Integrating Multiple Data Sources for Continental Scale Watershed Modeling

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Denver, Colorado

SMAP USGS Joint Tutorial
USGS National Center
Reston, Virginia
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Modeling of Watershed Systems (MoWS) Project

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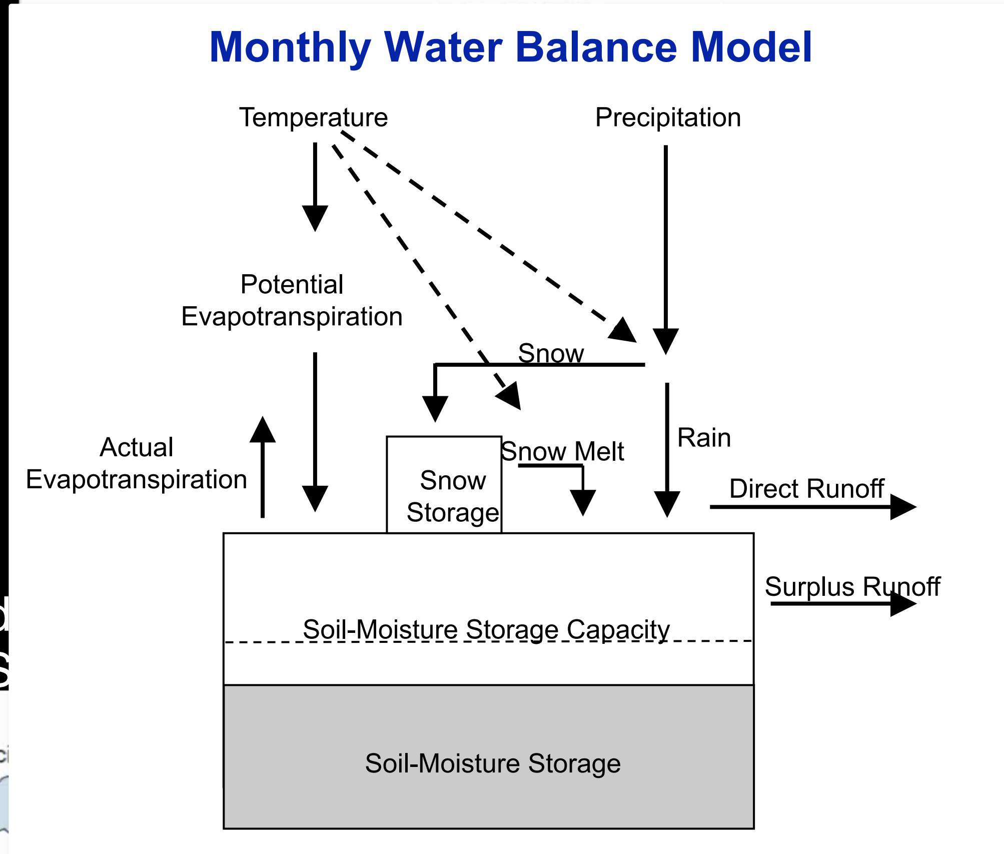
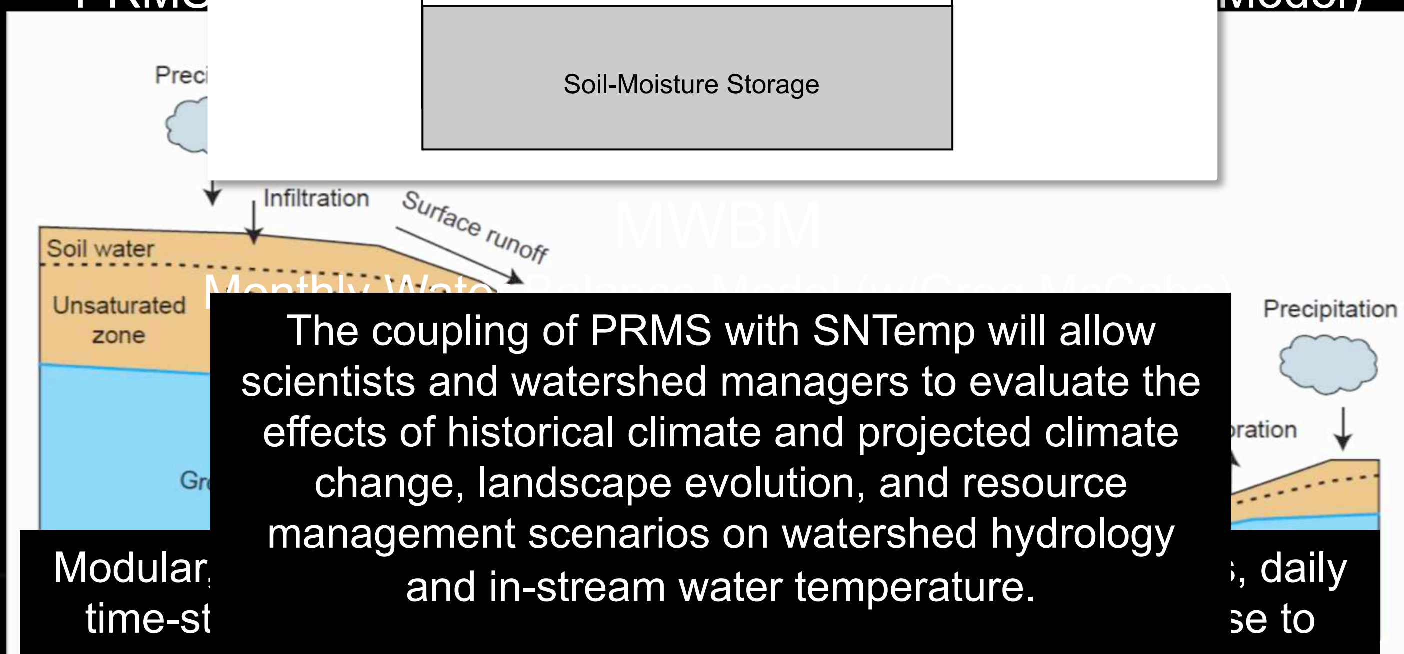


Coupled ground… the integration of PRMS… Model)



The coupling of PRMS with SNTemp will allow scientists and watershed managers to evaluate the effects of historical climate and projected climate change, landscape evolution, and resource management scenarios on watershed hydrology and in-stream water temperature.

Modular, … , daily time-st… se to

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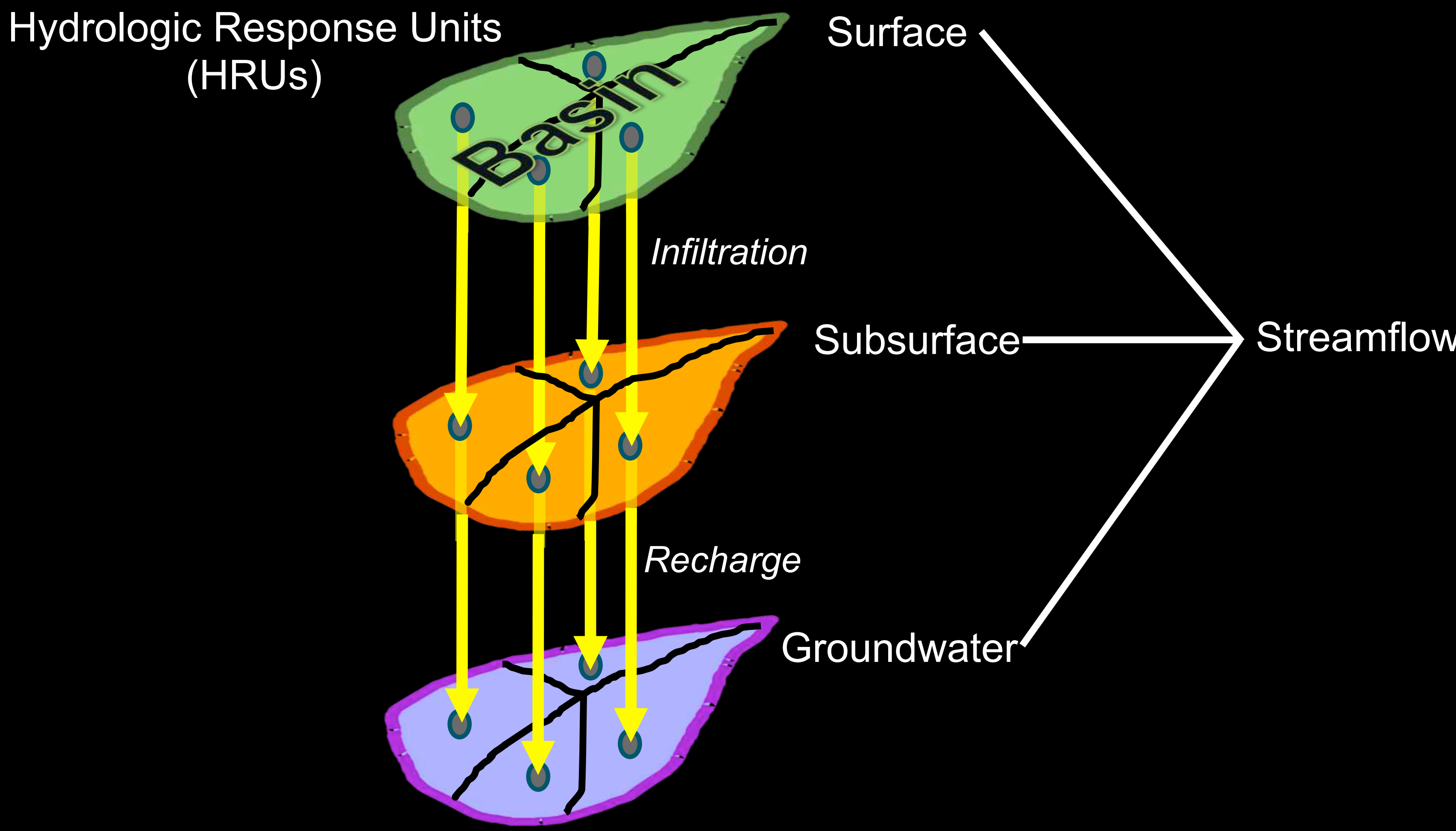
PRMS Conceptualization



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Objective: Simulate streamflow at any point in US

Create a Geospatial Fabric for National-Scale Hydrologic Modeling

- Use nationally consistent “geospatial fabric” of hydro features

Aggregate NHDPlus features based on Points of Interest (POIs) to make HRUs

POIs:

- Major confluences and waterbody inlets/outlets
- Gages II USGS Reference/non Ref. Gages
- SPARROW
- National Weather Service River Forecast Centers
- Travel time points (< 1 day)
- Elevation bands (500m)
- User supplied

