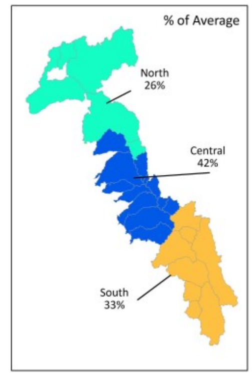
Real-Time Spatial Estimates of Snow-Water Equivalent (SWE)

Sierra Nevada Mountains, California
May 1, 2022



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Summary of current conditions

The regional summary map above shows the mean SWE above 5000' elevation for three major regions of the Sierra Nevada, percent of average is calculated from a long-term average of 2000-2020. As of May 1, percent of average SWE is highest in the central (42%), then south (33%) and lowest in the north (26%). Detailed SWE maps (in JPG format) and summaries of SWE (in Excel format) by individual basin and elevation band accompany the report and are publicly available on our website **here**.

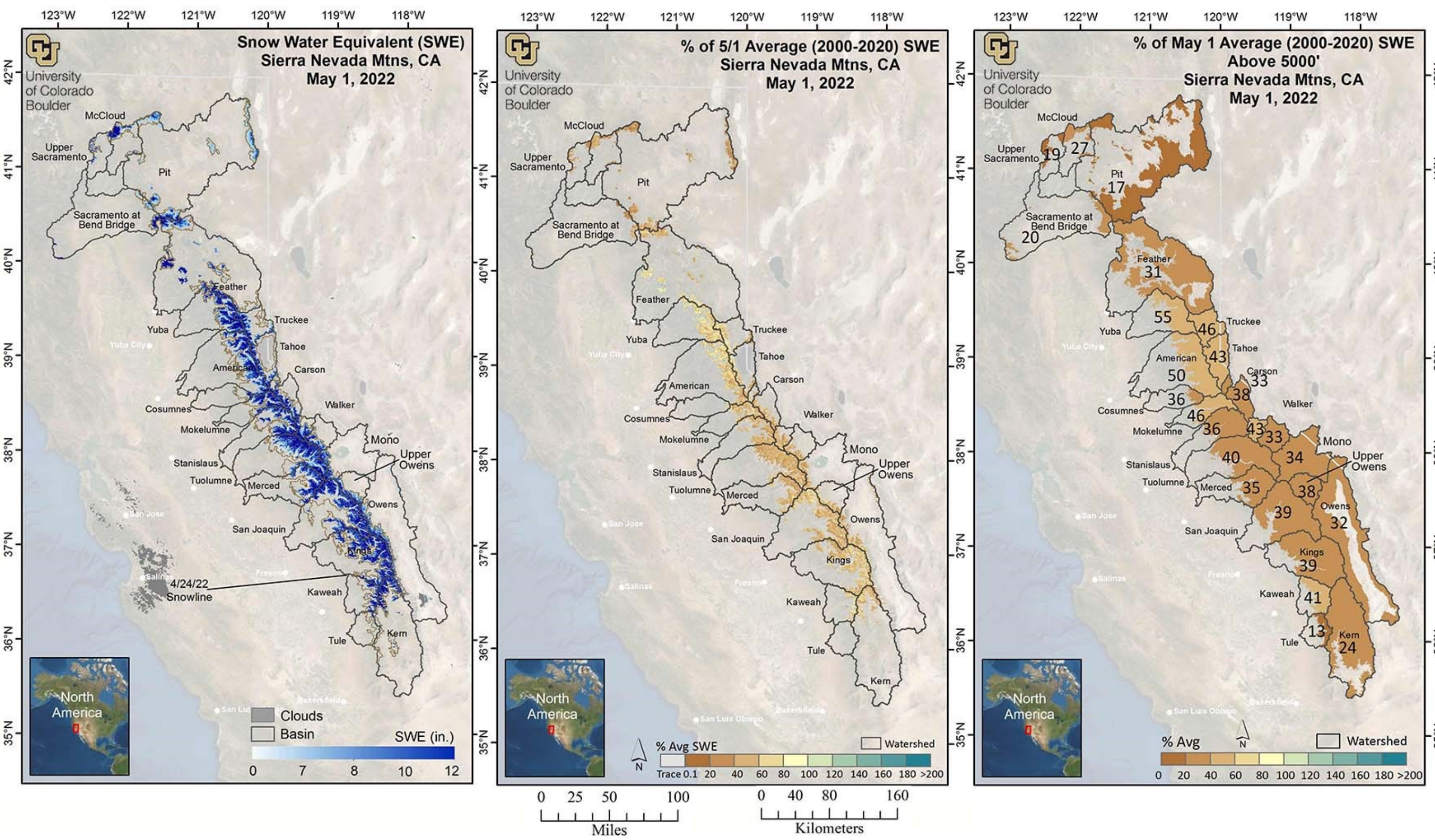

Figure 1. Estimated SWE and % of Average SWE across the Sierra Nevada. SWE amounts for May 1, 2022 (left), and percent of average (2000-2020) SWE for May 1, 2022 for the Sierra Nevada, calculated for each pixel (middle) and basin-wide (right). Basin-wide percent of average is calculated across all model pixels >5000' elevation.

Location of Reports and Excel Format Tables

http://instaar.colorado.edu/research/labs-groups/mountain-hydrology-group/page/37199/

About this report

This is an experimental research product that provides near-real-time estimates of snow-water equivalent (SWE) at a spatial resolution of 500 m for the Sierra Nevada in California from mid-winter through the melt season. The report is typically released within a week of the date of data acquisition at the top of the report. A similar report covering the Intermountain West is available and is distributed to water managers in Colorado, Utah and Wyoming.

The spatial SWE analysis method for the Sierra Nevada uses the following data as inputs:

- In-situ SWE from all operational CA and NV snow pillow sensor sites and CoCoRaHS SWE values when available and applicable
- MODSCAG fractional snow-covered area (fSCA) data from recent cloud-free MODIS satellite images
- Physiographic information (elevation, latitude, upwind mountain barriers, slope, etc.)
- Historical daily SWE patterns (1985-2016) retrospectively generated using historical MODSCAG data and an energy-balance model that back-calculates SWE given the fSCA time-series and meltout date for each pixel

For more details on the estimation method see the *Methods* section below. Please be sure to read the *Data Issues / Caveats* section for a discussion of persistent challenges or flagged uncertainties of the SWE product.

Data availability for this report

116 snow pillow sites in the Sierra Nevada network were recording SWE values out of a total of 132 sites, 16 were offline, and 41 were recording 0 (shown in black, red, and yellow respectively, in Figure 5, left map).

The value of spatially explicit estimates of SWE

Snowmelt makes up the large majority (~60-85%) of the annual streamflow in the Sierra Nevada. The spatial distribution of snow-water equivalent (SWE) across the landscape is complex. While broad aspects of this spatial pattern (e.g., more SWE at higher elevations and on north-facing exposures) are fairly consistent, the details vary a lot from year to year, influencing the magnitude and timing of snowmelt-driven runoff.

SWE is operationally monitored at over a hundred and thirty snow pillow sensor sites spread across the Sierra Nevada, providing a critical first-order snapshot of conditions, and the basis for runoff forecasts from the CA DWR, NRCS, and NOAA. However, conditions at snow pillow sites (e.g., percent of normal SWE) may not be representative of conditions in the large areas between these point measurements, and at elevations above and below the range of the sensor sites. The spatial snow analysis creates a detailed picture of the spatial pattern of SWE using snow sensors, satellite, and other data, extending beyond the snow sensor sites to unmonitored areas.

Interpreting the spatial SWE estimates in the context of snow pillows

The spatial product estimates SWE for every pixel where the MODSCAG product identifies snow-cover. Comparatively, snow sensor samples 8-20 points per basin within a narrower elevation range. Thus, the basin-wide percent of average from the spatial SWE estimates is not directly comparable with the snow sensor basin-wide percent of average. A better comparison might be made with the % of average in the elevation bands (Table 2) that contain snow sensor sites.

