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## Australian Bushfires

### Current Trends, Causes, and Social-Ecological Impacts

*Abstract:* Bushfires are common events in Australia reaching their peak each summer season. However, the last bushfire season from July 2019 until March 2020 was unprecedented. An estimated area between 240,000 up to 400,000 km<sup>2</sup> burned, with the southeast coast being particularly affected. The images of burnt flora and fauna and the fires that raged for months went around the world. It became clear how vulnerable both Australia's communities and ecosystems are to this natural hazard, which is becoming more frequent and intense. Australia's southeast is increasingly vulnerable against the often sudden event of bushfires. This article discusses the current trends, causes for this extreme fire season, the socio-economic and ecological impacts, and the resulting adaptation processes.

Bushfires are common natural hazards in Australia. During the warmer summer months, many Australian regions have to cope with intense and often unpredictable fires. While most communities go through the summer holidays without major disruptions, others are facing disasters that threaten their lives and properties.<sup>1</sup> At the same time, bushfires are an essential component of the specific ecosystems with many native plants adapted to regular fires. Tree species such as banksias and eucalyptus are resistant to fire. Their roots and seeds can survive smaller fires and are usually able sprout again very quickly. Aboriginal people have used fires as a land management tool since pre-colonial times, and fire is still intentionally used to clear land for agricultural purposes and to protect land and buildings from uncontrolled fires.

Yet, the last bushfire season, which lasted from July 2019 until March 2020, burning for 240 consecutive days, was one of the most devastating the continent has ever experienced.<sup>2</sup> Estimates of the total burnt area reach from 240,000 up to 400,000 km<sup>2</sup> – about two thirds or more than the size of Germany (fig. 1).<sup>3</sup> Thirty-four people died in the fires, and the smoke affected the health of millions of people over weeks.<sup>4</sup> The southeast coast was particularly affected – in New South Wales alone, an area of 55,000 km<sup>2</sup> burned, which accounts for 6.7 per cent of the state's total area. 2,476 homes were destroyed in this area.<sup>5</sup>

The last two decades have shown that bushfires are becoming more intense and frequent, burning throughout longer time periods and affecting larger areas – e.g., parts of Canberra burned in 2003, the fires in Victoria in 2009 and in Tasmania in 2013. Therefore, there is an increasingly urgent need to understand the causes of these fires and to develop more sustainable disaster risk reduction strategies. The following questions arise: What caused this unprecedented fire season of 2019/2020? What were the socio-economic and ecological impacts? And

1 Stewart Lockie, *Sociological responses to the bushfire and climate crises*, pp. 1-5.

2 New South Wales Government, *Final Report of the NSW Bushfire Inquiry*, p. 1.

3 Royal Commission into National Natural Disaster Arrangement, *Interim observations*, p. 5.

4 Stewart Lockie, *Sociological responses to the bushfire and climate crises*, pp. 1-5.

5 New South Wales Government, *Final Report of the NSW Bushfire Inquiry*, p. xxi.

what lessons can be learned to develop adaptive measures to prepare for more frequent and intense bushfires in the future?

