



Assessing vulnerability of Greek forests to fires within the context of climate change

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Vulnerability Definition

IPCC 2001 : *The degree to which a system is susceptible to, or unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude, and rate of climate variation to which a system is exposed, its sensitivity, and its adaptive capacity.*

- **Exposure** can be interpreted as the direct danger (i.e. the stressor), and the nature and extent of changes to a region's climate variables (e.g. temperature, precipitation, extreme weather events).
- **Sensitivity** describes the human–environmental conditions that can worsen the hazard, ameliorate the hazard, or trigger an impact.
- **Adaptive Capacity** represents the potential to implement adaptation measures that help avert potential impacts.





▪ **Exposure** reflects both the direct danger and the extent of changes to a region's climate variables.

➤ Fire occurrence strongly depends on drought conditions and summer temperature.

➤ In order to study the exposure of Greek forests to forest fires, climatic indices and the meteorologically based Fire Weather Index (FWI) were examined.

Canadian Fire Weather Index (FWI)

Fire weather observations

Temperature, relative humidity, wind, rain

Wind

Temperature, relative humidity, rain

Temperature, rain

Fuel moisture codes

Fine Fuel Moisture Code (FFMC)

Duff Moisture Code (DMC)

Drought Code (DC)

Initial Spread Index (ISI)

Buildup Index (BUI)

Fire Weather Index (FWI)

FWI is divided into four fire danger classes:

Low 0 – 7

Medium 8 – 16

High 17 – 31

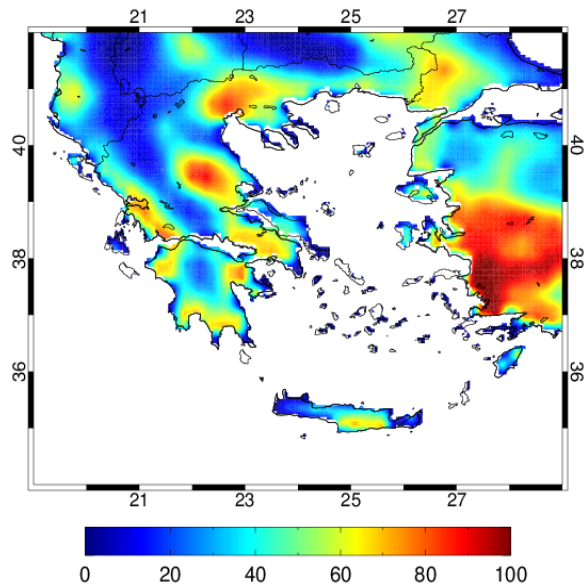
Extreme > 32

(van Wagner, 1987)

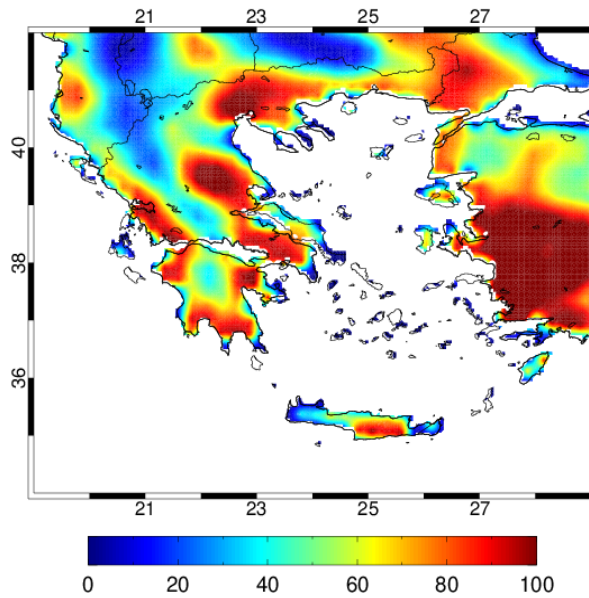
1961-1990

2021-2050

No of days with Tmax>30C (mean control)

