HAS YOUR MODELING LOST ITS SPARK?

Rekindling the modeling flame in the Upper Yellowstone River basin and beyond

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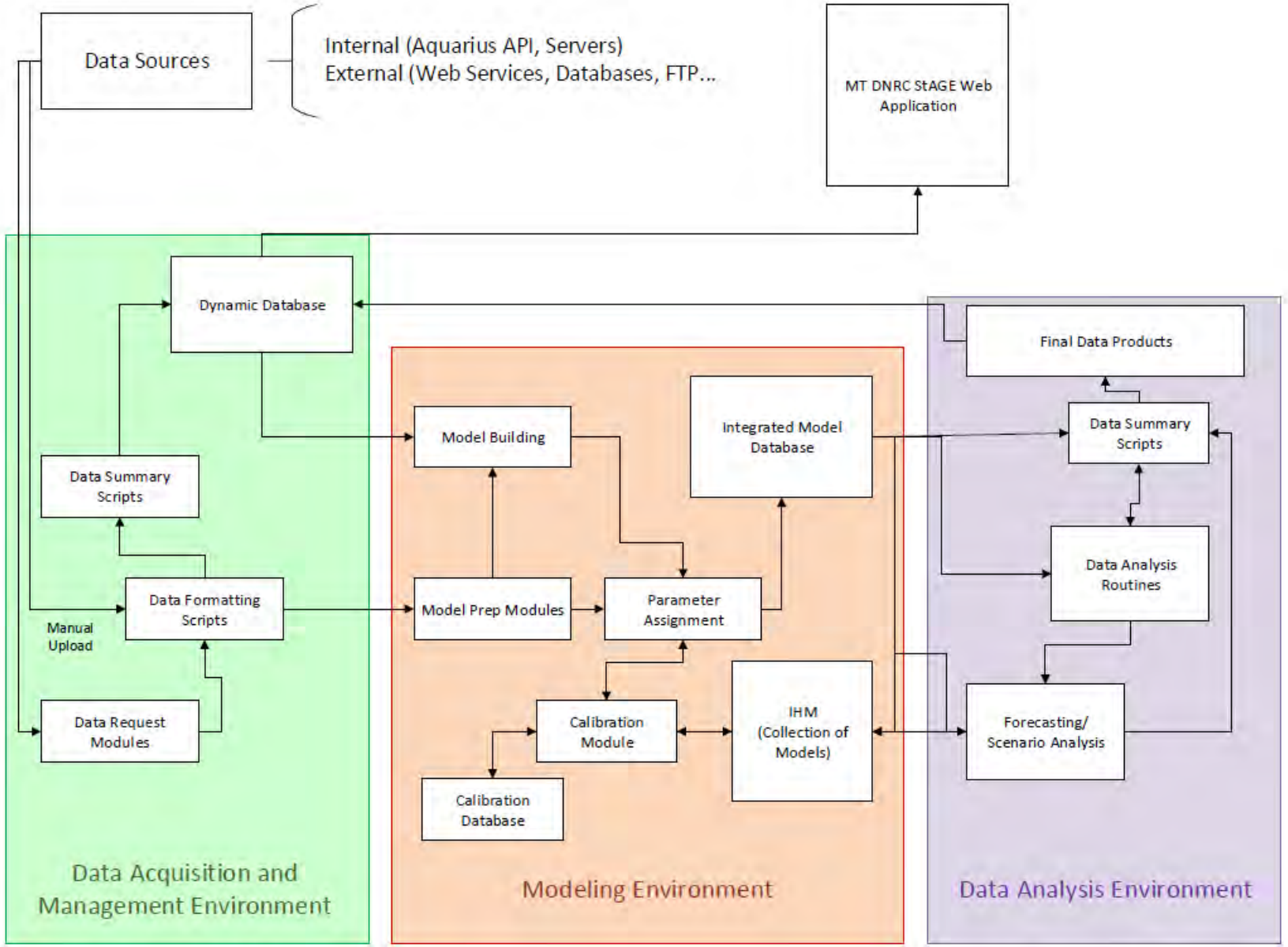
- DNRC's Relationship with Modeling
- A Honeymoon in the Upper Yellowstone
- Our 4-step process to fixing your modeling relationship!
  - Communication
  - Boundaries
  - Openness
  - Trust
- A future to look forward to

Background

The Montana Integrated Hydrologic Modeling System (MIHMS)

"The MIHMS is a standardized framework for interpreting and applying models and model output."

This framework provides a tool to evaluate the impact of changing water supply and development in Montana.


