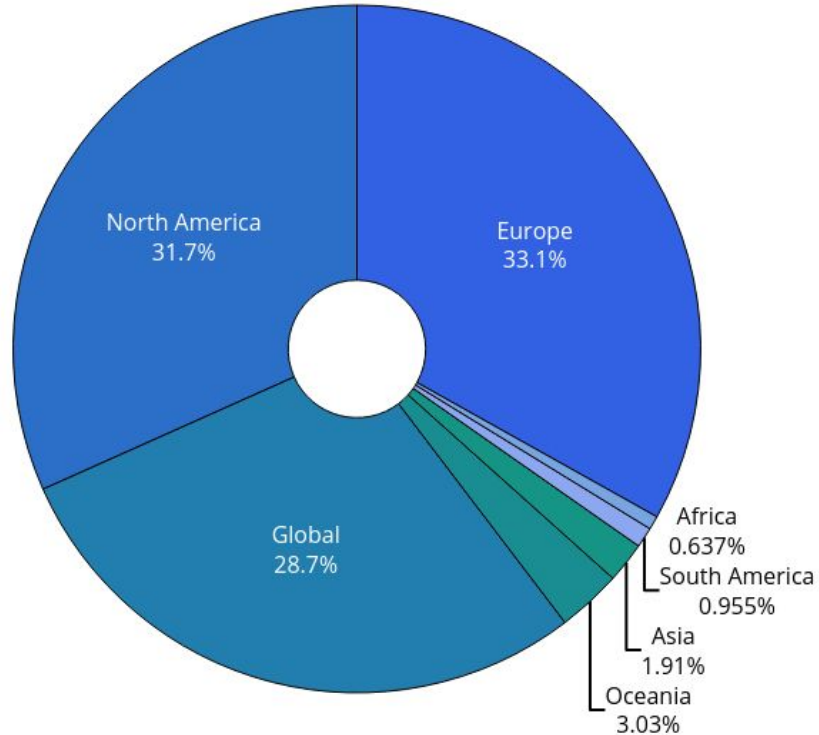
Projects and Topics

**Biosphere, Climate Science and Energy sector leading in project numbers.**

Remarkably few projects in topics like: Sustainable Investment, Carbon Offsets, Carbon Capture and Hydrogen.

Sustainable Rating and Investment

Assets under management (US$ trillion) N° Signatories

Number of Signatories
Number of Asset Owners
Assets under management
Asset Owners' Assets under management
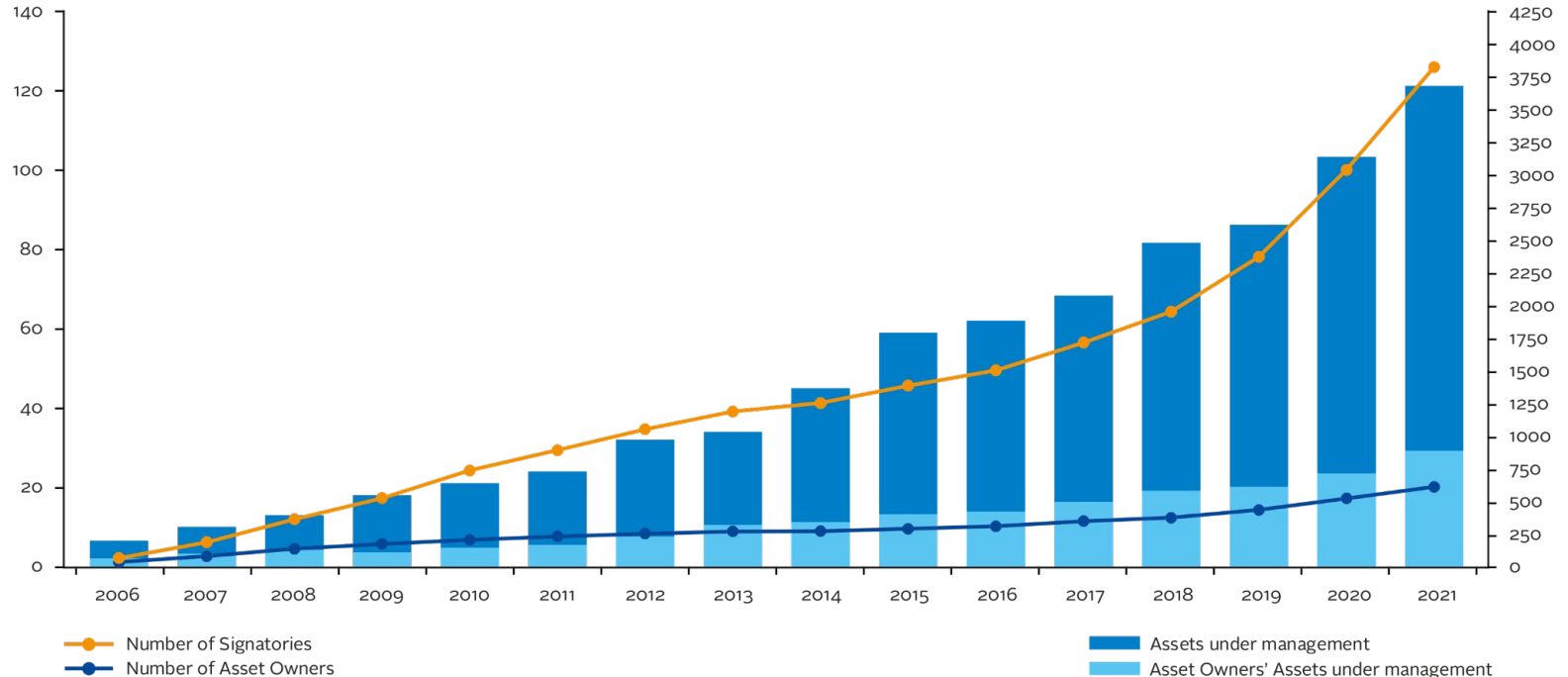
United Nations Principles for Responsible Investment

