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Future climate change impact on wildfire danger over the Mediterranean: the case of Greece

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Abstract

Recent studies have shown that temperature and precipitation in the Mediterranean are expected to change, contributing to longer and more intense summer droughts that even extend out of season. In connection to this, the frequency of forest fire occurrence and intensity will likely increase. In the present study, the changes in future fire danger conditions are assessed for the different regions of Greece using the Canadian fire weather index (FWI). Gridded future climate output as estimated from three regional climate models from the Coordinated Regional Downscaling Experiment are utilized. We use three representative concentration pathways (RCPs) consisting of an optimistic emissions scenario where emissions peak and decline beyond 2020 (RCP2.6), a middle-of-the-road scenario (RCP4.5) and a pessimistic scenario, in terms of mitigation where emissions continue to rise throughout the century (RCP8.5). Based on established critical fire FWI threshold values for Greece, the future change in days with critical fire danger were calculated for different areas of Greece domains. The results show that fire danger is expected to progressively increase in the future especially in the high-end climate change scenario with southern and eastern regions of Greece expected to have up to 40 additional days of high fire danger relative to the late 20th century, on average. Crete, the Aegean Islands, the Attica region, as well as parts of Peloponnese are predicted to experience a stronger increase in fire danger.

1. Introduction

Extreme wildfire events can have devastating consequences for ecosystems (Andela *et al* 2018), the atmospheric environment (Voulgarakis and Field 2015), human health (Chuvieco *et al* 2018) and the economy (Nielsen-Pincus *et al* 2014). Fire can be both a natural and an anthropogenic disturbance process prevalent across most land surfaces with regular ignitions from humans particularly in agricultural areas where it is often used as a tool (Abatzoglou *et al* 2018). In southern Greece, a wildfire in August 2007 resulted in a loss of 84 human lives more than 3000 destroyed houses and 270 000 ha of burnt area. The second deadliest wildfire event ever in the country (102 casualties) has been the recent wildfire in eastern Attica (July 2018), which burned an area of ∼1250 ha (Lagouvardos *et al* 2019).

Mediterranean ecosystems are considered fire-prone, with severe associated economic and environmental damages every year (Turco *et al* 2018). Although Mediterranean vegetation is able to cope with fire, land use changes in the area burned and the consequent changes in fire recurrence can have consequences at landscape level. Thus, understanding changes in fire regime and their relation to climate is a key factor for predicting the future of Mediterranean ecosystems (Pausas 2004).

Drought events of unforeseen spatial extent and duration, are projected to occur up to twice per decade in the future, regardless of the degree of mitigation for Europe (Grillakis 2019). Such climate-driven changes are expected to increase the risk of fire occurrence (Carvalho *et al* 2011, Dupuy *et al* 2020), reduce the time intervals between fire events (Pausas 2004) and lengthen the duration of the fire season (Goss *et al* 2020). Current trends in the Mediterranean climate and more specifically in Greece, indicate an increase in summer droughts due to global warming (Tramblay *et al* 2020). Studies have consistently reported that climate change is expected to increase summer temperatures especially in the southern parts of Europe by the end of the 21st century. Projections regarding the southeastern Mediterranean region for the end of the century have shown an increase of 1.7 °C–2.5 °C for the moderate climate change scenario (RCP4.5) and 3.5 °C–5 °C for the higher-end scenario (RCP 8.5) (Zittis *et al* 2019).

The fire weather index (FWI) index is solely based on meteorological parameters, disregarding geomorphic characteristics and vegetation types as well as related characteristics that may affect fire spread such as land use fragmentation and topography. To this end, the FWI is usually used along with related thresholds that have been found to work well for specific regions and vegetation types (De Groot *et al* 2007, Dimitrakopoulos *et al* 2011, Karali *et al* 2014). The FWI was developed for the eastern pine forests of Canada but has been used for several areas globally like for the Mediterranean region (Carvalho *et al* 2011, Bedia *et al* 2014, Ruffault *et al* 2020) focused on the frequency of current and future climate conditions associated with wildfires, finding that heat-induced fire-weather is projected to increase by 14% by the end of the century (2071–2100) under the RCP4.5 and by 30% under the RCP8.5 for the Mediterranean. These results are fairly similar with our calculated fire weather increase by 17% and by 26% respectively for the Greek domain. Novo and Lorenzo (2020) utilized the FWI along with additional forest fire occurrence indicators to study how forest management can be optimized in Spain in order to prevent the impacts of wildfires. Moreover Bedia *et al* (2014); Amatulli *et al* (2013) estimated the future fire danger using the FWI for several countries bordering the Mediterranean and found out that there is a strong correlation of the index with burnt area for the Mediterenean region, whereas that correlation is weaker when individual countries were examined. Giannaros *et al* (2021) used the number of days with FWI > 30 as an index for the assessment of fire weather extremes in the Euro-Mediterranean. Focusing on Greece Karali *et al* (2014) have correlated the number of fires with the FWI in order to determine the fire-related, region-specific thresholds for the FWI. They established three critical fire danger threshold values for the main areas of Greece based on daily mean meteorological data; these are FWI = 15, FWI = 30 and FWI = 45 increasing from the northwest to the southeast. These macroscale differences in the FWI thresholds were calculated by correlating the number of fires and the FWI for the different regions. During the 2018 Attica fires, the extreme fire growth on 23 July was associated with a sharp increase in FWI driven by hot (35 °C) and dry (RH = 29%) conditions and no precipitation during the previous two weeks (Field 2020). Giannakopoulos *et al* (2011) calculated different meteorological indices related to fire danger based on a single regional climate model (RCM). However there has not been a study in Greece using the FWI from different RCMs to reduce the influence of potential model biases to estimate fire prone areas, correlation with input weather variables and fire season length changes.