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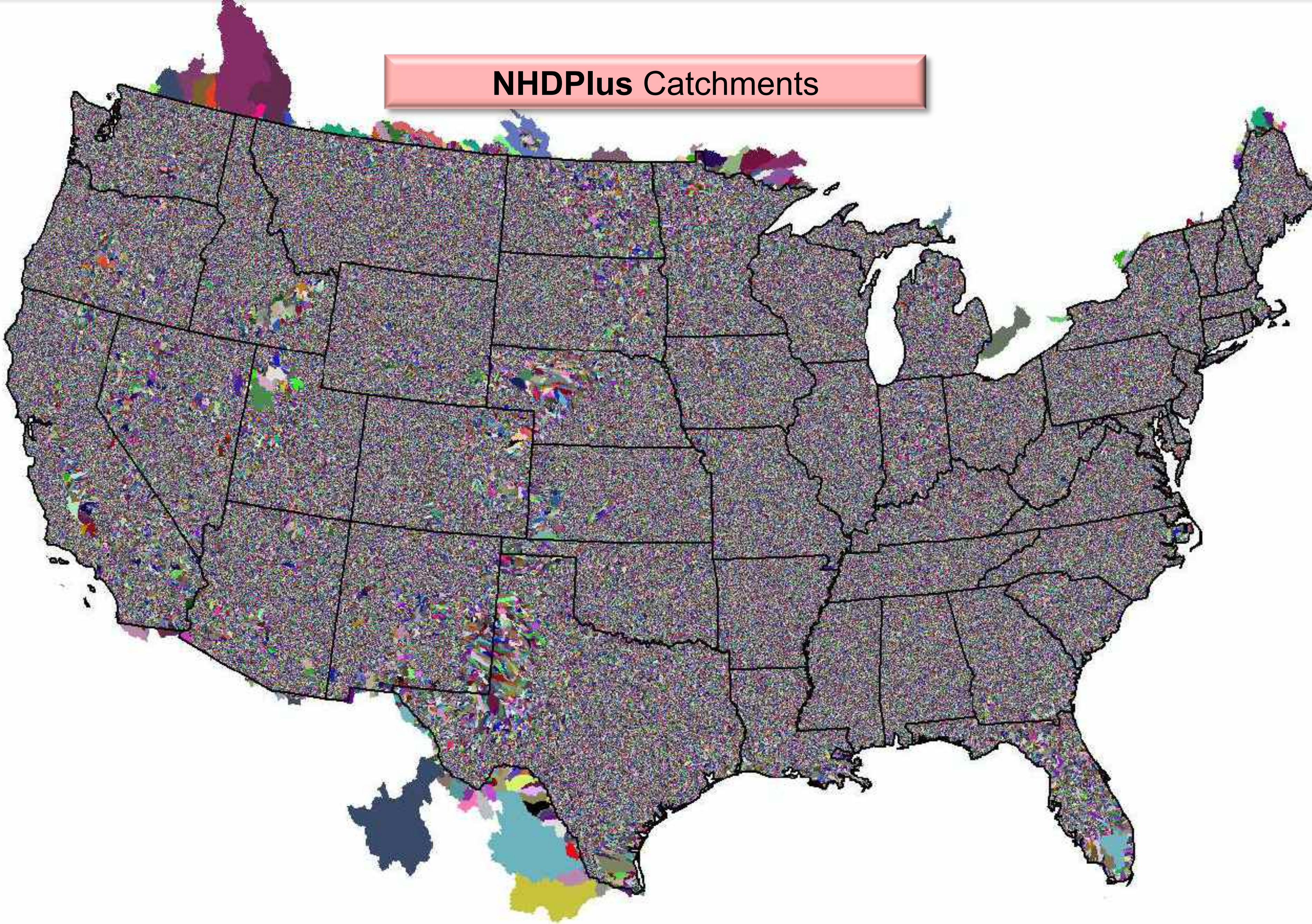
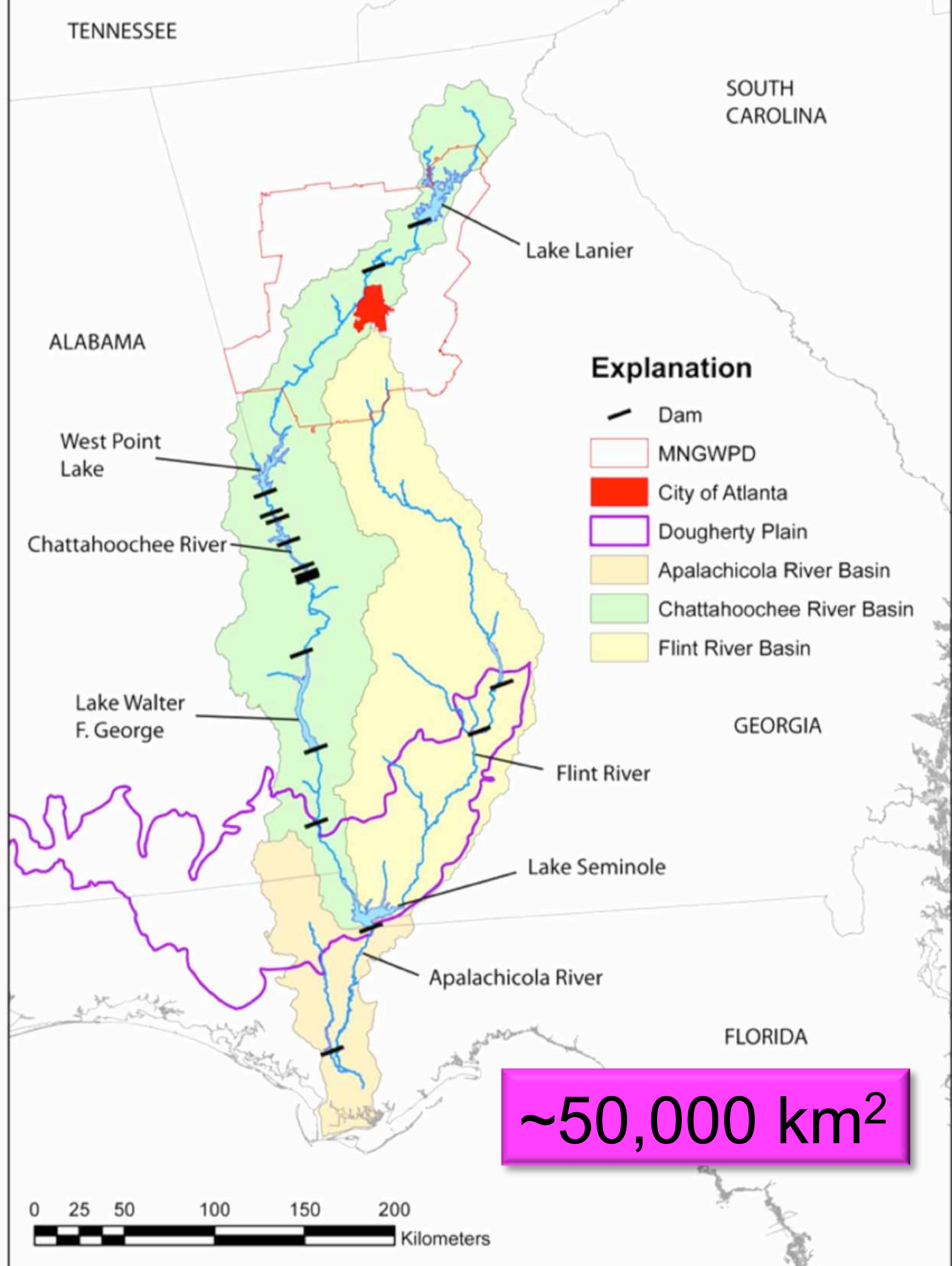
NHDPlus Catchments



Example of aggregated NHDPlus in the Apalachicola-Chattahoochee-Flint (ACF) River basin, Georgia



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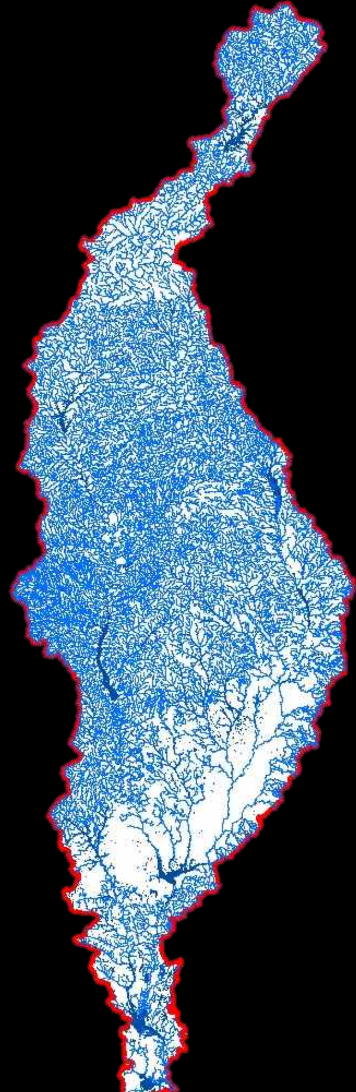
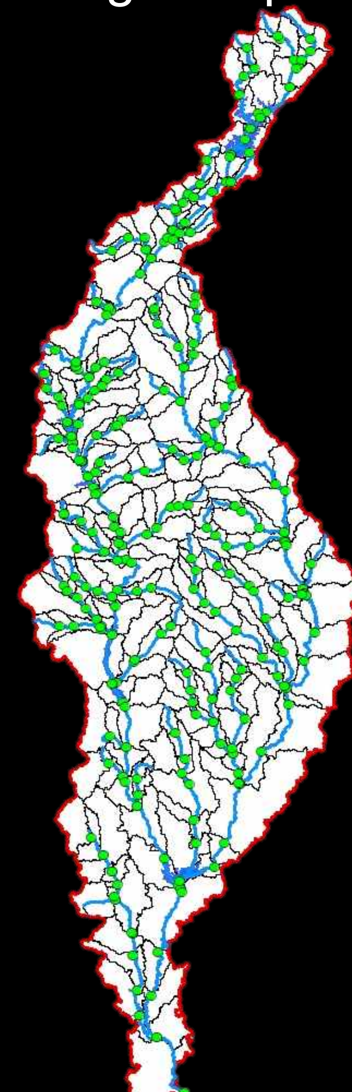
Original NHDPlus data:
5233 waterbodies
26,208 flowlines
25,908 catchments

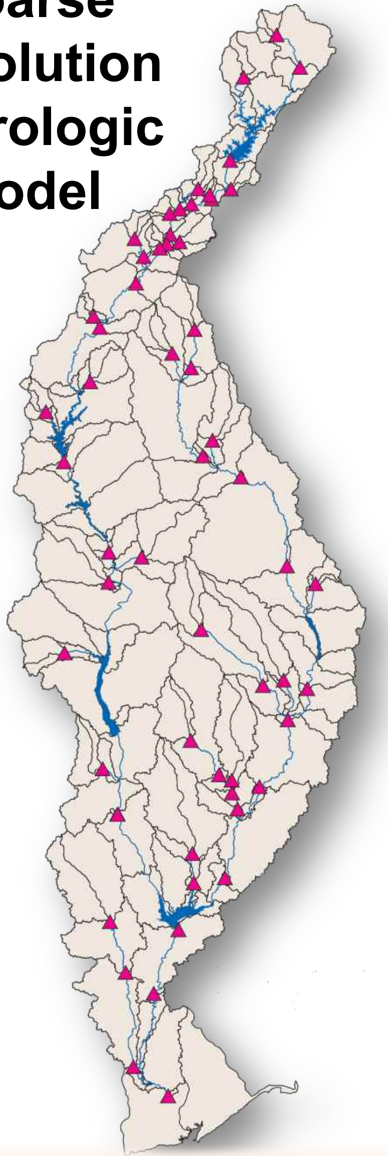


Geospatial Fabric:
7 major waterbodies
313 points of interest (POI)
652 hydrologic response units (HRUS)



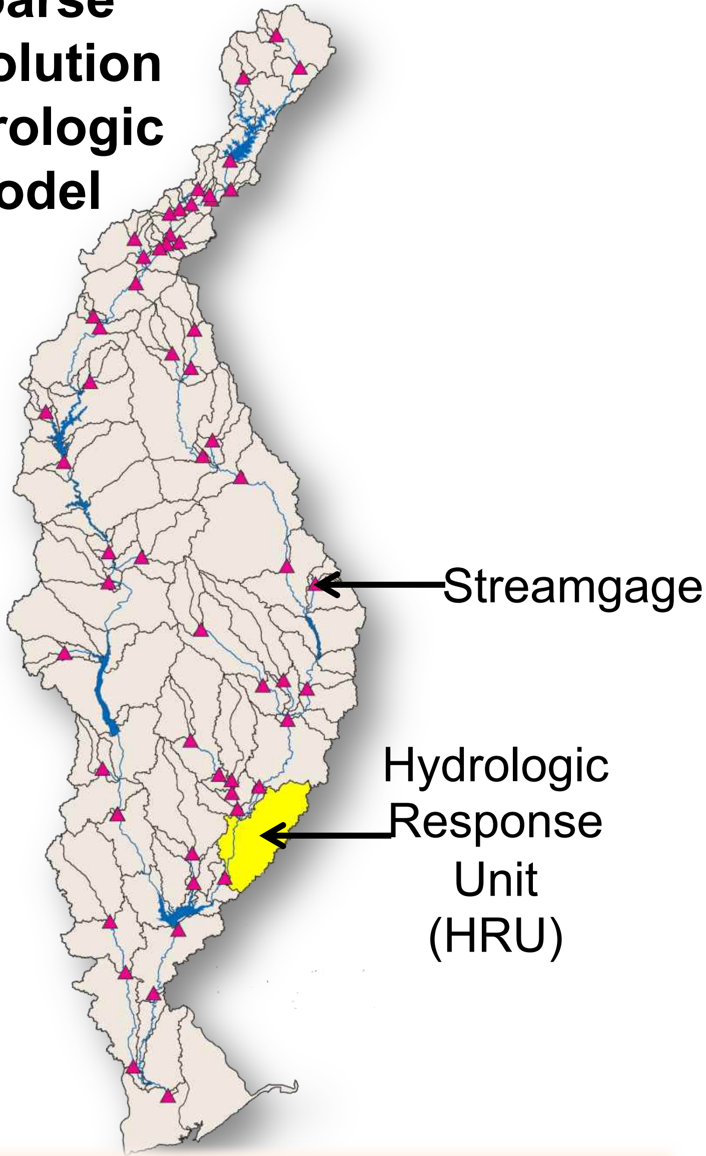
Jacob LaFontaine (GA WSC)

