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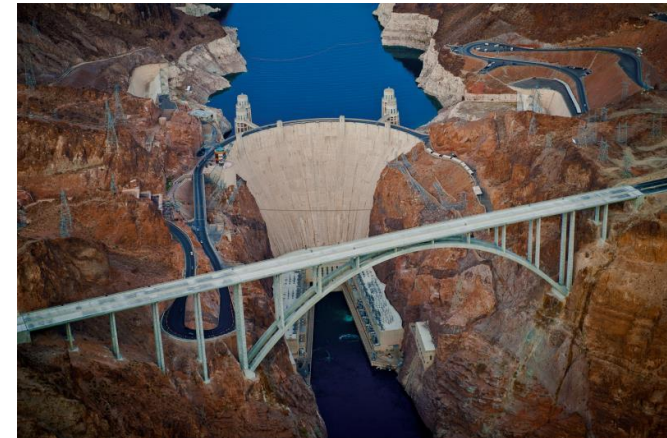
Potential for Incorporating S2S Forecasting in Colorado River Basin Modeling

May 18, 2022

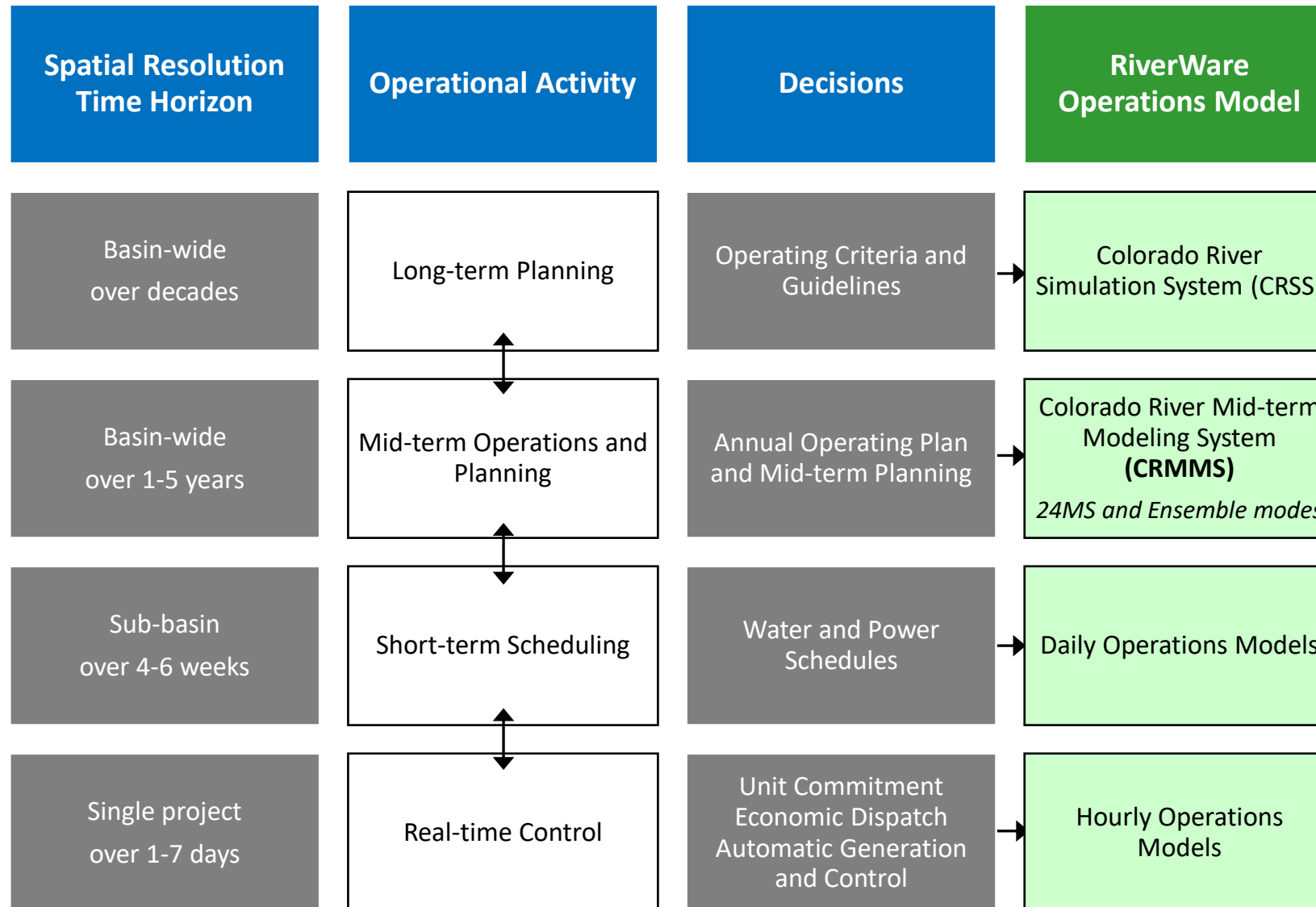
Sarah Baker

Overview

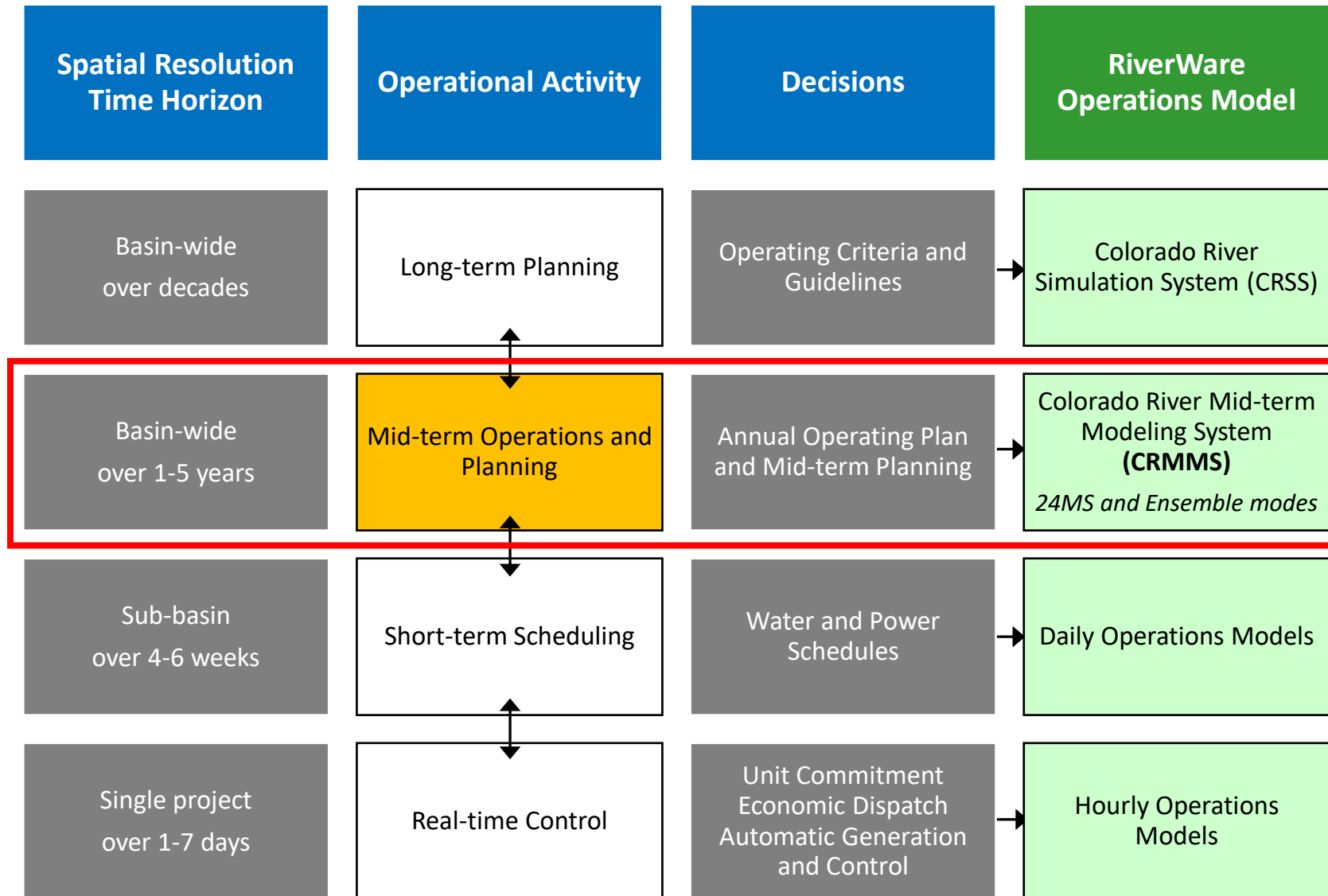
- Background
- Modeling Overview
- Current Needs
- Research Projects



