Australian floods and climate change

Frank Gaglioti
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The floods that devastated the east coast of Queensland and New South Wales during February and March have been of an unprecedented nature. The amounts of rainfall that have fallen over a short period are staggering, causing devastating flooding to whole communities and the death of 22 people. The repair bill for roads and bridges is expected to be $1 billion, let alone the damage to homes, public facilities, farms, businesses and infrastructure.

The Climate Council has estimated that the flooding event will be the worst on record. It concluded that weather patterns previously described as extreme and thought to occur once in a hundred years are now occurring more frequently.

Climate Council scientist Professor Will Steffan told the Australian Broadcasting Corporation (ABC): "The point is we're having extreme events more often. 'Ordinary' extreme events are occurring now in rapid succession."

The totals from 9 a.m. on 24 February to 9 a.m. on 28 February at three weather stations give an indication for the colossal amount of rainfall. Mt. Glorious, an area of rainforest located 84 kilometres northwest of the Queensland state capital Brisbane, experienced the largest amount, 1,637 millimetres (64 inches), while Pomona, 135 kilometres north of the capital, had 1,180 mm (46 in) and Bracken Ridge, an outer suburb of Brisbane, experienced 1,094 mm (43 in).

Brisbane recorded a record 677 mm (27 in) over three days. Northern New South Wales (NSW) has experienced similar torrential rainfall and flooding. In the northern NSW city of Lismore, the State Emergency Service was overwhelmed within minutes. It was unable to answer calls promptly, hamstrung by a lack of personnel and the availability of only two boats to cover a city of 44,000. Over 14,000 houses were destroyed.

In Sydney, the NSW state capital and Australia's largest city, the worst-hit areas were working-class suburbs in the city's southwest, with more than 60,000 people affected.

Several climate phenomena have conflated to drive the extreme weather event. The immediate cause of the rainfall is an extremely slow-moving low-pressure system that dragged moist air from the Coral Sea onto the Australian east coast, emptying its massive water content over a limited geographic area. The media has dubbed the phenomenon a "rain bomb."

Nina Ridder, a research associate at the Centre of Excellence for Climate Extremes, told the *New Scientist* that "because it's so slow-moving [the weather system]—it's basically stationary—it's dumping all the water that it has on the same area."

While determining the exact contribution of climate change to specific extreme weather events is difficult, scientists are drawing general conclusions.

According to the vice-chair of the Intergovernmental Panel on Climate Change (IPCC) and director of the ANU Institute for Climate, Energy and Disaster Solutions, Mark Howden, the climate crisis was "embedded in this event."

The latest IPCC report on climate change was released February 28, predicting that increased atmospheric and sea temperatures would lead to an increase in intensity of storms.

"One of the clear projections is an increase in the intensity of heavy-rainfall events," said the coordinating lead author of an Australia-New Zealand chapter of the IPCC report, Brendan Mackey.

Scientists calculate that the atmosphere will hold an extra 7 percent of moisture for every degree rise in atmospheric temperature, leading to heavier rain and more extreme flooding events. Increases in surface ocean warming increases evaporation, delivering greater amounts of moisture into global weather systems. The average atmospheric temperature in Australia has increased 1.4? since records began to be kept in 1910.

"Current ocean temperatures around eastern and northern Australia are about 1? warmer than the long-term average, and closer to 1.5? warmer than average off the NSW coast," Joëlle Gergis, senior lecturer in Climate Science at Australian National University (ANU), stated in the *Conversation*.

Climate change is mostly caused by the burning of fossil fuels such as coal and petrol, producing greenhouse gases including carbon dioxide and methane. How it affects the complex, interacting factors driving Australian weather patterns and therefore extreme events is often difficult to determine precisely.

One of the most important drivers of Australian weather systems involves variations in surface ocean temperatures in the Pacific, Indian and Southern oceans. A significant factor is the El Niño–Southern Oscillation (ENSO), currently in the La Niña phase. ENSO is associated with variation in wind and ocean temperatures in the eastern Pacific Ocean. La Niña is usually associated with low surface air pressure on the

Australian continent and thus wetter weather patterns. The 2010–2012 La Niña was associated with the wettest two-year period on record up to that time, including flooding on the Australian east coast and Brisbane.

