

Bulletin 120 Forecasting Methodology Trinity River Watershed

March 20, 2024

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Water Resources Engineer, Snow Surveys and Water Supply Forecasting Unit



California Cooperative Snow Surveys Program

- California Cooperative Snow Surveys (CCSS) Program started in 1929

“The department shall gather and correlate information and data pertinent to an annual forecast of seasonal water crop, including the making of snow surveys, either independently or in cooperation with any person or any county, State, Federal, or other agency.”

- [California Water Code § 228](#)



COOPERATING AGENCIES

Public Agencies

Buena Vista Water Storage District
 East Bay Municipal Utility District
 Eldorado Irrigation District
 Friant Water Users Association
 Kaweah Delta Water Conservation District
 Kern Delta Water District
 Kings River Conservation District
 Lower Tule River Irrigation District
 Merced Irrigation District
 Modesto Irrigation District
 Nevada Irrigation District
 North Kern Water Storage District
 Northern California Power Agency
 Oakdale Irrigation District
 Omochumne-Hartnell Water District
 Oroville-Wyandotte Irrigation District
 Placer County Water Agency
 Sacramento Municipal Utility District
 San Joaquin River Exchange Contractors Water Authority
 South San Joaquin Irrigation District
 Tri-Dam Project
 Truckee River Basin Water Commission
 Tulare Lake Basin Water Storage District
 Turlock Irrigation District
 Yuba County Water Agency
Private Organizations
 J.G. Boswell Company
 Kaweah and St. Johns River Association
 Kings River Water Association
 Tule River Association
 State Water Project Contractors

Municipalities

City of Bakersfield Water Department
 City of Los Angeles Department of Water and Power
 City and County of San Francisco Hetch Hetchy Water and Power

State Agencies

University of California
 Central Sierra Snow Laboratory
 Scripps Institution of Oceanography
 California Department of Forestry & Fire Protection
 California Department of Water Resources

Public Utilities

Pacific Gas and Electric Company
 Southern California Edison Company

Federal Agencies

U.S. Department of Agriculture
 Forest Service(14 National Forests)
 Natural Resource Conservation Service
 U.S. Department of Commerce
 National Weather Service
 U.S. Department of Interior
 Bureau of Reclamation
 Geological Survey, Water Resources
 National Park Service(3 National Parks)
 U.S. Department of Army
 Corps of Engineers

Other Cooperative Programs

Nevada Cooperative Snow Surveys
 Oregon Cooperative Snow Surveys

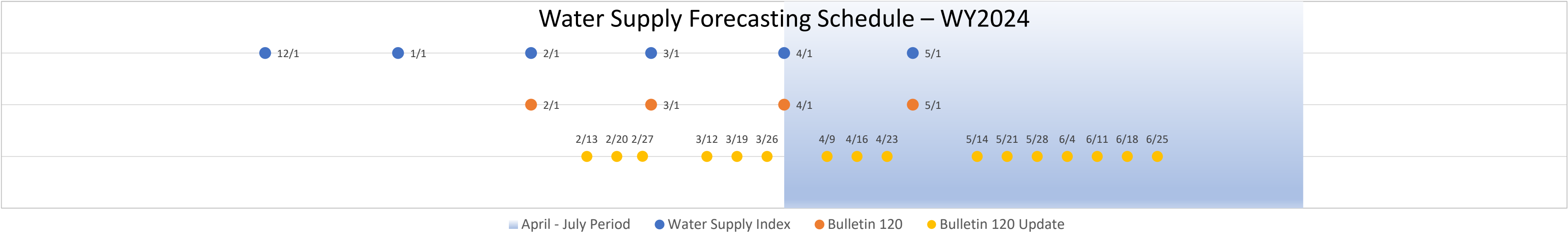
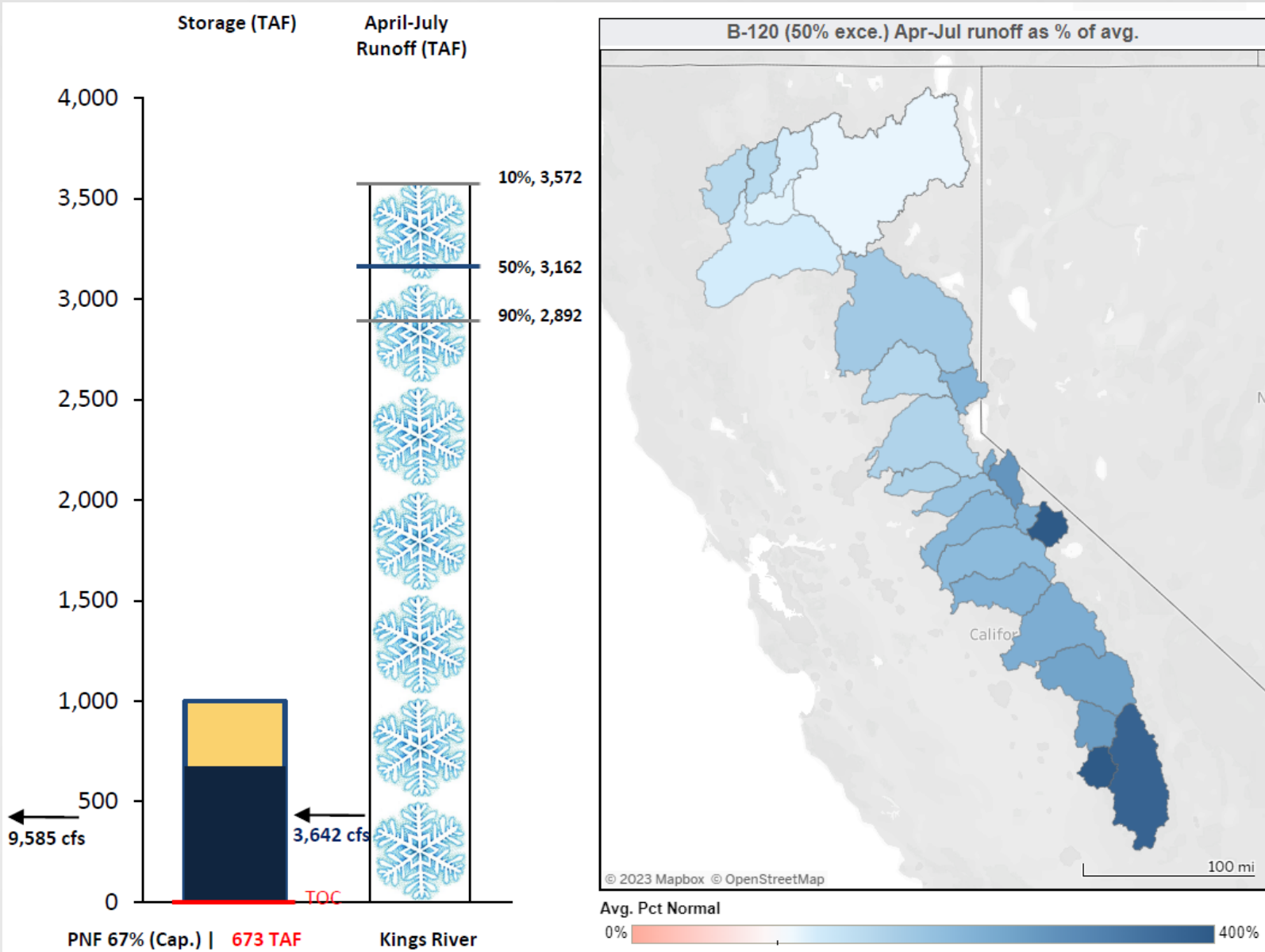
TRINITY RIVER

9	DEADFALL LAKES	DDF	7200	41.318001	-122.502998	31.2	Mount Shasta Ranger District
10	RED ROCK MOUNTAIN	RRM	6700	41.023621	-122.886627	40.9	Weaverville Ranger District
11	BEAR BASIN	BBS	6500	40.966999	-122.866997	38.3	Weaverville Ranger District
12	SHIMMY LAKE	SHM	6400	41.005299	-122.801598	44.0	Weaverville Ranger District
13	WOLFORD CABIN	WLC	6150	41.200001	-122.833000	32.2	Salmon/Scott River Ranger District
16	HIGHLAND LAKES	HIG	6030	41.091782	-122.491562	34.4	Weaverville Ranger District
15	MUMBO BASIN	MUM	5650	41.197819	-122.525963	21.6	Weaverville Ranger District
14	WHALAN	WHN	5400	41.150002	-122.449997	21.1	Weaverville Ranger District
17	BIG FLAT (COURSE)	BFT	5100	41.077000	-122.938004	11.5	Weaverville Ranger District



Bulletin 120: Water Conditions in California

- Published as a series of monthly reports titled Bulletin 120, “Water Conditions in California” at the start of February, March, April, and May of every year
- The bulletin series includes forecasts of median *unimpaired April through July runoff volume* and 80 percent confidence range for 24 river basins in the State
- Forecasts used for water supply operations and planning, flood control, allocations, environmental, biological, power generation, recreation, and more
- Update forecasts produced on a weekly basis until mid-June or later



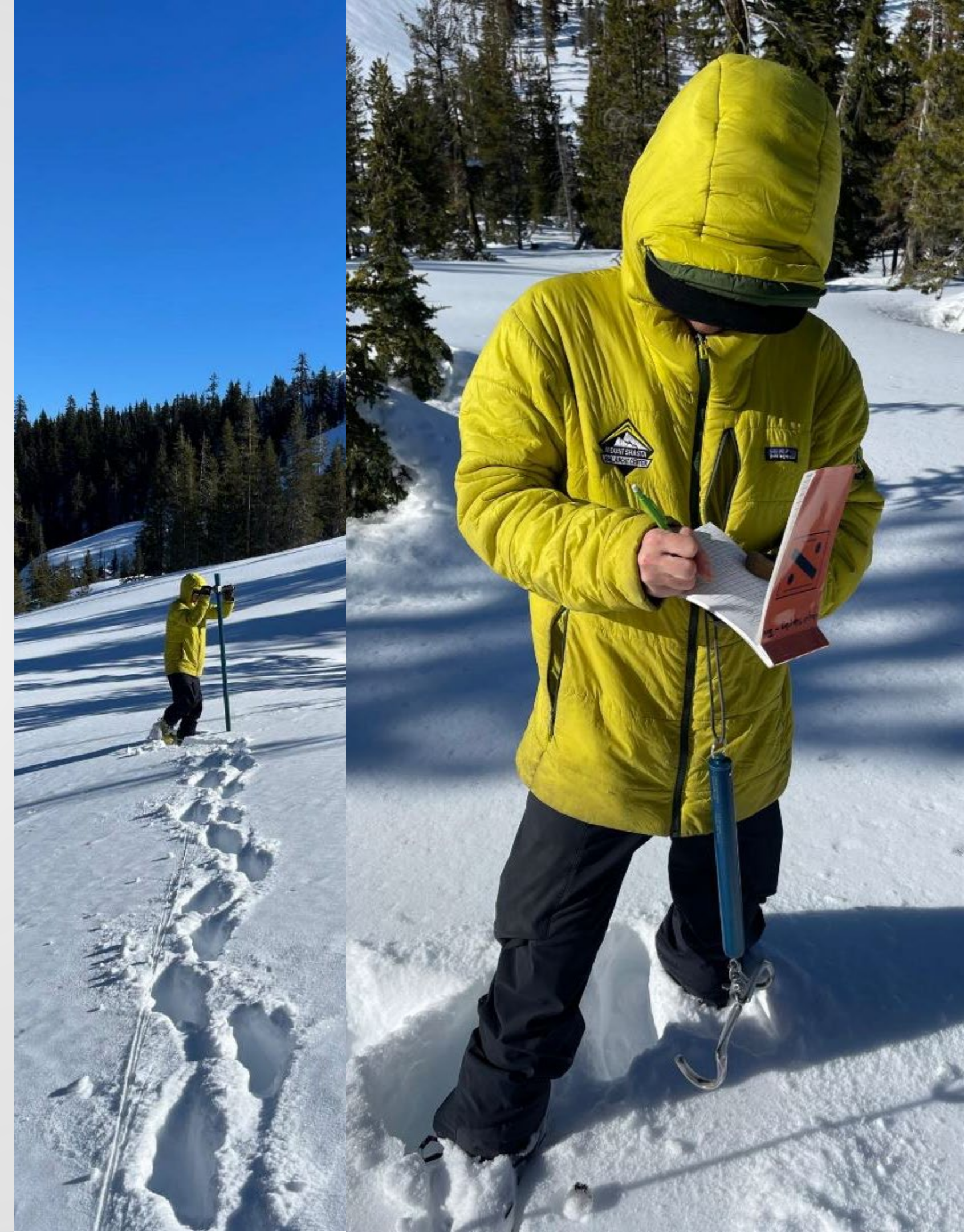
Bulletin 120 Legacy Forecasting Procedure

- Water supply forecasts are based on multiple linear regression equations that relate April-July unimpaired runoff to:
 - Snow
 - Precipitation
 - Runoff



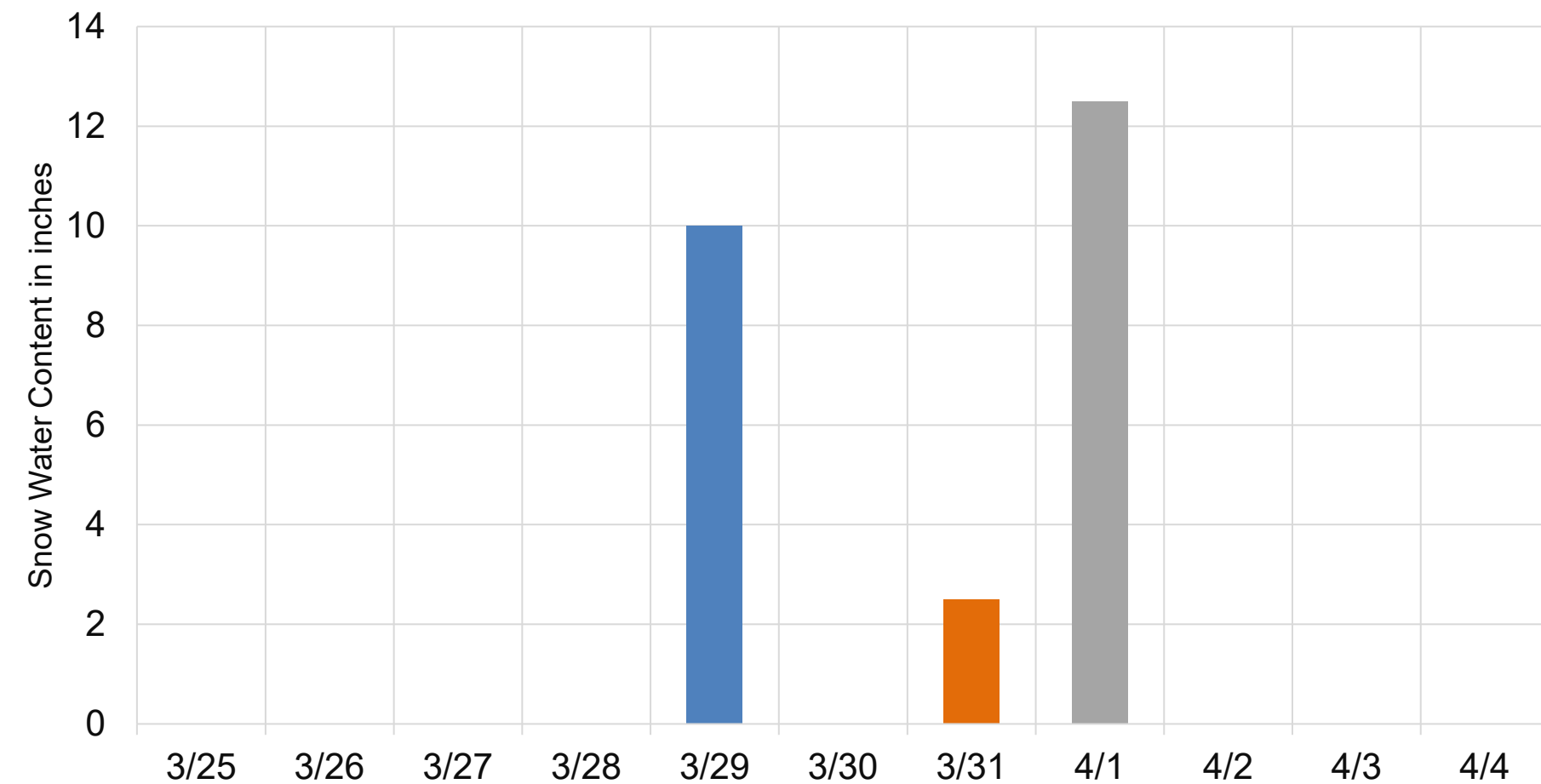
Adjustments to snow course measurements

- Snow surveyors measure snow water content at up to 260 snow courses in the State near the first of each month during January to June of every year
- These measurements provide the foundation for water supply forecasting and water resources management in the State
- For statistical consistency, all measurements should be taken at the same time each month, but mostly because of stormy weather, measurements are made over a 10-day period; beginning at about the last week of the month and ending on the third day of the following month
- The snow course measurements should be adjusted for any precipitation that fell between the time of snow course measurement and first of the month

