EO4EU

Earth Observation Data & Service Accessibility

EO4EU: An Integrated and Scalable Platform for Accessing and Processing Earth Observation and Earth Modeling data

October 1, 2024

Speakers: Dr. Claudio Pisa & Dr. Vasileios A. Baousis

Funded by the European Union

Challenges for exploiting EO data

Diverse sources of information

Data fragmentation

Difficulty to find and retrieve relevant data

Lack of tools to download and process EO data

EO4EU - brief intro

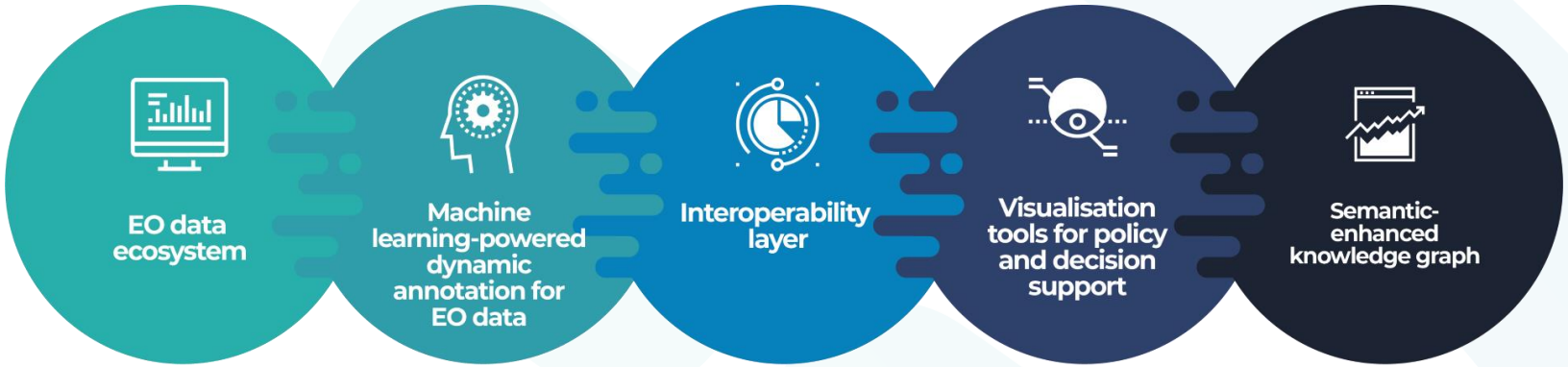
- EO4EU provides improved access to the EU EO data offered by a variety of platforms and data repositories.
- Data sources include Copernicus services and associate platforms like the DIAS, but also upcoming initiatives like Destination Earth (DestinE)
- Users interact through :
  - A multi-layered user interface (GUI) for visual analytics coupled with a Workflow Editor,
  - A Command Line Interface (CLI), and a respective Application Programming Interface (API),
  - An extended reality (XR) interface

EO4EU Partners

EO4EU Platform

The EO4EU Platform* allows for searching, discovering processing and analyzing EO data and is based on a series of innovative technologies which allow to:

- Access** EO data from different sources (e.g., Copernicus, Galileo, ECMWF)
- Support a sophisticated representation of data through a semantic-enhanced **Knowledge Graph**
- Use **Machine Learning** from marketplace to EO data processing
- Visualize EO data through easy-to-use graphical interfaces and **Extended Reality** applications



