EO4EU

Earth Observation Data & Service Accessibility

EO4EU Platform

2024 IEEE International Geoscience and Remote Sensing Symposium

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Speakers: Dr. Vasileios A. Baousis(ECMWF)

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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 architectural bird's-eye view

Orchestration Language

EO4EU applications

- Dashboards
- API
- Data processing workflows
- XR

EO4EU processing infrastructure

- Fusion
- Semantic annotation
- Compression
- Knowledge management

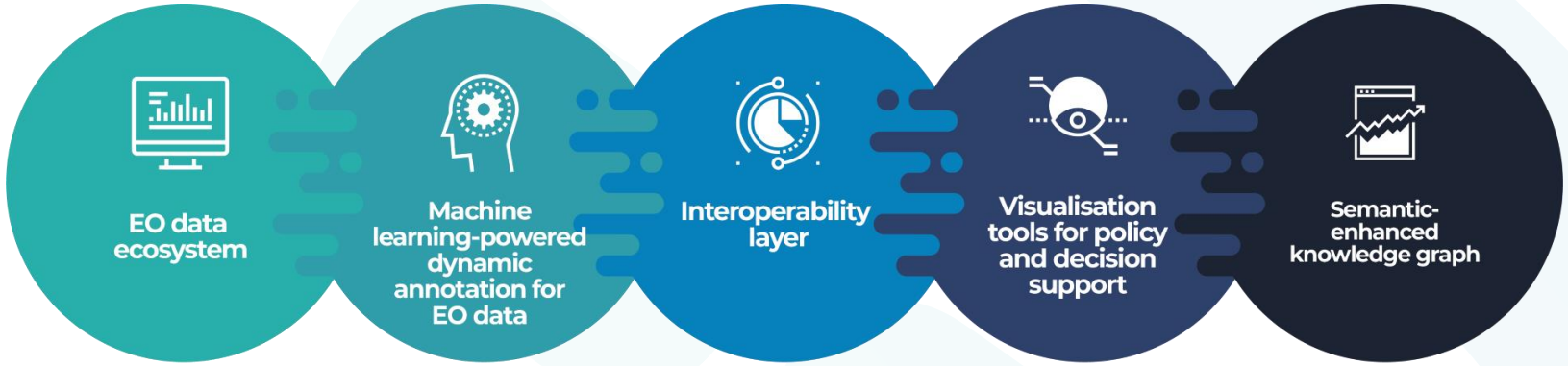