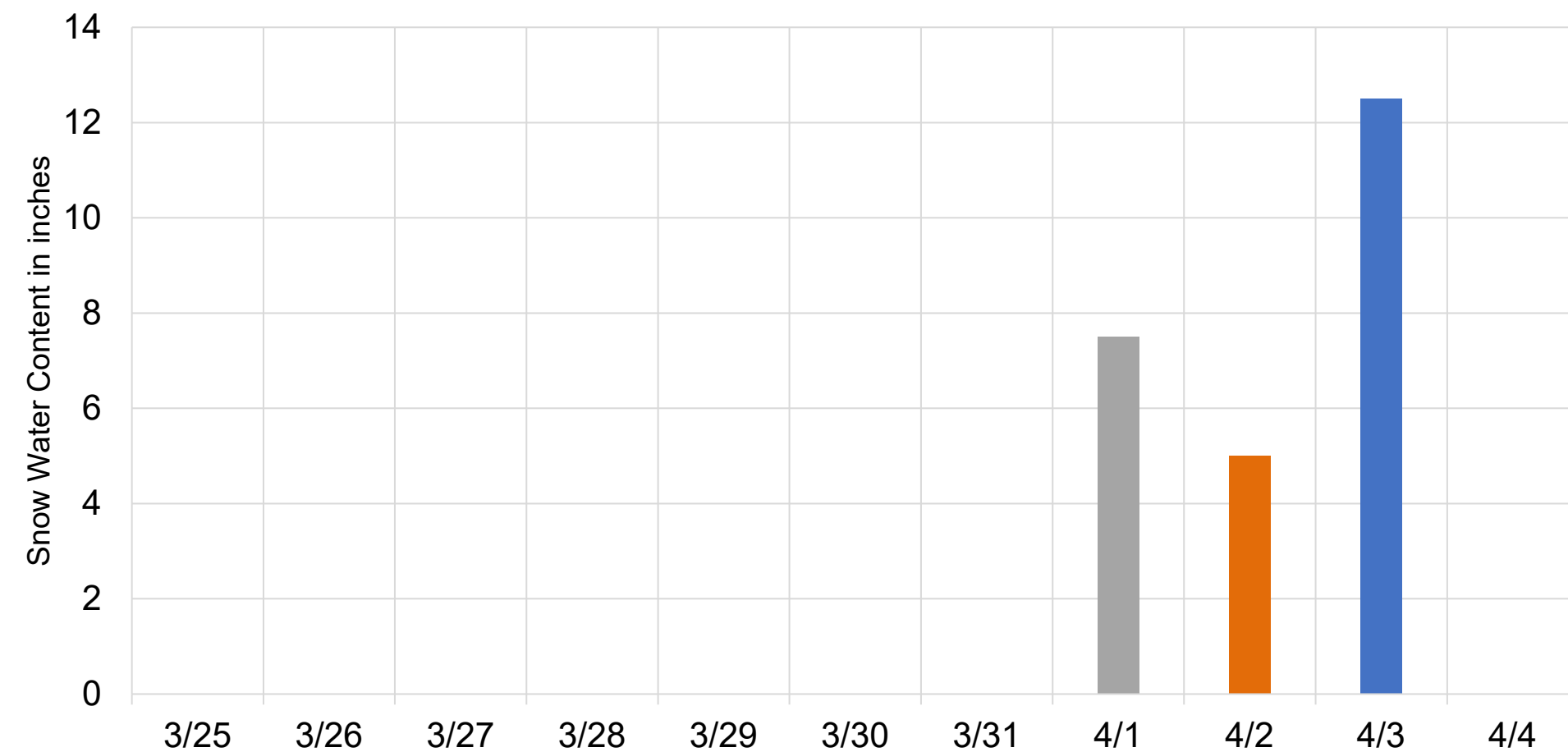


Intervening Precipitation

Precipitation that falls after the snow course was measured but before the first of the month



Precipitation that falls after the first of the month



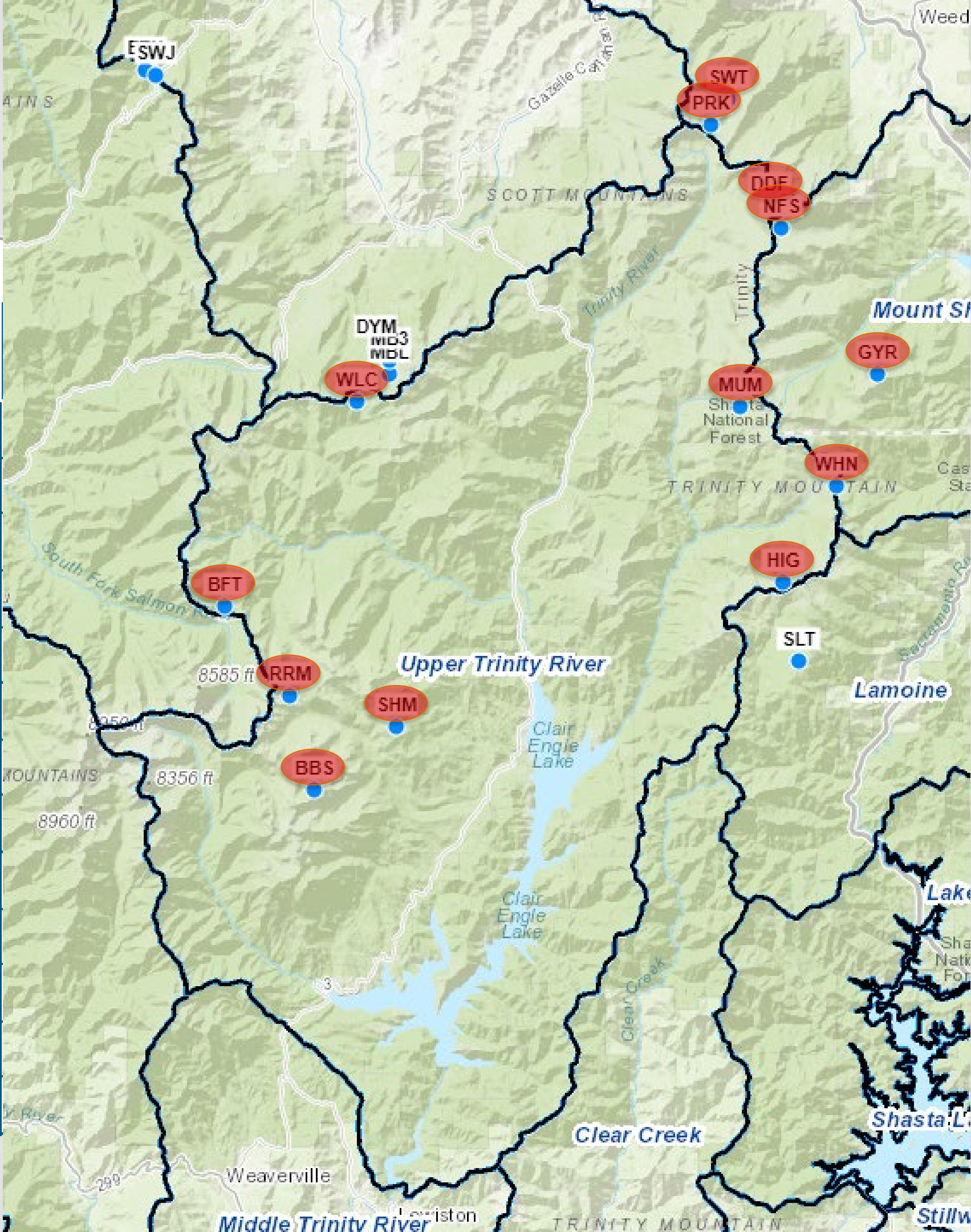
$$\text{Measured Snow Water Content} + \text{Intervening Precipitation} = \text{Adjusted Snow Water Content}$$



Snow Stations

Trinity River inflow to Lewiston Lake: Apr 01, 2023

CDEC ID	Station Name	River Basin	Dir	Elev (ft)	Lat °N
DDF	DEADFALL LAKES	Trin	↗	7,200	+41.3
PRK	PARKS CREEK	Shas	↗	6,700	+41.4
NFS	NORTH FORK SACRAMENTO R	Sac	↖	6,900	+41.3
RRM	RED ROCK MOUNTAIN	Trin	←	6,700	+41.0
BBS	BEAR BASIN	Trin	←	6,500	+41.0
GYR	GRAY ROCK LAKES	Sac	↗	6,200	+41.2
SHM	SHIMMY LAKE	Trin	←	6,400	+41.0
WLC	WOLFORD CABIN	Trin	↑	6,150	+41.2
HIG	HIGHLAND LAKES	Trin	↗	6,030	+41.1
SWT	SWEETWATER	Shas	↗	5,850	+41.4
MUM	MUMBO BASIN	Trin	↗	5,650	+41.2
WHN	WHALAN	Trin	↗	5,400	+41.2
BFT	BIG FLAT (COURSE)	Trin	←	5,100	+41.1



