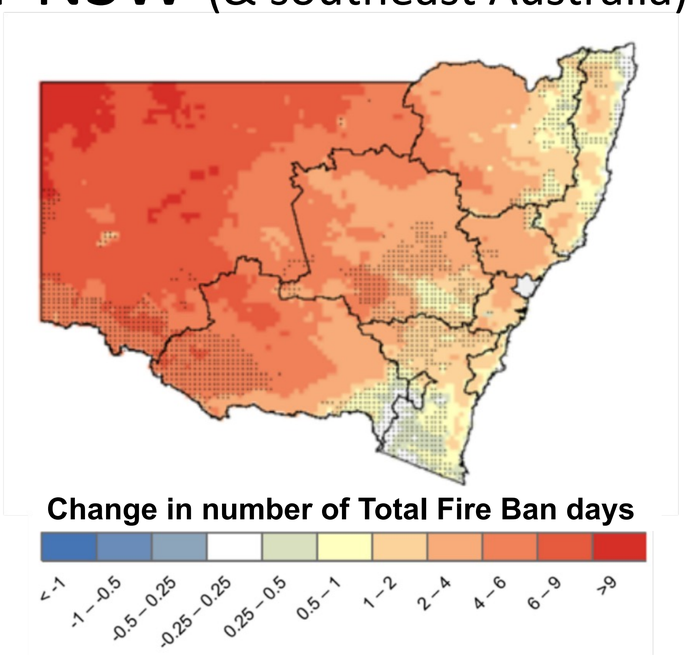
Climate change and bushfire

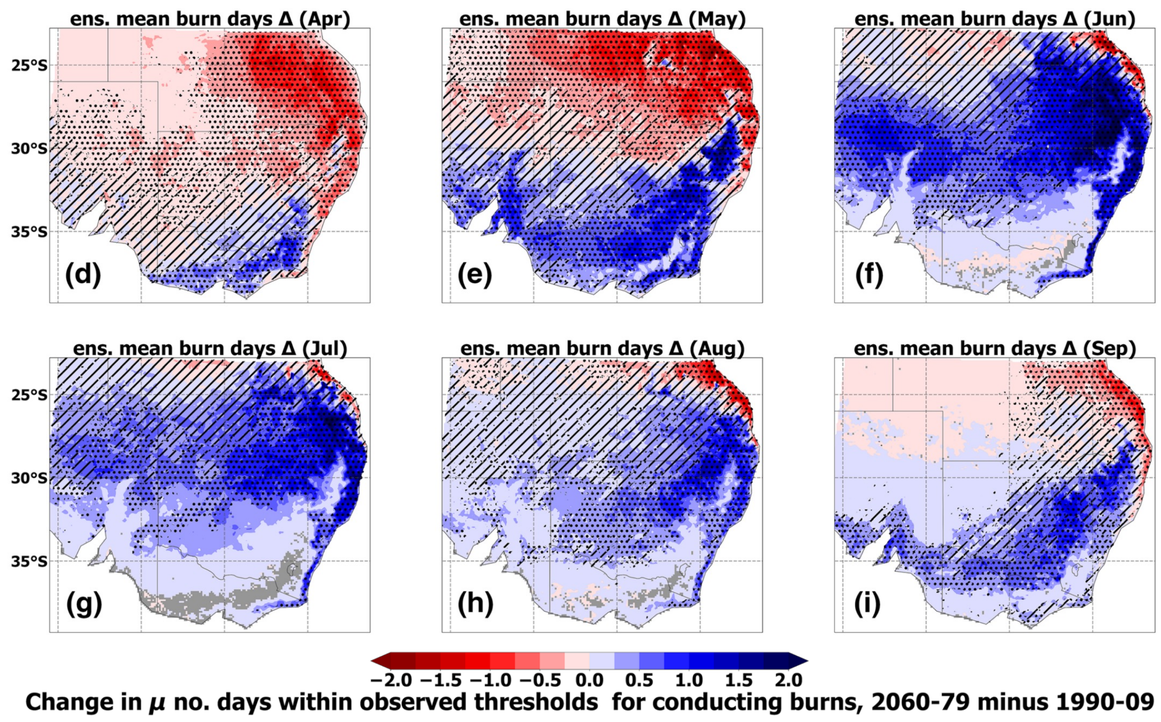
Climate change impacts how bushfires ignite and spread, how vegetation grows and then dries to become fuel, and the likelihood of bushfires intensifying enough to generate their own thunderstorms.

