Assessing Water Availability in the El Rito Watershed Using SWAT+ and Parameter Regionalization

H21N-1154 Hari Shreesh, Abdulla Azzam, Huidae Cho

Department of Civil and Environmental Engineering, New Mexico State University, Las Cruces, NM 88003

Introduction

Acequias in northern New Mexico represent integrated socio-environmental systems, combining irrigation infrastructure with community-based water management. These river-fed channels are becoming increasingly vulnerable because of climate change, urban growth, and changing community participation.

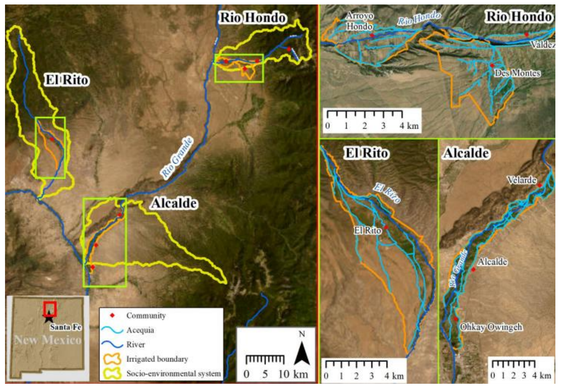

Figure 1. Study Area

This NSF-funded project simulates water availability in the El Rito watershed using the SWAT+ model and develops water availability indices.

Objectives

- Develop the SWAT+ model using parameter regionalization techniques.
- Simulate water availability for the El Rito watershed.
- Develop a Water Availability Index (WAI) to assess temporal and spatial water conditions.

Data and Methods

Parameter Regionalization: Because of limited data, we opted for a parameter regionalization approach to transfer parameters from a gauged to an ungauged site. The Pecos watershed was chosen as a surrogate based on similarities in several essential characteristics: (1) hydrological parameters, (2) climatic conditions, (3) soil type, land use, and land cover, and (4) comparable size and the availability of observed data.

Figure 2. Doner and Donee watershed

Weather Data: The weather data required for the SWAT+ model was sourced from PRISM climate data, providing daily records over a span of 33 years. We extracted the raster data to align with the extent of each watershed subbasin and computed the weighted average for every sub-basin using GRASS.

Figure 3. PRISM data processing on GRASS

Calibration of SWAT+ Model

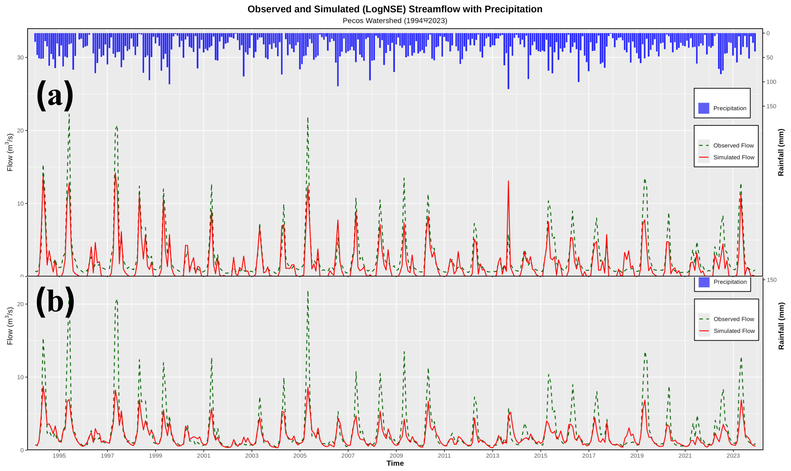

Figure 4. Model optimization using (a) NSE and (b) logNSE

Uncertainty Analysis: MC and GLUE

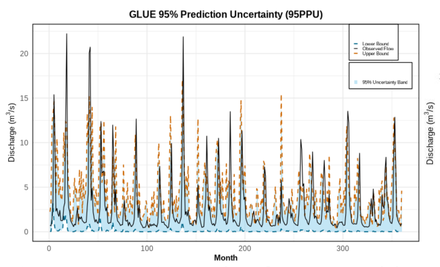

Figure 5. Uncertainty analysis for Pecos model

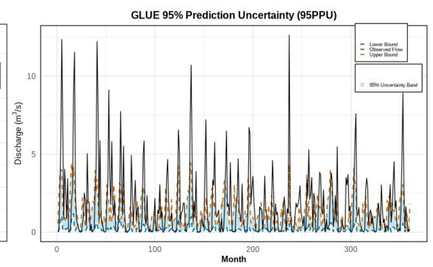

Figure 6. Uncertainty analysis for El Rito model

Water Availability Index (WAI)

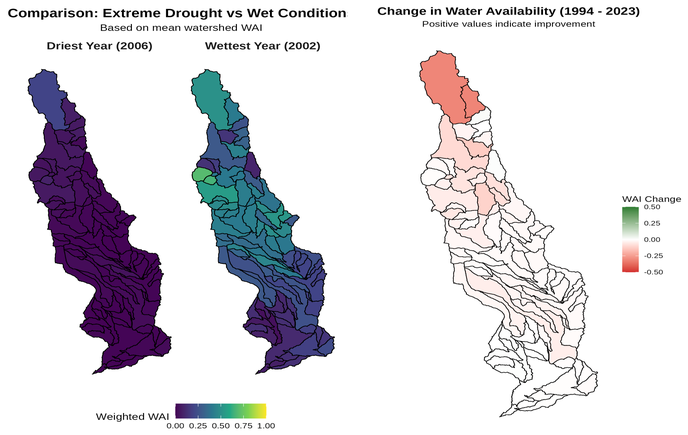

Figure 7. WAI comparison dry vs. wet year

Figure 8. Temporal WAI change

Watershed Water Balance and ET

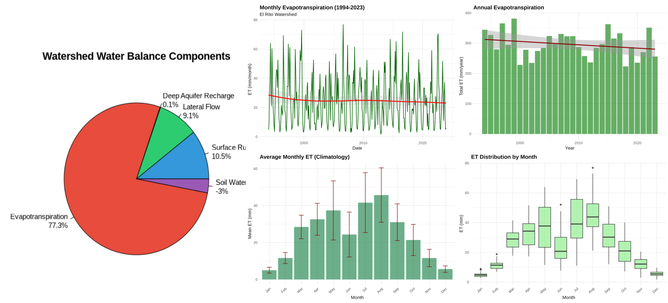

Figure 9. Actual ET summary at El Rito watershed

Conclusions

The SWAT+ model calibrated in the Pecos watershed performed well and enabled successful parameter transfer to the ungauged El Rito watershed. Key findings reveal a decreasing trend in WAI (slope: -0.0018/year), with highest availability in summer (mean: 0.2691) and spatial hotspots in subbasins 77, 11, and 1. Declining discharge (-0.0137 m³/s/year) and ET (-1.1142 mm/year) underscore climate vulnerabilities for the acequias.

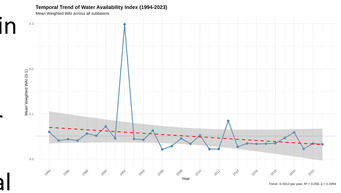

Figure 10. Trend analysis of WAI

Acknowledgements

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