Supplementary

High-Resolution Snow Water Equivalent Estimation: A Data-Driven Method for Localized Downscaling of Climate Data

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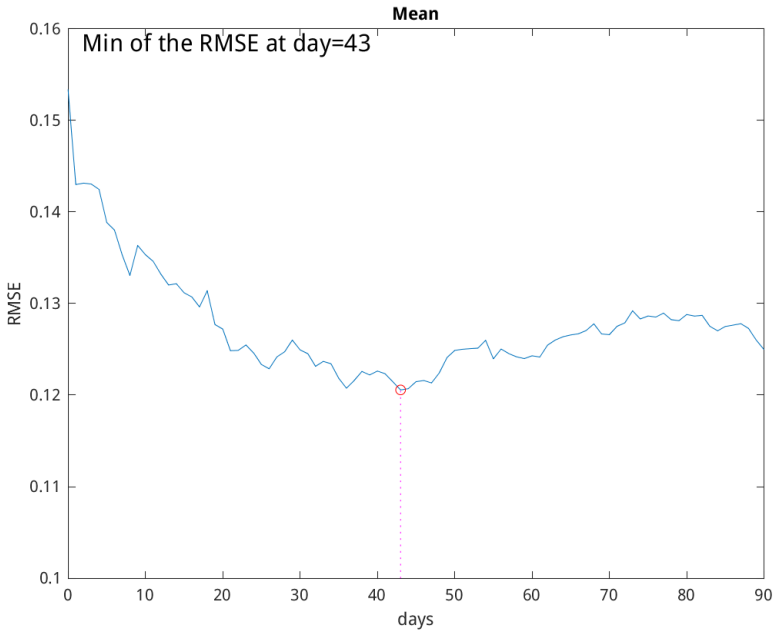
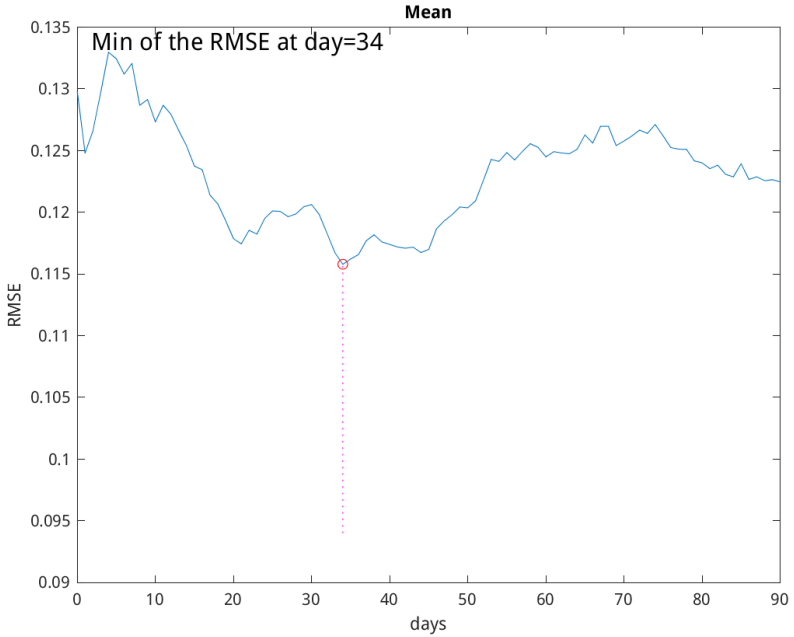
Table S1. Annual Averaged SPEI Values and Interpretations for California and Colorado, 1985-2014.

Year	California		Colorado	
	Averaged SPEI	**Interpretation**	**Averaged SPEI**	**Interpretation**
1985	0.02	Near Normal	0.86	Slightly Wet
1986	0.54	Incipient Wet Spell	0.85	Slightly Wet
1987	-0.25	Near Normal	-0.59	Incipient Dry Spell
1988	-0.9	Mild Drought	-0.61	Incipient Dry Spell
1989	-0.28	Near Normal	-1.04	Mild Drought
1990	-0.98	Mild Drought	-0.47	Near Normal
1991	0.33	Near Normal	0.11	Near Normal
1992	-0.23	Near Normal	-0.51	Incipient Dry Spell
1993	0.5	Incipient Wet Spell	0.63	Incipient Wet Spell
1994	-0.53	Incipient Dry Spell	-1.44	Moderate Drought
1995	1.21	Slightly Wet	1.58	Moderately Wet
1996	1.31	Moderately Wet	0.93	Slightly Wet
1997	0.18	Near Normal	0.85	Slightly Wet
1998	1.28	Slightly Wet	-0.07	Near Normal
1999	-0.26	Near Normal	0.07	Near Normal
2000	-0.15	Near Normal	-0.35	Near Normal
2001	-0.13	Near Normal	-0.74	Incipient Dry Spell
2002	-0.81	Mild Drought	-1.64	Severe Drought
2003	-0.66	Incipient Dry Spell	-0.32	Near Normal
2004	-0.65	Incipient Dry Spell	-0.65	Incipient Dry Spell
2005	0.89	Slightly Wet	0.54	Incipient Wet Spell
2006	0.03	Near Normal	-0.01	Near Normal
2007	-1.74	Severe Drought	-0.19	Near Normal
2008	-0.73	Incipient Dry Spell	0.5	Near Normal
2009	-0.1	Near Normal	-0.31	Near Normal
2010	0.87	Slightly Wet	-0.89	Mild Drought
2011	0.19	Near Normal	0.29	Near Normal
2012	-0.6	Incipient Dry Spell	-2.08	Extreme Drought
2013	-1.97	Severe Drought	0.62	Incipient Wet Spell
2014	-1.23	Mild Drought	0.96	Slightly Wet

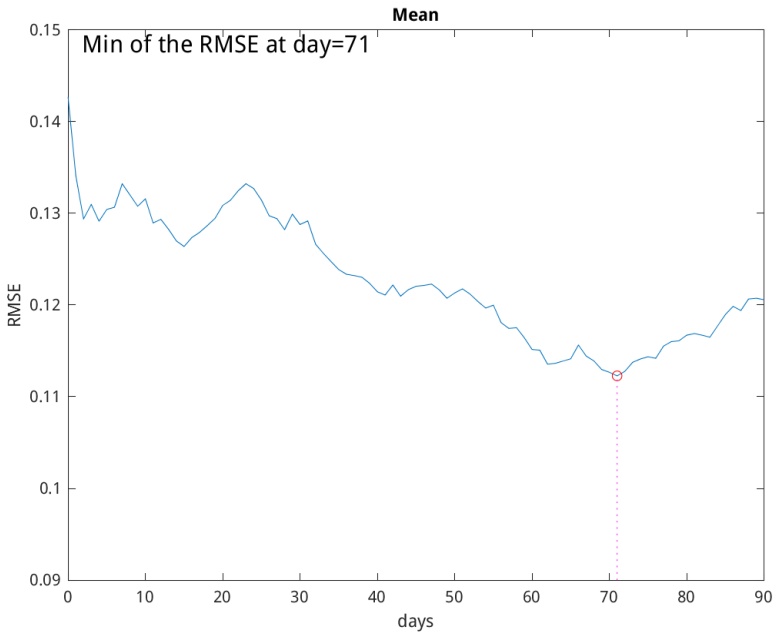
100 km

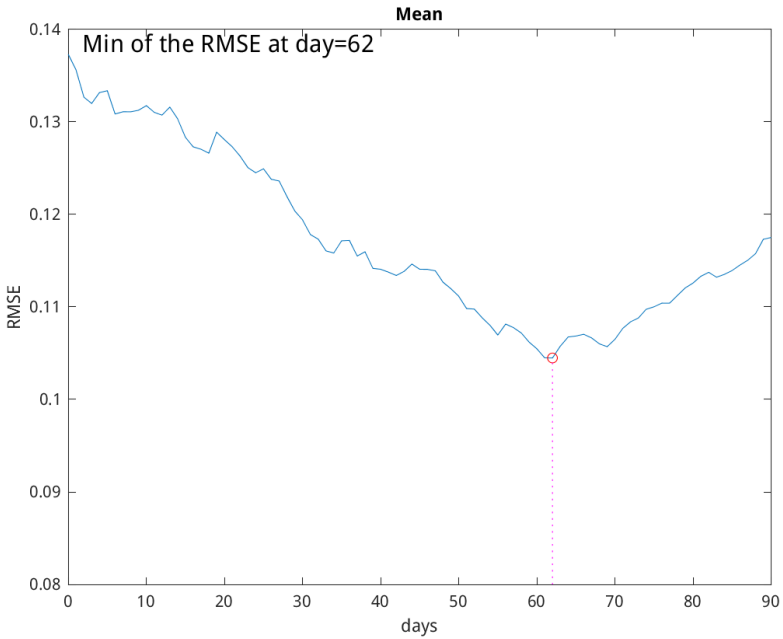


9 km

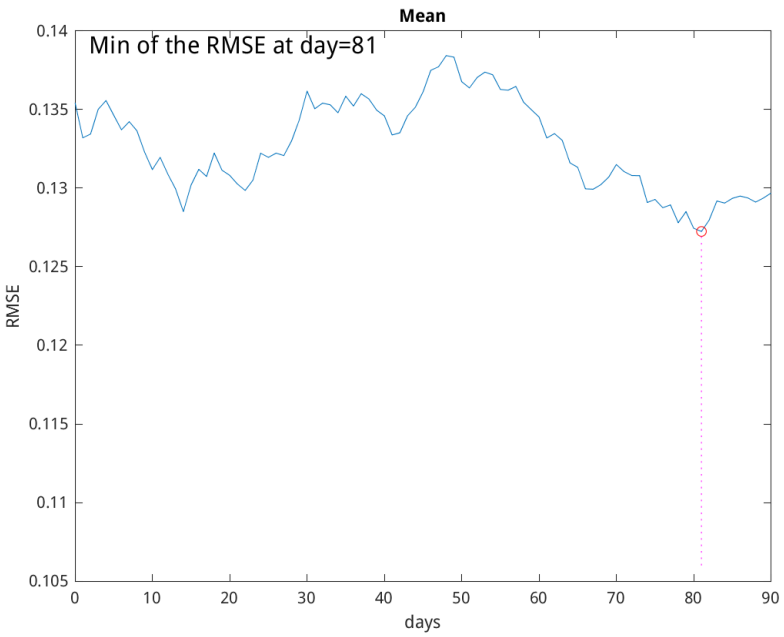


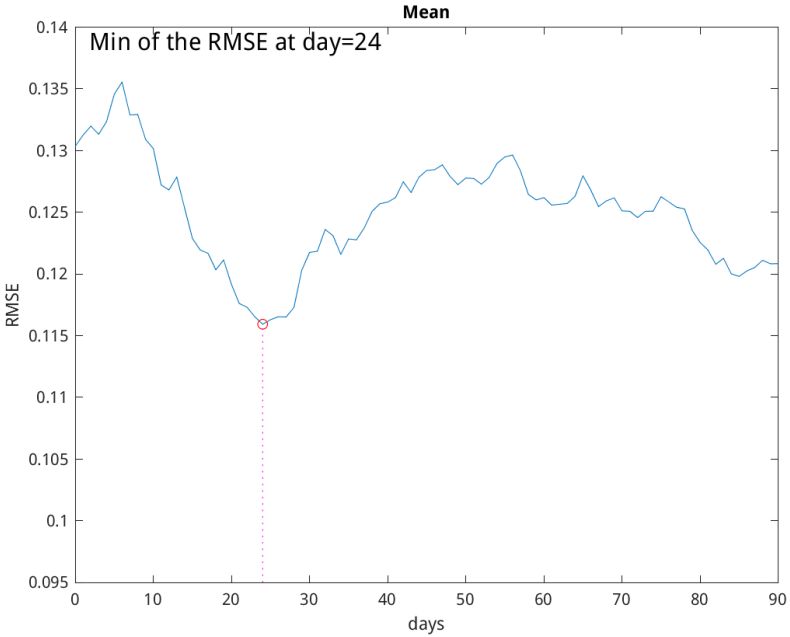
mpi-esm 1-2 Model





cnrm-esm 2-1 Model

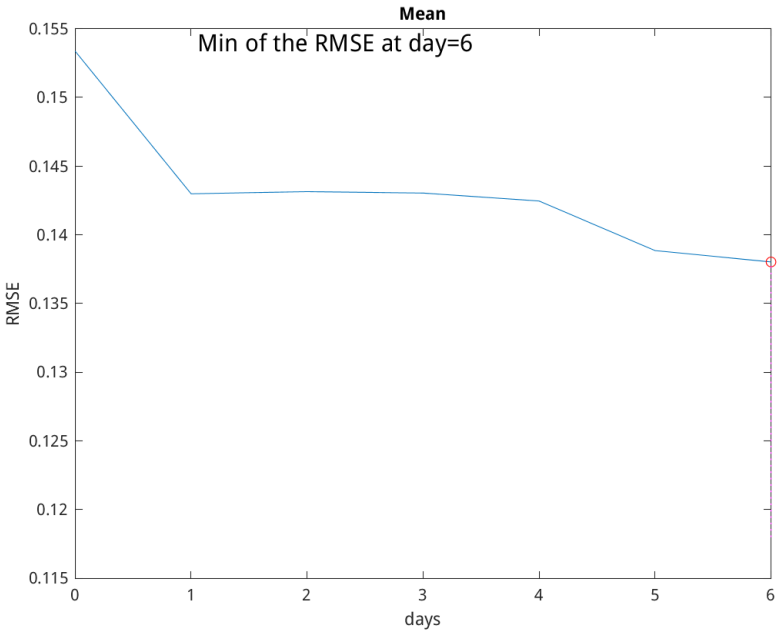




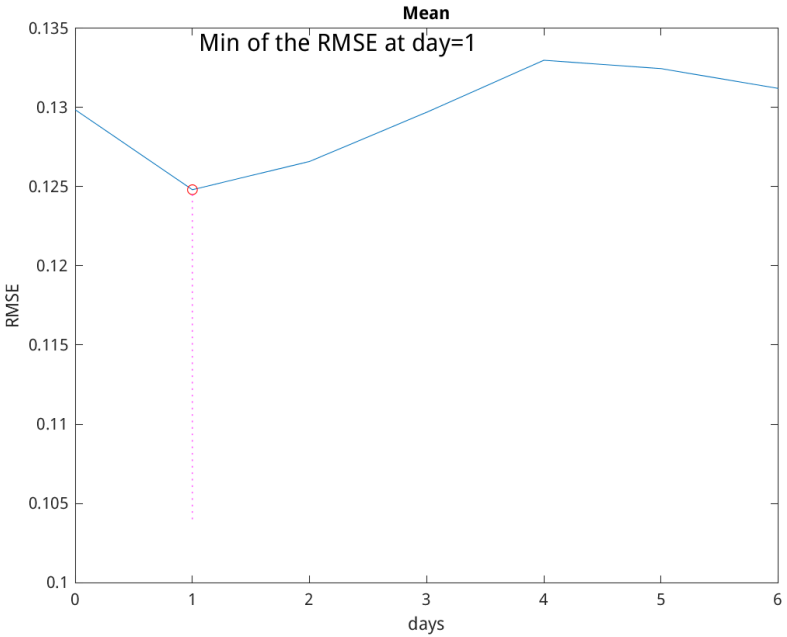
ec-earth3-veg Model

Fig. S1. Estimation of the Far Temporal Interval (FI) for Climate Data in California. The terms '9 km' and '100 km' indicate the resolution of the climate data estimators.

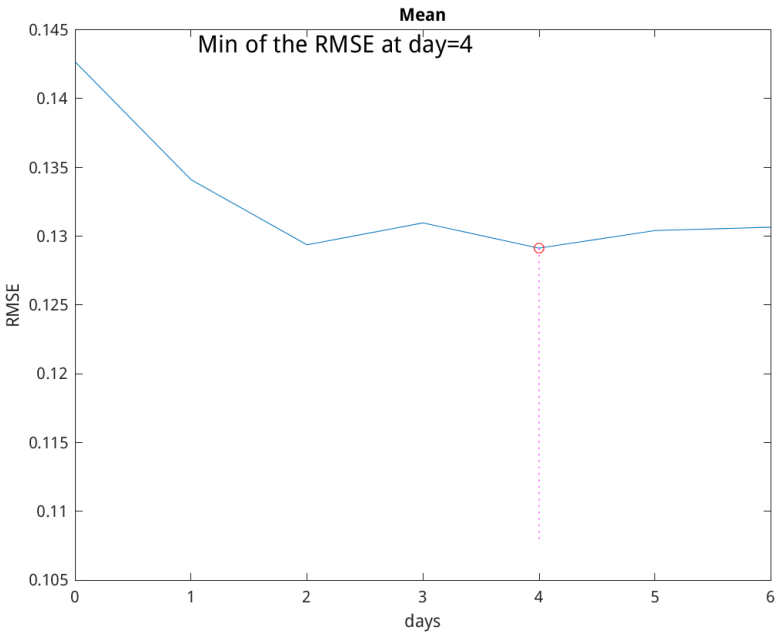
100 km

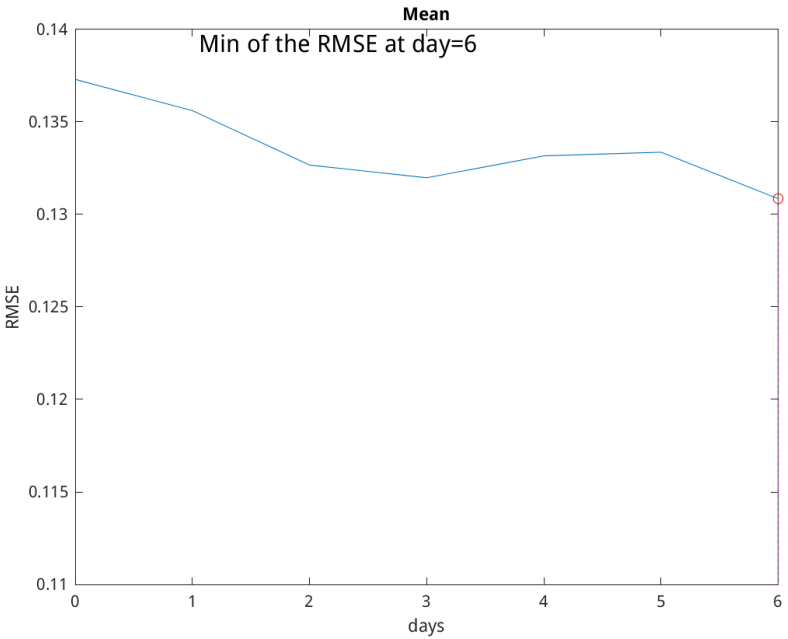


9 km

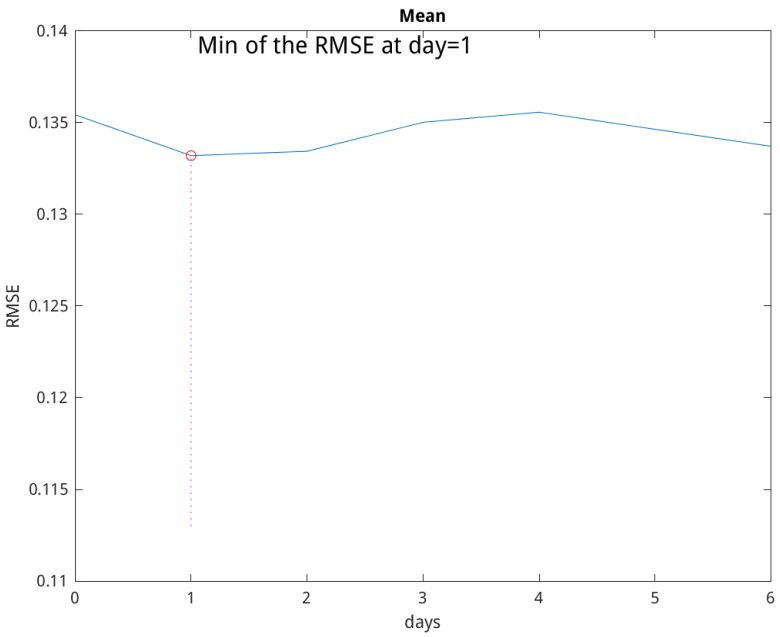


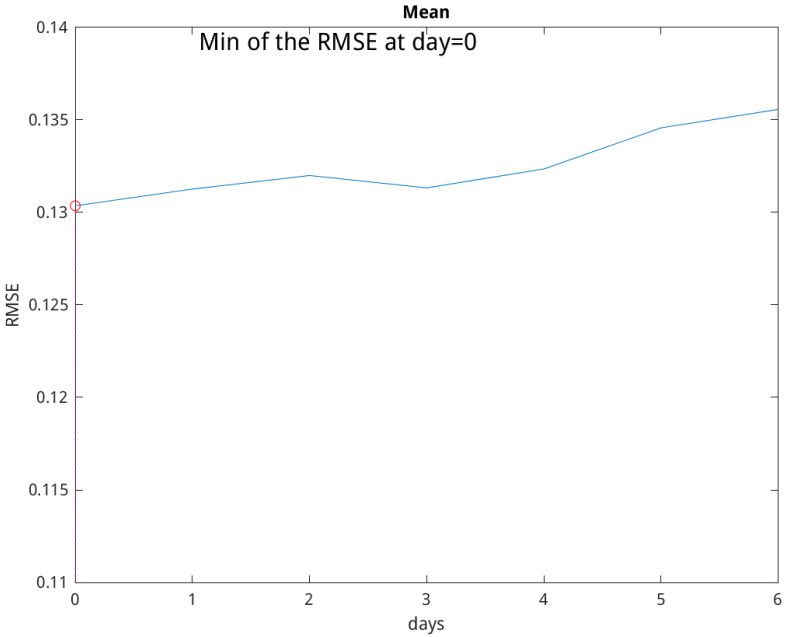
mpi-esm 1-2 Model





cnrm-esm 2-1 Model

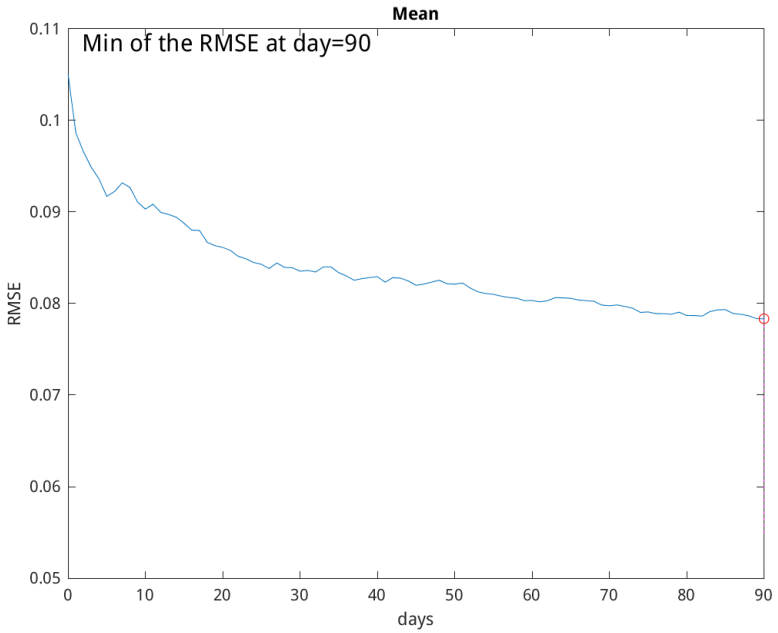




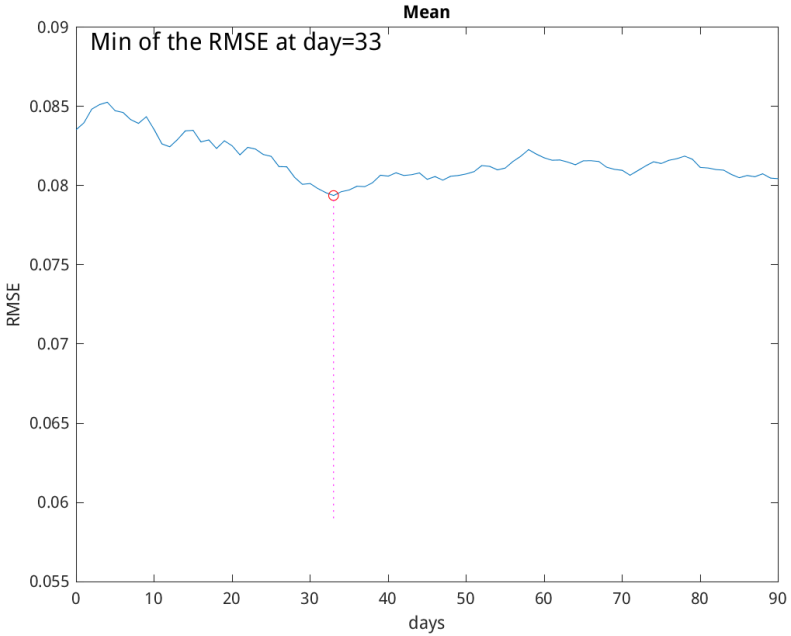
ec-earth3-veg Model

Fig. S2. Estimation of the Near Temporal Interval (NI) for Climate Data in California. The terms '9 km' and '100 km' indicate the resolution of the climate data estimators.