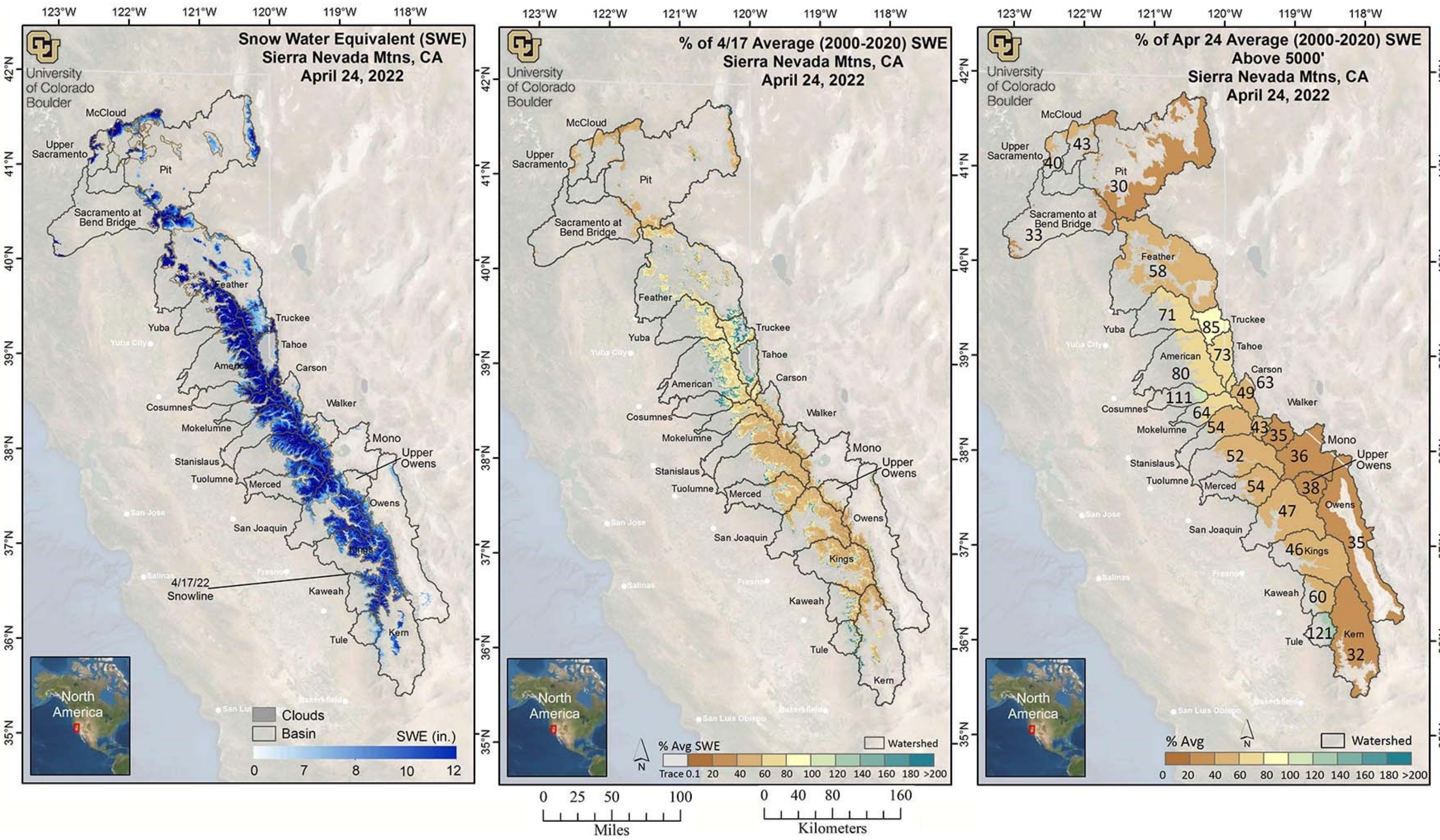

Figure 2. Estimated SWE and % of Average SWE across the Sierra Nevada. SWE amounts for April 24, 2022 (left), and percent of average (2000-2020) SWE for April 24, 2022 for the Sierra Nevada, calculated for each pixel (middle) and basin-wide (right). Basin-wide percent of average is calculated across all model pixels >5000’ elevation.

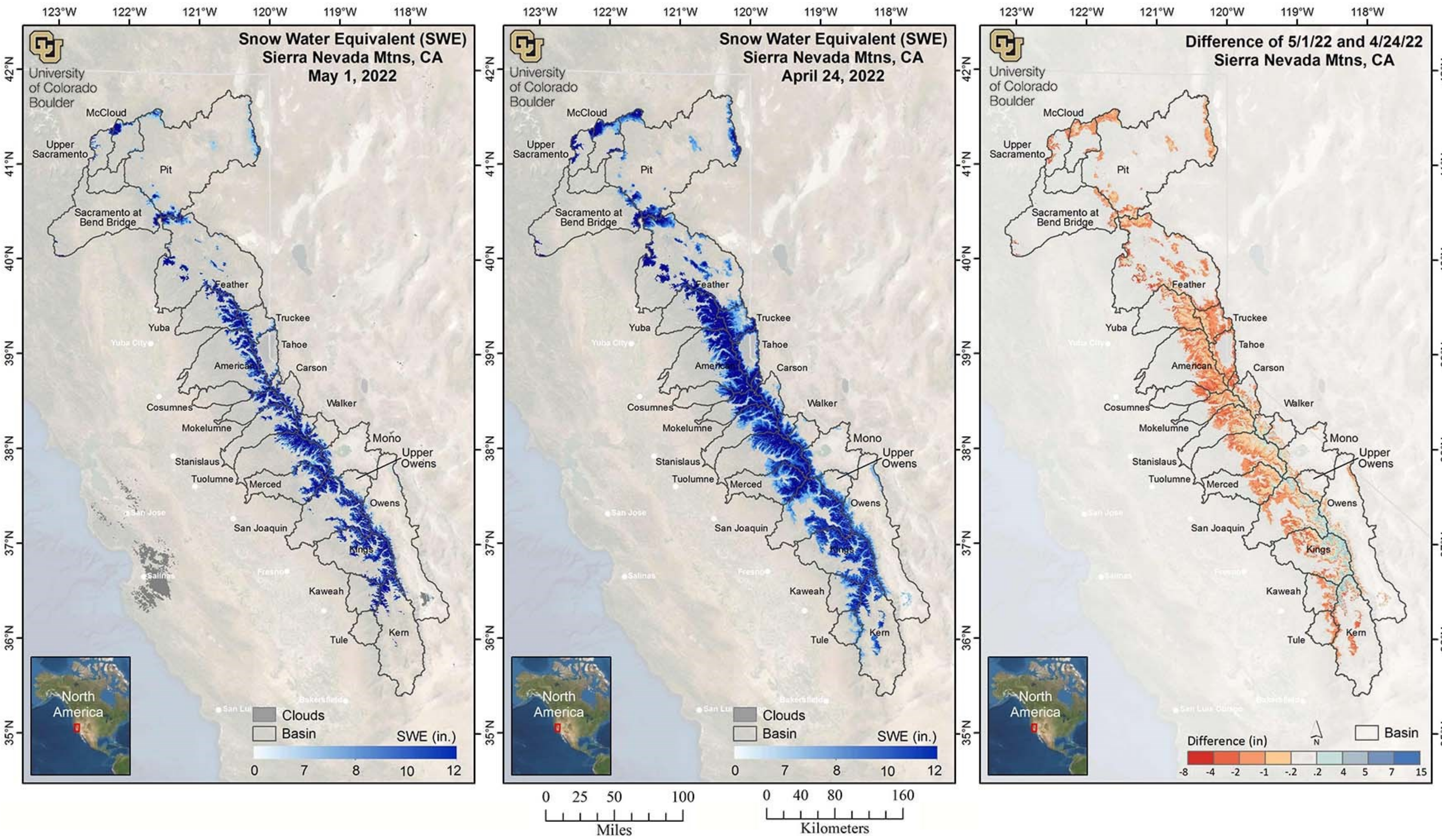

Figure 3. Estimated SWE across the Sierra Nevada, May 1, 2022. SWE amounts for May 1, 2022 (left), April 24, 2022 (middle) and the difference between May 1st and April 24th (right).