Snow Index Calculation for B120

$$D = A + (B \times C)$$



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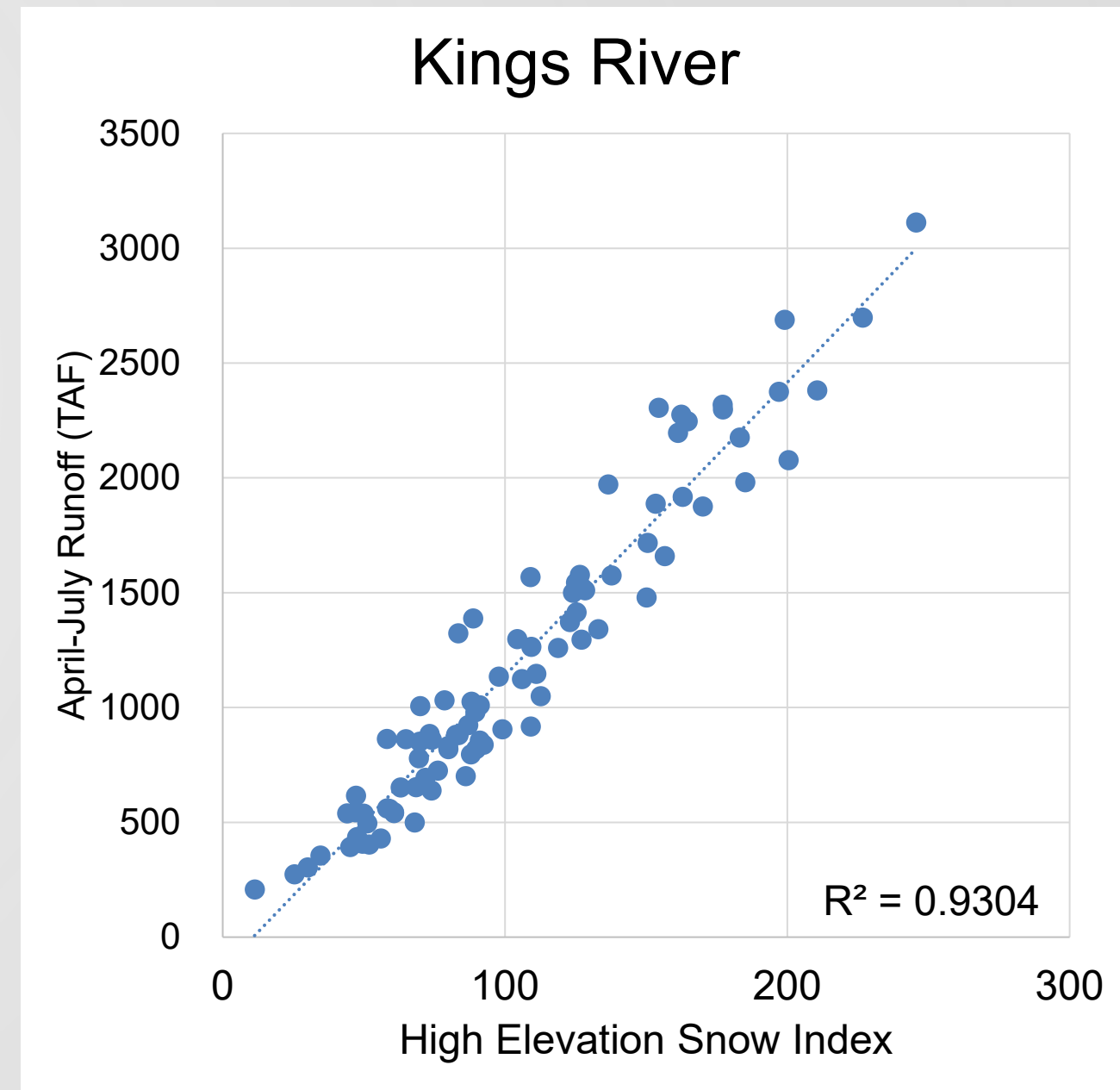
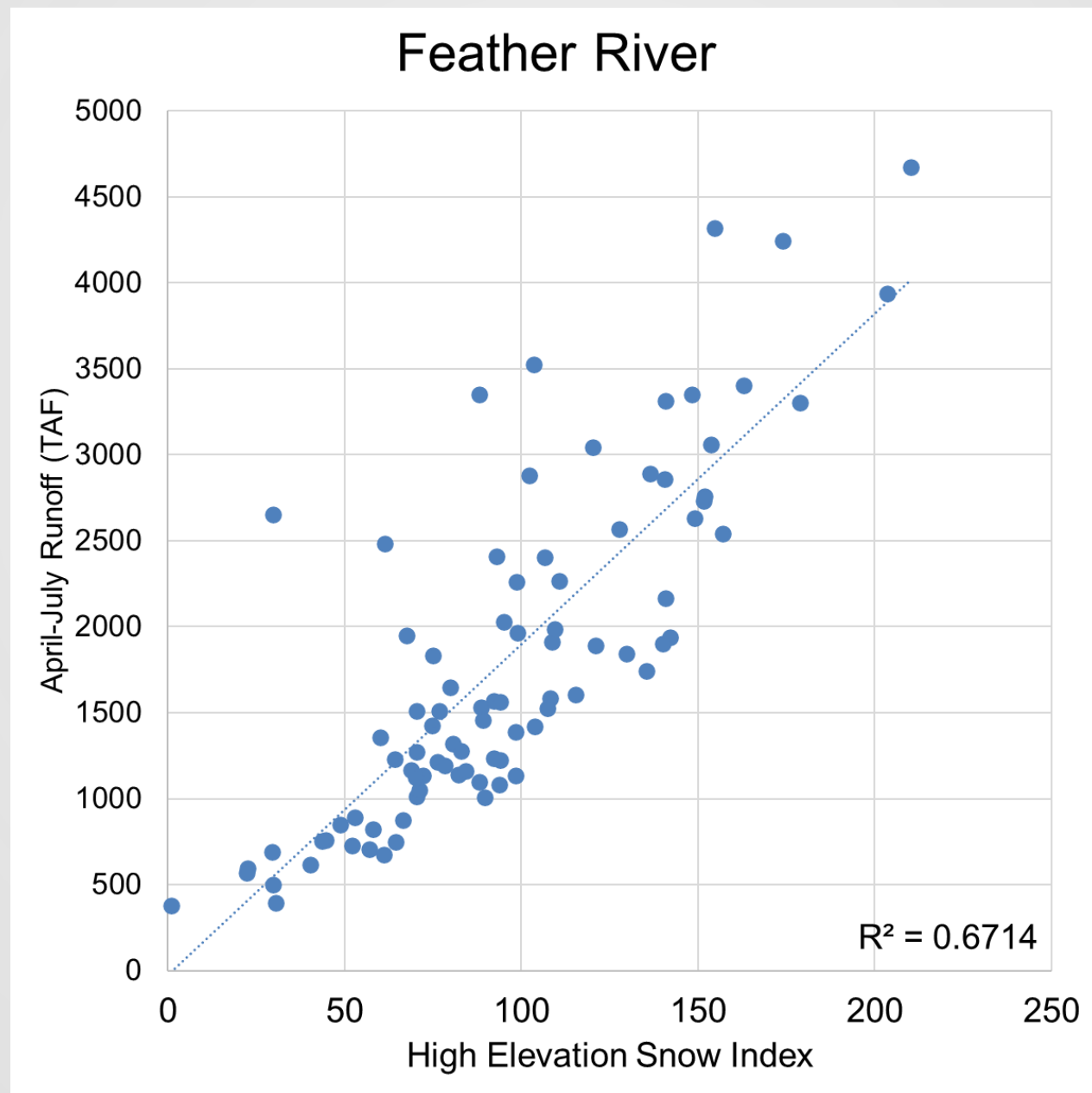
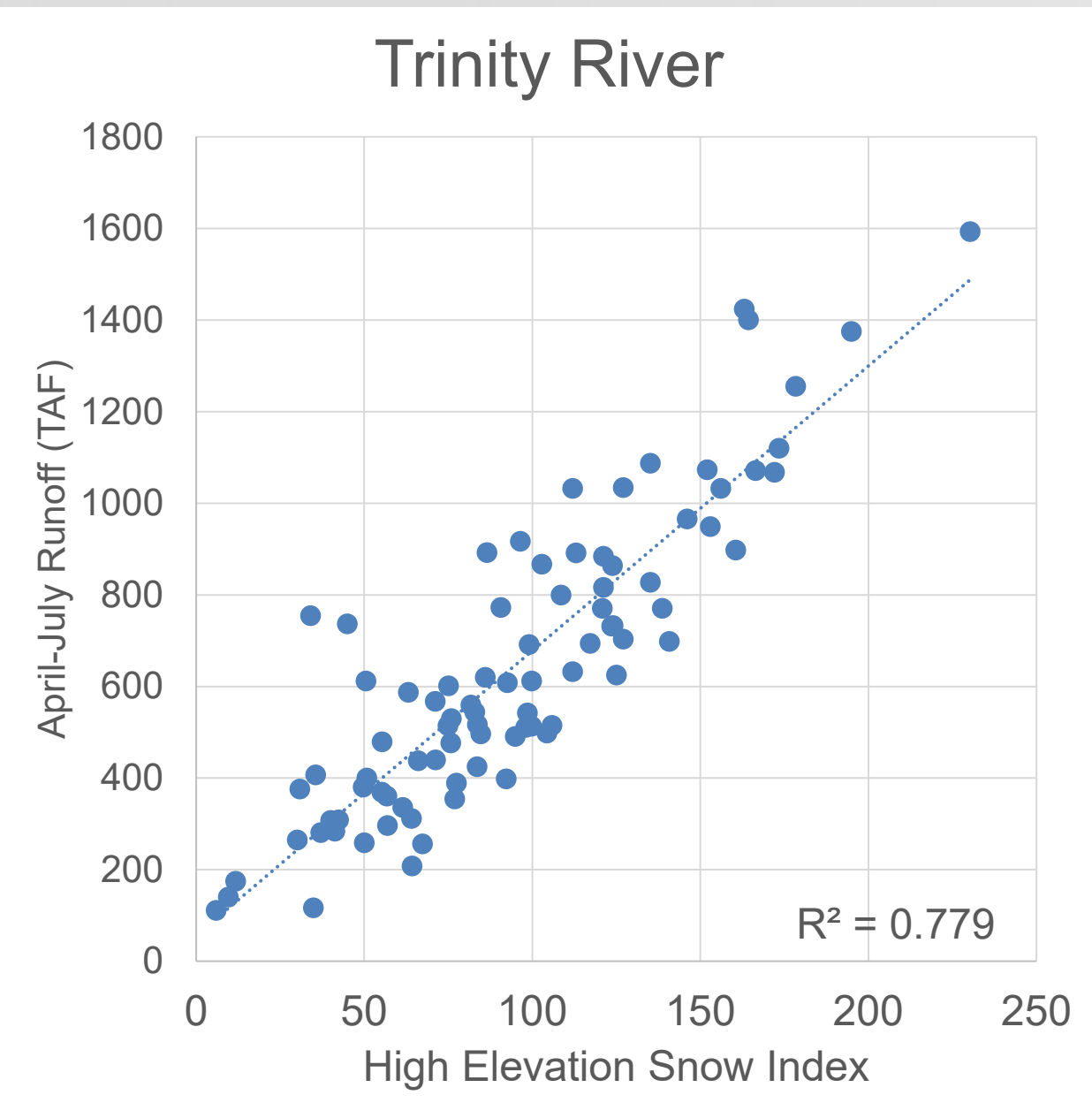
$$F = \frac{D}{E} \times 100$$

→ Snow WC Index Computations for Apr 01, 2023

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Close Editor						E	C										A	B	D	F						
Trinity River inflow to Lewiston Lake: Apr 01, 2023																										
CDEC ID	Station Name	River Basin	Dir	Elev (ft)	Lat °N	Apr 1 Avg	Precip Station	WC/PC Ratio	Feb 1 >>			Mar 1 >>			Apr 1							May 1				
									Adj WC	WC Idx	Adj Idx	Adj WC	WC Idx	Adj Idx	Exc.	Sched	Obs Dt	Obs WC	Int Pcp	Adj WC	WC Idx	Adj Idx	Adj WC	WC Idx	Adj Idx	
DDF	DEADFALL LAKES	Trin	↗	7,200	+41.3	31.22	WVR.DPCP	1.1	-	-	-	39.43	126.3	126.3	☐	_2345	03/24	41.00	1.67	42.84	137.2		44.39	137.2	142.2	
PRK	PARKS CREEK	Shas	↗	6,700	+41.4	32.00	MTS.DPCP	1.3	26.00	81.3	81.3	30.73	96.0	96.0	☐	_234_	03/24	45.00	0.00	45.00	140.6		46.28	140.6	144.6	
NFS	NORTH FORK SACRAMENTO R	Sac	↖	6,900	+41.3	24.02	MTS.DPCP	1.1	-	-	-	-	-	-	☐	__4_	03/24	40.00	0.00	40.00	166.5		41.55	166.5	173.0	
RRM	RED ROCK MOUNTAIN	Trin	←	6,700	+41.0	40.88	WVR.DPCP	1.5	39.50	96.6	96.6	-	-	-	☐	_2345	03/31	79.00	0.00	79.00	193.2		81.57	193.2	199.5	
BBS	BEAR BASIN	Trin	←	6,500	+41.0	38.25	WVR.DPCP	1.3	38.50	100.7	100.7	-	-	-	☐	_2345	04/02	71.50	-0.06	71.42	186.7		74.18	186.7	193.9	
GYR	GRAY ROCK LAKES	Sac	↗	6,200	+41.2	44.70	MTS.DPCP	2.1	-	-	-	-	-	-	☒	~~_2_4_~~	03/26	37.00	0.00	37.00	82.8		39.70	82.8	88.8	
SHM	SHIMMY LAKE	Trin	←	6,400	+41.0	44.04	WVR.DPCP	1.7	50.50	114.7	114.7	50.12	113.8	113.8	☐	~~_2345~~	-	71.20	-0.02	71.17	161.6		73.80	161.6	167.6	
WLC	WOLFORD CABIN	Trin	↑	6,150	+41.2	32.19	WVR.DPCP	1.2	-	-	-	-	-	-	☐	__4_	04/03	50.00	-0.08	49.90	155.0		51.88	155.0	161.2	
HIG	HIGHLAND LAKES	Trin	↗	6,030	+41.1	34.42	MTS.DPCP	1.6	41.50	120.6	120.6	49.74	144.5	144.5	☐	_2345	-	-	-	-	-		-	-	-	
SWT	SWEETWATER	Shas	↗	5,850	+41.4	12.74	MTS.DPCP	0.7	16.50	129.5	129.5	20.85	163.6	163.6	☐	_234_	03/24	26.50	0.00	26.50	208.0		27.73	208.0	217.7	
MUM	MUMBO BASIN	Trin	↗	5,650	+41.2	21.57	MTS.DPCP	1.2	-	-	-	35.91	166.5	166.5	☐	__4_	03/31	42.00	0.00	42.00	194.7		44.05	194.7	204.2	
WHN	WHALAN	Trin	↗	5,400	+41.2	21.09	MTS.DPCP	1.0	-	-	-	-	-	-	☐	__4_	03/31	54.00	0.00	54.00	256.0		57.01	256.0	270.3	
BFT	BIG FLAT (COURSE)	Trin	←	5,100	+41.1	11.49	WVR.DPCP	0.5	16.00	139.3	139.3	14.77	128.6	128.6	☐	_2345	-	-	-	-	-		-	-	-	
High Snowpack Average				4,500'	+41.1	29.89				32.64	111.8	111.8	34.51	134.2	134.2						50.80	171.1	180.0	52.92	171.1	178.5
Historical Median WC Increment										26.0	26.0		2.0	2.0						0.0	7.3		0.0	7.3		
Forecasted Apr 1 WC Index										137.8	137.8		136.2	136.2						171.1	187.3		0.0	0.0		

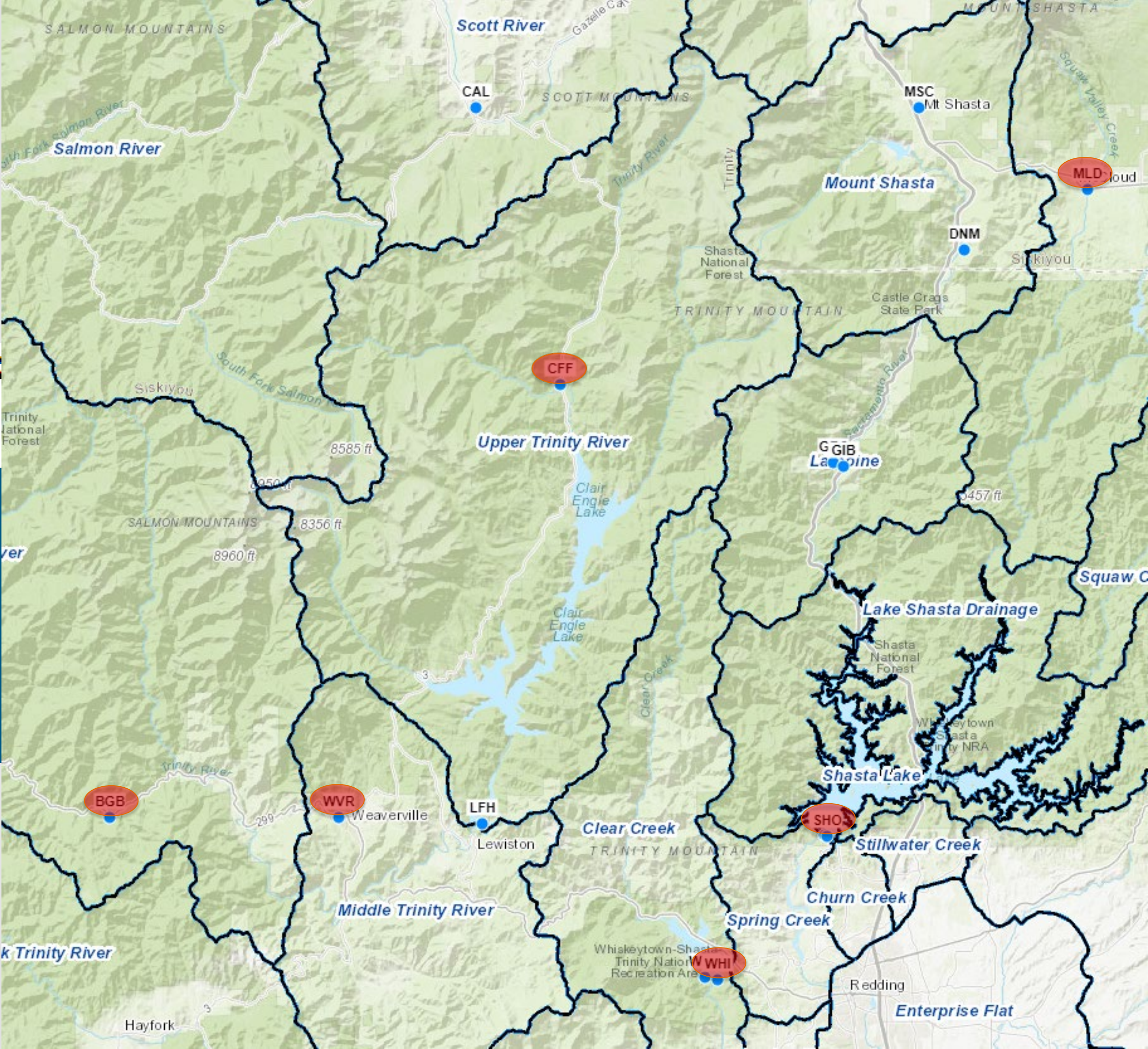
Correlation of April-July Runoff to Snow Index



