



DestinE Platform



Destination Earth



Exploring Destination Earth Platform

An end-user perspective.

Emanuel Goulart Farias

25/08/2025

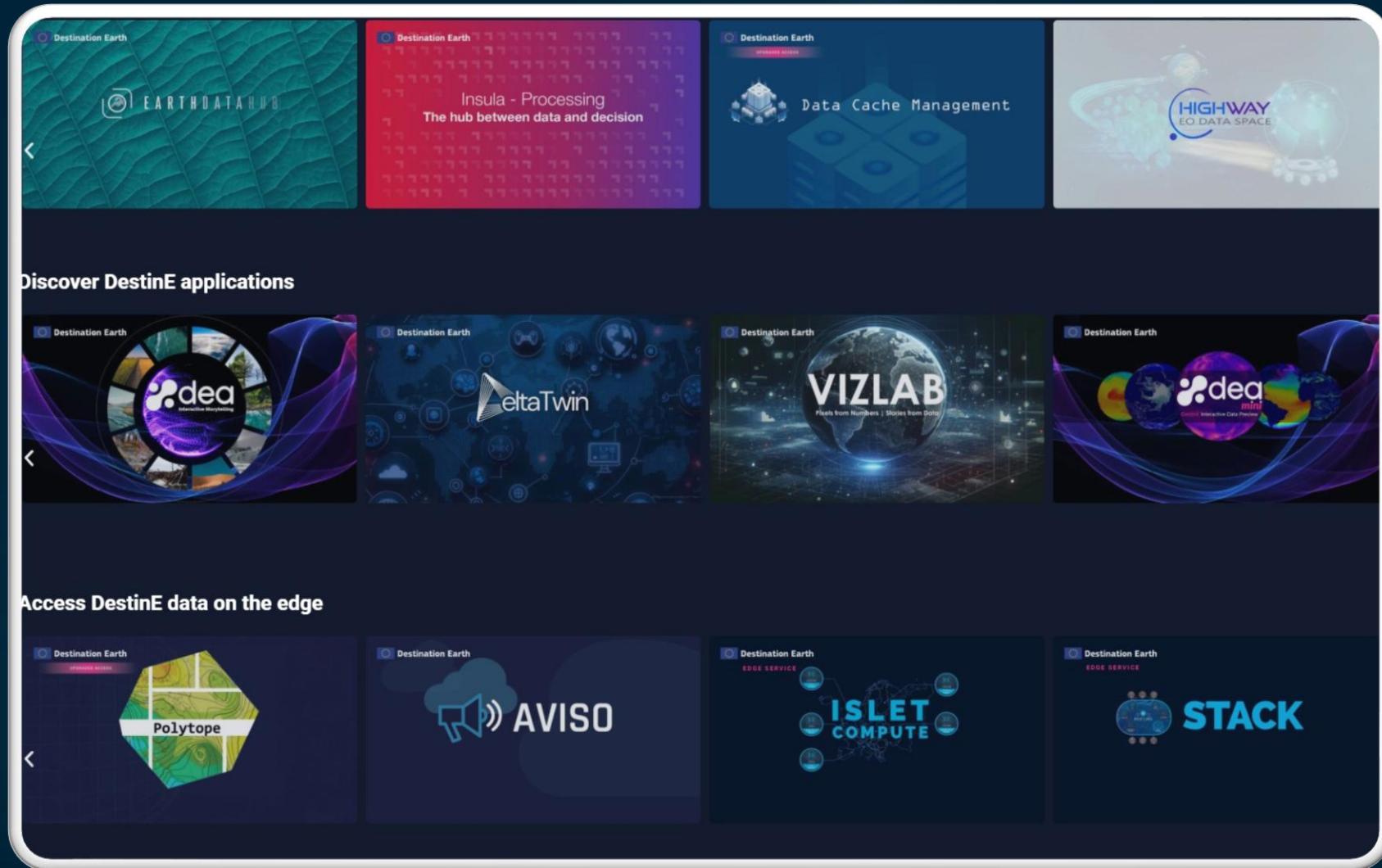
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Platform



Topics Structure:

1. Exploring DestinE Service DeltaTwin
2. End-User Experience
3. General Feedback of the Platform



1. Exploring DestinE Service:



1.1 - EO Point Cloud in DeltaTwin: 2 weeks

Creating and retrieving point clouds using EO data.

1.2 - Implementation of AI Atmospheric Correction in DeltaTwin: 2 weeks

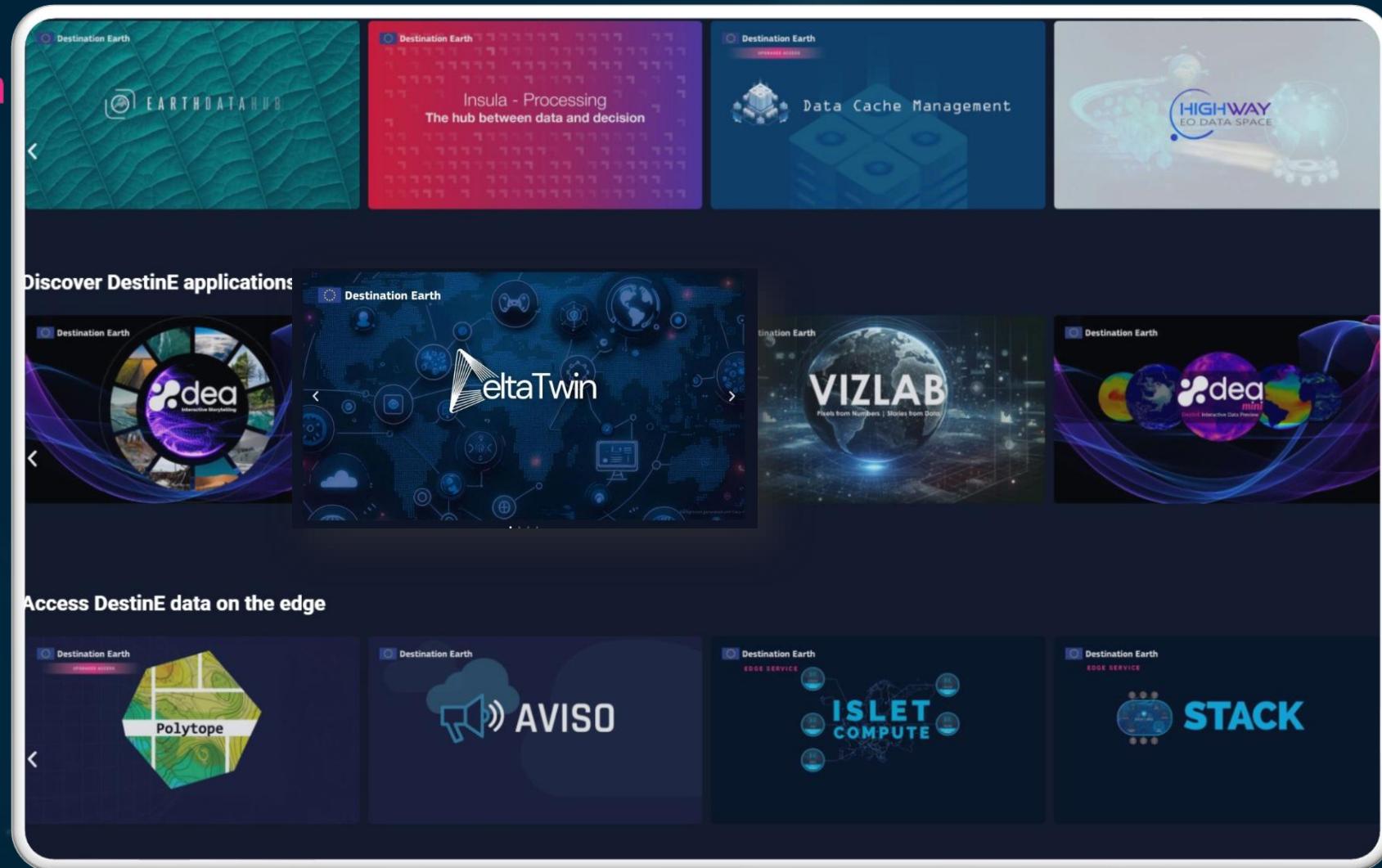
An AI MVP study focused on atmospheric correction of Sentinel-2 Level-1C data.

1.3 - End-to-End AI Pipeline: ~ 3 weeks

Design training pipeline to have baseline model of BigEarthNet.



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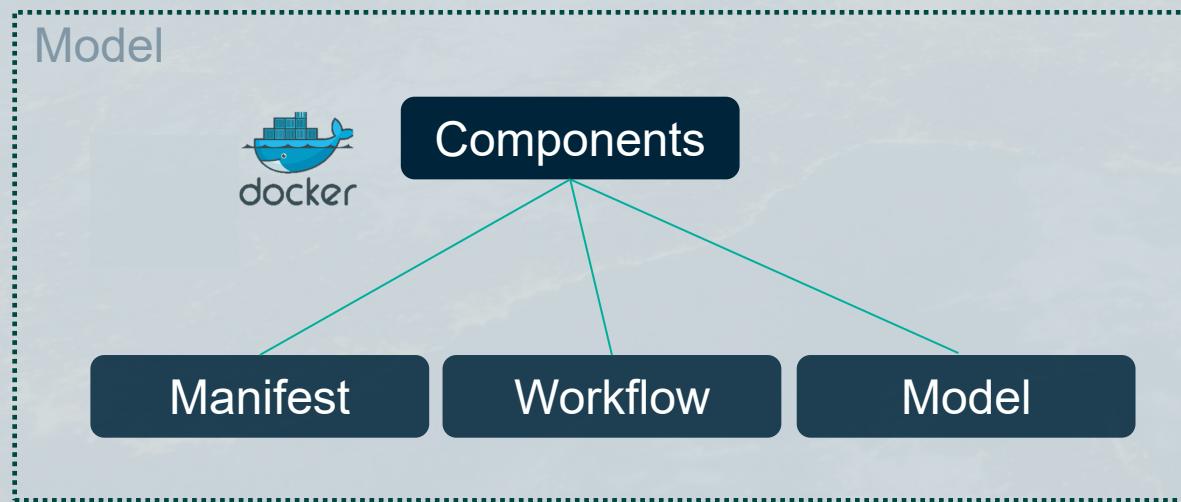


