



Supplement of

High-resolution snow water equivalent estimation: a data-driven method for localized downscaling of climate data

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Supplementary

Table S1. A summary of the selected features in each scenario.

Scenarios	Features
1 st scenario	Minimum and maximum temperatures, precipitation, downwelling shortwave radiation
2 nd scenario	Minimum and maximum temperatures, precipitation, downwelling shortwave radiation, LR-SWE
3 rd scenario	Minimum and maximum temperatures, precipitation, LR-SWE, MODIS snow cover
4 th scenario	Minimum and maximum temperatures, precipitation, LR-SWE, MODIS snow cover, monthly terrain shadow
5 th scenario	Minimum and maximum temperatures, precipitation, LR-SWE, downwelling shortwave radiation, MODIS snow cover
6 th scenario	Minimum and maximum temperatures, precipitation, LR-SWE, downwelling shortwave radiation, MODIS snow cover, monthly terrain shadow

To evaluate the efficacy of the chosen features, we synthesized SWE images of Colorado for six consecutive years (2005–2010) using ERA5-Land climate data, MODIS snow cover, and monthly terrain shadow with different combinations as explained in Table S1. We analyzed the months of January, February, March, April, November, and December across these years. The sum of the RMSE, (1-correlation), and Mean Difference was determined using a leave-one-out assessment, and the average was calculated to identify which parameters consistently outperformed the others (Fig. S1). As shown in Fig. S1, the second scenario generally demonstrates superior performance.

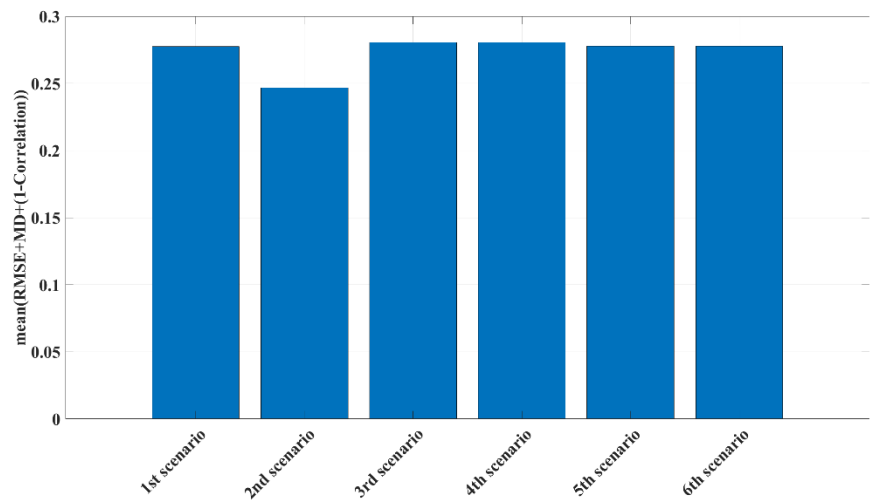


Fig. S1. Average mean absolute error for the scenarios outlined in Table S1.

Supplementary

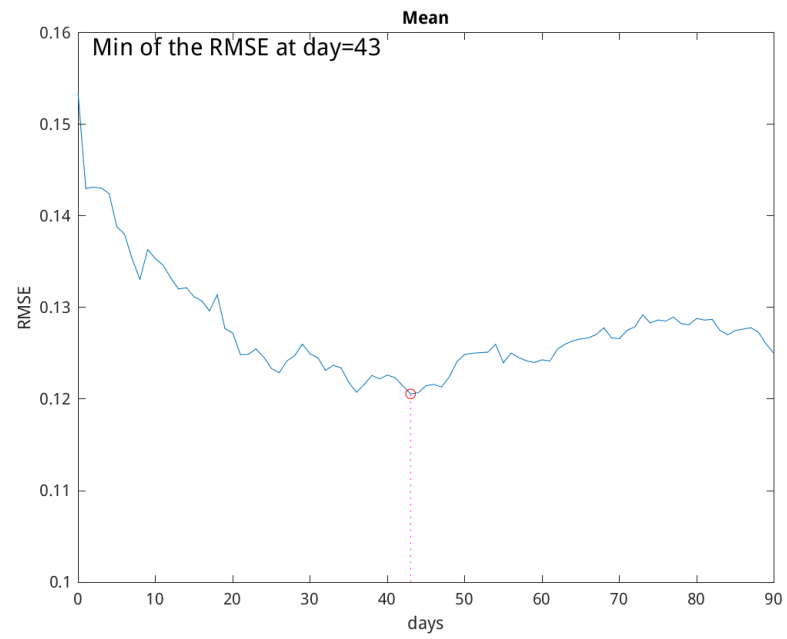
Table S2. Annual Averaged SPEI Values and Interpretations for California and Colorado, 1985-2014.

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

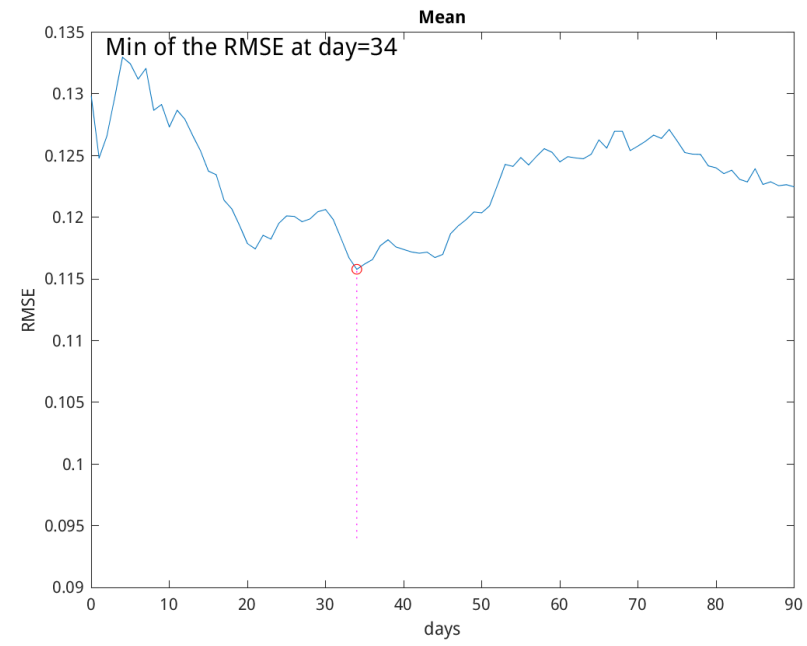
Table S3. A summary of accuracy assessment criteria, where $\widehat{SWE}_i$ is the downscaled SWE at the ith pixel, SWE_i is the observed (reference) SWE at the ith pixel, and N is the total number of pixels.

Mean Difference	A lower value indicates a better estimation	$MD = \text{Mean}(SWE - \widehat{SWE})$
Correlation	A higher value indicates a better estimation	$R = \frac{\sum_{i=1}^N (\widehat{SWE}_i - \overline{\widehat{SWE}}) (SWE_i - \overline{SWE})}{\sqrt{(\sum_{i=1}^N (\widehat{SWE}_i - \overline{\widehat{SWE}})^2) (\sum_{i=1}^N (SWE_i - \overline{SWE})^2)}}$
RMSE	A lower value indicates a better estimation	$MD = \sqrt{\sum_{i=1}^N (\widehat{SWE}_i - SWE_i)^2 / N}$

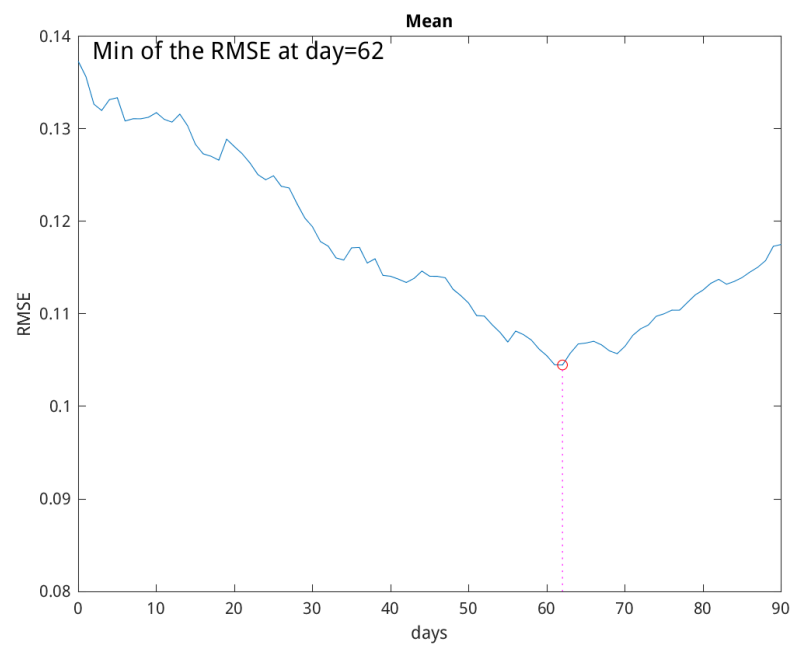
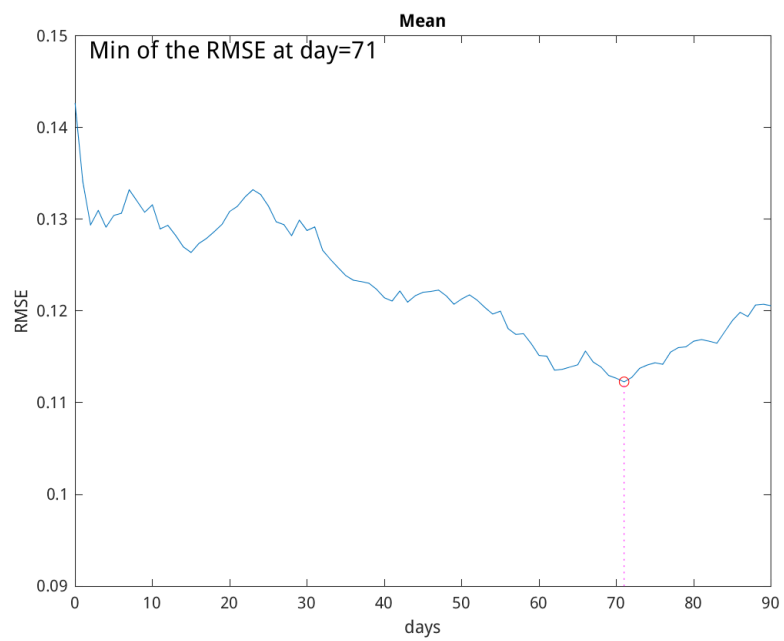
100 km



