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Climate Change Reduces Coral Reefs' Ability to Protect Coasts

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Aerial photograph of Kwajalein Atoll showing its low-lying islands and coral reefs. (High resolution image)

Aerial photograph of Kwajalein Atoll showing its low-lying islands and coral reefs. (High resolution image)

SANTA CRUZ, Calif. — Coral reefs, under pressure from climate change and direct human activity, may have a reduced ability to protect tropical islands against wave attack, erosion and salinization of drinking water resources, which help to sustain life on those islands. A new paper by researchers from the Dutch independent institute for applied research Deltares and the U.S. Geological Survey gives guidance to coastal managers to assess how climate change will affect a coral reef's ability to mitigate coastal hazards.

About 30 million people are dependent on the protection by coral reefs as they live on low-lying coral islands and atolls. At present, some of these islands experience flooding due to wave events a few times per decade. It is expected that this rate of flooding will increase due to sea level rise and coral reef decay, as the remaining dead corals are generally smoother in structure, and do less to dissipate wave energy. Loss of coral cover not only causes increased shoreline erosion but also affects the sparse drinking water resources on these islands, which may eventually make these islands uninhabitable. In order to prevent or mitigate these impacts, coastal managers need know to what extent their reef system may lose its protective function so that they can take action. The new study gives guidance on a local reef's sensitivity to change. The new research has been accepted for publication in "Geophysical Research Letters," a journal of the American Geophysical Union.

To gain insight into effects of changing conditions on coral reefs, the study authors used Xbeach (an open-source wave model). The computer model was first validated using field measurements obtained on the Kwajalein Atoll in the Marshall Islands in the Pacific Ocean, and was then used to investigate what the effects on water levels, waves, and wave-driven runup would be if certain reef properties change. Reef roughness, steepness, width and the total water level on the reef platform are all important factors for coastal managers to consider when planning mitigating measures.

The results suggest that coasts fronted by relatively narrow reefs with steep faces and deeper, smoother reef flats are expected to experience the highest wave runup and thus potential for island flooding. Wave runup increases for higher water levels (that are expected with sea level rise), higher waves, and lower bed roughness (as coral degrades and becomes smoother), which are all expected effects of climate change. Rising sea levels and climate change will have a significant negative impact on the ability of coral reefs to mitigate the effects of coastal hazards in the future.

The research paper, "The influence of coral reefs and climate change on wave-driven flooding of tropical coastlines," is published as an open-access paper and available online.

Quataert, E., C. Storlazzi, A. van Rooijen, O. Cheriton, and A. van Dongeren (2015), The influence of coral reefs and climate change on wave-driven flooding of tropical coastlines, Geophysical Research Letters, 42, doi:10.1002/2015GL064861

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