Climate Change increases the frequency of extreme fire weather over NSW (& southeast Australia)



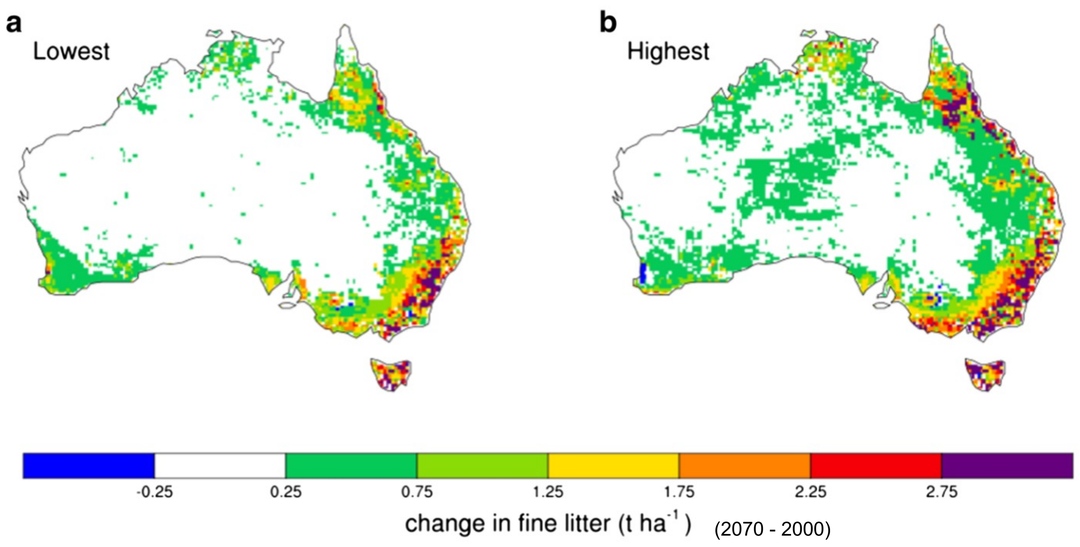
Clarke, H., and J. P. Evans, 2019: Exploring the future change space for fire weather in southeast Australia. Theor Appl Climatol, 136, 513–527, https://doi.org/10.1007/s00704-018-2507-4.

Climate Change alters when prescribed burns can be done



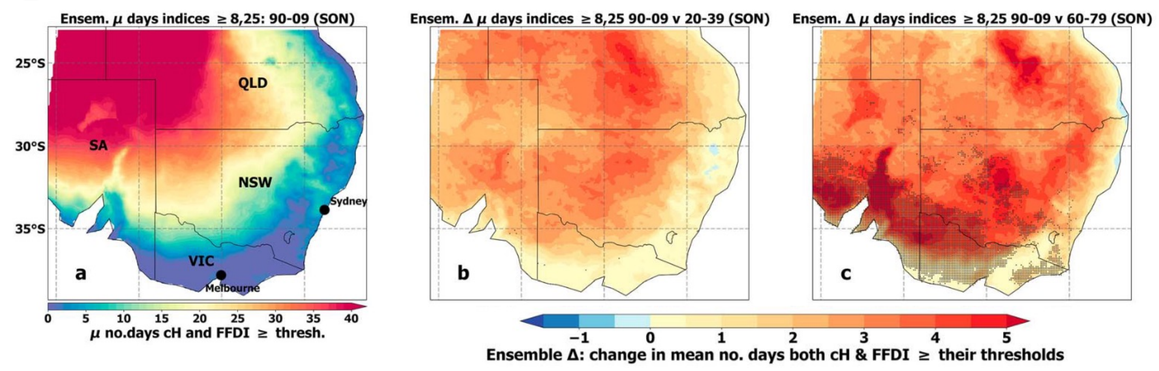
Di Virgilio, G., J. P. Evans, H. Clarke, J. Sharples, A. L. Hirsch, and M. A. Hart, 2020: Climate Change Significantly Alters Future Wildfire Mitigation Opportunities in Southeastern Australia. Geophysical Research Letters, 47, e2020GL088893, https://doi.org/10.1029/2020GL088893.

