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A team of UQ researchers is working tirelessly to find an environmental engineering solution for a very human problem in the Solomon Islands, where the lives of entire communities are in turmoil thanks to drastic sea level rises.

“We as the international community have a lot to learn...”

– Dr Simon Albert on his engagement with the Solomon Islanders

Dr Simon Albert wants to solve an urgent, catastrophic environmental engineering conundrum.

He is focused on the watery world of sea-level rise in the Solomon Islands – a ‘natural laboratory’ for one of the greatest challenges humanity has ever faced.

The research is a combined effort, and scientists include Dr Badin Gibbes and Dr Alistair Grinham from UQ’s School of Civil Engineering, as well as Dr John Church from CSIRO, Dr Javier Leon from the University of the Sunshine Coast, and Professor Colin Woodroffe from the University of Wollongong.

Dr Albert has conducted research that can be applied to the challenges faced by society – none more so than the impact of sea-level rise on communities across Melanesia as an early indicator of their devastating potential for the rest of the world.

At least five reef islands in the remote Solomon Islands, ranging from one to five hectares in size, have completely succumbed to sea-level rise and coastal erosion, and a further six islands have been severely eroded.

Although anecdotal accounts across the Pacific have for decades detailed the devastating impact of climate change on their coastlines, homes and communities, the first scientific evidence, published in *Environmental Research Letters*, now confirms that sea-level rises in the area do register above the global average of 3mm per year.

The compromised islands, which have experienced annual rates of sea-level rise of 7-10mm since 1993, once supported dense tropical vegetation that was at least 300 years

old. Nuatambu Island, for example, is home to 34 families, but has lost more than half of its habitable area, with 24 houses washed into the sea since 2011.

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Given that the Solomon Islands currently experience high sea-level rise rates, are home to low-lying coastal communities and absorb high wave energy (high intensity waves breaking onto the shoreline), they offer a vital glimpse of what the rest of the globe may experience as the second half of the 21st century ticks ever closer.

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“All that has happened in the Solomons over the last 20 years is not purely as a result of climate change – there’s certainly a natural cycle in play,” Dr Albert said.

“However, the effects of climate change are a big part of it, and the extraordinarily high rates of sea-level rise that we have seen in the Solomons are likely to be experienced globally into the future.”

Dr Albert’s work involves comparing historical photos dating from World War II with modern-day satellite images. More recently, unmanned aerial vehicles (commonly known as drones) have also been used to map the Islands in very high resolution, enabling the team to track the islands’ growth or retreat over time.

The team integrates this information with local traditional knowledge, radiocarbon dating

of trees, sea-level records, and wave models, to show the importance of integrating local assessments with traditional knowledge when planning for sea-level rise and climate change.

This global issue has gathered pace over more than one hundred years and will require long-term thinking to develop solutions. Even then, the solutions are likely to take decades to have an effect.

One of the most challenging aspects of that long-term thinking is working closely with communities whose whole livelihoods will be shattered by the inevitability of sea-level rises before a solution can rectify the damage.

“It can be difficult working with those local communities, especially when it comes to addressing these issues because clearly, remote Indigenous communities don’t have any capacity to address the root cause – that’s really up to the international community,” Dr Albert said.

Dr Albert’s team has found that the wisdom of the local people offers essential context for the science and engineering they employ.

Over a decade of engagement in the Solomons has cemented Dr Albert’s team’s close relationships with the government and the local communities. They’ve been able to tap into a rich pool of traditional knowledge, including ancient stories of changing coastline patterns, currents, waves and sea-levels.

“It’s obviously very difficult to go back in time to try to understand what the drivers were, but working closely with the local people has been a real strength of our work,” Dr Albert said.

“It’s allowed us to create some really rich case-studies about the experiences of those communities.”

These stories have garnered the strongest international interest in the team’s research. Rather than just presenting graphs, numbers

and predictions, the team has been able to offer a human face to the impact on the Solomon Islanders and their plight thanks to partnerships with local communities.