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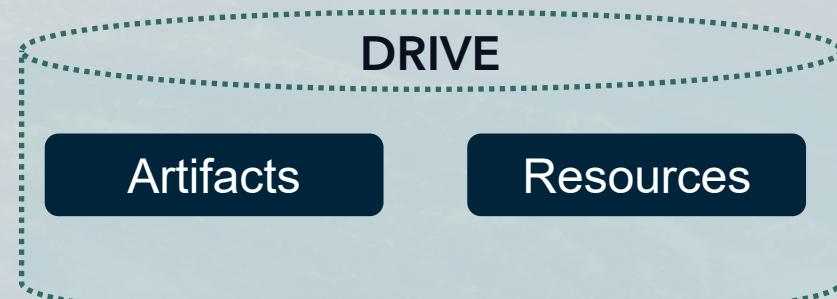
DestinE - DeltaTwin

- DeltaTwin is a collaborative toolbox to build and share digital twin components

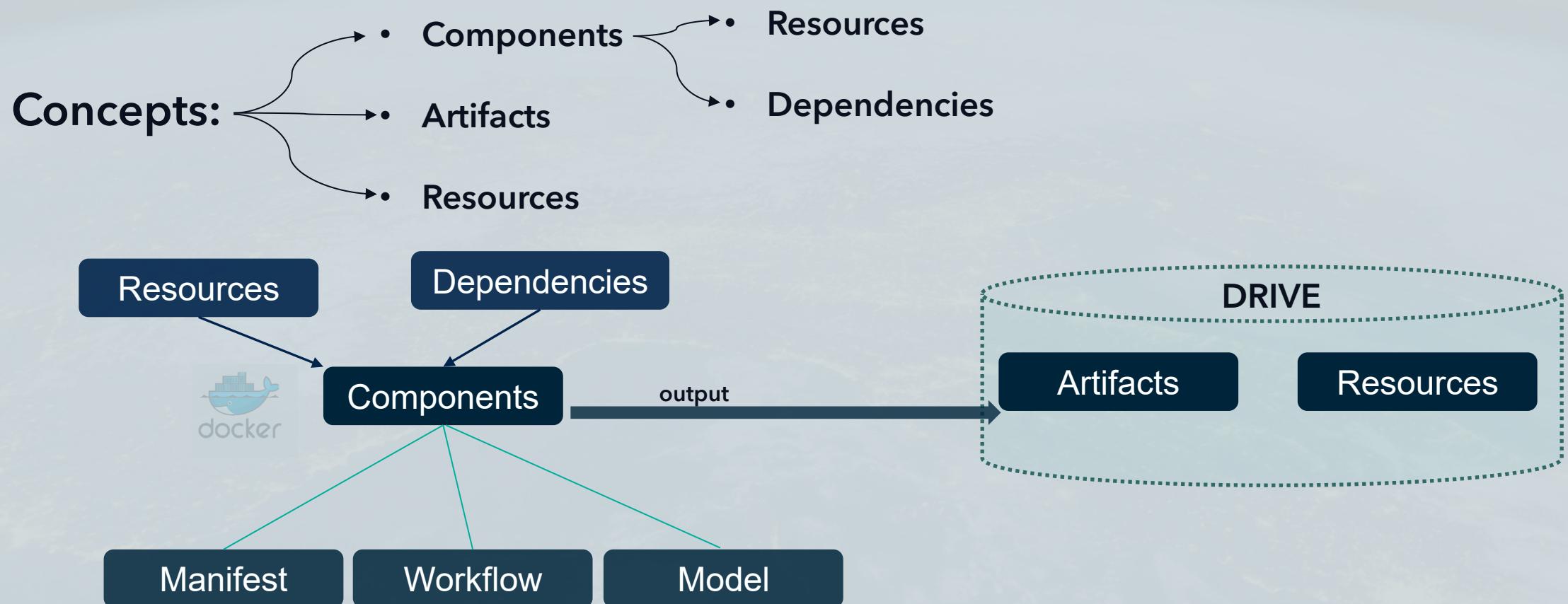


Concepts:

- Components
- Artifacts
- Resources



DestinE - DeltaTwin



1. Exploring DestinE Service:



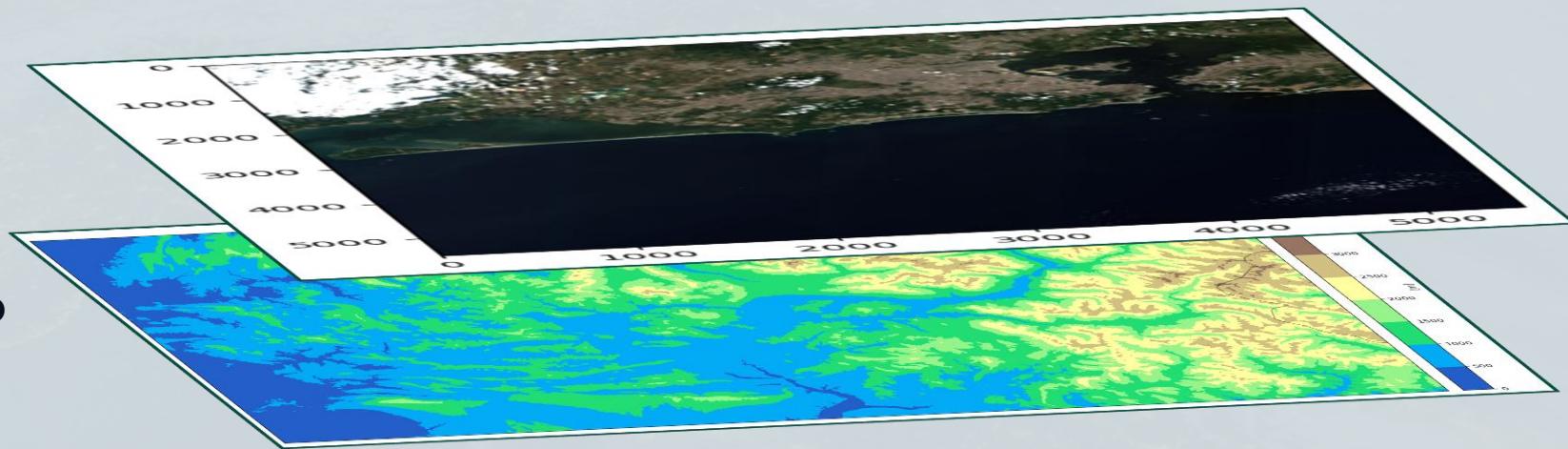
1.1 - EO Point Cloud:

Creating and retrieving point clouds using EO data.

