SOUTHERN Fire Exchange
Uniting Fire Science and Natural Resource Management

SFE Fact Sheet 2021-1

Wildland Fire and Climate Change Impacts in the Southern United States

Laurel Kays, NC State University
Rebecca Ward, NC State Climate Office, NC State University

Introduction

Climate change caused primarily by greenhouse gas emissions resulting from human actions is already impacting wildland fire occurrence and management across the South. These impacts will likely continue to escalate in the future. However, the degree will depend on what actions are taken to reduce emissions and how effectively human and natural communities can adapt. This fact sheet provides an overview of expected climatic changes that are most relevant to wildland fire management in the South and resulting projected changes to fire regimes. While uncertainty is always present in all forms of science, the conclusions presented here are based on findings for which there is substantial and compelling evidence.

Rising Temperatures

Surface temperature globally has increased by approximately 1.8°F/1°C since the start of the 20th century. While average temperature varies year-to-year, global surface temperatures are projected to continue to increase. At the regional level, temperature variation may also be influenced by other climatological factors. Across the Southern US, the El Niño Southern Oscillation is a large driver of year-to-year climate variation and correlates with temperature variations across the broader Southeast (National Oceanic and Atmospheric Administration [NOAA], n.d.; Ropelewski & Halpert 1986). The Southeast is one of the few regions that have not experienced a significant increase in daily maximum temperatures since 1900. However, the Southeast has warmed at a similar rate to the rest of the United States since the 1960s (USGCRP 2018, see Figure 1).

Other changes in temperature accompany this rise in overall surface temperatures. Days with minimum nighttime temperatures 75°F or warmer have increased across the Southeast (USGCRP 2018, see Figure 2).

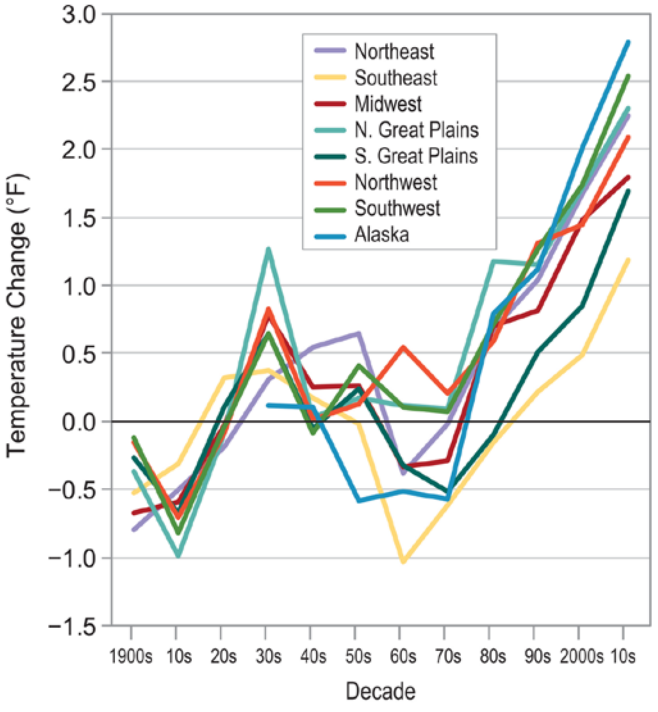

Figure 1: Temperature Change by Region (USGCRP, 2018)

