DroughtScope

Latitudo 40

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esa Microsoft ThalesAlenia Space

AI4EO Challenges by ESA Φ-lab

The hook

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

The team

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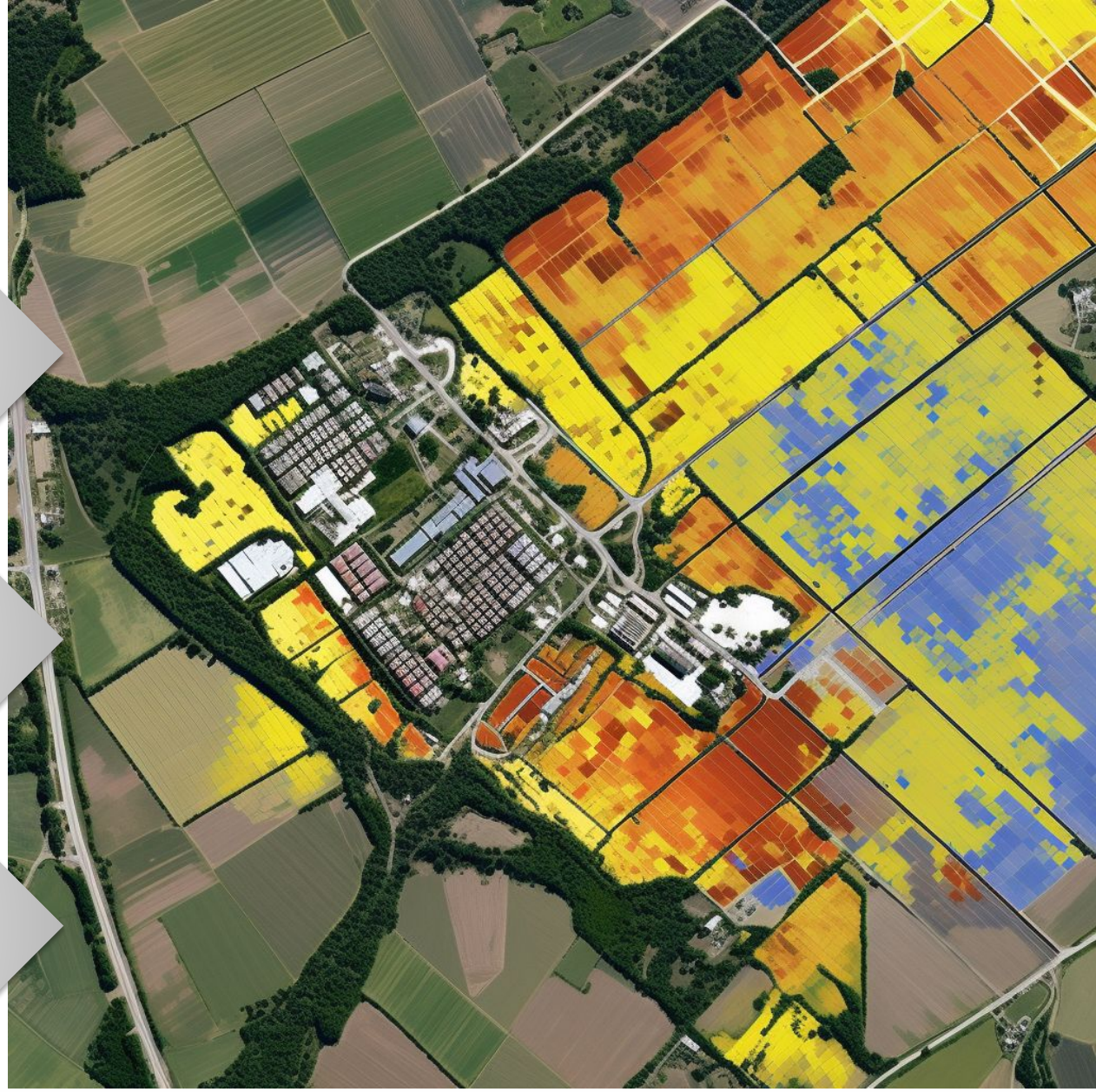
Value proposition