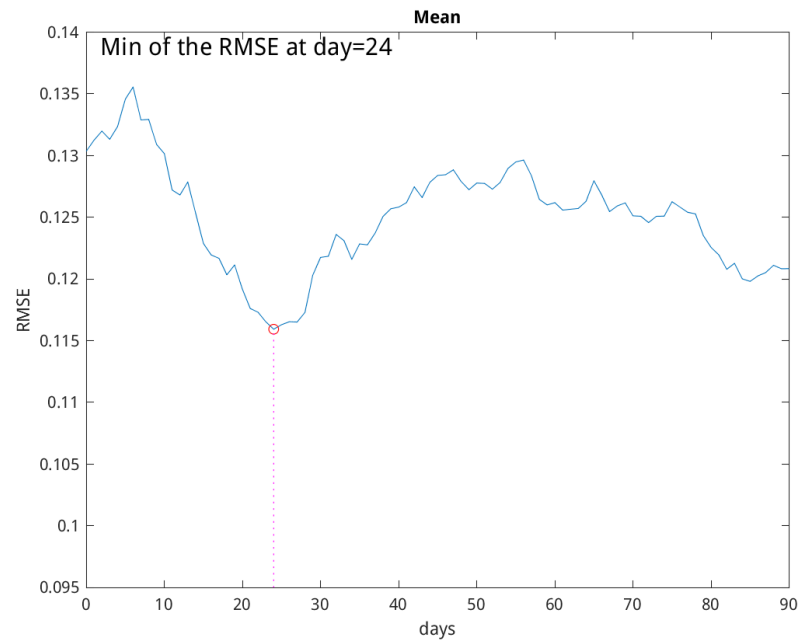
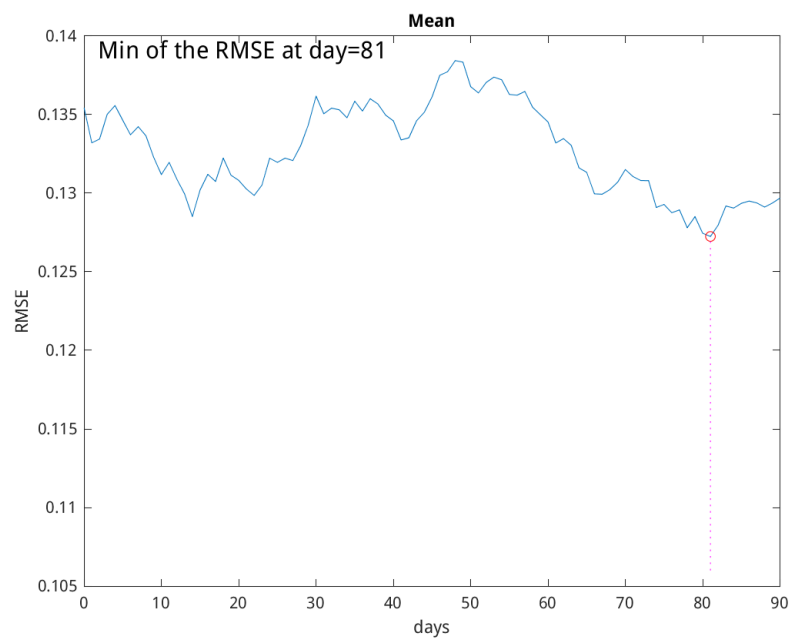
9 km



'mpi-esm 1-2' Model



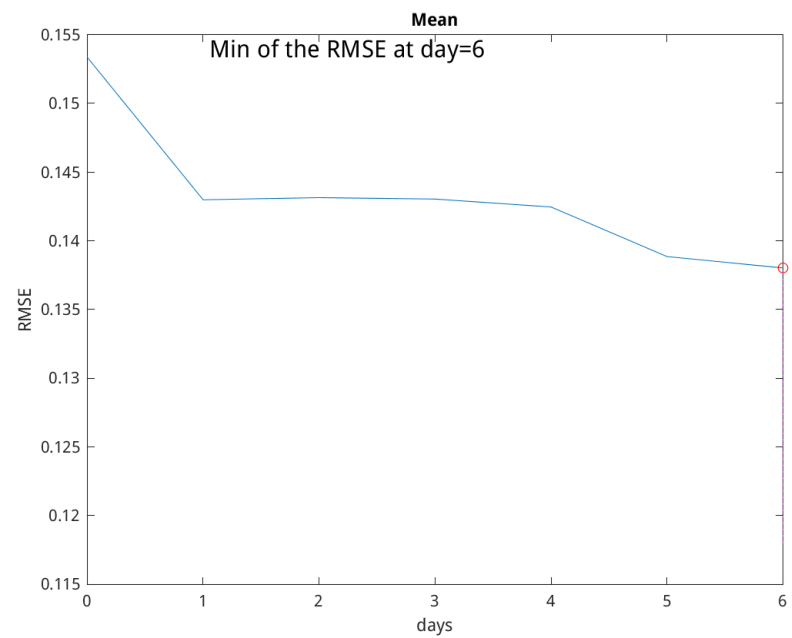
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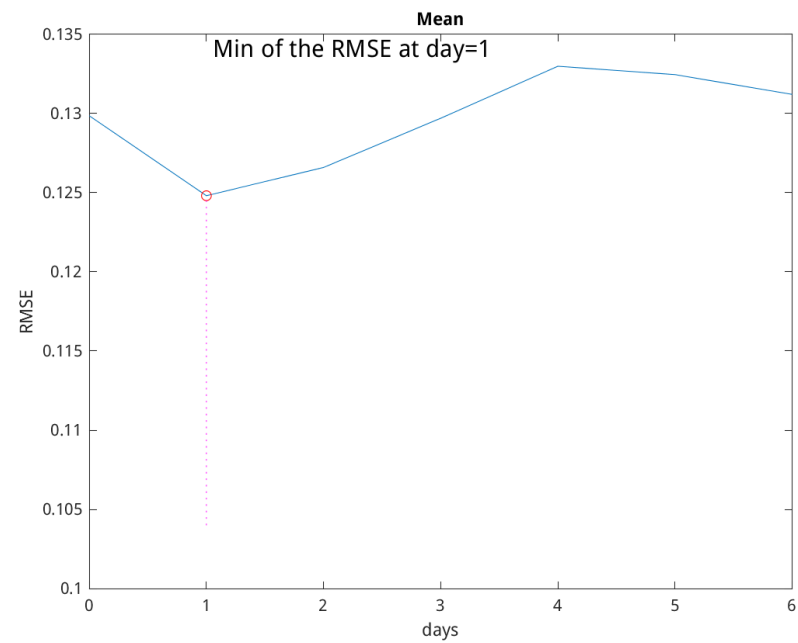
'ec-earth3-veg' Model

Fig. S2. 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.

