



Hydrologic and River System Modeling to Support End-of-Century, Future-Climate Water Availability in the Tongue River, Montana and Wyoming

An Update on the Tongue River 2100 Project

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Outline



Project background



Partners



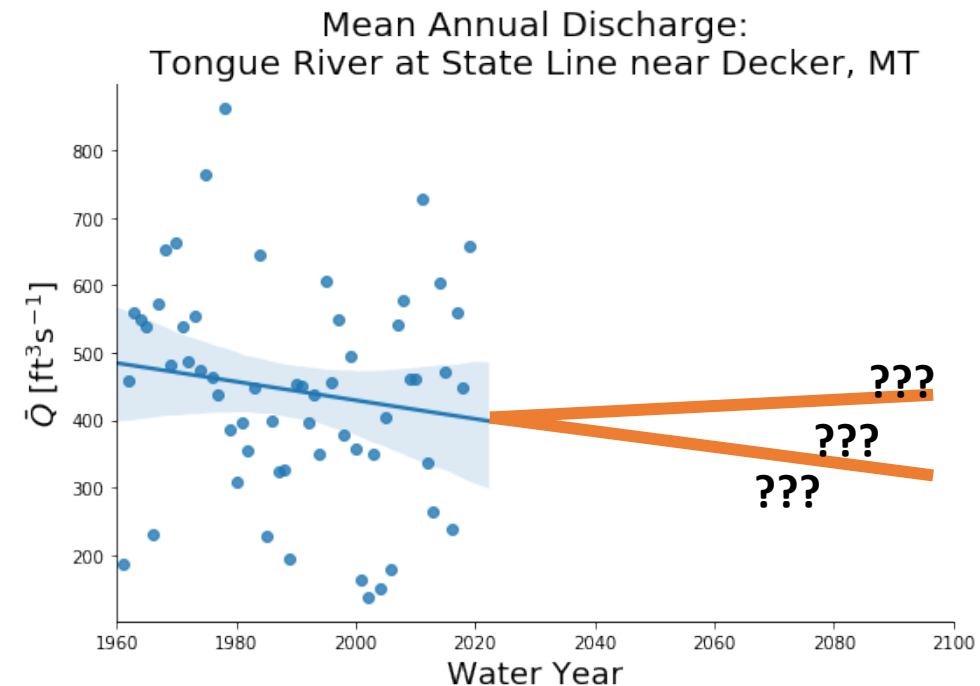
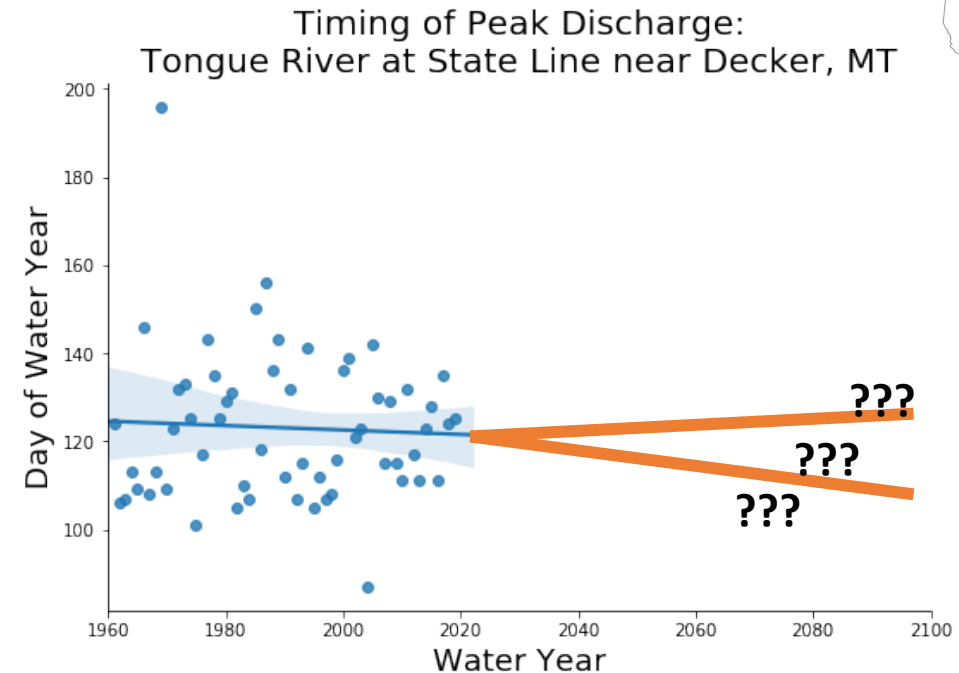
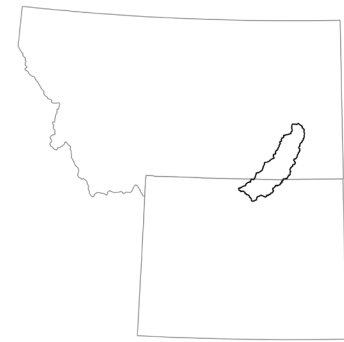
Approach



