European Commission

JRC PESETA III Science for Policy Summary Series

CLIMATE CHANGE AND FOREST FIRES

Forests cover around 215 million hectares across Europe, which is around 33% of the total land area. In recent years, large forest fires have repeatedly affected Europe, in particular Mediterranean countries. The danger of forest fires will increase with unmitigated climate change. Even with mitigation efforts, adaptation strategies are needed to tackle the devastating effects of forest fires on human settlements, ecosystem functioning and biodiversity. The three countries with the highest danger are Spain, Portugal and Turkey.

RISKS

Several factors contribute to forest fire occurrence, such as the moisture content of leaves on the ground's surface, as well as of larger materials on the ground such as pieces of wood. A wetter surface can lower the potential spreading of a fire, and also the ease of ignition. Climate variables like wind speed are also important because they can affect the rate at which a fire might spread following ignition.

A factor particularly linked with extreme weather (prolonged droughts and dry spells) is the amount of moisture in deep layers of wood, leaves, soil and other organic matter on the ground. The present pattern of moisture for this layer of ground across all of Europe is displayed in Figure 1.

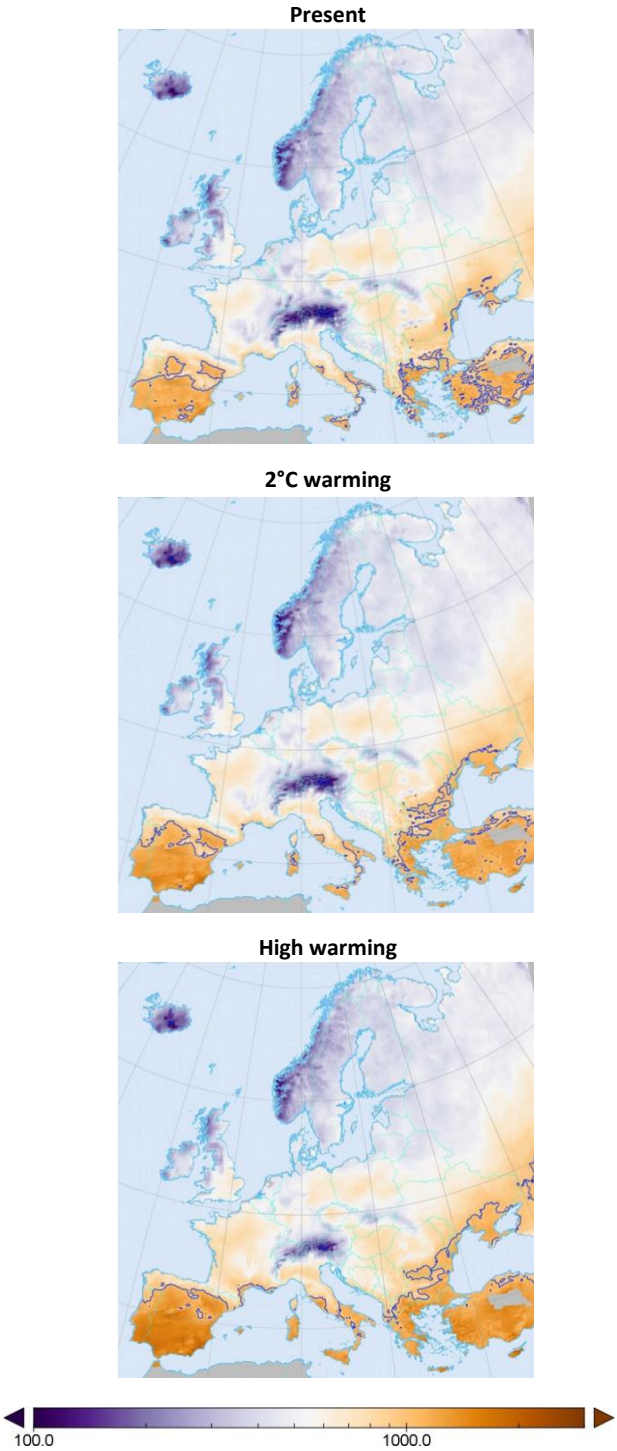
The lowest moisture levels are estimated around the Mediterranean, in southern Spain, southern Portugal, southern Italy, Greece and Turkey. Moisture levels generally increase moving northwards from this region.

IMPACTS

Climate change strengthens the current north-south pattern in the moisture levels of deep layers of wood, leaves, soil and other organic matter on the ground (Figure 1). The ground becomes drier from present around the Mediterranean region, under both a high warming scenario and a 2°C warming scenario – this raises the danger of forest fires. Furthermore, areas exhibiting low moisture extend further northwards from the Mediterranean than nowadays. The present area of high moisture surrounding the Alps decreases in size with climate change.

The declines in moisture for Mediterranean countries are smaller with mitigation that limits global warming to 2°C, relative to the high warming scenario, but the moisture levels are still lower than in present.

Figure 1. Moisture levels of deep layers of wood, leaves, soil and other organic matter on the ground, in present, and under two climate change scenarios.



Note: The dark blue lines denote corresponding orders of magnitude in scale of 10, 100 and 1000.

By combining moisture levels with the other factors that contribute to the danger of forest fires, it is possible to estimate the magnitude and spatial pattern of forest fire danger across all of Europe (Figure 2).