Coarse Resolution Hydrologic Model



Coarse HRUs based on stream gages and other "real-world" locations to enable nesting of models

Coarse Resolution Hydrologic Model



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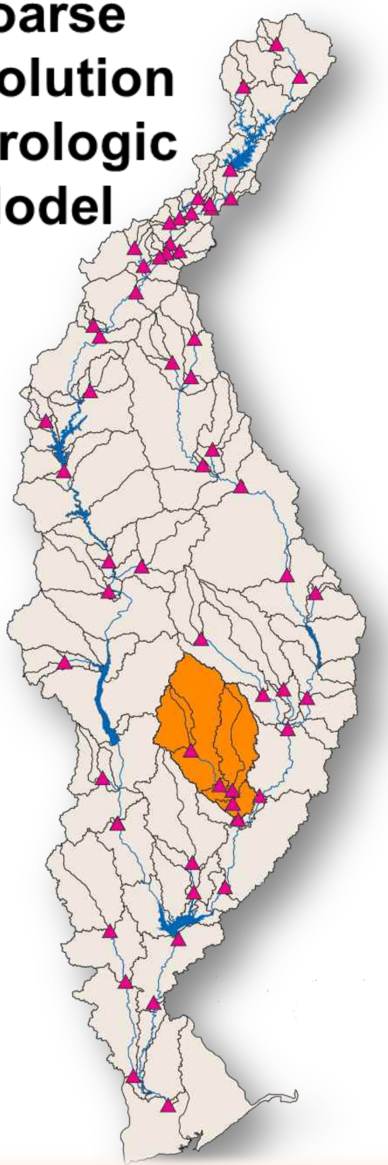
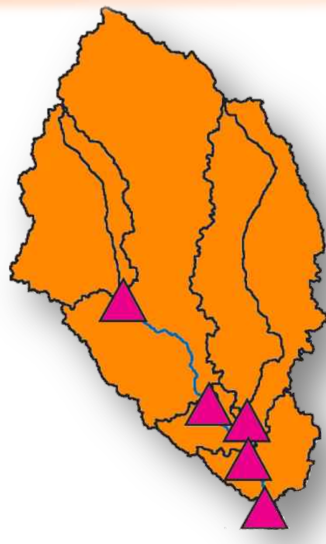


Coarse HRUs based on stream gages and other “real-world” locations to enable nesting of models

Pull a stand-alone coarse resolution model from the larger one



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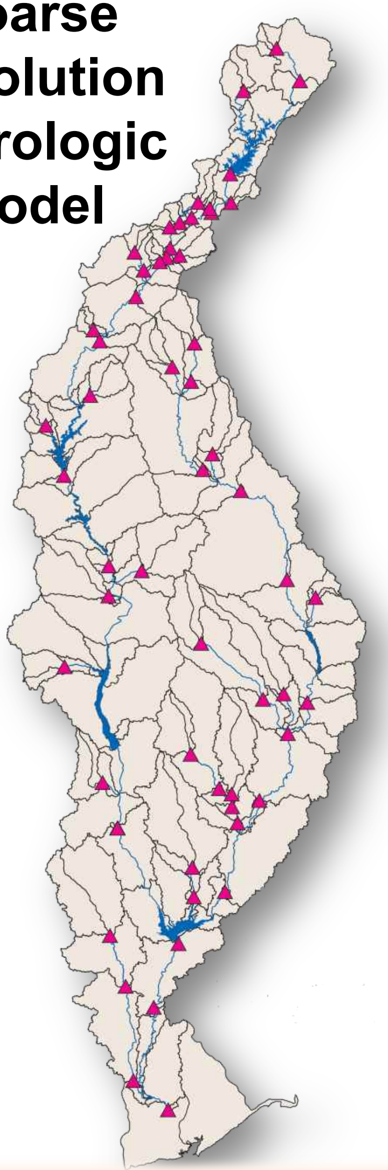

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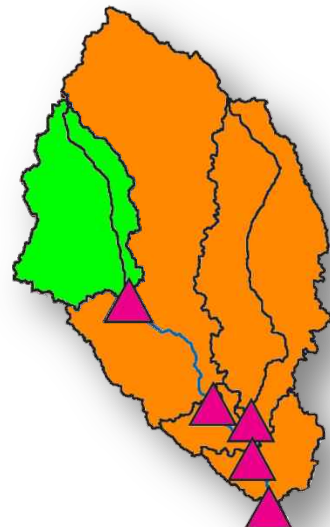
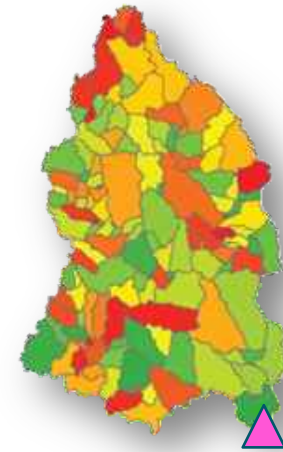
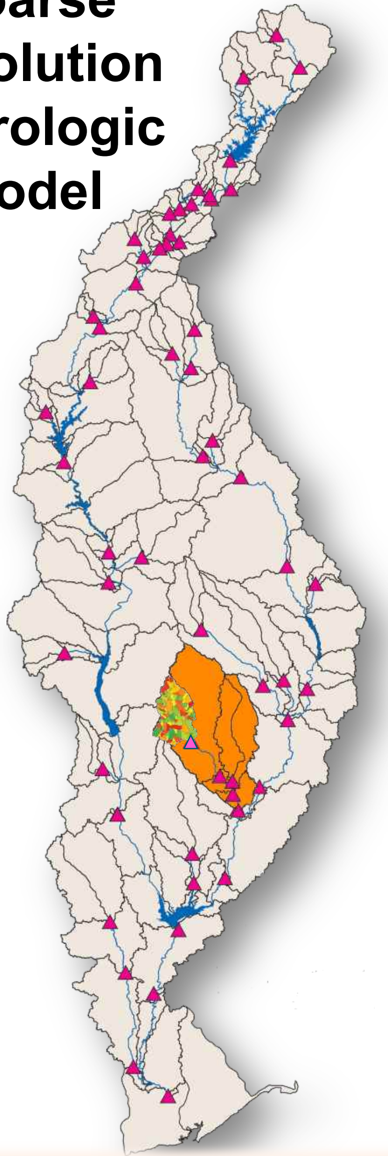




Nest a stand-alone fine resolution model

Coarse Resolution Hydrologic Model



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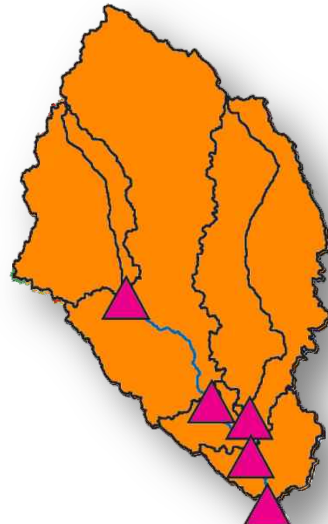
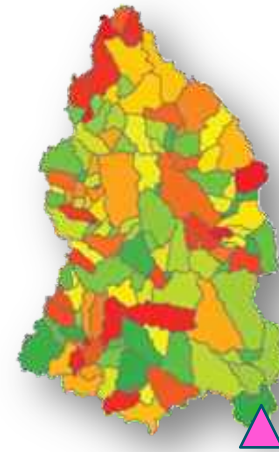