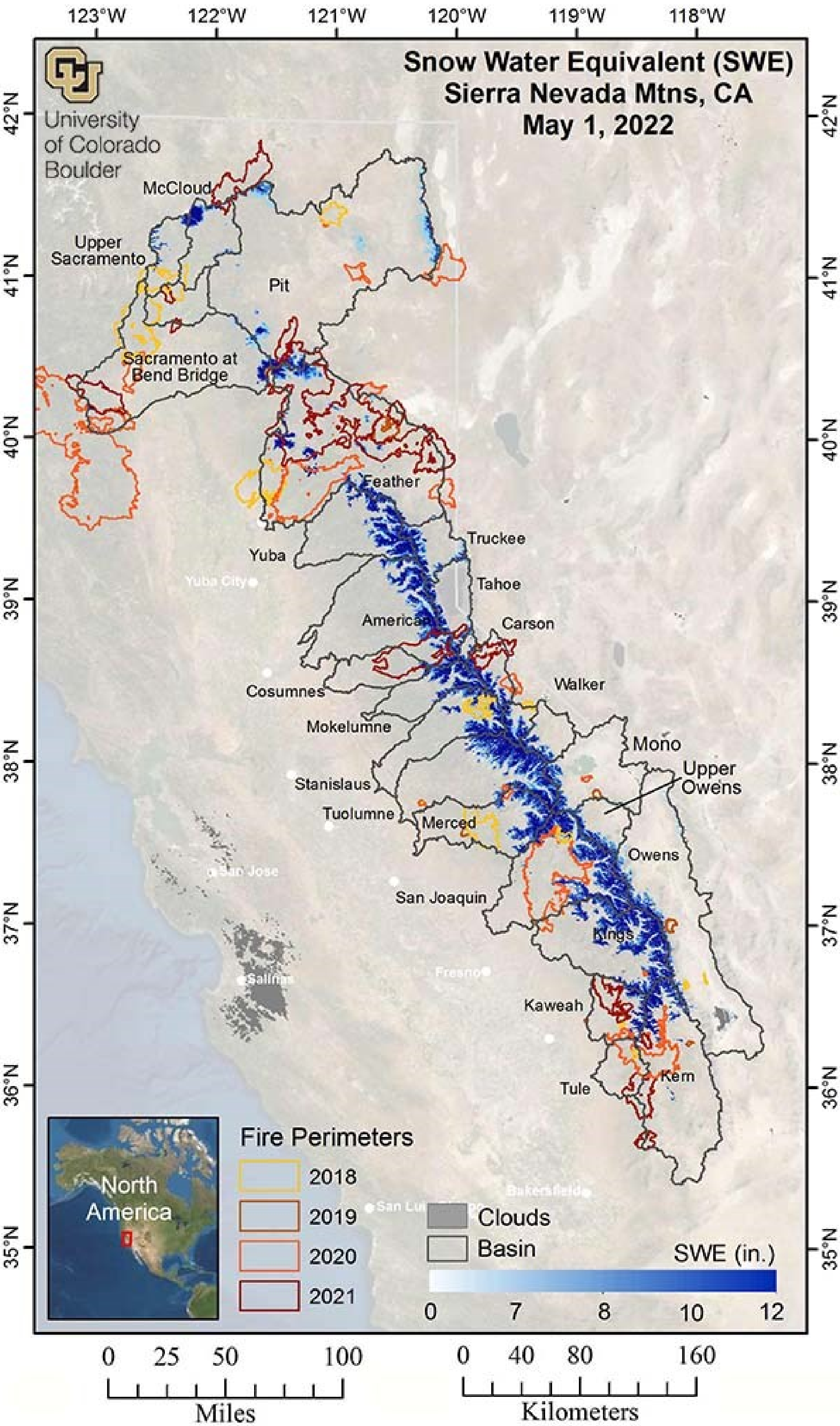

Figure 4. Estimated SWE with Fire Perimeters, Sierra Nevada. SWE amounts for May 1, 2022 are shown with fire perimeters from 2018-2021 (colored from yellow to red).

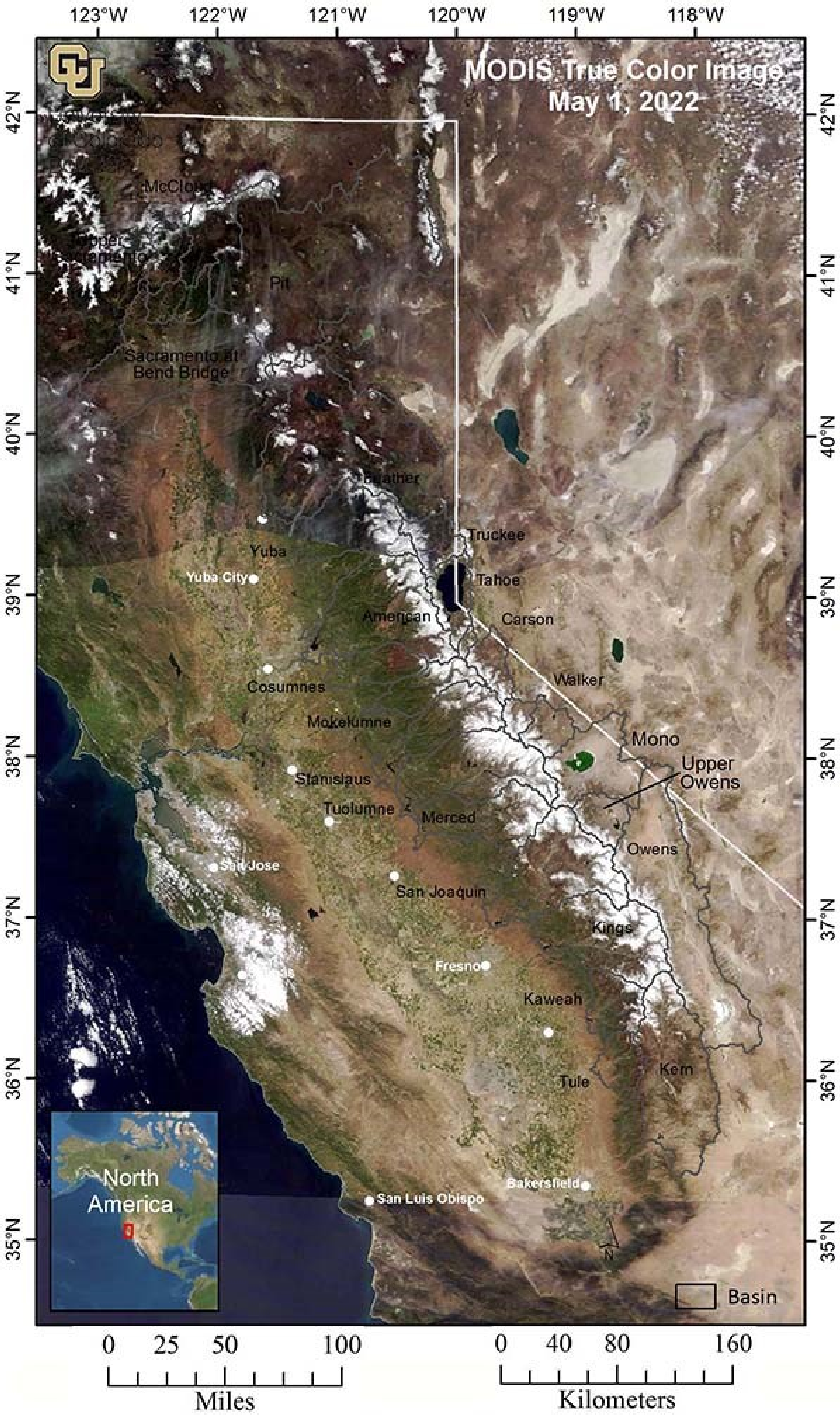

Figure 5. MODIS image, Sierra Nevada. A mostly cloud-free true color MODIS image, showing the composited image that was used for the May 1, 2022 regression model run.

