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

Western United States Region

May 3, 2025

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Introduction

Figure 1 below displays estimated SWE amounts across the Western United States. 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 here. Please note that the basin-wide percent of long-term average from the spatial SWE estimates is not directly comparable with the SNOTEL basin-wide percent of average. A better comparison might be made with the percent of average in the elevation banded tables (linked below) that contain SNOTEL sites.

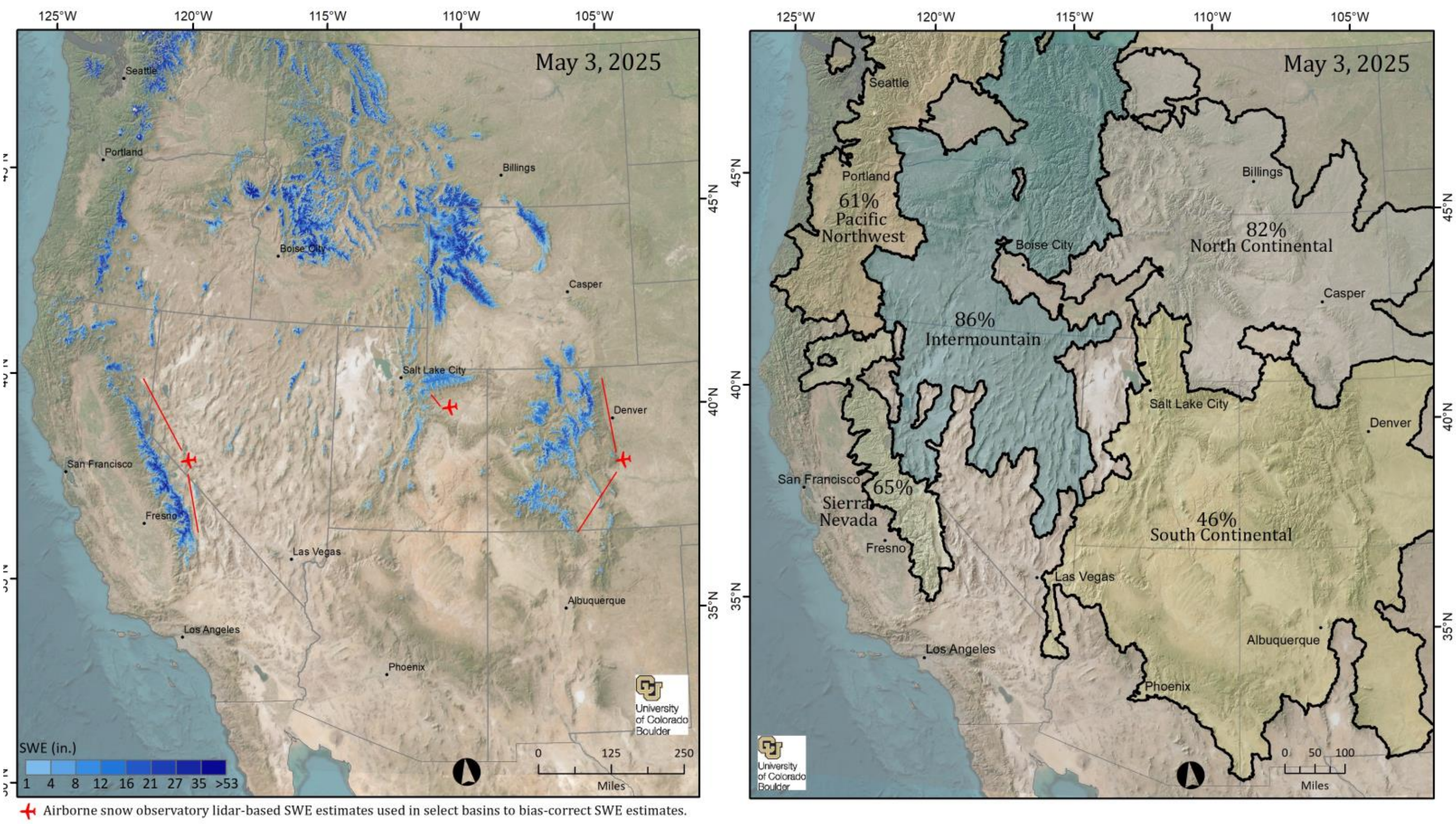

Figure 1. Estimated SWE and % of Average SWE across the Western U.S. SWE amounts across the entire Western region of the United States with red airplane markers indicating areas where the model was bias-corrected by Airborne Snow Observatory data (left) and percent of long-term average (2001-2021) by five regions (right). Region boundaries are delineated based on Snowpack regimes of the Western United States (Trujillo and Molotch, 2014) and the Commission for Environmental Cooperation (CEC) Ecological Regions of North America, Level III [Commission for Environmental Cooperation, 2009, available at http://www.cec.org/north-american-environmental-atlas/terrestrial-ecoregions-level-iii/].