Operational Decision-making Hierarchy



Operational Decision-making Hierarchy



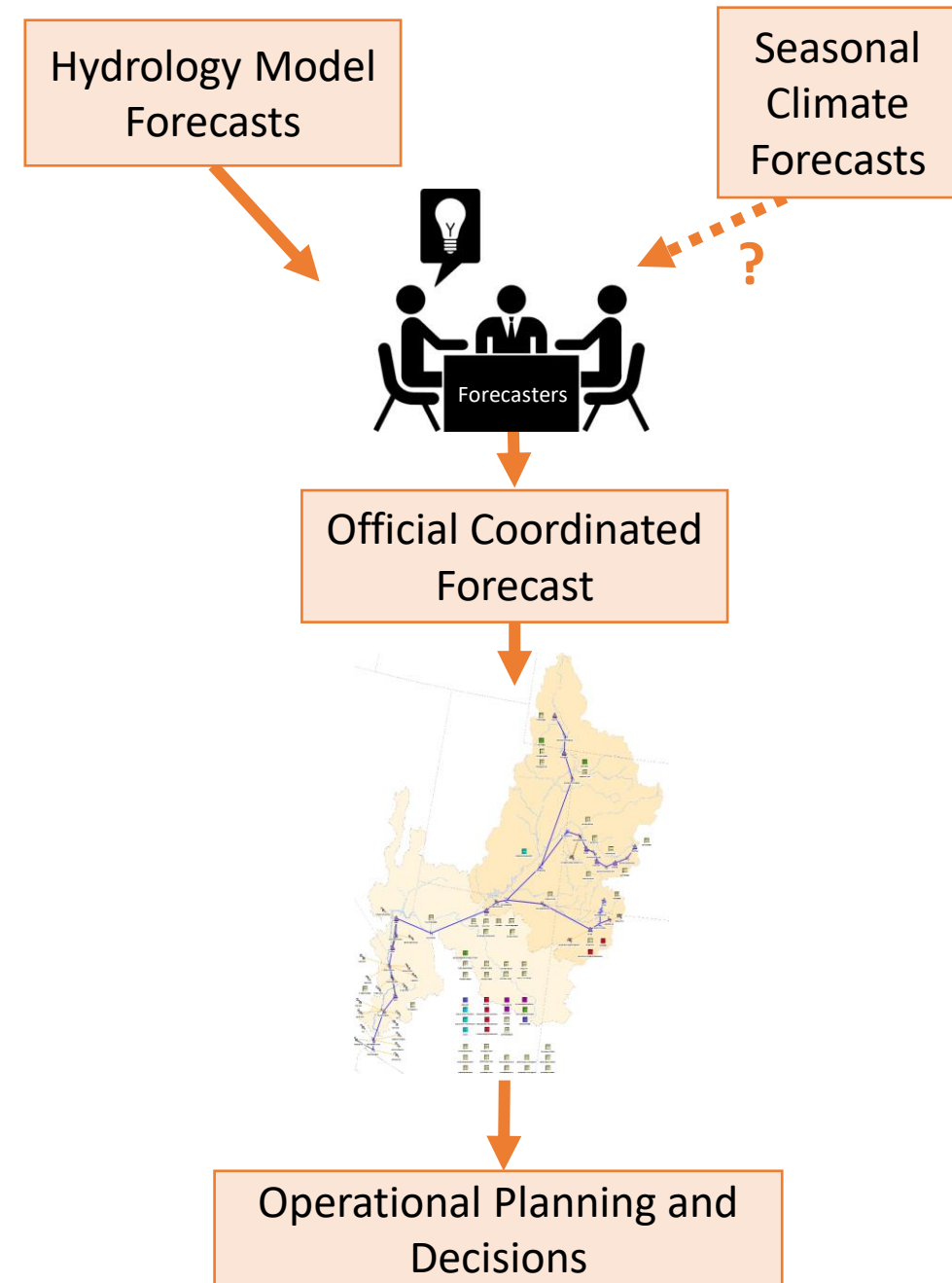
Reclamation Operational Modeling Model Comparison

	<i>Colorado River Mid-term Modeling System (CRMMS)</i>		<i>CRSS</i>
	<i>24-Month Study Mode (Manual Mode)</i>	<i>Ensemble Mode (Rule-based Mode)</i>	
Primary Use	AOP tier determinations and projections of current conditions	Risk-based operational planning and analysis	Long-term planning, comparison of alternatives
Simulated Reservoir Operations	Operations input manually	Rule-driven operations	
Probabilistic or Deterministic	Deterministic – single hydrologic trace	Deterministic OR Probabilistic 30 (or more) hydrologic traces	Probabilistic – 100+ traces
Time Horizon (years)			
Upper Basin Inflow	Unregulated forecast, 1 trace	Unregulated ESP forecast, 30 traces	Natural flow; historical, paleo, or climate change hydrology
Upper Basin Demands	Implicit, in unregulated inflow forecast		Explicit, 2016 UCRC assumptions
Lower Basin Demands	Official approved or operational		Developed with LB users



