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NEVADA IRRIGATION DISTRICT

NID-PFW
Global Climate Projections and Unimpaired Hydrology

July 25, 2023

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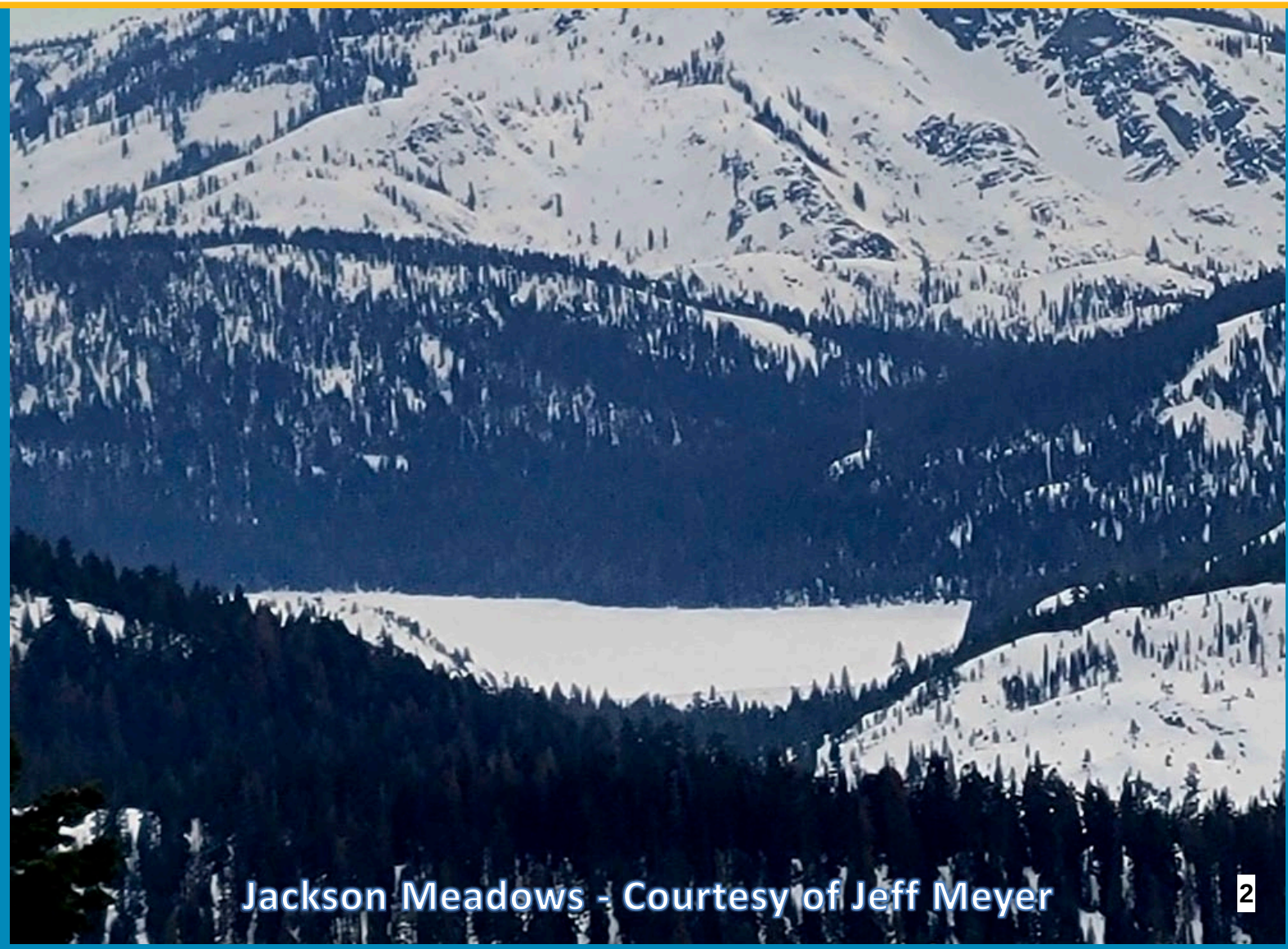
Agenda

Projected Hydrology

- Introduction
- Climate Change Scenarios
- Climate Change Hydrology
- Bias Correction
- Representative Scenarios

