SeasFire Project: ID 310568
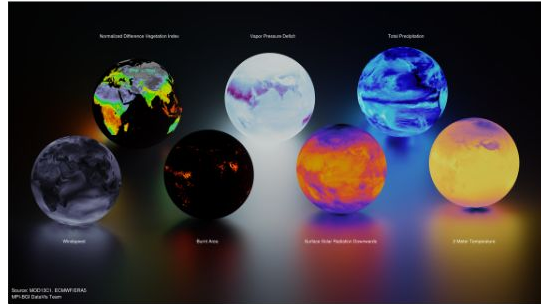
NoR Sponsorship Report
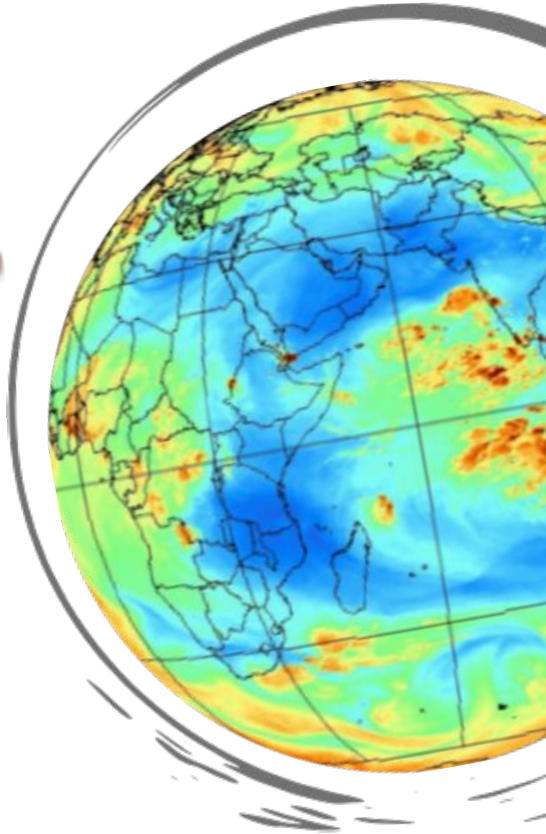
SeasFire

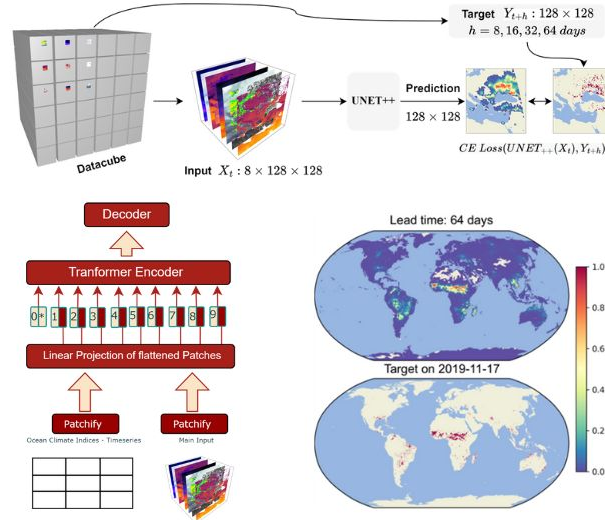## EARTH SYSTEM DEEP LEARNING FOR SEASONAL FIRE FORECASTING IN EUROPE

SeasFire Datacube

Earth System Datacube containing fire driver variables and fire products

Analysis-Ready, Cloud-Optimized Data

Public tutorials and data

Source: MOD13C1, ECMWF/ERA5
MPI-BGI DataVis Team

Earth System Deep Learning

Deep Learning can increase our ability to forecast and simulate wildfires

Novel modeling of the earth as a system can improve performance and understanding

$$\text{Target } Y_{t+h} : 128 \times 128$$
$$h = 8, 16, 32, 64 \, days$$

Input $X_t : 8 \times 128 \times 128$

Prediction 128×128

$CE\ Loss(UNET_{++}(X_t), Y_{t+h})$

Decoder

Tranformer Encoder

Linear Projection of flattened Patches

Patchify — Ocean Climate Indices - Timeseries

Patchify — Main Input

Lead time: 64 days

Target on 2019-11-17

Causal Analysis

Causal discovery with time-series from the SeasFire Cube reveals known driving mechanisms of burned areas with time lags

Mediterranean Forests, Woodlands & Scrub of Europe
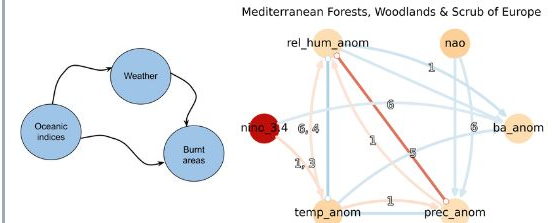
Prototype App

Application showing AI-based predictions of seasonal burned area patterns for Europe
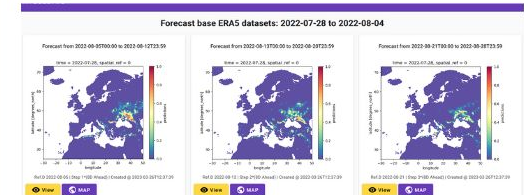
Objectives

The SeasFire project, funded by the ESA, is taking an innovative approach to predicting seasonal wildfire patterns in Europe.

SeasFire uses cutting-edge technology, such as modern **deep learning models** and **Earth Observation data**, to explore the spatio-temporal connections between atmospheric conditions and fire regimes to gain valuable insights into **predicting potential wildfires**.

SeasFire   Earth System Deep Learning for Seasonal Fire Forecasting in Europe

Max Planck Institute for Biogeochemistry

Funded by

esa

NoR Tools Usage - Training our DL models

- Our main usage was a node equipped with a GPU in CreoDias
- Good that we can scale up and down resources according to our needs
- Cloud helps us collaborate between different institutions, having a common environment and place for our data

SeasFire

Earth System Deep Learning for Seasonal
Fire Forecasting in Europe

ΧΑΡΟΚΟΠΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ
HAROKOPIO UNIVERSITY

Max Planck Institute
for Biogeochemistry

Funded by

esa

Highlights - benefits to society

- SeasFire aims to develop new methods for sub-seasonal to seasonal wildfire forecasting
- Increasing our wildfire forecasting capabilities can help optimize disaster management
- Improved methods for long-term forecasting may have applications to other domains (e.g. weather forecasting, drought forecasting) with huge benefits to society

Publications - Developed with NoR Support

Karasante, et al. "SeasFire as a Multivariate Earth System Datacube for Wildfire Dynamics." arXiv preprint arXiv:2312.07199 (2023). (submitted to Nature Scientific Data)

[NoR resources were used for training the Deep Learning models in the aforementioned paper, not for developing the datacube, or the models.]

Seasonal Fire Prediction using Spatio-Temporal Deep Neural Networks. Michail et al. 2024 (submitted to IEEE Geoscience and Remote Sensing Letters)

SeasFire

Earth System Deep Learning for Seasonal
Fire Forecasting in Europe

ΕΘΝΙΚΟ ΑΣΤΕΡΟΣΚΟΠΕΙΟ ΑΘΗΝΩΝ

ΧΑΡΟΚΟΠΕΙΟ ΠΑΝΕΠΙΣΤΗΜΙΟ
HAROKOPIO UNIVERSITY

Max Planck Institute
for Biogeochemistry

Funded by

esa