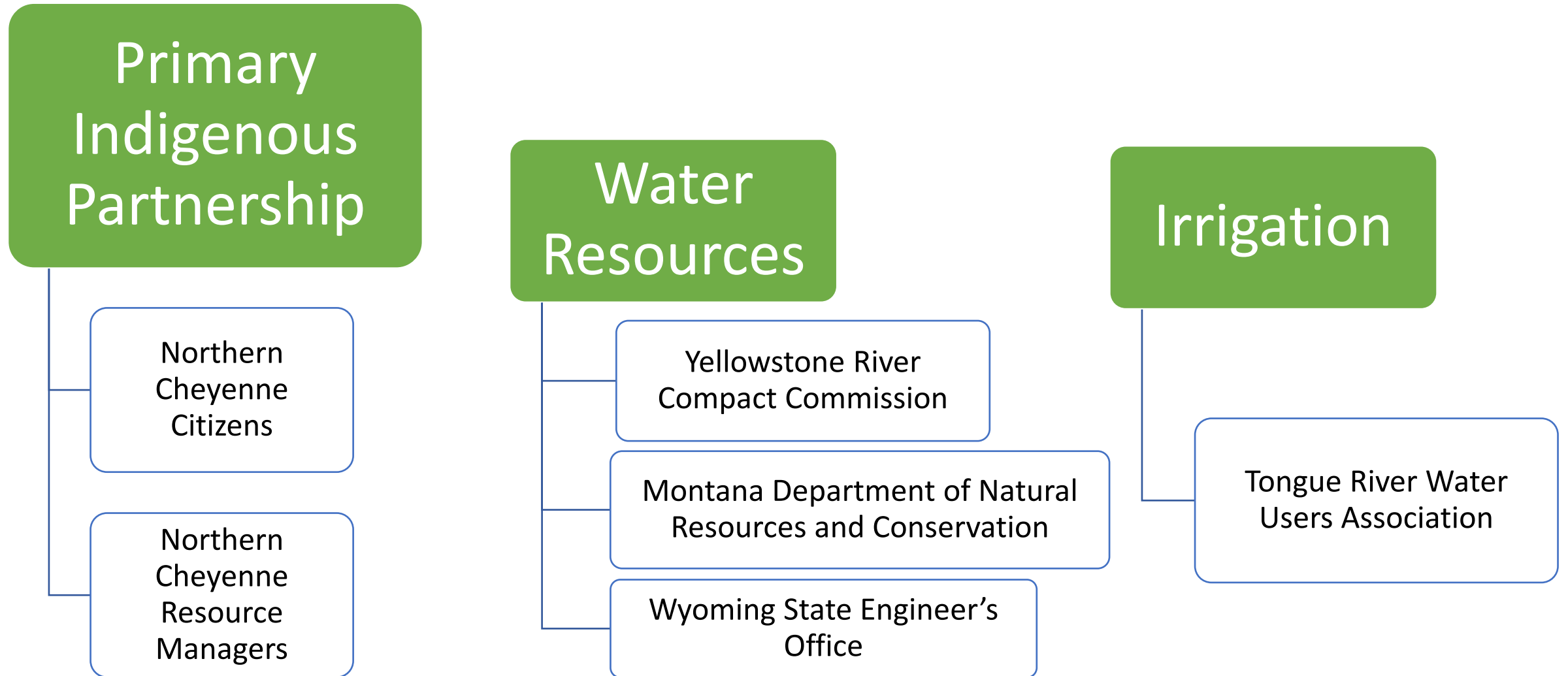
Results

Project Background

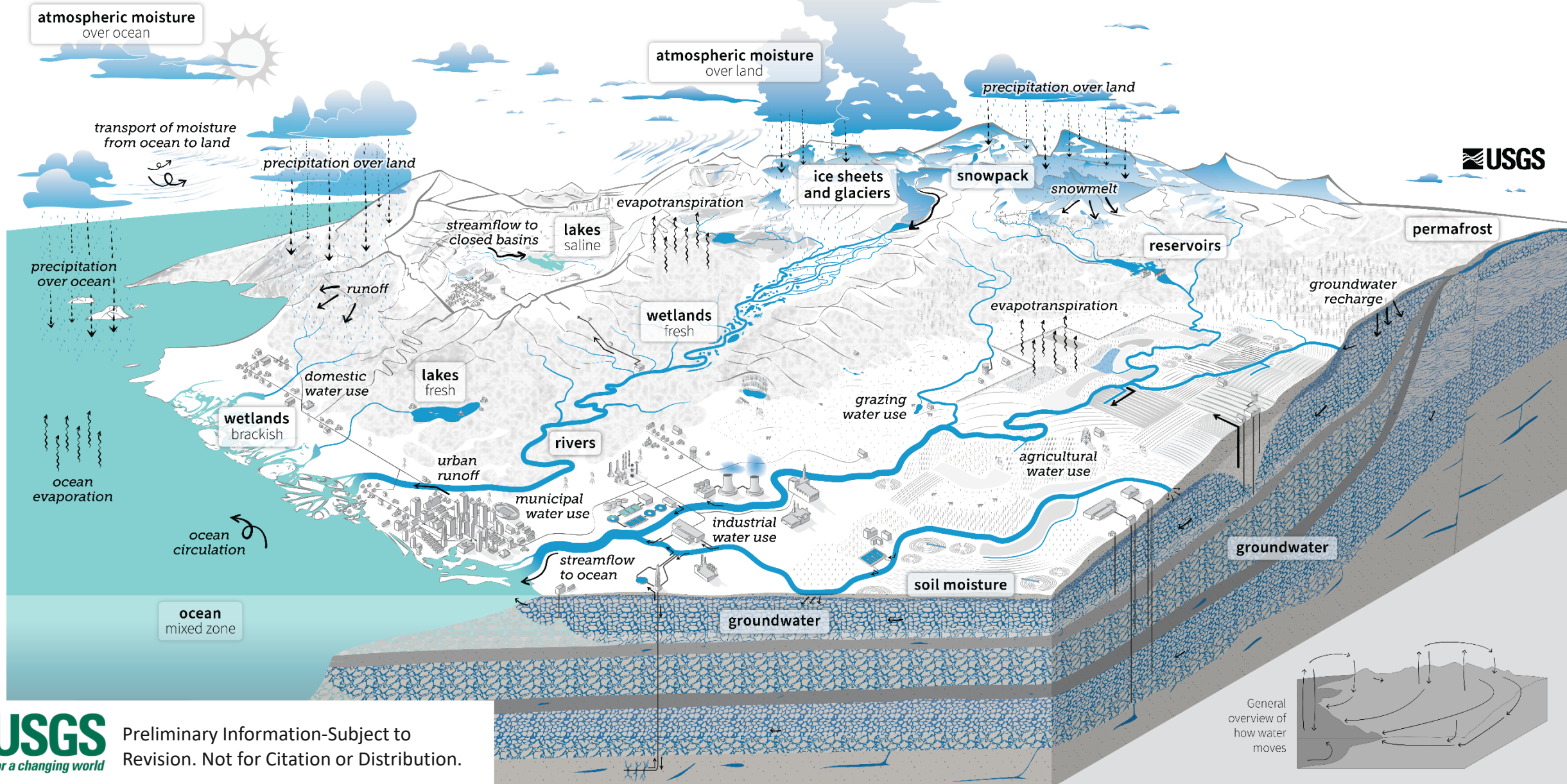
- Estimate end of century streamflow throughout the Tongue River Watershed.
 - 32 different climate models
 - 2 future climate scenarios
- Work closely with the Northern Cheyenne Tribe and other project partners to understand water management questions that can be addressed by this project.
- Construct and calibrate a river system model to account for diversions and reservoir operations.



Project Partners

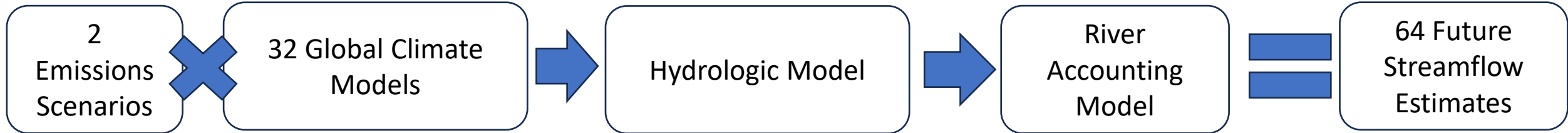
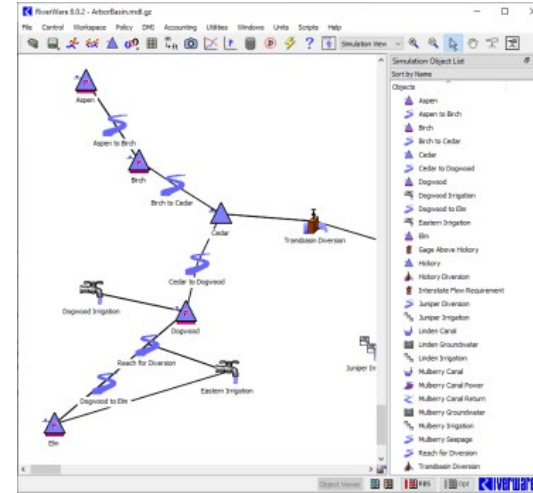
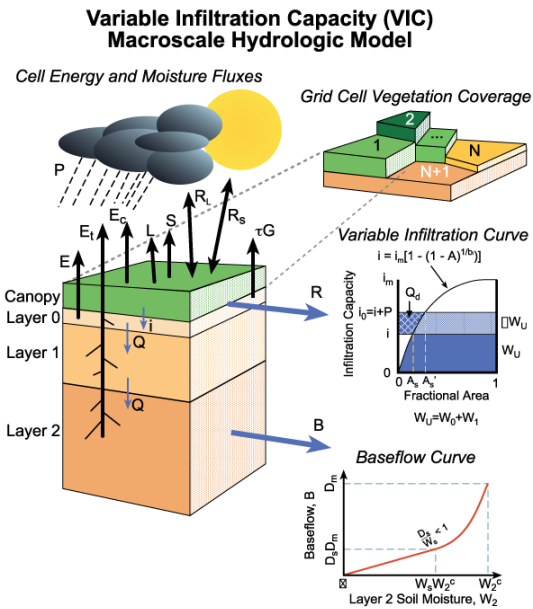
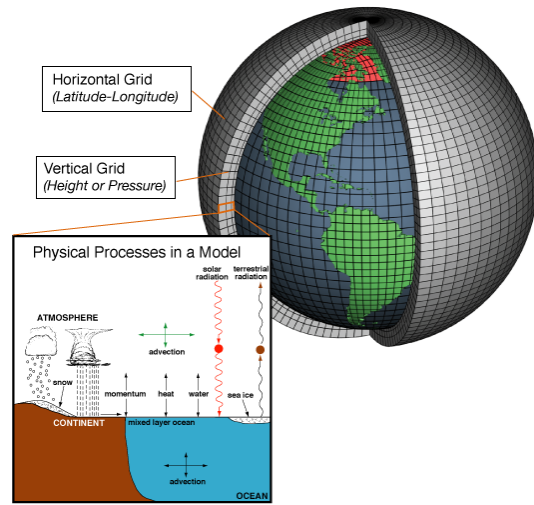