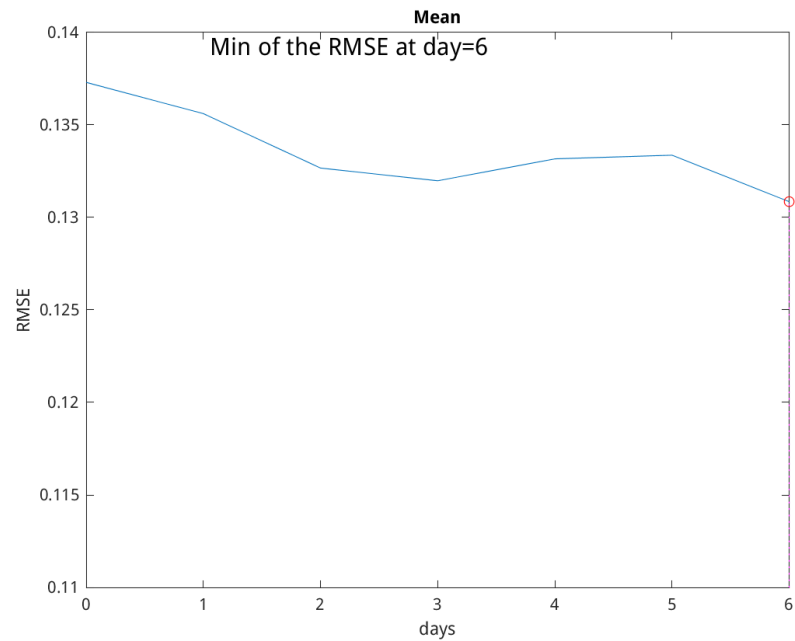
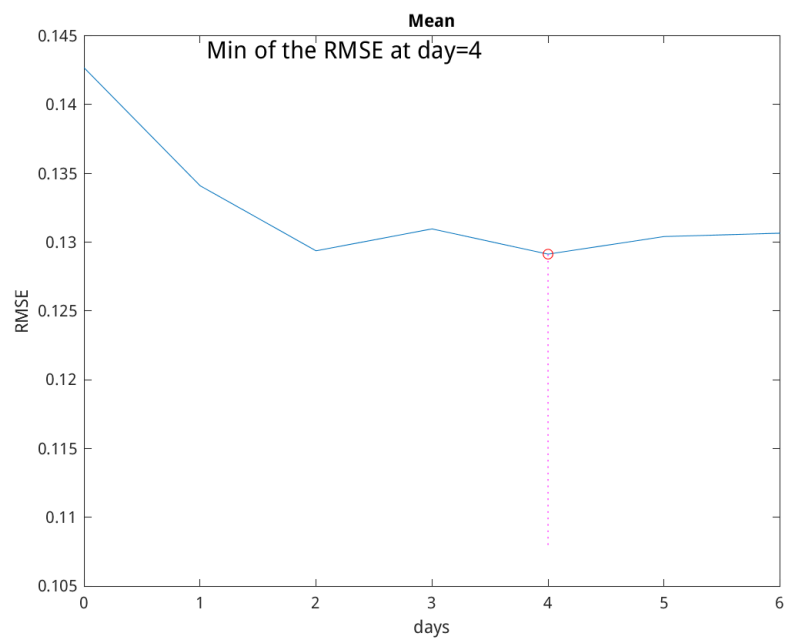
100 km



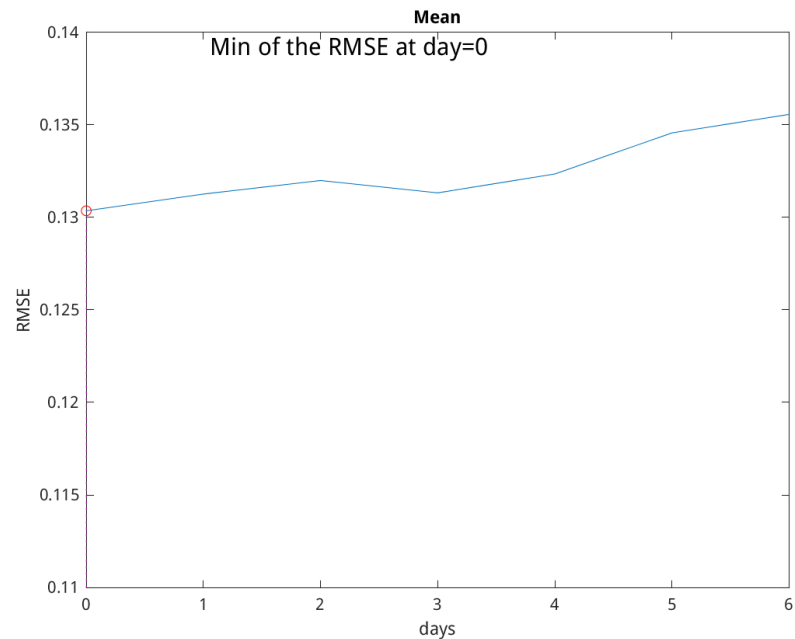
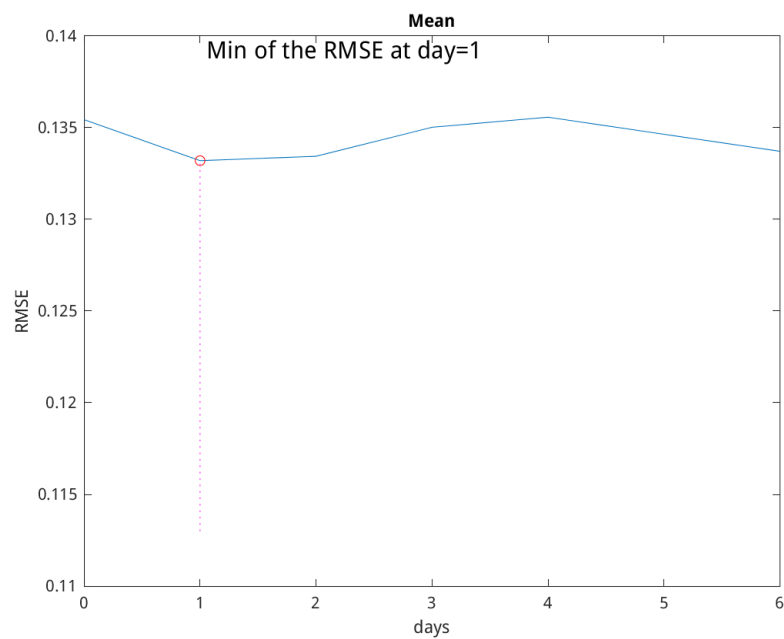
9 km



'mpi-esm 1-2' Model



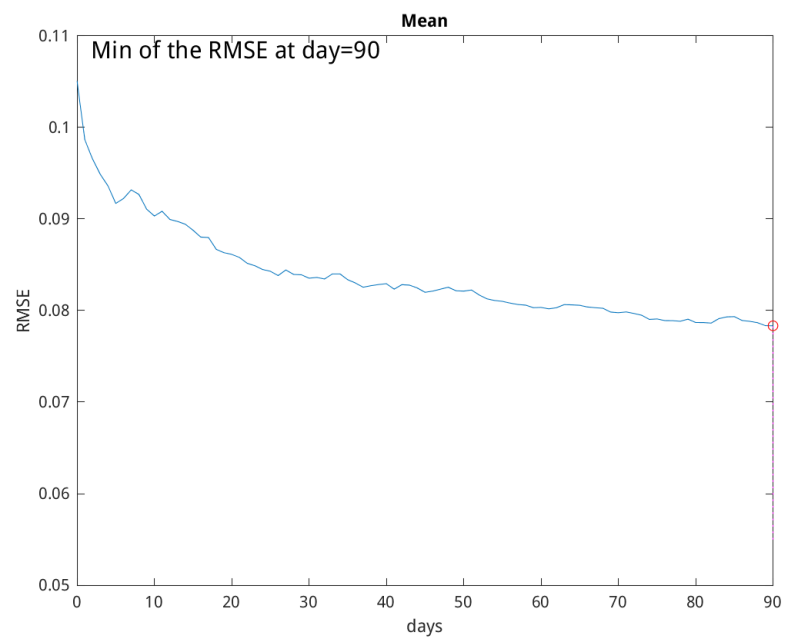
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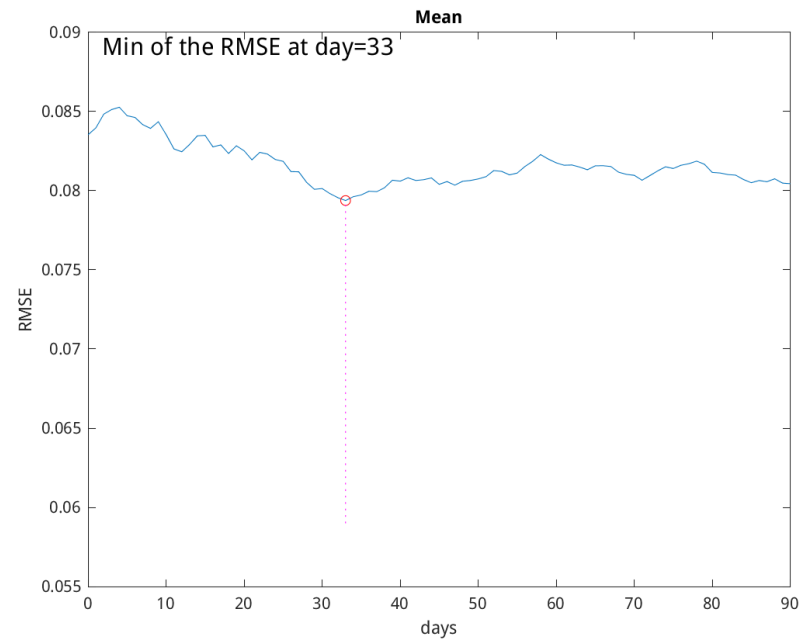
'ec-earth3-veg' Model

Fig. S3. 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.

