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RECLAMATION

Quantifying Sensitivity of Water Temperature Target Schedule to Meteorological Conditions

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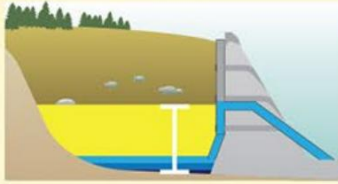
Forecasting with the WTMP



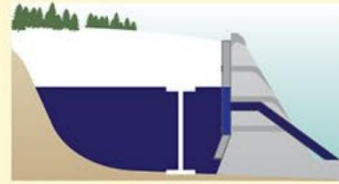
- Forecasting supports decision-making for reservoir management and operations
- Improved understanding of reservoir and in-stream water temperature conditions that may impact water quality and aquatic ecosystems
 - Impacts on winter-run and other populations of Chinook salmon
 - Ensure regulatory compliance
- Effective modeling of operations and management alternatives requires forecasting the necessary hydrology, meteorology, water temperature conditions
- Example of operations and decision making using the forecasting mode
 - Simulation outputs from this process



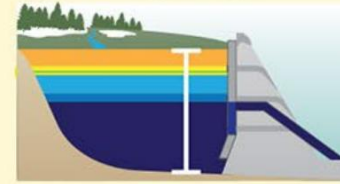
Fall



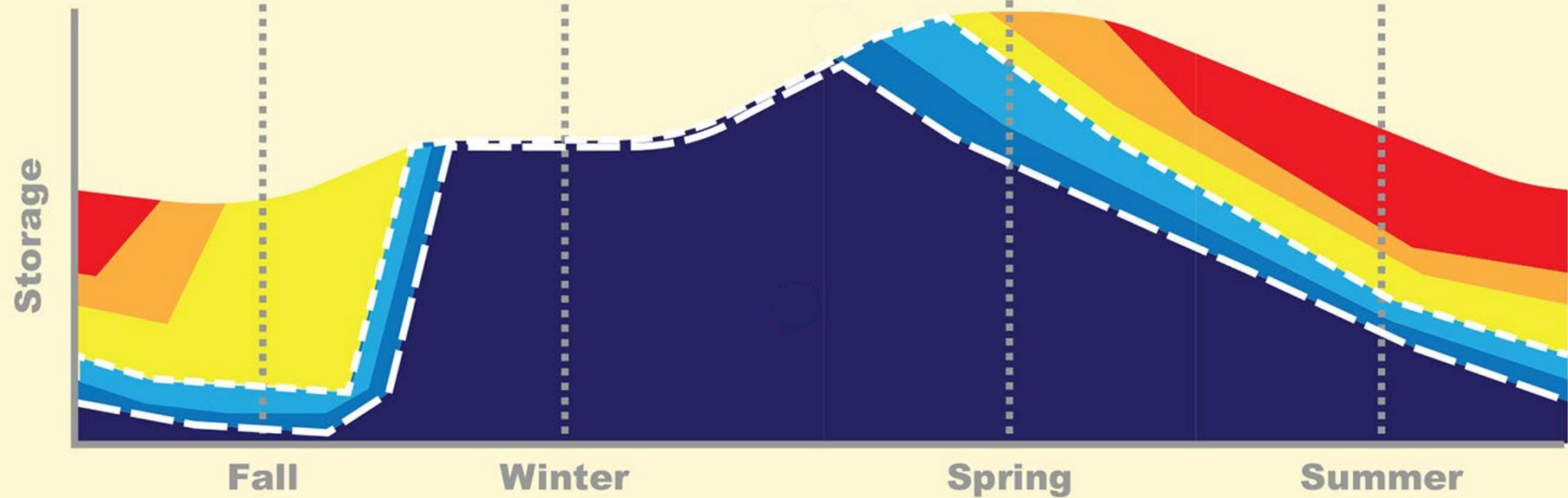
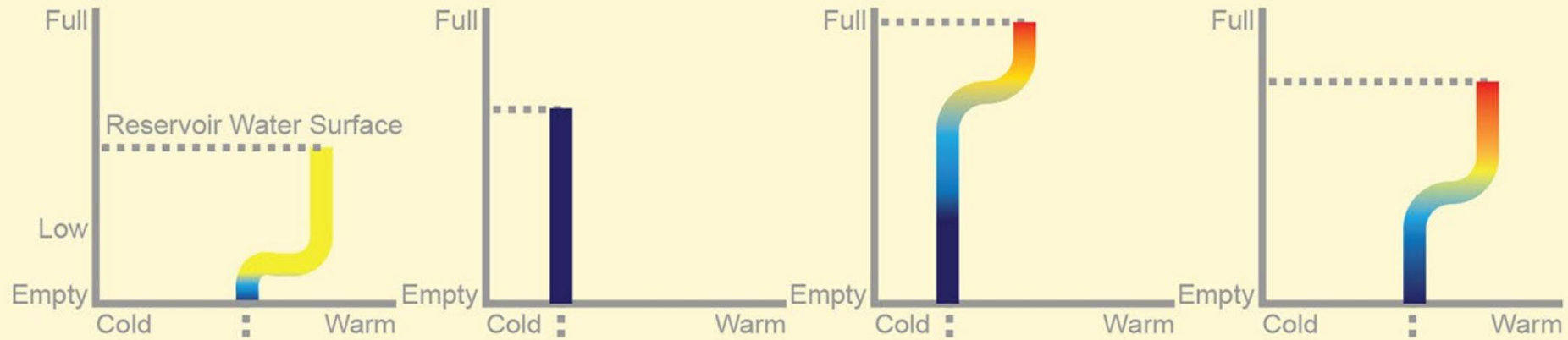
Winter