Projected Demand

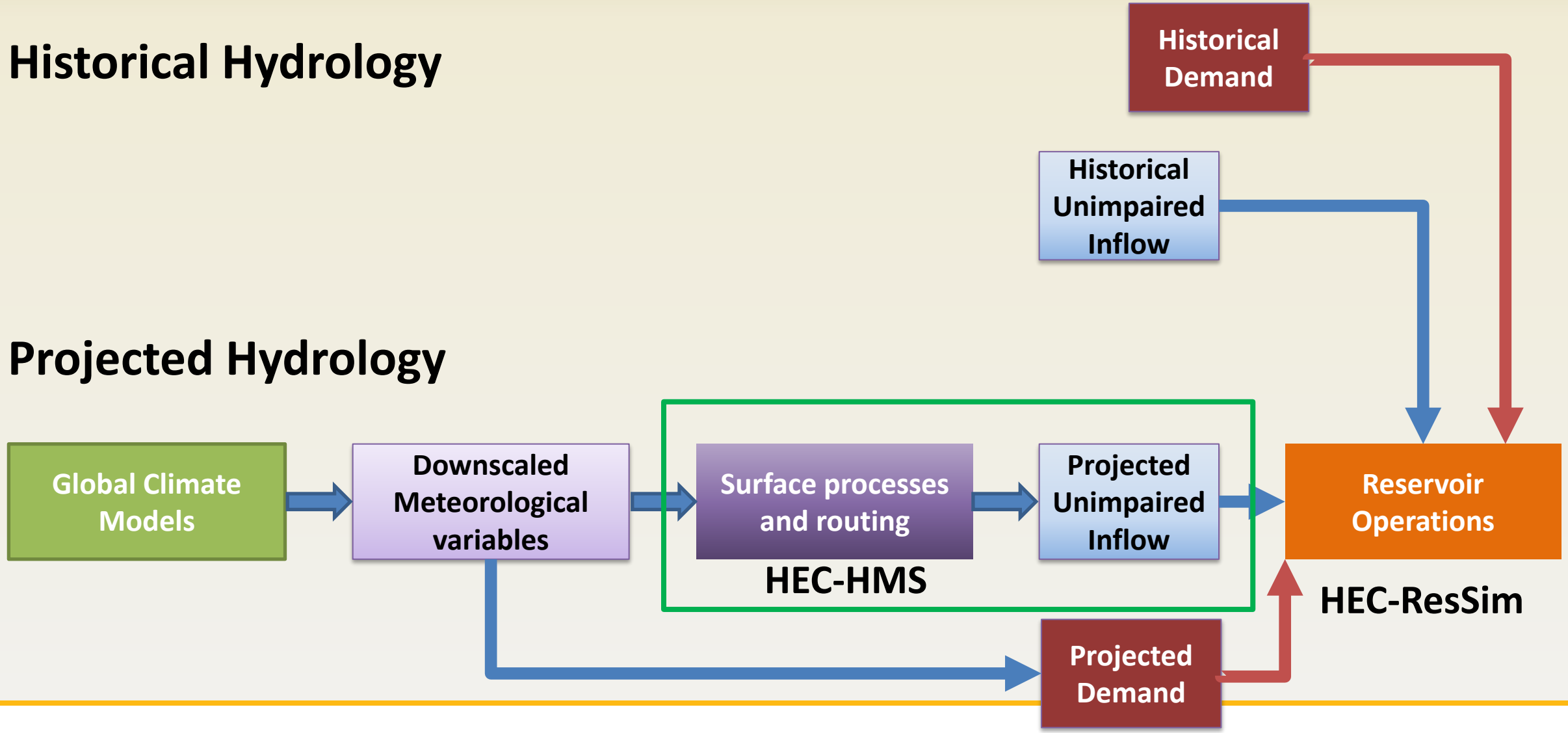


Jackson Meadows - Courtesy of Jeff Meyer

Introduction

Historical Hydrology

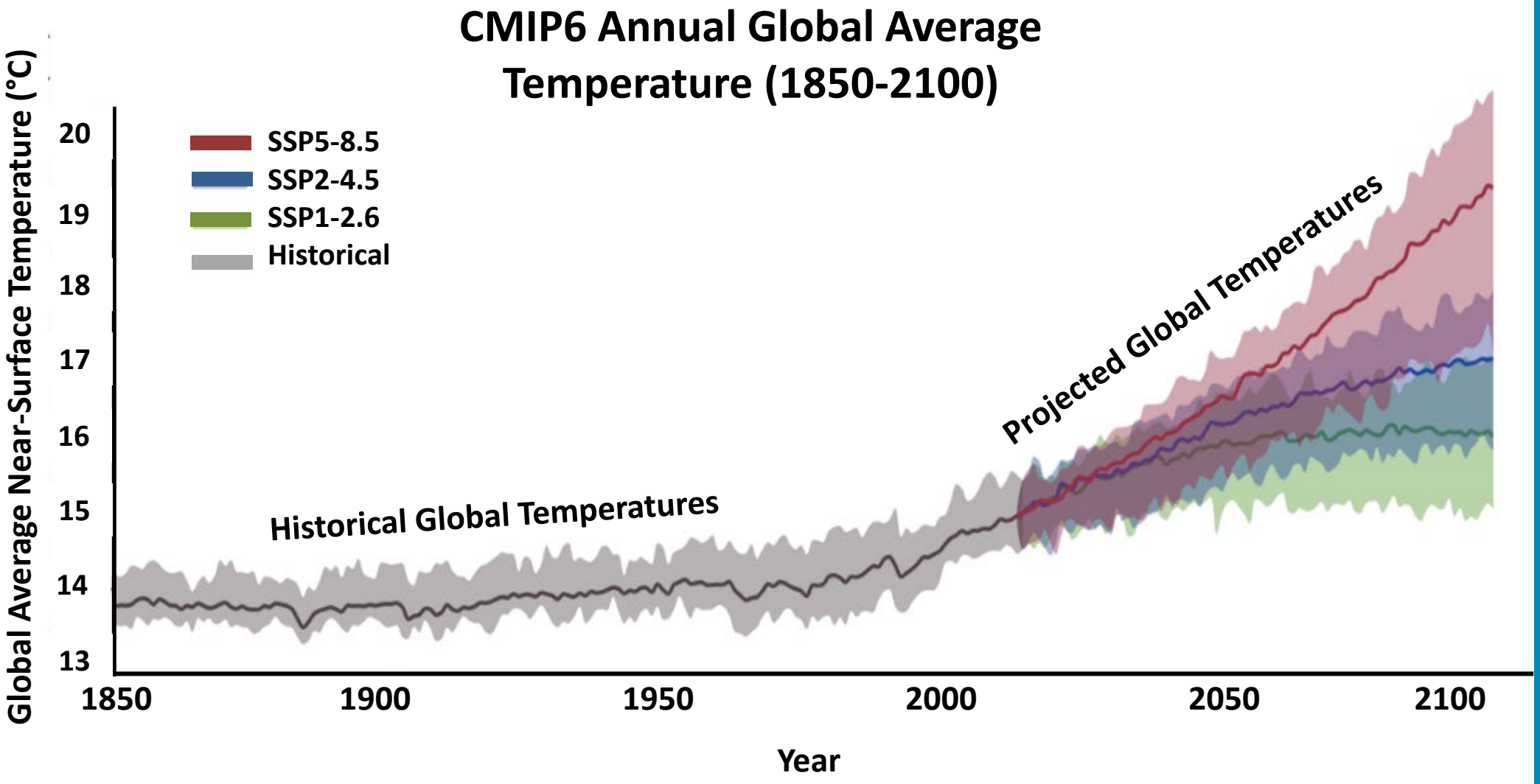
Projected Hydrology



GCM – CMIP6

Coupled Model Intercomparison Project Phase 6

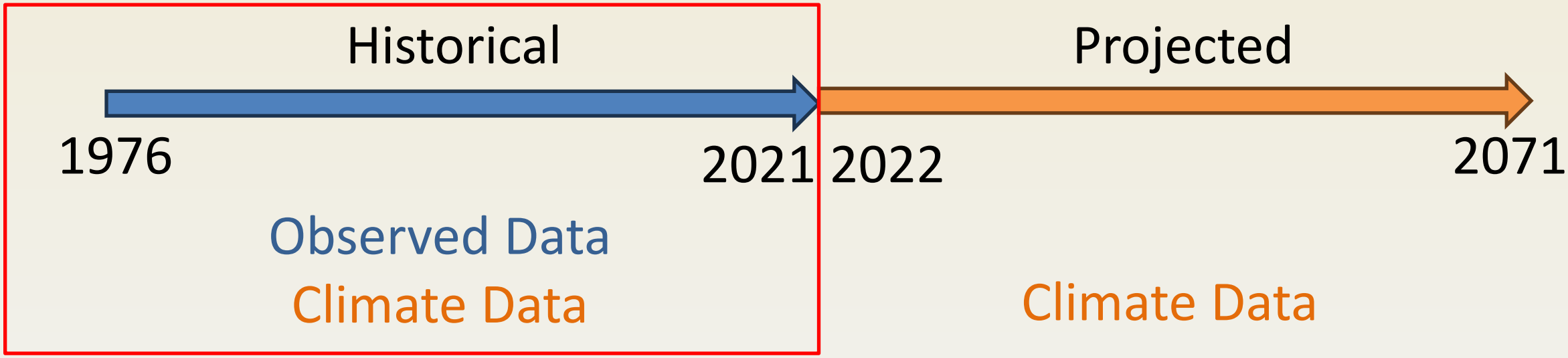
100 models - 50 modeling centers



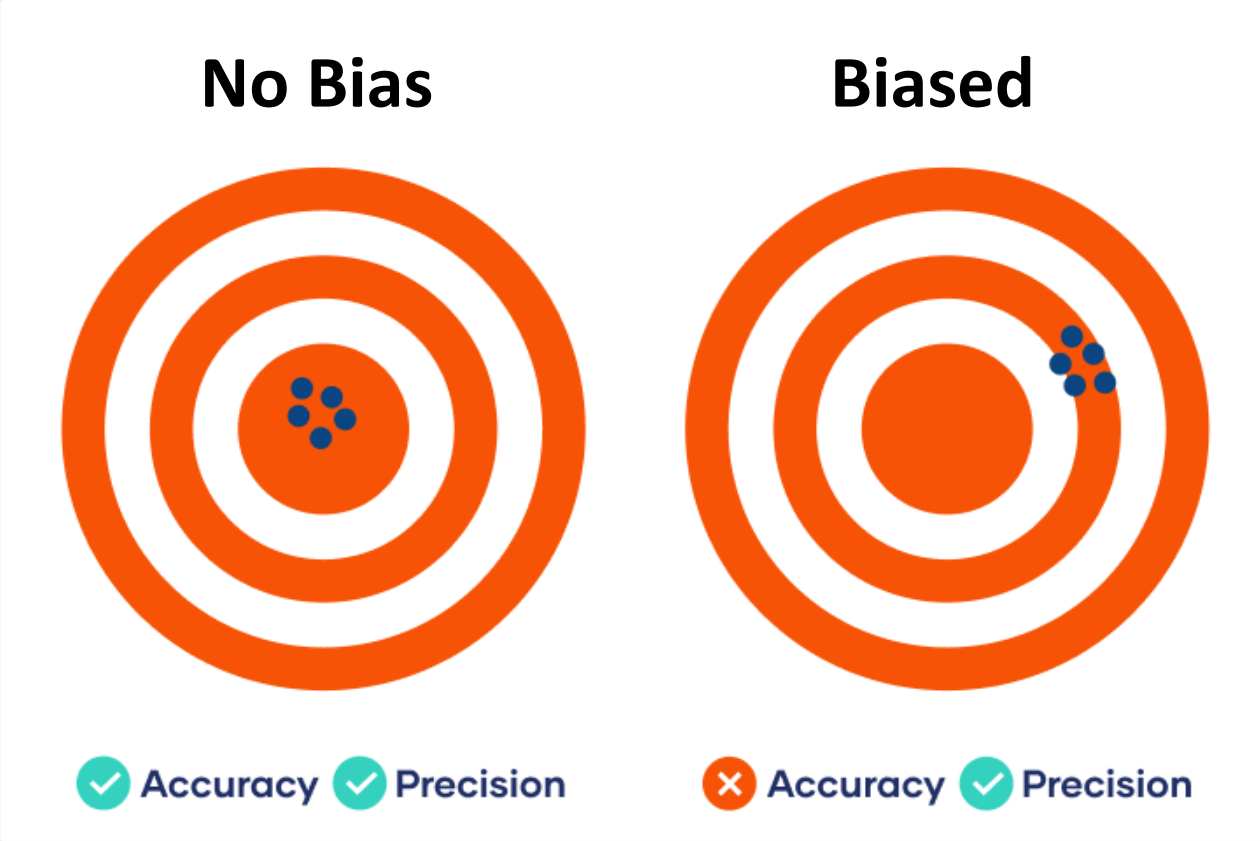
All scenarios have increasing temperature trends.

Climate Change Hydrology

Run the calibrated HEC-HMS to obtain local inflows:



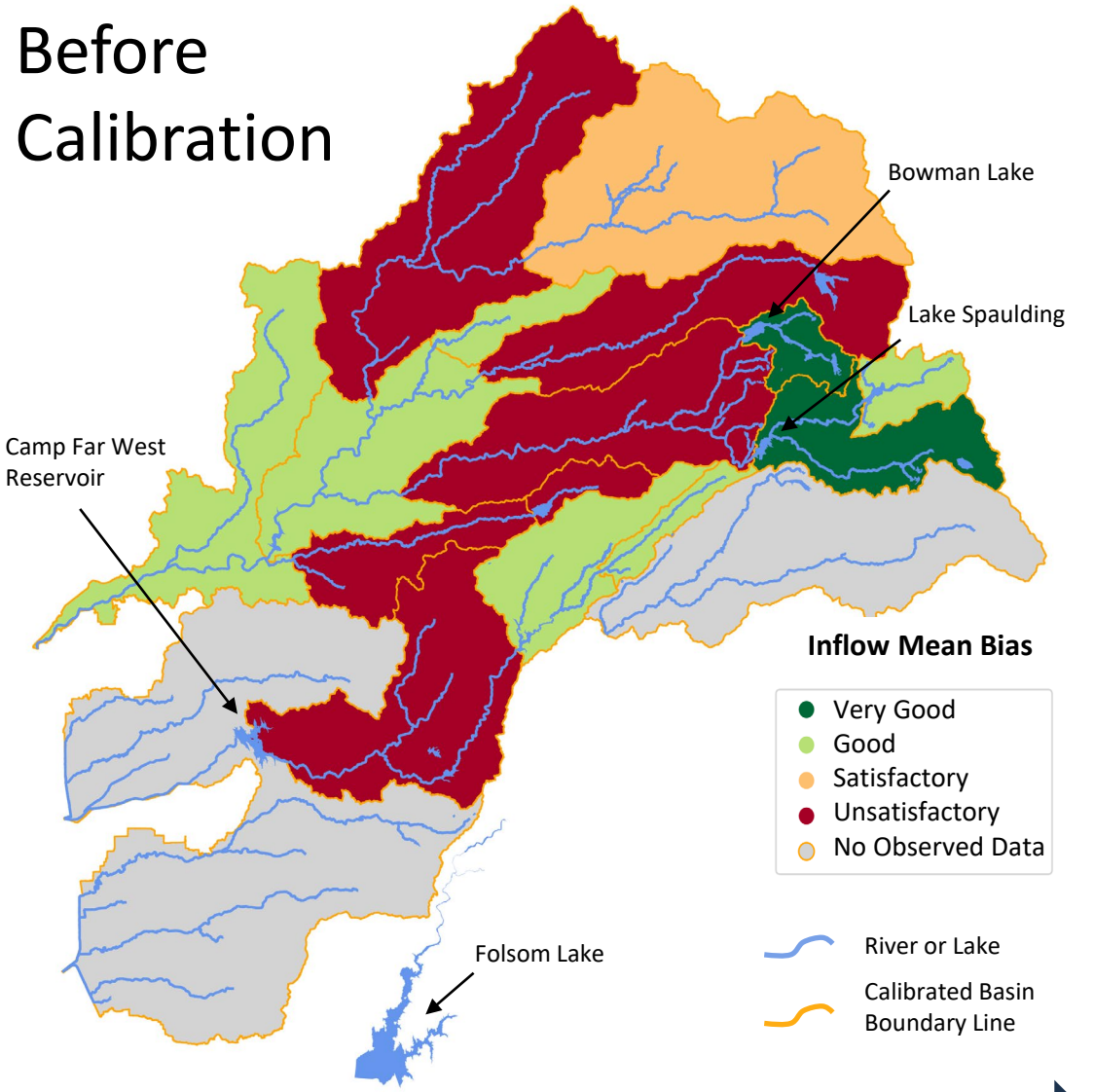
What is bias? Why should we care?



- Is the NID HEC-HMS biased?
- Are climate models biased?

