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# NID-PFW

## Global Climate Projections and Unimpaired Hydrology

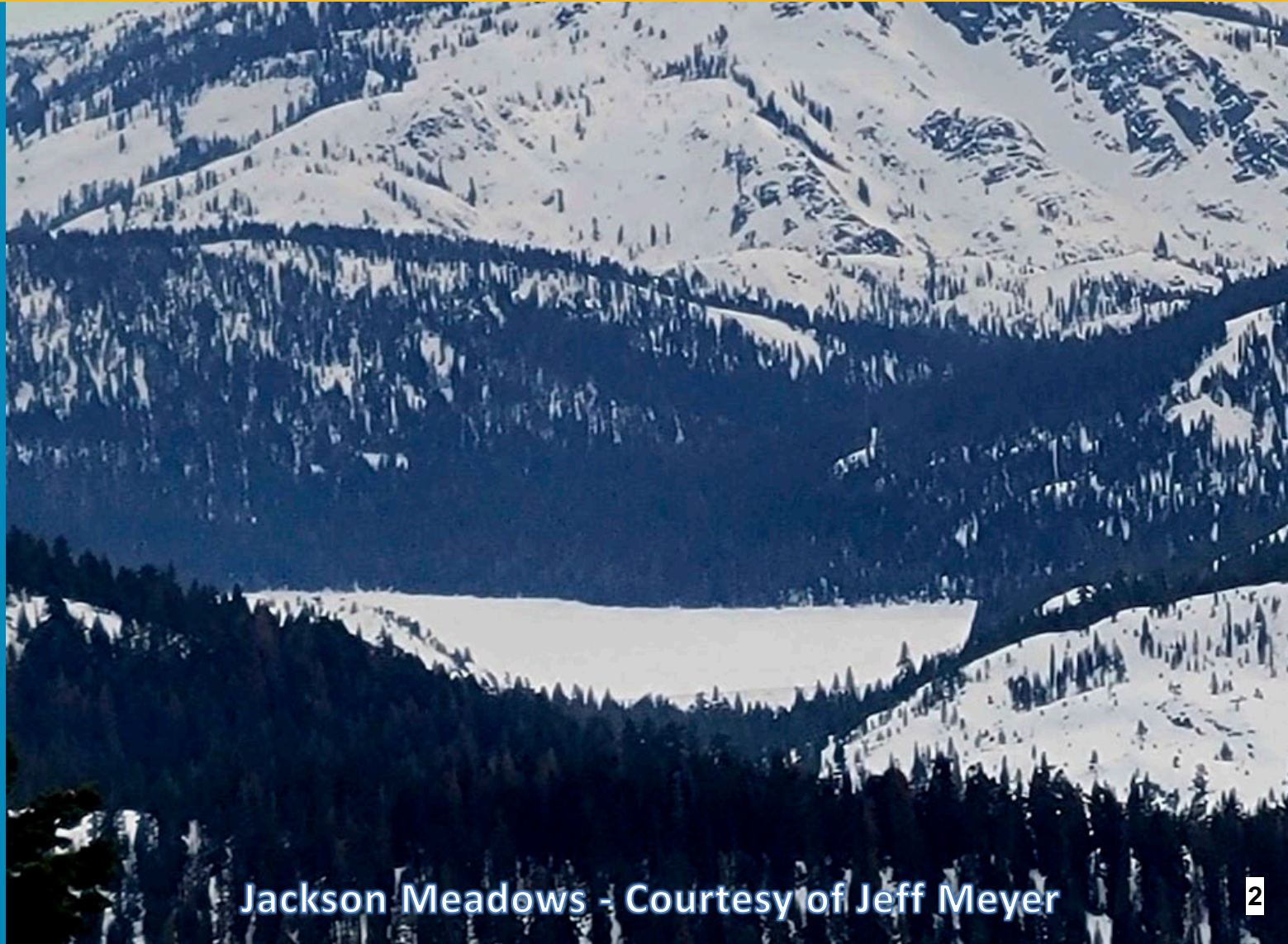
**May 23, 2023**



## Agenda

### Global Climate Projections

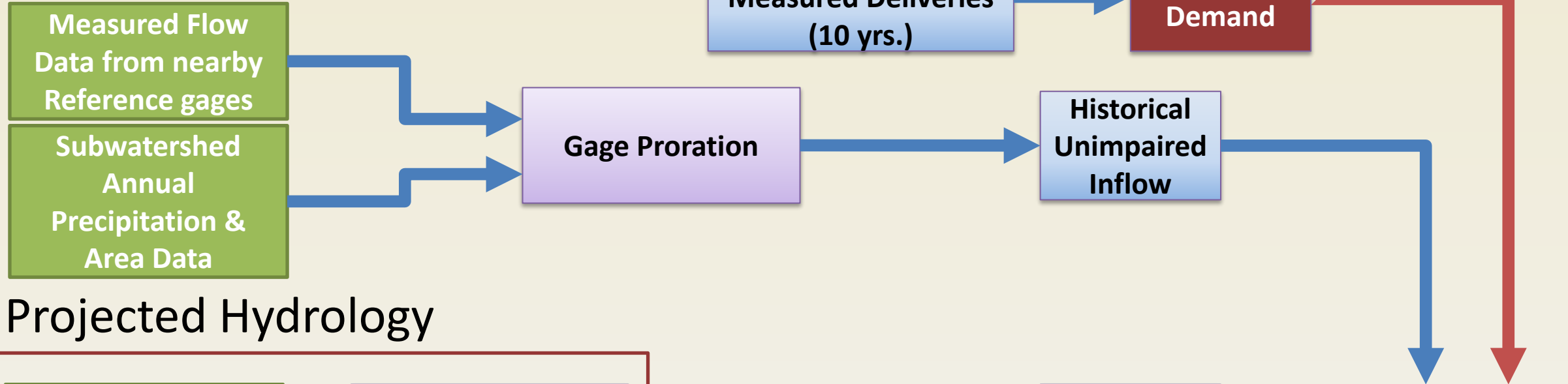
- Introduction
- GCM – CMIP6
- Downscaled GCM
- Model Selection
- Emission Scenarios
- Data Processing/Examples
- Next Steps



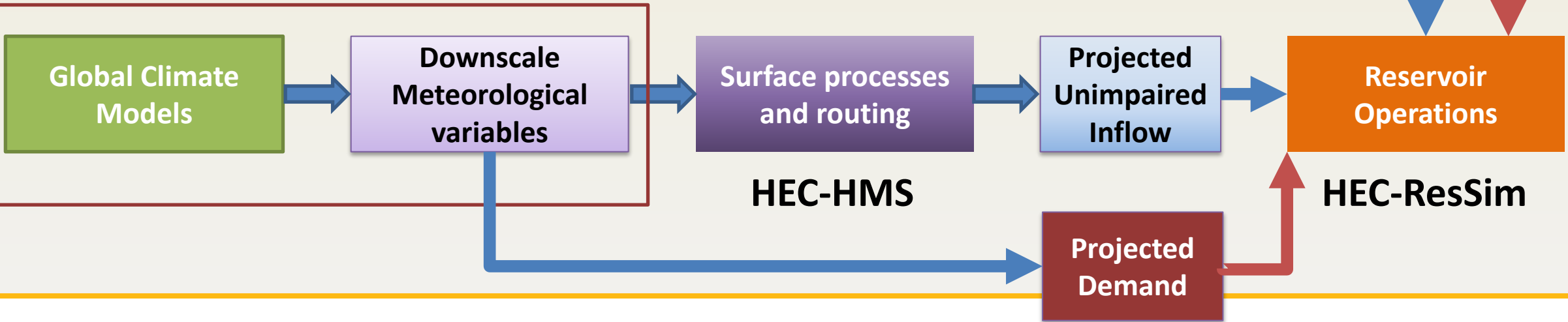
Jackson Meadows - Courtesy of Jeff Meyer