Point Cloud and Earth Observation Data



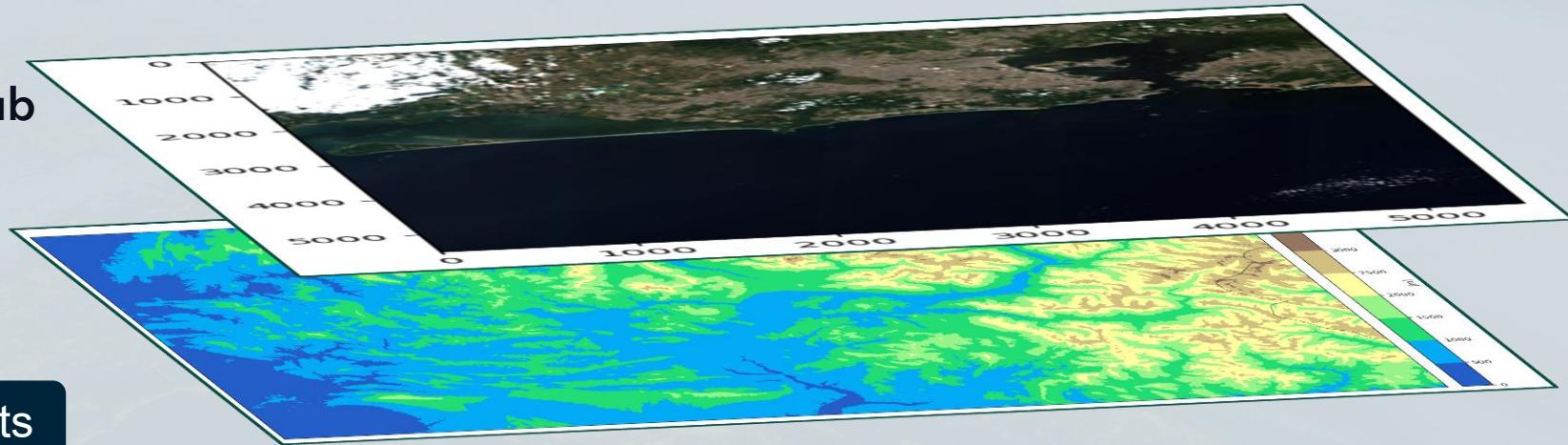
- Sentinel-2 : → CDSE



- DEM : → Earth Data Hub



- Sentinel-2 : → CDSE
- DEM : → Earth Data Hub



Components

Manifest

Workflow

Model

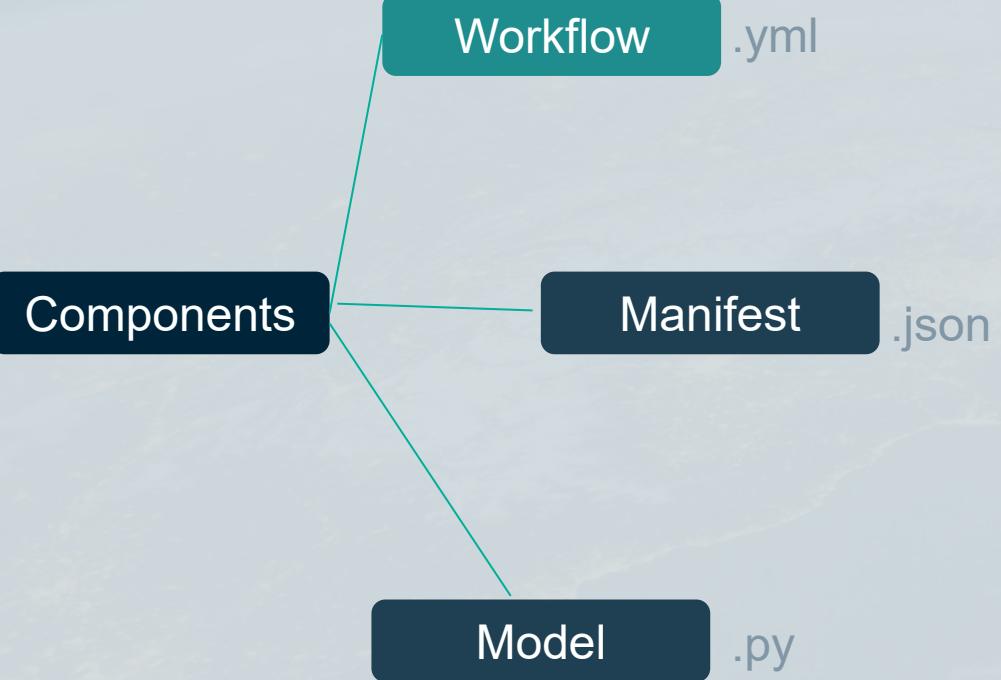




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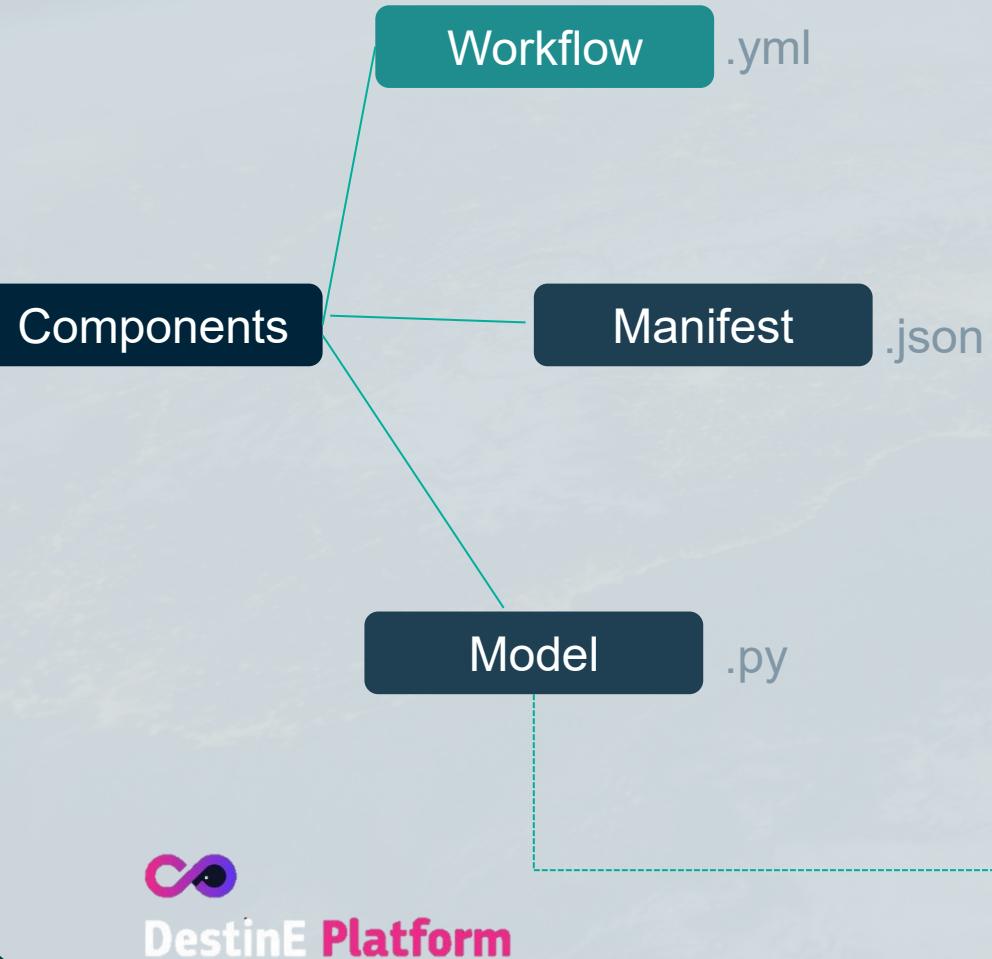




```
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  - id: cdse_secret  
    ref: inputs.cdse_secret  
  - id: earth_data_hub_key  
    ref: inputs.earth_data_hub_key  
  - id: bbox  
    ref: inputs.bbox  
  - id: sampled_fraction  
    ref: inputs.sampled_fraction  
  - id: point_cloud_generator  
    ref: models.point_cloud_generator  
  - id: output_point_cloud  
    ref: outputs.out  
  
edges:  
  - from:  
    id: cdse_key  
  to:  
    id: point_cloud_generator  
    port: cdse_key  
  - from:  
    id: cdse_secret  
  to:  
    id: point_cloud_generator  
    port: cdse_secret  
  - from:  
    id: earth_data_hub_key  
  to:  
    id: point_cloud_generator  
    port: earth_data_hub_key  
  - from:  
    id: bbox  
  to:  
    id: point_cloud_generator  
    port: bbox  
  - from:  
    id: sampled_fraction  
  to:  
    id: point_cloud_generator  
    port: sampled_fraction  
  - from:
```



DestinE Platform



Build

```
delta component build -t <tag name>
```

Publish

```
deltatwin component publish 1.0.0 --change-log "First version"
```



Tip!

The model does not accept folder-tree structure.
It ignores all other python files.



DeltaTwins / eo-point-cloud 0.8

Description Workflow Your runs Your artifacts

Description 

The current component is an Earth Observation (EO) Point Cloud generator. It retrieves data from Sentinel-2 and a Digital Elevation Model (DEM) to overlay both raster datasets, converting each pixel into a point within a 3D scene. The RGB color values from each pixel are assigned to the corresponding point, generating a point cloud data file (.ply). To access the data, you need valid CDSE credentials (key and secret) as well as an Earth Hub Data key within the DestinE services. Once you have the required keys, simply provide a bounding box (bbox) for your area of interest and specify a sampling fraction to reduce the size of the resulting point cloud (default is 0.2).

Inputs

Input	Type	Default Value	Description
cdse_secret	secret		CDSE: SECRET_ACCESS_KEY
cdse_key	secret		CDSE: ACCESS_KEY_ID
earth_data_hub_key	secret		Earth Data Hub: API_Key
bbox	string		Comma-separated coordinates representing: 'min_lon,min_lat,max_lon,max_lat'. (left, bottom, right, top). e.g: 3.2833,45.3833,11.2,50.1833
sampled_fraction	string		The fraction of the point cloud to be sampled in order to reduce computational resources. Default=0.2

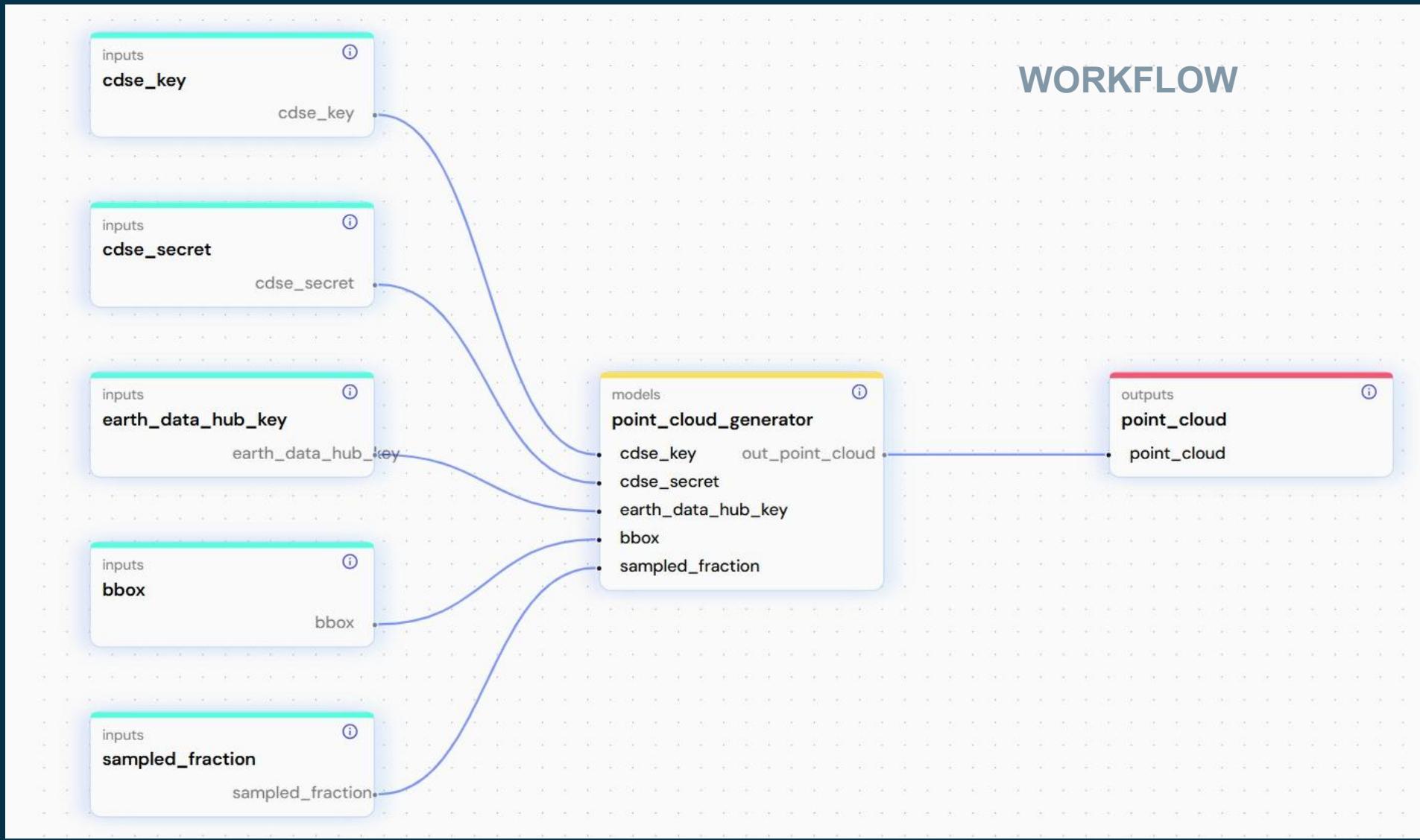
Outputs

Output	Type	Default Value	Description
out	Data		A point cloud file (.ply)

DeltaTwin - EO Point Cloud



DestinE Platform



DeltaTwin - EO Point Cloud



Technical Constraints:

- Some *aptRequirements* may be ignored when building the container:

- DeltaTwin has hardware requirements that put constraints on dealing with EO point clouds.
 - Sampling strategy is required to avoid killing the system.
- It does not accept Conda-Forge. All libraries should be installed with Pip and aptRequirements.



1. Exploring DestinE Service:



1.1 - EO Point Cloud:

Creating and retrieving point clouds using EO data.