Corporate Sustainability Assessment

Corporation

Sustainability Report

News about Corporation

Sustainability Sentiment
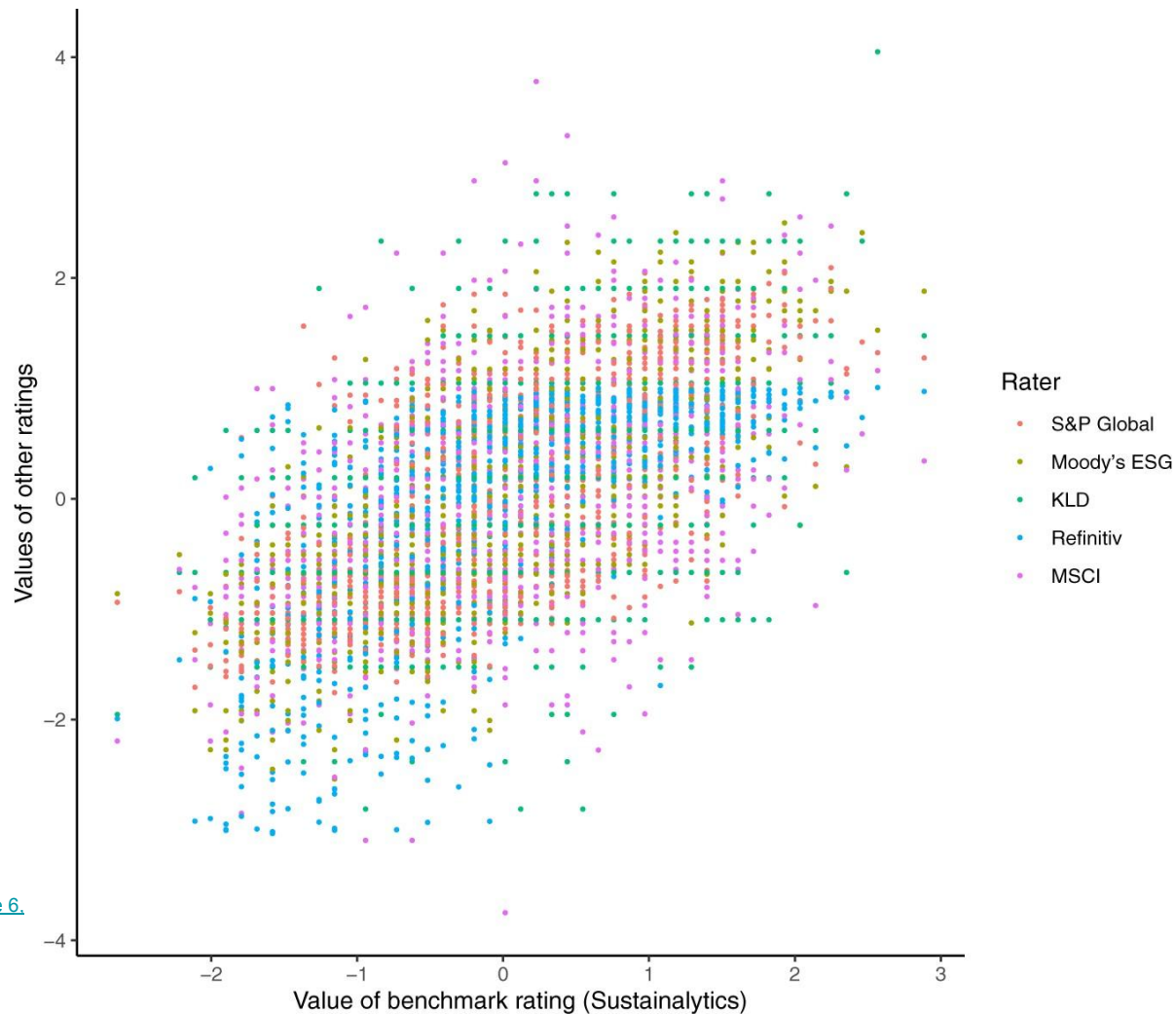
Sustainability Assessment

