First CLIM-RUN Workshop on Climate Services

Forest Fires

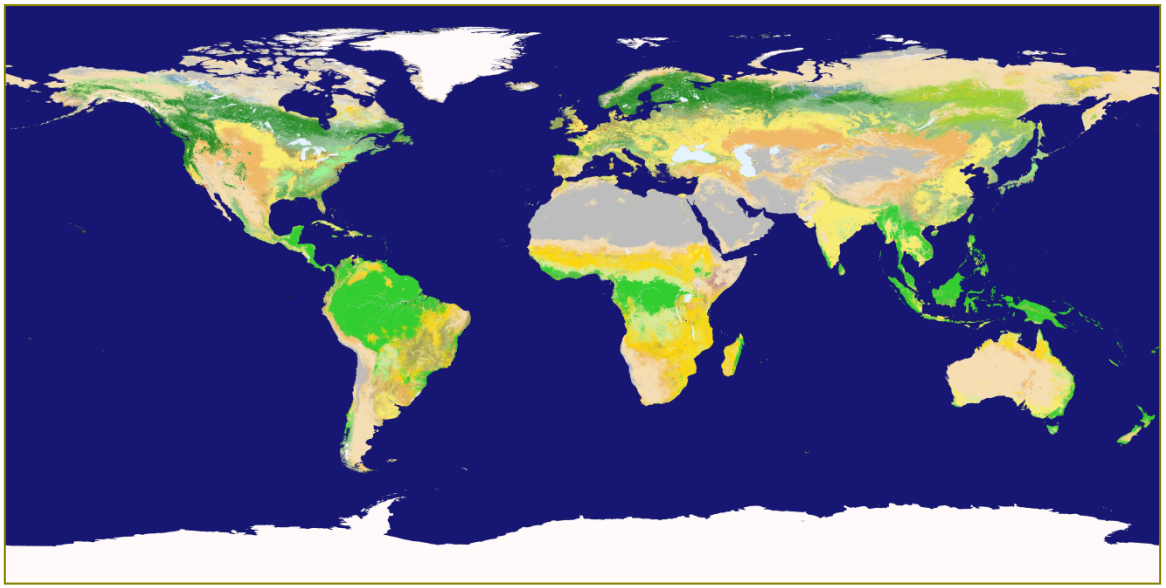
Christos Giannakopoulos

National Observatory of Athens

Wildfires

- On Earth, something is always burning. Wildfires are started by lightning or by people, and people use controlled fires to manage farmland and pasture and clear natural vegetation for farmland.

- Fires can generate large amounts of smoke pollution, release greenhouse gases, and unintentionally degrade ecosystems. But fires can also clear away dead and dying underbrush, which can help restore an ecosystem to good health. In many ecosystems, including boreal forests and grasslands, plants have co-evolved with fire and require periodic burning to reproduce.



Global Wildfires

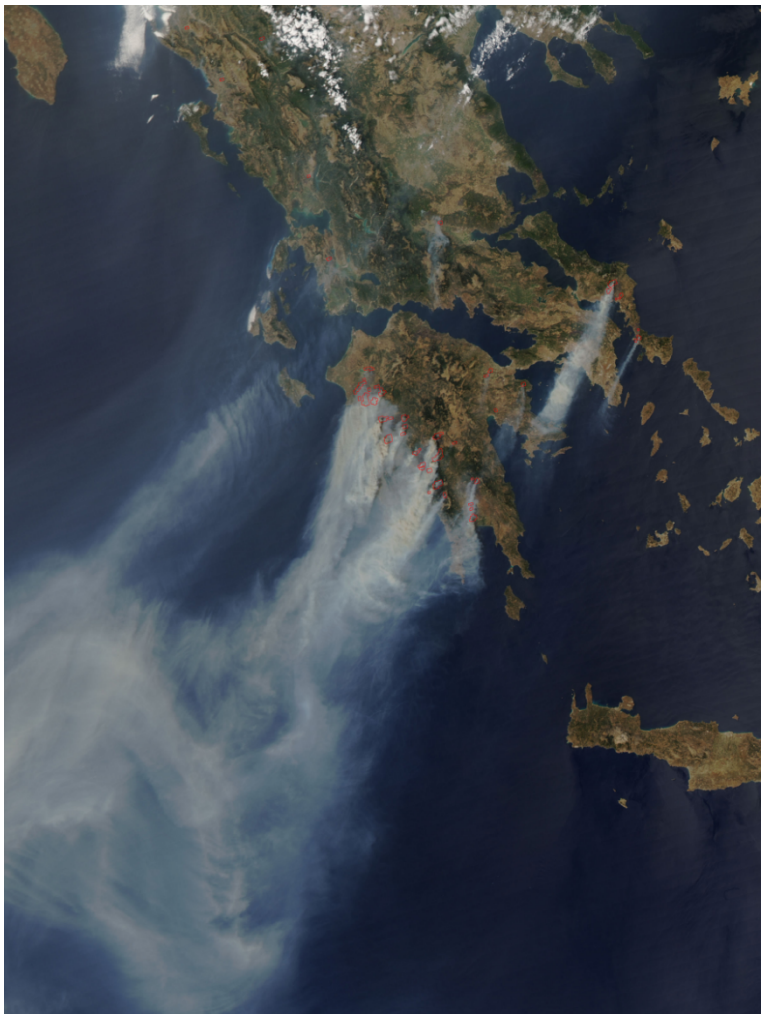
March 2000 – August 2012

- Some of the global patterns that appear in the fire maps over time are the result of natural cycles of rainfall, dryness, and lightning.