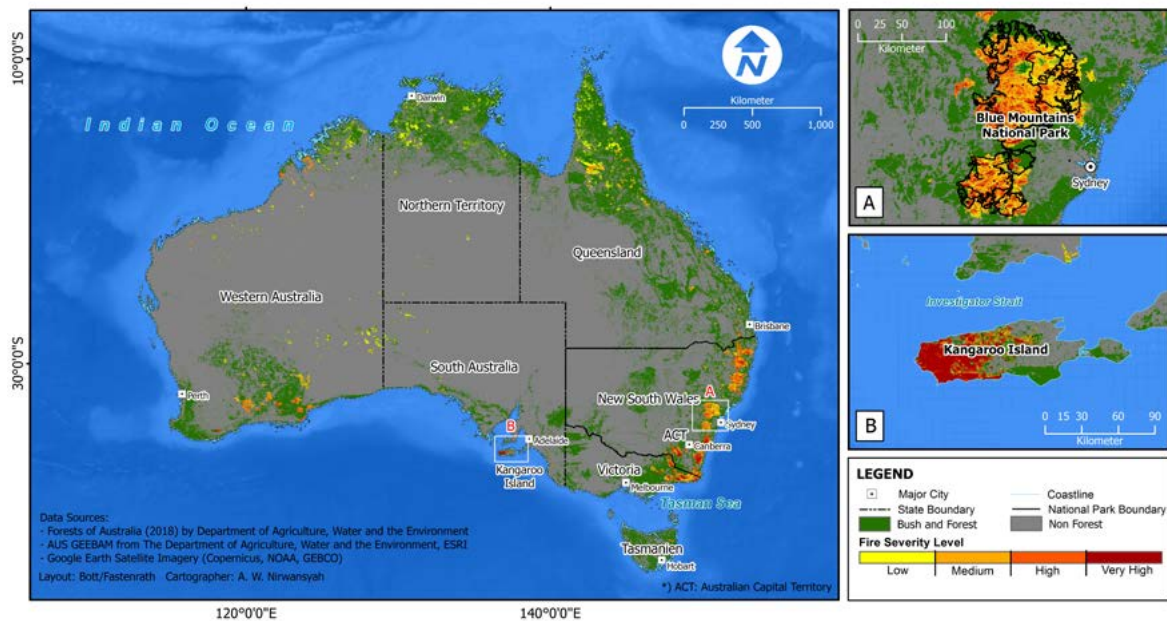


Fig. 1 - Overview of the Australian bushfires during the summer 2019/2020

### ***Why do bushfires occur and what factors can explain the extreme bushfire season of 2019/20?***

Bushfires are the result of specific weather conditions and are usually caused by lightning or human influences. The latter typically happens by accident, e.g. through the use of machinery in agriculture and forestry (e.g. a spark from a chain saw), but increasingly also through arson.<sup>6</sup>

Dry material on the ground, such as leaves, bark, small branches, and grass can catch fire and thus fuel major fires in forests and grasslands. The main determining factors are air temperature, humidity of air and vegetation, topography, and wind direction and speed. Most bushfires have an average speed of about 100 m/h in flat grasslands, but this speed increases in ascending terrain.<sup>7</sup> Usually the fires last only a few minutes, but they can also smolder for days and start burning again. The bushfire season 2019/2020 was characterized by unusually high temperatures, persistent drought, and strong winds, as analyses in the states of Queensland and New South Wales show.<sup>8</sup> The maximum temperatures in some areas were more than 10°C above the long-term average.<sup>9</sup> In addition, in some regions only 50 per cent of the usual precipitation was measured from January to August 2019, for some areas this was the driest period ever recorded.<sup>10</sup>

6 Janet Stanley, Alan March, James Ogloff et al., Feeling the heat.

7 Rachael Nolan, Richard Thornton, Bushfires 1. m/h = meters per hour.

8 Bureau of Meteorology, Special Climate Statement 71 - severe fire weather conditions in southeast Queensland and northeast New South Wales in September 2019.

9 Ibid.

10 Ibid.

As observed in the last fire season, extreme bushfires can cause cloud formations (pyrocumulonimbus), which show similarities to clouds that occur after