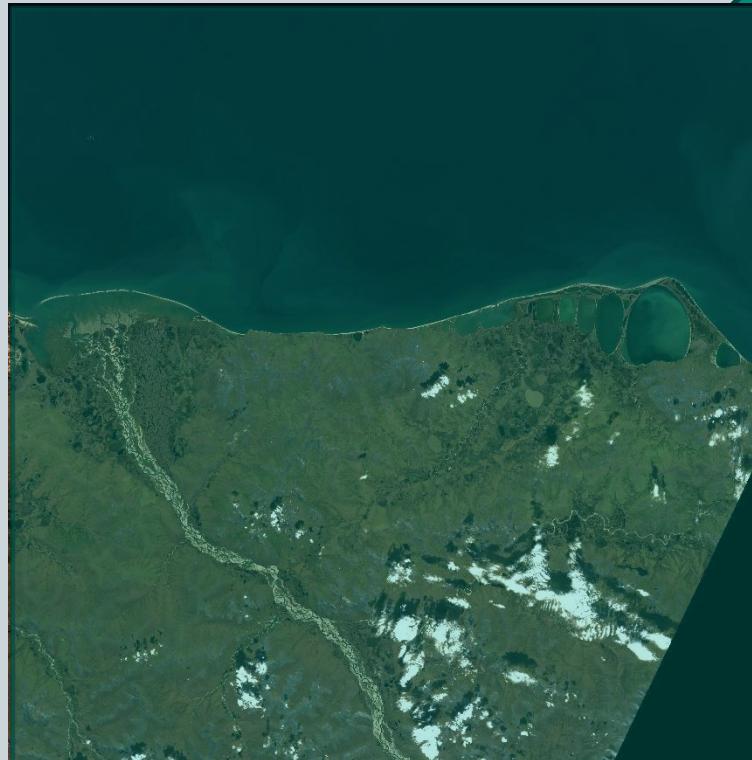
1.2 - Implementation of AI Atmospheric Correction in DeltaTwin:

An AI MVP study focused on atmospheric correction of Sentinel-2 Level-1C data.

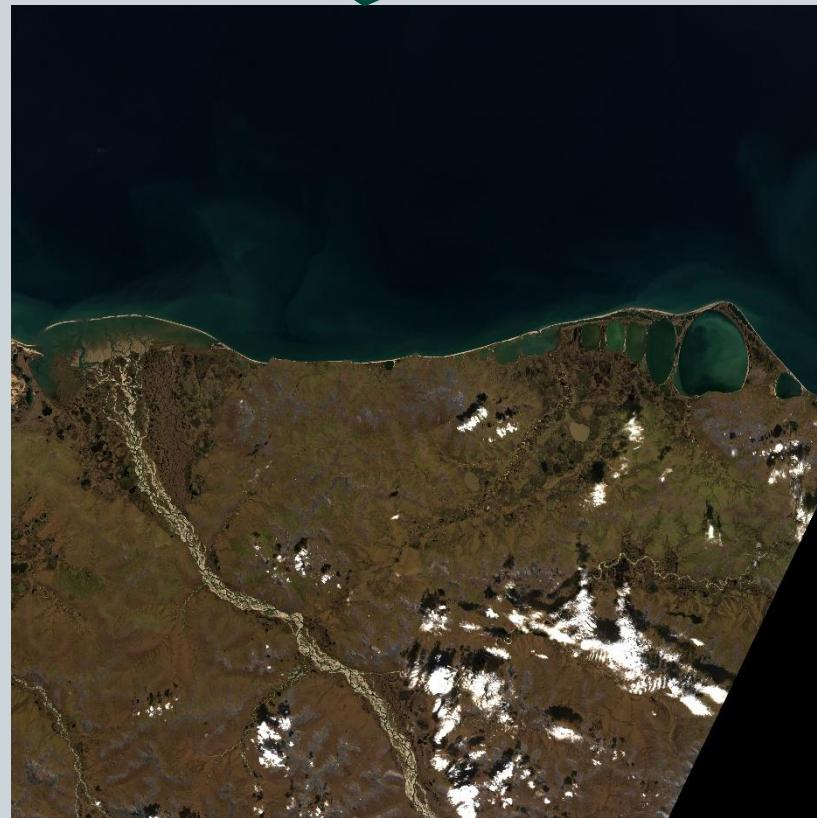
1.3 - End-to-End AI Pipeline:

Designed to validate the assessment and performance of AI-sen2cor.

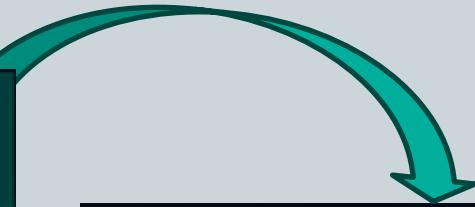
DeltaTwin - S2 L1C Atmospheric Correction



L1C



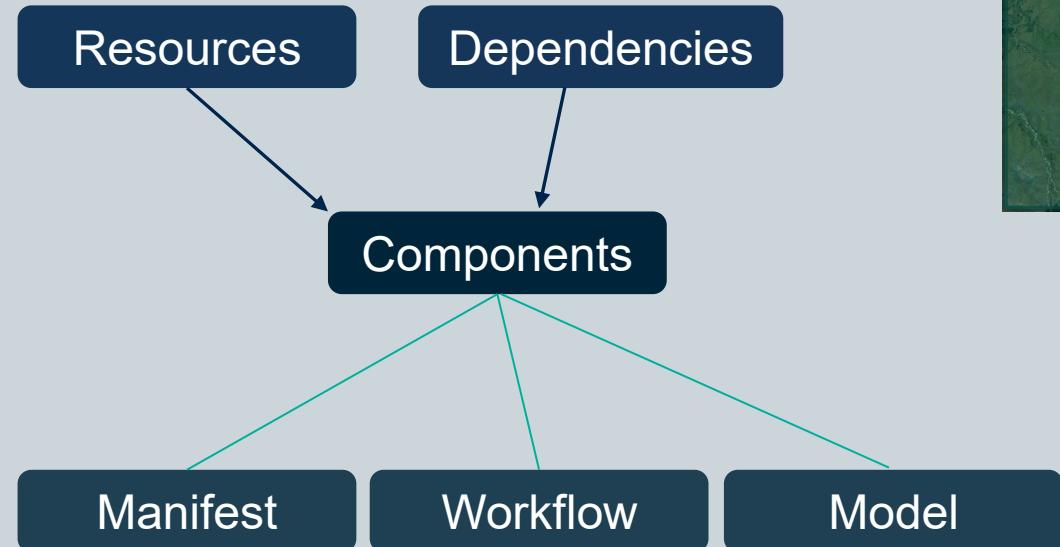
L2A



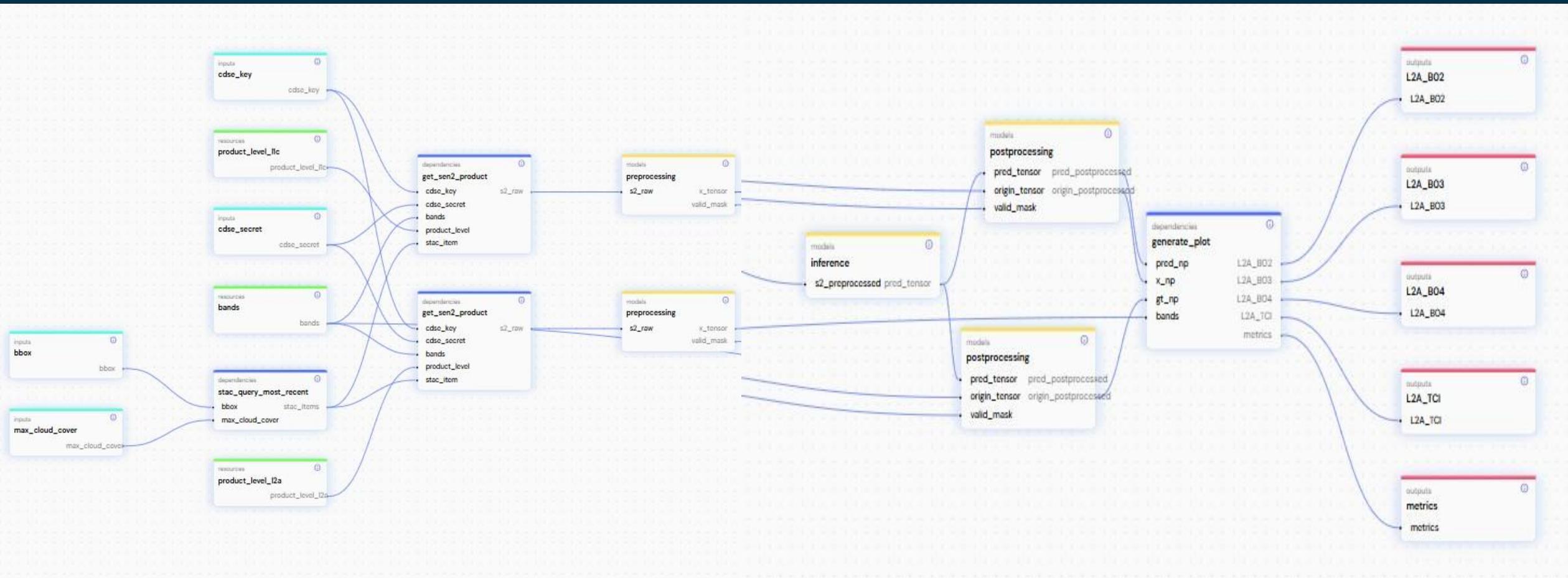
Model params:

- Unet Architecture
- Encoder:
 - Efficient-net-b2
- Output Layer:
 - reLu
- Supervised Training
- No auxiliary data, only trained in the visible band.