EO sources

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

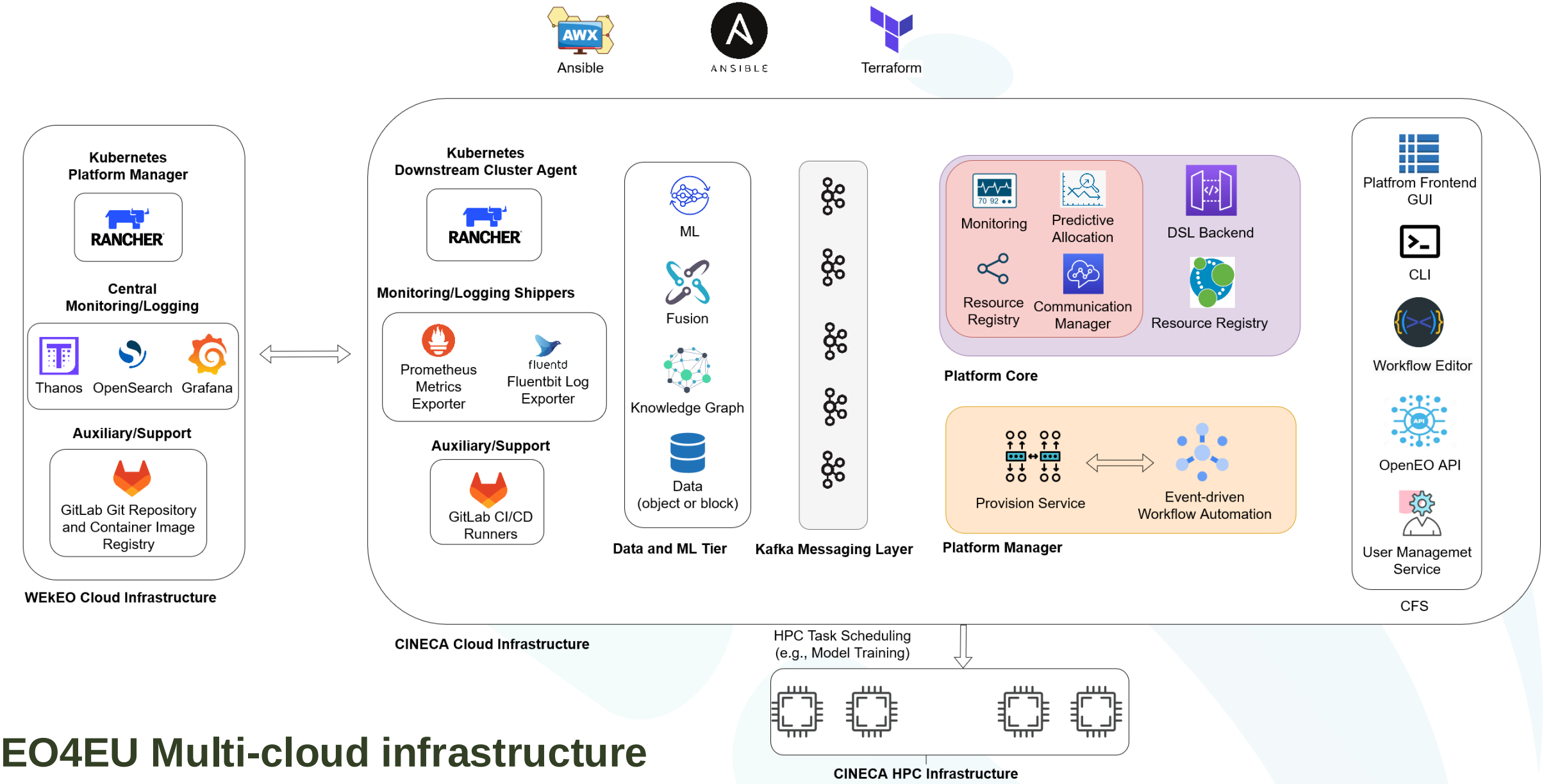
EO4EU Platform

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*

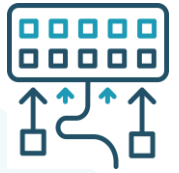


EO4EU Multi-cloud infrastructure

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

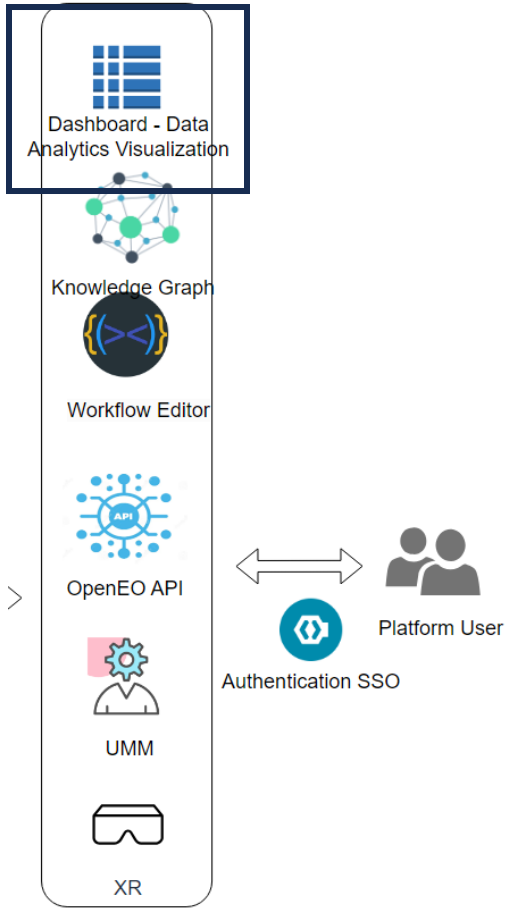
Ocean Monitoring: optimise shipping industry travel time across different oceans considering live weather data

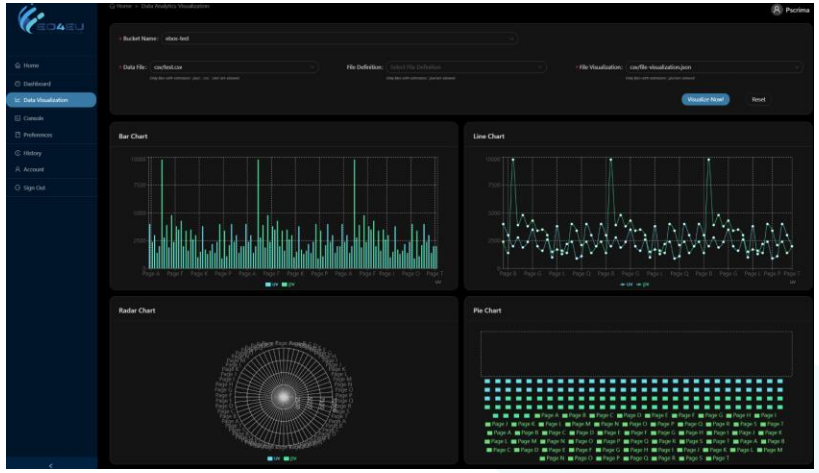
Forest Ecosystems: Improve forest productivity using EO4EU to simulate water, anergy and carbon fluxes

