Munich RE

Eberhard Faust, Markus Steuer

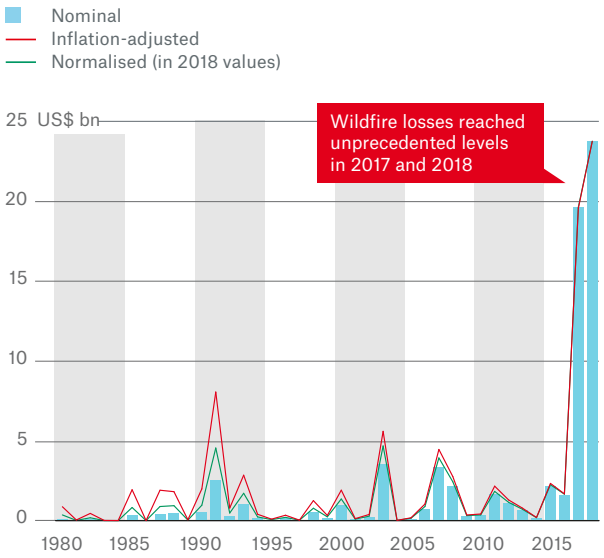
New hazard and risk level for wildfires in California and worldwide

The number of wildfires in California causing billions of dollars in damage has spiked over the last few years. While Southern California has seen an accumulation of such events since the early 2000s, the northern half of the state has only experienced a sharp rise in major loss events since 2015. Climate trends also show an increase in wildfire hazard, which is arguably higher now than it ever was in the 20th century. This illustrates that the overall risk and loss levels are significantly different than in the past. And as the state's climate continues to change, California will experience a further worsening of these conditions in the medium term.

The 2018 wildfire season in California – Records tumble yet again

Recent years have shown that wildfires in California can cause losses on a similar scale to hurricanes. Wildfire-related insured losses came to US$ 15bn in 2017 – a figure that was surpassed the following year (US$ 18bn).

California events fuel U.S. wildfire losses
Overall losses 1980–2018



Source: Munich Re NatCatSERVICE

Two fires struck Northern California during the summer of 2018. These were the Carr Fire and the Mendocino Complex Fire, the latter becoming the largest fire in terms of "acreage burned" in the history of California. But major loss events were still to come from the Camp Fire and the Woolsey Fire in November.

The Camp Fire has become the costliest wildfire on record worldwide. Just a few hours after it started, the flames, fanned by strong winds, had destroyed virtually the entire town of Paradise in the foothills of the Sierra Nevada mountain range. Around 14,000 homes and 500 businesses were gutted by the fire. Many of these buildings were situated in high-risk areas surrounded by vegetation or adjacent to canyons and forests. Overall losses were US$ 16.5bn, with about US$ 12.5bn of this insured. Unfortunately, the human toll was high as well, with eighty-five people lost in the fire.

Occurring at the same time as the Camp Fire, the Woolsey Fire, located just to the west of Los Angeles in the south of California, experienced similar fire conditions – very dry conditions with readily combustible vegetation in combination with strong winds. However, the damage profile and scale of destruction was different in the south. In contrast to the Camp Fire, far fewer buildings fell victim to the flames – only a total of 1,500 were destroyed. Even given the substantially lower number of homes destroyed, overall losses from the Woolsey Fire still came to over US$ 5bn and insured losses to US$ 4bn.

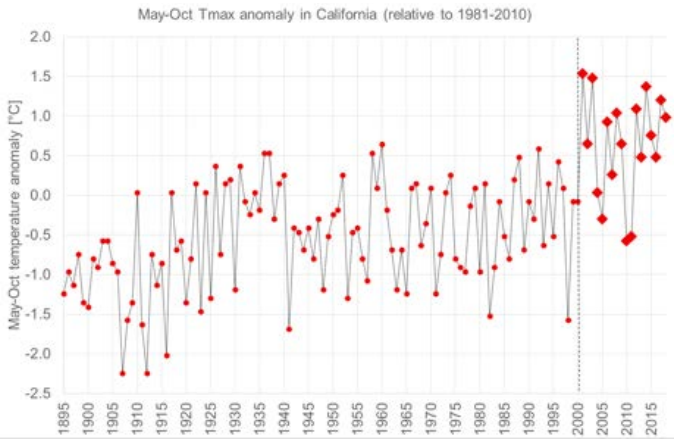
The reason for this was that it struck numerous high-value mansions in the exclusive enclave of Malibu, where the average house price is around US$ 3m. Substantial losses were caused by smoke damage as well as the flames.