Precipitation Stations

Trinity River inflow to Lewiston Lake: Apr 01, 2024

ID	Station Name	River Basin	Dir	Elev (ft)	Lat °N
Scale					
CFF	COFFEE CREEK RANGER ST	Trin	⊕	4,400'	+41.1
MLD	MCCLOUD	McCl	→	3,280'	+41.3
WVR	WEAVERVILLE RS	Trin	↙	2,050'	+40.7
WHI	WHISKEYTOWN DAM (USBR)	Sac	↓	1,210'	+40.6
BGB	BIG BAR	Trin	↙	1,270'	+40.7
SHA	SHASTA DAM (USBR)	Sac	↘	1,067'	+40.7



Precipitation Index Calculation for B120



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➔ Precipitation Index Computations for Apr 01, 2023

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Trinity River inflow to Lewiston Lake: Apr 01, 2023

ID	Station Name	River Basin	Dir	Elev (ft)	Lat °N	O-M Avg	Oct >>		Nov >>		Dec >>		Oct-Dec		Jan >>		Feb >>		Mar				A-J Avg	Apr		May		Jun		O-J Obs	WY Avg
							Prec.	Index	Prec.	Index	Prec.	Index	Index	Adj.	Prec.	Index	Prec.	Index	Exc.	Prec.	Ind.	Adj.		Prec.	Index	Prec.	Index	Prec.	Index		
Scale Factor							0.5		0.6		0.7				0.8		0.9		1.0					1.0		0.8		0.6			
CFF	COFFEE CREEK RANGER ST	Trin	⊕	4,400'	+41.1	35.70	0.00	0.0	2.76	4.6	13.00	25.5	30.1	30.1	18.18	40.7	4.79	12.1	☐	14.35	40.2		6.16	4.85	78.8	-	-	-	-	53.08	54.23
MLD	MCCLOUD	McCl	→	3,280'	+41.3	30.83	0.00	0.0	2.77	5.4	11.73	26.6	32.0	32.0	15.68	40.7	3.62	10.6	☐	12.31	39.9		6.65	4.49	67.5	-	-	-	-	46.11	47.55
WVR	WEAVERVILLE RS	Trin	↙	2,050'	+40.7	24.47	0.00	0.0	2.06	5.1	9.85	28.2	33.2	33.2	9.33	30.5	2.95	10.9	☐	9.29	38.0		4.58	2.83	61.8	-	-	-	-	33.48	37.40
WHI	WHISKEYTOWN DAM (USBR)	Sac	↓	1,210'	+40.6	42.05	0.00	0.0	3.80	5.4	11.74	19.5	25.0	25.0	22.91	43.6	5.62	12.0	☐	15.23	36.2		8.06	4.82	59.8	-	-	-	-	59.30	
BGB	BIG BAR	Trin	↙	1,270'	+40.7	22.23	0.06	0.1	2.57	6.9	9.58	30.2	37.2	37.2	10.89	39.2	4.00	16.2	☐	11.41	51.3		4.38	3.03	69.3	-	-	-	-	38.51	34.48
SHA	SHASTA DAM (USBR)	Sac	↘	1,067'	+40.7	41.61	0.00	0.0	3.37	4.9	11.76	19.8	24.6	24.6	18.59	35.7	4.25	9.2	☐	22.31	53.6		7.83	4.93	62.9	-	-	-	-	60.28	-
Basin Averages				4,500'	+41.1	32.82	0.01	0.0	2.89	5.4	11.28	25.0	30.4	30.4	15.93	38.4	4.21	11.8		14.15	43.2	43.2	6.28	4.16	66.7					48.46	43.42
Historical Median Index (month's share of period's index)															n/a		28.8			19.6			68.3		22.3		6.9				
October-March Indices												Jan 1	n/a	n/a	Feb 1	117.2	Mar 1	100.2		Apr 1	123.8	123.8		May 1		Jun 1		Jul 1			
April-July Indices														97.5		97.5		97.5				95.9									

$$D = \frac{B}{A} \times C \times 100$$

$$\text{April Precipitation Index} = \frac{\text{April Precipitation}}{\text{April - June Precipitation Average}} \times \text{Scale Factor} \times 100$$

$$78.8 = \frac{4.85}{6.16} \times 1.0 \times 100$$



CALIFORNIA
DEPARTMENT OF
WATER RESOURCES

Precipitation Index Calculation for B120

What about May and June?



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Precipitation Index Computations for Apr 01, 2023

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Trinity River inflow to Lewiston Lake: Apr 01, 2023

ID	Station Name	River Basin	Dir	Elev (ft)	Lat °N	O-M Avg	Oct >>		Nov >>		Dec >>		Oct-Dec		Jan >>		Feb >>		Mar				A-J Avg	Apr		May		Jun		O-J Obs	WY Avg				
							Prec.	Index	Prec.	Index	Prec.	Index	Index	Adj.	Prec.	Index	Prec.	Index	Exc.	Prec.	Ind.	Adj.		Prec.	Index	Prec.	Index	Prec.	Index						
Scale Factor							0.5		0.6		0.7				0.8		0.9		1.0					1.0		0.8		0.6							
CFF	COFFEE CREEK RANGER ST	Trin	⊕	4,400'	+41.1	35.70	0.00	0.0	2.76	4.6	13.00	25.5	30.1	30.1	18.18	40.7	4.79	12.1	☐	14.35	40.2		6.16	4.85	78.8	-	-	-	-	53.08	54.23				
MLD	MCCLOUD	McCl	→	3,280'	+41.3	30.83	0.00	0.0	2.77	5.4	11.73	26.6	32.0	32.0	15.68	40.7	3.62	10.6	☐	12.31	39.9		6.65	4.49	67.5	-	-	-	-	46.11	47.55				
WVR	WEAVERVILLE RS	Trin	↙	2,050'	+40.7	24.47	0.00	0.0	2.06	5.1	9.85	28.2	33.2	33.2	9.33	30.5	2.95	10.9	☐	9.29	38.0		4.58	2.83	61.8	-	-	-	-	33.48	37.40				
WHI	WHISKEYTOWN DAM (USBR)	Sac	↓	1,210'	+40.6	42.05	0.00	0.0	3.80	5.4	11.74	19.5	25.0	25.0	22.91	43.6	5.62	12.0	☐	15.23	36.2		8.06	4.82	59.8	-	-	-	-	59.30					
BGB	BIG BAR	Trin	↙	1,270'	+40.7	22.23	0.06	0.1	2.57	6.9	9.58	30.2	37.2	37.2	10.89	39.2	4.00	16.2	☐	11.41	51.3		4.38	3.03	69.3	-	-	-	-	38.51	34.48				
SHA	SHASTA DAM (USBR)	Sac	↘	1,067'	+40.7	41.61	0.00	0.0	3.37	4.9	11.76	19.8	24.6	24.6	18.59	35.7	4.25	9.2	☐	22.31	53.6		7.83	4.93	62.9	-	-	-	-	60.28	-				
Basin Averages				4,500'	+41.1	32.82	0.01	0.0	2.89	5.4	11.28	25.0	30.4	30.4	15.93	38.4	4.21	11.8		14.15	43.2	43.2	6.28	4.16	66.7					48.46	43.42				
Historical Median Index (month's share of period's index)															n/a		28.8				19.6			68.3		22.3		6.9							
October-March Indices												Jan 1	n/a	n/a	Feb 1	117.2	Mar 1	100.2		Apr 1	123.8	123.8		May 1		Jun 1			Jul 1						
April-July Indices														97.5		97.5		97.5				95.9													

$$D = A + B + C$$

April – June Precipitation Index = April Index + May Historical Median Index + June Historical Median Index

$$95.9 = 66.7 + 22.3 + 6.9$$

D

A

B

C

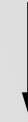
Median Increments

Feb 1 Forecast

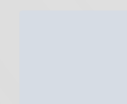


	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Oct-Mar Runoff										
High Snow										
Low Snow										
Oct-Mar Precip										
Apr-Jun Precip										

Apr 1 Forecast



	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Jul
Oct-Mar Runoff										
High Snow										
Low Snow										
Oct-Mar Precip										
Apr-Jun Precip										



Observed



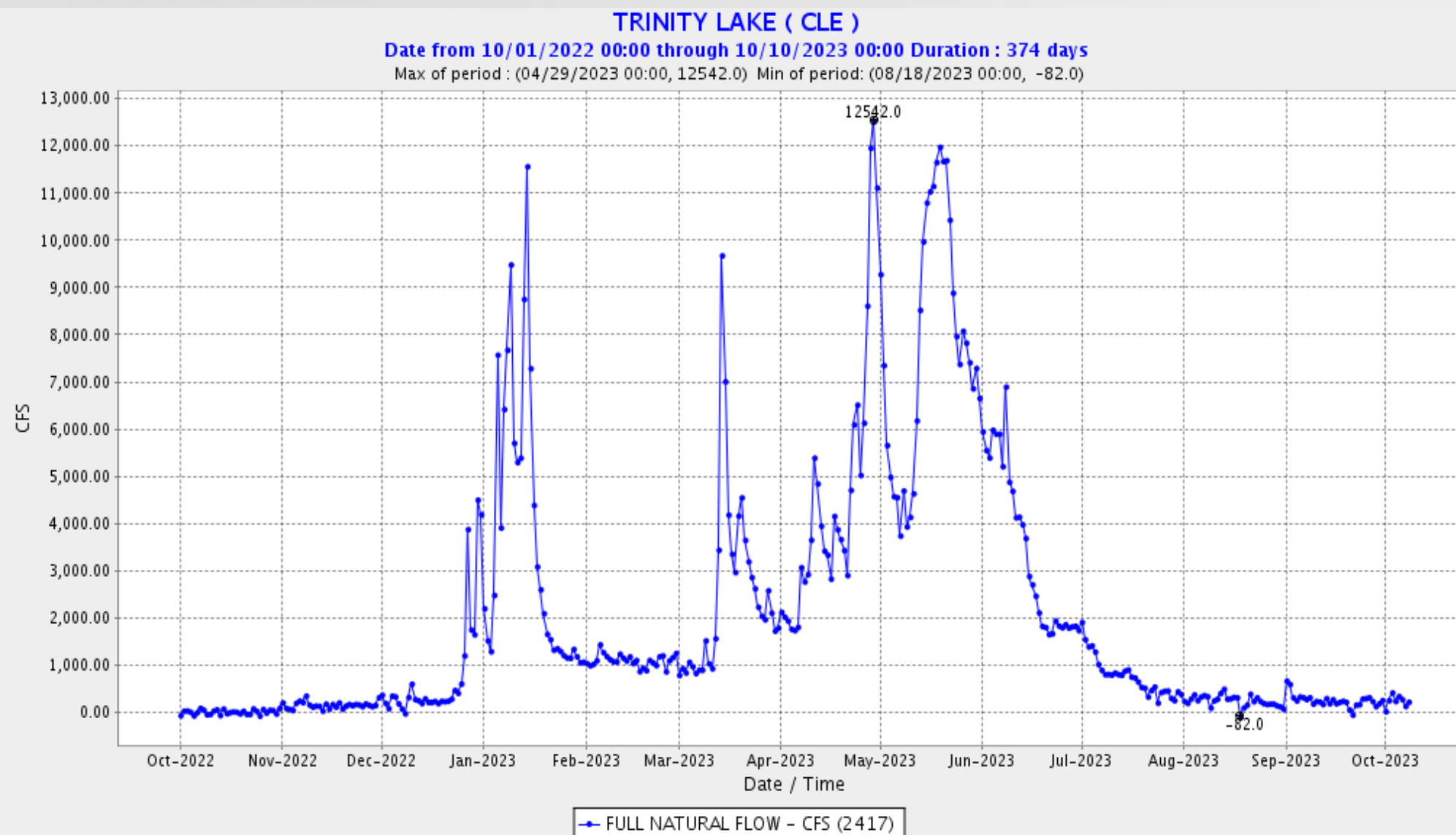
Best Estimate



Median Increment

Full Natural Flow (FNF)

- Daily and Monthly FNF calculated by USBR
 - <https://www.usbr.gov/mp/cvo/vungvari/trndop.pdf>
 - [CDEC Daily FNF \(CLE\)](#)
 - [CDEC Monthly FNF \(CLE\)](#)



Monthly FNF Calculations

FNF ID: **TNL**

Station: **TRINITY RIVER AT LEWISTON**

For the month: **April, 2023**

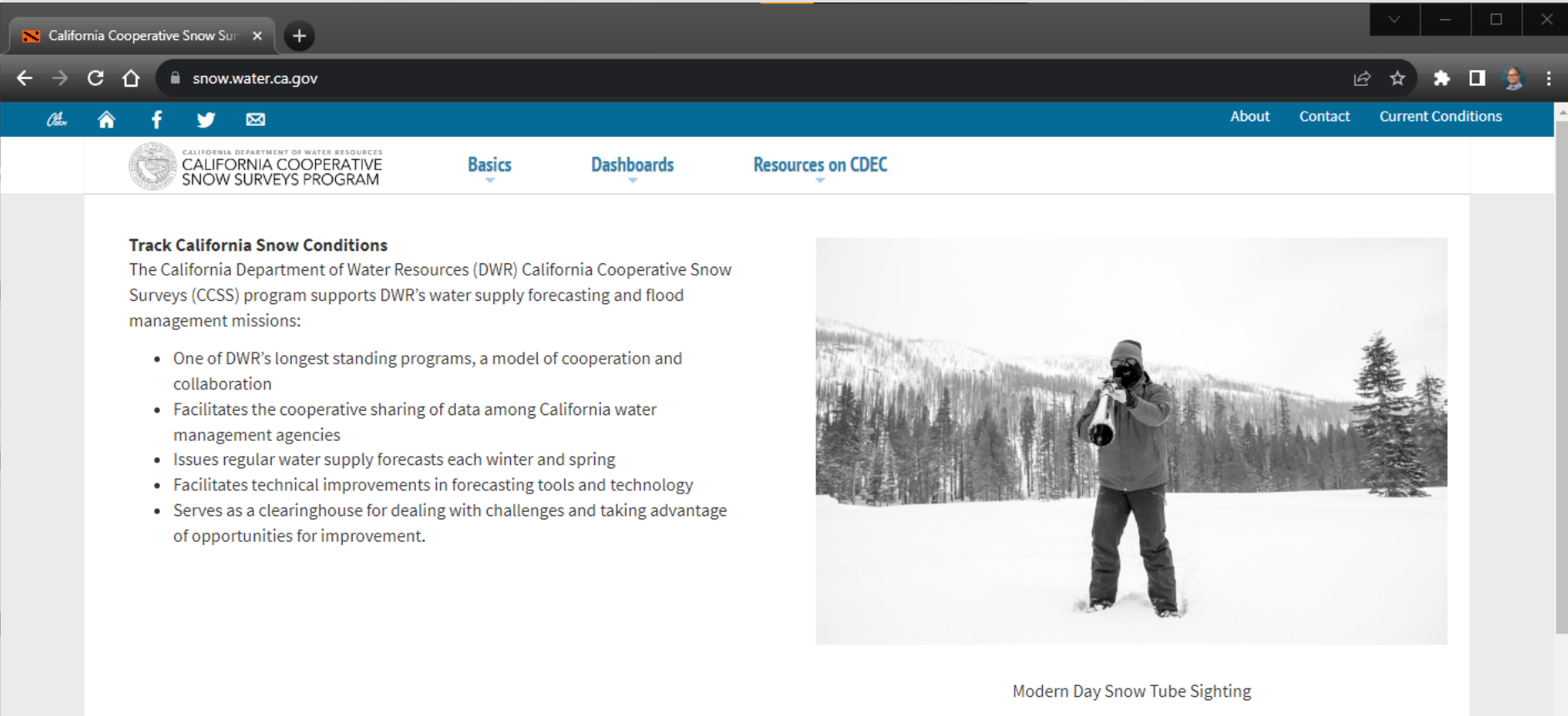
Print

Station ID	Station Name	Sensor Text	+/-	Value	Unit
TNL	TRINITY R AT LEWISTON	66-MON FLO	+	305,413	AF
JCR	JUDGE F CARR PH	69-DIVERSN	+	1,843	AF
CLE	TRINITY LAKE	68-LK EVAP	+	1,989	AF
CLE	TRINITY LAKE	15-STORAGE (Mar)910200 (Apr)889700	+	-20,500	AF
		Total Change in Storage		-20,500	AF
TNL	TRINITY RIVER AT LEWISTON	Computed Unimpaired Runoff		288,745	AF
		Mean Daily Flow		4,852	CFS
		Monthly Average		212,085	AF
		Percent of Average		136	%