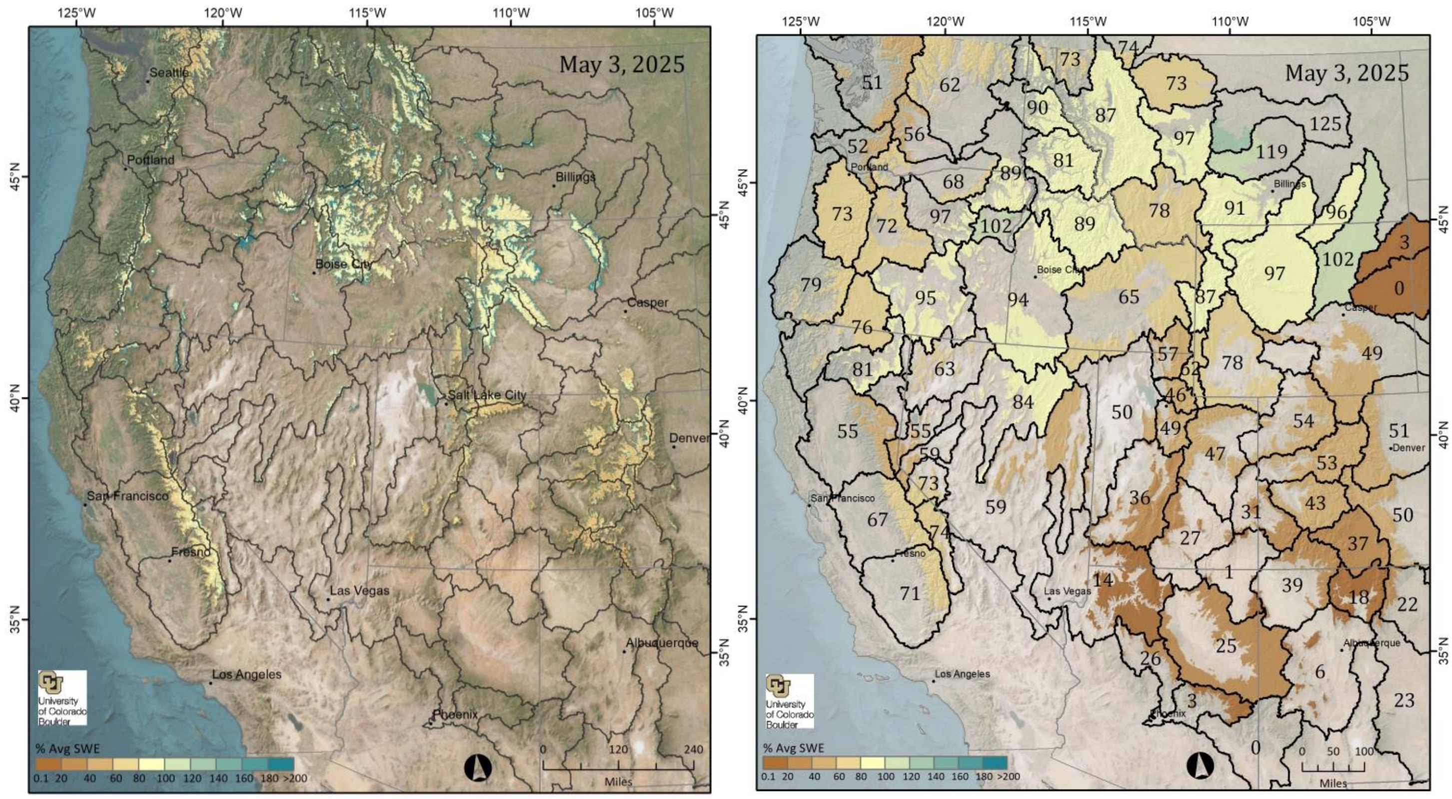

Figure 2. ***Estimated % of Average SWE across the Western U.S.*** Percent of long-term average (2001-2021) from the spatial SWE calculated for each pixel (left) and by HUC-6 basin (right); integer within each watershed represents the percent of average SWE for the report date. Shaded areas (right) correspond to the elevation bands used in the tables below.

For detailed maps and tabular summaries of SWE and snowpack water storage volumes for specific regions and watersheds, click on the links below:

Pacific Northwest
North Continental
South Continental
Intermountain
Sierra Nevada
Elevation Banded SWE Tables

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 meters for the Western region of the United States 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 Sierra Nevada has been distributed to water managers in California since 2012.

The spatial SWE data fusion (SWE-fusion) analysis method for the Western U.S. uses the following data as inputs:

- In-situ SWE from all operational NRCS and CDEC snow pillow sites, and the CoCoRaHS network when appropriate
- Fractional snow-covered area (fSCA) data from recent cloud-free satellite images
- Physiographic information (elevation, latitude, upwind mountain barriers, slope, etc.)
- Historical daily SWE patterns (1985-2021) retrospectively generated using historical fSCA data and an energy-balance model that back-calculates SWE given the fSCA time-series and meltout date for each pixel
- Satellite-observed daily mean fractional snow-covered area (DMFSCA)

For more details 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-fusion product.

SWE input data available for reporting

Snow pillows located throughout the Western U.S. region are input as the dependent variable in the SWE-fusion system. 799 Natural Resources Conservation Service (NRCS) Snow Telemetry (SNOTEL) sites and 131 California Department of Water Resources (CA-DWR) California Data Exchange Center (CDEC) are potentially available for each model run. In addition, the Community Collaborative Rain, Hail and Snow (CoCoRaHS, https://www.cocorahs.org/) network provides over 500 snow measurements across the modeling domain. When available and when appropriate SWE spatial data at 50-meter resolution from the Airborne Snow Observatory (Painter, et.al. 2016) is used to bias-correct model output.

Maps and tables by region

Maps and tables for each of the five western regions (Figure 1b) are shown below. Note that the basin-wide averages may reflect variable conditions across the elevation bands; see banded-elevation tables (linked below). Basin-wide percent of average is calculated across all model pixels inside a given basin and base elevation. Basin base elevations vary anywhere between 2,000’ to 7,000’. Base elevations are dependent on long-term snow coverage. For example, a base elevation in the north could be lower as compared to a base elevation in the south.

Pacific Northwest

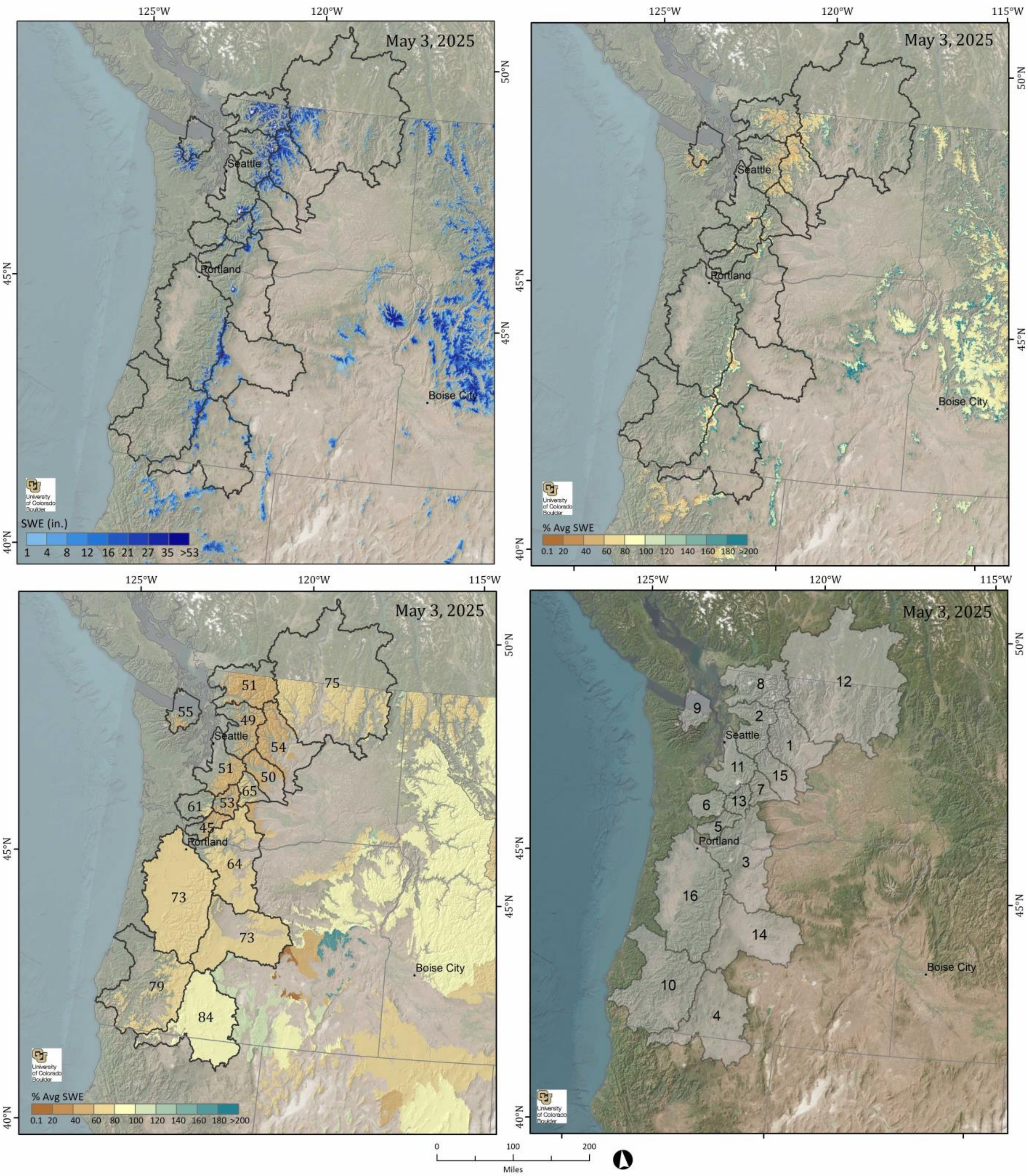

Figure 3. Estimated SWE and % of Average SWE across the Pacific Northwest Region. *SWE amounts (upper left), percent of long-term average (2001-2021) SWE calculated for each pixel (upper right), basin-wide percent of long-term average (lower left)* shaded areas correspond to the elevation bands used in the banded-elevation tables*, and basin identification numbers that correspond to Table 1 below (lower right). The North Puget Sound and Upper Columbia basin portions that are inside Canada do not contain SWE-fusion model data due to lack of data availability needed to run the model in Canada.*

