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Public Perceptions of Floods and Forest Fires as Climate Change Threats – The Case of Greece

Społeczne postrzeganie powodzi i pożarów lasów jako zagrożeń związanych ze zmianą klimatu – przypadek Grecji

Abstrakt

Morze Śródziemne jest jednym z najbardziej podatnych i wystawionym na działanie klimatu (Zmiany klimatyczne CC) regionem. Grecja, kraj we wschodniej części Morza Śródziemnego cechuje się różnorodnością geograficzną, topograficzną w poszczególnych jej regionach. Tak też w różny sposób zmienia się klimat i charakter ekstremalnych zjawisk pogodowych, takich jak powodzie i pożary lasów. W 2020 roku wyjątkowo dotkliwe okazały się w skutkach pożary lasów i powodzie będąc wyzwaniem społecznym, ekonomicznym i środowiskowym, któremu trudno było sprostać w obliczu pogarszającymi się warunkami klimatycznymi (CC). W artykule porównano zagrożenia pożarami lasów i powodziami w czterech regionach Centralnej Grecji, mianowicie Attica, Dytiki Ellada i Sterea Ellada a także Grecji południowej – Peloponnese przez pryzmat odnotowanych wydarzeń i strat (zagrożenie obiektywne) odniesionych w wyniku pożarów w okresie 1990–2020 a także ocen mieszkańców i organów administracji (zagrożenie subiektywne). Podstawowym celem było określenie zagrożenia obiektywnego i subiektywnego I identyfikacja czynników (klimatycznych, społecznych i politycznych), które utrudniają efektywne zarządzanie sytuacjami kryzysowymi. Na tej podstawie pojawiły się następujące pytania: w jakim stopniu zmiany klimatyczne ma wpływ na występowanie pożarów lasów i powodzie? W jaki sposób zmiany klimatyczne będą wpływać na te zagrożenia w przyszłości? Jak oceniają wpływ zmian klimatycznych na występowanie pożarów lasów i powodzie mieszkańcy i władze? Koncentrując się na terytorium Grecji Centralnej i Południowej autorki podjęły próbę: a) zaprezentować tendencje w występowaniu pożarów lasów i powodzi w ostatnich dekadach od lat 90. (na podstawie analizy statystycznej danych empirycznych) b) odnieść się do obecnych i przewidywanych zmian klimatycznych i oczekiwanego ich wpływu na występowanie zagrożenia pożarami lasów i powodziami c) przeprowadzić sondaż na temat tego jak mieszkańcy i władze dwóch regionów postrzegają (oceny) wpływ zmian klimatycznych na występowanie zagrożenia pożarami lasów i powodziami obecnie i w przyszłości

Słowa kluczowe: postrzeganie problemu w opinii publicznej, pożar lasów, powódź, zmiany klimatyczne

Abstract

The Mediterranean is one of the most exposed and vulnerable regions to Climate Change -CC. Greece, a country in the eastern part of Mediterranean features climatic, geographical and topographical characteristics that vary from one region to another. Respectively vary CC extreme weather events, such as floods and forest fires. Especially since 2000, forest fires and floods bedevil the country and remain an unmanageable social, economic and environmental challenge, worsening with CC. The present work compares forest fire and flood risk in four regions in central Greece, namely Attica, Dytiki Ellada and Sterea Ellada and south Greece, namely Peloponnese, through the lens of the recorded events and losses of forest fires and floods (objective risk) in the period 1990–2020 and the respective perceptions of citizens and management authorities (subjective risk). The basic aims have been to address both objective and subjective risk and to identify the factors (climatic, social and political) that complicate effective risk management. Consequently, some key questions arise: To what extent has Climate Change (CC) affected forest fires and floods? How will CC affect these risks in the future? What are the perceptions of citizens and management authorities about CC's impact on the trends of floods and forest fires? By focusing on central and south Greece as "Hot Areas", the authors attempt to: (a) present the forest fire risk and flooding trends of the last decades since the mid 90's (on the basis of statistical analysis of empirical data), (b) address the recent and predicted regional climate changes that are expected to affect the forest fire and flood risk and (c) conduct a survey on the perceptions of citizens and management authorities of the two regions on the effect of CC on forest fire and flood risk currently and in the future.

Keywords: Public Perceptions, Floods, Forest Fires, Climate Change

Introduction

The climate of an area is defined as the behavior of the atmosphere over long periods of time (usually thirty years or more), referring to the average weather conditions and rare and extreme weather events (World Meteorological Organization, 2018). According to the IPCC from 1880 to 2020 the average global temperature increased by 1.02 °C (National oceanic and Atmospheric Administration, 2019), while in the Mediterranean in 2018 the temperature was 1.4 °C higher (Marini, 2018). The rapid increase in global temperature over the last 20 years has been predominantly attributed to anthropogenic factors (IPCC, 2014, p.5). Since the beginning of the 21st century, CC has been of interdisciplinary research (Environmental Science, 2020) because among others if directly affects extreme weather events (extreme rainfall, droughts) and interrelated natural disasters. Studies have shown that with the rise of the global average temperature there have been significant increases in both the number and intensity of extreme weather events and natural disasters (National Climate Assessment U.S., 2014).