Wildfires, climate change and drought: Exposure and losses from fire are on the up

Wildfires in California are influenced by a number of factors, including ignition sources, wind and the amount of combustible brush. Environmental factors during the fire season play an especially crucial role. These include the drying of forest vegetation in the summer as the winter rains and spring snowmelt occur earlier each year as a result of climate change. Milder winters foster increasing bark beetle populations which result in flammable dead wood, and trees under water stress are particularly attractive to these insects.

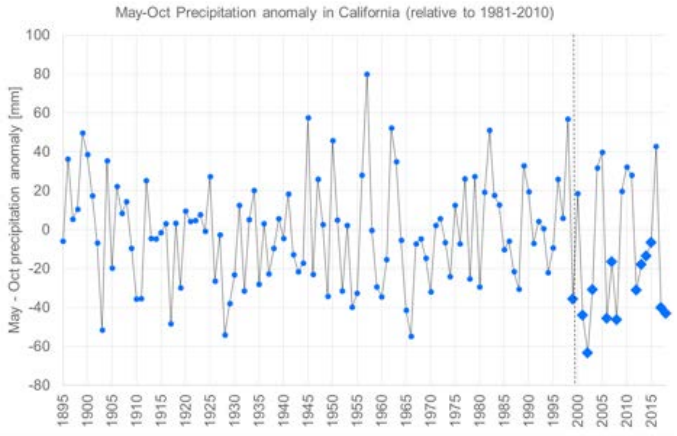
High temperatures in spring and summer create a high soil evaporation rate and increased plant transpiration that dry out the soil and vegetation much more quickly today than in the past. Since the early 2000s, the mean May to October maximum daily temperatures have been higher than ever before. At the same time, there has been a high number of years with unusually low precipitation. One result of this combination of low rainfall, higher temperatures and drier soil conditions is that forest areas are becoming increasingly flammable.

Mean daily maximum temperature from May to October for California over the period 1895–2018
Deviations relative to 1981–2010 are shown



Source: Munich Re, based on data from NOAA/National Centers for Environmental Information

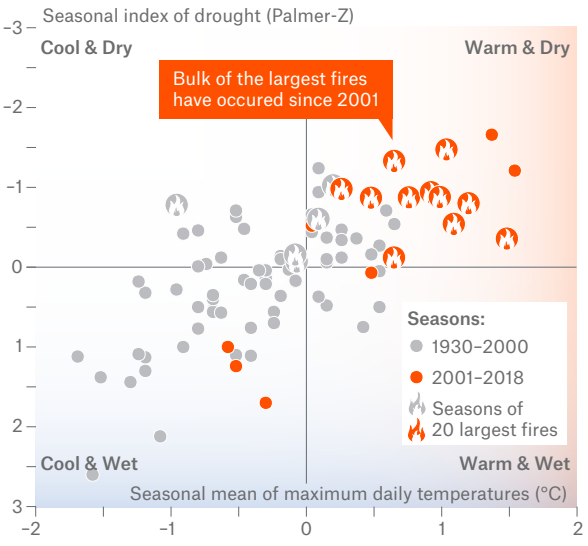
Distribution of rainfall from May to October for California over the period 1895–2010
Deviations relative to 1981–2010 are shown



Source: Munich Re, based on data from NOAA/National Centers for Environmental Information

Climate research has shown that the observed increase in temperature for California is broadly consistent with the signal of anthropogenic climate change. However, natural climate variability likely also has played a part on the precipitation side. The following picture emerges if we draw a scatter plot for the May to October season since 1930, showing the relationship between anomalies in the average daily maximum temperature and dryness (using the Palmer Z drought index), and then mark the seasons with the 20 biggest wildfires: the bulk of the 20 largest individual fires, i.e. 15 out of 20 (for which there have only been reliable records since 1930), have occurred in the years since 2001 – years which have been characterized by abnormally high maximum temperatures and exceptionally dry conditions.

