

Recovery of Atoll Aquifers from Marine Overwash Events: Federated States of Micronesia

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Abstract. Inundation of atoll islands by marine overwash is a serious threat to fresh groundwater, which often is used for domestic water needs when freshwater storage within household and community rain catchments has been exhausted. In contrast to El Niño-induced droughts, which often can be forecasted and which slowly exhaust water supplies, overwash events due to storm surge or tsunamis can occur with little warning, and can ruin both rain catchment storage and, due to salinization of the subsurface, fresh groundwater reserves. In this study, a numerical groundwater modeling approach is used to simulate the salinization of an atoll island aquifer due to an overwash event and the subsequent recovery of fresh groundwater. Using the SUTRA model, actual tidal and rainfall data from regions in the western Pacific are applied to simulated 30-month recovery periods for hypothetical islands with properties and conditions characteristic of the atoll islands of the Federated States of Micronesia. A number of geologic and environmental factors are varied within a suite of simulations, so as to assess the pattern of salinization and groundwater recovery for a number of island conditions. These factors include island width, rainfall pattern, hydraulic conductivity of the aquifer, the presence or absence of a reef flat plate at sea level, the timing of the overwash event (e.g., during the dry season or wet season), the duration of the overwash event, and the depth of the overwash. Results indicate that approximately 12-16 months are required to achieve 60% total recovery of fresh groundwater. However, the time required to restore useful quantities of groundwater to acceptable salt concentration at depths typical of hand-dug wells is only 5-10 months, depending on the size of the island, the characteristics of the overwash event, the aquifer properties, and rainfall patterns.