For example, naturally occurring fires are common in the boreal forests of **Canada** in the summer. In other parts of the world, the patterns are the result of human activity. For example, the intense burning in the heart of **South America** from August-October is a result of human-triggered fires, both intentional and accidental, in the **Amazon Rainforest** to the south. Across **Africa**, a band of widespread agricultural burning sweeps north to south over the continent as the dry season progresses each year. Agricultural burning occurs in late winter and early spring each year across **Southeast Asia**.

Source: NASA - Earth Observatory

Peloponnese - Greece



August 2007

"This period was an **all time record hot summer**, combined with a prolonged drought period and strong winds"

"**84 people** lost their lives"

"A total of **2700 km^2** of forest, olive groves and farmland were destroyed by the fires"

Chios Island - Greece

August 2012

"**Strong winds** ranged from 62-74 km per hour"

" The fire had scorched **12,740** hectares "

"Fire destroyed **more** than **half** of the island's mastic orchards"

Causes of wildfires

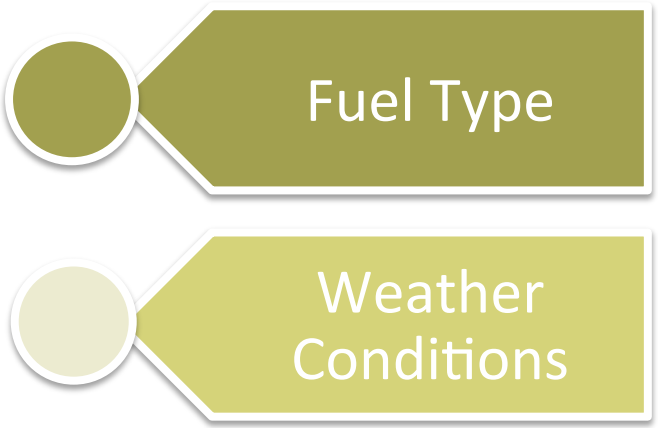
Natural

- Lighting
- Volcanic Eruption
- Spontaneous Combustion

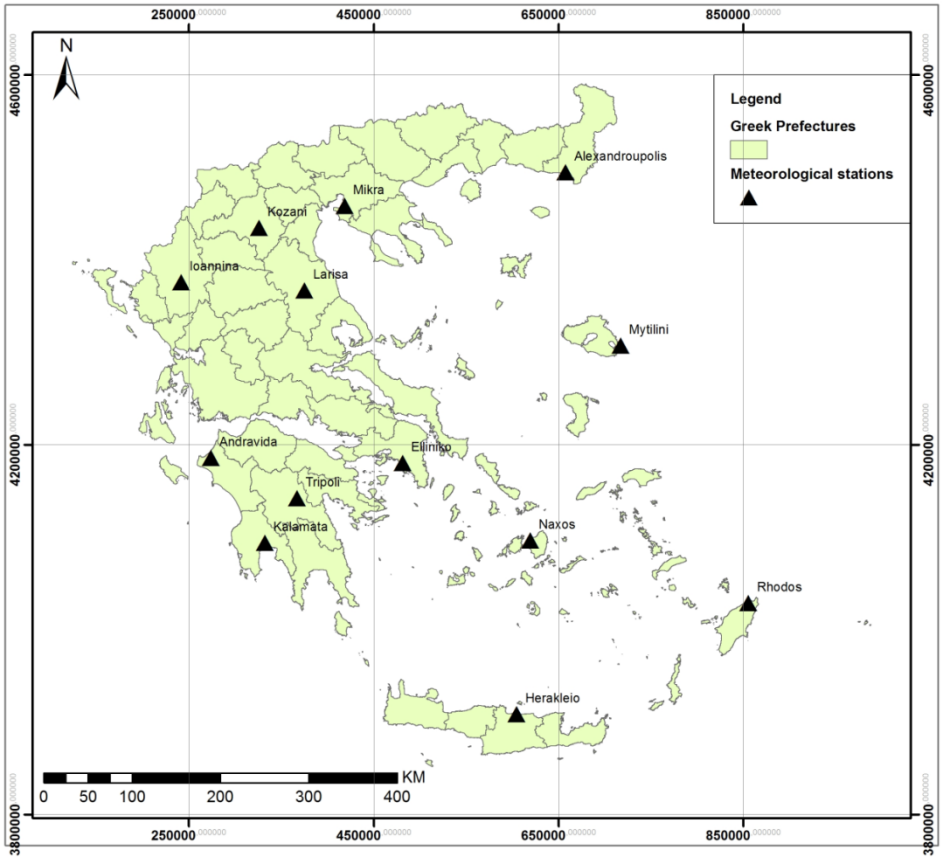
Human

- Arson
- Carelessness (discarded cigarettes, machinery sparks, power line arcs)

