Wildfires

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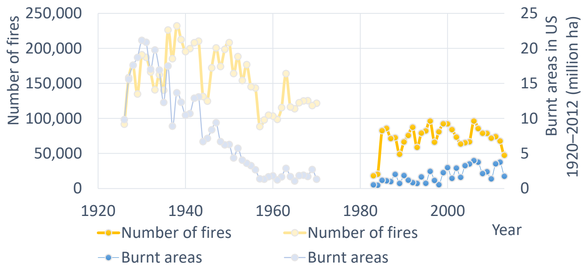
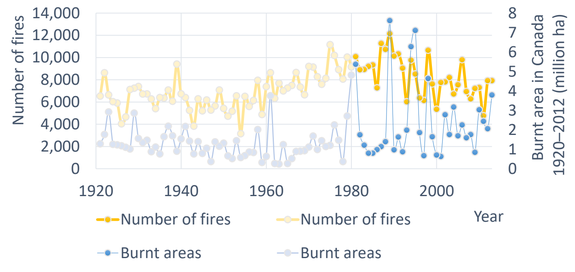
1. Introduction

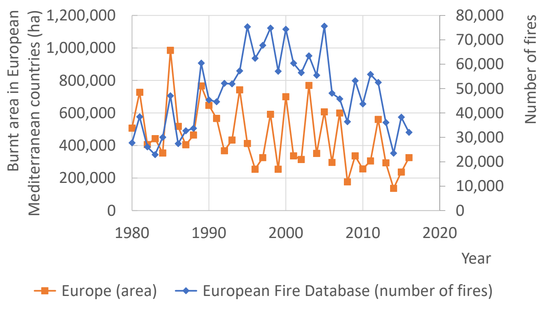
There is a widespread perception that every year wildfires are intensifying on a global scale, something that is often used as an indicator of the adverse impacts of global warming. However, from the analysis of wildfires that have occurred in the US, Canada, and Mediterranean countries, a trend that justifies this perception could not be identified. Arguably, instead of blaming climate change, research on the mitigation of wildfires should be re-directed to forest management policy and practices. Forests are admirable and complex natural ecosystems, and fires, albeit devastating, can be attributed to both human activity and to natural processes that contribute to their rebirth, with the latter constituting an intrinsic and perpetual process of the forest ecosystem. Other than their important ecological value, forests are, in the 21st century, also a capital resource, for many people's livelihoods depend on them. In this study, we proposed a method for taking mitigation measures against wildfires based on the partitioning of forests, considering both the protection of the ecosystem and the inhabitants and aiming to utilize their co-dependent nature for the general protection and preservation of forests. As a case study, we analyzed the current devastating fire in Euboea (occurred in August 2021), initially in terms of the spatio-temporal progression of the actual wildfire that lasted several days and then by examining how an implementation of the proposed method in the study area could contribute to both the recovery of the ecosystem and the enhancement of the quality of life of the inhabitants as well as their long-term protection.

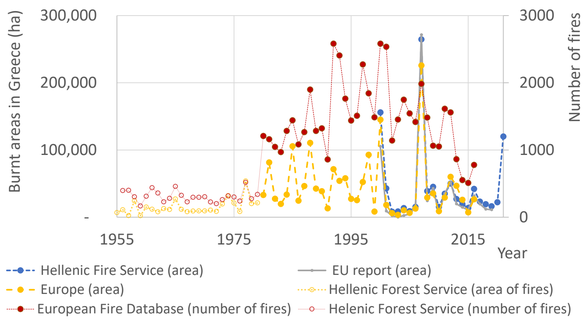
2. Inspecting Time Series of Fires

In August 2021, an alarming UN report blamed human activity for "unprecedented" changes to the climate. Fires have been used as an indicator of climate change, with different studies arguing that fires have the trend to be more destructive every year. Data from National Interagency Fire Center USA [16] (1983–2021) also confirm this trend. However, the reconstruction of time series between 1926 and 1970 using available data from the library of USA Genus Bureau allowed us to see that the positive trend was not verified. On the contrary, in other countries, such as Canada, a decreasing trend is observed between 1920 and 1960 and between 1980 and 2020, while an increasing trend of burnt areas is observed between 1960 and 1980. In addition, another interesting observation is that the trend of the number of fires and the trend of burnt areas are not always of the same direction or magnitude.









