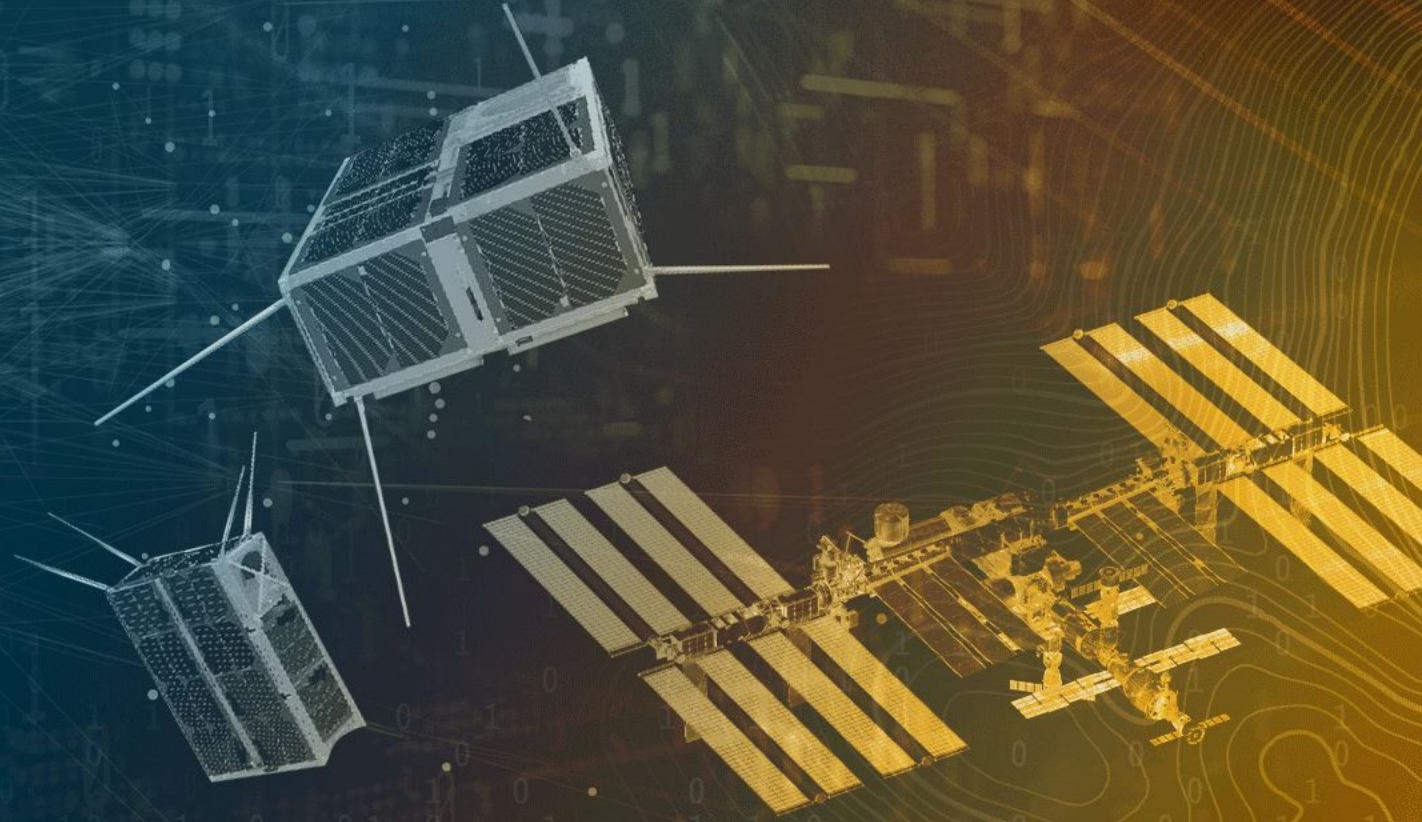


# DroughtScope

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Latitudo 40

September 2023





# The hook

*Saving the World from Drought, One Pixel at a Time, in Real-Time! With DroughtScope*