Environmental Pests: Locust plague impact assessment and prediction

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

EO4EU Components – Data visualization

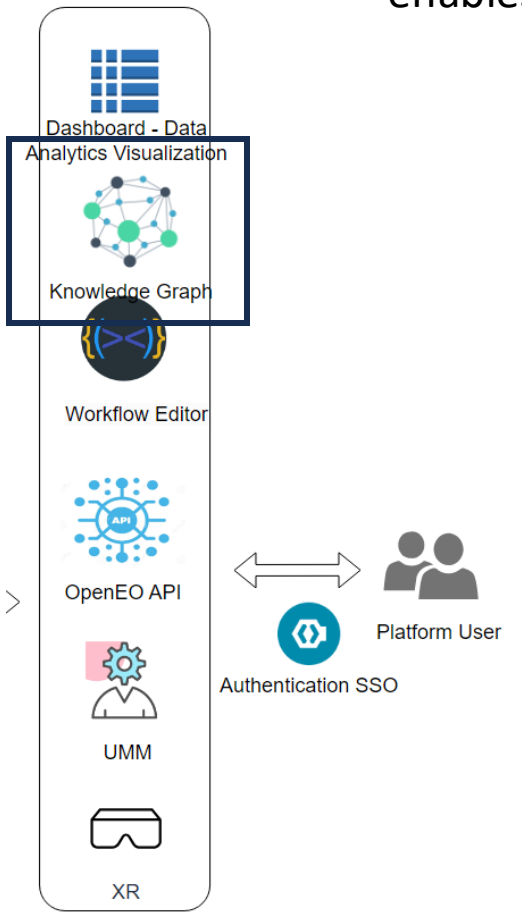


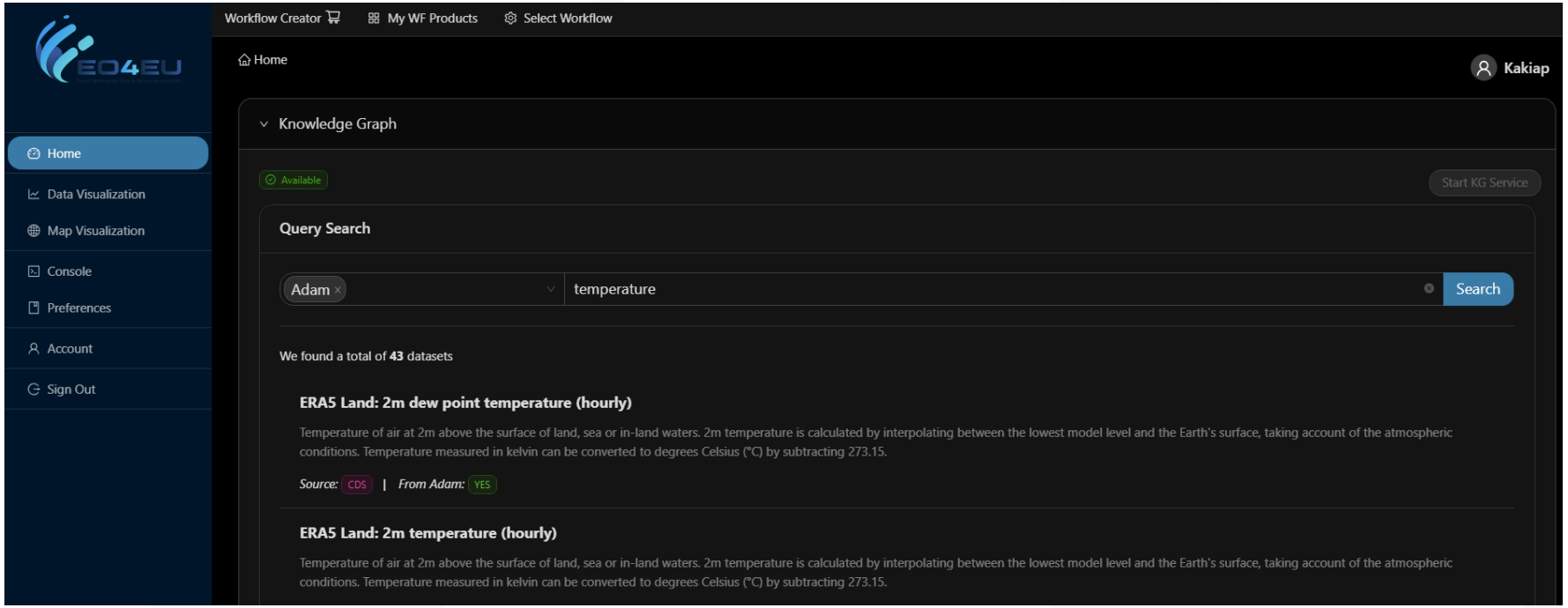


EO4EU Components – Knowledge Graph

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

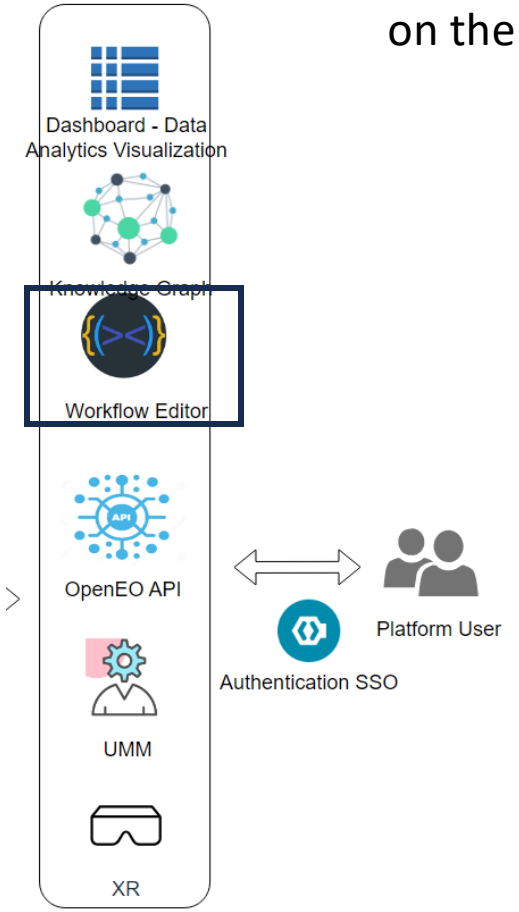
- integrates disparate datasets so that users can explore interconnected data points
- enables users to locate specific information effortlessly using natural language queries