However, CC and its effects are not always clear to people as it is difficult to have personal experience of the cause effect relationship between CC and extreme phenomena culturally constructed beliefs can strongly influence people's perceptions (Papoulis, Kaika, Bampatsou, Zervas, 2015, pp. 716–724).

In recent decades, more and more research has been focusing on if and how individuals perceive CC risk of. This research is based on the theoretic risk perception and risk culture attempting to explain how individuals judge whether something is dangerous or not, and to determine the factors which are contributing to this perception. Perception of people regarding CC hazard and risks is important for risk management authorities in order to understand the ways in which people respond to climate changes and the appropriate mitigation and adaptation measures (Slovic, 1987, pp. 280–285).

Risk perception is about "beliefs potential harm or the possibility of a loss. It is a subjective judgment that people make about the characteristics and severity of a risk" (Darker, 2013). The ways individuals perceive and react to risks have been shaped over the years, through their values, age, gender, emotional intelligence, social status, social and cultural views and demographic features (Slovic, 1992, pp. 117–152).

Understanding how individuals perceive risk is of particular importance, also for risk education and risk communication. In recent years, a number of studies have been conducted with the focus on the perception of CC hazards and risks in Greece. The most recent survey comes from the European Investment Bank (2021) with the main findings showing that the majority of Greeks believe CC originate from the human factor, also that it is the biggest challenge for humanity and has a direct impact on their daily lives, while they do not believe that Greece alone can drastically reduce carbon emissions by 2050 (European Investment Bank, 2021). However, there are no studies on public perception of floods and forest fires as CC threats in Greece.

The main objective of the present work is to confirm or question the correlations between CC and forest fires and floods through the prism of scientific assessments, historical empirical data and public perceptions in central and south Greece. The basic research queries are the following: What's the public opinion on the impact on CC of forest fires and floods? Does this perception identify with historical empirical data and forecasts?

Method

The study methodology is based on: (1) time-series statistical analysis of floods and forest fires in central and south Greece; (2) structured questionnaires administered to a sample of the general public and key informers in central and south Greece. Cross-examination of the results of these analyses, featured convergences and divergences amongst and between facts, predictions, and perceptions. The structured questionnaire was considered as the most appropriate research tool to achieve the objective. It has been designed on the basic samples of population in the four regions and the existing bibliography. An online questionnaire was distributed to the citizens and the management authorities through social media and e-mail. The sample of the study consisted of 317 residents, of whom 84 residents from the Region of Attica, 51 residents from the Region of Dytiki Ellada, 83 residents from the Region of Peloponnese and 99 were residents from the Region of Sterea Ellada. The sample included 166 females and 151 males, 183 participants were aged 18–35 years;

78 were aged 36–59 years and 56 were aged 60+ years. In addition, 22 held a compulsory education qualification, 93 held a secondary education qualification and 146 held a higher education qualification of which 56 held a Master's/Doctoral degree. The survey also involved 42 employees of management authorities (administrative regions, fire corps, and forest authorities), of whom 19.05% belong to Attica, 16.67% to Dytiki Ellada, 30.95% to Peloponnese and 33.33% to Sterea Ellada. It is obvious that young ages(18-35) and people of high education level were ore-represented in the sample owing to e-communication channels used and the profile of the survey organizer (a PhD student).

Results and discussion

The present work examines: (a) the objective/scientific effect of CC on forest fire and flood risk, i.e. if there are indications that CC affects forest fire and flood risk in central and south Greece and predictions/estimations regarding this affect in the future and (b) the subjective risk, i.e. public perceptions regarding CC effect on these risks, including the perceptions of the responsible risk management authorities.

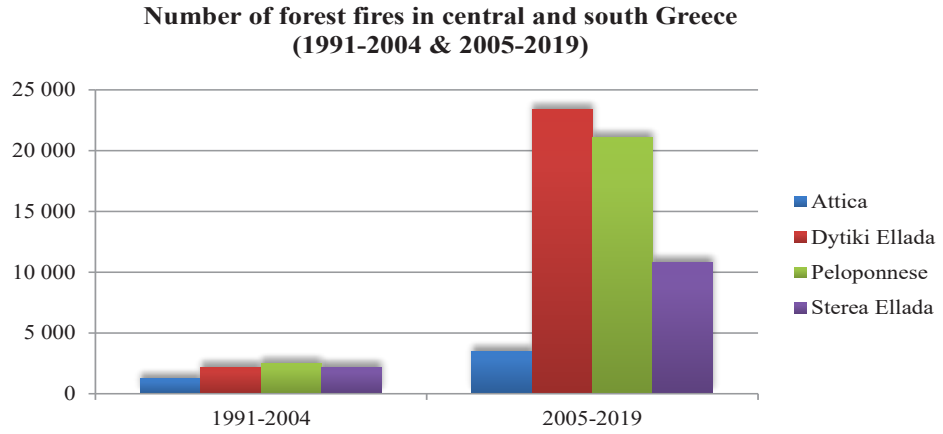
According to the literature and the RCP4.5 scenario (moderate scenario), the average temperature in central and south Greece it is estimated to increase by 0.97–1.7°C in the period 2031–2050 and will be higher by 1.6–4.7°C in the period 2081–2100. According to the same scenario, the annual rainfall rates will reduce by 2050 (compared to the period 1981–2000). Furthermore, according to the IPCC's A1B scenario (moderate older scenario), the number of very hot and dry days is also expected to increase by the end of the 21st century. At the same time, it is estimated that there will be an increase in extreme rainfall (Region of Attica-Directorate-General for Sustainable Development and Climate Change, 2020, pp. 239–246; Region of Dytiki Ellada, 2019; Region of Sterea Ellada, 2018, pp. 289–297; WWF, 2021; Bank of Greece, 2011, pp. 64–84; Region of Peloponnese and Academy of Athens, 2020).