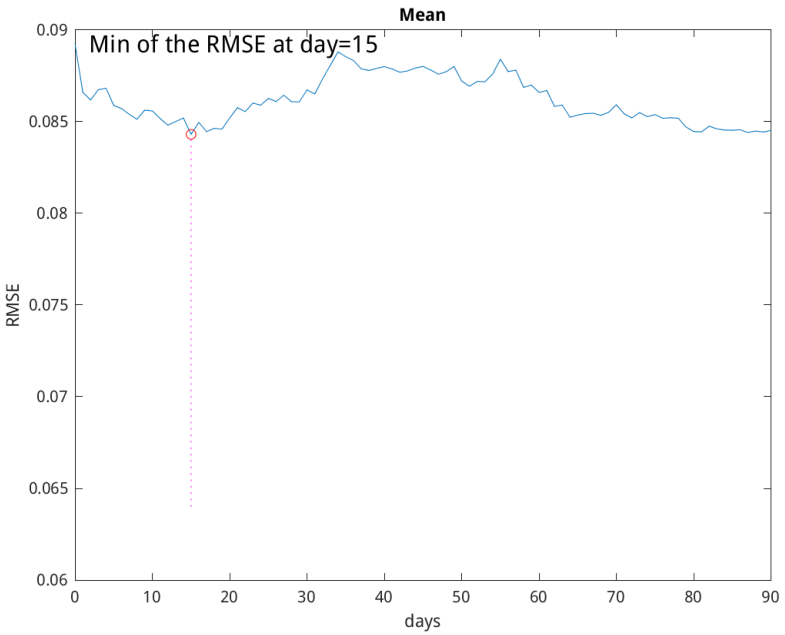
100 km

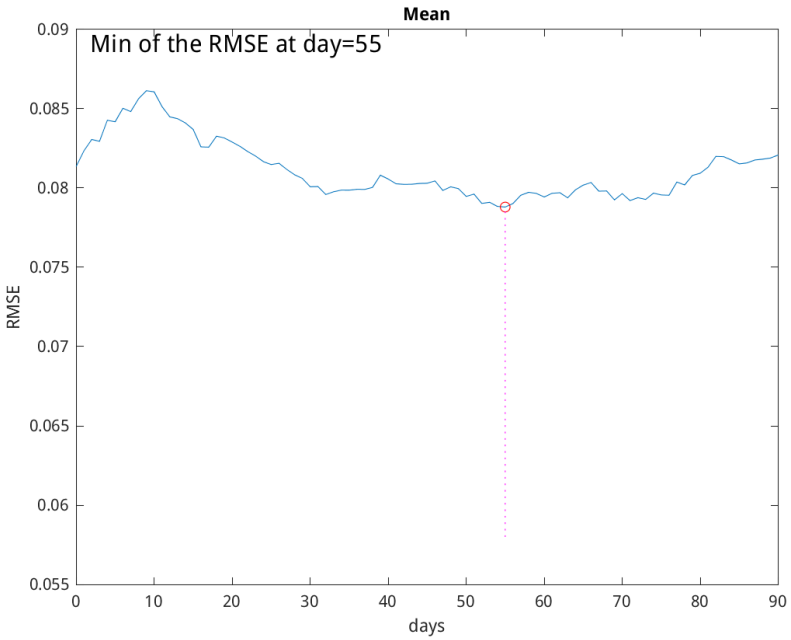


9 km

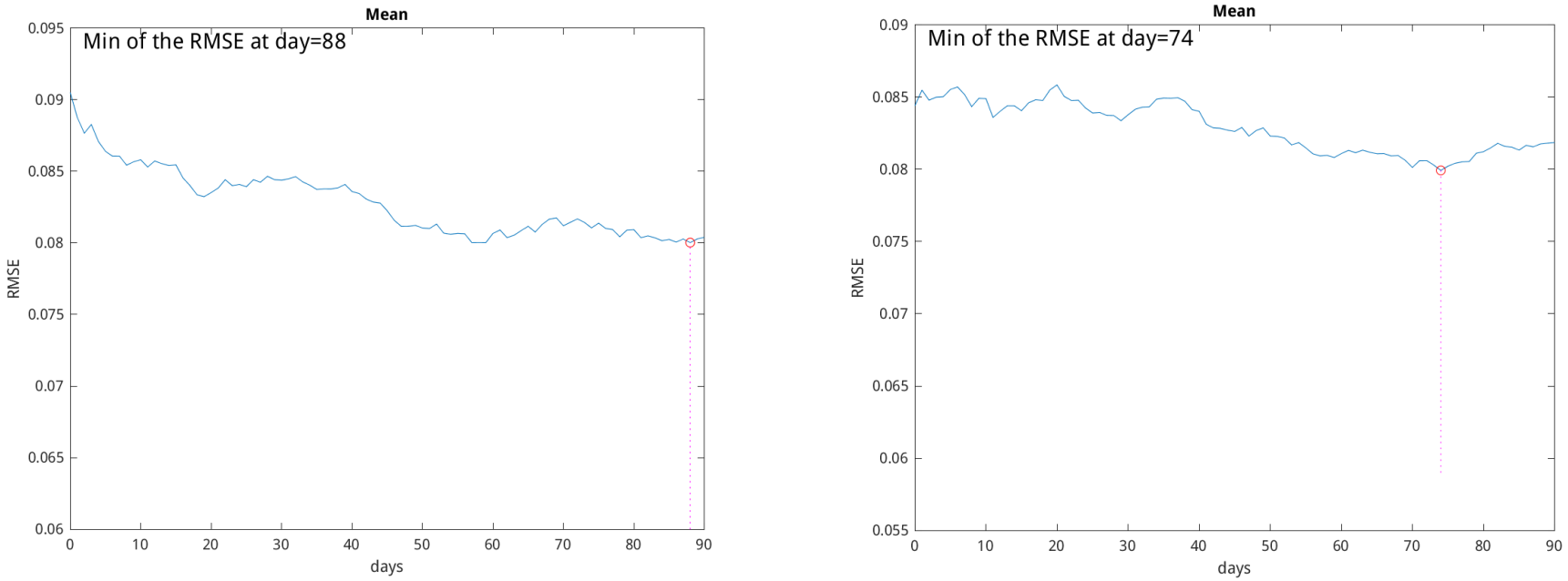


mpi-esm 1-2 Model





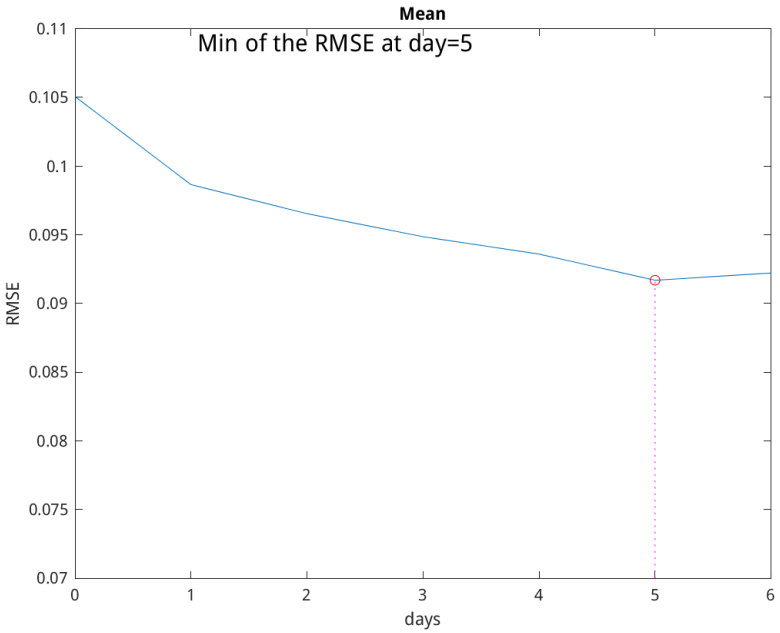
cnrm-esm 2-1 Model



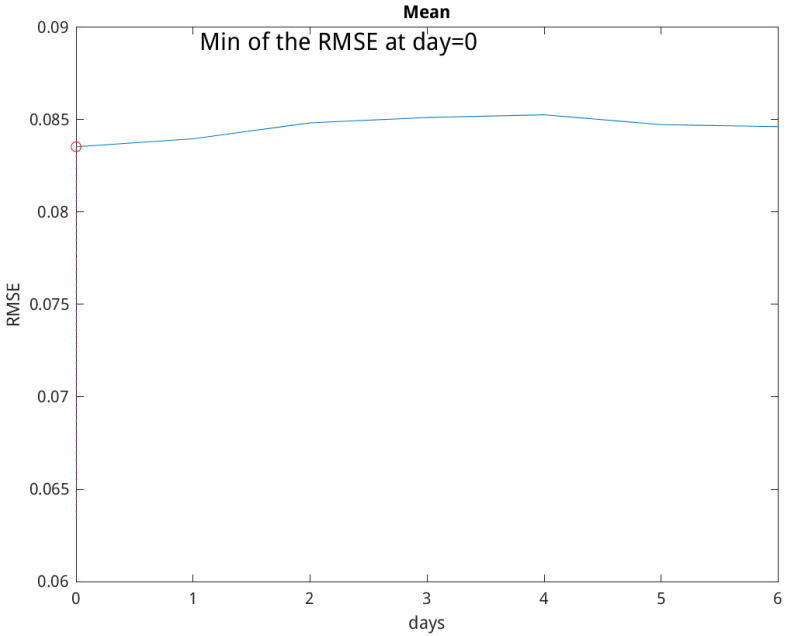
ec-earth3-veg Model

Fig. S3. Same as Fig. S1, but for Colorado.

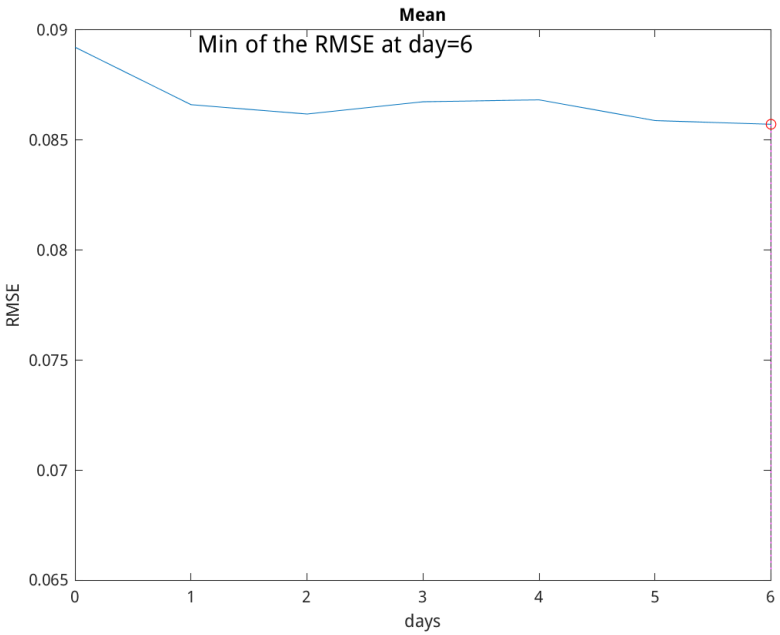
100 km

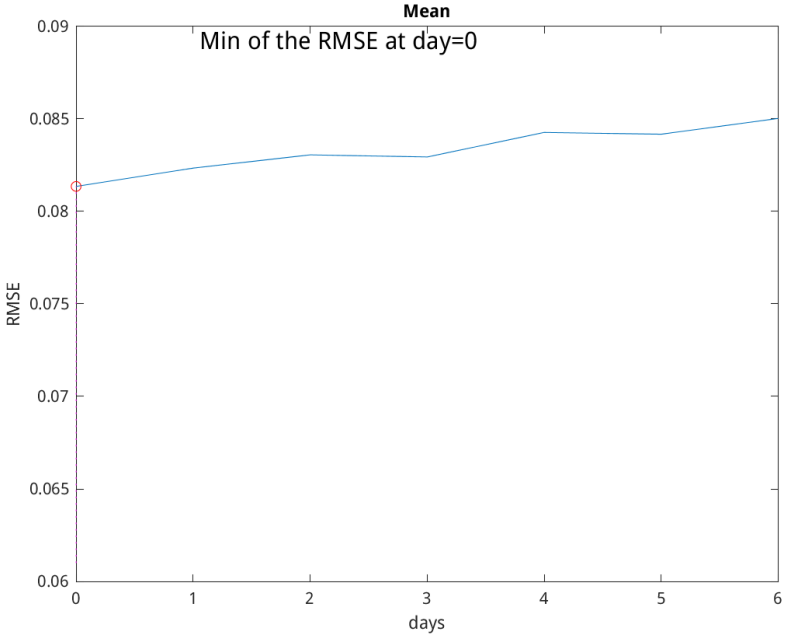


9 km

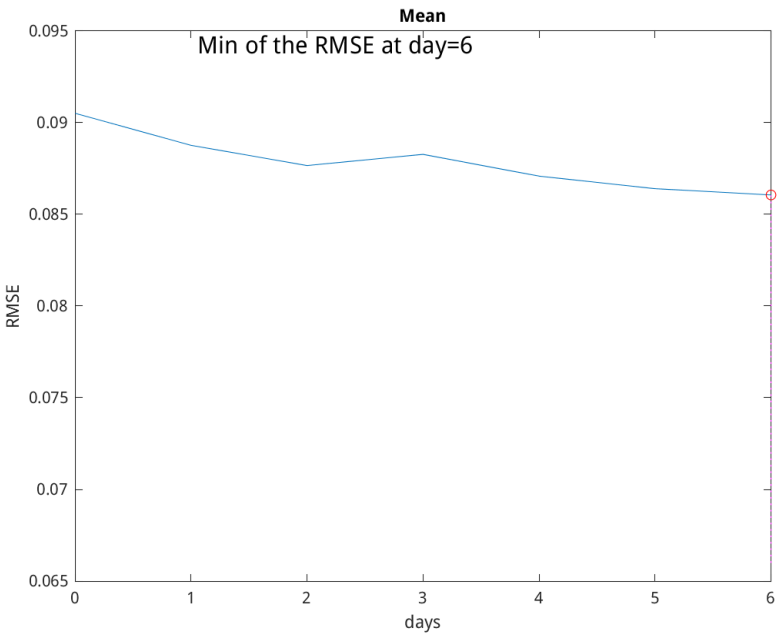


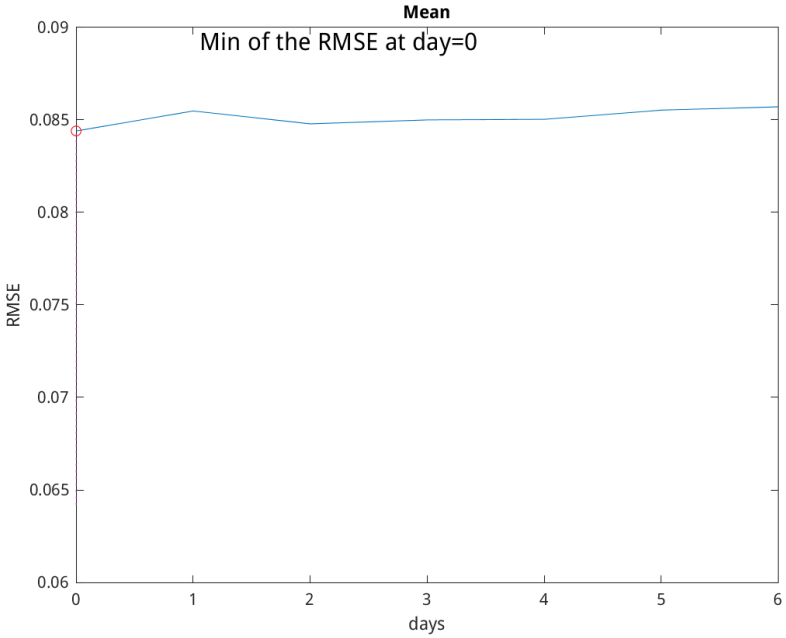
mpi-esm 1-2 Model





cnrm-esm 2-1 Model

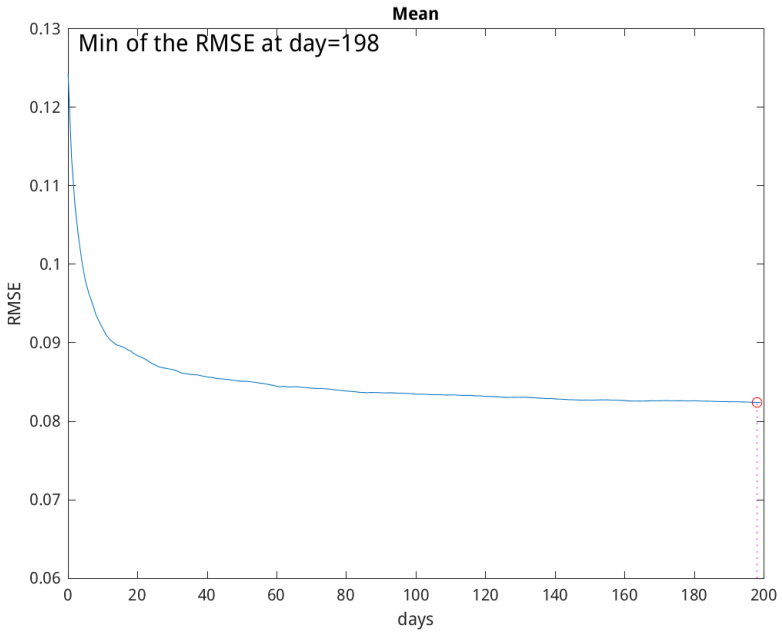




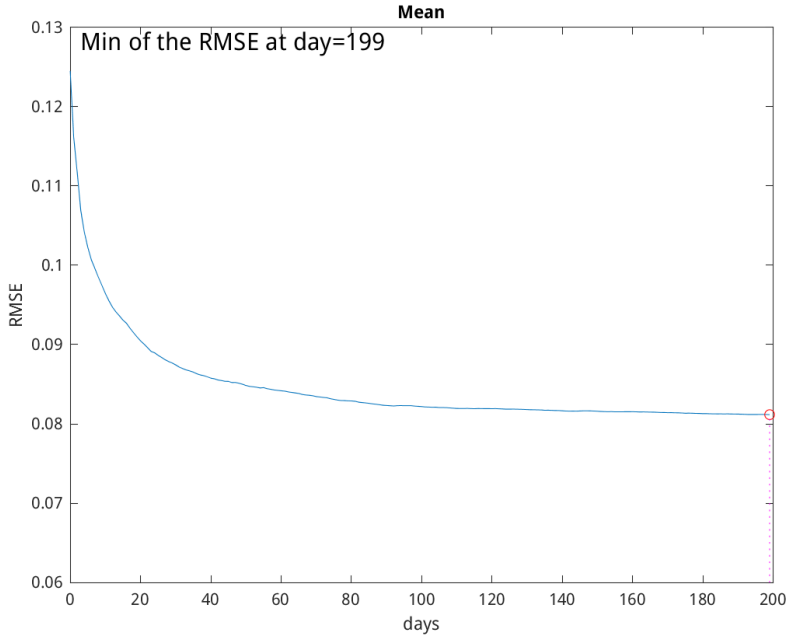
ec-earth3-veg Model

Fig. S4. Same as Fig. S2, but for Colorado.