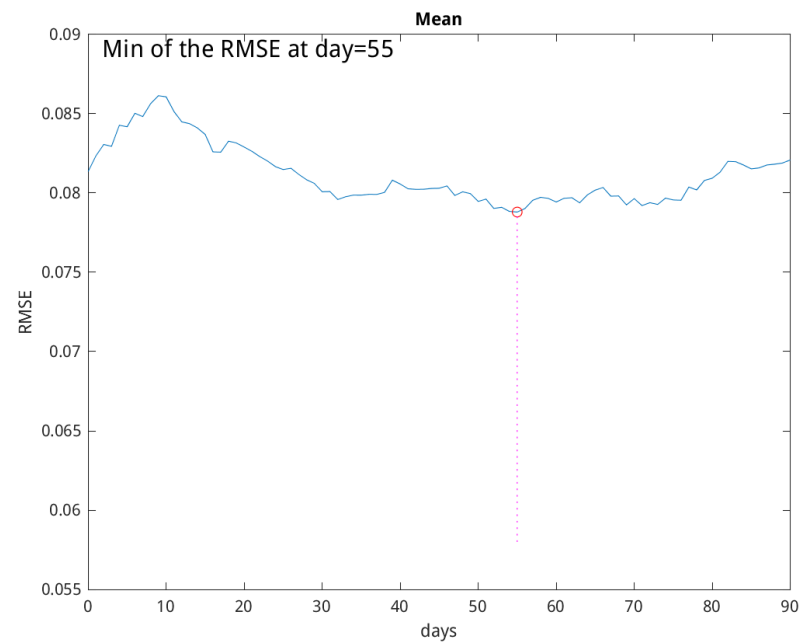
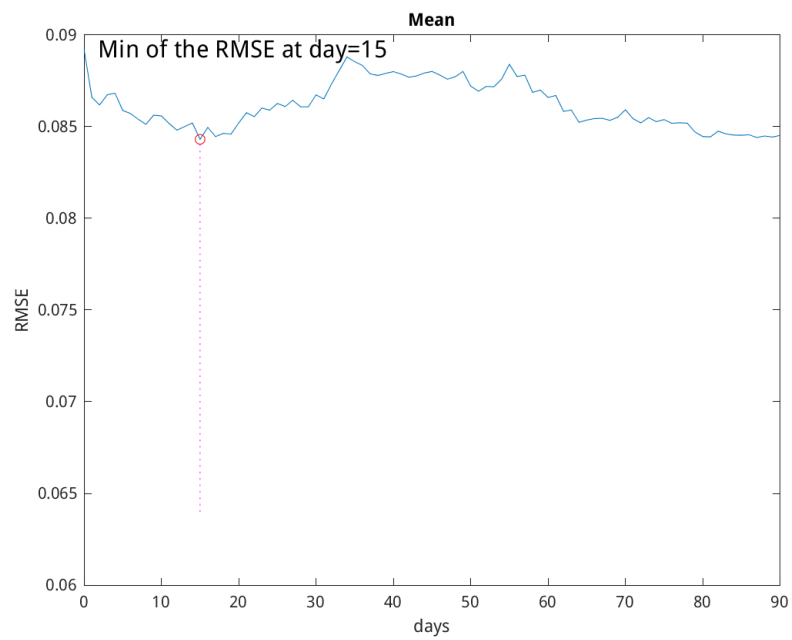
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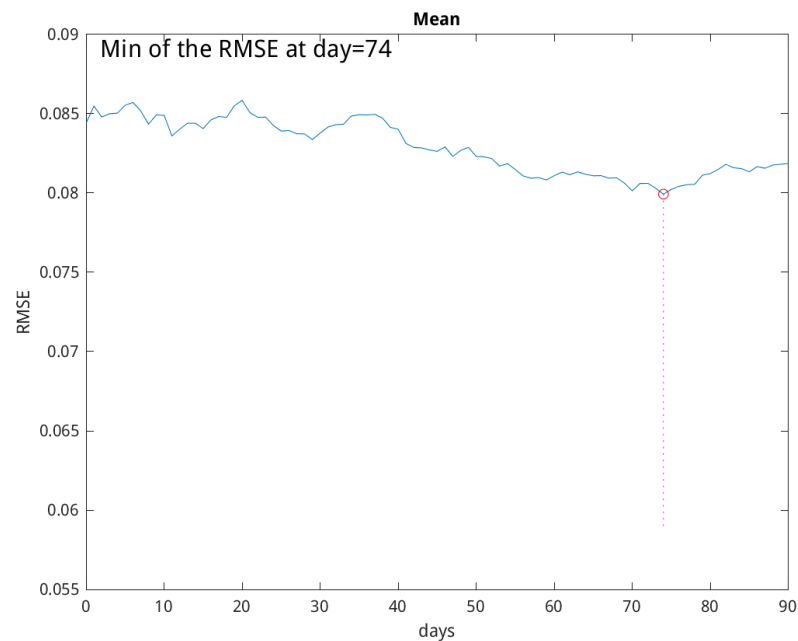
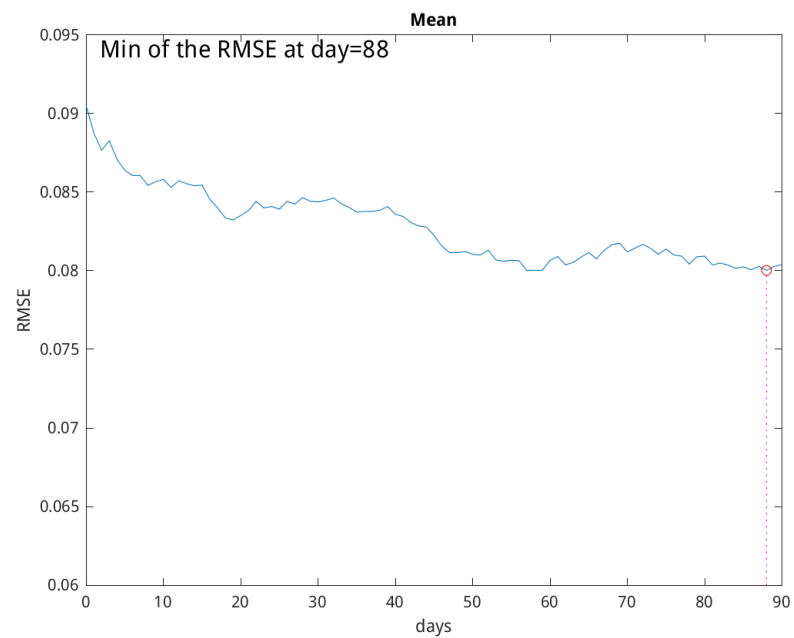
9 km



'mpi-esm 1-2' Model



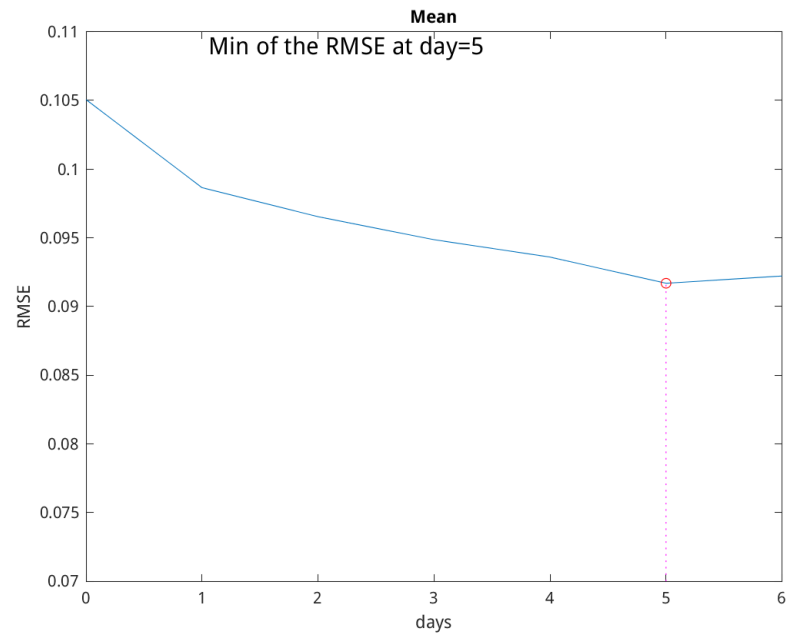
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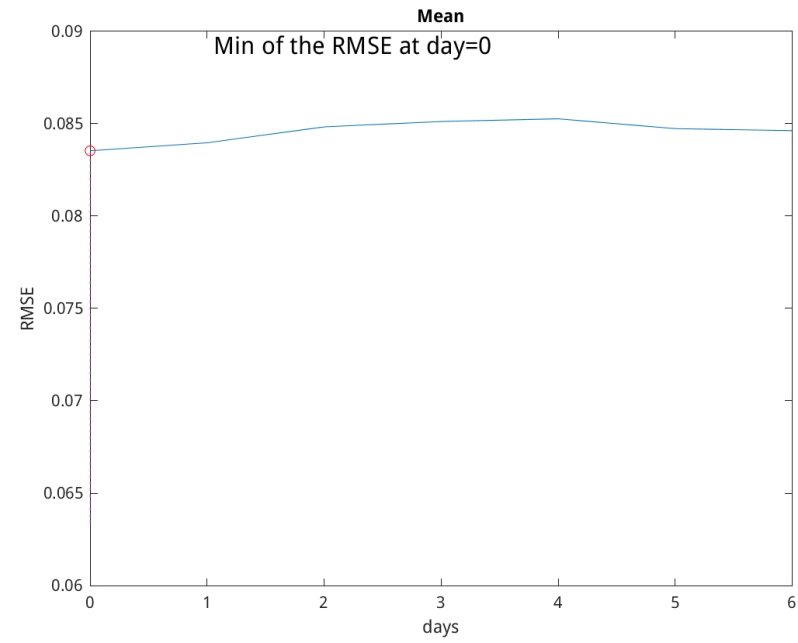
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Fig. S4. Estimation of the Far Temporal Interval (FI) for Climate Data in Colorado. The terms '9 km' and '100 km' indicate the resolution of the climate data estimators.

