

# HHAPI with Satellite Data

## Heat-Humidity-Air Pollution Index with Satellite Data



EUROPEAN  
MASTER IN  
OFFICIAL  
STATISTICS

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Athens University  
Economics and Business

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European Big Data Hackathon 2025

Earth Observation: from Space to European Statistics

Brussels, 6–11 March 2025



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# Motivation

- ▶ Greece (and not only) suffered from devastating wildfires during the last years
- ▶ Wildfires also affect the air quality substantially
- ▶ Also dust from Africa affects more often the air quality.
- ▶ How can we measure that and check the impact in human lifes?



**Idea:** Use of satellite data to create a relevant index



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# Our approach

- ▶ Propose an extended Discomfort index
- ▶ Use data from
  - ▶ Eurostat
  - ▶ Copernicus, Sentinel 2 and 5
  - ▶ Climate data store
- ▶ Create a composite index based on
  - ▶ temperature
  - ▶ humidity
  - ▶ dust and smoke in the atmosphere ([UV Aerosol Index \(UVAI\)](#))

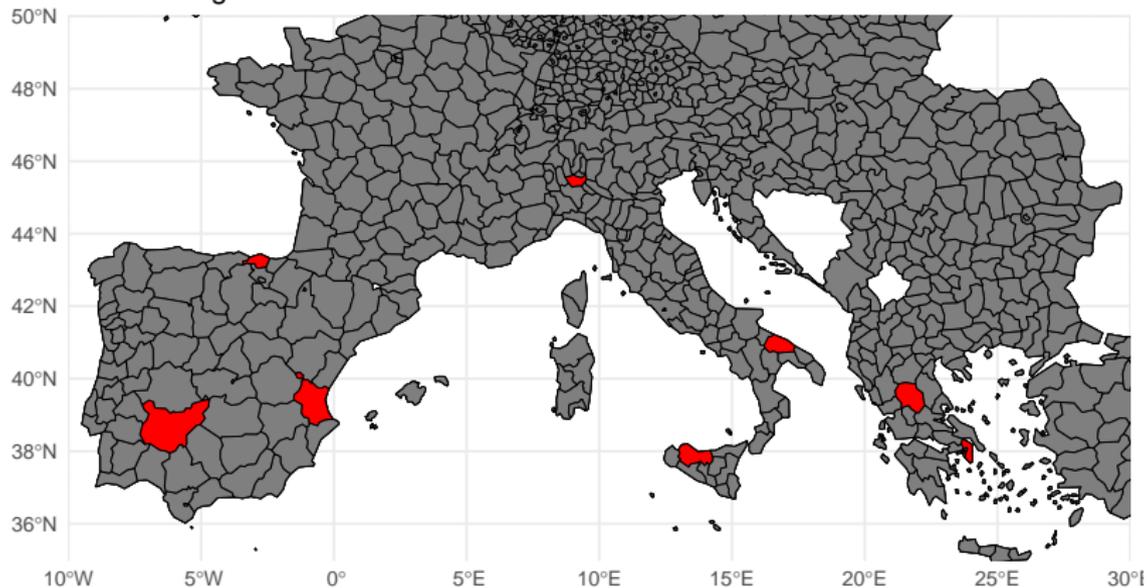
**Aim:** to put together different sources of data: challenges and caveats