* https://www.eo4eu.eu/platform
** *Public user access: May 2024*

EO4EU architectural bird's-eye view

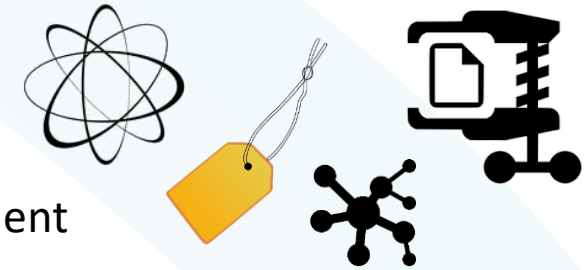
Orchestration Language

EO4EU applications

- Dashboards
- API
- Data processing workflows
- XR

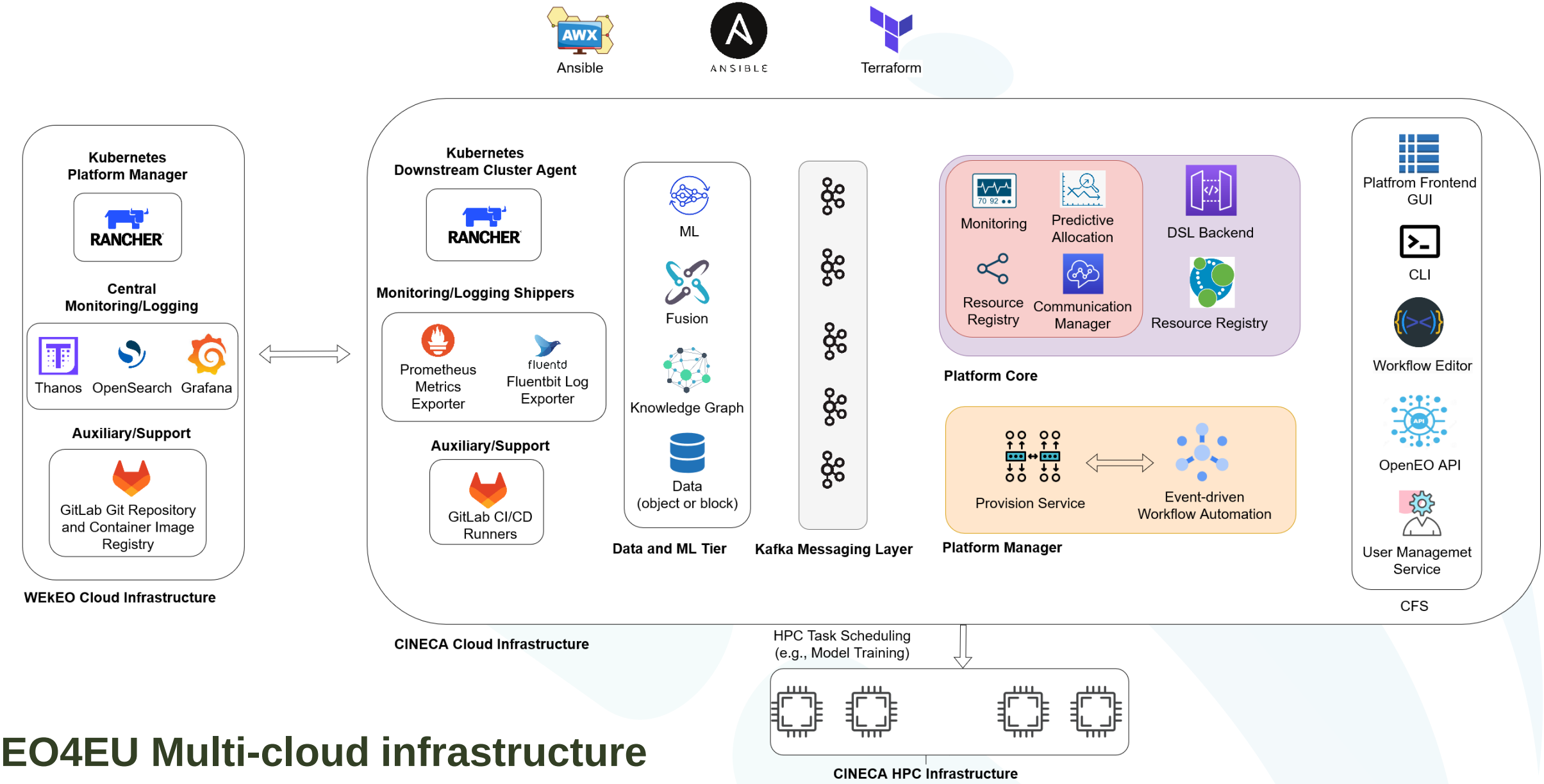
EO4EU processing infrastructure

- Fusion
- Semantic annotation
- Compression
- Knowledge management



EO sources

- Copernicus: CAMS-CDS-CLMS, CMEMS
- ADAM: Sentinel Satellite Missions, Copernicus Data space
- Other services & use cases :Istat.it, INSPIRE, CMCC, ECMWF, NOAA

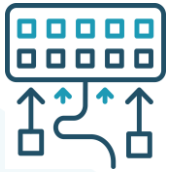


EO4EU Multi-cloud infrastructure

Key results

EO Data Ecosystem

Semantic Enhanced Knowledge Graphs



Data Fusion Techniques

Dynamic Semantic Annotation and Learned Compression

Augmented/ Extended Reality

Data Analytics Visualisations

Who benefits?

Researchers and Academia:
Supports research institutions with more accessible EO data

EO data providers:
Promotes further usage of EO data through value added tools

Citizens and scientists:
Enables new actions to reduce and monitor the impact of climate change

Policy-Makers:
Supports evidence-based policy-making and climate action

Private sector:
Encourages innovation through more accessible EO data for non-technical users

Standards Development Organisations:
Contributes to the revision of standards related to EO data

EO4EU Use Cases

EO for Personalised Health care Services: expand mobile allergy and airborne hazards forecasting

Food Security: improve adaptability of food production using EO4EU for live climate data tracking and analysis

Soil Erosion: Integrate rainfall datasets through EO4EU to assess soil susceptibility to water erosion

Civil Protection: Improve disaster and calamity prevention and response using EO datasets

