Corals on the Great Barrier Reef have bleached again in 2017 as a result of extreme summer temperatures. It's the fourth such event and the second in as many years, following earlier mass bleachings in 1998, 2002 and 2016.

The consecutive bleaching in 2016 and 2017 is concerning for two reasons. First, the 12-month gap between the two events is far too short for any meaningful recovery on reefs that were affected in 2016.

Second, last year's bleaching was most severe in the northern section of the reef , from the Torres Strait to Port Douglas, whereas this year the most intense bleaching has occurred further south, between Cooktown and Townsville. The combined footprint of this unprecedented back-to-back bleaching now stretches along two-thirds of the length of the Great Barrier Reef.

Last year, after the peak temperatures in March, 67% of the corals died along a 700km northern section of the reef – the single greatest loss of corals ever recorded on the reef .

Further offshore and to the south, most of the bleached corals regained their colour after the 2016 bleaching, and survived. The patchiness of the bleaching means that there are still sections of the Great Barrier Reef that remain in good condition.

It is still too early to tell how many corals will survive or die over the next few months in the central section as a result of this year's bleaching.

Four major events

Each of the four bleaching events has a distinctive geographic pattern that can be explained by where the water was hottest for sustained periods during each summer .

For example, the southern Great Barrier Reef escaped bleaching in both 2016 and 2017 because the summer sea temperatures there remained close to normal. Similarly, the earlier

mass bleaching events in 1998 and 2002 were relatively moderate, because the elevated water temperatures experienced then were lower than those in 2017 and especially 2016.

The marine heatwaves in 1998 and 2016 coincided with El Niño periods , but this was not the case in 2002 or this year, when water temperatures were also abnormally high. Increasingly around the tropics, we are seeing more and more bleaching events, regardless of the timing relative to the El Niño-La Niña cycle. This reflects the growing impact of global warming on these events.

The local weather also plays an important role in determining where and when bleaching occurs. For example, in 2016, ex-Tropical Cyclone Winston came from Fiji to Australia at the end of February as a rain depression, and cooled the southern region of the Great Barrier Reef, saving it from bleaching.

This year, the category 4 Tropical Cyclone Debbie tracked across the reef in late March, close to the southern boundary of the latest bleaching.

But TC Debbie was too far south to prevent the bleaching that was already under way in the reef's central and northern sections. Instead of helping to ameliorate the bleaching, this powerful cyclone has added to the pressures on some southern reefs by smashing corals and exacerbating coastal runoff.

Prospects for the future

The fallout from this and last year's events will continue to unfold in the coming months and years. It takes several months for severely bleached corals to regain their colour, or to die. On some reefs in the Great Barrier Reef's central region, underwater surveys in 2017 are already documenting substantial loss of corals.

The recovery times for northern and now central reefs that have lost many corals will be at least 10-15 years, assuming that conditions remain favourable for corals during that period .

We have a narrowing window of opportunity to tackle global warming, and no time to lose in moving to zero net carbon emissions. We have already seen four major bleaching events on the Great Barrier Reef with just 1 of global average warming.

The goals enshrined in the Paris climate agreement , which aims to hold global warming well below 2 and as close as possible to 1.5, will not be sufficient to restore the Great Barrier Reef to its former glory. But they should at least ensure that we continue to have a functioning coral reef system.

In contrast, if the world continues its business-as-usual greenhouse emissions for several more decades, it will almost certainly spell the end of the Great Barrier Reef as we now know it.

Terry Hughes receives competitive research funding from the Australian Research Council, and provides regular advice to both the Commonwealth and Queensland governments.

James Kerry does not work for, consult, own shares in or receive funding from any company or organisation that would benefit from this article, and has disclosed no relevant affiliations beyond the academic appointment above.

Authors: Terry Hughes, Distinguished Professor, James Cook University, James Cook University

Read more http://theconversation.com/back-to-back-bleaching-has-now-hit-two-thirds-of-the-great-barrier-reef-76092