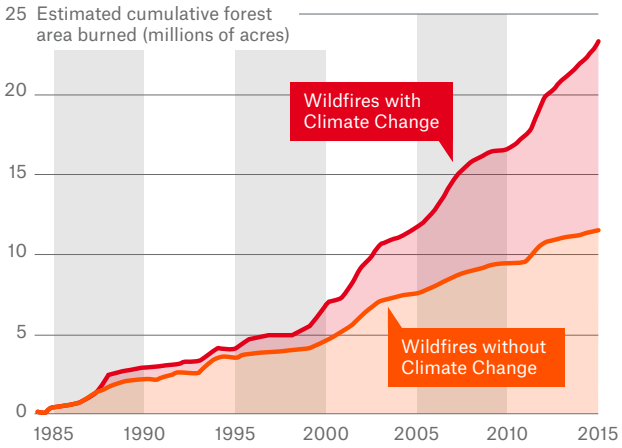
Weather and wildfires in California
May–Oct. anomalies relative to 1981–2010



Data source: NCEI/NOAA, California Department of Forestry and Fire Protection

However, it is not just climate change alone that has exacerbated the wildfire risk in California over recent decades. The accumulation of combustible brush as a result of changing forest management practices (mostly due to resident concern about controlled burns) has also been a contributory factor. A current modelling study comes to the general conclusion that the area burned in the western US since 1984 due to climate change is roughly twice as large as it would have been without this influence.

Climate Change has increased wildfire risk
Area burned in the western U.S. since 1984



Source: Abatzoglou/Williams 2016, PNAS 113

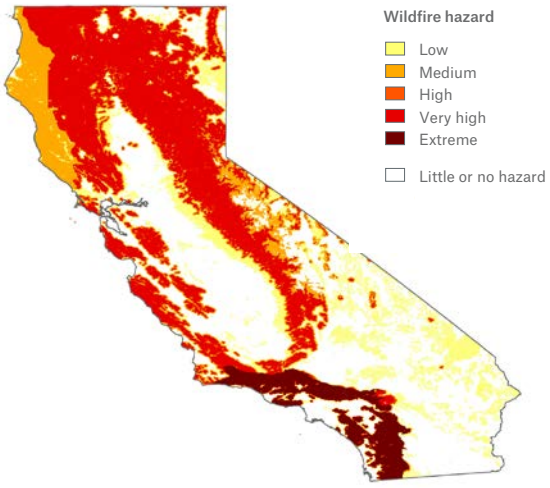
Overall, this means that, as climate change progresses, it is likely that severe fire years will no longer be the exception. Instead, the environmental conditions that foster large wildfires in California and the western US will continue and may even intensify.

Increasing losses

Statistics also show that it is not only the natural wildfire hazard in itself that has been at a higher level since the 2000s. Over the same period, the frequency of severe loss events has also increased.

Especially severe fires caused billions of dollars in insured losses in Southern California in the years 2003, 2007, 2017 and 2018, while record losses in excess of US$ 10bn in 2017 and 2018 in Northern California are a strong indication that we have reached a new hazard level there as well. Previously, the only event in Northern California to exceed the billion dollar threshold was the Tunnel Fire of 1991 with insured losses of US$ 1.7bn (original values). But given that the size of the losses in 2017 and 2018 were unprecedented in scope and that the fire hazard in the north of the state is less than in the south, disasters like this in the north may be expected to be low-frequency events, even if they did occur two years in a row.

Wildfire hazard in California



Source: Munich Re

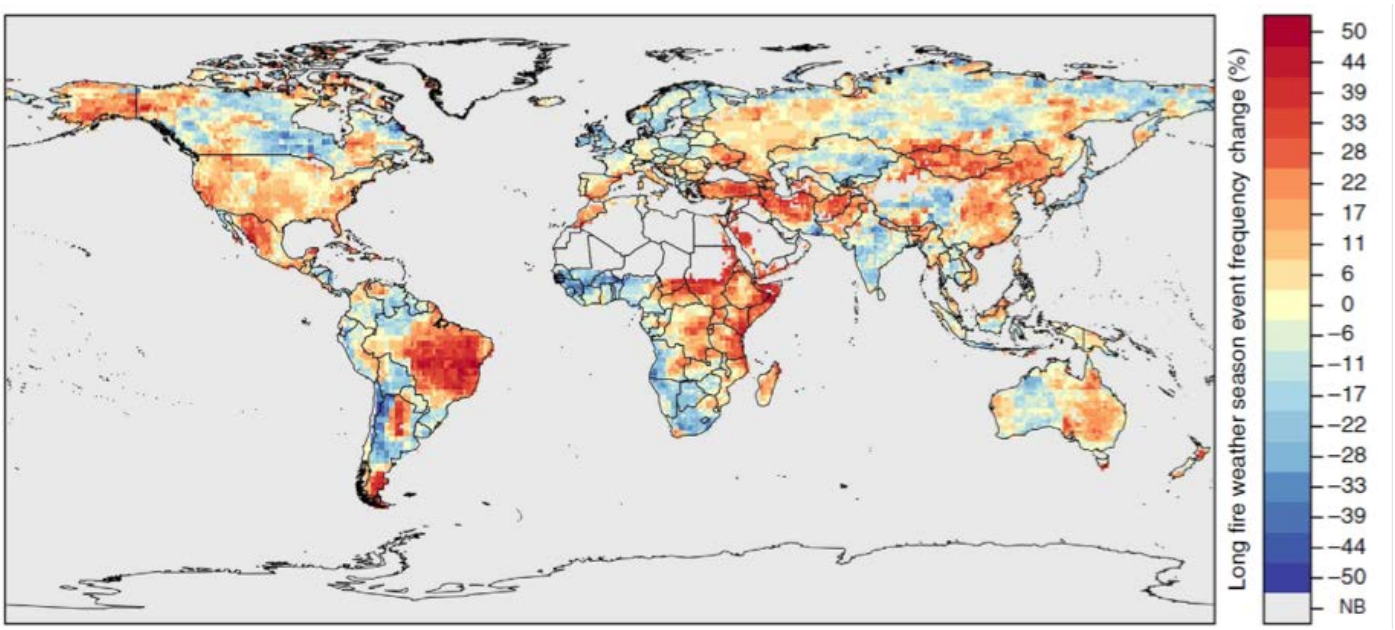
Because of the higher wildfire hazard and the increased frequency of large losses over the last two decades, the occurrence probability of severe loss events is likely to have increased as well. But since additional wildfire risk factors, such as the accidental or deliberate ignition of fires, the volume of easily combustible brush and high wind speeds, are all decisive factors for severe loss events, it is not possible to precisely quantify the singular influence of climate change on losses. The growth of values in exposed regions also plays a key role in the increased losses in California. For example, the number of homes in what is termed the wildland-urban interface – areas with buildings close to or in natural vegetation – has surged over the past few decades.