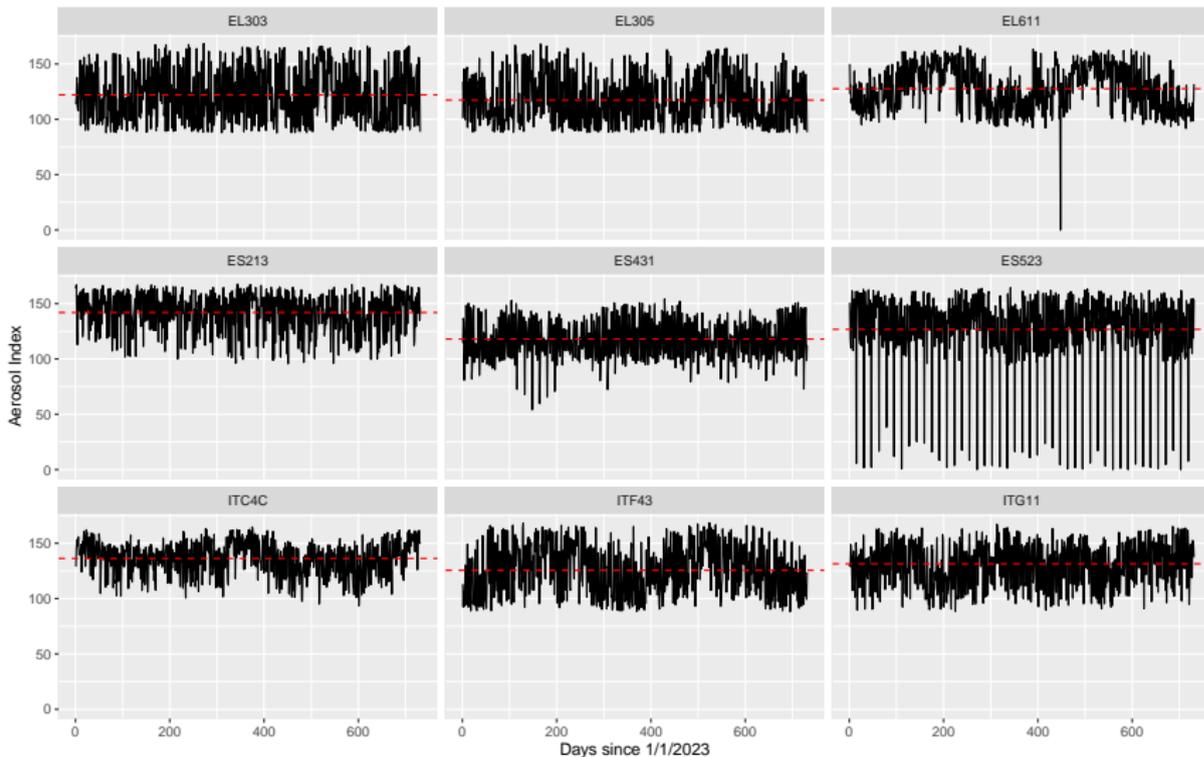
# Data Used

- ▶ 9 NUTS 3 areas in Greece, Spain and Italy

NUTS3 Regions used



# Aerosol Index



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# Some detail

- ▶ We downloaded the temperature and the Dew point (from Climate Data Store).
- ▶ From them we calculated the Relative Humidity using the Magnus-Tetens approximation formula
- ▶ Preprocessed data with advanced explainable Machine Learning methodologies
- ▶ Then we got the Discomfort Index



# Methodology for the new index

Existing Discomfort Index is based on Temperature and humidity using

$$DI = T - 0.55 \times \left(1 - \frac{RH}{100}\right) \times (T - 14.5)$$

where:

- ▶  $DI$  = Discomfort Index
- ▶  $T$  = Air Temperature ( $^{\circ}\text{C}$ )
- ▶  $RH$  = Relative Humidity (%)



# The new index

New Discomfort Index is based on Temperature and AER using

$$DI_n = T - 0.55 \times \left(1 - \frac{AER}{180}\right) \times (T - 14.5)$$

where:

- ▶  $DI$  = Discomfort Index
- ▶  $T$  = Air Temperature ( $^{\circ}\text{C}$ )
- ▶  $AER$  = Aerosol index

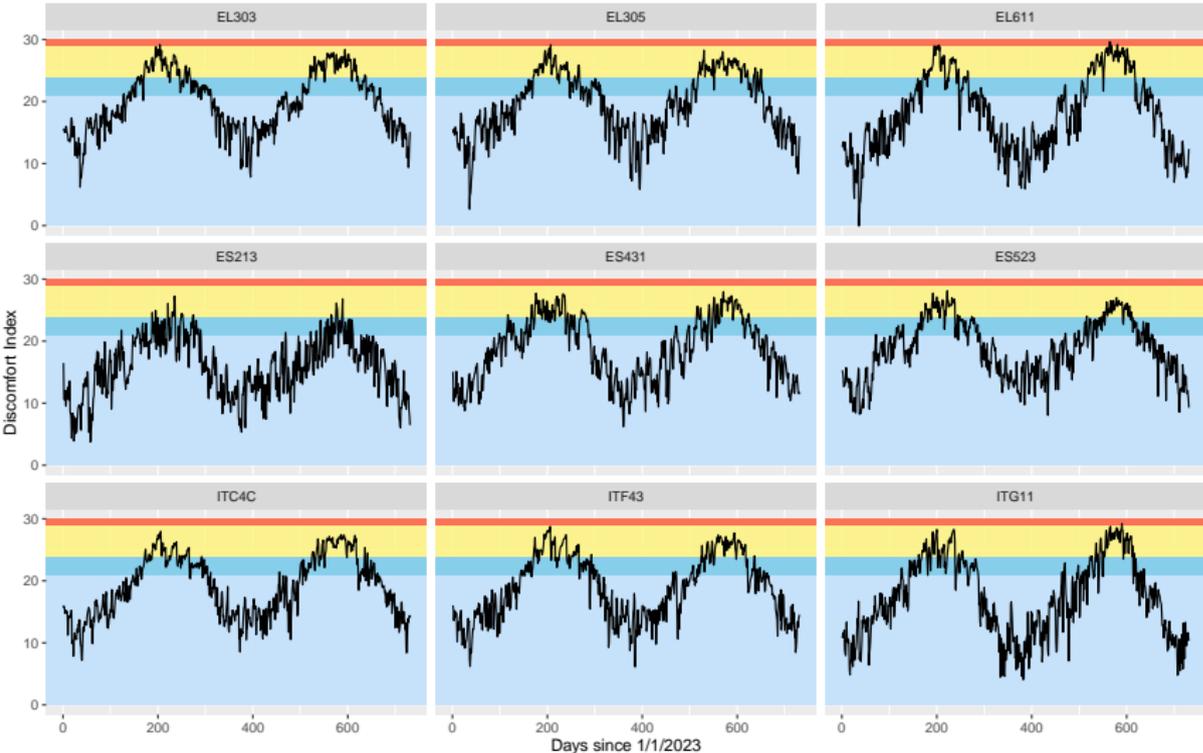
Formula mimics the impact of relative humidity Clearly needs calibration. We use as Index