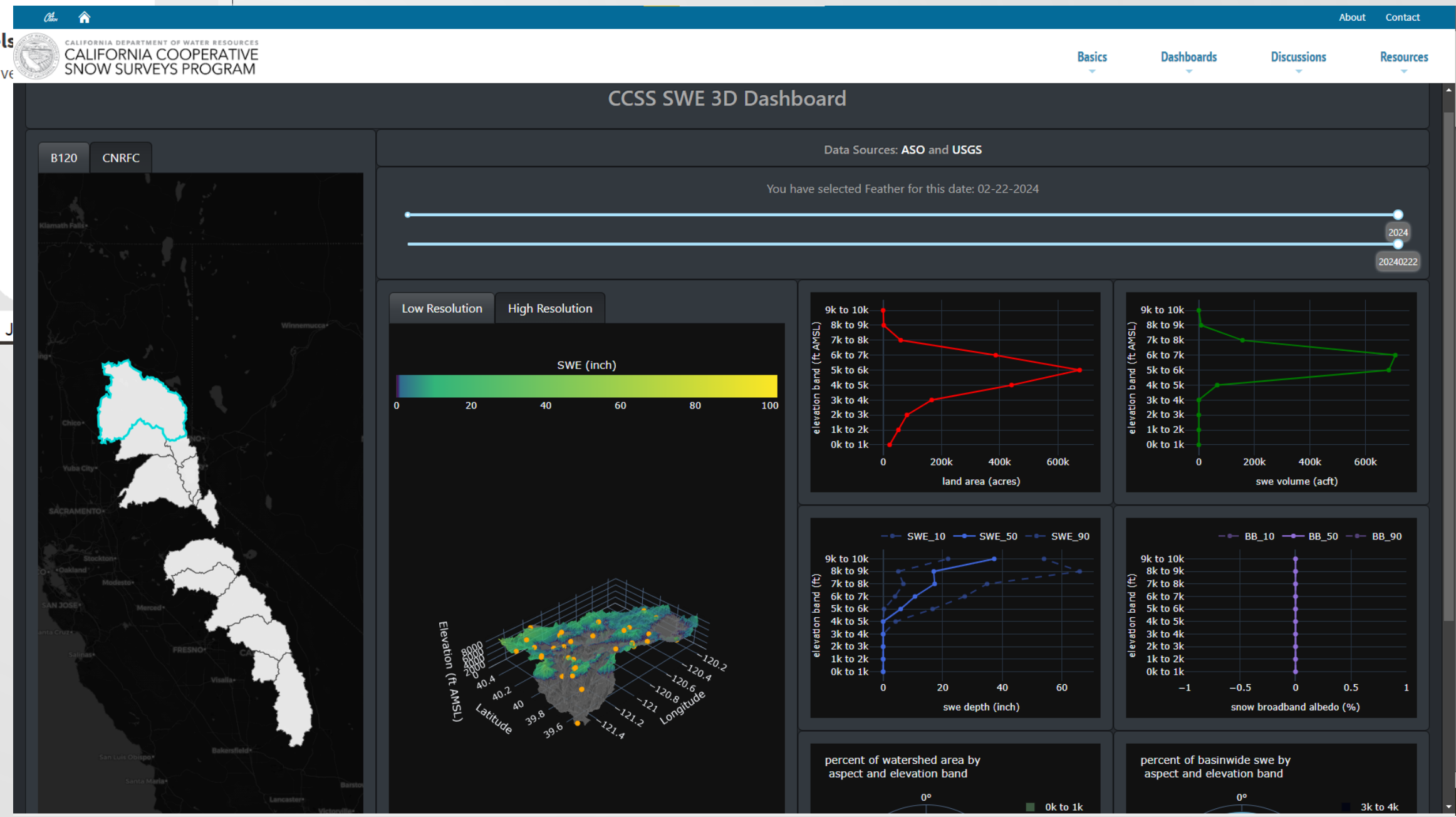
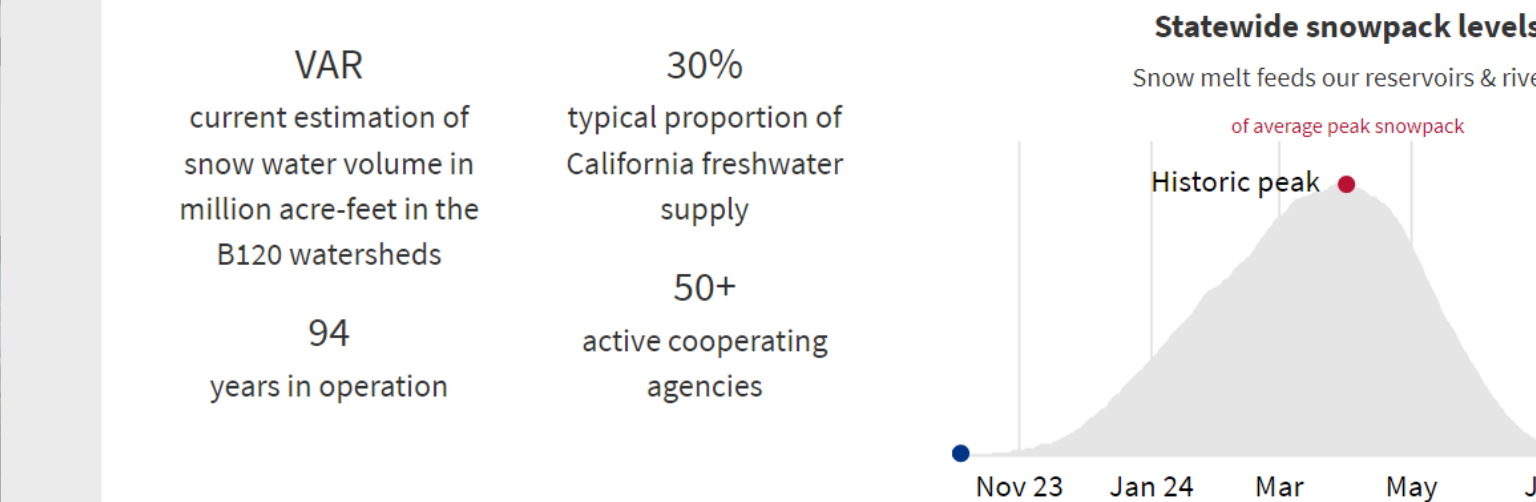
Trinity River B120 Statistical Models

Parameter Values	Equation Elements	Eq. 1		Eq. 2		Eq. 3		Eq. 5		Eq.2022	
		Equation Term	Runoff	Equation Term	Runoff	Equation Term	Runoff	Equation Term	Runoff	Equation Term	Runoff
Trinity River inflow to Lewiston Lake											
Basin Avg. A-J = 648 taf											
P[1] = 124 P[2] = 96 P[3] = 187 P[7] = 175	SNOW	4.96·P[3]	929	4.897·P[3]	917	5.0627·P[3]	948			0.2701·P[3] ^(1.5)	692
	OM_PRECIP	0.0072·P[1] ^(2.0)	110	1.077·P[1]	133	1.1979·P[1]	148	0.84·P[1]	104	30.7946·P[1] ^(0.5)	343
	AJ_PRECIP	0.0076·P[2] ^(2.0)	70	1.322·P[2] + 0.0028·P[2] ^(2.0)	152	1.7877·P[2] + 5.037E-5·P[2] ^(2.0)	172	1.9·P[2]	182	0.1606·P[2] ^(1.5)	151
	CONST	-8.7	-9	-101.0	-101	-169.0	-169	-254.3	-254	0.0 + (-241.1022)	-241
	PRE_AJ_RUNOFF							0.086·P[7]	15	4.2493·P[7] ^(0.5)	56
	HIGH_SNOW							5.63·P[3]	1054		
Basin Runoff (taf)			1100		1102		1099		1101		1001
Percent of Avg. AJ			170%		170%		170%		170%		155%

April 1, 2023 B120 50% Forecast Trinity = 1,030 TAF



Modern Day Snow Tube Sighting

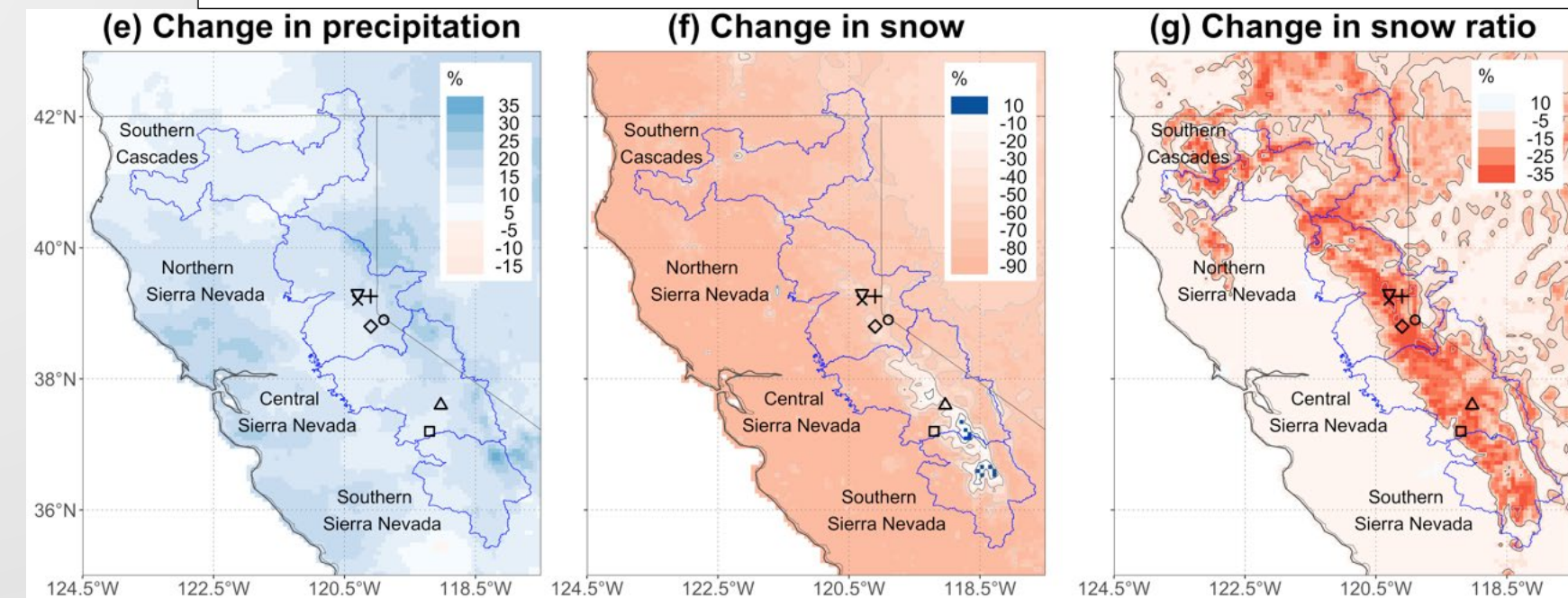
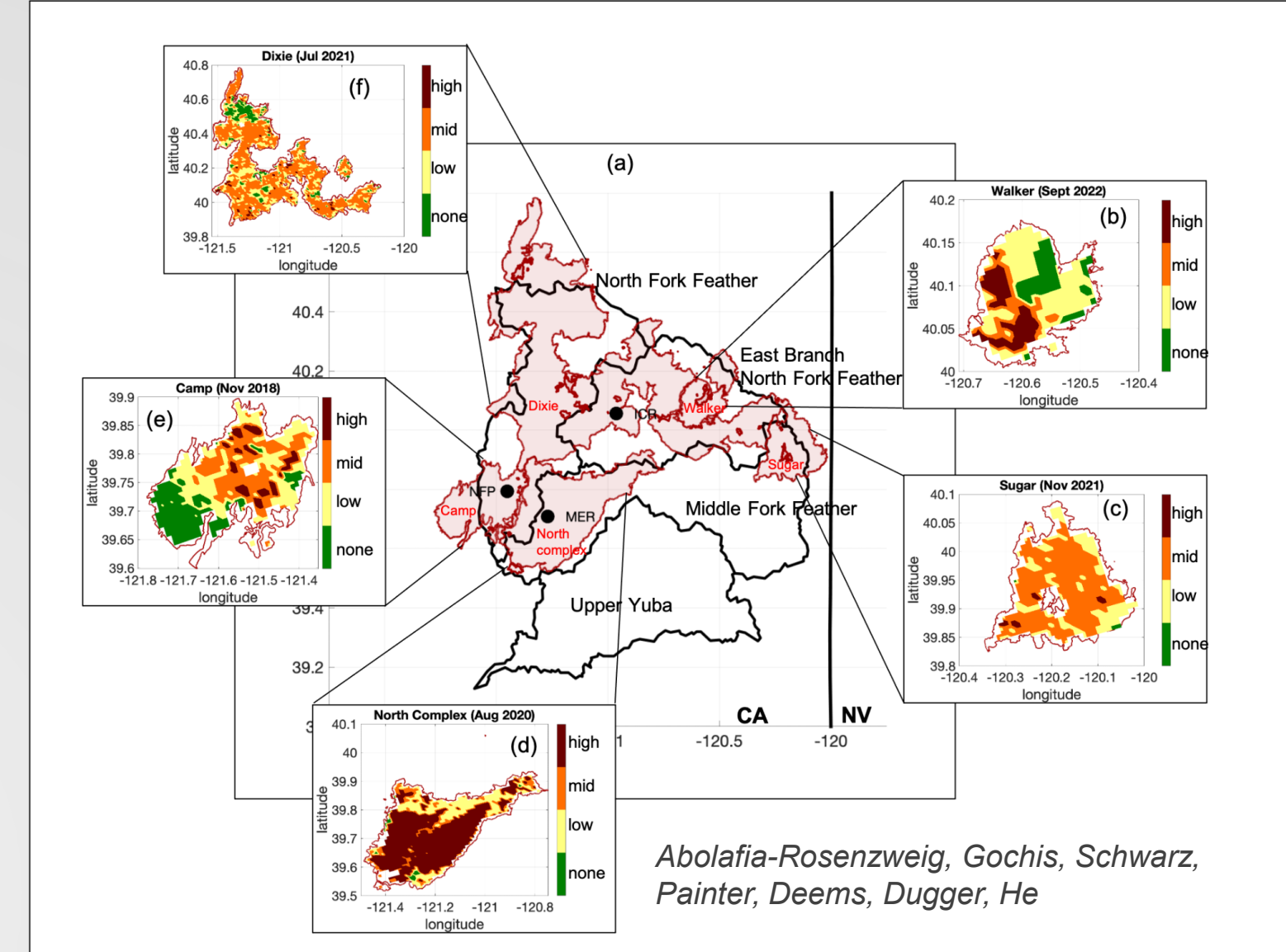