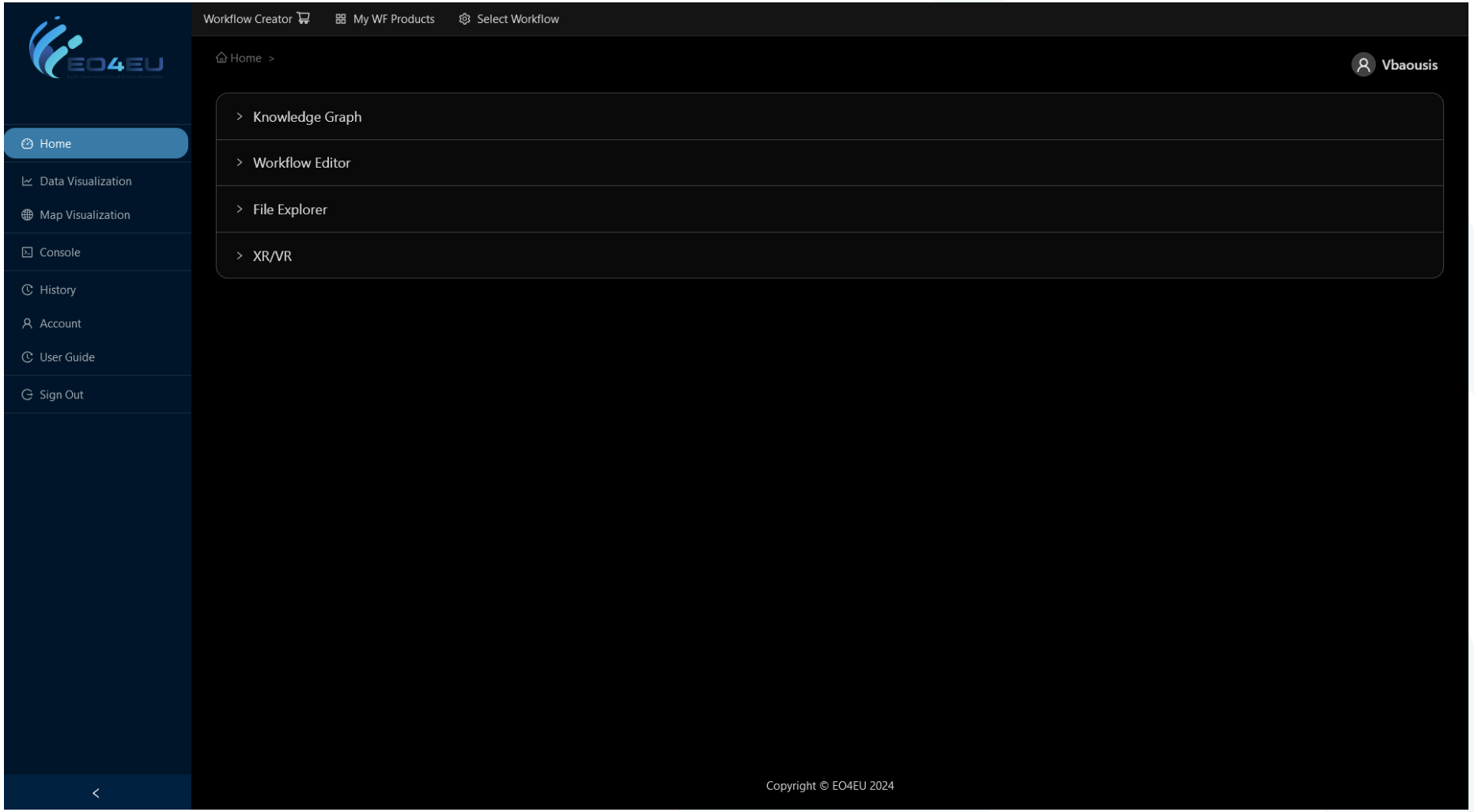
Ocean Monitoring: optimise shipping industry travel time across different oceans considering live weather data

Forest Ecosystems: Improve forest productivity using EO4EU to simulate water, anergy and carbon fluxes

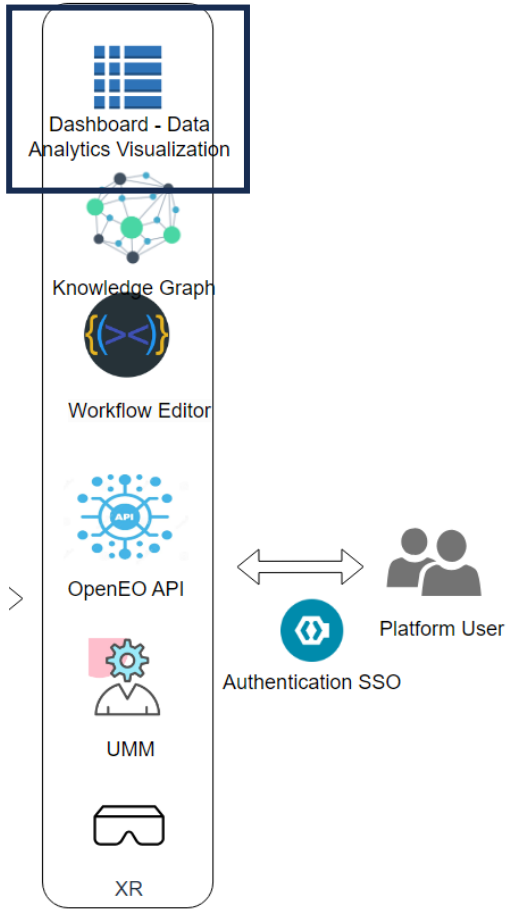
Environmental Pests: Locust plague impact assessment and prediction

