



## Fire danger in Tasmania: the next 100 years

South-eastern Australia is one of the three most fire-prone areas in the world. Fire danger has increased in recent decades, and is projected to increase further with global warming.

We assessed the regional changes in fire danger that are projected to occur in Tasmania through to 2100 under a high emissions scenario.

In contrast with previous, continental-scale studies, which show little change in Tasmanian fire danger, our results indicate an overall increase in fire danger, especially in spring, with more days per year likely to require total fire bans. This increase in fire danger will have social and political implications.



## Research outcomes

- » We now have fine-scale fire danger projections for Tasmania to 2100 under a high emissions scenario.
- » The projections indicate a steady increase in fire danger, especially in spring; a lengthening of the fire season; and more days at the highest range of fire danger at some locations.

## Why did we do this study?

### Tasmania is located in one of the world's three most fire-prone areas

We did this research primarily for the Tasmania State Emergency Service which, through its Natural Disaster Resilience Program, is building the resilience of communities to respond to natural disasters.

South-eastern Australia is one of the three most fire-prone areas in the world. Fire danger has increased in recent decades, and is projected to increase further with global warming. Bushfires already cause extensive damage and concern, and any increase in fire danger, or shifts in the frequency, intensity or timing of fires, will have widespread consequences for people and for nature.

In Tasmania, bushfires are as much of a concern as they are on mainland Australia. In January 2013, 40 bushfires burned across the state, four of which burnt about 40,000 hectares, causing widespread destruction of infrastructure, farms and homes, including 203 dwellings. The area burnt each year averages about 29,000 hectares, but can exceed 100,000 hectares.

All of Tasmania's landscapes are fire-prone under suitable conditions — the dry eucalypt forest that dominates much of eastern Tasmania; the wet eucalypt forest common in parts of the west, north and far south; the agricultural grasslands in the inland east; and the moorlands, especially in the west.

### Weather conditions associated with high fire danger are projected to change

Both weather and climate influence fire danger. Average conditions of temperature, rainfall, evaporation and radiation affect the amount of fuel and the rate at which it dries, while extremes of temperature, wind and relative humidity drive fire weather and the potential for fire to ignite.

The weather conditions associated with high fire danger in Tasmania are all projected to change.

Under a high emissions scenario (the IPCC's 'A2' scenario), to which global emissions are tracking quite closely, average temperatures in Tasmania are projected to increase by 2.6 °C to 3.3 °C by the end of this century. Temperature change is expected to be fairly uniform across the state and across seasons. In contrast, total annual rainfall is not expected to change, but where and when it falls is expected to change significantly, with more rain falling over coastal regions, and less rain falling over central and parts of north-west Tasmania. After 2050, winter rainfall on the west coast is expected to increase significantly and summer rainfall to decrease. This change in rainfall seasonality may lead to a shift in the timing of the bushfire season (currently October to March) and a narrowing of the shoulder season in which prescribed burning can be done safely.

### Climate projections are now available at the regional scale

Global climate models are generally used to project fire danger at the regional scale. But the resolution of these models is not fine enough to resolve regional climate processes over Tasmania — an island with a strong maritime influence, complex topography and several climatic zones. Now, thanks to CSIRO's dynamically downscaled regional climate model (known as CCAM), climate projections for Tasmania are available at a resolution of about 10 kilometres.

### Changes in synoptic weather patterns that affect fire danger are not well understood

While the interaction between high fire danger and atmospheric conditions is relatively well studied, there is still a lot we do not know about how changes to synoptic weather patterns might affect the level of fire danger.



## What did we do?

Our objectives were to:

- determine if climate data downscaled from a global climate model to the regional scale can be used to project fire danger in Tasmania
- assess the projected changes in fire danger for Tasmania up to 2100 under a high emissions scenario.

We also investigated the synoptic weather patterns associated with fire weather in different regions of Tasmania under future climate conditions.

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South-eastern Australia is one of the three most fire-prone areas in the world.

## How did we do it?

### Measuring fire danger for 1961–2100

Using daily climate data (rainfall, temperature, humidity and wind speed) from the CSIRO's downscaled climate model, at a resolution of about 10 kilometres, we calculated daily values of fire danger for Tasmania for 1961–2100.

We validated the modelled fire danger against observations from the Bureau of Meteorology's automatic weather stations for the years 2002–2012. The values matched well, giving us confidence in the model.

