Rising sea levels could benefit some reef systems

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Researchers at The University of Western Australia have found rising sea levels can significantly reduce daily water temperature extremes in many reefs worldwide that experience strong tidal conditions. The research was published today in the international journal *Science Advances*.

Professor Ryan Lowe, from UWA's Oceans Institute and School of Earth and Environment, led a research team from UWA, with support from the Western Australian Marine Science Institution, which investigated the mechanisms that drove local temperature variations within the reef systems of the remote and pristine marine environment of the Kimberley coast.

The Kimberley region is home to some of the world's most extreme tidal ranges, sometimes more than 12 metres.

Climate-driven ocean warming arguably poses the greatest threat to the world's coral reefs and scientists warn higher levels of atmospheric carbon dioxide will cause substantial changes to ocean temperatures and chemistry over the next century, increasing the frequency and severity of mass bleaching and other stresses on coral reefs.

Professor Lowe said temperatures within shallow reefs could often differ substantially from the surrounding ocean, so predicting future patterns of bleaching and other stresses on reefs depended on our capacity to predict conditions in reef environments.

"Temperature is widely recognised as a key environmental driver of reefs and temperature extremes are known to be one of the key stressors to coral reef communities around the world," he said.

Recent research has focused on trying to improve predictions of regional ocean warming patterns that are being driven by long-term climate change as well as the intensification of short-term climate patterns such as the El Niño-Southern Oscillation cycle.

Yet scientists currently lack the ability to predict how tides generally control temperature extremes across a wide geographic range of reef systems, and in turn how projected rising sea levels and reduced reef growth rates will alter the thermal conditions within reef waters.

UWA's researchers developed a model to accurately predict temperature variations within shallow reef systems based on local tidal conditions, solar heating properties and reef structures.

Professor Lowe said field studies revealed extreme temperature fluctuations in the reef reaching 38C and varying by more than 10C over a single tidal cycle.

Over a 15-day cycle, the water temperatures became most extreme when the low tide period drifted to align with maximum heating by the sun at noon, which warmed the shallow water on the reefs, Professor Lowe said.

"These temperatures are particularly extreme in regions when the tidal range is large when compared to the water depth over a reef, which can cause shallow water to 'pond' within reefs for extended periods of time each day," he said.

"So even a modest rise in sea level could help lower the water

temperature of the reef and may also partially reduce reef heat extremes in the world's warming oceans."

More information: R. J. Lowe et al. Rising sea levels will reduce extreme temperature variations in tide-dominated reef habitats, *Science Advances* (2016). DOI: 10.1126/sciadv.1600825

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