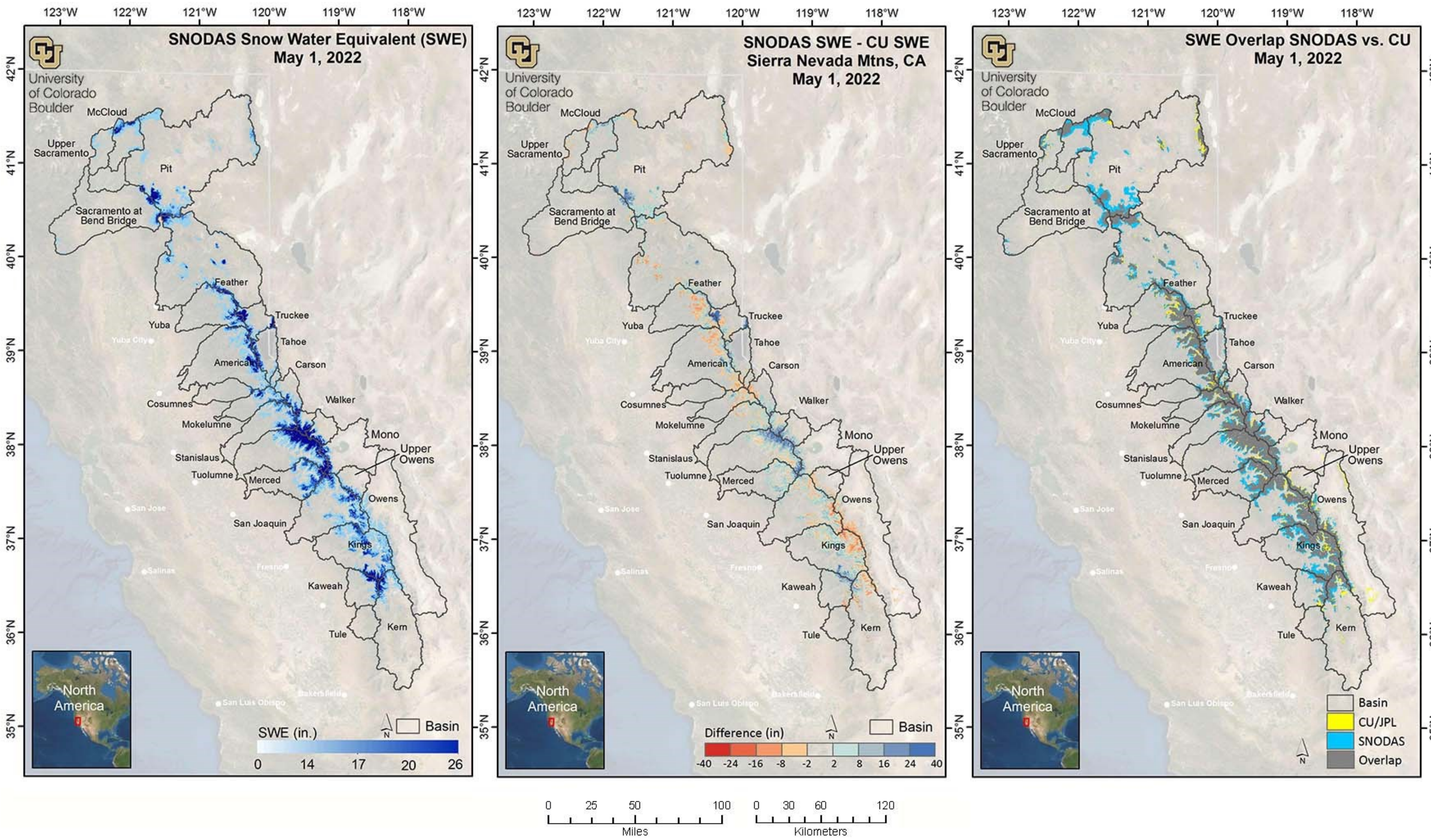

Figure 6. Comparison of CU regression SWE product and SNODAS SWE for the Sierra Nevada. The map on the left shows estimated SWE for May 1st from the NOAA National Weather Service's National Operational Hydrologic Remote Sensing Center (NOHRSC) SNOw Data Assimilation System (SNODAS). The middle map shows the difference between the May 1st SNODAS SWE estimate and CU regression SWE estimate. Red pixels denote areas where SNODAS SWE is less than CU SWE and blue pixels show areas where SNODAS SWE is higher than CU SWE. The map on the right shows the snow-cover extent of SNODAS and CU SWE estimates. Yellow pixels show where the location of CU snow extends beyond the location of the SNODAS snow extent. Blue pixels show where the SNODAS snow extends beyond the CU snow extent. Gray areas indicate regions where both products agree on the snow-cover extent.

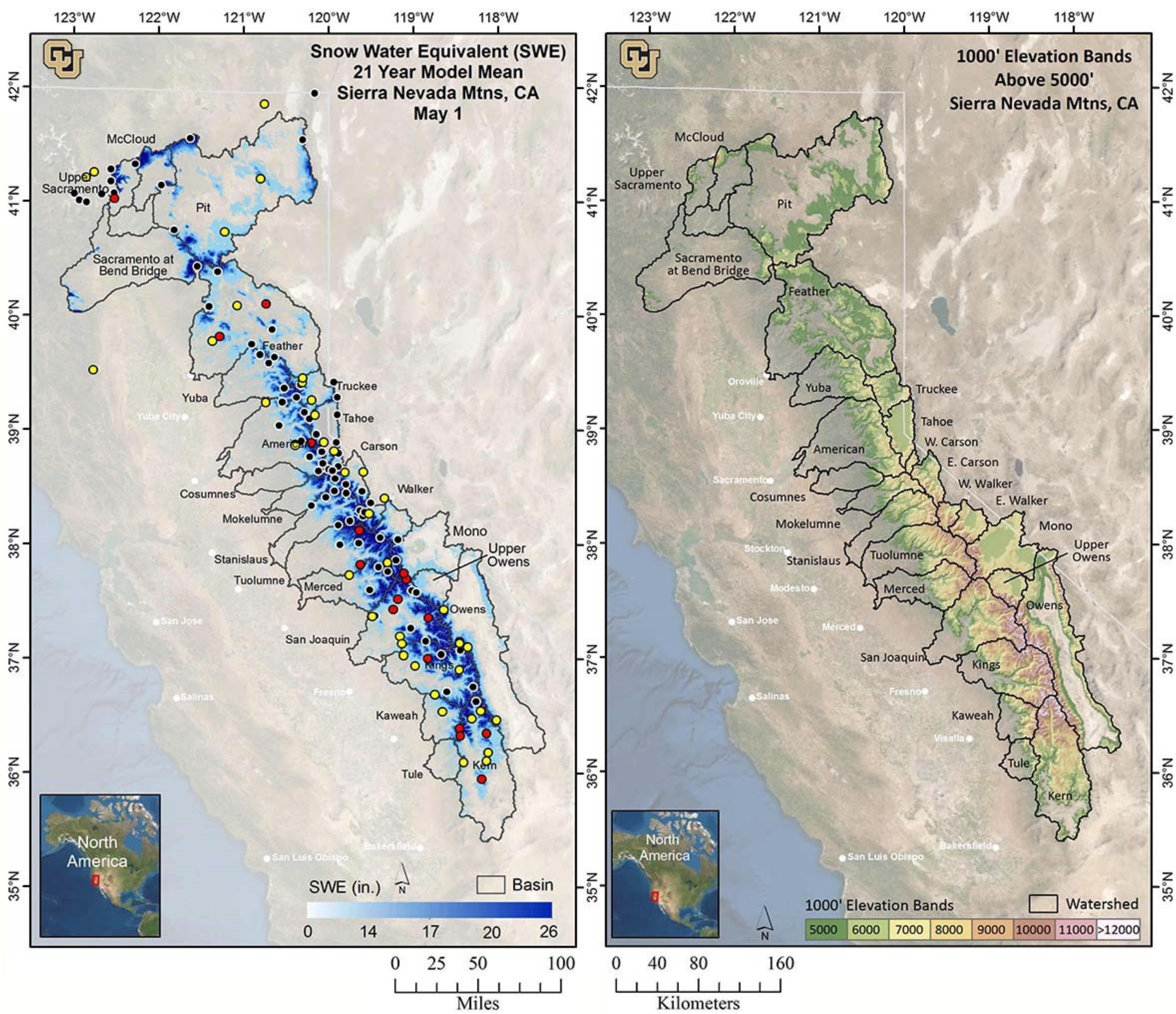

Figure 7. Historical average May 1st and Elevation Bands for the Sierra Nevada. Average SWE (2000-2020) for May 1st (left), and the Banded Elevation map (right) identifies basins used in this report (black boundaries) and 1000' elevation bands (colored shading) that match those used in Table 1 and Table 2. Map on left shows snow pillow sensor sites recording SWE on May 1st (black), sites that were offline are shown in red, and sites recording zero are shown in yellow.

Methods

The spatial SWE estimation method is described in Yang, et al. (2022) and Schneider and Molotch (2016). The method uses linear regression in which the dependent variable is derived from the operationally measured in situ SWE from all online snow pillow sensor sites in the domain. The snow pillow sensor SWE observations are scaled by the fractional snow-covered area (fSCA) across the 500 m pixel containing that snow pillow sensor site before being used in the linear regression model. The fSCA is a combination of a near-real-time cloud-free MODIS satellite image which has been processed using the MODIS Snow Cover and Grain size (MODSCAG) fractional snow-covered area algorithm program (Painter, et al. 2009) and the Snow Today fSCA image when necessary (Rittger, et al. 2019, https://nsidc.org/snow-today).

The following independent variables (predictors) enter into the linear regression model:

- Physiographic variables that affect snow accumulation, melt, and redistribution, including elevation, latitude, upwind mountain barriers, slope, and others. See Table 1 in Yang, et al. (2022) for the full set of these variables.
- The historical daily SWE pattern (1985-2016) retrospectively generated using historical MODSCAG data, and an energy-balance model that back-calculates SWE given the fractional Snow-Covered Area (fSCA) time series and meltout date for each pixel. See Margulis, et al. (2016) for details. (For computational efficiency, only one image from either the 1st or 15th of

each month during the 1985-2016 period that best matches the real-time snow pillow-observed pattern is selected as an independent variable.)

