CSSI Framework: Computational and data innovation implementing a national community hydrologic modeling framework for scientific discovery

Award #: 1835903

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*This project blends **hydrology, computer science,** and **education and outreach** to accelerate simulation, adoption and engagement of continental scale simulation of the flow of water through rivers, streams and groundwater.*

- Leverage advances in computer science to transform simulation and data-driven discovery in the Hydrologic Sciences and beyond
- Conduct decadal, national scale simulations to provide an unprecedented resource for both the hydrologic community and beyond
- Remove computational barriers of entry to provide seamless access to what will be almost 10 PB of simulated outputs
- Engage with users from hydrologic modelers to scientists
- Develop K-12 educational modules on different hydrologic systems

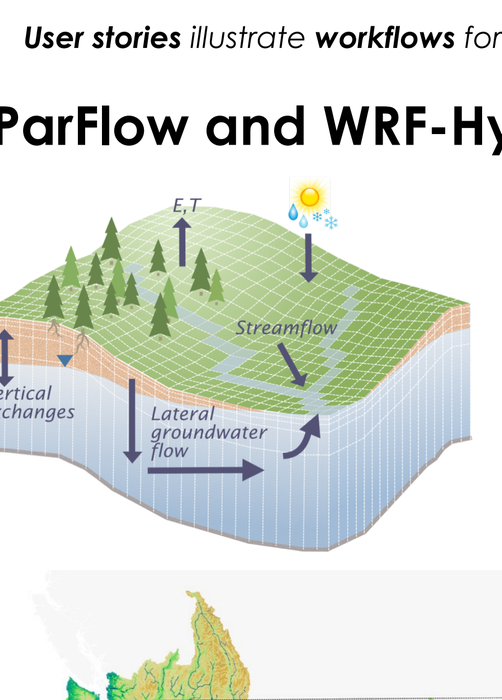
*Our framework, **HydroFrame**, is being developed to provide novel approaches for users to interact with massive datasets and stakeholder outreach will propel understanding of the hydrologic cycle.*

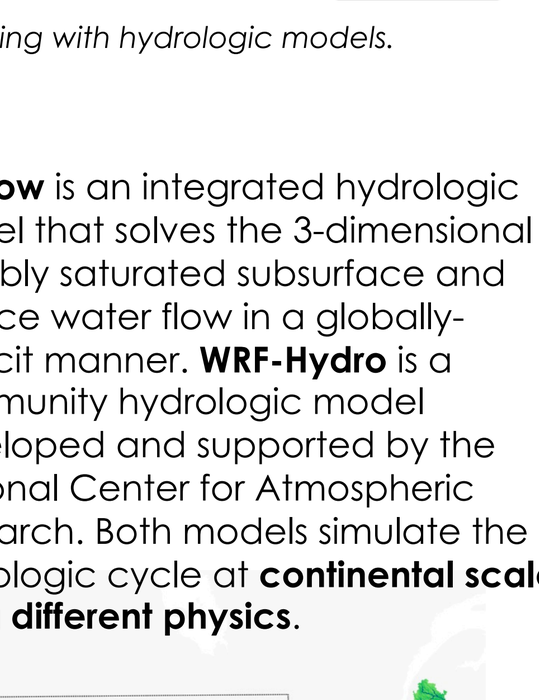
HydroFrame

https://www.hydroframe.org

HydroFrame is a framework that leverages existing capabilities, like the **Kepler** workflow and **HydroShare** which connects hydrologists and data, studies code performance and portability, and provides easy data interfaces. We focus on three **user stories, the modeler, the analyst and the science educator.**