In one modelling study, future wildfires under different climate change scenarios anticipate a further increase in the number of large wildfires in Northern California (Westerling A. L. and Bryant B. P. 2008: Climate change and wildfire in California. Climatic Change, 87 (Suppl 1), pp 231–249). This finding ties in with the surge in losses in this region since 2015. Because of the further population growth in California in the coming years – the California Department of Finance expects the population to expand by 6.5m people over the next 20 years – the number of homes surrounded by or close to forest will also potentially increase. The raised hazard and the higher values in exposed regions are factors that are expected to make severe loss events even more frequent in the future.

Wildfires worldwide

On a global level, there are many regions where the environmental conditions favoring a severe local fire season have intensified significantly over the last few decades as well. One study investigated this by comparing the two periods, 1979–1996 and 1996–2013. It used a combination of various meteorological conditions that can lead to severe wildfires as a measure to determine the change in frequency of such conditions. This produced the following map of the local changes.

Change in the frequency of meteorological-environmental conditions required for a severe fire season (a severe fire season is defined as a deviation from the long-term mean of the meteorological measure of at least one standard deviation)
The map shows a comparison of the periods 1996–2013 minus 1979–1996



Source: Jolly, W.M., et al., 2015: Climate-induced variations in global wildfire danger from 1979 to 2013. Nature communications, DOI:10.1038/ncomms8537.

According to this, the frequency of meteorological drivers for severe fire seasons has increased not just in the west of the US, but also in many other parts of the world, including Mexico, Brazil, the Mediterranean region of southern Europe, large parts of sub-Saharan Africa, the east of Australia, eastern China and Korea, and in a number of other regions as well. Regions like the Mediterranean in Europe merit particular attention to wildfire risk because of the exposed values there.

Conclusion

The Governor of California aptly described the severe wildfires of 2017 and 2018 as “the new abnormal”. Climate data and claims records indicate a significant rise in hazard and loss levels in California. The size of the losses highlights the large accumulation potential, something that was often underestimated for Northern California before 2017. In the medium term, the wildfire risk in California can be expected to heighten further.

Any estimate of loss return periods in California that uses a longer claims history as a calculation basis will seriously underestimate the risk. Risk models should therefore be modified to take account of the change in loss levels. Insurers should only use the recent past as the basis for pricing, incorporating the new loss experience into their accumulation control considerations.

The frequency of meteorological conditions that favor severe fire seasons has also increased in many regions around the world. Of major importance for the insurance industry in this context are regions with highly exposed values, such as the Mediterranean in Europe and regions in Australia.

Contact

Eberhard Faust
Head of Research:
Climate Risks and Natural Hazards
Tel.: +49 89 3891-4939
efaust@munichre.com

Markus Steuer
Consultant and wildfire expert,
Corporate Underwriting
Tel.: +49 89 3891-5290
msteuer@munichre.com