However, some changes have already appeared. More specifically, in central Greece the average maximum monthly temperature and the average monthly rainfall increased in the period 2011–2020 (compared to the period 1955–2010), and the average monthly humidity, presented lower rates in the period 2000–2020 (compared to the period 1955–2020). On the other hand it is worth-mentioning that, in south Greece the average monthly temperature, increased only in March and September in the period 2011–2020 (compared to the period 1955–2010), and the average monthly rainfall was higher in the period 2011–2020 compared to 1955–2010. Additionally, the average monthly humidity increased in the period 2000–2020 (compared to 1955–2020) (National Weather Service, 2020; World Data info, 2021). It is obvious that CC varies from one region to another (even in cases of neighboring regions). These variations are confirmed by the historical data recorded in the area and they are also evident in the Figures following.

Forest fires are a fairly common phenomenon in Greece, constituting an important problem that is directly related to the prevailing meteorological conditions (Xanthopoulos, 2009, pp. 7–11). The burnt areas in Greece for the period 1991–2020 amount to 13,009,032 acres of which 51.83% are located in central and south

Greece. In the period 2005-2020 (compared to the period 1991–2004) there has been a dramatic increase in the number of fires especially in Dytiki Ellada and Sterea Ellada (parts of central Greece) and Peloponnese (south Greece) (Fire Brigade of Greece, 2020; Kaoukis, 2009).

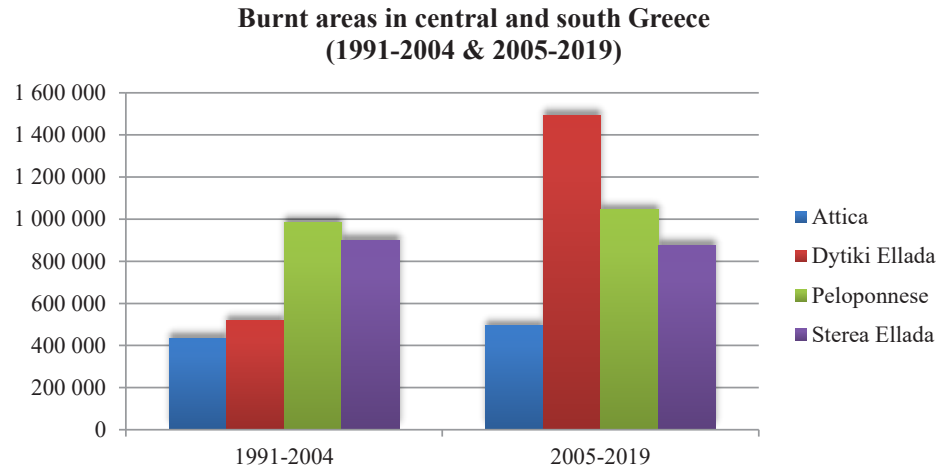
Figure 1. Number of forest fires in central and south Greece (1991–2004 and 2005–2020)



Source: author's elaboration.

However, as far as the burnt areas are concerned, a significant increase occurred basically in Dytiki Ellada (in 2005–2020 compared to the previous period).

Figure 2. Burnt areas in central and south Greece (1991–2004 and 2005–2020)

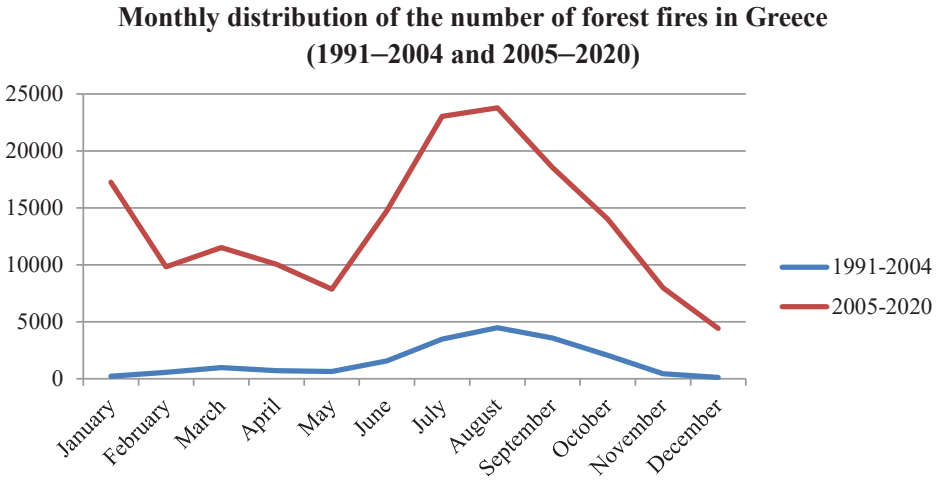


Source: author's elaboration.