Approach: The Water Cycle



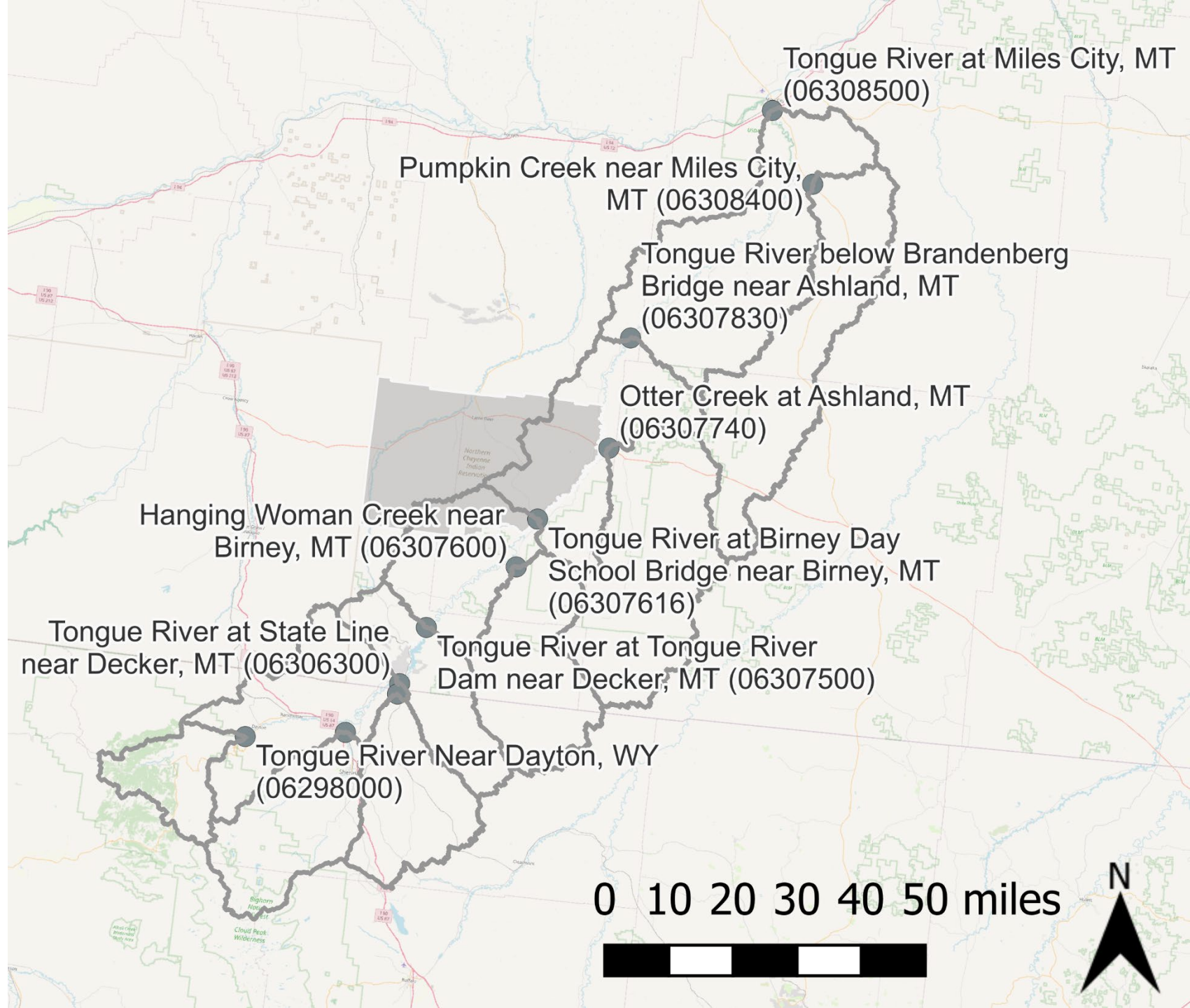
Preliminary Information-Subject to Revision. Not for Citation or Distribution.