Sustainability Rating

Throwing the Dice

"Addressing ESG rating divergence requires one to understand how the data that underpin ESG ratings are generated."

Florian Berg, Julian F Kölbel, Roberto Rigobon, Aggregate Confusion: The Divergence of ESG Ratings, *Review of Finance*, Volume 26, Issue 6, November 2022, Pages 1315–1344,

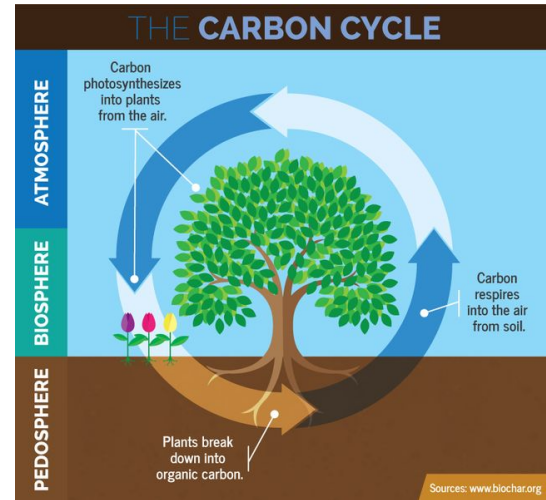# Carbon Offsets and Credits

94.9m carbon credits claimed

5.5m real emissions reductions

THE **CARBON CYCLE**

ATMOSPHERE

BIOSPHERE

PEDOSPHERE

Carbon photosynthesizes into plants from the air.

Carbon respires into the air from soil.

Plants break down into organic carbon.
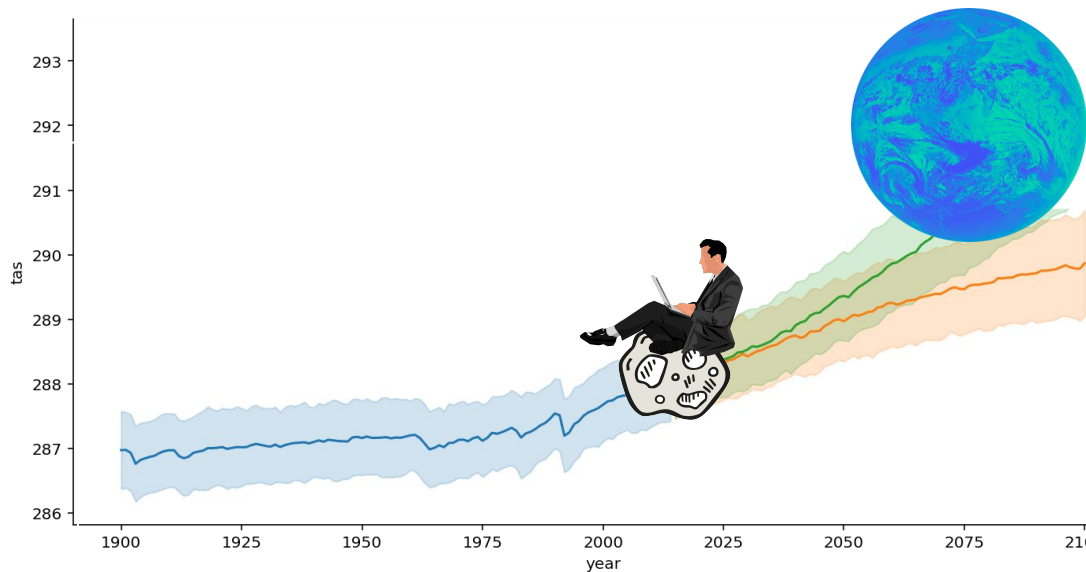
Sources: www.biochar.org