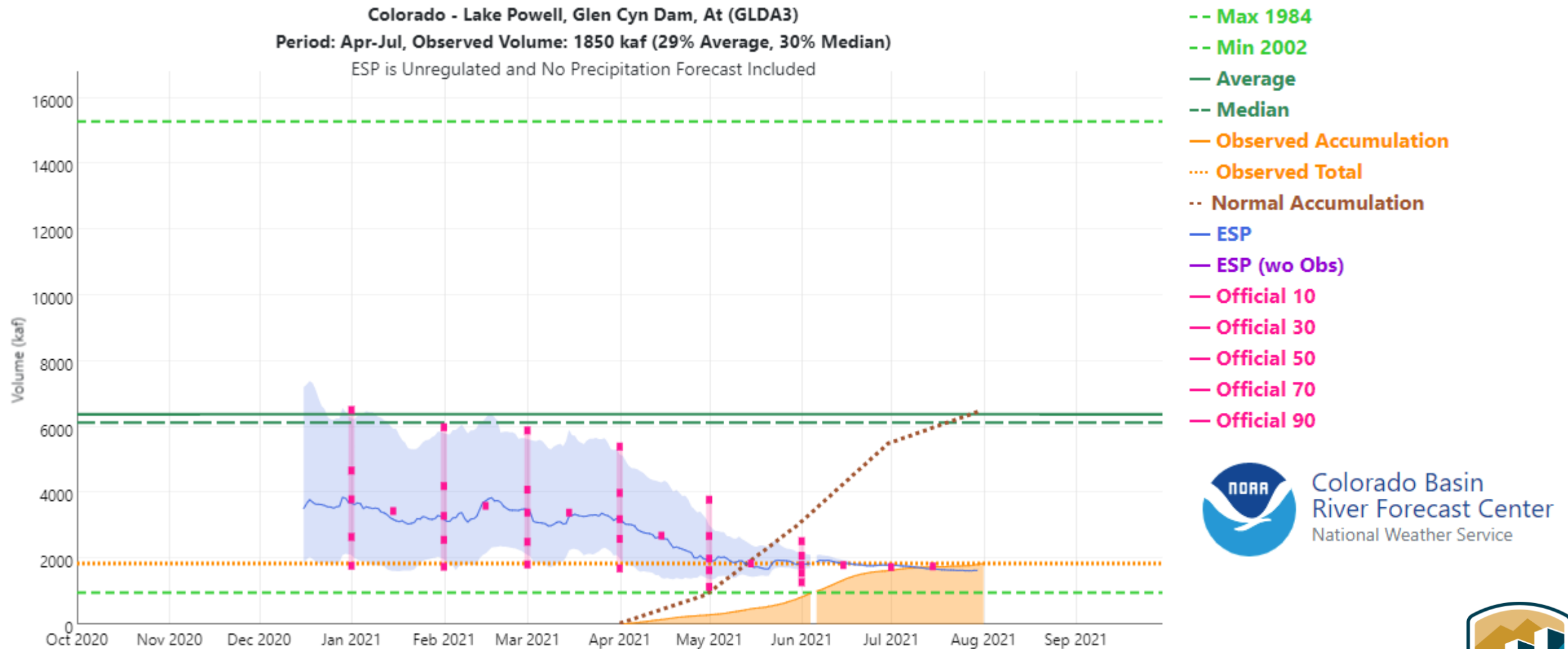
Streamflow Forecasting

- Streamflow forecasts are important inputs to operations and planning models to project reservoir operations, as well as useful to agricultural, municipal, and recreation water users
- Operational streamflow forecasts used by water managers in the CRB are produced by Colorado Basin River Forecasting Centers (CBRFC)
- Streamflow forecasts are not informed by climate forecasts in a procedural way

