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TITLE: Predicting Future Groundwater Resources of Coral Atoll Islands

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ABSTRACT:

Abstract Fresh groundwater reserves on small coral islands are under continual threat of salinization and contamination because of droughts, storm?surge overwash events, over?extraction, island community urbanization, and sea level rise. Whereas storm?surge overwash events can cause sudden groundwater salinization, long?term changes in rainfall patterns and sea level elevation have the potential of rendering these islands uninhabitable in the coming decades. This study demonstrates the use of a tested freshwater lens thickness simulator to estimate the groundwater resources of a set of atoll islands in the coming decades. The method uses ranges of projected rates of annual rainfall and sea level rise (SLR) to provide a range of probable lens thickness for each island. Projected rainfall is provided by General Circulation Models that accurately replicate the historical rainfall patterns in the geographic region of the islands. Methodology is applied to 68 atoll islands in the Federated States of Micronesia. These islands have widths that range between 150 and 1000 m, and experience annual rainfall rates of between 2.8 and 4.8 m. Results indicate that under average conditions of SLR, beach slope, and rainfall, almost half of the island will experience a 20% decrease in lens thickness by the year 2050. For worst?case scenarios (high SLR, low rainfall), average decrease in lens thickness is 55%, with almost half of the islands experiencing a decrease of greater than 75% and half of the islands having a lens thickness less than 1.0 m. Small islands (widths less than 400 m) are particularly vulnerable because of shoreline recession. Groundwater on islands in the western region is less vulnerable to SLR because of a projected increase in rainfall during the coming decades. Results indicate the vulnerability of small islands to changing climatic conditions, and can be used for water resources management and community planning. Methodology can be applied to any group of islands as a first approximation of the effect of future climate conditions on groundwater resources. Copyright © 2016 John Wiley & Sons, Ltd.

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