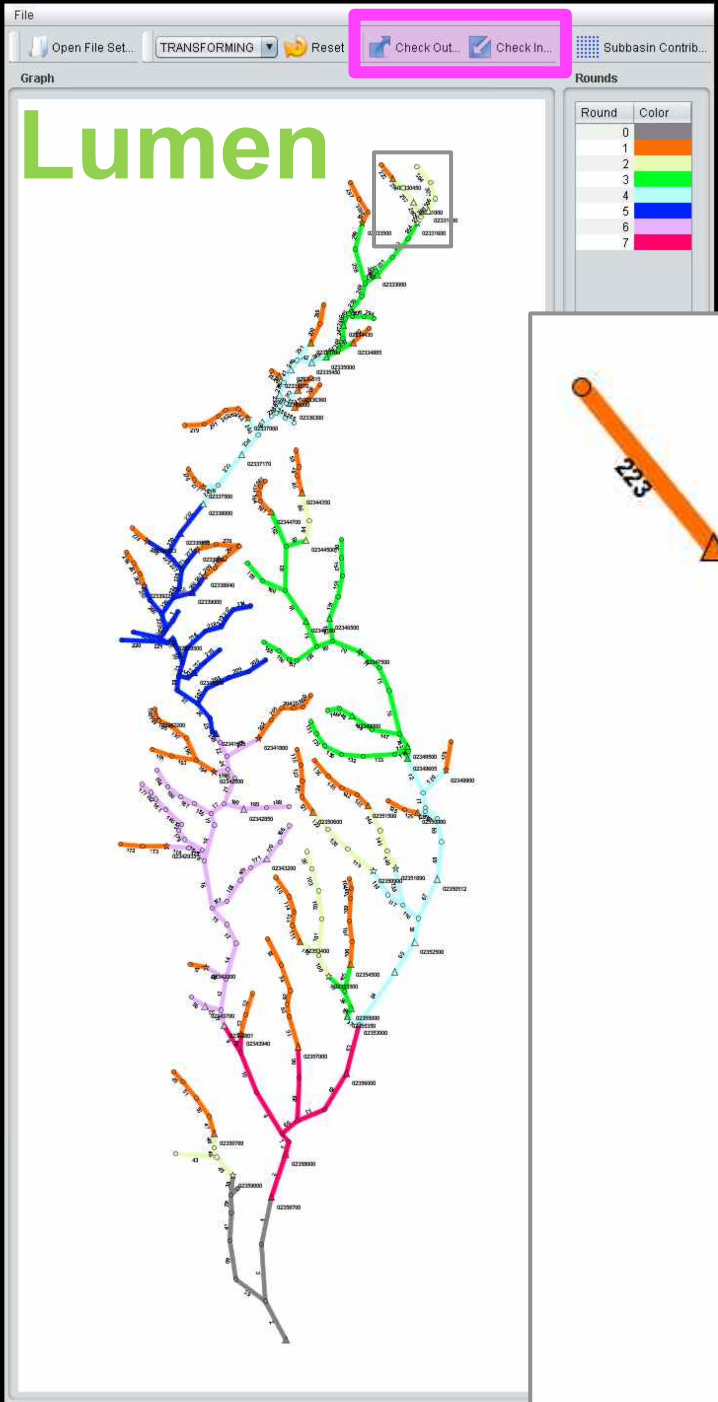


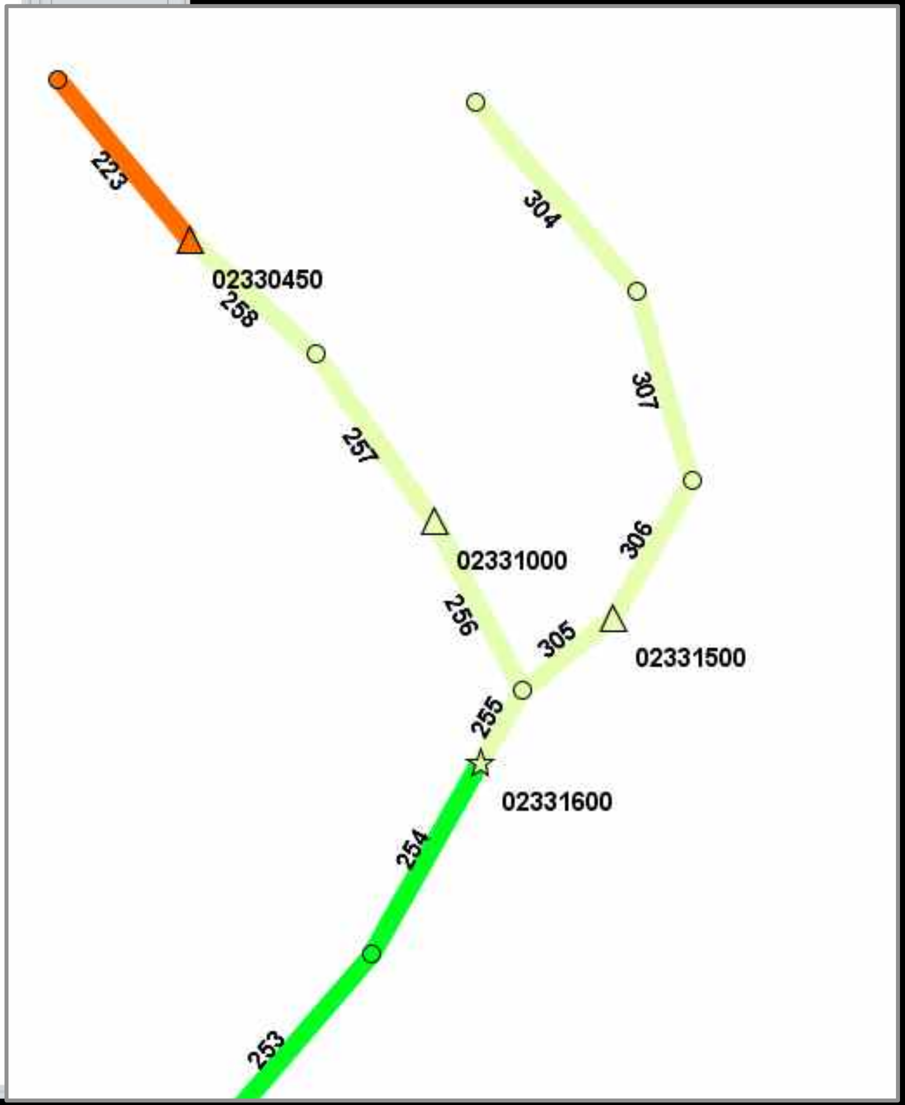
Nest a stand-alone fine resolution model

Coarse HRUs based on stream gages and other “real-world” locations to enable nesting of models

Stand-alone models can be re-calibrated and nested back into the coarse resolution model

- Stream network
- Gages
- Calibration rounds based on gages





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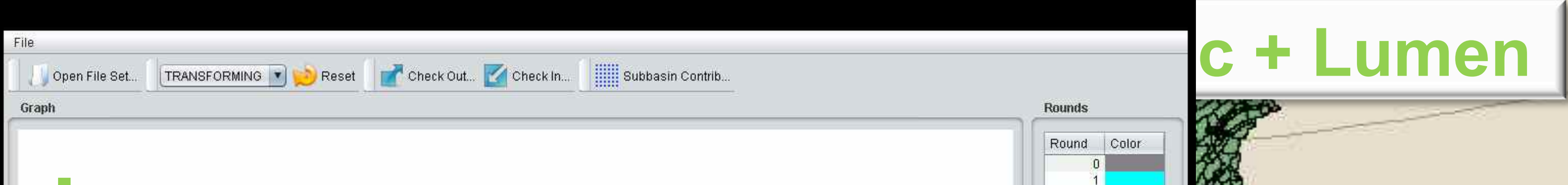
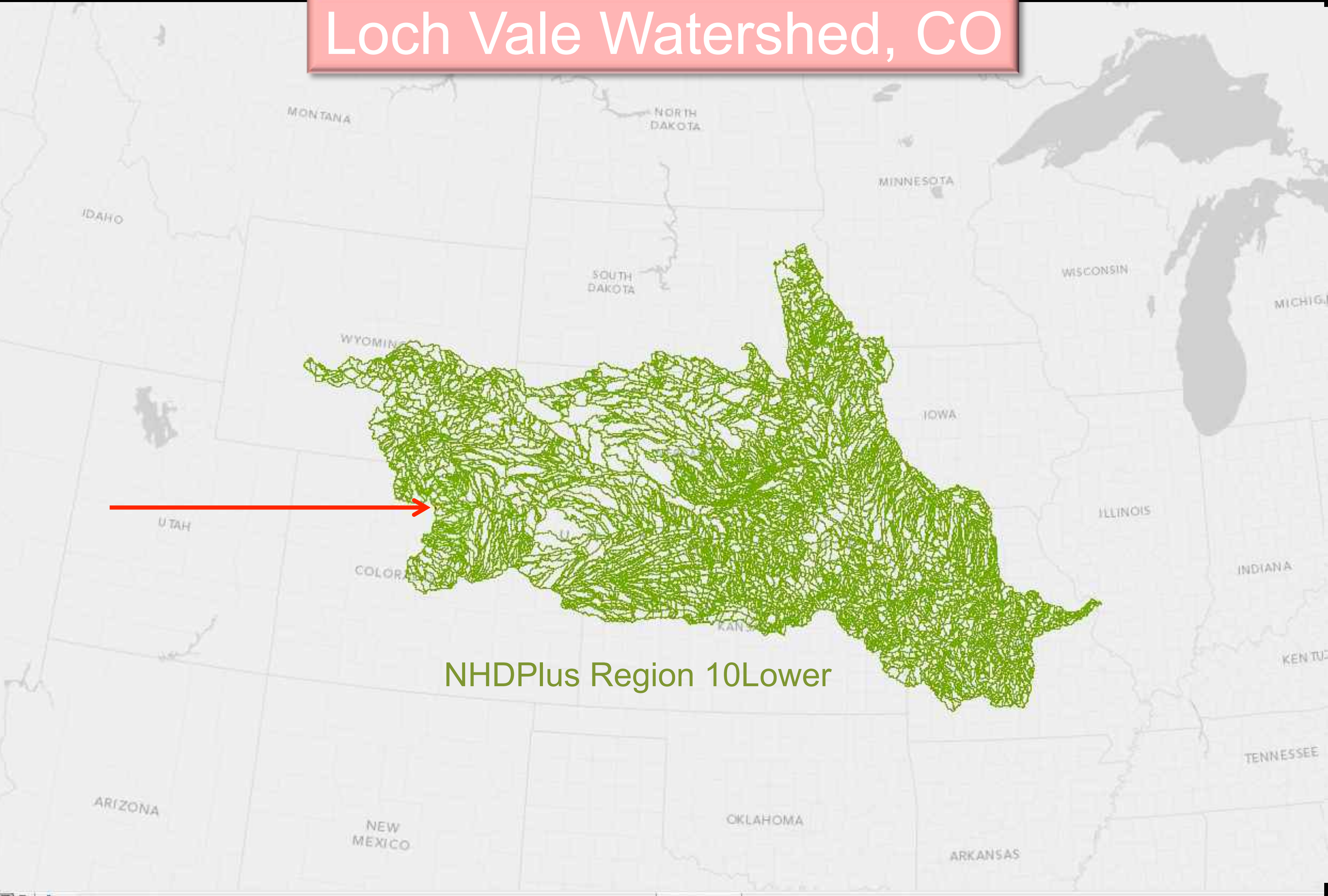


Author	Title
Session I: Moderator Jacob LaFontaine	
Steven Markstrom	National Hydrologic Model -- Overview
Roland Viger	Geospatial Fabric for a National Hydrologic Model using NHDPlus
Steve Regan	Adaptive Enhancements for the National Hydrologic Model
Lauren Hay	National Hydrologic Model Calibration
Session II: Moderator Steven Regan	
Andy Bock	Application of a monthly water balance model to guide the constraint of higher resolution hydrologic models
Jacob LaFontaine	An Application of the National Hydrologic Model in the Apalachicola-Chattahoochee-Flint River Basin, Southeastern USA
Adel Haj	Simulation of Runoff and Reservoir Inflow using the Precipitation-Runoff Modeling System (PRMS) for the Missouri River Watershed
David Blodgett	An Open Architecture for the Hydrologic Modeling Decision Support Lifecycle
Session III: Moderator Lauren Hay	
Ana Maria Garcia	Approach for assessment of water availability in major river basins in Alabama
Ashley Van Beusekom	An Application of the National Hydrologic Model in Puerto Rico
Emily Kuhr	An Application of the National Hydrologic Model in the Upper South Platte River Basin, Colorado
Katherine Chase	Combining the Precipitation-Runoff Modeling System with the Reg3CM Regional Climate Model to Estimate Potential Effects of Climate Change on Northern Great Plains Streams
Session IV: Moderator Steven Markstrom	
Julie Kiang	A comparison of methods to estimate daily streamflows in the Southeastern U.S.
Thomas Over	Comparison of three monthly modeling approaches in southeastern United States
Stacey Archfield	Fitting three- and four-parameter probability distributions to daily streamflow
William Farmer	A Framework for Evaluation of Methods for Estimation of Streamflow at Ungaged Locations
Session V: Posters	
Jacob LaFontaine	Simulation of hydrologic response to climate change using the Precipitation Runoff Modeling System in the Apalachicola-Chattahoochee-Flint River Basin, southeastern USA
Thomas Over	Tests of Seemingly-Unrelated Regression for Estimation of Regional Daily Flow-Duration Curves
Shannon Poole	Tools for National Hydrologic Model Application Development
Steven Markstrom	Enhancements to the Precipitation-Runoff Modeling System for simulating in-stream water temperature
Kasey Hutchinson	Simulation of Daily Streamflow Using the Precipitation-Runoff Modeling System within the Des Moines and Iowa River Basins, Iowa