Approach

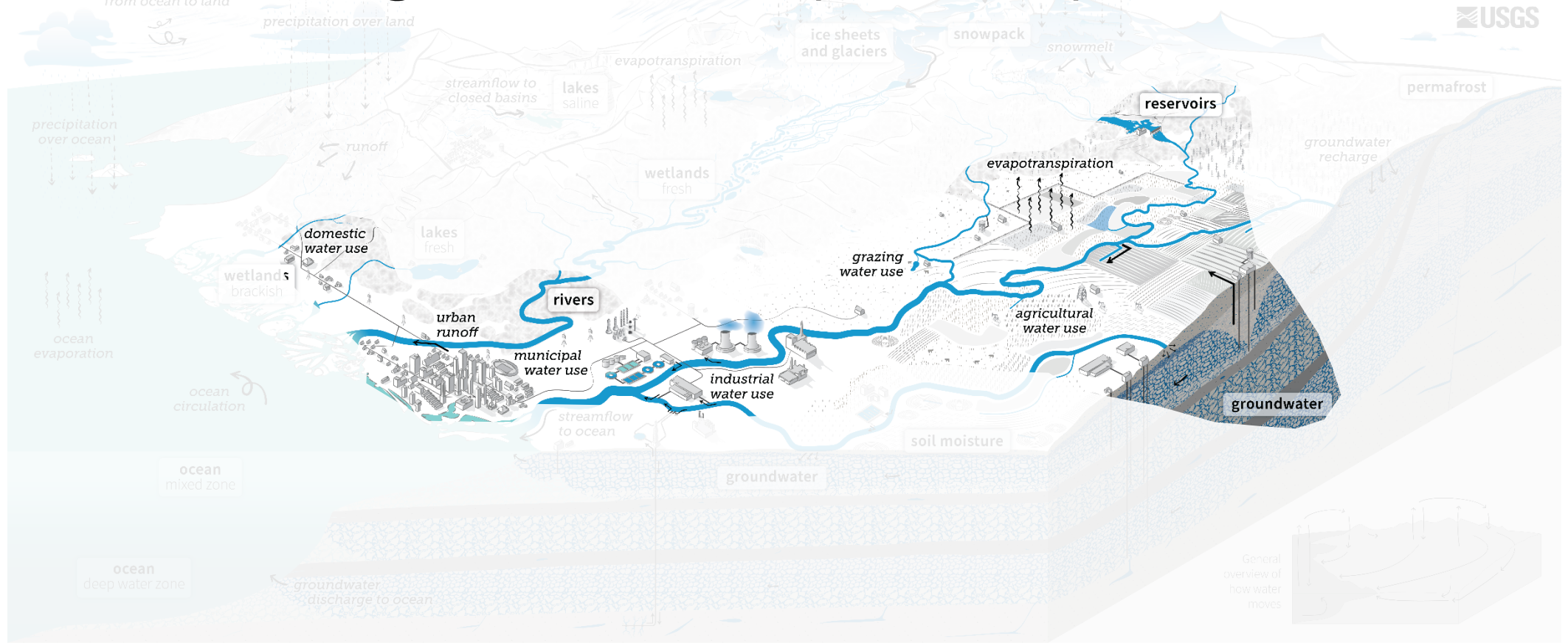


Approach: Catchments

- The watershed has been divided into 11 catchments.
- The catchments allow the future hydrology estimates to be summarized and fed into the river accounting model.



Approach: River Accounting Model - The Tongue River Water Management Model (TRWMM)