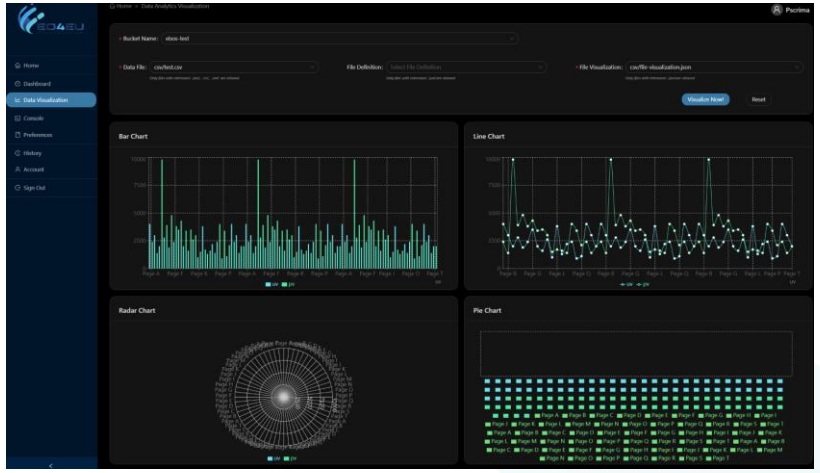
Visit https://eo4eu.eu/use-cases

Access to the platform : https://dashboard.apps.eo4eu.eu/home



EO4EU Components – Data visualization

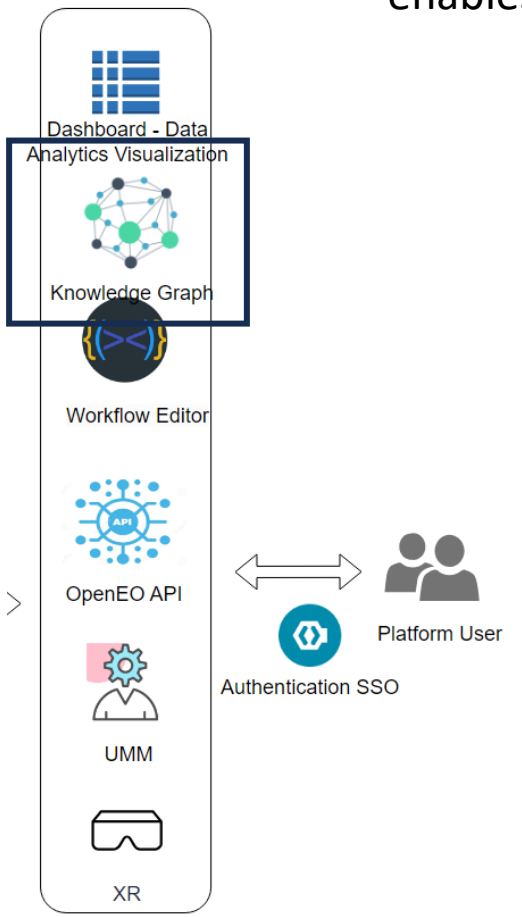


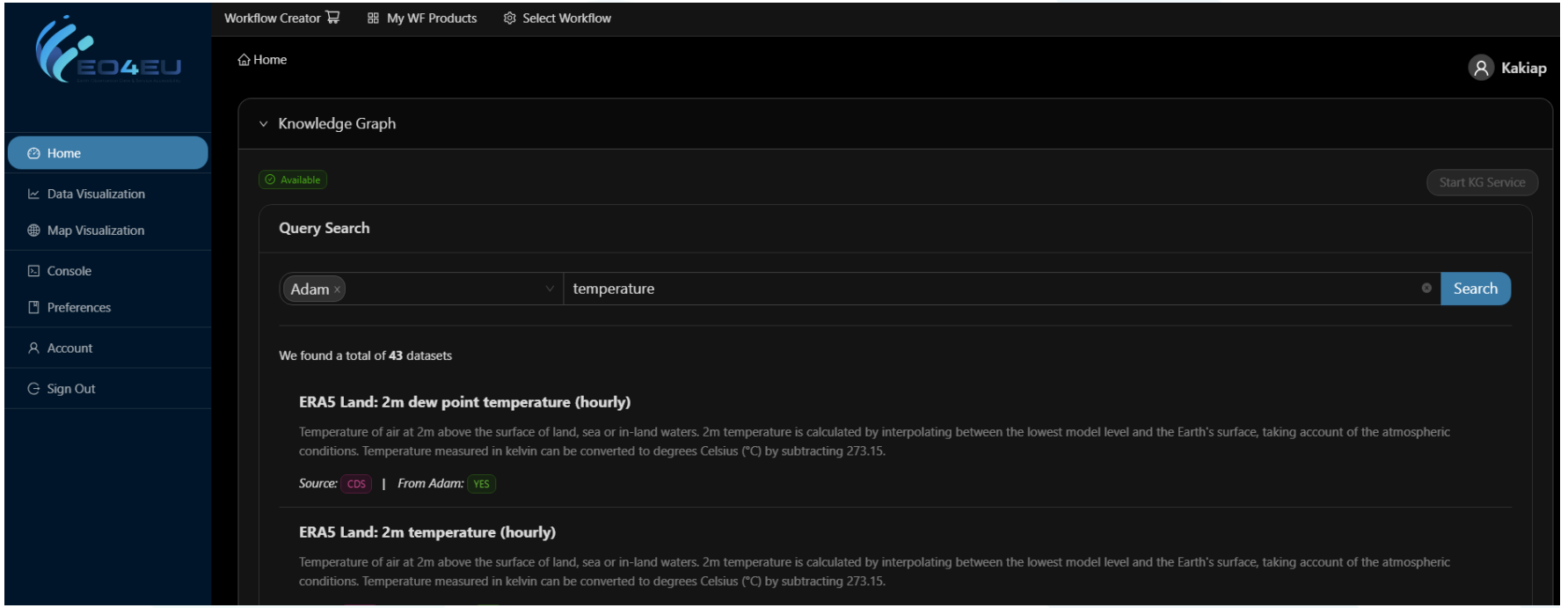


EO4EU Components – Knowledge Graph

EO4EU knowledge graph enables users to access and explore EO data and derive valuable insights.