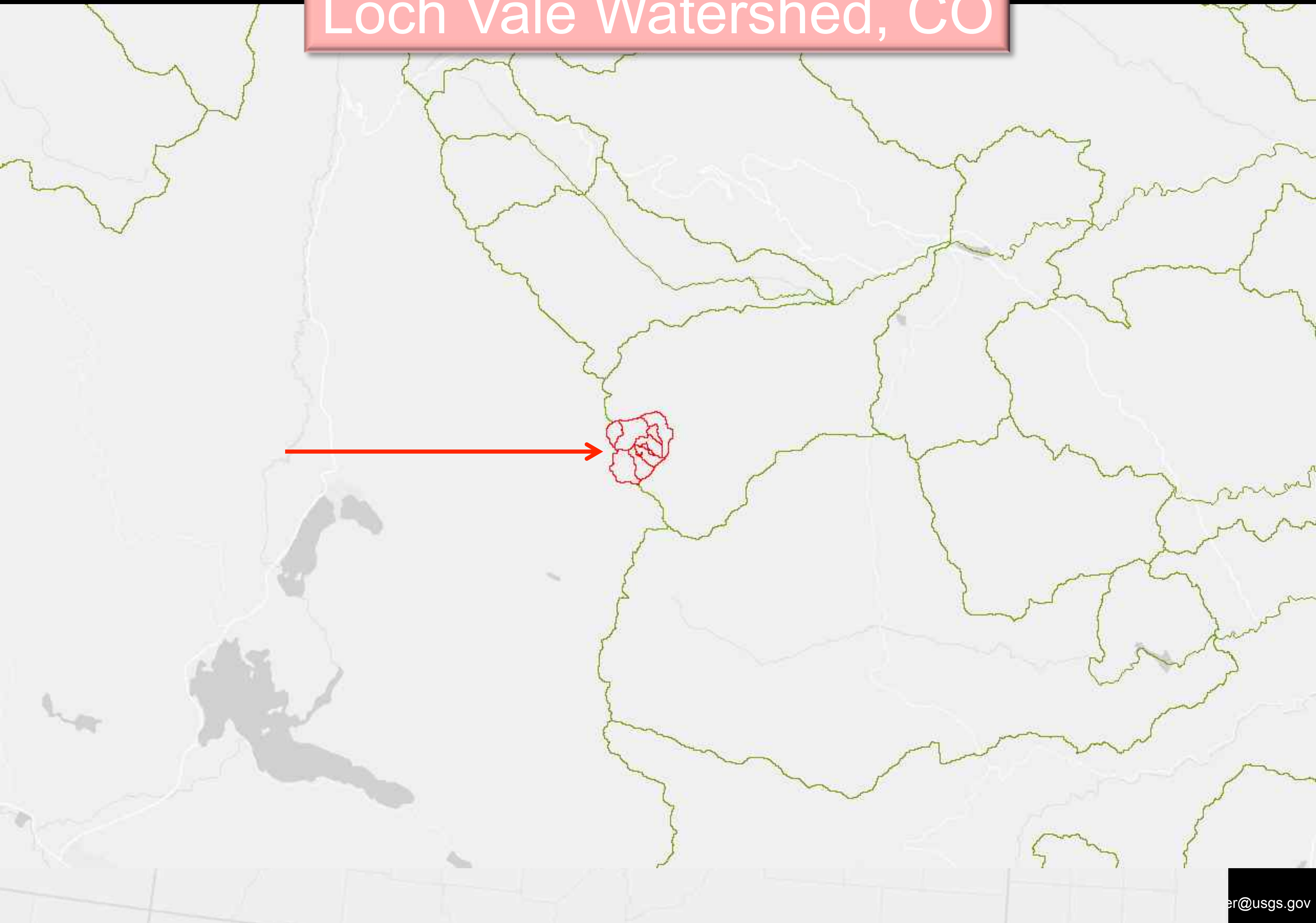
WEBB basins

Coarse Resolution models

Loch Vale Watershed, CO



Loch Vale Watershed, CO



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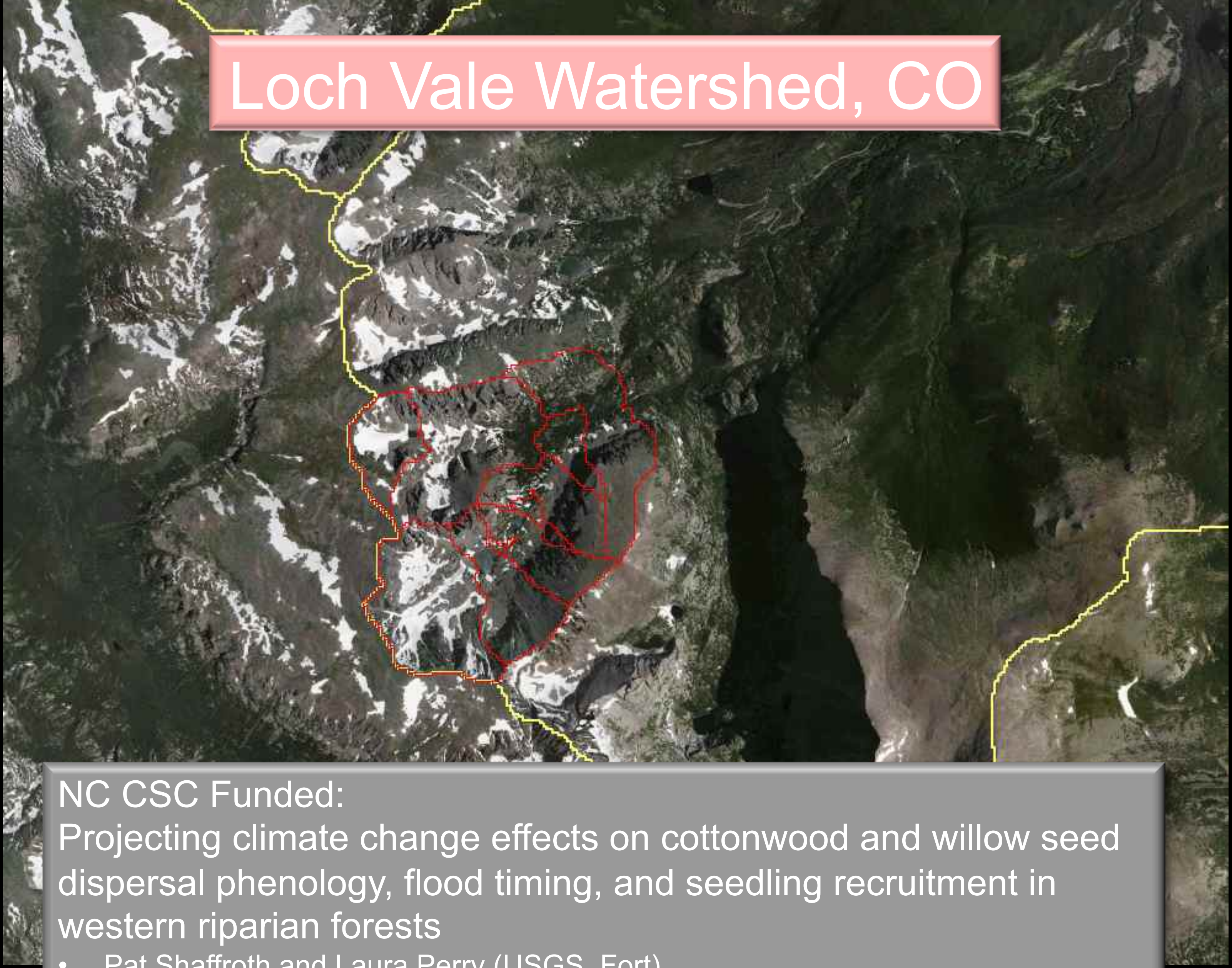

NC CSC Funded:

Projecting climate change effects on cottonwood and willow seed dispersal phenology, flood timing, and seedling recruitment in western riparian forests

- Pat Shaffroth and Laura Perry (USGS, Fort)
- Lauren Hay, Roland Viger, Steve Markstrom (USGS, NRP)
- Glen Liston (CSU CIRA)
- David Blodgett and Nate Booth (USGS CIDA)

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Geo Data Portal (GDP)

Model Inputs

Center for Integrated Data Analytics (CIDA)

http://cida.usgs.gov/climate/gdp/

- Climate
- Parameters
- Calibration and evaluation data sets

Portal (website) that allows users an easy way to obtain:

- Spatial data for model input (e.g., DEMs, land cover, soils, geology)
- Climate data for model forcing
- Loosely couple models

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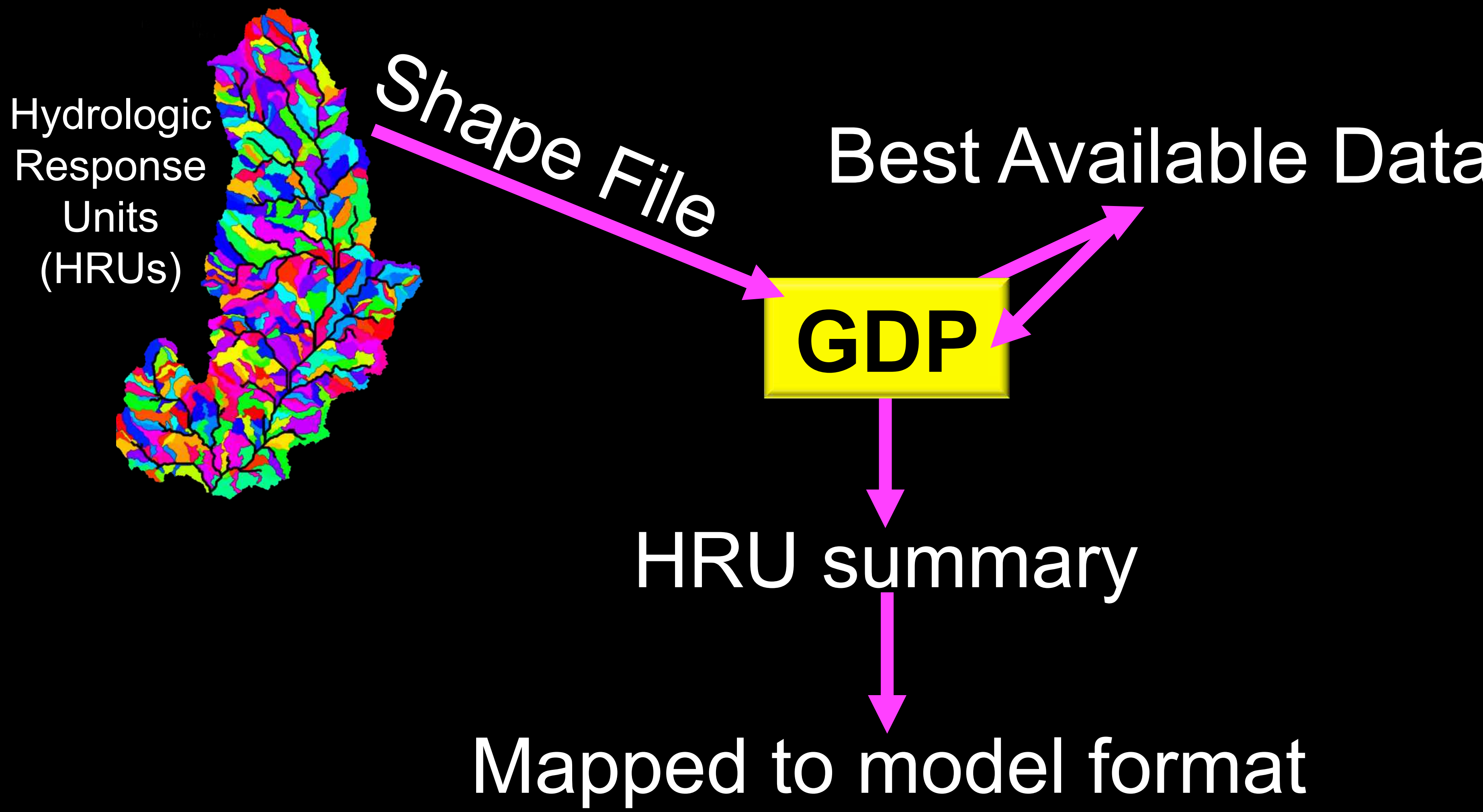
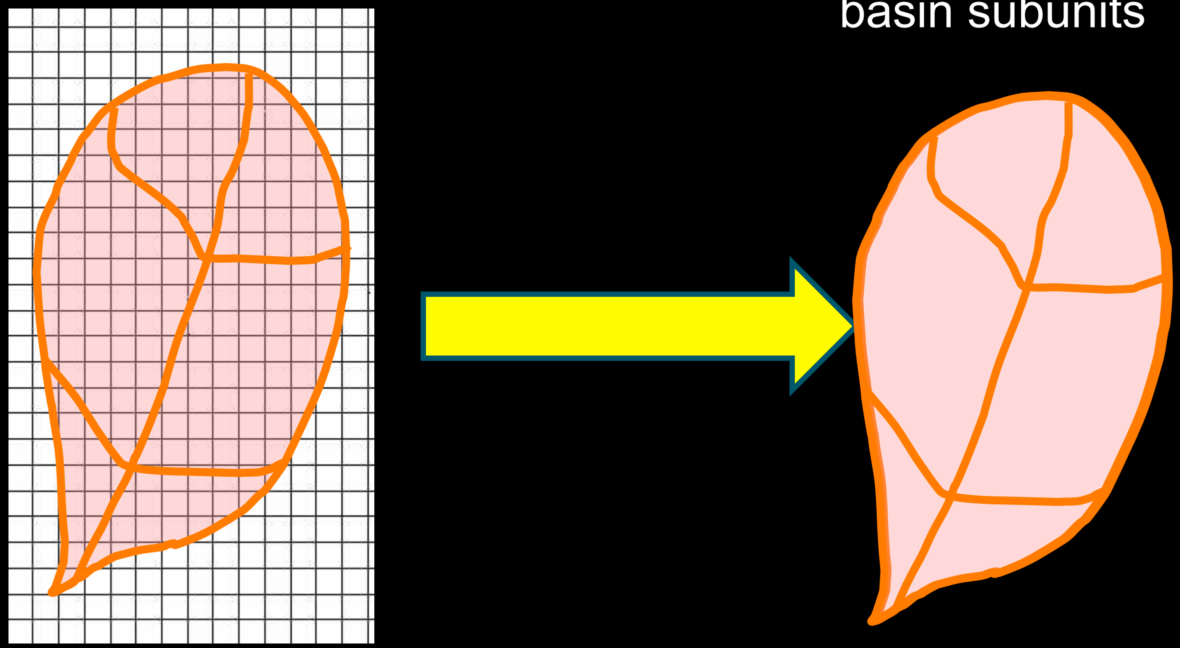


What happened behind the scenes?

