F.A.I.R. information cube

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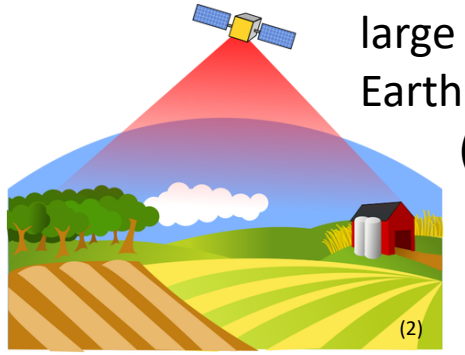
Learn more here:

Overview

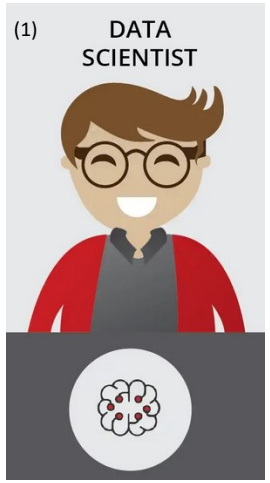
- Motivation
- FAIRiCUBE Objectives
- Use cases

*«Deliver the power of **data cubes and ML** to decision/policy makers and data scientists»*

Motivation



large regular, gridded Earth Observation (EO) data

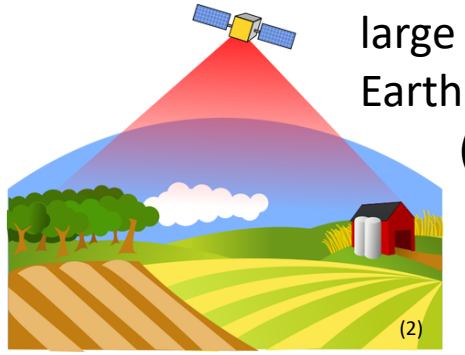


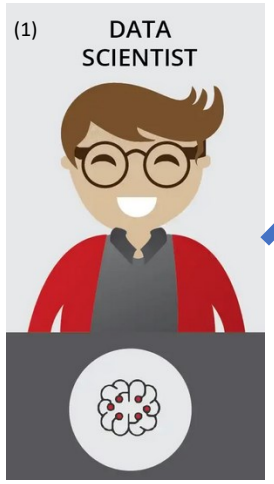
environmental problem

[1] https://medium.com/dataseries/what-does-a-data-scientist-do-a6553dc720f
[2] https://publicdomainvectors.org/en/free-clipart/Satellite-imaging/82710.html
[3] https://www.mindler.com/blog/careers-to-save-the-environment/

Motivation – Ideal case

large regular, gridded Earth Observation (EO) data





local resources

clever processing

environmental problem

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[4] www.rawpixel.com

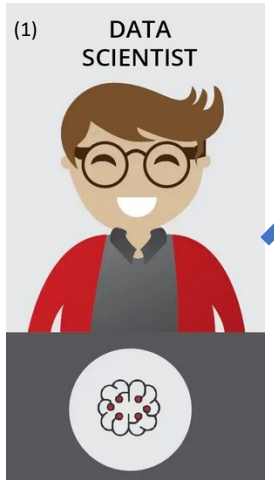
Motivation – Real case

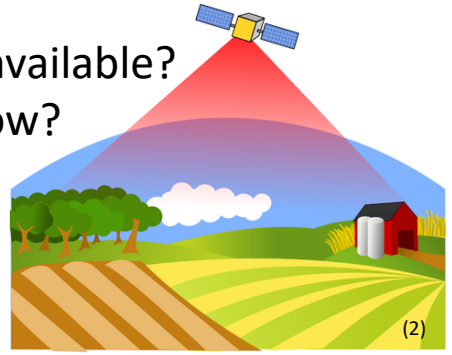
What data is available?
Where and how?

more data needed

What algorithm works best?
Machine learning?
AI ethics?