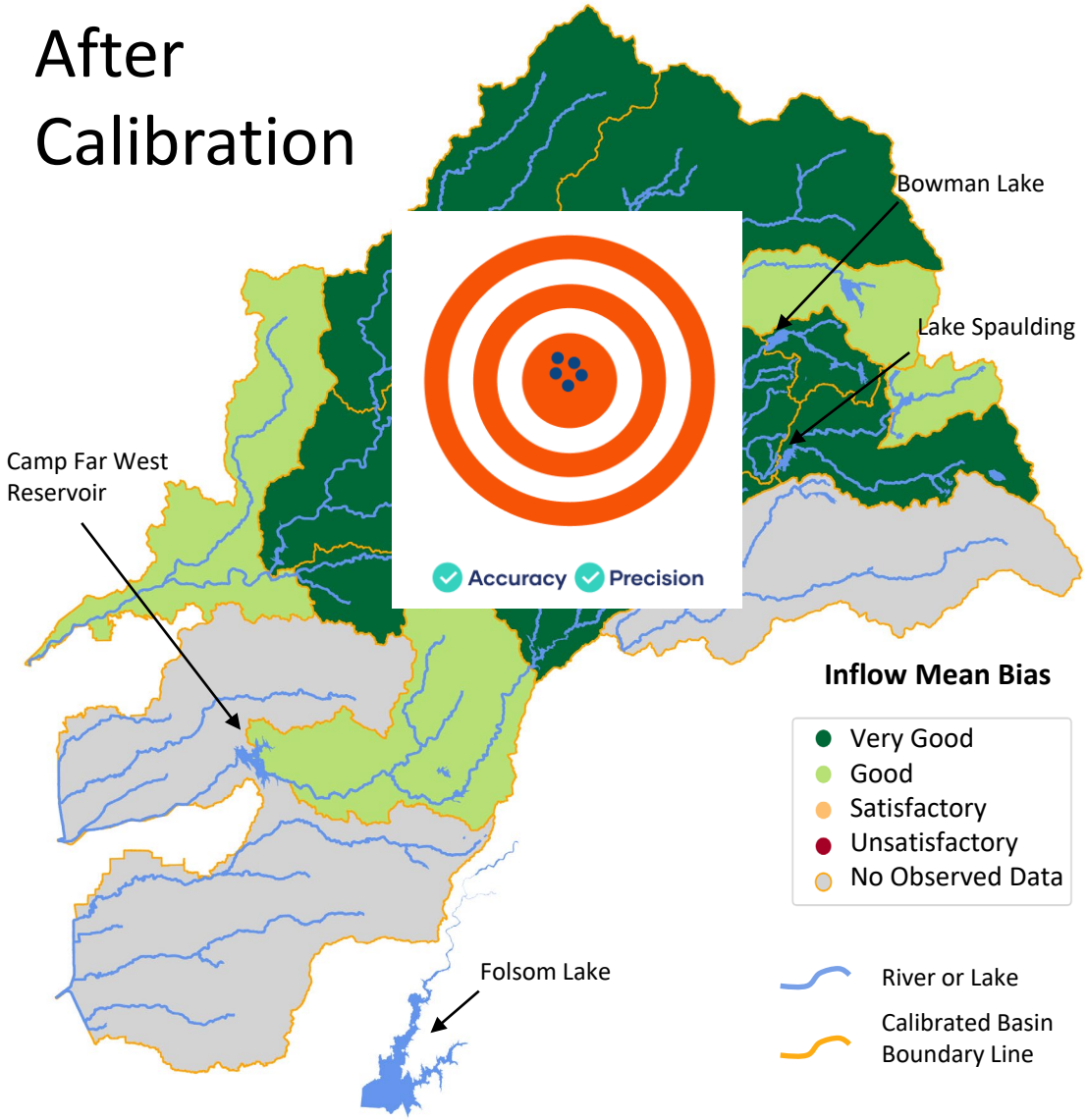
Update on HEC-HMS Calibration

Before Calibration



2004

After Calibration



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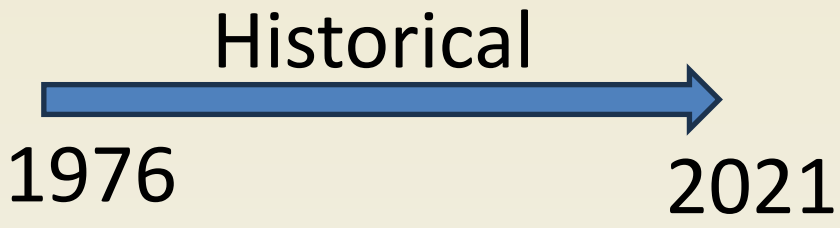
HEC-HMS Model Verification

Methods:



1. Gage proration

2. Water balance

   - Measured USGS streamflow at NID downstream locations
   - Estimated annual applied water and losses

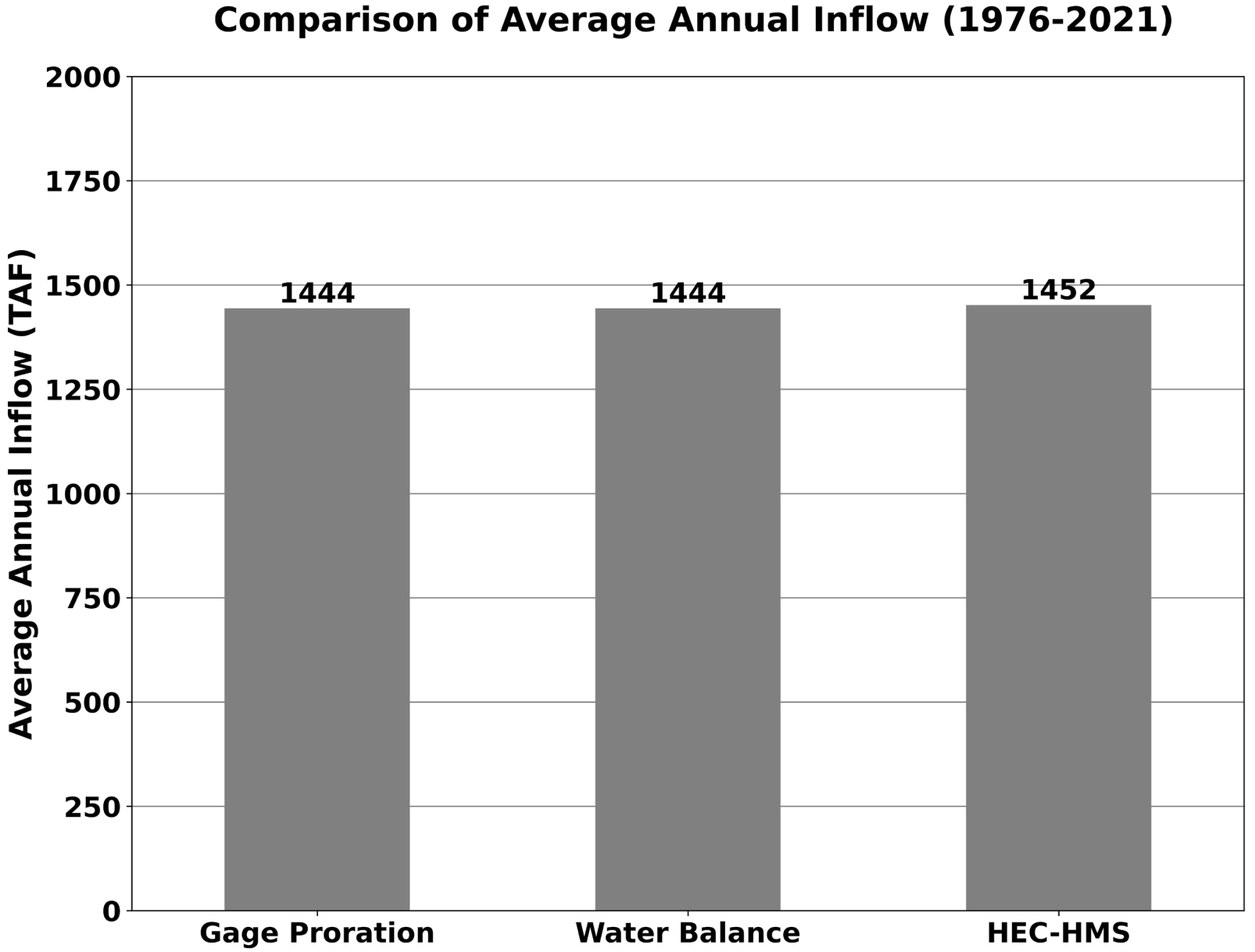
3. HEC-HMS

Is the NID HEC-HMS biased?

No

Historical

1976 2021



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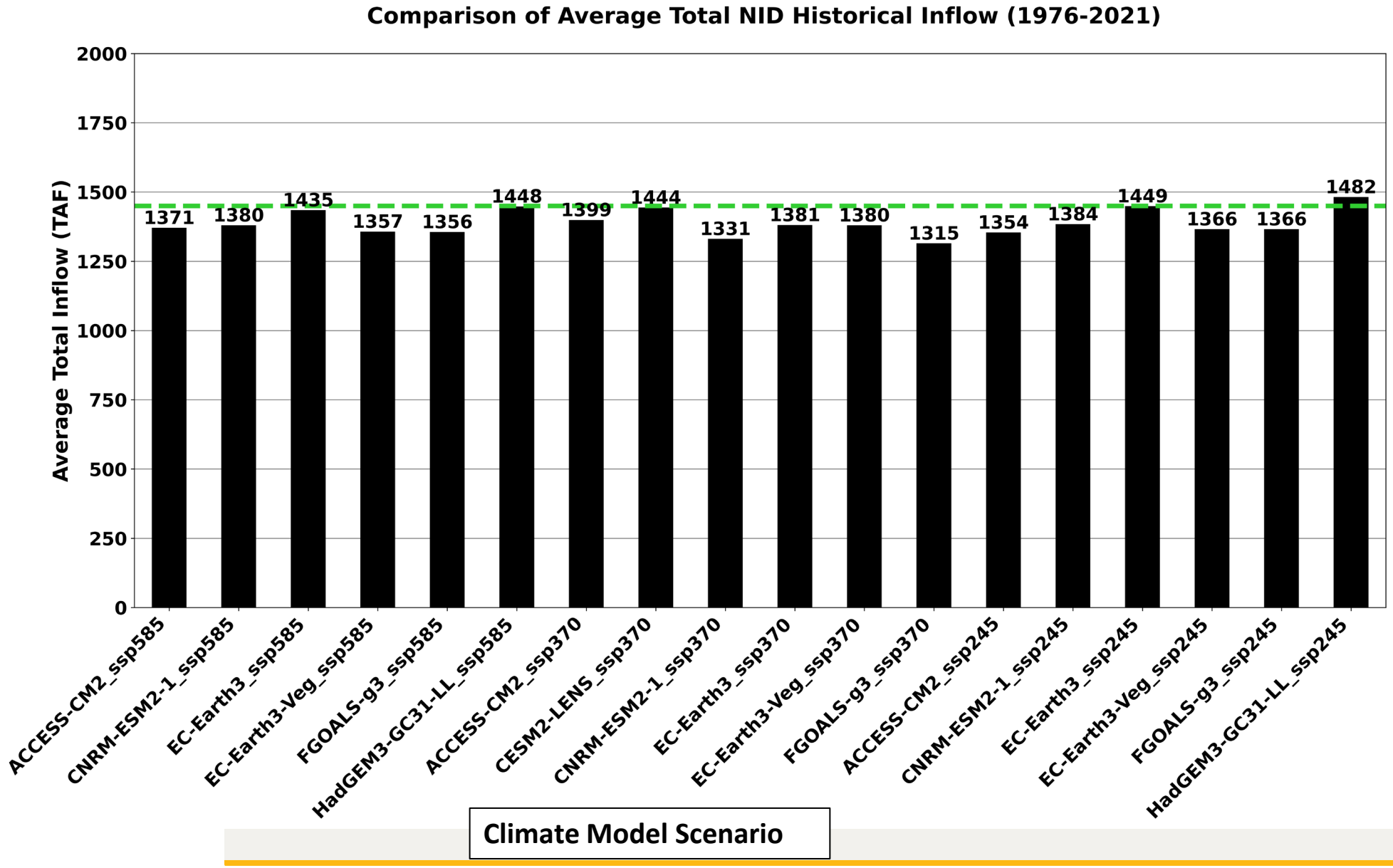
Are climate models biased?

