INTERNATIONAL PACIFIC RESEARCH CENTER
IN THE SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY AT THE UNIVERSITY OF HAWAI'I AT MĀNOA

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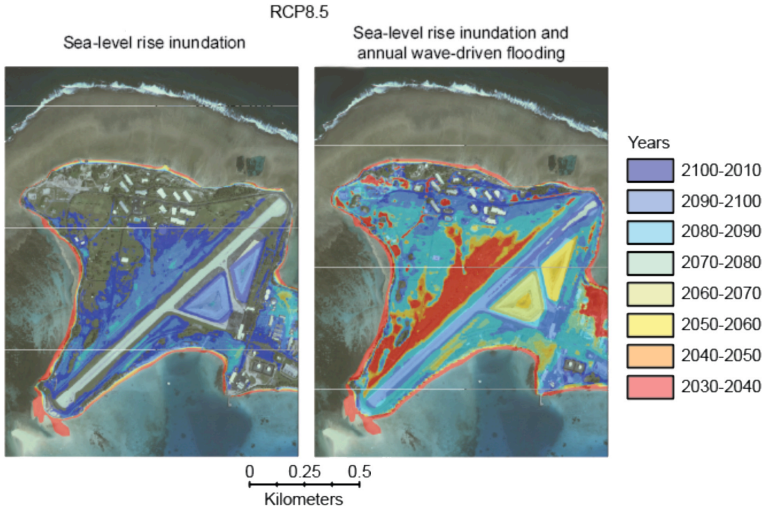
Low-lying island habitability threatened by wave-driven inundation sooner than previously thought

New estimates derived from an international effort predict that many low-lying atoll islands throughout the Pacific, and beyond, may become uninhabitable by mid-century. The combination of rising sea levels and wave-driven flooding will cause frequent damage to infrastructure and will irreversibly contaminate island freshwater resources by 2030-2060, a new study published in *Scientific Advances* states.

Researchers from the US Geological Survey (USGS), the National Oceanic and Atmospheric Administration (NOAA), the International Pacific Research Center (IPRC) at the University of Hawai'i at Mānoa (UHM), and others, improved estimates of atoll habitability by considering not just sea level rise, but also the effects of wave activity that drive overwash flooding of these low-lying islands with elevations less than two meters.

Previous studies have considered only the hazard from the rise in average sea level gradually inundating the atolls, and estimated that the islands would still be livable until 2100 or later. This study, however, focusing on Roi-Namur Island of Kwajalein Atoll in the Republic of the Marshall Islands, includes the additional effects of waves, which begin to have serious consequences far sooner.



Flooding projections comparing the effects of just sea level rise with SLR plus wave-driven flooding, for high greenhouse-gas emission conditions.

With multi-meter-high waves riding a higher average sea level, active flooding can occur more frequently as seawater breaches coastal berms, damaging coastal infrastructure and soaking into the shallow freshwater lens, contaminating the limited aquifer. Subsequent rainfall can replenish the freshwater of the aquifer over time, but if a second flooding event occurs too soon, salinity levels in the aquifer will remain too high for safe drinking.

"The tipping point when potable groundwater on the majority of atoll islands will be unavailable is projected to be reached no later than the middle of the 21st century," said Curt Storlazzi, USGS geologist and lead author of the new report.

Accurate climate models for the area were key to establishing this timeline. Hariharasubramanian Annamalai, of the IPRC, and Matthew Widlansky, of the UH Sea Level Center, evaluated 41 global climate models for those that best simulated recent conditions and trends (precipitation, sea surface temperatures, wind variability, etc.) in the Pacific and Indian Ocean regions. From this pool, they selected five models that best captured past patterns and used them to project future conditions, particularly storm activity, each decade until 2100.

"The worldwide teamwork is the beauty of this project, with all the different modeling aspects—climate, wave dynamics, groundwater hydrology—all brought together so smoothly and efficiently," said Annamalai. He emphasized that the wave-driven flooding, compounding sea level rise, is the key to this new story, as the wave hazard "adds flame to the fire."

Storlazzi notes that their results are applicable to low-lying islands throughout the Pacific and beyond, underlying the urgency to evaluate which islands are most vulnerable and to begin exploring possible political and engineering solutions. Annamalai plans to expand on this work by applying the same techniques to island groups in the Indian Ocean (the Seychelles and the Maldives) where communities are already suffering greatly from increased cyclone activity.

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Citation:
Storlazzi CD, Gingerich SB, van Dongeren A, Cheriton OM, Swarzenski PW, Quartaert E, Voss CI, Field DW, Annamalai H, Piniak GA, & McCall R (2018). Most atolls will be uninhabitable by the mid-21st century due to sea-level rise exacerbating wave-driven flooding. *Scientific Advances* doi: 10.1126/sciadv.aap9741.

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