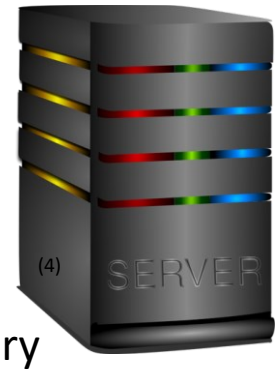
environmental problem





CRS
data/file format
data extend

out of budget



out of memory
takes forever

[1] medium.com/dataseries/what-does-a-data-scientist-do-a6553dc720f
[2] publicdomainvectors.org/en/free-clipart/Satellite-imaging/82710.html
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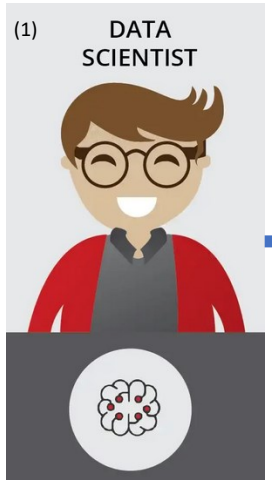
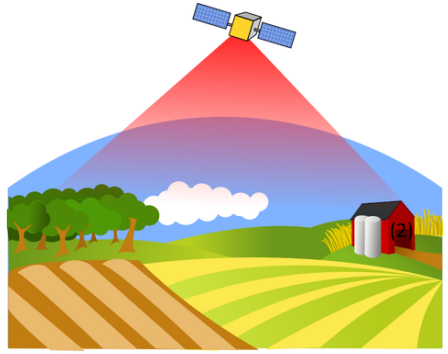
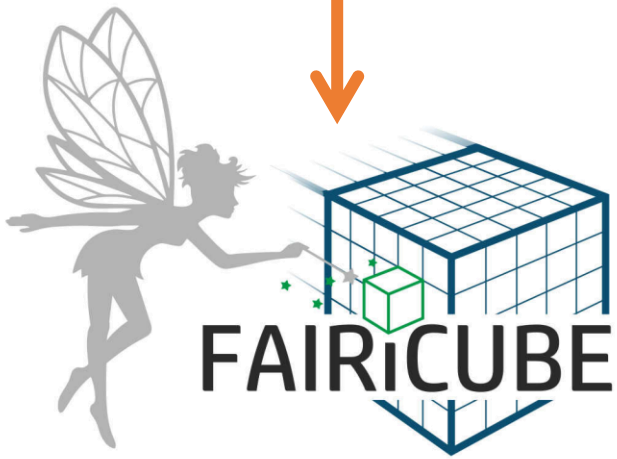
Motivation – FAIRiCUBE case







FAIRiCUBE Hub

environmental problem

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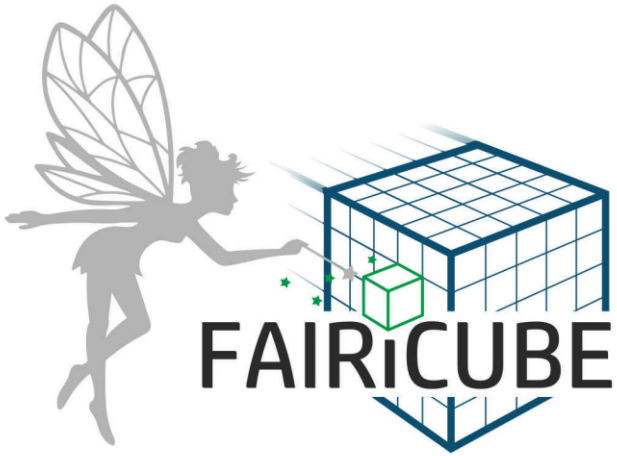
FAIRiCUBE Objectives