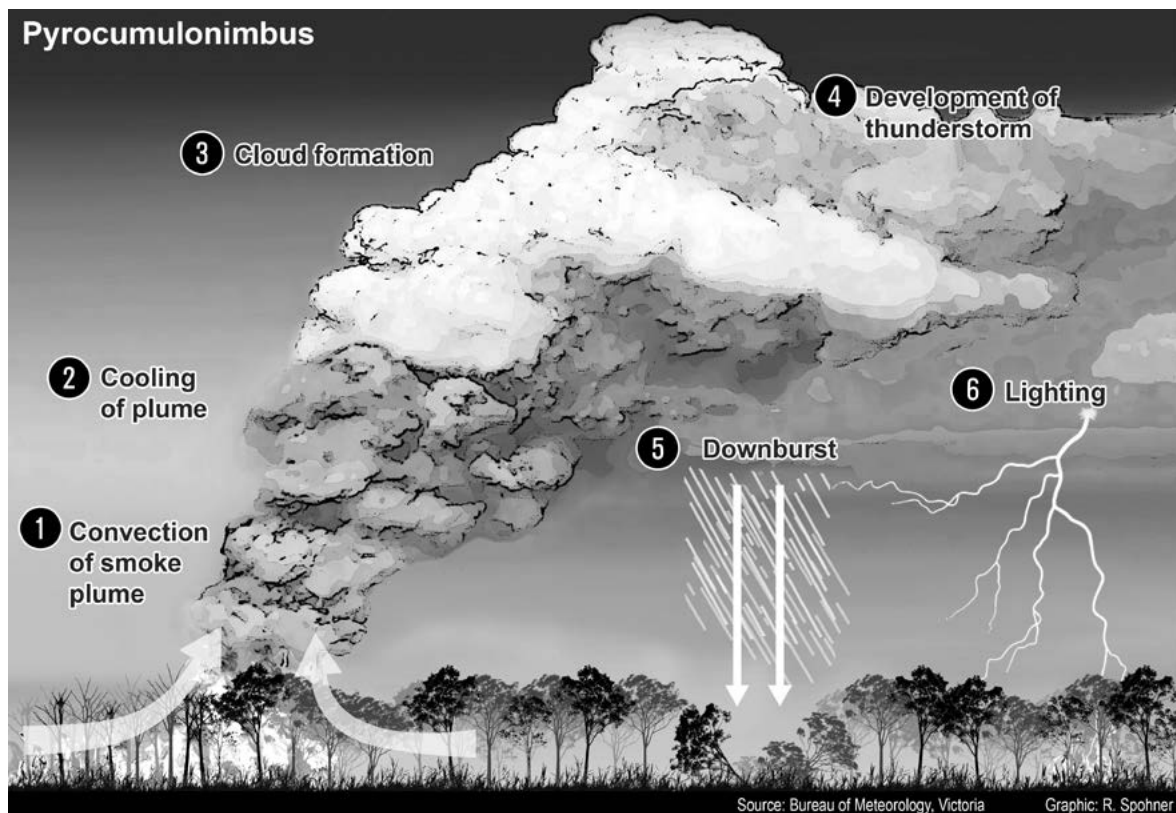


Fig. 2 - The formation of pyrocumulonimbus

volcanic eruptions (fig. 2).<sup>11</sup> This weather phenomenon can result in lightning, tornadoes, and firestorms, which can ignite new fires and potentially intensify already burning ones. These clouds of smoke can rise up to a height of 15 km. Satellite images from NASA show that during the last fire season smoke clouds even reached as far as New Zealand, 2000 km away.<sup>12</sup> It is estimated that the bushfires released 434 million tons of carbon dioxide.<sup>13</sup> This represents 84 per cent of Australia's annual CO<sub>2</sub> emissions in 2016 (approx. 519 million tons).<sup>14</sup>

Although the exact impact is unclear, the increasing frequency of extreme bushfires hints at a correlation with the changing climate in Australia,<sup>15</sup> a country whose own energy supply is 81 per cent reliant on non-renewable fossil fuels.<sup>16</sup> A decrease in precipitation of 61 per cent in southeast Australia has been observed

- 11 David Peterson, James Campbell, Edward Hyer et al., *Wildfire-driven thunderstorms cause a volcano-like stratospheric injection of smoke*, pp. 1-8. Copyright for illustrations by authors.
- 12 NASA, *NASA Animates World Path of Smoke and Aerosols from Australian Fires*.
- 13 Copernicus Atmosphere Monitoring Service, *Wildfires continue to rage in Australia*.
- 14 Climate Watch, *Australia*.
- 15 Ritaban Dutta, Aruneema Das, Jagannath Aryal, *Big data integration shows Australian bush-fire frequency is increasing significantly*; Jason Sharples, Geoffrey Cary, Paul Fox-Hughes et al., *Natural hazards in Australia*, pp. 85-99.
- 16 Department of the Environment and Energy, *Australian Energy Update 2019*.