Climate Change generally increases fuel load over Australia



Clarke, H., A. J. Pitman, J. Kala, C. Carouge, V. Haverd, and J. P. Evans, 2016: An investigation of future fuel load and fire weather in Australia. Climatic Change, 139, 591–605, https://doi.org/10.1007/s10584-016-1808-9.

Climate Change Increases the Potential for Extreme Wildfires that generate thunderstorms



Di Virgilio, G., J. P. Evans, S. A. P. Blake, M. Armstrong, A. J. Dowdy, J. Sharples, and R. McRae, 2019: Climate Change Increases the Potential for Extreme Wildfires. Geophysical Research Letters, 46, 8517–8526, https://doi.org/10.1029/2019GL083699.

We have found that climate change will make many aspects of bushfires worse, though the size of the changes varies a lot over Australia.

Further research is needed into climate change impacts on other aspects of bushfires, as well as to reduce the uncertainties so the projections are useful for fire management decisions.

UNSW Climate Change Research Centre

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Global impacts of extreme wildfires

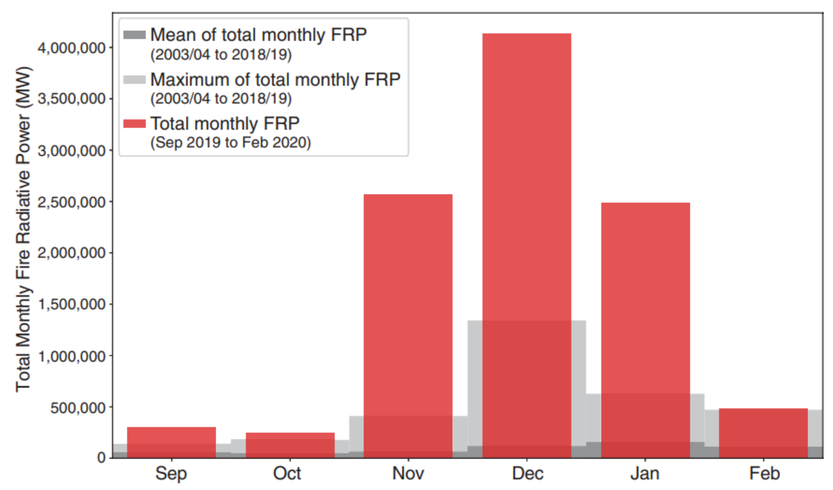
Extreme wildfires, including pyrocumulonimbus (fire thunderstorms), can have far-reaching global impacts on various ecosystems and climate drivers. They constitute a major climate feedback and disruption to the Earth System. Addressing these extreme events is a global priority that requires implementation of various mitigation measures at appropriate scale.