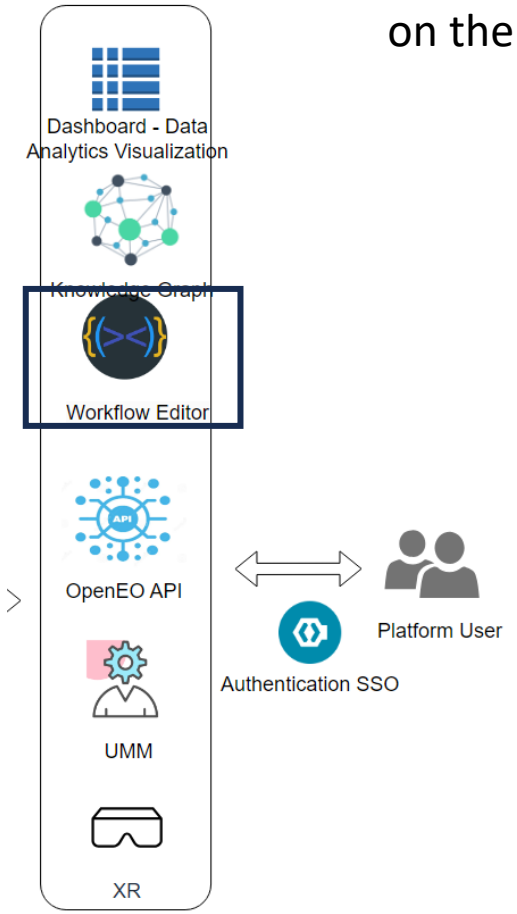
- integrates disparate datasets so that users can explore interconnected data points
- enables users to locate specific information effortlessly using natural language queries

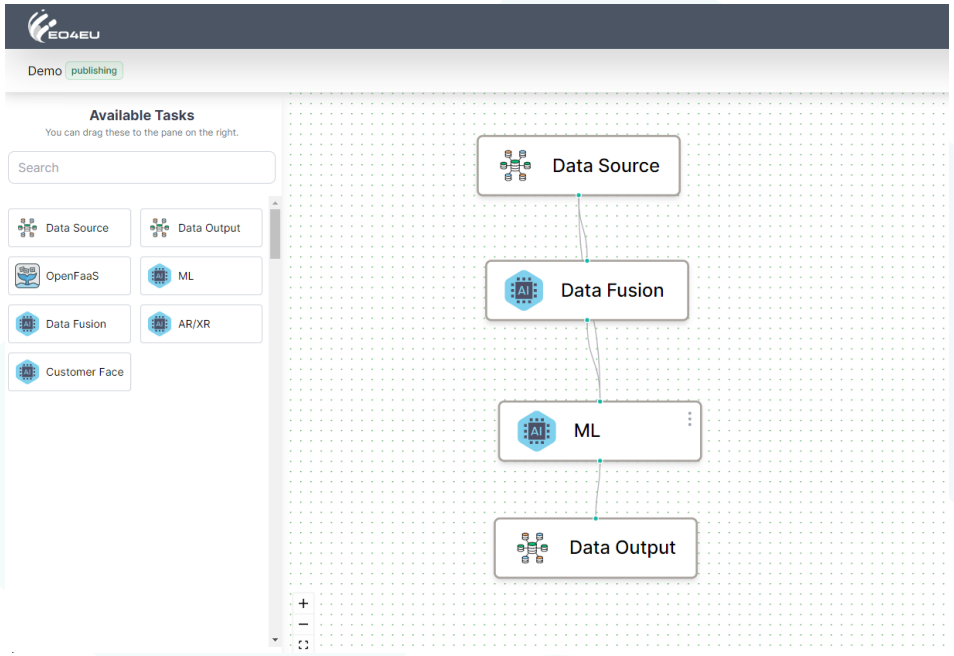




EO4EU Components – Workflow Editor

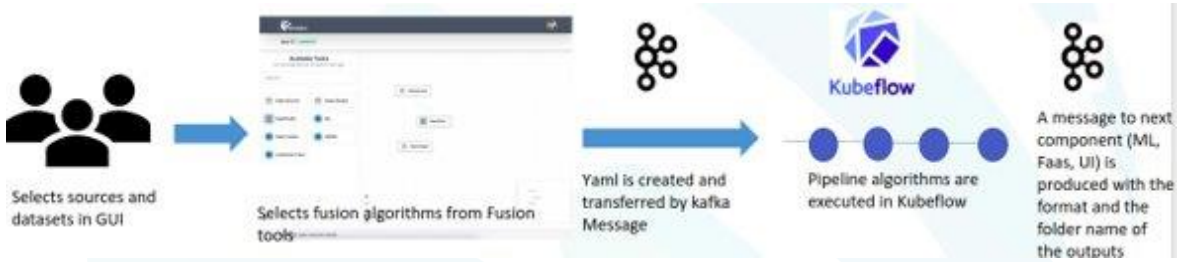
- Canvas with all the available tasks represented as blocks in the left column.
- User can drag & drop the block on the central canvas and connect the block using the links
- Blocks can also be configured by opening the configuration form available by clicking on the menu on the top right of the block