The real-time regression model for this date has been validated by cross-validation, whereby 10% of the snow pillow data are randomly removed and the model prediction is compared to the measured value at the removed snow pillow stations. This is repeated 30 times to obtain an average R-squared value, which denotes how closely the model fits the snow pillow data. During development of this regression method, the model was also validated against independent historical SWE data collected in snow surveys at 9 locations in Colorado, and an intensive field survey in north-central Colorado. Data utilized to generate this report change to optimize model performance. To maintain consistency across the historical record, the percent of average values are based on our baseline algorithm and therefore there can be discrepancies between absolute SWE values and corresponding percent of averages.

Data Issues/Caveats for* May 1, 2022 *– IMPORTANT – READ THIS!

- NEW AVERAGE CALCULATIONS – Average calculations are based on 2000-2020 model values, this includes the drought years (2012-2016) which brings our overall average SWE down considerably, thereby increasing percent of averages.
- DENSE FOREST COVER – Dense forest cover at lower elevations where snow-cover is discontinuous can cause the satellite to underestimate the snow-cover extent, leading to underestimation of SWE.
- CLOUD COVER – Cloud cover can obscure satellite measurements of snow-cover. While careful checks are made, occasionally the misclassification of clouds as snow or *vice versa* may result in the mischaracterization of SWE or bare-ground.
- MODELING METHODS - We work to generate the best SWE estimates for each reporting date. Our methods can change from one report to another. Sometimes data changes between reports is an artifact of method changes.

List of All Known Data Issues/Caveats

- NEW AVERAGE CALCULATIONS – Average calculations are based on 2000-2020 model values, this includes the drought years (2012-2016) which brings our overall average SWE down considerably, thereby increasing percent of averages.
- RECENT SNOWFALL – There are occasionally problems with lower-elevation SWE estimates due to recent snowfall events that result in extensive snow-cover extending to valley locations where measurements are not available. This scenario results in an over-estimation of lower- elevation SWE.
- LIMITED SNOW PILLOW DATA – When snow at the snow pillow sites melts out, but remains at higher elevations, the model tends to underestimate SWE at the under-monitored upper elevations. This issue typically occurs late in the melt season, resulting in less accurate SWE prediction at higher elevations compared to earlier in the snow season.
- CLOUD COVER – Cloud cover can obscure satellite measurements of snow-cover. While careful checks are made, occasionally the misclassification of clouds as snow or *vice versa* may result in the mischaracterization of SWE or bare-ground.
- LOW LOOK ANGLE – When a satellite does not pass directly over a region but the area is still included within the satellite sensor's field of view, this is referred to as a low "look angle". The resulting image has lower effective resolution – this "blurry" MODSCAG data still contains useful information but may lead to overestimation of SWE near the margins of the snow-cover extent.
- POOR QUALITY SNOW SENSOR DATA – Although data QA/QC is performed, occasional sensor malfunction may result in localized SWE errors.
- ANOMALOUS SNOW PATTERNS – Anomalous snow years or snow distributions may cause SWE error due to the model design to search for similar SWE distributions from previous years. If no close seasonal analogue exists, the model is forced to find the most similar year, which may result in error.
- DENSE FOREST COVER – Dense forest cover at lower elevations where snow-cover is discontinuous can cause the satellite to underestimate the snow-cover extent, leading to underestimation of SWE.
- MISSING SWE VALUES - Volume calculations for the Kings, Kaweah, Kern, and Tule basins are based on place-holder values for SWE in the lower elevations. Place-holder values are based on average SWE accumulation values at higher elevations where we have higher confidence in the SWE estimates.
- PERCENT OF AVERAGE CALCULATIONS - Data utilized to generate this report change to optimize model performance. To maintain consistency across the historical record, the percent of average values are based on our baseline algorithm and therefore there can be discrepancies between absolute SWE values and corresponding percent of averages.
- MODELING METHODS - We work to generate the best SWE estimates for each reporting date. Our methods can change from one report to another. Sometimes data changes between reports is an artifact of method changes.

Table 1. Estimated SWE by basin. *The basin-wide SWE values and averages, are across all pixels at elevations >5000'. Shown are April 24th percent of April 24th average SWE, May 1st percent of May 1st average SWE (between 2000-2020 as derived from the regression model), April 24th mean SWE, May 1st mean SWE, May 1st percent of snow-covered area, May 1st water volume (acre-feet), the change in SWE between May 1st and April 24th, the area (mi²) inside each basin that contains data pixels (not including cloud-covered pixels, lakes or other satellite no data pixels), May 1st surveys, April 24th snow pillow data, and May 1st snow pillow data for those areas collected, summarized for each basin. The last column shows May 1st mean SWE from SNODAS*.*

Basin	4/24/22 % 4/24 Avg.	5/1/22 % 5/1 Avg.	4/24/22 SWE (in)	5/1/22 SWE (in)	5/1/22 % SCA	5/1/22†† Vol (af)	4/24 thru 5/1/22 Chg. in SWE (in)	Area (mi2) > 5000'	5/1/22 Surveys	4/24/22 Pillows	5/1/22 Pillows	5/1/22 SNODAS* (in)
Upper Sacramento	40	19	9.3	4.2	45.2	28,734	-5.2	129.7	5.0 (3)	4.8 (1)	2.3 (1)	2.5
McCloud	43	27	10.0	5.5	53.8	53,180	-4.4	179.7	3.0 (2)	7.8 (1)	3.7 (1)	9.9
Pit	30	17	2.2	1.0	15.2	129,160	-1.1	2309.5	NA	8.4 (5)	5.7 (5)	2.2
Sac at Bend Bridge	33	20	5.9	3.2	31.7	43,687	-2.8	258.5	NA	NA	NA	5.7
Feather	58	31	3.8	1.5	13.6	179,748	-2.3	2,281.2	4.3 (20)	6.2 (5)	2.9 (5)	2.0
Yuba	71	55	10.0	6.3	60.4	185,322	-3.7	555.7	13.6 (17)	28.0 (5)	23.3 (5)	7.2
American	80	50	10.3	5.1	49.6	229,797	-5.3	852.4	5.7 (17)	8.2 (11)	8.3 (12)	5.1
Cosumnes	111	36	7.7	1.4	12.3	7,237	-6.2	94.4	NA	NA	NA	1.6
Mokelumne	64	46	9.3	5.6	50.0	99,785	-3.7	336.8	10.9 (9)	15.4 (1)	13.1 (1)	5.4
Stanislaus	54	36	7.9	4.3	39.8	137,097	-3.6	591.8	8.7 (14)	19.1 (7)	15.5 (7)	5.2
Tuolumne	52	40	8.1	5.4	44.2	275,396	-2.7	961.4	10.2 (16)	8.8 (6)	7.1 (6)	10.1
Merced	54	35	7.5	4.2	35.7	125,178	-3.4	565.3	9.2 (5)	14.2 (3)	10.2 (3)	6.7
San Joaquin	47	39	6.5	4.6	36.2	313,708	-1.8	1,271.5	11.9 (9)	3.0 (6)	0.9 (6)	5.1
Kings	46	39	6.2	4.7	31.6	317,512	-1.5	1,258.5	6.0 (22)	8.1 (9)	6.6 (9)	5.8
Kaweah	60	41	5.5	3.1	20.1	53,438	-2.4	326.1	4.2 (3)	0.0 (1)	0.0 (1)	5.6
Tule	121	13	4.2	0.3	1.8	2,077	-4.0	143.2	0.0 (1)	1.6 (1)	0.0 (1)	0.3
Kern	32	24	2.0	1.2	5.8	115,772	-0.8	1,748.3	0.0 (1)	0.8 (5)	0.4 (5)	1.1
Truckee	85	46	8.6	3.5	35.1	85,350	-5.0	451.0	23.3 (2)	11.4 (4)	10.1 (4)	7.4
Tahoe	73	43	8.7	4.1	40.0	73,925	-4.6	336.0	NA	9.2 (8)	6.1 (8)	6.1
W Carson	63	33	10.1	4.4	37.3	16,558	-5.7	70.6	3.5 (1)	11.1 (2)	8.7 (2)	3.0
E Carson	49	38	5.0	3.2	27.4	66,306	-1.7	382.9	NA	6.4 (5)	3.5 (5)	4.0
W Walker	43	43	6.9	6.3	45.1	64,146	-0.6	192.1	4.0 (1)	18.6 (3)	18.2 (3)	12.4
E Walker	35	33	2.8	2.2	14.9	45,242	-0.5	379.0	NA	10.7 (1)	9.2 (1)	5.1
Mono	36	34	1.2	1.0	7.4	58,932	-0.2	1,072.8	NA	NA	NA	1.8
Upper Owens	38	38	2.5	2.1	16.2	45,582	-0.4	397.5	NA	25.2 (1)	24.4 (1)	1.9
Owens	35	32	1.4	1.1	5.8	111,703	-0.3	1,871.3	14.5 (1)	0.8 (5)	0.0 (5)	0.4

†† For volume totals above Shasta Lake add Upper Sac, McCloud and Pit volumes. For volume totals above Bend Bridge add Upper Sac, McCloud, Pit and Sac at Bend Bridge volumes.