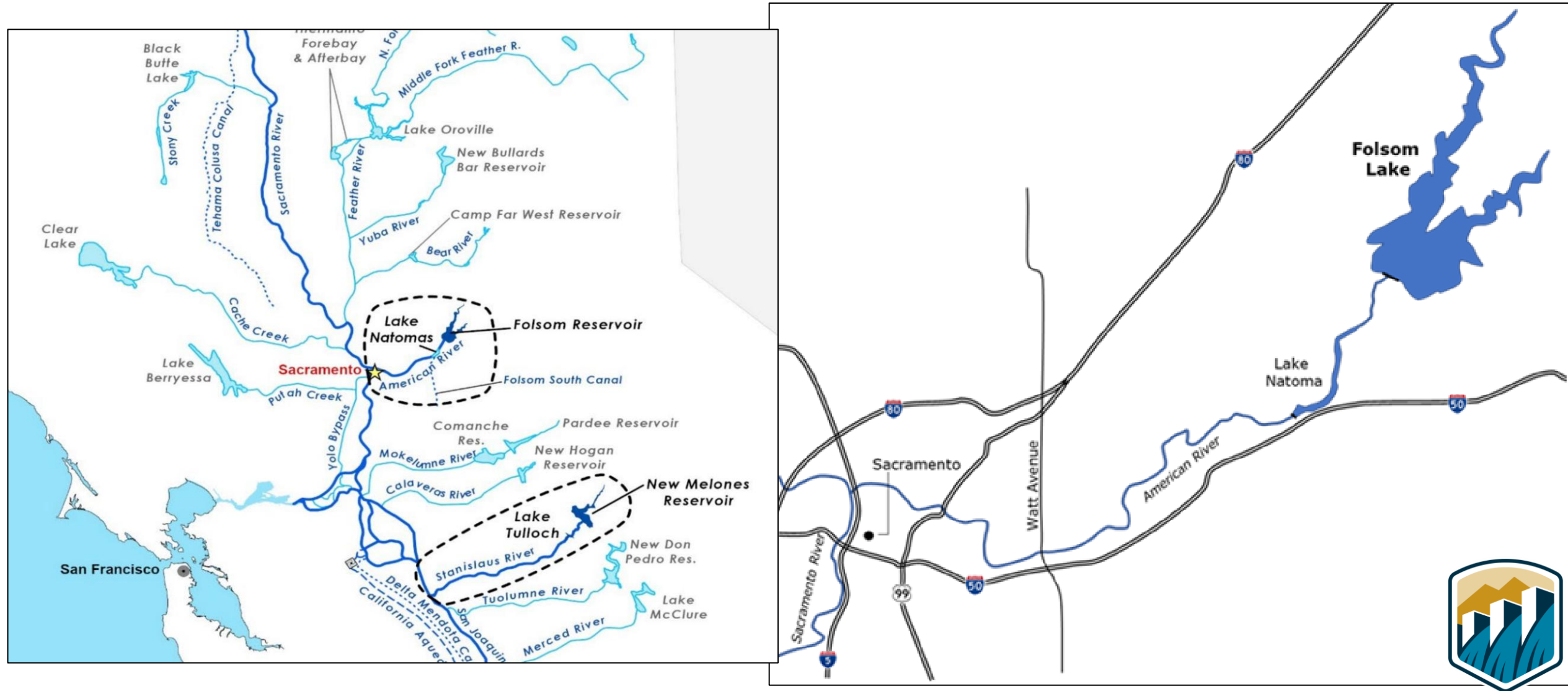
Spring



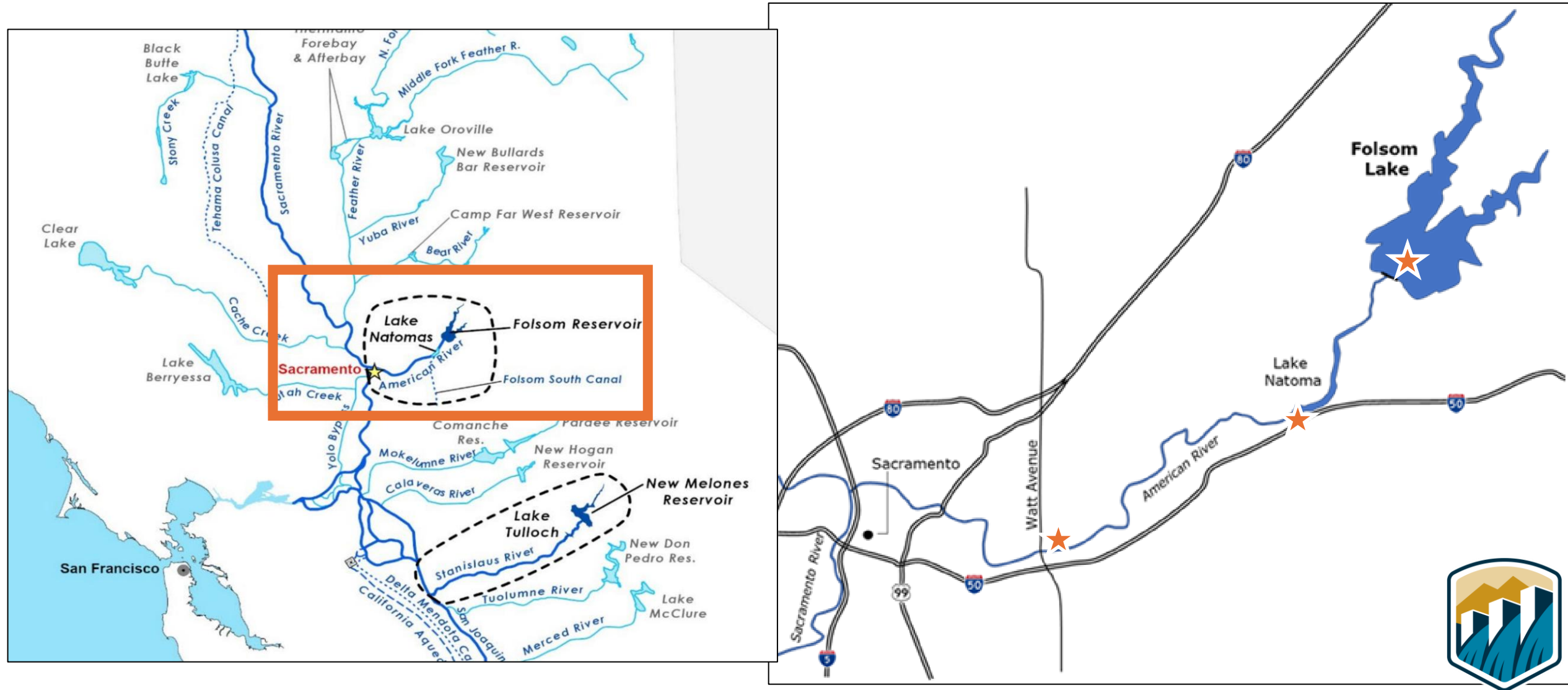
Summer



Study Domain: American River System

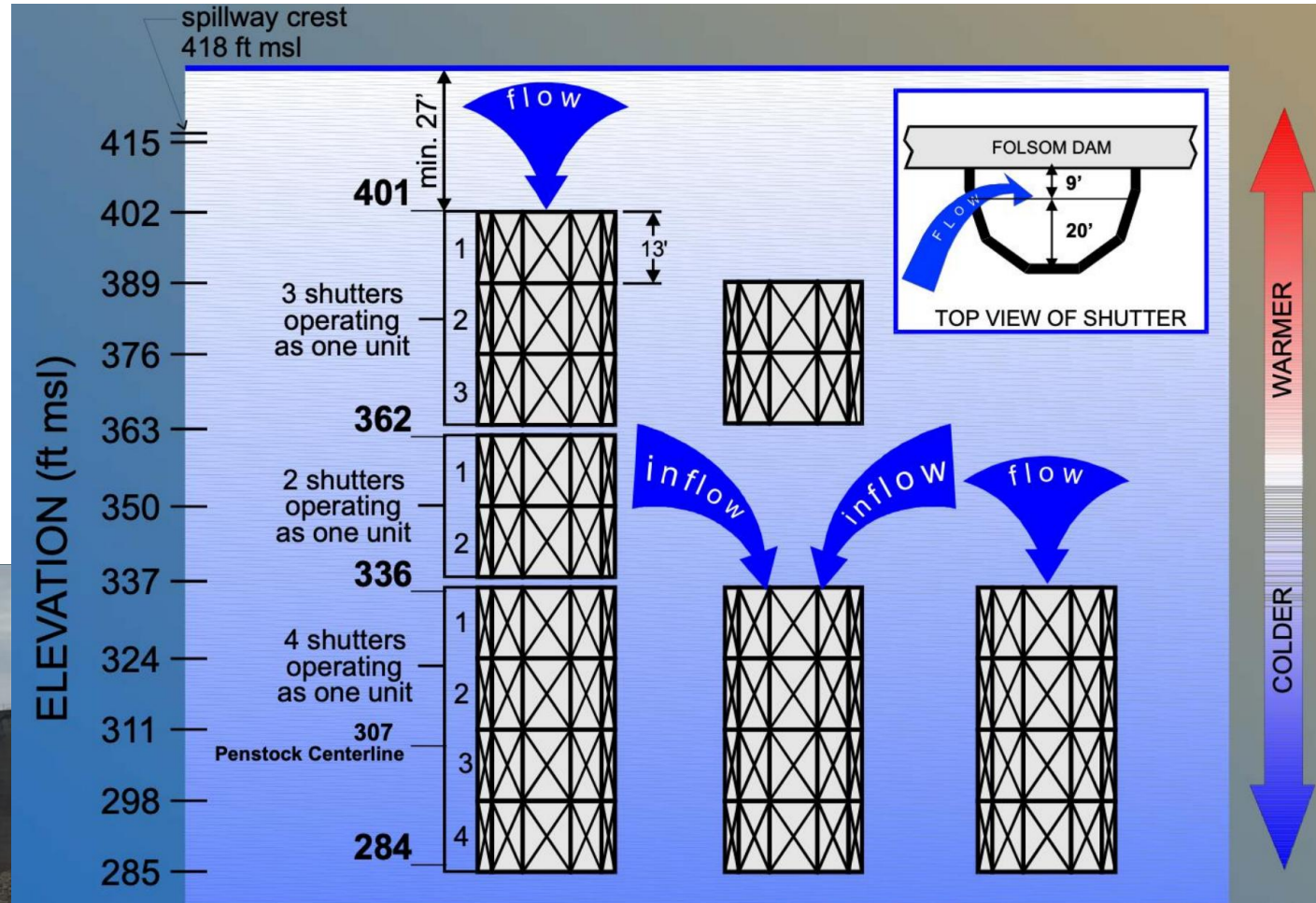


Study Domain: American River System



Temperature Controls

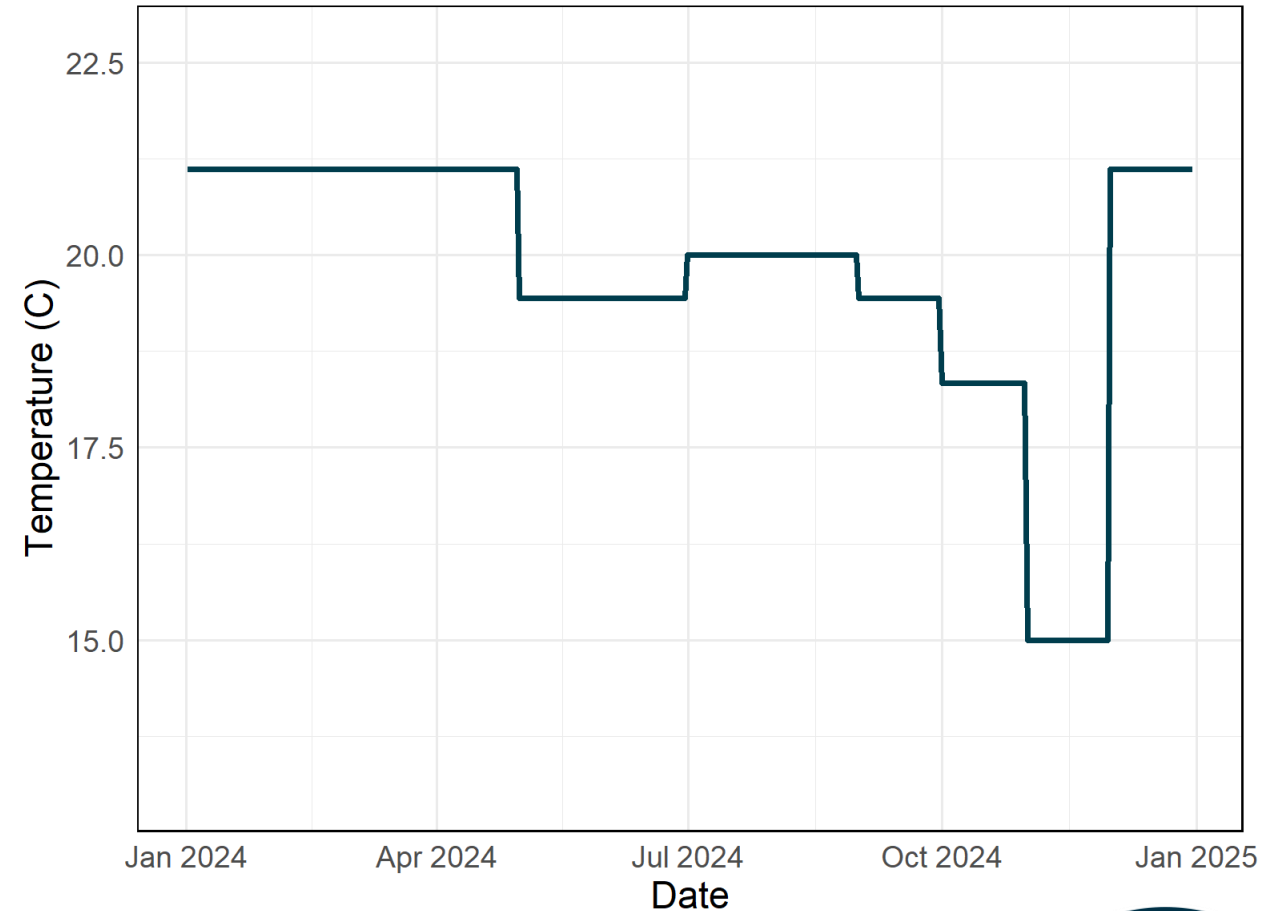
- Temperature Control Device (TCD) at Folsom Dam
- Shutter panels are operated as units of 3-2-4
- Cooler water accessed from lower panels