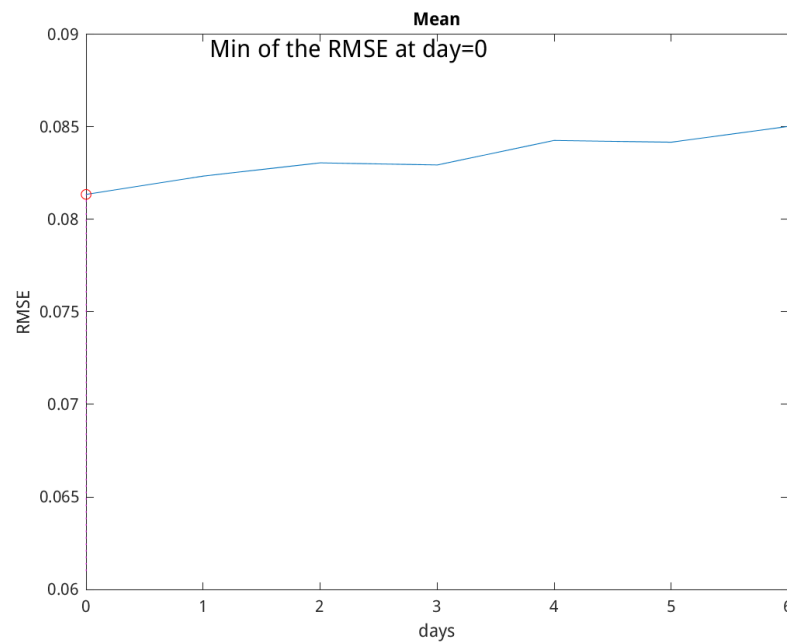
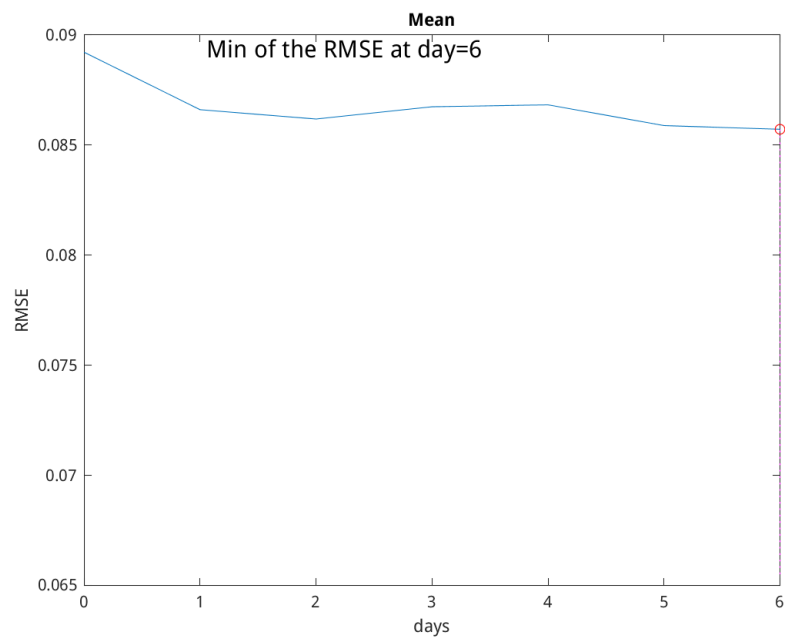
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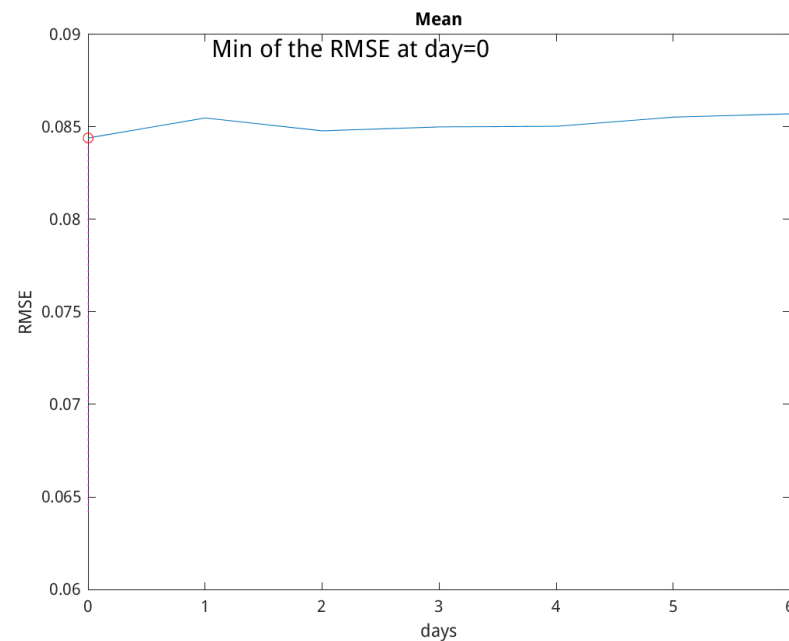
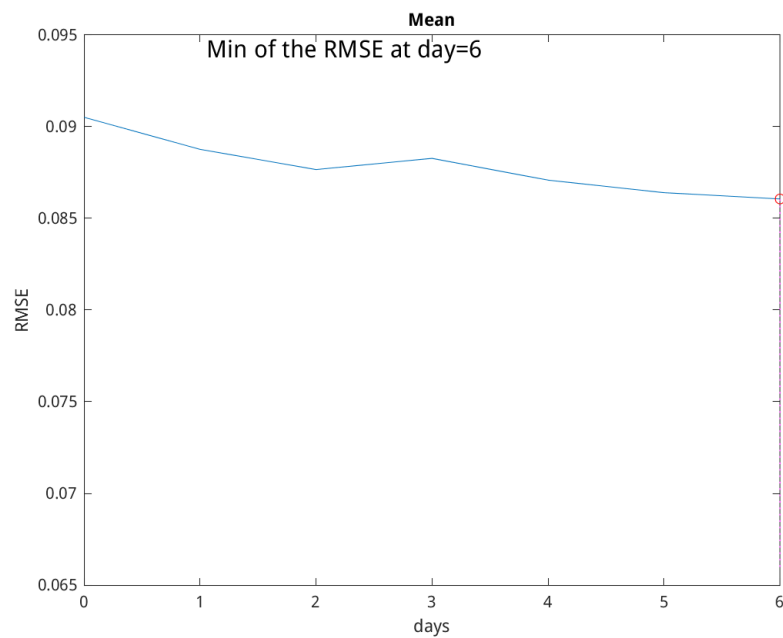
9 km