# Introduction

## Historical Hydrology



## Projected Hydrology



# GCM – CMIP6

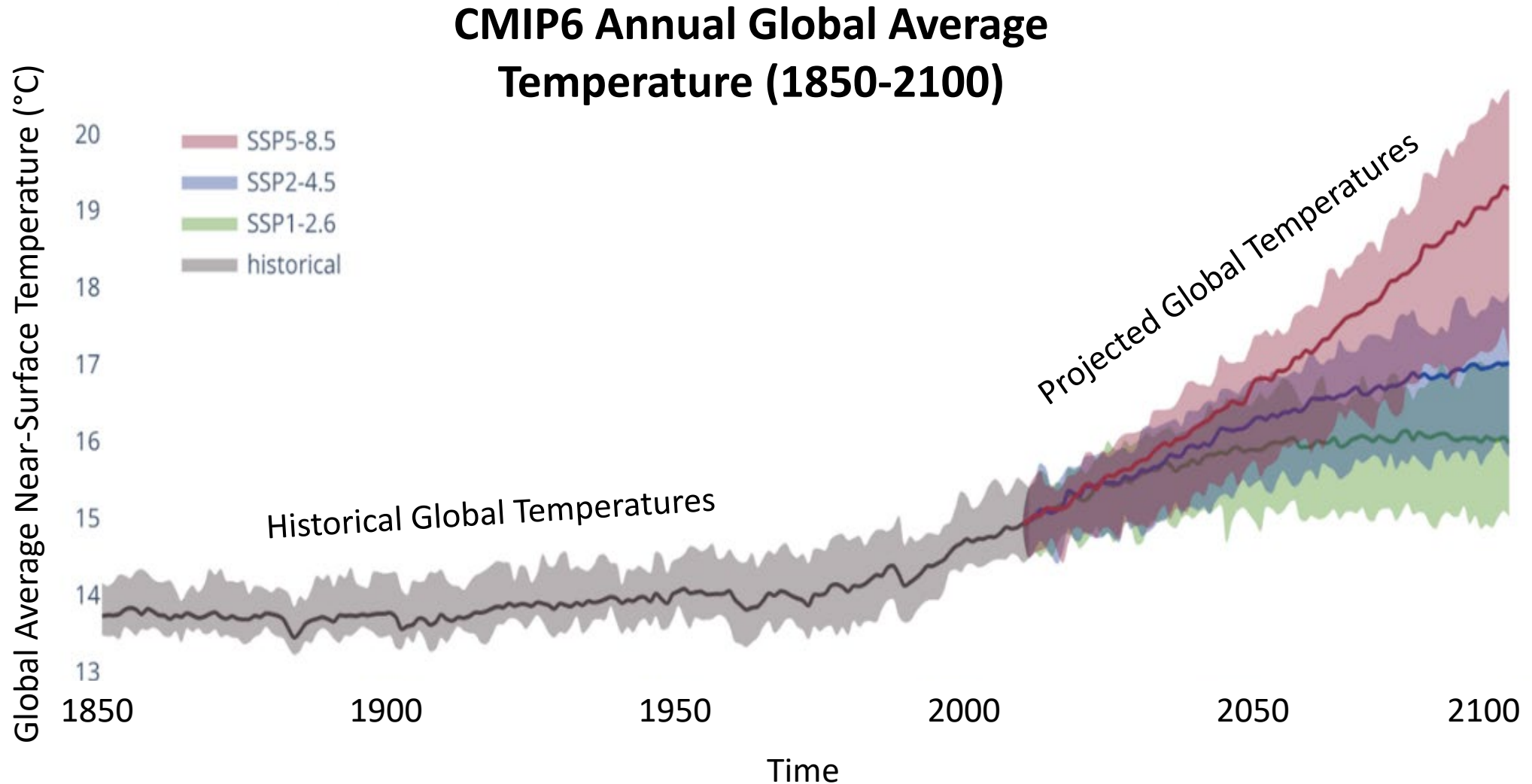
## Coupled Model Intercomparison Project Phase 6

*“The CMIP6 generation of models includes GCMs that improve the representation of continental-scale atmospheric circulation patterns that produce realistic weather and climate in California in both an average sense and in terms of variability compared to CMIP5 (Cannon, 2020; Simpson et al., 2020).”*

# GCM – CMIP6

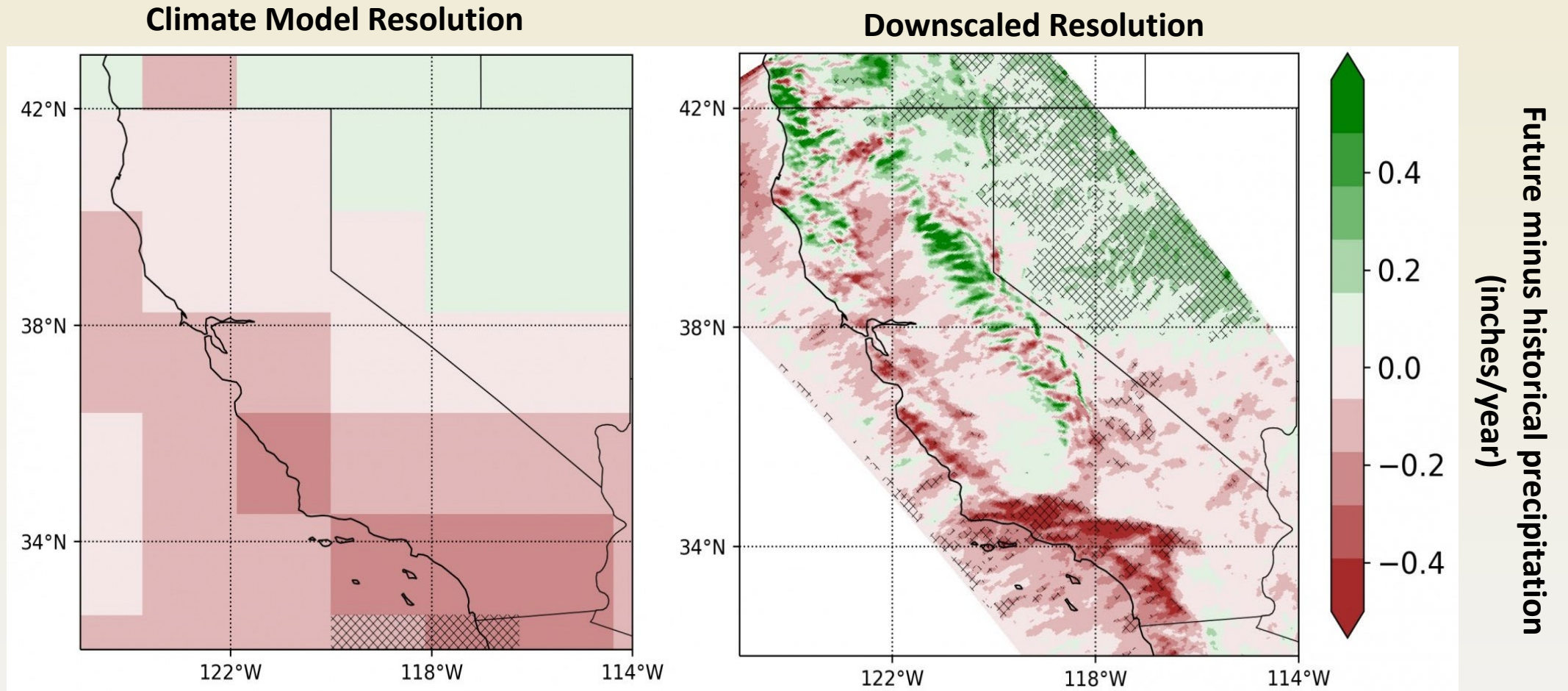
## Coupled Model Intercomparison Project Phase 6

100 models - 50 modeling centers





# Downscaled Climate Data



Future (2080-2100 average) minus historical (1980-2015 average) simulated precipitation anomalies [mm/d]. Source: [CMIP6 Downscaling Using WRF | Alex Hall's Research Group \(ucla.edu\)](#)

# Downscaling Datasets

## 1) Statistically downscaled (LOCA):

David Pierce

CW3E, California Energy Commission

**1950**-2100

**27 models, 3 scenarios**

Multiple Ensembles

## 2) Dynamically downscaled:

UCLA Alex Halls Group WRF

**1980**-2100

**Limited models, scenarios**

**Still under review**

# Climate Model Selection

Models are not created equal

## **Model Ranking (Process-based)**

- Large-scale patterns of circulation, pressure, and moisture transport

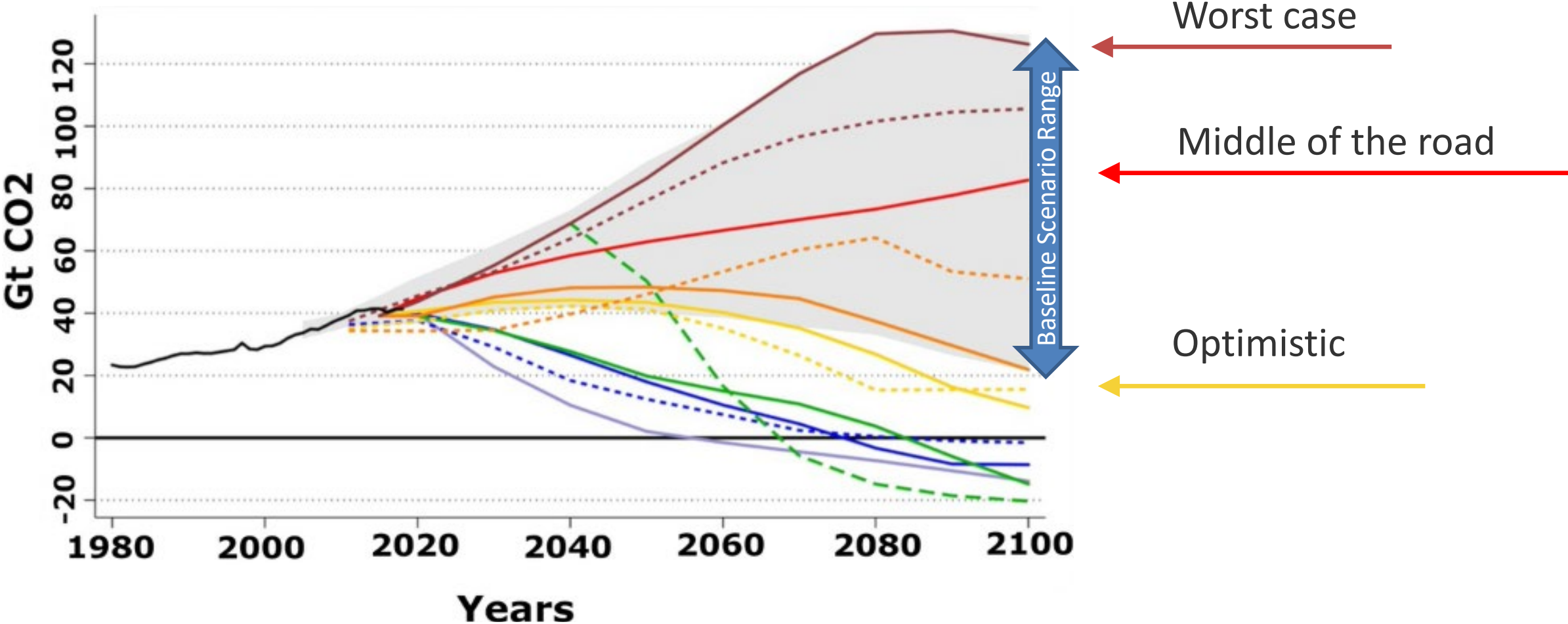
## **Model Ranking (Local climate)**

- Seasonal and annual patterns
  - Temperature and precipitation
  - Mean and variability