Temperature Schedules

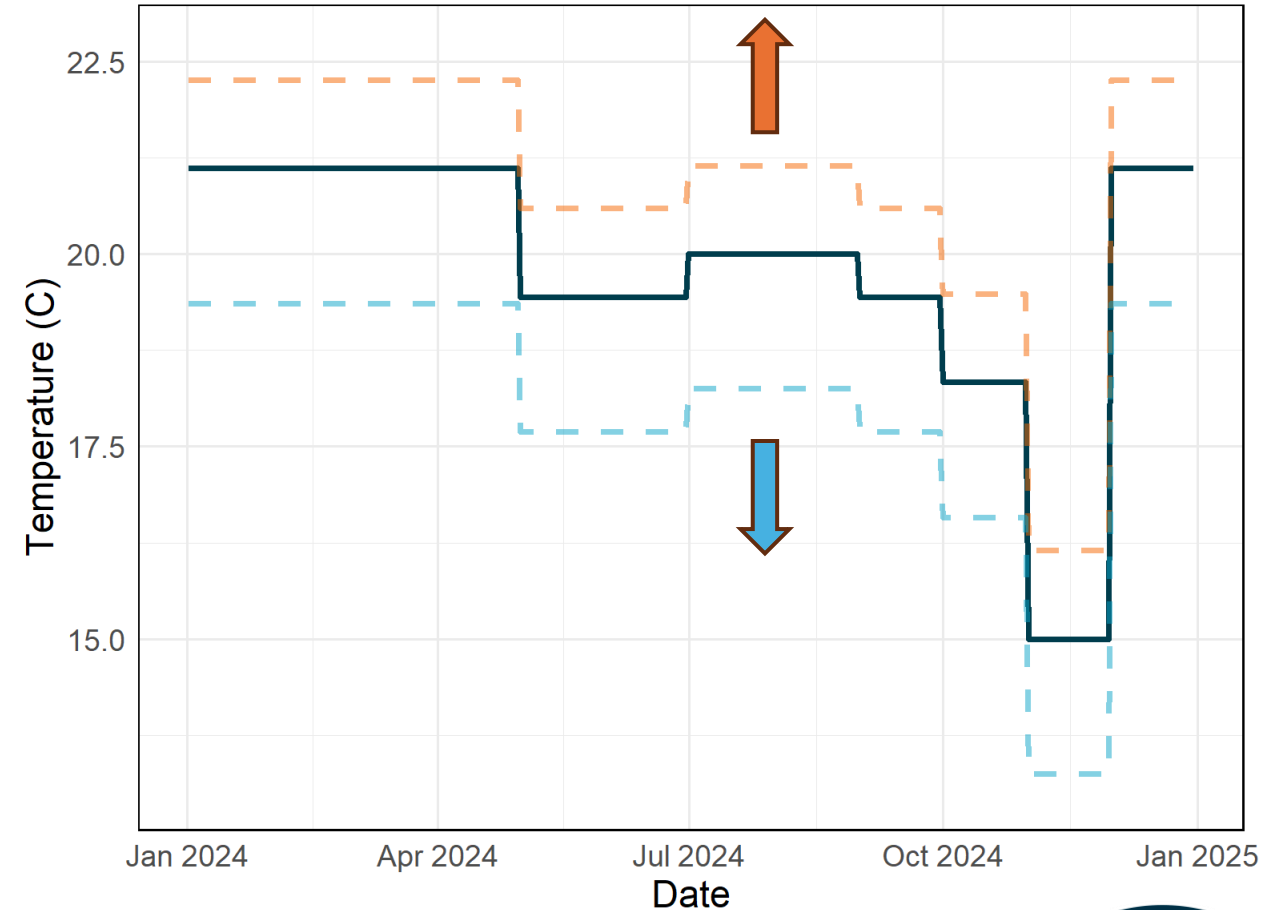
- Developed by the Water Forum
- Temperature targets establish thresholds used to evaluate reservoir releases
 - Downstream impacts
- Adjust releases through structures (e.g. Folsom's temperature control shutters) to regulate in-stream temperatures throughout the year
- Higher number temperature schedule indicate warmer in-stream temperatures
- Serve as modeling performance benchmarks



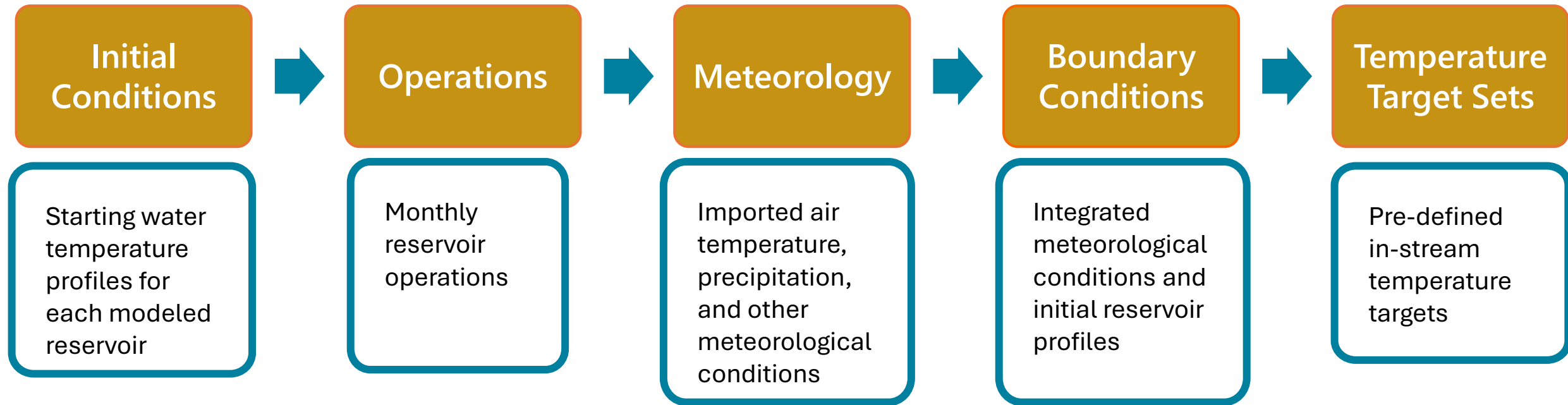
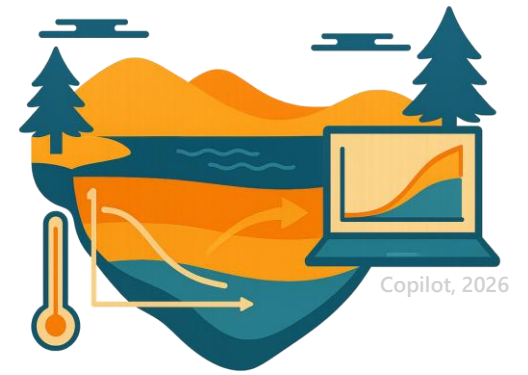
Iterative Temperature Schedule Selection