No

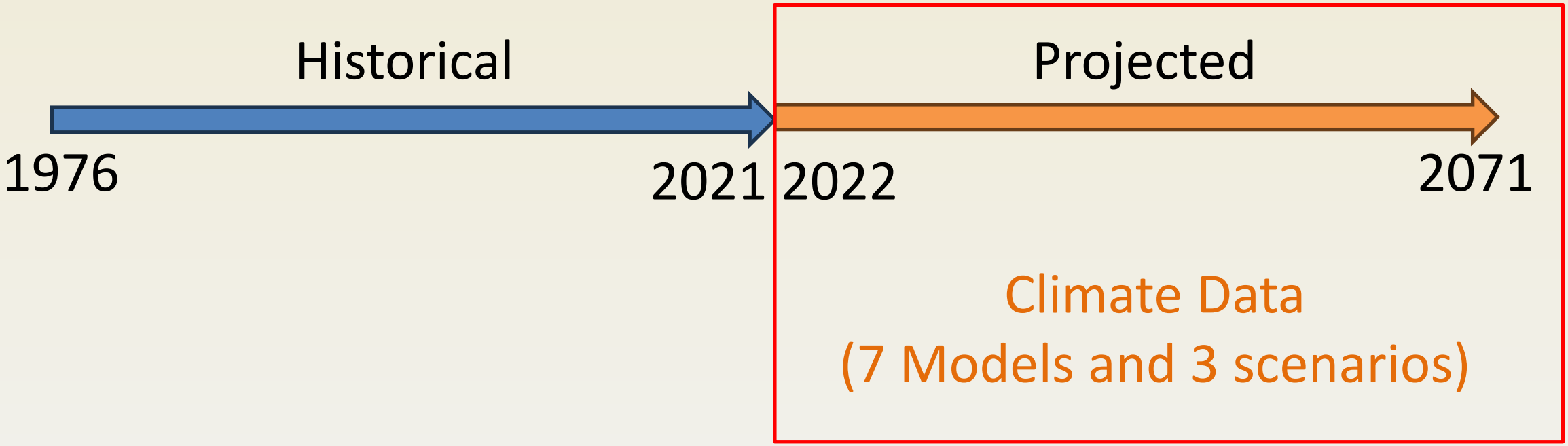
Historical

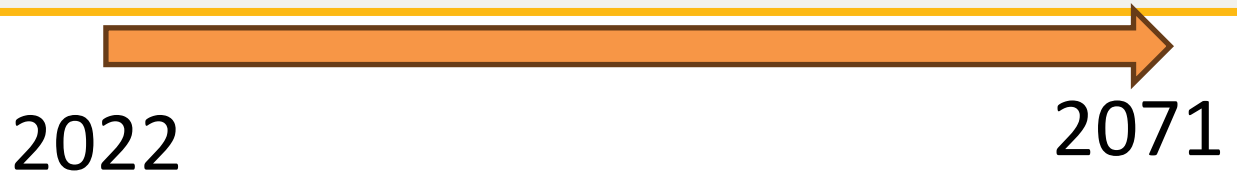
1976

2021



Projected Hydrology Scenarios





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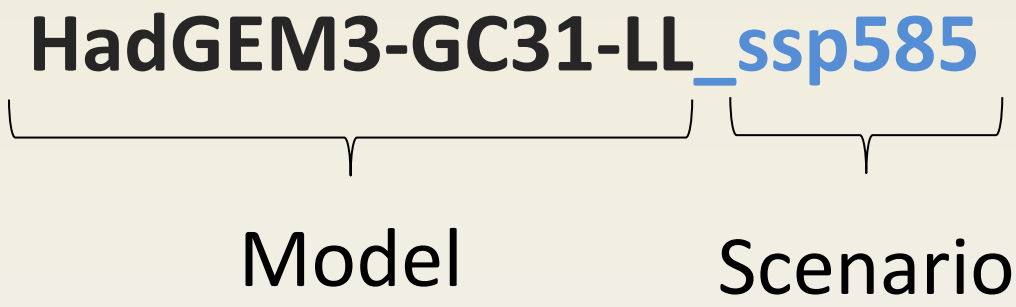
Projected Hydrology Scenarios

7 Models and 3 scenarios

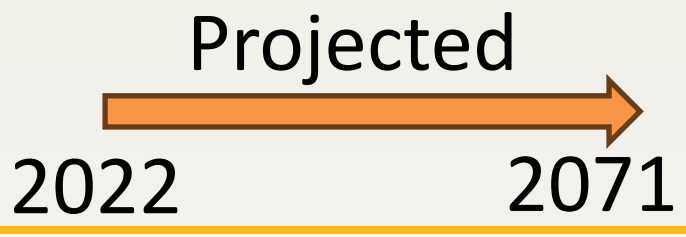
GCM Models	Emissions		
	ssp245	sso370	ssp585
ACCESS-CM2	√	√	√
EC-Earth3	√	√	√
EC-Earth3-Veg	√	√	√
CNRM-ESM2-1	√	√	√
FGOALS-g3	√	√	√
HadGEM3-GC31-LL	√		√
CESM2-LENS		√	

Name Convention (example)



Projected: Scenarios Selection

Scenarios	Models and Emissions
High Bookend (Wet)	HadGEM3-GC31-LL_ssp585
Median	CNRM-ESM2 1_ssp245
Low Bookend (Dry)	CESM2-LENS_ssp37



LEGEND

High Bookend (wet)

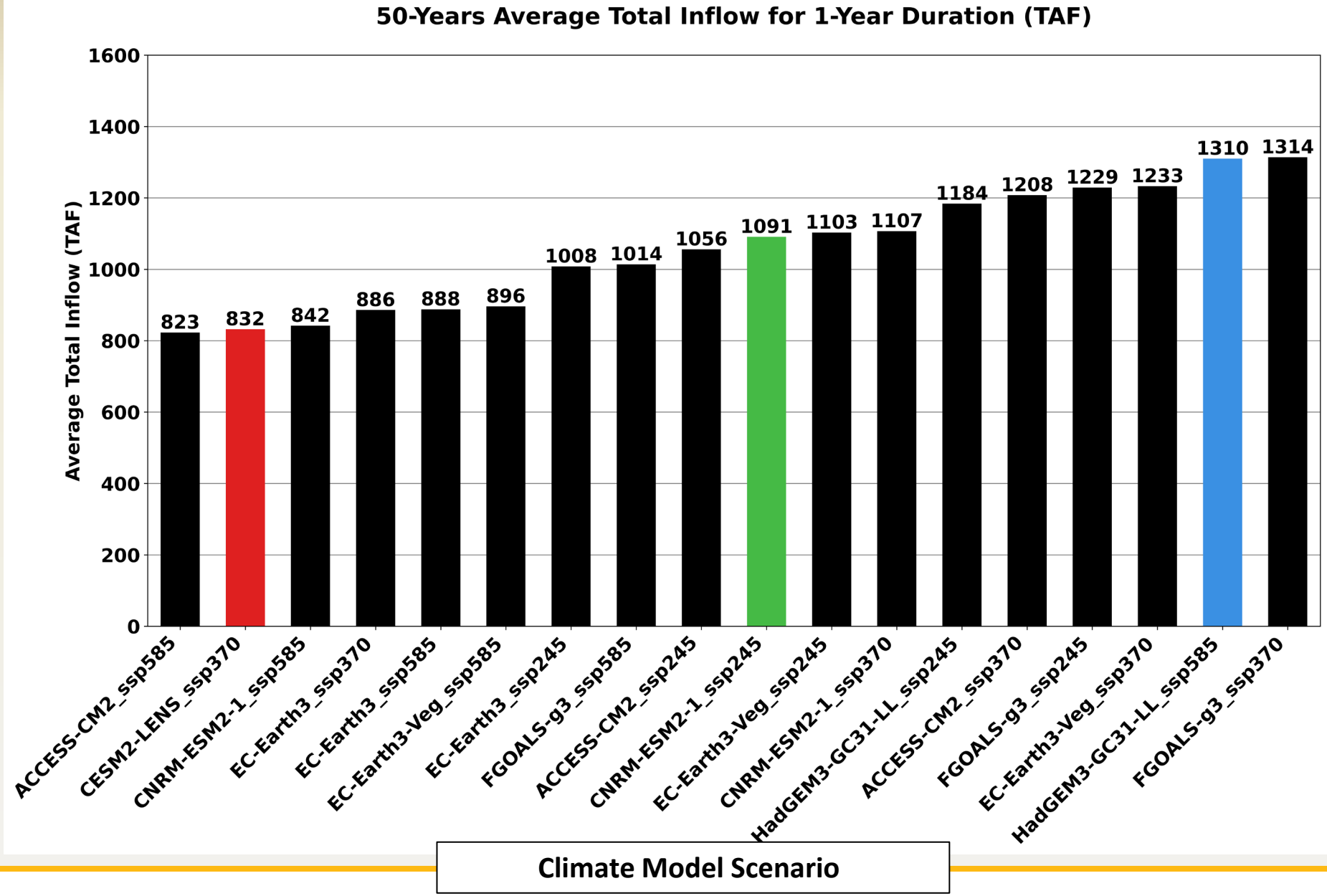
Median

Low Bookend (dry)

Not Selected

Projected

2022 2071



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LEGEND

High Bookend (wet)

