

Estimation of Future Freshwater Supply of Micronesian Atoll Islands using Simulated Climate Data

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Abstract. Proper water management on atoll islands of the Federated of Micronesia (FSM) is of critical importance due to the fragile nature of their water supply. Accurate estimation of the quantity of freshwater, derived from both the groundwater lens and through rainwater harvesting, is required to help island communities effectively manage this supply. Of principal concern is the quantity of freshwater expected to be present in the coming decades under the influence of changing rainfall patterns. In this study, the three-dimensional groundwater flow and transport model SEAWAT is used to simulate the dynamics of the freshwater lens of FSM atoll islands for future climate conditions. Previous studies have modeled the freshwater lens in two dimensions using historical rainfall to simulate the aquifer in a cross-section of the island, but have not three-dimensionally examined what effect future climate change could have on atoll groundwater supply. The performance of rainwater catchment systems is also assessed for future climate conditions, and design curves are developed to assist island communities in optimal system sizing. Assessment is made for the 2010-2050 time period, with rainfall and temperature variability provided by general circulation models participating in the CMIP5 framework. A case study is conducted for Pakein Atoll in the Pohnpei State, where observed values of lens thickness on Nikahlap, its westernmost island, provide information used for groundwater model calibration. Concurrent simulation of groundwater and captured rainwater volumes provides an estimate of the total amount of available freshwater. Not only will the results from this study prove useful in estimating the future availability of atoll island water supply, but they will also promote sustainable water resource management by island communities.