Gridded output

Statistical
summaries of
gridded output by
basin subunits



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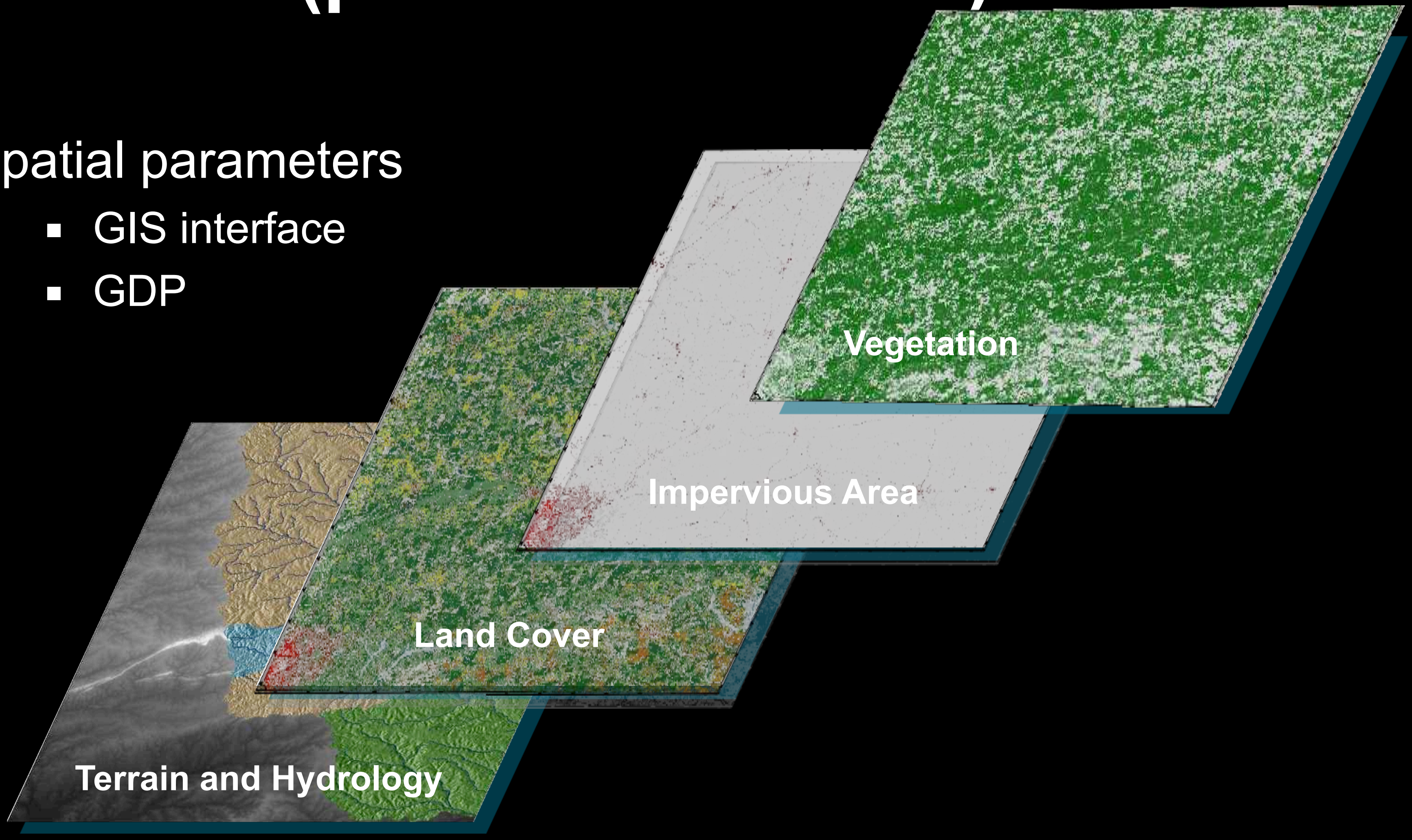
Hydrologic Model (parameterization)

Spatial parameters

- GIS interface
- GDP



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Climate data for model forcing

Example -- GDP available data for current conditions:

- PRISM (4x4km)
- XYZ (by HRU)
- DayMET (1x1km)
- Maurer (12x12km)

Based on station data

- NARCCAP (50km; CRCM)
- RegCM (15km; GFDL, MPI, GENMOM, NOAA)

Dynamically downscaled GCMs

Andy Bock (CO WSC)
Greg McCabe (NRP)
Dwight Atkinson (EPA)

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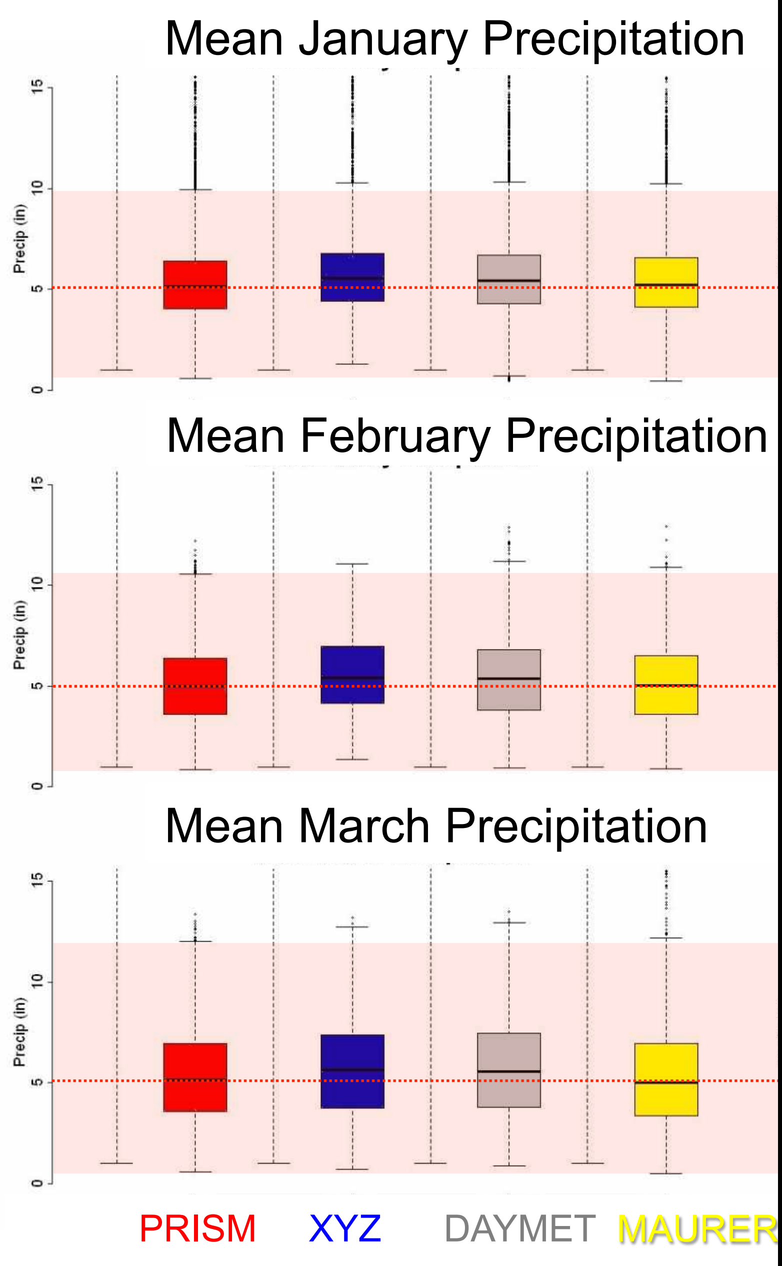
Climate data for model forcing (ACF HRUs)



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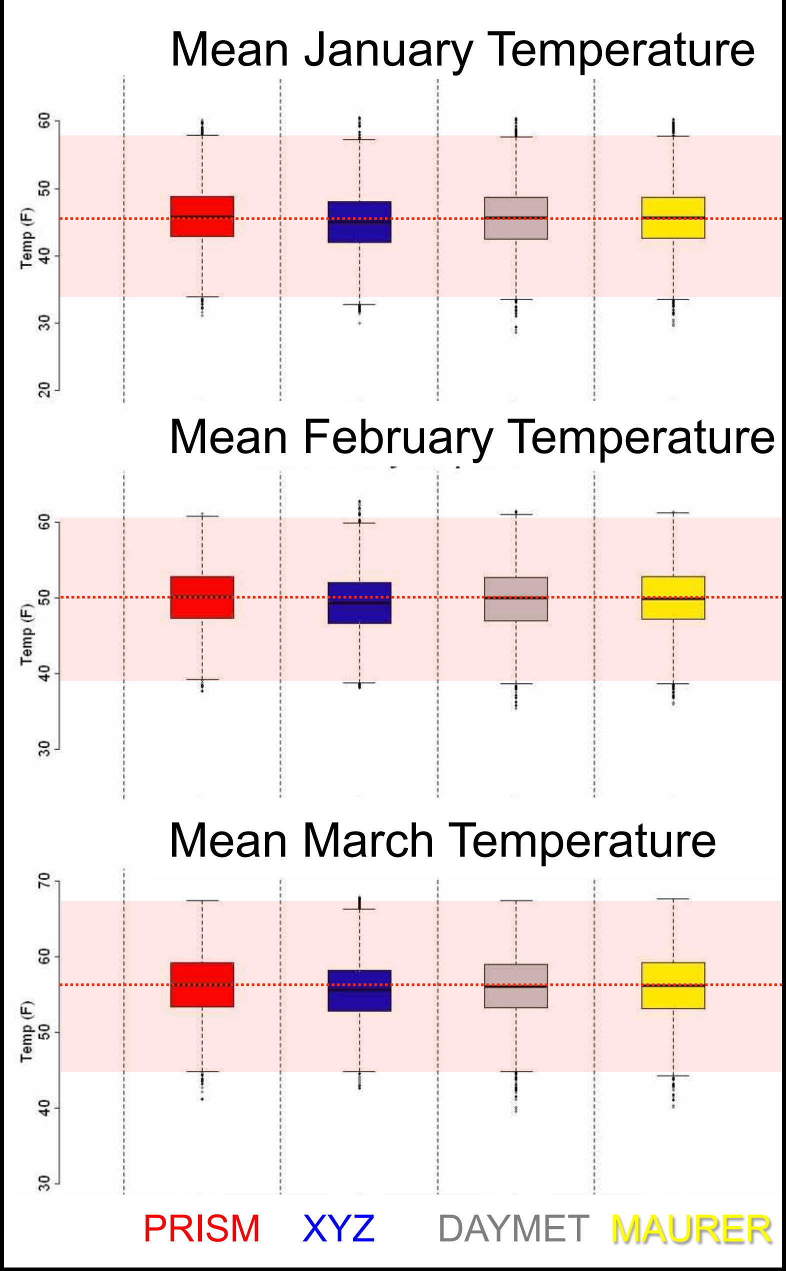