On top of the above changes, it seems that after 2005 the forest fire period tends to cover the whole year, as fire season has been extended to include even spring and winter seasons: January, February, March, April, November and December (with

almost zero events in the preceding period) (Fire Brigade of Greece, 2020; Kaoukis, 2009).

Figure 3. Monthly distribution of the number of forest fires in Greece (1991–2004 and 2005–2020)



Source: author's elaboration.

As far as floods are concerned, in the period 1960-2020 a total of 642 serious events were recorded in central and south Greece. Since the beginning of the 21st century (compared to the period 1960–1999), there has been a significant increase in flooding in the respective four regions, especially in Attica and Sterea Ellada. More specifically, in the period 2000-2020 there were 131 floods in Attica, 127 in Sterea Ellada, 84 in Dytiki Ellada and 69 in Peloponnese (Ministry of Environment and Energy, 2012; Meteo. Map of High-Impact Weather Events, 2020).

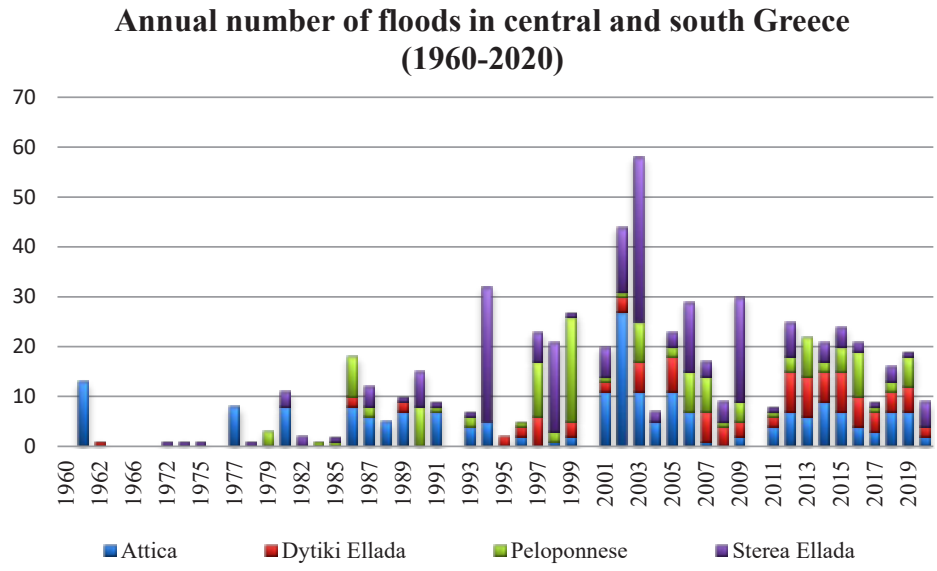
As far as the monthly distribution of floods is concerned, it is noted that in the period 2005–2020 flooding increased significantly throughout the year and the hot period for floods has been significantly extended (Ministry of Environment and Energy, 2012; Meteo. Map of High-Impact Weather Events, 2020).

These conclusions are analogous to the findings referring to forest fires and indicate that the once seasonal meteorological and climatic disasters are increasing rapidly throughout the year and their occurrence should be expected at any time.

Perceptions of citizens and management authorities play a key role in addressing CC challenges, either through adaptation or mitigation. Appropriate training and continuous dissemination of information on CC-related issues can help individuals and societies understand the serious impacts of CC and obtain knowledge and practical skills for mitigation and adaptation measures. Important step to this end is addressing current perceptions of people and responsible authorities on CC.

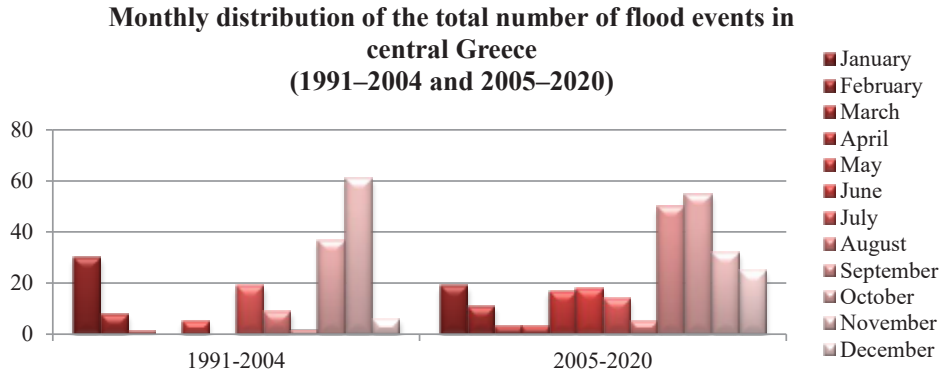
The survey conducted revealed that the majority of residents of all four Regions believe that CC exists and that it is mainly due to the human factor.

