

## Processes leading to flash droughts in Australia

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**Abstract:** Flash droughts are a recently recognized type of extreme events characterised by rapid intensification of dry conditions with wide-ranging impacts. They unfold on timescales of a few weeks. Recent studies show that flash droughts have become more common over much of the world. They have been projected to expand globally in the future and would possibly be made worse due to continued anthropogenic climate change. Moreover, due to their sudden onset and due to lack of knowledge about the governing mechanisms, flash droughts pose multiple challenges in their understanding, predictability and monitoring. In order to better understand their rapid onsets and to move towards better adaptation and resilience development for these, it is important to identify the physical processes responsible for causing flash droughts.

In this study, we examined the physical processes leading to rapid drought onset. To this end, we studied flash drought events that have occurred in the last 50 years over the Australian region. Flash drought spells over a region were identified using the rate of change of evaporative stress and root zone soil moisture to capture rapid intensification of dry conditions. Due to the tight coupling between evapotranspiration and soil moisture, rapid drying caused due to increased evaporative stress rapidly primes the region to transition from being energy limited to being water-limited, eventually impacting vegetation health. Many of the flash drought periods identified were also found to be associated with episodes of bushfires following the rapid intensification period, suggesting a compounding of threat from such events. Given there is growing awareness that future precipitation, temperature, and evaporative demand will change due to effects from anthropogenic warming, the understanding obtained from these driving processes have the potential to improve sub-seasonal predictions of flash drought events. The knowledge of these processes can be incorporated into early warning systems and risk management to allow for better preparedness and adaptation for these events.

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