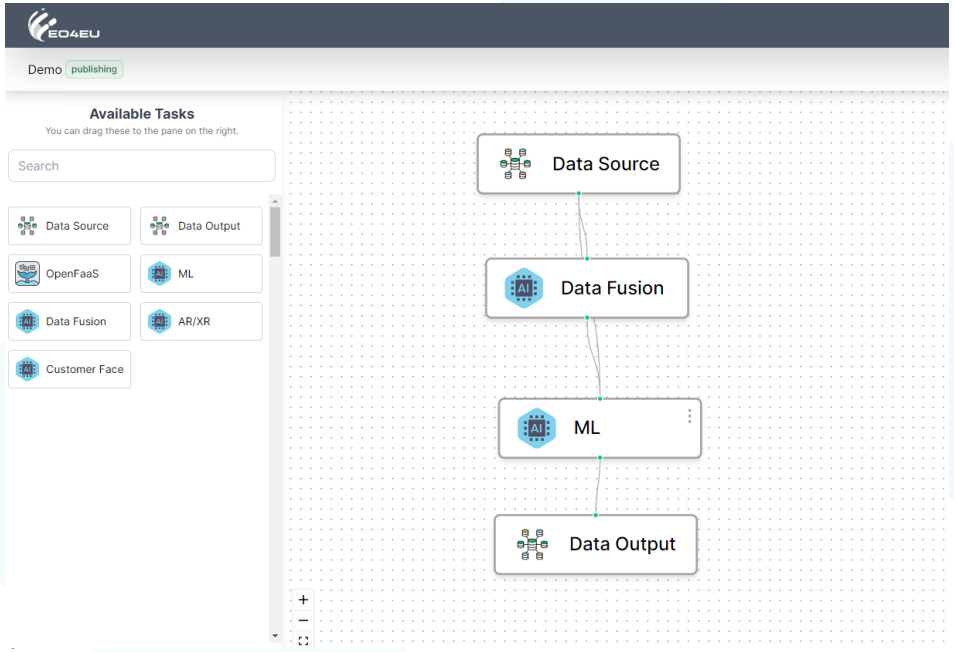




EO4EU Components – Workflow Editor

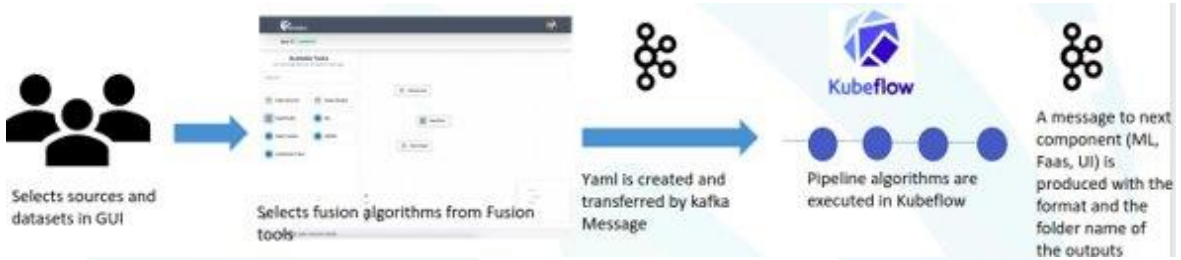
- Canvas with all the available tasks represented as blocks in the left column.
- User can drag & drop the block on the central canvas and connect the block using the links
- Blocks can also be configured by opening the configuration form available by clicking on the menu on the top right of the block