The present study aims to estimate future fire danger for the Greek domain using the FWI index using climate output from EURO-CORDEX RCM simulations, as it was projected for three future emissions scenarios namely the RCP2.6, RCP4.5 and RCP8.5. The RCM outputs have a high resolution of 0.11 degrees since the GCM's can only model processes in coarse grid-cells which are unsuitable for local level case studies (Jacob *et al* 2020, Navarro-Racines *et al* 2020). Especially for mountainous terrains like that of Greece increasing the model's resolution has benefits in simulating temperature, precipitation, and wind extremes over Europe (Torma *et al* 2015, Iles *et al* 2020). On the other hand downscaling from GCM to RCM leads to sources of uncertainty which in this study is accounted for by using the results from an ensemble of RCMs (Chokkavarapu and Mandla 2019). Results are analyzed and compared for three time periods (1971–2000, 2021–2050, 2069–2098) and for several key Greek regions, using metrics like the the number of days with FWI > 30 as well as by calculating the FWI changes between the aforementioned time periods. The fire season length is another useful metric quantifying the persistence of fire wheather, so we determine how much this metric is predicted to change in the future. Based on the three models that were utilized in this study, temperature is expected to increase by up to 2.5 °C in the near future (2021–2050) and up to 5 °C in the distant future (2069–2098) for the RCP8.5 scenario. It is shown that the three scenarios considered exhibit a similar warming pattern in the near future, while temperature trajectories vary considerably beyond the 2050s.

This is the first study that assesses the impact of climate change on a fire danger index over Greece using the output from multiple climate models. We present our data and methods in section 2, our results in section 3, and our main conclusions in section 4.

2. Data and methodology

2.1. Study area characteristics

The area studied is Greece and its sub-regions located in southeastern Europe between 34° and 42° northern latitude and 19° and 28° eastern longitude, covering an area of approximately 132 000 km^2 and occupying the southernmost part of the Balkan Peninsula.

Climatologically, Greece mainly belongs to the Mediterranean climatic type. It is characterized by mild winters during which precipitation peaks, relatively warm and dry summers and a long sunshine duration almost throughout the year. It varies from continental Mediterranean in the country's north (Csa), according to the Köppen climate classification) to subtropical Mediterranean in the far south (Csb) (Kottek *et al* 2006).

Moreover, the annual cycle can be divided climatologically into a cold and rainy period (October–March) as well as a warm and dry period (April–September), while October and April can be characterized as transition months (Karali *et al* 2014).

Situated in the eastern Mediterranean basin, Greece is also an area highly responsive to climate change particularly with respect to temperature rise, precipitation decrease and fire danger increase. Temperature has been documented to increase since the mid-1970s (Giannakopoulos *et al* 2011), while fire statistics indicate a significant increase in both the number of wildfires and the burnt area (Dimitrakopoulos *et al* 2011). According to the official records of the Greek Fire Service, the dominant vegetation types affected by wildfires are phryganic ecosystems, Pinus halepensis and Pinus brutia forests, Quercus coccifera shrublands, and grasslands, which collectively cover about 39% of the total surface of Greece (Dimitrakopoulos 2002).

2.2. FWI description and thresholds

There are many fire weather indices other than the FWI with the most notable ones being the National Fire Danger Rating System in US (Bradshaw *et al* 1984), the forest fire danger index (FFDI) (Noble *et al* 1980) and a much simpler FWI (F index) developed by Sharples *et al* (2009) and used for Mediterranean climates by Satir *et al* (2016). Dowdy *et al* (2009) have made comparisons between the FWI and FFDI and the main conclusion is that these indexes are very similar in terms of their fire weather predicting capability. Fire weather indices are widely used to estimate current fire danger such as in the European forest fire information system (EFFIS), the Canadian Wildland Fire Information System and the Australian FDI forecast system.

The FWI System is composed of three fuel moisture codes and three fire behavior indexes and uses 12:00 local time surface temperature, relative humidity, wind speed and 24-hour precipitation as input. The Fine Fuel Moisture Code is a numeric rating of the moisture content of litter and other cured fine fuels and is considered as an indicator of the relative ease of ignition and flammability of fine fuels (Stocks *et al* 1989). The Duff Moisture Code is a numeric rating of the moisture content of loosely compacted organic (duff) layers of moderate depth. The Drought Code is a numeric rating of the moisture content of deep compact organic layers. When it comes to the two intermediate fire behavior indexes (steps), the initial spread index (ISI) is a numeric rating of the expected rate of fire spread. The buildup index (BUI) is a numeric rating of the total amount of fuel available for combustion. The FWI, combines ISI and BUI to represent the intensity of a spreading fire as energy output rate per unit length of fire front (Van Wagner 1987).