over the last decades, particularly in the autumn months of March to May.<sup>17</sup> It is not yet clear to what extent these changes are caused by climate change. It is likely that the El Niño Southern Oscillation (ENSO) is also exerting a strong influence on the precipitation pattern and thus the susceptibility to bushfires. ENSO is a complex coupled system of ocean currents and atmospheric circulations. During an El Niño event, weaker or absent trade winds lead to colder water temperatures along Australia's Pacific coast, which result in less precipitation over east Australia. Regardless of the exact influence of climate change, it is likely that the climatic condition will become more favorable for more frequent extreme bushfires in the future. Further temperature extremes, more frequent heatwaves, longer periods of drought interrupted by heavy rainfall events are likely.<sup>18</sup>

However, weather extremes and changing climate are not the only factors that explain more frequent and devastating bushfires. Another reason for the increase in intensity and damage is the continuing land use change. The urban sprawl of Australian cities<sup>19</sup> contributes to a greater extent of damages through new residential property developments in fire risk areas. Bushland and residential areas increasingly overlap. This situation not only makes fire-fighting more difficult, as larger areas need to be covered, but also further increases the risk of fires ignited by human activities.

### ***What are the socio-ecological and economic impacts?***

#### *Human consequences*

Extreme fires have devastating effects on communities and the environment. In the 2019/20 fire season, 34 people died;<sup>20</sup> a higher number of fatalities could be avoided by early and extensive evacuations.

It is not yet possible to estimate the long-term health damage caused by heavy smoke development.<sup>21</sup> Smoke affected not only the inhabitants of small regional towns in the immediate vicinity of the fires, but also the metropolitan areas of Sydney, Canberra, and Melbourne. These cities were repeatedly shrouded in thick smoke for weeks. Measuring stations in Melbourne indicated health-endangering levels, comparable to smoking tobacco, and even smoke alarms in apartments were activated. On some days, the southeast Australian cities even had the world's most toxic air pollution levels.<sup>22</sup>

In addition to the effects on physical health, fires also have psychological impacts. Both survivors of extreme bushfires and firefighters often have to deal with anxiety and posttraumatic stress disorders. Losing homes, properties, and

17 Bradley Murphy, Bertrand Timbal, A review of recent climate variability and climate change in southeastern Australia, pp. 859-879.

18 Lesley Head, Michael Adams, Helen McGregor, Stephanie Toole, Climate change and Australia, pp. 175-197.

19 Boris Braun, Sebastian Fastenrath, Resilient Melbourne, pp. 10-15.

20 Stewart Lockie, Sociological responses to the bushfire and climate crises, pp. 1-5.

21 Australian Academy of Science, Long-term health impacts of bushfires still unknown.

22 Sotiris Vardoulakis, Guy Marks, Michael Abramson, Lessons Learned from the Australian Bushfires Climate Change, Air Pollution, and Public Health, pp. 635 f..



items of personal memory as well as the destruction of familiar landscapes, not to mention the loss of lives, cause strong grief or even trauma. The Australian government authorized AUD 76 million for “mental health responses to bushfire trauma”.<sup>23</sup>

There is broad agreement that the trauma, grief but also the traditional knowledge of Aboriginal people (e.g. about land care strategies) need more recognition. The cultural identities of Aboriginal people are strongly linked to the land. Thus, the burning of ancient forests, trees, and landscapes that are sacred to them as well as the destruction of totemic plants and animals result in unique experiences; their sorrow not only concerns human communities but also non-human relations. These facts need to be understood to support communities and to guide socio-ecological and economic recovery in a sensitive manner.<sup>24</sup>

### *Economic impact*

The costs for the affected communities, the state, and the private sector are enormous. Every year, billions are spent on firefighting, reconstruction, insurance premiums, and health care systems. The 2019/2020 fires destroyed thousands of homes, agricultural land and critical infrastructure such as power lines, cell phone towers, and roads. The estimated damage to the economy is more than AUD 100 billion.<sup>25</sup> In New South Wales alone, the costs of infrastructure loss accounted for AUD 899 million and the destroyed telecommunication sites for AUD 43 million.<sup>26</sup>

In addition to numerous agricultural businesses, the tourism industry was particularly affected. Regions such as Gippsland in Victoria or the South Coast in New South Wales are popular destinations for residents of Melbourne and Sydney and international tourists during the warmer months. Due to the risk of fire and associated evacuations, tens of thousands of tourists stayed away.<sup>27</sup> With the Covid-19 pandemic since March 2020, this situation has worsened for those regions. Apart from lacking tourists, Victoria’s and New South Wales’ agricultural sector is also suffering due to lower demand of high-end products from restaurants in Melbourne and Sydney.