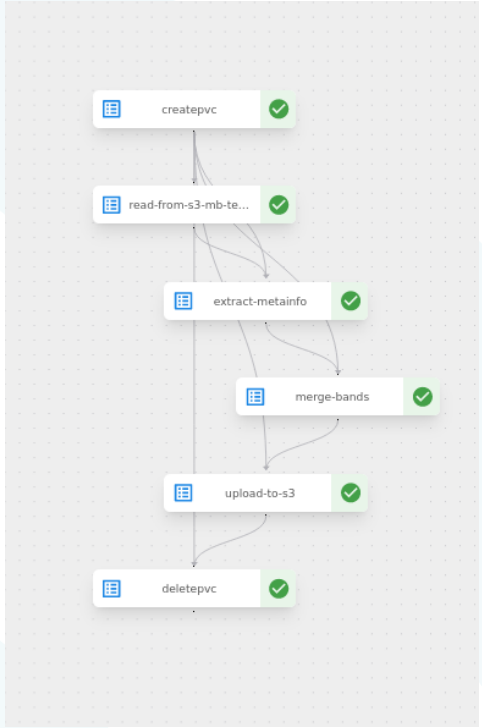




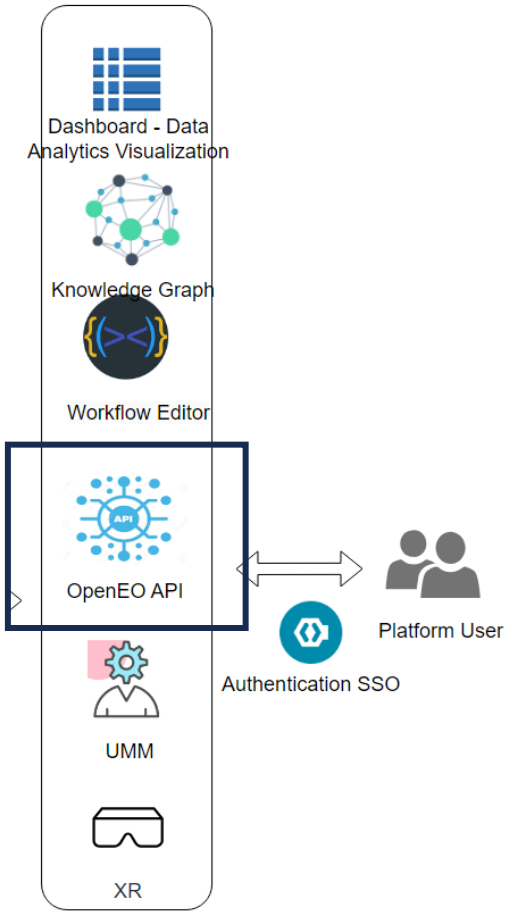
EO4EU Components – Fusion Engine

- Creates pipelines for
  - Spatiotemporal processing
  - Cleaning and preparation of data
- Based on Kubeflow and Python
- Messaging through Kafka
- Connection with Marketplace