Figure 4. Annual number of floods in central and south Greece (1960–2020)



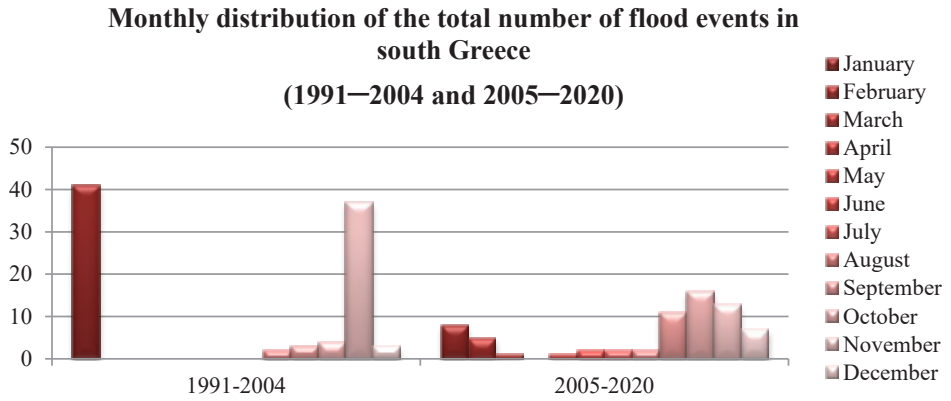
Source: author's elaboration.

Figure 5. Monthly distribution of the total number of flood events in central Greece (1991–2004 and 2005–2020)



Source: author's elaboration.

Figure 6. Monthly distribution of the total number of flood events in central Greece (1991–2004 and 2005–2020)



Source: author's elaboration.

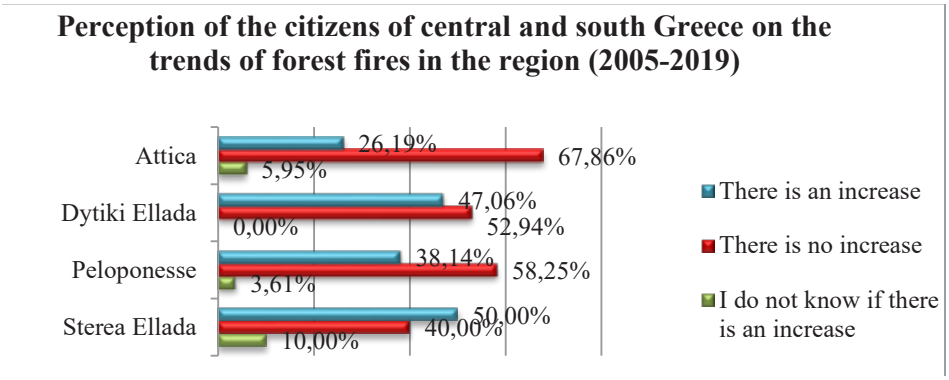
The majority of Attica's residents have observed in their area more heatwaves, warmer winters, warmer summers and always more intense extreme rainfall, over the last 15 years. However, they have not seen any increase in forest fires and floods; they believe though that CC can increase both forest fires and floods.

The majority of residents of Dytiki Ellada have observed in their place of residence mainly warmer winters, more heat waves, warmer summers and always more intense extreme rainfall, in the last 15 years. Like the residents of Attica however, they have not noticed an increase in forest fires while they have observed an increase in floods in their area. At the same time, they believe that CC can increase both forest fires and floods.

As far as the majority of the residents of the Peloponnese are concerned they have observed in the place of their permanent residence more heatwaves, warmer winters, warmer summers, more intense extreme rainfall and a decrease in total rainfall, in the last 15 years. However, they have not seen any increase in forest fires and floods, while they believe that CC can increase both forest fires and floods.

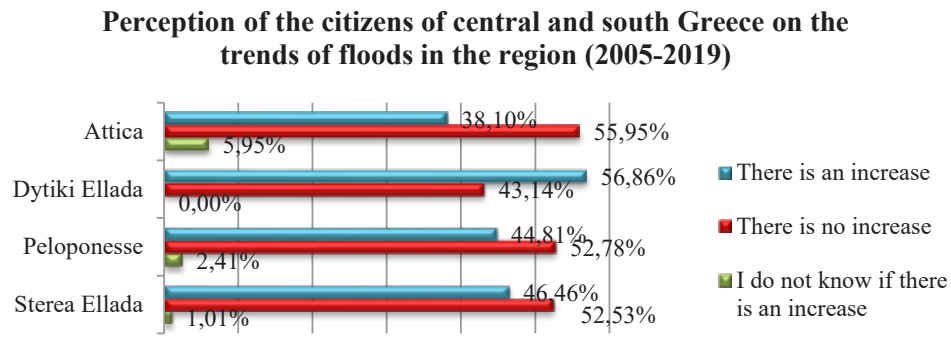
Finally, with regard to Sterea Ellada, most residents have observed warmer winters, warmer summers, more heat waves, more intense extreme rainfall, changes in flowering times and plant growth and reduction of total rainfall, in the last 15 years. As far as forest fires are concerned, the majority have noticed that the catastrophic events have increased in the area in the last 15 years, something which is not confirmed for the floods of the Region. However, in this case too, residents believe that CC can increase both forest fires and floods.

Figure 7. Perception of the citizens of Attica, Dytiki Ellada, Peloponnese and Sterea Ellada on the trends of forest fires in the region (2005–2019)



Source: suthor's elaboration.

Figure 8. Perception of the citizens of central and south Greece on the trends of floods in the region (2005–2019)



Source: author's elaboration.