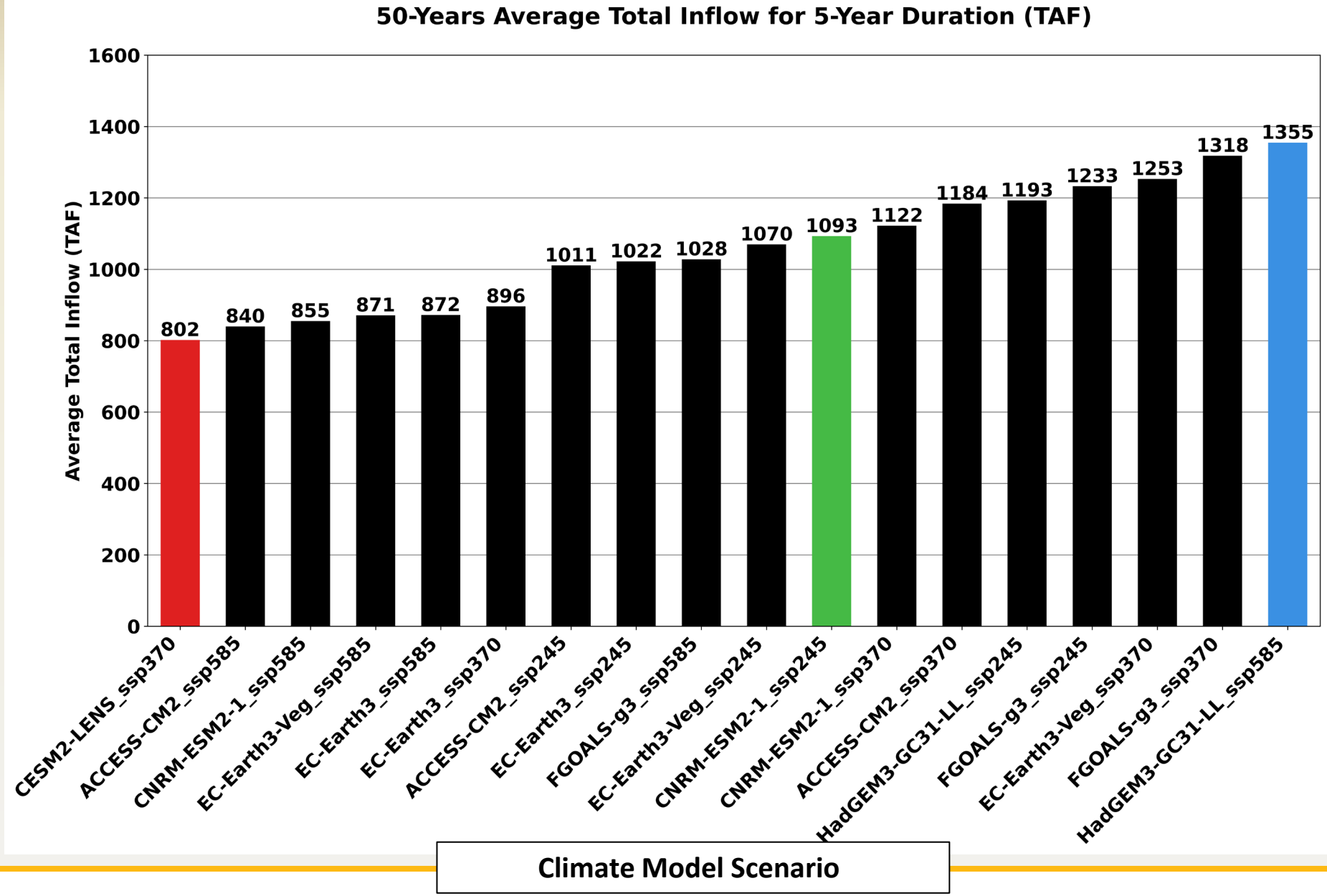
Median

Low Bookend (dry)

Not Selected

Projected

2022 2071



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LEGEND

High Bookend (wet)

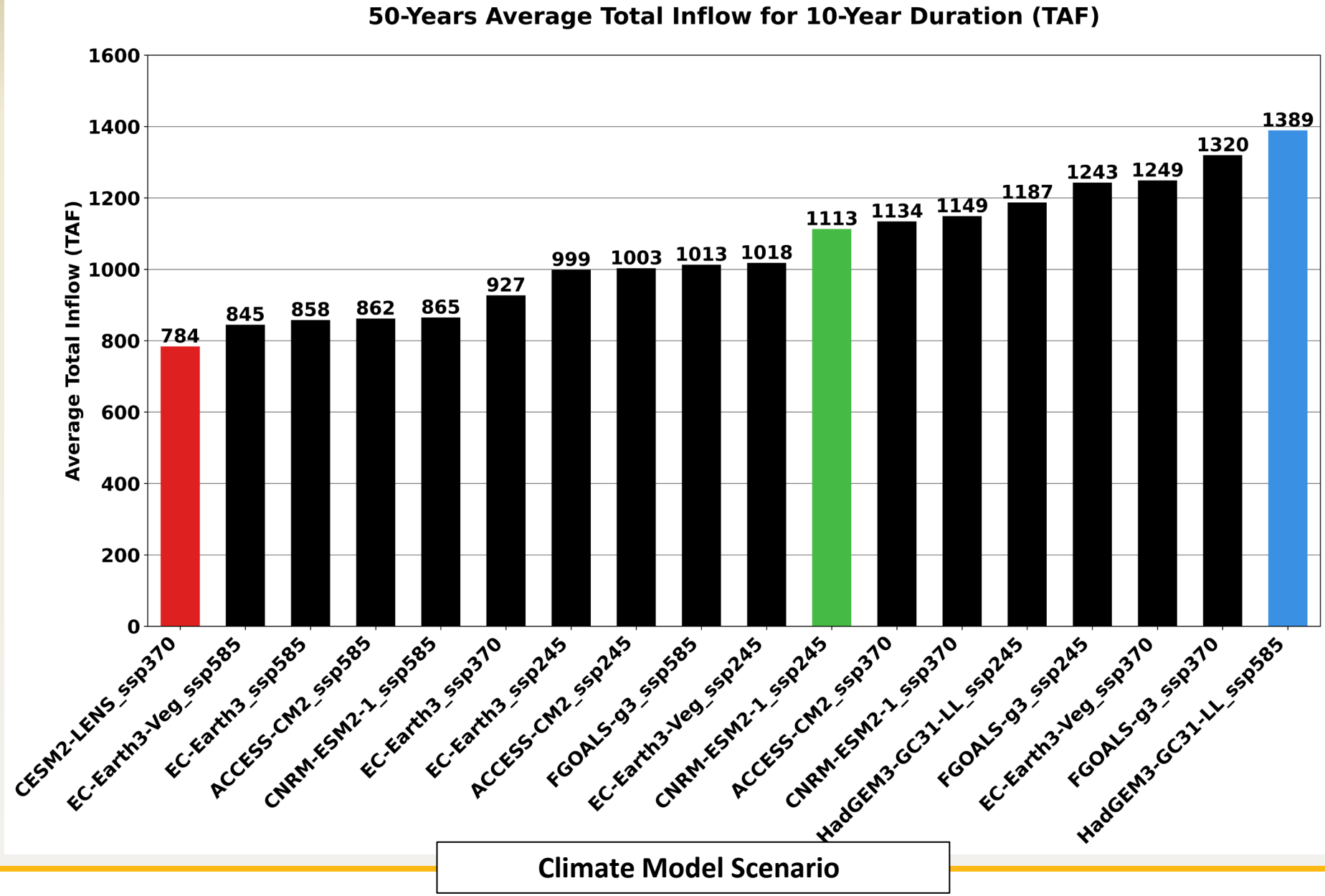
Median

Low Bookend (dry)