Here, a threshold of FWI = 30 has been used for determining the critical fire danger regions, following the research of Papagiannaki *et al* (2020) and Karali *et al* (2014), as a representative value for the entire Greek domain. Furthermore, the number of days with FWI > 30 was also estimated as an index quantifying the increase in fire weather severity in the future periods when compared to the reference one.

2.3. Climate data used for predictions

Readily available projection data for FWI from the Copernicus Climate Change Service (C3S) (Giannakopoulos and Karali 2019) were downloaded to determine the wildfire danger over the Greek domain. This data derives from meteorological variables every three hours of which the three hourly data at 12UTC was used as proxy for the noon value which is needed for the FWI calculation. Simulations from three versions of the RCA4 RCM were used, driven by three different global GCMs which were part of the EURO-CORDEX initiative (Jacob *et al* 2013). The RCA4 is stated by Kjellström *et al* (2016) that is useful with regards to helping in the creation of fundamental climate information. Three GCMs were used the HadGEM2-ES (UK Met Office, UK), EC-EARTH (ICHEC, Ireland) and MPI-ESM-LR (MPI, Germany) since only those three had the variables of interest and were available for all RCP8.5, RCP4.5 and RCP2.6, to more accurately compare results from these scenarios. These models are some of the most established ones able to accurately represent the climate (Jacob *et al* 2020). Iles *et al* (2020) studied how well EURO-CORDEX models captured reality by comparing several meteorological parameters with gridded data based on observations (E-OBS). They found that these models tend to overestimate temperature, precipitation and wind speed extremes for the period 1985–2011. Also atmospheric humidity is found to positively correlate well with temperature for these EURO-CORDEX models (Knist *et al* 2016). When it comes to the EC-EARTH GCM, it is found to represent the main patterns of climate variability well, though with colder surface temperatures (Hazeleger *et al* 2012). Based on other studies all three models underestimate rainfall and thus represent a slightly dryer and hotter version of the actual climate. (Ayugi *et al* 2020, Bartok *et al* 2021). Le Pichon *et al* (2015) used high-resolution ground-based observations and determined that the MPI-ESM-LR and EC-EARTH have a good agreement with wind and temperature. The RCM's (and therefore the calculated FWI's) resolution is 0.11 degrees which is a novelty since it makes it possible to study the domain of interest in detail. In order to assess the impact of climate change on wildfire danger, an optimistic, a mid-range and a pessimistic RCP were used (Moss *et al* 2010, O'Neill *et al* 2014). The RCP2.6 is an optimistic emission scenario where emissions peak and decline beyond 2020. RCP4.5 is a mid-range climate change scenario that describes a stabilization in the radiative forcings after 2100 (Wise *et al* 2009). RCP8.5 is a high-end climate change scenario with radiative forcing increasing steadily until 2100 and beyond (Riahi *et al* 2011). Comparisons are made using a recent reference period (1971–2000) and two future time periods i.e. the period 2021–2050 (mid-century) and 2069–2098 (late century).

2.4. Signal to noise ratio

The signal to noise ratio (SN) was also calculated as it represents the strength of the change signal compared to natural variability (noise) and the signal stands out against the noise when and where this ratio is large (Julien *et al* 2018). The SN was calculated individually for each grid cell and for the entire sequence of daily FWI values within the three 30 year time periods as seen in equation (1):

$$SN = \left|\frac{\Delta}{\sigma}\right| \tag{1}$$

where SN is the signal to noise ratio of a specific variable, Δ is the difference between the 30 year average FWI value of the future minus the reference periods, and σ is the standard deviation of the FWI over the reference period. Specifically the SN was calculated using the aforementioned way for each of the three RCM simulations and then averaged to represent the ensemble mean. This same process was followed for each of the three RCP scenarios individually and for the entire sequence of daily values within three 30 year time periods. In section 3.1 the FWI and the values that are higher than the 90th percentile of the SN ratio has been calculated since this percentile has been established by other papers to be a threshold representative of extreme values (Wang *et al* 2015, Kirchmeier-Young *et al* 2017).

2.5. Fire season length

This metric is defined by (W.Matt *et al* 2015) and (Abatzoglou *et al* 2019) as the number of days each year when fire danger is above half its value range, for each year in each grid cell. The change in fire season length was calculated for all RCP scenarios by calculating the difference between the future periods and the reference and by averaging the results from all individual climate models temporally as seen in figure 3 and subplots (a, b, c, d, e and f) for the entire Greek domain. Wildfire season can become longer based on conditions that allow fires to start and to burn, e.g. extended drought, tree mortality from pine beetles and invasive species such as cheat grass that allow fire to ignite easily and spread rapidly (Flannigan *et al* 2013).