Drought problems, especially for crops

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

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

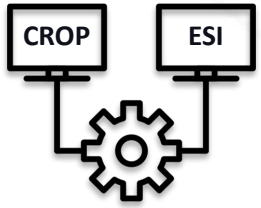


Solution

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

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

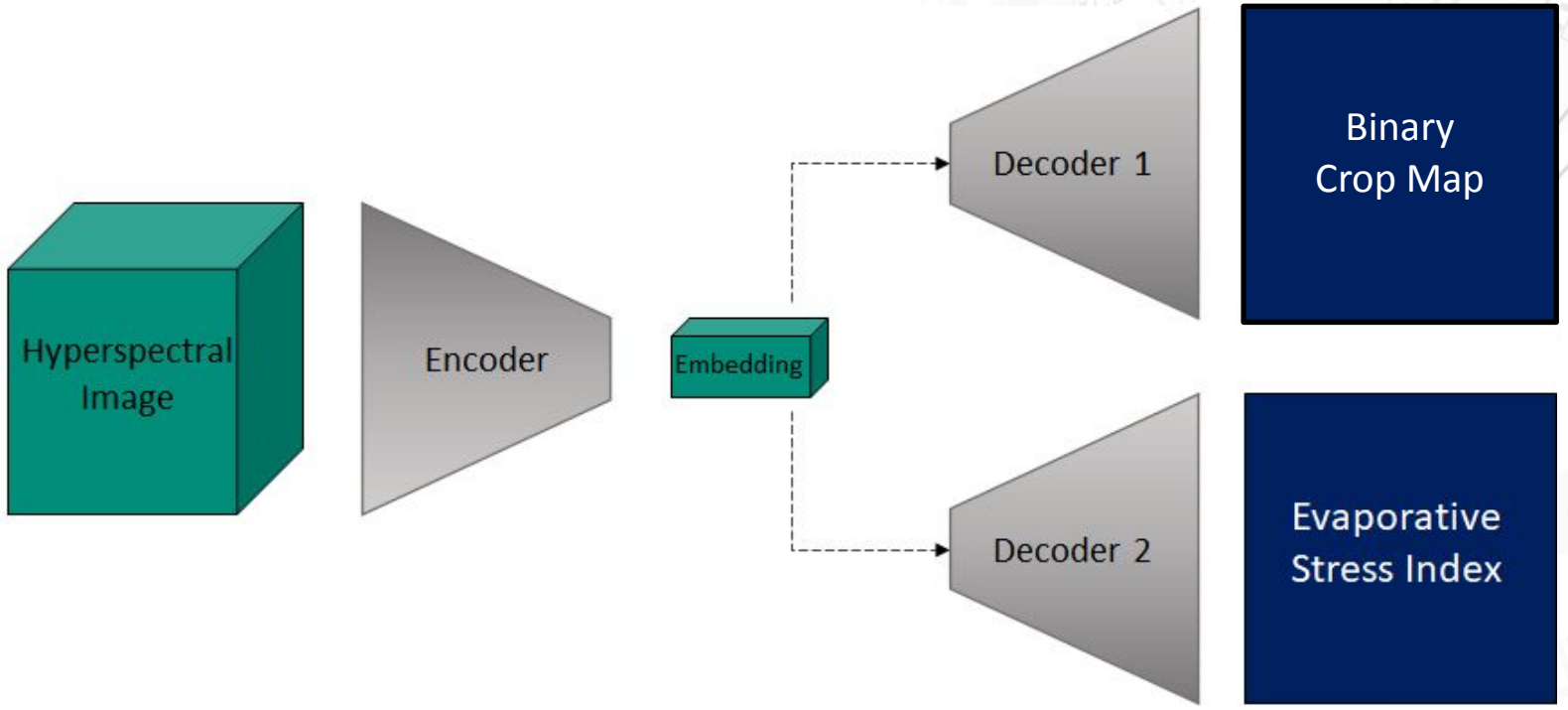
Multi-task neural architecture for ESI estimation and crop mapping