The majority of the management authorities of central and south Greece consider that CC exists and that it is due to both natural and anthropogenic factors, except for the management authorities of south Greece where the majority believes that is due to the human factor.

In addition, the management authorities of the Region of Attica have observed warmer summers, always more intense extreme rainfall and more heat waves, over the last 15 years.

The majority of the management authorities of the Region of Dytiki Ellada have observed warmer winters, warmer summers, decrease in rainfall, changes in flowering times and plant growth, more intense extreme rainfall and more heat waves, over the last 15 years.

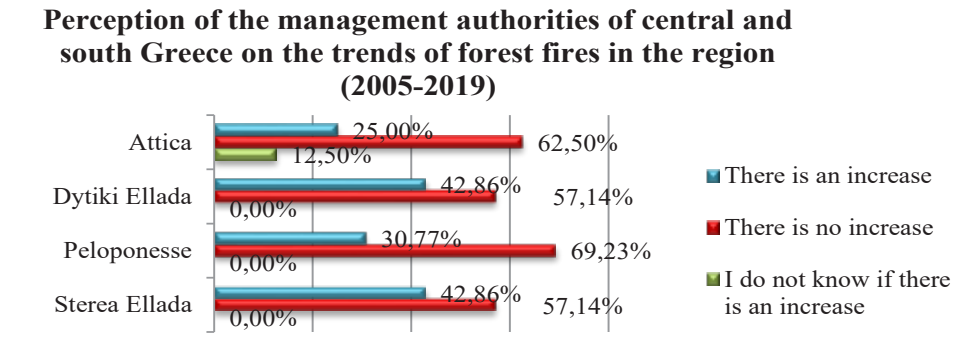
The majority of the management authorities of the Region of Peloponnese have observed warmer winters, more heat waves, more intense extreme rainfall, changes

in flowering times and plant growth, reduction of rainfall, more storms and stronger winds and warmer summers, in the last 15 years.

The majority of the management authorities of Sterea Ellada have observed warmer winters, changes in flowering times and plant growth, more storms and stronger winds, warmer summers, rising sea levels and more heat waves in the last 15 years.

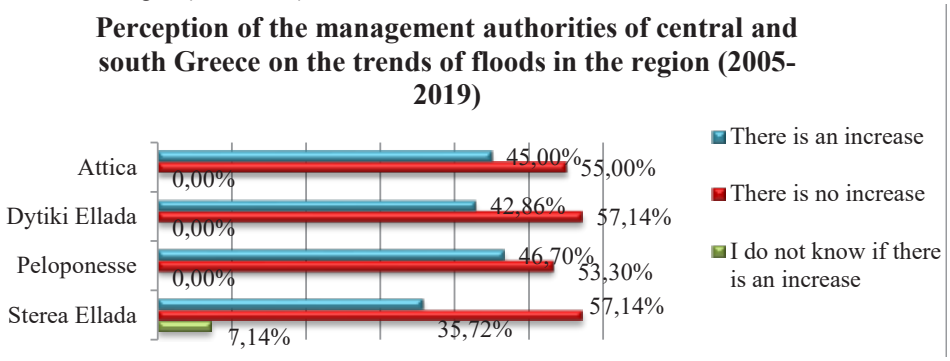
However, the majority of the management authorities of all four Regions of central and south Greece have not noticed an increase in forest fires and floods in their areas over the last 15 years, but they believe that CC can increase both catastrophic phenomena.

Figure 9. Perception of the management authorities of central and south Greece on the trends of forest fires in the region (2005-2019)



Source: author's elaboration.

Figure 10. Perception of the management authorities of central and south Greece on the trends of floods in the region (2005–2019)

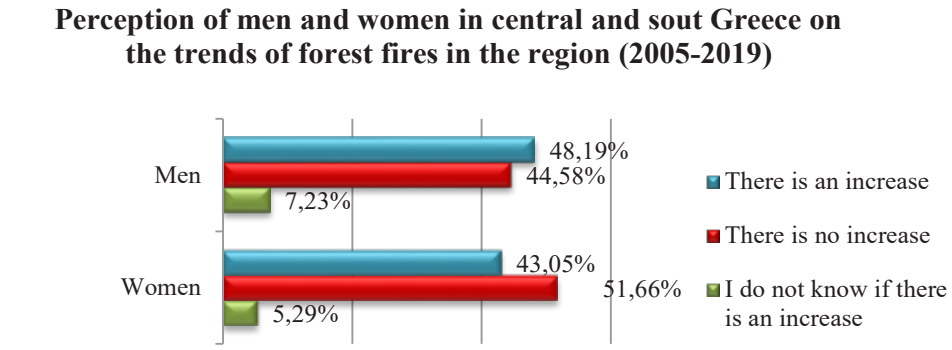


Source: author's elaboration.