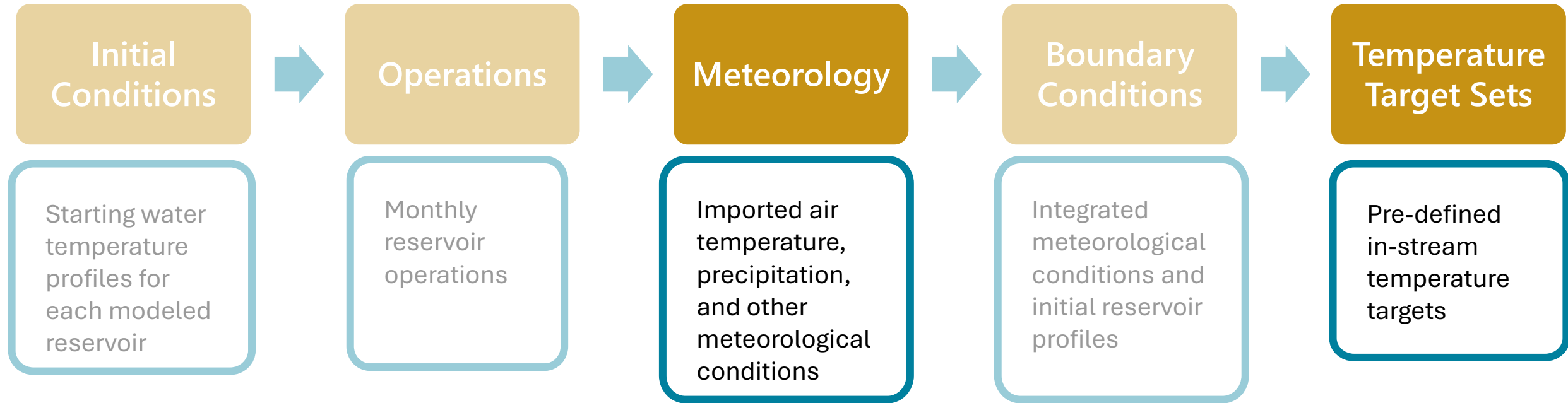
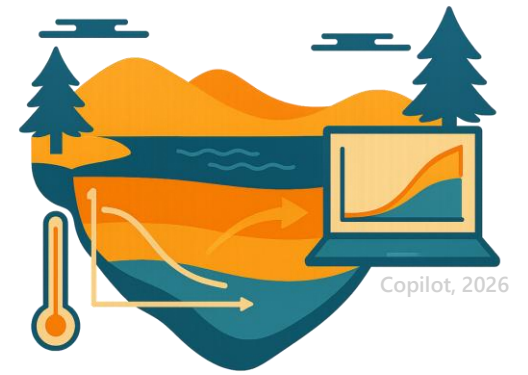
- Model iterations determine which temperature schedule can be met
 - Given meteorological conditions
- Model run requires greater computational time
- If the preferred schedule is not met, the simulation shifts to a lower or higher schedule to match the cold water availability for that year
- WTMP-modeled parameters that may inform operations:
 - Downstream temperatures (Watt Ave)
 - Gate configurations
 - Folsom releases



WTMP Workflow Overview

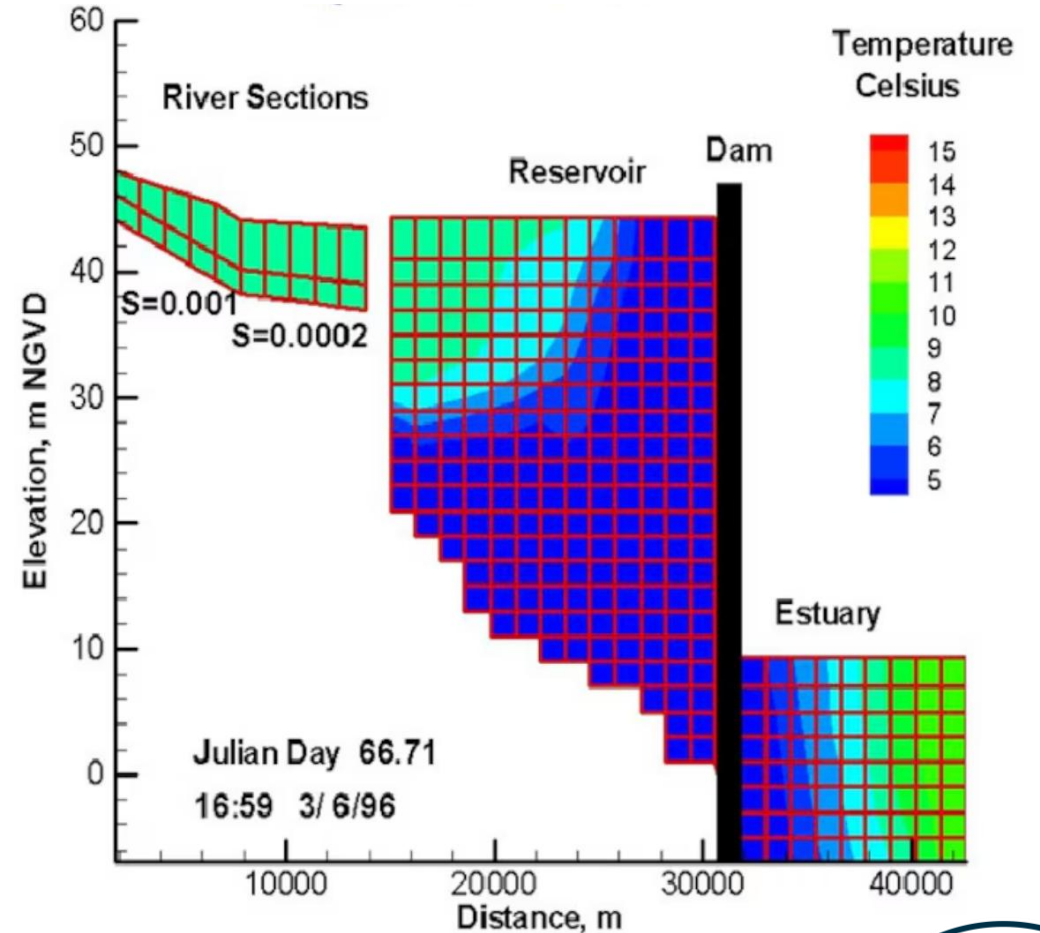


WTMP Workflow Overview



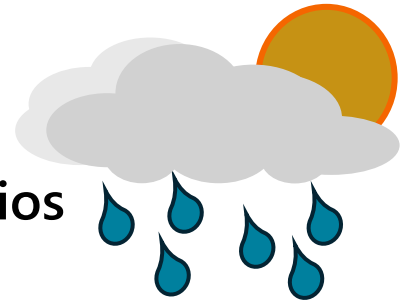
CE-QUAL-W2

- Developed by the US Army Corps of Engineers
- Two-dimensional (2D) longitudinal/vertical, hydrodynamics, and water quality model
- Simulates temperature and a variety of other water quality metrics
- Assumes lateral homogeneity
- CE-QUAL-W2 has been applied to rivers, lakes, reservoirs, estuaries, and combinations thereof



Meteorological Conditions Simulated

- American iterative WTMP model simulations executed for 2024
 - Temperature schedules were examined for a range of meteorological scenarios
- 3 meteorological conditions, model runs initiated over 7 months (April-October)
- Meteorological conditions used:
 - 2011 (normal water year)
 - 2017 (wet water year)
 - 2020 (warm and dry water year)
- Questions:
 - How do meteorological conditions impact temperature schedule selection by the iterative forecast model?
 - What are the associated temperature trade-offs for each meteorological condition?
 - How can this modeling process be used to inform operations?