3. Results and discussion

3.1. Determining areas of increased fire danger

Based on the aforementioned FWI thresholds determined in Karali *et al* (2014) and according to the Greek climatological conditions, locations where the FWI index is greater than 30 are considered prone to fire occurrence. Initially the number of days with FWI > 30 for the reference period (1971–2000), both annually and for the fire season (May–September) were calculated (figure 1, panels (a) and (b) respectively). The higher values occur in the lower elevation areas. High fire danger areas are also predominantly found along the eastern Greek coastline due to the presence of the pindus mountain range acting as a precipitation barrier for the eastern coastline (Tsiros *et al* 2020). The higher number of days with FWI > 30 for the reference period is occurring for the coastal parts of Macedonia and Thrace, Thesssaly, Attica region, Peloponnese and Crete. The change in the number of days with FWI > 30 was calculated based on the average of all three RCMs, for the near (2021–2050) and distant (2069–2098) future figure 1 panels (c, d, e, f, g, h). First the number of days with FWI > 30 was calculated for each RCM individually based on daily FWI values and then these results were averaged to find the multi-model mean. There is a negative correlation between the aforementioned areas in figure 1, panels (a) and (b) with the areas that experience the greatest change in number of days with FWI > 30 figure 1, panels (c, d, e, f, g, h) due to saturation effects at high end climate change. The majority of those fire prone areas exhibiting the greatest change are located at the country's central and southern parts according to the spatial patterns that highlight hotspots of danger in figure 1 panels (c, d, e, f, g, h). The left panels (c, e, g), which depict the change in the number of days with FWI > 30 between the near future and reference periods for all RCP scenarios show a 2 week increase in the potential fire danger days. The left panels also exhibit less spatial heterogeneity than the right panels. Changes for the distant future right panels (d, f, h) are found to be more drastic, especially for the RCP8.5 having the highest number of days with FWI > 30 with some areas in central and southern Greece having 14–20