3. Analyzing the data

Analyzing the data, we note that there is not a standard mathematical expression of the dependence of y on x (e.g., linear, logarithmic, power, polynomial) which could simplify the problem of curve fitting. Therefore, the determination of the parameters of a mathematical expression, a task typically accomplished using regression (or least-squares) techniques, cannot be done.

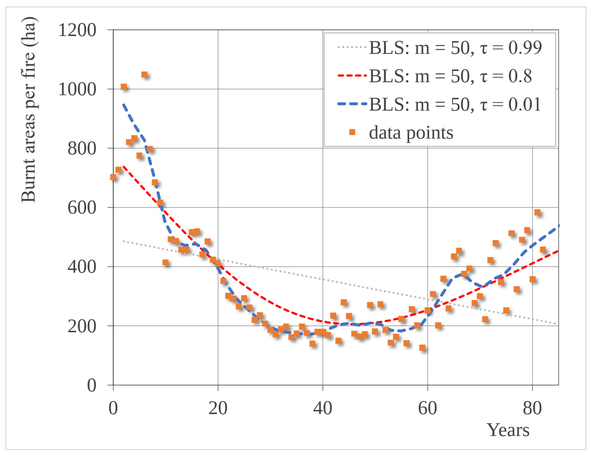
Traditionally, these cases have been remedied by graphical techniques such as drawing an "eyeball" curve on a scatterplot of points (xi, yi). This is apparently a non-parametric approach in the sense that it does not use any parameters of a specified law (in contrast to parametric regression techniques) but has the flaws of being subjective and unsusceptible to an algorithmic treatment, and thus it is not programmable to computers.

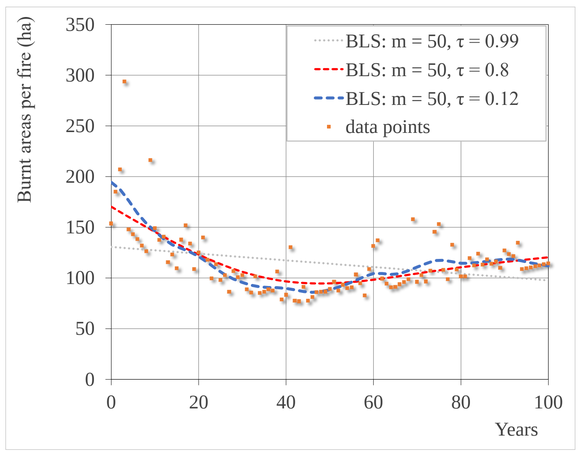
Another alternative is the use of smoothing techniques in which the fitted value of y for any value of x is determined from the available data points (xi, yi) using weights for each one so that the weight for (xi, yi) is large if x is close to xi and small otherwise.

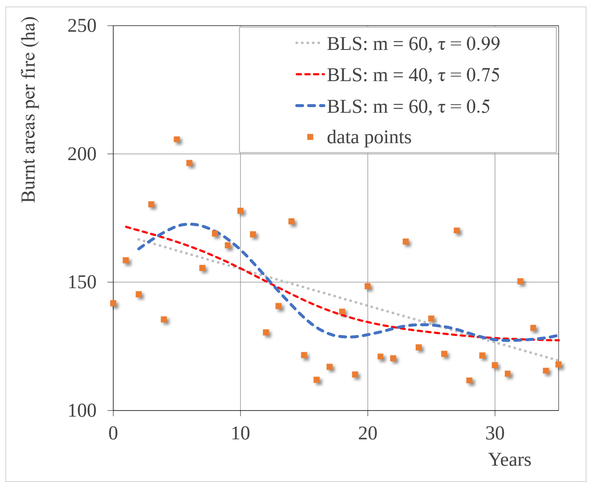
We chose to analyze the data using the broken line smoothing model (BLS) which is considered as a better alternative to numerical smoothing and interpolating methods yet close to the approach of the traditional graphical method. The method is also closely related to piecewise linear regression and to smoothing splines, as it approximates a smooth curve that may be drawn for the data points (xi, yi) with a broken line (or open polygon) which can be numerically estimated by means of a least-squares fitting procedure.

