Earth Systems and Climate Change Hub

National Environmental Science Programme

climate change **science brief**

Drought projections for Australia

At any given time, regions in Australia are prone to drought. This is primarily a result of our large natural climate variability. However, parts of Australia are likely to spend more time in drought under a warming climate, particularly in the south and east.

To help Australia build resilience and preparedness under a changing climate, researchers at the Earth Systems and Climate Change Hub have delivered updated and improved drought projections for Australia at a national and regional level.

These new drought projections extend existing projections (based solely on a rainfall-based drought index) by incorporating a soil moisture-based drought index. As a result, the new drought projections provide water managers and decision makers with a more complete picture of future changes to drought in Australia.

Updating and improving drought projections for Australia

To better understand future drought in Australia, researchers in the Earth Systems and Climate Change (ESCC) Hub have investigated how time spent in drought, mean drought duration, drought frequency, and drought intensity may change under a warmer climate. Projections were developed out until the year 2100.

Projections were developed for change to both drought and extreme drought. Drought refers to an event whose probability of recurrence is around once in 6 years, whereas extreme drought is a roughly once in 40 years event. In other words, drought might occur about 17 times in 100 years, while extreme drought might happen only twice or three times in 100 years.

Projections were developed for two important drought indexes, the Standardised Precipitation Index (SPI) and the Standardised Soil Moisture Index (SSMI), which refer to the deviation of rainfall and soil moisture from its normal condition, respectively. SPI represents a meteorological drought hazard, while SSMI represents soil moisture or agricultural drought hazard.

When developing projections for drought, it is important to use more than one drought index to ensure multiple factors which contribute towards drought conditions, such as rainfall, temperature and evapotranspiration, are considered.

The new drought projections were developed for Australia as a whole, as well as for four National Resource Management super cluster regions: Eastern Australia (EA), Southern Australia (SA), Northern Australia (NA) and Rangelands (R), (as described in the *Climate Change In Australia* national projections website: www.climatechangeinaustralia.gov.au).

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Drought projection results

The new drought projections indicate that under a warming climate Australia will spend more time in drought, with longer and more intense drought conditions, particularly across southern and eastern Australia.

Research under the ESCC Hub also indicates that there is an increasing trend for all drought metrics except for drought frequency, across most of Australia.

Regionally, the future periods considered (2030, 2050, 2070, 2090) experience significantly different conditions compared to the baseline period (1995), except for Northern Australia and, to a lesser extent, the Rangelands region. This indicates that there is strong model agreement in the projected changes.

Understanding projection uncertainty

Although more severe drought conditions are projected under climate change, a large range in the projected severity of future drought exists in the climate models.

There is more certainty in projections for the south-west of Australia, and to a lesser extent southern Australia, where all models show an increase in severe drought conditions.

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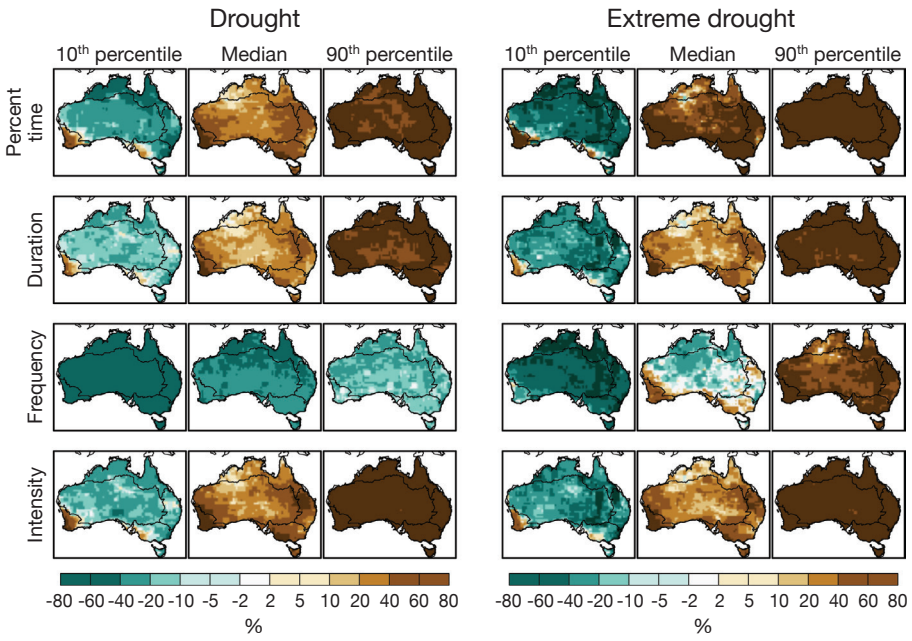

FIGURE 1 Projected changes of the Standardised Soil Moisture Index (SSMI) drought metrics in the 21st century (2006-2100) under the RCP8.5 (high emission scenario), relative to the 20th century (1900-2005). The multi-model ensemble is shown as median and the 10th–90th percentile. Taken from *Kirono et al 2020*, which also shows results for the SPI.

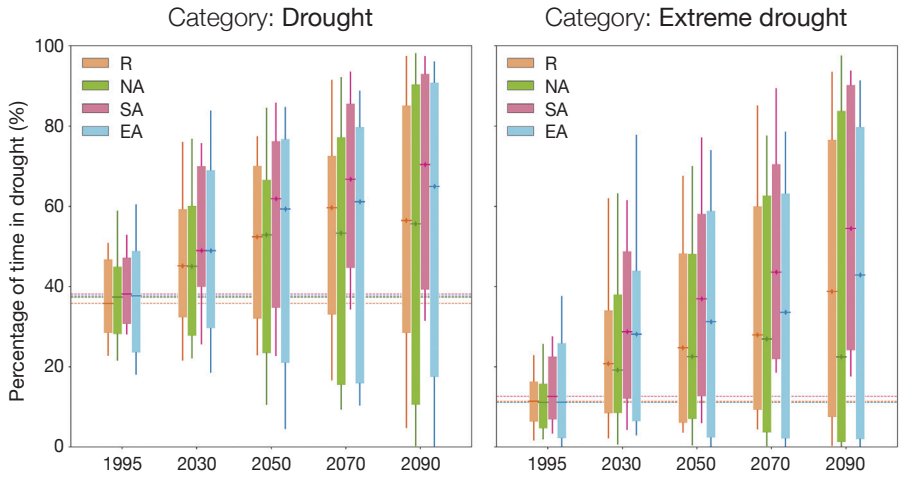

FIGURE 2 Time spent in SSMI drought for the four NRM super cluster regions. The multi-model ensemble is shown as median, 10th-90th percentile and minimum-maximum values. The diamonds show that the condition at a given period in the future statistically differs from that in the reference period (1995). Taken from *Kirono et al 2020*, which also shows results for the SPI.

Informing water managers and decision makers

The new and improved drought projections produced under the ESCC Hub provide water managers and decision makers with a more complete picture of future changes to drought in Australia. Robust projections of water futures are important for impact assessments and developing adaptation options to climate change impacts in the water sector, as well as sectors which rely heavily on water, such as agriculture and ecosystem management.

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