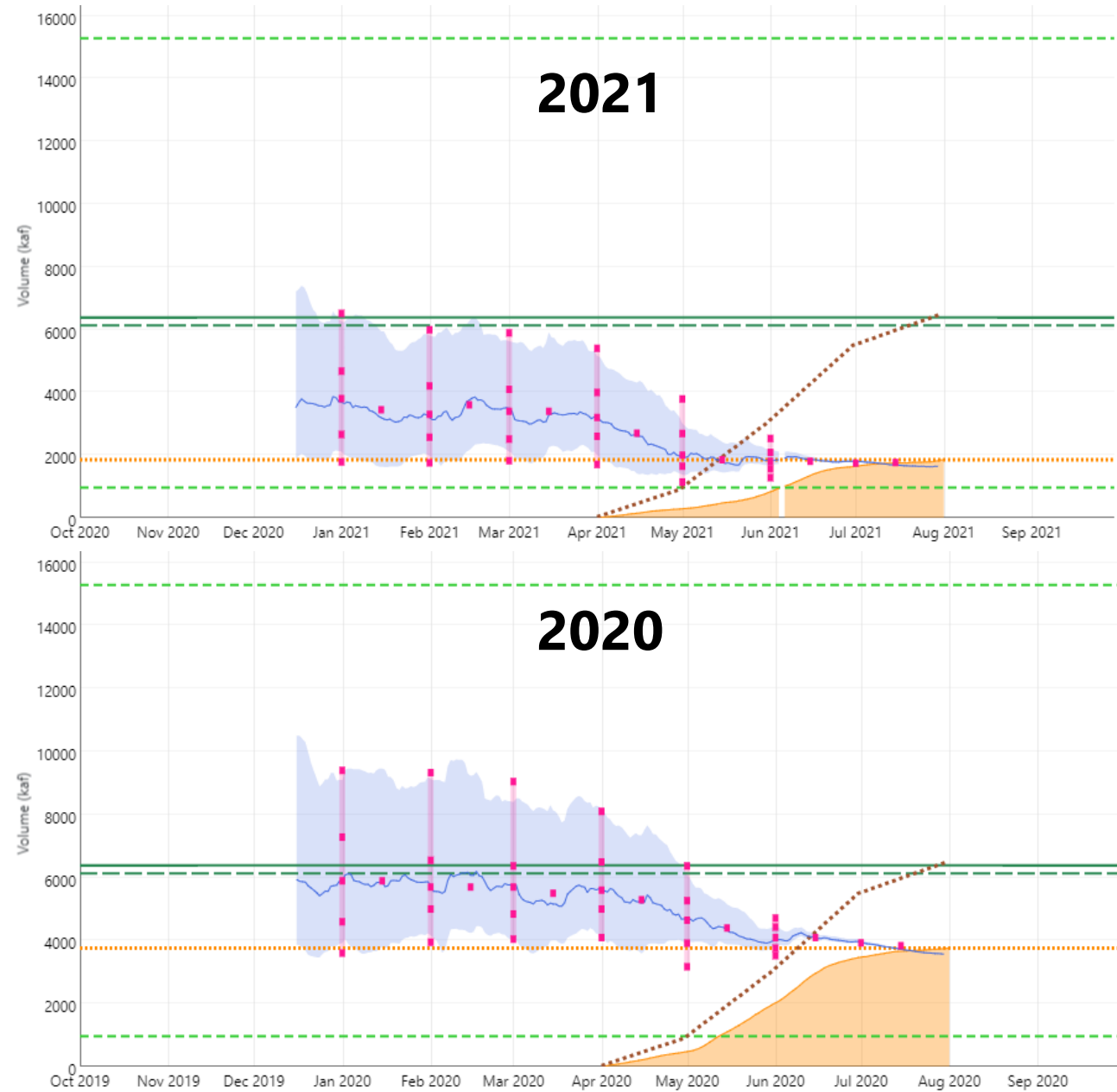


Lake Powell Unregulated Inflow

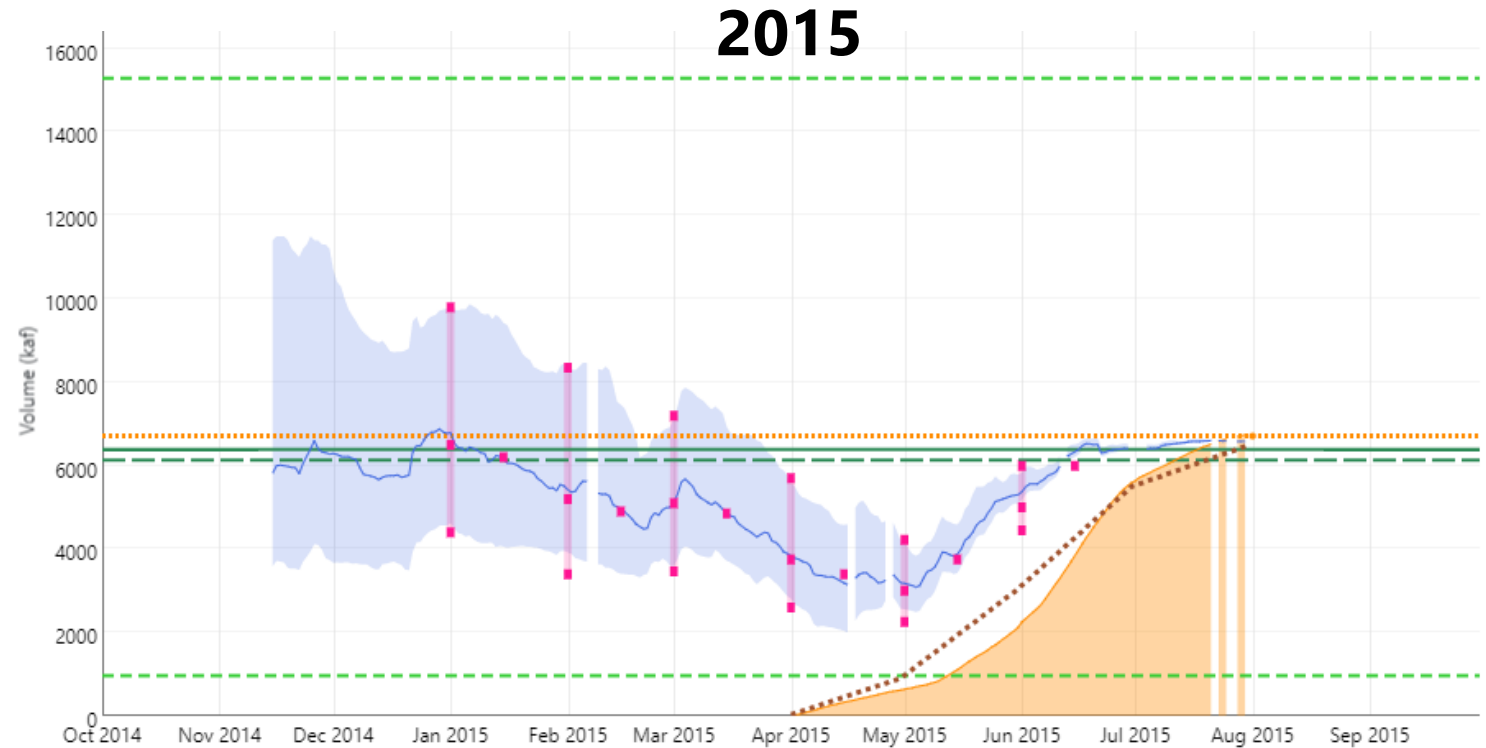
2021 Runoff Season



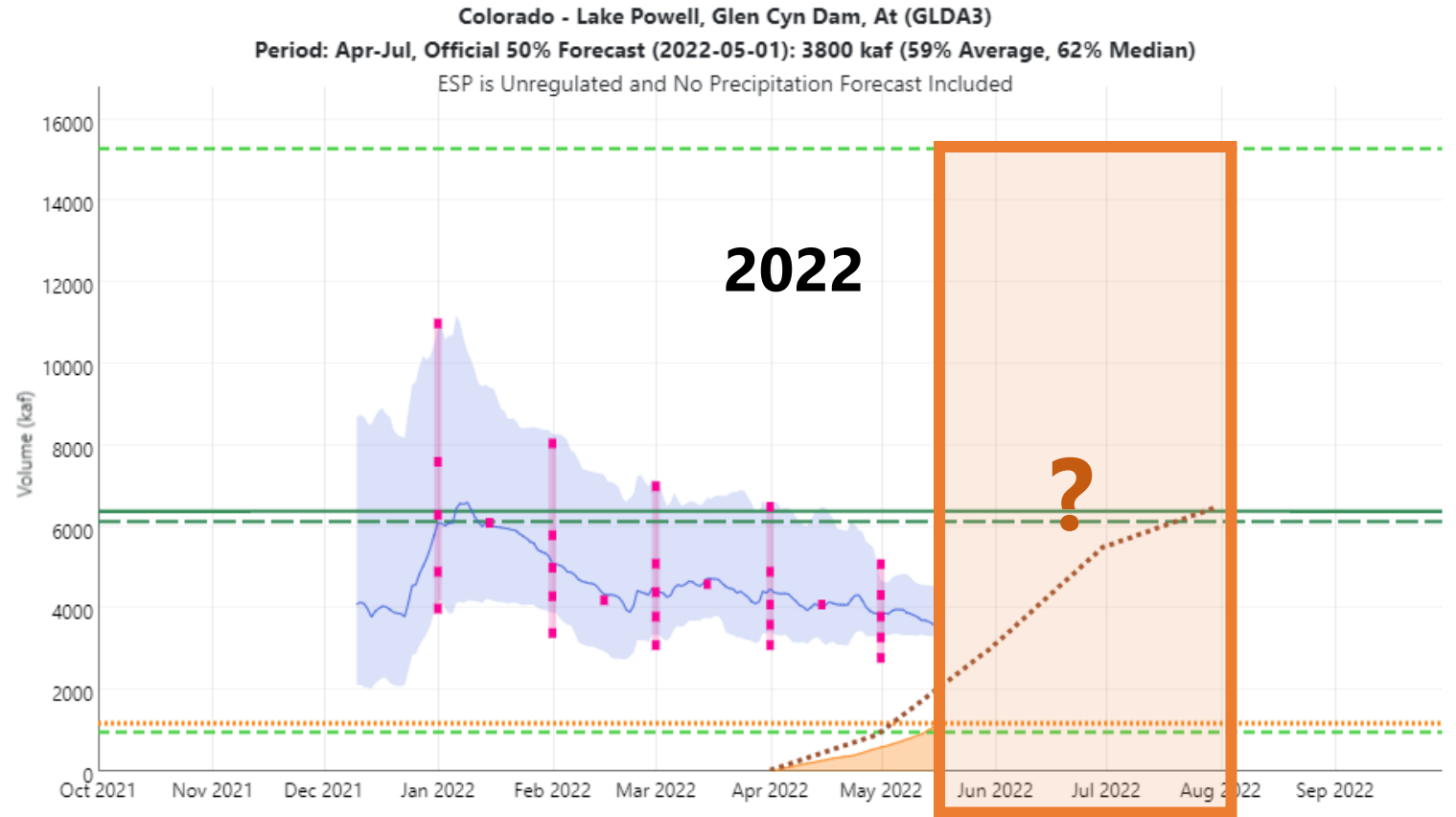
Powell Unregulated inflow forecasts are an important input to Reclamation's water management models



