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# EARTH OBSERVATION TRAINING DATA LAB

## Draft Brochure

27/10/2022

esa

European Space Agency

# Background

- One of the most limiting factors of AI for EO applications is the scarcity of suitable and accessible **Training Datasets** (TDS). As the name suggests, TDS are used to train an AI model to perform a specific task. Currently, the main barrier is that gathering and labelling EO data is a convoluted process. Some techniques exist that can help alleviate this issue, for example transfer learning or unsupervised learning, but annotated data is always required for fine-tuning and final validation of AI models.

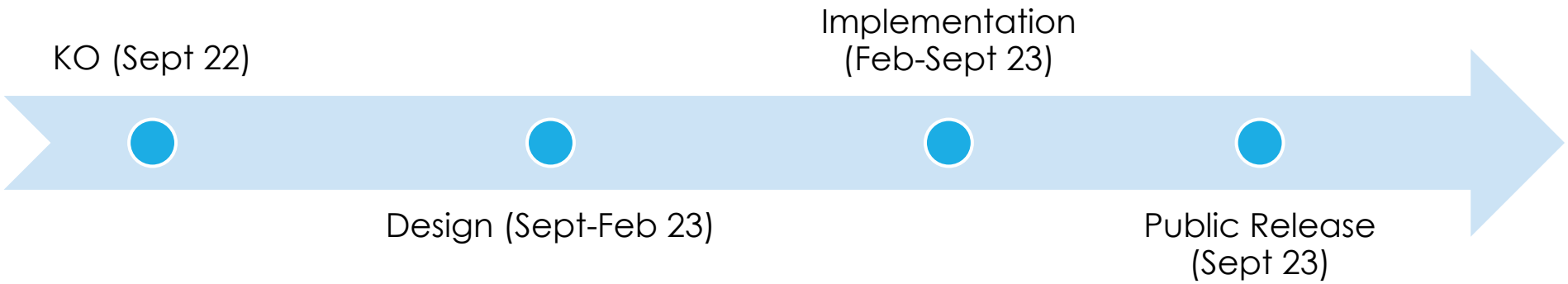
- Generating TDS is time consuming and expensive. Data access is usually limited and costly, especially for Very High Resolution (VHR) images that allow objects like trees to be clearly identified. In some cases, domain experts or even in-person (in-situ) trips are required to manually confirm the objects in a satellite image are correctly annotated with a high degree of quality. This results in the field of AI for EO applications lagging when compared to other fields, impeding the development of new applications and limiting the full potential of AI in EO.

# The Earth Observation Training Data Lab

- The European Space Agency (ESA) **Earth Observation Training Data Lab** (EO-TDL) will address key limitations and capability gaps for working with Machine Learning (ML) training data in EO by providing a set of open-source tools to create, share, and improve datasets as well as training ML algorithms in the cloud. EO-TDL will also offer an online repository where datasets and models can be explored and accessed.

- The curation mechanism and repository will cover a wide range of dataset types: training, validation, test, benchmark and reference datasets (in-situ data, product validation datasets).

- The EO-TDL is expected to launch in September 2023, with over 100 available datasets for a wide range of applications and data sources.