Not Selected

Projected

2022 2071



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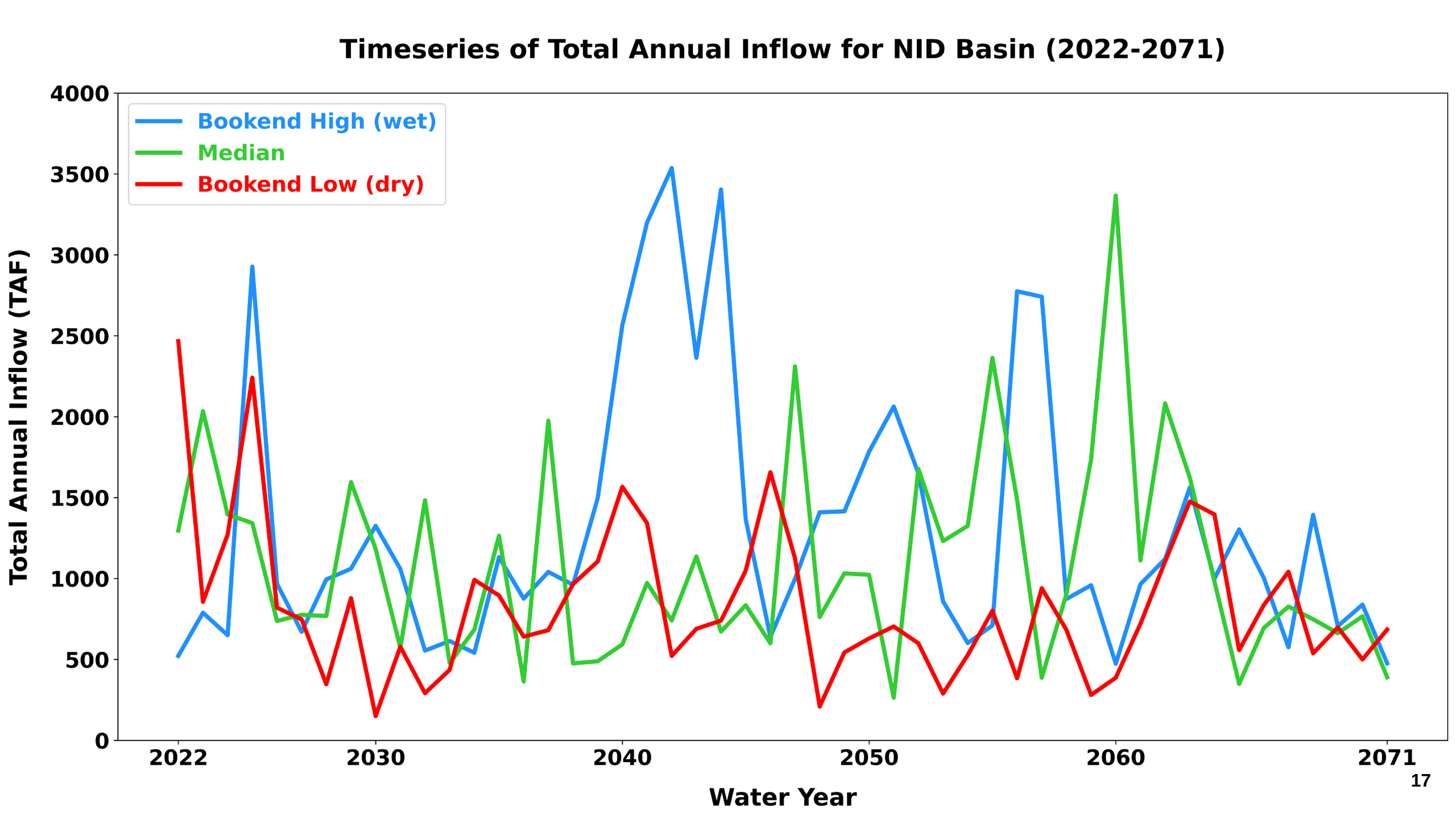
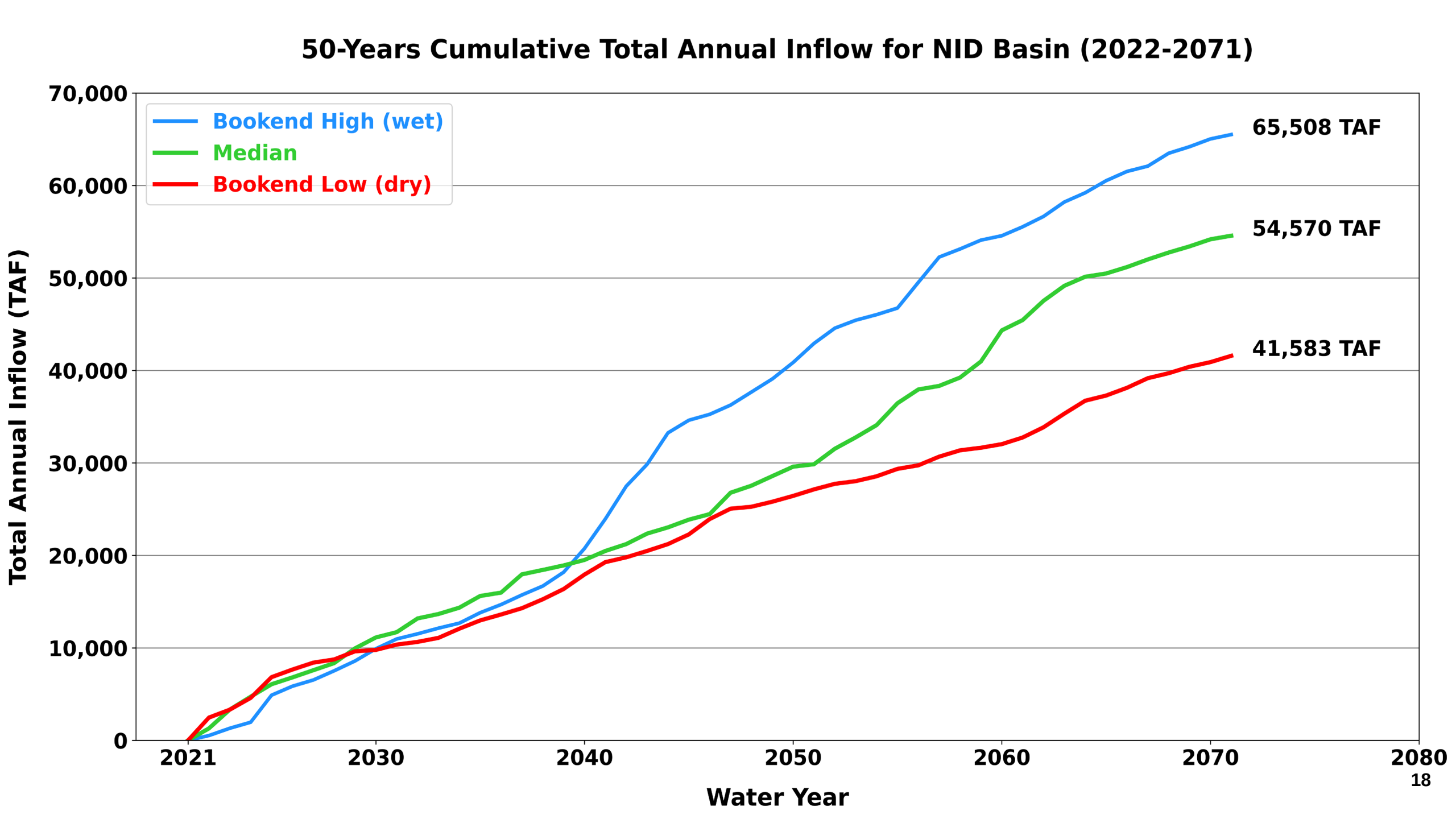
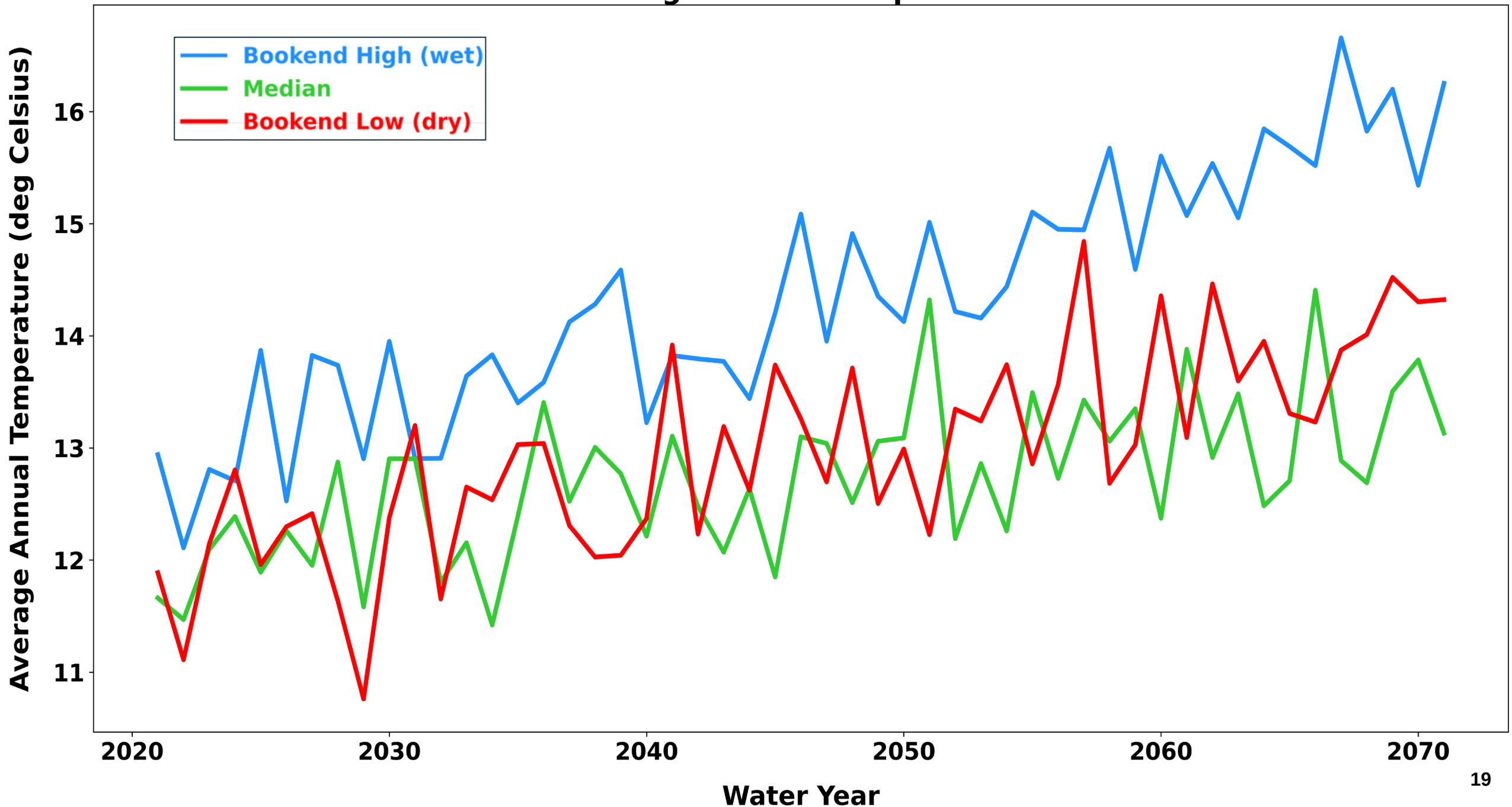

Timeseries of Total Annual Inflow for NID Basin (2022-2071)
Bookend High (wet)
Median
Bookend Low (dry)
Total Annual Inflow (TAF)
0
500
1000
1500
2000
2500
3000
3500
4000
2022
2030
2040
2050
2060
2071
Water Year


50-Years Cumulative Total Annual Inflow for NID Basin (2022-2071)
Bookend High (wet)
Median
Bookend Low (dry)
65,508 TAF
54,570 TAF
41,583 TAF
Total Annual Inflow (TAF)
70,000
60,000
50,000
40,000
30,000
20,000
10,000
0
2021
2030
2040
2050
2060
2070
2080
Water Year

Average Annual Temperature



Next Steps

- Develop Nine (3x3) HEC-ResSim Projected Simulations
  - 3 climate and 3 demand scenarios
- Select three representative scenarios (bookends and median)
- Simulate strategic alternatives

