HISTORIC, CURRENT AND FUTURE AQUIFER RECHARGE ESTIMATES FOR THE PUERTO RICO SOUTH COAST AQUIFER

Eric W. Harmsen Truckenbrod

University of Puerto Rico, Depart. of Agricultural and Biosystems Engineering, Mayaguez, PR.
Email: eric.harmsen@upr.edu

For many years, the condition of the South Coast Aquifer (SCA) of Puerto Rico has been of concern to experts in hydrogeology and water management. Numerous studies by the US Geological Survey have documented problems related to over-pumping of the aquifer, increasing salinity levels, and declining groundwater levels, sometimes below sea levels. Climate change studies generally agree that the Caribbean region will become drier in the future. Drying conditions, sea-level rise, and increasing demand for groundwater suggest that the SCA will be under increasing pressure in the coming years. Therefore, it is helpful to understand the spatial and temporal variation of aquifer recharge in the SCA area. Aquifer recharge is composed of recharge produced from rainfall and other sources, such as irrigation applications that exceed the soil field capacity, recharge entering the SCA across its northern boundary, and induced aquifer recharge. Studies are needed to understand better each type of recharge occurring within the SCA. This study produced historic, current, and future recharge estimates resulting from rainfall using a gridded water and energy balance model.

Results from the operational water and energy balance model GOES-PRWEB indicate that between 2009 and 2020, estimated rainfall recharge varied between 10 mm (about 0.4 in) to 50 mm (about 2 in) per year. Aquifer recharge represented only 3.3% of the rainfall over the SCA. Ten percent of the annual rainfall is commonly assumed to be converted to aquifer recharge in humid areas. Owing to the climatic conditions of the South Coast, the soil profile is typically depleted of water, making it difficult for recharge to occur and consequently resulting in a lower percentage of rainfall converting to recharge compared with more humid areas. Groundwater levels dropped in 8 of the 12 years when the estimated annual recharge rate was less than 25 mm (about 1 in). Hurricane Maria occurred in 2017, resulting in an estimated annual recharge rate of 157 mm (about 6.2 in). The large recharge rate resulted in a significant increase in groundwater levels in several SCA wells. The results suggest that groundwater levels can recover when extreme rainfall events occur. Unfortunately, extreme rainfall events can also bring widespread devastation to the island.

Bowden et al. (2018) used the Weather Research Forecast model to dynamically downscale climate simulations from two global circulation models for Puerto Rico. The downscaled weather data was used in GOES-PRWEB to estimate reference evapotranspiration (ET_o) and aquifer recharge. Results for the future (2040-2060), as compared to the past (1985-2005), indicate that ET and aquifer recharge will increase and decrease by 5.8% and 40%, respectively. The increased ET_o implies that crop water requirements will increase, and the significant reduction in aquifer recharge implies that less water will be available in the future for irrigation and domestic water supply. Results from this study support the need for careful management of the groundwater extraction from the SCA.