# The team

## Giovanni Giacco

CTO & PhD student in  
Artificial Intelligence  
and Expert Software  
Engineer



## Paolo De Piano

Data Scientist &  
Expert in Remote  
Sensing and GIS



## Antonio Elia Pascarella

PhD student in AI,  
National Programme



## Mattia Rigioli

PhD Student in AI / Remote  
Sensing & Data Scientist



## Donato Amitrano

PhD in Remote Sensing &  
Senior Researcher





# Value proposition



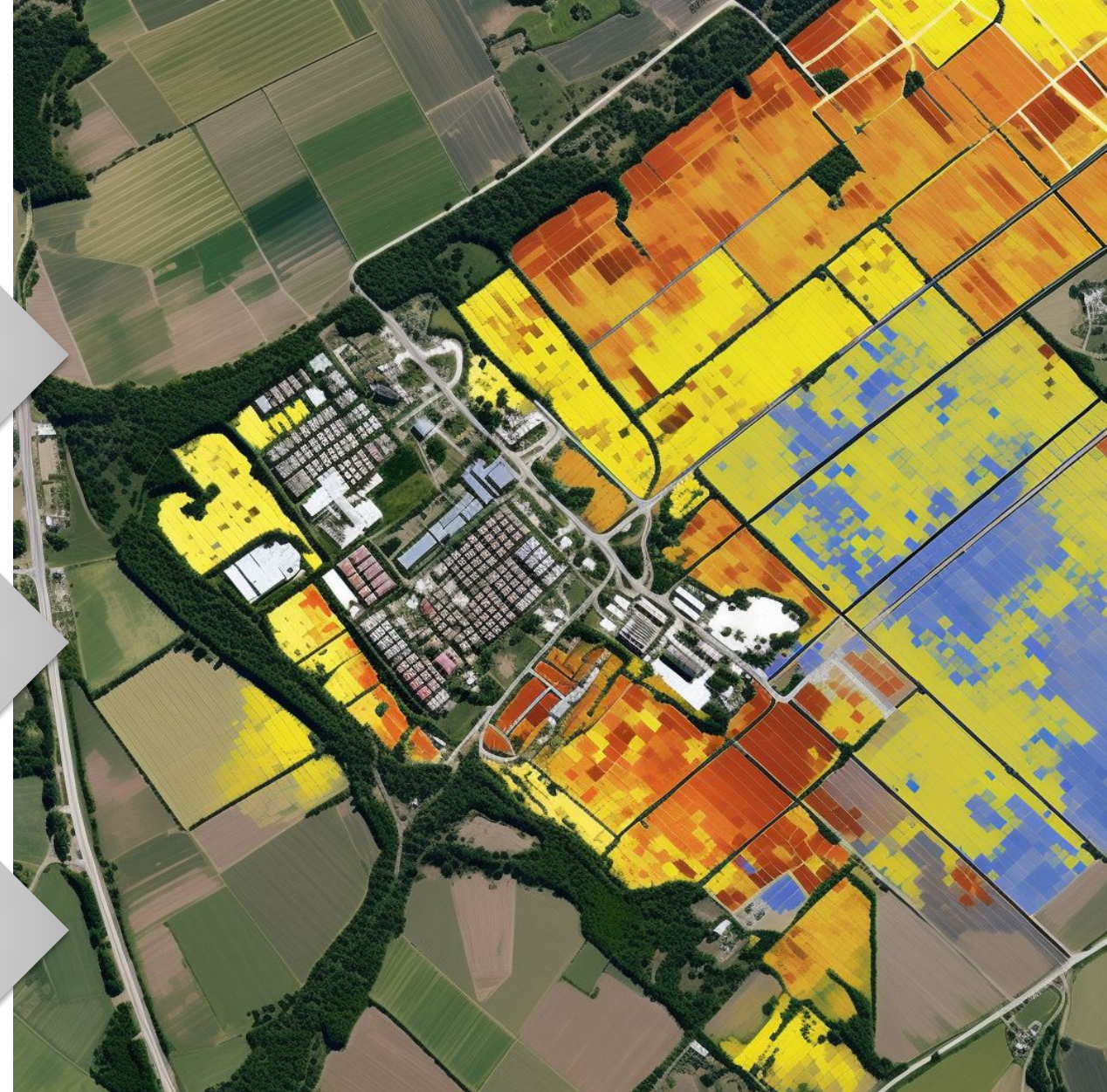
**Drought** problems,  
especially for crops