Safety Critical Decision Making

**Open science
in the creation of knowledge
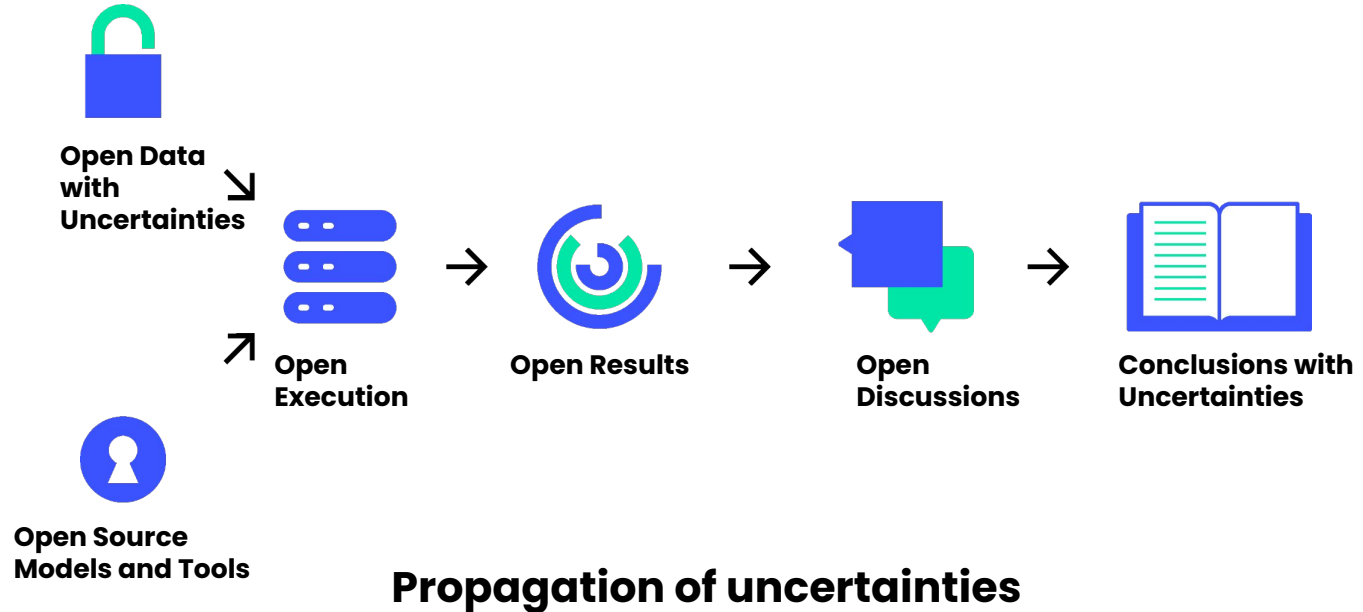on the state and predictions of
natural resources** ✅

**Open science
in the decision making
and assessment of
sustainable investment** ❌

Global Mean Surface Temperature prediction with Pangeo, an open source development environment for the earth science.

#FreeTheModels

Traceability and Uncertainty of Environmental Information

Open Data with Uncertainties

Open Execution

Open Results

Open Discussions

Conclusions with Uncertainties

Open Source Models and Tools

Propagation of uncertainties

Openness as key Indicator for Sustainability

By providing open data and open source models on sustainable intelligence, actors demonstrate their sustainable intention.

Cedalion standing on the shoulders of Orion from Blind Orion Searching for the Rising Sun by Nicolas Poussin 1658