Spread of Wildfires



The case study of Greece

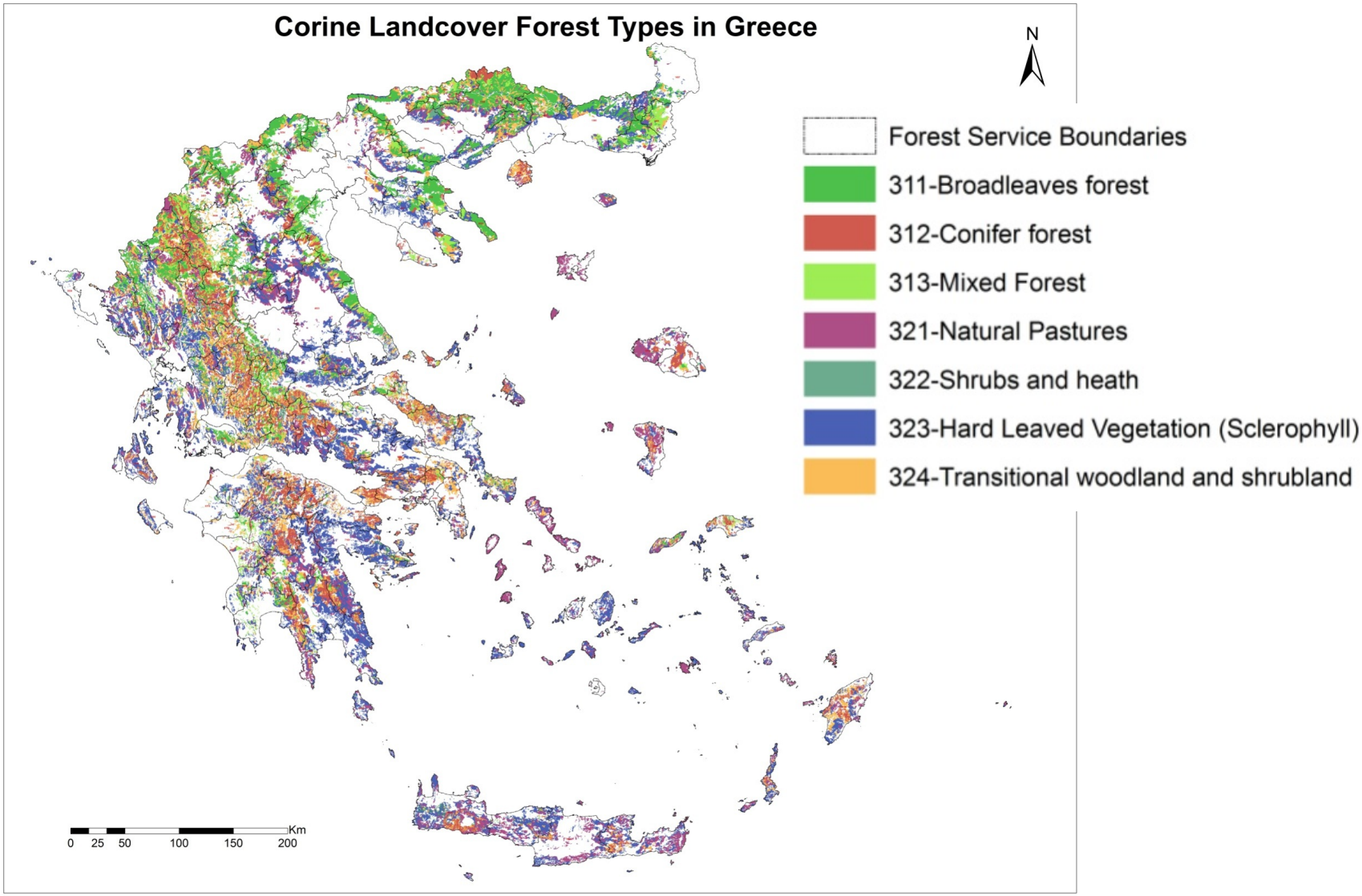


Study Period : 1983- 1997

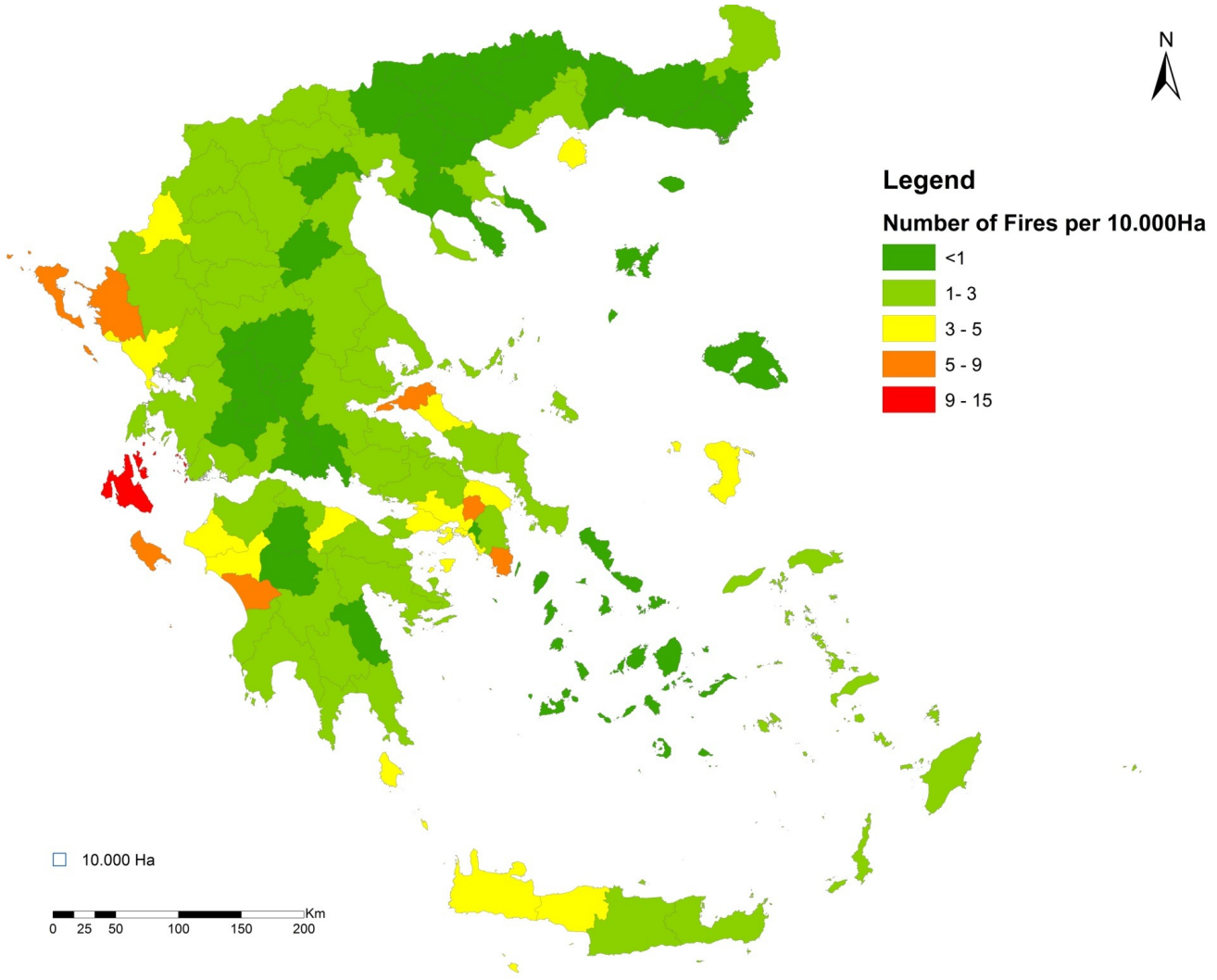
Data :