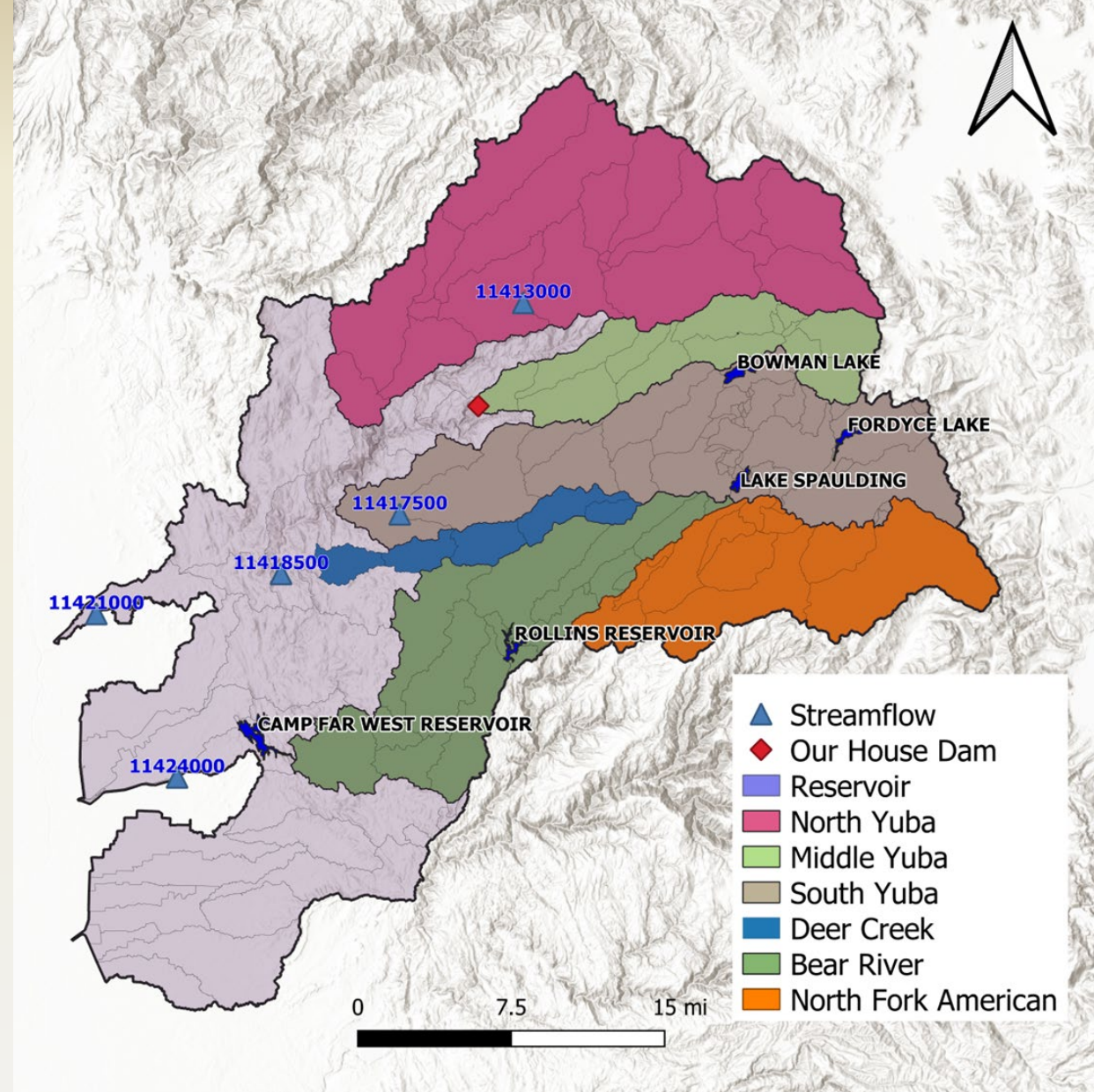
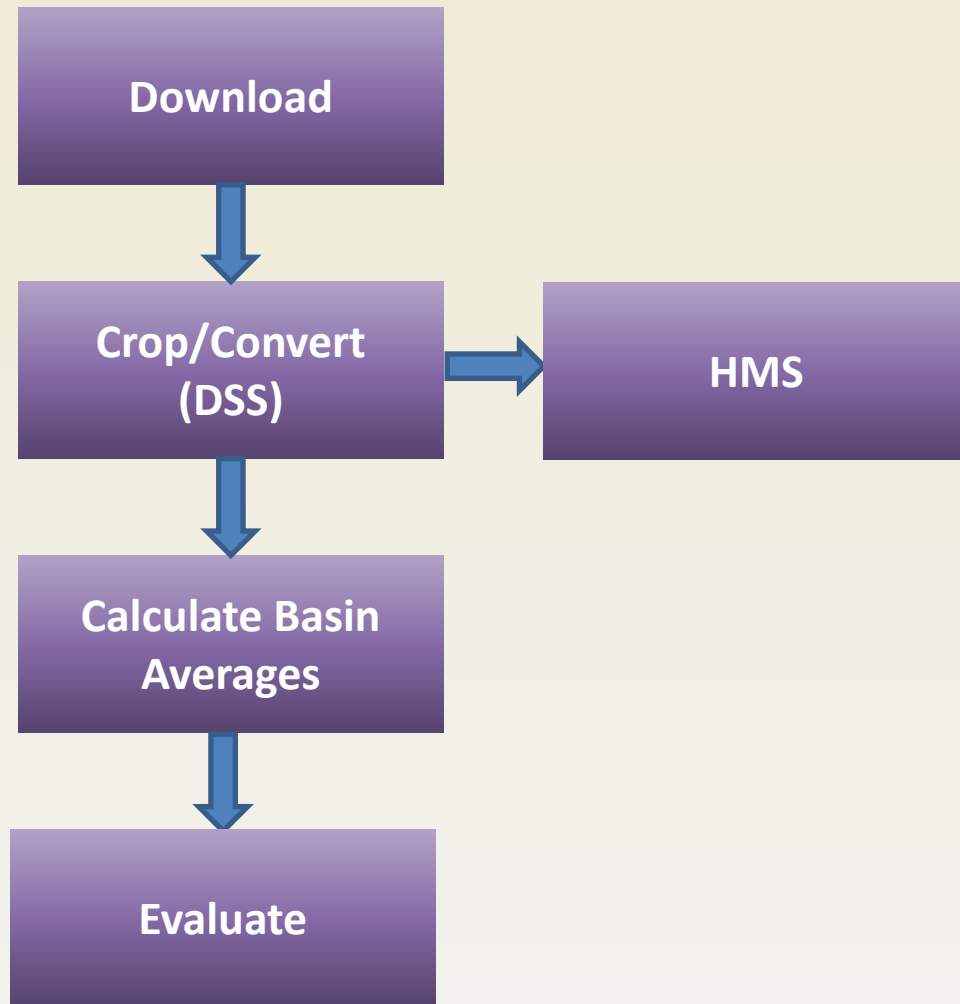