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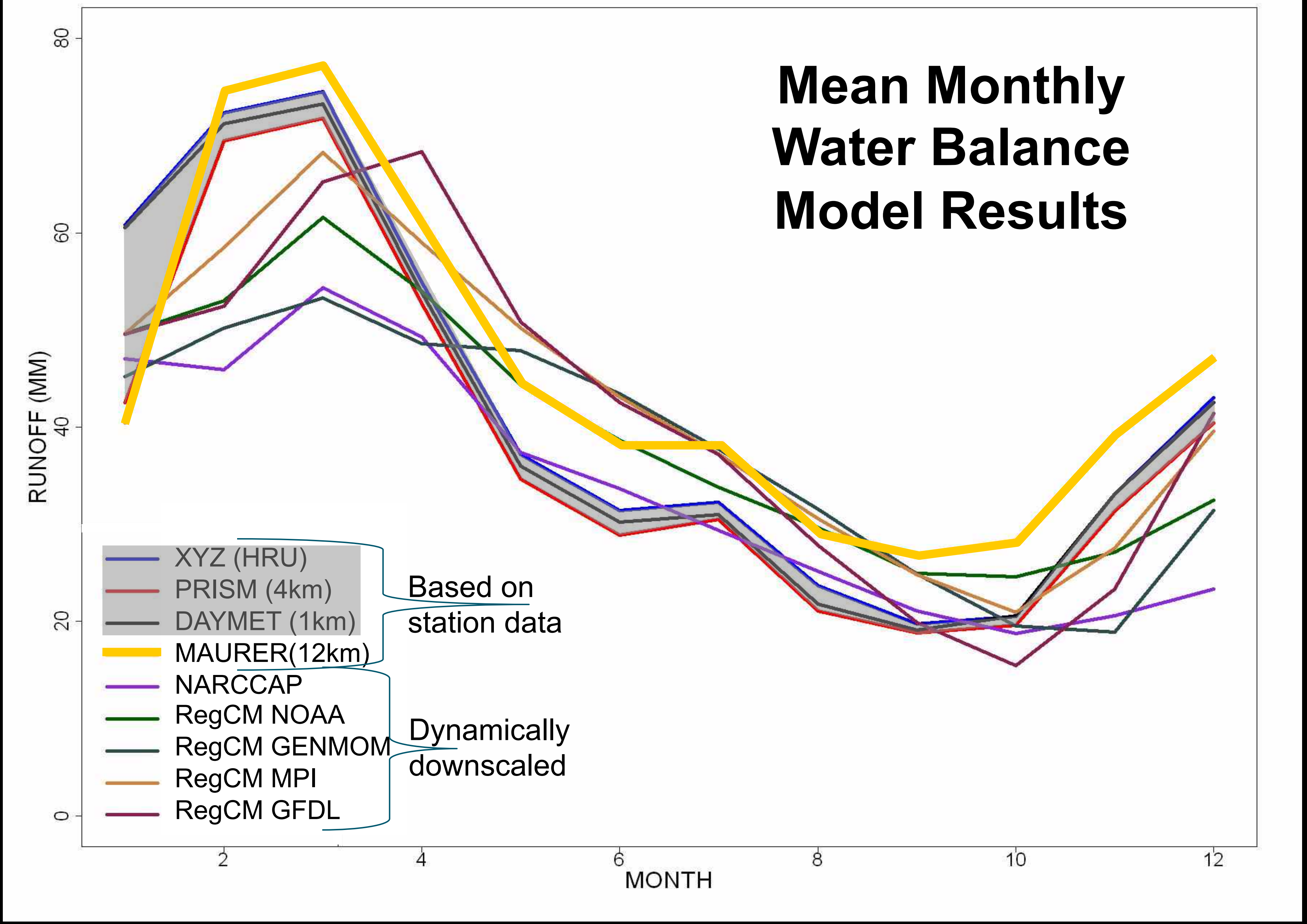

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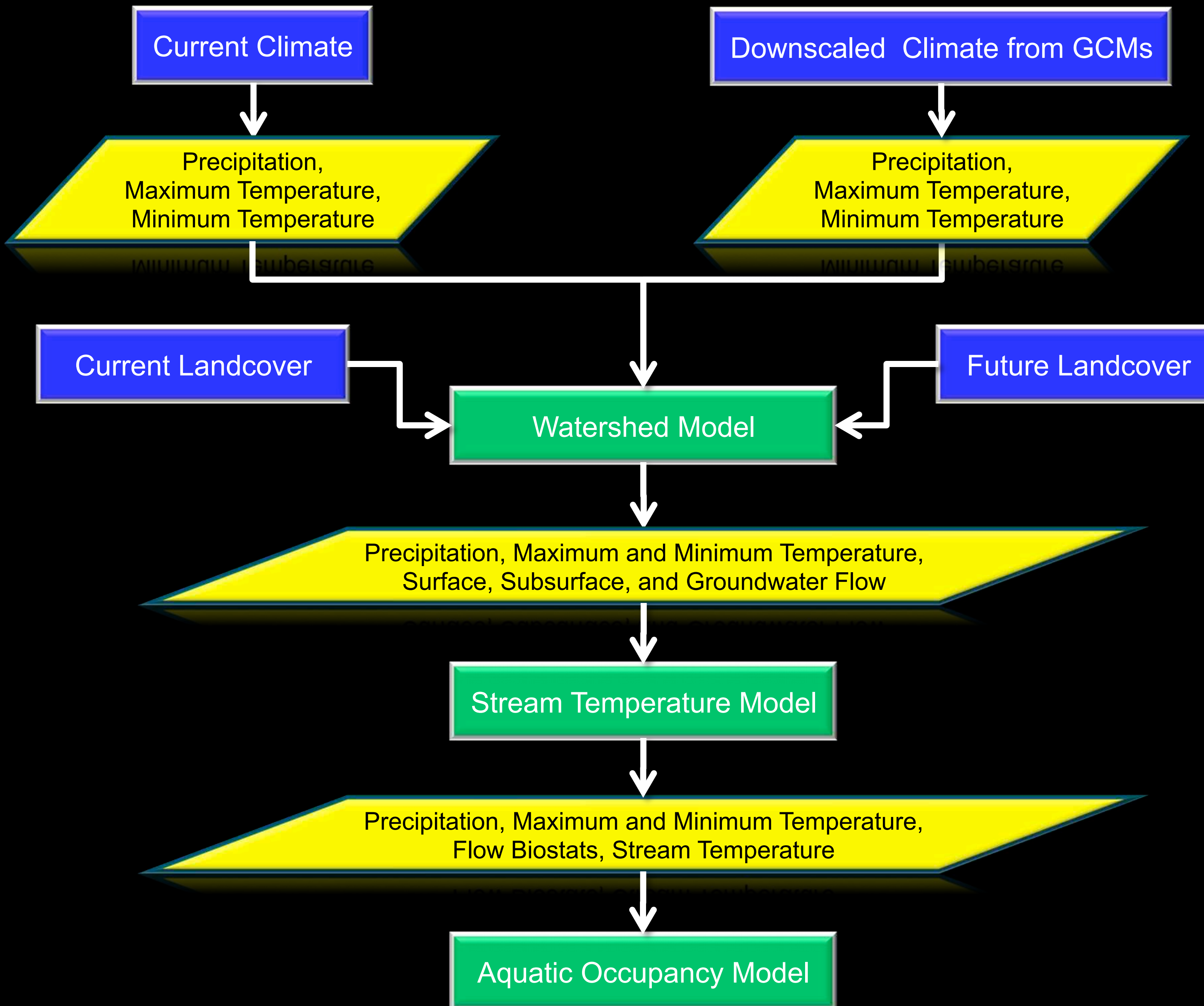

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Data used for NHM application

- Climate data input
- Streamflow
- NHDPlus (V1 → V2)
  - HRUs, segments, routing parameters
- Topography (NED)
- Soil properties (STATSGO → SSURGO)
  - AWC, texture parameters
- Hydrogeology (Gleeson permeability map)
  - Subsurface flux parameters
- Landuse Data (NLCD 2001 → NLCD 2006 → NLCD??)
  - Impervious area, cover type/vegetation, density parameters

Data needs made available thru OPeNDAP/WCS

Parameterization (static and dynamic)

- canopy density, growing season, land cover, soils, impervious, water bodies, burn area

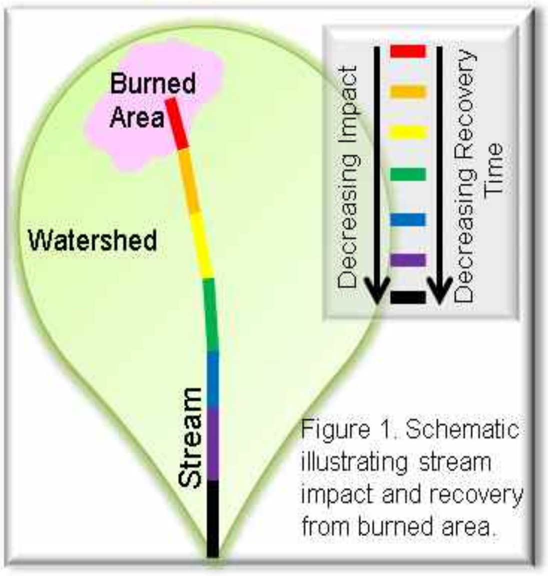

Figure 1. Schematic illustrating stream impact and recovery from burned area.

OPeNDAP
- framework that simplifies all aspects of scientific data networking.
- provides software which makes local data accessible to remote locations regardless of local storage format.

WCS
- provides access to coverage data in forms that are useful as input into scientific models
- allows clients to choose portions of a server's information holdings based on spatial constraints and other query criteria.

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Data needs made available thru OPeNDAP/WCS

Parameterization (static and dynamic)

- canopy density, land cover, water bodies, soils, impervious, burn area, growing season

Calibration/evaluation (any time step)

- streamflow and components of flow
- climate
- gaining and loosing streams, sinks, springs
- SCA, SWE, albedo
- cloud cover
- PET, AET
- soil moisture
- solar radiation

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Questions

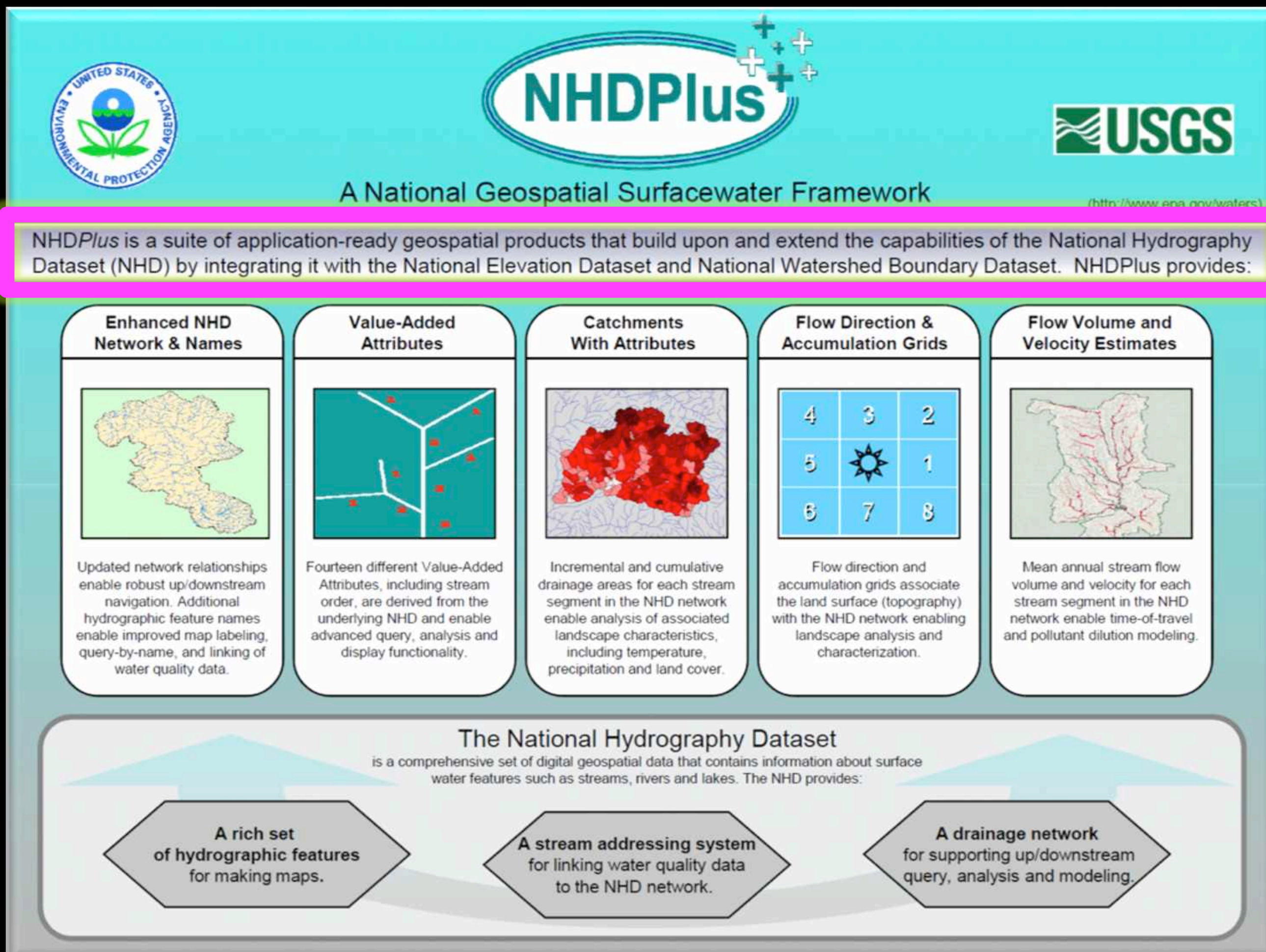
Catalog services for the web (CSW)