Table 1. SWE by watershed. Shown are percent of average SWE to date for the current date (2001-21 as derived from the regression model), mean SWE for the current report, current percent of snow-covered area, current SWE volume (acre-feet), the area (mi^2) inside each basin that contains data pixels (not including cloud-covered pixels, lakes or other satellite no data pixels), first of the month snow surveys, and current snow pillow sensors (the number of stations are in parentheses), for those areas collected, summarized for each basin. *SWE tables by banded elevation are here.*

Pacific Northwest SWE Report for 5/3/2025

	% of Average		SWE (in)					Pillows		Surveys
Basin	4/27	5/3	4/27	5/3	SCA	Vol. (AF)	Area (mi. sq)	4/27	5/3	5/1
1. Central Columbia	89	54	14.5	7.4	39.5	842,763	2,136	12.9 (7)	10.0 (7)	NA
2. Central Puget Sound	75	49	12.2	7.2	39.3	476,964	1,238	30.1 (5)	24.9 (5)	NA
3. Hood-Sandy-Lower Deschutes	105	64	1.7	0.8	4.8	213,220	5,080	14.4 (11)	12.0 (11)	1.1 (2)
4. Klamath	134	84	1.7	1.0	6.5	368,722	7,199	13.0 (14)	10.6 (14)	17.9 (4)
5. Lewis	58	45	2.5	1.4	8.3	44,537	581	37.8 (6)	29.6 (7)	NA
6. Lower Cowlitz	84	61	4.8	2.7	15.8	26,926	185	18.4 (2)	16.4 (2)	NA
7. Naches	98	65	7.2	3.6	20.9	116,707	610	35.8 (4)	31.3 (4)	NA
8. North Puget Sound	84	51	10.7	6.0	32.7	741,344	2,313	34.5 (9)	31.2 (9)	NA
9. Olympic	94	55	21.3	10.5	53.4	132,630	238	25.4 (3)	22.7 (3)	9.3 (3)
10. Rogue-Umpqua	107	79	3.2	2.2	12.3	387,698	3,371	6.8 (6)	4.5 (6)	7.1 (10)
11. South Puget Sound	80	51	4.4	2.4	14.4	148,343	1,148	17.6 (13)	13.6 (14)	NA
12. Upper Columbia	126	75	4.6	2.2	12.7	655,424	5,502	7.1 (7)	5.7 (7)	NA
13. Upper Cowlitz	75	53	7.1	4.0	22.4	153,888	714	29.4 (3)	23.9 (3)	NA
14. Upper Deschutes-Crooked	128	73	2.7	1.3	7.8	390,543	5,608	12.4 (6)	14.3 (7)	0.0 (2)
15. Upper Yakima	76	50	6.4	3.3	18.5	182,534	1,033	10.5 (3)	5.2 (3)	NA
16. Willamette	107	73	1.2	0.7	3.6	394,407	11,356	9.0 (16)	6.7 (17)	NA

§ Data in all ASO-collected basins have been bias-corrected using ASO data and therefore the SWE changes might not represent snowmelt/accumulation but rather an update to the SWE estimates based on airborne data.

† Deep and recent snow in areas that typically are snow-free can report high percent of average for this date because the mean 2001-2021 regression-derived SWE for that area is low or 0.

*Basin boundaries were derived from a combination of NRCS basins and HUC8 boundaries.

North Continental

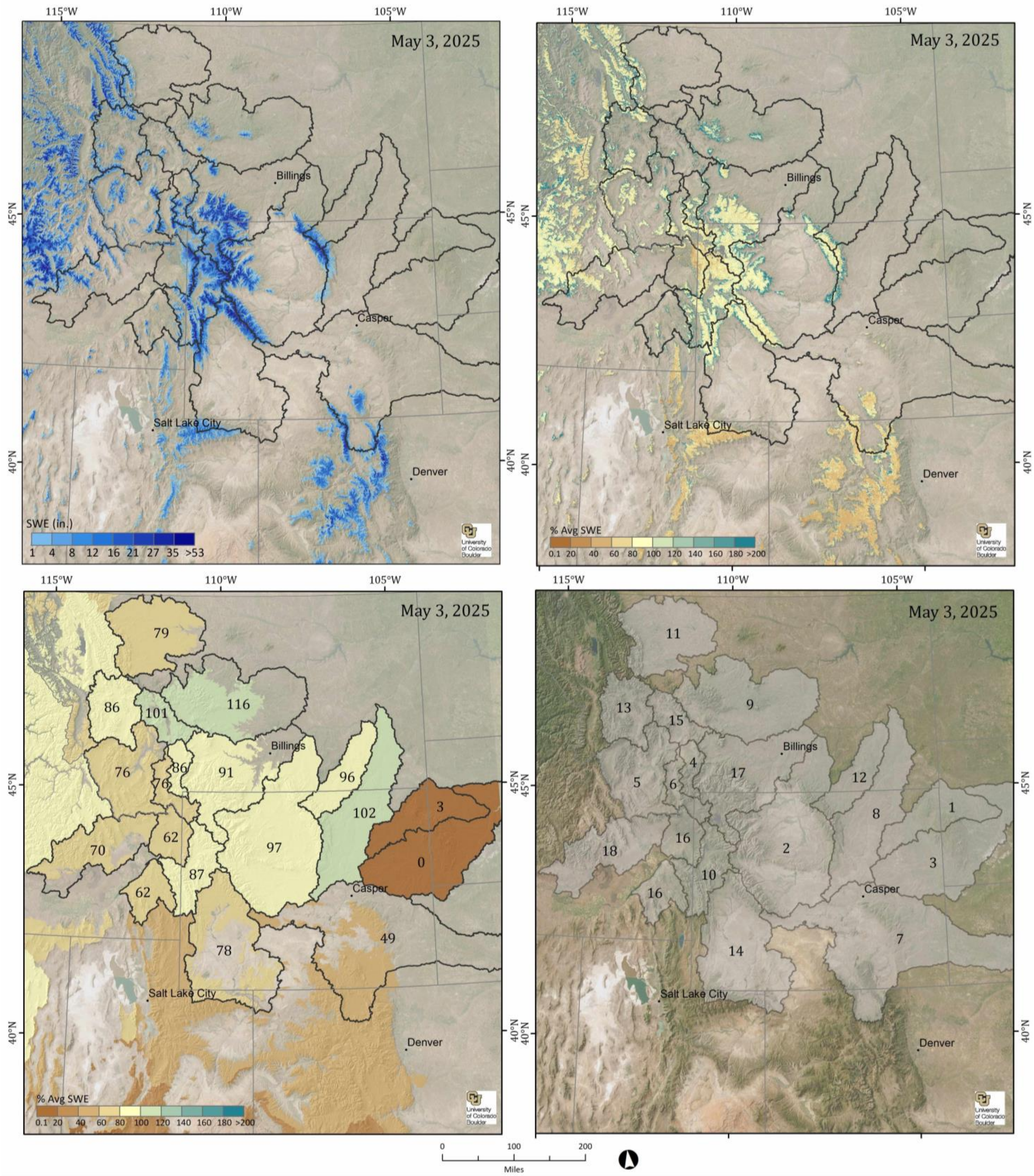

Figure 4. Estimated SWE and % of Average SWE across the North Continental Region. *SWE amounts (upper left), percent of long-term average (2001-2021) SWE calculated for each pixel (upper right), basin-wide percent of long-term average (lower left)* shaded areas correspond to the elevation bands used in the banded-elevation tables*, and basin identification numbers that correspond to Table 2 below (lower right).*