Bulletin 120 50% Exceedance Percent Error Timeseries



Climate Change Impacts on Snowpack and Runoff

- Warming climate leads to more rain instead of snow
- Rising snowline
- Increased winter flood frequency
- Impacts to flood control reservoir operations
- Snowfall distribution
- Wildfire impacts to watersheds
- Lowered snow albedo
- Loss of canopy leads to increased solar radiation
- Watershed runoff behaviors



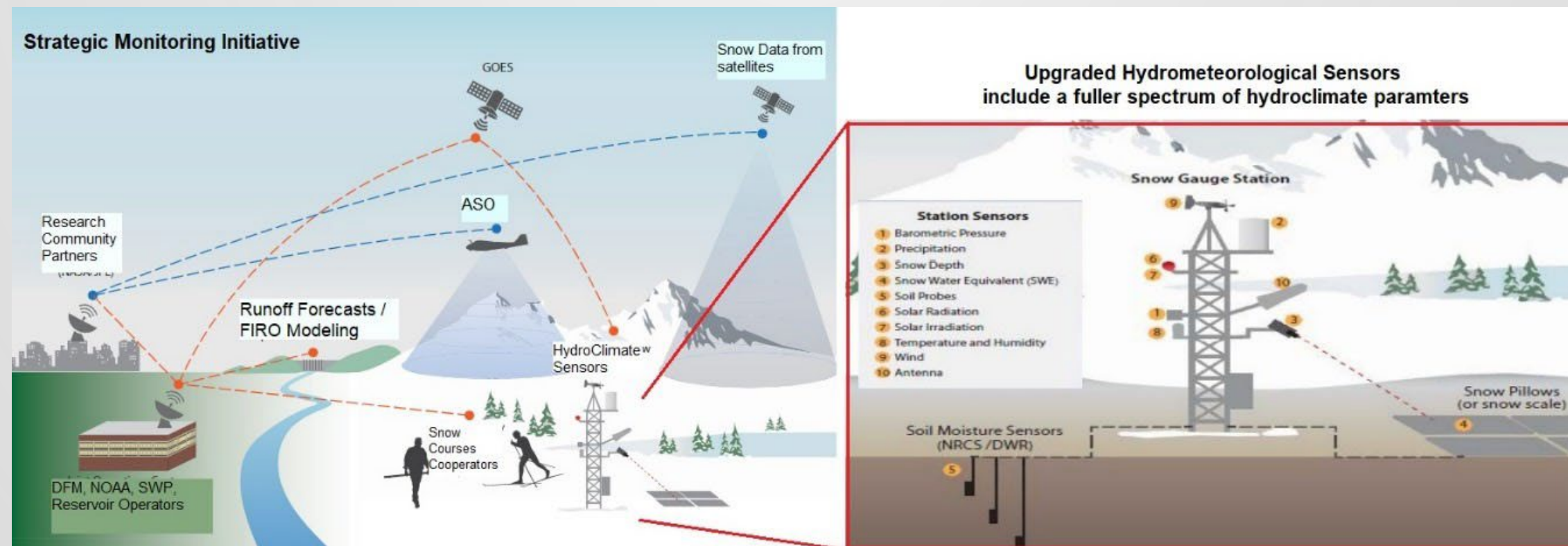
“Snow accumulation would decline to less than half of historical by late 21st century, with the greatest snow loss at mid elevations from 1500 m to 3300 m”

Shulgina, Gershunov, Hatchett, Guirguis, Subramanian, Clemesha, et al, 2023

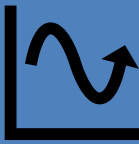
Observed and projected changes in snow accumulation and snowline in California's snow mountains

Roadmap for a Climate Resilient Forecasting Framework Goals

1. Transition from index-based statistical forecasting tools, such as linear regression of precipitation, snowpack, and runoff indices, to *spatially explicit, physically based, and climate informed* modeling tools such as watershed models that simulate the physical processes of snow accumulation and melt and can incorporate forecasts.
2. Create an integrated forecast platform that allows easier visual inspection of observed conditions and a customizable decision support dashboard that connects observations, high resolution near-term forecasting, standard weather forecasting, week 2 to 4 outlooks, sub-seasonal to seasonal outlooks, and water year outlooks.



Roadmap for a Climate Resilient Forecasting Framework Objectives

 Observation	 Forecasting	 Decision Support
1. Upgrade/replace Statewide Monitoring Network (SMN) in instrumentation 2. Centralized SMN facility for testing, calibration, fabrication, and storage 3. Fully develop spatially explicit data collection from radar, airborne remote sensing (AR-RECON and ASO) 4. Augment observed datasets with Basin Characterization Model (BCM)	1. Adapt new methods to produce accurate runoff forecasts 2. Develop physically based and climate informed modeling framework 3. Develop physically based WEHY model for Sacramento Basin 4. Develop S2S and long-range weather and climate forecasts 5. Augment capabilities to use USACE and CNRFC models for river forecasting and ER	1. Develop multi-platform observations display 2. Develop forecast model input file development tool 3. Develop forecast display systems supporting flood ER, FIRO, watershed forecasting, and climate change tracking 4. Advance data management and resources 5. Develop forecast model performance and hindcast tools available for public consumption

Aerial Remote Sensing of Snow Program (ARSS)



KINGS RIVER BASIN MARCH 31 - APRIL 2, 2023 SURVEY

Survey Date: March 31 - April 2, 2023
Survey # of Water Year 2023: 3
Report Delivery Date: April 6, 2023

Full basin SWE: 3772 ± 132 TAF
Change in SWE since Mar 16-17, 2023: + 280 TAF
Estimated snowline: 4600 feet

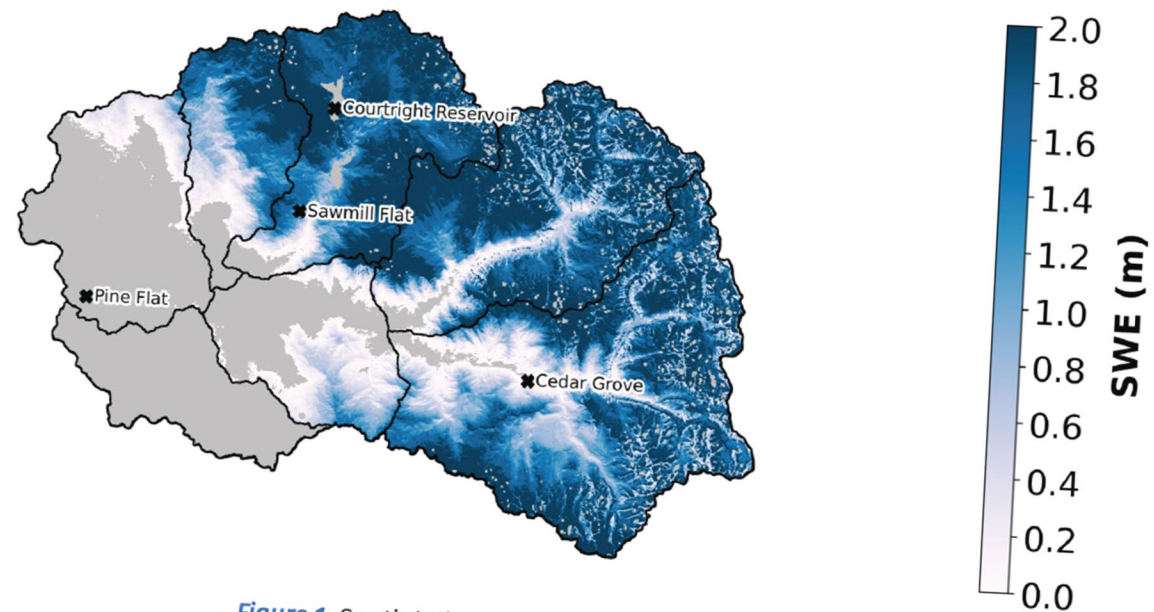


Figure 1. Spatial distribution of SWE depth (m).

YUBA RIVER BASIN APRIL 18, 2023 MODELING REPORT

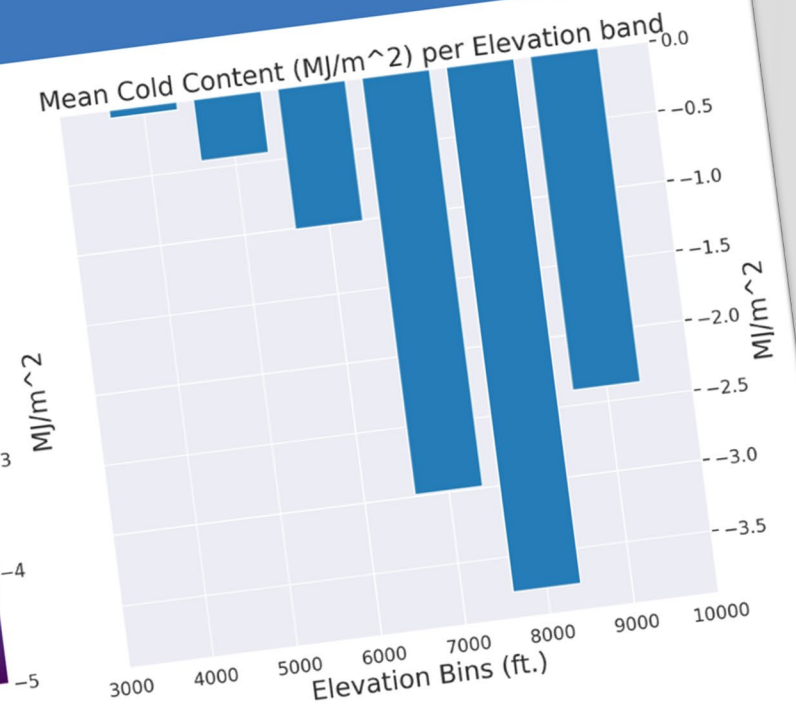
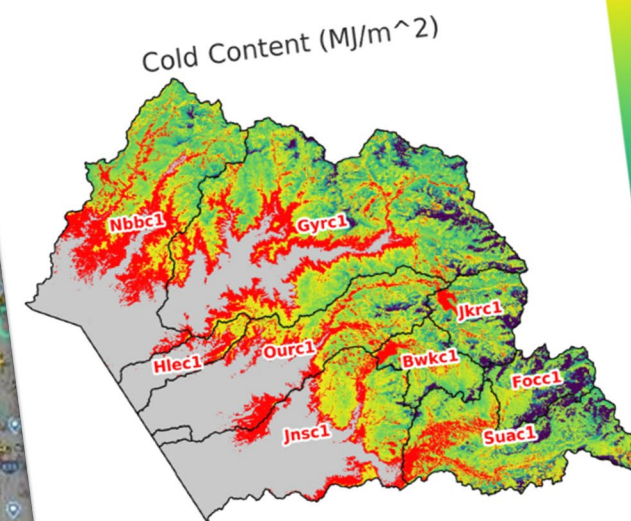
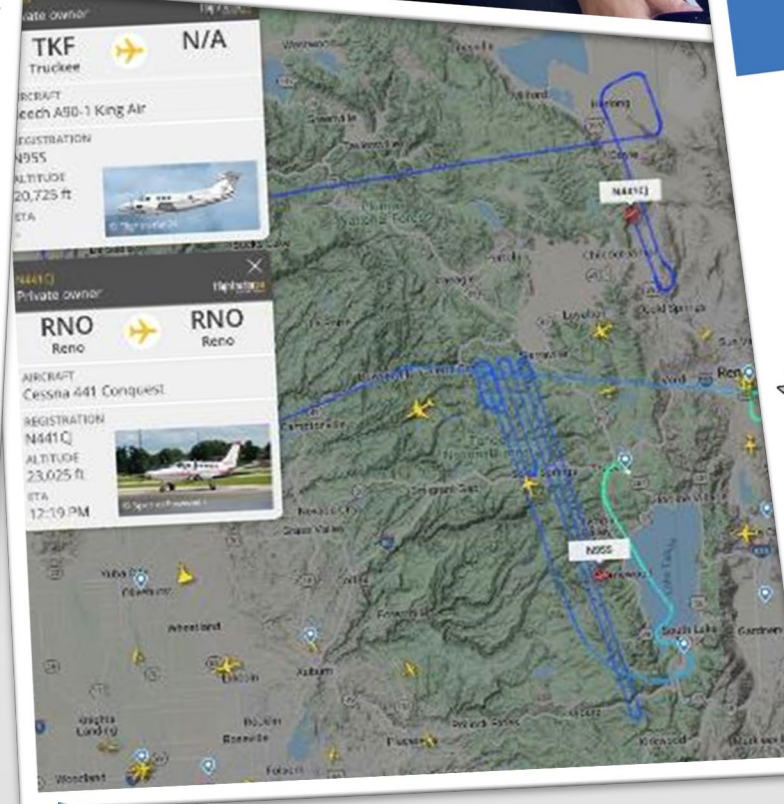


Fig.8 Cold Content as of 2023-04-18

The un-ripe snow represents approximately 92.50% of the basin SWE.

