

# Watermark

Severe dust storm approaching Bedourie, QLD (Image from ABC News)

## Extreme Weather

**“ ... the question is not whether climate change is the cause of an extreme event, but whether we are seeing more of these events because of climate change.”**

(Sarah Perkins-Kirkpatrick, UNSW Climate Science Research Centre, 2015)

This issue of Watermark responds to a year of extreme weather events - most recently a damaging storm in South Australia in late September, flooding rains in western NSW in October - and reviews the current observations and published research of Australian and global climate scientists about the relationship between extreme weather events and global climate change.

**Research by ANU in 2015 found that experiencing extreme weather activity - excessive heat, droughts, flooding, and hurricanes - had a modest but positive increase in the level of an individual's concern about climate change.**

### State of the Climate 2016

The *State of the Climate 2016* report was released by the Bureau of Meteorology and CSIRO on 27 October 2016.

The report focuses on current climate trends that are likely to continue into the near future.

This acknowledges that climate change is happening now, and that we will be required to adapt to changes during the next 30 years.

A new inclusion in the report is the “science of extreme event attribution”.

#### MORE INSIDE

Watermark is a regular publication of the Conference of Leaders of Religious Institutes in NSW

**"Global warming continues, due in part to human activity:**

**2015 was the warmest year on record, and 2016 will likely be warmer still...**

**This is leading to ever more severe droughts, floods, fires and extreme weather events."**

(Pope Francis, Message marking World Day of Prayer for the Care of Creation, 1 October 2016)

## LONG TERM CHANGE 1

### Earth heating up causing ocean warming

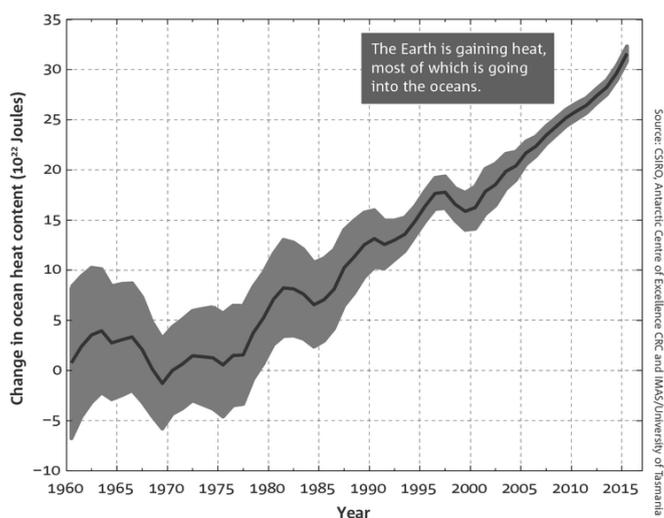
While natural variability continues to play a large role in Australia's climate, the *State of the Climate 2016* report indicates some apparent long term trends.

The terrestrial climate has warmed by around 1 degree Celsius since 1910, with an accompanying increase in the duration, frequency and intensity of extreme heat events across large parts of Australia.

There has been an increase in extreme fire weather, and a lengthening of the fire season in most fire prone regions since the 1970s.

Observations indicate that atmospheric circulation changes in the Southern Hemisphere have led to an average reduction in rainfall across parts of southern Australia.

Australia's oceans have also warmed, with sea surface temperature increases closely matching those experienced on land.



## LONG TERM CHANGE 2

### Ocean warming affecting Australia's weather systems

When we talk about the climate system continuing to warm in response to historical greenhouse gas emissions, that is almost entirely due to ongoing ocean warming, which the above observations show is now steadily in train.

Ocean warming affects both the marine environment and Australia's terrestrial climate, due to the considerable influence of surrounding oceans on our weather systems.

## Australia's changing climate: TEMPERATURE

### Key points

- Australia's climate is warming, with around a 1 °C increase in both mean surface air temperature and surrounding sea surface temperature since 1910.
- The duration, frequency and intensity of extreme heat events have increased across large parts of Australia.
- The number of days per year over 35 °C has increased in recent decades, except in parts of northern Australia.

### FIRE SEASON

#### Key point

- There has been an increase in extreme fire weather, and a longer fire season, across large parts of Australia since the 1970s.

### RAINFALL

#### Key points

- May–July rainfall reduced by around 19 per cent since 1970 in the southwest of Australia.
- A decline of around 11 per cent since the mid-1990s in the April–October growing season rainfall in the continental southeast.
- Rainfall increased across parts of northern Australia since the 1970s.

For more detail on these topics in the *State of the Climate 2016* report go to <http://www.bom.gov.au/state-of-the-climate/australias-changing-climate.shtml>

Climate scientists, such as NASA's Gavin Schmidt, emphasize that while individual weather events and even monthly rankings may be newsworthy, "they are not nearly as important as long-term trends".