Table 2. SWE by watershed. Shown are percent of average SWE to date for the current date (2001-21 as derived from the regression model), mean SWE for the current report, current percent of snow-covered area, current SWE volume (acre-feet), the area (mi^2) inside each basin that contains data pixels (not including cloud-covered pixels, lakes or other satellite no data pixels), first of the month snow surveys, and current snow pillow sensors (the number of stations are in parentheses), for those areas collected, summarized for each basin. *SWE tables by banded elevation are here.*

North Continental SWE Report for 5/3/2025

Basin	% of Average 4/27	% of Average 5/3	SWE (in) 4/27	SWE (in) 5/3	SCA	Vol. (AF)	Area (mi. sq)	Pillows 4/27	Pillows 5/3	Surveys 5/1
1. Belle Fourche	12	3	0.0	0.0	0.0	153	7,200	0.0 (1)	0.0 (1)	0.0 (2)
2. Bighorn	106	97	2.3	2.0	14.1	2,419,236	22,740	11.0 (21)	10.8 (21)	4.6 (10)
3. Cheyenne	44	0	0.0	0.0	0.0	17	15,348	0.1 (2)	0.0 (2)	NA
4. Gallatin	82	86	3.8	3.7	29.4	365,813	1,846	21.8 (4)	21.3 (4)	12.1 (4)
5. Jefferson	95	76	2.6	1.8	13.8	850,633	8,788	11.8 (14)	11.2 (14)	9.8 (11)
6. Madison Headwaters in WY	83	76	4.6	3.9	31.0	526,691	2,524	15.9 (7)	14.3 (7)	2.9 (5)
7. North Platte	58	49	1.4	1.1	11.0	610,344	10,281	15.0 (22)	13.7 (22)	10.9 (12)
8. Powder	87	102	0.2	0.2	2.6	174,732	13,385	4.3 (5)	4.5 (5)	8.2 (1)
9. Smith-Judith-Musselshell	148	116	1.0	0.6	5.5	288,342	8,335	14.0 (9)	12.4 (9)	11.1 (4)
10. Snake	99	87	9.1	7.5	53.1	2,264,231	5,626	18.8 (11)	17.0 (11)	9.1 (5)
11. Sun-Teton-Marias	93	79	0.7	0.5	4.1	298,091	10,463	5.3 (5)	3.2 (5)	4.0 (4)
12. Tongue	97	96	0.8	0.8	6.5	223,717	5,400	9.5 (6)	10.6 (6)	13.1 (3)
13. Upper Clark Fork	110	86	2.5	1.6	12.8	520,478	5,981	11.0 (12)	9.3 (12)	7.1 (13)
14. Upper Green	90	78	3.2	2.7	18.6	1,350,242	9,539	11.0 (21)	9.0 (21)	21.0 (1)
15. Upper Missouri	141	101	0.8	0.5	4.5	76,002	2,951	2.8 (2)	0.1 (2)	4.3 (3)
16. Upper Snake Basins	85	62	2.4	1.7	13.7	621,044	6,875	13.2 (11)	10.3 (11)	7.4 (12)
17. Upper Yellowstone	94	91	5.1	4.7	33.5	2,803,098	11,070	15.4 (19)	14.6 (19)	8.8 (7)
18. Wood and Lost Basins	104	70	2.3	1.4	9.7	545,007	7,420	6.1 (16)	4.0 (16)	NA

§ Data in all ASO-collected basins have been bias-corrected using ASO data and therefore the SWE changes might not represent snowmelt/accumulation but rather an update to the SWE estimates based on airborne data.

† Deep and recent snow in areas that typically are snow-free can report high percent of average for this date because the mean 2001-2021 regression-derived SWE for that area is low or 0.

*Basin boundaries were derived from a combination of NRCS basins and HUC8 boundaries.

South Continental

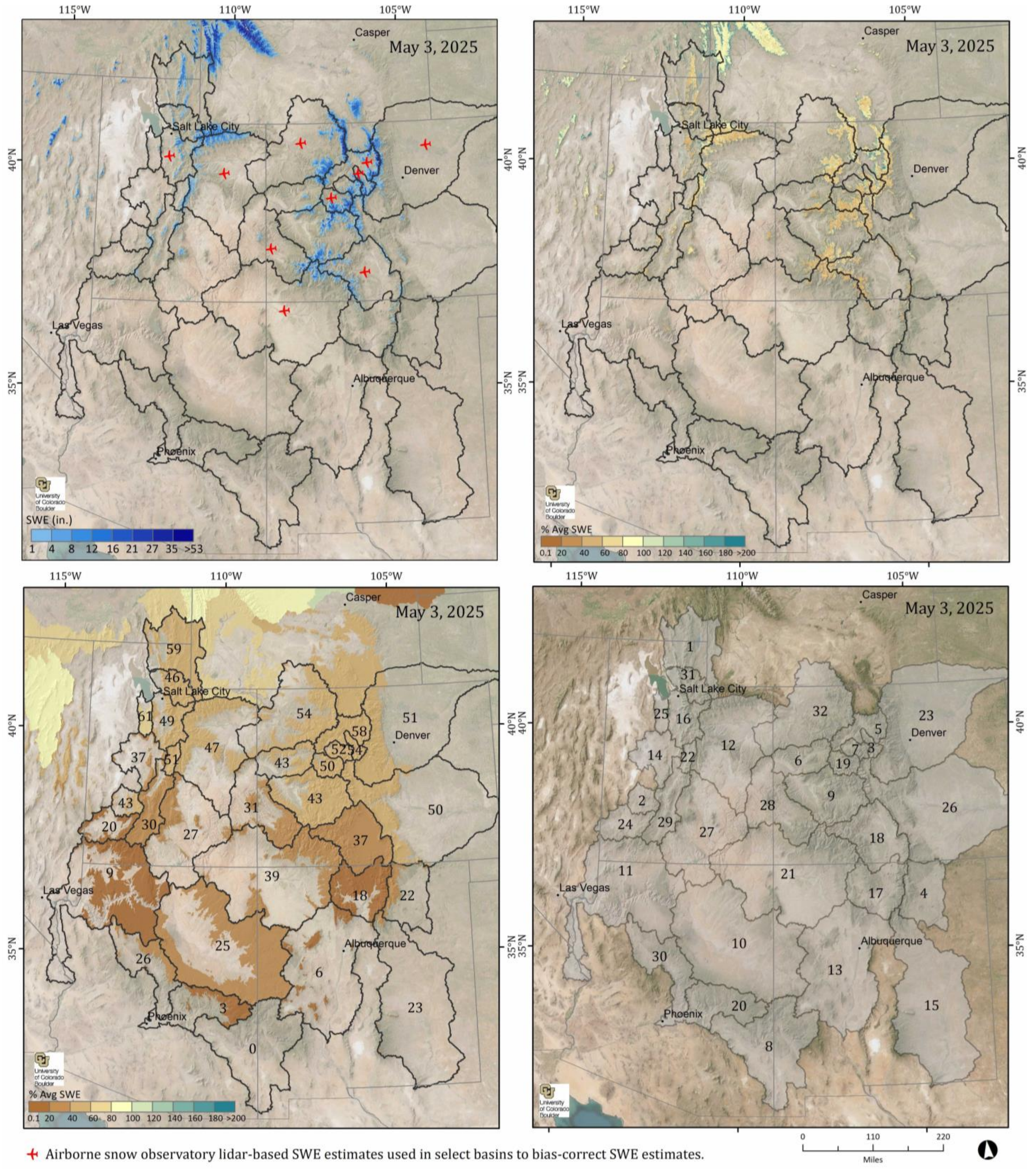

Figure 5. Estimated SWE and % of Average SWE across the South Continental Region. SWE amounts with red airplane markers indicating upper basin areas where the model was bias-corrected by Airborne Snow Observatory data (upper left), percent of long-term average (2001-2021) SWE calculated for each pixel (upper right), basin-wide percent of long-term average (lower left) shaded areas correspond to the elevation bands used in the banded-elevation tables, and basin identification numbers that correspond to Table 3 below (lower right).