- data catalogue of pre-gridded, pre-aligned, pre-referenced EO data
  - create your own custom data cube
- data storage & compute resources
- data processing catalogue (including Machine Learning)
- community platform sharing
  - data layers, data products
  - processing steps (e.g. Python Notebooks)
  - ML models & AI ethics
  - documents
- if all this works: F.A.I.R. ✓

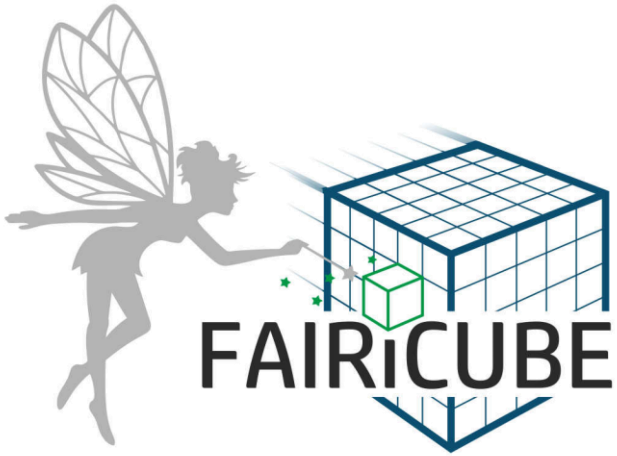
FAIRiCUBE Objectives

The **core objective** of FAIRiCUBE is to enable players from beyond classic Earth Observation (EO) domains to **provide, access, process, and share gridded data and algorithms** in a FAIR and TRUSTable manner.

The project's goal is to **leverage the power of Machine Learning** (ML) operating on multi-thematic datacubes for a broader range of **governance and research institutions** from diverse fields, who at present cannot easily access and utilize these potent resources.

Project duration: 07/2022 – 06/2025
kick-off held 01.07.2022, technical kick off 13/14.10. 2022 ✓

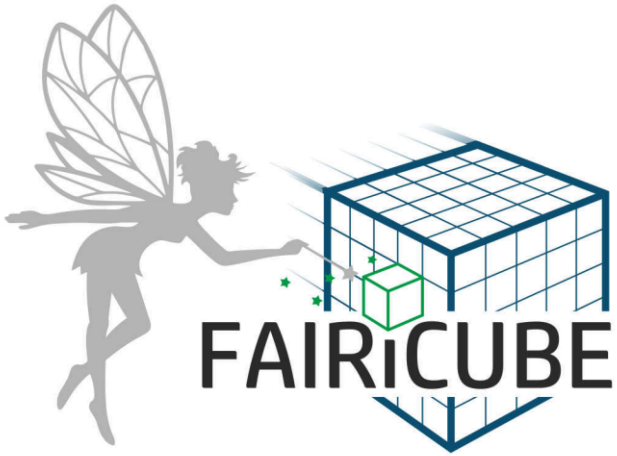
FAIRiCUBE Partners



- data cubes are mature, performance, scalability and capability is proven
- platforms are well established

- data cube platform providers are project partners
  - Jacobs University / rasdaman (EarthServer), Germany
  - EOX (EuroDataCube), Austria
- research institutes
  - **NILU**, Climate and environmental research institute, Norway
  - Wageningen university and research, Holland
  - Museum of Natural History, Vienna, Austria
- environmental SME's
  - space4environment, Luxembourg
  - 4sfera, Spain
  - epsilon, Italia

Use case «demonstrators»



- 4 Use Cases being executed on the FAIRiCUBE Hub
  - addressing **EU green deal** action items
  - urban / regional focus
  - Barcelona / Vienna / Oslo / Luxembourg
  - using different scale length, areas, objectives, technical platforms
  - research questions formulated
  - What data is available?
  - How can we make this data available through the FAIRiCUBE Hub

1) Urban adaptation to climate change

2) Spatial and temporal assessment of neighborhood building stock (urban)

3) Biodiversity and agriculture nexus (regional)