Data Sources
Internal (Aquarius API, Servers)
External (Web Services, Databases, FTP…
MT DNRC StAGE Web Application
Dynamic Database
Data Summary Scripts
Data Formatting Scripts
Manual Upload
Data Request Modules
Data Acquisition and Management Environment
Model Building
Integrated Model Database
Model Prep Modules
Parameter Assignment
Calibration Module
IHM (Collection of Models)
Calibration Database
Modeling Environment
Final Data Products
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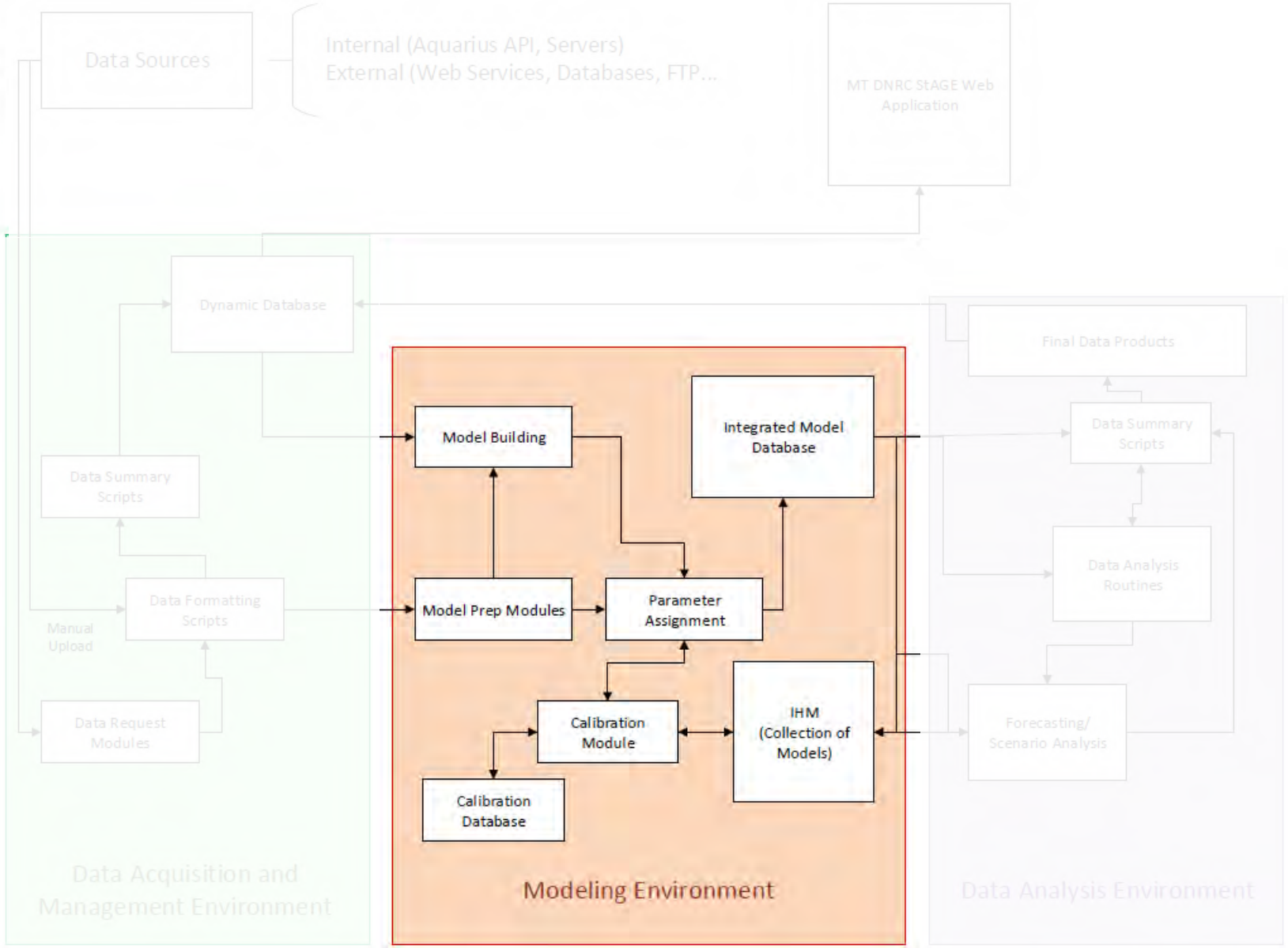
Data Analysis Routines
Forecasting/ Scenario Analysis
Data Analysis Environment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The Upper Yellowstone Study

The Yellowstone River is an iconic Montana river but impacts of water use and changing water supply are not well quantified.

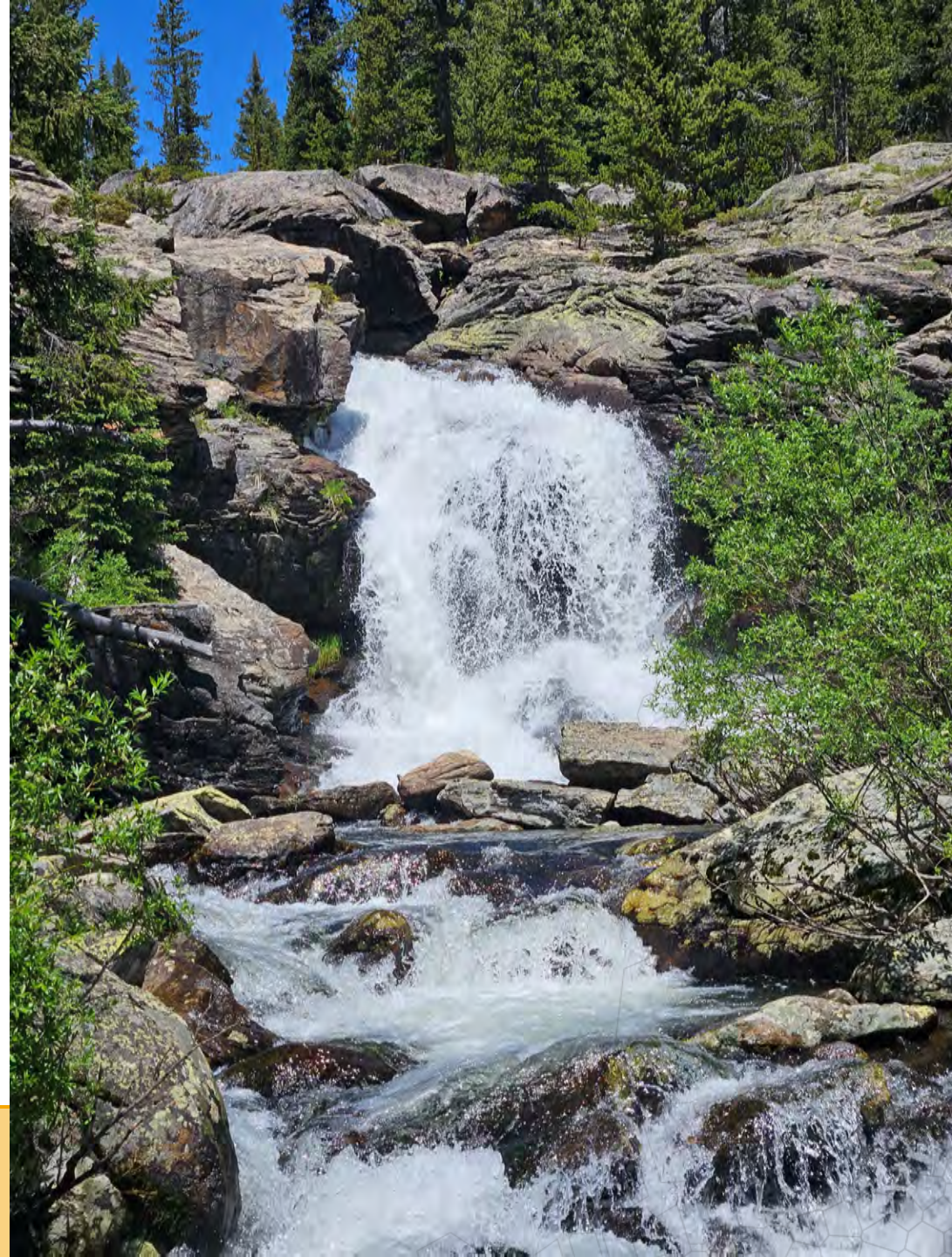
Provide a comprehensive Water Balance and modeling tools to aid local decision making.