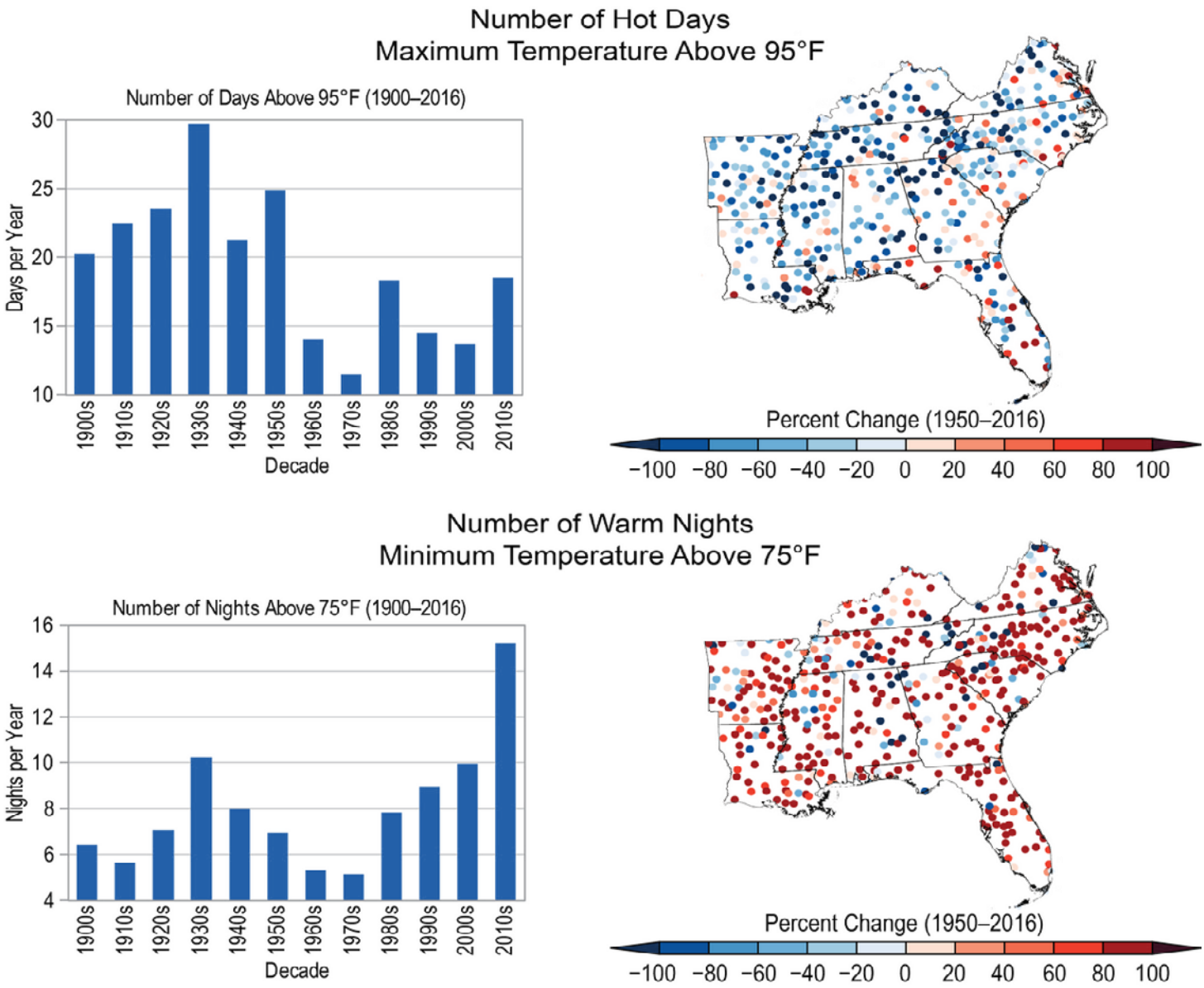

Figure 2: Changes in Hot Days and Warm Nights Across the Southern US. (USGCRP, 2018)

In contrast, there is not a trend from 1950 to the present in the number of days with maximum temperatures 95°F or higher. Future projections are for the Southeast to see increases in both of these (USGCRP 2018). In addition, the length of freeze-free seasons has increased across most of the region, particularly since the 1980s (USGCRP 2018).

Drought and Rainfall Events

While it is difficult to forecast changes in annual precipitation, there is high and growing confidence that there will be changing patterns of intense precipitation. A warmer atmosphere caused by rising temperatures is capable of holding more water vapor, which can increase the intensity of rain events (Kunkel et al. 2020). Air temperatures will continue to warm. Therefore, it is virtually certain that water vapor in the atmosphere will also increase. The annual number of days with more than three inches of precipitation has been increasing since the early 1900s (USGCRP 2018, see Figure 3). More than 70% of long-term weather stations in the region have shown upward trends since 1950. The minority of stations that are trending downward are mostly located in the Appalachian Mountains and the Florida peninsula (USGCRP 2018).

The human impact on drought occurrence is complicated, involving both climatic changes and land management practices. Seasonal precipitation deficits are not confidently projected in the Southeast. However, even if precipitation remains at historic levels, increasing temperatures will lead to higher evaporation rates and corresponding reductions in soil moisture. Therefore, the south will experience drier soils and less runoff. (USGCRP 2018). All else being equal, future