Table 3. SWE by watershed. Shown are percent of average SWE to date for the current date (2001-21 as derived from the regression model), mean SWE for the current report, current percent of snow-covered area, current SWE volume (acre-feet), the area (mi^2) inside each basin that contains data pixels (not including cloud-covered pixels, lakes or other satellite no data pixels), first of the month snow surveys, and current snow pillow sensors (the number of stations are in parentheses), for those areas collected, summarized for each basin. *SWE tables by banded elevation are here.*

South Continental SWE Report for 5/3/2025

	% of Average		SWE (in)					Pillows		Surveys
Basin	4/27	5/3	4/27	5/3	SCA	Vol. (AF)	Area (mi. sq)	4/27	5/3	5/1
1. Bear	83	59	1.9	1.3	12.4	416,543	6,181	9.7 (18)	7.6 (18)	9.2 (3)
2. Beaver	41	43	0.3	0.3	5.0	13,923	836	7.5 (2)	7.1 (2)	NA
3. Blue§	71	54	7.1	5.5	43.6	195,471	670	13.9 (5)	13.8 (5)	2.0 (2)
4. Canadian	14	22	0.0	0.1	1.1	3,599	1,265	0.1 (2)	0.2 (2)	NA
5. Colorado Headwaters§	68	58	4.0	3.5	29.1	536,460	2,874	11.9 (13)	11.7 (13)	8.7 (13)
6. Colorado Headwaters-Plateau	49	43	1.5	1.3	14.2	122,689	1,801	7.9 (1)	5.4 (1)	8.2 (1)
7. Eagle	62	52	4.1	3.4	32.2	165,386	921	6.5 (3)	4.2 (3)	9.8 (3)
8. Gila	0	0	0.0	0.0	0.0	0	4,924	0.0 (6)	0.0 (6)	NA
9. Gunnison§	48	43	1.9	1.7	18.7	599,145	6,433	4.8 (11)	2.9 (11)	3.3 (6)
10. Little Colorado	25	25	0.0	0.0	0.0	1,333	16,379	0.6 (5)	0.5 (5)	0.0 (3)
11. Lower Colorado Mainstream	10	9	0.0	0.0	0.3	2,237	10,695	0.5 (5)	0.0 (5)	NA
12. Lower Green§	55	47	2.0	1.5	17.6	446,093	5,647	4.4 (24)	3.3 (24)	17.9 (1)
13. Lower Rio Grande	1	6	0.0	0.0	0.0	234	1,795	0.0 (6)	0.0 (6)	NA
14. Lower Sevier	45	37	0.2	0.2	3.3	7,640	897	5.3 (4)	4.5 (4)	NA
15. Pecos	9	23	0.1	0.2	2.9	3,067	331	0.2 (2)	0.4 (2)	NA
16. Provo-Utah Lake-Jordan§	61	49	1.7	1.1	13.3	163,865	2,681	12.5 (16)	8.5 (18)	7.9 (7)
17. Rio Chama-Upper Rio Grande	17	18	0.1	0.1	1.7	23,852	5,207	0.9 (13)	0.6 (13)	0.7 (2)
18. Rio Grande Headwaters§	43	37	0.7	0.6	8.2	257,760	7,595	2.8 (14)	2.0 (14)	0.8 (9)
19. Roaring Fork§	59	50	5.6	4.8	39.4	349,309	1,359	9.0 (7)	7.7 (7)	4.5 (2)
20. Salt	0	3	0.0	0.0	0.0	240	2,361	0.0 (7)	0.0 (7)	NA
21. San Juan	42	39	0.8	0.7	7.8	229,623	6,406	3.4 (15)	2.5 (15)	0.0 (1)
22. San Pitch	53	51	1.3	1.1	13.0	50,190	857	6.2 (6)	4.7 (6)	15.7 (1)
23. South Platte§	57	51	1.5	1.3	12.0	386,541	5,620	11.3 (20)	9.9 (21)	5.1 (28)
24. Southwestern Utah	17	20	0.0	0.0	1.3	3,180	1,440	1.1 (5)	0.8 (5)	0.0 (2)
25. Toole Valley-Vernon Creek	91	61	0.3	0.2	1.9	8,366	906	5.2 (4)	4.1 (4)	NA
26. Upper Arkansas	54	50	0.9	0.8	8.7	250,263	5,875	2.4 (6)	1.1 (6)	4.8 (5)
27. Upper Colorado-Dirty Devil	30	27	0.3	0.3	4.0	41,069	2,597	0.2 (7)	0.1 (7)	0.8 (2)
28. Upper Colorado-Dolores§	32	31	0.6	0.7	5.8	130,251	3,434	3.8 (8)	2.5 (9)	2.3 (3)
29. Upper Sevier	30	30	0.3	0.3	4.3	55,134	3,758	2.6 (16)	1.9 (16)	0.0 (2)
30. Verde	69	26	0.0	0.0	0.0	225	1,816	0.1 (7)	0.1 (7)	NA
31. Weber-Ogden	63	46	1.7	1.1	12.8	119,479	2,041	9.4 (16)	6.3 (17)	NA
32. White-Yampa§	66	54	3.0	2.3	20.1	734,486	5,948	12.4 (15)	10.8 (15)	7.1 (4)

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† Deep and recent snow in areas that typically are snow-free can report high percent of average for this date because the mean 2001-2021 regression-derived SWE for that area is low or 0.

*Basin boundaries were derived from a combination of NRCS basins and HUC8 boundaries.