'mpi-esm 1-2' Model



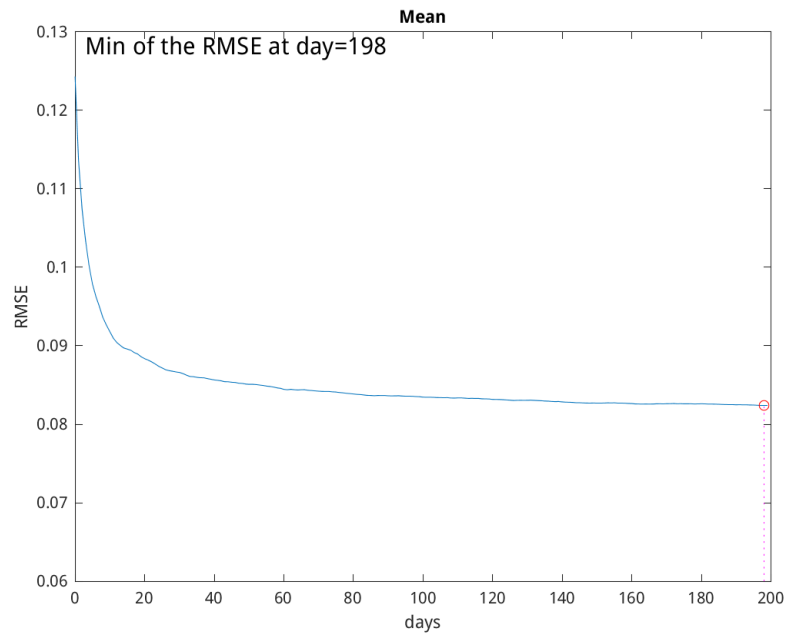
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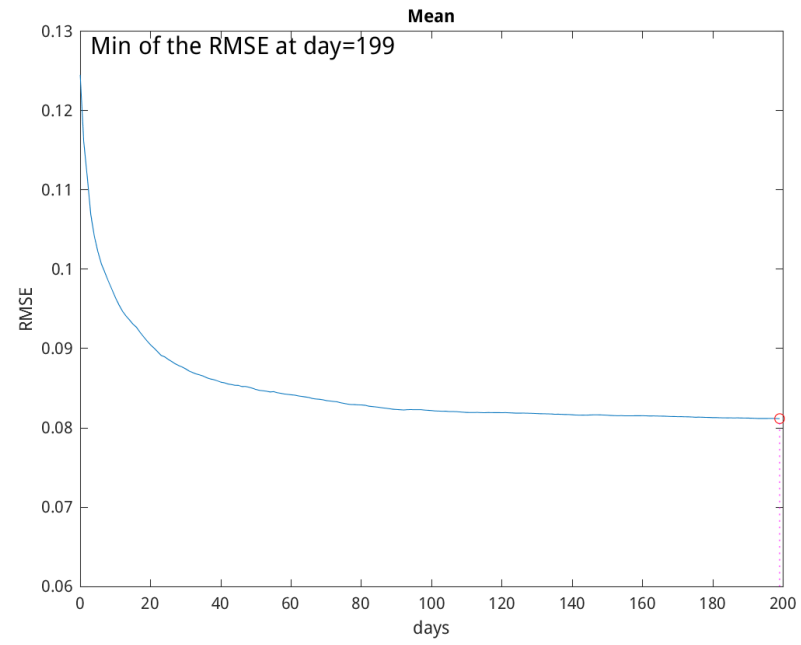
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Fig. S5. Estimation of the Near Temporal Interval (NI) for Climate Data in Colorado. The terms '9 km' and '100 km' indicate the resolution of the climate data estimators.

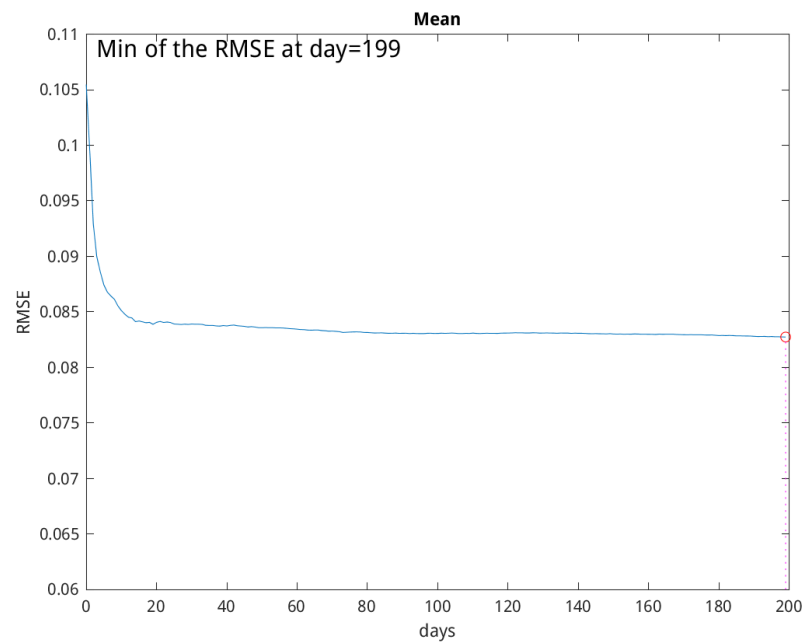
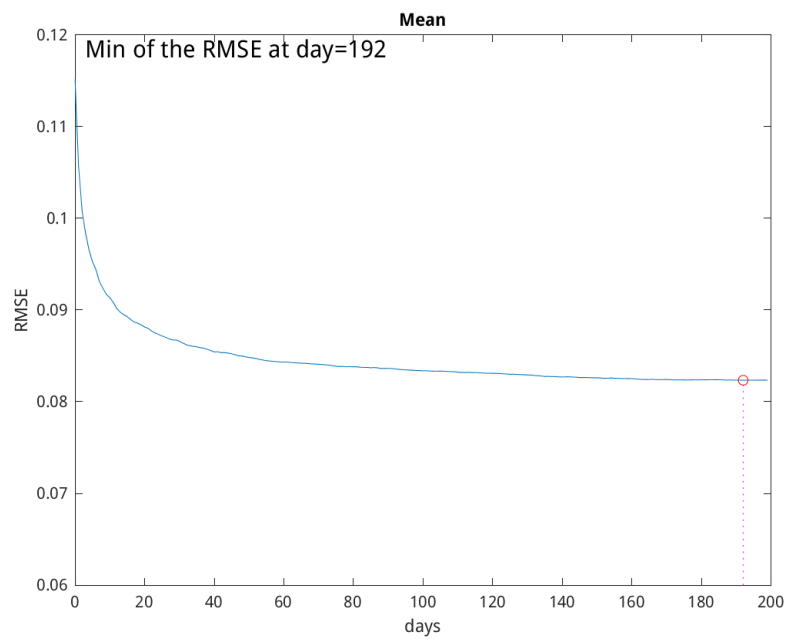
100 km



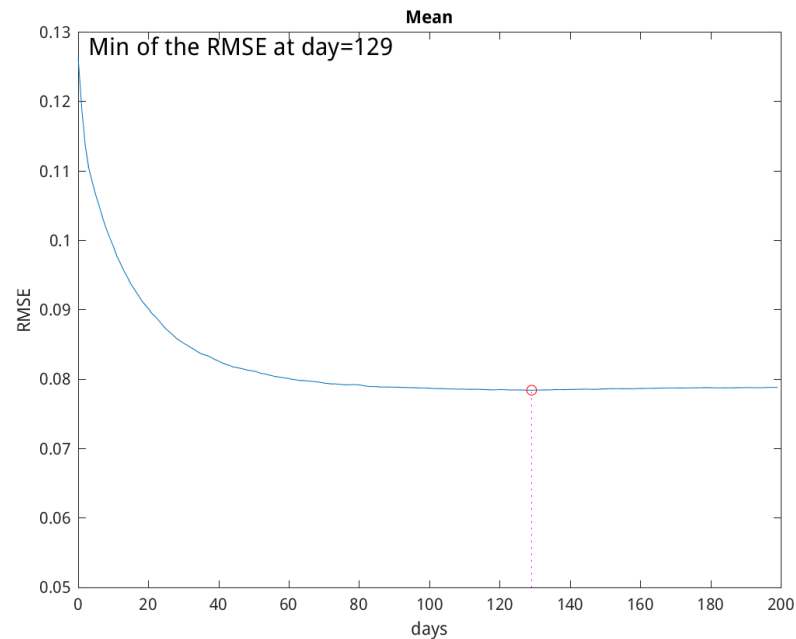
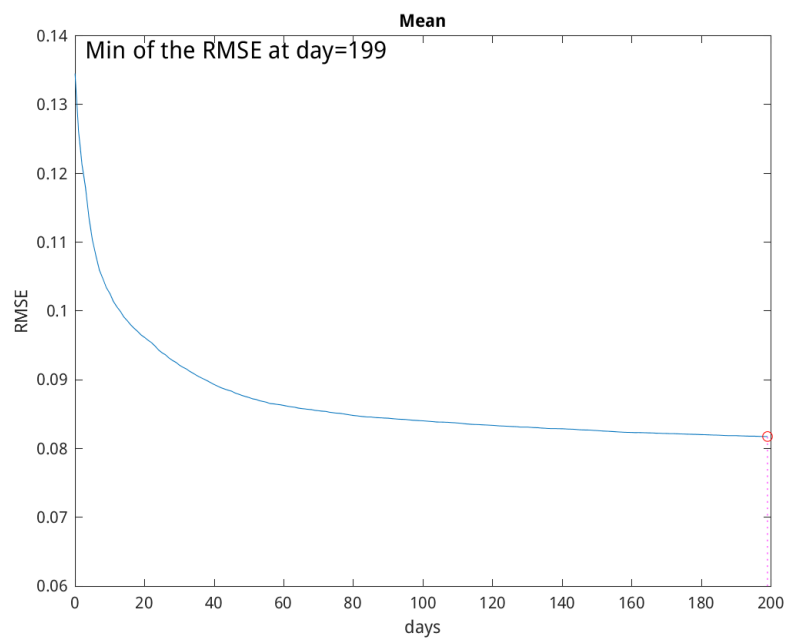
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'mpi-esm 1-2' Model