Implementation of AI Atmospheric Correction



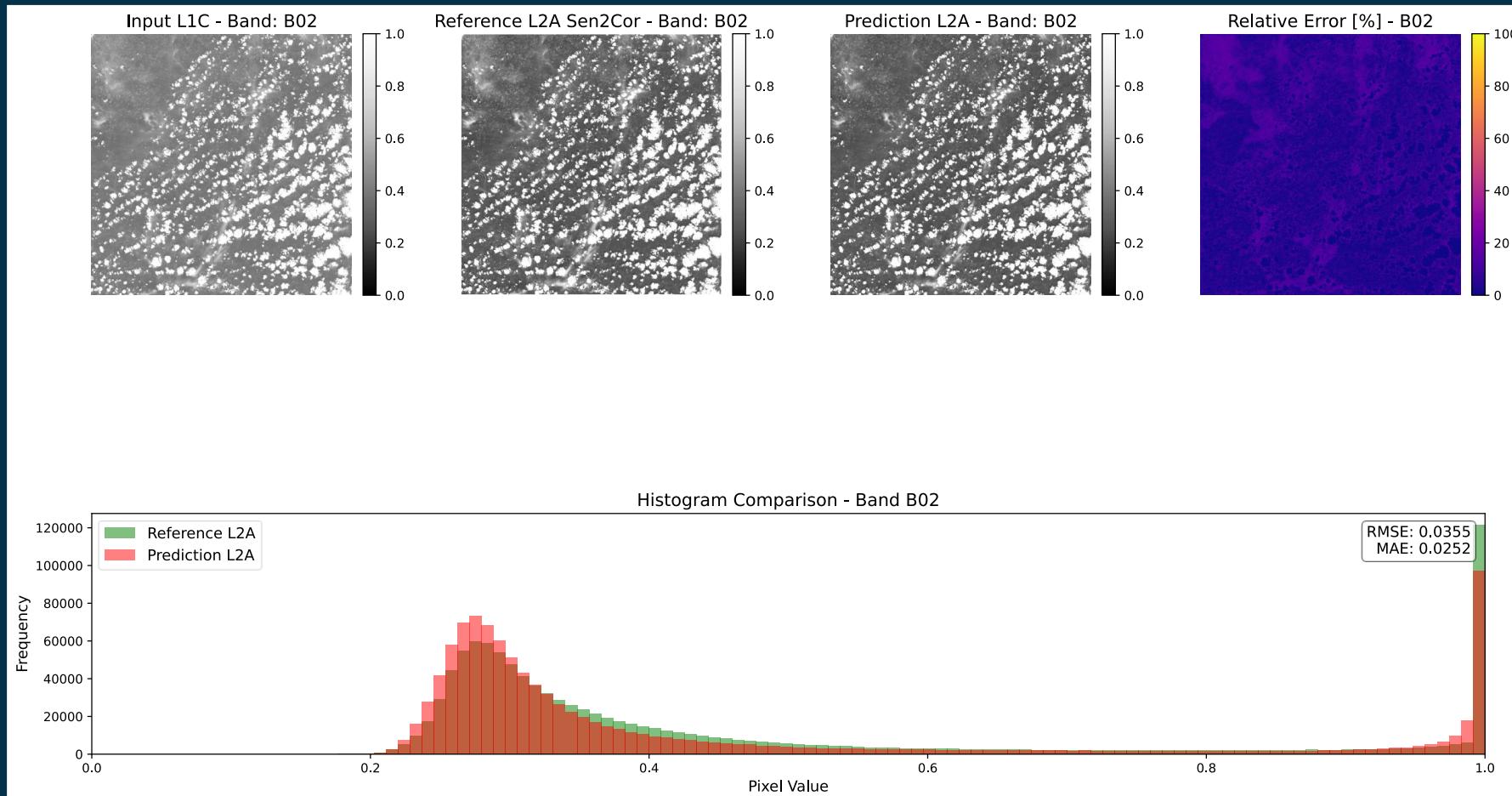
DeltaTwin - S2 L1C Atmospheric Correction



DeltaTwin - S2 L1C Atmospheric Correction

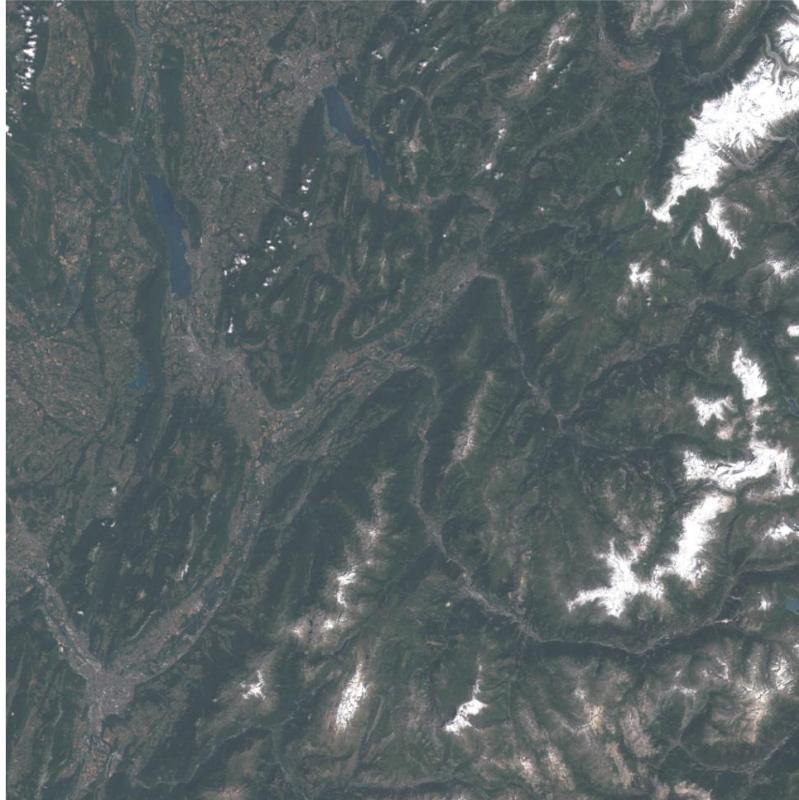


Results:

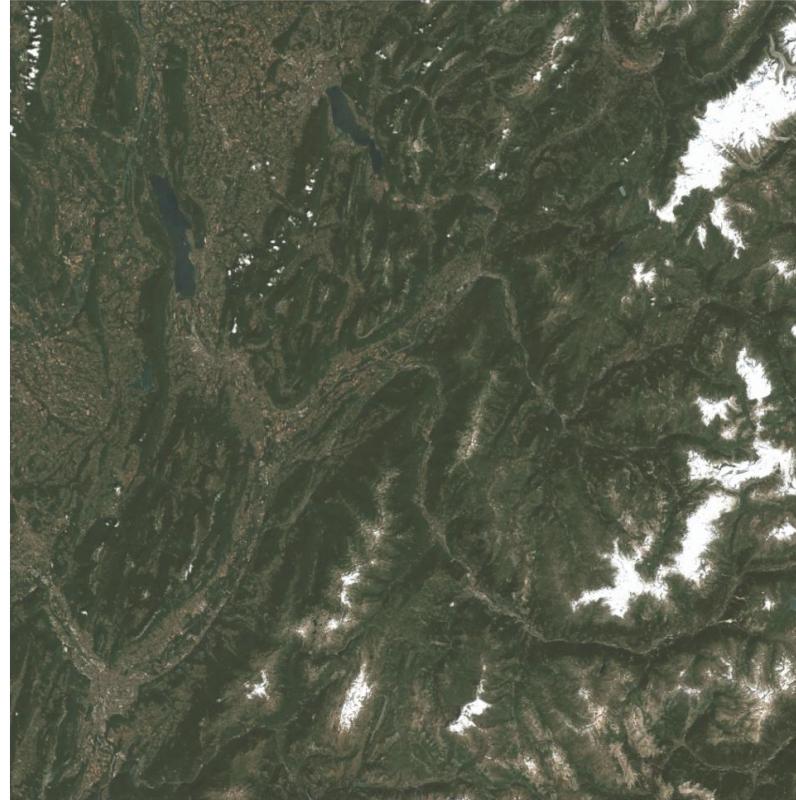


Results:

Input L1C - True Color Index ['B04', 'B03', 'B02']



Reference L2A Sen2Cor- True Color Index ['B04', 'B03', 'B02']



Predicted L2A - True Color Index ['B04', 'B03', 'B02']



Technical Constraints:

- Optimization for AI related libraries:
 - The Orchestrator demands all libraries to be constructed with *aptRequirements/Pip*, not allowing using Pytorch Docker Images.
- Limited support for common AI data formats
DeltaTwin resources do not support common AI data formats for neural network model weights, limiting machine learning workflow compatibility

Supported Resource Types

DeltaTwin® Drive supports the following resource types:

- **Text Files:** CSV, JSON, XML, TXT
- **Binary Files**
- **Other Data Formats:** Images, video, compressed files

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1.2 - AI-sen2cor:

An AI pilot study focused on atmospheric correction of Sentinel-2 Level-1C data.

1.3 - End-to-End AI Pipeline:

Designed to validate the assessment and performance of AI-sen2cor.



Scope:

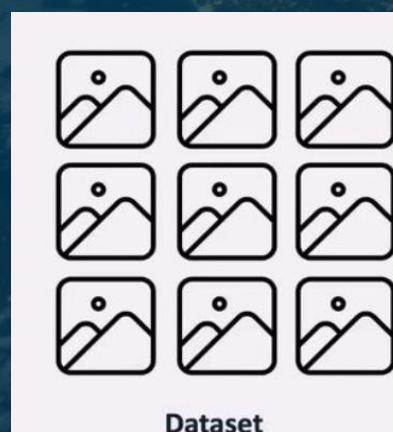
Develop a flexible, scalable ML pipeline

Scope:

Develop a flexible, scalable ML pipeline



Establish robust data analysis framework

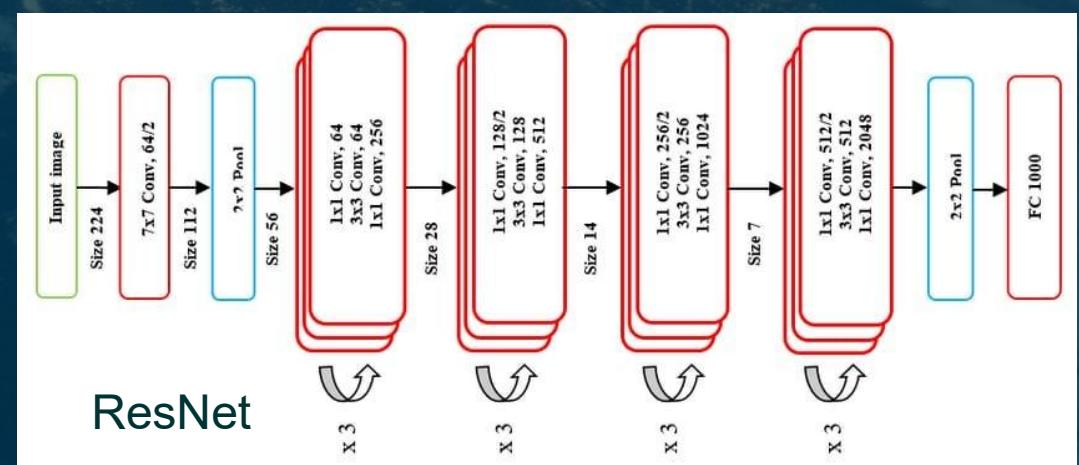
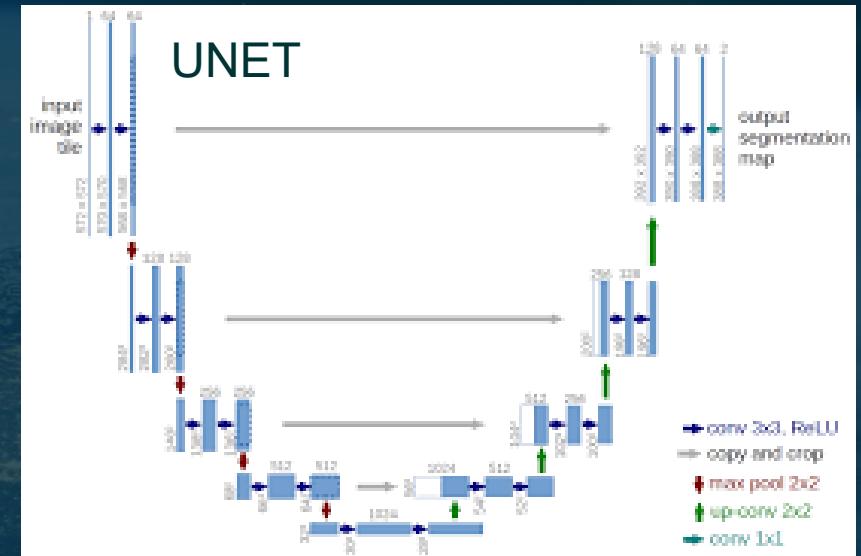


Scope:

Develop a flexible, scalable ML pipeline

Establish robust data analysis framework

Evaluate and optimize model architectures



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Develop a flexible, scalable ML pipeline

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Evaluate and optimize model architectures

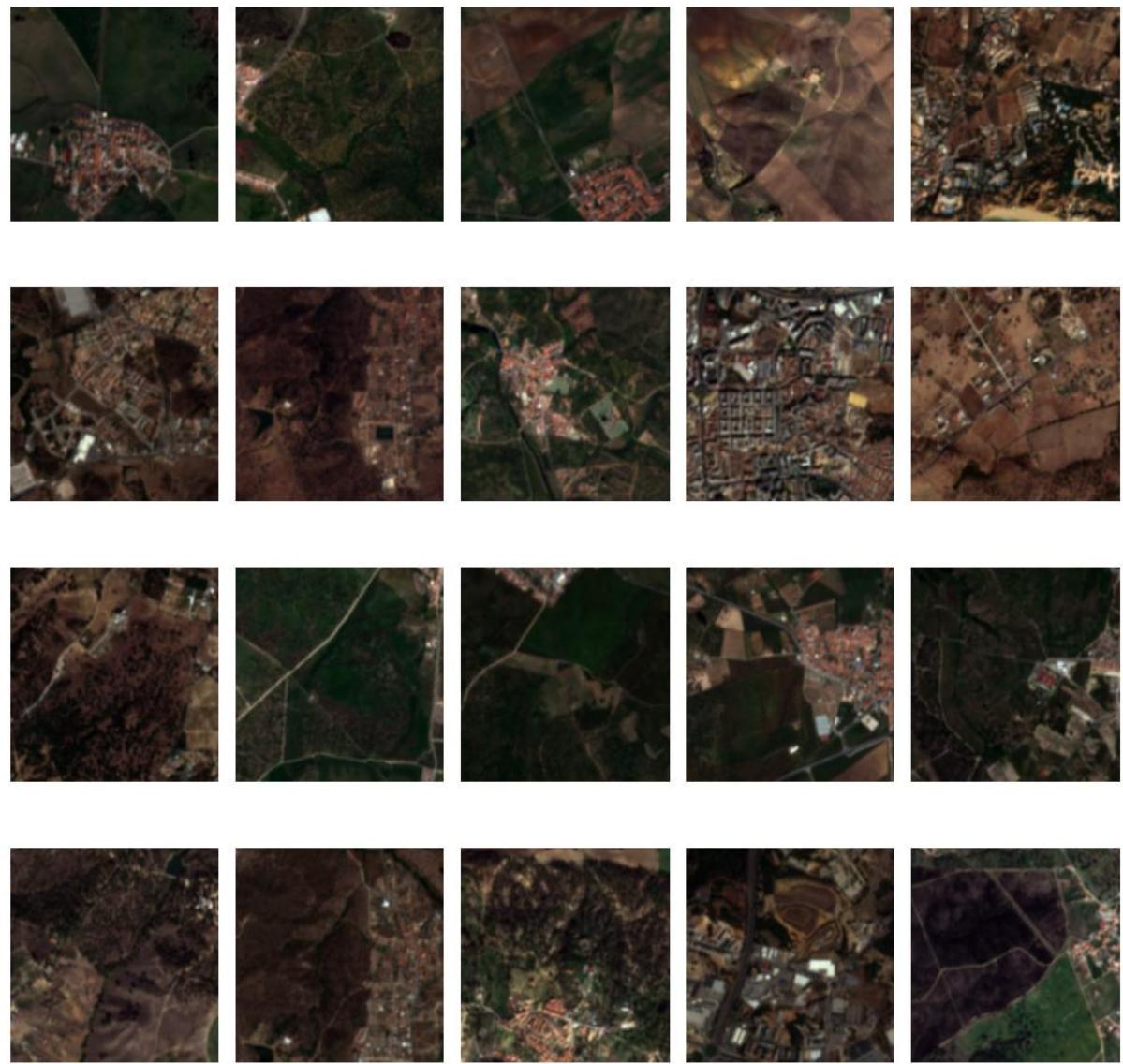
Deliver clean, maintainable code

**JR DEV WRITES
UNMAINTAINABLE CODE**

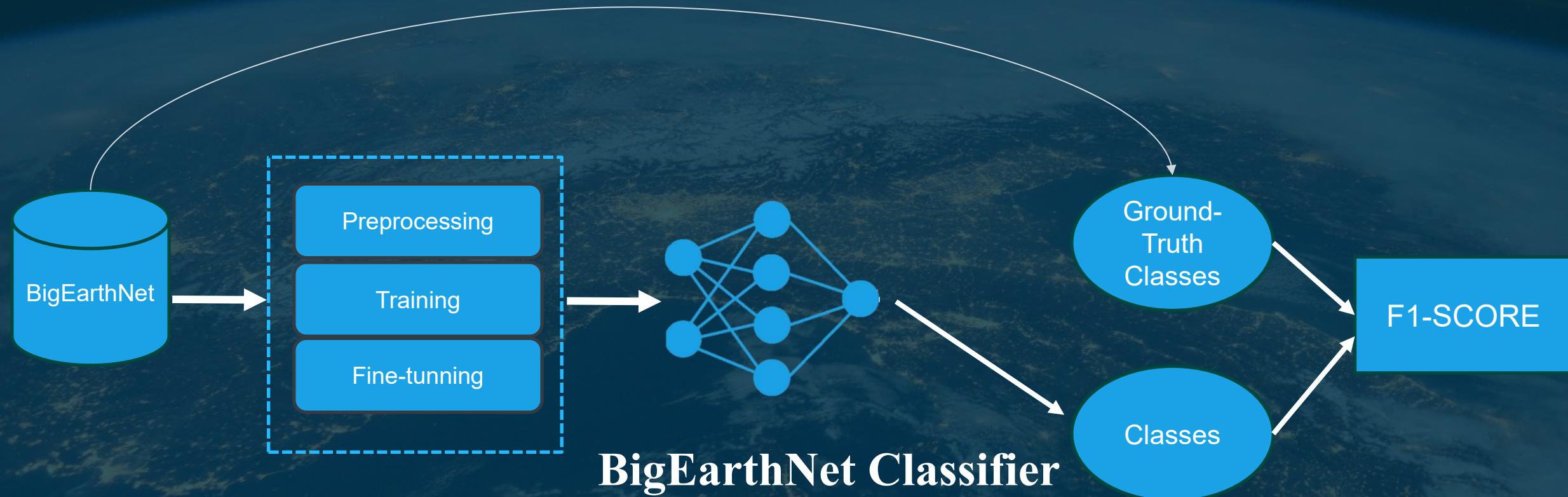


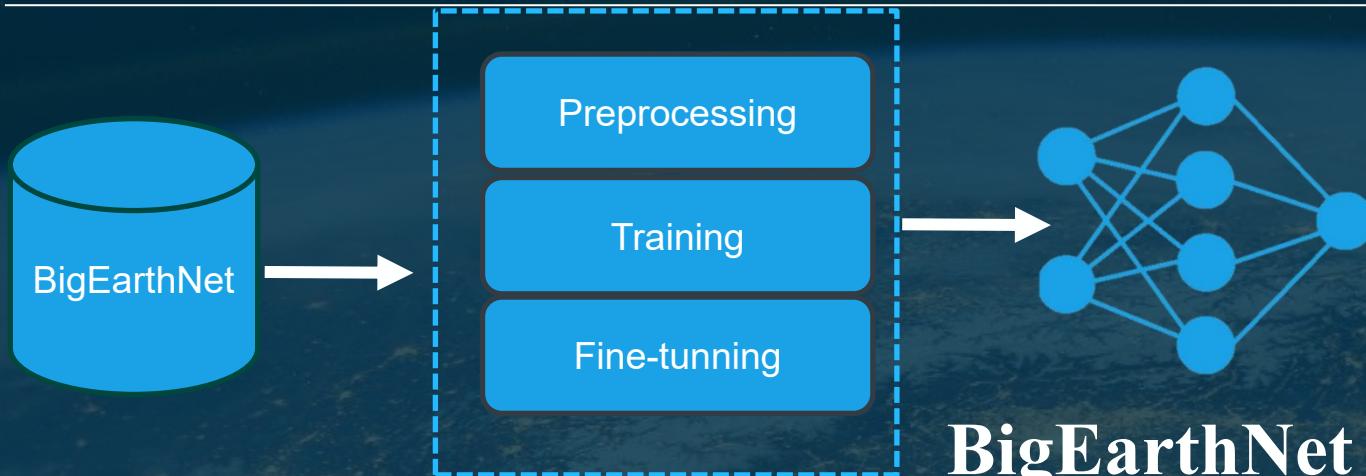


- 549,488 patches of Sentinel images in Europe
- 19 classes of Land Cover
- Patches of 1200m x 1200m
- 13 Bands available