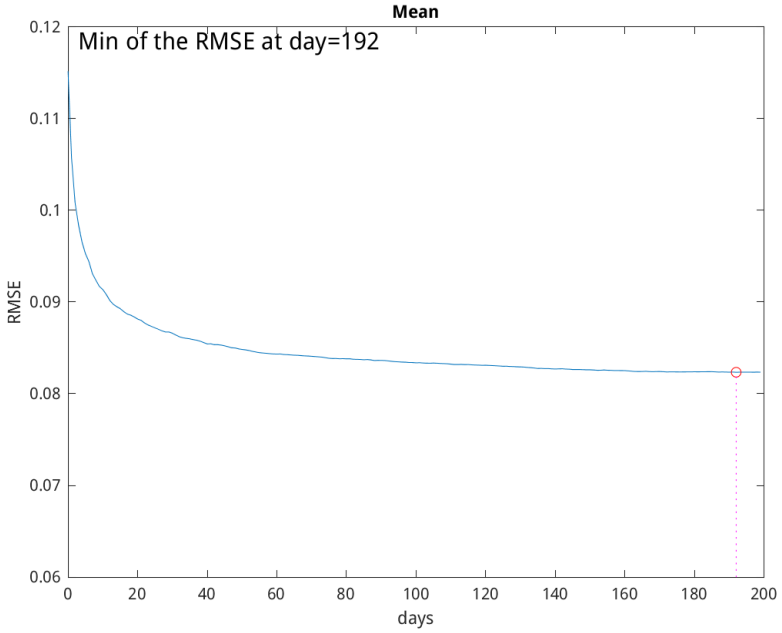
100 km

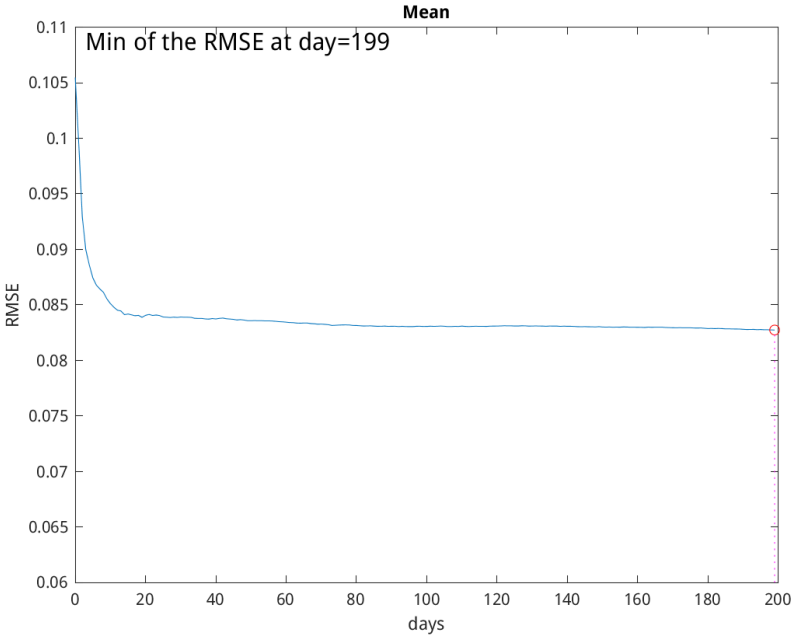


9 km

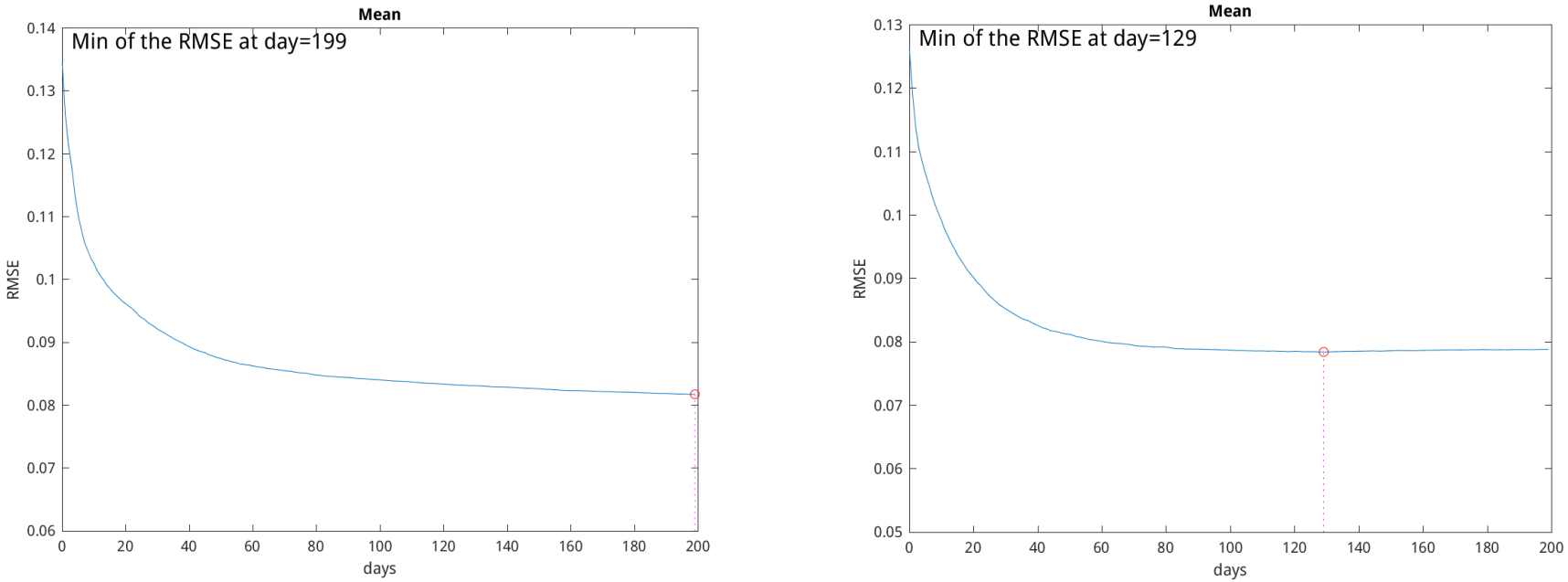


mpi-esm 1-2 Model





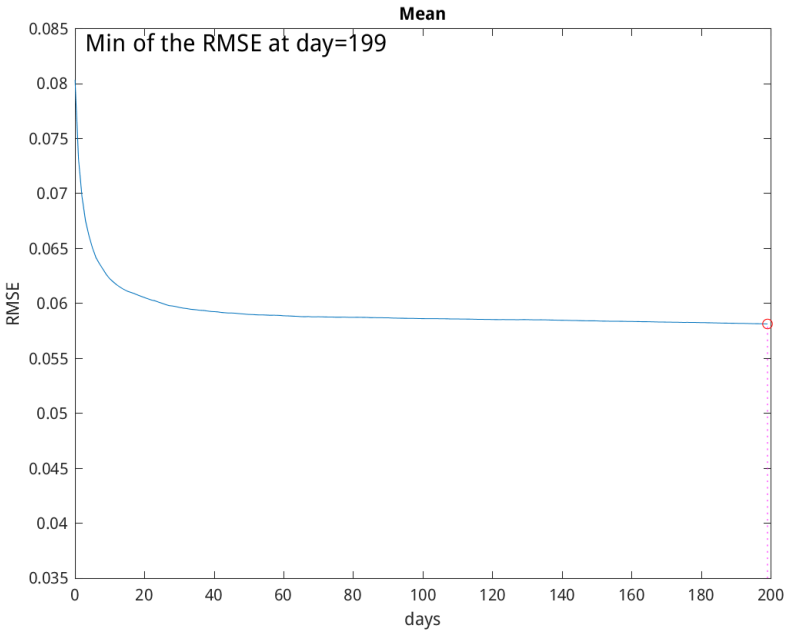
cnrm-esm 2-1 Model



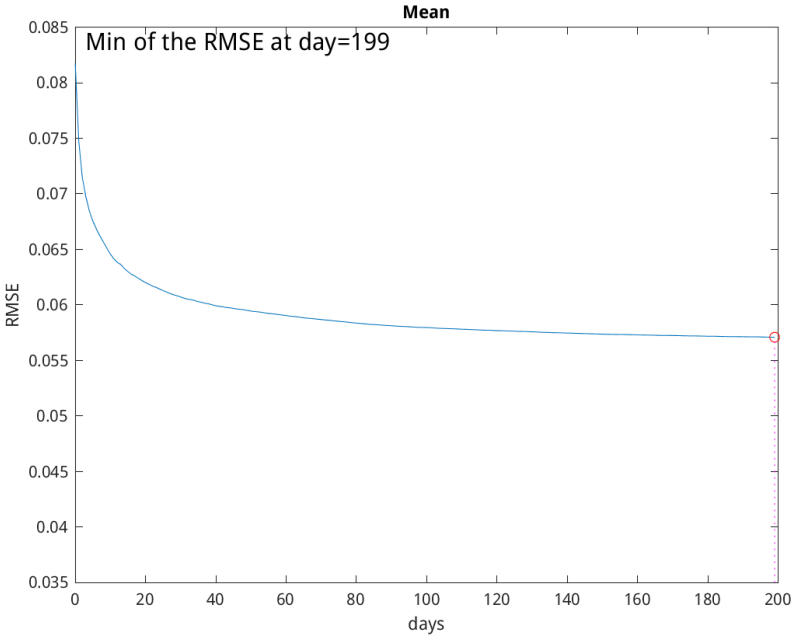
ec-earth3-veg Model

Fig. S5. Estimating the Number of K-Nearest Observations for California. '9 km' and '100 km' denote the resolution of the climate data estimators.

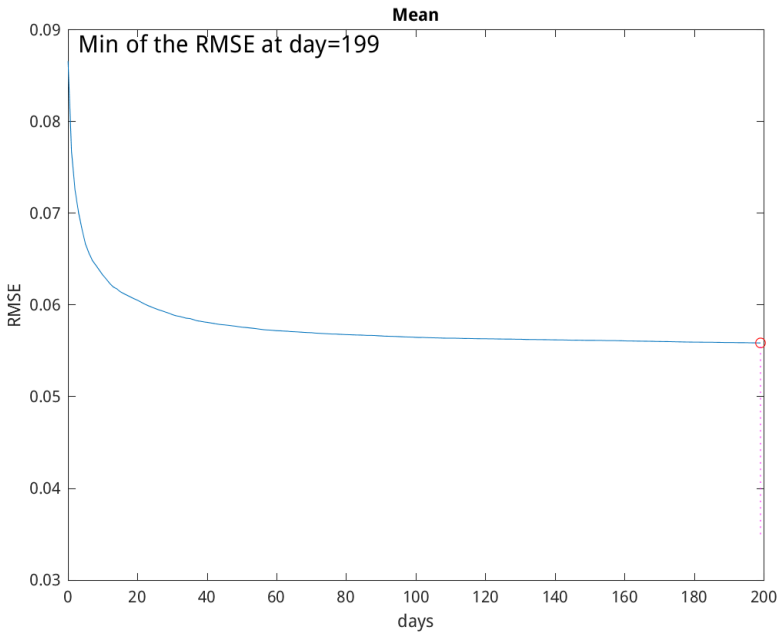
100 km

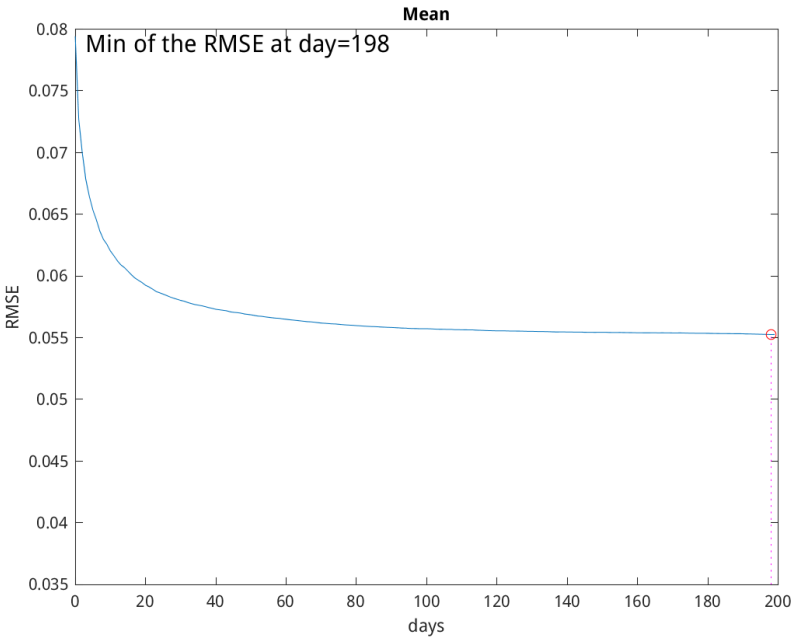


9 km

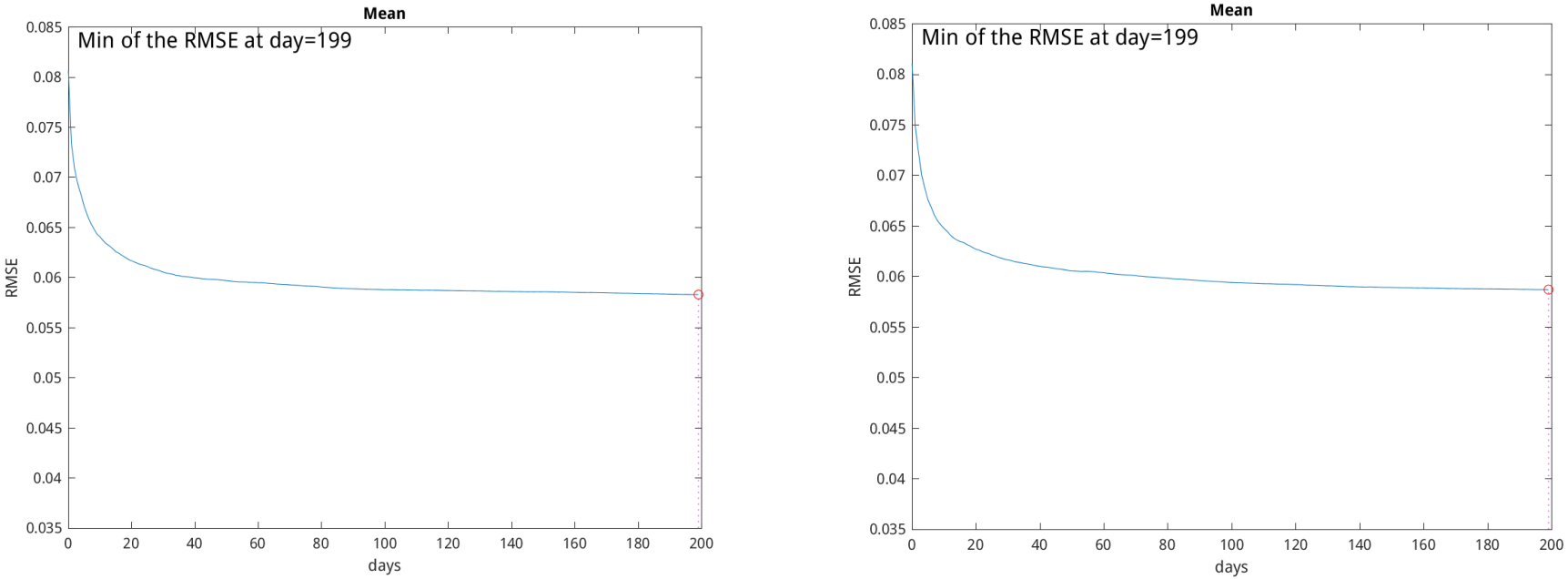


mpi-esm 1-2 Model





cnrm-esm 2-1 Model



ec-earth3-veg Model

Fig. S6. Same as Fig. S5, but for Colorado.

Table S2. Accuracy assessment of downscaling cross-validation in California: metrics include Correlation Coefficient (R), Mean Difference (MD), and Root-Mean-Squared Error (RMSE). Here, 'h' denotes elevation, 'Forest' pertains to forest land cover pixels, 'NoForest' to non-forest pixels, and '9 km' and '10 km' represent the resolutions of the climate data estimators.

cnrm-esm2-1 Model

	RMSE												Correlation												Mean Difference											
	h<2k		2k<h<3k		h>3k		All		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest	
	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100
Oct	.01	.01	.01	.01	.01	.01	.02	.02	.01	.01	.01	.01	.76	.73	.75	.73	.75	.73	.79	.78	.66	.64	.76	.74	0	0	0	0	0	0	0	0	0	0	0	0
Nov	.03	.03	.02	.02	.03	.03	.04	.04	.03	.03	.03	.03	.56	.56	.53	.53	.56	.56	.7	.7	.47	.47	.57	.57	-.01	-.01	-.01	-.01	-.02	-.02	-.03	-.02	-.02	-.02	-.01	-.01
Dec	.07	.08	.04	.05	.08	.1	.11	.12	.09	.11	.07	.08	.85	.85	.84	.84	.85	.84	.85	.84	.8	.8	.85	.85	-.01	-.02	0	-.01	-.02	-.03	-.03	-.04	-.02	-.03	-.01	-.02
Jan	.09	.1	.06	.06	.1	.11	.13	.14	.12	.12	.09	.09	.95	.95	.95	.95	.95	.94	.92	.92	.9	.9	.95	.95	-.01	-.02	-.01	-.01	-.02	-.02	-.03	-.04	-.03	-.04	-.01	-.02
Feb	.12	.11	.08	.08	.13	.13	.16	.15	.16	.16	.12	.11	.95	.95	.95	.95	.95	.95	.93	.92	.91	.91	.95	.95	-.01	0	-.01	0	-.01	0	-.02	-.01	-.03	-.02	-.01	0
Mar	.15	.17	.09	.1	.17	.2	.21	.24	.2	.22	.15	.17	.96	.95	.96	.96	.95	.95	.93	.93	.93	.92	.96	.95	.04	.07	.02	.03	.06	.1	.07	.14	.06	.12	.04	.07
Apr	.21	.22	.12	.13	.24	.26	.32	.35	.26	.28	.21	.22	.95	.95	.95	.95	.95	.95	.93	.93	.92	.92	.95	.95	.07	.08	.03	.03	.09	.11	.14	.19	.11	.14	.07	.08
May	.18	.19	.11	.11	.21	.22	.31	.32	.21	.22	.18	.19	.92	.93	.92	.92	.92	.92	.91	.91	.91	.91	.92	.93	.01	.03	0	.01	.01	.04	.03	.09	.01	.05	.01	.03
Jun	.11	.1	.06	.05	.13	.11	.2	.18	.11	.1	.11	.1	.83	.84	.83	.83	.83	.84	.81	.82	.82	.82	.83	.84	0	0	0	0	0	0	0	.02	-.01	0	0	0
Jul	.04	.04	.02	.02	.05	.04	.09	.08	.04	.03	.04	.04	.71	.72	.7	.71	.71	.72	.7	.72	.67	.68	.71	.73	0	0	0	0	0	0	0	0	0	0	0	0
Aug	.02	.02	.01	.01	.02	.02	.04	.04	.01	.01	.02	.02	.63	.65	.62	.64	.63	.65	.65	.67	.54	.57	.63	.65	0	0	0	0	0	0	-.01	-.01	0	0	0	0
Sep	.01	.01	.01	.01	.01	.01	.02	.02	.01	.01	.01	.01	.68	.74	.68	.74	.67	.73	.71	.76	.57	.65	.68	.74	0	0	0	0	0	0	0	0	0	0	0	0

ec_earth3_veg Model

	RMSE												Correlation												Mean Difference											
	h<2k		2k<h<3k		h>3k		All		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest	
	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100
Oct	.01	.01	.01	.01	.01	.01	.02	.02	.01	.01	.01	.01	.76	.75	.77	.76	.75	.74	.78	.77	.69	.66	.76	.75	0	0	0	0	0	0	0	0	0	0	0	0
Nov	.02	.02	.01	.01	.02	.02	.04	.04	.02	.02	.02	.02	.67	.69	.65	.67	.67	.68	.72	.75	.59	.59	.67	.69	-.01	0	0	0	-.01	-.01	-.02	-.01	-.01	0	-.01	0
Dec	.06	.05	.04	.03	.07	.06	.09	.08	.07	.07	.06	.05	.84	.85	.83	.84	.84	.85	.83	.84	.79	.8	.84	.85	-.01	-.01	0	0	-.01	-.01	-.02	-.03	-.01	-.01	-.01	-.01
Jan	.1	.11	.06	.07	.12	.12	.15	.16	.13	.14	.1	.11	.95	.95	.95	.95	.95	.95	.92	.92	.91	.91	.95	.95	.04	.03	.02	.01	.05	.04	.06	.04	.06	.05	.04	.03
Feb	.13	.15	.08	.09	.15	.17	.18	.2	.18	.2	.13	.14	.95	.95	.95	.95	.95	.95	.93	.93	.91	.91	.95	.95	.04	.04	.02	.02	.06	.05	.08	.06	.07	.07	.04	.04
Mar	.14	.14	.09	.09	.16	.16	.21	.2	.19	.19	.14	.14	.96	.96	.96	.96	.95	.96	.94	.94	.92	.93	.96	.96	.04	.03	.02	.01	.06	.04	.08	.06	.07	.06	.04	.03
Apr	.17	.18	.11	.11	.2	.21	.27	.28	.22	.24	.17	.18	.95	.95	.95	.95	.95	.95	.94	.93	.93	.93	.96	.95	.03	.04	.01	.01	.04	.05	.07	.09	.05	.07	.03	.04
May	.18	.17	.1	.1	.21	.2	.3	.3	.2	.2	.18	.17	.93	.93	.92	.92	.92	.92	.91	.91	.91	.91	.93	.93	.02	.02	0	.01	.02	.03	.06	.07	.02	.03	.02	.02
Jun	.11	.12	.06	.07	.13	.14	.2	.22	.11	.13	.11	.12	.83	.82	.83	.82	.83	.82	.81	.81	.82	.81	.83	.82	.02	.02	.01	0	.02	.02	.06	.06	.02	.02	.02	.02
Jul	.04	.04	.02	.02	.05	.04	.08	.08	.04	.03	.04	.04	.71	.72	.7	.71	.71	.72	.7	.72	.68	.68	.71	.73	0	0	0	0	0	0	-.01	0	0	0	0	0
Aug	.02	.02	.01	.01	.02	.02	.03	.04	.01	.01	.02	.02	.7	.68	.7	.67	.7	.67	.73	.7	.58	.6	.71	.68	0	0	0	0	0	0	0	-.01	0	0	0	0
Sep	.01	.01	0	.01	.01	.01	.02	.02	.01	.01	.01	.01	.75	.71	.75	.71	.74	.7	.78	.74	.63	.6	.75	.71	0	0	0	0	0	0	0	0	0	0	0	0

mpi-esm1-2 Model

	RMSE												Correlation												Mean Difference											
	h<2k		2k<h<3k		h>3k		All		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest	
	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100
Oct	.01	.01	.01	.01	.01	.01	.02	.02	.01	.01	.01	.01	.73	.74	.73	.75	.72	.73	.77	.77	.64	.66	.73	.74	0	0	0	0	0	0	0	0	0	0	0	0
Nov	.02	.02	.01	.01	.03	.03	.04	.04	.03	.02	.02	.02	.65	.7	.62	.67	.65	.69	.74	.77	.54	.6	.65	.7	-.01	-.01	0	0	-.01	-.01	-.02	-.02	-.01	-.01	-.01	-.01
Dec	.07	.06	.05	.04	.08	.07	.11	.09	.09	.08	.07	.06	.84	.85	.83	.83	.84	.84	.83	.84	.79	.8	.84	.85	-.03	-.02	-.01	-.01	-.04	-.03	-.06	-.05	-.04	-.03	-.03	-.02
Jan	.1	.1	.07	.07	.12	.11	.16	.14	.13	.13	.1	.1	.95	.95	.95	.95	.95	.95	.92	.92	.91	.91	.95	.95	-.03	-.03	-.01	-.01	-.04	-.04	-.07	-.06	-.04	-.04	-.03	-.03
Feb	.13	.14	.08	.09	.15	.17	.18	.2	.18	.2	.13	.14	.95	.95	.95	.95	.95	.95	.93	.93	.91	.91	.95	.95	.02	.04	.01	.02	.03	.05	.02	.05	.03	.06	.02	.04
Mar	.15	.17	.09	.11	.18	.2	.22	.26	.2	.23	.15	.17	.96	.96	.96	.96	.95	.96	.93	.94	.93	.93	.96	.96	.05	.07	.02	.03	.07	.1	.09	.14	.09	.12	.05	.07
Apr	.19	.2	.11	.12	.22	.23	.29	.31	.24	.25	.19	.2	.95	.96	.96	.96	.95	.95	.93	.94	.93	.93	.95	.96	.07	.07	.03	.03	.09	.09	.14	.15	.12	.11	.07	.07
May	.18	.18	.11	.11	.21	.21	.31	.31	.21	.21	.18	.18	.93	.93	.93	.92	.92	.92	.91	.91	.91	.91	.93	.93	.04	.03	.01	.01	.06	.04	.11	.09	.06	.04	.04	.03

Jun	.11	.12	.06	.06	.13	.13	.21	.21	.12	.12	.11	.12	.84	.83	.83	.82	.83	.83	.82	.82	.82	.82	.84	.83	.01	-.01	0	0	.01	-.01	.04	-.01	.01	-.02	.01	-.01
Jul	.04	.04	.02	.02	.04	.05	.08	.09	.04	.04	.04	.04	.72	.69	.71	.68	.72	.69	.71	.69	.69	.66	.72	.7	0	-.01	0	0	0	-.01	-.01	-.02	0	-.01	0	-.01
Aug	.02	.02	.01	.01	.02	.02	.04	.04	.01	.02	.02	.02	.66	.62	.66	.62	.66	.62	.67	.63	.61	.57	.67	.62	0	0	0	0	0	0	-.01	-.01	0	0	0	0
Sep	.01	.01	.01	.01	.01	.01	.02	.03	.01	.01	.01	.01	.67	.64	.68	.64	.66	.63	.69	.66	.6	.56	.67	.64	0	0	0	0	0	0	0	-.01	0	0	0	0

Table S3. Same as Table S2, but for Colorado.

cnrm-esm2-1 Model

	RMSE												Correlation												Mean Difference											
	h<2k		2k<h<3k		h>3k		All		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest	
	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100
Oct	.01	.01	0	0	.01	.01	.01	.02	.01	.01	.01	.01	.61	.59	.39	.41	.64	.62	.57	.57	.62	.6	.61	.6	0	0	0	0	0	0	0	0	0	0	0	0
Nov	.03	.03	0	.01	.02	.02	.03	.03	.03	.03	.03	.03	.78	.77	.56	.55	.79	.77	.76	.76	.79	.77	.78	.77	0	-.02	0	0	0	-.01	0	-.02	0	-.02	0	-.02
Dec	.06	.05	.01	.01	.05	.04	.07	.06	.06	.05	.06	.05	.84	.85	.83	.83	.86	.86	.83	.84	.83	.85	.84	.86	-.02	-.01	0	-.01	-.01	-.01	-.02	-.02	-.02	-.01	-.02	-.01
Jan	.09	.06	.02	.02	.07	.05	.1	.07	.09	.06	.09	.06	.86	.85	.8	.81	.86	.86	.85	.84	.83	.83	.86	.85	-.05	0	0	0	-.03	0	-.06	0	-.05	0	-.05	0
Feb	.09	.08	.03	.03	.08	.07	.1	.08	.09	.08	.09	.08	.85	.85	.81	.83	.85	.86	.84	.84	.82	.83	.85	.85	-.02	.01	.01	0	-.01	.01	-.03	.01	-.02	.01	-.02	.01
Mar	.1	.09	.03	.03	.09	.08	.11	.1	.1	.09	.1	.09	.86	.87	.88	.9	.87	.88	.84	.85	.84	.85	.86	.87	-.01	-.01	0	-.01	0	-.01	-.02	-.01	-.01	0	-.01	-.01
Apr	.13	.12	.03	.03	.12	.1	.14	.13	.13	.12	.13	.12	.88	.89	.89	.91	.89	.9	.86	.87	.87	.88	.88	.89	.01	0	0	0	.01	.01	.01	0	.02	.01	.01	0
May	.12	.12	.01	.01	.1	.1	.14	.13	.12	.12	.12	.12	.87	.87	.82	.85	.88	.88	.85	.86	.87	.87	.87	.87	-.01	.03	0	0	0	.02	-.02	.04	0	.04	-.01	.03
Jun	.07	.08	0	0	.05	.06	.08	.09	.06	.08	.07	.08	.76	.76	.71	.71	.78	.78	.74	.74	.78	.78	.76	.76	0	-.01	0	0	0	0	-.01	-.01	0	0	0	-.01
Jul	.02	.05	0	0	.02	.04	.03	.06	.02	.05	.02	.05	.62	.56	.27	.29	.65	.58	.58	.54	.63	.57	.62	.56	0	-.02	0	0	0	-.01	0	-.03	0	-.02	0	-.02
Aug	.01	.04	0	0	.01	.03	.01	.04	.01	.04	.01	.04	.6	.44	.21	.13	.63	.46	.55	.41	.6	.43	.6	.44	0	-.02	0	0	0	-.01	0	-.03	0	-.02	0	-.02
Sep	.01	.02	0	0	0	.02	.01	.02	.01	.02	.01	.02	.59	.46	.16	.14	.63	.49	.54	.43	.58	.45	.6	.46	0	-.01	0	0	0	-.01	0	-.01	0	-.01	0	-.01

ec_earth3_veg Model

	RMSE												Correlation												Mean Difference											
	h<2k		2k<h<3k		h>3k		All		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest	
	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100
Oct	.01	.01	0	0	.01	.01	.01	.01	.01	.01	.01	.01	.56	.63	.42	.36	.59	.65	.53	.6	.58	.63	.56	.63	0	0	0	0	0	0	0	0	0	0	0	0
Nov	.03	.07	.01	.02	.02	.06	.03	.08	.03	.07	.03	.07	.76	.71	.54	.48	.77	.71	.75	.7	.77	.7	.76	.71	-.01	-.05	0	-.01	-.01	-.04	-.01	-.06	-.01	-.06	-.01	-.05
Dec	.07	.11	.02	.03	.06	.09	.07	.12	.07	.11	.07	.11	.86	.84	.82	.8	.86	.85	.84	.83	.85	.83	.86	.84	-.04	-.09	-.01	-.02	-.04	-.08	-.05	-.1	-.05	-.1	-.04	-.09
Jan	.07	.08	.02	.03	.06	.07	.08	.09	.07	.08	.07	.08	.85	.85	.81	.82	.86	.85	.84	.84	.83	.83	.85	.85	-.03	-.04	0	0	-.02	-.03	-.04	-.05	-.03	-.05	-.03	-.04
Feb	.09	.08	.03	.03	.08	.07	.09	.09	.09	.08	.09	.08	.84	.84	.83	.83	.85	.85	.84	.83	.82	.82	.84	.84	.02	.02	.02	.01	.02	.02	.02	.01	.02	.02	.02	.02
Mar	.11	.12	.03	.03	.1	.11	.12	.13	.11	.12	.11	.12	.85	.85	.89	.88	.86	.86	.84	.84	.83	.83	.85	.85	.04	.06	0	0	.04	.05	.04	.07	.04	.07	.04	.06
Apr	.13	.17	.03	.03	.11	.14	.14	.18	.13	.17	.13	.17	.87	.87	.88	.86	.88	.88	.85	.85	.86	.86	.87	.87	.03	.08	0	-.01	.03	.05	.03	.1	.04	.09	.03	.08
May	.13	.17	.02	.02	.11	.14	.14	.19	.13	.17	.13	.17	.87	.86	.8	.76	.87	.87	.85	.84	.86	.86	.87	.86	0	.05	0	0	0	.03	-.01	.06	0	.05	0	.05
Jun	.09	.1	0	0	.07	.07	.1	.11	.09	.09	.09	.09	.75	.75	.65	.58	.77	.77	.73	.72	.77	.77	.75	.75	0	.02	0	0	0	.01	0	.02	.01	.02	0	.02
Jul	.03	.03	0	0	.02	.02	.04	.03	.03	.03	.03	.03	.58	.58	.22	.21	.6	.61	.55	.55	.6	.61	.58	.59	0	0	0	0	0	0	0	0	0	0	0	0
Aug	.01	.01	0	0	.01	.01	.02	.01	.01	.01	.01	.01	.53	.53	.12	.13	.57	.57	.49	.49	.53	.53	.54	.53	0	0	0	0	0	0	0	0	0	0	0	0
Sep	.01	.01	0	0	.01	.01	.01	.01	.01	.01	.01	.01	.54	.54	.15	.12	.58	.58	.49	.5	.54	.54	.54	.54	0	0	0	0	0	0	0	0	0	0	0	0

mpi-esm1-2 Model

	RMSE												Correlation												Mean Difference											
	h<2k		2k<h<3k		h>3k		All		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest		All		h<2k		2k<h<3k		h>3k		Forest		NoForest	
	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100	9	100
Oct	.01	.01	0	0	.01	.01	.01	.01	.01	.01	.01	.01	.6	.61	.39	.4	.63	.64	.57	.57	.62	.6	.61	.61	0	0	0	0	0	0	0	0	0	0	0	0
Nov	.02	.03	0	.01	.02	.03	.03	.04	.02	.03	.02	.03	.77	.76	.56	.51	.78	.76	.75	.74	.78	.76	.77	.76	0	-.02	0	-.01	0	-.01	0	-.02	0	-.02	0	-.02