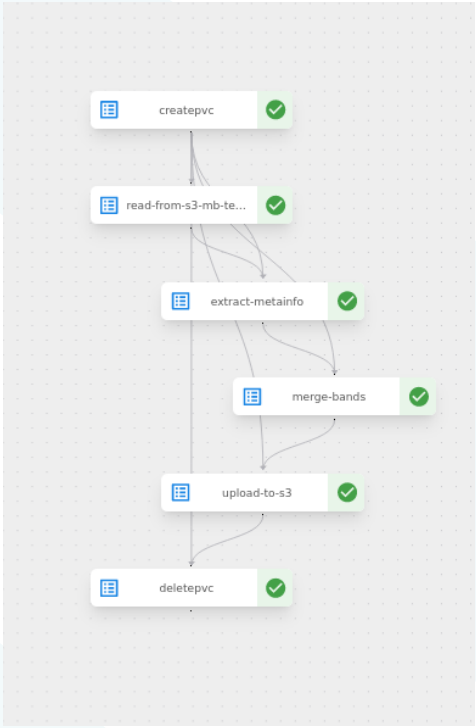




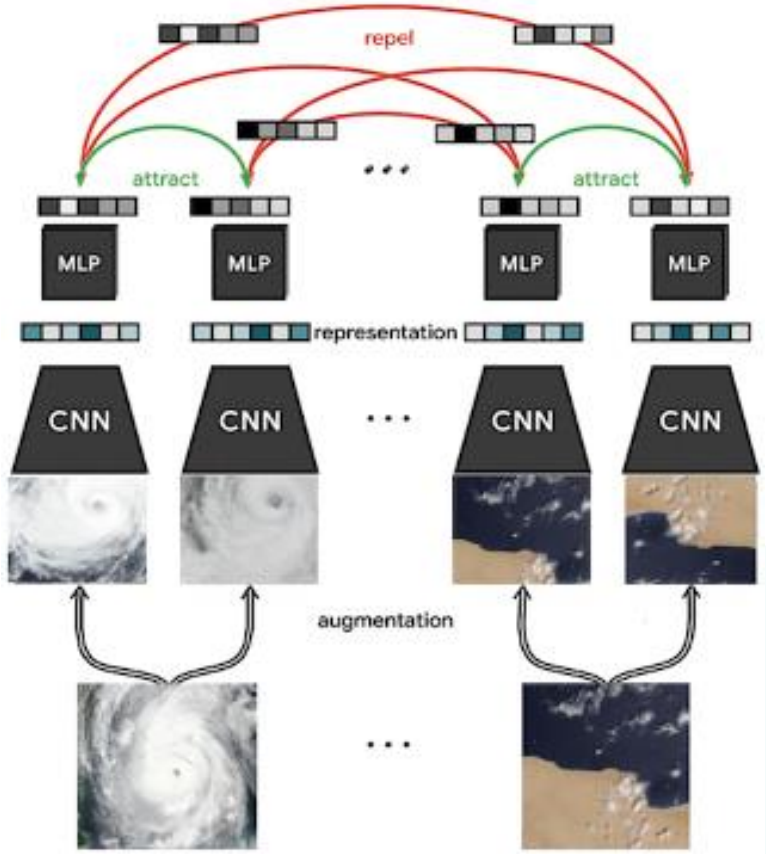
EO4EU Components – Fusion Engine

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



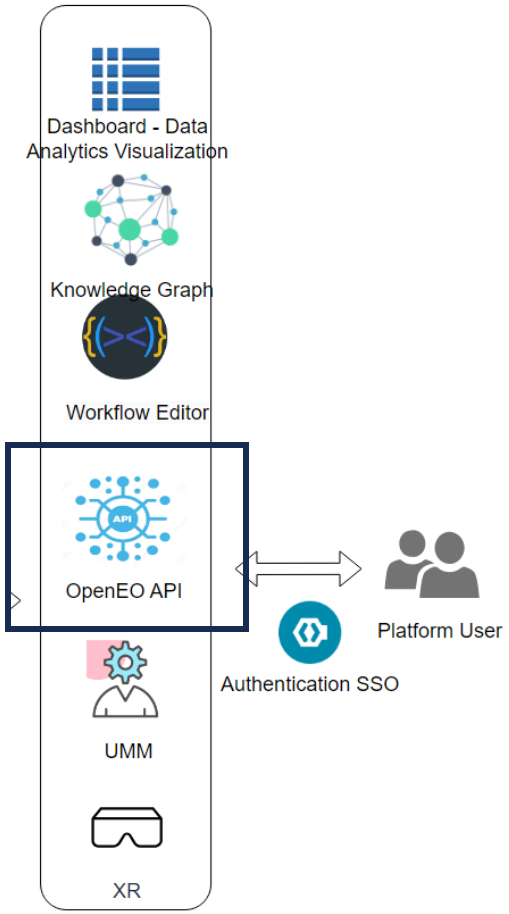


Self Supervised Learning for EO Data



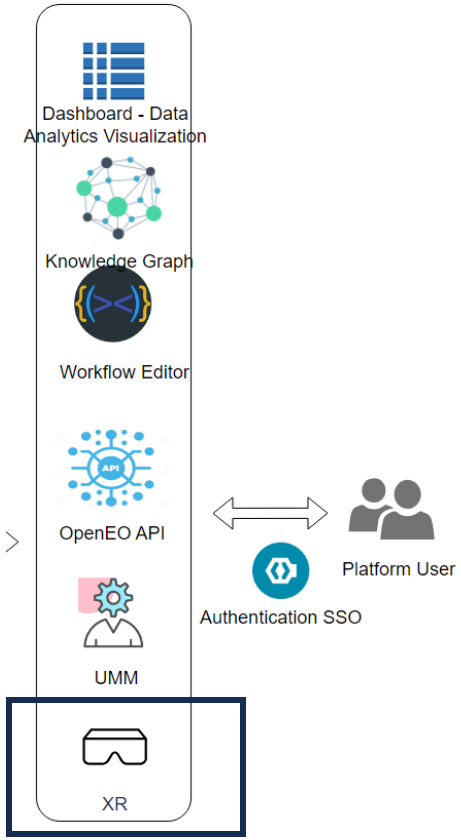
- We used contrastive learning
  - to learn representations that bring close instances that should be similar
  - using ConvNets and MLPs
  - With EO specific augmentations,
- We evaluate the learnt representations in downstream supervised tasks, land coverage.