## Determining the cause of extreme weather events

As the global climate system has warmed, changes have occurred to both the frequency and severity of extreme weather.

In Australia, the most obvious change has been an increase in the occurrence of record-breaking heat.

Quantifying the influence of increasing atmospheric greenhouse gases on extreme weather events is an important component of communicating and planning for future climate change.

## Recent Severe Storms

The potential increase in storm intensity is embedded in the extra energy warmer air and warmer water hold.

Hurricane Matthew, and the damage it created in Haiti through to the Carolina states of the USA in October 2016, is an example of how storms that feed off warmer waters have a greater likelihood of being stronger.

Cold front-causing storms as experienced in South Australia in September 2016 become stronger when the front undercuts warm air and thus releases massive amounts of energy.

However, the question of how the intensity of a storm, cyclone or hurricane will increase and which regions will be most affected is not straightforward.

“Tornadoes, typhoons, hurricanes and mid-latitude storms – along with heatwaves and floods – are widely regarded as climate change’s shock troops;

The atmosphere is far from isolated and interacts with other elements of the so-called “Earth system”, such as the oceans, ice caps and even the ground beneath our feet, in complex and often unexpected ways...”

*Bill McGuire is professor emeritus in geophysical and climate hazards at UCL. His current book is **Waking the Giant: How a Changing Climate Triggers Earthquakes, Tsunamis and Volcanoes.***

## Land of Flooding Rain

2016 has been a year of severe and torrential flooding – affecting Victoria, Tasmania, South Australia and most recently Western NSW.

**In a special climate statement in mid October, the Bureau of Meteorology said that the Murray-Darling Basin had its wettest September on record.**

“The May to September period was Australia’s wettest on record, with each of the five individual months ranking in the 10 wettest in the last 117 years,” the report said.

Results regarding the altered risk in rainfall events, due to human influence, have been inconsistent.

However, there is a link between a warming world and rain extremes.

**Scientists estimate that the atmosphere can hold seven per cent more moisture for each degree of warming.**

This has been the reality since the Industrial Revolution when we began burning fossil fuel and clearing land for agriculture.

Sea levels have risen around Australia, which have the potential to amplify the effects of high tides and storm surges.

“In the face of the emergencies of human-induced climate change, social exclusion, & extreme poverty, we join together to declare that:

Human-induced climate change is a **scientific reality**, and its decisive mitigation is a **moral and religious imperative** for humanity.”

Pontifical Academies of Sciences and Social Sciences



## Climate Change and Rural Communities

The '*On the Frontline: Climate Change and Rural Communities Report*' from the Climate Council in August 2016 indicates how climate change will worsen the systemic disadvantages suffered by rural and regional communities in Australia.

**The report finds the increase in extreme weather events, such as bushfires and droughts, is disproportionately affecting those in rural areas with serious social, health and economic impacts.**

Whilst there is great resilience and incremental signs of adaptation to climate change, rural communities have experienced:

- a loss of population, services and employment;
- increased debt taken on by agricultural businesses
- concerns that agricultural productivity gains may falter.

With Australian agriculture providing about **93% of domestic food needs**, the report details observed and projected impacts of climate change on five of Australia's major crops.

The report sees opportunities for communities tackling climate change, especially in the area of renewable energies.

### LEARN MORE

*State of the Climate 2016 can be read on either the Bureau or CSIRO's websites. The online report includes an extensive list of references and useful links.*

*Watch the State of the Climate 2016 summary video.*

*CSIRO, the Bureau of Meteorology and the Department of the Environment and Energy have provided a comprehensive portal for climate projection science, data and information called Climate Change in Australia. This website includes regional climate projections, a publication library, guidance material and a range of interactive tools.*



Flooding in NSW © DWSPL/T.Scott (HR)

### Pope Francis Offers Six New Beatitudes

*\*Blessed are those who remain faithful while enduring evils inflicted on them by others and forgive them from their heart.*

*\*Blessed are those who look into the eyes of the abandoned and marginalized and show them their closeness.*

*\*Blessed are those who see God in every person and strive to make others also discover him.*

*\*Blessed are those who protect and care for our common home.*

*\*Blessed are those who renounce their own comfort in order to help others.*

*\*Blessed are those who pray and work for full communion between Christians.'*

**- Pope Francis, 1 November 2016, Sweden**

### USEFUL WEBSITES

Climate Council  
<https://www.climatecouncil.org.au/>

Global Catholic Climate Movement  
<https://catholicclimatemovement.global/>

Catholic Earthcare Australia  
<http://catholicearthcare.org.au/>

Australian Religious Response to Climate Change  
<http://www.arrcc.org.au/>