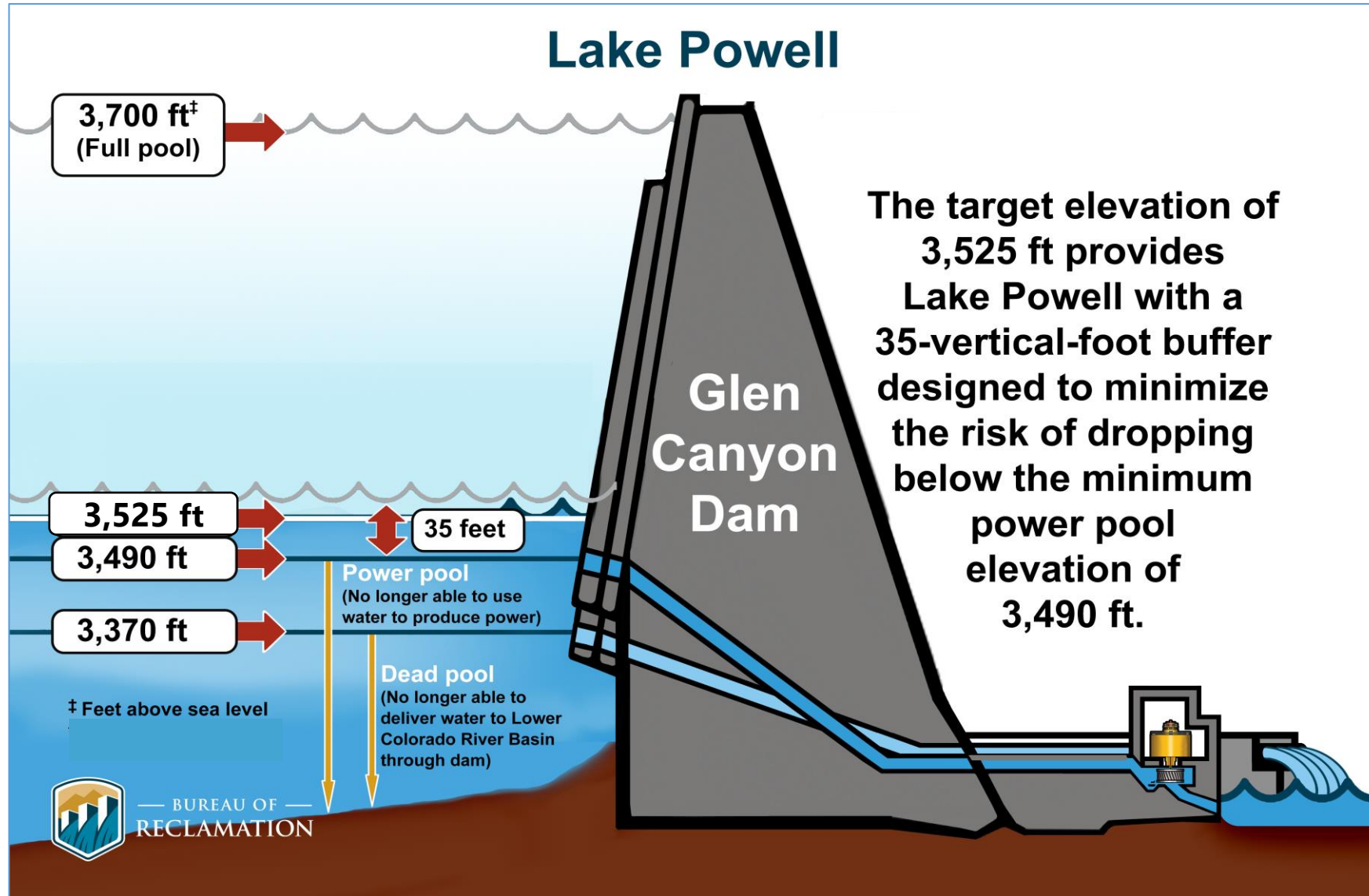
Powell Unregulated inflow forecasts are an important input to Reclamation's water management models



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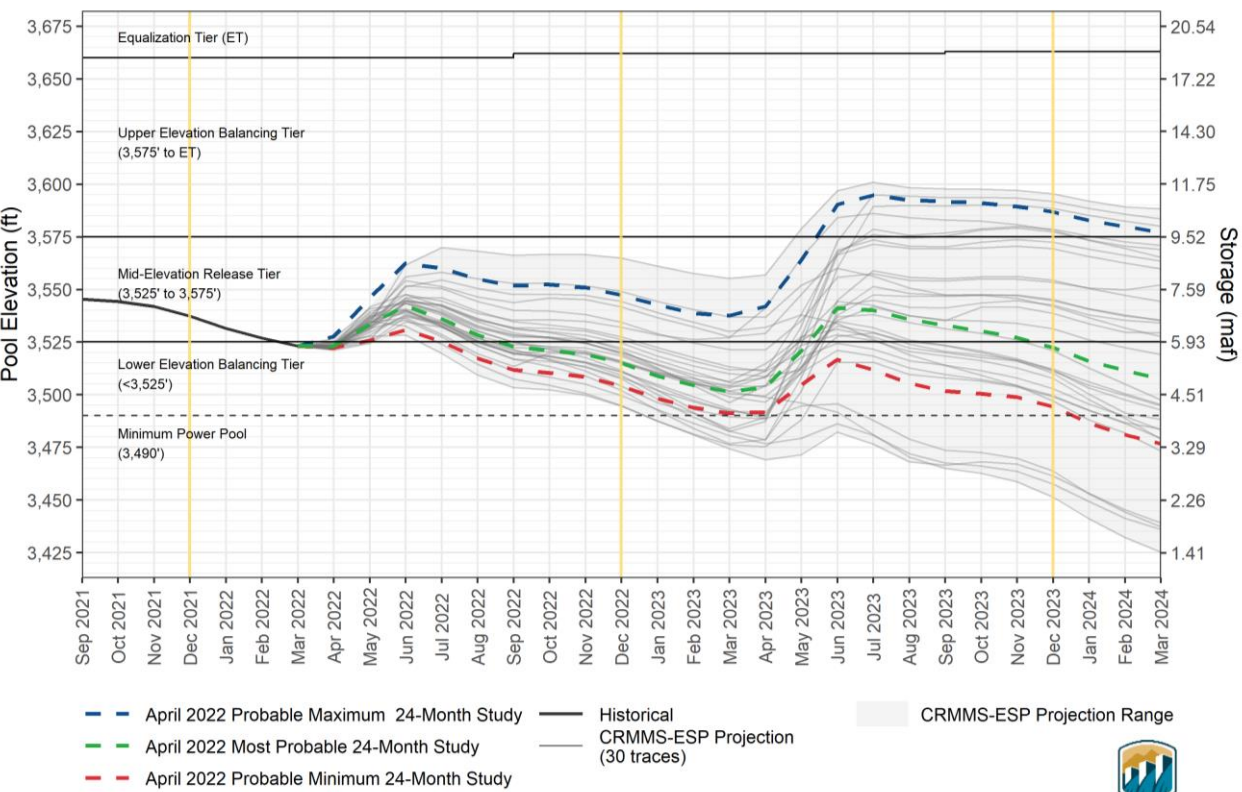
Lake Powell Key Elevations