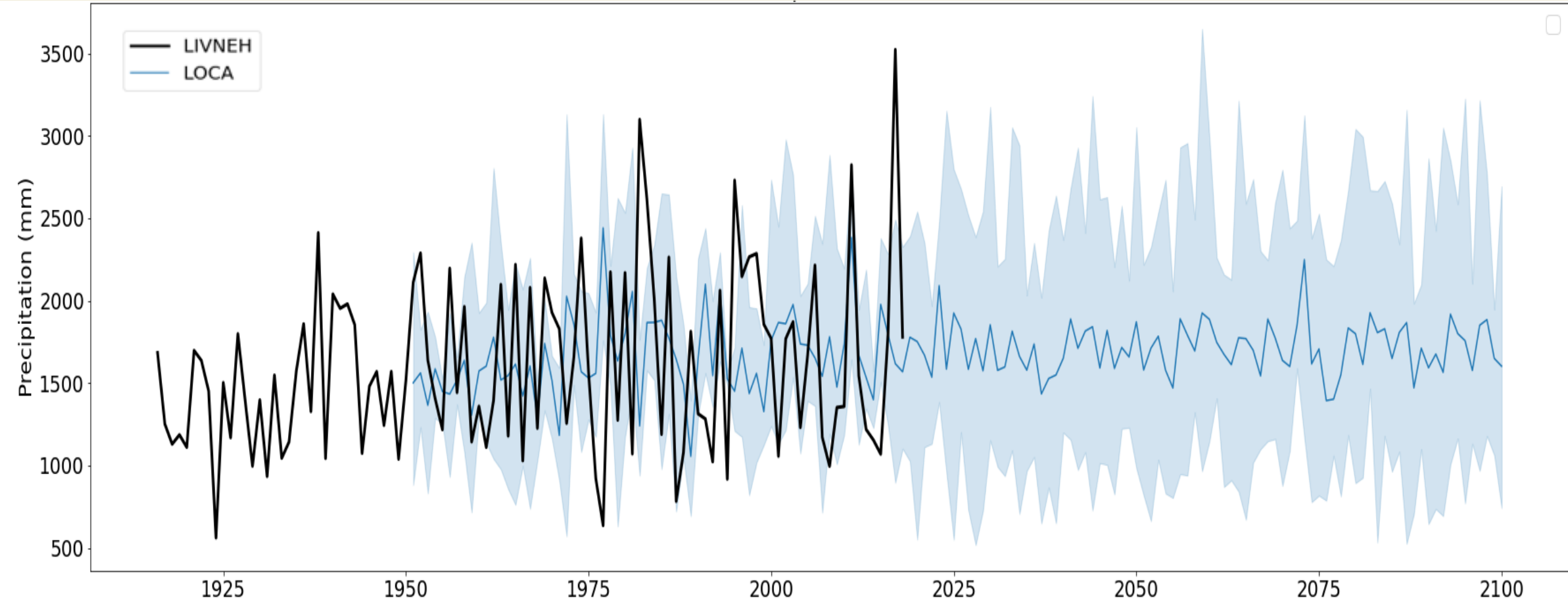
# Emission Scenarios



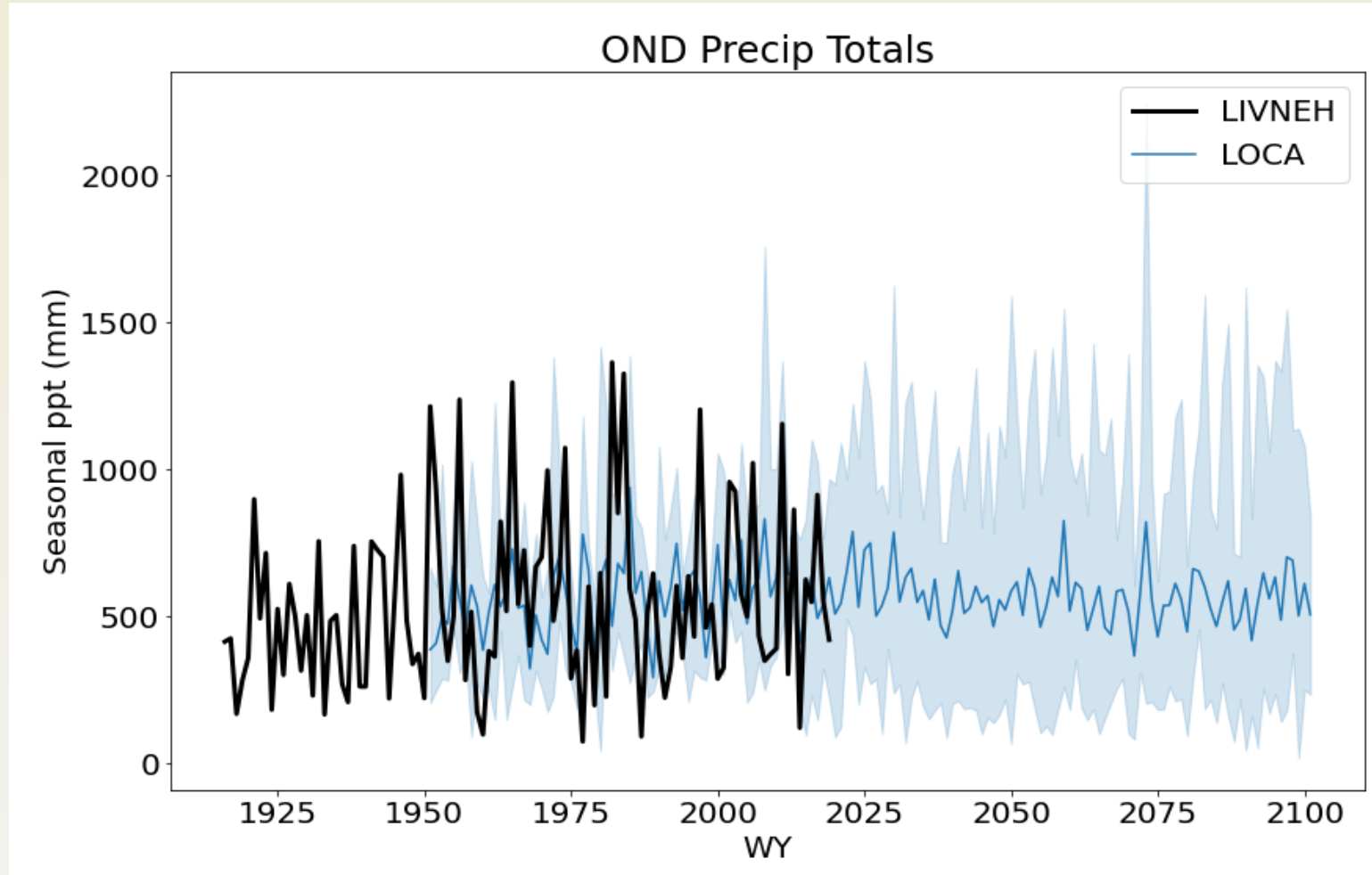
# Data Processing/Examples



# Middle Yuba River



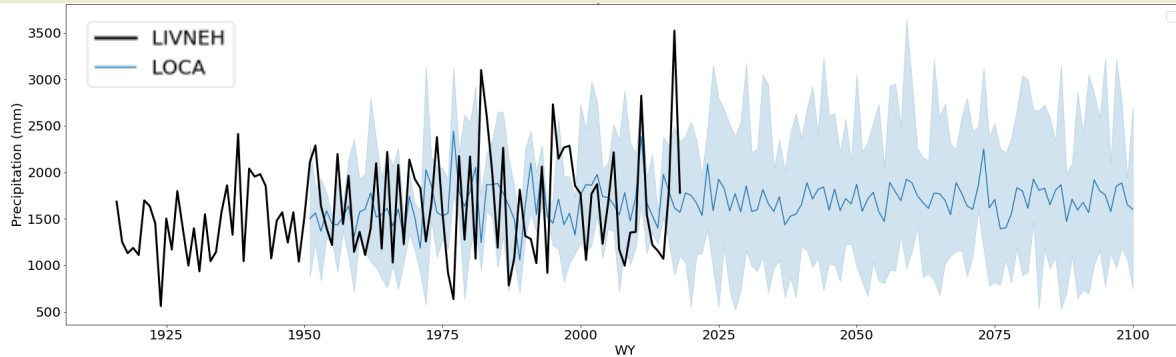
# Middle Yuba River



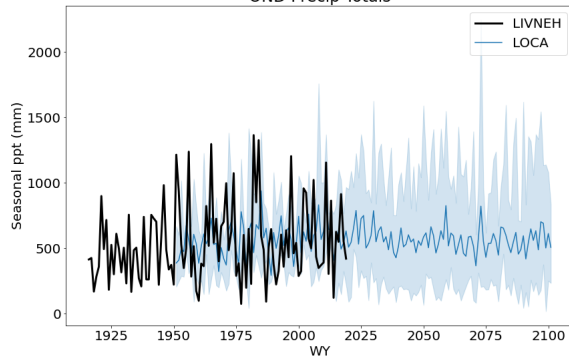


# Middle Yuba River

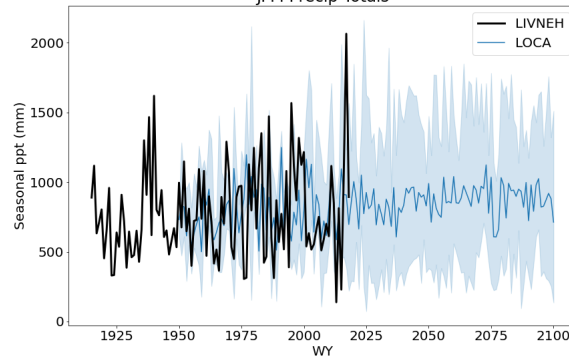
## Annual/Seasonal Precipitation



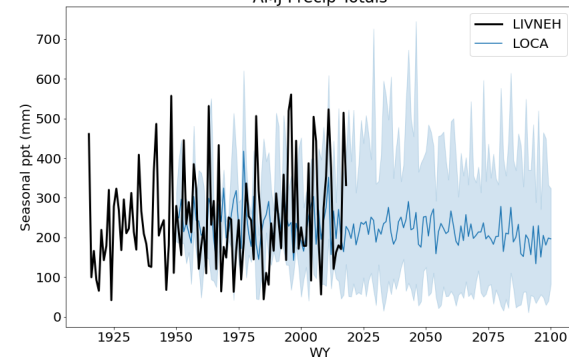
OND Precip Totals



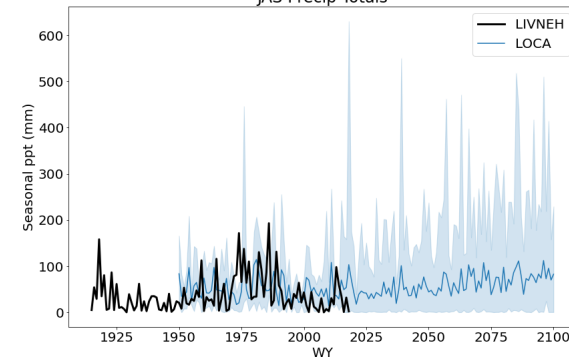
JFM Precip Totals



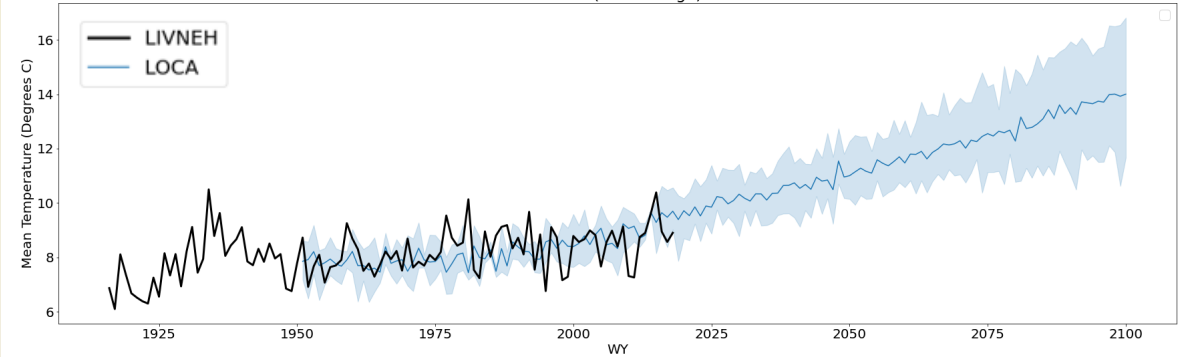
AMJ Precip Totals



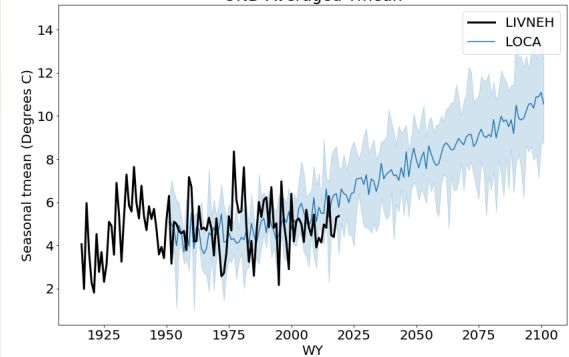
JAS Precip Totals



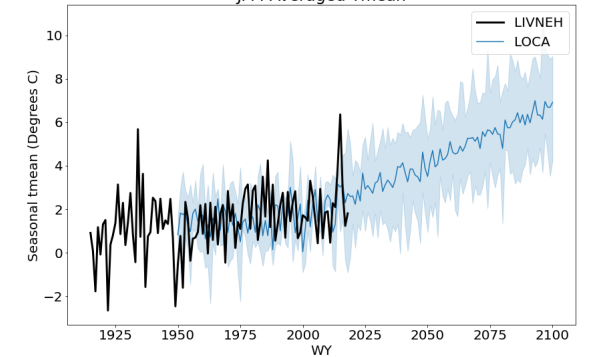