Oceanographers from the University of NSW who studied those floods found that it was likely that climate change had compounded the heavy rains during that La Niña event. Gergis explained that "their analysis highlighted how long?term ocean warming can modify rain-producing systems, increasing the probability of extreme rainfall during La Niña events."

Other significant factors contributing to current extreme rainfall are the negative Indian Ocean Dipole (IOD) and a positive Southern Annular Mode (SAM). The IOD is a difference in sea temperatures between two poles in the Arabian Sea and the eastern Indian Ocean south of Indonesia. This is known to affect rainfall patterns in Australia and neighbouring countries. In its negative phase it is associated with cooler sea surface temperatures and is known to cause more rainfall in northern and southern Australia.

The Southern Annular Mode (SAM) refers to the strong westerly winds that blow almost continuously in the mid- to high-latitudes of the southern hemisphere. These winds move from west to east and are known to bring rainfall to southern Australia. In its positive phase, the winds contract towards the South Pole, increasing the chance of summer rain in southwest Australia.

Since the 1980s, climate scientists have been warning that as a consequence of global warming extreme weather events would increase in frequency. Australia has been periodically devastated by extreme weather patterns over an extended period, including a record drought, devastating bush fires and floods. While they have previously occurred through history, these phenomena have been exacerbated by climate change, causing an increasing series of devastating climate events.

The Millennium drought from late 1996 to mid-2010 was part of a long-term drying trend that has persisted for more than four decades. It affected the Murray-Darling Basin and most of the country's state capital cities. It caused the northern subtropical areas of Australia to experience higher monsoonal rainfall. This was driven by a very strong El Niño phase.

In 2009 the state of Victoria was devastated by bush fires that killed 173 people. The Millennium drought was ended by the double La Niña of 2010-11 and 2011-12. This was accompanied by flooding in Queensland, NSW and Victoria in 2010-11. In 2013 there was significant flooding in NSW and Queensland due to Cyclone Oswald.

Honorary professor in the University of Melbourne School of Geography, Earth and Atmospheric Sciences David Karoly told the Australian Broadcasting Corporation (ABC) that both climate change and the occurrence of La Niña are likely to have contributed to the increased risk of heavy rainfall in southeast Queensland in the current event.

"The difficult part is to precisely quantify the increase in risk or the contribution to the amount of rainfall, both of which are uncertain," he said.

Researchers are continuing to examine more closely the linkages between climate change and the drivers of extreme weather events in Australia.

Wenju Cai, director of Southern Hemisphere Oceans Research at the Commonwealth Scientific and Industrial Research Organisation (CSIRO), and his team published a paper in August 2021 titled "Changing El Niño–Southern Oscillation in a warming climate." It examined ENSO events from the 1950s and compared them to the climate indicated by geological records. Their modelling implied "that ENSO would become more unstable and favour greater amplitude events under warming."

A study by John Fasullo, project scientist at the Climate and Global Dynamics Laboratory, and his associates, titled "ENSO's Changing Influence on Temperature, Precipitation, and Wildfire in a Warming Climate," also found that the effects of ENSO would be magnified under global warming. Examining the impact of El Niño, which is the opposite to La Niña, they predicted the worst impact would be felt in the US and Australia with increased impact of bush fires or wildfires and extreme temperatures.

Based on the study, Fasullo told the *Guardian*: "We can say that an El Niño of a given magnitude that forms in the future is likely to have more influence over our weather than if the same El Niño formed 50 years ago."

Australian politicians attempted to blame the current flood crisis on processes over which they have no control. NSW Liberal Premier Dominic Perrottet described the flooding as a "one-in-a-1000-year event," while Queensland Labor Premier Annastacia Palaszczuk said "I can't do anything about mother nature."

While huge natural forces are at work, governments have done little or nothing to warn about the floods, implement flood prevention and mitigation measures, ensure necessary emergency services are available or fund necessary aid and reconstruction.

At same time, governments in Australia, like those around the world, have ignored the warnings of climate scientists and refused to implement policies to halt and reverse climate change. Their cosmetic measures will only ensure the extreme weather events, including droughts and floods, will become more frequent and more severe in the future.