Serve as Phase II – Modeling Framework Development for the MIHMS project.


What you NEED to get the most out of
your modeling relationship

Communication

- The cornerstone of ANY relationship, right?
- Python code to build model communication tools
- Improve efficiency and ease of building and working with various models
- Build translators that make communication between models possible

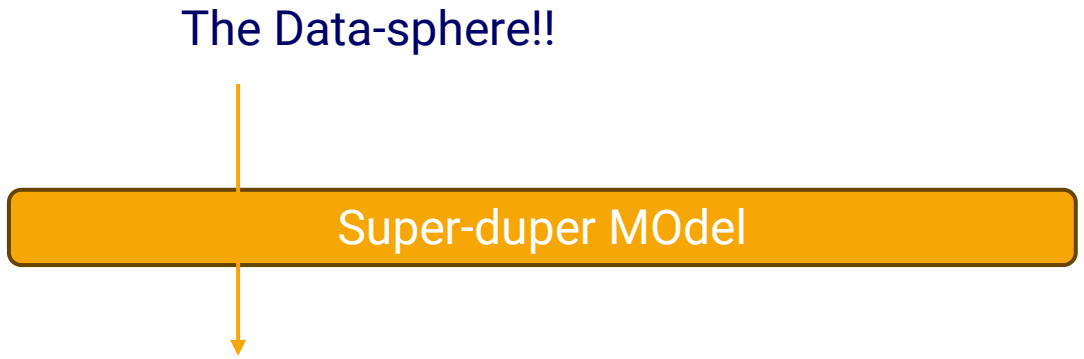


Communication

Super-duper MOdel

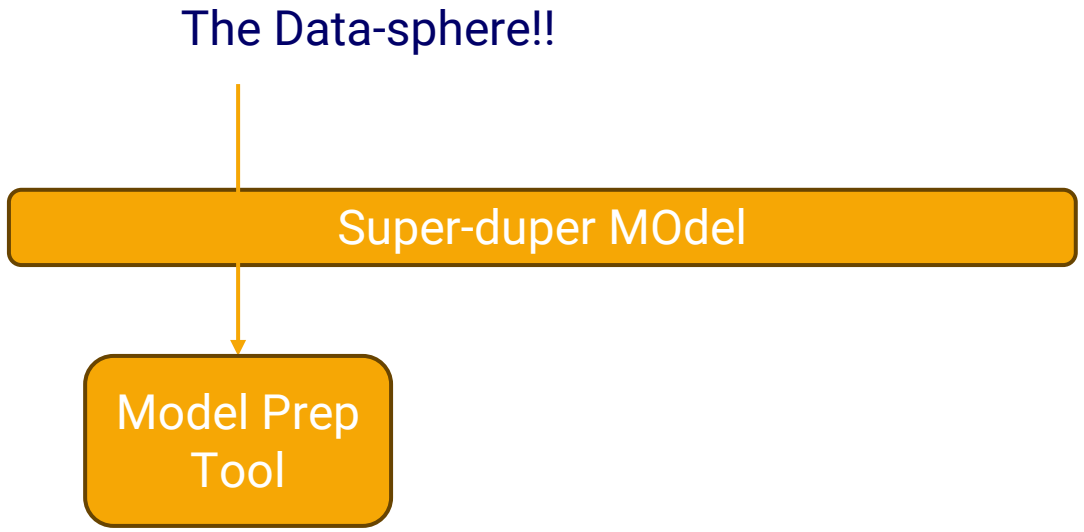
Communication

1. Data Acquisition



Communication

1. Data Acquisition
2. Model Prep
   - 2.1 Data Org
   - 2.2 Domain
   - 2.3 Parameters
   - 2.4 Model Files



Communication

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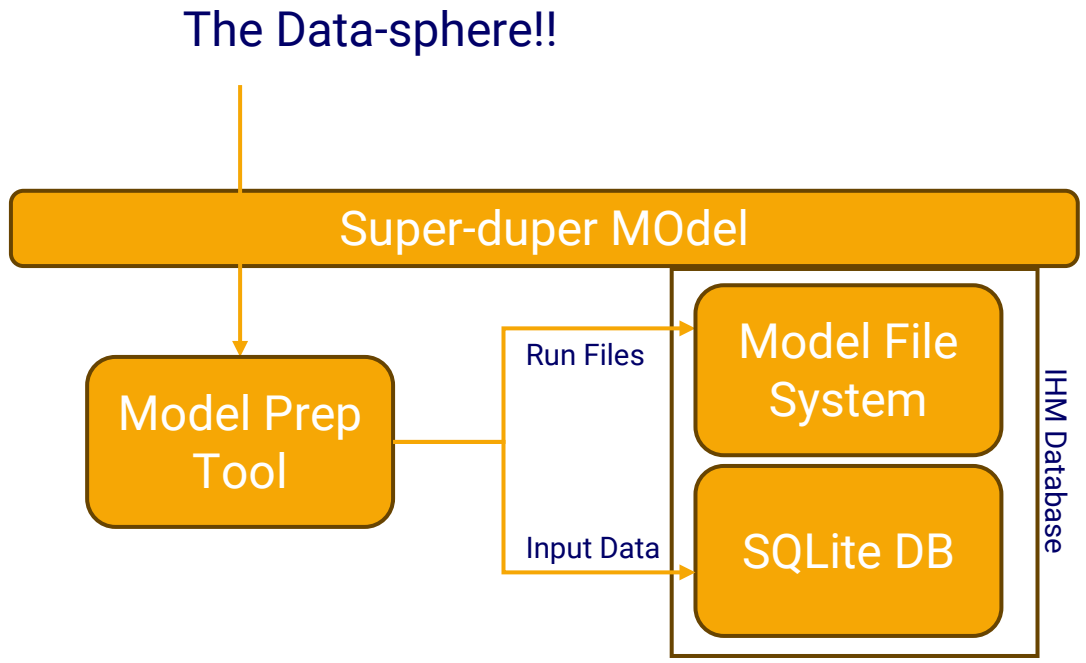
3. Integration/Dbase