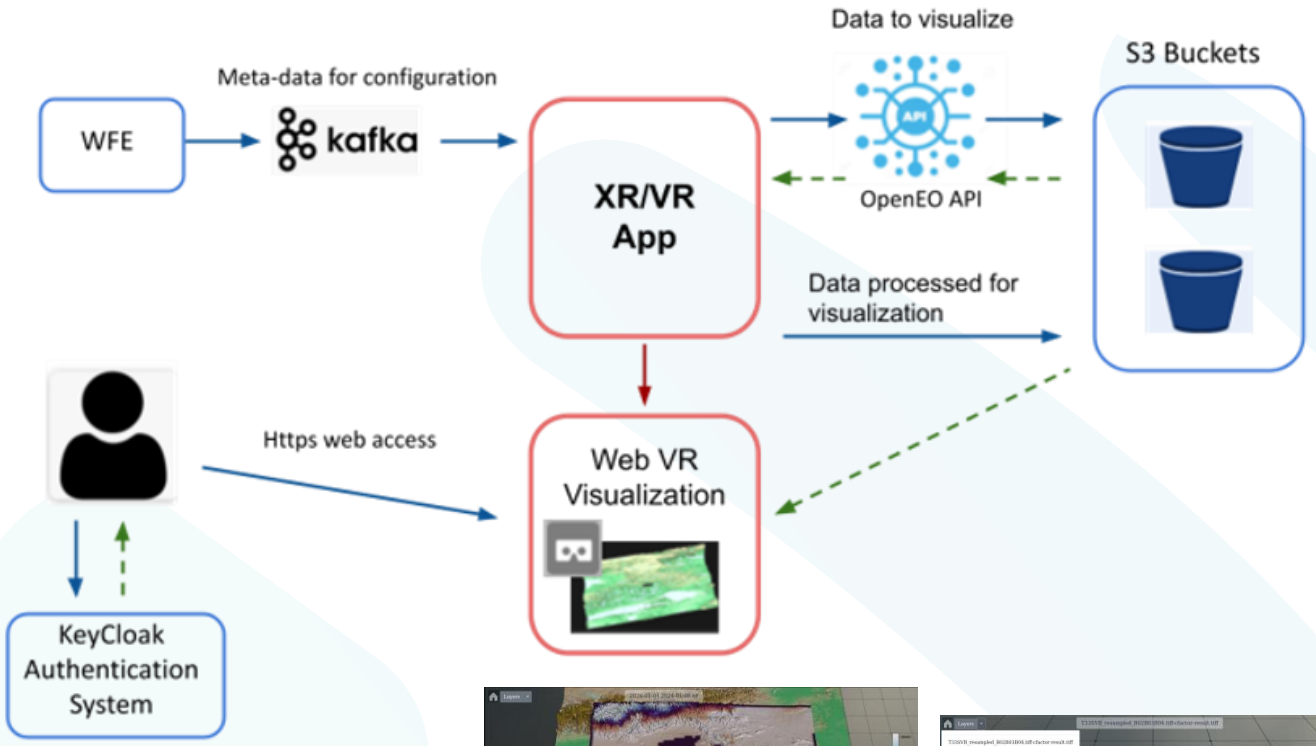
EO4EU Components – OpenEO API

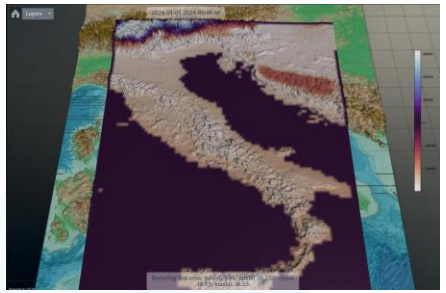


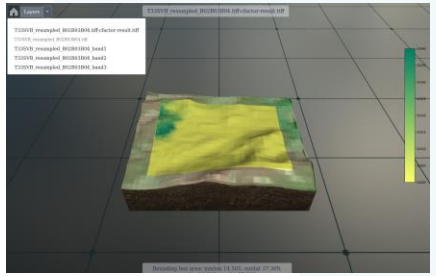
- External user access to the EO4EU platform using their own dashboard, using compatible OpenEO API can:
  - Connect with KG
  - Create/start/select aWF workflow
  - Communicate with CFS components
  - Access S3 bucket
  - Visualize Data

EO4EU Components – XR/VR









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.
  - Access to real time data collections streamlines (for live connections with devices and applications).
  - Access to open access cohorts of the EC through cloud-based platforms established to provide centralized access to Copernicus data, as well as to GEOSS, INSPIRE, DestinE, Galileo/ EGNOS programmes.
  - Access to open datasets and services provided by ECMWF.

Data Tier

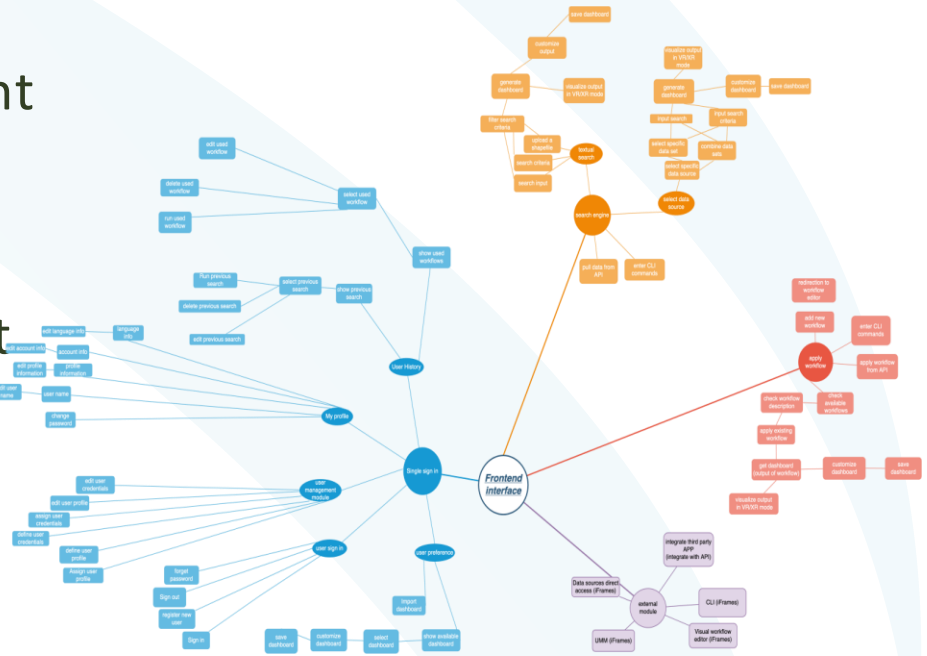
Knowledge Graph-based Decision Making

- A Graph-Based Text Representation is introduced.
- This approach 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 - Dashboard - Data Analytics Visualization

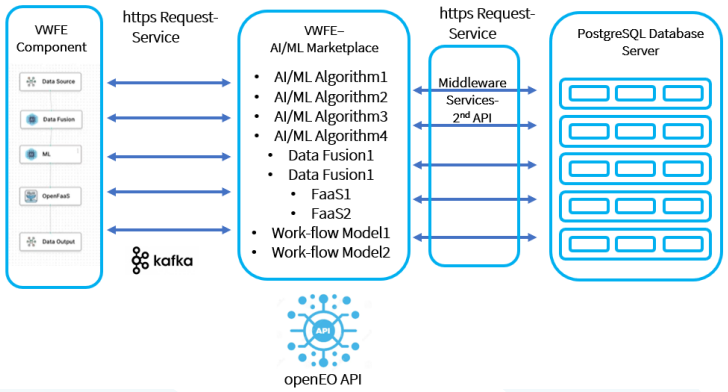
Provides multi-dimensional User Interface-UI (Web, XR, CLI, API) that enables the user to interact and control the platform.

- Decision-making and policy-maker
- Real-time data analytics and interpretation of environment observations
- Real-time mapping and interactions
- Smart Search Engine based on Text or Annotation – Select Data - Smart Category-Type-Parameters Search Engine of the searched item
- Dashboard creation
- Web XR/VR Visualization methods
- Data Analytics based on statistical metrics