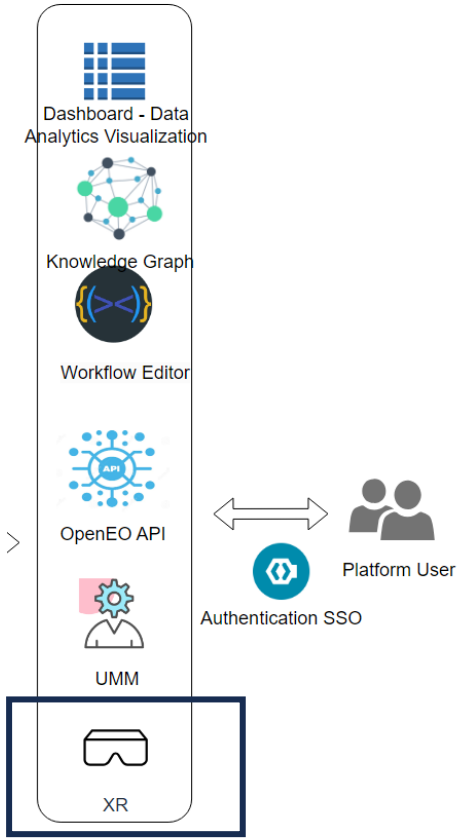


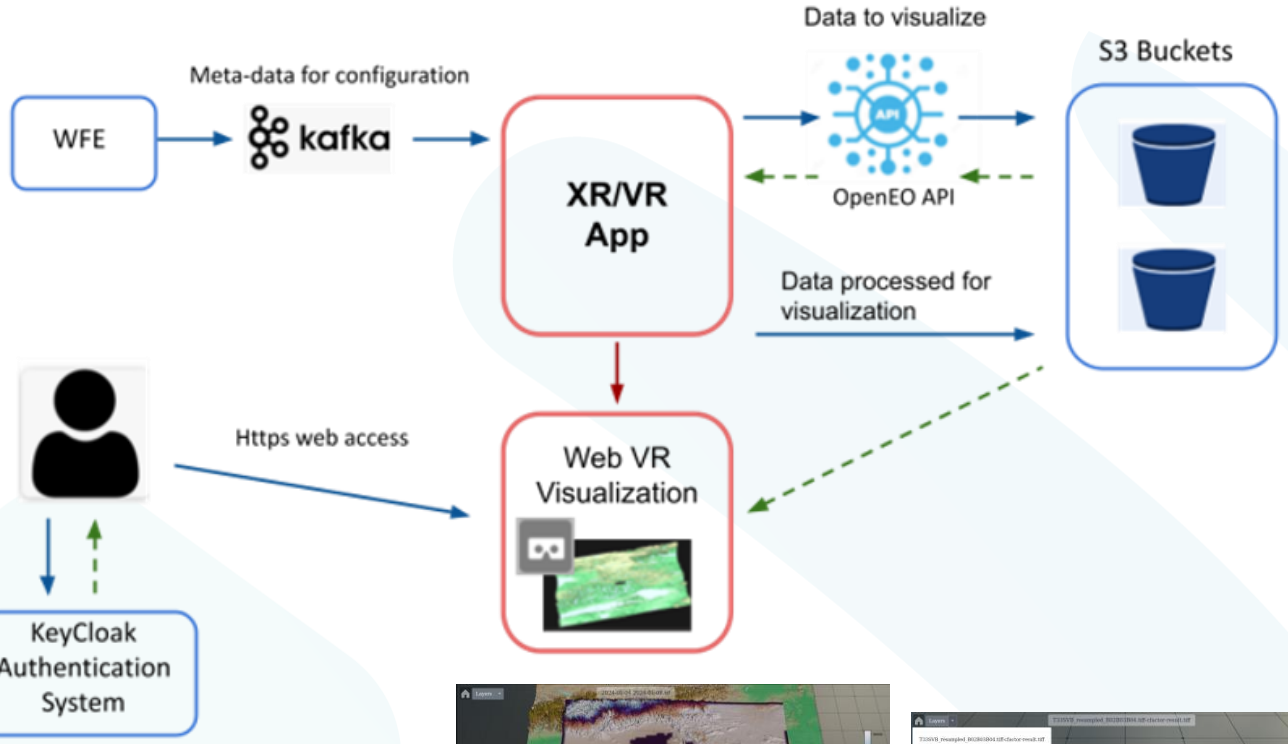
EO4EU Components – OpenEO API

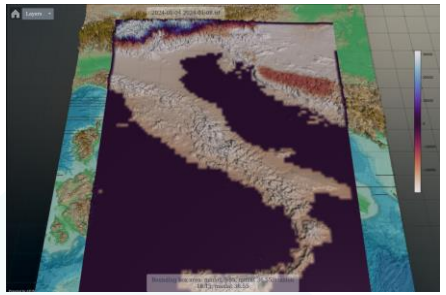


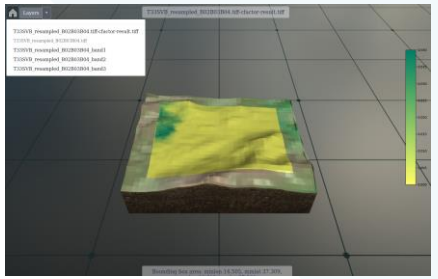
- External user access to the EO4EU platform using their own dashboard, using compatible OpenEO API can:
  - Connect with KG
  - Create/start/select aWF workflow
  - Communicate with CFS components
  - Access S3 buckets
  - Visualize Data

EO4EU Components – XR/VR









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Data Tier

A set of data sources is the input of the platform. Heterogeneous data that need pre-processing with the help of a Knowledge Graph.

- **Data Sources**
  - Interlink heterogeneous data sources (different type formats) with the EO4EU ecosystem through Open APIs (e.g. Climate Data Store API for historical occurrence of extreme weather events).
  - Access to
    - Historical and daily EO datasets.
    - Real time data collections streamlines (for live connections with devices and applications).
    - Copernicus data, as well as to GEOSS, INSPIRE, DestinE etc
    - Open datasets and services provided by ECMWF.
  - User provided in-situ data

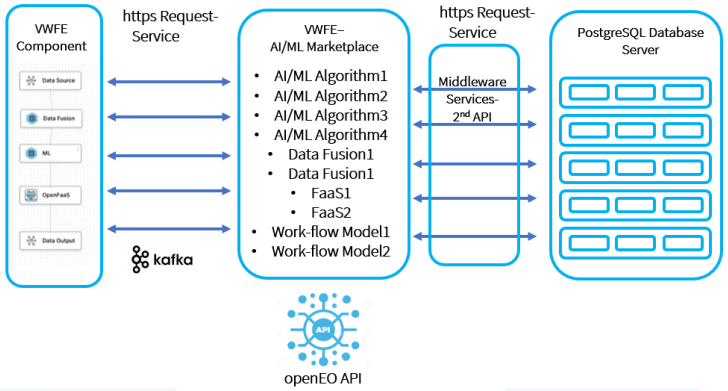
Data Tier

Knowledge Graph-based Decision Making

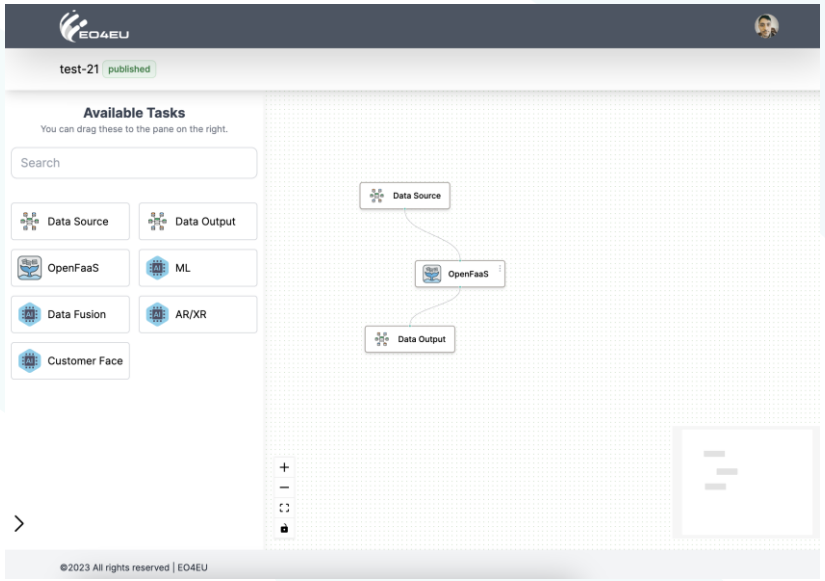
- The KG enables the extraction of informative features, structural or textual, for each entity related to the whole knowledge graph.
- For structure-related features, graph measures or indices such as common neighbors, preferential attachment and Adamic Adar indexing will be used.
- For text-related features, graph similarity techniques including graph neural networks and graph kernels will be used.
- By establishing a link prediction pipeline, EO4EU focuses on predicting possible relationship types between nodes of a knowledge graph.