Communication

1. Data Acquisition
2. Model Prep
   - 2.1 Data Org
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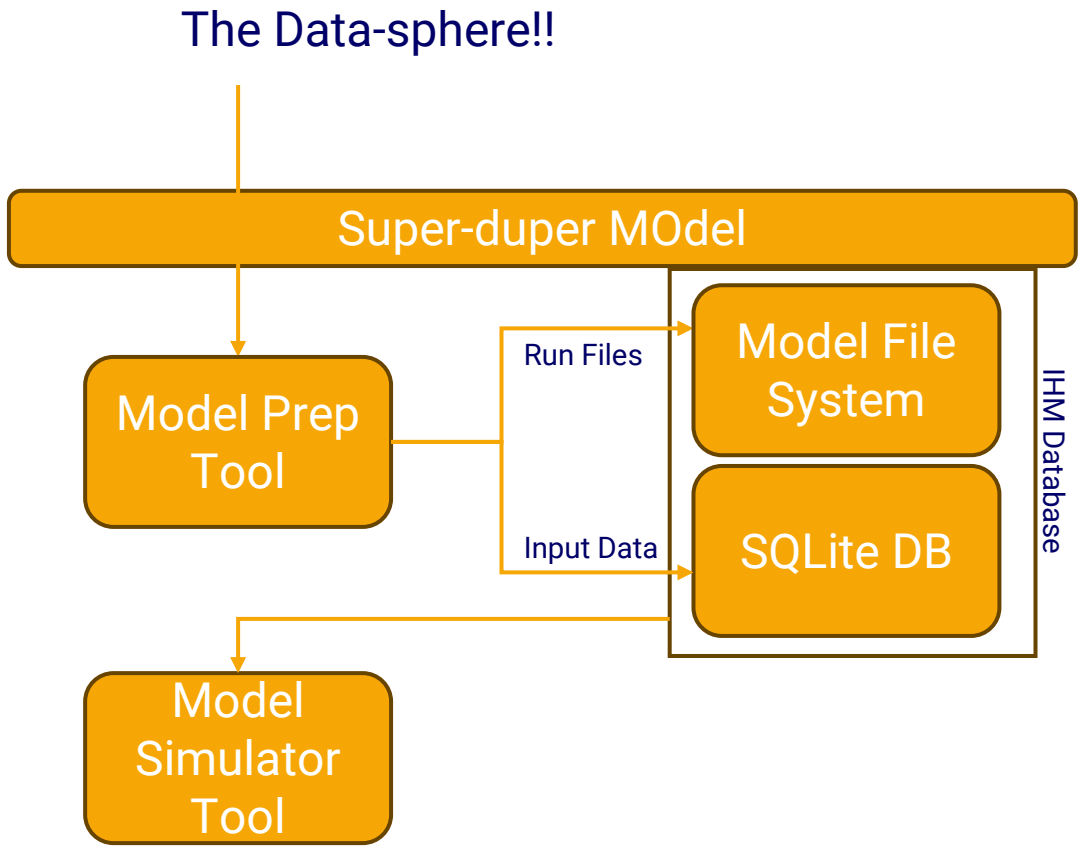
   - 2.3 Parameters
   - 2.4 Model Files
3. Integration/Dbase
4. Simulator



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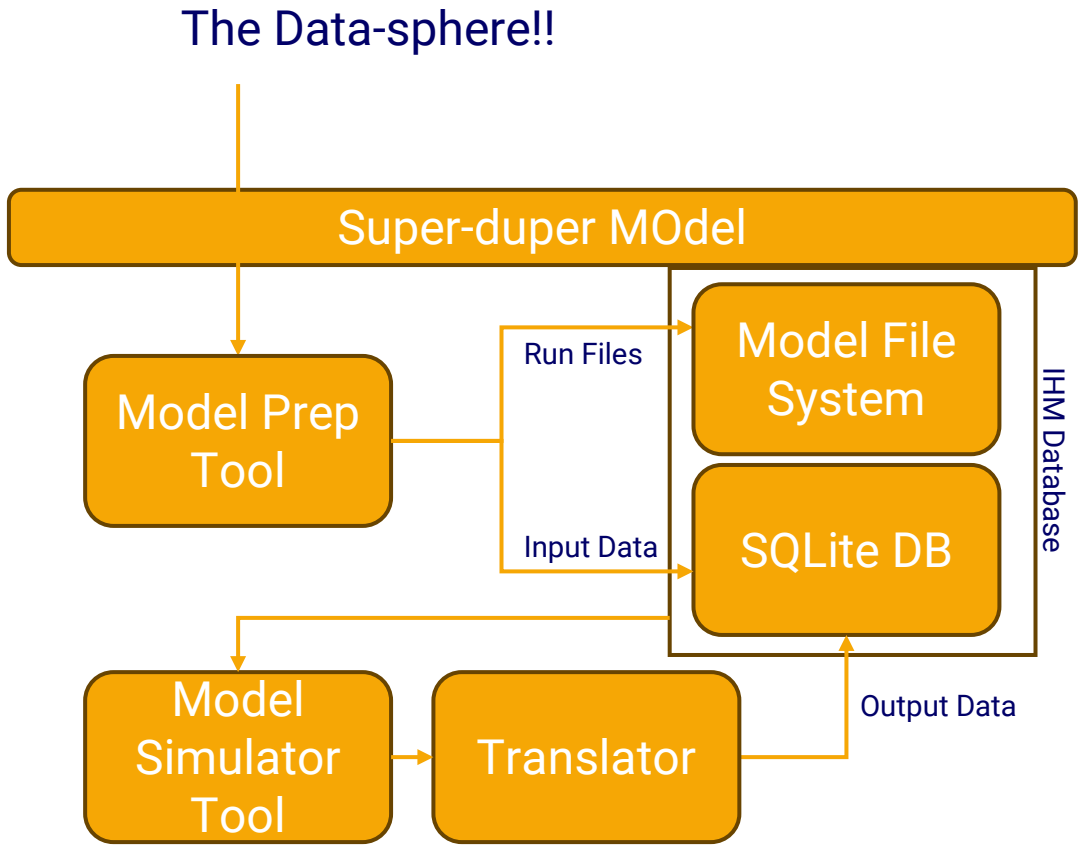
4. Simulator
5. Translator