**DroughtScope**, our  
AI model, provides  
water stress **alerts**  
on crops



Actions to improve  
**water** resource  
management, and  
food production



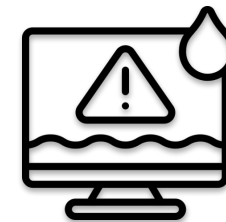
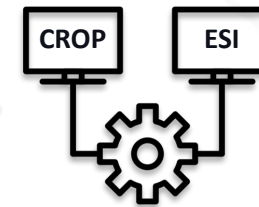
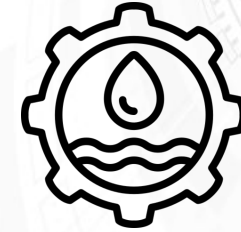
# Solution

Management of water resources to cope with **droughts** in crop fields

**Early warnings** about crop water stress based on evaporative stress index (ESI) estimation

**Multi-task neural** architecture for ESI estimation and crop mapping

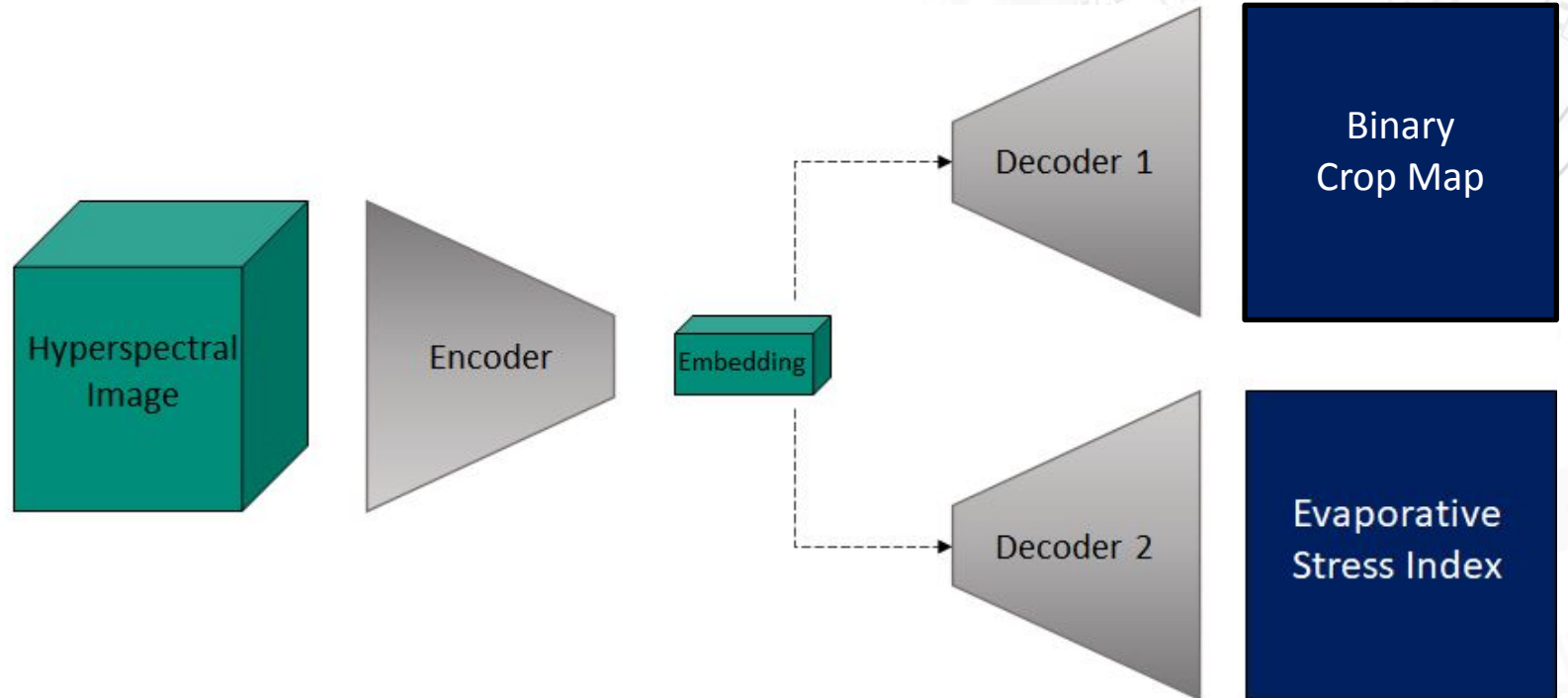
Innovative **water stress estimation** on crops and alerts enabled by **real-time** provisioning





# Technical aspects

*As a novelty, we introduced a **multi-task neural architecture**, proposed ad hoc for this task, that processes a hyperspectral tensor: an encoder network creates a high-level embedding used by two decoders.*