Intermountain

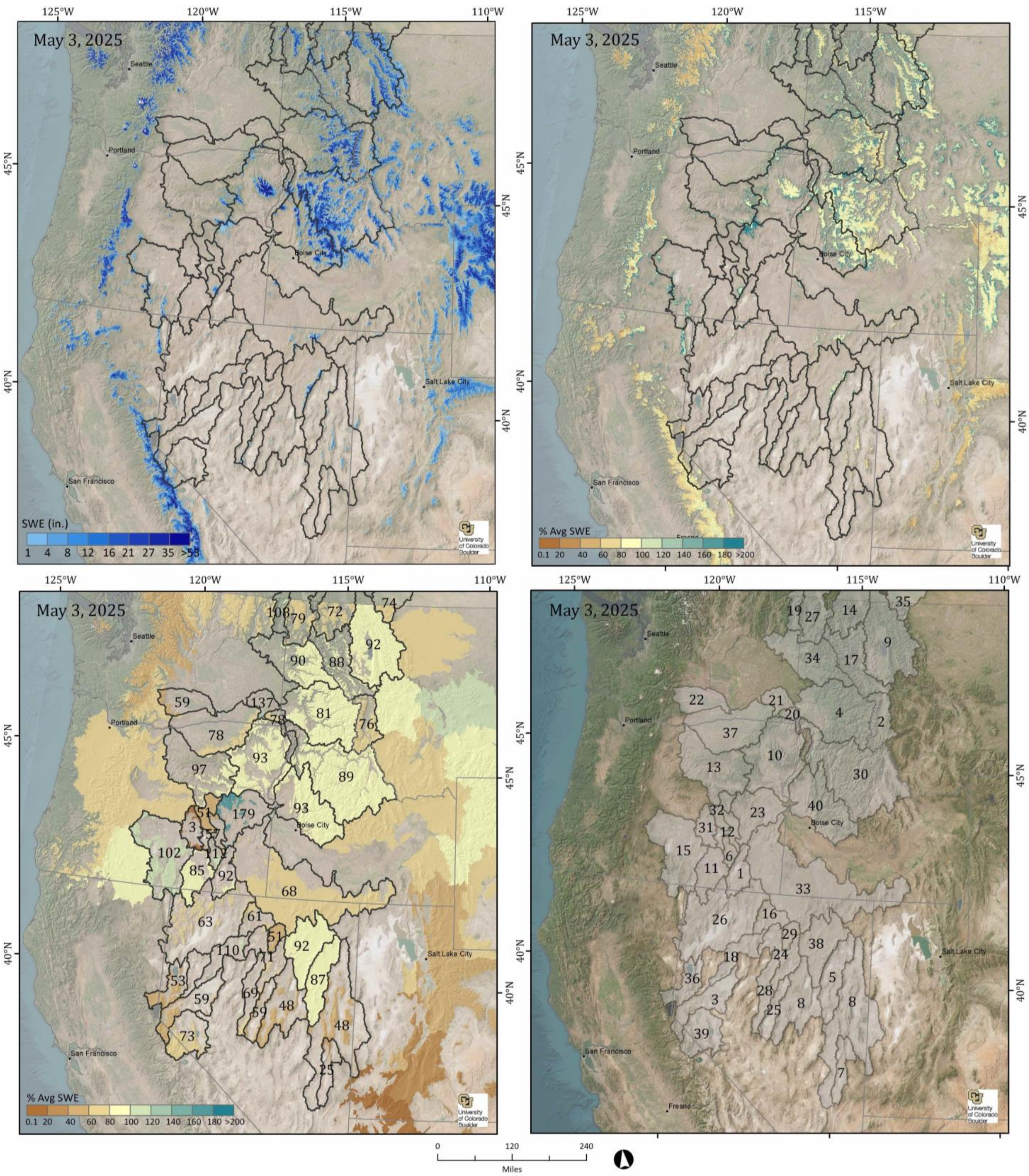

Figure 6. Estimated SWE and % of Average SWE across the Intermountain Region. SWE amounts (upper left), percent of long-term average (2001-2021) SWE calculated for each pixel (upper right), basin-wide percent of long-term average (lower left) shaded areas correspond to the elevation bands used in the banded-elevation tables, and basin identification numbers that correspond to Table 4 below (lower right).

Table 4. SWE by watershed. Shown are percent of average SWE to date for the current date (2001-21 as derived from the regression model), mean SWE for the current report, current percent of snow-covered area, current SWE volume (acre-feet), the area (mi^2) inside each basin that contains data pixels (not including cloud-covered pixels, lakes or other satellite no data pixels), first of the month snow surveys, and current snow pillow sensors (the number of stations are in parentheses), for those areas collected, summarized for each basin. *SWE tables by banded elevation are here.*

Intermountain SWE Report for 5/3/2025

	% of Average		SWE (in)					Pillows		Surveys
Basin	4/27	5/3	4/27	5/3	SCA	Vol. (AF)	Area (mi. sq)	4/27	5/3	5/1
1. Alvord Lake	127	92	1.2	0.9	7.1	15,005	324	NA	NA	8.0 (2)
2. Bitterroot	96	76	6.6	4.7	32.9	486,102	1,952	13.8 (4)	10.3 (4)	NA
3. Carson	80	59	2.6	1.5	10.6	110,292	1,405	10.5 (7)	7.5 (7)	NA
4. Clearwater Basin	103	81	5.4	3.8	25.7	1,498,917	7,488	24.9 (11)	21.2 (11)	NA
5. Clover Valley and Franklin	105	87	0.2	0.2	2.1	40,682	4,048	7.9 (2)	5.7 (2)	NA
6. Donner und Blitzen	128	112	5.3	4.0	30.4	46,730	222	32.0 (2)	27.0 (2)	NA
7. Dry Lake Valley	15	25	0.1	0.1	1.3	926	289	NA	NA	NA
8. Eastern Nevada	43	48	0.2	0.3	3.8	59,405	4,372	2.1 (8)	2.1 (8)	NA
9. Flathead	103	92	4.9	3.9	27.2	1,569,442	7,526	20.7 (13)	17.8 (13)	10.5 (16)
10. Grande Ronde-Burnt-Powder_Imnaha	115	93	3.6	2.6	15.2	737,328	5,312	10.7 (10)	7.4 (10)	16.5 (5)
11. Guano	122	85	0.1	0.0	0.3	2,645	2,036	0.1 (1)	0.0 (1)	0.0 (2)
12. Harney-Malheur Lakes	28	57	0.0	0.0	0.4	442	276	NA	NA	0.0 (1)
13. John Day	126	97	2.8	1.7	14.3	139,301	1,502	5.2 (2)	1.3 (2)	NA
14. Kootenai	89	72	3.5	2.5	19.1	226,626	1,673	19.5 (5)	16.7 (5)	19.4 (2)
15. Lake County-Goose Lake	147	102	1.3	0.8	7.0	154,078	3,602	18.0 (2)	16.4 (2)	5.3 (5)
16. Little Humboldt	92	61	0.4	0.3	3.0	6,854	419	6.7 (3)	5.8 (3)	NA
17. Lower Clark Fork	113	88	6.8	4.6	33.1	360,149	1,465	40.3 (4)	37.9 (4)	23.4 (5)
18. Lower Humboldt	208	110	0.4	0.3	5.2	4,354	274	0.0 (1)	0.0 (1)	NA
19. Lower Pend Oreille	135	108	9.7	7.3	48.1	50,024	129	24.6 (1)	19.9 (1)	NA
20. Lower Snake-Asotin	101	78	0.5	0.3	2.6	5,132	328	0.8 (2)	0.0 (2)	NA