* This is a comparison to the SNODAS (SNOw Data Assimilation System) nationwide product from the National Weather Service.

Table 2. Estimated SWE by basin and elevation band. *The basin-wide SWE values and averages, are across all pixels at elevations >5000'. Elevation bands begin at 5000' and extend past the highest point in the basin. Note that the area of the highest 2-5 bands is typically much smaller than the lower bands. Shown are April 24th percent of April 24th average SWE, May 1st percent of May 1st average SWE (between 2000-2020 as derived from the regression model), April 24th mean SWE, May 1st mean SWE, May 1st percent of snow-covered area, May 1st water volume (acre-feet), the change in SWE between May 1st and April 24th, the area (mi²) inside each basin that contains data pixels (not including cloud-covered pixels, lakes or other satellite no data pixels), May 1st surveys, April 24th snow pillow data, and May 1st snow pillow data for those areas collected, summarized for each 1000' elevation band inside each basin. The last column shows May 1st mean SWE from SNODAS*.*

Basin	Elevation Band	4/24/22 % 4/24 Avg.	5/1/22 % 5/1 Avg.	4/24/22 SWE (in)	5/1/22 SWE (in)	5/1/22 % SCA	5/1/22†† Vol (af)	4/24 thru 5/1/22 Chg. in SWE (in)	5/1/22 Area (mi2)	5/1/22 Surveys	4/24/22 Pillows	5/1/22 Pillows	5/1/22 SNODAS* (in)
Upper Sacramento	5000-6000'	33	9	6.4	1.6	19.5	6,283	-4.8	72.8	0.0 (1)	NA	NA	0.6
	6000-7000'	46	26	11.8	6.2	70.6	13,083	-5.6	39.5	5.5 (1)	4.8 (1)	2.3 (1)	3.9
	7000-8000'	47	31	13.5	8.6	93.7	4,342	-4.8	9.4	9.5 (1)	NA	NA	7.8
	> 8000'	49	28	16.0	9.6	98.9	1,778	-6.4	3.5	NA	NA	NA	9.9
McCloud	5000-6000'	39	13	7.2	2.1	32.7	11,994	-5.1	106.1	4.5 (1)	7.8 (1)	3.7 (1)	7.1
	6000-7000'	45	37	11.0	8.1	79.2	19,163	-2.9	44.4	1.5 (1)	NA	NA	14.1
	7000-8000'	52	43	15.9	12.2	96.6	9,929	-3.6	15.2	NA	NA	NA	13.4
	8000-9000'	53	41	19.0	14.0	97.0	5,100	-5.0	6.8	NA	NA	NA	16.6
	> 9000'	51	42	20.2	16.4	85.1	2,809	-3.8	3.2	NA	NA	NA	15.7
Pit	5000-6000'	14	5	0.6	0.1	2.5	11,582	-0.5	1,581.9	NA	22.6 (1)	17.9 (1)	1.0
	6000-7000'	35	18	4.3	1.9	30.2	57,878	-2.4	562.6	NA	4.6 (2)	2.7 (2)	3.5
	7000-8000'	51	34	9.6	6.3	85.2	47,432	-3.3	141.4	NA	5.1 (2)	2.5 (2)	8.1
	8000-9000'	54	41	12.7	9.4	98.9	10,953	-3.3	21.8	NA	NA	NA	12.3
	9000-10,000'	55	45	16.9	13.6	92.1	1,314	-3.3	1.8	NA	NA	NA	17.1
Sac at Bend Bridge	5000-6000'	19	6	2.7	0.6	13.4	5,603	-2.0	170.9	NA	NA	NA	3.3
	6000-7000'	44	27	10.3	5.7	58.0	20,054	-4.6	65.7	NA	NA	NA	8.5
	7000-8000'	54	48	17.6	15.0	96.9	13,300	-2.6	16.6	NA	NA	NA	14.8
	8000-9000'	52	42	21.6	17.2	95.1	4,279	-4.4	4.7	NA	NA	NA	19.2
	9000-10,000'	51	37	21.2	15.1	79.9	451	-6.0	0.6	NA	NA	NA	13.3
Feather	5000-6000'	44	14	1.7	0.4	3.0	25,628	-1.3	1,359.0	1.8 (10)	NA	NA	0.4
	6000-7000'	68	38	6.2	2.6	24.9	111,468	-3.5	790.5	6.7 (8)	6.2 (5)	2.9 (5)	3.2
	7000-8000'	62	42	10.5	6.0	56.3	40,711	-4.5	127.1	7.3 (2)	NA	NA	10.5
	8000-9000'	59	36	14.0	7.9	59.4	1,941	-6.0	4.6	NA	NA	NA	13.2
Yuba	5000-6000'	65	19	4.7	0.9	13.8	9,820	-3.8	204.1	4.8 (5)	NA	NA	0.6
	6000-7000'	72	61	11.5	7.8	82.0	95,087	-3.7	229.5	13.0 (8)	26.6 (4)	21.7 (4)	6.9
	7000-8000'	72	64	15.6	12.3	97.5	77,104	-3.3	117.6	25.9 (4)	33.5 (1)	30.0 (1)	17.5
	8000-9000'	75	54	20.5	13.9	100.0	3,310	-6.6	4.5	NA	NA	NA	47.3
American	5000-6000'	111†	11	6.1	0.3	4.8	5,113	-5.8	314.3	0.2 (3)	1.3 (3)	0.1 (3)	0.3
	6000-7000'	78	52	10.8	5.5	61.8	82,202	-5.3	281.3	7.3 (9)	18.7 (2)	14.8 (2)	4.1
	7000-8000'	71	56	13.7	9.4	88.2	88,790	-4.3	176.9	4.8 (4)	5.8 (4)	2.0 (4)	11.3
	8000-9000'	71	54	17.6	12.3	97.4	46,508	-5.3	70.8	12.0 (1)	12.8 (2)	20.8 (3)	14.1
	9000-10,000'	66	52	19.6	14.9	97.0	7,184	-4.7	9.1	NA	NA	NA	11.6
Cosumnes	5000-6000'	169†	0	5.9	0.0	0.0	0	-5.9	62.5	NA	NA	NA	0.0
	6000-7000'	89	29	10.7	2.3	19.4	3,112	-8.3	24.9	NA	NA	NA	2.2
	7000-8000'	65	69	12.8	11.1	96.9	4,125	-1.7	7.0	NA	NA	NA	13.4
Mokelumne	5000-6000'	62	0	2.0	0.0	0.2	19	-2.0	88.4	0.0 (1)	NA	NA	0.0
	6000-7000'	77	20	8.6	1.6	17.8	5,725	-7.0	68.4	0.0 (1)	NA	NA	1.2
	7000-8000'	61	50	11.4	8.0	79.4	38,821	-3.5	91.2	10.0 (4)	NA	NA	7.9
	8000-9000'	62	54	14.6	11.6	95.3	49,539	-3.0	80.1	19.3 (3)	15.4 (1)	13.1 (1)	11.4
	9000-10,000'	58	47	16.0	12.3	89.1	5,682	-3.7	8.6	NA	NA	NA	11.1
Stanislaus	5000-6000'	74	0	1.8	0.0	0.0	0	-1.8	112.2	NA	NA	NA	0.0
	6000-7000'	61	4	6.5	0.3	2.8	2,208	-6.2	141.4	0.3 (3)	15.2 (1)	13.1 (1)	0.2
	7000-8000'	53	32	8.9	4.4	48.0	35,755	-4.5	152.2	4.4 (6)	20.9 (2)	16.5 (2)	3.2
	8000-9000'	51	44	11.0	8.7	82.5	54,931	-2.3	118.6	20.0 (3)	19.9 (3)	16.5 (3)	11.8
	9000-10,000'	51	48	13.5	12.1	92.2	34,709	-1.4	53.8	17.0 (2)	17.0 (1)	12.6 (1)	17.2
	10,000-11,000'	48	46	14.2	13.1	88.7	9,258	-1.1	13.3	NA	NA	NA	18.0
	> 11,000'	45	44	13.4	12.8	82.6	238	-0.6	0.3	NA	NA	NA	18.3