## Annual/Seasonal Temperature



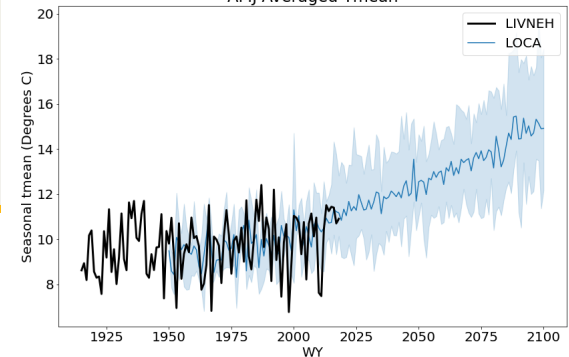
OND-Averaged Tmean



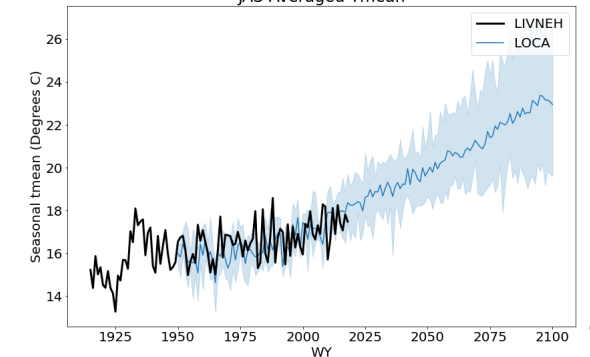
JFM-Averaged Tmean



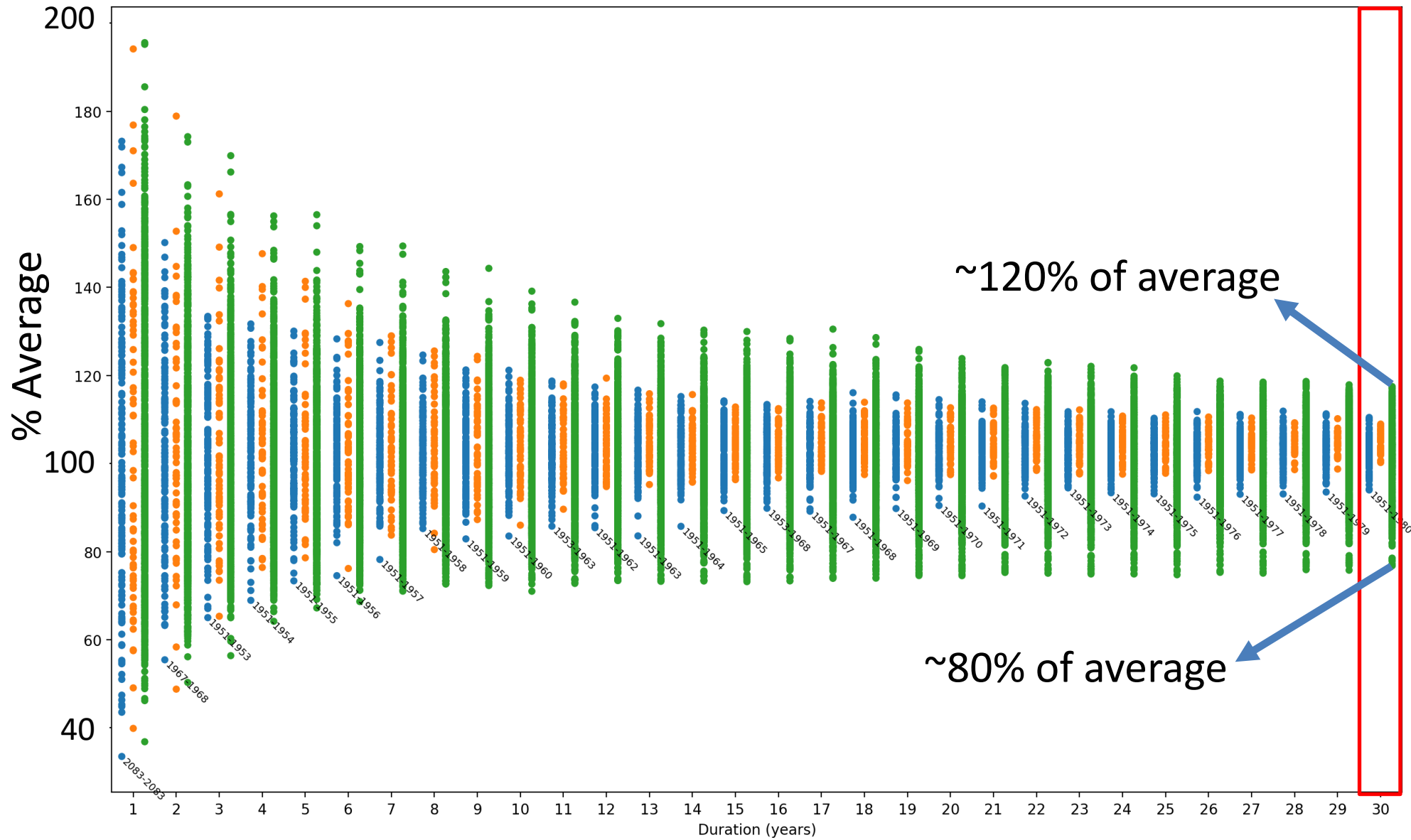
AMJ-Averaged Tmean



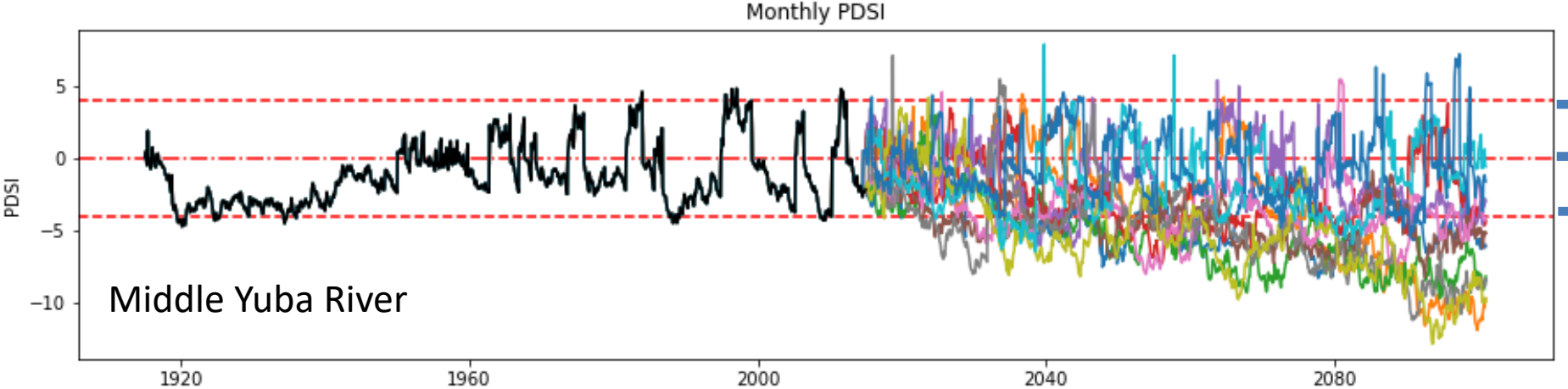
JAS-Averaged Tmean



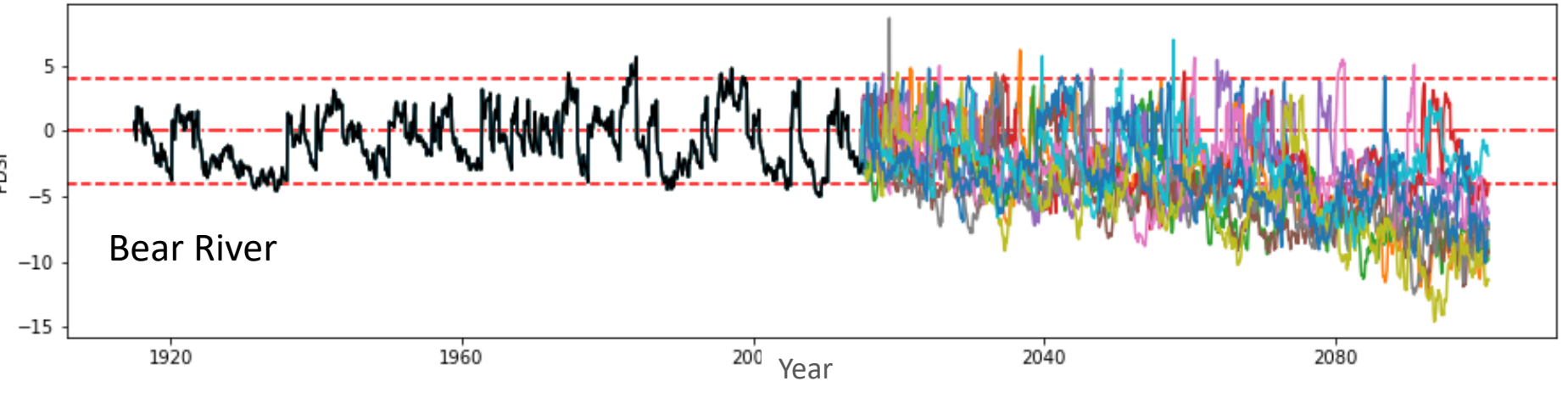
# Paleo Data



# Precipitation and Temperature: Combined Effect

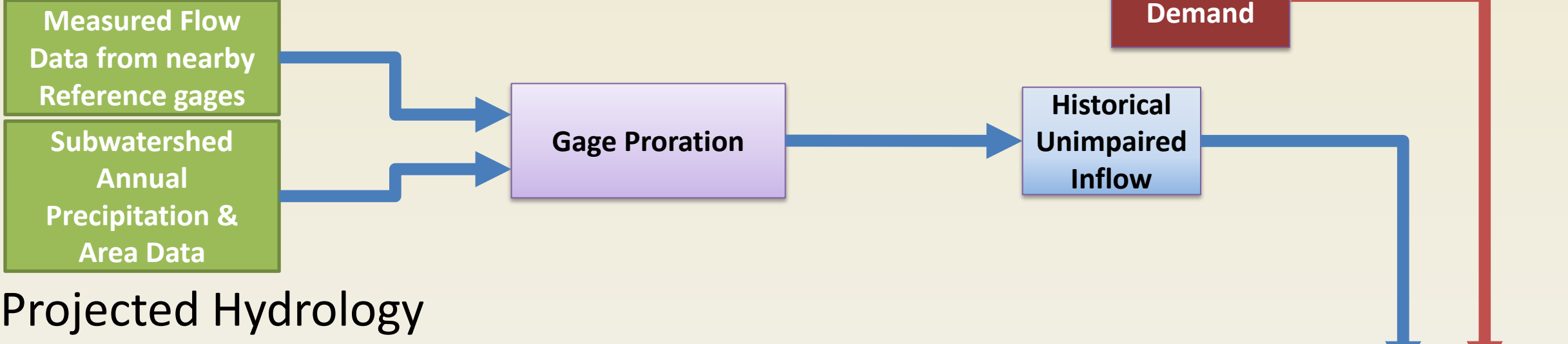


Extreme Wet Spell  
Normal  
Extreme Dry Spell

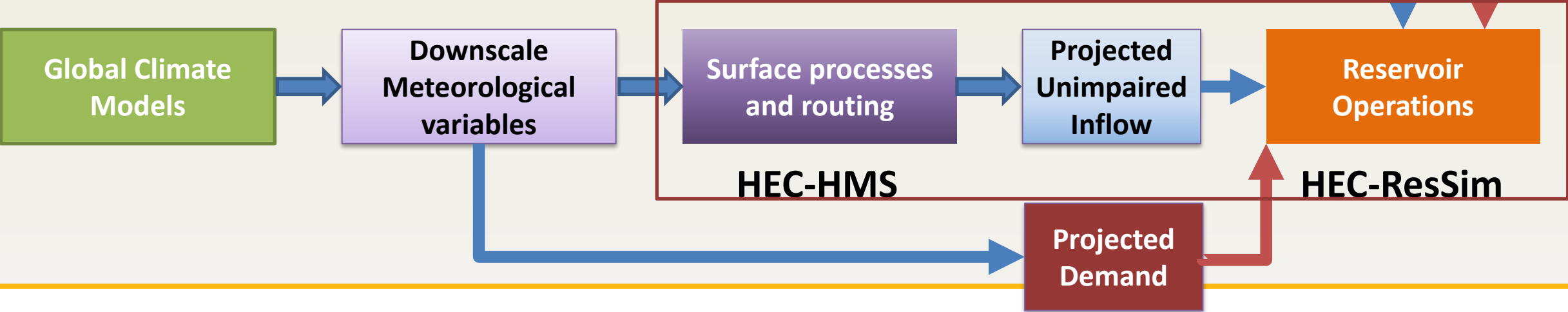


# Next Step

## Historical Hydrology



## Projected Hydrology



# Historical Unimpaired Hydrology

NID Plan for Water  