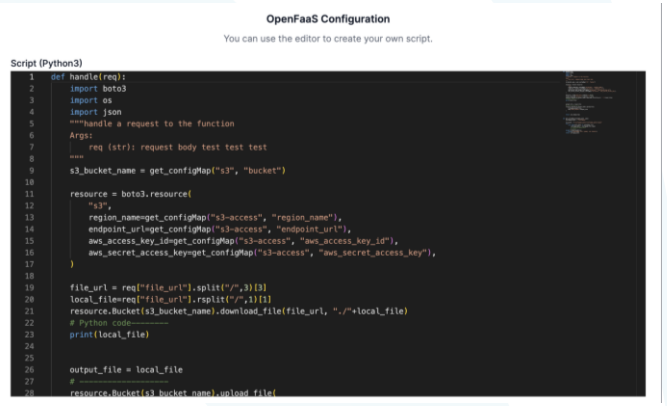
Front-end Tier - AI/ML Marketplace

- AI/ML Models-Algorithms-Techniques
- Metadata
- Data Models for Processing and Communication from Block to Block
- Programming Code
- Configuration Files
- Documentation

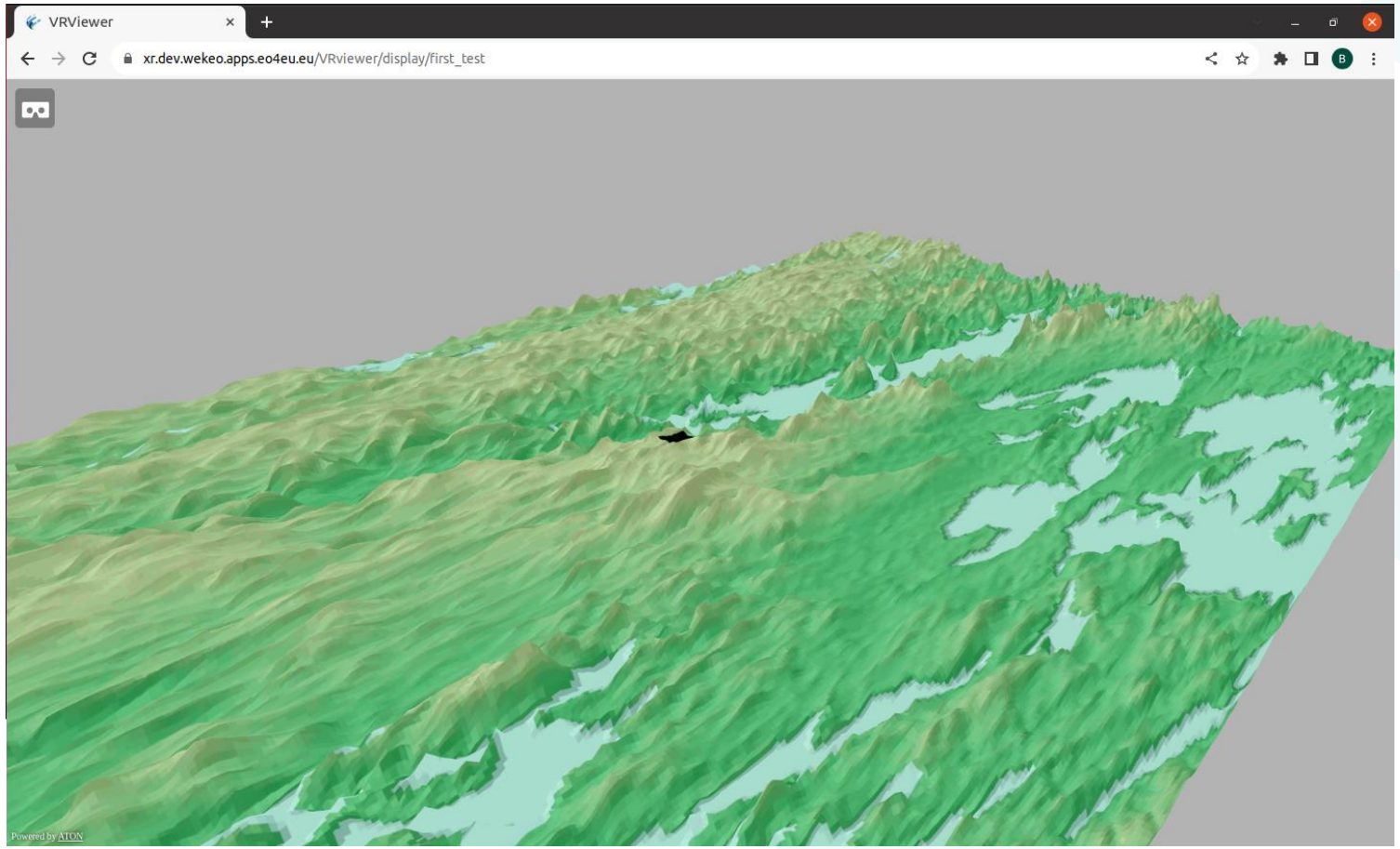


Building processing workflows





Workflow



https://xr.dev.wekeo.apps.eo4eu.eu/VRviewer

Prepare the EO data

- Download the data from S3 bucket
- Reproject the data to EPSG:4326

Prepare the 3D model

- Get the Digital Elevation Model
- Get the texture for the context
- Create a 3D model integrating the EO data, the context data and the DEM

Export and Display

- Export the 3D model to GLTF
- Create 3D tiles from the exported model
- Display on a Webpage