The Water Cycle

TRWMM Progress

Mapping Water Use

90%

Realistic Agricultural Water Use

75%

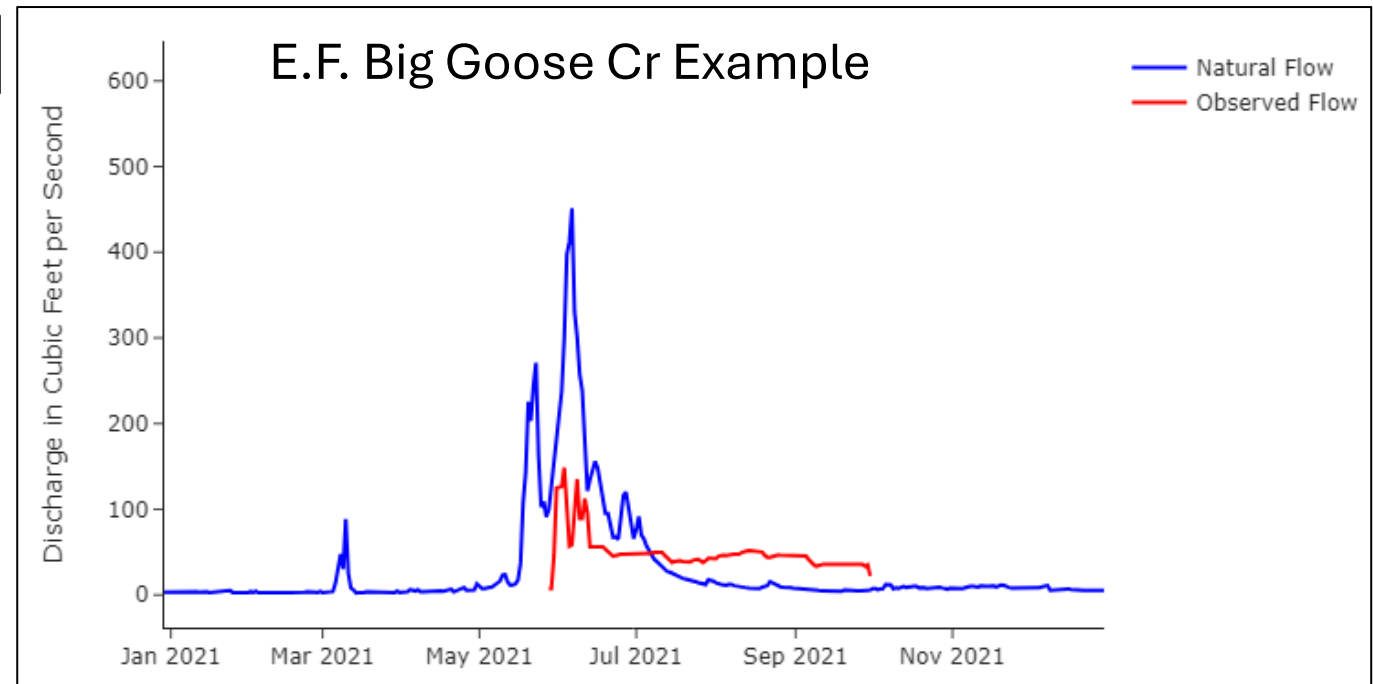
Better Reservoir Evaporation

75%

Fill in Missing Information

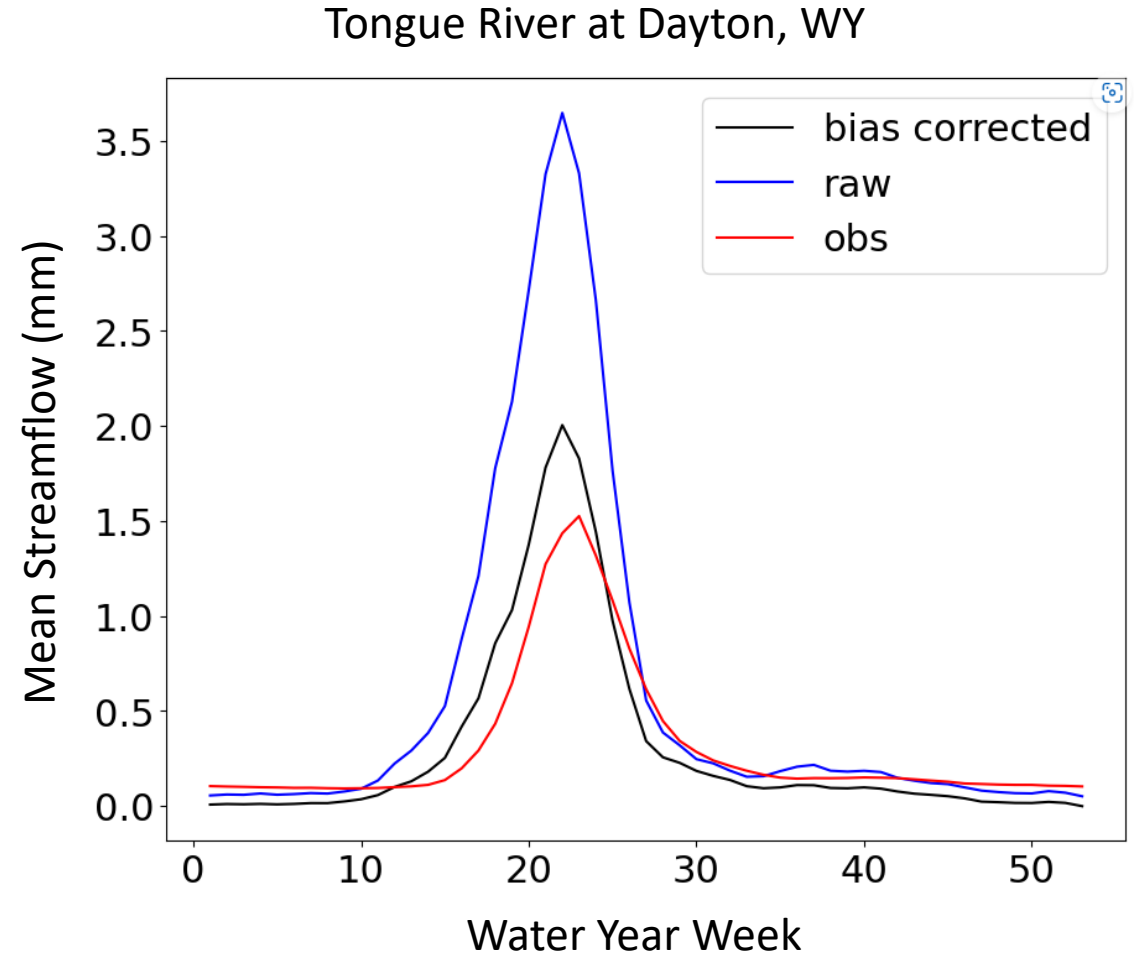
95%

Use Model to Estimate Natural Flows 10%



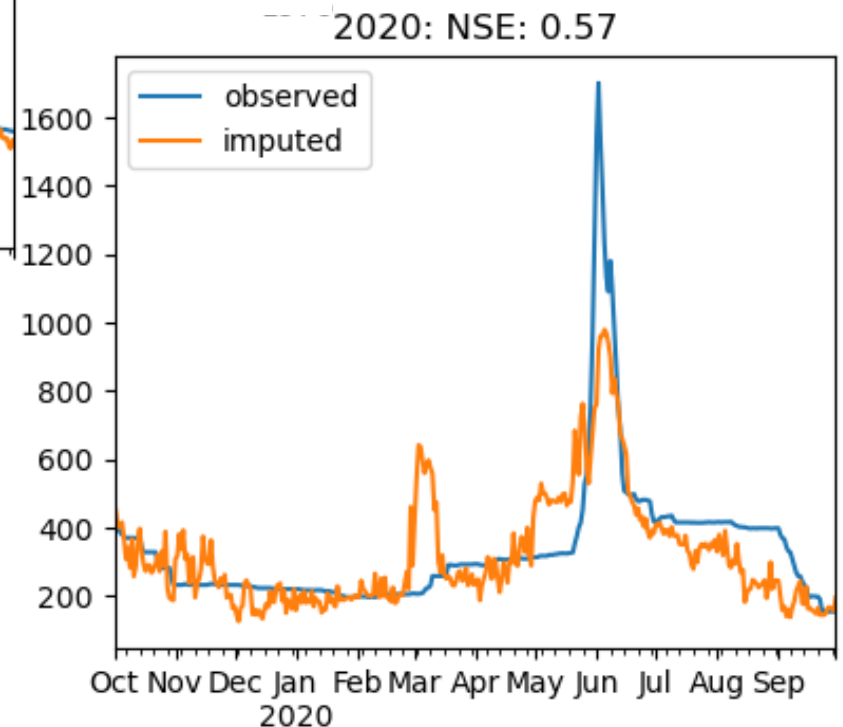
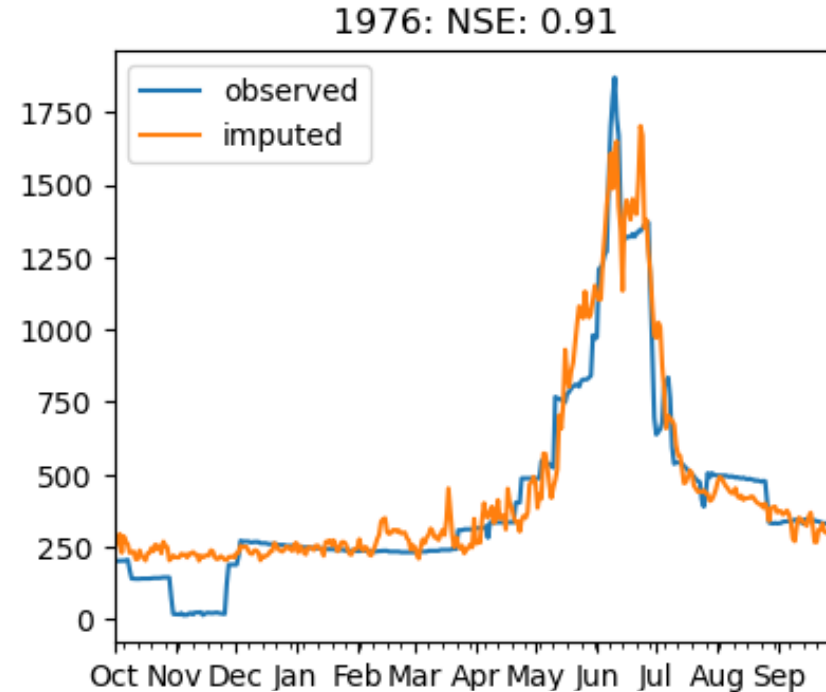
Approach: Bias Correction

- Corrects bias in the simulated streamflow.
- Used in place of calibration to correct streamflow timing and volumes throughout the watershed.
- Quantile mapping approach (e.g. Hashino et al., 2007).