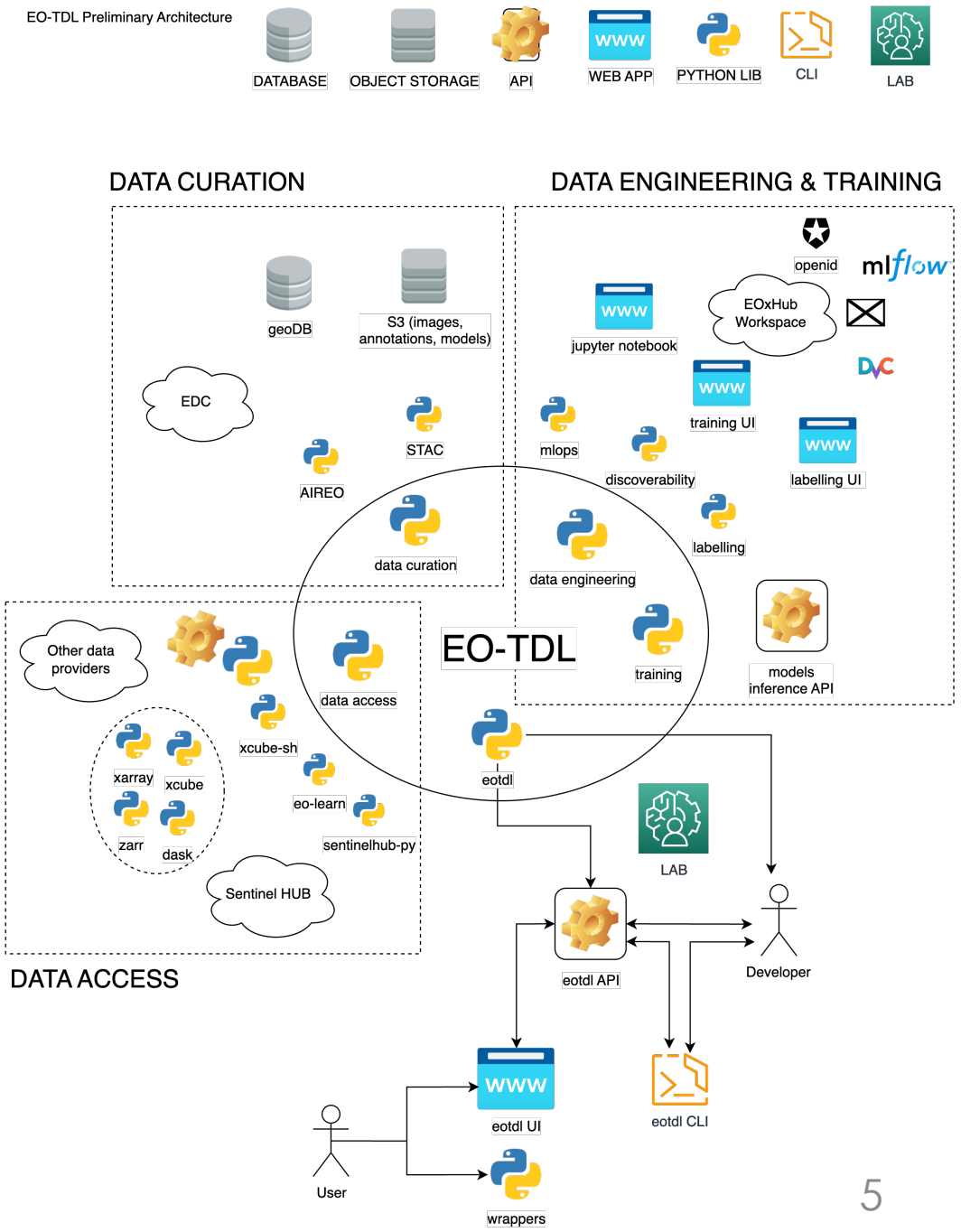


# Objectives

- To contrast the lack of suitable TDS, the EO-TDL has the **objective of providing a set of open-source tools to generate, curate, analyse, and use AI-ready training datasets.** This environment will act as a cloud repository, where TDS can be created, imported, maintained, and improved by everyone.
- EO-TDL will be connected to effective data access mechanisms and feature engineering tools, allowing (among other things) training models with the hosted datasets directly on the cloud with multi-GPU machines.
- The EO-TDL will thus create a lab for ML training data, with a focus on EO applications. There will be a particular emphasis on datasets to overcome existing barriers such as Unsupervised learning, Data Fusion, multitask Learning and the development of custom architectures.
- EO-TDL will provide interoperability with third party platforms, such as Radiant Earth MLHub, and will provide a diverse set of AI ready datasets.
- Community engagement will be incentivised to stimulate collaboration in dataset creation, enhancement and quality assurance.

# Ecosystem

- The EO-TDL ecosystem will be built on top of open source projects, and will be open source as well.
- Users will be able to access data for dataset creation, selecting data source, time range and areas of interest.
- Metadata for data curation and quality assurance will be generated following the STAC specification. Automatic QA mechanisms will be available during the process of dataset creation.
- Engineering tools will allow for data versioning, reproducible advanced feature engineering, labelling, bias discoverability, etc. Training ML models in the cloud with multi-GPU machines will be transparently enabled.
- The Lab will be accessible at multiple levels thanks to user interfaces, web APIs, CLIs and Python libraries.



# Who is this for?

- The EO-TDL will be available to everyone, with special tiers for prime commercial users.
- Many areas will benefit from this platform. Having a repository of AI-ready training datasets will strengthen industry capabilities for exploiting EO data as a whole and help accelerate EO market penetration. Furthermore, to enable Digital Twin Earth simulations , access to these quality datasets is necessary for researchers and engineers as they build and apply quality models.
- The initial data population at release will consist on over 100 datasets especially selected to cover a wide range of applications and ML techniques, ranging from Computer Vision tasks such as classification or object detection to parameter estimation or 3D applications on different data sources such as Sentinel 1 and 2, Airbus SPOT and PLEIADES, UAV imagery or vector data. But, with the provided tools, it is our objective to increase this quantity over time.

# Community

- The flagship characteristic of the EO-TDL is its community and open-source nature. All the code will be hosted on Github, where the community can contribute with improvements and new features. A public Discord server will enable discussion and community engagement.
- Not only will users be able to train their AI models on the cloud with the available datasets, but they will also be encouraged and incentivised to contribute to the enrichment of the platform. Users making significant contributions, such as the addition of new datasets or the enhancing of existing ones, will be rewarded in the form of credits. A larger community will thus correspond to a better and more versatile platform for everyone.
- The EO-TDL will facilitate integration by popular Machine Learning libraries, like Scikit-Learn, Pytorch and Tensorflow. Furthermore, the platform will provide tools to ingest datasets (including legacy data) with automated quality assurance procedures.

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