User Stories

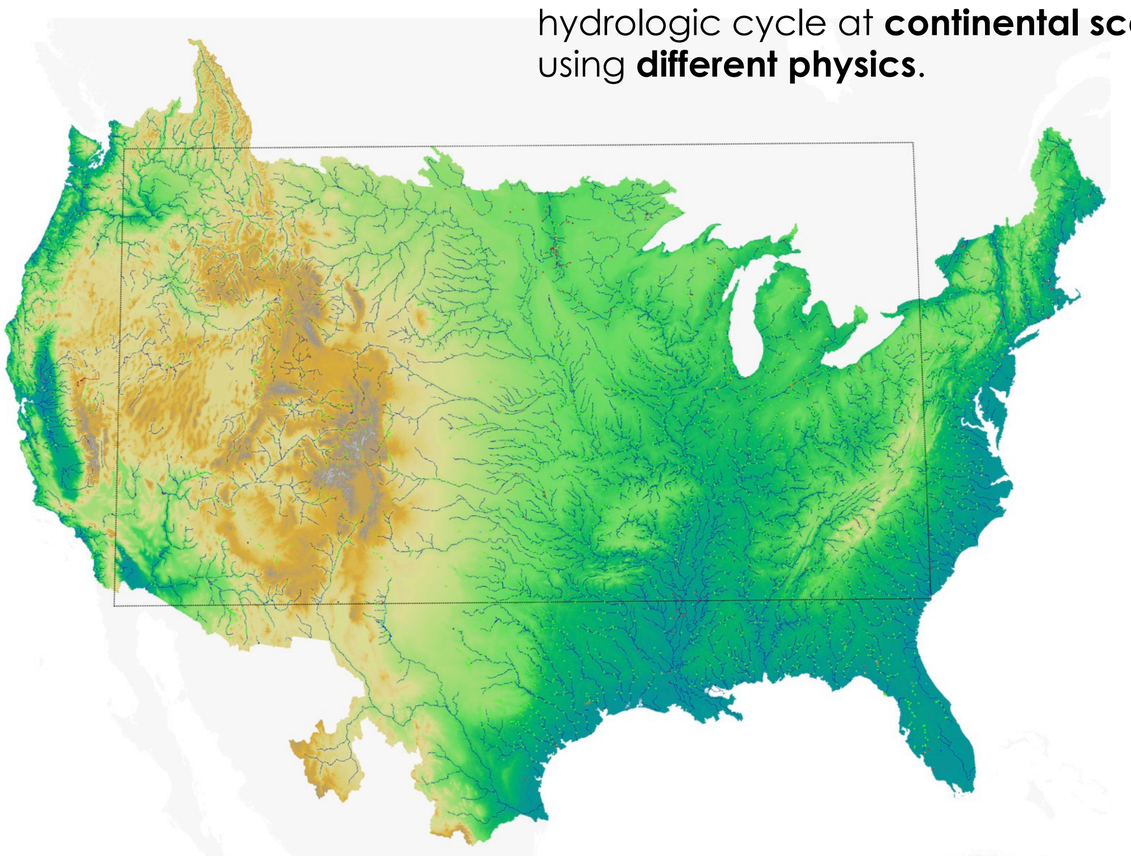




***User stories** illustrate **workflows** for interacting with hydrologic models.*

ParFlow and WRF-Hydro

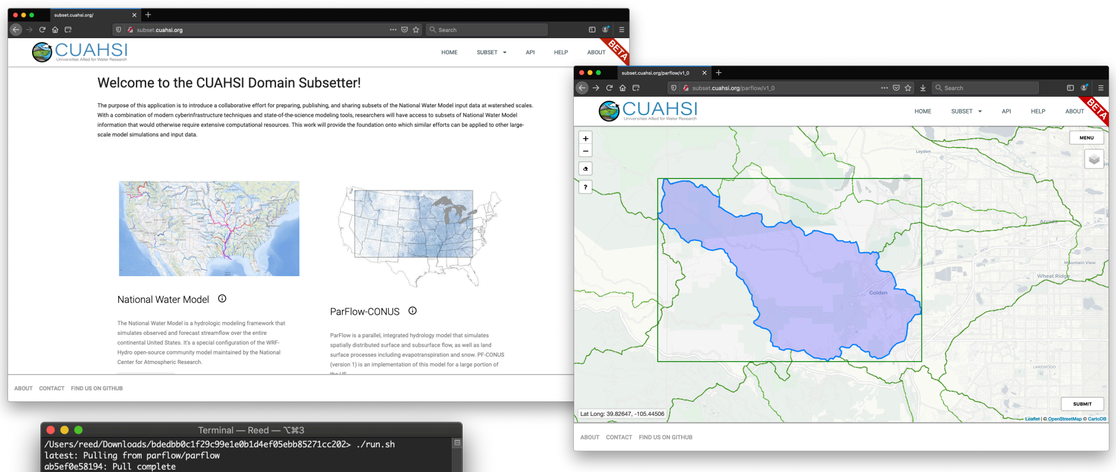
ParFlow is an integrated hydrologic model that solves the 3-dimensional variably saturated subsurface and surface water flow in a globally-implicit manner. **WRF-Hydro** is a community hydrologic model developed and supported by the National Center for Atmospheric Research. Both models simulate the hydrologic cycle at **continental scale** using **different physics**.

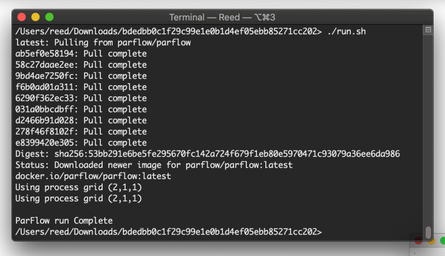


Two hyperresolution hydrologic models of the CONUS are the initial focus of this framework.

