Assessing wildfire risk spatiotemporal changes in coppice and high Oak and Beech forest ecosystems of Greece

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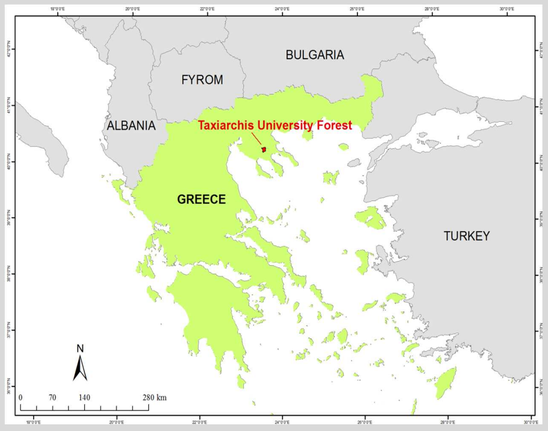
Aim of the study

The objective of the current study is to assess past and future wildfire risk metrics to typical coppice and high Oak and Beech forest ecosystems in Northern Greece.



Study area

Taxiarchis University Forest is located in Northern Greece and covers 60 km. The altitude ranges from 320 to 1200 m. The area's climate is characterized as Mediterranean with short periods of drought, hot summers and mild winters. Common forest species are Italian oak (*Quercus frainetto*), Black pine (*Pinus nigra*), Beech (*Fagus moesiaca*), and Norway spruce (*Picea abies*). Also, patches within the forest are covered with shrubs (*Quercus ilex, Quercus coccifera, Erica arborea,* etc.), low herbaceous vegetation, and scattered oak trees.

Materials & Methods

Fuel sampling → Custom fuel models → Fuel mapping with Remote Sensing & GIS

eCognition® · FlamMap 5.0 · ArcFuels

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Fuel2000 & Fuel2020 → 10.000 random fire events → Fire behavior simulation → Fire risk metrics

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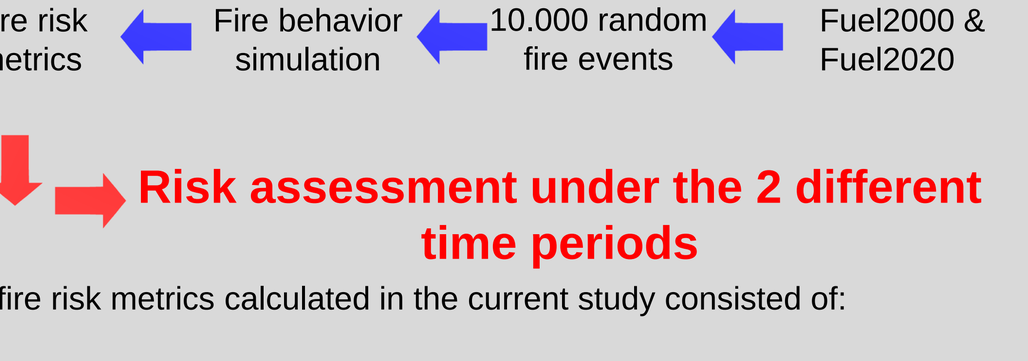
Risk assessment under the 2 different time periods

Wildfire risk metrics calculated in the current study consisted of:

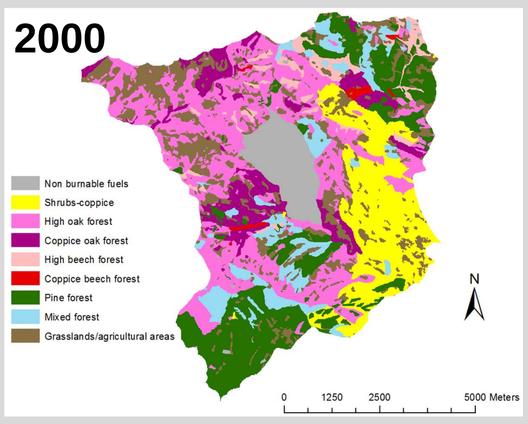
1. **Burn Probability (BP):** the probability of a pixel burning given one random ignition on the landscape.
2. **Fire Size (FS):** The expected fire size of each fire simulated
3. **Conditional Flame Length (CFL):** the probability-weighted flame length given when a fire occurs.
4. **Source-Sink Ratio (SSR):** A pixel's wildfire contribution to the surrounding landscape relative to the frequency with which it is burned by fires that originated elsewhere or were ignited on the pixel .

