

# *University of Wyoming HPC Facilities*

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UNIVERSITY  
OF WYOMING  
*New Thinking*

## *CI-WATER Project*

- NSF Cyberinfrastructure Cooperative Agreement joint between Utah and Wyoming EPSCoR jurisdictions. Total budget \$6.0M
- Focused on acquisition of hardware, development of software, capacity building, education, and outreach.
- Sept. 1, 2011– Aug. 31, 2015



## *Project Goals*

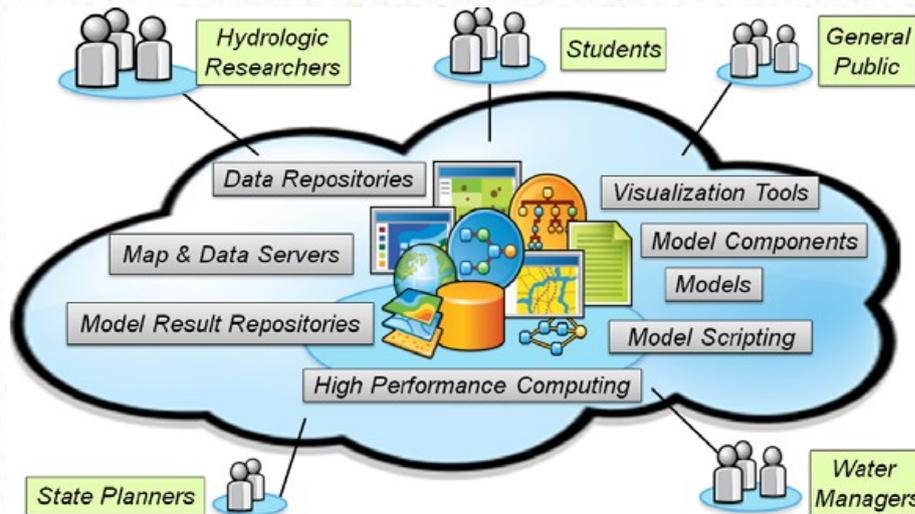
- **Enhance cyberinfrastructure facilities**

### Take-aways

- ✓ Significant CI facilities have been deployed
- ✓ Facilities are transforming scientific discovery
- ✓ Plan and commitments guarantee sustainability of CI

- **Enhance access to data- and computationally-intensive modeling**
- **Advance high-resolution multi-physics watershed modeling**
- **Promote STEM learning and water science engagement**

## CI-Water Grand Vision



### Collaboratory.

established tools developed associated with the NSF-funded TerraGrid project [16, 17]. Our CyberCollaboratory will blend hydrologic data and information system capability developed as part of our work on the Consortium of Universities for the Advancement of Hydrologic Science, Inc. (CUAHSI) Hydrologic Information System (HIS) [2, 3, 18] with internet portal and content management capability developed in support of high performance and grid computing by the NSF-supported HUBZero project [17]. We will draw upon open source ezHPC and ezVIZ components developed at the US Army Engineer Research and Development Center (ERDC) Information Technology Laboratory (ITL). These provide graphical user interface and visualization elements for HPC. Our collaborative partnership with ERDC on projects such as GSSHA (<http://chl.erd.c.usace.army.mil/gssha>), TauDEM (<http://hydrology.usu.edu/taudem>) and WMS (<http://chl.erd.c.usace.army.mil/wms>), (see commitment

“support the development and use of large-scale, high-resolution computational water resources models

“successful integration requires data, software, hardware, simulation models... to engage

stakeholders and impart science into policy management, and decisions”

We will build a Science Gateway CyberCollaboratory based on

## *High Performance Computing*

- ✓ Mt Moran installed in Fall 2011
- ✓ IBM System X cluster
- ✓ 4256 cores and growing
- ✓ 150 teraflop with optimized infiniband
- ✓ Based on condo model with core funding from UW.
- ✓ CI-Water's share ~49%
- ✓ 200+ users associated with 31 projects
- ✓ Running on average about 90% capacity



“Through this project, UWYO will acquire a 100+ TFLOPs hybrid multi-processor computer system and associated storage resources dedicated to supporting the combined HPC modeling needs of our Consortium”