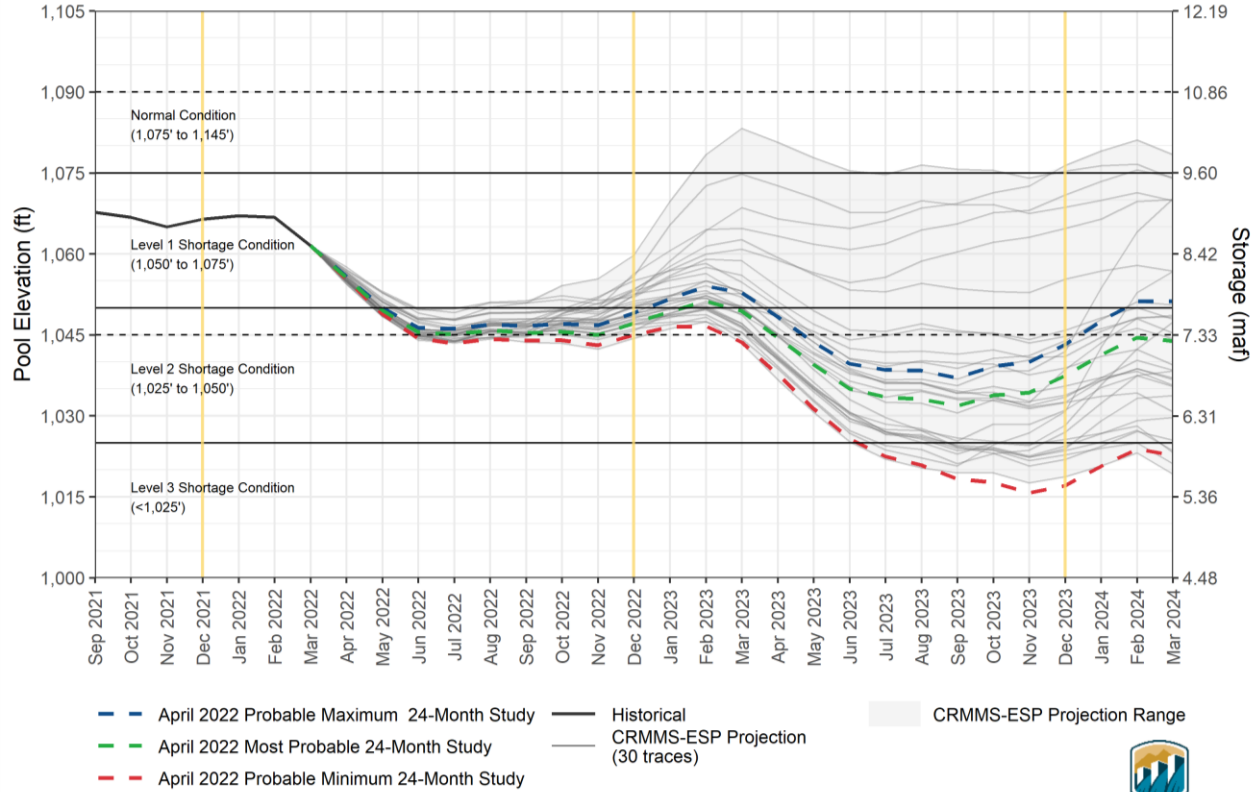
April 2022 CRMMS-ESP

End-of-Month Elevations

Lake Powell



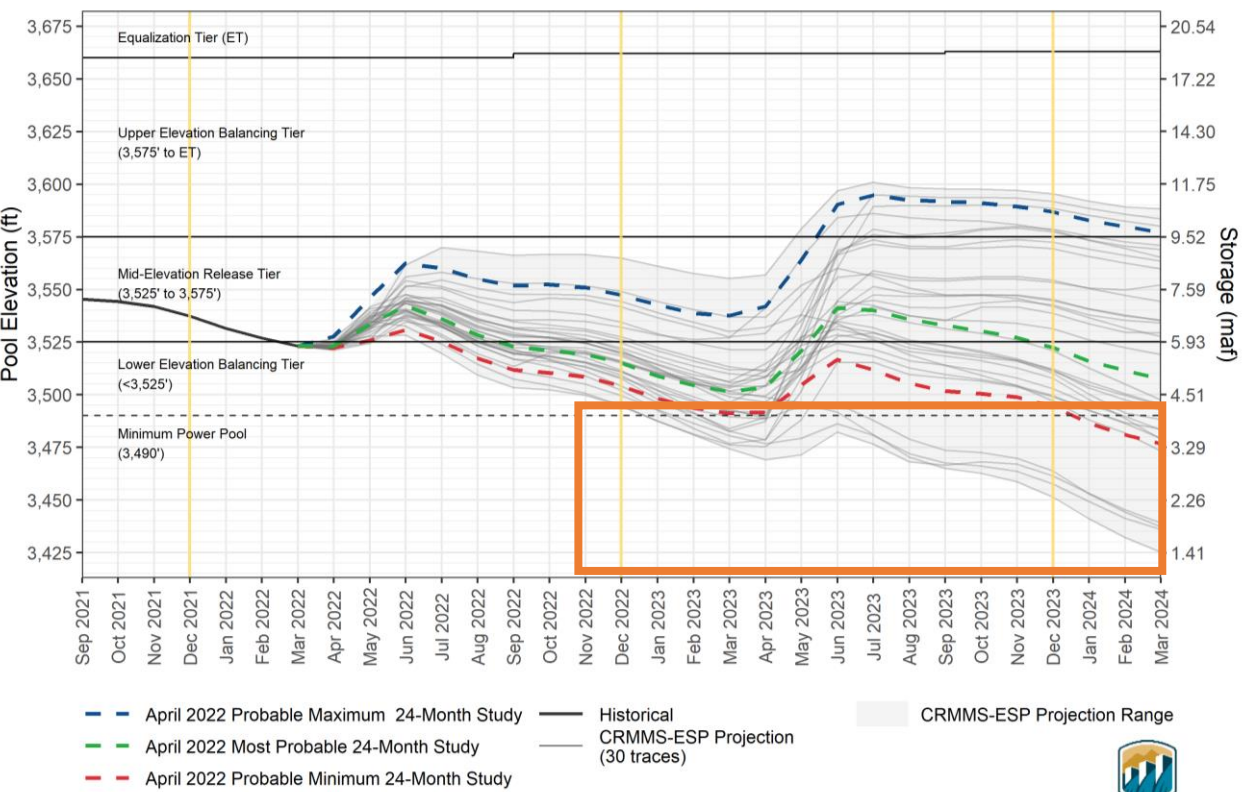
Lake Mead



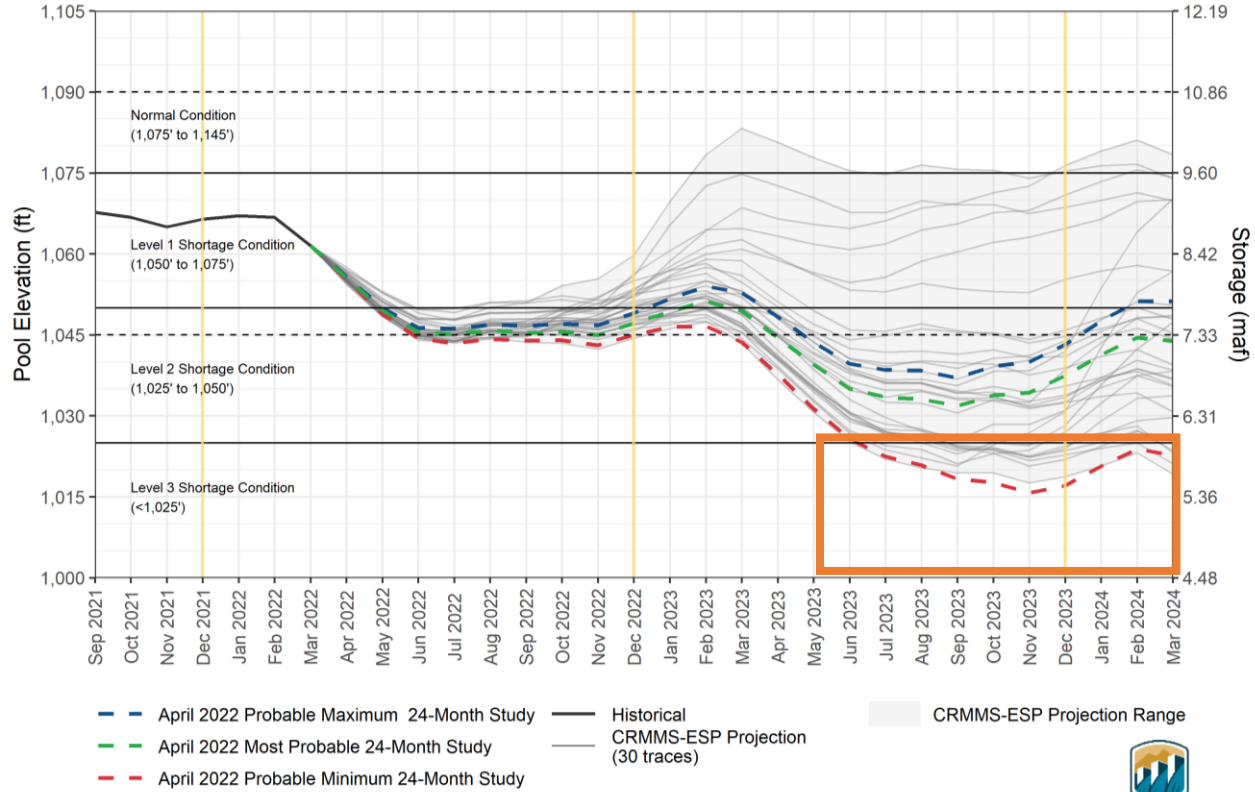
April 2022 CRMMS-ESP

End-of-Month Elevations

Lake Powell



Lake Mead



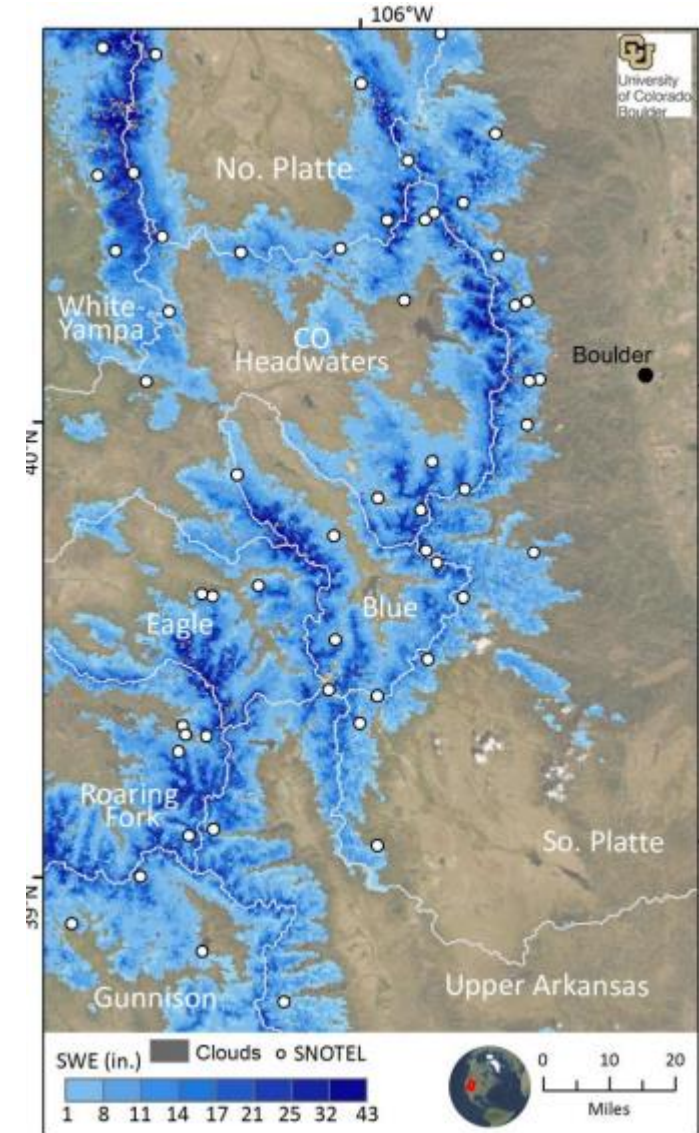
Colorado River Basin Research-to-Operations (CRB R2O) Program

- Improving transition from research to experimentation to application
 - Building in-house capacity to test research in operational context
 - Emphasizing testing as part of research scope
- Collaborating with a variety of scientists, gov't agencies, and stakeholders to scope, fund, and perform research
- Exploring decision science in addition to climate and hydrology
- Projects addressing short-, mid-, and long-term needs



