Puerto Rico Water Resources and Environmental Research Institute

University of Puerto Rico, at Mayagüez

About Us

We are one of the 54 Water Resources Research Centers in the United States and its territories. Established in 1964 by the Water Resources Act (1964), the Institute conducts basic and applied research to solve water and environmental problems unique to Puerto Rico, the Caribbean and Latin America. We conduct research to find innovative solutions to problems related to water resources and the environment. To do so, we support students and scientists with our projects, and provide them with knowledge as an integral part of UPRM education programs. We publish research results on our website, in local, national, and international journals and magazines. Our applied research contributes to the development of the next generation of water and natural resources professionals and supports young scientists and engineers.

Field reconnaissance visit to Rio Grande de Añasco. Mayagüez. PR. January 2023.

Application of Rusle2 for Erosion Control on Construction Sites

Erosion is the main source of sediment that pollutes streams, fills reservoirs, creates hazardous situations in rural and urban environments, and affects marine ecosystems. This process of land degradation has been a principal focus of world soil management. The impacts of erosion will be aggravated by the intensification of droughts and precipitation events propelled by climate change. Erosion and sediment control are critical to preserving the natural ecosystems in Puerto Rico. Engineering methods assisted by computer algorithms, like RUSLE2, play a crucial role in the design of effective Best Management Practices (BMPs) for erosion and sediment control in construction projects.

RUSLE2 is a computer algorithm created cooperatively by the USDA-Agricultural Research Service (ARS), the USDA-Natural Resources Conservation Service (NRCS), and the Biosystems Engineering and Environmental Science Department of the University of Tennessee based on the use of the Revised Universal Soil Loss Equation (RUSLE). It is used to estimate soil loss during a period in (tons/acre)/period considering the site's climatology, soil type, topography, land cover, and management practices. The initial methodology consisted of using RUSLE2 to model Best Management Practice scenarios in Puerto Rico with and without the practice applied to quantify impacts. A RUSLE2 user and installation guide for Puerto Rico, including its designated databases, will promote the use of this tool in the preparation of Erosion and Sedimentation Control plans.

Scenario:	RUSLE Soil Loss (t/ac-yr)	RUSLE2 Soil Loss (t/ac-yr)	Diff.	%Diff.
Full Ryegrass throughout the year	5.57	5.02	0.55	9.87
With Additional Cover and EC Practices	6.427	8.2	1.77	27.59
Increase in Soil Loss (t/ac*yr)	0.857	3.18	-	-
Increase in Soil Loss (%)	15.39	63.35	-	-

Scenario Soil Loss in tons/(acre*year) results and comparison between RUSLE hand computations and RUSLE2 simulation.

Meander Evolution at the Río Grande De Añasco Lower Valley

The objective of this project is to predict meander migration after a meander cutting in the lower valley of the Río Grande de Añasco. Figure 1 shows an aerial photo of the study area. The flow direction is from left to right. The photo from 2018, was taken during the operations for cutting the meander. A raw water intake is located immediately downstream of the newly created oxbow. A meander was cut to reduce the risk of the merging of two meanders and, consequently, isolate the water intake from the river. However, the cut-off altered the dynamic behavior of rivers that try to obtain additional length elsewhere in search of an overall new equilibrium. Therefore, new changes in the planform of the meanders near the cut-off are expected. Part of these changes involves accelerated bank and bed erosion, and possible sediment deposition near the water intake.

A state-of-the-art movable boundary, morpho dynamic hydraulic model (Nays2DH) is used to predict possible meander migration. The methodology is divided into three parts: (1) Field and historic data collection, (2) numerical model assembling, calibration, and (3) application of the model. This will make it possible to estimate the impacts associated with the meander cutting and to evaluate another risk that affects the water intake and sediment balance.

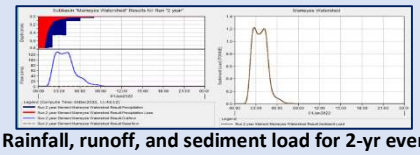
Meander cut-off at Río de Añasco (Google Earth) (2018)

Soil Erosion and Sediment Analysis for the Mameyes River Watershed Using HEC-HMS and GIS

The Mameyes river watershed comprises 10.4% of the El Yunque National Forest. The steep slopes in the watershed and the humid climate make it a candidate for significant production of soil erosion. This river is important for its biological and historic value; however, watershed erosion is impacting its water quality and the ecosystem. This research presents a computerized method to estimate the average soil losses and sediment yield in any watershed of Puerto Rico.

Different formulations have been developed over the years to estimate the yearly soil loss. For this research, the hydrologic model Hydrologic Modeling System (HEC-HMS (V.4.10)) was used to estimate soil loss and sediment yield using the Universal Soil Loss Equation (USLE) and the Modified Universal Soil Loss Equation (MUSLE) for rainfall events of 24 hours and different return periods. Precipitation data was taken from the NOAA ATLAS 14 Point Precipitation Frequency Estimates. All the parameters needed for the MUSLE were spatially distributed and processed in the Geographic Information for the hydrographs, sediment loading, and soil erosion for the watershed given a certain storm event and lapse of time. As needed, many simulations can be executed for different events to compare the results and see the differences in erosion. From these results, we can analyze how severe the erosion is and propose mitigation plans for certain conditions. Results are presented for design storms in Puerto Rico for exceedance probabilities of 2, 10, 25, 50, and 100 yrs. and a duration of 24 hours.

Mameyes River at Luquillo (CZO Archive)



Rainfall, runoff, and sediment load for 2-yr event

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