Dynamic atolls give hope that Pacific Islands can defy sea rise

April 17 2014, by Paul Kench

The tiny Pacific nation of the Marshall Islands could avoid being swamped entirely, although it will still suffer profoundly from sea-level rise. Credit: Christopher Johnson/Wikimedia Commons

It is widely predicted that low-lying coral reef islands will drown as a result of sea-level rise, leaving their populations as environmental refugees. But new evidence now suggests that these small islands will be

more resilient to sea-level rise than we thought.

That is not to say that these tiny nations won't face significant environmental challenges. Built of sand and shingle and lying just 1-3m above the current sea level, coral reef islands in the central Pacific and Indian Oceans are considered among the most vulnerable places on Earth.

The new findings suggest that, rather than being passive lumps of rock that will be swamped by rising seas and eroded by storms, the islands are dynamic structures that can move and even grow in response to changing seas.

But although the islands may survive into the future, the changes could still affect issues like fresh water and agriculture, potentially making life on these islands much more difficult than it is today.

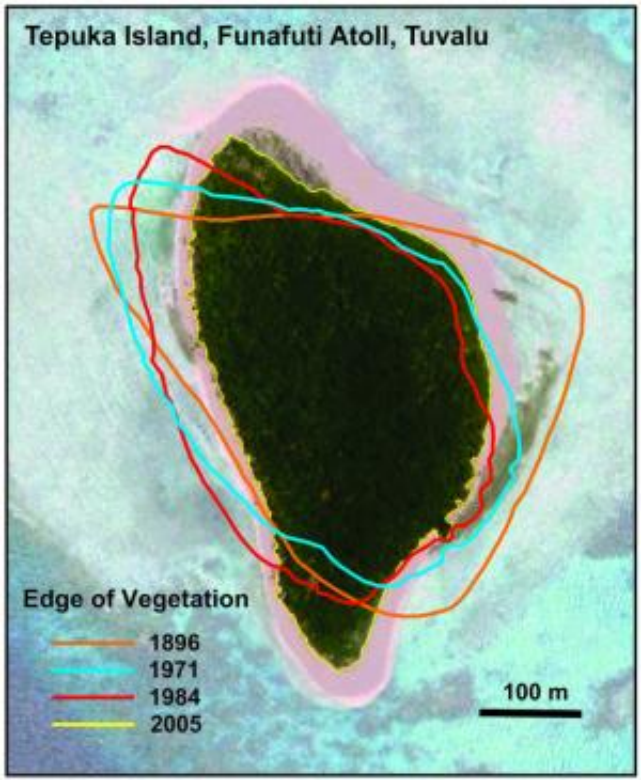
Long-term island formation

We have closely examined how reef islands formed over the past 5,000 years in response to past changes in sea level, in a bid to find out how islands might behave in the future. In our most recent study, we show that Jabat Island in the Marshall Islands, central Pacific, was created 5,000 years ago as sea level rose to 1.5m above its present level.

Since that time, sea levels have fallen once more, leaving the island much higher relative to the current sea level. Over the coming century, future sea-level rise will simply reoccupy the levels under which the island formed. This finding is consistent with our case studies in the Great Barrier Reef and the Maldives, which show that islands can form under a range of sea-level conditions including rising, falling, and stable.

Together, these studies show that sea level alone is not the main factor

that controls the formation and subsequent change of reef islands. These processes also depend on the surrounding coral reef generating sufficient sand and shingle to build islands.



Changes in vegetated shoreline on Tepuka Island, Funafuti Atoll, Tuvalu 1896-2005.

Changes over the past century

We also looked at how islands have physically changed over the past 60 to 100 years. Our study sites are in regions of the Pacific Ocean where sea level has been rising at more than 2mm per year for the past five decades.

Using comparisons of historical maps, aerial photographs and satellite images, we have been able to test the hypothesis that central Pacific Islands have begun to erode away in response to this sea-level rise.

One example is the reef islands in Funafuti Atoll, Tuvalu, in the central Pacific. Our study found that most of these islands either remained stable in size or grew larger over the past few decades, in spite of rising sea levels.

Another of our studies found that islands in Nadikdik Atoll, Marshall Islands, have been rebuilt over the past century despite being destroyed by a typhoon in 1905. All of this shows that reef islands are able to grow under current climate conditions.

Dynamic islands

This suggests that coral islands are very dynamic landforms that adjust their shape and position on reef surfaces over decades. Low-lying islands are built by the action of waves and currents, which deposit sand and gravel at the shoreline. Just like any beach, as wave and current processes change, island sand and shingle is mobilised and deposited elsewhere on the shoreline. Through this ongoing process islands can change their shape and migrate across reef surfaces.

We are now aiming to work out the scale and speed of these changes – which will be crucial for helping island communities to adapt to the rising seas. One question is whether islands can build vertically to keep pace with rising sea levels.

Our results suggest that islands can grow upwards when waves wash over them during storms or tsunami, depositing sand in the process. This suggests that islands may be able to withstand rising sea levels and increased storminess – although life on those islands may be very

different to today.

What does this mean for small island nations?

On the face of it, this is potentially good news for Pacific communities. The islands they call home may be less vulnerable than is commonly thought.

But our findings also suggest that although the islands may not be swamped by rising seas, they are likely to change in size and shift their position on the surface of reefs. The rate of these changes may also increase as sea level rises.

This raises questions for their ongoing habitation. How will physical changes to the islands affect drinking water supplies, and how will communities need to adapt their farming practices? Questions about island change must be addressed urgently in order to inform decision making and secure the future of Pacific nations.

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