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Discussion and Questions

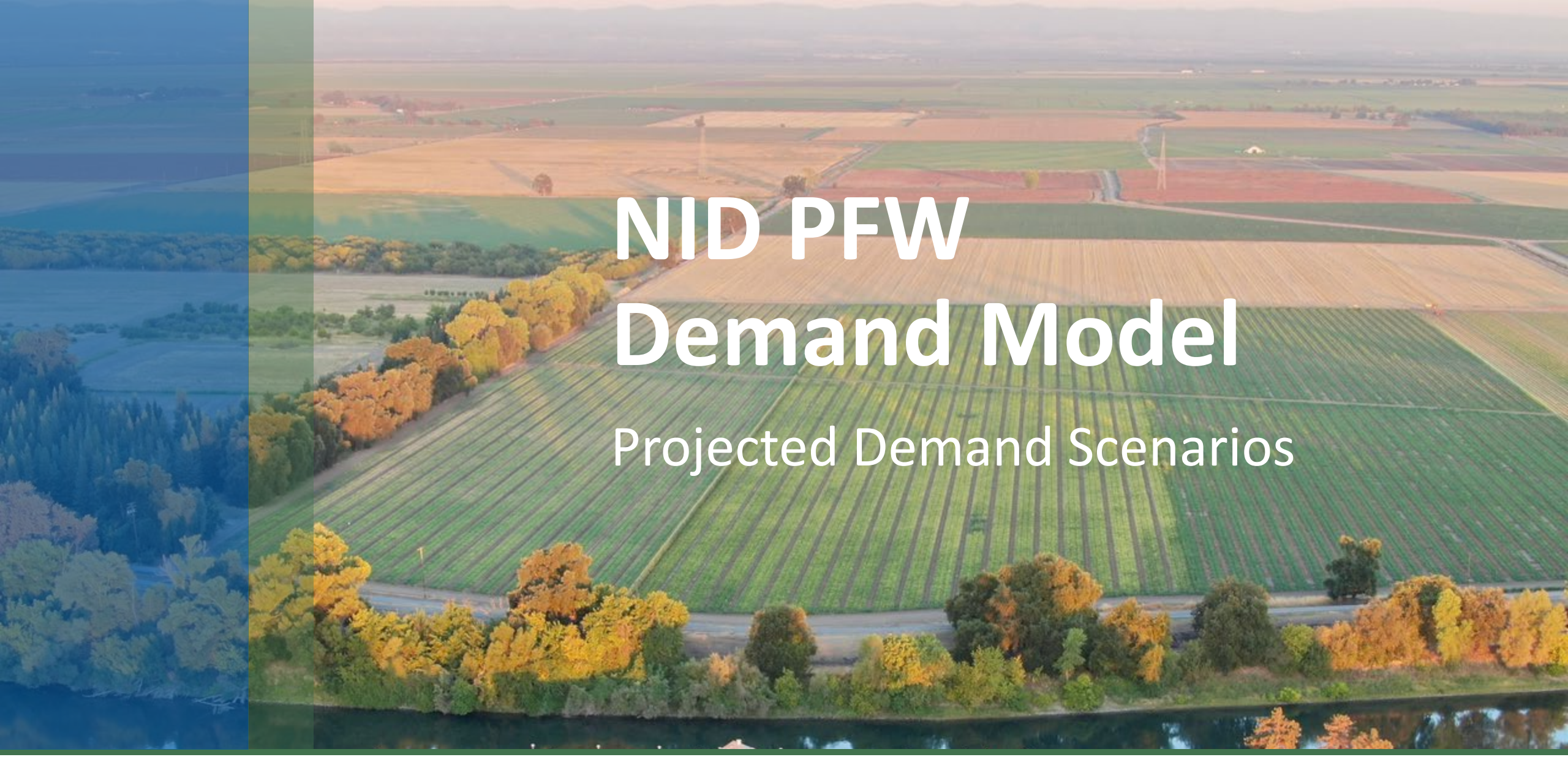
References

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



NID PFW Demand Model

Projected Demand Scenarios

DAVIDS ENGINEERING, INC

Serving Stewards of Western Water Since 199

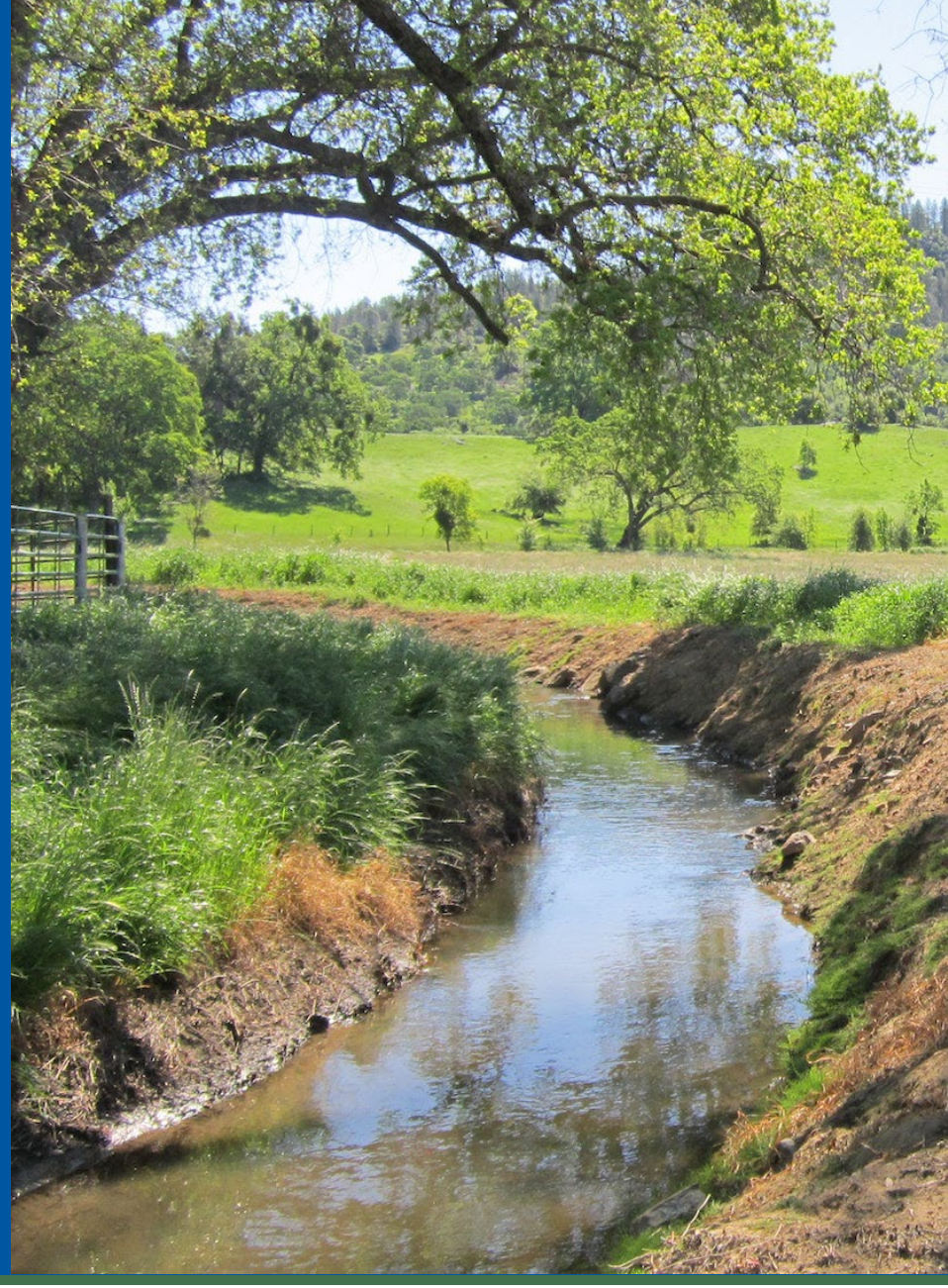
Agenda

- Review of Demand Model
- Projected Demand Scenarios
  - High Bookend
  - Baseline
  - Low Bookend
- Projected Demand Scenario Results
- Next Steps

Overview of Demand Model

What is Demand?

- "Demand" is the volume of water needed to satisfy water users' needs
  - Raw water
  - Treated water
  - System losses
  - Municipal
  - Environmental flows

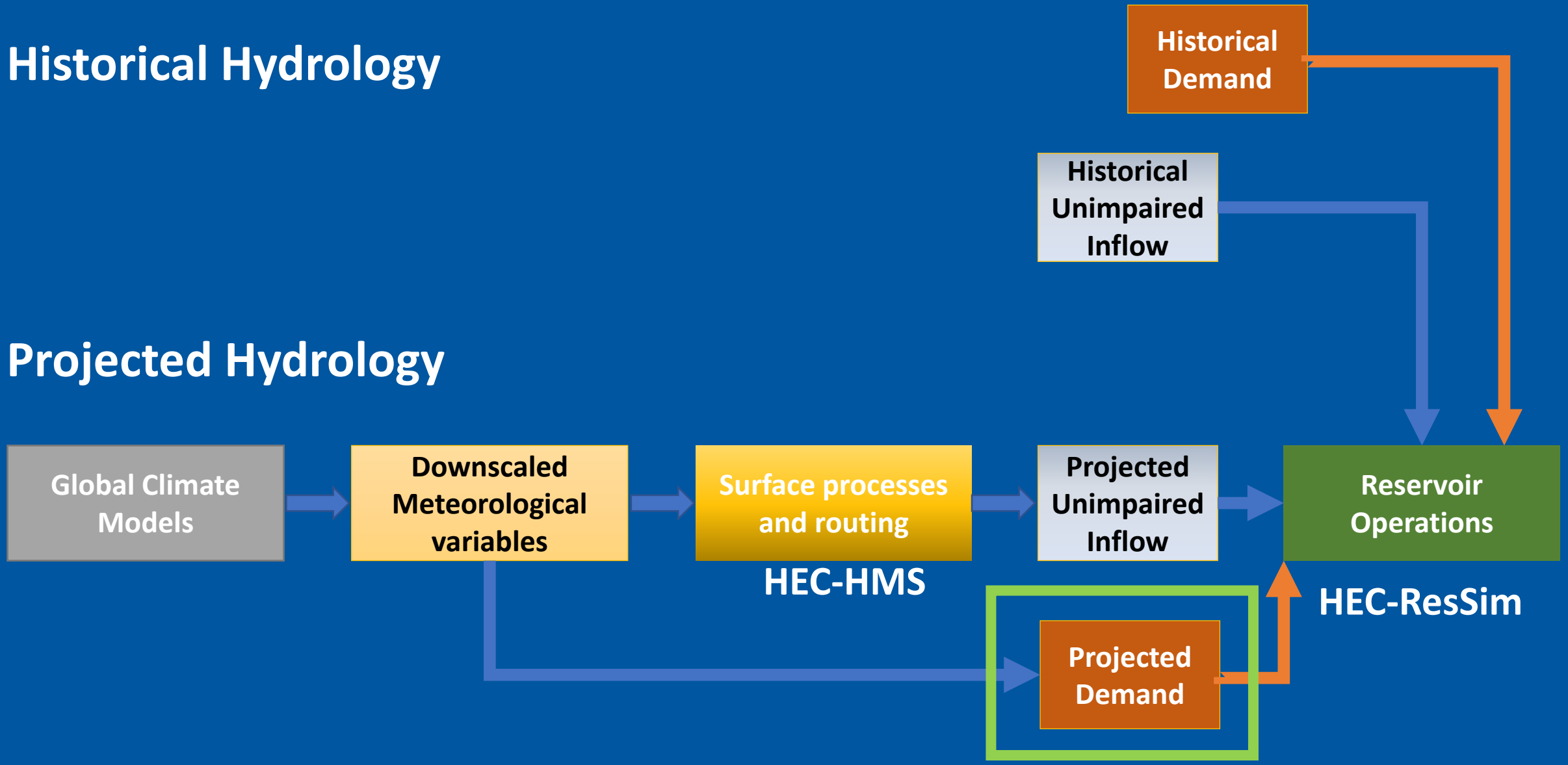


Demand Modeling Approach

- **Demand Model for Customer Parcels**
  - Simulate raw and treated water demand
  - Calibrated, physical model
- **Water Balance for Conveyance System**
  - Simulate system flows, losses
  - Link back to reservoirs
- Add in municipal, environmental flows

Source(s): https://www.nidwater.com/getting-irrigation-water

Historical Hydrology



Projected Demand Scenarios

Purpose and Assumptions

Purpose of the Projected Demand Scenarios

- Develop and evaluate bookend scenarios to capture a range of potential projected conditions
  - Low Bookend
  - Baseline
  - High Bookend

Parameters Adjusted Between Scenarios

Discussed further on next slides

- Raw Water Customers
- Treated Water Customers
- Evapotranspiration (ET)
  - Reference ET (projected temperature consistent with climate change analyses)
  - Crop coefficients (cultivation and crop-related)
- System Losses
  - Low: 10% → Baseline: 15% → High: 20%
- Projected Precipitation

Demand Scenarios and Climate Change Scenarios

Demand Scenarios	Climate Change Scenarios		
	Wet	**Median**	**Dry**
Low Bookend	Low-Wet	Low-Median	Low-Dry
Baseline	Baseline-Wet	Baseline-Median	Baseline-Dry
High Bookend	High-Wet	High-Median	High-Dry

Raw Water and Treated Water Customers

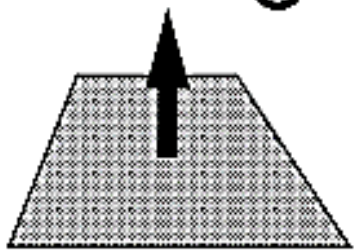
Scenario	Raw Water	Treated Water
Low Bookend	**Idling to reduce 20% demand** *from baseline*	**Pop. decline to lowest since 2000**
Baseline	**Expansion to soft service areas** *similar to historical rate (**~20 ac/yr** developed land)*	**Expansion to soft service areas** *similar to historical rate (**~50 customers/yr**)*
High Bookend	**Greater expansion to soft service areas** *at 1.5X baseline rate (**~30 ac/yr** developed land)*	**Greater expansion to soft service areas** *at 1.5X baseline rate (**~75 customers/yr**)*

