Rainwater Catchment Analysis to Assess Existing and Potential Water Supply for Micronesian Atoll Islands

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Abstract. Atoll island communities rely on rainwater catchment systems (RWCS) as a primary method for storing freshwater. However, stored freshwater can be depleted during times of drought, requiring importation of water to sustain community living. To maintain adequate water supply under future climatic conditions, the current performance of RWCS in atoll communities must be analyzed and optimal designs must be adopted. In this study, a quantitative analysis of stored daily water volumes is provided for atoll islands within the Federated States of Micronesia (FSM), with Nikahlap Island, Pakein Atoll and a generic island in western FSM used as representative cases. Using a daily water balance model for the RWCS, baseline conditions are simulated for the 1997-1999 time period, during which an intense El Niño-induced drought occurred, and a sensitivity analysis is performed to quantify the influence of RWCS features on water system outputs, whereupon an optimal RWCS design using existing infrastructure is analyzed. Results indicate the strong influence of catchment area, system efficiency, and storage capacity on water volumes and the depletion of water during dry seasons and drought periods under current RWCS infrastructure conditions. Adequate storage can be maintained during a major drought if unused RWCS features are employed and if minimal water rationing is adopted. The prospective performance of optimal RWCS design is then examined using simulated future climatic conditions acquired from the Coupled Model Intercomparison Project Phase 5 (CMIP5), at which point the potential effects of sea level rise and climate change on atoll island community water supply are also estimated. Study results provide water resource managers and government officials with valuable data for consideration in water security measures.