Dec	.06	.05	.01	.02	.05	.04	.07	.05	.06	.05	.06	.05	.86	.85	.82	.78	.87	.86	.84	.84	.85	.84	.86	.85	-.02	-.02	0	-.01	-.01	-.02	-.02	-.03	-.02	-.03	-.02	-.02
Jan	.07	.06	.02	.02	.06	.05	.08	.06	.07	.06	.07	.06	.85	.85	.81	.77	.86	.86	.84	.84	.83	.83	.85	.85	-.03	.01	0	0	-.02	.01	-.03	0	-.03	.01	-.03	.01
Feb	.09	.1	.03	.04	.08	.09	.1	.11	.09	.1	.09	.1	.84	.84	.83	.77	.85	.85	.83	.83	.82	.82	.84	.84	.01	.06	.01	.01	.02	.05	.01	.06	.02	.07	.01	.06
Mar	.11	.14	.03	.04	.1	.12	.12	.15	.11	.15	.11	.14	.86	.85	.88	.83	.87	.86	.84	.84	.84	.83	.86	.85	.04	.09	0	0	.03	.07	.04	.1	.04	.1	.04	.09
Apr	.13	.18	.03	.03	.12	.15	.14	.2	.14	.19	.13	.18	.88	.87	.89	.86	.89	.88	.86	.85	.87	.86	.88	.87	.04	.1	0	-.01	.03	.07	.05	.13	.05	.11	.04	.1
May	.12	.18	.01	.02	.1	.15	.14	.2	.12	.18	.12	.18	.87	.85	.84	.71	.88	.86	.86	.84	.87	.85	.87	.85	.03	.08	0	0	.02	.04	.03	.1	.03	.08	.03	.07
Jun	.08	.09	0	0	.06	.07	.09	.1	.08	.09	.08	.09	.77	.73	.75	.49	.78	.74	.74	.71	.78	.74	.77	.73	-.01	.03	0	0	0	.02	-.01	.04	0	.03	-.01	.03
Jul	.03	.03	0	0	.02	.02	.04	.03	.03	.02	.03	.03	.6	.61	.28	.17	.63	.64	.57	.58	.62	.63	.61	.61	-.01	0	0	0	0	0	-.01	0	0	0	-.01	0
Aug	.01	.01	0	0	.01	.01	.01	.01	.01	.01	.01	.01	.56	.58	.19	.14	.6	.62	.52	.54	.57	.57	.57	.59	0	0	0	0	0	0	0	0	0	0	0	0
Sep	.01	.01	0	0	0	.01	.01	.01	.01	.01	.01	.01	.58	.57	.2	.17	.63	.61	.53	.53	.58	.55	.59	.58	0	0	0	0	0	0	0	0	0	0	0	0

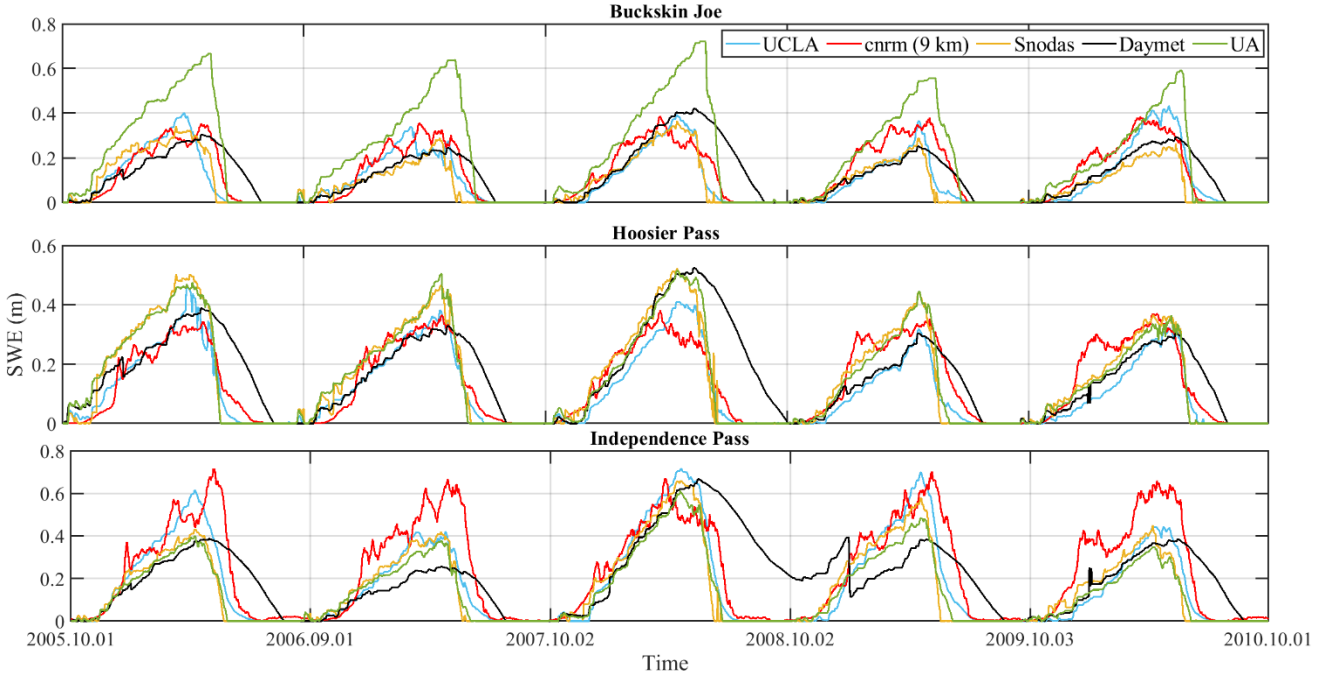


Fig. S7. The SWE time series spans a six-year period at the three highest elevations in-situ locations (Table 4) in Colorado. "UA" represents the University of Arizona SWE datasets. The downscaled SWE (SŴE) results were obtained from the ' cnrm-esm2-1' climate data at a 9 km resolution.

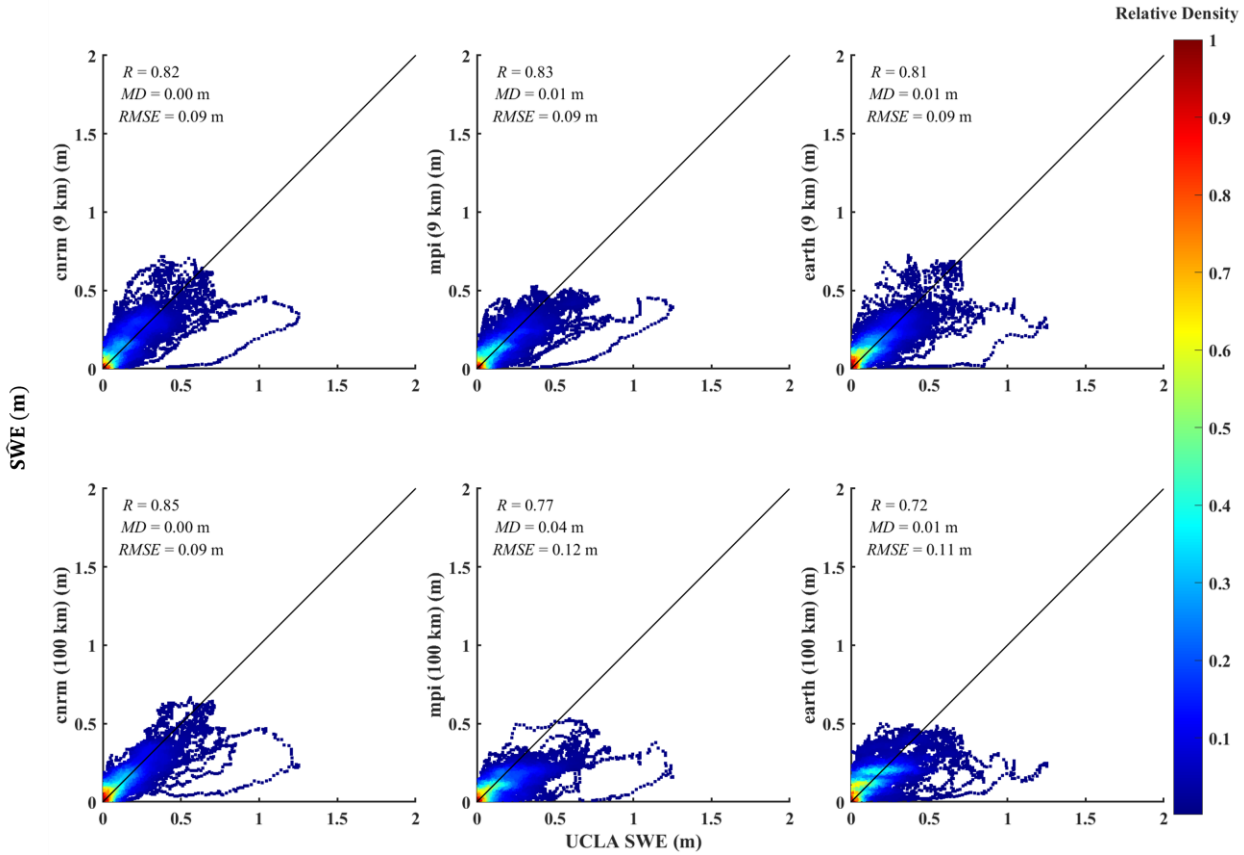


Fig. S8. A density scatter plot in Colorado from 2005 to 2010 compares in-situ data locations (Table 4) from UCLA SWE images to the downscaled SWE (SŴE) values. The solid black line represents the 1:1 line. The displayed metrics include the correlation coefficient (R), mean difference (MD), and Root-Mean-Squared Error (RMSE). Only data with SWE values greater than 1 cm are included in the comparison.

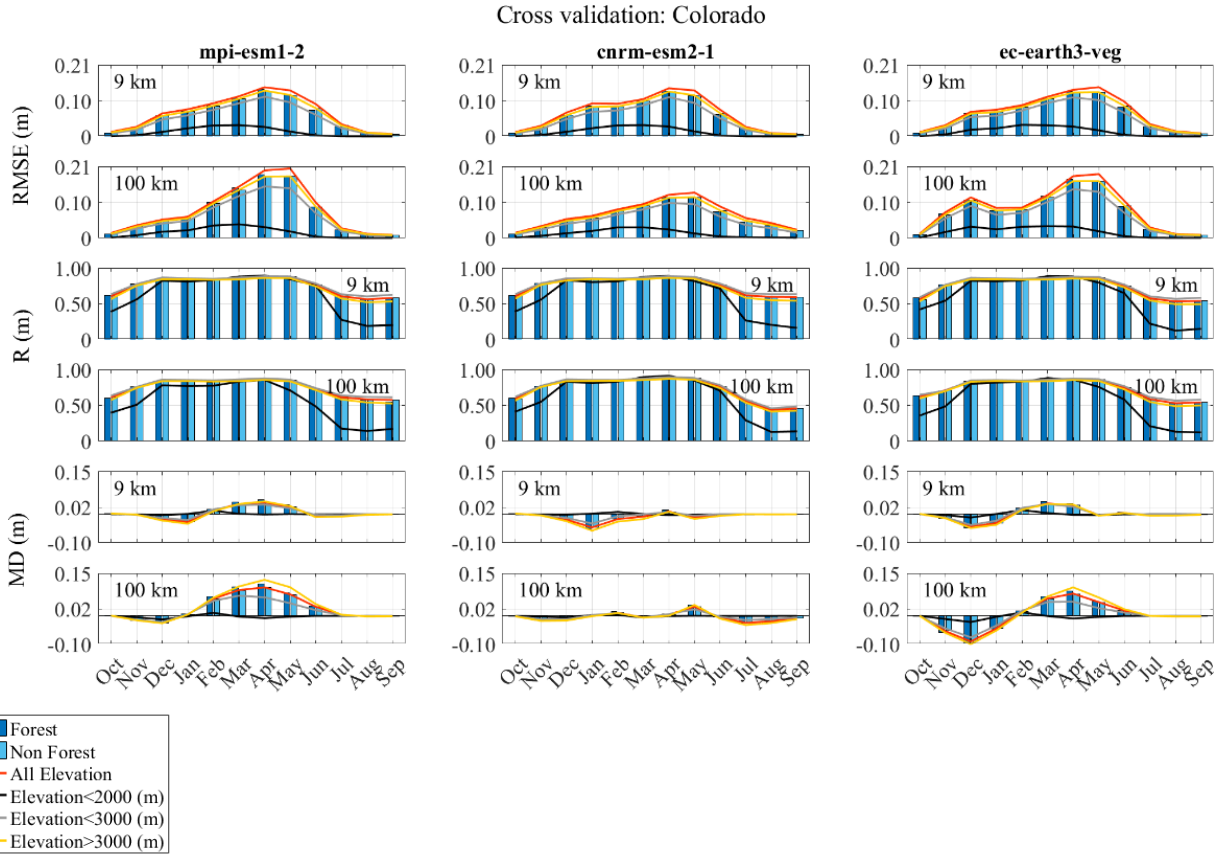


Fig. S9. Accuracy assessment of downscaling cross-validation, conducted in Colorado, over the six-year period from 2005 to 2010. Column titles indicate the results for downscaled SWE (SWE) using respective climate models as estimators. '9 km' and '100 km' refer to the resolutions of the climate data. The evaluation metrics include the Correlation Coefficient (R), Mean Difference (MD), and Root-Mean-Squared Error (RMSE). These metrics are considered in different elevation values and different land covers. In the legend, 2000 m <Elevation< 3000 m is shown as Elevation< 3000 m.

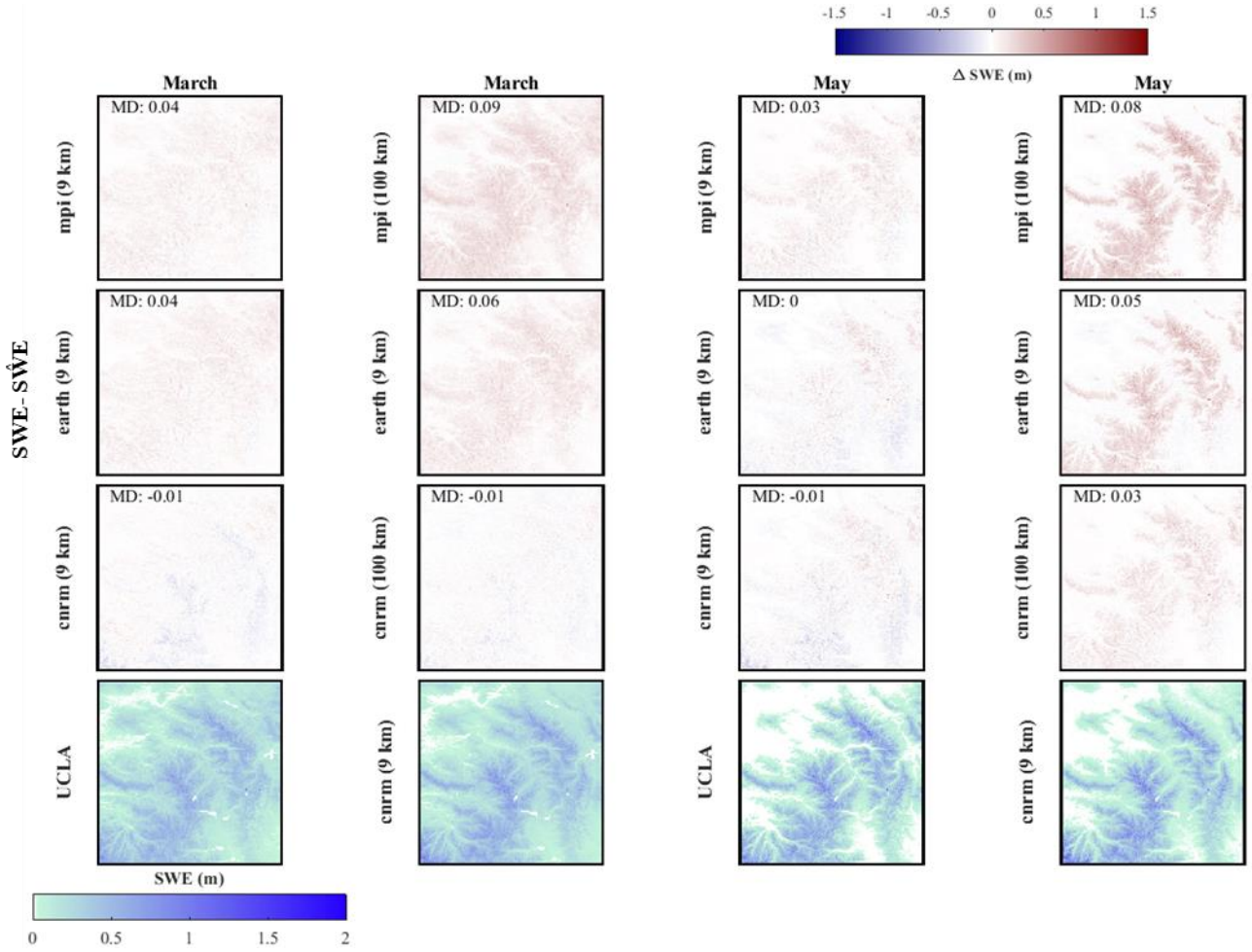


Fig. S10. Spatial assessment of the downscaling. The first three rows represent the mean difference between UCLA SWE and downscaled SWE (SWE- SŴE) over Colorado throughout the 6-year testing period (2005-2010) for two different months (March and May). The last row represents the averaged reference SWE (UCLA SWE) or averaged downscaled SWE (SŴE) throughout the 6-year testing period (2005-2010) for two different months (March and May). The evaluation metric includes Mean Difference (MD).

Table S4. Comparison of downscaled SWE (SŴE) or UCLA SWE with 1 km SWE from the SNODAS Dataset over California (CA) and Colorado (CO). Metrics displayed include Correlation Coefficient (R), Mean Difference (MD), and Root-Mean-Squared Error (RMSE). Consideration is given only to swe values greater than 1 cm. 'Forest' denotes pixels with forest land cover, and 'NoForest' refers to non-forest pixels. The terms '9 km' and '100 km' indicate the resolutions of the climate data estimators.