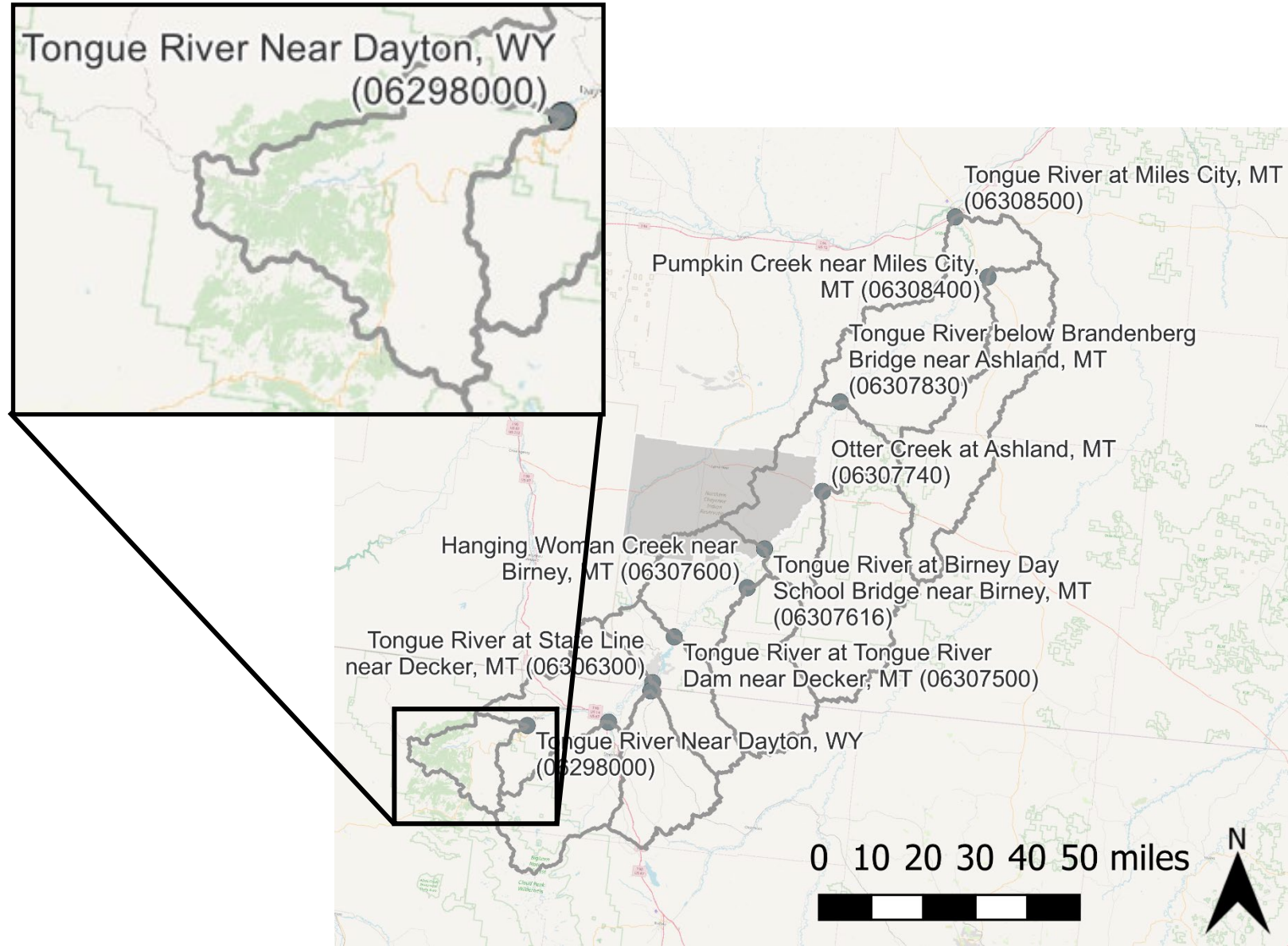
Approach: Streamflow Gap Filling

- The river accounting model cannot run if there is missing streamflow data.
- We used a recursive random forest modeling technique to fill missing streamflow records throughout the watershed (Stekhoven and Buhlmann, 2012).



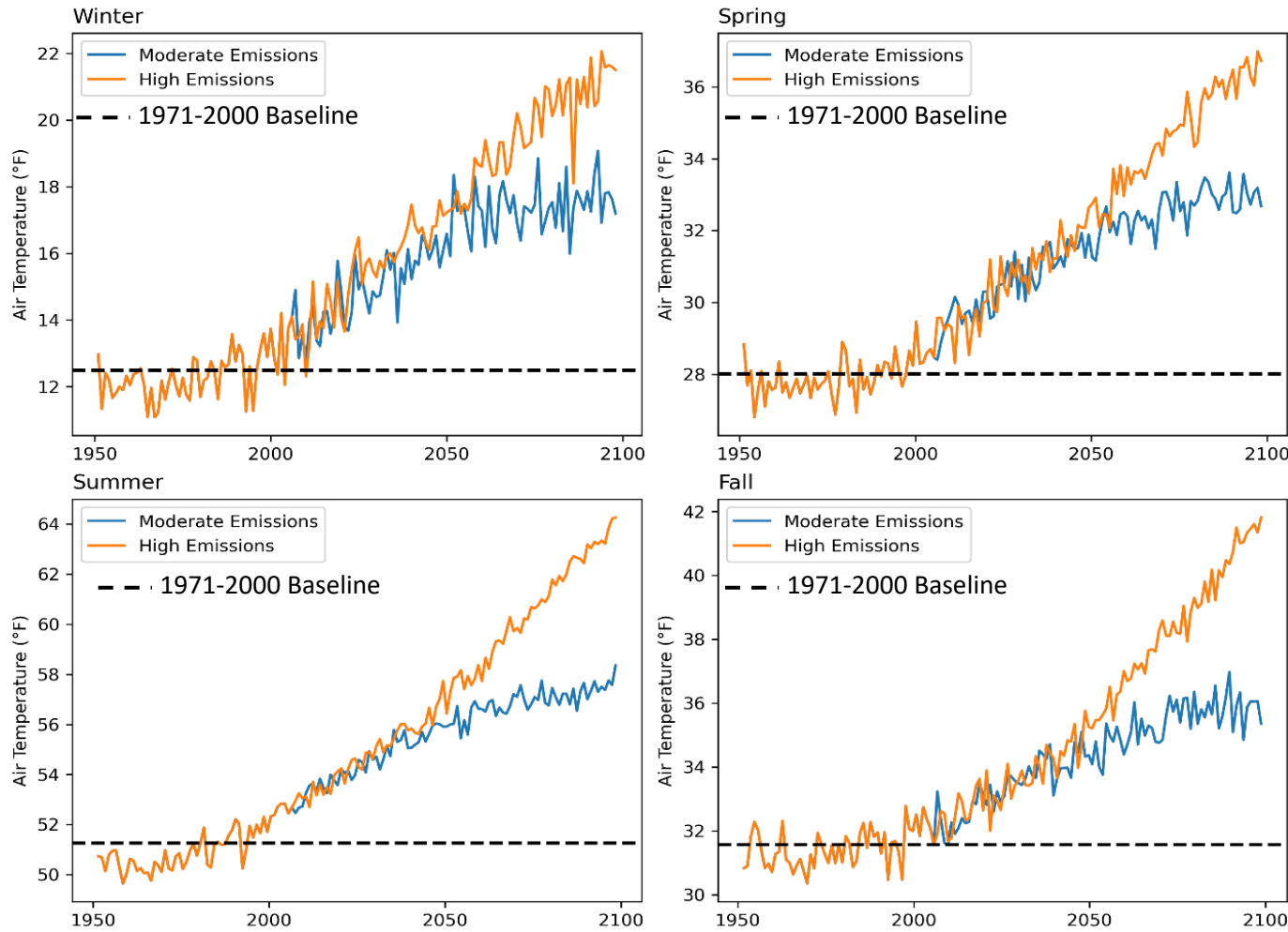
Results: Future Climate and Streamflow

- The next five slides focus on the Tongue River Near Dayton, WY.
- This area is largely free of diversions and water management.