Regarding the gender of the respondents, there are no big differences in perception between men and women in central and south Greece. The majority of both men and women believe that CC exists and it is due to the human factor. In general

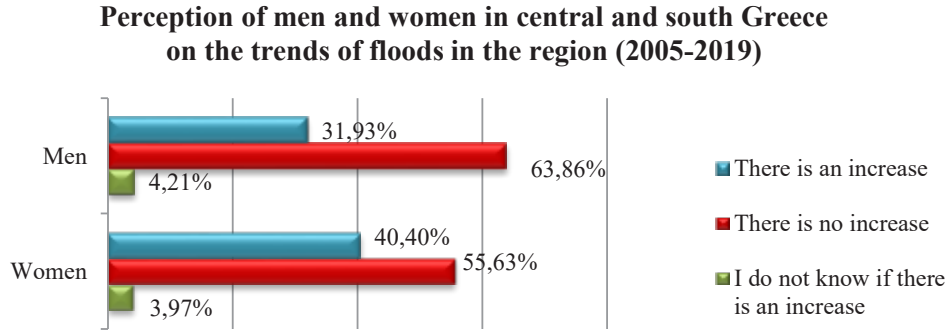
terms increase of forest fires is more observable than increase of floods. Especially in the case of forest fires increase in the number of events is more observable by men while flood event increases are more observable by women. Nevertheless, both men and women believe that CC can increase both forest fires and floods.

Figure 11. Perception of men and women in central and south Greece on the trends of forest fires in the region (2005-2019)



Source: author's elaboration.

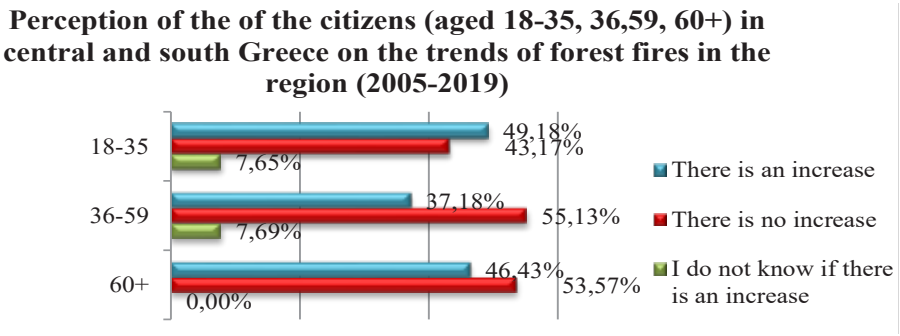
Figure 12. Perception of men and women in central and south Greece on the trends of floods in the region (2005-2019)



Source: author's elaboration.

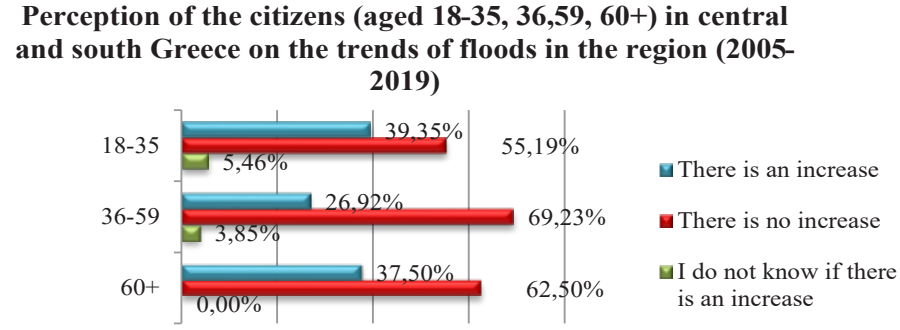
Based on the age of the respondents, it seems that the majority of all age groups (18–35, 36–59, 60+) of central and south Greece consider that CC exists and that it is mainly due to the human factor. The majority of respondents in the 18–35 age group have observed an increase in forest fires over the last 15 years, while they have not noticed an increase in floods. However, the majorities of people in the 36–59 and 60+ age groups have not seen any increase in forest fires and floods either. In addition, people in the 18–35 and 36–59 age groups believe that CC can increase both forest fires and floods, but the majority of people in the 60+ age group believe that CC can increase floods but not forest fires.

Figure 13. Perception of the citizens (aged 18–35, 36–59, and 60+ years) of central and south Greece on the trends of forest fires in the region (2005-2019)



Source: author's elaboration.

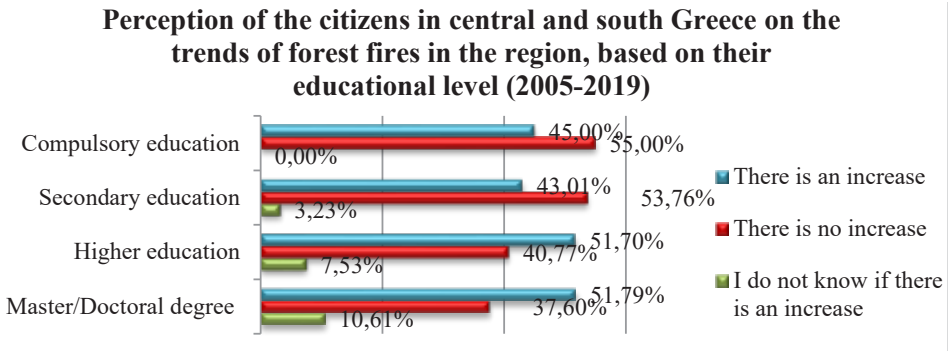
Figure 14. Perception of the citizens (aged 18–35, 36–59, and 60+ years) of central and south Greece on the trends of floods in the region (2005-2019)



Source: author's elaboration.