RMSE	Elevation<2k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nov	0.03	0.03	0.03	0.04	0.02	0.03	0.02	0.07	0.03	0.03	0.02	0.04	0.01	0.03
Dec	0.09	0.07	0.10	0.06	0.08	0.07	0.08	0.11	0.09	0.07	0.08	0.06	0.05	0.05
Jan	0.16	0.11	0.16	0.08	0.17	0.09	0.17	0.10	0.17	0.09	0.16	0.07	0.12	0.07
Feb	0.20	0.12	0.20	0.10	0.22	0.11	0.23	0.10	0.22	0.11	0.23	0.11	0.17	0.10
Mar	0.28	0.15	0.30	0.14	0.28	0.13	0.28	0.13	0.28	0.13	0.30	0.13	0.23	0.13
Apr	0.39	0.19	0.40	0.19	0.36	0.17	0.37	0.17	0.37	0.18	0.38	0.17	0.29	0.19
May	0.37	0.22	0.37	0.18	0.36	0.20	0.36	0.18	0.37	0.20	0.37	0.18	0.30	0.21
Jun	0.25	0.10	0.24	0.11	0.24	0.10	0.25	0.08	0.25	0.12	0.25	0.07	0.22	0.10
Jul	0.08	0.02	0.08	0.06	0.09	0.03	0.08	0.02	0.08	0.03	0.09	0.01	0.08	0.02
Aug	0.02	0.01	0.02	0.04	0.02	0.01	0.02	0.01	0.02	0.01	0.03	0.01	0.02	0.01
Sep	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
RMSE	2k<Elevation<3k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.02	0.01	0.02	0.01	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.01	0.01	0.00
Dec	0.06	0.03	0.06	0.02	0.05	0.03	0.05	0.04	0.06	0.03	0.05	0.03	0.04	0.02
Jan	0.10	0.05	0.10	0.05	0.11	0.05	0.11	0.05	0.11	0.05	0.10	0.04	0.08	0.04
Feb	0.13	0.06	0.13	0.06	0.15	0.06	0.15	0.06	0.15	0.06	0.15	0.06	0.12	0.06
Mar	0.19	0.06	0.20	0.07	0.18	0.06	0.19	0.05	0.19	0.06	0.20	0.05	0.16	0.06
Apr	0.25	0.05	0.25	0.05	0.23	0.04	0.24	0.04	0.24	0.04	0.24	0.04	0.19	0.05
May	0.23	0.02	0.23	0.01	0.22	0.03	0.22	0.02	0.22	0.01	0.22	0.02	0.19	0.02
Jun	0.14	0.00	0.13	0.00	0.13	0.00	0.14	0.00	0.14	0.00	0.14	0.00	0.12	0.00
Jul	0.04	0.00	0.04	0.00	0.04	0.00	0.04	0.00	0.04	0.00	0.05	0.00	0.04	0.00
Aug	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
Sep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00
RMSE	Elevation>3k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nov	0.04	0.02	0.03	0.03	0.03	0.03	0.02	0.06	0.03	0.02	0.03	0.03	0.01	0.02
Dec	0.11	0.06	0.12	0.05	0.09	0.06	0.09	0.10	0.10	0.06	0.09	0.05	0.05	0.05
Jan	0.18	0.09	0.18	0.07	0.19	0.08	0.20	0.09	0.19	0.08	0.19	0.07	0.14	0.07
Feb	0.23	0.10	0.23	0.09	0.26	0.09	0.27	0.09	0.25	0.09	0.27	0.09	0.19	0.09
Mar	0.32	0.13	0.34	0.13	0.31	0.12	0.31	0.11	0.32	0.12	0.34	0.12	0.26	0.13
Apr	0.44	0.17	0.46	0.16	0.41	0.15	0.42	0.14	0.42	0.16	0.43	0.15	0.32	0.17

May	0.43	0.17	0.43	0.15	0.42	0.16	0.42	0.14	0.43	0.16	0.42	0.14	0.34	0.17
Jun	0.29	0.08	0.28	0.08	0.28	0.07	0.29	0.06	0.29	0.09	0.29	0.05	0.25	0.08
Jul	0.10	0.01	0.10	0.04	0.10	0.02	0.10	0.01	0.10	0.02	0.11	0.01	0.09	0.02
Aug	0.03	0.00	0.03	0.03	0.02	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.02	0.00
Sep	0.01	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.00

RMSE	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.01	0.01	0.01	0.01	0.00	0.01	0.00	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Nov	0.04	0.03	0.03	0.04	0.02	0.03	0.02	0.07	0.03	0.03	0.03	0.04	0.01	0.03
Dec	0.11	0.07	0.12	0.06	0.10	0.07	0.09	0.12	0.11	0.08	0.10	0.06	0.06	0.05
Jan	0.19	0.11	0.20	0.08	0.21	0.09	0.22	0.10	0.21	0.09	0.20	0.08	0.15	0.08
Feb	0.27	0.12	0.27	0.10	0.30	0.11	0.31	0.11	0.30	0.11	0.31	0.11	0.22	0.10
Mar	0.36	0.15	0.38	0.14	0.35	0.14	0.36	0.13	0.37	0.13	0.38	0.14	0.30	0.13
Apr	0.47	0.19	0.48	0.19	0.44	0.18	0.45	0.17	0.45	0.19	0.46	0.18	0.35	0.19
May	0.40	0.22	0.40	0.19	0.39	0.21	0.39	0.19	0.39	0.21	0.39	0.19	0.33	0.22
Jun	0.22	0.10	0.21	0.10	0.21	0.10	0.22	0.07	0.22	0.12	0.23	0.06	0.19	0.10
Jul	0.06	0.02	0.06	0.06	0.06	0.02	0.06	0.02	0.06	0.03	0.07	0.01	0.06	0.02
Aug	0.02	0.00	0.02	0.04	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.00
Sep	0.01	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.00	0.00

RMSE	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nov	0.03	0.03	0.03	0.04	0.02	0.03	0.02	0.07	0.03	0.03	0.02	0.04	0.01	0.03
Dec	0.09	0.07	0.10	0.06	0.08	0.07	0.08	0.11	0.09	0.07	0.08	0.06	0.05	0.05
Jan	0.16	0.11	0.16	0.08	0.17	0.09	0.17	0.10	0.17	0.09	0.16	0.07	0.12	0.07
Feb	0.20	0.12	0.20	0.10	0.22	0.11	0.23	0.10	0.22	0.11	0.23	0.11	0.17	0.10
Mar	0.28	0.15	0.29	0.14	0.27	0.13	0.28	0.13	0.28	0.13	0.30	0.13	0.23	0.13
Apr	0.38	0.19	0.40	0.19	0.36	0.17	0.36	0.17	0.37	0.18	0.37	0.17	0.28	0.19
May	0.37	0.22	0.37	0.18	0.36	0.20	0.36	0.18	0.37	0.20	0.36	0.18	0.30	0.21
Jun	0.25	0.10	0.24	0.11	0.24	0.10	0.25	0.08	0.25	0.12	0.25	0.07	0.22	0.10
Jul	0.08	0.02	0.08	0.06	0.09	0.03	0.08	0.02	0.09	0.03	0.09	0.01	0.08	0.02
Aug	0.02	0.01	0.02	0.04	0.02	0.01	0.02	0.01	0.02	0.01	0.03	0.01	0.02	0.01
Sep	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00

RMSE	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.01	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01
Nov	0.05	0.04	0.05	0.04	0.04	0.04	0.04	0.08	0.05	0.03	0.04	0.04	0.02	0.03
Dec	0.14	0.08	0.15	0.06	0.12	0.08	0.11	0.12	0.13	0.08	0.11	0.06	0.07	0.06
Jan	0.23	0.11	0.23	0.08	0.25	0.10	0.25	0.11	0.24	0.10	0.23	0.08	0.17	0.08
Feb	0.28	0.12	0.28	0.11	0.32	0.11	0.33	0.11	0.31	0.11	0.33	0.11	0.23	0.10
Mar	0.39	0.15	0.42	0.14	0.39	0.14	0.39	0.13	0.40	0.14	0.43	0.14	0.31	0.14

Apr	0.56	0.20	0.59	0.20	0.52	0.18	0.53	0.18	0.53	0.19	0.55	0.19	0.39	0.20
May	0.58	0.24	0.59	0.21	0.57	0.23	0.56	0.20	0.58	0.23	0.57	0.21	0.44	0.23
Jun	0.42	0.12	0.40	0.12	0.41	0.11	0.42	0.09	0.42	0.14	0.42	0.08	0.36	0.12
Jul	0.14	0.02	0.14	0.07	0.15	0.03	0.14	0.02	0.15	0.04	0.16	0.02	0.13	0.02
Aug	0.04	0.01	0.04	0.04	0.04	0.01	0.04	0.01	0.04	0.01	0.05	0.01	0.03	0.01
Sep	0.02	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.00

R	**Elevation<2k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.09	NaN	-0.07	0.04	-0.07	NaN	-0.05	NaN	-0.03	NaN	-0.09	NaN	0.07	0.53
Nov	0.02	0.19	0.03	0.17	-0.05	0.00	-0.03	-0.15	0.00	0.13	-0.02	-0.18	0.01	0.28
Dec	0.57	-0.07	0.57	-0.01	0.55	0.02	0.56	0.07	0.56	-0.06	0.56	0.07	0.54	-0.05
Jan	0.75	-0.12	0.75	-0.06	0.71	-0.07	0.72	-0.05	0.74	-0.07	0.73	-0.11	0.70	-0.06
Feb	0.75	-0.01	0.75	0.03	0.72	0.01	0.72	0.03	0.72	0.02	0.72	-0.08	0.69	0.06
Mar	0.70	0.03	0.70	0.12	0.69	0.06	0.69	0.10	0.70	0.09	0.71	0.06	0.67	0.09
Apr	0.49	0.33	0.51	0.30	0.51	0.29	0.49	0.33	0.49	0.24	0.52	0.28	0.48	0.21
May	0.24	0.31	0.23	0.37	0.23	0.27	0.23	0.17	0.21	0.32	0.23	0.34	0.22	0.40
Jun	0.04	NaN	0.04	NaN	0.04	NaN	0.05	NaN	0.04	NaN	0.05	NaN	0.04	NaN
Jul	-0.10	NaN	-0.08	NaN	-0.05	NaN	-0.07	NaN	-0.06	NaN	-0.07	NaN	-0.01	NaN
Aug	-0.11	NaN	-0.14	NaN	0.06	NaN	-0.23	NaN	-0.10	NaN	-0.11	NaN	-0.17	NaN
Sep	0.55	NaN	0.48	NaN	-0.59	NaN	0.66	NaN	0.50	NaN	0.66	NaN	0.79	NaN

R	**2k<Elevation<3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.09	-0.01	-0.07	-0.02	-0.07	0.06	-0.07	0.05	-0.02	-0.02	-0.07	-0.01	0.10	0.07
Nov	0.02	0.12	0.02	0.15	-0.07	0.15	-0.05	0.21	-0.02	0.09	-0.04	0.15	0.01	0.10
Dec	0.57	0.50	0.56	0.53	0.54	0.54	0.55	0.56	0.56	0.50	0.56	0.54	0.53	0.48
Jan	0.70	0.60	0.70	0.60	0.68	0.60	0.68	0.60	0.70	0.60	0.69	0.60	0.67	0.58
Feb	0.70	0.61	0.70	0.60	0.68	0.61	0.69	0.61	0.69	0.61	0.69	0.61	0.66	0.60
Mar	0.68	0.57	0.68	0.57	0.67	0.57	0.67	0.57	0.68	0.57	0.69	0.57	0.66	0.55
Apr	0.48	0.41	0.49	0.41	0.49	0.42	0.48	0.42	0.49	0.39	0.51	0.41	0.48	0.36
May	0.24	0.10	0.24	0.07	0.24	0.11	0.24	0.12	0.22	0.07	0.23	0.09	0.23	0.07
Jun	0.01	-0.02	0.01	-0.03	0.01	-0.01	0.02	-0.02	0.01	-0.03	0.02	-0.06	-0.01	-0.01
Jul	-0.14	-0.07	-0.14	0.28	-0.11	0.02	-0.11	-0.02	-0.11	0.13	-0.13	-0.18	-0.07	-0.03
Aug	-0.17	NaN	-0.16	NaN	0.01	NaN	-0.22	NaN	-0.23	NaN	-0.20	NaN	-0.16	NaN
Sep	0.57	0.10	0.23	0.05	-0.37	0.08	0.69	0.12	0.41	0.15	0.49	0.08	0.79	-0.03

R	**Elevation>3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.10	0.00	-0.09	-0.04	-0.08	0.05	-0.09	0.03	-0.04	-0.01	-0.11	-0.01	0.05	0.05
Nov	-0.01	0.08	0.00	0.12	-0.07	0.12	-0.04	0.16	-0.05	0.06	-0.05	0.12	-0.01	0.09
Dec	0.54	0.41	0.54	0.45	0.53	0.45	0.53	0.46	0.54	0.42	0.54	0.45	0.49	0.40
Jan	0.67	0.53	0.67	0.51	0.66	0.51	0.66	0.51	0.67	0.52	0.67	0.52	0.62	0.50
Feb	0.67	0.54	0.67	0.53	0.67	0.53	0.67	0.53	0.67	0.54	0.67	0.53	0.62	0.53

Mar	0.67	0.52	0.67	0.52	0.67	0.51	0.67	0.52	0.68	0.52	0.68	0.51	0.64	0.51
Apr	0.51	0.41	0.52	0.41	0.52	0.41	0.51	0.42	0.52	0.40	0.53	0.41	0.50	0.39
May	0.21	0.08	0.22	0.06	0.22	0.10	0.22	0.10	0.20	0.06	0.21	0.09	0.20	0.08
Jun	-0.06	-0.03	-0.06	-0.05	-0.06	-0.02	-0.05	-0.03	-0.05	-0.04	-0.05	-0.05	-0.07	-0.01
Jul	-0.18	-0.12	-0.18	0.26	-0.16	-0.02	-0.16	-0.05	-0.16	0.08	-0.17	-0.27	-0.12	0.00
Aug	-0.15	NaN	-0.13	NaN	-0.04	NaN	-0.29	NaN	-0.11	NaN	-0.11	NaN	-0.22	NaN
Sep	0.65	0.08	0.60	0.05	-0.36	0.06	0.75	0.13	0.62	0.09	0.74	0.02	0.78	-0.02

R	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.10	-0.01	0.14	-0.02	0.10	0.06	0.19	0.05	0.02	-0.01	0.04	-0.02	0.01	0.07
Nov	0.23	0.09	0.22	0.12	0.21	0.13	0.19	0.17	0.25	0.08	0.23	0.13	0.17	0.10
Dec	0.46	0.39	0.47	0.41	0.46	0.42	0.46	0.43	0.45	0.39	0.46	0.41	0.44	0.38
Jan	0.52	0.48	0.53	0.46	0.52	0.46	0.53	0.46	0.54	0.47	0.54	0.45	0.52	0.45
Feb	0.51	0.48	0.51	0.46	0.52	0.47	0.51	0.47	0.51	0.48	0.51	0.46	0.52	0.46
Mar	0.56	0.47	0.55	0.45	0.58	0.46	0.56	0.45	0.56	0.46	0.57	0.44	0.56	0.45
Apr	0.46	0.34	0.46	0.35	0.48	0.34	0.46	0.33	0.46	0.33	0.47	0.33	0.45	0.32
May	0.27	0.02	0.27	0.01	0.28	0.03	0.28	0.02	0.26	0.00	0.27	0.01	0.25	0.01
Jun	0.04	-0.05	0.04	-0.09	0.02	-0.07	0.02	-0.06	0.04	-0.06	0.06	-0.06	0.04	-0.05
Jul	-0.07	-0.33	-0.09	0.05	-0.04	-0.25	-0.08	-0.37	-0.07	-0.21	-0.10	-0.42	-0.05	-0.02
Aug	0.24	NaN	0.05	NaN	0.14	NaN	0.17	NaN	-0.08	NaN	0.16	NaN	0.27	NaN
Sep	-1.00	0.08	-1.00	0.18	-1.00	0.05	1.00	0.09	-0.92	-0.08	-0.82	-0.01	0.72	-0.02

R	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.09	0.00	-0.07	-0.03	-0.07	0.05	-0.08	0.04	-0.02	-0.01	-0.08	-0.01	0.09	0.07
Nov	0.02	0.10	0.02	0.14	-0.07	0.13	-0.05	0.19	-0.02	0.08	-0.04	0.14	0.01	0.10
Dec	0.58	0.48	0.58	0.51	0.56	0.52	0.56	0.53	0.57	0.48	0.57	0.51	0.54	0.46
Jan	0.72	0.59	0.72	0.58	0.69	0.58	0.70	0.58	0.72	0.58	0.71	0.58	0.68	0.57
Feb	0.72	0.60	0.72	0.59	0.70	0.59	0.70	0.59	0.71	0.60	0.71	0.59	0.68	0.58
Mar	0.70	0.56	0.70	0.56	0.68	0.57	0.68	0.57	0.70	0.56	0.70	0.56	0.67	0.55
Apr	0.50	0.43	0.51	0.43	0.51	0.43	0.50	0.44	0.50	0.41	0.52	0.43	0.49	0.39
May	0.25	0.11	0.25	0.08	0.25	0.12	0.25	0.13	0.23	0.08	0.24	0.11	0.24	0.09
Jun	0.01	-0.03	0.01	-0.05	0.02	-0.02	0.03	-0.02	0.02	-0.03	0.03	-0.06	0.00	-0.01
Jul	-0.14	-0.11	-0.14	0.27	-0.10	-0.01	-0.12	-0.04	-0.11	0.09	-0.13	-0.26	-0.07	-0.03
Aug	-0.16	NaN	-0.16	NaN	0.00	NaN	-0.23	NaN	-0.20	NaN	-0.18	NaN	-0.18	NaN
Sep	0.58	0.09	0.37	0.06	-0.38	0.08	0.69	0.13	0.47	0.12	0.58	0.04	0.80	-0.02

R	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.09	0.00	-0.07	-0.03	-0.07	0.05	-0.08	0.04	-0.02	-0.01	-0.08	-0.01	0.09	0.07
Nov	0.02	0.10	0.02	0.14	-0.07	0.13	-0.04	0.19	-0.02	0.08	-0.04	0.14	0.01	0.10
Dec	0.57	0.47	0.57	0.51	0.55	0.51	0.56	0.53	0.56	0.47	0.57	0.51	0.54	0.46
Jan	0.72	0.59	0.72	0.58	0.69	0.57	0.70	0.58	0.72	0.58	0.71	0.58	0.68	0.56

Feb	0.72	0.59	0.72	0.58	0.70	0.59	0.70	0.59	0.71	0.59	0.70	0.58	0.68	0.58
Mar	0.69	0.56	0.69	0.56	0.68	0.56	0.68	0.56	0.69	0.56	0.70	0.56	0.67	0.54
Apr	0.50	0.43	0.51	0.43	0.51	0.43	0.50	0.44	0.50	0.41	0.52	0.43	0.49	0.39
May	0.25	0.10	0.25	0.08	0.25	0.12	0.25	0.12	0.23	0.07	0.24	0.10	0.24	0.09
Jun	0.02	-0.03	0.02	-0.05	0.02	-0.02	0.03	-0.02	0.02	-0.04	0.03	-0.06	0.00	-0.01
Jul	-0.14	-0.11	-0.14	0.27	-0.10	-0.01	-0.11	-0.04	-0.11	0.09	-0.12	-0.25	-0.07	-0.03
Aug	-0.16	NaN	-0.16	NaN	0.00	NaN	-0.23	NaN	-0.20	NaN	-0.18	NaN	-0.18	NaN
Sep	0.58	0.09	0.36	0.06	-0.38	0.08	0.69	0.13	0.46	0.12	0.58	0.04	0.79	-0.02

MD	**Elevation<2k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
Dec	0.01	0.01	0.00	0.01	0.01	0.00	0.01	-0.01	0.00	0.01	0.00	0.00	0.01	0.02
Jan	0.01	0.02	0.01	0.03	0.04	0.02	0.03	0.02	0.01	0.02	0.01	0.02	0.02	0.02
Feb	0.02	0.03	0.03	0.02	0.05	0.04	0.05	0.03	0.04	0.03	0.05	0.03	0.03	0.02
Mar	0.06	-0.01	0.07	-0.02	0.06	0.00	0.06	-0.01	0.07	0.00	0.07	-0.01	0.04	-0.01
Apr	0.08	-0.02	0.08	-0.02	0.06	-0.02	0.07	-0.03	0.08	-0.02	0.08	-0.02	0.05	-0.02
May	0.04	-0.01	0.05	0.00	0.05	-0.01	0.05	-0.01	0.06	0.00	0.05	-0.01	0.04	0.00
Jun	0.01	0.00	0.01	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.01	0.00	0.02	0.00
Jul	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Aug	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MD	**2k<Elevation<3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	-0.02	0.00	-0.02	-0.01	-0.01	-0.01	-0.01	-0.04	-0.01	0.00	-0.01	-0.01	0.00	0.00
Dec	0.00	0.00	-0.01	0.00	0.01	-0.02	0.00	-0.06	-0.02	0.00	-0.01	-0.01	0.02	0.01
Jan	0.02	-0.03	0.01	0.01	0.09	-0.02	0.07	-0.03	0.00	-0.02	0.00	0.01	0.04	0.00
Feb	0.04	-0.02	0.05	0.00	0.11	0.01	0.11	0.01	0.08	0.00	0.10	0.04	0.05	-0.01
Mar	0.15	-0.03	0.19	-0.04	0.14	0.01	0.13	0.02	0.16	0.00	0.19	0.04	0.09	-0.03
Apr	0.21	-0.03	0.24	-0.03	0.16	-0.01	0.17	0.01	0.21	-0.01	0.21	0.03	0.12	-0.04
May	0.12	-0.04	0.15	-0.02	0.13	-0.04	0.14	-0.01	0.17	-0.02	0.15	0.00	0.11	-0.04
Jun	0.04	-0.02	0.05	-0.03	0.07	-0.02	0.07	-0.01	0.06	-0.03	0.04	0.00	0.05	-0.02
Jul	0.00	0.00	0.00	-0.02	0.00	-0.01	0.01	0.00	0.00	-0.01	-0.01	0.00	0.00	0.00
Aug	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MD	**Elevation>3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	-0.03	0.00	-0.03	-0.01	-0.02	-0.01	-0.02	-0.06	-0.03	0.00	-0.02	-0.01	0.00	0.00
Dec	0.00	-0.01	-0.02	0.00	0.00	-0.03	0.00	-0.08	-0.04	-0.01	-0.02	-0.01	0.03	0.02

Jan	0.04	-0.05	0.04	0.01	0.14	-0.03	0.12	-0.04	0.01	-0.02	0.01	0.01	0.07	0.01
Feb	0.08	-0.03	0.09	0.01	0.18	0.01	0.16	0.01	0.12	0.01	0.15	0.06	0.10	0.00
Mar	0.22	-0.03	0.28	-0.02	0.22	0.02	0.20	0.06	0.24	0.02	0.29	0.09	0.14	-0.01
Apr	0.32	-0.01	0.37	-0.02	0.25	0.01	0.27	0.08	0.33	0.02	0.34	0.11	0.18	-0.02
May	0.20	-0.07	0.27	-0.01	0.23	-0.06	0.24	0.01	0.28	-0.02	0.26	0.05	0.17	-0.05
Jun	0.09	-0.05	0.11	-0.06	0.15	-0.04	0.14	-0.02	0.12	-0.06	0.08	0.00	0.08	-0.05
Jul	0.00	-0.01	0.00	-0.04	-0.01	-0.01	0.00	-0.01	-0.01	-0.02	-0.02	-0.01	0.00	-0.01
Aug	-0.01	0.00	-0.01	-0.03	-0.01	-0.01	-0.01	0.00	-0.01	0.00	-0.02	0.00	-0.01	0.00
Sep	-0.01	0.00	-0.01	-0.01	0.00	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00

MD	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	-0.01	0.00	-0.01	-0.01	0.00	-0.01	0.00	-0.05	-0.01	0.00	0.00	-0.01	0.00	0.01
Dec	0.01	0.00	0.00	0.00	0.02	-0.03	0.02	-0.08	-0.01	0.00	0.00	-0.01	0.03	0.02
Jan	0.03	-0.04	0.02	0.01	0.11	-0.02	0.10	-0.04	0.02	-0.02	0.02	0.02	0.06	0.01
Feb	0.05	-0.02	0.07	0.01	0.16	0.02	0.15	0.01	0.12	0.01	0.15	0.07	0.09	0.00
Mar	0.19	-0.02	0.24	-0.02	0.19	0.03	0.19	0.05	0.22	0.03	0.25	0.09	0.13	-0.02
Apr	0.26	-0.01	0.28	-0.02	0.21	0.01	0.22	0.06	0.27	0.02	0.26	0.09	0.16	-0.03
May	0.12	-0.06	0.15	-0.02	0.13	-0.06	0.13	0.00	0.16	-0.02	0.14	0.03	0.11	-0.06
Jun	0.02	-0.04	0.03	-0.04	0.05	-0.03	0.05	-0.02	0.04	-0.04	0.02	-0.01	0.03	-0.04
Jul	0.00	-0.01	0.00	-0.03	0.00	-0.01	0.00	-0.01	0.00	-0.01	-0.01	0.00	0.00	-0.01
Aug	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RMSE	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	-0.01	0.00	-0.01	-0.01	0.00	-0.01	0.00	-0.05	-0.01	0.00	-0.01	-0.01	0.00	0.00
Dec	0.00	0.00	0.00	0.00	0.01	-0.03	0.01	-0.08	-0.01	0.00	0.00	-0.01	0.02	0.01
Jan	0.02	-0.04	0.01	0.01	0.07	-0.02	0.06	-0.04	0.01	-0.02	0.01	0.01	0.03	0.01
Feb	0.04	-0.03	0.05	0.00	0.09	0.01	0.09	0.01	0.07	0.01	0.08	0.05	0.05	-0.01
Mar	0.12	-0.03	0.15	-0.03	0.12	0.02	0.11	0.04	0.13	0.01	0.15	0.07	0.07	-0.02
Apr	0.16	-0.02	0.18	-0.03	0.13	0.00	0.14	0.05	0.16	0.01	0.16	0.07	0.10	-0.03
May	0.09	-0.06	0.12	-0.02	0.10	-0.05	0.10	0.00	0.13	-0.02	0.12	0.03	0.09	-0.05
Jun	0.03	-0.04	0.04	-0.04	0.06	-0.03	0.05	-0.02	0.05	-0.04	0.03	0.00	0.04	-0.04
Jul	0.00	-0.01	0.00	-0.03	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00	-0.01
Aug	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MD	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	-0.01	0.00	-0.01	-0.01	0.00	-0.01	0.00	-0.05	-0.01	0.00	-0.01	-0.01	0.00	0.00

Dec	0.00	0.00	0.00	0.00	0.01	-0.03	0.01	-0.08	-0.01	0.00	0.00	-0.01	0.02	0.01
Jan	0.02	-0.04	0.01	0.01	0.07	-0.02	0.06	-0.04	0.01	-0.02	0.01	0.01	0.03	0.01
Feb	0.04	-0.02	0.05	0.00	0.09	0.01	0.09	0.01	0.07	0.01	0.08	0.05	0.05	-0.01
Mar	0.12	-0.03	0.15	-0.03	0.12	0.02	0.11	0.04	0.13	0.01	0.15	0.07	0.07	-0.02
Apr	0.17	-0.02	0.18	-0.03	0.13	0.00	0.14	0.05	0.17	0.01	0.17	0.07	0.10	-0.03
May	0.09	-0.06	0.12	-0.02	0.10	-0.05	0.11	0.00	0.13	-0.02	0.12	0.03	0.09	-0.05
Jun	0.03	-0.04	0.04	-0.04	0.06	-0.03	0.05	-0.02	0.05	-0.04	0.03	0.00	0.04	-0.04
Jul	0.00	-0.01	0.00	-0.03	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00	-0.01
Aug	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

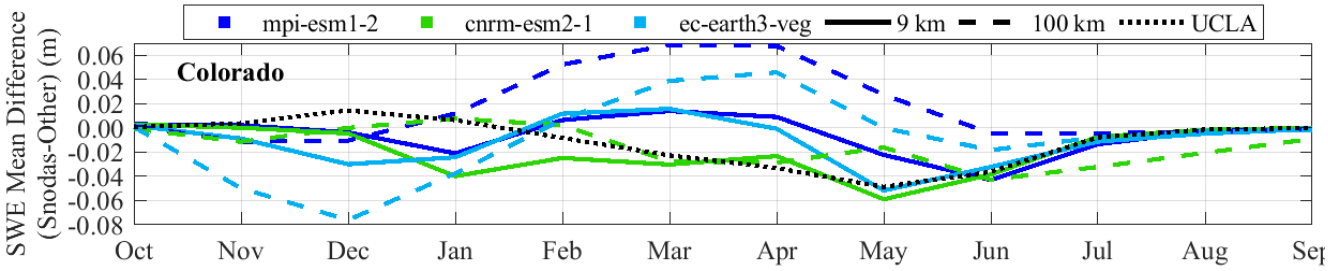


Fig. S11. The average mean difference of SWE over Colorado for the 6-year testing period (2005-2010) compares UCLA SWE (black dotted line) and downscaled SWE (SŴE) data (blue and green lines) against SNODAS. The SŴE data, derived from various climate estimators, are identified in the legend by their names and associated colors: light blue for 'ec-earth3-veg', green for 'cnrm-esm2-1', and dark blue for 'mpi-esm1-2'. Within each color group, line styles distinguish the spatial resolutions of the climate data: solid lines indicate climate estimators at a 9 km resolution, while dashed lines represent climate estimators at a 100 km resolution.