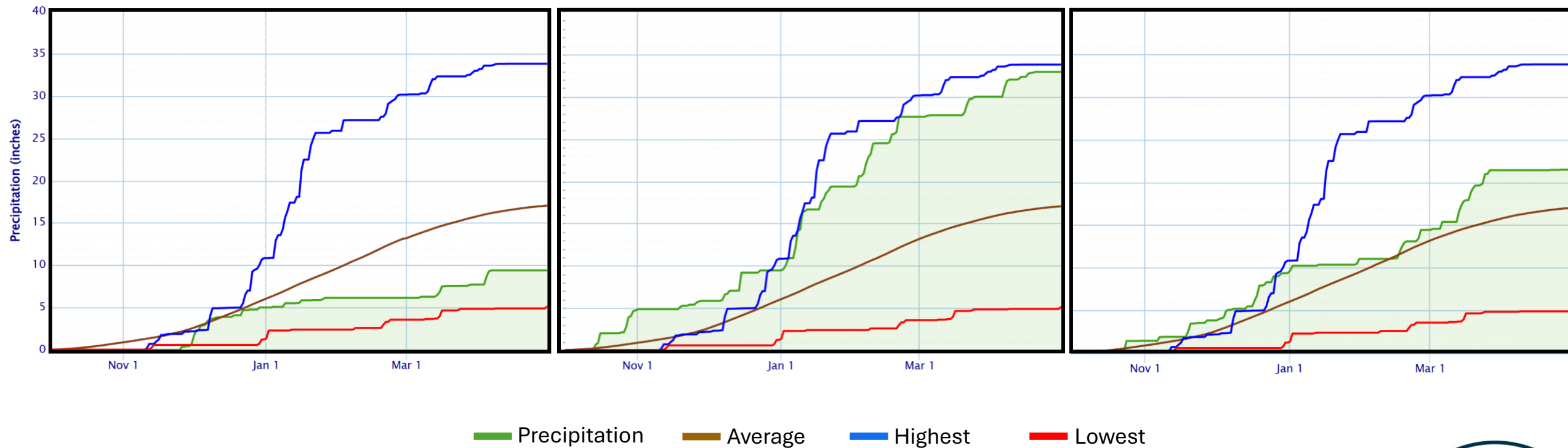


Cumulative Precipitation

2020

2017

2011

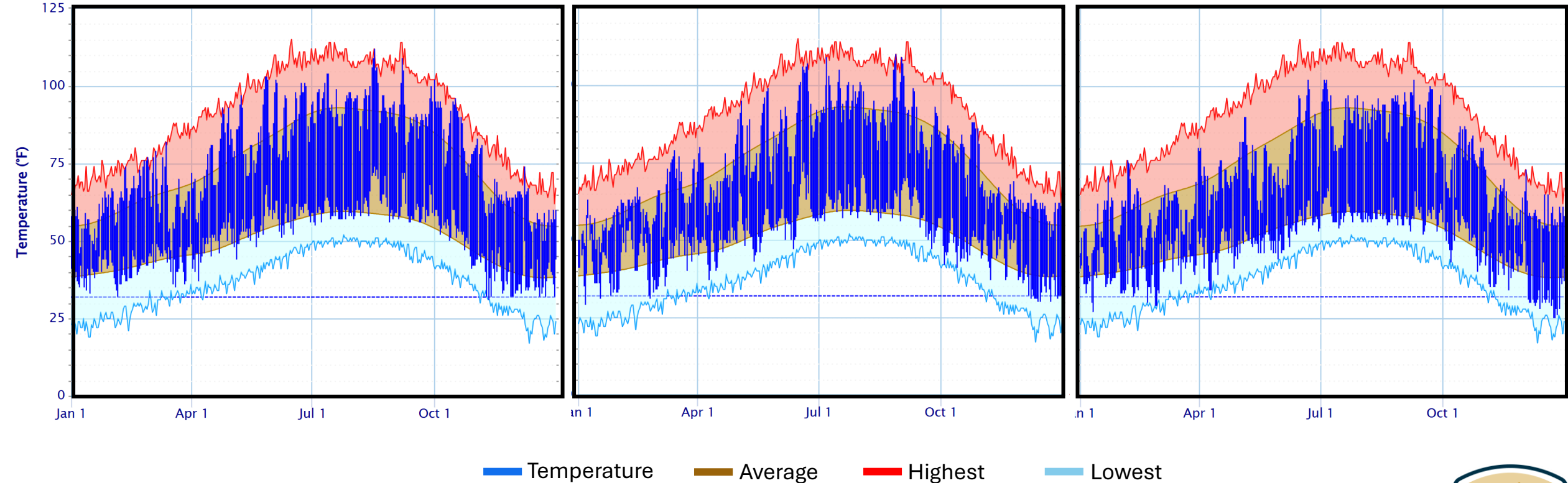


Average Daily Temperature

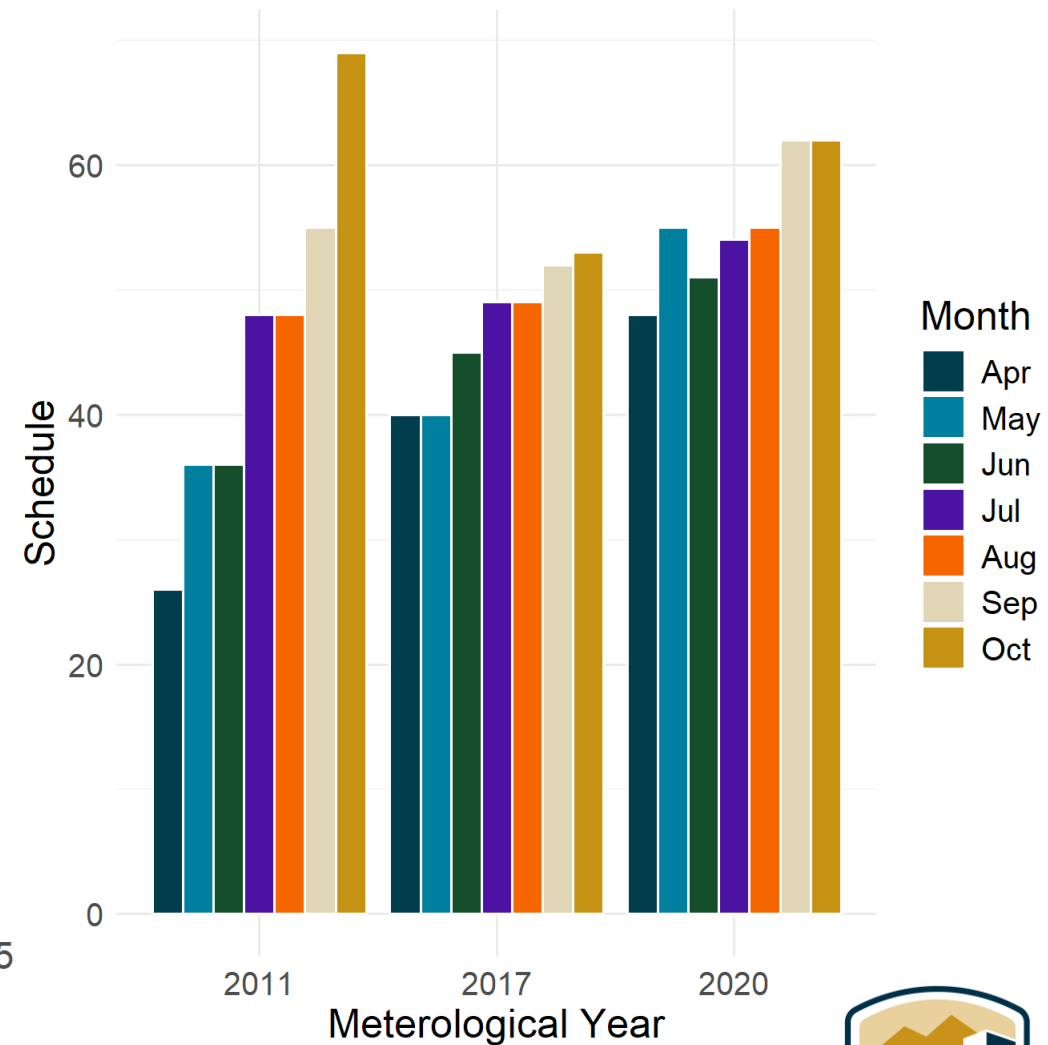
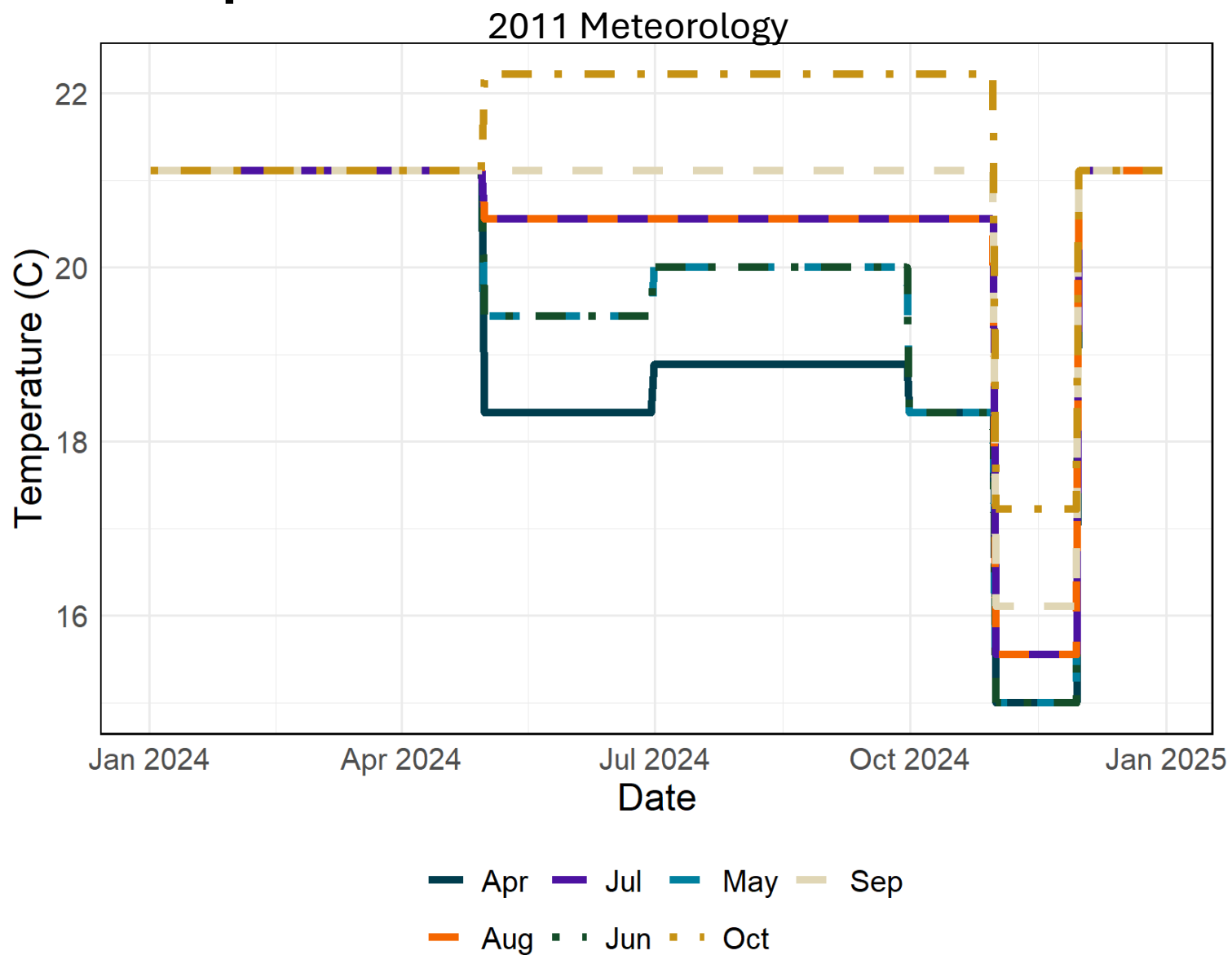
2020

