# EXTREME RAINFALL: THE INFLUENCE OF CLIMATE CHANGE

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## Background

This factsheet provides an overview of the influence of climate change on extreme rainfall and flooding.

As the heavy downpours and thunderstorms begin to hit Victoria and Australia's southeast, some of Victoria's most intense rainfall in decades is expected to fall over the next two to three days. Across the northern and central regions of the state, 100-200 mm is expected over three days, while rain totals may reach 250mm+ in the northeast ranges. Some parts are expected to receive more than 50 mm of rain in one hour. As a result, dangerous and widespread flash flooding is expected across Victoria.

## Key points

1. Climate change is influencing all extreme rainfall events. The warmer atmosphere holds more moisture, about 7% more than previously. This increases the risk of heavier downpours.
2. Globally, there are more areas with significant increases in heavy rainfall events than with decreases.
3. Extreme rainfall events like the Victoria rains are expected to further increase in intensity across most of Australia.
4. While there isn't a significant trend in observed extreme rainfall in Victoria yet, maximum one-day rainfall is projected to increase by 2-23% in Victoria by the end of the century if greenhouse gas emissions continue to rise.
5. It is critical that communities and emergency services have access to information about rainfall in a changing climate to ensure they can prepare for the future.

## The influence of climate change on extreme rainfall

The heavy downpours across southeast Australia are yet another reminder of how extreme weather events place lives, property and critical infrastructure at risk. Climate change is intensifying many extreme weather events in an atmosphere that is warmer and wetter because of increasing greenhouse gas emissions from human activities, primarily the burning of fossil fuels – coal, oil and gas.

### Extreme Rainfall

As greenhouse gases increase in the atmosphere, the climate system is warming because these gases are trapping more heat. The oceans are also warming, especially at the surface, and this is driving higher evaporation rates that, in turn, increases the amount of water vapour in the atmosphere (Figure 1). A warmer atmosphere can hold more water vapour, leading in turn to more intense rainfall. The 1°C temperature rise that has already occurred, together with increasing evaporation, has led to an increase of about 7% in the amount of water vapour in the atmosphere (Hartmann et al. 2013). This means that there is a greater risk of heavy downpours.