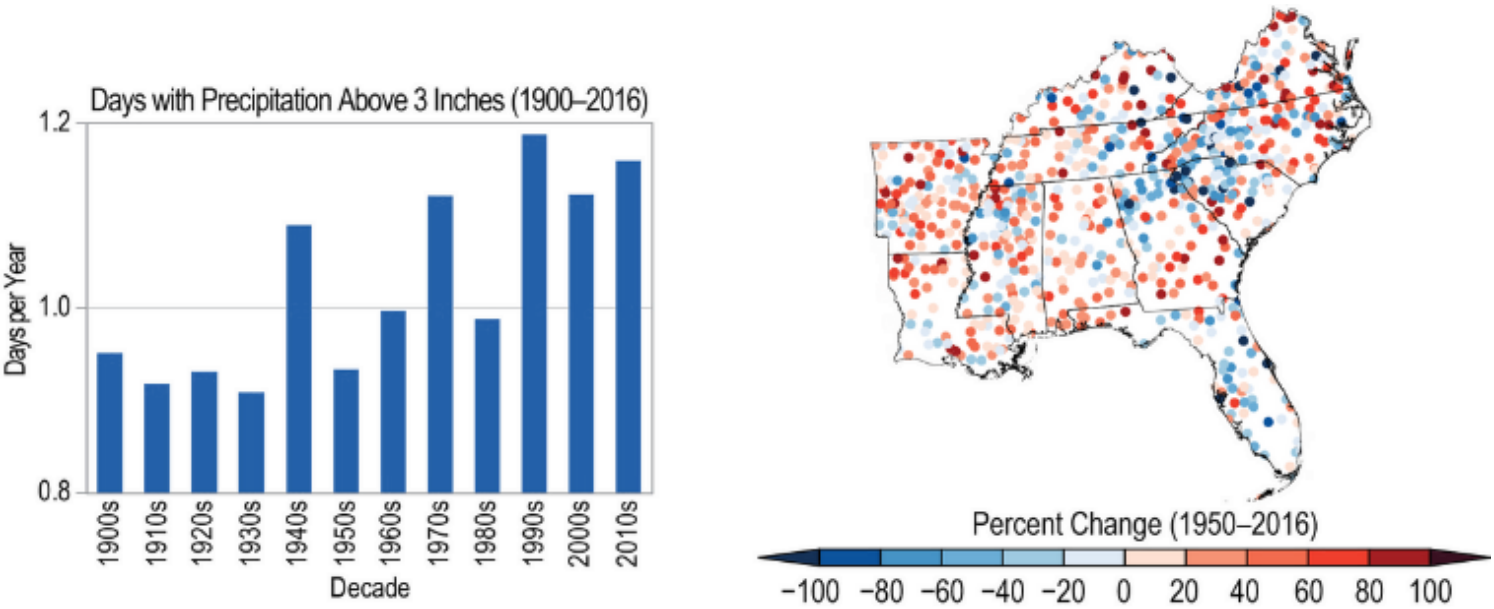

Figure 3: Historical Change in Heavy Precipitation in the Southeast (USGCRP, 2018)

drought impacts will likely be more severe because of this increased soil drying. Additionally, the future likelihood of flash droughts - drought events characterized by quick onset associated with low or rapidly declining soil moisture and often accompanied by heatwaves - are likely to increase (Mo & Lettenmaier 2016).

Overall, while it is unclear if annual precipitation amounts will shift, there will be shifts in the intensity and frequency of individual precipitation events. Precipitation patterns will increasingly be punctuated by boom and bust cycles of intense precipitation and periods of drought.

Hurricanes

Recent research indicates that hurricanes are becoming more intense, with higher sustained wind speeds in water bodies that border the Southern United States (Emannuel 2020; Kossin et al. 2020). While climate change contributes to heavier rainfall rates within hurricanes, there is limited understanding of how future storm tracks will alter and little evidence for any changes to the likelihood of hurricanes stalling near land (USGCRP 2018; Kunkel et al. 2020).

Hurricanes are important factors in flooding events. As sea levels rise and saltwater intrudes into previously freshwater ecosystems, hurricane-caused storm surges and flooding will likely have substantial impacts (USGCRP 2018). Streamflow and flooding events are also impacted by many other factors, including deforestation, urbanization, and agricultural practices (USGCRP 2018).

Forest Pests

The response of forest pests to climate change is complex and will depend on a variety of factors including host trees and the impacts of heat waves on tree health and mortality (Jactel et al. 2019). However, some species, most notably the southern pine beetle (*Dendroctonus frontalis*) are projected to expand northward due to warming low temperatures that currently constrain their range (Zimmerman 1999; USGCRP 2018; Ungerer et al. 1999). Within the current extent of the southern pine beetle, temperature has been found to be second only to local outbreak history in predicting southern pine beetle infestations. (Duehl et al. 2011). Accordingly, climate change impacts are likely to increase the area of southern pine beetle infestations.

