Year 2 Annual Reporting Form for NSF

Year 2 DISES Reporting Period: <mark>July 1, 2024 to June 30, 2025</mark>

Accomplishments

You have the option of selecting "nothing to report" in this section.

What were the major goals of your portion of the project from July 01, 2024 to June 30, 2025?

We advanced hydrologic modeling for three critical watersheds—Rio Hondo, Alcalde, and El Rito—while gaining on-ground insights into local snow and water management practices to enhance model fidelity. Since one of our collaborators has been working on the Rio Hondo watershed for his cellular automata research and the Alcalde watershed was found to have structural and data limitations, we focused on the El Rito watershed.

The El Rito watershed lacks observational streamflow data, making model calibration infeasible. A primary goal for the past one year was to identify a comparable watershed with available observations, enabling parameter calibration and subsequent transfer to the El Rito model. This parameter regionalization was required to better model the El Rito watershed without its own observation data.

What was accomplished under these goals (you must provide information for at least one of the 4 categories below)?

Major Activities:

- Attended stakeholder meetings on-site and online to enhance understanding of local hydrology and water use practices
  - Visited Taos Ski Valley to observe snow management operations and upstream water flow controls
  - Participated in a community engagement visit to Arroyo Hondo, observing domestic and agricultural water use practices and attending a local council meeting to understand regional concerns
  - Visited the project sites twice for data verification and to contextualize model discrepancies
- Created a new model for the Pecos watershed for parameter regionalization
- Calibrated the Pecos model for low-flow simulations
- Conducted Monte-Carlo simulations for uncertainty analysis for the Pecos watershed

Specific Objectives:

- Improve the models by incorporating field-observed hydrologic features and operational insights

- Address calibration challenges in data-sparse regions through innovative modeling techniques

- Calibrate the model parameters indirectly for the El Rito watershed by parameter regionalization

- Evaluate parameter uncertainty for the study watersheds

Significant Results:

We revised the SWAT+ models for the Rio Hondo and El Rito watersheds and addressed the lack of streamflow data in El Rito by devising a parameter regionalization approach. This involved identifying the hydrologically similar Pecos watershed based on literature review, calibrating its SWAT+ model, and demonstrating reliable low-flow simulation performance for irrigation purposes, enabling parameter transfer to the El Rito model.

Key outcomes or other achievements:

To overcome the lack of observed streamflow data in El Rito, we developed criteria through literature review, for identifying the hydrologically similar Pecos watershed for regionalization-based modeling. We developed and calibrated the Pecos model using USGS streamflow data. The calibrated Pecos model demonstrated reliable low-flow simulation performance for irrigation purposes and will serve as the basis for parameter transfer to the El Rito model, enabling calibration in a data-scarce environment.

What opportunities for training and professional development did you receive or provide through this project provided?

Cho provided two graduate students (Azzam and Shreesh) with hands-on training in various aspects of the modeling workflow, including data collection and preprocessing, model development, optimization, uncertainty analysis, postprocessing, and execution on High-Performance Computing (HPC) resources.

What do you plan to do during the next reporting period to accomplish your goals in this project?

We plan to transfer the Pecos model parameters to the other watershed models and conduct analysis.

Products

You have the option of indicating "nothing to report" in this section.

List any products (completed or currently in progress) resulting from your work on the project during the specified reporting period, such as:

Journals:

Books:

Book Chapters:

Thesis/Dissertations:

Conference Papers and Presentations:

- Poster Presentation: Hari Shreesh, Abdullah Azzam, Huidae Cho, November 5, 2024. Assessing Water Availability in the El Rito Watershed Using SWAT and Parameter Regionalization. 2024 New Mexico Water Conference. Buffalo Thunder Hilton Resort, Pojoaque, NM.

Other Publications:

Technologies or Techniques:

Patents:

Inventions:

Licenses:

Websites:

Other Products:

NOTE: You may send me PDF files with images, tables, charts, or other graphics in support of the Products section.

Participants

Project participants are defined as any person or organization who worked the equivalent of one person-month (160 hours) or more for the project reporting period. You have the option of selecting "nothing to report" in this section.

How many person-months do you estimate you worked on the project during this reporting period? (1 person-month = 160 hours)

- Cho: 1.5 person-months
- Azzam: 1.5 person-months (0.5 person-month for 3 months)
- Shreesh: 4.5 person-months (0.5 person-month for 9 months)

Did you work with any organizations or individuals outside the project team in your

work on DISES during this reporting period?

No

If so, please provide the following additional information such as:
- Type of Partner/Organization
- Name
- Location
- Partner's contribution to the project

Impacts

You have the option of selecting "nothing to report" in this section.

Did your work have any impacts on the development of the principal discipline(s) of the project? (Hydrology, Ethnography, GIS)

Yes, our work contributed to advancements in all three principal disciplines of the project (hydrology, ethnography, and GIS). In hydrology, we developed and applied novel modeling approaches—such as distributed Monte-Carlo simulations and distributed optimization on High-Performance Computing (HPC) resources—to improve understanding of watershed behavior in data-scarce regions by parameter regionalization using a donor watershed with observed data. This approach enables more reliable modeling in ungagged basins. In ethnography, we integrated community knowledge to inform watershed characterization and ensure hydrologically contextual relevance. In GIS, we enhanced geospatial workflows to support donor watershed selection, hydrologic modeling, and uncertainty analysis using open-source tools and high-resolution spatial data, including locally collected LiDAR data and USGS Digital Elevation Model (DEM) data. These interdisciplinary contributions strengthen the scientific basis for integrated watershed research and management.

Did your work contribute to any impacts on other disciplines?

Yes, our work contributed to impacts beyond the core disciplines by informing methods in environmental modeling and computer science. The use of parameter regionalization for ungauged basins supports broader applications in ecohydrology. Our integration of High-Performance Computing (HPC) and uncertainty analysis contributes to computational workflows relevant in other fields that rely on large-scale simulations and geospatial data processing.

Did your work have any impacts on society beyond science and technology?

Yes, our work has had societal impacts beyond science and technology. By improving hydrologic modeling and water resources management in critical watersheds, our research supports more informed decision-making for local communities dependent on these basins. Integrating on-ground insights into snow and water management practices fosters stronger community engagement and helps promote sustainable water use. These efforts contribute to enhancing water security and resilience in regions facing water shortages.

Changes / Problems

If not previously reported in writing to the agency through other mechanisms, provide the following additional information or state, "Nothing to Report", if applicable.

Have you made any changes in approach? If so, please list the reason(s) for change:

No

Have you encountered any actual or anticipated problems or delays? If so, please list any actions or plans to resolve them:

No

Have you made any changes that have a significant impact on expenditures?

No