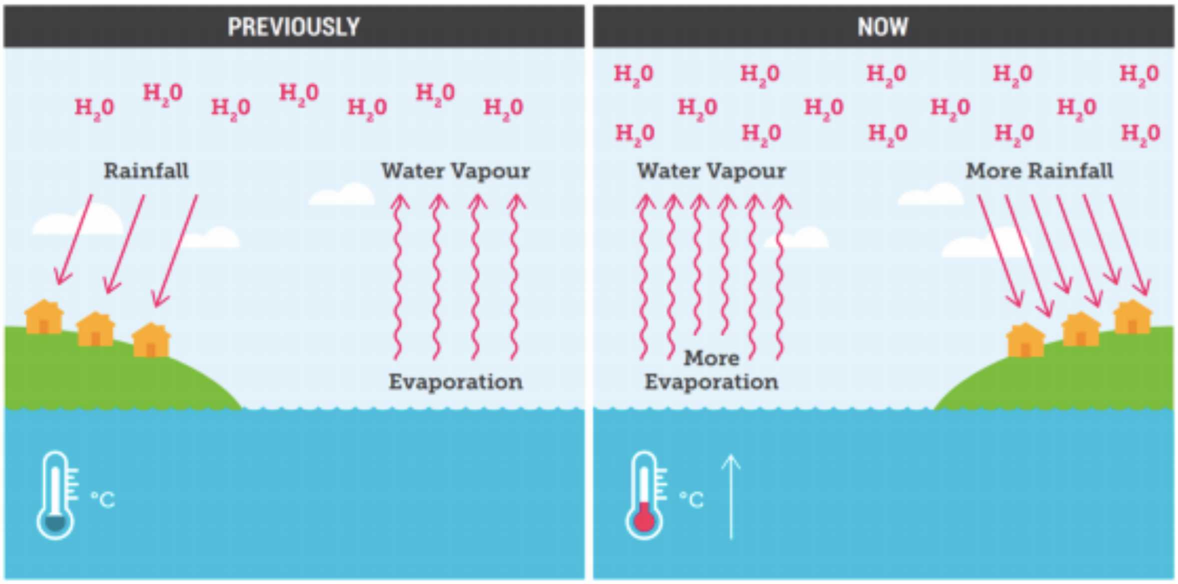


**Figure 1:** The influence of climate change on the water cycle. Left: The pre-climate change water cycle. Right: The water cycle operating under higher surface and ocean air temperatures, leading to more water vapour ($H_2O$) in the atmosphere, and in turn, more rainfall (Climate Council 2017).

## Impacts of Extreme Rainfall

Extreme rainfall has devastating effects on human health and our economy. A few examples are listed below.

### Health Impacts

Periods of heavy rainfall can threaten human health and wellbeing. While intermediate levels of rainfall can cause damage to property, heavy rainfall can claim lives. For example, in 2011 three intense downpours of 40-50 mm in only 30 minutes falling in already saturated catchments in Toowoomba and the Lockyer Valley led to burst creeks and caused flash flooding of up to 11 m through the Toowoomba city centre (Coates et al. 2012); 23 people drowned in these floods (van den Honert and McAneney 2011). Seventy eight percent of Queensland (an area larger than France and Germany combined) was declared a disaster zone. The floods created major health risks, including contamination of drinking water and food, as well as difficulties in accessing health services and treatments.

### Economic Impacts

In recent years, Melbourne has been significantly affected by several storms. In March 2010, a hailstorm brought very large hailstones – some of the biggest to hit Melbourne city in decades – resulted in over $1 billion in insured losses. Houses, businesses and schools were most affected. Eighteen months later, in December 2011, thunderstorms and torrential rain, hailstones and even tornadoes affected Melbourne, especially the northern and eastern suburbs. This storm resulted in over $700 million in insured losses, with significant damage to property, transport and infrastructure. In early 2011, floods throughout Victoria caused more than $1.5 billion of damage to the state's agriculture industry, with 2000 km of fencing damaged, more than 40,000 ha of crops destroyed, and over 6000 livestock killed (The Age 2011).


**Figure 2:** Extreme rainfall and storms in 2010 brought flash flooding to the streets of Melbourne.

## Extreme Rainfall projections

A 2°C rise in average global temperatures could result in a 10-30% increase in extreme downpours (Bao et al. 2017). In Australia, extreme rainfall events are projected, with high confidence, to increase in intensity, where extreme events are defined as the wettest day of the year and the wettest day in 20 years (CSIRO and BoM 2015; Bao et al. 2017). The tendency for an increase in intensity may be stronger for the larger, rarer events (current 1- in-20 year events) (Rafter and Abbs 2009) particularly at the sub-daily timescale (Westra et al. 2013).

For Victoria, the state likely to be most affected by the extreme rainfall, such events are likely to become more intense in future. For example, maximum one-day rainfall is expected to increase by 2-23%, by the end of the century for a high emissions scenario, relative to 1986-2005 climate (CSIRO and BoM 2015).

## Insurance

In Australia, flooding along Australia's densely populated coast is a significant societal risk. The most damaging events are likely to arise when inland flooding, storm surges and high tides occur concurrently. Climate change is a significant risk to the sustainability of current insurance practices. Further, the existing challenge of insuring natural catastrophes is made more difficult as climate change intensifies extreme weather events, combined with higher concentrations of wealth located in disaster-prone areas (CoastAdapt 2015). In March 2017, Australia's chief financial regulator, the Australian Prudential Regulation Authority, warned that banks and insurers must "rise to the challenge" of climate change.

## Halting the escalating risks of extreme weather

Extreme weather events such as extreme rainfall and consequent flooding are very likely to become more intense and destructive over the next couple of decades because of the climate change that is already locked in from past greenhouse gas emissions. But the severity of extreme weather events that our children and grandchildren will face later this century depends on how fast and how deeply greenhouse gas emissions can be reduced now, next year and over the next couple of decades.

## References

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