### *Ecological impacts*

According to initial estimates by Australian biologists, more than one billion mammals, birds, and reptiles (including some endangered species) were affected. Many animals were burnt or suffocated. Some ecosystems have been completely destroyed or will take decades to recover.<sup>28</sup> Particular attention has been paid to the Blue Mountains National Park, 80 km from Sydney (fig. 1A). More than 80 per

23 Australian Government - Department of Health, Australian Government mental health response to bushfire trauma.

24 Bhiamie Williamson, Jessica Weir, Vanessa Cavanagh, Strength from perpetual grief.

25 Stewart Lockie, Sociological responses to the bushfire and climate crises, pp. 1-5.

26 New South Wales Government, Final Report of the NSW Bushfire Inquiry, p. xxi.

27 VisitVictoria, Gippsland Insights.

28 Michelle Ward, Six million hectares of threatened species habit up in smoke.

cent of the UNESCO World Heritage Site has been affected. The national park stands for a particularly high biodiversity (e.g., 91 eucalyptus species) and provides habitat for extremely rare and endangered plant species such as the Wollemie pine (*Wollemia nobilis*).<sup>29</sup> Images of Kangaroo Island, southwest of Adelaide in South Australia, also went around the world. Almost 50 per cent of the island's landscape burned down (fig. 1B). The island is one of the last refuges for endangered species such as the Kangaroo Island dunnart.

However, first analyses also give hope for the future of the burnt nature and habitats. Single vegetation islands have been spared and provide a survival space for a core population of plants and animals. In addition, bacteria and fungi decompose the ashes and enable a restart of the ecosystems. Some endemic plants even depend on the high alkaline PH values of the burnt soils to germinate. The coming months and years will show whether a sufficient large number of individuals of endangered species have survived the extreme bushfires so that the populations can recover.<sup>30</sup>

### ***Climate mitigation, adaptation to bushfires and learning from previous events***

The increase in extreme bushfires clearly calls for mitigation strategies addressing greenhouse gas emissions, especially in a country which still heavily mines coal, both for domestic energy supply (60 per cent of all energy sources)<sup>31</sup> and for export trade (Australia ranks first worldwide in coal exports). A turn towards more sustainable sources and away from the so-called 'carbon lock-in' is needed.<sup>32</sup> In this regard, federal or state climate change litigations provide first measures for improving climate change and hazard management in Australia.<sup>33</sup>

Nevertheless, even the strictest greenhouse gas mitigation will not be sufficient to prevent extreme bushfires from happening. Mitigation needs to be supported by further adaptation strategies to deal with the impacts of fires and to address further root causes besides changing climatic conditions. These strategies include measures to prepare for future fires, to take action during fires, and to recover after them. Land use and urban planning, insurances, building codes, emergency management, and agriculture and forest management are just some target areas where reorganization and new practices are required.<sup>34</sup>

The first steps towards a more sustainable future are risk awareness and willingness to act.<sup>35</sup> In this regard, the initial apathy of prime minister Morrison

29 WHC – World Heritage Convention, Weltkulturerbe Blue Mountains.

30 Peggy Rismiller, Mike McKelvey, Field Fire Update from established data sites that were within the December 2019/January 2020 fire area.

31 Department of the Environment and Energy, Australian Energy Update 2019.

32 Karen Seto, Steven Davis, Ronald Mitchell et al., Carbon Lock-In, pp. 425-452.

33 Laura Schuijers, Margaret A. Young, Climate change litigations on Australia, pp. 1-26.

34 Stewart Lockie, Sociological responses to the bushfire and climate crises, pp. 1-5.

35 Neil Adger, Shardul Agrawala, Monirul Qader Mirza et al., Assessment of adaptation practices, options, constraints and capacity, pp. 717-743.

towards the extreme fires caused strong political controversies.<sup>36</sup> In the aftermath of the fires, the debate on climate change and energy politics revealed a noticeable change within the Australian public. According to a polling by The Australia Institute (2020),<sup>37</sup> 72 per cent of Australians saw the extreme bushfires of 2019/2020 as a wake-up call on climate change. The share of Australians who are very concerned about climate change rose to 47 per cent, a 10 per cent increase compared to July 2019.