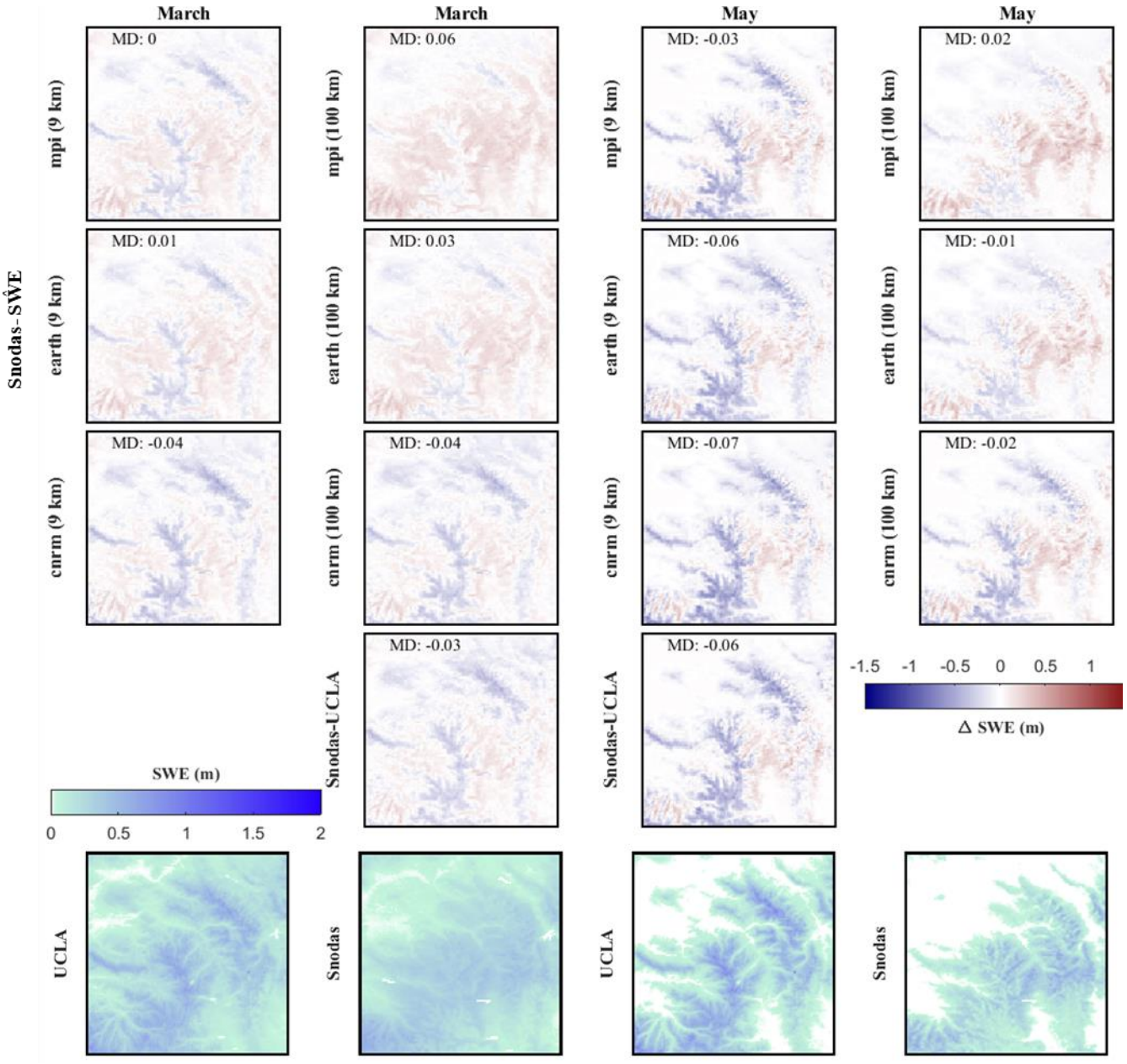


Fig. S12. Comparison with SNODAS data. The first four rows present the average difference between SNODAS and downscaled SWE (SŴE) or UCLA SWE (SNODAS- SŴE or SNODAS-UCLA) over Colorado for March and May during the 6-year testing period (2005-2010). The last row compares the average UCLA SWE or SNODAS SWE over Colorado for March and May during the same 6-year testing period (2005-2010). The evaluation metric includes Mean Difference (MD).

Table S5. Comparison of downscaled SWE (SŴE) or UCLA SWE with 1 km SWE from the Daymet Dataset over California (CA) and Colorado (CO). Metrics displayed include Correlation Coefficient (R), Mean Difference (MD), and Root-Mean-Squared Error (RMSE). Consideration is given only to swe values greater than 1 cm. 'Forest' denotes pixels with forest land cover, and 'NoForest' refers to non-forest pixels. The terms '9 km' and '100 km' indicate the resolutions of the climate data estimators.

RMSE	Elevation<2k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06
Nov	0.05	0.07	0.05	0.07	0.04	0.07	0.04	0.09	0.04	0.06	0.04	0.06	0.05	0.07
Dec	0.10	0.10	0.11	0.08	0.08	0.09	0.08	0.12	0.10	0.07	0.09	0.08	0.10	0.08
Jan	0.15	0.09	0.16	0.06	0.10	0.08	0.11	0.08	0.17	0.08	0.18	0.07	0.15	0.08
Feb	0.21	0.09	0.20	0.08	0.16	0.08	0.17	0.08	0.18	0.09	0.17	0.09	0.21	0.09
Mar	0.20	0.11	0.16	0.10	0.20	0.11	0.21	0.10	0.19	0.11	0.16	0.12	0.20	0.11
Apr	0.17	0.13	0.17	0.13	0.20	0.12	0.20	0.14	0.17	0.13	0.16	0.16	0.17	0.13
May	0.17	0.15	0.15	0.16	0.16	0.15	0.16	0.19	0.16	0.16	0.16	0.21	0.17	0.15
Jun	0.14	0.17	0.14	0.17	0.16	0.19	0.17	0.20	0.15	0.17	0.14	0.22	0.14	0.18
Jul	0.12	0.15	0.12	0.13	0.12	0.15	0.12	0.15	0.12	0.14	0.11	0.16	0.12	0.15
Aug	0.08	0.10	0.08	0.09	0.08	0.10	0.08	0.10	0.08	0.10	0.08	0.10	0.08	0.10
Sep	0.05	0.07	0.05	0.06	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07
RMSE	2k<Elevation<3k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00
Nov	0.03	0.01	0.03	0.01	0.03	0.01	0.02	0.02	0.03	0.01	0.03	0.01	0.03	0.01
Dec	0.06	0.02	0.07	0.02	0.05	0.02	0.05	0.03	0.06	0.02	0.06	0.02	0.06	0.02
Jan	0.09	0.03	0.09	0.03	0.06	0.03	0.07	0.03	0.10	0.03	0.10	0.03	0.09	0.03
Feb	0.12	0.04	0.12	0.04	0.10	0.04	0.10	0.04	0.11	0.04	0.10	0.04	0.12	0.04
Mar	0.12	0.05	0.10	0.04	0.12	0.05	0.12	0.04	0.11	0.05	0.09	0.05	0.12	0.04
Apr	0.10	0.05	0.11	0.05	0.12	0.05	0.12	0.05	0.10	0.06	0.10	0.05	0.10	0.05
May	0.10	0.04	0.09	0.05	0.10	0.04	0.10	0.04	0.10	0.05	0.10	0.05	0.10	0.05
Jun	0.09	0.03	0.09	0.03	0.10	0.03	0.10	0.03	0.10	0.03	0.09	0.03	0.09	0.03
Jul	0.07	0.01	0.07	0.01	0.07	0.01	0.08	0.01	0.07	0.01	0.07	0.01	0.07	0.01
Aug	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.00	0.05	0.00
Sep	0.03	0.00	0.03	0.00	0.03	0.00	0.03	0.00	0.03	0.00	0.03	0.00	0.03	0.00
RMSE	Elevation>3k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04	0.04
Nov	0.05	0.05	0.05	0.05	0.05	0.05	0.04	0.07	0.05	0.04	0.05	0.04	0.05	0.05
Dec	0.11	0.07	0.13	0.06	0.10	0.07	0.10	0.09	0.12	0.06	0.11	0.06	0.11	0.06
Jan	0.18	0.07	0.19	0.05	0.12	0.06	0.13	0.07	0.21	0.07	0.21	0.06	0.18	0.07
Feb	0.25	0.08	0.24	0.07	0.19	0.07	0.20	0.07	0.22	0.08	0.20	0.08	0.25	0.08

Mar	0.23	0.09	0.19	0.09	0.23	0.10	0.25	0.09	0.22	0.09	0.18	0.11	0.23	0.09
Apr	0.20	0.12	0.20	0.12	0.23	0.11	0.23	0.12	0.19	0.12	0.19	0.13	0.20	0.12
May	0.20	0.13	0.18	0.14	0.19	0.13	0.18	0.15	0.18	0.14	0.18	0.17	0.20	0.14
Jun	0.16	0.13	0.15	0.13	0.18	0.15	0.19	0.16	0.17	0.13	0.16	0.16	0.16	0.14
Jul	0.14	0.11	0.13	0.09	0.13	0.11	0.14	0.11	0.13	0.10	0.13	0.11	0.14	0.11
Aug	0.09	0.07	0.08	0.06	0.09	0.07	0.08	0.07	0.08	0.07	0.08	0.07	0.09	0.07
Sep	0.05	0.05	0.05	0.04	0.06	0.05	0.06	0.05	0.06	0.05	0.06	0.05	0.05	0.05

RMSE	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.02	0.04	0.02	0.04	0.02	0.04	0.02	0.04	0.02	0.04	0.02	0.04	0.02	0.04
Nov	0.04	0.05	0.04	0.05	0.03	0.05	0.02	0.08	0.03	0.05	0.03	0.05	0.04	0.05
Dec	0.10	0.09	0.11	0.07	0.08	0.09	0.09	0.12	0.12	0.06	0.10	0.06	0.10	0.07
Jan	0.21	0.09	0.22	0.06	0.13	0.08	0.14	0.09	0.23	0.08	0.23	0.07	0.21	0.08
Feb	0.30	0.09	0.28	0.08	0.20	0.09	0.21	0.08	0.24	0.09	0.21	0.09	0.30	0.09
Mar	0.25	0.11	0.20	0.10	0.25	0.11	0.26	0.10	0.23	0.11	0.19	0.12	0.25	0.11
Apr	0.18	0.14	0.17	0.13	0.23	0.12	0.22	0.14	0.18	0.14	0.17	0.16	0.18	0.13
May	0.16	0.16	0.14	0.16	0.15	0.15	0.15	0.19	0.14	0.16	0.14	0.20	0.16	0.15
Jun	0.12	0.16	0.11	0.16	0.13	0.18	0.14	0.19	0.13	0.16	0.12	0.21	0.12	0.17
Jul	0.09	0.13	0.09	0.11	0.09	0.13	0.09	0.13	0.09	0.13	0.09	0.14	0.09	0.13
Aug	0.05	0.08	0.05	0.07	0.05	0.07	0.05	0.08	0.05	0.08	0.05	0.08	0.05	0.08
Sep	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05

RMSE	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06	0.04	0.06
Nov	0.05	0.07	0.05	0.07	0.04	0.07	0.04	0.09	0.04	0.06	0.04	0.06	0.05	0.07
Dec	0.10	0.10	0.11	0.08	0.08	0.09	0.08	0.12	0.10	0.07	0.09	0.08	0.10	0.08
Jan	0.15	0.09	0.16	0.06	0.10	0.08	0.11	0.08	0.17	0.08	0.18	0.07	0.15	0.08
Feb	0.21	0.09	0.20	0.08	0.16	0.08	0.17	0.08	0.18	0.09	0.17	0.09	0.21	0.09
Mar	0.20	0.11	0.16	0.10	0.20	0.11	0.21	0.10	0.18	0.11	0.16	0.12	0.20	0.11
Apr	0.17	0.13	0.17	0.13	0.20	0.12	0.20	0.14	0.17	0.13	0.16	0.16	0.17	0.13
May	0.17	0.15	0.15	0.16	0.16	0.15	0.16	0.19	0.16	0.16	0.15	0.21	0.17	0.15
Jun	0.14	0.17	0.13	0.17	0.16	0.19	0.17	0.20	0.15	0.17	0.14	0.22	0.14	0.18
Jul	0.12	0.15	0.12	0.13	0.12	0.15	0.12	0.15	0.12	0.14	0.11	0.16	0.12	0.15
Aug	0.08	0.10	0.08	0.09	0.08	0.10	0.08	0.10	0.08	0.10	0.08	0.10	0.08	0.10
Sep	0.05	0.07	0.05	0.06	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07	0.05	0.07

RMSE	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.09	0.07	0.09	0.07	0.09	0.07	0.09	0.07	0.09	0.07	0.09	0.07	0.09	0.07
Nov	0.10	0.08	0.10	0.08	0.09	0.08	0.09	0.11	0.09	0.08	0.09	0.07	0.10	0.08
Dec	0.17	0.11	0.19	0.10	0.15	0.11	0.15	0.13	0.17	0.08	0.15	0.09	0.17	0.09
Jan	0.20	0.09	0.21	0.07	0.14	0.08	0.16	0.09	0.24	0.08	0.25	0.07	0.20	0.08

Feb	0.27	0.10	0.26	0.09	0.21	0.09	0.24	0.09	0.25	0.10	0.23	0.10	0.27	0.10
Mar	0.27	0.11	0.23	0.11	0.26	0.12	0.28	0.11	0.25	0.11	0.22	0.13	0.27	0.11
Apr	0.27	0.14	0.27	0.14	0.28	0.13	0.29	0.15	0.25	0.14	0.25	0.17	0.27	0.14
May	0.28	0.16	0.26	0.17	0.27	0.16	0.25	0.20	0.26	0.17	0.25	0.23	0.28	0.16
Jun	0.25	0.19	0.24	0.19	0.29	0.21	0.30	0.23	0.28	0.19	0.25	0.25	0.25	0.21
Jul	0.24	0.18	0.24	0.15	0.24	0.17	0.25	0.18	0.23	0.17	0.23	0.18	0.24	0.18
Aug	0.17	0.12	0.17	0.10	0.17	0.11	0.17	0.12	0.17	0.12	0.17	0.12	0.17	0.12
Sep	0.12	0.08	0.12	0.08	0.12	0.08	0.12	0.08	0.12	0.08	0.12	0.08	0.12	0.08

R	**Elevation<2k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.04	0.78	0.00	0.66	-0.05	0.73	-0.04	0.74	0.01	NaN	0.01	NaN	-0.04	0.76
Nov	0.14	0.73	0.12	0.68	0.18	0.72	0.17	0.76	0.18	0.67	0.15	0.73	0.14	0.46
Dec	0.49	0.83	0.50	0.81	0.50	0.82	0.50	0.83	0.50	0.81	0.50	0.78	0.49	0.75
Jan	0.76	0.85	0.76	0.85	0.75	0.87	0.76	0.88	0.77	0.87	0.76	0.78	0.76	0.80
Feb	0.77	0.86	0.77	0.87	0.77	0.89	0.77	0.90	0.78	0.89	0.78	0.78	0.77	0.84
Mar	0.80	0.87	0.80	0.89	0.79	0.88	0.79	0.89	0.80	0.87	0.80	0.82	0.80	0.86
Apr	0.78	0.84	0.79	0.84	0.78	0.86	0.77	0.87	0.77	0.82	0.79	0.85	0.78	0.80
May	0.74	0.80	0.73	0.77	0.72	0.80	0.73	0.81	0.69	0.76	0.71	0.78	0.74	0.73
Jun	0.62	0.76	0.62	0.79	0.59	0.74	0.57	0.73	0.59	0.68	0.62	0.72	0.62	0.42
Jul	0.40	NaN	0.44	0.68	0.44	NaN	0.42	NaN	0.44	NaN	0.46	NaN	0.40	-0.02
Aug	0.27	NaN	0.29	0.37	0.25	NaN	0.28	NaN	0.25	NaN	0.28	NaN	0.27	NaN
Sep	0.18	NaN	0.15	NaN	0.13	NaN	0.17	NaN	0.18	NaN	0.20	NaN	0.18	NaN

R	**2k<Elevation<3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.05	0.36	-0.02	0.36	-0.05	0.34	-0.05	0.40	-0.01	0.34	-0.02	0.38	-0.05	0.29
Nov	0.09	0.49	0.08	0.52	0.13	0.54	0.12	0.55	0.13	0.47	0.12	0.50	0.09	0.29
Dec	0.47	0.72	0.47	0.73	0.47	0.73	0.47	0.73	0.47	0.70	0.47	0.72	0.47	0.64
Jan	0.70	0.82	0.70	0.82	0.69	0.82	0.71	0.82	0.71	0.82	0.70	0.81	0.70	0.76
Feb	0.70	0.85	0.70	0.84	0.70	0.85	0.71	0.85	0.72	0.85	0.72	0.84	0.70	0.78
Mar	0.76	0.87	0.77	0.86	0.74	0.86	0.75	0.86	0.76	0.86	0.76	0.85	0.76	0.80
Apr	0.75	0.86	0.76	0.86	0.75	0.86	0.74	0.86	0.75	0.84	0.76	0.85	0.75	0.79
May	0.72	0.81	0.72	0.78	0.71	0.82	0.71	0.82	0.69	0.78	0.70	0.77	0.72	0.70
Jun	0.62	0.60	0.62	0.66	0.60	0.61	0.58	0.57	0.60	0.61	0.62	0.44	0.62	0.43
Jul	0.39	0.30	0.42	0.50	0.42	0.41	0.41	0.33	0.43	0.37	0.45	0.26	0.39	0.13
Aug	0.22	0.25	0.25	0.36	0.22	0.35	0.23	0.30	0.21	0.29	0.24	0.28	0.22	0.07
Sep	0.15	0.40	0.14	0.37	0.13	0.34	0.14	0.38	0.14	0.41	0.15	0.38	0.15	0.14

R	**Elevation>3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.07	0.30	-0.05	0.32	-0.09	0.28	-0.09	0.36	-0.04	0.30	-0.05	0.34	-0.07	0.27
Nov	0.08	0.48	0.08	0.51	0.10	0.52	0.09	0.52	0.10	0.48	0.09	0.50	0.08	0.31
Dec	0.42	0.70	0.43	0.69	0.43	0.69	0.42	0.69	0.43	0.67	0.43	0.68	0.42	0.61

Jan	0.69	0.80	0.69	0.79	0.69	0.79	0.70	0.80	0.70	0.79	0.70	0.79	0.69	0.73
Feb	0.70	0.82	0.70	0.82	0.70	0.82	0.71	0.82	0.71	0.82	0.71	0.81	0.70	0.75
Mar	0.76	0.84	0.77	0.83	0.74	0.84	0.75	0.83	0.76	0.83	0.76	0.83	0.76	0.77
Apr	0.76	0.84	0.76	0.84	0.75	0.84	0.75	0.84	0.75	0.83	0.76	0.83	0.76	0.77
May	0.73	0.81	0.72	0.78	0.71	0.81	0.72	0.82	0.69	0.77	0.71	0.77	0.73	0.70
Jun	0.61	0.63	0.61	0.68	0.57	0.63	0.55	0.61	0.58	0.64	0.62	0.45	0.61	0.46
Jul	0.36	0.32	0.39	0.54	0.40	0.43	0.38	0.37	0.40	0.40	0.43	0.26	0.36	0.12
Aug	0.22	0.24	0.24	0.37	0.20	0.33	0.23	0.27	0.20	0.26	0.24	0.25	0.22	0.03
Sep	0.12	0.33	0.10	0.33	0.08	0.29	0.11	0.31	0.12	0.33	0.13	0.32	0.12	0.09

R	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.08	0.30	0.11	0.32	0.08	0.30	0.03	0.37	0.12	0.28	0.13	0.33	0.08	0.22
Nov	0.13	0.45	0.12	0.50	0.14	0.51	0.15	0.53	0.13	0.44	0.25	0.47	0.13	0.28
Dec	0.46	0.70	0.46	0.69	0.47	0.70	0.47	0.70	0.47	0.68	0.47	0.69	0.46	0.62
Jan	0.66	0.79	0.66	0.78	0.68	0.78	0.69	0.78	0.67	0.78	0.68	0.77	0.66	0.71
Feb	0.62	0.82	0.63	0.81	0.65	0.82	0.66	0.81	0.65	0.81	0.66	0.80	0.62	0.75
Mar	0.75	0.84	0.76	0.83	0.77	0.83	0.76	0.82	0.76	0.83	0.76	0.81	0.75	0.77
Apr	0.76	0.85	0.77	0.85	0.78	0.84	0.77	0.83	0.76	0.83	0.77	0.82	0.76	0.79
May	0.71	0.81	0.71	0.79	0.72	0.81	0.71	0.81	0.70	0.79	0.71	0.77	0.71	0.73
Jun	0.60	0.62	0.60	0.69	0.58	0.62	0.57	0.59	0.59	0.64	0.61	0.47	0.60	0.49
Jul	0.36	0.28	0.40	0.52	0.40	0.38	0.38	0.31	0.40	0.37	0.42	0.24	0.36	0.19
Aug	0.20	0.22	0.23	0.31	0.20	0.28	0.21	0.21	0.22	0.24	0.22	0.22	0.20	0.17
Sep	0.22	0.38	0.23	0.30	0.16	0.28	0.18	0.32	0.21	0.38	0.19	0.35	0.22	0.27

R	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.06	0.33	-0.03	0.35	-0.06	0.31	-0.06	0.38	-0.02	0.32	-0.02	0.36	-0.06	0.30
Nov	0.10	0.50	0.09	0.53	0.13	0.54	0.12	0.55	0.13	0.49	0.12	0.51	0.10	0.32
Dec	0.48	0.72	0.48	0.73	0.48	0.73	0.48	0.72	0.49	0.70	0.49	0.72	0.48	0.64
Jan	0.73	0.82	0.72	0.82	0.71	0.82	0.73	0.82	0.73	0.81	0.73	0.81	0.73	0.76
Feb	0.73	0.84	0.73	0.84	0.72	0.84	0.73	0.84	0.74	0.84	0.74	0.83	0.73	0.78
Mar	0.78	0.86	0.78	0.85	0.76	0.86	0.76	0.85	0.78	0.85	0.78	0.85	0.78	0.79
Apr	0.76	0.86	0.77	0.86	0.76	0.86	0.75	0.86	0.76	0.84	0.77	0.85	0.76	0.79
May	0.73	0.82	0.73	0.79	0.71	0.82	0.72	0.83	0.69	0.78	0.71	0.78	0.73	0.71
Jun	0.62	0.62	0.62	0.68	0.60	0.63	0.58	0.60	0.60	0.63	0.63	0.46	0.62	0.45
Jul	0.39	0.33	0.42	0.53	0.42	0.44	0.40	0.37	0.43	0.41	0.45	0.28	0.39	0.15
Aug	0.23	0.26	0.25	0.39	0.22	0.36	0.24	0.31	0.21	0.30	0.24	0.29	0.23	0.08
Sep	0.15	0.37	0.14	0.36	0.12	0.33	0.14	0.36	0.14	0.38	0.15	0.37	0.15	0.14