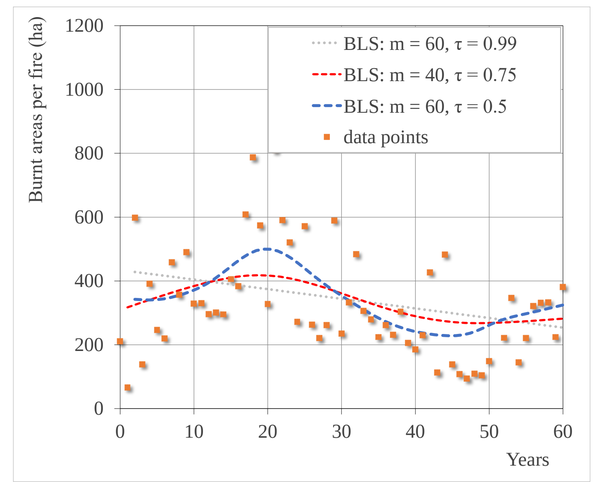
Although we observed an increasing trend in the US in the last 40 years (which was also observed by Nunes in Portugal for the last 30 years), this trend cannot be detected either in Canada, the Mediterranean countries, or Greece. Therefore, a systematic trend is not obvious.

Fires are devastating; however, according to the examined data, in recent years, their magnitude does not seem to be increasing, as referenced also in other related studies for other areas.









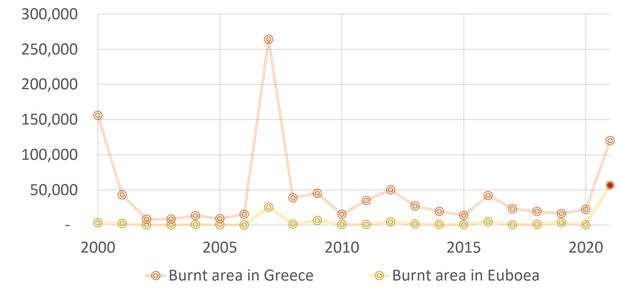
4. The Evolution of Fire

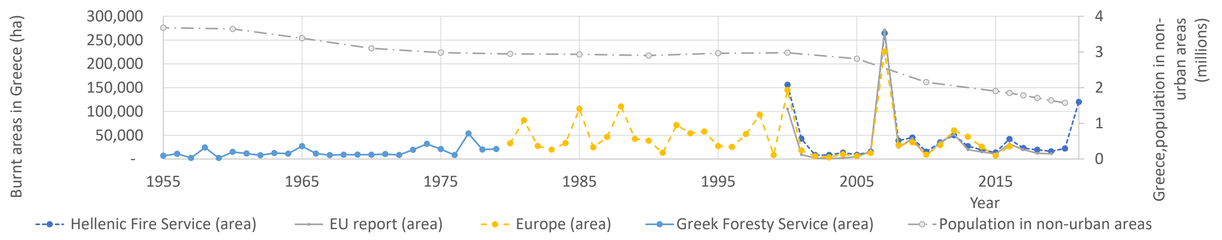
Forests are a precious ecological source that hosts a significant part of our society, and the practice of fire mitigation should not be left undeveloped, nor should relevant shortcomings be attributed to uncontrollable natural phenomena.

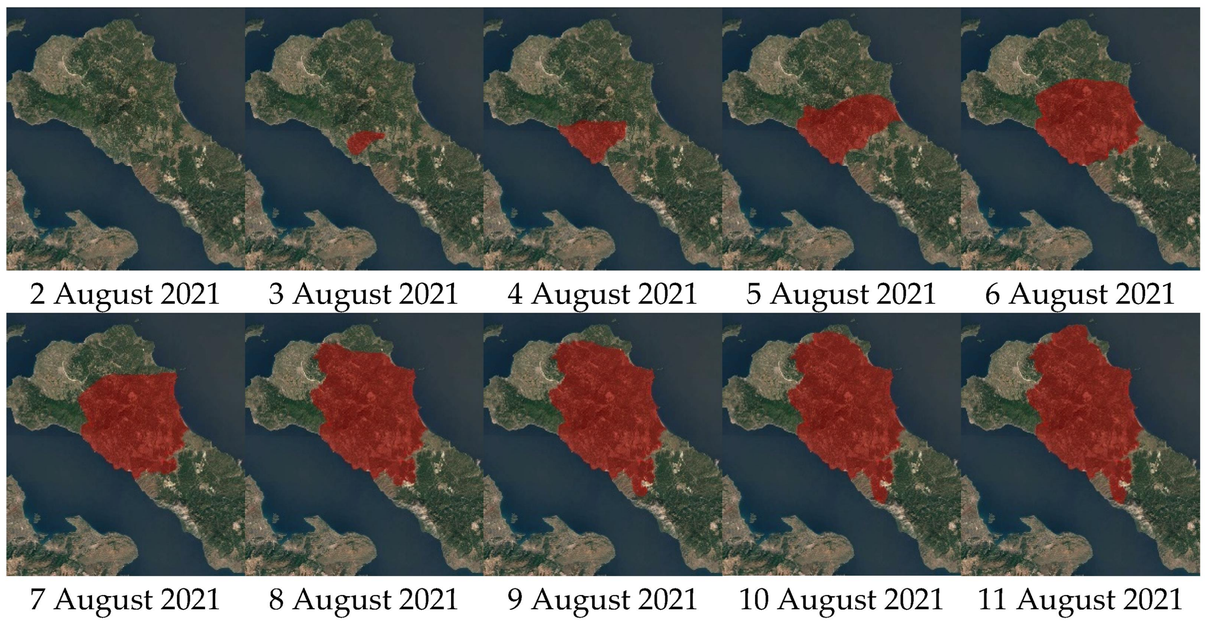
Fire requires three elements to expand—oxygen, heat, and fuel—which are also known as "the triangle of fire". In wildfires, the oxygen depends on the wind conditions, the air temperature, and the fuel within the combustible materials.