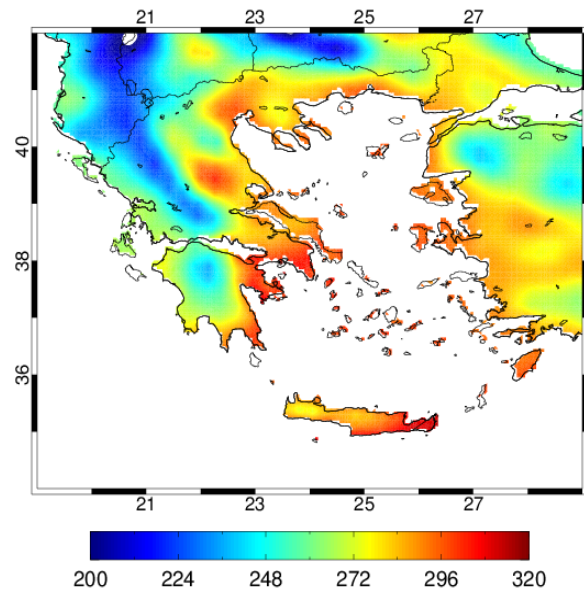


No of days with Tmax>30C (near future)

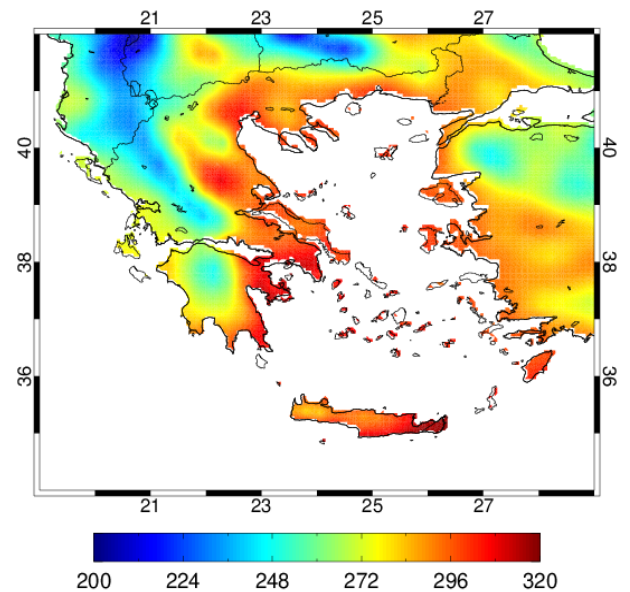


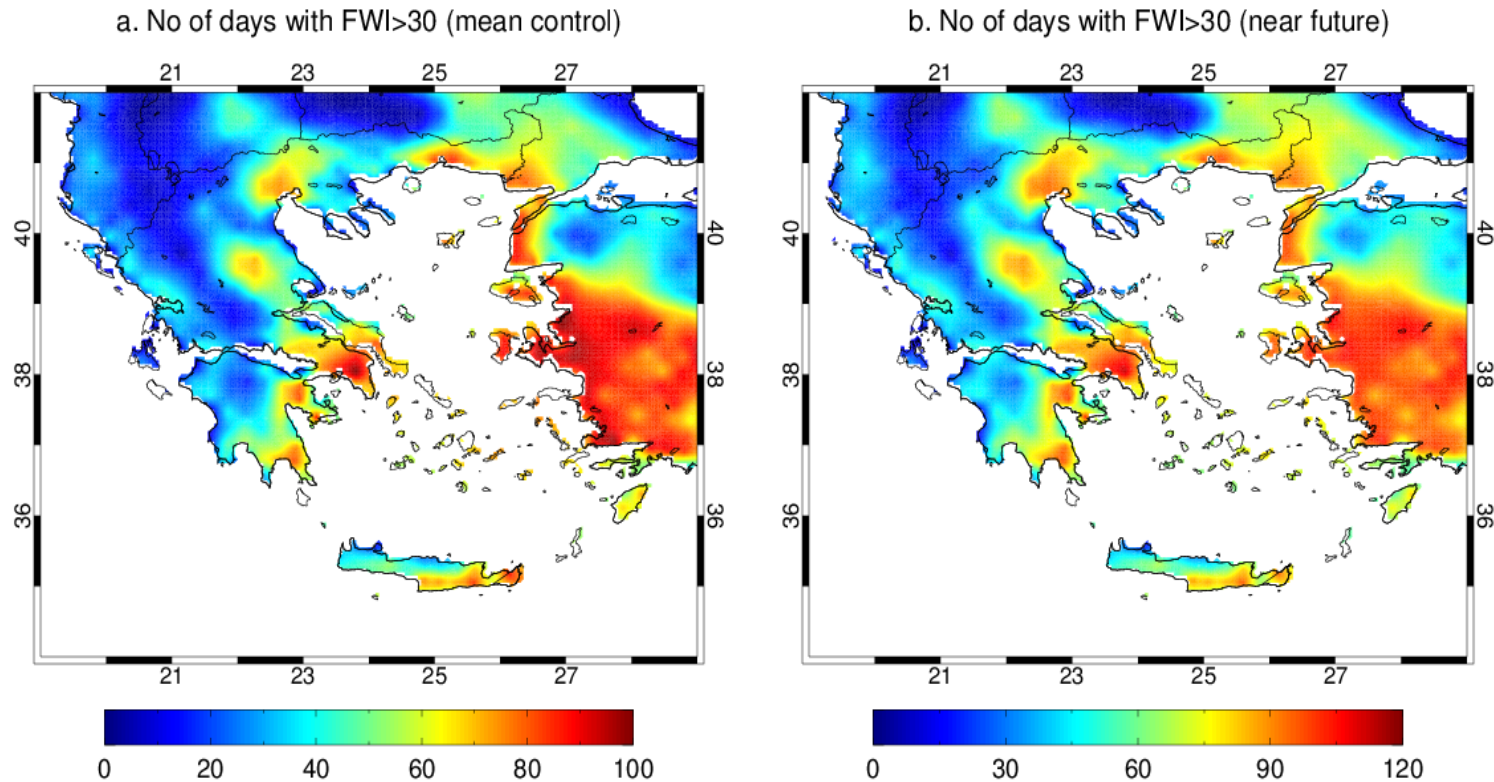
RCM :KNMI-RACMO2
Horizontal res. : 25x25km