- Mean Daily Values of Meteorological Parameters for 13 stations
- Forest Fire Data from the National Forest Service

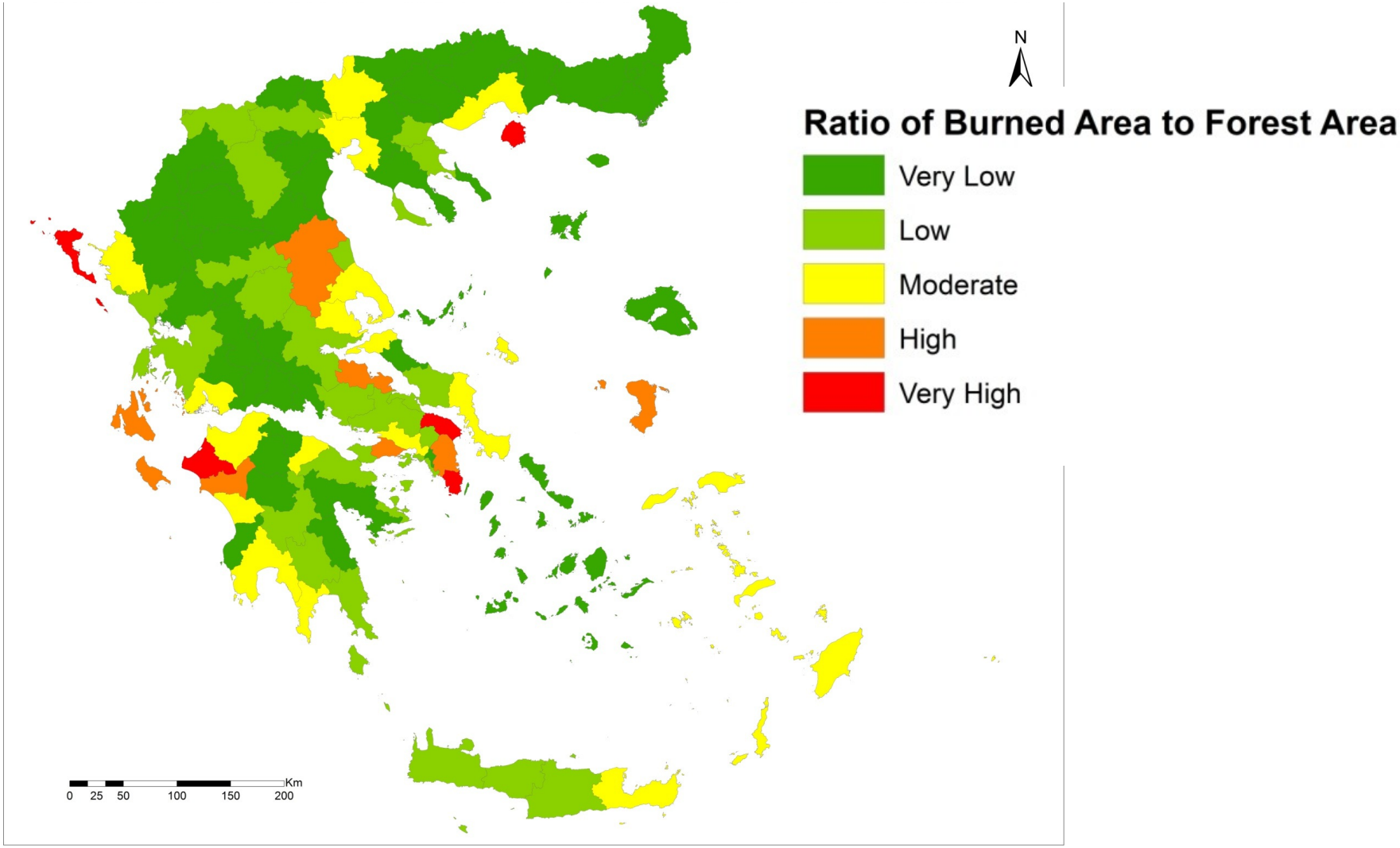
Forest Types in Greece



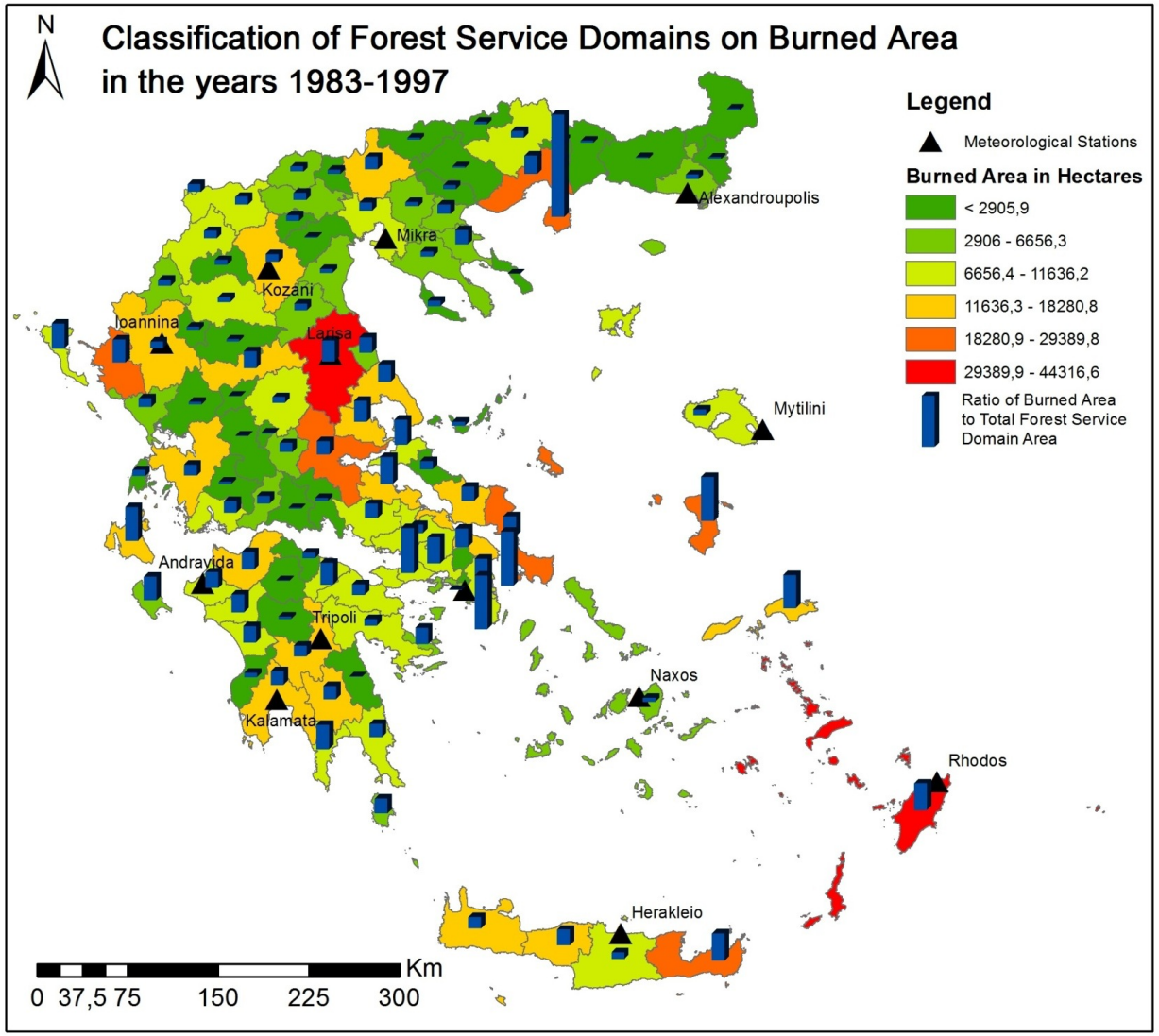
Fires during 1983-1997



Burnt Forests during 1983-1997



Most vulnerable regions



Canadian Forest Fire Index (FWI)-I

• **Daily meteorological-based index** used worldwide to estimate **fire danger** in a generalized fuel type (pine tree), taking into account the effects of fuel moisture and wind on fire behaviour

• **6 standard components** each measuring a different aspect of fire danger (Van Wagner, 1987):

- **There are 3 fuel moisture codes** following daily changes in the moisture contents of three classes of forest fuel with different drying rates, depending on the nature of these materials
  - Fine fuel moisture code (FFMC) → litter and other cured (dry) fuels
  - Duff moisture code (DMC) → loosely compacted organic layer of 7cm depth
  - Drought Code (DC) → deep and compact organic layer