*The first, trained with a cross-entropy loss function, generates a **crop map**. The second, employing a Mean Absolute Error function, predicts the **ESI map**. The total loss is calculated from both tasks, optimizing them simultaneously. The shared representation learning used enhances efficiency.*

# Validation of the model

## Crop Detection Classification metrics

**Accuracy:** 0.8

**Recall:** 0.8

**Precision:** 0.6

**F1-Score:** 0.7

## Evaporative Stress Index (ESI) Regression metrics

**RMSE:** 0.1

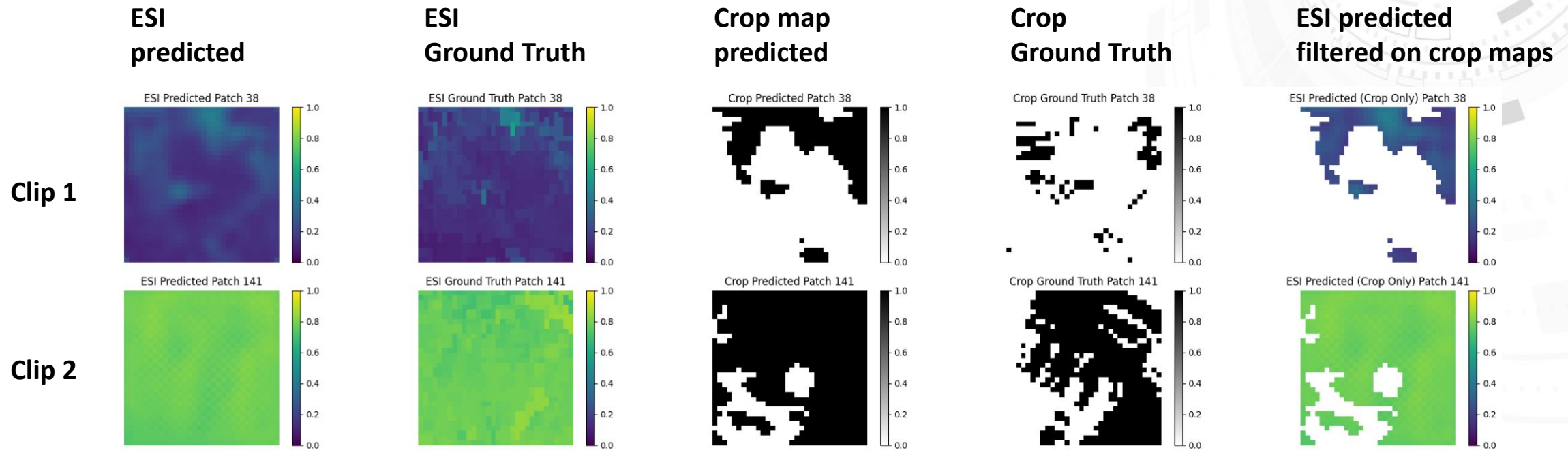
## Model Size

**Model Size:** 165 MB

**Parameters:** 40 M

We used a 70-15-15 holdout split; the division was made after performing a shuffle over random and representative areas in **Europe**

# Validation of the model



Examples of produced maps and  
corresponding ground truth on the test set



# Proof of concept

Our solution involves a 165 MB model that is **compliant** with the onboard **computational** resources of 32 GB, as outlined in the specifications. Moreover, our solution is meaningful precisely because it needs to provide **real-time responses**, which aligns with the core purpose of the mission itself. This solution is also **feasible scientifically** since the literature already highlighted the correlation between narrowband indices and Evapotranspiration [1]

[1] M. Marshall, P. Thenkabail, T. Biggs, K. Post, "Hyperspectral narrowband and multispectral broadband indices for remote sensing of crop evapotranspiration and its components (transpiration and soil evaporation)", *Agricultural and Forest Meteorology*, vol. 218-219, pp. 122-134, 2016.





# Contribution to open science

Use only **open-data**

A **new dataset** for  
ESI and Crop  
Classification

**Share results** with  
scientific community

**Architecture**  
designed to **save**  
**weights** by sharing  
one encoder for  
multiple tasks

Explore **correlation**  
between **ET** and  
**hyperspectral** data  
at **global scale**

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# Call to action

We are researchers from both *academia* and *industry*,  
and with our proposal, we aim to help mitigate  
*drought* issues to optimize *food security*,  
especially for poor countries