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Intermountain SWE Report for 5/3/2025										
	% of Average		SWE (in)					Pillows		Surveys
Basin	4/27	5/3	4/27	5/3	SCA	Vol. (AF)	Area (mi. sq)	4/27	5/3	5/1
21. Lower Snake-Tucannon	163	137	3.1	1.9	16.8	10,988	109	NA	NA	NA
22. Lower Yakima	104	59	1.6	0.7	4.7	19,130	489	11.0 (2)	7.8 (2)	NA
23. Malheur	161	179	1.9	1.5	13.7	77,890	992	3.7 (3)	1.5 (3)	NA
24. Middle Humboldt	154	71	0.1	0.1	0.8	1,720	633	NA	NA	NA
25. Northern Big Smoky Valley	65	59	0.5	0.5	8.1	16,455	570	NA	NA	NA
26. Northern Great Basin	91	63	0.2	0.1	1.4	15,779	2,226	0.7 (2)	0.0 (2)	0.0 (2)
27. Panhandle Basins	102	79	4.4	3.2	22.4	282,780	1,644	28.6 (3)	25.7 (3)	7.8 (1)
28. Reese	83	69	0.6	0.6	8.8	14,964	491	5.5 (2)	4.9 (2)	NA
29. Rock	157	51	0.1	0.0	0.2	842	835	7.0 (1)	3.7 (1)	NA
30. Salmon Basin	112	89	7.7	5.6	37.0	3,546,511	11,932	18.6 (11)	15.4 (11)	NA
31. Silver	74	3	0.1	0.0	0.0	11	431	NA	NA	NA
32. Silvies	124	51	0.3	0.1	0.7	5,655	1,316	8.0 (1)	0.9 (2)	NA
33. Southern Snake Basins	109	68	0.3	0.2	1.6	127,246	12,500	5.0 (13)	3.7 (13)	0.0 (6)
34. Spokane	114	90	1.9	1.2	9.3	197,832	3,146	11.4 (8)	7.2 (8)	6.8 (4)
35. St. Mary	78	74	7.1	5.8	38.4	199,219	648	0.2 (1)	0.0 (1)	24.1 (5)
36. Truckee	65	53	1.9	1.5	11.7	117,084	1,420	13.4 (9)	12.4 (9)	NA
37. Umatilla-Walla Walla-Willow	111	78	0.5	0.3	2.8	20,789	1,434	13.0 (7)	10.5 (7)	NA
38. Upper Humboldt	119	92	0.6	0.5	4.1	136,988	5,032	7.7 (8)	6.1 (8)	NA
39. Walker	79	73	2.1	1.5	11.0	156,145	1,939	13.7 (7)	12.6 (7)	NA
40. West Central Basins	121	93	7.1	5.1	30.7	1,522,312	5,620	19.4 (15)	15.7 (15)	12.0 (9)

§ Data in all ASO-collected basins have been bias-corrected using ASO data and therefore the SWE changes might not represent snowmelt/accumulation but rather an update to the SWE estimates based on airborne data.

† Deep and recent snow in areas that typically are snow-free can report high percent of average for this date because the mean 2001-2021 regression-derived SWE for that area is low or 0.

*Basin boundaries were derived from a combination of NRCS basins and HUC8 boundaries.

Sierra Nevada

There is a separate SWE report which also includes maps and tables that has a stronger focus on the Sierra Nevada, it is available [here](). The Sierra report incorporates additional vetting and can include bias-corrections with Airborne Snow Observatory data. Below is one of the maps from the current report.

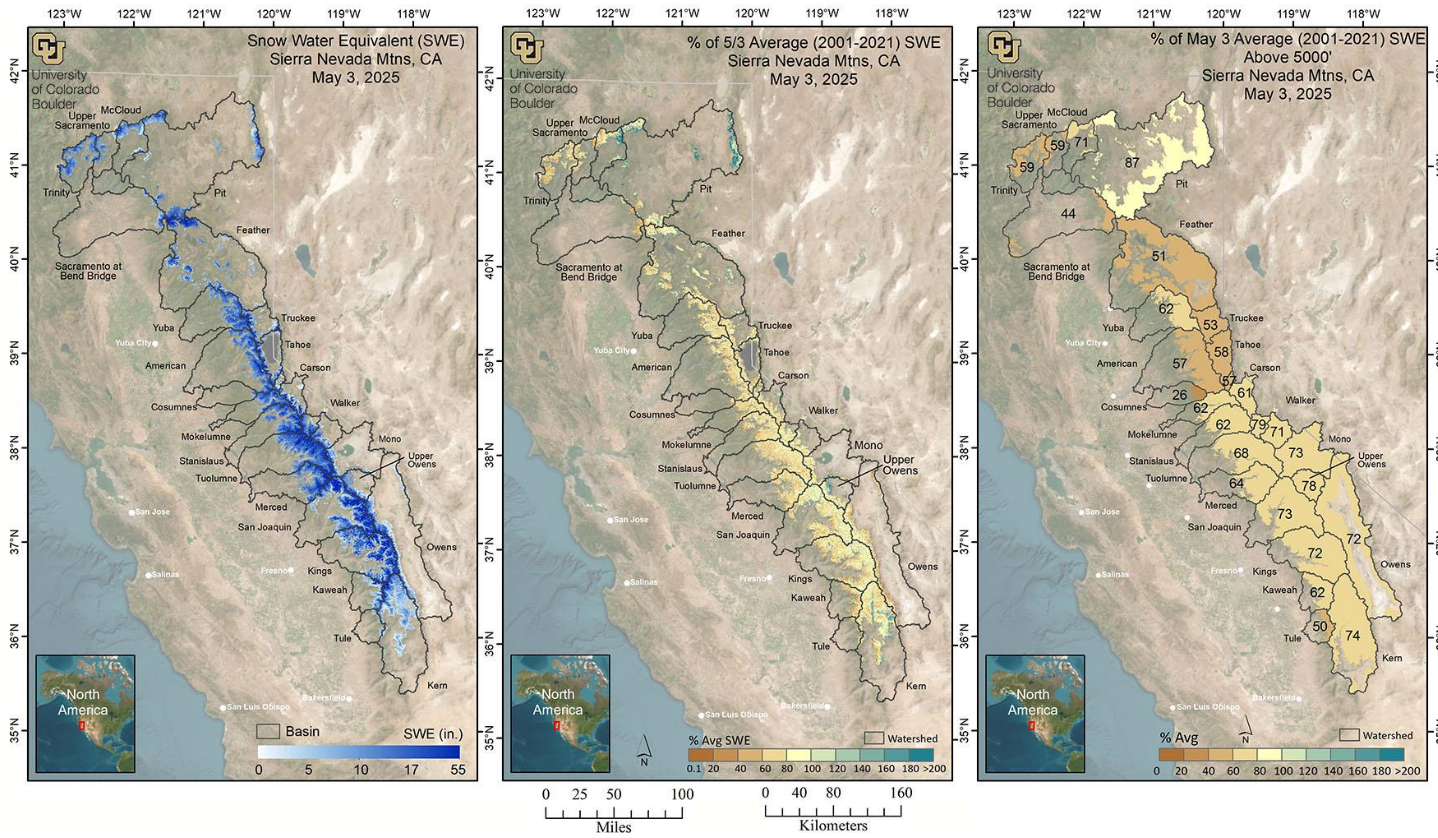

Figure 7. Estimated SWE and % of Average SWE across the Sierra Nevada. SWE amounts (left), and percent of average (2001-2021) SWE for the Sierra Nevada, calculated for each pixel (middle) and basin-wide (right). Basin-wide percent of average is calculated across all model pixels >5000’ elevation.