Future Climate

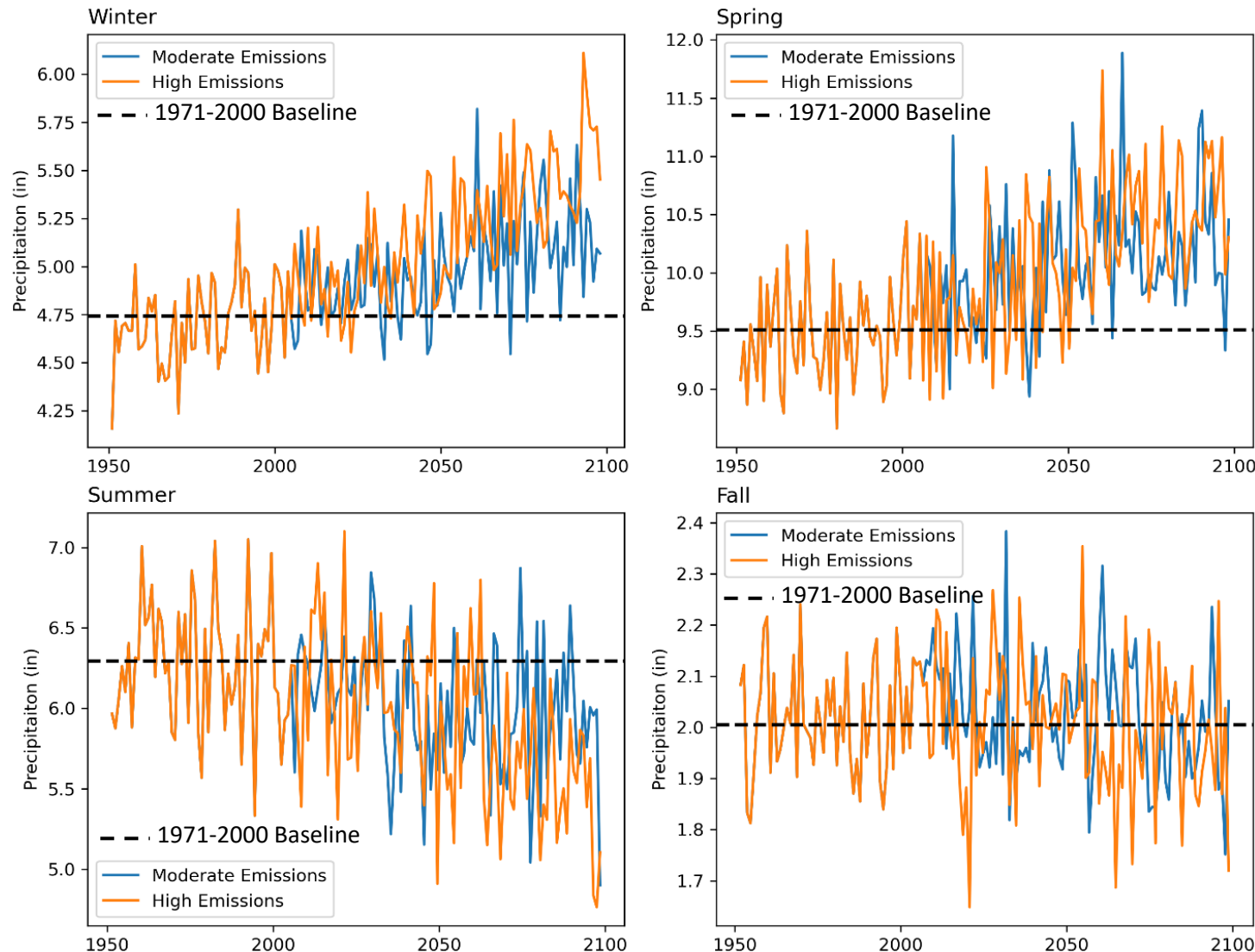
Tongue River Near Dayton, WY



- The Tongue River Near Dayton catchment is anticipated to get warmer under both scenarios in the future.