May 23, 2023





# AGENDA

## Historical Unimpaired Hydrology

- Objectives
- History
- Database & Hydrology Extension
- Validation

# Objectives

- Develop unimpaired hydrology representative of historical conditions
- Compatible with HEC-ResSim
- Support NID's Plan for Water process



# Timeline of Historic Unimpaired Hydrology Development

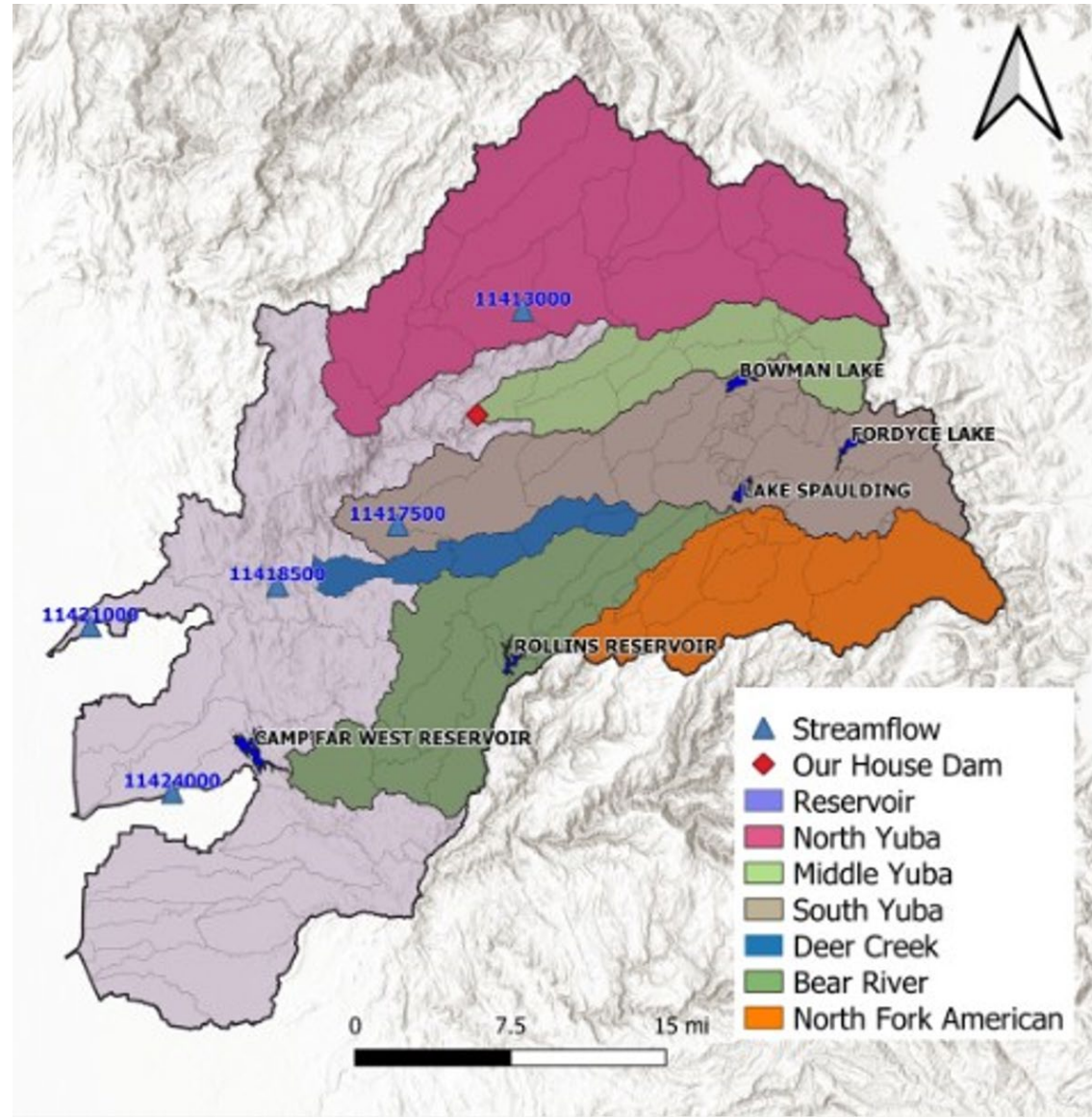
- 2010 FERC relicensing
  - WYs 1976-2008
- 2020 Raw Water Master Plan (RWMP) update
  - WYs 1976-2011
- 2023 Plan for Water
  - WYs 1976-2021
- All datasets were developed for compatibility with NID's HEC-ResSim model