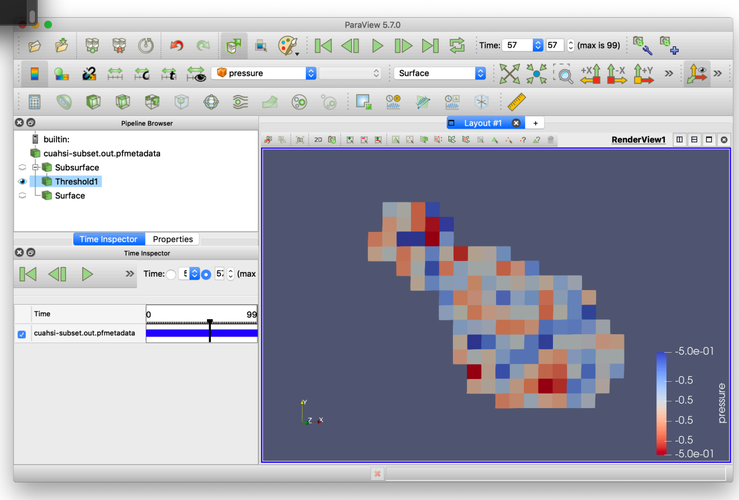
Sample initial application

Initial applications like the CUAHSI Domain Subsetter allow more direct **user interaction** with these large-scale models.





This service selects a watershed and can **automatically run ParFlow-CONUS** using containers.



Thanks to complete **integration** between ParaView and ParFlow, output can be immediately viewed.

This process lowers the barrier to **community engagement.** We reach a **wide range of user stories** not just modelers. This increases **transparency** in the large-scale modeling process. We will further integrate this component with other framework tools like Kepler and HydroShare.

Education and Outreach

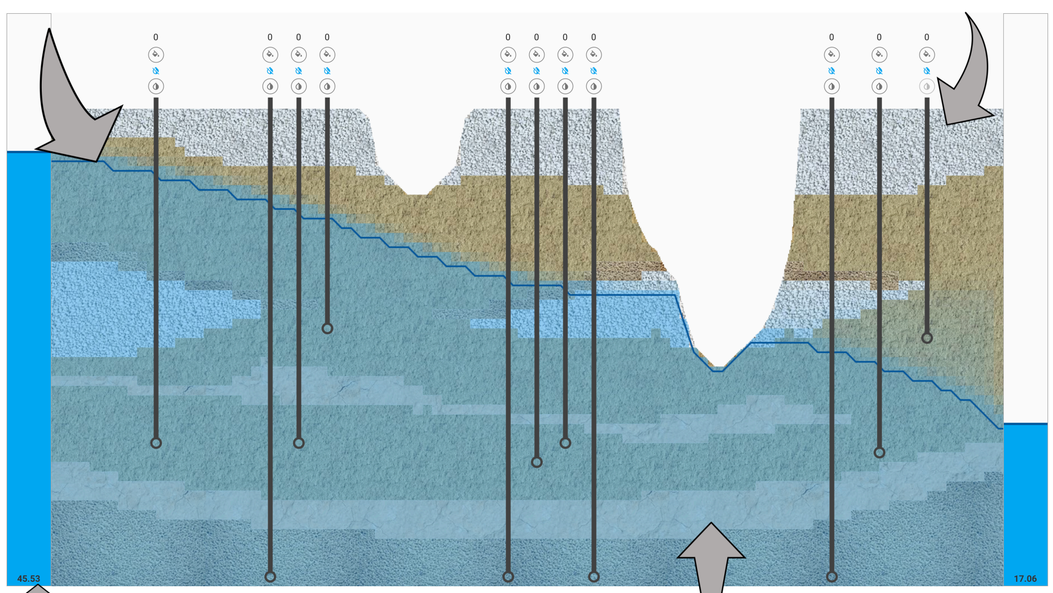
Physical models provide an excellent medium to translate large scale hydrologic concepts to students. Sandtanks are used to facilitate lessons on groundwater movement, differences in soil types, contaminant flow using dye, and the effects of well pumping. Our team wanted to increase accessibility and versatility of the physical sandtank by developing a computer model that could be used in place of or in tandem with a physical model.

Dr. Lisa Gallagher from the Integrated Groundwater Modeling Center in Golden, CO teaching students with a stream table and a sandtank aquifer model.

Our team translated the physical sandtank model to a more readily accessible computer model. This model allows users to alter configurations that are static on the physical sandtanks to gain additional insights to the hydrologic system. Additionally, the app demonstrates the utility of using models to represent our natural systems.

Visual representation of water table

Ability to pump or inject water



Adjustable water heads

Ability to adjust sandtank materials