Spatial Finance

Using Earth observation to measure the environmental impact and geolocation of business activity and supply chain.
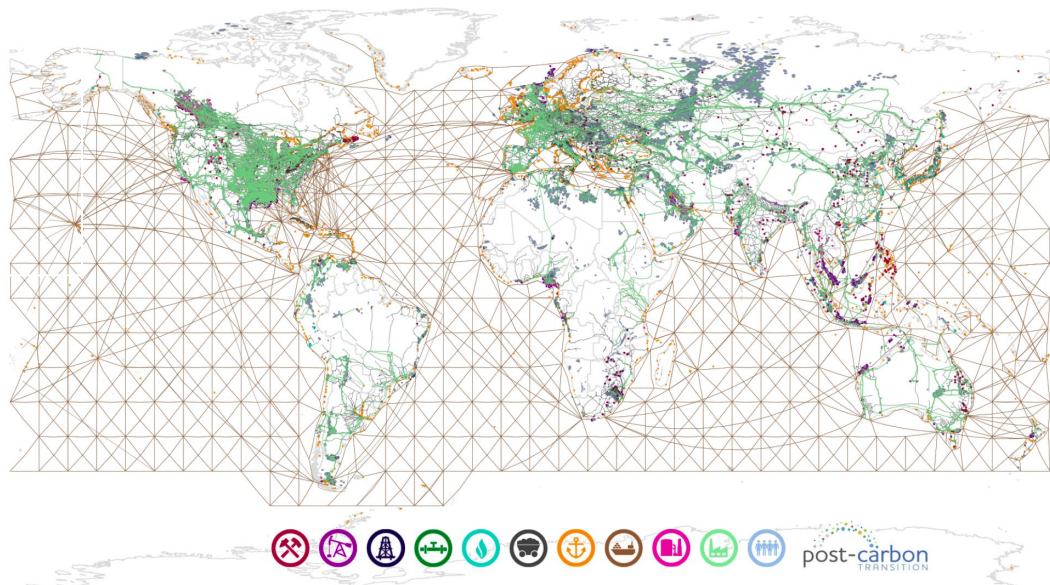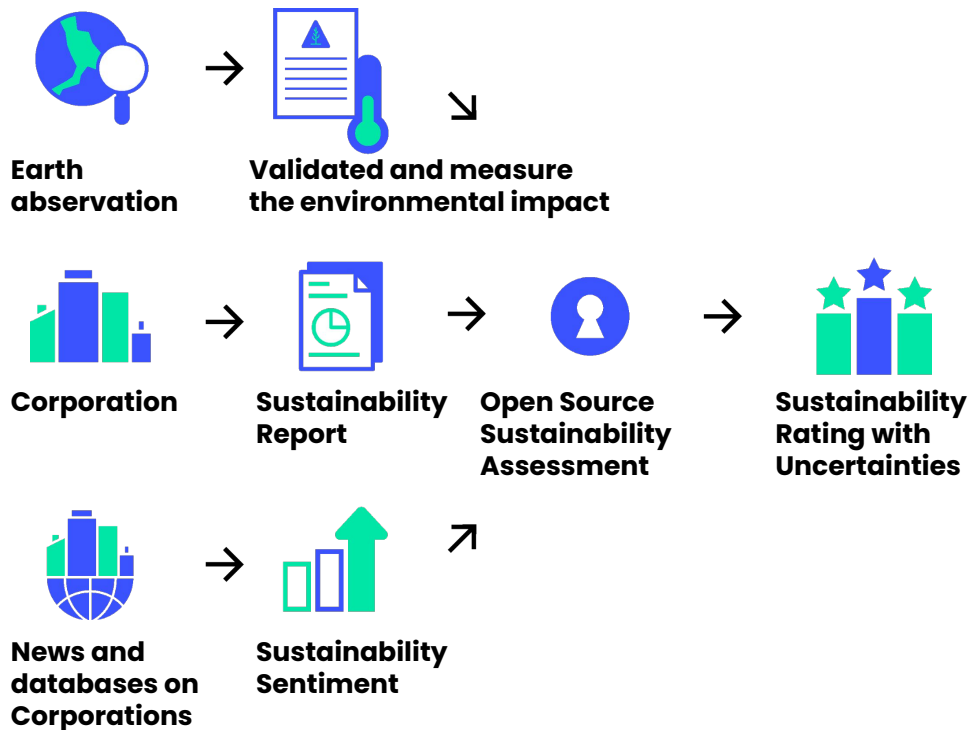

[Asset-Level Transition Risk in the Global Coal, Oil, and Gas Supply Chains](#)

Open Sustainability in Investment

Openness as key measure of traceability and uncertainty in sustainability rating.

Earth observation → **Validated and measure the environmental impact**

Corporation → **Sustainability Report** → **Open Source Sustainability Assessment** → **Sustainability Rating with Uncertainties**

News and databases on Corporations → **Sustainability Sentiment**

Open Source - The most underestimated climate strategy

Let's build a free and open operating system for global environmental sustainability together.

Read the full report: https://report.opensustain.tech/