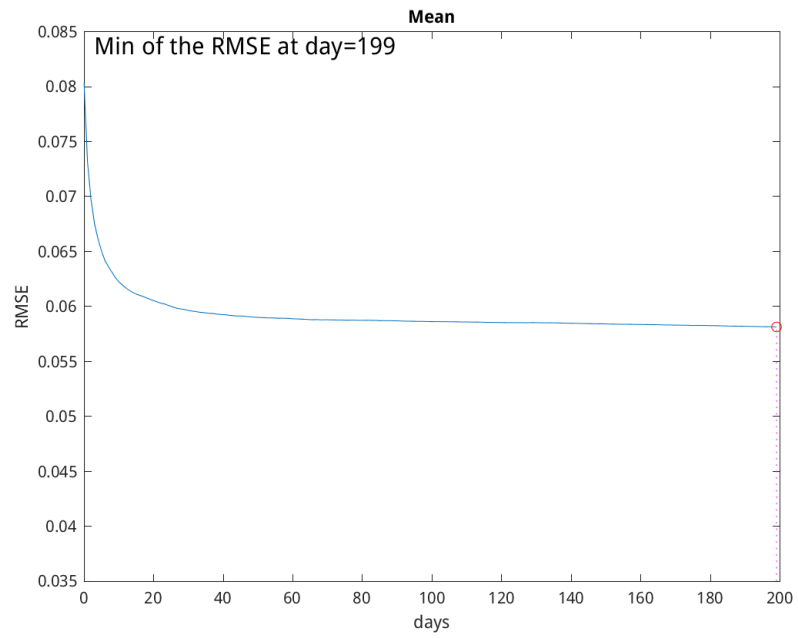
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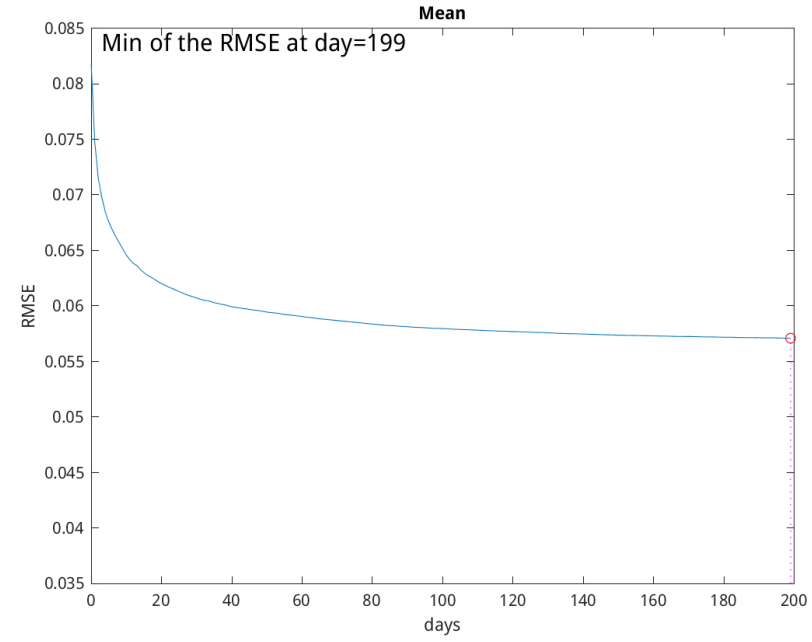
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Fig. S6. Estimating the Number of K-Nearest Observations for California. '9 km' and '100 km' denote the resolution of the climate data estimators.

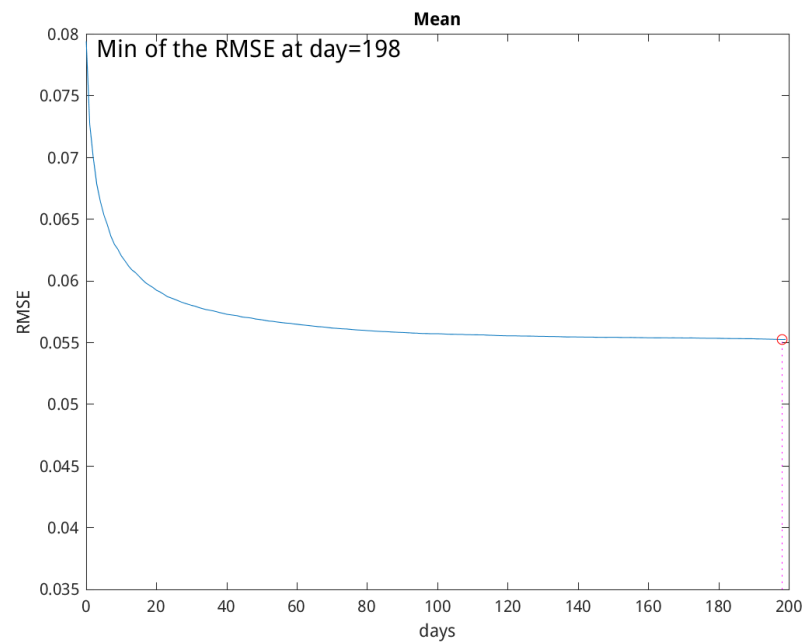
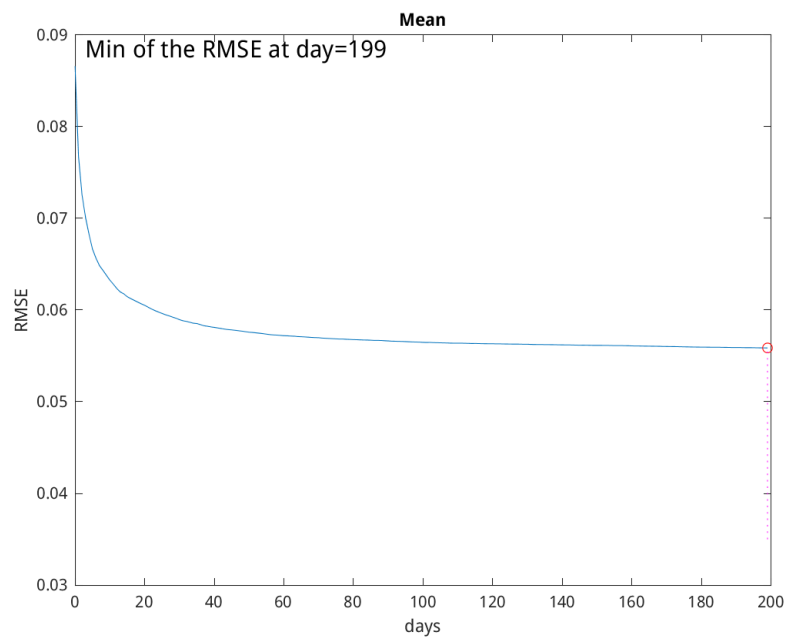
100 km



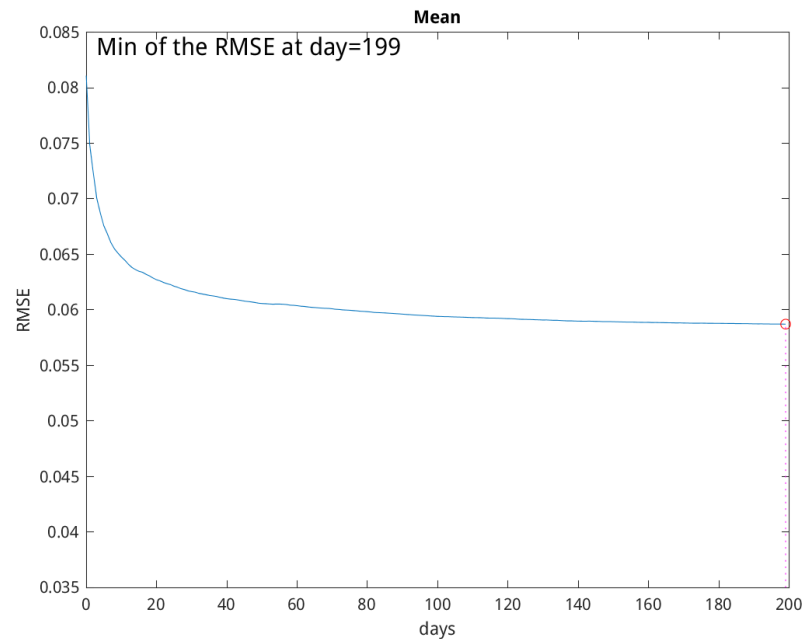
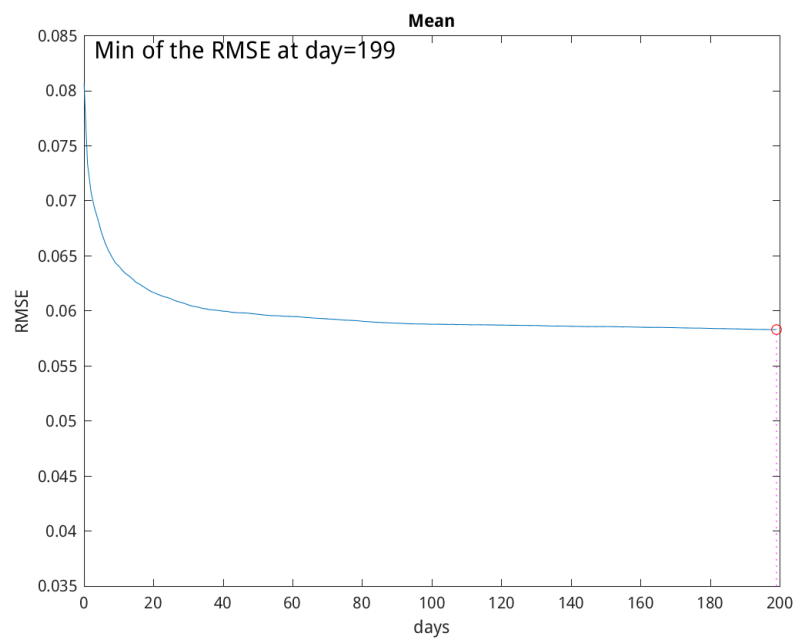
9 km