DestinE Platform - End-to-End AI Pipeline





BigEarthNet Classifier

Loss: BCELogitLoss
- Positional Weights

Metrics:
Accuracy, Precision, Recall and F1-Score

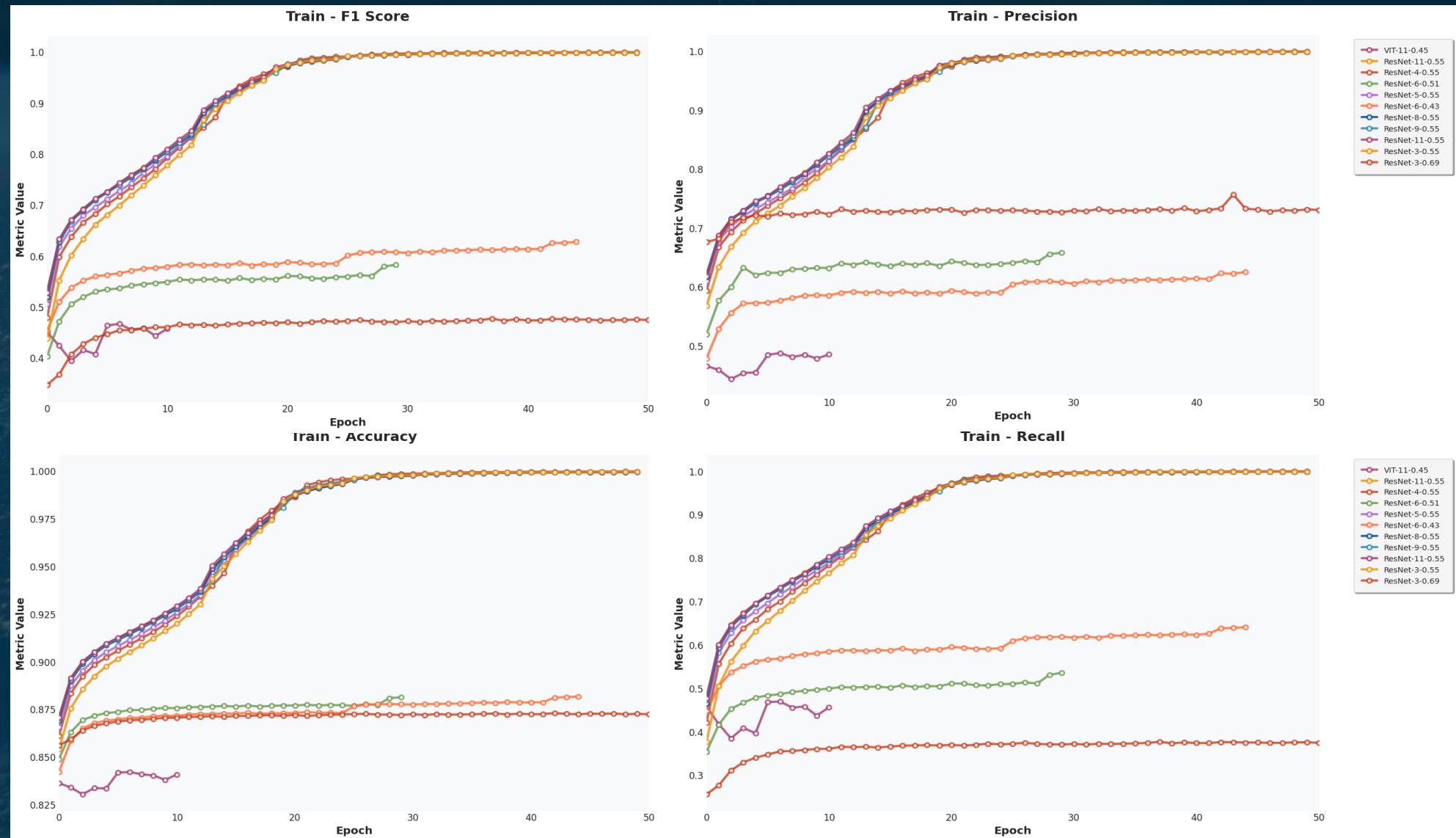
Dataset:
Resizing
Upscaling Method
Data Augmentation

Model Architecture:
Resnet50, Resnet26, ViT-small-patch

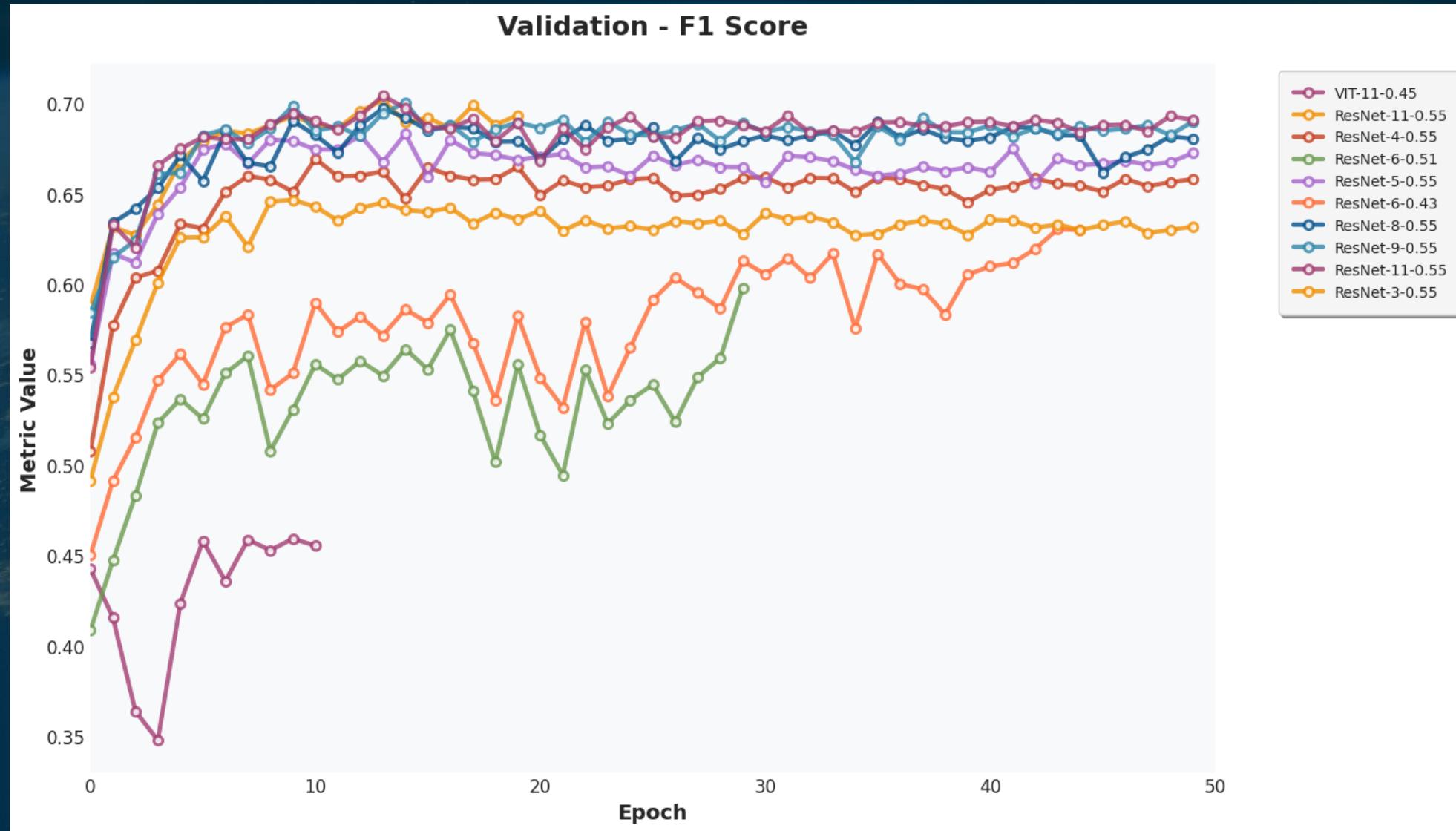
Feature Selection:
Number of bands, Index [NDVI]
Thresholding (Sensitivity)

Fine-Tuning:
Learning-rate.
Weight Decay
Schedulers: ReduceLROnPlateau
Early Stopping

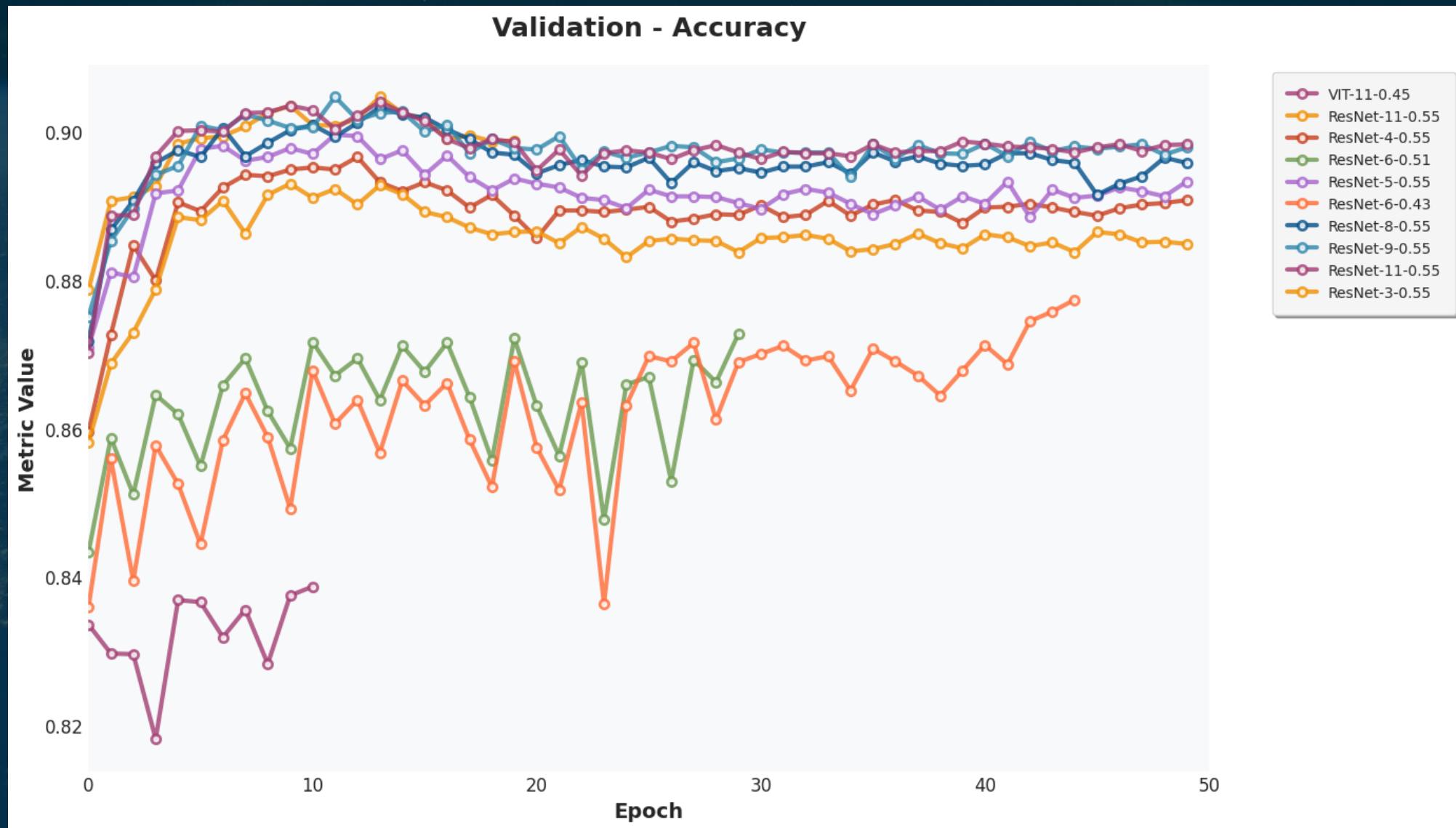
DestinE Platform - End-to-End AI Pipeline