R	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	-0.06	0.33	-0.03	0.35	-0.06	0.31	-0.06	0.38	-0.02	0.32	-0.02	0.36	-0.06	0.29
Nov	0.09	0.50	0.09	0.53	0.13	0.54	0.12	0.55	0.13	0.49	0.12	0.51	0.09	0.31

Dec	0.47	0.72	0.48	0.72	0.48	0.72	0.48	0.72	0.48	0.70	0.48	0.71	0.47	0.64
Jan	0.73	0.82	0.72	0.82	0.71	0.82	0.73	0.82	0.73	0.81	0.73	0.81	0.73	0.76
Feb	0.72	0.84	0.73	0.83	0.72	0.84	0.73	0.84	0.74	0.84	0.73	0.83	0.72	0.78
Mar	0.78	0.86	0.78	0.85	0.76	0.85	0.76	0.85	0.78	0.85	0.78	0.85	0.78	0.79
Apr	0.76	0.86	0.77	0.86	0.76	0.86	0.75	0.86	0.76	0.84	0.77	0.84	0.76	0.79
May	0.73	0.82	0.72	0.79	0.71	0.82	0.72	0.83	0.69	0.78	0.71	0.78	0.73	0.71
Jun	0.62	0.62	0.62	0.68	0.60	0.63	0.58	0.60	0.60	0.63	0.63	0.46	0.62	0.45
Jul	0.39	0.33	0.42	0.53	0.42	0.43	0.40	0.37	0.43	0.41	0.45	0.28	0.39	0.15
Aug	0.23	0.26	0.25	0.39	0.22	0.35	0.24	0.30	0.21	0.30	0.24	0.29	0.23	0.07
Sep	0.15	0.37	0.13	0.36	0.12	0.33	0.14	0.36	0.14	0.38	0.15	0.37	0.15	0.14

MD	**Elevation<2k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00
Dec	-0.01	0.01	-0.01	0.01	-0.01	0.00	-0.01	-0.01	-0.02	0.01	-0.01	0.00	-0.01	0.02
Jan	-0.03	0.02	-0.03	0.02	0.00	0.02	-0.01	0.01	-0.03	0.02	-0.03	0.02	-0.03	0.02
Feb	-0.04	0.02	-0.04	0.02	-0.01	0.03	-0.02	0.03	-0.02	0.03	-0.02	0.03	-0.04	0.01
Mar	-0.02	0.03	-0.01	0.02	-0.02	0.03	-0.02	0.03	-0.01	0.03	-0.01	0.03	-0.02	0.03
Apr	0.01	0.03	0.01	0.03	-0.01	0.03	0.00	0.02	0.01	0.03	0.01	0.02	0.01	0.03
May	0.01	0.02	0.02	0.02	0.01	0.02	0.01	0.02	0.02	0.02	0.02	0.02	0.01	0.02
Jun	0.02	0.01	0.02	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.02	0.01	0.02	0.01
Jul	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00
Aug	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00
Sep	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00

MD	**2k<Elevation<3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Nov	-0.01	0.01	-0.01	0.00	0.00	0.00	0.00	-0.03	-0.01	0.01	0.00	0.00	-0.01	0.01
Dec	-0.05	0.01	-0.06	0.01	-0.04	-0.02	-0.04	-0.05	-0.07	0.01	-0.06	0.00	-0.05	0.02
Jan	-0.11	-0.02	-0.12	0.02	-0.04	-0.01	-0.06	-0.02	-0.13	-0.01	-0.13	0.02	-0.11	0.01
Feb	-0.15	0.00	-0.14	0.01	-0.08	0.03	-0.09	0.02	-0.11	0.02	-0.09	0.06	-0.15	0.00
Mar	-0.10	0.01	-0.06	0.00	-0.10	0.04	-0.11	0.06	-0.08	0.04	-0.06	0.08	-0.10	0.01
Apr	-0.02	0.04	0.00	0.04	-0.07	0.06	-0.06	0.09	-0.02	0.07	-0.02	0.10	-0.02	0.04
May	-0.01	0.07	0.03	0.10	0.01	0.07	0.01	0.10	0.04	0.10	0.03	0.12	-0.01	0.08
Jun	0.06	0.08	0.07	0.08	0.09	0.09	0.08	0.09	0.07	0.08	0.05	0.10	0.06	0.08
Jul	0.06	0.05	0.06	0.04	0.06	0.05	0.07	0.05	0.06	0.05	0.05	0.05	0.06	0.05
Aug	0.03	0.02	0.03	0.01	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02	0.03	0.02
Sep	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01

MD	**Elevation>3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.05	0.03	0.05	0.02	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03	0.05	0.03

Nov	0.01	0.03	0.01	0.01	0.02	0.02	0.02	-0.03	0.01	0.03	0.01	0.01	0.01	0.03
Dec	-0.04	0.01	-0.06	0.02	-0.04	-0.01	-0.05	-0.06	-0.08	0.02	-0.06	0.01	-0.04	0.04
Jan	-0.13	-0.04	-0.14	0.01	-0.04	-0.02	-0.06	-0.04	-0.17	-0.02	-0.17	0.02	-0.13	0.02
Feb	-0.18	-0.02	-0.16	0.01	-0.08	0.02	-0.10	0.02	-0.14	0.01	-0.11	0.07	-0.18	0.00
Mar	-0.12	-0.02	-0.05	-0.01	-0.11	0.04	-0.13	0.07	-0.10	0.04	-0.05	0.10	-0.12	0.00
Apr	-0.01	0.02	0.04	0.01	-0.08	0.04	-0.07	0.11	-0.01	0.06	0.00	0.14	-0.01	0.01
May	0.01	0.07	0.08	0.12	0.04	0.08	0.05	0.15	0.10	0.11	0.08	0.18	0.01	0.08
Jun	0.15	0.15	0.17	0.14	0.21	0.16	0.21	0.18	0.19	0.14	0.14	0.20	0.15	0.15
Jul	0.18	0.12	0.18	0.09	0.17	0.11	0.18	0.12	0.17	0.11	0.16	0.12	0.18	0.12
Aug	0.11	0.06	0.11	0.04	0.11	0.06	0.11	0.06	0.11	0.06	0.10	0.06	0.11	0.06
Sep	0.07	0.03	0.07	0.02	0.07	0.03	0.07	0.03	0.07	0.03	0.07	0.03	0.07	0.03

MD	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
Nov	-0.02	0.01	-0.02	0.00	0.00	0.00	0.00	-0.04	-0.01	0.02	-0.01	0.00	-0.02	0.02
Dec	-0.07	0.01	-0.08	0.01	-0.05	-0.02	-0.06	-0.07	-0.08	0.01	-0.08	0.00	-0.07	0.02
Jan	-0.18	-0.04	-0.19	0.02	-0.09	-0.02	-0.10	-0.04	-0.19	-0.02	-0.19	0.02	-0.18	0.01
Feb	-0.25	-0.02	-0.23	0.01	-0.14	0.02	-0.15	0.01	-0.18	0.01	-0.16	0.06	-0.25	0.00
Mar	-0.19	-0.02	-0.14	-0.01	-0.18	0.03	-0.19	0.06	-0.16	0.03	-0.13	0.10	-0.19	-0.01
Apr	-0.09	0.03	-0.07	0.02	-0.14	0.05	-0.13	0.10	-0.08	0.06	-0.09	0.13	-0.09	0.01
May	-0.06	0.07	-0.03	0.12	-0.04	0.08	-0.04	0.13	-0.02	0.11	-0.03	0.16	-0.06	0.08
Jun	0.01	0.12	0.02	0.12	0.04	0.13	0.04	0.14	0.03	0.12	0.01	0.16	0.01	0.12
Jul	0.03	0.08	0.03	0.06	0.03	0.08	0.03	0.08	0.03	0.08	0.02	0.09	0.03	0.08
Aug	0.01	0.04	0.01	0.02	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.03	0.01	0.04
Sep	0.00	0.02	0.00	0.01	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02

RMSE	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02
Nov	-0.01	0.02	-0.01	0.01	0.00	0.01	0.00	-0.03	0.00	0.02	0.00	0.01	-0.01	0.02
Dec	-0.03	0.01	-0.04	0.02	-0.03	-0.01	-0.03	-0.06	-0.05	0.01	-0.04	0.01	-0.03	0.03
Jan	-0.08	-0.03	-0.08	0.02	-0.03	-0.02	-0.04	-0.03	-0.09	-0.01	-0.09	0.02	-0.08	0.01
Feb	-0.11	-0.01	-0.10	0.01	-0.05	0.02	-0.05	0.02	-0.07	0.02	-0.06	0.06	-0.11	0.00
Mar	-0.06	-0.01	-0.03	0.00	-0.06	0.04	-0.07	0.06	-0.05	0.04	-0.03	0.09	-0.06	0.00
Apr	0.00	0.03	0.01	0.03	-0.04	0.05	-0.03	0.10	0.00	0.06	0.00	0.12	0.00	0.02
May	0.01	0.07	0.03	0.11	0.02	0.08	0.02	0.13	0.04	0.11	0.03	0.15	0.01	0.08
Jun	0.05	0.12	0.05	0.11	0.07	0.13	0.07	0.14	0.06	0.11	0.04	0.15	0.05	0.12
Jul	0.05	0.09	0.05	0.06	0.05	0.08	0.05	0.09	0.05	0.08	0.04	0.09	0.05	0.09
Aug	0.03	0.04	0.03	0.02	0.03	0.04	0.03	0.04	0.03	0.04	0.02	0.04	0.03	0.04
Sep	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02

MD	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**

Oct	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02
Nov	-0.01	0.02	-0.01	0.01	0.00	0.01	0.00	-0.03	0.00	0.02	0.00	0.01	-0.01	0.02
Dec	-0.03	0.01	-0.04	0.02	-0.03	-0.01	-0.03	-0.06	-0.05	0.01	-0.04	0.01	-0.03	0.03
Jan	-0.08	-0.03	-0.08	0.02	-0.03	-0.02	-0.04	-0.03	-0.09	-0.01	-0.09	0.02	-0.08	0.01
Feb	-0.11	-0.01	-0.10	0.01	-0.05	0.02	-0.06	0.02	-0.08	0.02	-0.06	0.06	-0.11	0.00
Mar	-0.07	-0.01	-0.04	0.00	-0.07	0.04	-0.07	0.06	-0.05	0.04	-0.03	0.09	-0.07	0.00
Apr	-0.01	0.03	0.01	0.03	-0.04	0.05	-0.03	0.10	0.00	0.06	-0.01	0.12	-0.01	0.02
May	0.00	0.07	0.03	0.11	0.01	0.08	0.02	0.13	0.04	0.11	0.03	0.15	0.00	0.08
Jun	0.05	0.12	0.05	0.11	0.07	0.13	0.07	0.14	0.06	0.11	0.04	0.15	0.05	0.12
Jul	0.05	0.09	0.05	0.06	0.05	0.08	0.05	0.09	0.05	0.08	0.04	0.09	0.05	0.09
Aug	0.03	0.04	0.03	0.02	0.03	0.04	0.03	0.04	0.03	0.04	0.02	0.04	0.03	0.04
Sep	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.02

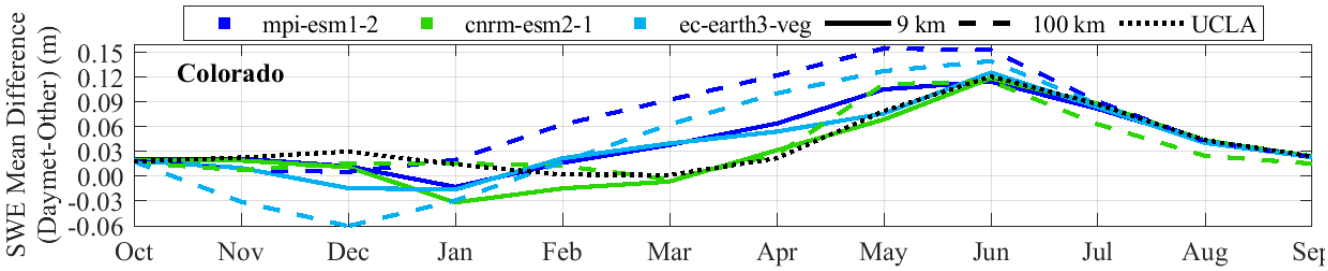


Fig. S13. Same as Fig. S11, but for comparison against the Daymet data.

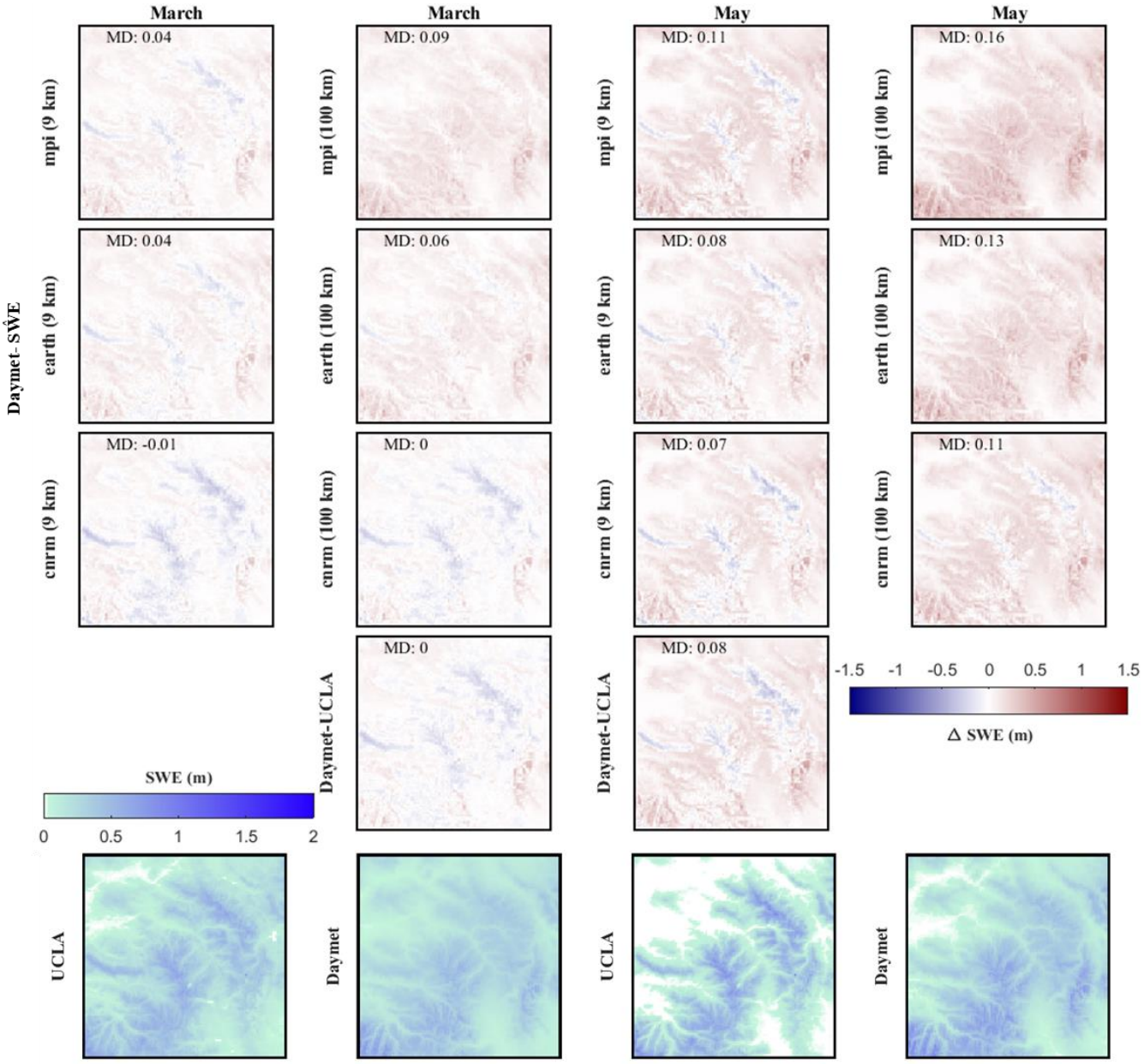


Fig. S14. Same as Fig. S12, but for comparison against the Daymet data.

Table S6. Comparison of downscaled SWE (SŴE) or UCLA SWE with 4 km SWE from the University of Arizona Dataset over California (CA) and Colorado (CO). Metrics displayed include Correlation Coefficient (R), Mean Difference (MD), and Root-Mean-Squared Error (RMSE). Consideration is given only to swe values greater than 1 cm. 'Forest' denotes pixels with forest land cover, and 'NoForest' refers to non-forest pixels. The terms '9 km' and '100 km' indicate the resolutions of the climate data estimators.

RMSE	Elevation<2k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Nov	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.06	0.02	0.03	0.02	0.03	0.01	0.03
Dec	0.08	0.06	0.09	0.05	0.06	0.05	0.06	0.08	0.07	0.07	0.06	0.05	0.03	0.05
Jan	0.11	0.08	0.11	0.07	0.12	0.07	0.13	0.07	0.12	0.07	0.11	0.07	0.06	0.07
Feb	0.13	0.09	0.13	0.09	0.15	0.10	0.16	0.09	0.15	0.10	0.16	0.12	0.08	0.08
Mar	0.18	0.11	0.20	0.11	0.17	0.12	0.17	0.13	0.18	0.12	0.20	0.15	0.11	0.11
Apr	0.27	0.15	0.29	0.14	0.23	0.14	0.24	0.17	0.24	0.14	0.26	0.18	0.14	0.14
May	0.26	0.16	0.27	0.15	0.26	0.16	0.26	0.18	0.27	0.16	0.27	0.19	0.15	0.15
Jun	0.16	0.09	0.15	0.10	0.16	0.10	0.17	0.10	0.17	0.11	0.17	0.09	0.10	0.09
Jul	0.03	0.02	0.03	0.05	0.04	0.03	0.03	0.02	0.04	0.03	0.04	0.02	0.03	0.02
Aug	0.01	0.00	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Sep	0.01	0.00	0.00	0.02	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00
RMSE	2k<Elevation<3k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.02	0.00	0.02	0.00	0.01	0.00	0.01	0.02	0.01	0.00	0.01	0.01	0.01	0.00
Dec	0.05	0.02	0.05	0.01	0.04	0.01	0.04	0.03	0.04	0.02	0.04	0.01	0.02	0.01
Jan	0.07	0.02	0.07	0.02	0.08	0.02	0.08	0.02	0.08	0.02	0.07	0.02	0.04	0.02
Feb	0.08	0.02	0.08	0.03	0.10	0.03	0.10	0.03	0.09	0.03	0.10	0.03	0.06	0.02
Mar	0.11	0.04	0.12	0.04	0.11	0.04	0.11	0.04	0.11	0.04	0.12	0.04	0.07	0.02
Apr	0.16	0.03	0.17	0.02	0.14	0.03	0.14	0.04	0.15	0.03	0.15	0.03	0.09	0.02
May	0.15	0.01	0.16	0.00	0.15	0.01	0.15	0.01	0.15	0.00	0.15	0.01	0.09	0.00
Jun	0.09	0.00	0.08	0.00	0.08	0.00	0.09	0.00	0.09	0.00	0.09	0.00	0.05	0.00
Jul	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.02	0.00	0.01	0.00
Aug	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00
Sep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RMSE	Elevation>3k													
	cnrm-esm2-1				ec-earth3-veg				mpi-esm1-2				UCLA SWE	
	9 km		100 km		9 km		100 km		9 km		100 km			
	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO	CA	CO
Oct	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Nov	0.03	0.02	0.03	0.02	0.02	0.02	0.02	0.05	0.03	0.02	0.02	0.03	0.01	0.02
Dec	0.09	0.05	0.10	0.04	0.07	0.05	0.07	0.07	0.09	0.06	0.07	0.04	0.03	0.05
Jan	0.13	0.07	0.13	0.06	0.14	0.06	0.15	0.06	0.14	0.06	0.13	0.06	0.07	0.06
Feb	0.15	0.08	0.14	0.08	0.17	0.09	0.18	0.08	0.17	0.09	0.18	0.10	0.09	0.07
Mar	0.21	0.10	0.23	0.09	0.19	0.10	0.19	0.11	0.21	0.10	0.23	0.13	0.12	0.09

Apr	0.31	0.13	0.34	0.12	0.27	0.12	0.28	0.14	0.29	0.13	0.30	0.15	0.16	0.12
May	0.31	0.13	0.33	0.11	0.30	0.13	0.30	0.14	0.32	0.12	0.31	0.15	0.18	0.12
Jun	0.19	0.07	0.18	0.08	0.19	0.08	0.20	0.07	0.20	0.08	0.20	0.07	0.12	0.07
Jul	0.04	0.01	0.04	0.04	0.04	0.02	0.04	0.02	0.04	0.02	0.05	0.01	0.03	0.01
Aug	0.01	0.00	0.01	0.03	0.01	0.01	0.01	0.00	0.01	0.01	0.02	0.01	0.01	0.00
Sep	0.01	0.00	0.01	0.01	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00	0.00

RMSE	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01
Nov	0.02	0.03	0.02	0.03	0.01	0.03	0.01	0.07	0.02	0.03	0.02	0.03	0.01	0.02
Dec	0.07	0.06	0.08	0.04	0.06	0.05	0.05	0.10	0.07	0.06	0.06	0.04	0.04	0.04
Jan	0.11	0.08	0.12	0.06	0.12	0.07	0.12	0.08	0.12	0.07	0.11	0.06	0.07	0.05
Feb	0.17	0.09	0.15	0.08	0.16	0.08	0.17	0.08	0.15	0.09	0.16	0.10	0.11	0.06
Mar	0.18	0.10	0.18	0.09	0.16	0.10	0.16	0.10	0.17	0.09	0.18	0.13	0.15	0.07
Apr	0.22	0.13	0.24	0.12	0.21	0.11	0.21	0.13	0.21	0.11	0.22	0.15	0.17	0.11
May	0.17	0.16	0.17	0.11	0.16	0.15	0.16	0.15	0.16	0.13	0.17	0.16	0.12	0.13
Jun	0.06	0.08	0.06	0.09	0.04	0.09	0.05	0.08	0.05	0.11	0.07	0.07	0.04	0.08
Jul	0.01	0.02	0.01	0.07	0.01	0.03	0.01	0.02	0.01	0.03	0.01	0.01	0.00	0.02
Aug	0.00	0.00	0.00	0.04	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00
Sep	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.00

RMSE	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00	0.01
Nov	0.03	0.03	0.03	0.03	0.02	0.03	0.02	0.06	0.02	0.03	0.02	0.03	0.01	0.03
Dec	0.08	0.06	0.09	0.05	0.06	0.05	0.06	0.08	0.07	0.07	0.06	0.05	0.03	0.05
Jan	0.11	0.08	0.11	0.07	0.12	0.07	0.13	0.07	0.12	0.07	0.11	0.07	0.06	0.07
Feb	0.13	0.09	0.12	0.09	0.15	0.10	0.16	0.09	0.14	0.10	0.16	0.12	0.08	0.09
Mar	0.18	0.11	0.20	0.11	0.17	0.12	0.17	0.13	0.18	0.12	0.20	0.15	0.11	0.11
Apr	0.27	0.15	0.28	0.14	0.23	0.14	0.24	0.17	0.24	0.14	0.26	0.19	0.14	0.14
May	0.26	0.16	0.27	0.15	0.25	0.16	0.25	0.18	0.27	0.16	0.26	0.19	0.15	0.15
Jun	0.16	0.09	0.15	0.10	0.16	0.10	0.17	0.10	0.17	0.10	0.17	0.09	0.10	0.09
Jul	0.03	0.02	0.03	0.05	0.04	0.03	0.03	0.02	0.04	0.03	0.04	0.02	0.03	0.02
Aug	0.01	0.00	0.01	0.03	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.00
Sep	0.01	0.00	0.00	0.02	0.00	0.01	0.00	0.01	0.01	0.00	0.01	0.01	0.00	0.00

RMSE	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.01	0.01	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Nov	0.04	0.04	0.04	0.04	0.03	0.04	0.03	0.06	0.03	0.04	0.03	0.04	0.02	0.03
Dec	0.10	0.07	0.12	0.06	0.08	0.06	0.08	0.09	0.09	0.07	0.08	0.06	0.04	0.06
Jan	0.14	0.08	0.14	0.08	0.17	0.07	0.17	0.08	0.16	0.08	0.14	0.08	0.07	0.07
Feb	0.16	0.10	0.15	0.09	0.20	0.10	0.20	0.09	0.19	0.10	0.21	0.12	0.10	0.09