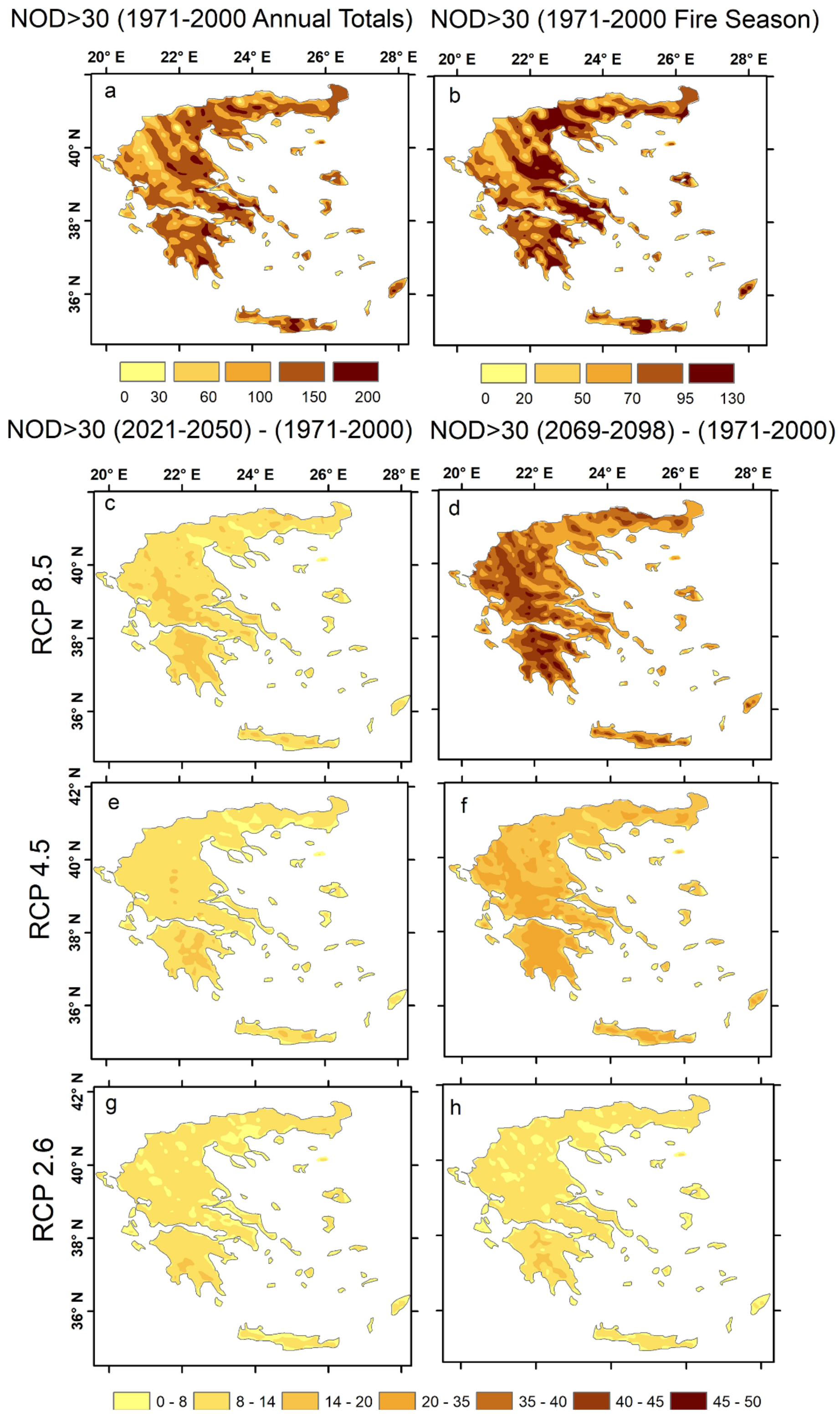

Figure 1. Panel (a) represents the annual ensemble mean total number of days (NOD) with FWI > 30 for the reference period (1970–2000). Panel (b) is the (NOD)> 30 for the fire season only of the same ensemble mean and time period as panel (a). Panels (c)–(h) showcase the difference in the annual ensemble mean (NOD) with FWI > 30 for every RCP scenario separately between the future periods and the reference period. The left column corresponds to the difference for the near future period [(2021–2050)—(1971–2000)] and the right column to the difference for the distant future [(2069–2098)—(1971–2000)].

additional fire danger days for the near future and 40–50 additional fire danger days in the distant future. The RCP2.6 scenario shows a peak in the radiative forcing of around 3 W m^{-2} mid-century resulting in up to 14 fire danger days and a decline afterwards to 2.6 W m^{-2} (van Vuuren *et al* 2011). This decline translates into fairly similar distant future FWI values as those for the near future resulting in the same fire danger days. Finally, the RCP4.5 predicts up to 20 FWI > 30 d for the distant future. From figure 1,