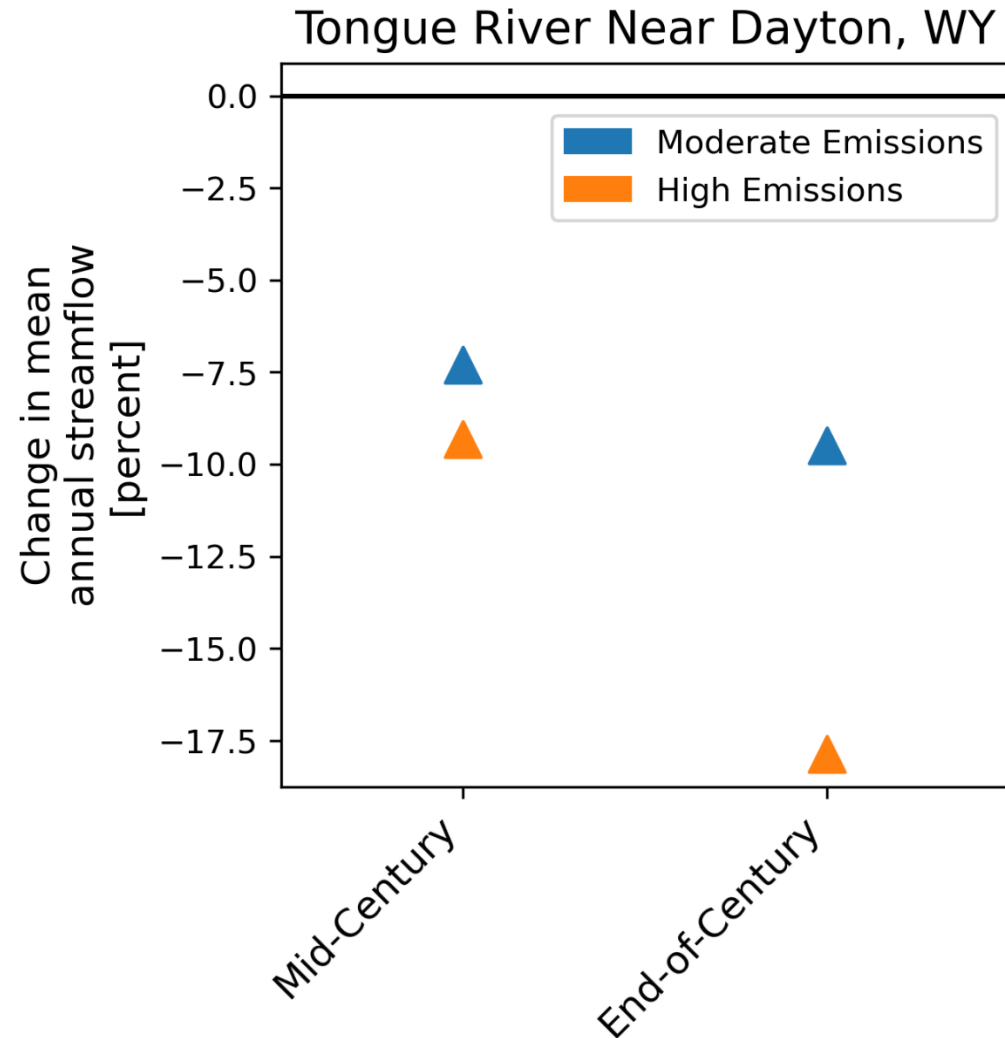
Future Climate

Tongue River Near Dayton, WY



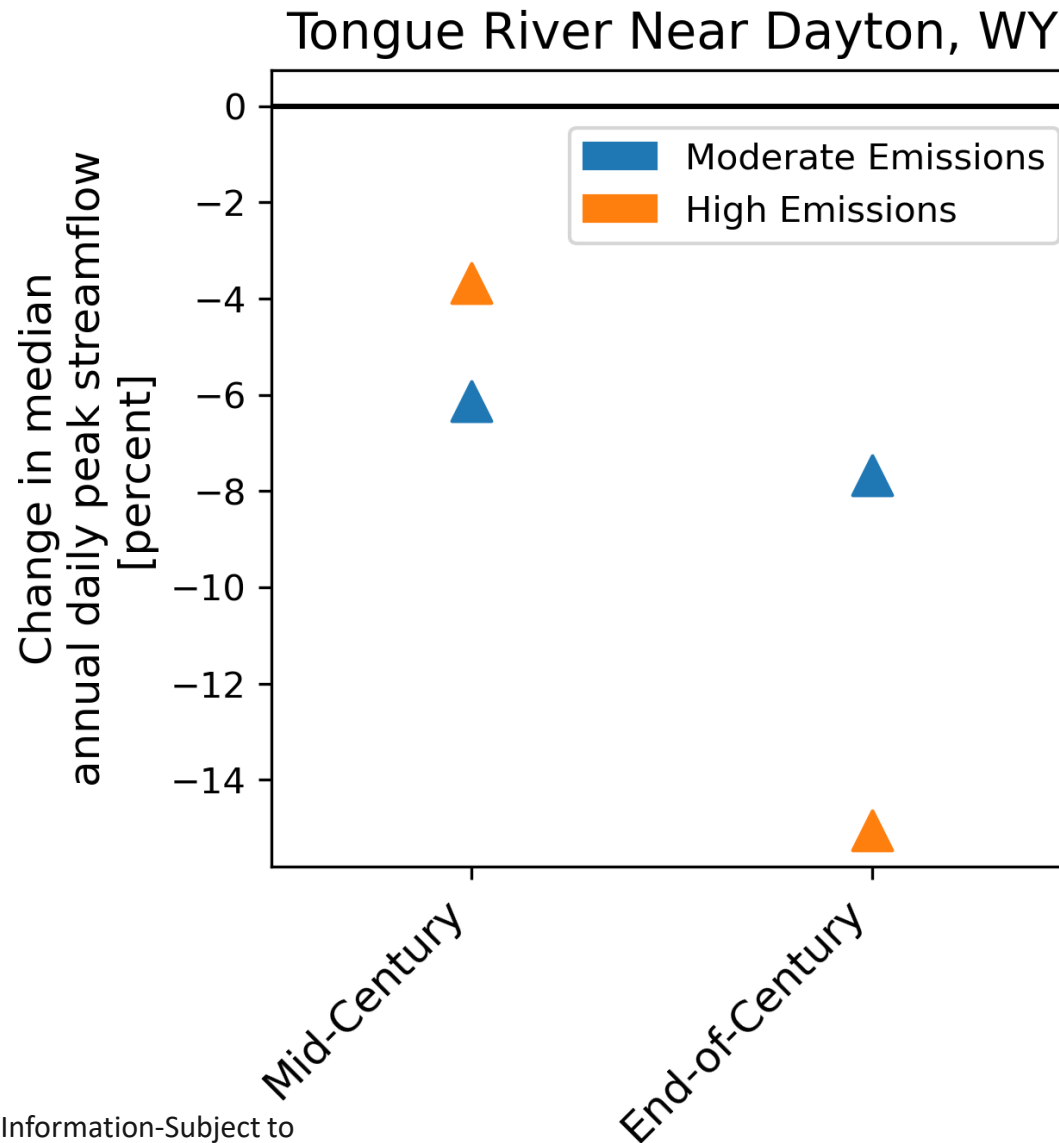
- The Tongue River Near Dayton catchment is anticipated to have increased precipitation in the winter and spring months and decreased summer precipitation.
- Fall precipitation remains about the same as the historical period.

Streamflow Volume



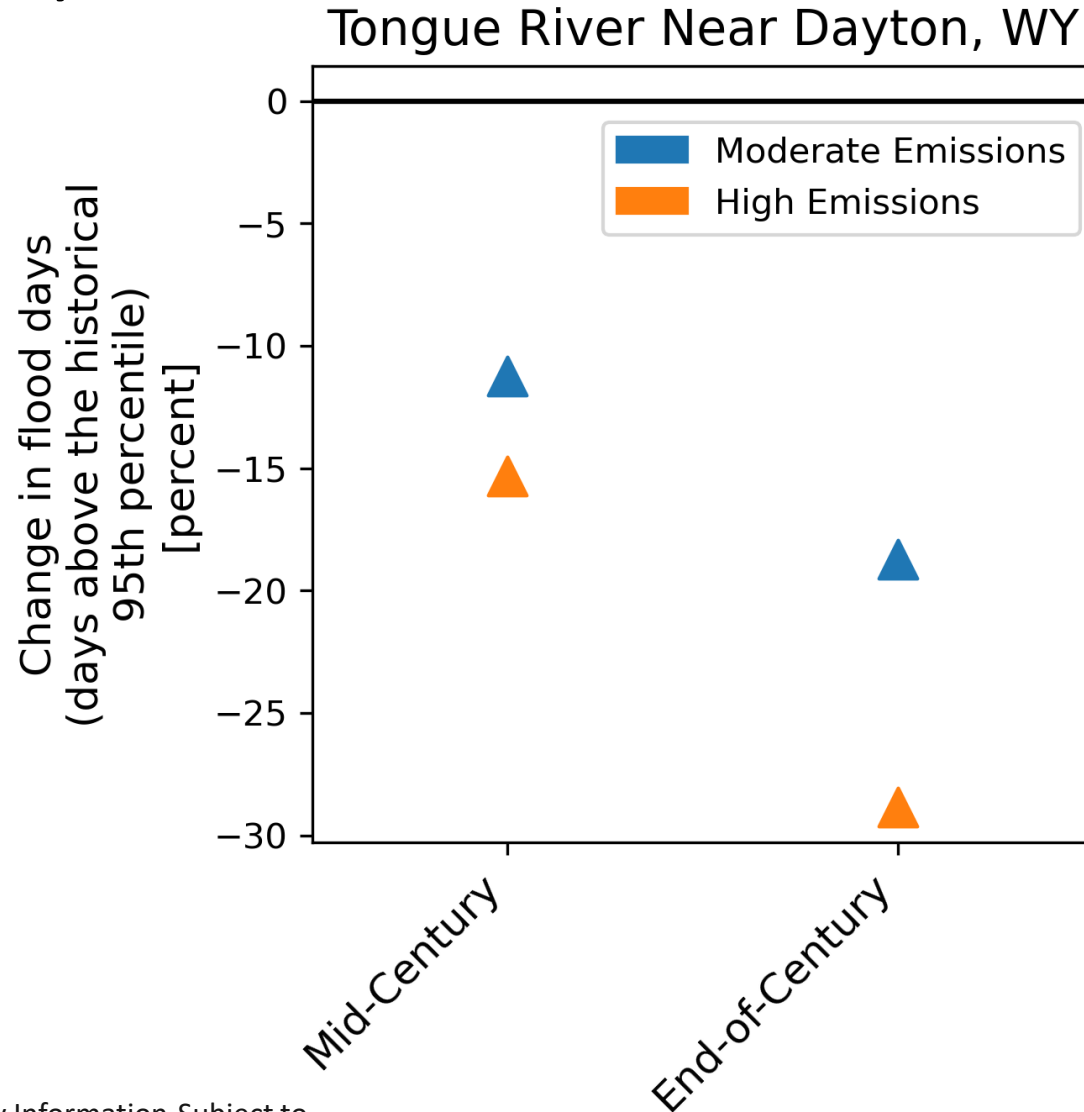
- Streamflow volumes are anticipated to decrease under both future climate scenarios with larger decrease under the high emissions scenario and by the end of the century.

Flood Peaks



- Peak daily streamflow is anticipated to decline in the future.

Flood Days



- The number of days with streamflow greater than the historical 95th percentile is anticipated to decline in the future.

Summary and Next Steps

- A river accounting model is in development for the Tongue River watershed.
 - Streamflow observations have been gap-filled.
 - Bias correction workflow has been tested.
 - We are awaiting naturalized streamflow before proceeding.
- Preliminary results from the headwaters of the domain suggest:
 - Warmer and slightly wetter conditions in the future.
 - A decrease in streamflow volume and generally lower peak streamflow is anticipated.
- Completion of the river accounting model will allow similar analyses throughout the watershed.

Questions?

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contact QR code below.

Project Web Page



Contact Information



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