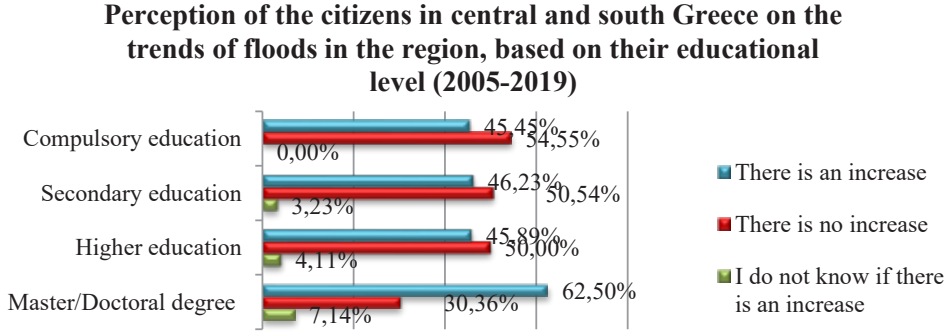
As far as educational attainment is concerned, the majority of respondents from all levels of education consider that there is CC. The majority of people belonging to compulsory and secondary education consider that CC is due to the human factor, while the majority of respondents holding a higher education degree and a master/doctoral degree consider that CC is due to both physical and anthropogenic factors. Moreover, the majority of respondents belonging to compulsory and secondary education have not noticed an increase in forest fires in the last 15 years. On the contrary, the majority of people who hold a higher education degree and a master/doctoral degree have observed an increase in forest fires. Moreover, only the majority of the respondents belonging to the holders of master/doctoral degree have noticed an increase in floods at the same period. However, the majority of all respondents believe that CC can increase both forest fires and floods.

Figure 15. Perception of the citizens in central and south Greece on the trends of forest fires in the region (2005-2019), based on their educational level



Source: Author's elaboration.

Figure 16. Perception of the citizens in central and south Greece on the trends of floods in the region (2005-2019), based on their educational level



Source: author's elaboration.

Conclusion

Greece is one of the most exposed and vulnerable areas of the Mediterranean to CC. In this paper we presented (a) the scientific assumptions about climate changes in central and south Greece; (b) the actual changes in the climatic and meteorological variables that are critical for forest fire and flood risk in central and south Greece in the last seven decades; (c) the forest fire and flood disaster history of these hotspots; and (d) the perceptions and observations of local communities and risk management authorities as to the actual CC effect on local floods and forest fires.

According to the bibliographic research carried out, scientific models of CC in central and south Greece currently and in the future indicate significant climate changes, which directly contribute to the increase of forest fires and floods. However, CC varies by region. It is noteworthy that although central and south

Greece are adjacent, central Greece is in a worse position than south Greece, both in terms of CC and in terms of the increase of forest fires and floods, as in south Greece these risks have not shown significant changes, so far.

Regarding the views of the residents and the management authorities of central and south Greece, regarding the increase of forest fires and floods in their place of residence, in relation to the local CC, it seems that demographic characteristics, gender, age and educational level as well as real changes in the local catastrophic affect perceptions. Specifically, only the majority of respondents of Sterea Ellada observed an increase in forest fires in the last 15 years, while only the majority of the inhabitants of Dytiki Ellada observed an increase in floods during the same period.

Taking into account the gender of respondents in central and south Greece, it seems that the majority of men have observed an increase in forest fires, as opposed to women, while the majority of both sexes have not noticed an increase in floods in the last 15 years. This may be due to the fact that in Greece a large percentage of men (compared to women) are employed in open-air professions related to the natural environment (e.g. agriculture, forestry, etc.).

With regard to the age of the respondents, it appears that people belonging to the 18-35 age group have seen an increase in forest fires in the last 15 years, as opposed to the other two age groups. This may be due to the fact that in the last two decades there has been an effort to include environmental education and CC issues in the curricula of the country's schools. In addition, people of younger age groups have at their disposal more information channels, compared to the elderly. However, the majority of respondents from all three age groups have not noticed an increase in flooding.

The educational level of respondents also plays a key role in their responses, as the majority of people holding a higher education degree and the majority of those with a master's/doctoral degree have seen an increase in forest fires. But only the majority of people with a Master's/PhD degree have seen an increase in flooding. Higher education level translates into a higher interest for the environment and CC impacts and continuous search for relevant information. In the case of educated people awareness of CC impact on meteorological and climatological hazards and consequent risks is not empirical (as in the case of farmers). It comes from environmental and social concern and secondary information and data accessd by this group.

It is noteworthy, that a large percentage of respondents, although they have observed an increase in forest fires in recent years, they have not noticed an increase in floods. This may be due to the fact that a large proportion of the floods recorded did not involve urban flooding, hence they do not cause concern to urban populations. Besides, fires cause more fear than floods according to relevant research.

Above findings point to the urgent need for environmental information and education on CC and interconnections with disaster risks and natural disasters, already from the early childhood, Additionally, involvement of local residents in mitigation and adaptation, forest fire and flood disaster prevention and preparedness measures and a culture of volunteerism in this field are necessary preconditions for raising local communities' awareness.

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