### Analysing seasonal changes

We analysed changes in fire danger over time for the fire season (October–March), and for spring (September–November), summer (December–February) and autumn (March–May). Little fire activity occurs during the Tasmanian winter (June–August).

### Examining synoptic weather patterns

We also examined regional mean sea level and surface pressure patterns to see if they resembled the observed patterns often associated with days of dangerous fire weather. This allowed us to verify that the models were behaving consistently with observed synoptic patterns of elevated fire danger, and to identify any future changes in those patterns associated with dangerous fire weather.

## What did the results tell us?

### CSIRO model is useful for understanding fire danger and associated weather patterns

CSIRO's downscaled climate model proved to be a useful tool for characterising changes in fire danger in Tasmania, matching the observations from the Bureau of Meteorology's automatic weather stations. The model also allows us to see a pressure pattern associated with many of the highest fire danger days across south-east Tasmania — a lee low-pressure system ahead of a cool change — and other synoptic weather patterns associated with elevated fire danger in several other regions.

### We can expect an increase in fire danger, especially in spring

In Tasmania, under the high emissions scenario, up to 2100 we can expect to see:

- a steady increase in fire danger
- a continuation of the trend of increasing fire danger in spring, a gradual increase in summer, and little change in autumn
- an overall lengthening of the fire season
- an increase in the number of days at the highest range of fire danger at a number of locations, associated with synoptic patterns conducive to dangerous fire weather.

### There are social and political implications of increased fire danger

The overall increase in fire danger will have social and political implications, such as influencing the pace and direction of fire policy, logistics and funding; and alerting people to the need to build community resilience. People also need time to adapt to lost or changing ecosystems.

### Planning and management needs to be flexible

There will be more days a year on which a total fire ban is likely to be declared on the basis of fire weather, and in spring there are likely to be more high fire danger days. This has implications for the ability to suppress fires and for using prescribed burning to minimise the risk of fire.

The regional and seasonal changes in the occurrence of high fire danger over time will require flexible planning and management throughout Tasmania.

## Where to from here?

By indicating how critical fire danger thresholds may change over the next several decades, this work can inform public discussions in Australia about approaches to wildfire safety and management. We also hope that the work will be useful for managers of parks, reserves and forests, allowing them to assess likely changes in the timing and extent of opportunities for reducing fuel safely and effectively and for burning to trigger regeneration.

## Who are the researchers?

Paul Fox-Hughes



Paul is a senior severe-weather meteorologist with the Bureau of Meteorology. He has worked as a bushfire weather analyst on our Climate Futures Project which is generating fine-scale resolution climate projections for the Australian Alps. Paul researched likely changes to bushfire risk under a changing climate.

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Dr Rebecca ('Bec') Harris



Bec has an extensive background in field ecology. As part of the Climate Futures Project, she works closely with researchers across the Landscapes and Policy Hub to extract, analyse and interpret climate projections for species under threat from climate change.

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## Antarctic Climate & Ecosystems Cooperative Research Centre

Both Paul and Bec work for the Antarctic Climate & Ecosystems Cooperative Research Centre, where the fine-scale climate projections were generated by the Climate Futures for Tasmania project.

We did this research primarily for the Tasmania State Emergency Service which, through its Natural Disaster Resilience Program, is building the resilience of communities to respond to natural disasters.

## Further reading

Fox-Hughes P, Harris RMB, Lee G, Grose M & Bindoff N (2014) Future fire danger climatology for Tasmania, Australia, using a dynamically downscaled regional climate model, *International Journal of Wildland Fire*. Available online: <http://www.publish.csiro.au/?paper=WF13126>

Grose MR, Fox Hughes P, Harris RMB & Bindoff, NL (2014) Changes to the drivers of fire weather with a warming climate — a case study of southeast Tasmania. *Climatic Change*. 124, 255–269.

## About the NERP Landscapes and Policy Hub

The Landscapes and Policy Hub is one of five research hubs funded by the National Environmental Research Program (NERP) for four years (2011–2014) to study biodiversity conservation.

We integrate ecology and social science to provide guidance for policymakers on planning and managing biodiversity at a regional scale. We develop tools, techniques and policy options to integrate biodiversity into regional-scale planning.

The University of Tasmania hosts the hub.

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