Another important aspect of adaptation to natural hazards is learning from past disasters and their socio-technical and economic consequences, which is a central goal of Australian disaster management agencies. Since the 'Black Saturday' bushfires in Victoria in 2009, in which 173 people died, disaster management has received special attention.<sup>38</sup> The analysis helped to develop more effective mechanisms for preparedness, response, and reconstruction.

To connect all key actors and their expertise, the 'Bushfire and Natural Hazards Cooperative Research Centre' opened in 2013. It brings together all fire and rescue authorities of Australia and New Zealand, planning authorities, NGOs, and scientists. The aim is to research the causes, consequences, and containment options of bushfires and other natural hazards. In the event of bushfires, the population is now warned earlier – for example by SMS or app messages from the civil protection authorities. The protection of human life and land is the top priority, but increasing attention is also being paid to nature conservation and Indigenous cultural heritage.

The vulnerability of the energy supply is also being discussed. During the 2019/2020 fires in Gippsland, many rural communities were cut off from their power supplies for weeks due to destroyed power lines. Smart grid systems are now being tested to increase energy security. Such networks, powered locally by renewable energies, could sustain power and cooling systems during bushfire scenarios and supply energy for fire-resistant emergency shelters (Community Fire Refuges). These measures would have two advantages: adaptation to the natural hazard of bushfires and reduction of greenhouse gas emissions.<sup>39</sup>

The recovery process has already started in early 2020. In Victoria, a new state government agency, 'Bushfire Recovery Victoria' was established. Victorians who lost their homes during the bushfires were provided with temporary modular homes by the Victorian government. In addition, several Community Recovery Committees (CRC) were set up and supported across the bushfire affected communities. At the same time, a 'Local Economic Recovery Program' was initiated by the state and federal government. The goal is to support affected communities through a place-based, locally led recovery program that involves community groups, local businesses and governments.<sup>40</sup> The focus of these recovery strategies lies on supporting small businesses, infrastructure projects to stimulate

36 Nick O'Malley, *The world has made the link between Australian coal, fires and climate.*

37 The Australia Institute, *Polling - Climate change concerns.*

38 Lesley Head, Michael Adams, Helen McGregor, Stephanie Toole, *Climate change and Australia*, pp. 175-197.

39 Leo Goedegebuure, Bruce Wilson, Lars Coenen et al., *Developing and Implementing a Smart Specialisation Approach for Gippsland, Victoria (2018-2020)*, pp. 1-36.

40 Victoria Government, *Local Economic Recovery Program.*

the economy, and building economic and community resilience through new communication infrastructure such as the expansion of the broadband network and mobile phone towers.

## **Conclusion**

Bushfires are a common and natural event of the Australian ecosystem, one that many native plant species have adapted to or even require to sprout. However, there is a considerable difference between small fires, which only burn a few minutes in small areas, and extreme bushfires that devastated entire landscapes and communities. The extreme fire season of 2019/2020 can be seen as a wake-up call for more effective mitigation and adaptation strategies to save lives and properties as well as to conserve the unique local ecosystems.

Australia is not alone in the face of more frequent and more extreme wildfires. Around the globe, other regions such as the Amazon, California, Southern Europe and Indonesia have been affected by devastating fires during the last few years. While writing this paper (Sep. 2020), major wildfires are burning from California up to Washington State. Thus, urgent action is required on all scales – global, regional, and local, to prevent and to better prepare for more frequent and intense bushfires.

A remaining question is how Australia's extreme bushfire season of 2019/2020 will influence international and national politics around climate change, energy supply, and land use. There is hope that this disastrous event is a lesson that provides opportunities for political change and support for a transition towards a more sustainable future.