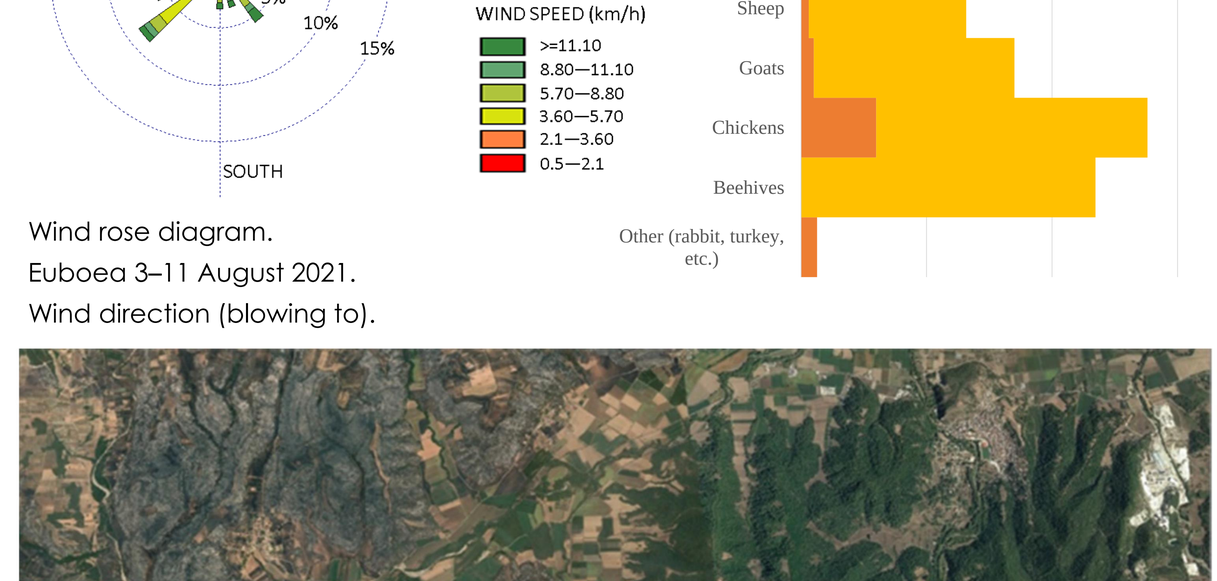
However, wildfires are a more complex phenomenon. The evolution of wildfires also depends on the technological aspects of prediction, mitigation, the populations' density, and the "resident fire culture". In addition, crucial parameters of the evolution of the fire are: the relief of the landscape as rugged relief supports the fire, with high wind speeds that accelerate the flames spreading the fire.

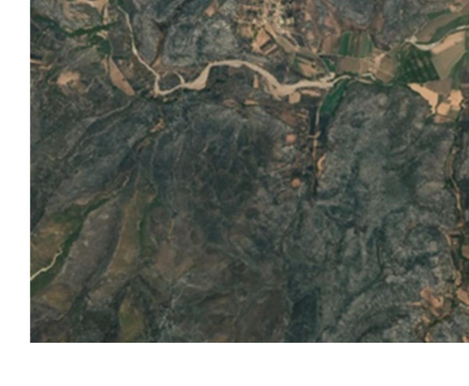
5. Case Study: The Fire in Euboea











Wind rose diagram.
Euboea 3–11 August 2021.
Wind direction (blowing to).