Projected Wildland Fire Impacts

Globally and nationally, the frequency and severity of wildfires have already increased due to climate change (Kunkel et al. 2020; USGCRP 2018). In the Southeastern US, climate change is expected to increase fire seasons' length and average land area burned by individual wildfires (Kunkel et al. 2020). In addition, the percentage of days generally suitable for prescribed fire is expected to decrease, particularly in the summer and fall months, with spring and early fall burn windows also likely to diminish (Kupfer et al. 2020, see Figure 4). Texas and Louisiana are projected to experience the most severe declines in days with weather parameters conducive to prescribed fire (Kupfer et al. 2020). Across the Coastal Plain, the dry season has already lengthened by as much as 130% over the past 120 years. This extension of the dry season with

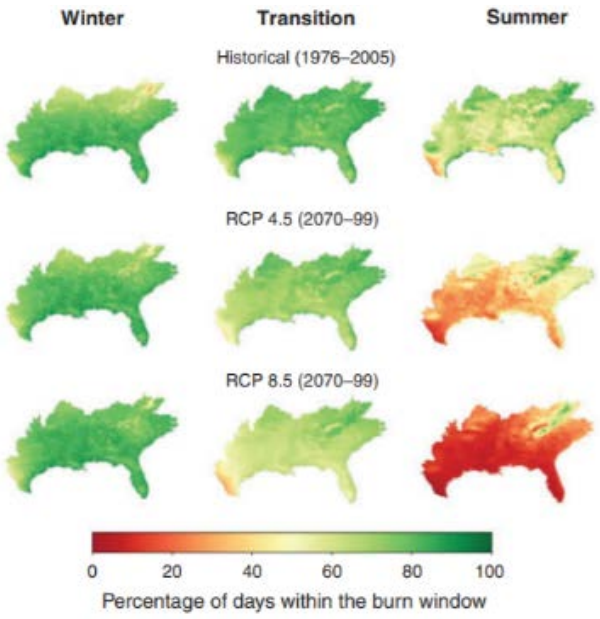

Figure 4: Change in Percentage of Days within Commonly Used Burn Window Parameters Under Different Climate Change Scenarios (Kupfer et al., 2020)

no change in seasonal thunderstorm patterns increases the potential for lightning-ignited wildfires and fire severity (Fill et al. 2019). Because most wildfires in the Southeast are human-caused, a longer dry season is also likely to lead to more human-ignited wildfires, in the absence of human behavior changes, as conditions suitable for wildfires become more common (Fill et al. 2019; Nagy et al. 2018).

Locally, many factors complicate how climate change impacts wildfire. In coastal areas affected by sea-level rise, sufficient levels of salinization prevent the post-fire regeneration of tree species such as pond pine (*Pinus serotina*), leading to the conversion of previously forested areas to marshes (Tallie et al. 2019). The frequent use of prescribed fire in the Southeast is a significant reason the region is less at risk for catastrophic wildfires (Hunter & Robles 2020; Long & Oxarart 2017). Climate change is projected to reduce the days that meet commonly used basic burn criteria, including parameters of relative humidity, wind speed, and temperature (Kupfer et al. 2020). Additionally, an increase in wildfire incidence and size is more likely during drought (Addington et al. 2015).

Climate change impacts in other regions may also impact the future of wildland fire in the Southeast. Climate-induced changes in the length and severity of Western wildfire seasons, for example, could have an impact on the fire management resources available for conducting prescribed fires and suppressing wildfires in the South (Kupfer et al. 2020).

Adapting to climate-induced changes presents a substantial challenge to fire managers, many of whom are already dealing with other issues such as limited resources, suburban encroachment, and smoke management. For some managers, it may be necessary to consider measures such as burning earlier in the morning, burning on weekends and holidays, and making use of technology such as drones to continue meeting objectives while staying within appropriate weather parameters (Kupfer et al. 2020).

Climate change impacts are also expected to continue to disproportionately impact vulnerable communities, including people of color and those living in poverty (USGCRP 2018). The South stands out as an area with exceptionally high socio-economic vulnerability to wildfire impacts (Davies et al. 2018). Relatedly, wildfires have been shown to spread faster on heirs' properties, a type of property ownership, especially prevalent among African Americans in the South (Aragon et al. 2019). Hurricanes already impact low-income and minority households to a greater extent than high-income households (Krause & Reeves 2017). These discrepancies may be of particular importance to fire professionals responding to future wildfire events or managing smoke from prescribed fires.

Summary

The Southeast's climate is changing and will continue to change. This is due to greenhouse gas concentrations in the atmosphere from both ongoing and previous human-caused emissions. Temperatures are projected to continue to rise, and heavy precipitation events are expected to increase across the Southeast. These trends will result in increased evaporation and surface drying that will likely increase future drought severity. Hurricanes are projected to become stronger, with heavier rainfall rates and higher wind speeds.

The effects of climate change, which are already being felt across the region, are not uniformly distributed across all regions and populations, and are projected to continue to disproportionately impact already vulnerable human populations. Planning for these changes and their impacts are essential in developing regional resilience. Unfortunately, translating these regional climatic changes into wildland fire impacts at the local level where fire managers operate is challenging. However, prescribed fire is likely to become more difficult due to the increasing frequency of unfavorable conditions for burning. This greater difficulty in applying prescribed fire, accompanied by increasing droughts, will likely lead to a rise in regional wildfire activity.

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Authors: Laurel Kays and Rebecca Ward, North Carolina State University.
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