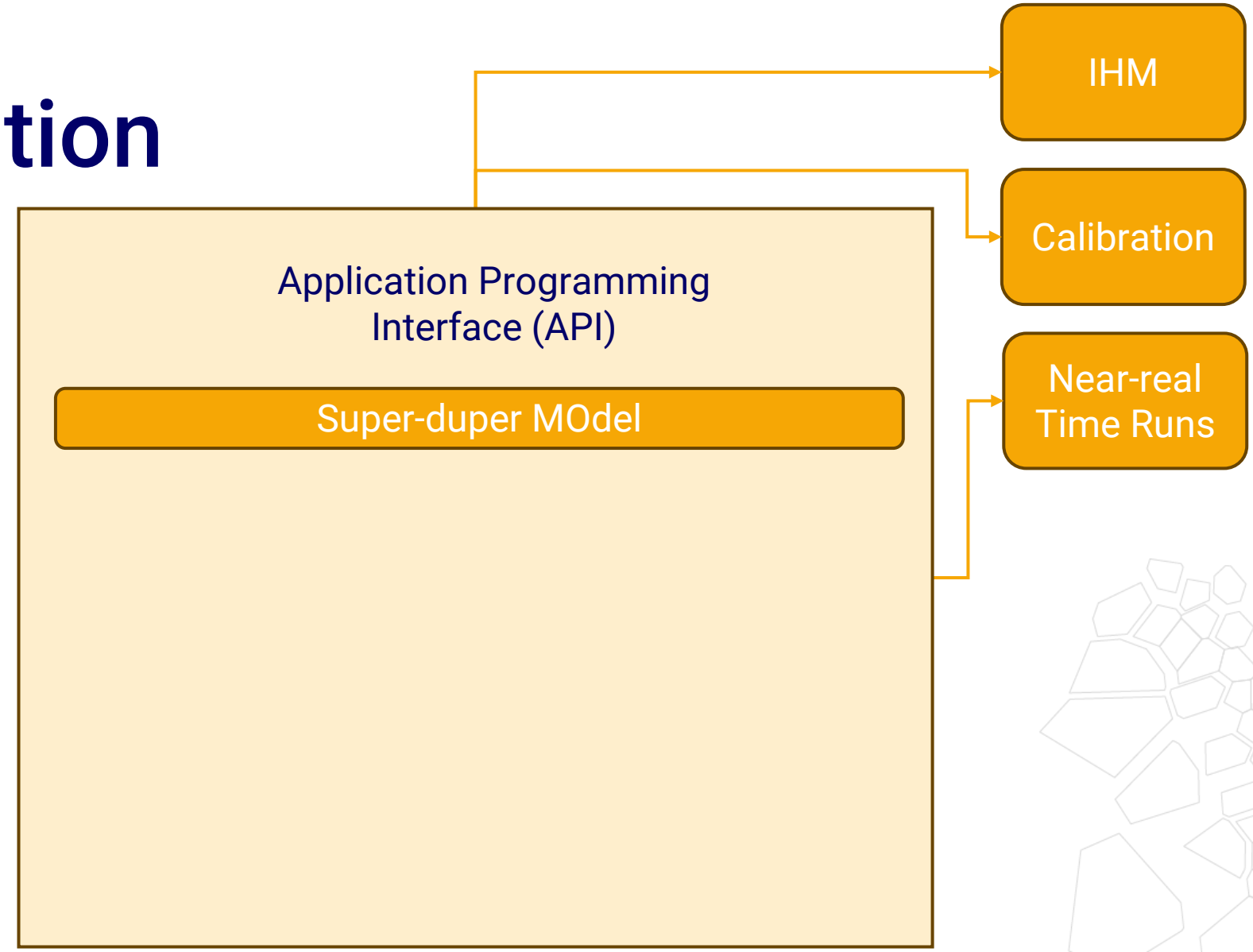


Communication

Communication Tools!