Table 5. SWE by watershed. Shown are percent of average SWE to date for the current date (2001-21 as derived from the regression model), mean SWE for the current report, current percent of snow-covered area, current SWE volume (acre-feet), the area (mi^2) inside each basin that contains data pixels (not including cloud-covered pixels, lakes or other satellite no data pixels), first of the month snow surveys, and current snow pillow sensors (the number of stations are in parentheses), for those areas collected, summarized for each basin. [*SWE tables by banded elevation are here.*]

Sierra Nevada SWE Report for 5/3/2025

	% of Average		SWE (in)					Pillows		Surveys	
	4/27	5/3	4/27	5/3	SCA	Vol. (AF)‡	Area (mi. sq)	4/27	5/3	5/1	SNODAS*
Trinity	68	59	12.4	10.3	58.0	175,965	321.4	20.7 (4)	12.8 (4)	32.5 (4)	22.7
Upper Sacramento	70	59	11.3	9.2	53.7	56,356	115.2	12.5 (1)	3.0 (1)	36.2 (2)	19.7
McCloud	85	71	11.5	9.2	63.0	81,144	164.9	28.5 (1)	23.9 (1)	20.0 (2)	31.2
Pit	114	87	3.5	2.5	14.5	272,740	2065.9	13.5 (7)	10.6 (7)	4.0 (1)	2.9
Sacramento at Bend Bridge	58	44	5.4	3.9	21.3	49,543	239.8	NA	NA	0.0 (1)	6.6
Feather§	61	51	4.3	2.5	17.0	272,948	2087.7	16.0 (6)	12.0 (6)	10.7 (19)	5.8
Yuba	77	62	11.4	8.9	48.4	244,486	516.4	40.7 (5)	36.7 (5)	22.7 (16)	18.0
American	73	57	9.8	7.7	37.4	325,665	795.3	12.9 (11)	10.1 (11)	10.0 (19)	9.2
Cosumnes	37	26	2.7	1.8	10.4	8,738	91.9	NA	NA	NA	2.4
Mokelumne	70	62	10.8	8.9	43.1	149,863	315.1	32.7 (2)	28.1 (2)	17.1 (11)	11.6
Stanislaus	71	62	11.0	9.1	39.0	269,719	557.4	23.7 (5)	21.2 (5)	15.2 (12)	10.6
Tuolumne	77	68	12.4	10.8	48.1	525,870	910.3	18.9 (7)	15.4 (8)	16.6 (12)	15.8
Merced	67	64	10.4	9.3	40.8	268,277	538.8	21.2 (2)	17.8 (2)	19.6 (5)	12.2
San Joaquin§	66	73	10.4	10.3	44.0	662,198	1208.5	5.7 (7)	1.7 (6)	18.0 (9)	8.7
Kings§	68	72	11.1	10.7	49.6	691,008	1207.3	12.7 (5)	10.8 (5)	12.2 (22)	9.6
Kaweah§	67	62	6.5	5.8	37.6	96,627	314.1	18.2 (2)	17.2 (2)	10.6 (4)	9.6
Tule	66	50	2.8	2.0	14.0	14,349	137.6	0.0 (1)	0.0 (1)	0.0 (1)	1.0
Kern§	67	74	3.4	3.4	21.4	307,355	1682.1	10.5 (6)	7.3 (5)	9.3 (11)	3.3
Truckee§	66	53	7.5	6.0	31.4	132,370	412.0	13.5 (6)	11.9 (6)	26.0 (1)	8.1
Tahoe§	79	58	10.6	8.6	40.8	140,221	306.0	13.3 (7)	9.8 (7)	NA	7.5
W Carson§	75	57	12.5	6.3	40.9	21,909	65.0	13.6 (3)	10.5 (3)	19.5 (1)	6.9
E Carson§	83	61	8.5	5.4	28.1	101,794	354.3	8.1 (4)	5.2 (4)	NA	6.5
W Walker	81	79	12.7	11.7	49.7	112,385	179.6	16.9 (4)	16.5 (4)	11.5 (1)	16.9
E Walker	77	71	4.7	4.1	21.9	76,370	351.0	14.8 (1)	13.7 (1)	NA	5.8
Mono	66	73	1.9	2.0	10.5	105,622	1004.4	NA	NA	NA	2.0
Upper Owens	75	78	4.8	4.8	23.1	95,193	374.5	34.9 (1)	33.7 (1)	NA	2.4
Owens	54	72	2.0	2.6	15.8	243,180	1772.0	5.4 (5)	3.3 (5)	14.5 (1)	1.2

§ Data in all ASO-collected basins have been bias-corrected using ASO data and therefore the SWE changes might not represent snowmelt/accumulation but rather an update to the SWE estimates based on airborne data.

† Deep and recent snow in areas that typically are snow-free can report high percent of average for this date because the mean 2001-2021 regression-derived SWE for that area is low or 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.

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

Elevation Banded SWE Tables
Due to the length of the banded elevation tables (tables 6-10), that data is being hosted on our GitHub repository. Direct links to all of the tables are below. Access to the GitHub repository for the tables in both HTML and CSV formats is **here**.

- Pacific Northwest (Table 6)
- North Continental (Table 7)
- South Continental (Table 8)
- Intermountain, part 1 (Table 9a)
  Intermountain, part 2 (Table 9b)
- Sierra Nevada (Table 10)

The value of spatially explicit estimates of SWE
Snowmelt makes up the large majority (~60-85%) of the annual streamflow in the Western U.S. The spatial distribution of 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 hundreds of NRCS SNOTEL and California DWR CDEC snow pillow sites spread across the Western U.S., 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 pillow sites. The spatial SWE-fusion creates a detailed picture of the spatial pattern of SWE using snow pillows, satellite, and other data, extending beyond the snow pillow sites to unmonitored areas.

Interpreting the spatial SWE estimates in the context of snow pillow sites
The spatial SWE-fusion product estimates SWE for every pixel where the fractional snow-covered area (fSCA) satellite product identifies snow-cover. Comparatively, snow pillow samples on average 8-20 points per basin within a narrower elevation range. Thus, the basin-wide percent of long-term average from the spatial SWE-fusion estimates is not directly comparable with the snow pillow basin-wide percent of average. A better comparison might be made with the % average in the elevation bands (elevation-banded tables 6-10) that contain snow pillow sites.

Location of Reports, Excel Format Tables, and JPG Maps
https://github.com/CU-Mountain-Hydrology/WestWide

Methods
The spatial SWE-fusion estimation method is described in Yang, et al. (2022) and Schneider and Molotch (2016). The method uses a General Linear Model in which the dependent variable is derived from the operationally measured in situ SWE from all online NRCS SNOTEL and CDEC snow pillow sites in the domain and when applicable the CoCoRaHS SWE values. The snow pillow SWE observations are scaled by the satellite-based fractional snow-covered area (fSCA) across the 500-meter pixel containing that snow pillow site before being used in the linear regression model. The fSCA is a near-real-time cloud-free daily satellite image from the Snow Today fSCA image (Rittger, et al. 2019, https://nsidc.org/snow-today) which uses the SPIReS algorithm (Bair, et al. 2021).

The following independent variables (predictors) enter 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 (1985-2021) retrospectively generated using historical Landsat 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 Fang, et al., (2022) for details. (For computational efficiency, only one image during the 1985-2021 period that best matches the real-time snow pillow-observed pattern is selected as an independent variable.)
- Satellite-observed daily mean fractional snow-covered area (DMFSCA) derived from Rittger, et al., (2019) data.

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 from Airborne Snow Observatory lidar data (Painter, et.al. 2016) and from snow surveys at 10 locations in Colorado. Additionally, as a final step, when appropriate and when available, ASO data can be used to bias-correct model output.

List of All Known Data Issues/Caveats

- SATELLITE FSCA - Recent snowpack accumulation particularly in the Arizona / NM region may be under-estimated due to issues with satellite-observed fSCA.
- GLACIER & NON-SEASONAL SNOW – SWE values on non-seasonal snow and glaciers need to be excluded before data analysis.
- 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 overestimate 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 SNOTEL 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.
- 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.
- EARLY SEASON FSCA ERRORS – The gap-filled fSCA requires some cloud-free images to determine fSCA amounts. Early in the season and if it has been particularly cloudy the algorithm hasn't had time to calculate fSCA amounts in some areas, typically in the Pacific Northwest and northern areas of the domain.

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