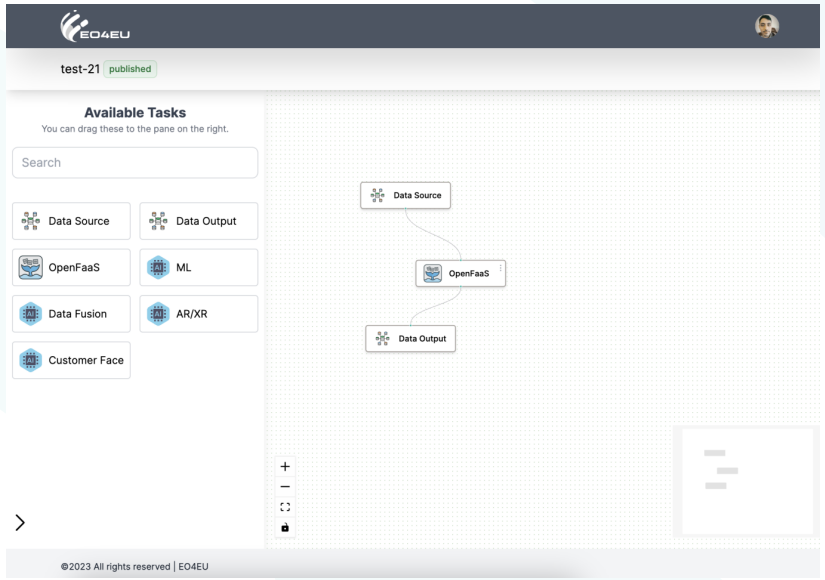


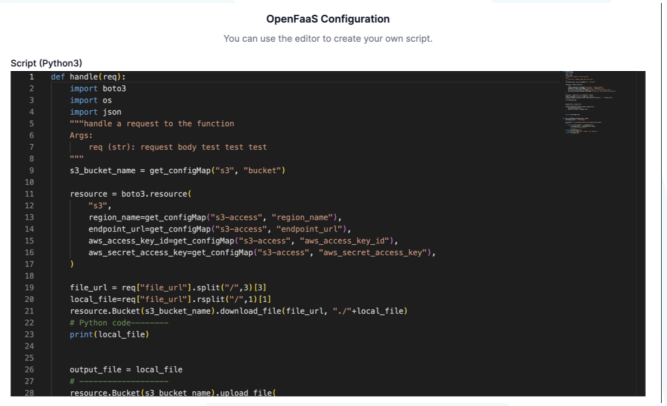
Front-end Tier - AI/ML Marketplace

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



Building processing workflows





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