Airborne Snow Observatories, Inc.

mapping the two most critical snow properties to forecast runoff volume & timing

Snow Water Equivalent

Snow depth from lidar elevation

SWE from coupling with obs & modeled density

Snow Albedo

HySpex VSWIR spectrometers

Albedo & surface properties

Physical Modeling

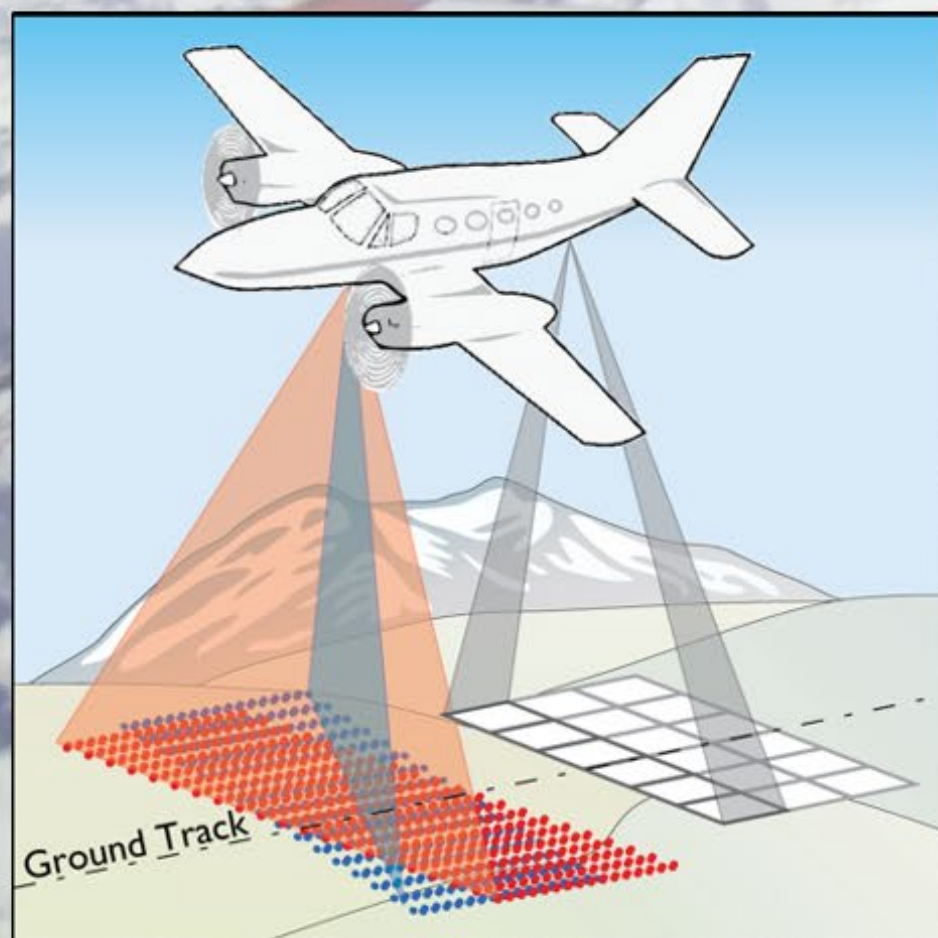
Coupled lidar & spectrometer

Physical snowpack & runoff modeling

Unique Operations

High-altitude operations

Rapid product turnaround



JPL



Basin snowpack indexed using station data

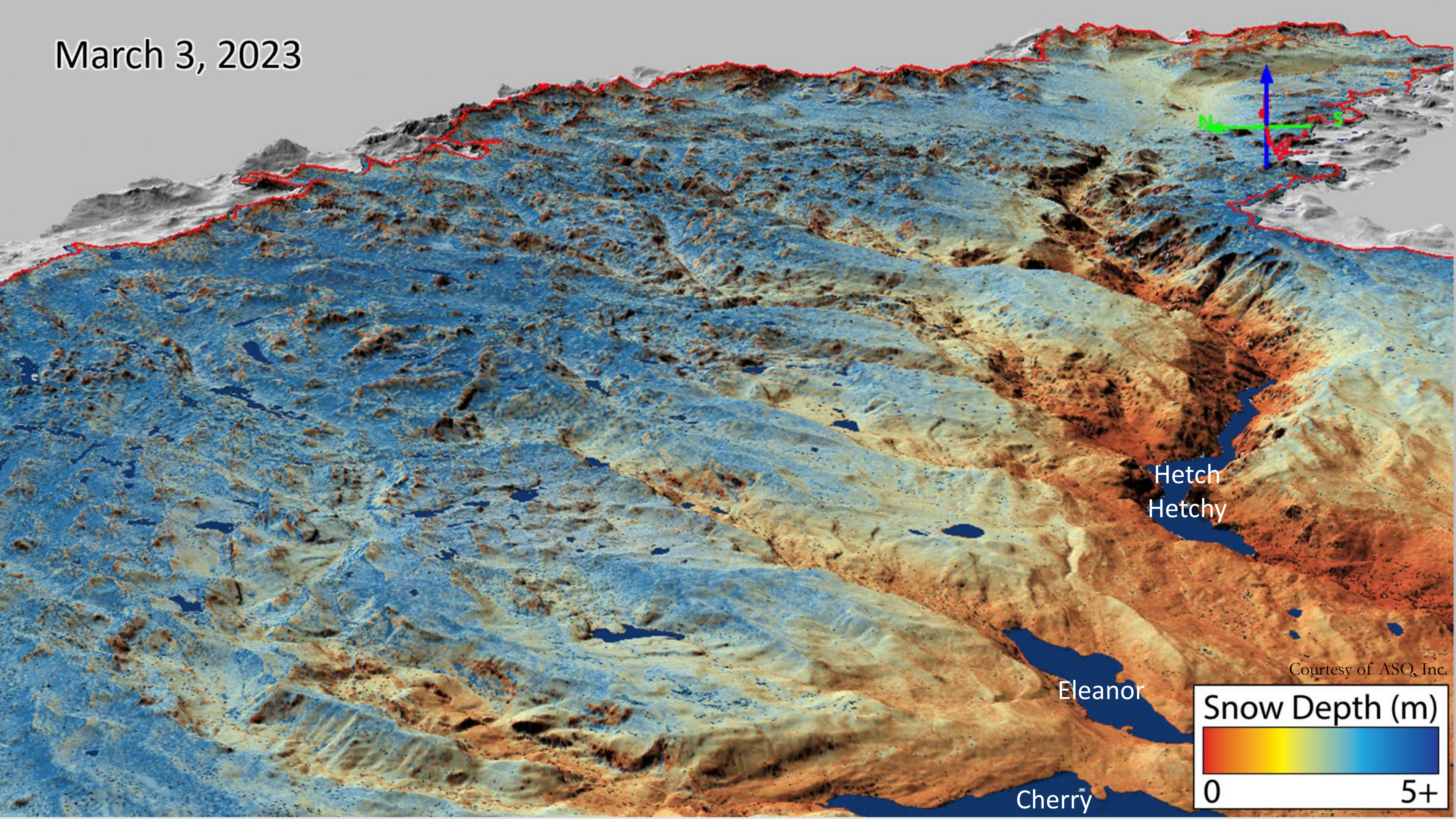


Courtesy of ASQ, Inc.

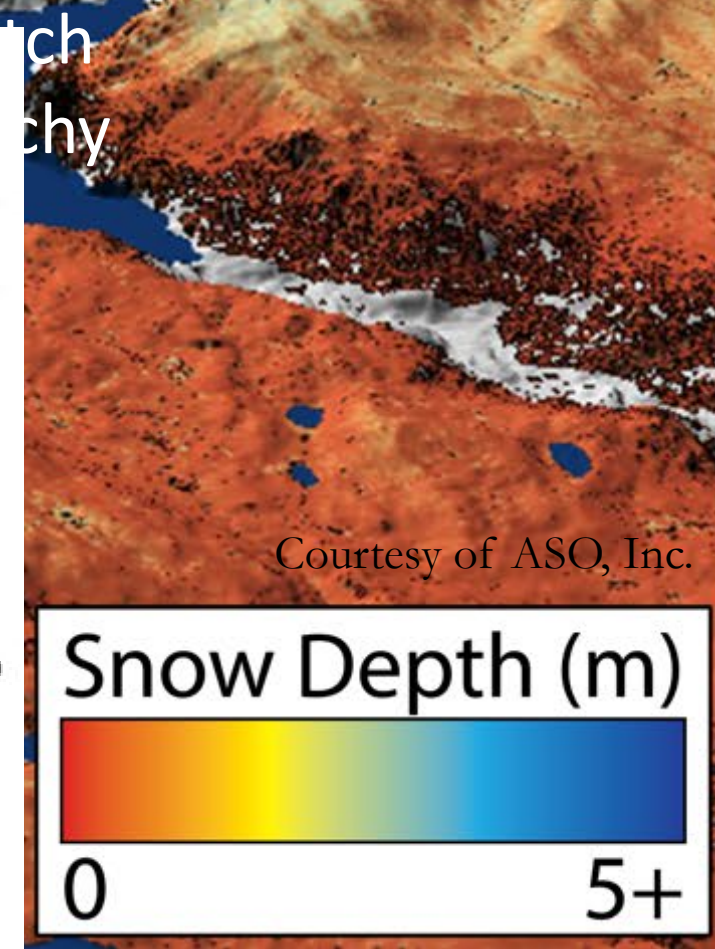
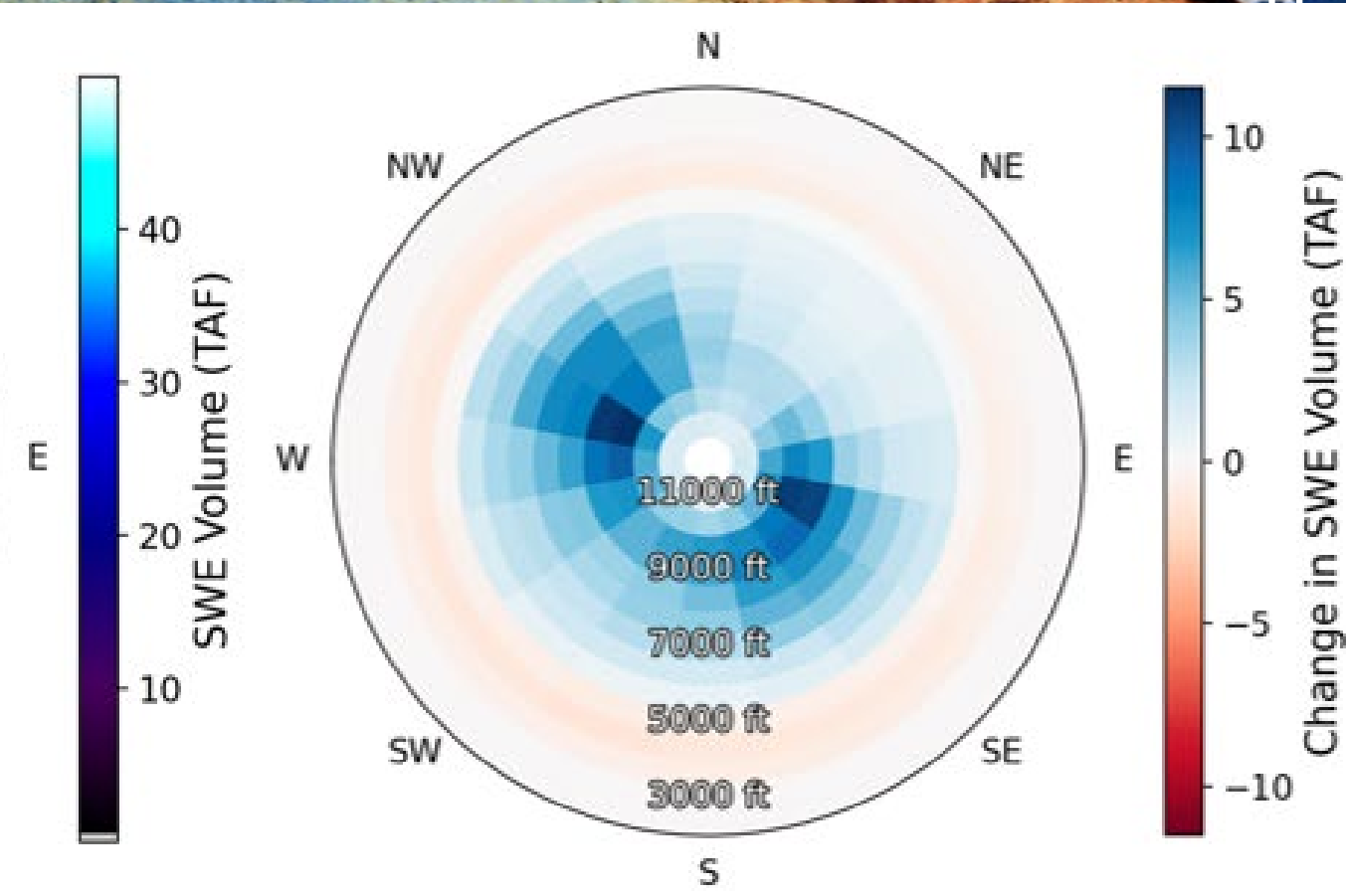
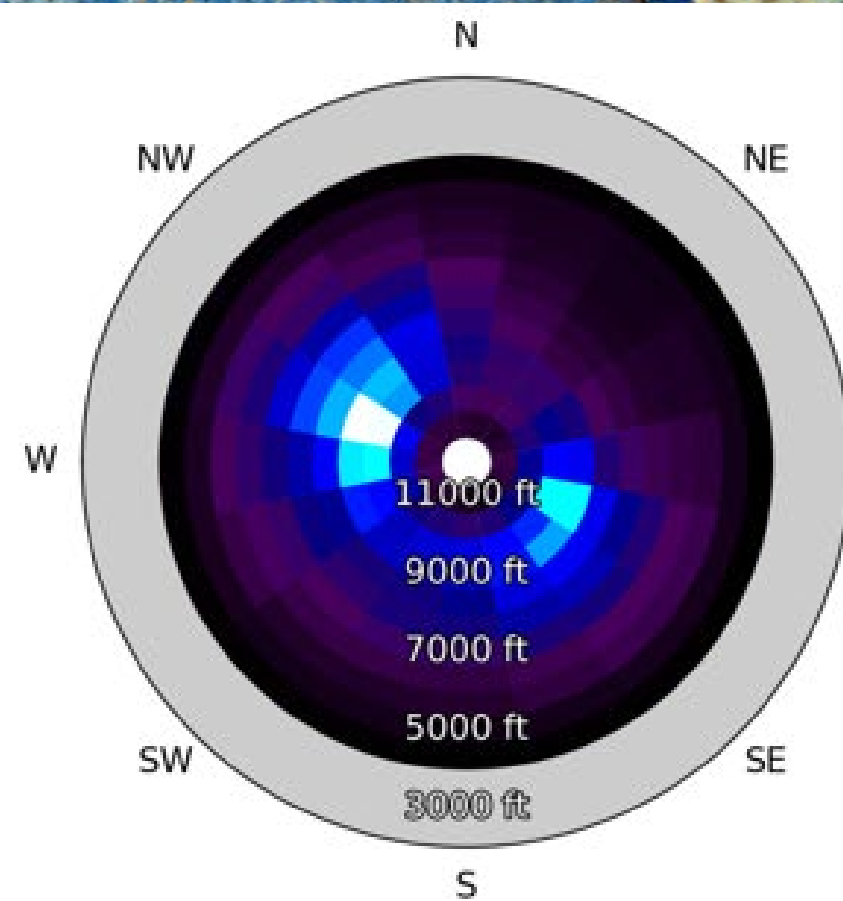
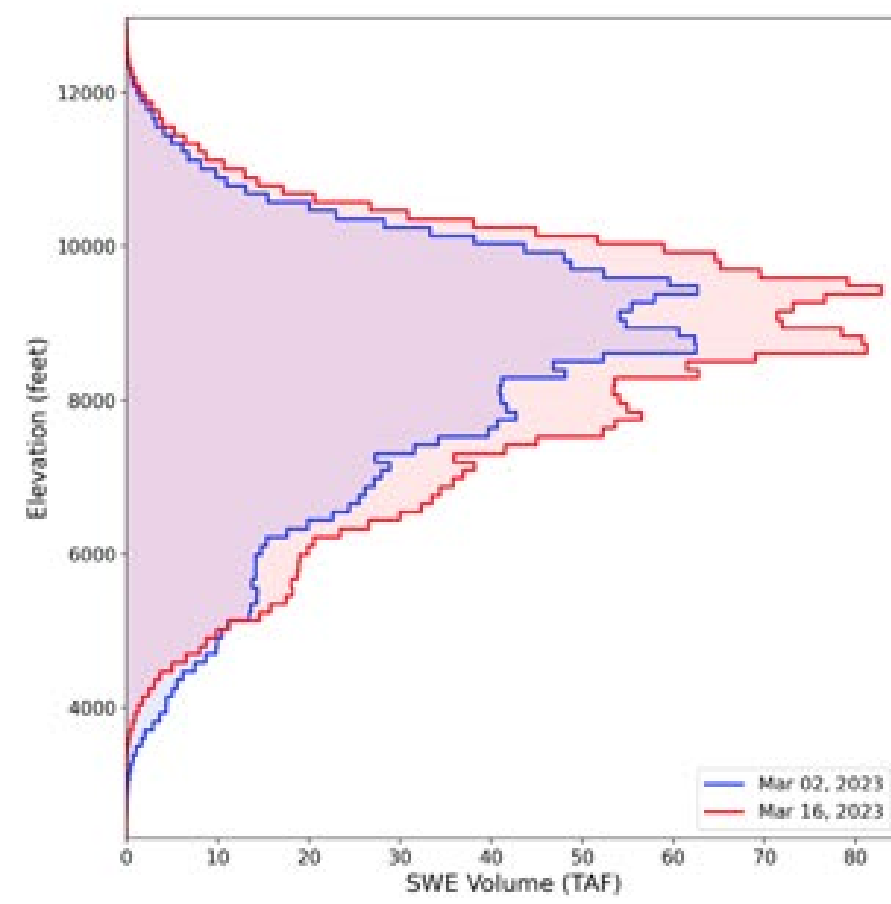
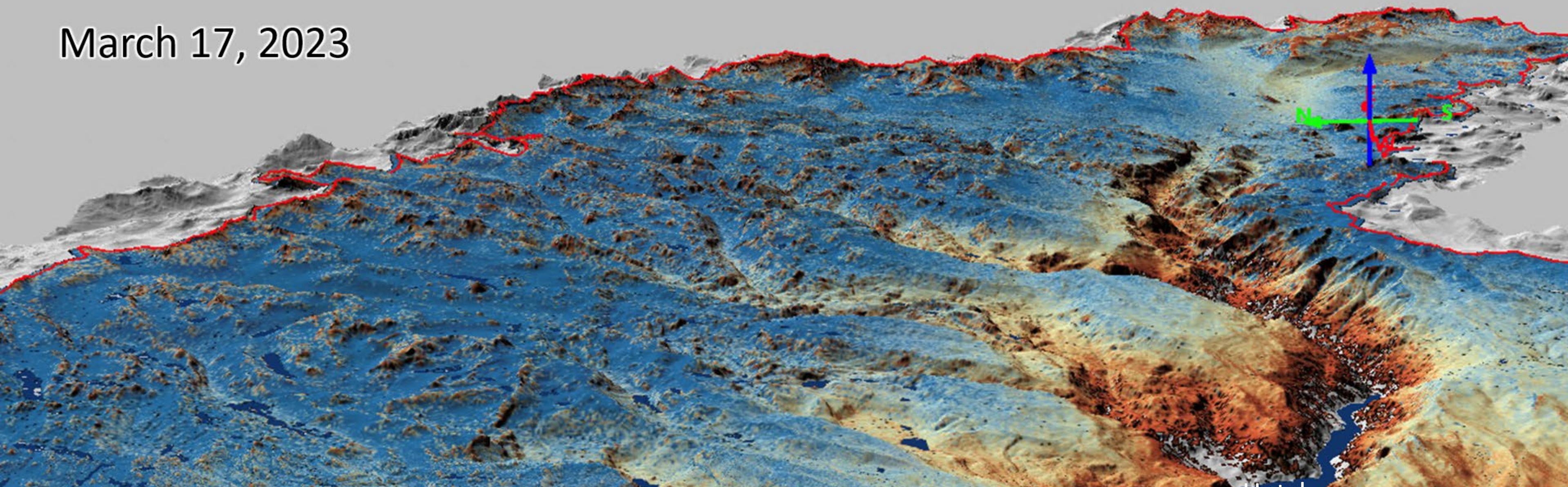
Elk Range
ASQ Snow Depth
April 2019