The surge of global extreme wildfire events (e.g., Australia 2019/20, Canada 2023), provides a glimpse of the terrifying potential for climate change driven wildfires to cause damage from local to global scales. Statistics associated with the Black Summer fires include:

***Fig. 1**: Pyrocumulonimbus explodes over British Columbia, 2021. Photo: Kyle Brittain, Weather Network*

- Burnt 20% of temperate eucalypt forest.
- Major ecosystem & socio-economic damage.
- 33 deaths + 450 smoke-related deaths.
- Released over 700Tg of CO_2.
- Injected 1Tg of smoke into the stratosphere.
- Prolonged urban smoke exposure.
- Ozone depletion in upper atmosphere.
- Affected climate modes (triple La Nina).
- Ocean-scale algal blooms.

Extreme wildfire events can cause disastrous harm to societies and amplify climate change impacts. Hence, there is urgency to find means to mitigate them. Policy discussion has mostly centred on disaster management, firefighting capability, and early fire detection using novel technologies, but sustainable fire management must apply a mix of technological approaches in combination with the wisdom of Indigenous fire management. This will require significant investment to achieve the necessary scale and rethinking the basis of fire management, underpinned by a robust scientific understanding of the hazards and processes associated with extreme wildfires.



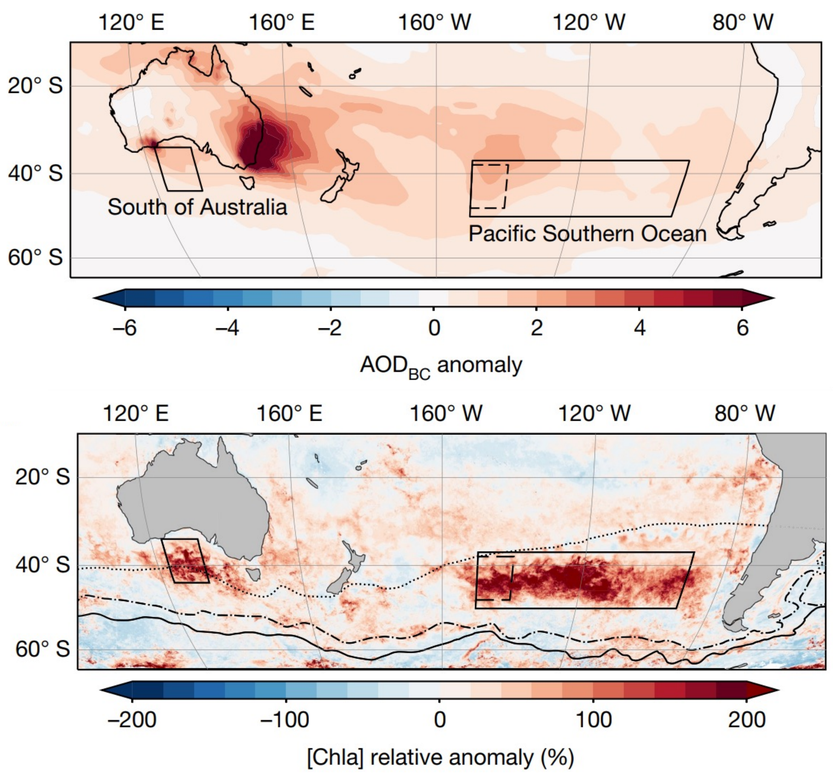


***Fig. 2**: (top) Black Summer monthly Fire Radiative Power (FRP) (red), with monthly mean FRP (dark grey) and maximum monthly FRP (light grey) (Abram et al. Comm. Earth. Env. 2021); (middle) Cumulative black carbon anomaly for the 2019–2020 austral summer; (bottom) Satellite chlorophyll concentration relative anomaly for the 2019–2020 austral summer (Tang et al. Nature 2021).*

