The journal Climatic Change has published a special edition of review papers discussing major natural hazards in Australia. This article part of a series looking at those threats in detail.

Australia is no stranger to heatwaves. Each summer, large areas of the continent fry under intense heat for days on end, causing power outages , public transport delays , and severe impacts to human health . The estimated impact on our workforce alone is US$6.2 billon per year . Heatwaves are also Australia's deadliest natural hazard, accounting for well over half of all natural disaster-related deaths.

Along with our colleagues, we have taken a close look at what we know and don't know about heatwaves in Australia, as part of a series of reviews produced by the Australian Energy and Waster Exchange initiative .

Let's start with the stuff we know. First, we are very clear on the weather systems that drive heatwaves in Australia's densely populated coastal areas. Typically, a persistent high-pressure system sits next to the region experiencing the heatwave , pushing hot air from the centre of Australia towards that region. The location of the high depends on the region experiencing the heatwave, but there is always one there.

These high-pressure systems are created and sustained by other weather influences farther afield, for instance. We know for instance that heatwaves in Melbourne are coupled with tropical cyclones to the northwest of Australia.

Other, longer-term variables can affect not just individual heatwaves but their patterns, timing and severity too. So heatwaves are likely to be much longer and more frequent during El Niño

than La Niña phases over much of northern and eastern Australia. However, this does not influence heatwaves
over Australia’s far southeast
– here, the most important driver is changes to
wind patterns over the Southern Ocean
.

We also know that heatwave trends have increased in the observational record, and, unfortunately, that they will continue to do so. By far the strongest trend is in the number of heatwave days experienced each season. Over much of eastern Australia, this trend is as large as two extra days per season, per decade .

Looking into the future , heatwaves are projected to become more frequent, with increases of between 20 and 40 extra days per season in the north and 5-10 extra days in the south likely by the end of this century, under a “business as usual” scenario. The intensity of heatwaves over southern Australia is also increasing faster than the average temperature. This is not good news for our ageing population, our fragile ecosystems and our outdated infrastructure.

The Australian research community has been successful in leading the development of a comprehensive way to measure marine heatwaves . Just like the atmosphere, areas of the ocean can experience prolonged periods of abnormally warm temperatures. These marine heatwaves can be every bit as damaging as atmospheric ones, decimating marine habitats and killing coral.

What we don’t yet know

Perhaps surprisingly, given the amount of research and public attention that heatwaves attract, they still do not have an official definition. The Bureau of Meteorology uses a concept called ex
cess heat factor
, which looks at maximum temperatures and ensuing minimum temperatures over a three-day period, incorporating the key characteristic of heatwaves of heat tending to persist overnight. However, we still do not have a universal definition that fits all situations.

We are also unclear on how the physical mechanisms that drive heatwaves will change under ongoing greenhouse warming. Recent research suggests that background warming will predominantly drive future increases in heatwaves, with some heatwave-inducing systems

moving further south. But we don't really know how future changes to patterns such as El Niño will continue to influence our heatwaves.

We also don't really understand the extent to which the land surface drives Australian heatwaves. European studies have shown that dry conditions leading up to heatwave season, resulting in more parched soils, are a recipe for more intense and longer events, particularly when coupled with a persistent high-pressure system.

For Australia, we know that dry soil contributed to the deadly heatwave that preceded the Black Saturday bushfires in 2009. But more extensive studies are needed to understand this complex relationship over Australian soil (pun intended).

We also need a more comprehensive understanding of marine heatwaves. So far there has been only a handful of studies describing individual events . We still don't know how much marine heatwaves have increased over recent decades, or how their causes and severity will change in the future. Given how vulnerable we are to marine heatwaves here in Australia, this topic should be a national research priority.

Finally, we need to develop more practical predictions of how heatwaves are likely to affect people in the future. We know how bad the impacts of heatwaves can be, and we know in general terms how heatwaves will change in the future. Yet the vast majority of our projections come from global climate models . Forecasting the exact impacts calls for finer spatial detail, using regional climate models. But these models are far more computationally expensive to run, and more investment into this area is necessary.

There is no doubt that heatwaves have been, and will continue to be, an integral feature of Australia's climate, and recent research has taught us a lot about them. But there is more work to be done if we want to safeguard Australians properly from their deadly impacts in the future.

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Read more http://theconversation.com/weve-learned-a-lot-about-heatwaves-but-were-still-just-warming-up-68174