4) Biodiversity occurrence cubes (urban / regional)

EOX rasdaman raster data manager

JACOBS UNIVERSITY

space 4 environment

WAGENINGEN UNIVERSITY & RESEARCH

nhm naturhistorisches museum wien

NILU

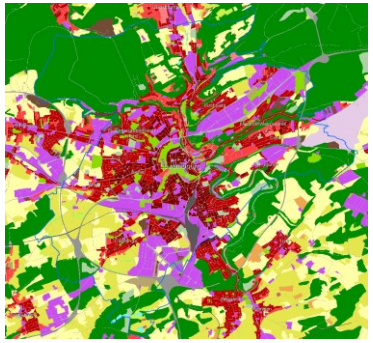
4sfera innova

EPSILON Italia

Urban adaptation to climate change

space 4 environment

- Cities face a lot of challenges combating the impacts of climate change → "If you can't measure it, you can't manage it" → basis for all actions are reliable and accessible data and information of high quality
- Creation of dashboards with indicators describing status and trends of parameters of single cities, comparable across Europe since based on European data
- Collect local data and indicators based on stakeholder exchange; harmonise them with other data
- Use of simulations/models/scenarios/machine-learning to simulate possible outcomes and the consequences thereof
- We try to provide a "tool kit" to cities to make better informed decisions by having as much data as possible at their fingertips and being able to simulate their decision-making process:
  - What happens if one parameter changes intentionally by decisions?
  - Which parameter has the strongest influence on improving the quality of life?