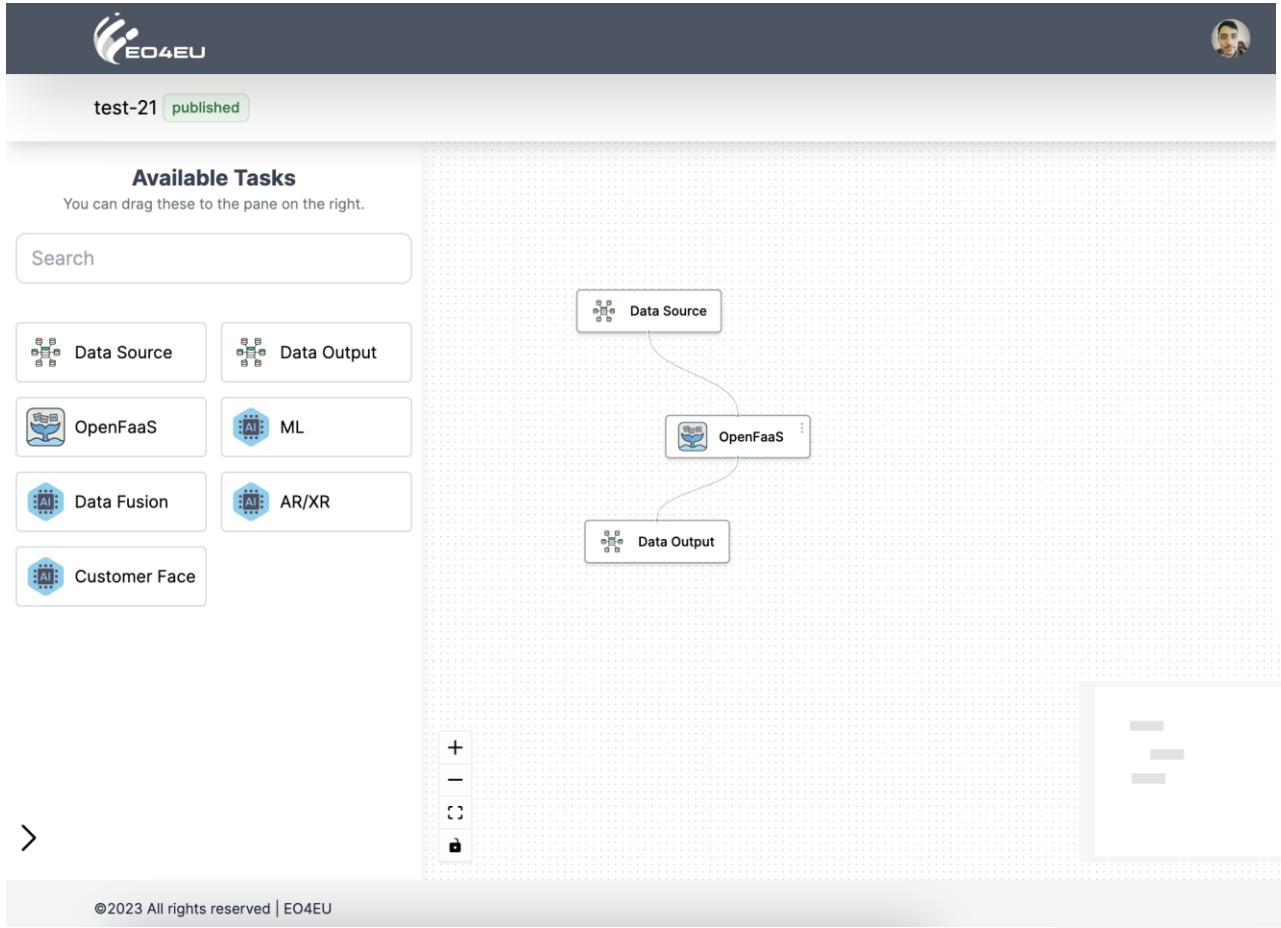
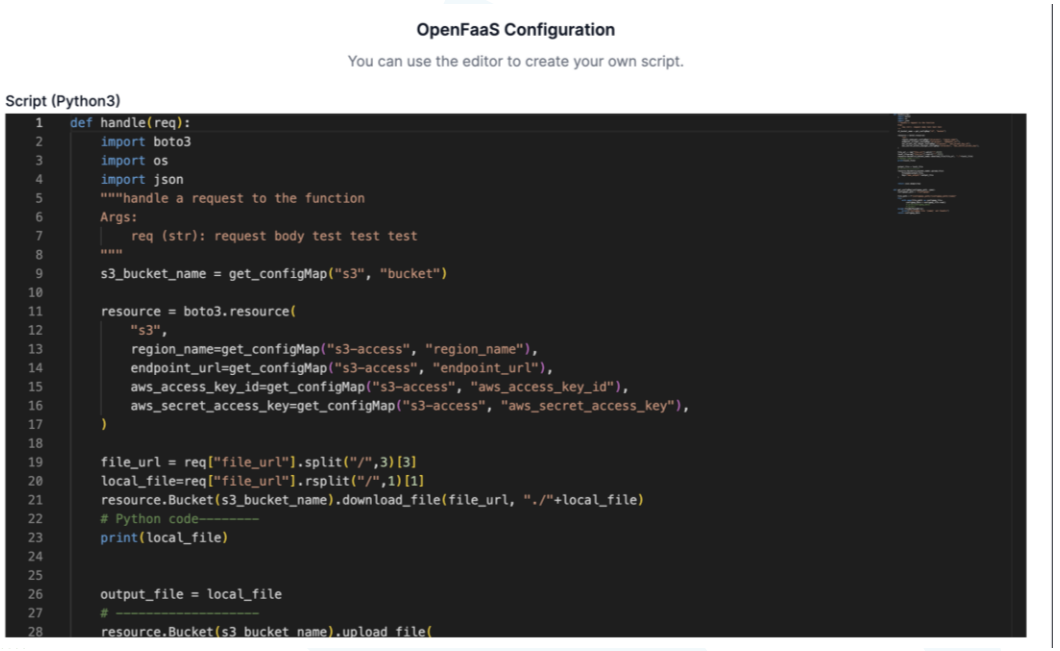
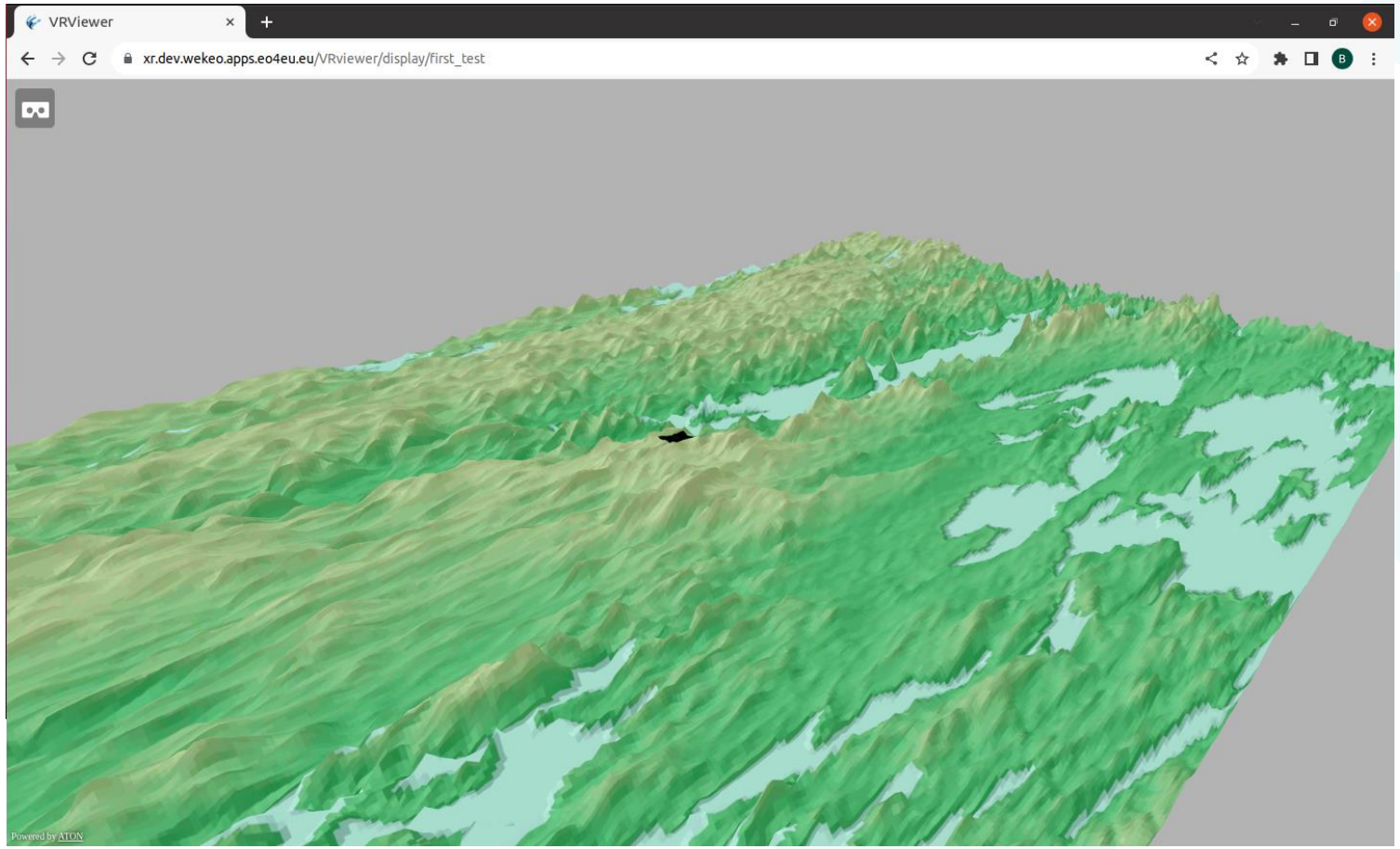




Workflow



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

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