## **Bibliography**

- Adger, W. Neil, Shardul Agrawala, Monirul Qader Mirza, Cecilia Conde, Karen O'Brien, Juan Pulhin, Roger Pulwarty, Barry Smit, Kiyoshi Takahashi, Assessment of Adaptation Practices, Options, Constraints and Capacity, in: IPCC (Ed.) *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press 2007, pp. 717-743.
- Australian Academy of Science, Long-term health impacts of bushfires still unknown, <https://www.science.org.au/news-and-events/news-and-media-releases/long-term-health-impacts-bushfires-still-unknown> (accessed 15 October 2020).
- Australian Government – Department of Health, Australian Government mental health response to bushfire trauma, <https://www.health.gov.au/health-topics/emergency-health-management/bushfire-information-and-support/australian-government-mental-health-response-to-bushfire-trauma> (accessed 24 September 2020).
- Braun, Boris, Sebastian Fastenrath, Resilientes Melbourne: Nachhaltigkeit und naturbasierte Strategien der Stadtentwicklung in Australien, in: *Geographische Rundschau*, 72, 2020, 10, pp. 10-15, <https://www.westermann.de/anlage/4624907/Resilientes-Melbourne-Nachhaltigkeit-und-naturbasierte-Strategien-der-Stadtentwicklung-in-Australien>.
- Bureau of Meteorology (BOM), Special Climate Statement 71 – severe fire weather conditions in southeast Queensland and northeast New South Wales in September 2019,



- <http://www.bom.gov.au/climate/current/statements/scs71.pdf> (accessed 24 September 2019).
- Climate Watch, Australia: Greenhouse gas emissions and emission targets (CAIT), <https://www.climatewatchdata.org/countries/AUT> (accessed 15 October 2020).
- Copernicus Atmosphere Monitoring Service (CAMS), <https://atmosphere.copernicus.eu/wildfires-continue-rage-australia> (accessed 24 July 2020).
- Department of the Environment and Energy, Australian Energy Update 2019: Australian Energy Statistics, Canberra: Department of the Environment and Energy 2019.
- Dutta, Ritaban, Aruneema Das, Jagannath Aryal, Big data integration shows Australian bush-fire frequency is increasing significantly, in: *Royal Society Open Science*, 3, 2016, 2, 150241.
- Goedegebuure, Leo, Bruce Wilson, Lars Coenen, Marian Schoen, Sebastian Fastenrath, Chloe Ward, Emma Shortis, Developing and Implementing a Smart Specialisation Approach for Gippsland, Victoria (2018-2020), Melbourne: The University of Melbourne, RMIT University 2020.
- Head, Lesley, Michael Adams, Helen McGregor, Stephanie Toole, Climate change and Australia, in: *Wiley Interdisciplinary Reviews: Climate Change*, 5, 2014, 2, pp. 175-197.
- Lockie, Stewart, Sociological responses to the bushfire and climate crises, in: *Environmental Sociology*, 6, 2020, 1, pp. 1-5.
- Murphy, Bradley F., Bertrand Timbal, A review of recent climate variability and climate change in southeastern Australia, in: *International Journal of Climatology* 28, 2008, pp. 859-879.
- NASA, NASA Animates World Path of Smoke and Aerosols from Australian Fires, <http://www.nasa.gov/feature/goddard/2020/nasa-animates-world-path-of-smoke-and-aerosols-from-australian-fires> (accessed 24 July 2020).
- New South Wales Government, Final Report of the NSW Bushfire Inquiry. Department of Premier and Cabinet (NSW), <https://apo.org.au/sites/default/files/resource-files/2020-07/apo-nid307786.pdf> (accessed 24 July 2020).
- Nolan, Rachael, Richard Thornton, Bushfires 1: Understanding bushfires, Australian Academy of Science, <https://www.science.org.au/curious/bushfires> (accessed 15 October 2020).
- O'Malley, Nick, The world has made the link between Australian coal, fires and climate, <https://www.smh.com.au/environment/climate-change/the-world-has-made-the-link-between-australian-coal-fires-and-climate-20200103-p53omu.html> (accessed 30 September 2020).
- Peterson, David A., James R. Campbell, Edward J. Hyer, Michael D. Fromm, George P. Kablick III, Joshua H. Cossuth, Matthew T. DeLand, Wildfire-driven thunderstorms cause a volcano-like stratospheric injection of smoke, in: *npj Climate and Atmospheric Science*, 1, 2018, 30, pp. 1-8.
- Rismiller, Peggy, Mike McKelvey, Field Fire Update from established data sites that were within the December 2019/January 2020 fire area, <https://www.tourkangarooisland.com.au/sites/tki5/media/banner/ki-fires-2020/dr-p-rismiller-jan-2020-fire-survey-report.pdf> (accessed 24 September 2020).
- Royal Commission into National Natural Disaster Arrangement, Interim observations, [https://naturaldisaster.royalcommission.gov.au/system/files/2020-08/Interim%20Observations%20-31%20August%202020\\_0.pdf](https://naturaldisaster.royalcommission.gov.au/system/files/2020-08/Interim%20Observations%20-31%20August%202020_0.pdf) (accessed 15 October 2020).
- Schuijers, Laura, Margaret A. Young, Climate Change Litigations on Australia: Law and Practice in the Sunburnt Country, University of Melbourne Legal Studies Research Paper Series No. 900, forthcoming in: Ivano Alogna, Christine Bakker, Jean-Pierre Gauci (eds.), *Climate Change Litigation: Global Perspectives*, Brill, [https://papers.ssrn.com/sol3/papers.cfm?abstract\\_id=3672870](https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3672870) (accessed: 15 October 2020).
- Seto, Karen C., Steven J. Davis, Ronald B. Mitchell, Eleanor C. Stokes, Gregory Unruh, Diana Ürge-Vorsatz, Carbon Lock-In: Types, Causes, and Policy Implications, in: *Annual Review of Environmental Resources*, 41, 2016, pp. 425-452.
- Sharples, Jason J., Geoffrey J. Cary, Paul Fox-Hughes, Scott Mooney, Jason P. Evans, Michael-Shawn Fletcher, Mike Fromm, Pauline F. Grierson, Rick McRae, Patrick Baker, Natural hazards in Australia: extreme bushfire, in: *Climatic Change*, 139, 2016, pp. 85-99.
- Stanley, Janet, Alan March, James Ogloff, Jason Thompson, Feeling the heat: International perspectives on the prevention of wildfire ignition, Malaga: Vernon Press 2020.