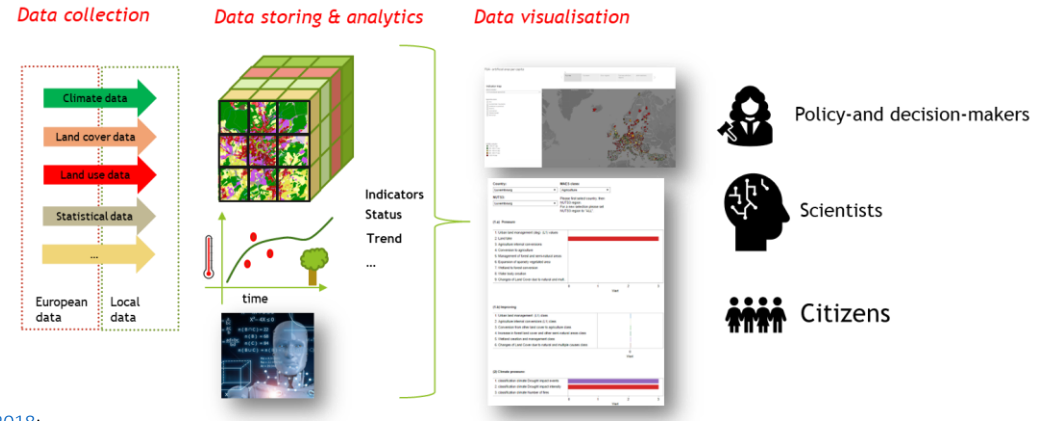


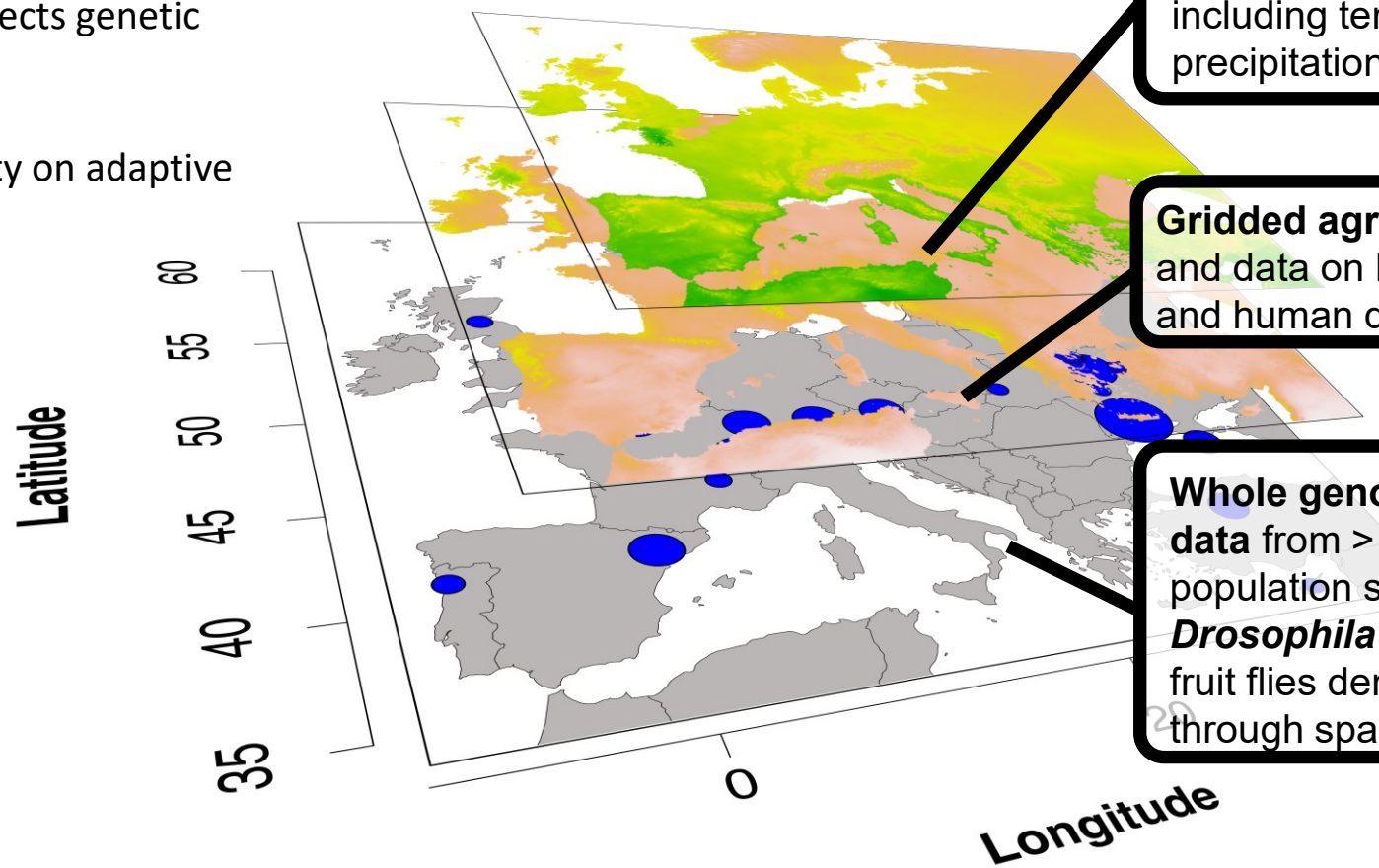
Image sources: Urban Atlas map of Luxembourg from https://land.copernicus.eu/local/urban-atlas/urban-atlas-2018; pedestrian zone in Guangzhou/China from https://urban.uw.edu/news/accessible-pedestrian-routing-tools-expand-to-three-washington-cities/

Linking climatic and genetic variation for biodiversity inference

- API to intersect quantitative genomic and spatial datasets
- To investigate how climatic variation affects genetic diversity
- To assess the influence of human activity on adaptive evolution

Drosophila melanogaster

as a genomic and ecological model organism



Gridded climatic data, including temperature, precipitation, seasonality, etc.