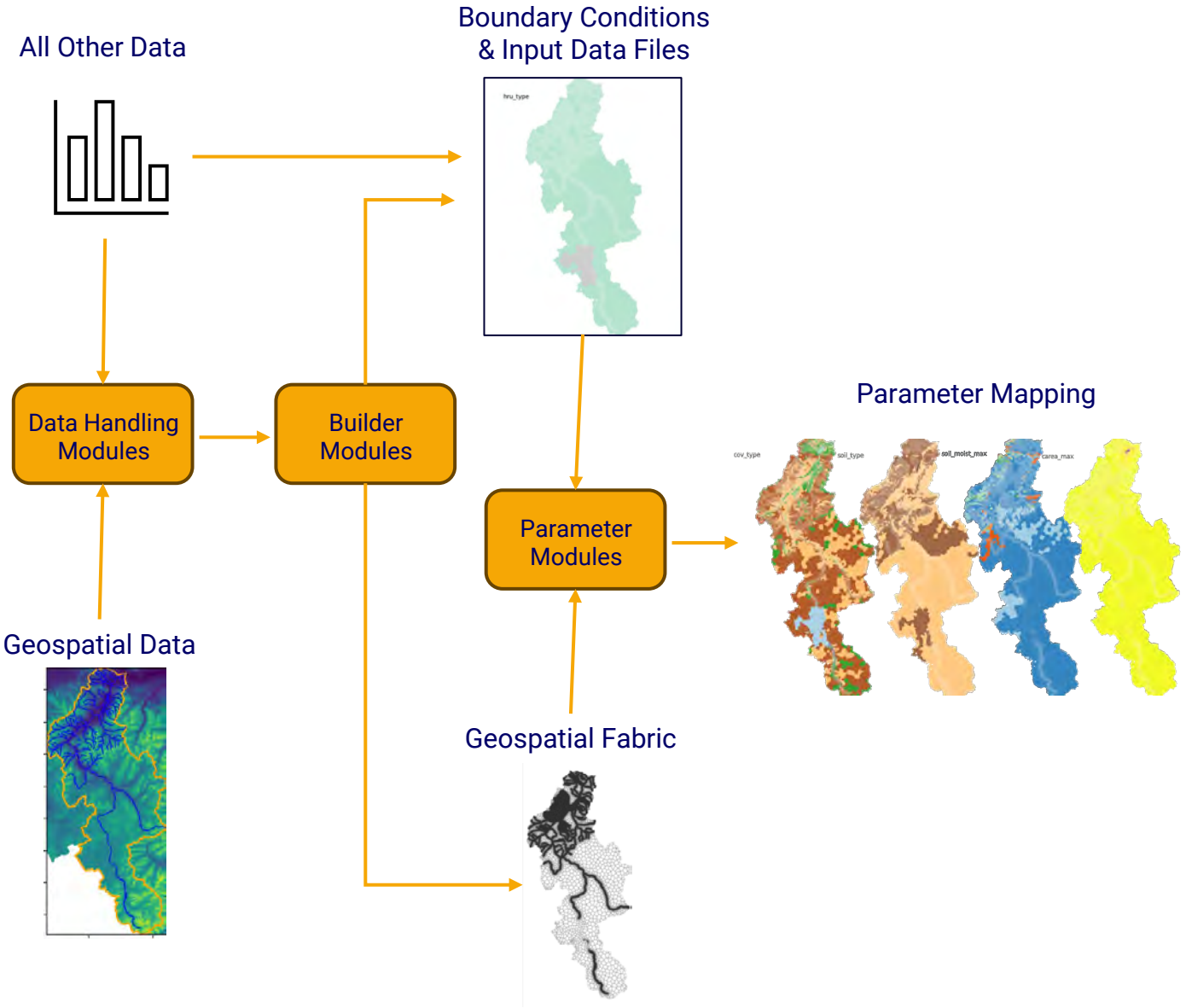
6. Calibration

8. Ops Run



Boundaries

- Every relationship needs boundaries!
- Use communication tools to:
  - Automate parts of model building
  - Create repeatable model setups
  - Easily define boundary conditions
- Every model is different, but the process is the same



Openness

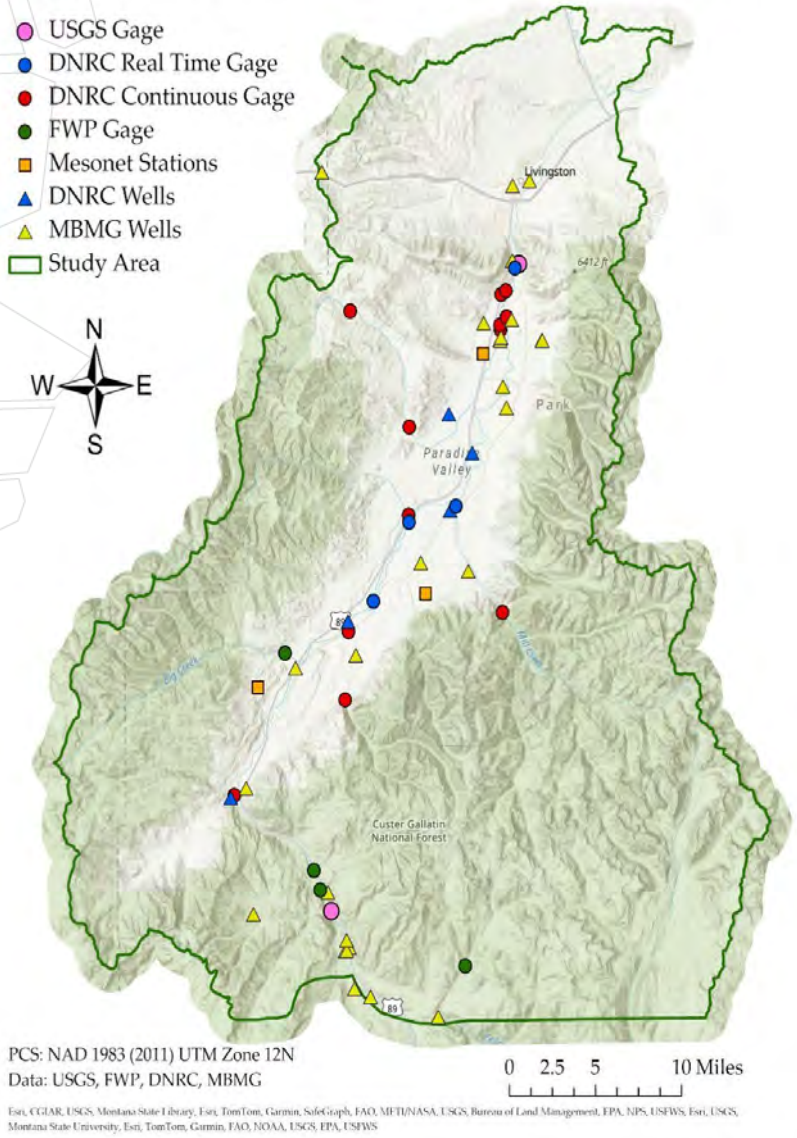
- Sharing is Caring!
- Real data and LOT's of supplemental information (even conceptual)
- Use with communication tools for better model outcomes