No of dry days(mean control)




No of dry days(near future)





Exposure

- Eastern lowlands are more exposed to fire risk followed by eastern high elevation areas. This means that they present a high number of days with elevated fire risk, both for the control and the future period.
- The western lowlands and high elevation areas are the least exposed regions.

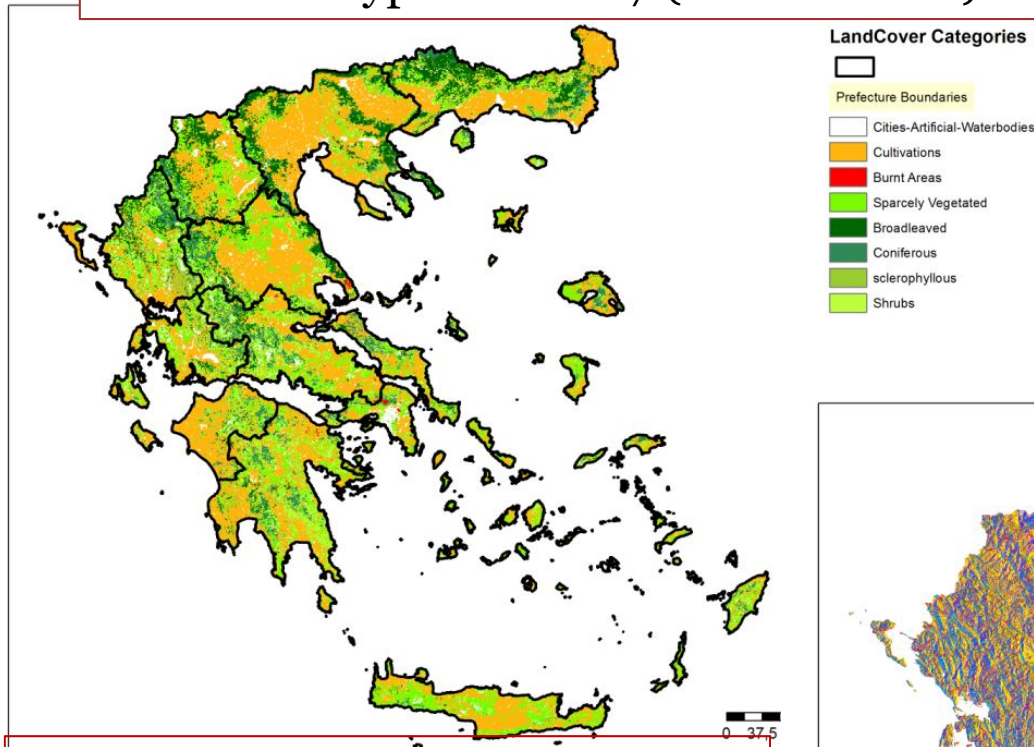


▪ **Sensitivity** describes the environmental conditions that can worsen the hazard, ameliorate the hazard, or trigger an impact.

➤ In order to assess this factor static information concerning fire affecting factors, namely topography and vegetation, was used to create a fire hazard map.