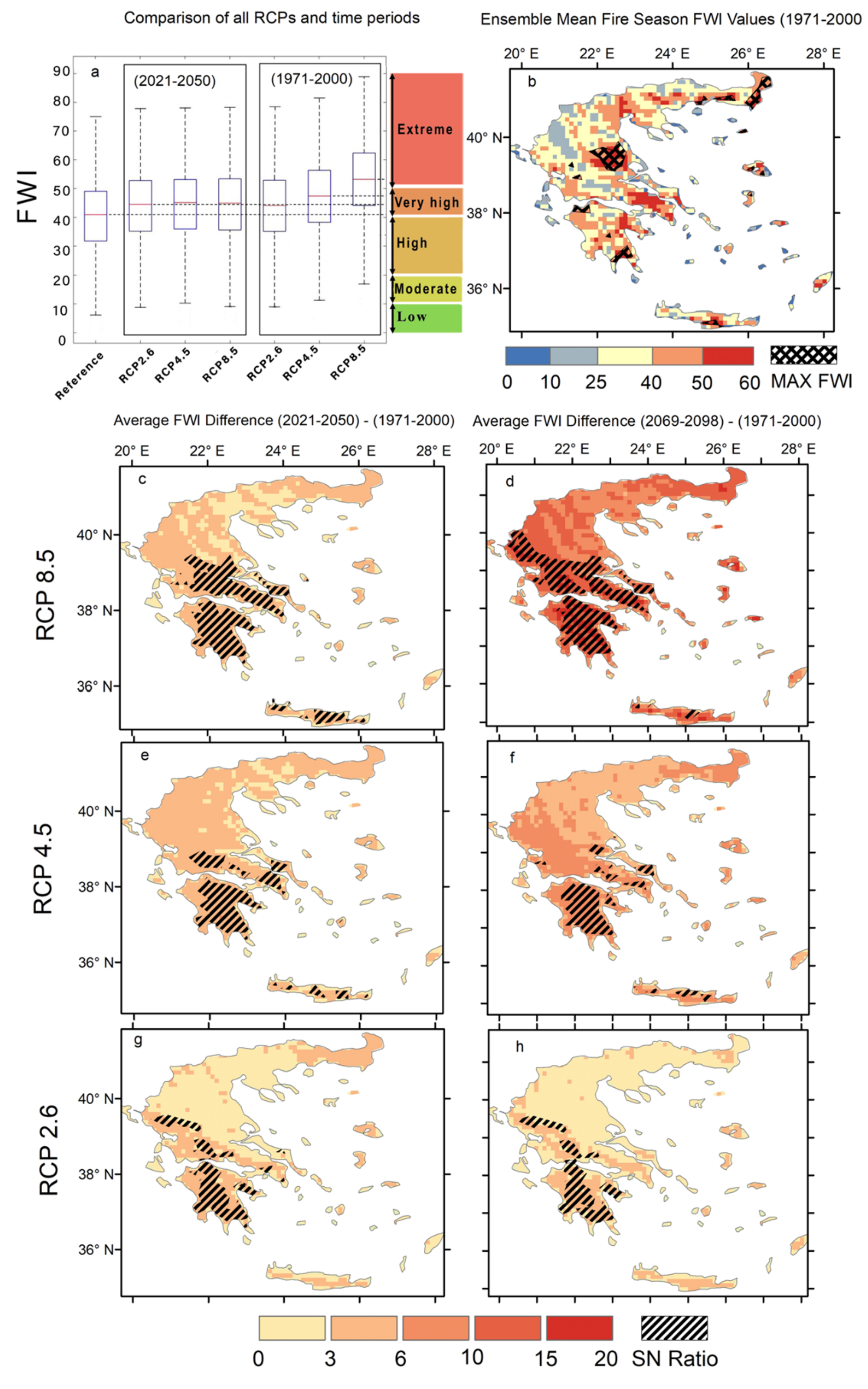

Figure 2. Panel (a) is a comparison of spatially averaged yearly FWI fire season values of all RCP scenarios and time periods against the EFFIS fire danger classes shown on the right hand side of the *y* axis of panel (a). Panel (b) shows the average fire season FWI values from all models together with the extreme FWI > 150 as depicted by the cross hatched regions, whereas maps (c)–(h) representing the 30 year ensemble average FWI change based on the average of all three different GCM simulations during the fire season months (May–September) between the two future time periods from the reference period, for all RCP scenarios. Hatched regions depict the values that are higher than the 90th percentile of the SN ratio for the corresponding time period.

the Greek areas predicted to experience the greatest increases in fire danger in the future, based solely on climatic conditions are Crete, the Aegean Islands, the Attica region, parts of central Peloponnese and central Greece as well as parts of Thrace.

In addition to threshold exceedances, the multi-model mean FWI values were also calculated based on the fire season months (May–September) of the Reference time period from all individual RCMs based on daily FWI values. Overlaid on top of figure 2(b) shown by the hatched areas is the extreme FWI > 150 corresponding to the 90th percentile of the maximum FWI values from the reference period. Moreover, the changes in average FWI during the fire season

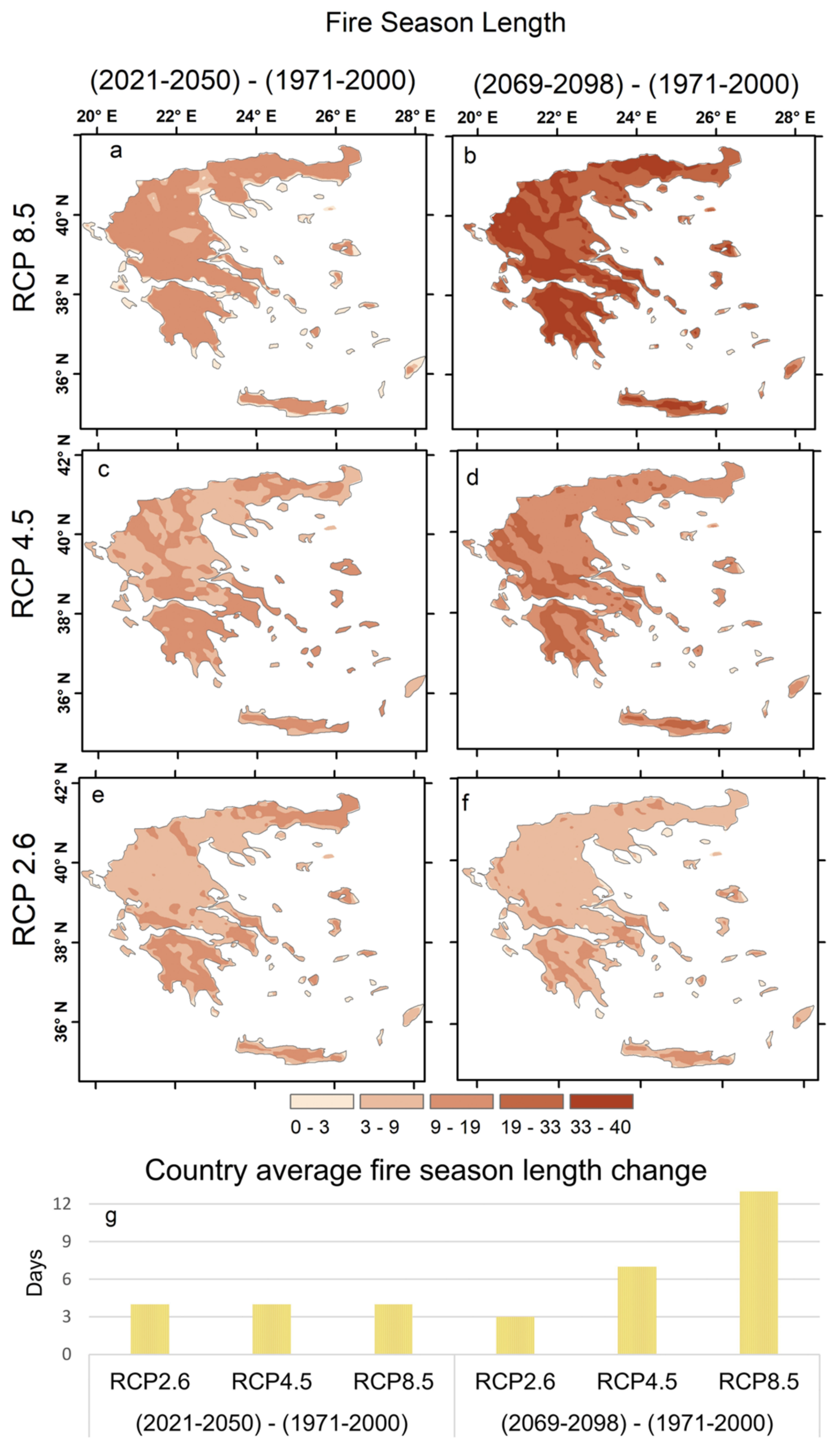

Figure 3. All model average fire season length change between the future periods (for all future scenarios) and the reference. Subplots (a)–(f) represent the 30 year average difference whereas subplot (g) represent the entire Greek domain averaged fire season length change for every RCP scenario and time period.