Evapotranspiration (ET)

ETo Calculated from Projected Temperature

Local Crop Coefficients (Kc)

Kc adj

ET_o x  = 

ET_c adj

Projected ETc

Recent historical conditions in NID, based on OpenET data

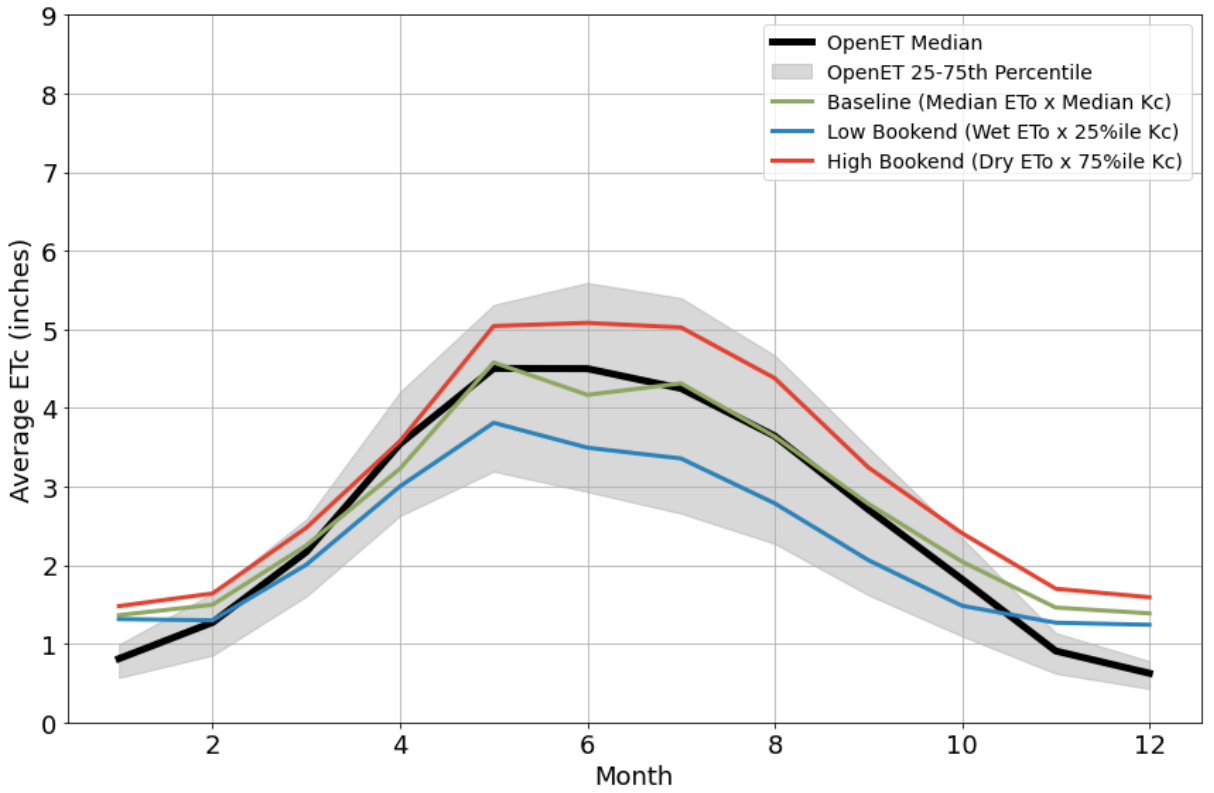
ETo for Different Climate Change Scenarios

Demand Scenarios	Climate Change Scenarios		
	Wet	**Median**	**Dry**
Low Bookend	Low-Wet	Low-Median	Low-Dry
Baseline	Baseline-Wet	Baseline-Median	Baseline-Dry
High Bookend	High-Wet	High-Median	High-Dry

Evapotranspiration (ET)

Scenario	Reference ET (ETo) *Temperature-Related*	Crop Coefficient (Kc) *Cultivation and Crop-related*
Low Bookend *(Low Demand)*	**Wet Climate Scenario**	**25th percentile** *(By land use, 2022)*
Baseline *(Moderate Demand)*	**Median Climate Scenario**	**50th percentile** *(By land use, 2022)*
High Bookend *(High Demand)*	**Dry Climate Scenario**	**75th percentile** *(By land use, 2022)*

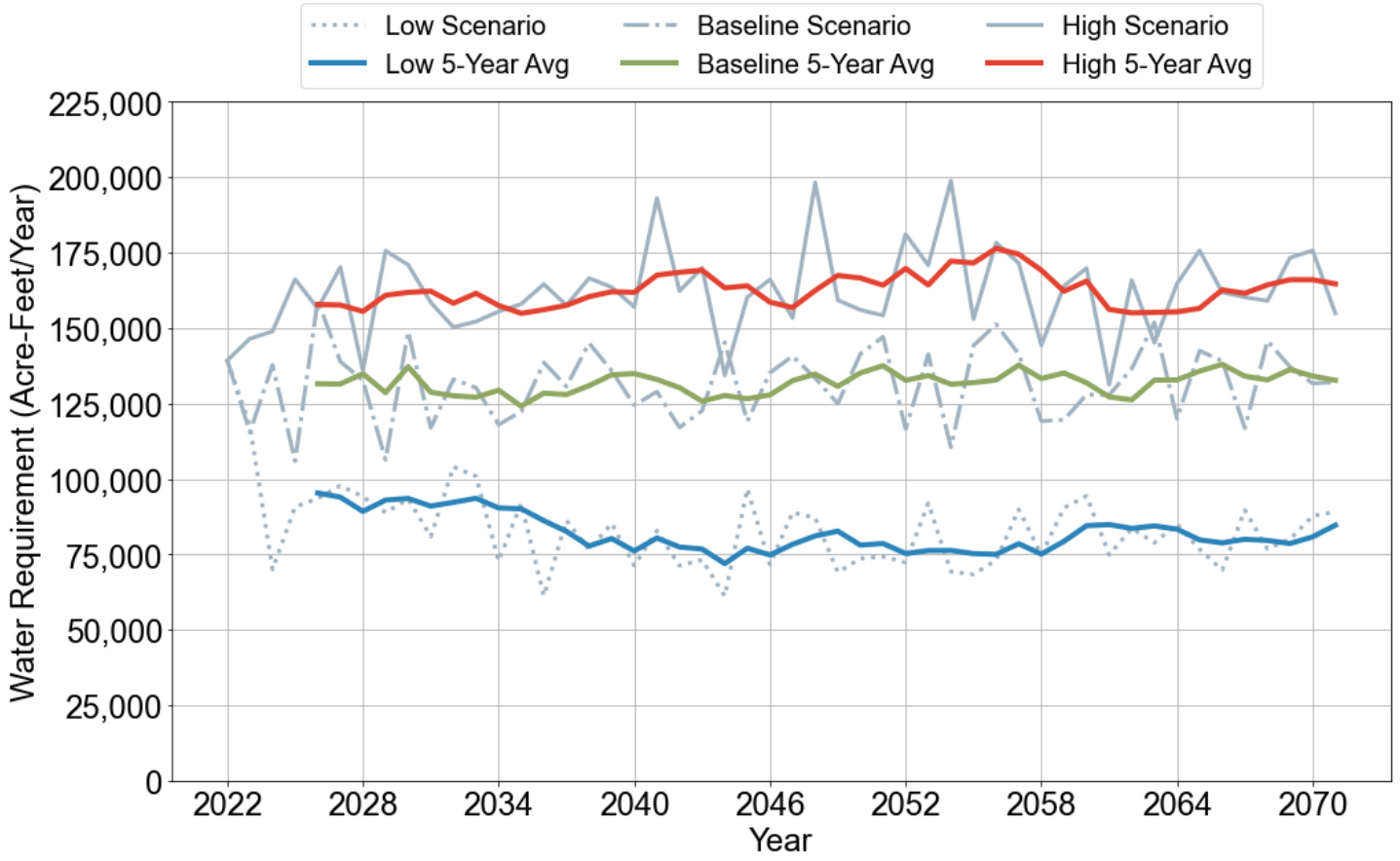
Comparison of ET Projection Method with OpenET ETc (2016-2022) (Pasture)

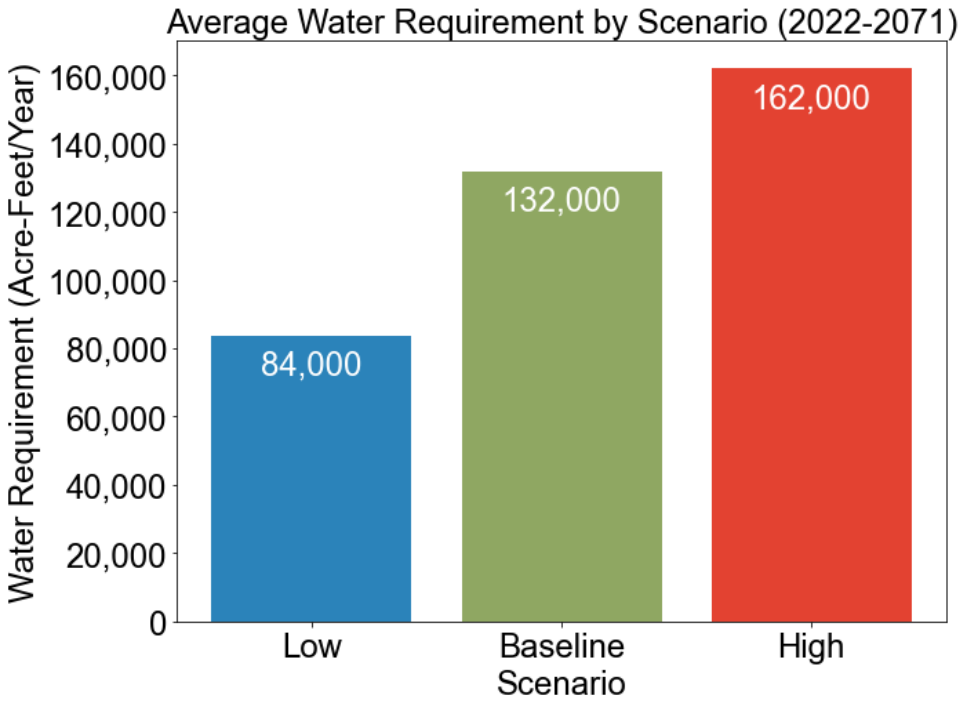


Projected Demand Scenarios

Results

Projected Demand Scenarios





Next Steps

- Evaluate projected demand scenarios in the context of reservoir operations
  - Evaluate potential unmet demand
  - Present in August
- Evaluate strategic alternative scenarios

Discussion and Questions