March 3, 2023



March 17, 2023



Water Year 2023-2024:

A peek into the ARSS Program

- ASO data acquisition flights on the following watersheds

Feather

Yuba

American

Tuolumne

Merced

San Joaquin

Kings

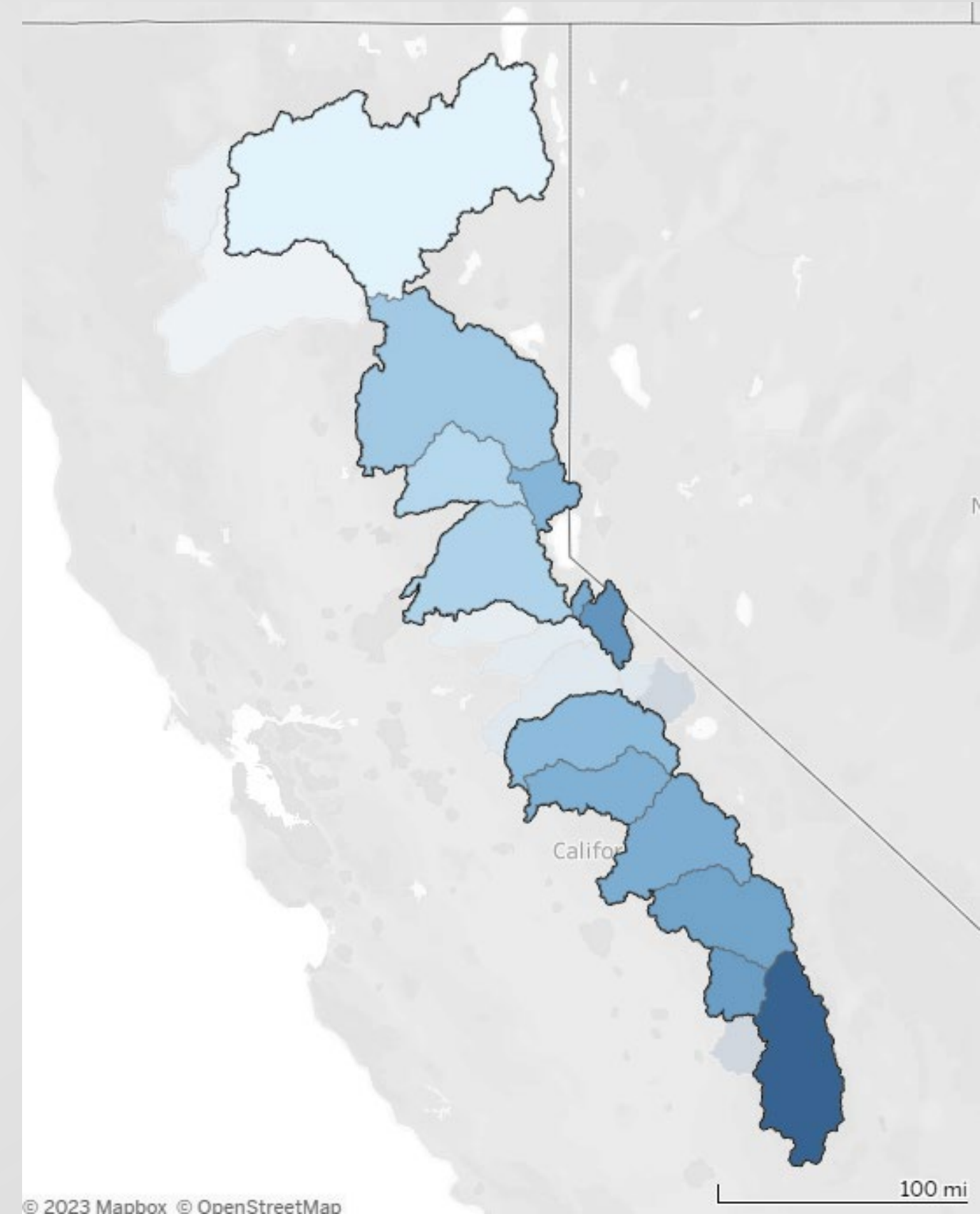
Kaweah

Kern

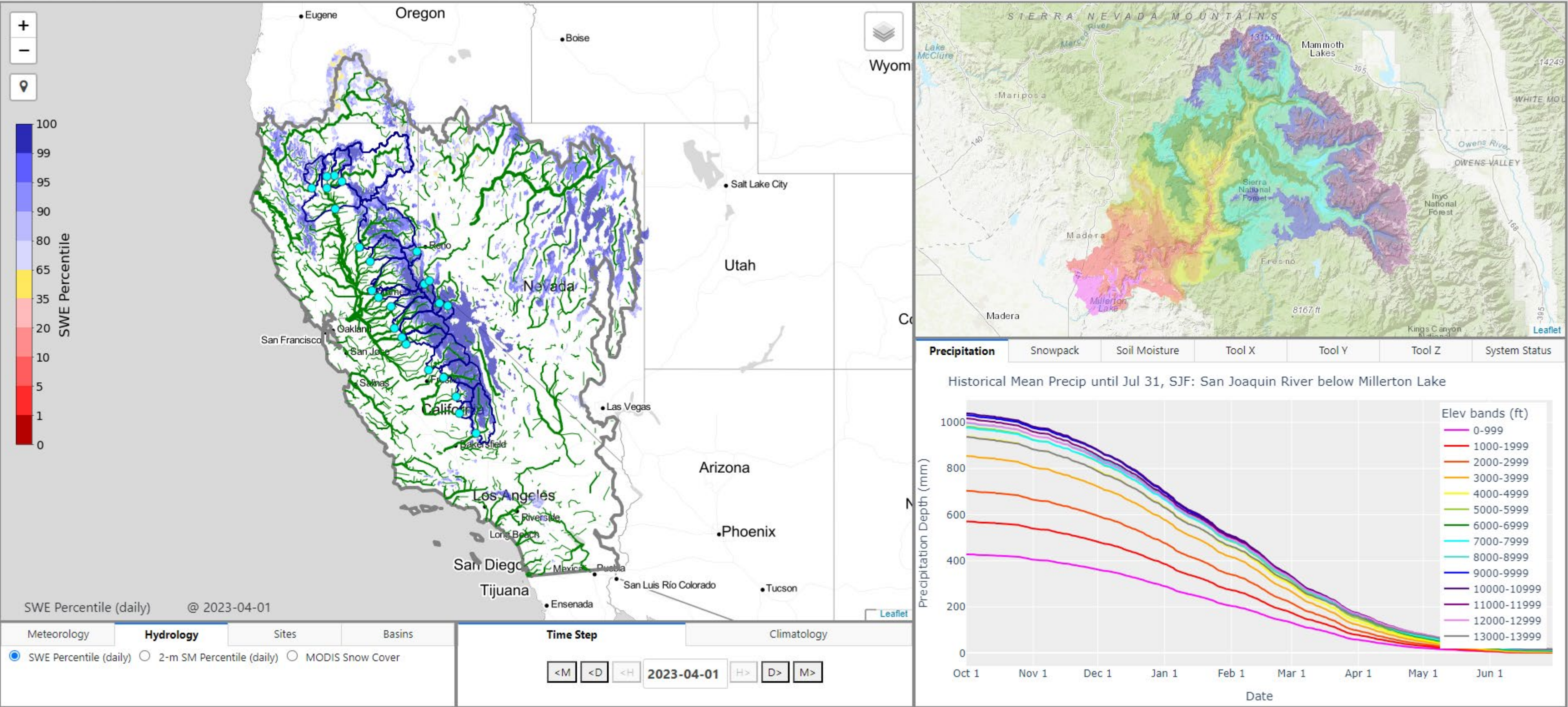
Truckee

Carson

- iSnobal modeling through M3Works for 10 watersheds
- WRF-Hydro modeling ASO, Inc for Feather, Merced, Tuolumne, San Joaquin, and Kings watersheds



CW3E Modernized WRF-Hydro/B120 Dashboard



Bulletin 120 and Water Supply Index Webpage

Bulletin 120 Forecast

<https://cdec.water.ca.gov/reportapp/javareports?name=B120>

Bulletin 120 Weekly Update Forecast

<https://cdec.water.ca.gov/reportapp/javareports?name=B120UP>

Bulletin 120 WY Forecast Summary and Monthly Distribution

<https://cdec.water.ca.gov/reportapp/javareports?name=B120DIST>

Water Supply Index Forecast

<https://cdec.water.ca.gov/reportapp/javareports?name=WSI>

San Joaquin River Water Year Forecast Breakdown from Water Supply Index Forecast

<https://cdec.water.ca.gov/reportapp/javareports?name=SJWSI.pdf>

Forecast Discussion

<https://cdec.water.ca.gov/reportapp/javareports?name=WSFCastDiscussion.pdf>

SnowTrax

<https://snow.water.ca.gov>

Bulletin 120 and Water Supply Index Forecast Schedule - Water Year 2024

Forecast Type	Forecast Date	Issue Date	Issue Day of Week	Notes
WSI	12/1/2023	12/8/2023	Friday	
WSI	1/1/2024	1/9/2024	Tuesday	
Bul 120 & WSI	2/1/2024	2/8/2024	Thursday	
Bul 120 update	2/13/2024	2/15/2024	Thursday	
Bul 120 update	2/20/2024	2/22/2024	Thursday	
Bul 120 update	2/27/2024	2/29/2024	Thursday	
Bul 120 & WSI	3/1/2024	3/8/2024	Friday	
Bul 120 update	3/12/2024	3/14/2024	Thursday	
Bul 120 update	3/19/2024	3/21/2024	Thursday	
Bul 120 update	3/26/2024	3/28/2024	Thursday	
Bul 120 & WSI	4/1/2024	4/8/2024	Monday	
Bul 120 update	4/9/2024	4/11/2024	Thursday	
Bul 120 update	4/16/2024	4/18/2024	Thursday	
Bul 120 update	4/23/2024	4/25/2024	Thursday	
Bul 120 & WSI	5/1/2024	5/8/2024	Wednesday	
Bul 120 update	5/14/2024	5/16/2024	Thursday	
Bul 120 update	5/21/2024	5/23/2024	Thursday	
Bul 120 update	5/28/2024	5/30/2024	Thursday	
Bul 120 update	6/4/2024	6/6/2024	Thursday	
Bul 120 update	6/11/2024	6/13/2024	Thursday	
Bul 120 update	6/18/2024	6/20/2024	Thursday	
Bul 120 update	6/25/2024	6/27/2024	Thursday	

Notes:

B120 and WSI forecasts are issued six business days after the first of the month in February, March, April, and May

B120 Update forecasts are issued weekly after B120 forecasts

B120 Update forecasts are for conditions as of Tuesday morning and issued on the Thursday the same week unless

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Questions?

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