- The Australia Institute, Polling – Climate change concerns, January 2020, Canberra: Australia Institute, <https://www.tai.org.au/sites/default/files/Polling%20-%20January%202020%20-%20Climate%20change%20concern%20and%20attitude%20%5BWeb%5D.pdf> (accessed 30 September 2020).
- Vardoulakis, Sotiris, Guy Marks, Michael J. Abramson, Lessons Learned from the Australian Bushfires Climate Change, Air Pollution, and Public Health, *JAMA Internal Medicine* 180, 2020, 5, pp. 635-636.
- Victoria Government, Local Economic Recovery Program – Support available for local community and economic recovery in bushfire-affected communities, [https://www.vic.gov.au/local-economic-recovery-program-bushfire-affected-communities?utm\\_source=miragenews&utm\\_medium=miragenews&utm\\_campaign=news](https://www.vic.gov.au/local-economic-recovery-program-bushfire-affected-communities?utm_source=miragenews&utm_medium=miragenews&utm_campaign=news) (accessed 12 October 2020).
- VisitVictoria, Gippsland Insights, <https://corporate.visitvictoria.com/resources/regional-insights/gippsland> (accessed 24 July 2020).
- Ward, Michelle, Six million hectares of threatened species habit up in smoke, <https://theconversation.com/six-million-hectares-of-threatened-species-habitat-up-in-smoke-129438> (accessed 24 July 2020).
- Williamson, Bhiamie, Jessica Weir, Vanessa I. Cavanagh, Strength from perpetual grief: how Aboriginal people experience the bushfire crisis. Faculty of Social Sciences - Papers. <https://ro.uow.edu.au/sspapers/4709>. (accessed 15 October 2020).
- World Heritage Convention (WHC), Weltkulturerbe Blue Mountains, <https://whc.unesco.org/en/list/917> (accessed 24 July 2020).