Static Risk = Vegetation × Aspect × Altitude

Land cover types for 2007 (WWF Greece)

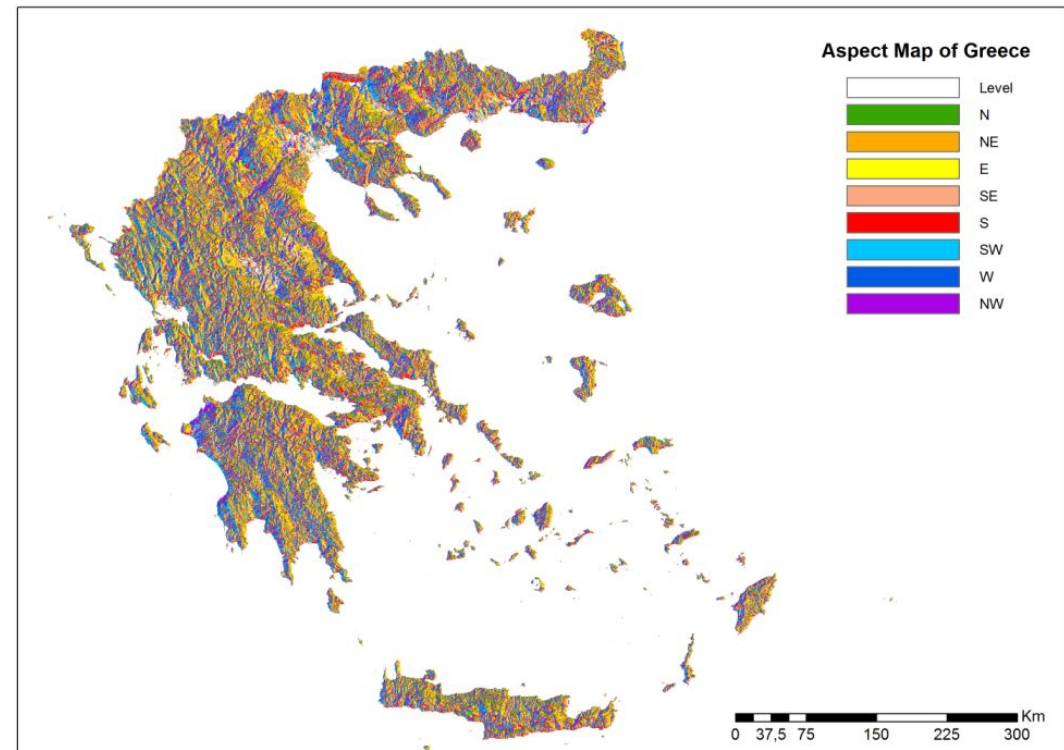


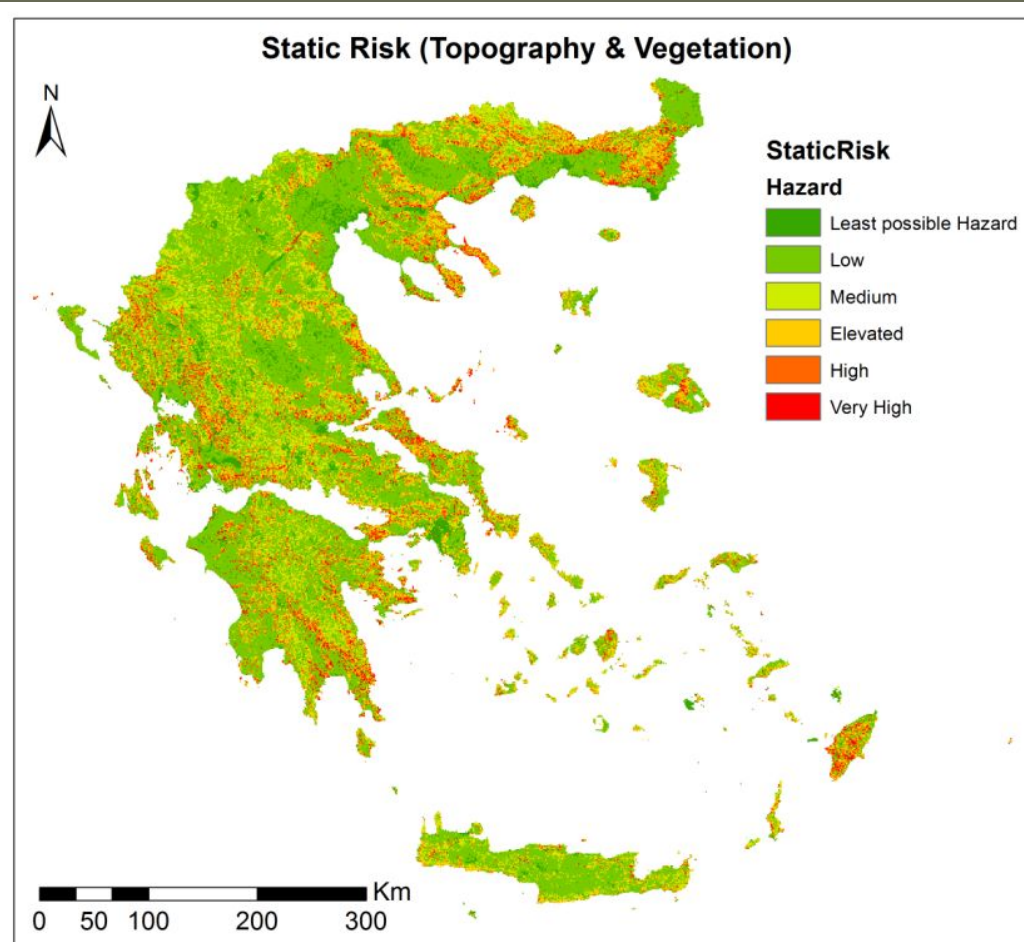
Most flammable species:

- shrubs
- schlerophyllous vegetation
- Coniferous trees

DEM –NOAA (1km horizontal resolution)


- South/west aspects more fire prone
- High altitude less possibilities of fire ignition





Sensitivity

- Low to medium elevation south or west facing continental areas can be characterized as “high” fire hazard areas.
- Cultivated lowlands can be characterized as “low” and “medium” fire hazard areas.



▪ **Adaptive Capacity** is defined by the ability of forests to adapt to changing environmental conditions which is also enhanced by the measures implemented in order to mitigate the adverse impacts on this sector.

- In order to assess this factor the knowledge and expertise of local stakeholders was taken into account.
- Stakeholders and fire experts combined vegetation information and changes in climatic conditions.
- Forests of northern/western Greece are expected to be more adaptive than their eastern counterparts.

Vulnerability= Impact – Adaptive Capacity
where

Impact = sqrt(exposure × sensitivity)

Degree of Sensitivity, Exposure & Adaptive Capacity		Degree of Vulnerability		Legend
Least	1	Least	$V \leq 1$	
Low	2	Low	$1 < V \leq 2$	
Medium	3	Medium	$2 < V \leq 3$	
Elevated	4	Elevated	$3 < V \leq 4$	
High	5	High	$4 < V \leq 5$	
Very High	6	Very High	$5 < V \leq 6$	

Overall Vulnerability

	Eastern Greece		Western Greece	
	Lowlands	Medium to High elevation areas	Lowlands	Medium to High elevation areas
Sensitivity	High	Medium	High	Medium
Exposure	Very high	High	Elevated	Elevated
Adaptive Capacity	Low	Low	Medium	Medium
Vulnerability	Elevated	Low	Low	Least

Adaptation Options

- Multi-criteria analysis is proposed as the most appropriate method to accomplish decision making in the field of adaptation to climate change.
- This method is used to evaluate options based on a set of criteria. Stakeholder analysis and expert judgment provides identification of all possible decisions/options.
- Through weights and scores, the performance of each adaptation option is measured against criteria.

- The evaluation criteria which are chosen and used in the framework of the CLIM-RUN Project for the case study of Greece are the following:
 - Efficiency of the Measure
 - Environmental Friendliness
 - Supporting the Prevention of Climate Impacts
 - Urgency for Implementing the Measure
 - Usefulness of Implementation Irrespective of Climate Change
 - Technical Viability
 - Economic Viability
 - Social Acceptance



The **proposed adaptation measures** for Greek forests in descending order of priority are the following:

- Fire prevention measures
- Inclusion of the private forest covered areas in the fire fighting schemes of the Department of Forests
- Classification of forests according to the risk of fire
- Vital national resources and the implementation of a national fire protection plan
- Reforestation of burnt areas
- Immediate reforestation of areas destroyed by fire and implementation of appropriate silvicultural measures
- Infrastructure to improve forest resilience to fires
- Planning and development of forest ecosystems that would make the start and speed of expansion of fires more difficult

**Thank you for your
attention!**



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