months figures 2(c)–(h) and the corresponding SN of their changes were also calculated. The values that are higher than the 90th percentile of the SN ratio for the corresponding time period are shown as hatched areas on the figures 2(c)–(h) with black lines. Using this definition, changes in the parts of Thrace and northern Greece are subject to more noise despite showing strong future changes. Based on all RCP scenarios the higher SN is occurring mainly in Central and Southern parts of Greece and so these areas are

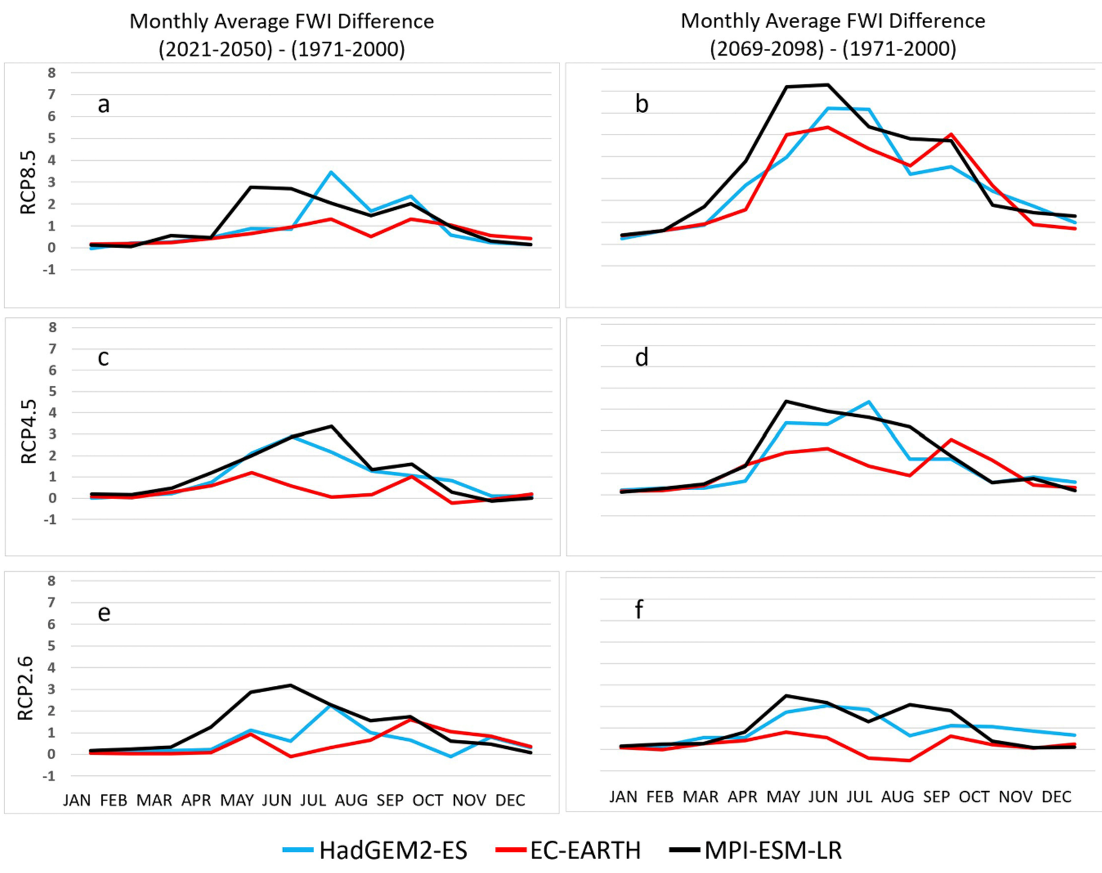

Figure 4. Seasonal variability change between near future and reference period in sub-figure (a) and distant future and reference period in sub-figure (b) for each of the three climate models for the entire Greek domain, under all the tested RCP scenarios.

considered to have less noise than Northern Greece since the signal between these three main regions is very comparable.

Figure 2(a) was made by calculating the spatial average yearly FWI values from all models for the fire season and that was done for each of the three 30 year time periods and for every RCP scenario separately. Since these are country wide averages an increase of one EFFIS fire danger class is a drastic change. That way the potential severity in fire danger is better understood. It can be seen that the three RCP scenarios in the near future have a slightly higher mean FWI compared to the reference period, whilst being in the same class nonetheless. RCP4.5 in the distant future is in the same fire danger class but has slightly higher FWI than the near future and reference period. RCP2.6 is almost identical in the distant future to what it is for the near future. Finally, RCP8.5 in the distant future showcase the greatest differences compared to the reference period as it is increasing by one class (from 'very high' to 'extreme').