Canadian Forest Fire Index (FWI)- II

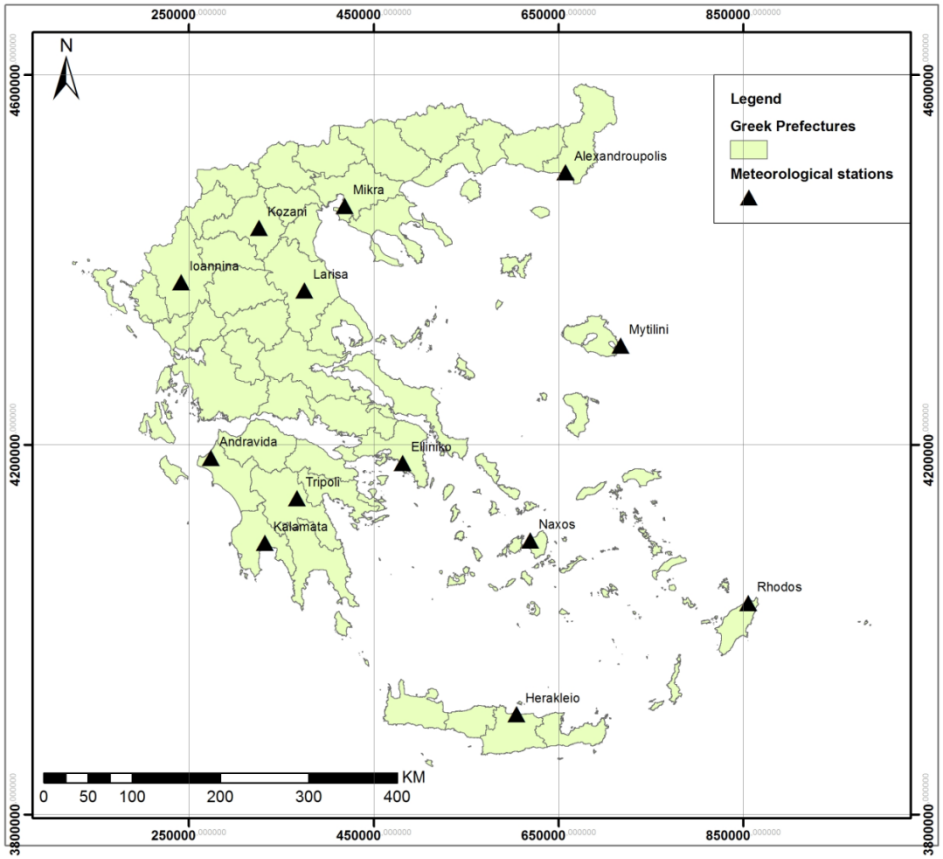
➢**There are 3 fire behaviour indices**

- **Initial Spread Index (ISI)** → numerical rating of expected fire rate of spread
- **Build-up Index (BUI)** → numerical rating of fuel available for combustion
- **FWI** → rating of **fire intensity** that combines ISI and BUI

•FWI components depend on **daily noon** measurements of **dry-bulb temperature, air relative humidity, 10m wind speed** and **24 h accumulated precipitation**

• The index is divided into categories, defined by **sensitivity studies** tailored to the region of interest

The case study of Greece

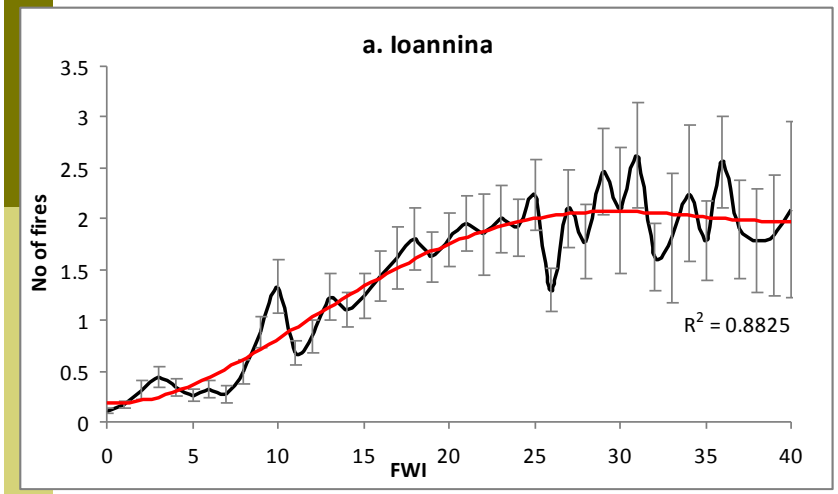


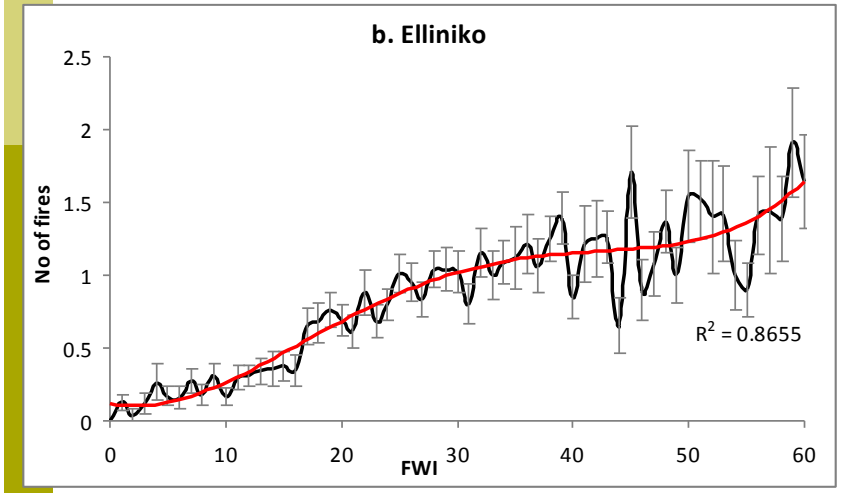
Study Period : 1983- 1997

Data :

- Mean Daily Values of Meteorological Parameters for 13 stations
- Forest Fire Data (number of fire events/burnt area)

FWI Evaluation - I

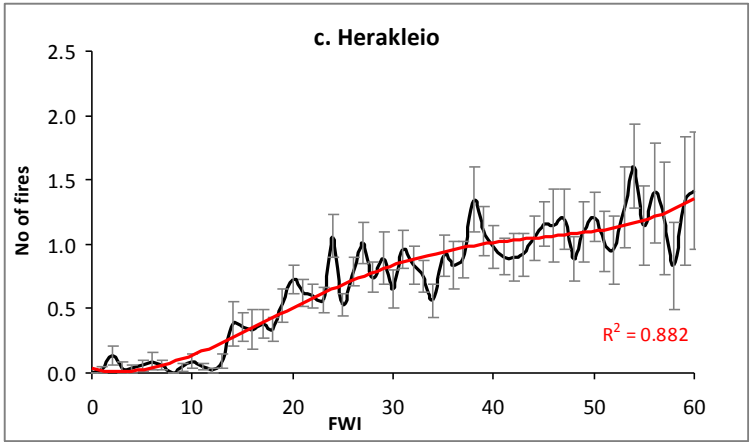




- The index was classified in categories of bin with size 1 and the average value of the number of fires that occurred at each category was calculated for each station
- The best estimated polynomial fit was applied on the data

- A pattern seems to emerge from the results analysis which classifies the domain into two distinct areas of different fire behaviour
- In Eastern Continental Greece (ECG) one fire per day (extreme fire risk) occurs when FWI=30
- In Western Continental Greece (WCG) one fire per day occurs when FWI=15