Basin	Elevation Band	4/24/22 % 4/24 Avg.	5/1/22 % 5/1 Avg.	4/24/22 SWE (in)	5/1/22 SWE (in)	5/1/22 % SCA	5/1/22†† Vol (af)	4/24 thru 5/1/22 Chg. in SWE (in)	5/1/22 Area (mi2)	5/1/22 Surveys	4/24/22 Pillows	5/1/22 Pillows	5/1/22 SNODAS* (in)
Tuolumne	5000-6000'	40	0	0.6	0.0	0.0	12	-0.6	179.6	NA	NA	NA	0.0
	6000-7000'	68	2	5.6	0.1	0.7	714	-5.5	147.2	0.3 (6)	2.7 (1)	1.0 (1)	0.3
	7000-8000'	53	23	8.3	2.9	24.7	24,224	-5.4	157.4	11.0 (2)	7.5 (2)	4.9 (2)	3.6
	8000-9000'	51	41	10.3	7.3	67.6	67,589	-3.0	173.2	15.0 (4)	1.1 (1)	0.0 (1)	12.0
	9000-10,000'	50	48	12.1	10.7	87.5	105,110	-1.4	183.8	19.6 (4)	16.9 (2)	16.0 (2)	21.7
	10,000-11,000'	47	49	12.5	12.2	90.1	59,630	-0.3	91.4	NA	NA	NA	26.5
	11,000-12,000'	45	46	12.4	11.8	82.1	16,260	-0.5	25.8	NA	NA	NA	22.4
	> 12,000'	44	43	12.9	11.9	80.0	1,858	-1.0	2.9	NA	NA	NA	13.9
Merced	5000-6000'	117†	0	0.4	0.0	0.0	0	-0.4	75.2	NA	NA	NA	0.0
	6000-7000'	73	0	3.8	0.0	0.1	29	-3.8	82.9	NA	NA	NA	0.1
	7000-8000'	56	11	7.0	1.1	12.1	8,126	-5.9	142.1	6.0 (2)	NA	NA	2.9
	8000-9000'	51	35	9.3	5.5	54.9	36,356	-3.8	124.7	11.3 (3)	12.5 (2)	7.9 (2)	9.4
	9000-10,000'	53	47	11.8	9.5	79.4	44,681	-2.2	87.9	NA	NA	NA	13.3
	10,000-11,000'	51	49	13.4	12.3	86.6	26,178	-1.1	39.8	NA	17.6 (1)	14.8 (1)	18.0
	11,000-12,000'	51	51	14.9	14.3	83.6	8,746	-0.5	11.4	NA	NA	NA	23.4
	> 12,000'	48	46	15.4	14.3	85.0	1,061	-1.2	1.4	NA	NA	NA	21.1
San Joaquin	5000-6000'	41	0	0.3	0.0	0.0	0	-0.3	144.7	NA	NA	NA	0.0
	6000-7000'	47	0	2.1	0.0	0.0	0	-2.1	187.0	1.0 (1)	0.2 (2)	0.0 (2)	0.0
	7000-8000'	51	5	4.6	0.3	3.0	3,564	-4.3	222.3	0.0 (1)	4.6 (3)	1.8 (3)	0.9
	8000-9000'	51	30	7.2	3.5	33.8	37,996	-3.7	203.1	NA	NA	NA	3.7
	9000-10,000'	50	45	9.7	8.0	70.5	88,443	-1.7	207.5	10.5 (2)	3.8 (1)	0.2 (1)	8.7
	10,000-11,000'	46	49	10.6	10.7	79.0	92,426	0.1	162.0	13.3 (3)	NA	NA	15.6
	11,000-12,000'	41	48	10.6	11.9	75.8	74,076	1.3	117.1	22.8 (2)	NA	NA	10.0
	12,000-13,000	39	44	10.7	11.8	69.1	16,477	1.0	26.3	NA	NA	NA	2.1
	> 13,000	35	36	9.6	9.3	58.8	726	-0.3	1.5	NA	NA	NA	0.3
Kings	5000-6000'	7	0	0.0	0.0	0.0	0	0.0	101.4	NA	NA	NA	0.0
	6000-7000'	21	0	0.6	0.0	0.0	0	-0.6	137.2	0.0 (1)	0.0 (1)	0.0 (1)	0.0
	7000-8000'	37	1	2.7	0.1	0.4	513	-2.7	177.3	0.0 (3)	0.0 (1)	0.0 (1)	0.3
	8000-9000'	51	16	6.3	1.6	14.6	19,153	-4.7	221.1	2.4 (8)	0.9 (1)	0.0 (1)	3.9
	9000-10,000'	50	38	8.5	5.7	47.5	67,460	-2.8	221.8	8.1 (5)	15.6 (2)	13.4 (2)	9.4
	10,000-11,000'	47	50	9.6	9.4	63.5	96,744	-0.2	193.2	13.3 (4)	12.2 (3)	9.2 (3)	13.0
	11,000-12,000'	45	56	10.3	12.3	65.5	101,332	2.0	154.3	20.0 (1)	4.6 (1)	4.7 (1)	9.8
	12,000-13,000	40	49	10.3	11.9	63.3	30,368	1.6	48.0	NA	NA	NA	4.3
	>13,000'	35	35	9.3	8.8	57.5	1,942	-0.5	4.1	NA	NA	NA	2.7
Kaweah	5000-6000'	85	0	0.3	0.0	0.0	0	-0.3	61.5	NA	NA	NA	0.0
	6000-7000'	98	0	2.0	0.0	0.0	0	-2.0	60.8	0.0 (1)	0.0 (1)	0.0 (1)	0.0
	7000-8000'	76	3	5.3	0.1	0.9	415	-5.2	62.5	NA	NA	NA	0.8
	8000-9000'	62	28	8.1	2.9	27.2	9,011	-5.2	57.8	6.3 (2)	NA	NA	5.4
	9000-10,000'	54	50	9.4	7.6	52.5	17,699	-1.8	43.7	NA	NA	NA	13.8
	10,000-11,000'	49	60	10.7	12.1	65.2	20,033	1.5	31.0	NA	NA	NA	22.2
	>11,000'	49	60	11.7	13.4	70.8	6,281	1.7	8.8	NA	NA	NA	19.9
Tule	5000-6000'	> 200†	0	1.6	0.0	0.0	0	-1.6	55.2	NA	NA	NA	0.0
	6000-7000'	> 200†	0	4.8	0.0	0.0	0	-4.8	41.8	NA	NA	NA	0.0
	7000-8000'	93	2	6.3	0.1	0.2	72	-6.2	26.8	0.0 (1)	1.6 (1)	0.0 (1)	0.0
	8000-9000'	65	8	7.6	0.6	4.2	467	-7.0	14.8	NA	NA	NA	1.0
	9000-10,000'	54	45	9.3	6.4	42.6	1,538	-2.9	4.5	NA	NA	NA	4.7
Kern	5000-6000'	> 200†	0	0.1	0.0	0.0	0	-0.1	258.1	NA	NA	NA	0.0
	6000-7000'	170†	2	0.4	0.0	0.0	46	-0.4	358.5	NA	NA	NA	0.0
	7000-8000'	51	0	0.9	0.0	0.0	0	-0.9	340.5	NA	0.0 (1)	0.0 (1)	0.0
	8000-9000'	27	2	1.8	0.1	0.5	1,434	-1.8	326.0	0.0 (1)	1.1 (1)	0.0 (1)	0.1
	9000-10,000'	21	10	2.5	0.9	5.6	9,599	-1.6	193.4	NA	NA	NA	1.0
	10,000-11,000'	31	27	5.7	4.4	21.3	31,434	-1.2	133.1	NA	0.0 (2)	0.0 (2)	5.5
	11,000-12,000'	39	47	8.8	9.8	43.9	49,568	1.1	94.6	NA	3.1 (1)	1.9 (1)	8.1
	12,000-13,000	35	43	9.1	10.3	45.0	20,796	1.2	37.7	NA	NA	NA	6.1
	>13,000'	32	34	8.8	8.6	40.5	2,895	-0.2	6.3	NA	NA	NA	3.5