DestinE Platform - End-to-End AI Pipeline



DestinE Platform - End-to-End AI Pipeline



DestinE Platform - End-to-End AI Pipeline



Model	F1-Score	Accuracy	Recall	Precision
Resnet50-11Bands	0.65	0.89	0.65	0.72
Resnet50-7Bands	0.58	0.85	0.54	0.65
Resnet26-11Bands	0.55	0.84	0.50	0.62
VIT-11Bands	0.52	0.69	0.530	0.52

** 75% Representative Test patches

End-User Feedback:



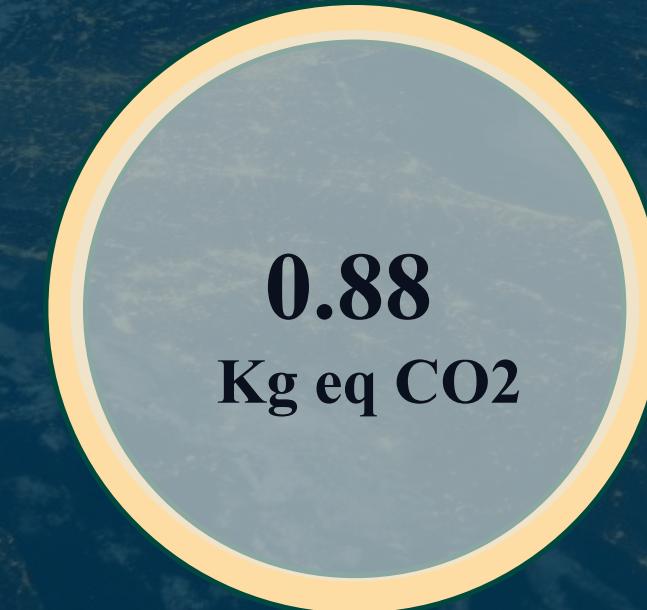
End-User Feedback:



- Powerful ecosystem







2 months later and 54 models ran...

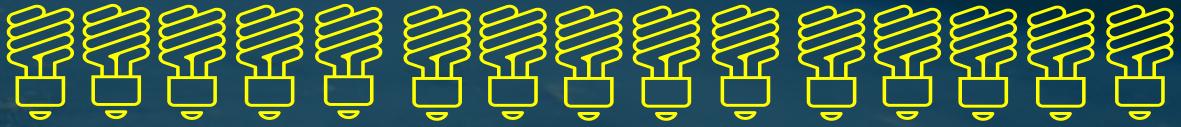
- One 9W bulb for 15 days



3.29 kWh

2 months later and 54 models run...

- One 9W bulb for 15 days



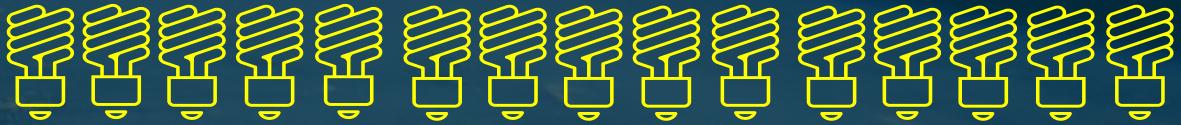
3.29 kWh

- A fan for 3 days straight





- One 9W bulb for 15 days



- A fan for 3 days straight

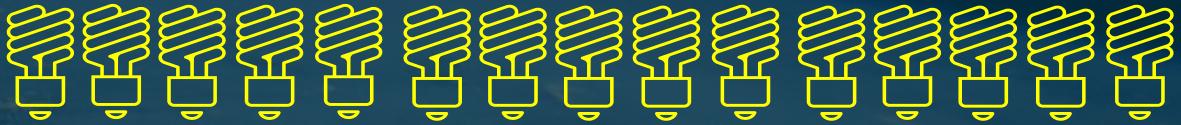


- 41 Hours of TV watching



3.29 kWh

- One 9W bulb for 15 days straight
- A fan for 3 days straight
- 41 Hours of TV watching



5 seasons of The office

- 4 km in a gasoline car



0.88
Kg eq CO₂

0.88
Kg eq CO₂

- 4 km in a gasoline car



- 40 km in a train



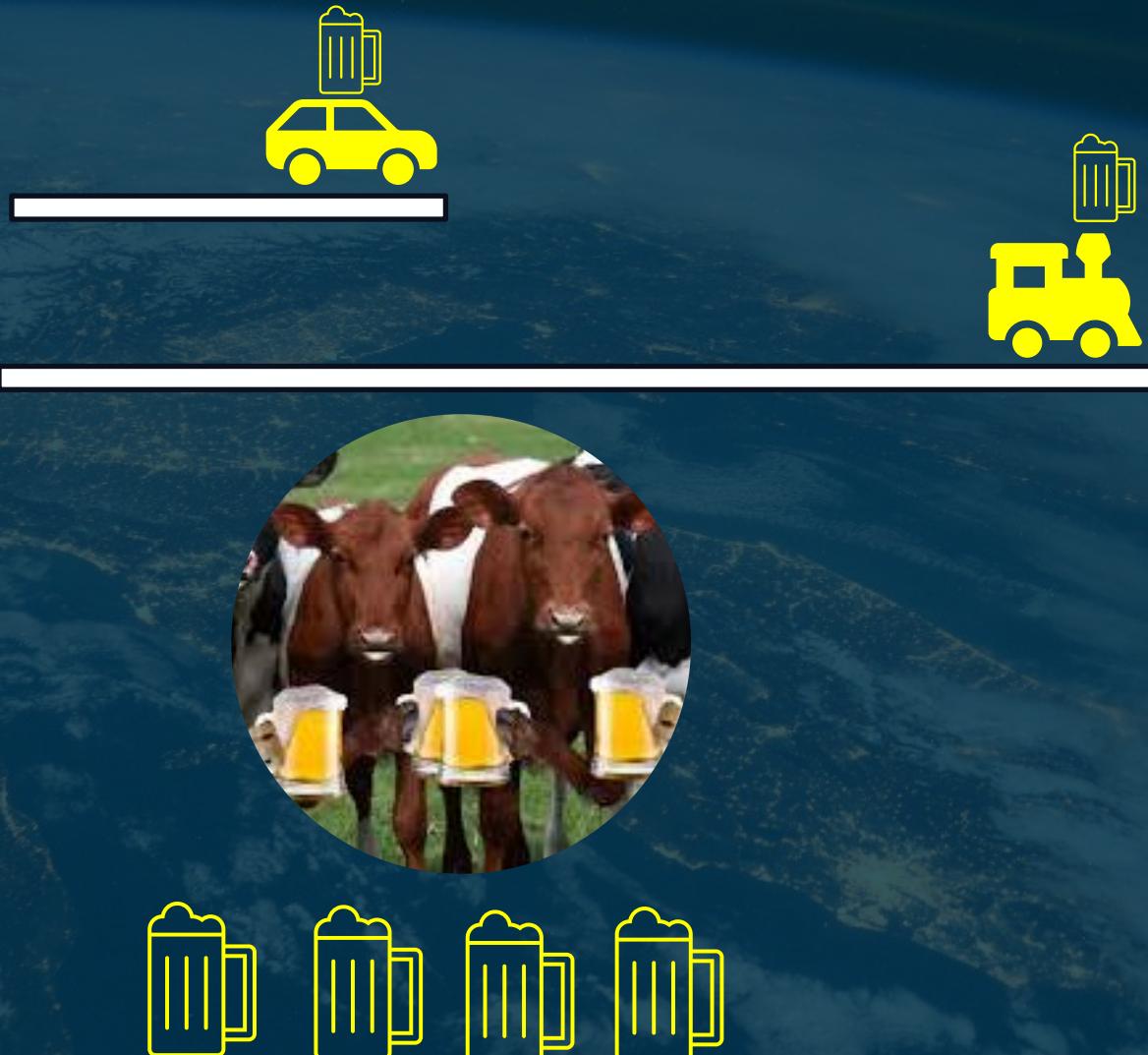
0.88
Kg eq CO₂

- 4 km in a gasoline car
- 40 km in a train
- 1 glass of Milk (250ml)



0.88
Kg eq CO₂

- 4 km in a gasoline car
- 40 km in a train
- 1 glass of Milk (250ml)
- 4 bottles of Beer (355ml)



THANK YOU!

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GITHUB

[emanuel-gf/BigEarthNet-Models: Playground of AI models for BigEarthNet Dataset](#)

[emanuel-gf/EO-Point-Cloud: This repository is ready to run as a model within the Destination Earth - DeltaTwin project. It retrieves Earth Observation data from Sentinel-2 and Digital Elevation Models \(DEM\) and creates a point cloud file.](#)

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