# Unimpaired Hydrology Database

## 82 Total Subbasins:

- Middle Yuba River
- South Yuba Rivers
- NF of NF American River
- Bear River
- Deer Creek
- Coon Creek
- Auburn Ravine

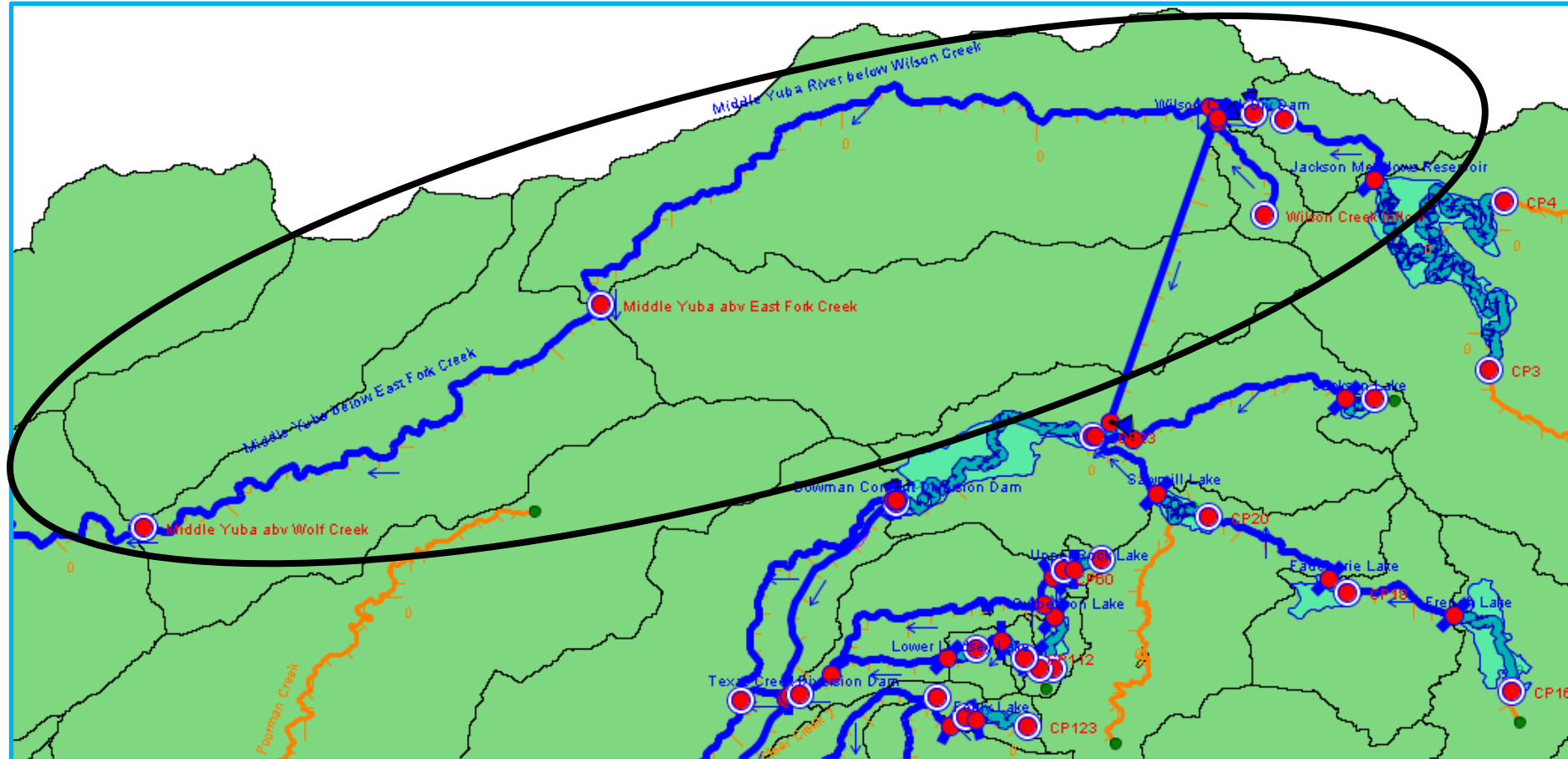


# Hydrology Extension

- WYs 2012 through 2021
- Used existing gage proration methods (HDR 2020)
- Gage proration assumes runoff is proportional to the drainage area and annual precipitation.