Basin	Elevation Band	4/24/22 % 4/24 Avg.	5/1/22 % 5/1 Avg.	4/24/22 SWE (in)	5/1/22 SWE (in)	5/1/22 % SCA	5/1/22†† Vol (af)	4/24 thru 5/1/22 Chg. in SWE (in)	5/1/22 Area (mi2)	5/1/22 Surveys	4/24/22 Pillows	5/1/22 Pillows	5/1/22 SNODAS* (in)
Truckee	5000-6000'	> 200†	24	3.3	0.0	0.6	150	-3.3	70.1	NA	NA	NA	0.0
	6000-7000'	103	33	7.4	1.4	19.0	17,101	-5.9	221.6	NA	11.4 (4)	10.1 (4)	1.9
	7000-8000'	72	53	11.8	7.3	69.3	46,926	-4.5	120.0	23.3 (2)	NA	NA	14.3
	8000-9000'	66	50	15.0	10.4	86.1	17,116	-4.6	31.0	NA	NA	NA	29.3
	9000-10,000'	54	38	13.9	9.1	93.7	3,843	-4.8	8.0	NA	NA	NA	33.5
	10,000-11,000'	47	35	13.6	9.6	100.0	213	-4.0	0.4	NA	NA	NA	33.8
Tahoe	6000-7000'	117†	28	4.8	0.6	6.9	4,308	-4.2	131.3	NA	7.1 (3)	4.6 (3)	1.4
	7000-8000'	74	45	9.7	4.6	46.5	27,515	-5.1	113.3	NA	11.2 (4)	8.0 (4)	7.1
	8000-9000'	62	45	12.9	8.3	81.3	32,561	-4.6	73.2	NA	7.8 (1)	3.1 (1)	11.0
	9000-10,000'	56	41	14.3	9.8	92.0	9,094	-4.5	17.4	NA	NA	NA	14.9
	10,000-11,000'	48	38	13.4	10.0	86.7	447	-3.4	0.8	NA	NA	NA	16.1
W. Carson	5000-6000'	0	0	0.0	0.0	0.0	0	0.0	0.2	NA	NA	NA	0.0
	6000-7000'	101†	0	1.6	0.0	0.0	0	-1.6	2.2	NA	NA	NA	0.0
	7000-8000'	75	18	8.9	1.6	15.1	2,789	-7.3	32.2	NA	NA	NA	1.8
	8000-9000'	59	39	11.5	6.5	54.7	9,753	-4.9	28.0	3.5 (1)	11.1 (2)	8.7 (2)	3.2
	9000-10,000'	52	42	12.9	9.7	77.5	3,741	-3.2	7.3	NA	NA	NA	7.4
	10,000-11,000'	43	28	11.0	6.7	70.5	275	-4.3	0.8	NA	NA	NA	13.0
E. Carson	5000-6000'	92	0	0.0	0.0	0.0	0	0.0	50.3	NA	NA	NA	0.0
	6000-7000'	71	3	0.7	0.0	0.1	36	-0.7	78.4	NA	0.0 (1)	0.0 (1)	0.0
	7000-8000'	51	23	4.0	1.2	11.8	6,963	-2.7	104.8	NA	10.5 (1)	5.8 (1)	0.8
	8000-9000'	49	38	8.6	5.9	51.3	31,776	-2.7	101.8	NA	7.2 (3)	3.9 (3)	6.0
	9000-10,000'	48	47	11.4	10.4	83.0	20,302	-1.0	36.5	NA	NA	NA	17.1
	>10,000'	46	47	12.6	12.3	92.7	7,230	-0.3	11.0	NA	NA	NA	19.7
W. Walker	6000-7000'	0	0	0.0	0.0	0.0	0	0.0	7.8	NA	NA	NA	0.0
	7000-8000'	21	4	0.8	0.1	0.9	214	-0.7	41.1	NA	0.0 (1)	0.0 (1)	0.1
	8000-9000'	42	28	5.5	3.2	28.4	8,144	-2.3	48.2	4.0 (1)	11.8 (1)	10.9 (1)	6.7
	9000-10,000'	47	49	10.4	10.2	73.6	35,702	-0.2	65.3	NA	43.9 (1)	43.6 (1)	20.8
	10,000-11,000'	44	49	11.9	12.8	82.7	18,724	0.9	27.3	NA	NA	NA	24.0
	> 11,000'	39	43	11.0	11.4	79.2	1,362	0.4	2.2	NA	NA	NA	21.9
E. Walker	6000-7000'	15	515	0.0	0.0	0.0	52	0.0	60.7	NA	NA	NA	0.0
	7000-8000'	23	1	0.4	0.0	0.1	56	-0.4	120.4	NA	NA	NA	0.0
	8000-9000'	24	11	1.8	0.6	4.6	3,257	-1.2	96.5	NA	NA	NA	1.9
	9000-10,000'	39	37	6.8	5.7	39.5	17,607	-1.0	57.6	NA	10.7 (1)	9.2 (1)	13.9
	10,000-11,000'	41	46	9.8	10.5	67.0	19,469	0.7	34.8	NA	NA	NA	22.3
	>11,000'	39	41	10.2	10.2	66.5	4,801	0.0	8.9	NA	NA	NA	18.0
Mono	6000-7000'	> 200†	203	0.1	0.1	0.2	919	0.0	322.4	NA	NA	NA	0.0
	7000-8000'	24	1	0.1	0.0	0.0	49	-0.1	419.4	NA	NA	NA	0.0
	8000-9000'	14	4	0.6	0.1	0.8	1,117	-0.5	186.8	NA	NA	NA	0.2
	9000-10,000'	38	32	5.1	3.8	30.3	13,029	-1.4	65.1	NA	NA	NA	6.0
	10,000-11,000'	45	48	10.0	10.1	72.7	26,078	0.1	48.5	NA	NA	NA	19.3
	11,000-12,000'	41	44	10.8	10.9	70.6	15,171	0.1	26.2	NA	NA	NA	20.3
	> 12,000'	43	42	11.7	11.0	72.1	2,570	-0.7	4.4	NA	NA	NA	15.4
Upper Owens	6000-7000'	25	492	0.0	0.0	0.0	26	0.0	66.0	NA	NA	NA	0.0
	7000-8000'	5	0	0.1	0.0	0.0	0	-0.1	152.7	NA	NA	NA	0.0
	8000-9000'	35	26	2.7	1.6	15.7	6,747	-1.1	80.3	NA	NA	NA	0.7
	9000-10,000'	49	44	6.5	5.3	42.8	12,430	-1.3	44.1	NA	25.2 (1)	24.4 (1)	4.0
	10,000-11,000'	45	49	8.5	8.6	59.6	15,929	0.1	34.6	NA	NA	NA	10.9
	11,000-12,000'	40	45	9.5	10.3	63.1	8,803	0.8	16.0	NA	NA	NA	7.7
	> 12,000'	37	33	9.4	8.0	59.3	1,646	-1.3	3.8	NA	NA	NA	1.7
Owens	5000-6000'	0	0	0.0	0.0	0.0	0	0.0	447.0	NA	NA	NA	0.0
	6000-7000'	60	0	0.0	0.0	0.0	0	0.0	359.6	NA	NA	NA	0.0
	7000-8000'	16	0	0.0	0.0	0.0	0	0.0	336.1	NA	NA	NA	0.0
	8000-9000'	22	2	0.2	0.0	0.1	150	-0.2	190.8	NA	NA	NA	0.0
	9000-10,000'	28	11	1.4	0.5	2.1	3,756	-0.9	154.8	NA	0.4 (3)	0.0 (3)	0.2
	10,000-11,000'	35	26	4.1	2.7	14.8	24,262	-1.4	168.7	NA	1.5 (2)	0.0 (2)	1.7
	11,000-12,000'	39	39	7.2	6.8	35.7	49,154	-0.4	135.6	14.5 (1)	NA	NA	2.2
	12,000-13,000	36	38	8.1	8.3	42.3	29,725	0.2	67.5	NA	NA	NA	1.2
	>13,000'	33	34	8.0	7.7	43.1	4,656	-0.2	11.3	NA	NA	NA	1.0

†† For volume totals above Shasta Lake add Upper Sac, McCloud and Pit volumes. For volume totals above Bend Bridge add Upper Sac, McCloud, Pit and Sac at Bend Bridge volumes.

† Deep, low-elevation snow in areas that typically are snow-free can report exceptionally high percent of average for this date because the mean 2000-2020 regression-derived SWE for that area is low or 0.

* This is a comparison to the SNODAS (SNOw Data Assimilation System) nationwide product from the National Weather Service.

Location of Reports and Excel Format Tables

http://instaar.colorado.edu/research/labs-groups/mountain-hydrology-group/page/37199/

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