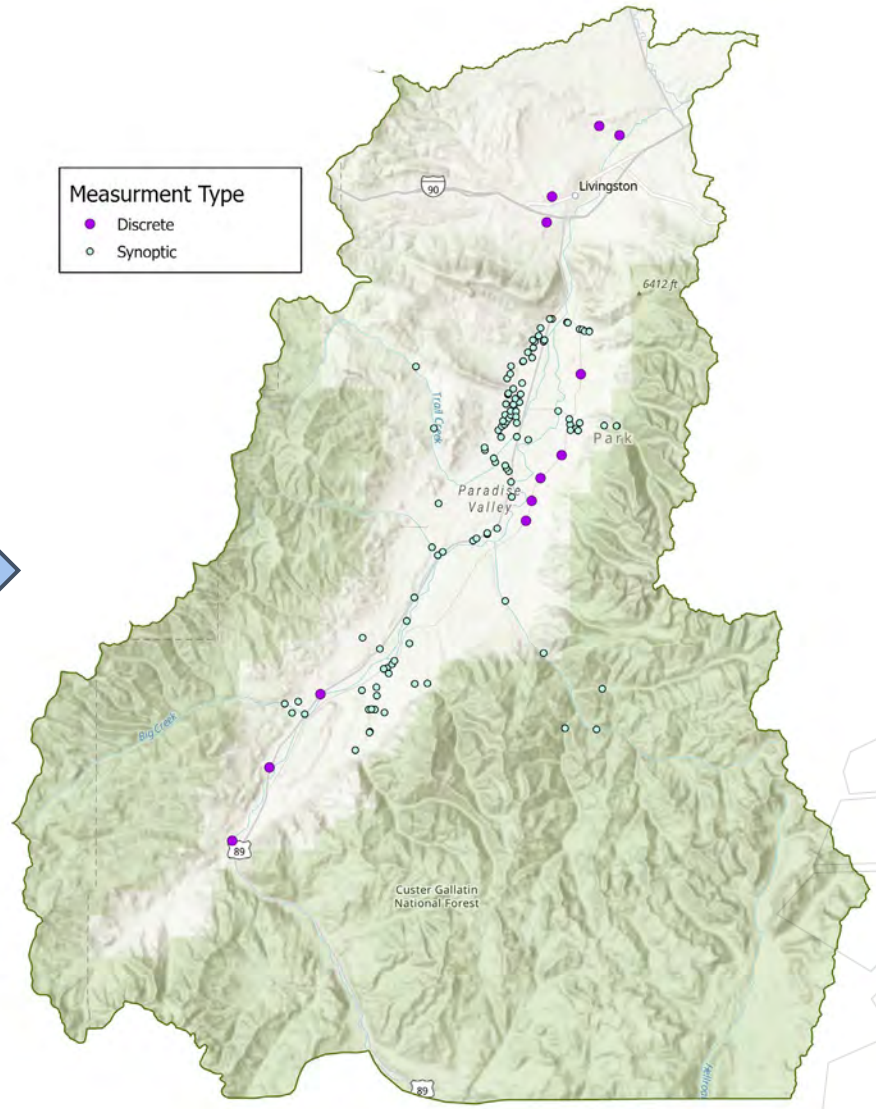
ERROR:

WARNING:

NSE = 0.0

Upper Yellowstone Study Monitoring Sites

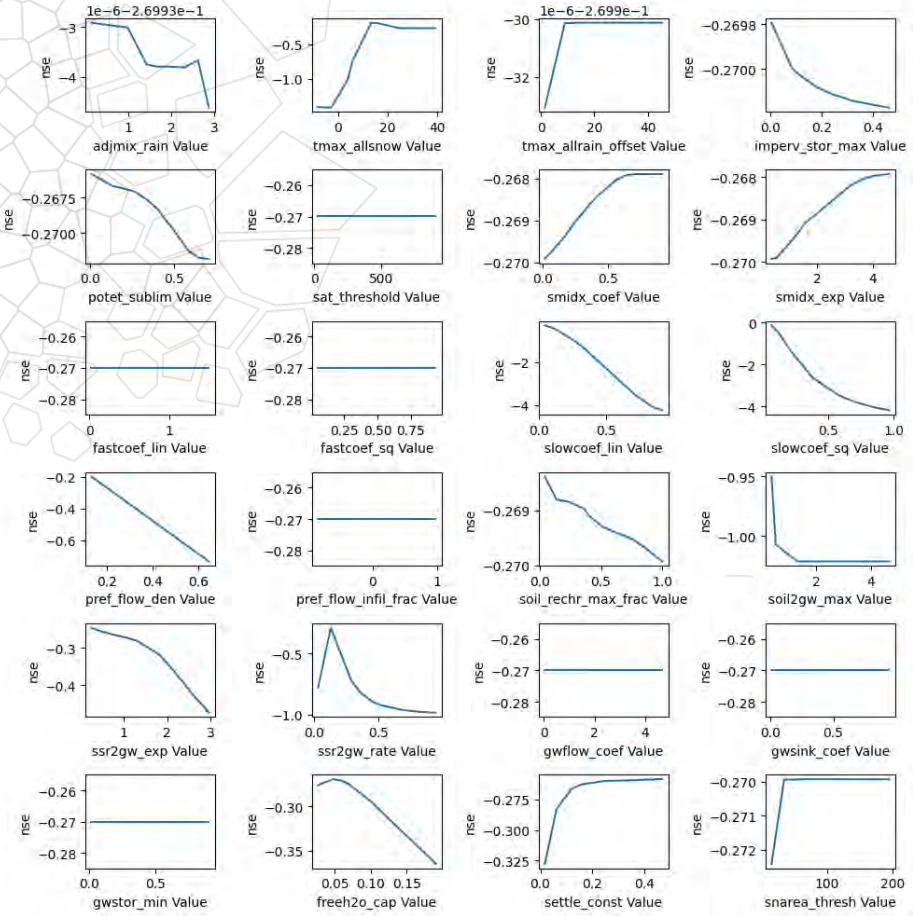


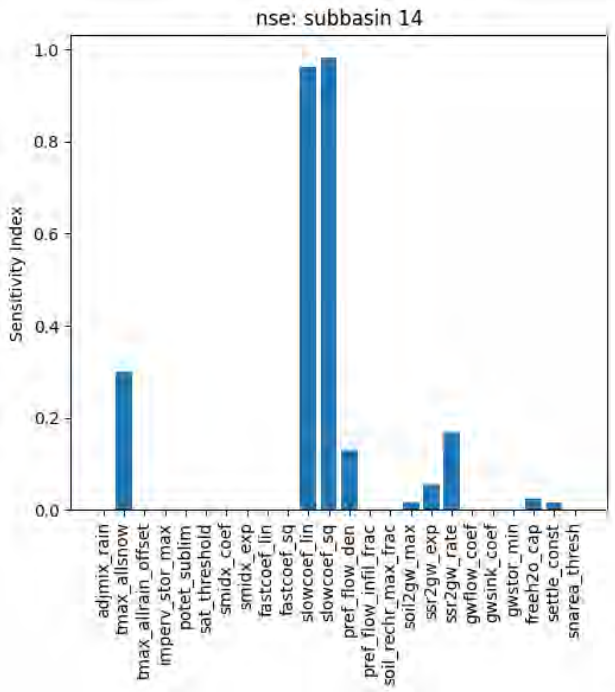


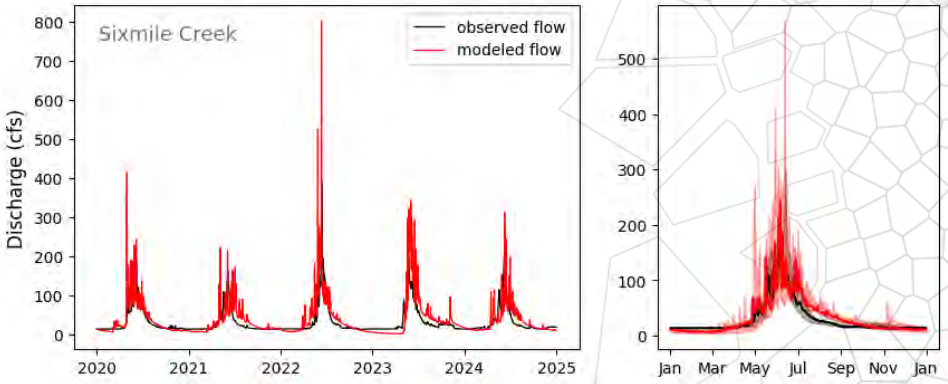
Trust

- Bring it all together, the apex of the relationship, “can we now trust each other?”
- No better way to see than calibration
- Using our communication tools and model building code we’ve designed a calibration method that can:
  - Assess many parameters at once
  - Measure calibration success using multiple objectives
  - Calibrate in 2-dimensions (space/time) simultaneously

Calibration and Uncertainty Analysis

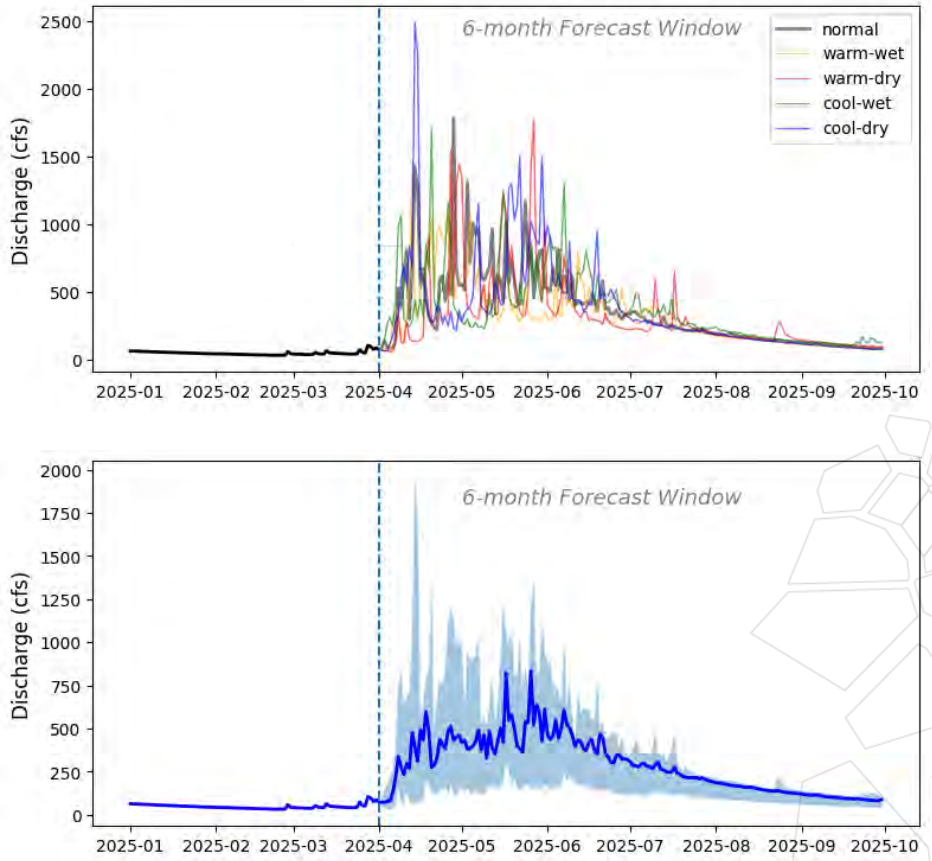






What's Next?

- Short Term Streamflow Forecasts
  - Using 7 – 10 day weather forecast
- Mid-Range Forecasts
  - Using historical weather ensembles
- Long-Term Forecasts
  - Monthly to multiple month water supply probabilities



What's Next?

- Practical Applications of the Upper Yellowstone IHM
  - Aid Upper Yellowstone Watershed Group with Drought Planning
    - Model scenarios/conditions needed to reconnect selected tributaries
    - Model options for fall fisheries flushing flows
  - Irrigation Management on Park Branch Canal
    - Model & Test different irrigation scheduling strategies
  - Livingston Municipal Water Management
    - Incorporate Livingston's city water infrastructure in the accounting model and build tools to assess water use scenarios

What's Next?

- Improvements (calibration)
- Testing in other watersheds
- Use our new relationship tools to tour the WHOLE state (construction of a statewide IHM).

Partners

- Park Branch Canal WUA
- Paradise Canal WUA
- Livingston Ditch WUA
- Countless private landowners, producers

AMBWEST

MBMG
Montana Bureau of Mines and Geology

USDA NRCS
United States Department of Agriculture
Natural Resources Conservation Service

MONTANA
FRESHWATER
PARTNERS

USGS
science for a changing world

Thank You & Questions!

Funding for Upper Yellowstone Study

- Grants
  - Bureau of Reclamation Applied Science WaterSMART Grant
- Financially Supporting Groups:
  - Upper Yellowstone Watershed Group
  - Arthur M. Blank Family Foundation
  - DNRC
- In-kind Contributions:
  - Upper Yellowstone Watershed Group
  - Montana Fish, Wildlife, & Parks
  - Park County Environmental Council
  - Montana Freshwater Partners
  - DNRC

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