Linking their experiences and knowledge with the ability to see high resolution topographic mapping has also helped the locals to plan how they can adapt to the rise.

In many cases, traditional concrete seawalls are not a viable option on these remote islands and can be counter productive as they interfere with natural island building processes. However, Dr Albert's team are exploring emerging technologies such as deploying three-dimensional printed coral-like structures that can act as a submerged seawall to reduce the erosion caused by waves under high sea levels.

For some communities, relocation is the only option. The ocean has already claimed their houses, so adaptation techniques such as foreshore revegetation, mangrove planting or sea walls aren't feasible from an engineering perspective. Based on that knowledge, Dr Albert and his team have therefore advised and offered planning support to these communities to help with their relocation.

"Often these people have an incredible amount of resilience and wisdom in their own right, and they're already making smart decisions about how that relocation takes place," he said.

"At least half a dozen villages, with up to 200 people each, are going through this process of relocation now.

"A thousand people in a large provincial town, with infrastructure like a hospital, schools, communication networks and its own local government, will also have to relocate in the next decade, which is obviously a much more complicated process because of the infrastructure involved."

Although the global Green Climate Fund has around US\$100 billion available to support developing countries to adapt to climate change, accessing these funds is a major challenge for small affected communities, which Dr Albert's research has highlighted.

"How does that high-level fund link down to these remote, rural communities that are relocating at the moment with just their own resources?" he said.

"We've worked with many families that are quite literally trying to scratch together \$500-1000 to help them buy petrol for their chainsaw to cut some timber so they can rebuild their family home that's been lost from sea-level rise.

"That disconnect between the global effort and these remote communities on the front line is a real issue, and we've been hoping that by documenting their stories and communicating them to a global audience, we can help to bridge that gap."

Engineers don't usually like talking about their emotions according to Dr Albert, but from an environmental engineering perspective, the stories and the people in the Solomons actually inspire him to continue his work.

"We as the international community have a lot to learn from these people.

"Too often, we go out to these places and do this work with a vision of imparting knowledge and teaching people – but in my experience, it's been much more of a two-way dialogue that gives me incredible inspiration.

"To be able to learn from these wise, resilient people who are on the front line of such a globally important topic, I find it inspiring to be able to communicate their stories, to drive the climate dialogue forward from being so bogged-down in data and numbers and projections – and try to put a human face on that where possible," Dr Albert said.

Ultimately, the team hopes that their research in the Solomons will help to develop a best-practice guide to develop novel, holistic approaches to sea-level rise adaptation and relocation that consider the science and data of these problems equally alongside their social and human dimensions.

What will happen to the rest of the world? Dr Albert is realistic.

"The projections for the major cities around the world are really confronting and challenging," Dr Albert said.

"The more research that's completed and the better that scientists can communicate it, the more that town planners and governments can start to take these planning issues much more seriously.

"It's not something that will happen in an election cycle, or even in a generation, so in many ways, this is a first for humanity – addressing a multi-generational planning challenge that affects us all."

In other words, there is no easy answer. But research like Dr Albert's is helping to plan for possible global contingencies as the tide inevitably continues to rise.

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(Image credit: Dr Simon Albert)

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Progress to date

2010–2012: Awarded a grant from the Australian Government to understand vulnerability of the Solomon Islands to climate change

2013: Sea-level rise research program started after observing first hand houses and islands being lost to sea level rise

2014: Partnership with The Nature Conservancy provided resources to conduct initial surveys of islands

2015: Strategic funding from UQ enabled the team to scale up surveys to 33 islands

2016: Paper in Environmental Research Letters published that documented the dramatic erosion of islands

2016: Global media coverage from *BBC*, *CNN*, *Time*, *The Conversation*, *Washington Post*, and *Scientific American* provided widespread awareness of the research findings

Now: Preparation of grant proposals to scale the work up further to new geographic areas

Future: Install real-time monitoring networks on vulnerable islands to guide the design of coastal adaptation options