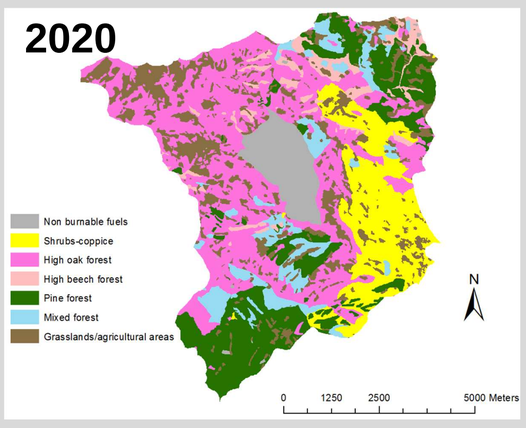
Results

Object based image analysis



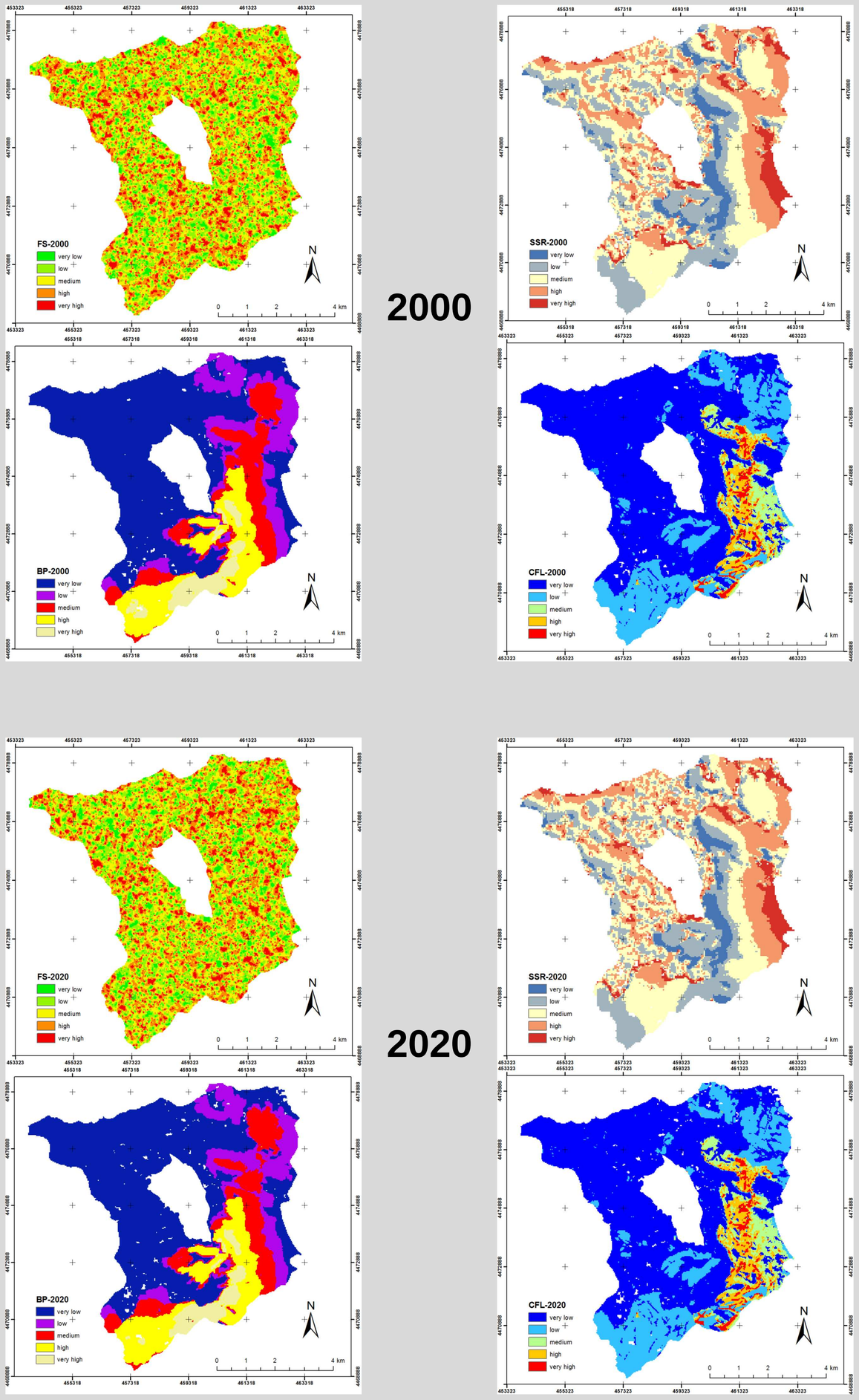
Fuel maps





Wildfire risk metrics in the two different time periods

The wildfire risk metrics (BP, FS, CFL & SSR) provided by the fire simulator presented differences among the two examined time periods. Wildfire risk assessment under the two different time periods resulted from the reclassification wildfire risk metrics data into 5 risk classes.



The table presents the average wildfire risk metrics (BP & FS) per fuel type in the area. Risk assessment in coppice and high Oak and Beech forest woodlands in the two studied periods are highlighted in red.

Fuel type	2000		2020	
	Average Fire Size (ha)	Average Burn Probability	Average Fire Size (ha)	Average Burn Probability
Shrublands	344.4	0.045	334.2	0.043
Litter of High Oak Forests	28.6	0.008	30.1	0.011
Litter of Coppice Oak Forests	23.1	0.007	-	-
Litter of High Beech Forests	35.8	0.009	37.7	0.009
Litter of Coppice Beech Forests	47.6	0.004	-	-
Litter of Pine Forests	224.3	0.049	209.1	0.056
Litter of Mixed Forests	42.4	0.012	40.4	0.012
Grasslands	83.6	0.019	87.1	0.018

Conclusions

- The localized custom fuel models developed and mapped in a typical Oak and Beech forest ecosystems of Greece will improve the fire simulation capabilities
- The conversion of coppice Oak and Beech forest into high forest woodlands resulted in slight increase of wildfire risk in terms of burn probability and the expected fire size.
- The proposed methodology will allow forest and fire managers to more accurately design fuel treatments across landscape for mitigating the expected forest loss in Oak and Beech forests.

References

Mallinis, G. Mitsopoulos, I. et al. 2008. Integration of local scale fuel type mapping and fire behavior prediction using high spatial resolution imagery. IEEE Journal of Selected Topics in Applied Earth Observation 4: 230-238

Mallinis, G. Mitsopoulos, I. et al. 2013. Canopy Fuel Load Mapping of Mediterranean Pine Sites Based on Individual Tree-Crown Delineation. Remote Sensing 5(12), 6461-6480