NASA really doing a great job on a number of these fronts

Need more promotion/presence→USGS Community for Data Integration

Methods

Aggregate NHDPlus catchments based on Points of Interest (POIs) to make HRUs



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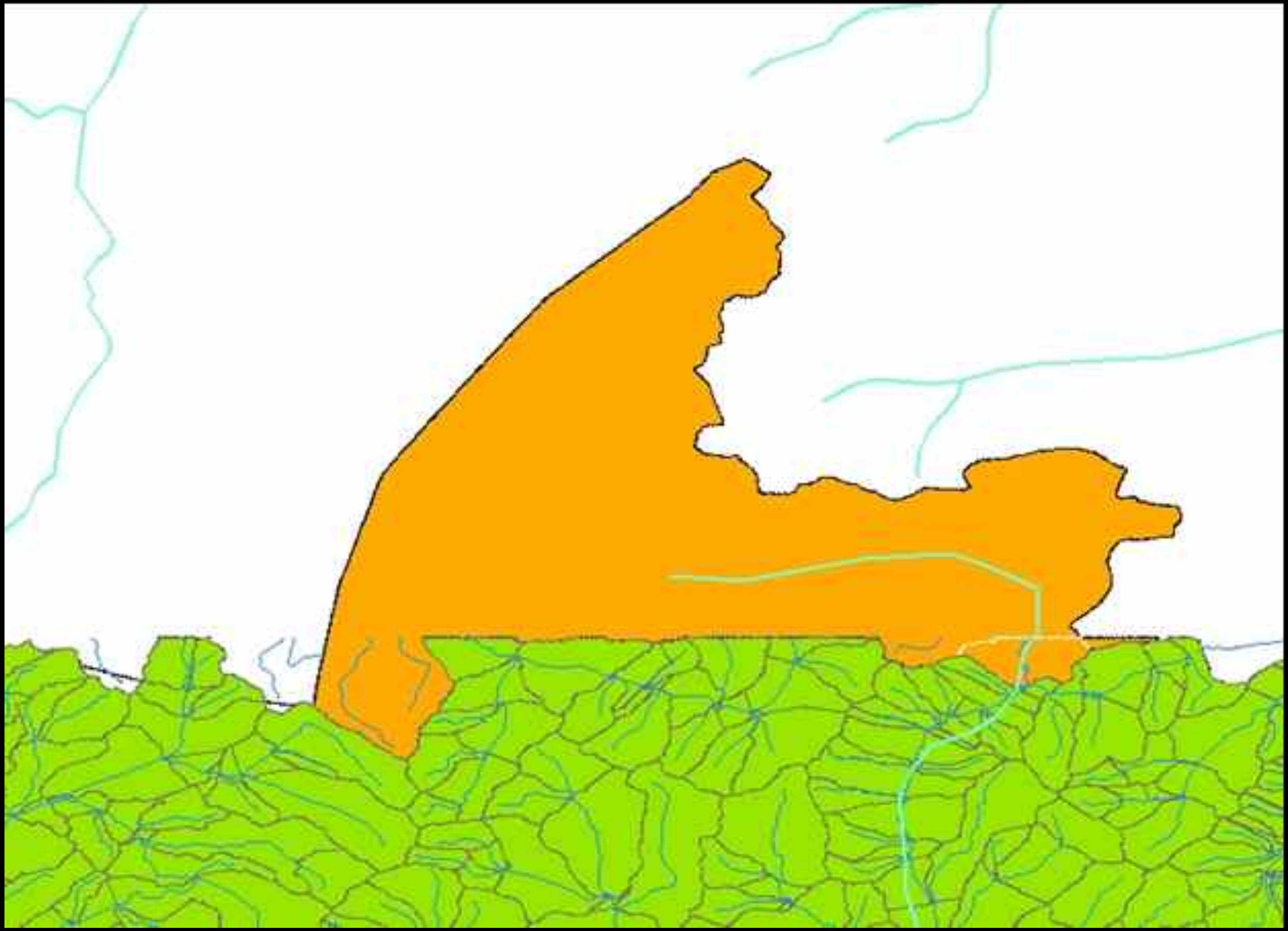
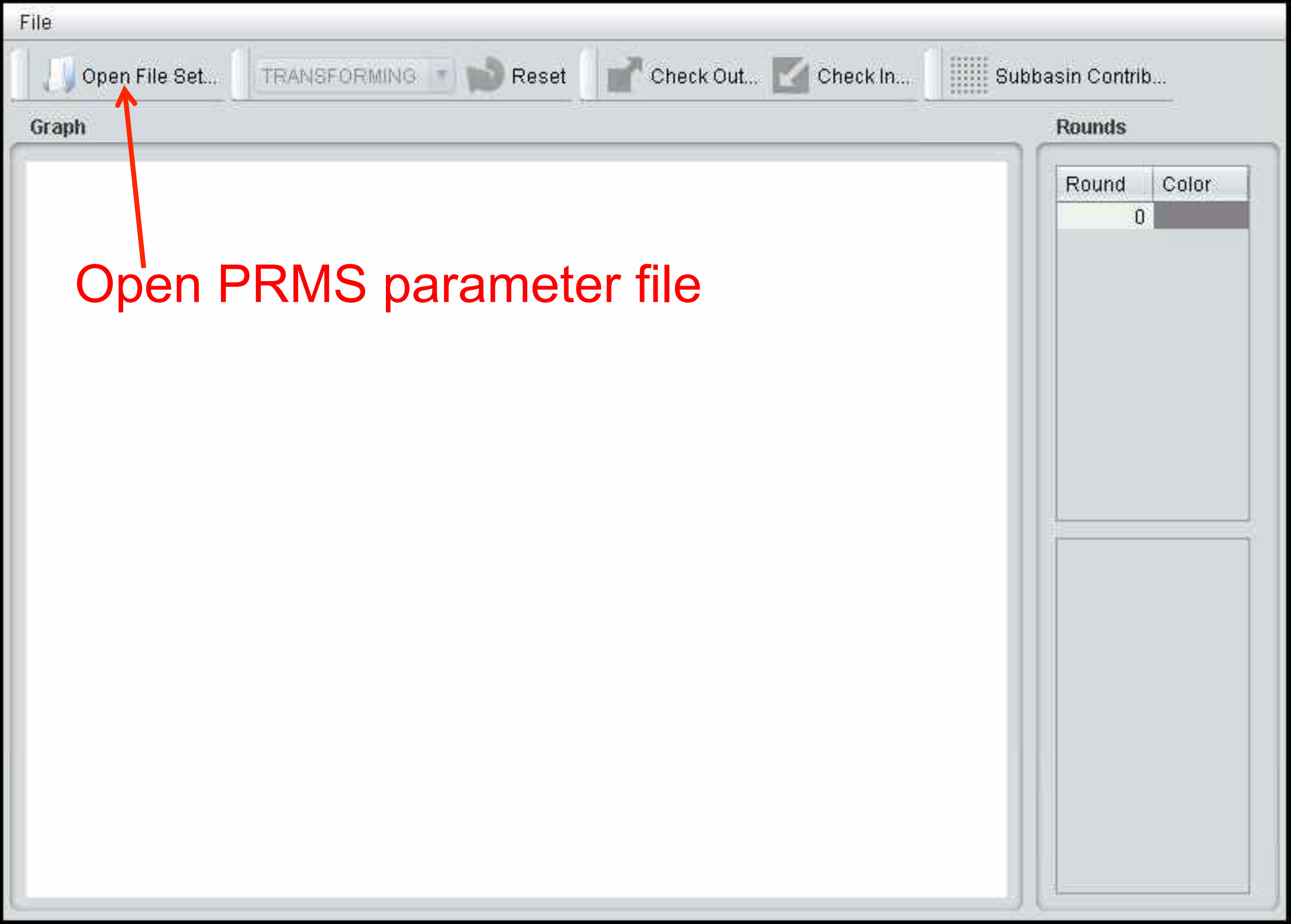
NHDPlus Catchments
Example of an international catchment on the Canadian border



Lumen



File
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Reset
Check Out...
Check In...
Subbasin Contrib...
Graph
Rounds
Round
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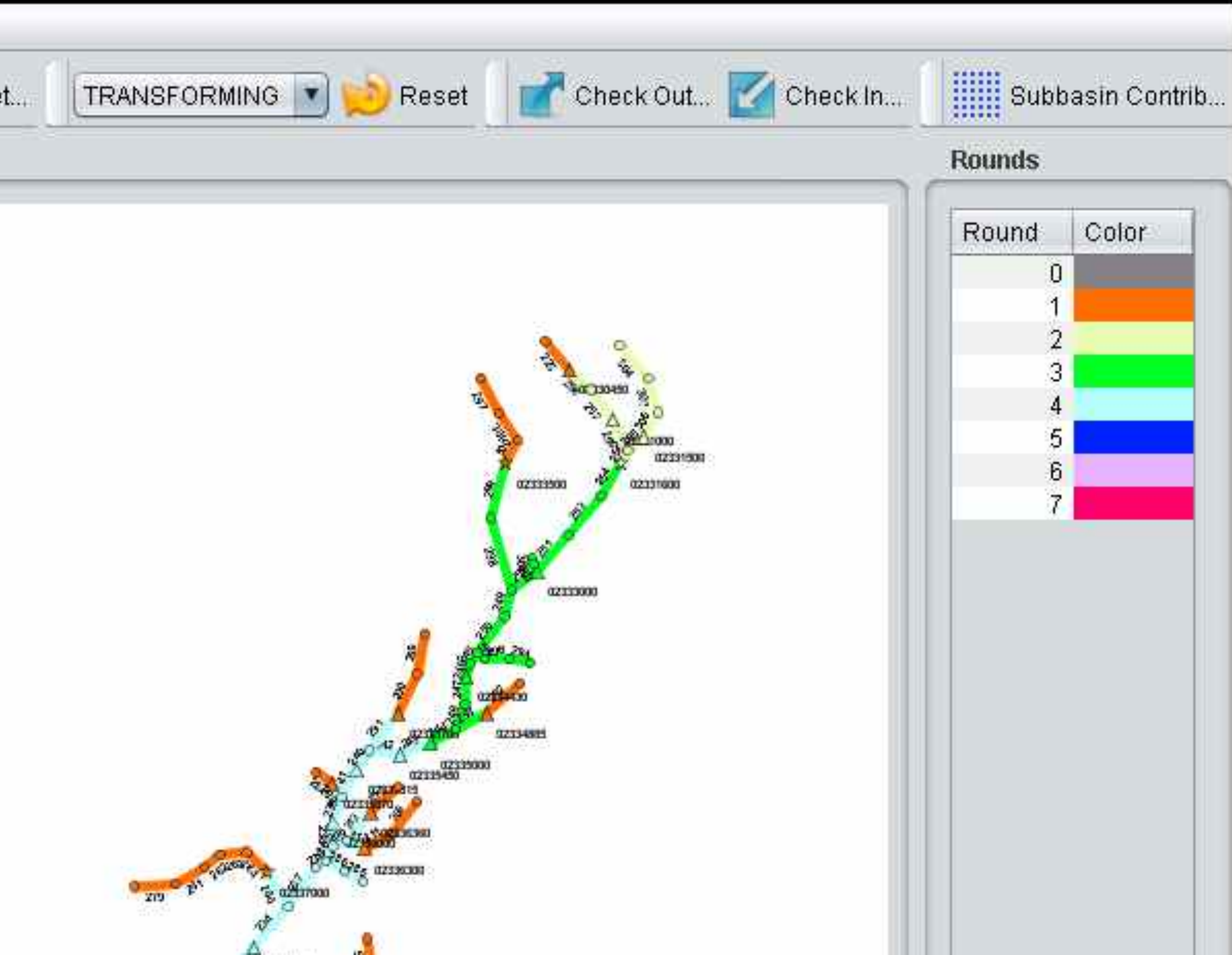
Open PRMS parameter file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Subbasin Contrib...
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Model Parameterization

- Parameter Sources :

1. GDP (DEM, soils, land cover, hydrogeology)
2. GIS (depression storage)
3. Routing (comes directly from NHDPlus analysis)
4. Default values

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