$$DI_{new} = \max\{DI, DI_n\}$$

The rational is to consider both combinations.



# Discomfort Index - Existing

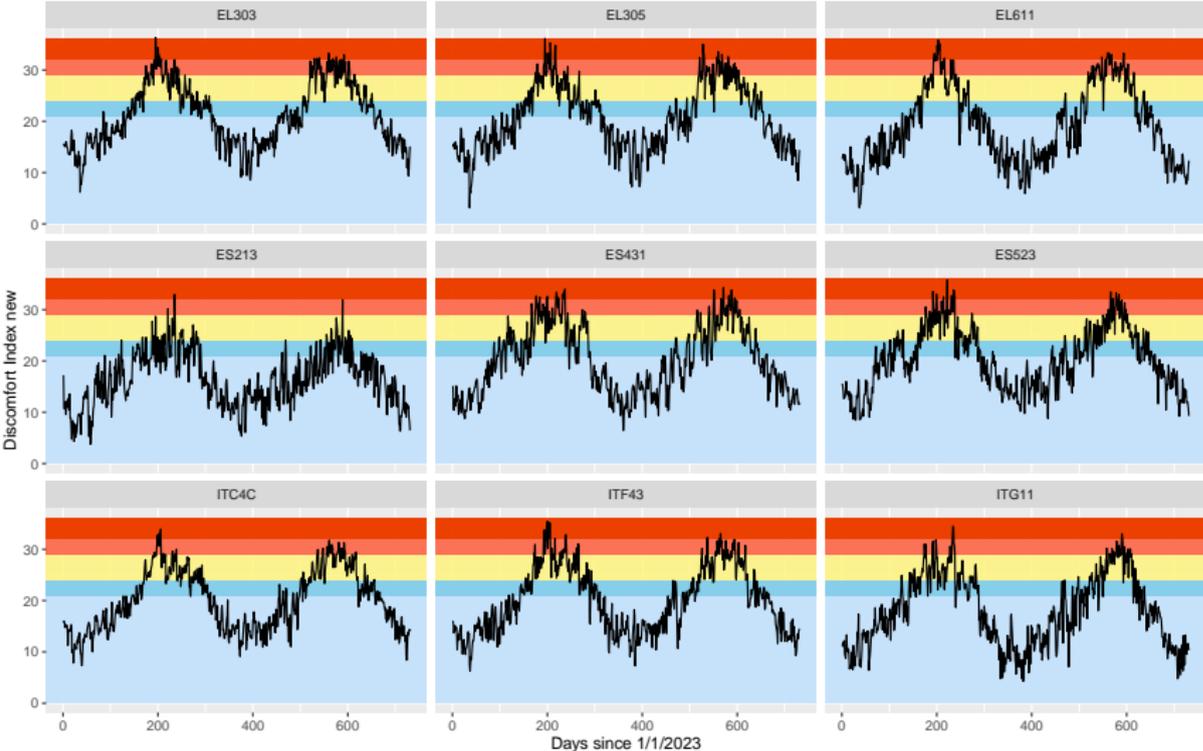


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# Discomfort Index new



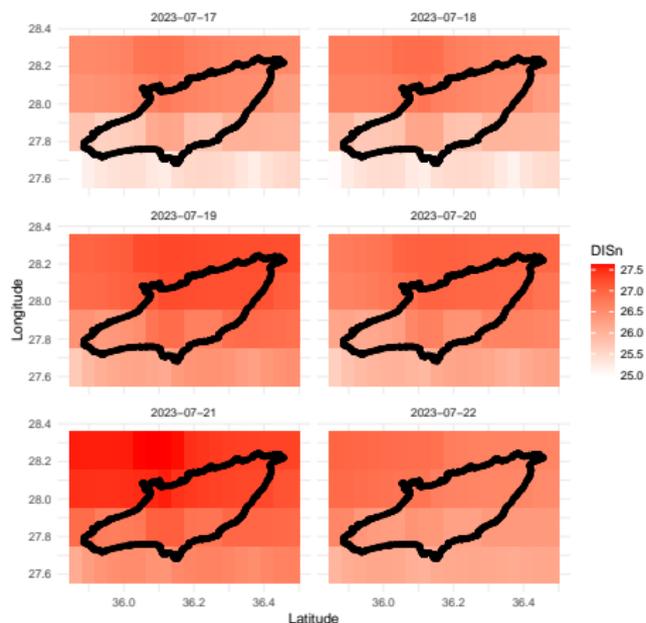
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# Grid based calculation

- ▶ Index in a grid level
- ▶ Rhodes (Greece) in 6 consecutive days
- ▶ Challenge: different granularity in different data sources
- ▶ Need for spatial interpolation
- ▶ Bottom up approach to aggregate the data weighting by the population of each grid.



# Sum-up

- ▶ **Innovative** use of Satellite data: challenges and issues identified