FWI Evaluation - II

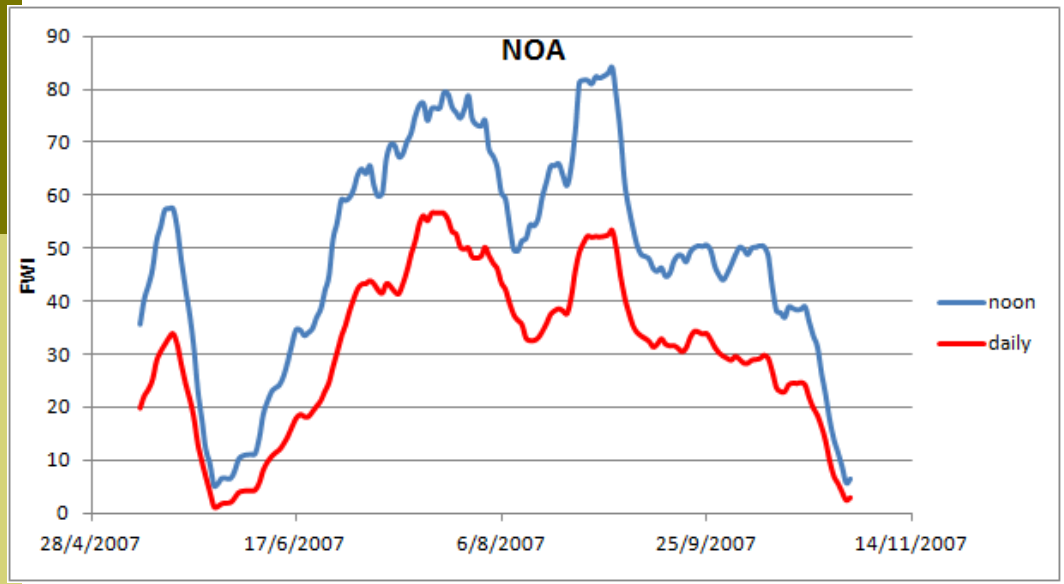


- In **Crete** one fire per day occurs when FWI=40

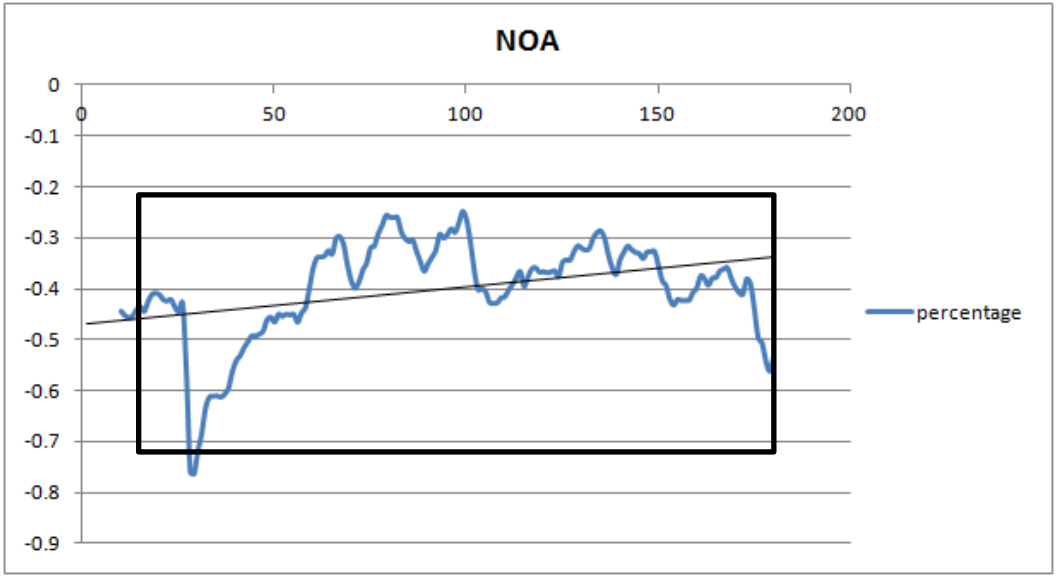
- The results for the islands of the Aegean do not seem to fit into a pattern as they show great variability in the relationship between fire events and FWI values - due to the small total number of fires and complex local topography

- This distinct behaviour can be attributed to the different meteorological regimes prevalent in each of the three regions. Specifically, **WCG** is characterized by high precipitation amounts (resulting in higher fuel moisture content), while in **ECG** and **Crete**, precipitation amounts are substantially lower and dry northern winds mostly prevail during the warm period of the year

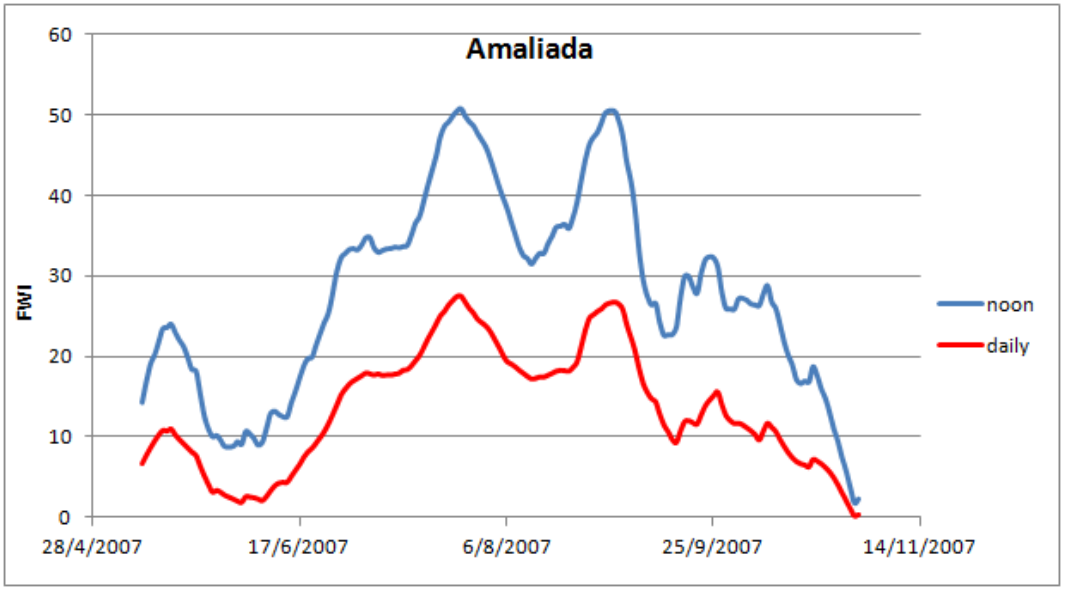
Daily versus noon meteorological values - I