## *High Performance Computing*

- ✓ **CI-Water has received two large allocations totally ~10M core hours**
- ✓ **Use-age last year (6M core hours) ranks as tops from UW, and in top 20 overall**



**NCAR Wyoming Supercomputing Center**

**1.5 petaflop machine  
75,000 cores**

**Wyoming and its collaborators  
have 20% share**

# *High Performance Computing*

## **Mt Moran will**

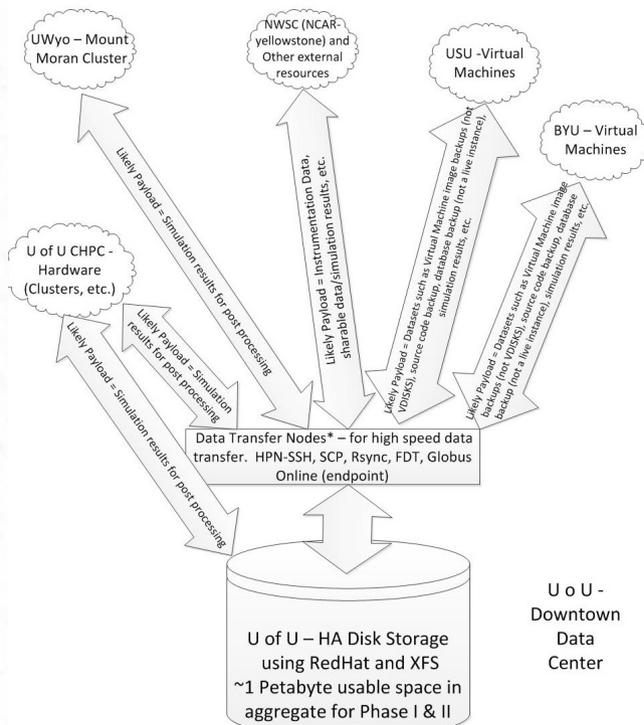
- ✓ “Serve as a gateway to the NWSC machine for running simulations of large watersheds, such as the upper Colorado River basin”
- ✓ “Run at a sustained speed of 1% or greater of the peak speed of the NWSC machine-this level of performance never been seen before in hydrology codes”
- ✓ “Enable and support to the development of a new hydrology model”



**Mount Moran**

## High Performance Storage

A shared data repository



\* Data Transfer Nodes are utilized for "put & get" type of operations. The software stack typically offers fast transfer of data.

✓ “supports and provides access to large volumes of hydrologic and atmospheric data”

✓ “provides a database and data modeling infrastructure to support integration and assimilation of local, regional, and national data tied to the research projects in this Consortium”

## *High Performance Storage*

**CI-Water project has**

- ✓ **400 TB use-able storage at U. Utah**
- ✓ **Improved links to UW, USU and BYU, NWSC (2 PB storage, 20 PB tape available) resources**
- ✓ **Effective data curation and external data access policies**



**University of Utah's  
data center  
1 petabyte**

## *High Performance Storage @ UW*

- ✓ **UW's Bighorn: 400 TB useable global parallel file system supports Mt Moran computing**
- ✓ **New global scratch space enables data-intensive computing**
- ✓ **In initial stages of Wyoming petalibrary: an expandable, petascale storage system—phase 1 will be deployed by January and support CI-Water**

## *Visualization*

Upper Green River basin:

- Basin area: 1220 km<sup>2</sup>

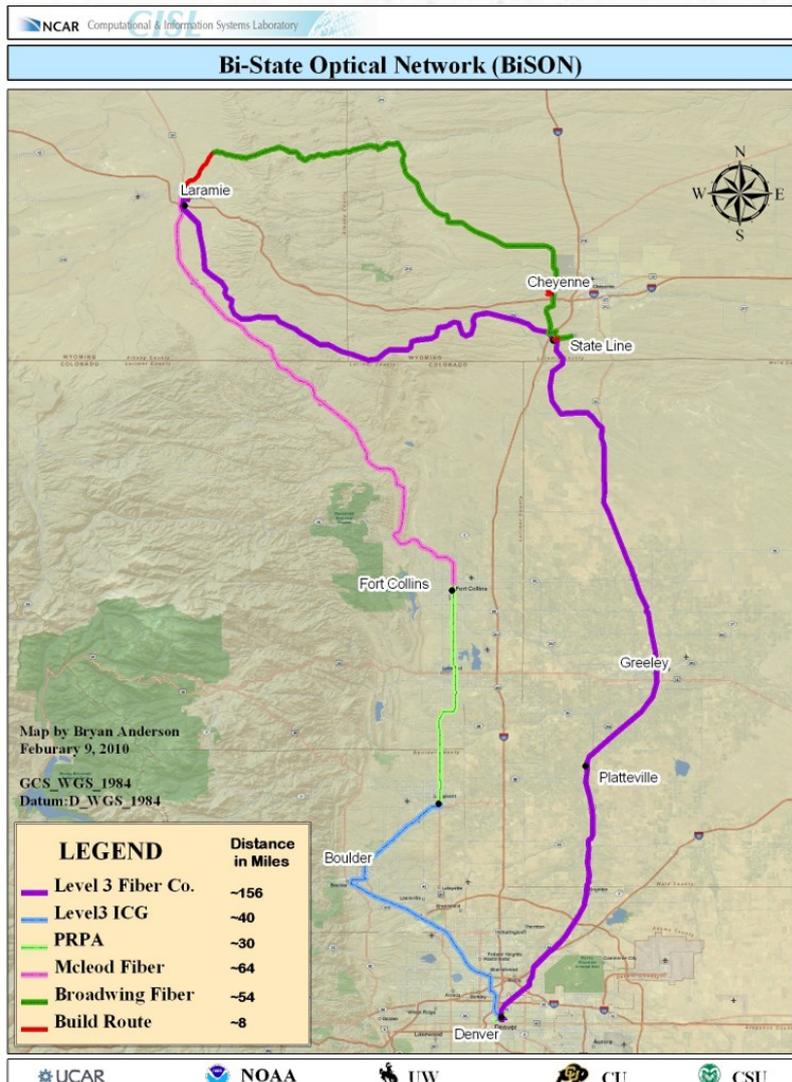
. Equipment includes:

- Four-wall CAVE (Cave Automatic Virtual Environment)
- 2x3 array video wall capable of displaying 3-D images
- A three screen portable "mini-cave" visualization system

UW's visualization research laboratory enables scientists and engineers and policy makers to visualize and interact with highly complex data sets.

The laboratory connects via 10-gigabit lines to the NWSC and to Mt Moran.

## Networking



Project leverages  
Internet II  
Front-range Gigapop  
Utah Education network  
Bi-State Optical network  
and recent NSF funded  
network projects to

- ✓ “create access to data, HPC resources”, and collaboration tools
- ✓ Increase network capacity between institutes

## *Personnel*

**UW's Advanced Research Computing Center was created in 2011 to support projects like CI-Water, and to oversee CI development.**

**Existing personnel (on state-funded lines) include a Director, Architect & Sysadmin, HPC User-support, Application Specialist and Storage Architect & Manager. Will hire data-specialist by January.**

## *Sustainability*

### **Plans incorporate:**

- ✓ Shared responsibility with researchers
- ✓ Long-term base-funding from universities
- ✓ Commitment to computational and data sciences in universities' plans
- ✓ Strategic growth to meet needs without over extending commitments
- ✓ Aggressive pursuit of external funding
- ✓ Leveraging of partnerships

## *Impacts @ UW*

- ✓ **Increased competitiveness:**  
**Track I (\$20M), DOE (\$5M), NSF Networking (\$ 5M), NSF Panama (\$2.89 M) all leverage CI-Water**
- ✓ **Increased # of proposals are cyber-centric**
- ✓ **About \$500K in grants funds to support UW CI**
- ✓ **Increased demand at undergrad and grad level for computational and modeling courses**
- ✓ **New/stronger partnerships**  
**INL, NCAR, LLNL, RMACC, CASC**
- ✓ **Improved success in recruiting high-caliber researchers**

## *NWSC tour tomorrow*

**Depart from Hilton Lobby at 7:30 a.m.**

**Wear closed toe shoes, long pants, long-sleeve shirt.**