Mar	0.23	0.11	0.26	0.11	0.23	0.12	0.23	0.13	0.24	0.12	0.28	0.15	0.13	0.11
Apr	0.36	0.15	0.39	0.14	0.31	0.14	0.32	0.18	0.33	0.15	0.35	0.20	0.18	0.14
May	0.39	0.17	0.41	0.17	0.38	0.17	0.38	0.20	0.40	0.18	0.39	0.22	0.23	0.17
Jun	0.26	0.10	0.25	0.11	0.27	0.11	0.28	0.11	0.28	0.12	0.28	0.11	0.17	0.10
Jul	0.05	0.02	0.05	0.06	0.06	0.03	0.05	0.02	0.06	0.03	0.07	0.02	0.04	0.02
Aug	0.01	0.00	0.02	0.04	0.01	0.01	0.02	0.01	0.02	0.01	0.02	0.01	0.01	0.00
Sep	0.01	0.00	0.01	0.02	0.01	0.01	0.01	0.01	0.01	0.00	0.01	0.01	0.01	0.00

R	**Elevation<2k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.30	NaN	0.31	NaN	0.40	NaN	0.39	NaN	0.31	NaN	0.37	NaN	0.27	NaN
Nov	0.50	NaN	0.50	NaN	0.51	NaN	0.46	NaN	0.48	NaN	0.47	NaN	0.32	NaN
Dec	0.83	NaN	0.83	NaN	0.83	NaN	0.83	NaN	0.82	NaN	0.82	NaN	0.84	NaN
Jan	0.94	NaN	0.94	NaN	0.94	NaN	0.94	NaN	0.94	NaN	0.94	NaN	0.94	NaN
Feb	0.93	NaN	0.93	NaN	0.94	NaN	0.94	NaN	0.94	NaN	0.94	NaN	0.94	NaN
Mar	0.92	NaN	0.92	NaN	0.92	NaN	0.92	NaN	0.93	NaN	0.93	NaN	0.92	NaN
Apr	0.89	NaN	0.89	NaN	0.88	NaN	0.88	NaN	0.89	NaN	0.89	NaN	0.88	NaN
May	0.80	NaN	0.80	NaN	0.79	NaN	0.79	NaN	0.79	NaN	0.79	NaN	0.82	NaN
Jun	0.64	NaN	0.64	NaN	0.66	NaN	0.66	NaN	0.65	NaN	0.64	NaN	0.74	NaN
Jul	0.42	NaN	0.44	NaN	0.43	NaN	0.44	NaN	0.44	NaN	0.44	NaN	0.53	NaN
Aug	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Sep	0.41	NaN	0.39	NaN	0.27	NaN	0.31	NaN	0.34	NaN	0.29	NaN	NaN	NaN

R	**2k<Elevation<3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.34	0.38	0.33	0.34	0.43	0.38	0.40	0.30	0.33	0.41	0.42	0.30	0.31	0.33
Nov	0.48	0.56	0.47	0.58	0.51	0.56	0.48	0.57	0.48	0.56	0.45	0.56	0.34	0.52
Dec	0.82	0.81	0.82	0.82	0.81	0.82	0.82	0.82	0.81	0.80	0.81	0.82	0.83	0.78
Jan	0.93	0.79	0.93	0.80	0.92	0.80	0.93	0.81	0.93	0.79	0.93	0.80	0.92	0.78
Feb	0.92	0.79	0.92	0.78	0.93	0.80	0.93	0.80	0.93	0.79	0.93	0.79	0.92	0.77
Mar	0.92	0.80	0.92	0.80	0.92	0.81	0.92	0.81	0.92	0.80	0.93	0.80	0.92	0.77
Apr	0.89	0.76	0.89	0.76	0.89	0.76	0.89	0.77	0.90	0.76	0.90	0.76	0.89	0.73
May	0.82	0.55	0.82	0.54	0.83	0.55	0.82	0.56	0.82	0.53	0.82	0.54	0.84	0.46
Jun	0.68	0.35	0.68	0.31	0.70	0.37	0.69	0.36	0.69	0.31	0.68	0.40	0.75	0.23
Jul	0.45	0.61	0.47	0.57	0.46	0.66	0.46	0.61	0.46	0.59	0.47	0.51	0.54	0.47
Aug	NaN	NaN	NaN	0.46	NaN	-1.00	NaN	-1.00	NaN	NaN	NaN	NaN	NaN	-1.00
Sep	0.41	0.46	0.38	0.36	0.18	0.45	0.32	0.26	0.32	0.31	0.28	0.30	NaN	0.56

R	**Elevation>3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.40	0.36	0.36	0.24	0.55	0.30	0.46	0.22	0.35	0.40	0.50	0.22	0.41	0.25
Nov	0.55	0.42	0.56	0.44	0.56	0.38	0.52	0.39	0.53	0.40	0.52	0.40	0.50	0.43
Dec	0.85	0.75	0.85	0.75	0.85	0.71	0.85	0.71	0.85	0.72	0.85	0.73	0.87	0.68
Jan	0.96	0.74	0.96	0.75	0.96	0.74	0.96	0.75	0.96	0.73	0.96	0.75	0.95	0.72

Feb	0.96	0.74	0.96	0.74	0.96	0.75	0.96	0.76	0.96	0.74	0.96	0.75	0.95	0.72
Mar	0.95	0.76	0.95	0.74	0.95	0.76	0.96	0.76	0.95	0.75	0.95	0.75	0.95	0.72
Apr	0.92	0.71	0.92	0.71	0.93	0.72	0.93	0.70	0.93	0.71	0.93	0.69	0.93	0.68
May	0.83	0.43	0.84	0.41	0.84	0.43	0.84	0.42	0.84	0.40	0.84	0.38	0.86	0.36
Jun	0.71	0.23	0.72	0.19	0.73	0.24	0.72	0.23	0.71	0.19	0.72	0.29	0.75	0.15
Jul	0.40	0.64	0.39	0.58	0.39	0.69	0.36	0.66	0.43	0.62	0.45	0.60	0.58	0.48
Aug	NaN	NaN	NaN	0.56	NaN	-1.00	NaN	-1.00	NaN	NaN	NaN	NaN	NaN	-1.00
Sep	-0.20	0.57	-0.22	0.39	0.15	0.50	-0.63	0.29	-0.35	0.41	-0.50	0.42	NaN	0.53

R	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	NaN	0.11	NaN	0.31	NaN	0.19	NaN	0.25	NaN	0.12	NaN	0.29	1.00	0.51
Nov	0.16	0.67	0.16	0.70	0.15	0.63	0.02	0.64	0.22	0.62	0.17	0.67	0.69	0.65
Dec	0.67	0.88	0.67	0.87	0.65	0.86	0.64	0.85	0.65	0.86	0.66	0.87	0.58	0.85
Jan	0.83	0.86	0.83	0.86	0.83	0.85	0.84	0.86	0.86	0.86	0.86	0.86	0.79	0.84
Feb	0.79	0.86	0.80	0.85	0.82	0.86	0.82	0.86	0.82	0.86	0.82	0.86	0.80	0.84
Mar	0.85	0.88	0.85	0.88	0.86	0.88	0.85	0.88	0.85	0.88	0.85	0.87	0.78	0.87
Apr	0.80	0.88	0.79	0.88	0.80	0.87	0.79	0.87	0.79	0.88	0.79	0.87	0.74	0.86
May	0.73	0.70	0.74	0.71	0.72	0.69	0.73	0.70	0.70	0.71	0.69	0.67	0.76	0.67
Jun	0.89	0.13	0.90	0.09	0.90	0.09	0.89	0.12	0.87	0.07	0.88	0.13	0.95	0.22
Jul	NaN	-0.72	NaN	-0.85	NaN	-0.88	NaN	-0.80	NaN	-0.78	NaN	-0.29	NaN	0.23
Aug	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN	NaN
Sep	NaN	-1.00	NaN	0.14	NaN	-0.10	NaN	0.34	NaN	-1.00	NaN	1.00	NaN	0.37

R	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.32	0.39	0.32	0.32	0.42	0.36	0.39	0.29	0.32	0.41	0.40	0.27	0.30	0.31
Nov	0.48	0.50	0.48	0.52	0.51	0.49	0.47	0.50	0.48	0.50	0.45	0.50	0.33	0.49
Dec	0.82	0.79	0.82	0.80	0.82	0.79	0.83	0.79	0.82	0.78	0.82	0.79	0.83	0.75
Jan	0.93	0.77	0.93	0.78	0.93	0.78	0.93	0.79	0.94	0.77	0.94	0.78	0.93	0.76
Feb	0.93	0.77	0.93	0.77	0.93	0.78	0.93	0.79	0.94	0.77	0.93	0.78	0.93	0.75
Mar	0.93	0.78	0.93	0.78	0.93	0.79	0.93	0.80	0.93	0.78	0.93	0.79	0.92	0.75
Apr	0.89	0.74	0.89	0.74	0.89	0.75	0.89	0.75	0.90	0.74	0.90	0.74	0.89	0.71
May	0.82	0.50	0.82	0.49	0.82	0.51	0.82	0.51	0.82	0.48	0.82	0.48	0.84	0.42
Jun	0.67	0.36	0.67	0.32	0.69	0.38	0.68	0.37	0.68	0.32	0.67	0.40	0.75	0.25
Jul	0.44	0.62	0.46	0.58	0.45	0.67	0.45	0.64	0.46	0.61	0.46	0.54	0.53	0.48
Aug	NaN	NaN	NaN	0.53	NaN	-1.00	NaN	-1.00	NaN	NaN	NaN	NaN	NaN	-1.00
Sep	0.40	0.52	0.38	0.37	0.20	0.48	0.31	0.26	0.32	0.37	0.28	0.36	NaN	0.55

R	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.32	0.38	0.32	0.31	0.42	0.35	0.39	0.28	0.32	0.41	0.40	0.27	0.30	0.31
Nov	0.48	0.50	0.48	0.52	0.51	0.49	0.47	0.49	0.48	0.49	0.45	0.49	0.33	0.48
Dec	0.82	0.79	0.82	0.80	0.82	0.79	0.83	0.78	0.82	0.78	0.82	0.79	0.83	0.75

Jan	0.93	0.77	0.93	0.78	0.93	0.78	0.93	0.79	0.94	0.77	0.94	0.78	0.93	0.76
Feb	0.93	0.77	0.93	0.77	0.93	0.78	0.93	0.79	0.93	0.77	0.93	0.78	0.93	0.75
Mar	0.92	0.79	0.92	0.78	0.92	0.79	0.92	0.80	0.93	0.78	0.93	0.79	0.92	0.75
Apr	0.89	0.74	0.89	0.74	0.89	0.75	0.89	0.75	0.90	0.74	0.90	0.74	0.89	0.71
May	0.82	0.50	0.82	0.48	0.82	0.50	0.82	0.50	0.82	0.48	0.82	0.48	0.84	0.41
Jun	0.67	0.34	0.67	0.30	0.69	0.36	0.68	0.35	0.68	0.31	0.68	0.39	0.75	0.24
Jul	0.44	0.63	0.46	0.58	0.46	0.67	0.45	0.64	0.46	0.61	0.47	0.55	0.53	0.48
Aug	NaN	NaN	NaN	0.54	NaN	-1.00	NaN	-1.00	NaN	NaN	NaN	NaN	NaN	-1.00
Sep	0.40	0.52	0.38	0.37	0.19	0.48	0.31	0.26	0.32	0.37	0.27	0.37	NaN	0.55

MD	**Elevation<2k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	-0.01	0.00	0.00
Dec	0.00	0.01	0.00	0.01	0.00	-0.01	0.00	-0.03	0.00	0.01	0.00	0.00	0.00	0.01
Jan	0.01	0.01	0.01	0.02	0.03	0.01	0.03	0.01	0.01	0.01	0.01	0.02	0.01	0.01
Feb	0.01	0.02	0.01	0.01	0.03	0.03	0.03	0.03	0.02	0.03	0.03	0.03	0.01	-0.01
Mar	0.03	0.01	0.04	-0.01	0.03	0.02	0.03	0.01	0.04	0.01	0.04	0.01	0.02	-0.01
Apr	0.04	-0.02	0.05	-0.01	0.03	-0.02	0.03	-0.03	0.04	-0.01	0.04	-0.03	0.02	-0.01
May	0.01	-0.01	0.02	0.00	0.02	-0.01	0.02	-0.01	0.03	0.00	0.02	-0.01	0.01	0.00
Jun	0.00	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Jul	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
Aug	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MD	**2k<Elevation<3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Nov	-0.01	0.01	-0.01	0.00	0.00	0.00	0.00	-0.04	-0.01	0.01	-0.01	0.00	0.00	0.01
Dec	-0.01	0.02	-0.02	0.02	0.00	-0.01	-0.01	-0.05	-0.03	0.02	-0.02	0.01	0.01	0.03
Jan	0.00	-0.01	-0.01	0.03	0.07	0.00	0.06	-0.01	-0.02	0.01	-0.02	0.03	0.02	0.03
Feb	0.00	0.01	0.02	0.03	0.08	0.04	0.07	0.03	0.04	0.03	0.06	0.07	0.02	0.02
Mar	0.09	0.01	0.13	0.00	0.09	0.04	0.08	0.06	0.11	0.04	0.13	0.08	0.03	0.01
Apr	0.15	0.00	0.18	0.00	0.10	0.02	0.12	0.05	0.16	0.03	0.16	0.07	0.06	-0.01
May	0.07	-0.04	0.10	0.00	0.08	-0.03	0.09	0.00	0.12	-0.01	0.10	0.02	0.06	-0.03
Jun	0.01	-0.02	0.01	-0.02	0.04	-0.02	0.03	-0.01	0.02	-0.02	0.00	0.00	0.01	-0.02
Jul	-0.01	0.00	-0.01	-0.02	-0.01	-0.01	-0.01	0.00	-0.01	-0.01	-0.02	0.00	-0.01	0.00
Aug	-0.01	0.00	-0.01	-0.01	0.00	0.00	-0.01	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MD	**Elevation>3k**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.01	0.00	0.00	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.01	0.00	0.00
Nov	-0.01	0.01	-0.01	0.00	0.00	0.01	0.00	-0.04	-0.01	0.02	-0.01	0.00	0.01	0.02

Dec	0.00	0.01	-0.02	0.02	0.00	-0.01	0.00	-0.06	-0.03	0.02	-0.02	0.01	0.02	0.04
Jan	0.03	-0.02	0.02	0.03	0.11	0.00	0.09	-0.02	-0.01	0.00	0.00	0.04	0.05	0.03
Feb	0.04	-0.01	0.06	0.03	0.13	0.04	0.11	0.03	0.08	0.03	0.10	0.08	0.05	0.02
Mar	0.15	0.00	0.20	0.01	0.15	0.05	0.14	0.08	0.16	0.05	0.20	0.11	0.08	0.01
Apr	0.23	0.02	0.26	0.01	0.17	0.04	0.19	0.11	0.23	0.05	0.23	0.13	0.11	0.01
May	0.15	-0.02	0.20	0.03	0.17	-0.01	0.18	0.06	0.22	0.02	0.20	0.09	0.13	0.00
Jun	0.06	-0.03	0.07	-0.03	0.10	-0.02	0.10	0.00	0.08	-0.03	0.05	0.02	0.06	-0.02
Jul	-0.01	-0.01	-0.02	-0.04	-0.02	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03	0.00	-0.01	-0.01
Aug	-0.01	0.00	-0.01	-0.03	-0.01	-0.01	-0.01	0.00	-0.01	0.00	-0.01	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00

MD	**Forest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Nov	-0.01	0.01	-0.01	-0.01	0.00	-0.01	0.00	-0.06	0.00	0.01	0.00	-0.01	0.00	0.01
Dec	-0.02	0.00	-0.03	0.01	0.00	-0.03	-0.01	-0.09	-0.03	0.01	-0.03	0.00	-0.01	0.03
Jan	-0.06	-0.04	-0.07	0.02	0.03	-0.02	0.02	-0.04	-0.06	-0.02	-0.06	0.03	-0.03	0.02
Feb	-0.09	-0.02	-0.07	0.02	0.02	0.02	0.02	0.01	-0.01	0.02	0.01	0.08	-0.05	0.00
Mar	-0.02	-0.02	0.02	-0.02	-0.01	0.03	-0.01	0.07	0.01	0.04	0.03	0.11	-0.07	-0.01
Apr	0.02	-0.03	0.03	-0.04	-0.03	-0.01	-0.02	0.06	0.02	0.01	0.01	0.10	-0.07	-0.05
May	-0.05	-0.09	-0.03	-0.03	-0.04	-0.08	-0.04	0.00	-0.02	-0.04	-0.04	0.04	-0.05	-0.08
Jun	-0.03	-0.05	-0.03	-0.05	-0.01	-0.04	-0.02	-0.02	-0.02	-0.06	-0.04	0.00	-0.02	-0.05
Jul	0.00	-0.01	-0.01	-0.05	0.00	-0.02	0.00	-0.01	0.00	-0.02	-0.01	-0.01	0.00	-0.01
Aug	0.00	0.00	0.00	-0.03	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RMSE	**NoForest**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00
Nov	-0.01	0.01	-0.01	0.00	0.00	0.00	0.00	-0.04	-0.01	0.01	0.00	0.00	0.00	0.01
Dec	-0.01	0.01	-0.01	0.02	0.00	-0.01	0.00	-0.06	-0.02	0.01	-0.01	0.01	0.01	0.03
Jan	0.01	-0.02	0.00	0.03	0.06	0.00	0.05	-0.01	-0.01	0.00	-0.01	0.03	0.02	0.03
Feb	0.01	0.00	0.02	0.03	0.06	0.04	0.06	0.03	0.04	0.03	0.05	0.08	0.02	0.02
Mar	0.07	0.00	0.10	0.00	0.07	0.05	0.06	0.07	0.08	0.04	0.10	0.10	0.03	0.01
Apr	0.11	0.01	0.13	0.00	0.08	0.03	0.09	0.08	0.11	0.04	0.11	0.10	0.05	0.00
May	0.05	-0.03	0.07	0.01	0.06	-0.03	0.06	0.02	0.08	0.00	0.07	0.05	0.04	-0.02
Jun	0.00	-0.02	0.01	-0.03	0.03	-0.02	0.02	0.00	0.02	-0.03	0.00	0.01	0.01	-0.02
Jul	-0.01	-0.01	-0.01	-0.03	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	0.00	-0.01	-0.01
Aug	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

MD	**All**													
	cnrm-esm2-1				**ec-earth3-veg**				**mpi-esm1-2**				**UCLA SWE**	
	9 km		**100 km**		**9 km**		**100 km**		**9 km**		**100 km**			
	CA	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**	**CA**	**CO**
Oct	0.00	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.01	0.00	0.00	0.00	0.00

Nov	-0.01	0.01	-0.01	0.00	0.00	0.00	0.00	-0.04	-0.01	0.01	0.00	0.00	0.00	0.01
Dec	-0.01	0.01	-0.01	0.02	0.00	-0.01	0.00	-0.06	-0.02	0.01	-0.01	0.01	0.01	0.03
Jan	0.01	-0.02	0.00	0.03	0.06	0.00	0.05	-0.01	-0.01	0.00	-0.01	0.03	0.02	0.03
Feb	0.01	0.00	0.02	0.03	0.06	0.04	0.06	0.03	0.04	0.03	0.05	0.08	0.02	0.02
Mar	0.07	0.00	0.10	0.00	0.07	0.05	0.06	0.07	0.08	0.04	0.10	0.10	0.03	0.01
Apr	0.11	0.01	0.13	0.00	0.08	0.03	0.09	0.08	0.12	0.04	0.12	0.10	0.05	0.00
May	0.05	-0.03	0.07	0.01	0.06	-0.03	0.06	0.02	0.08	0.00	0.07	0.05	0.04	-0.02
Jun	0.00	-0.02	0.01	-0.03	0.03	-0.02	0.02	0.00	0.02	-0.03	0.00	0.01	0.01	-0.02
Jul	-0.01	-0.01	-0.01	-0.03	-0.01	-0.01	-0.01	-0.01	-0.01	-0.01	-0.02	0.00	-0.01	-0.01
Aug	0.00	0.00	0.00	-0.02	0.00	0.00	0.00	0.00	0.00	0.00	-0.01	0.00	0.00	0.00
Sep	0.00	0.00	0.00	-0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

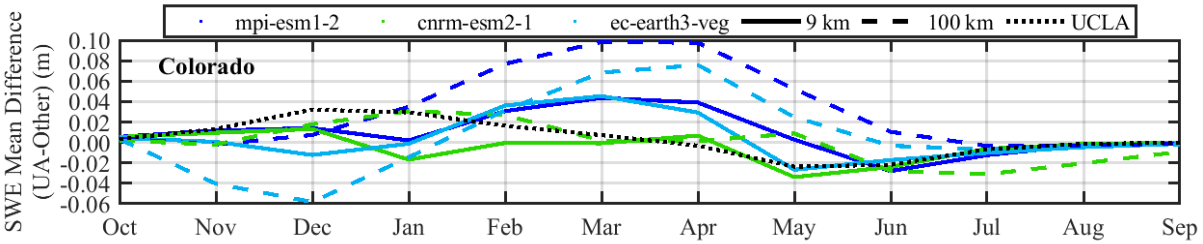


Fig. S15. Same as Fig. S11, but for comparison against the University of Arizona (UA) data.

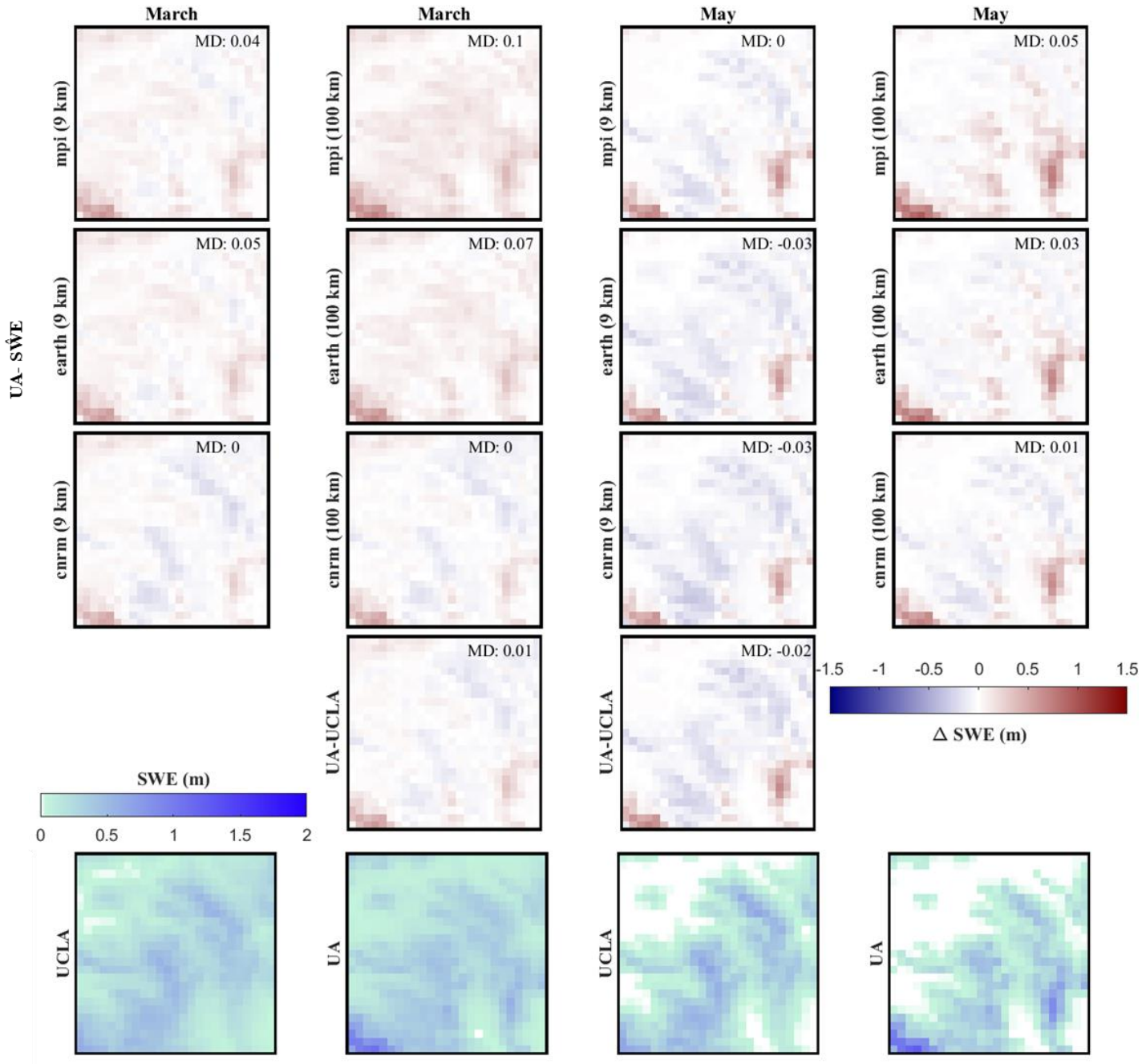


Fig. S16. Same as Fig. S12, but for comparison against the University of Arizona (UA) data.