Gridded agricultural data and data on land-use, traffic and human demography

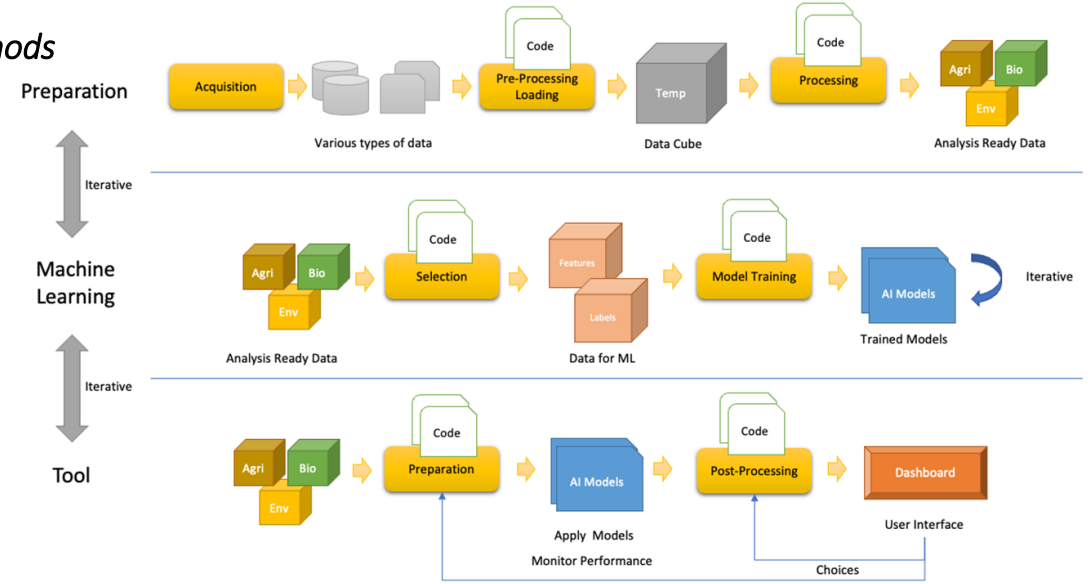
Whole genome sequencing data from > 170 European population samples of ***Drosophila melanogaster*** fruit flies densely sampled through space and time

Agriculture and Biodiversity Nexus

WAGENINGEN UNIVERSITY & RESEARCH

- Clarify links between biodiversity and agriculture by detecting patterns in the data through the use of **explainable machine learning;**
- Provide a step forward in making more precise **estimates of biodiversity** in a spatial context;
- Improve the **data challenges** by the use and sharing of prepared **data and occurrence cubes;**
- Add to the **current knowledge base** by cooperating with **domain experts;**
- Ultimately assist stakeholders in selecting more **nature-inclusive practices promoting biodiversity**

Methods



Data

- **Biodiversity –** species occurrences (NDFF, GBIF, statistical), existing RS derived products (HR-VPP,...)
- **Agricultural –** crop parcel registration, agricultural nature management, farm management activities, .
- **Environmental –** remote sensing (signals, markers, indices), land use/cover, terrain, soil, weather, ...

Building stock model at neighbourhood level

- Buildings are the cornerstone of our living; however, they have faced multidimensional challenges, for instance:
  - They consume tremendous amount of natural resources to be built and generate enormous construction waste at the end of their life cycle,
  - They consume more than 1/3 of final energy use and emit more than 1/3 of global energy-related greenhouse gas emissions,
  - They are energy inefficient and at the same have faced the aging problem,
  - They are at risk of being unable to cope with the negative effects of climate change
- Answering such challenges require sufficient knowledge to benefit energy and resource efficiency at reduced impacts to environment
- This use case aims at developing models based on data compliant with F.A.I.R-data definition to estimate (a) material use intensity and energy performance and (b) associated greenhouse gas emissions of building stocks (LOD2 or above)
- The work uses machine-learning models, energy modelling and life cycle assessment to estimate circularity and energy performance and in-service materials at a neighbourhood level

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Many thanks for your attention

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FAIRiCUBE

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