Collaborator:
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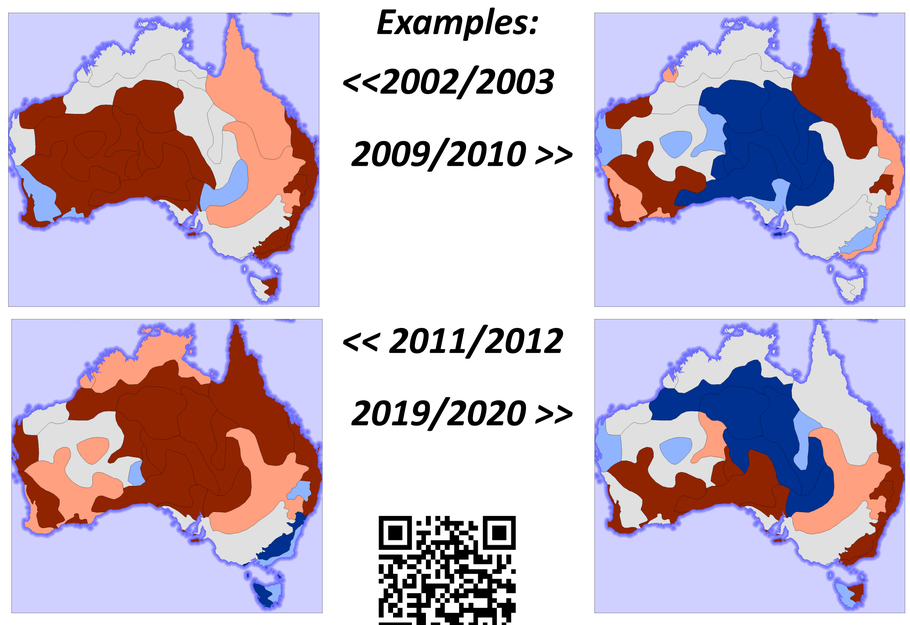
Find out more

Monitoring trends in fire activity

This research is using satellite data to analyse fire seasonality and inter-decadal changes in fire activity. It has highlighted regional changes in fire activity and is informing further assessment of climate change impacts.

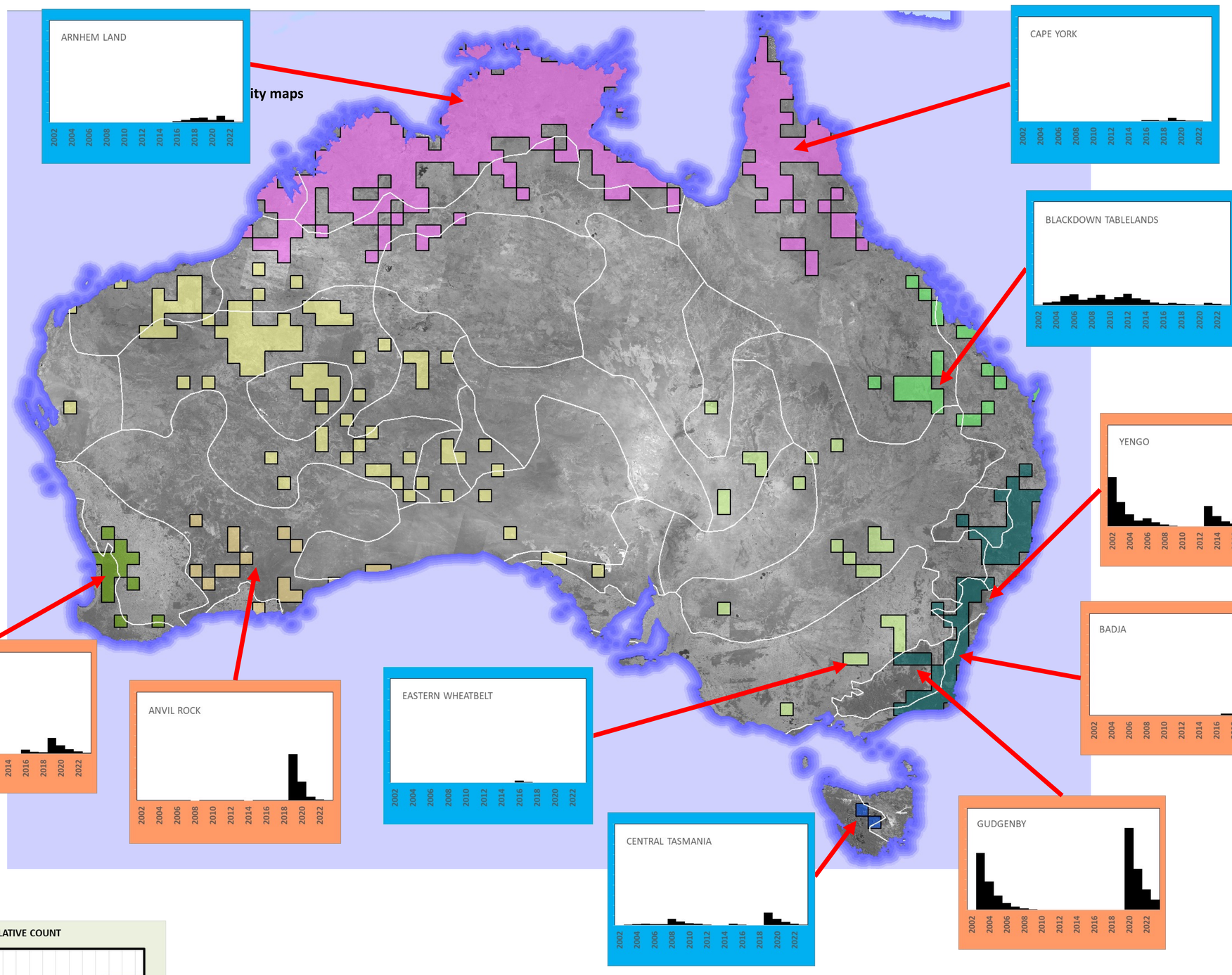
Fire **seasonality maps** show which parts of Australia have had more (brown) or less (blue) fire activity than expected based on historical occurrence patterns derived from MODIS satellite data. These data were also used to assess **changes in fire activity** from one decade to another. The coloured regions in the map below are areas where bushfire risk needs to be carefully assessed.