2017

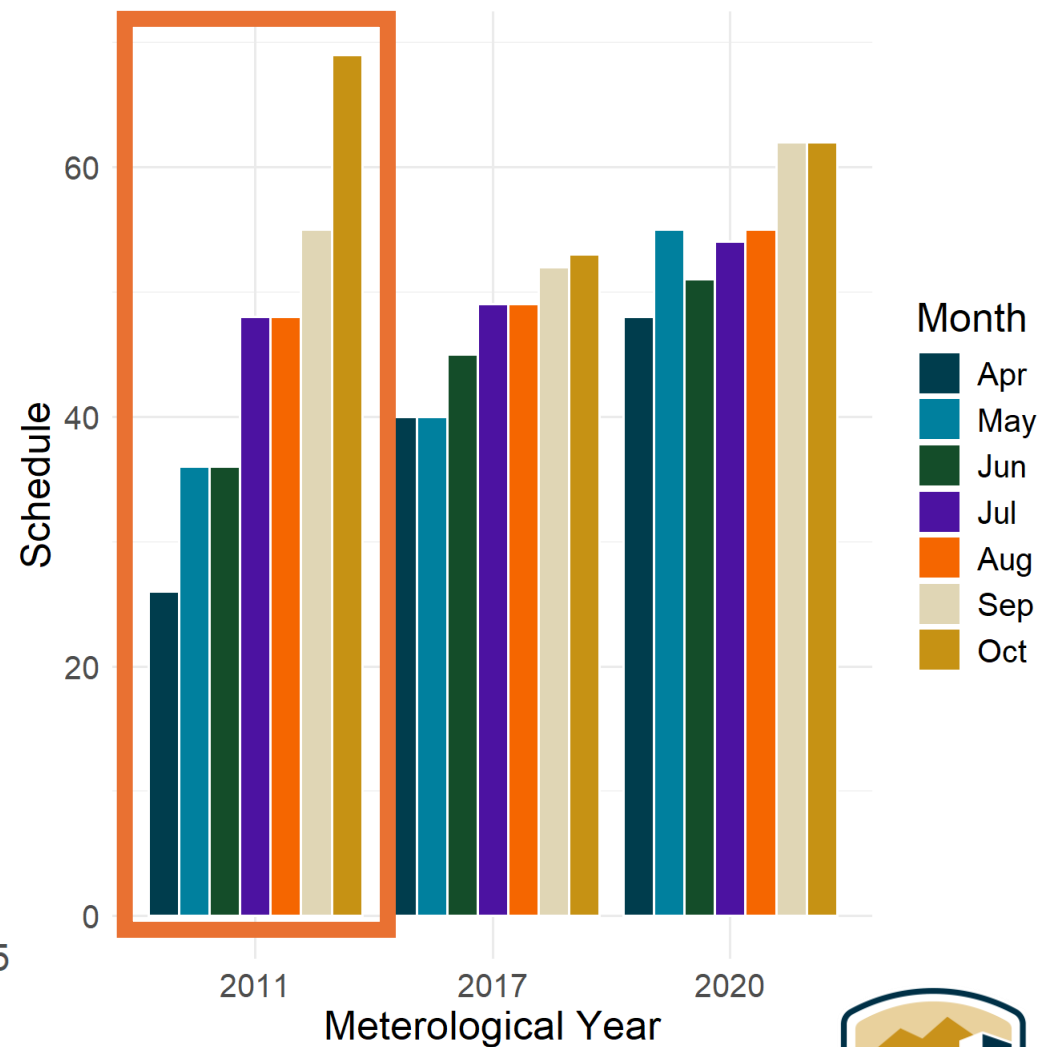
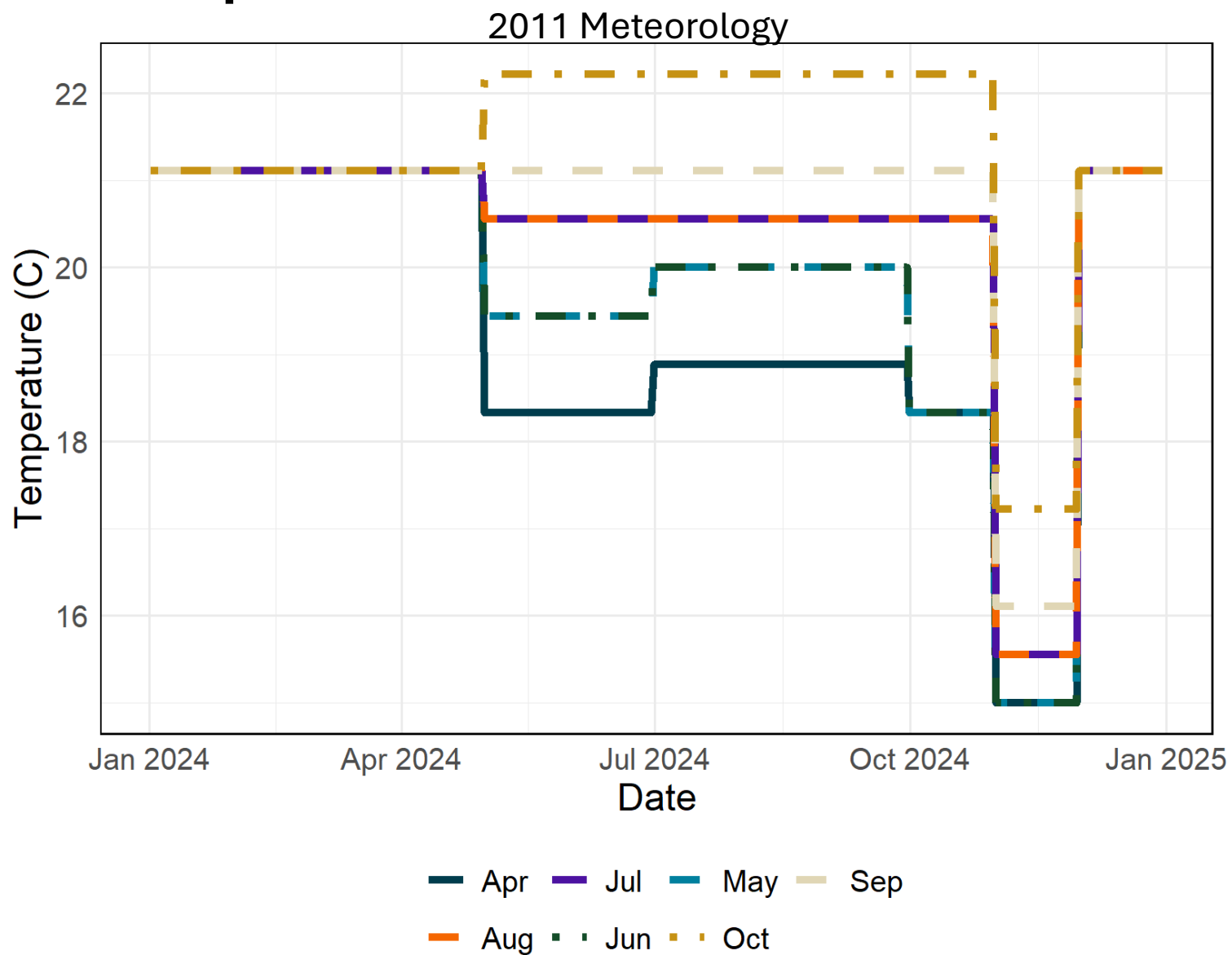
2011