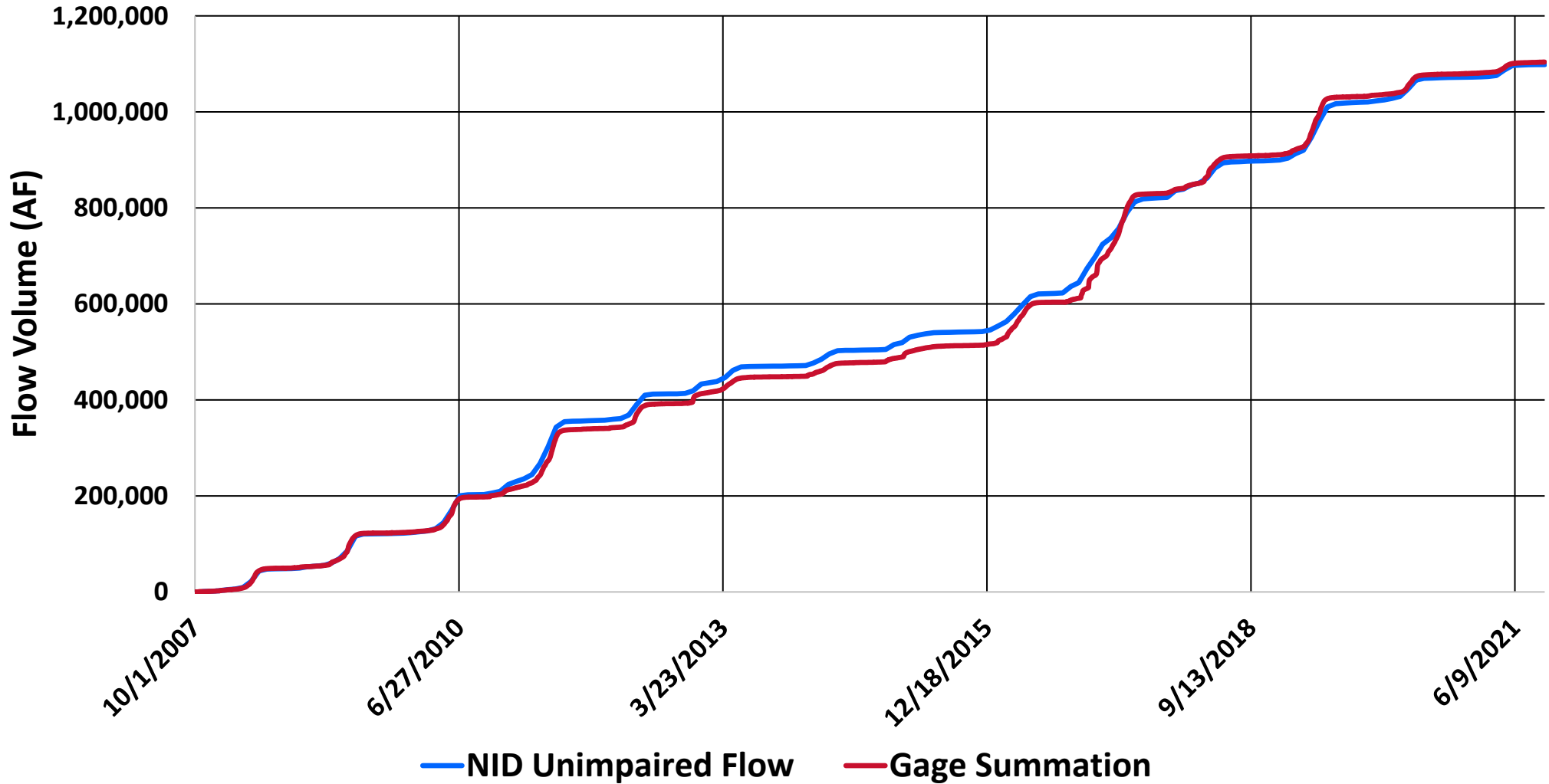


# Example: Middle Yuba River



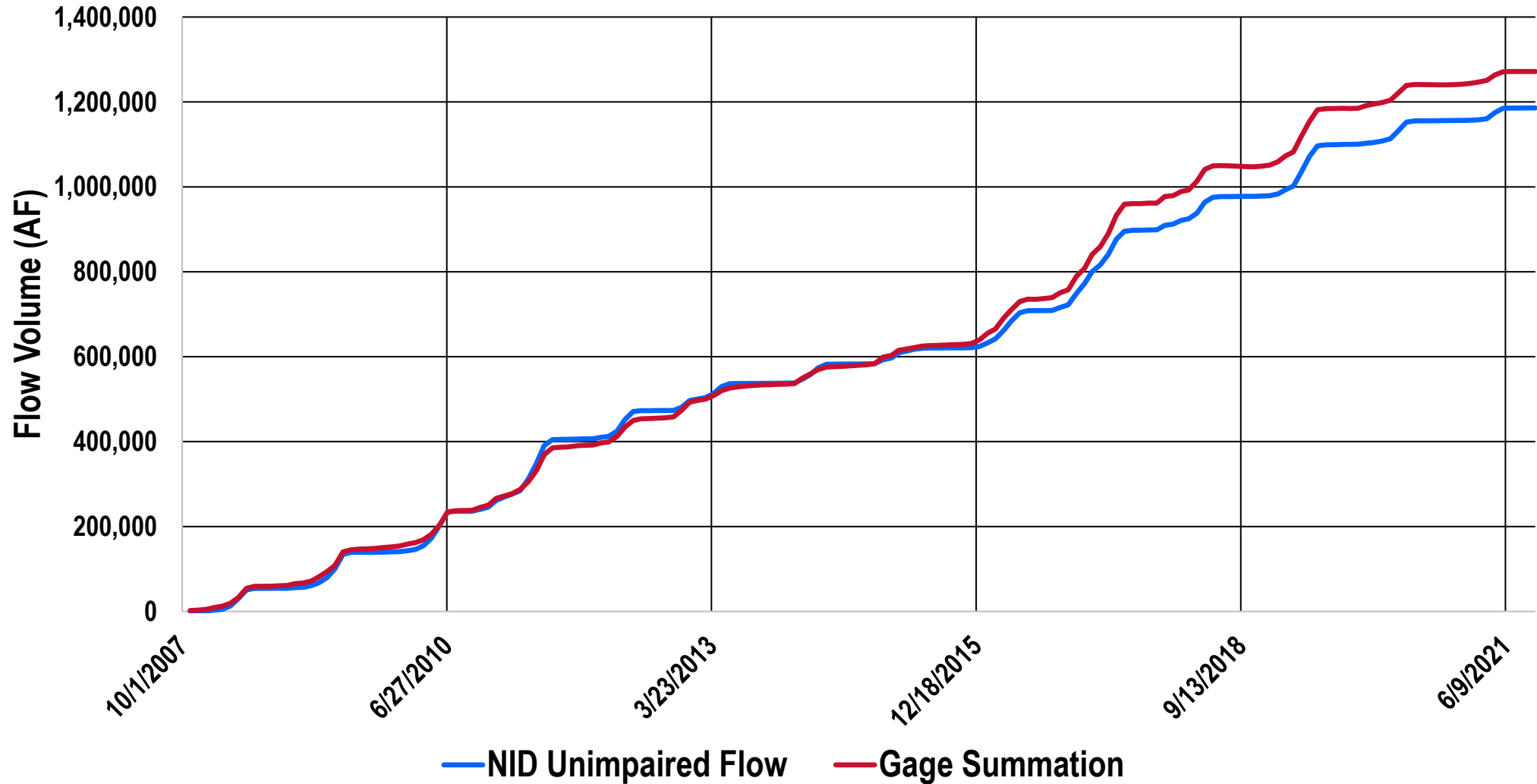
# Middle Yuba River Flow Validation

## Jackson Meadows Monthly Accumulation: 2008-2021



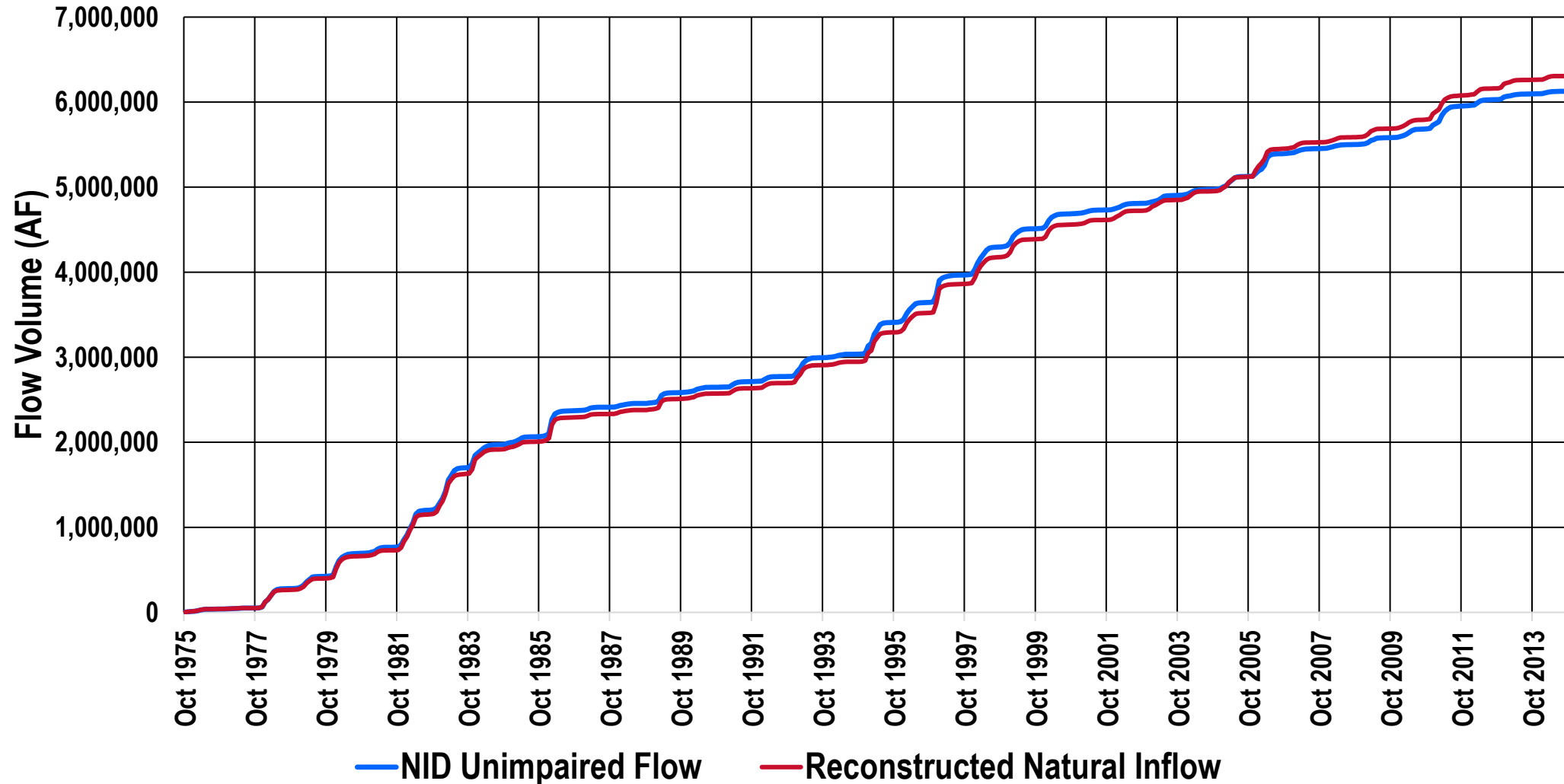
# Canyon Creek Flow Validation

## Bowman Lake Monthly Accumulation: 2008-2021



# Bear River Flow Validation

## Rollins Reservoir Monthly Accumulation 1976-2014



## Next Steps

- Incorporate extended hydrology dataset into HEC-ResSim
- Validate regulated model output against regulated gage data





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# Discussion and Questions

## Global Climate Projections and Unimpaired Hydrology



## References

### CMIP6

- <https://pcmdi.llnl.gov/CMIP6/>
- <https://www.wcrp-climate.org/wgcm-cmip/wgcm-cmip6>
- [CMIP6 Downscaling Using WRF | Alex Hall's Research Group \(ucla.edu\)](#)

### LOCA

- [LOCA statistical downscaling - LOCA Statistical Downscaling \(Localized Constructed Analogs\) \(ucsd.edu\)](#)
- [Mean and Extreme Climate Change Impacts on The State Water Project](#)
- [Guidance for Climate Change Data Use During Groundwater Sustainability Plan Development](#)
- [Cal-adapt](#)