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.*



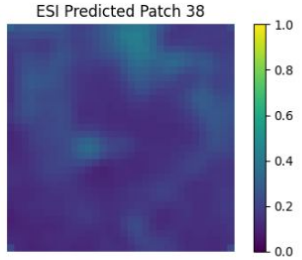
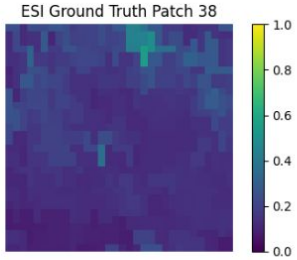
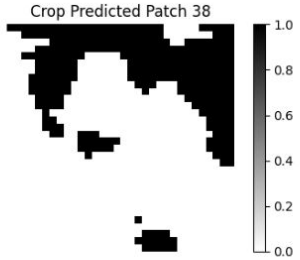
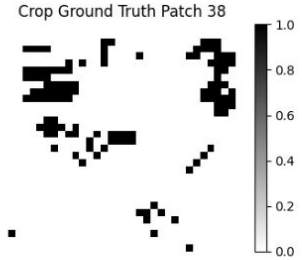
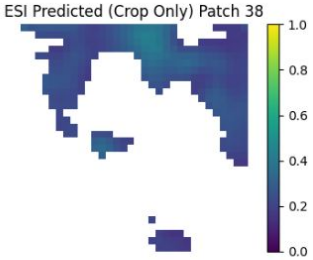
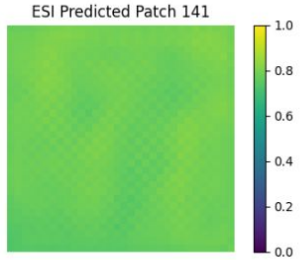
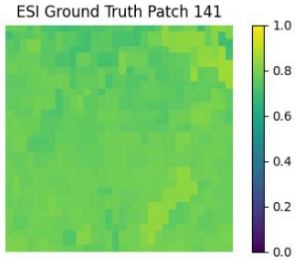
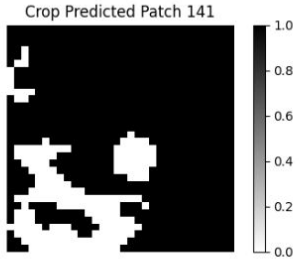
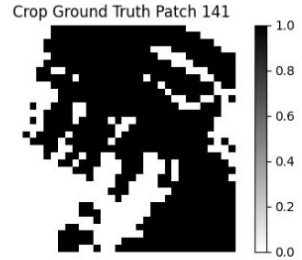
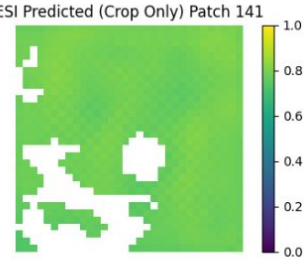
*The first, trained with a cross-entropy loss function, generates a **crop map**. The second, employing a Mean Absolute Error function, predicts the **ESI map**. The total loss is calculated from both tasks, optimizing them simultaneously. The shared representation learning used enhances efficiency.*

Validation of the model

Crop Detection Classification metrics	Evaporative Stress Index (ESI) Regression metrics	Model Size
Accuracy: 0.8	**RMSE**: 0.1	**Model Size**: 165 MB
Recall: 0.8		**Parameters**: 40 M
Precision: 0.6		
F1-Score: 0.7		

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

	ESI predicted	ESI Ground Truth	Crop map predicted	Crop Ground Truth	ESI predicted filtered on crop maps
Clip 1					
Clip 2					

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**

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