Temperature Schedule

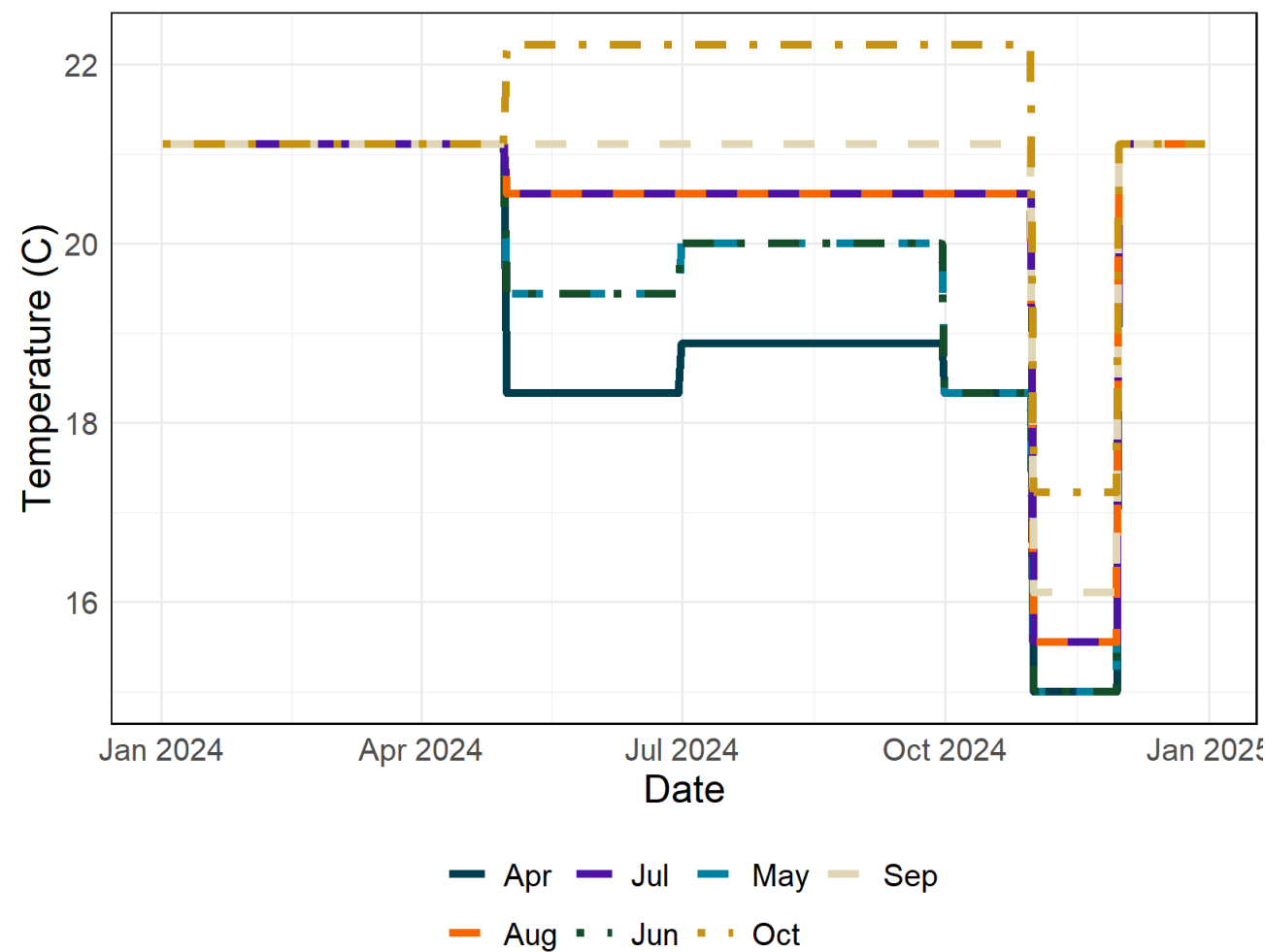


Temperature Schedule

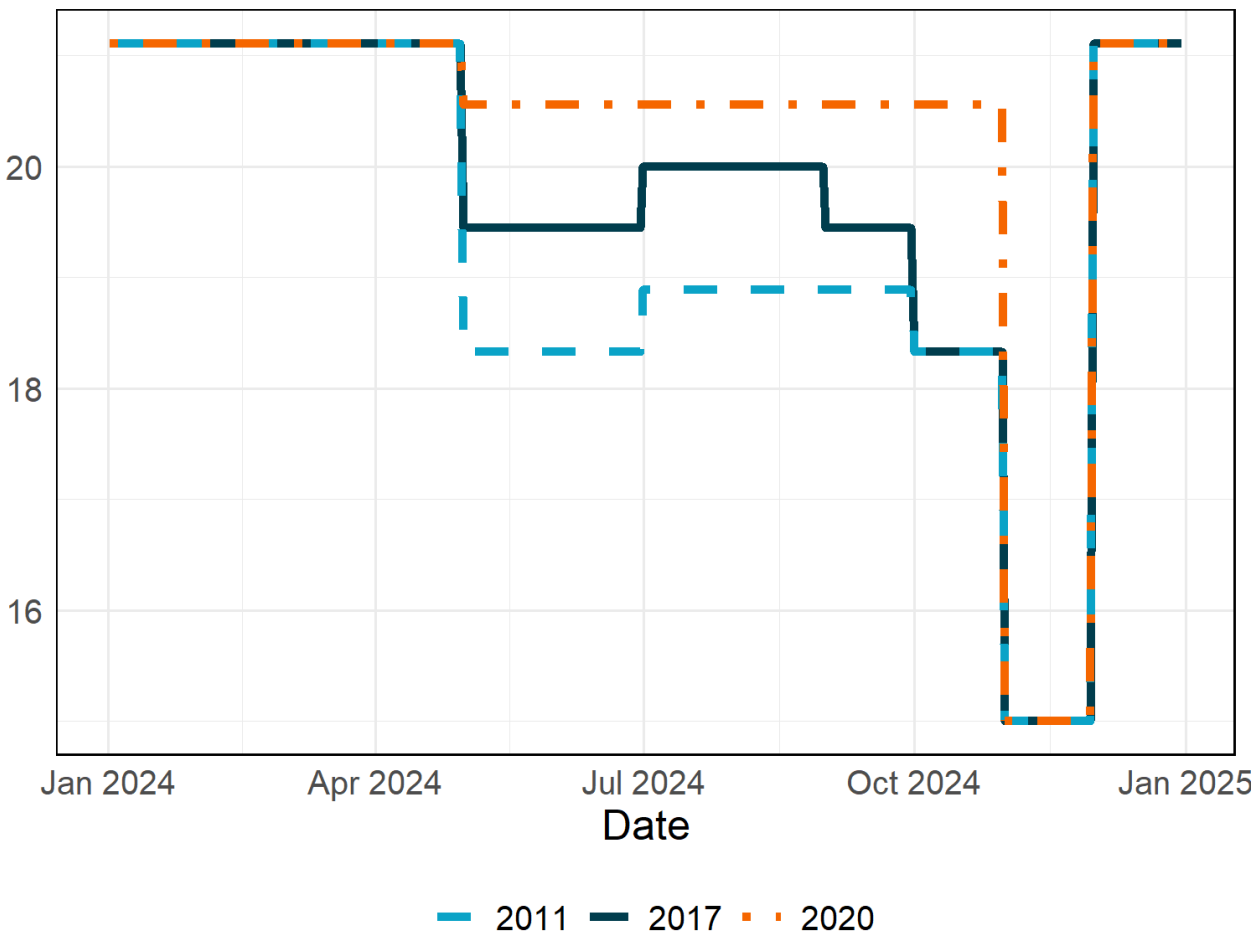


Temperature Schedule

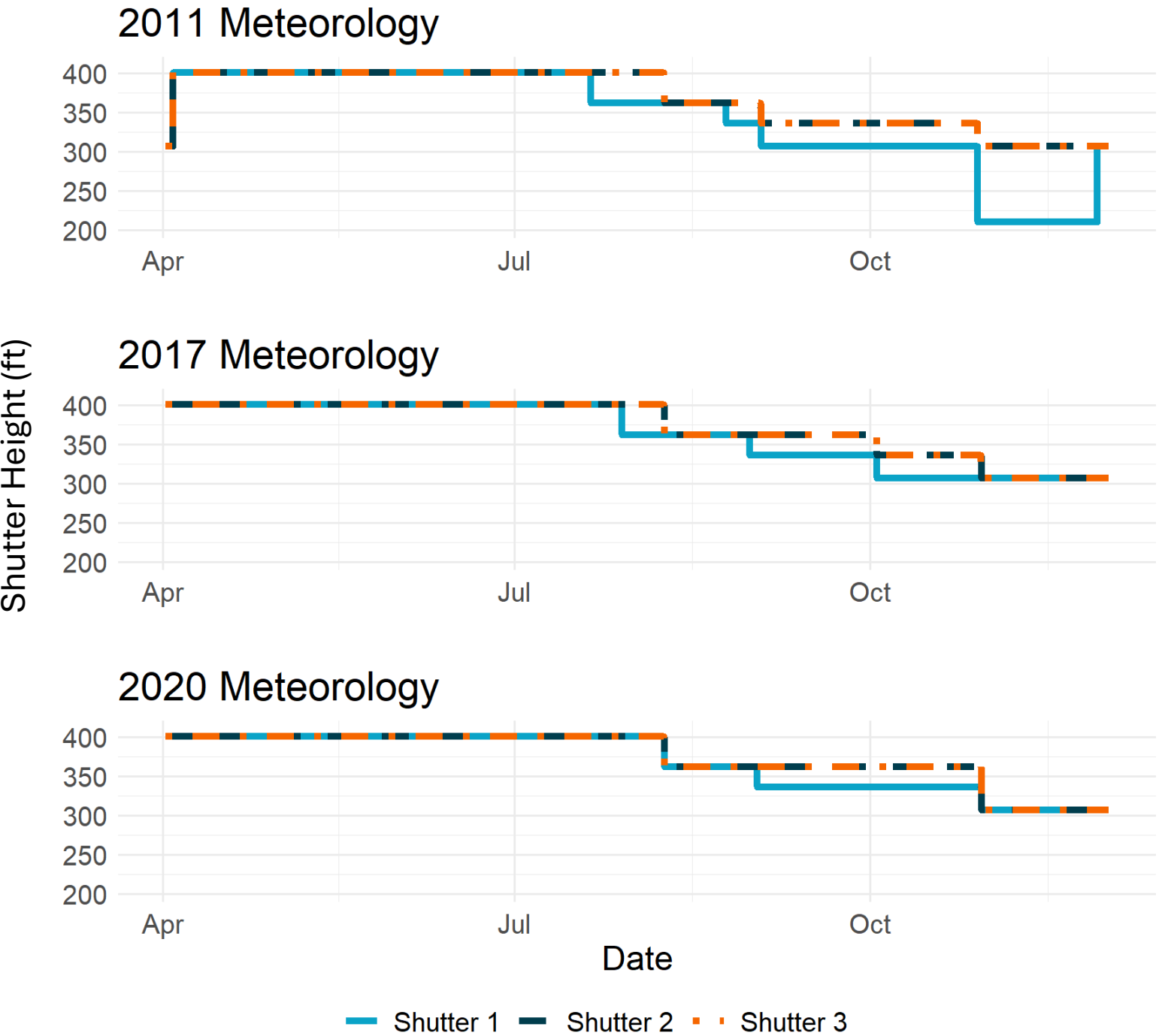
2011 Meteorology



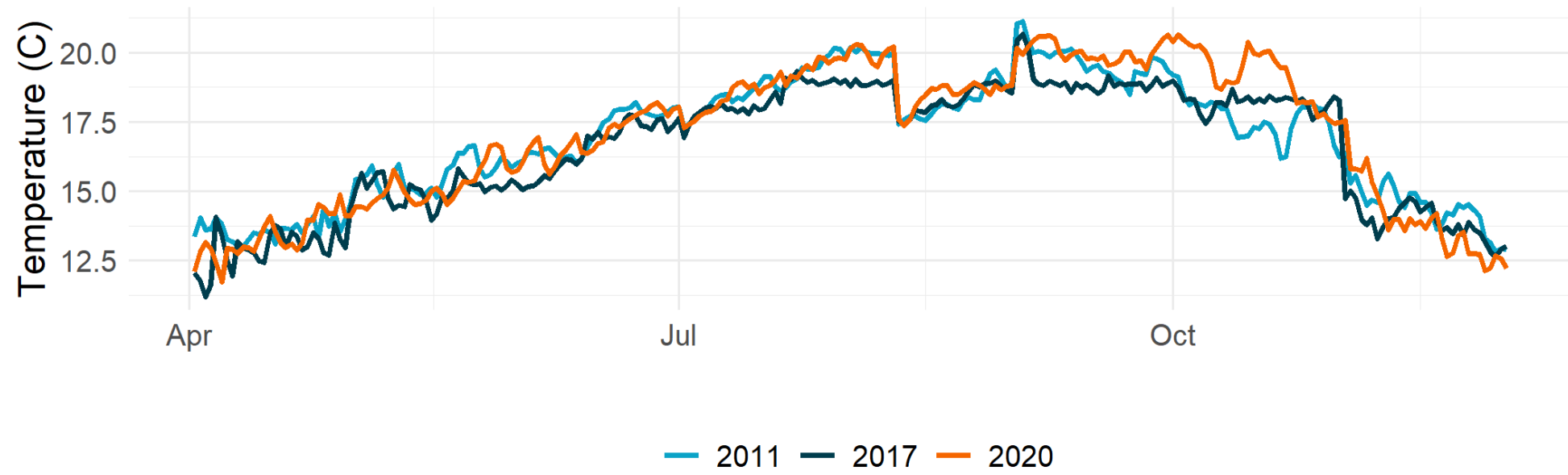
April Forecast



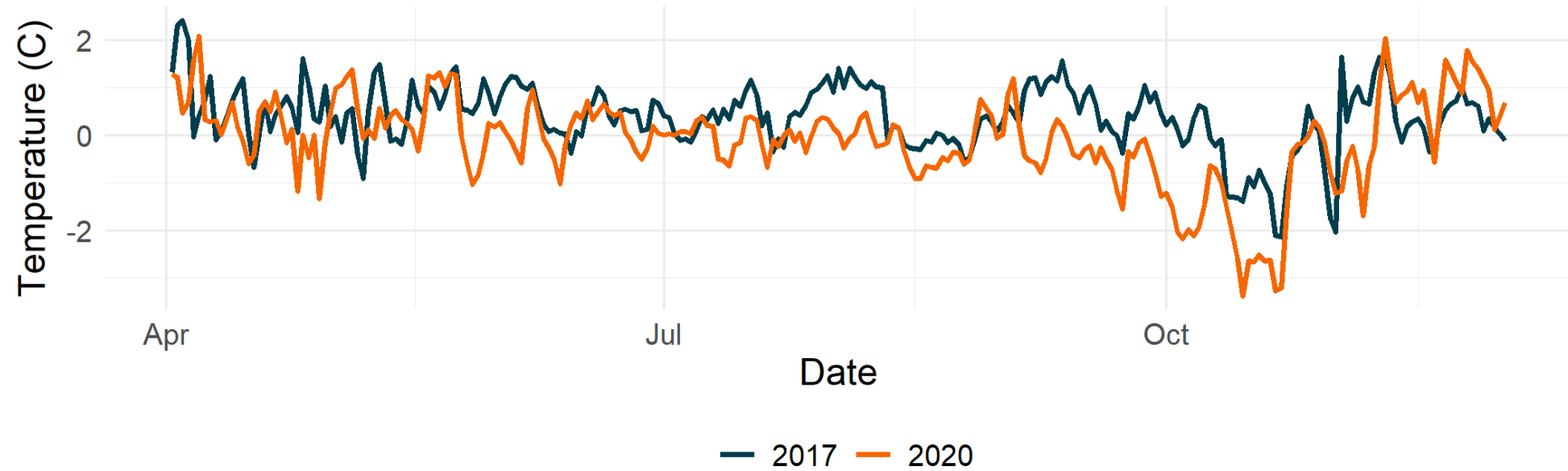
Shutter Height Evolution

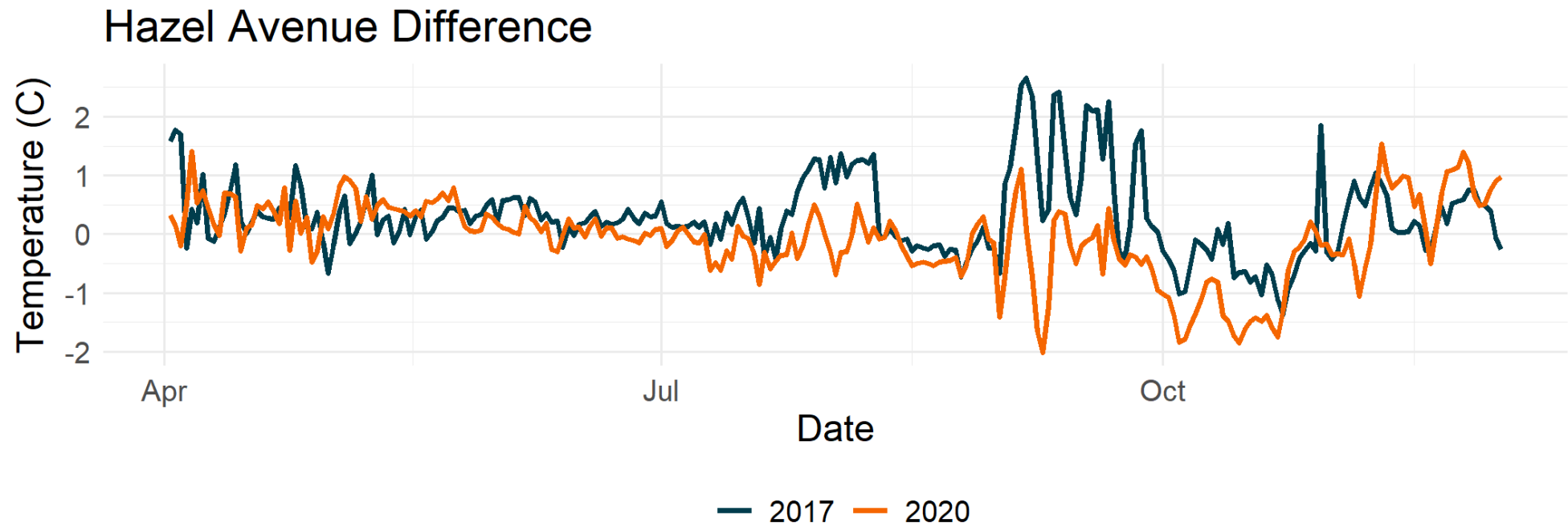
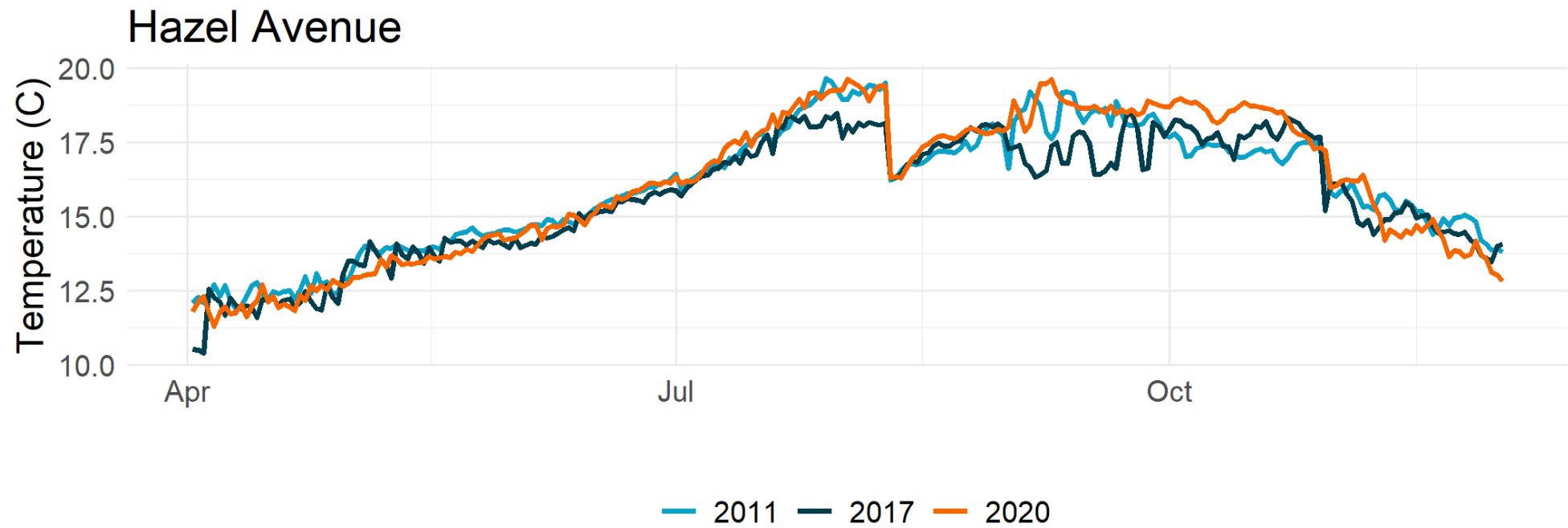


Watt Avenue



Watt Avenue Difference





Key Takeaways

- Iterative simulations were utilized to determine the temperature schedule that can be used to meet downstream requirements
- Meteorological conditions used in WTMP forecasting simulations provide insight into seasonal operations
 - Temperature schedule; temperature at Watt Ave and Hazel Ave
- Gate configuration is impacted by meteorological condition selected
- Trade-offs between cold water pool and downstream temperatures
- Simulating a range of meteorological conditions provides an ensemble approach to forecasting reservoir and in-stream conditions



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