3.2. Fire season length and seasonal variability change

So far for the creation of the previous figures the typical fire season (May–September) was used however to determine how the fire season has been affected during the three studied time periods the change in fire season length is calculated. Regarding the maps under the RCP8.5 scenario some areas in the distant future are exhibiting an increase in the fire season length of up to 40 d whereas the RCP4.5 scenario is predicting an increase of up to 33 d. The RCP2.6 is predicting an increase of up to 19 d. Considering the entire Greek domain by observing the bar graph of figure 3 panel (g) representing the country wide fire season length change, RCP8.5 is predicting an average increase of up to 13 d in the distant future compared to the reference, whereas the RCP4.5 an average increase of up to 7 d. The RCP2.6 however does not predict any increase in fire season as its emissions peak and decline beyond 2020 resulting in 3 d in the distant future, which is less than the near future estimate (4 d)

As a final step of the analysis, the change in seasonal variability between the two future periods and the reference was examined for all RCP scenarios for the entire domain of Greece. Figure 4 shows the multi-year monthly mean FWI. For the majority of the models the summer months are exhibiting the highest change however for many models there is a secondary spike for the month of September. That can be verified by another paper from (Dimitrakopoulos *et al* 2011) where they found the majority of fires to occur during the month of September for the Eastern Mediterranean environment as they explain that no rain has occurred since late spring, creating a prolonged drought period. The strongest increase for the distant future under the RCP8.5 scenario in figure 4(b) is found for the MPI-ESM-LR model during the month of June and estimated to be 7 units.

On the other hand for the near future figure 4(a) even though the HadGEM2-ES model shows the strongest increase in a single month (July), the MPI-ESM-LR model shows the overall strongest average FWI change and overall it is the model with the consistently strongest increase between all RCP scenarios and time periods.

4. Conclusions

The present study evaluated the FWI index as calculated from the output of three different RCM simulations. We analyze results for three time periods (1971–2000, 2021–2050, 2069–2098), and for three climate change scenarios, i.e. RCP2.6, RCP4.5 and RCP8.5. The following Greek areas are deemed to have the highest fire danger in the reference period (recent past): Crete, the Aegean Islands, the Attica region, and parts of Peloponnese. These fire prone areas seem to link closely with the areas in Greece with the highest burnt area as found by Papagiannaki *et al* (2020). Regarding the future, the results showcase a general trend of increasing FWI index, indicating increased wildfire danger for Greece in response to global warming.

The threshold FWI > 30 has been established for the Greek climate as it represents potential fire danger. Even though this threshold is found to be representable of the entire Greek domain other more precise thresholds have been found ranging from northwest to southeast Greece which might result in over or under estimates depending on the area (Karali *et al* 2014). On a broader sense, these FWI thresholds are custom for every country and largely dependent on the country's climatological conditions. For example in Canada where this index was created an FWI value above 30 is considered extreme (Kirchmeier-Young *et al* 2017) while for a Mediterranean type climate extreme FWI values start above 150 as seen in figure 2. That is why the country specific calibration of the index is very important. Based on the threshold of FWI > 30, it was calculated that in the distant future, there is the possibility of 40–50 additional fire danger days when compared to the reference period under the RCP8.5 scenario. This number is also in line with the fire danger days found in (Karali *et al* 2014).

In the distant future it is also predicted for the Greek domain to experience an increase of one fire danger class under the RCP8.5 scenario. The length of the fire season for some areas under the RCP8.5 scenario is predicted to increase in the distant future up to 40 d and up to 13 d when taking into account the entire Greek domain. Looking at the fire season length in a global context, most of the Northern hemisphere is predicted to experience an increase in the future of up to 20 additional days with some Mediterranean (e.g. Greece) and central European Countries as well as eastern and southern US states experiencing an increase of more than 20 d (Wotton and Flannigan 1993, Flannigan *et al* 2013). Increase in the fire season length leads to potentially higher number of fires and thus increase in human respiratory symptoms due to hazardous fire emitted particles (Lazaridis *et al* 2008). Finally, after calculating the seasonal variability for all available climate models a trend toward increasing FWI average monthly values was found for the month of September.

This study is subject to certain limitations. First, the results are estimated under the assumption of a stationary land cover which makes the threshold employed (FWI = 30) valid for the present, but potentially not valid in the distant future under a changed climate. Furthermore, it has to be noted here that the FWI estimation provided by Copernicus is based on climate model output that is uncorrected for biases, which may influence our results as well. Nevertheless, our results show clear indications of increased fire danger over Greece in the future due to the ongoing climate change that takes place and is expected to further unfold.

Data availability statement

The data that support the findings of this study are openly available at the following URL/DOI: https://doi.org/10.24381/cds.ca755de7.

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Conflict of interest

The authors declare no competing financial interests.

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