Current Research Projects

- *Quantifying the Value of the Natural Resources Conservation Service's SNOwpack TELelemetry (SNOTEL) Network to Water Supply Forecasting and Data Planning*
 - Quantify the influence of the SNOTEL network on the River Forecasting Center's (RFC) water supply forecast and model simulation skill
- *Development of New Snow Data for Colorado River Basin Management*
 - Explore the utility of University of Colorado snow water equivalent product for runoff forecasts generated by the Colorado Basin RFC

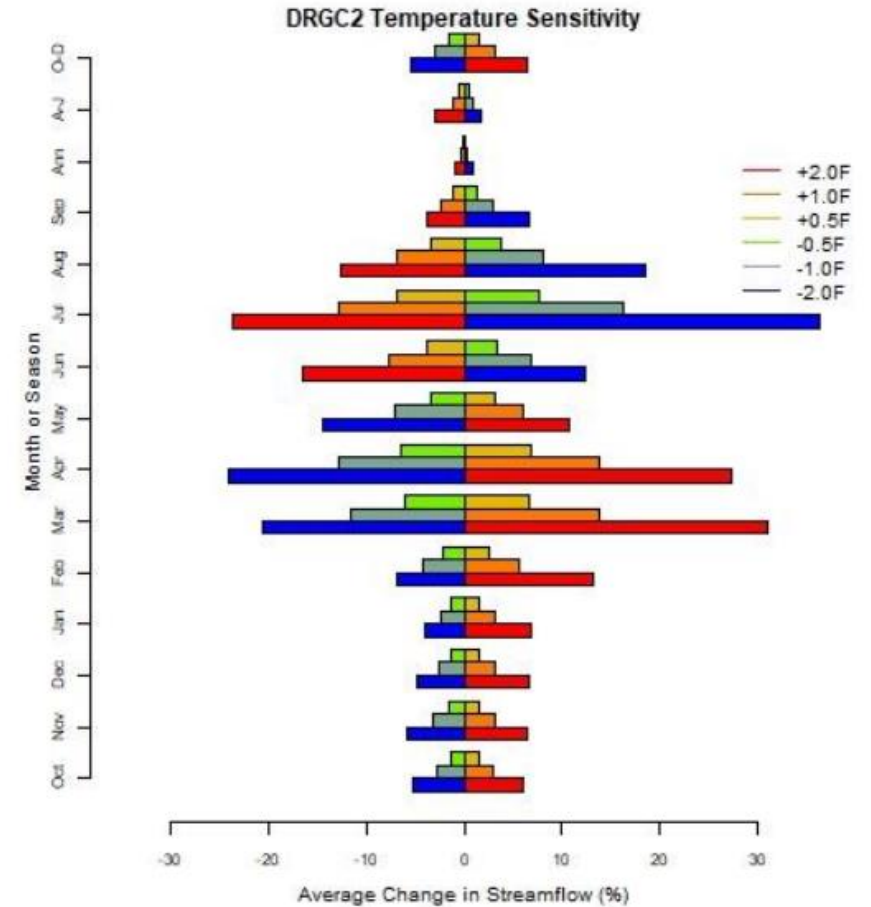


May 1, 2022 Spatial Estimates of Snow Water Equivalent (Molotch and Lestak, CU Boulder)



Current Research Projects

- *Improving Streamflow Forecasts and Reservoir Projections Through Temperature Detrending and Dynamic Evapotranspiration Modeling*
 - Develop a new methodology to use dynamic ET in the CBRFC's forecast model
- *NASA Land Information System (LIS) Hydrologic Forecasts for Hydropower Optimization in the Upper Colorado Basin*
 - Integrate several NASA remotely sensed data sets into a new modeling framework that would inform decision making in the context of hydropower generation

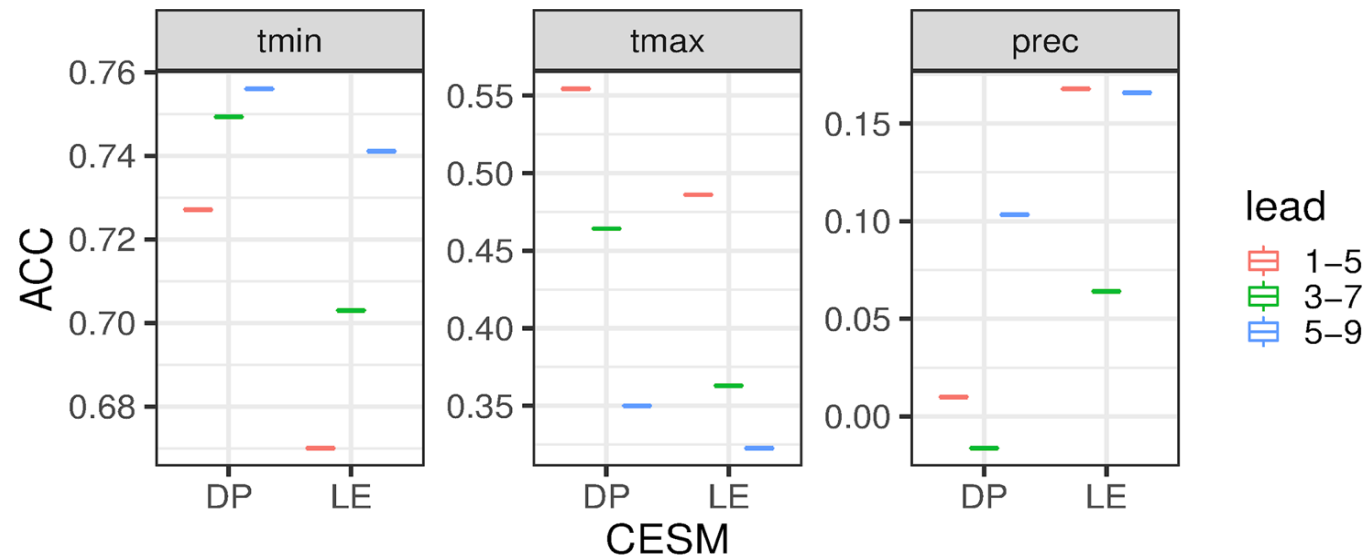


Sensitivity of streamflow to temperature perturbation levels at Animas River at Durango from "CBRFC Model Sensitivity Analysis" (2020).



Current Research Projects

- *Temperature-informed streamflow projections (Towler) & Experimental forecasts aimed to exploit sensitivity of Colorado River Basin flows to climate (Woodson)*
 - Exploit decadal temperature to develop streamflow forecast methods to improve multi-year streamflow forecasts



Anomaly correlation skill score (ACC) of CESM-LE and CESM-DPLE projections of multiyear mean temperature (maximum, minimum) and precipitation during a 30-year hindcast from 1981-2011. "Lead" indicates both the lead time and the specific years used in multi-year averaging. (Towler)



Summary

- There is potential for skillful S2S precipitation forecasts to inform Reclamation's operational planning and water management through climate informed streamflow forecasts
 - This becomes even more important as we near critical thresholds in reservoirs
- Reclamation will continue to engage with research communities
- Focus on applying research to operations to transition recent advancements into Reclamation's water management models



Questions?



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