The bar graphs show estimated fire impacts on different landscapes (using MODIS Fire Radiative Power data) and the recovery process afterwards.

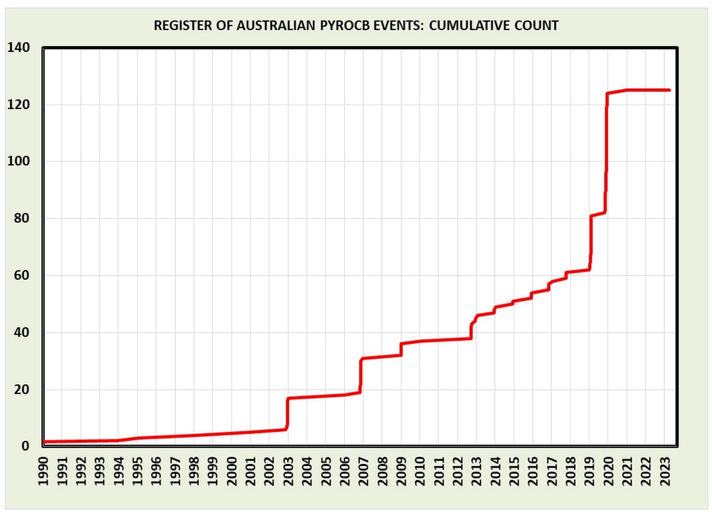


See the data online

Read about this study in **The Conversation***:*



See the data online



The graphs above with orange margins show the impact of pyrocumulonimbus events (pyroCbs, or fire thunderstorms). These are a sign of the rapid and novel changes to the bushfire threat. Indeed, the plot to the left indicates a significant increase in pyroCb activity over the last two decades.

Collaborators:
This is derived from work within BNHCRC/AFAC Seasonal Bushfire Outlook working groups.

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