- ▶ Calibrate/interpret/understand further the new index (e.g. optimal weights, other variables)
- ▶ Index offers large granularity
- ▶ **Policy** related implementation



# Shiny App: Heatmap-Calendar



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# Shiny App: Time-Series Plot

## Discomfrot indices by Region and Month

Select Region:

EL611

Select Year/Month:

2023/07

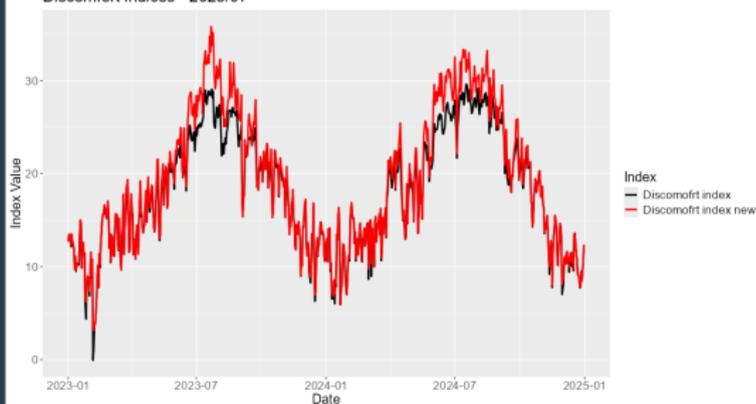
Choose Plot Type:

- Gradient Calendar
- Time Series

Visualization

NUTS3 Map

Discomfrot indices - 2023/07



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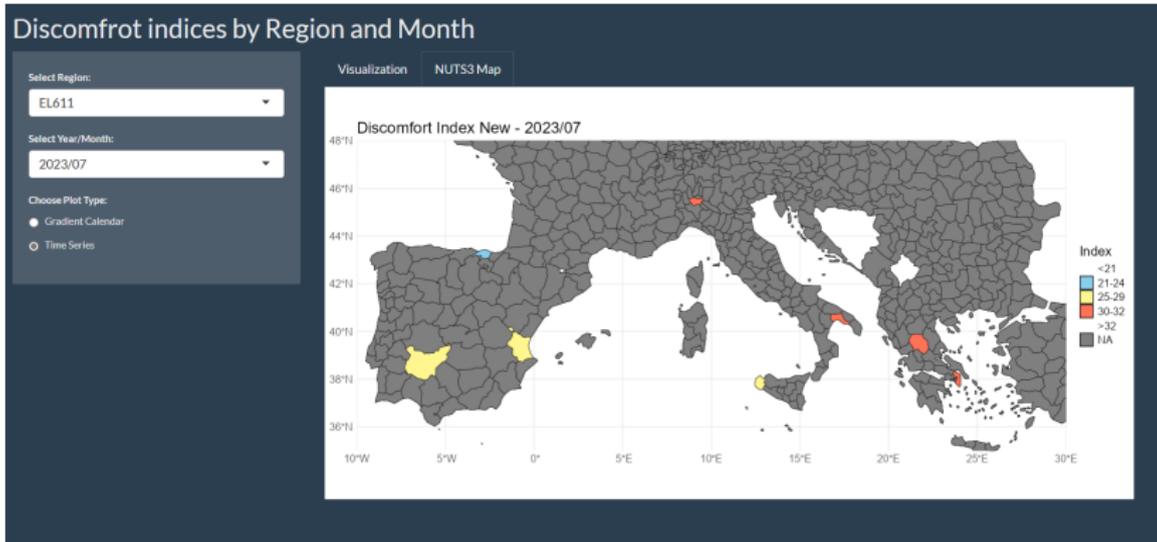
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# Shiny App: NUTS3 Map



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