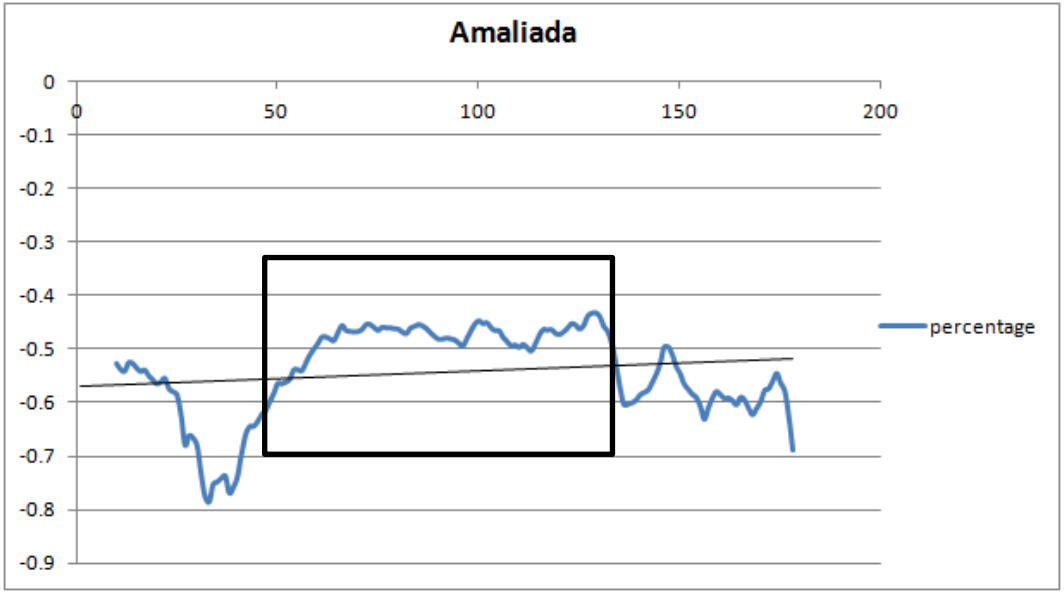
Underestimation 40%



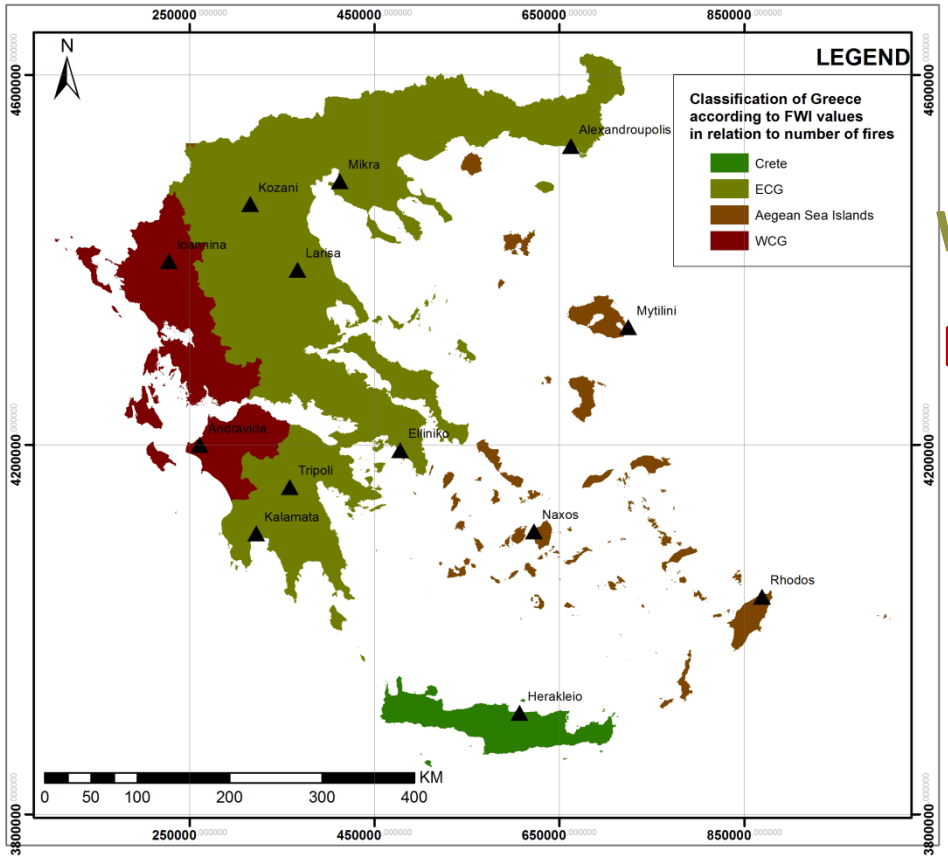
Daily versus noon meteorological values - II



Underestimation 50% during summer period



FWI Classification



Thresholds of extreme fire risk

West Continental Greece : FWI≥15

East Continental Greece : FWI≥ 30

Crete : FWI≥ 40