Whilst there is some uncertainty in the magnitude of the effect of climate change, it is clear that the danger of forest fires increases with climate change around the Mediterranean. The three countries with the highest danger are Spain, Portugal and Turkey.

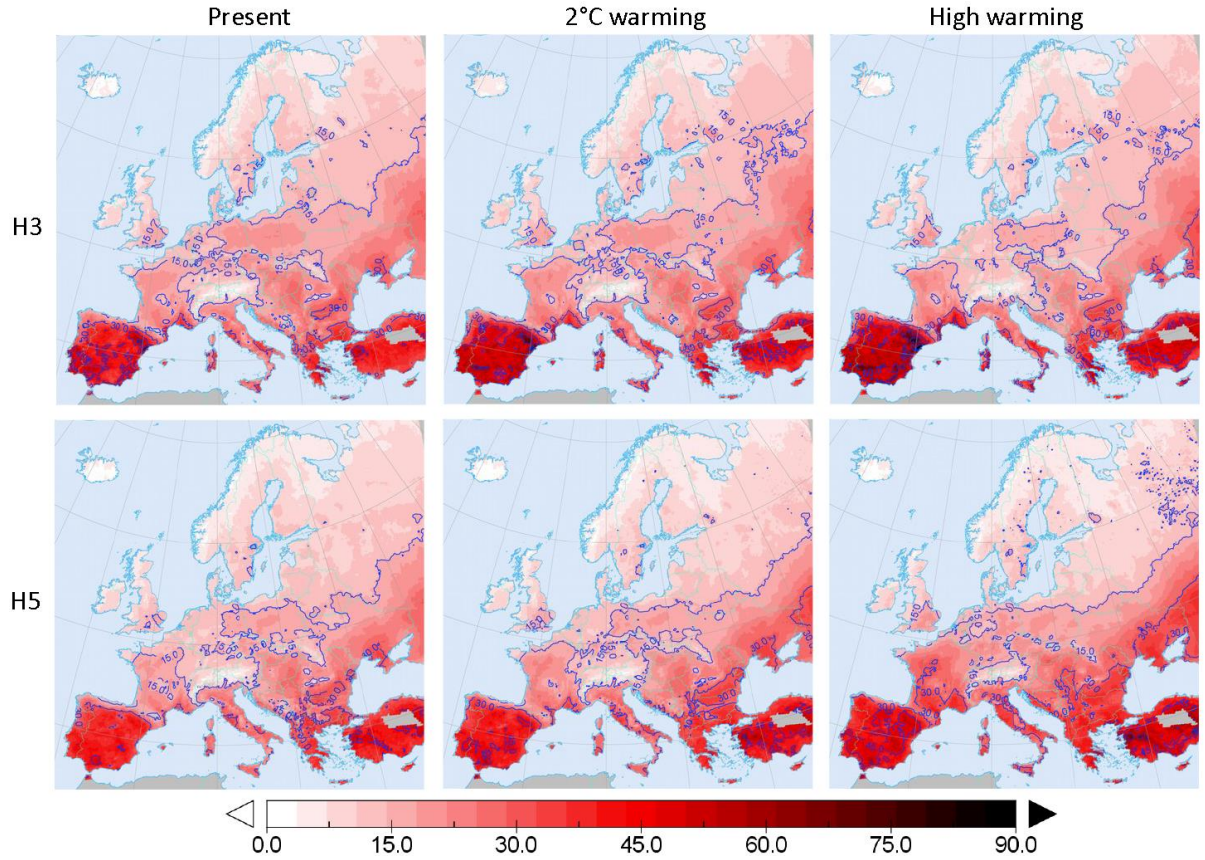
Areas at moderate danger from forest fires are pushed north by climate change, up to central Europe. There is relatively little change in fire danger due to climate change across northern Europe.

ADAPTATION

Even with mitigation, in the Mediterranean region the danger of forest fires increases relative to present due to climate change. This suggests that effective adaptation strategies will be crucial to lessening the detrimental impacts of climate change on forest fires, and the reductions in biomass and biodiversity that they can cause.

PESETA III did not explicitly model adaptation scenarios for forest fire danger. However, evidence does suggest that areas protected for biodiversity conservation may be affected less by forest fires than unprotected areas, despite containing more combustible material. Increasing the area of protected areas, such as Natura 2000 sites, is one potential option for adaptation. Other strategies to reduce the likelihood of severe fires include thinning vegetation by cutting, planned burning, and the use of animal grazing.

Figure 2. Forest fire danger in present, and under two climate change scenarios, according to two different climate models (H3, H5), selected to demonstrate the effect of using different climate models.



Note: The dark blue lines mark the boundaries between areas with similar values in increments of 5 units.

APPROACH

This PESETA III study investigated how the danger of forest fires might be affected by climate change across Europe, under two scenarios: 1) a high warming scenario at the end of the century; and 2) a 2°C warming scenario. Overall forest fire danger was estimated by using the Canadian Forest Fire Weather Index (FWI) system. The FWI has been used in many studies to indicate how climate change may result in changes in fire severity and damage. Climate projections of rainfall, relative humidity, temperature and wind speed were obtained from five climate models and used as input to the FWI. The effects of future adaptation were not modelled. The geographical scope of the study was all of Europe.

Read more

PESETA III Task 11: Forest fire danger extremes in Europe under climate change: variability and uncertainty. Available on our website https://ec.europa.eu/jrc/en/peseta