A Great Basin Regional Case Study for the U.S. National Water Model Community NextGen Framework

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1. Research Goal

•**Introduce a case study** for the Great Salt Lake Basin, focusing on its unique hydroclimatic characteristics as a snowmelt-driven and rainfall-influenced system.

•**Leverage the U.S. National Water Model (NWM) NextGen Framework** to explore hydrological modeling within the basin.

•**Advance community-driven modeling capabilities** by integrating local knowledge and expertise through the NOAA CIROH collaboration.

•**Facilitate testing of the Community NextGen In A Box (NGIAB)** in diverse hydroclimatic contexts to assess its adaptability.

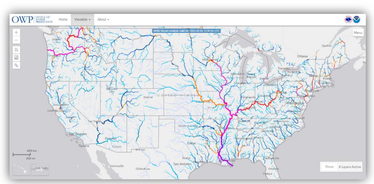
•**Explore regionalization of calibration parameters** and the integration of locally relevant model components, such as snowmelt models, for improved regional representation.

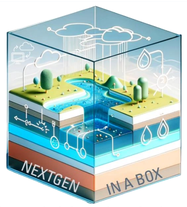
•**Present technological and data challenges, solutions, and preliminary findings** from the Great Basin NGIAB case study.

•**Demonstrate the potential of NGIAB** to support local customization and contribute to NOAA's broader modeling capacity.

2. Methods

2.1. Hydrologic Modeling





- **National Water Model (NWM):** The current operational model for simulating and forecasting water conditions across the U.S. covering 3.4 million miles of rivers and streams

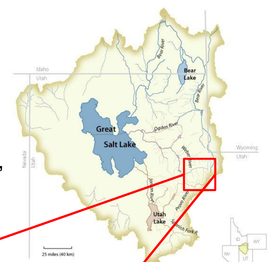
- **NextGen Framework:**
•The next generation of the NWM, designed for **modularity and adaptability**.
•Uses the **Hy_Features conceptual model** to represent water flow networks.
•Built around the **Basic Model Interface (BMI)** to integrate custom model components.
•Enhances flexibility for researchers to localize and experiment with hydrologic modeling.

➢ **NextGen In A Box (NGIAB)**
•A **containerized version of the NextGen Framework** for ease of deployment.
•Combines **Docker** (for general environments) and **Singularity** (for HPC) technologies.
•Encapsulates key components for hydrologic modeling:
  •**Hydrofabric:** Provides spatial representation of landscapes and flow networks.
  •**Catchments and Nexus Data:** Defines water flow regions and convergence points.

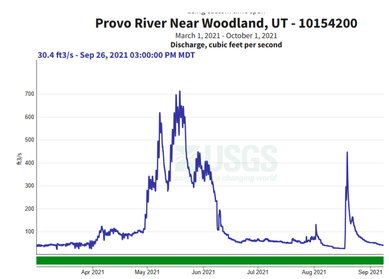
3. Study Area

•**Great Salt Lake (GSL) Basin** in the Intermountain West of the U.S.

•**Example Subwatershed:**
•Provo Basin, a subwatershed of the GSL Basin.
•Draining to: USGS Station Provo River at Provo, UT (Station ID: 10154200, Catchment ID: 2853863).
•Sample Study period: **2021-03-01 to 2022-9-15**, a timeframe characterized by snowmelt-driven increases in flow and flooding.



Source: https://learn.genetics.utah.edu/content/gsl/physical_char/



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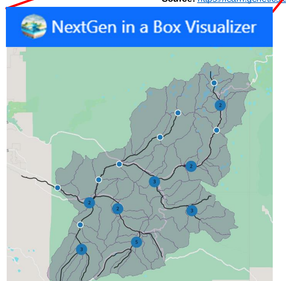
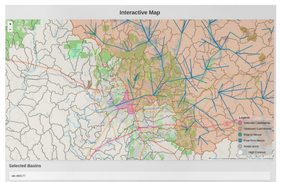


Created for this study through NGIB Visualizer App

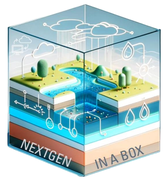
2.2 NGIAB End to End Workflow

NGIAB Data Preprocess



Interactive tool for preparing input data, including catchments and date ranges

NGIAB



The core containerized framework

Calibration

Tune parameters lumped in .ini files to improve model accuracy

TEEHR
Tools for Exploratory Evaluation in Hydrologic Research

Python-based framework for analyzing model performance

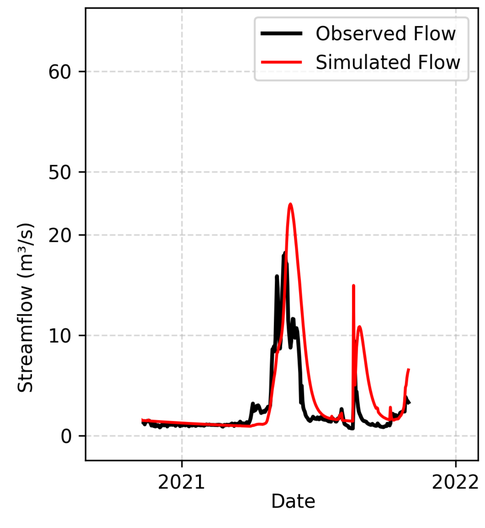
Enables geospatial and time-series visualization of model results

2.3 Snowmelt Model

• In snowy basins, coupling a snow model is essential for accurate streamflow simulation, as rainfall-runoff models alone cannot represent snow processes.
• **Need for a snowmelt model** for accurate modeling in snowmelt-driven systems like the Provo Basin.
• **Snow-17 Model:** Simulates snow accumulation and melt with **elevation band separation**.

4. Ongoing Work

Calibrated model (pre-snow model): Simulated versus observed streamflow



• The simulated streamflow shows significant deviations from observed flow, especially during peaks, highlighting missing snow processes.

• Coupling a snowmelt model is essential to address these discrepancies.

• Calibration alone cannot ensure accuracy or physical correctness without it.

•It realistically captures the processes driving streamflow.

•**Ongoing Work:** Coupling the Snow-17 model to improve streamflow simulation results

•**Current Challenge:** Snow-17 does not currently handle sub-basin variability in NextGen. Although it can run multiple HRUs within a catchment, NextGen lacks a mechanism to adjust forcing data for elevation bands across these HRUs.