'mpi-esm 1-2' Model



'cnrm-esm 2-1' Model



'ec-earth3-veg' Model

Fig. S7. Estimating the Number of K-Nearest Observations for Colorado. '9 km' and '100 km' denote the resolution of the climate data estimators.

Table S4. 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			
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		
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	
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	
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			
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	
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	
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			
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		
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 S5. Accuracy assessment of downscaling cross-validation in Colorado: 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	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	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	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	0	0	0	0	0	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

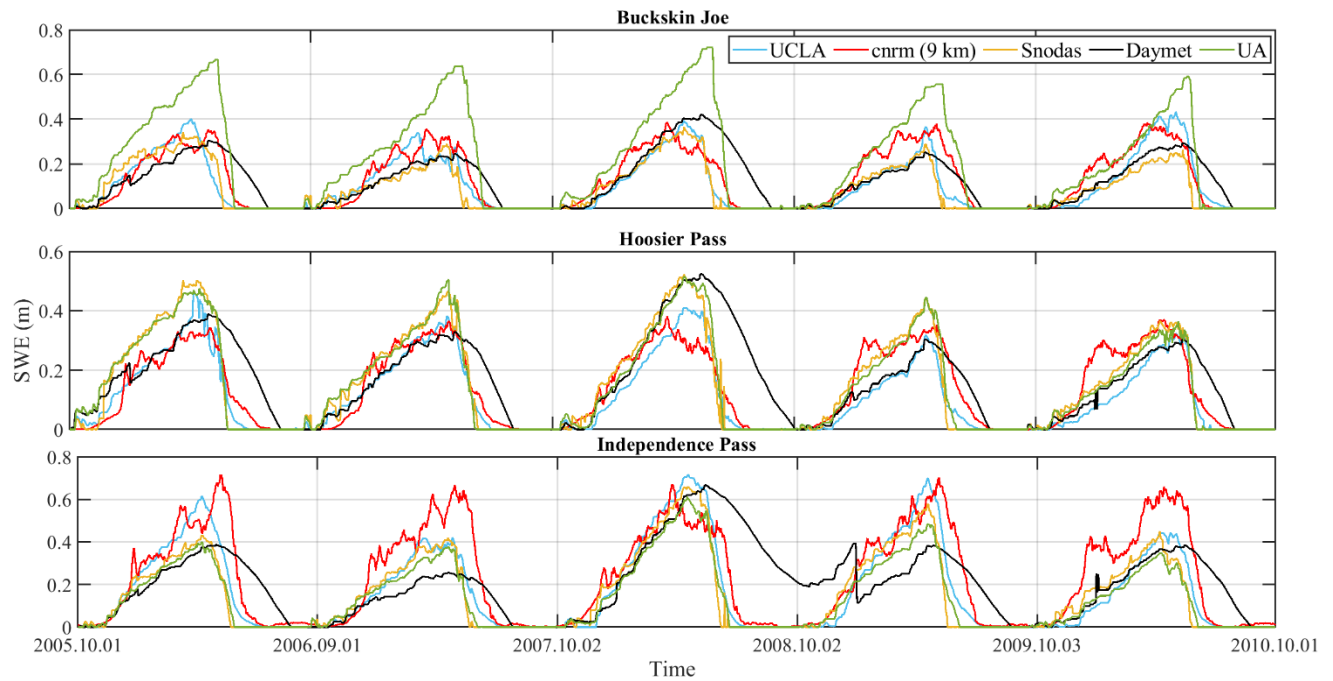


Fig. S8. The SWE time series spans a six-year period at the three highest elevations in-situ locations (Table 3) in Colorado. "UA" represents the University of Arizona SWE datasets. The downscaled SWE (SWE) results were obtained from the 'cnrm-esm2-1' climate data at a 9 km resolution.

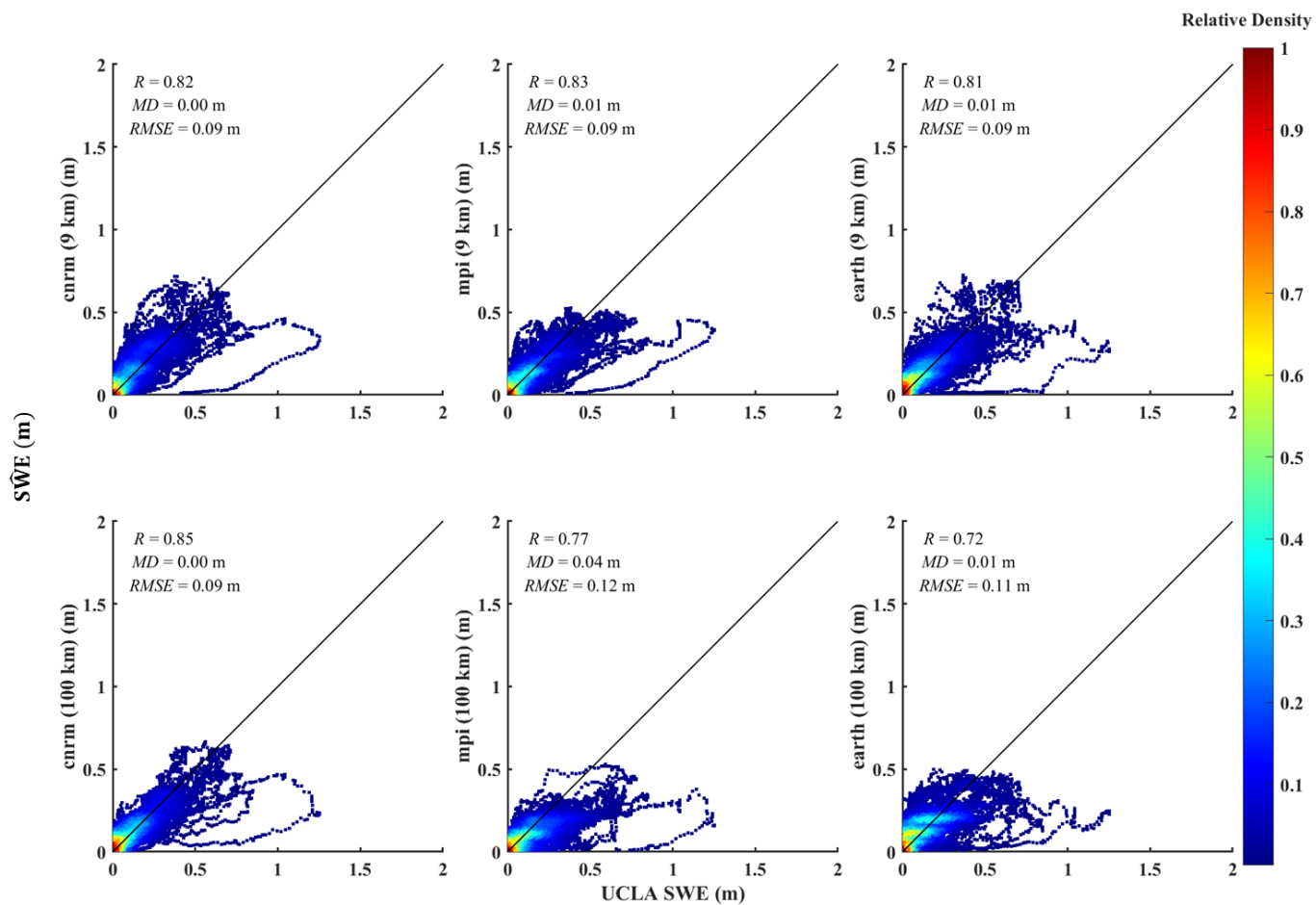


Fig. S9. A density scatter plot in Colorado from 2005 to 2010 compares in-situ data locations (Table 3) from UCLA SWE images to the downscaled SWE ($\hat{SWE}$) values. The solid black line represents the 1:1 line. The displayed metrics include the correlation coefficient (R), mean difference (MD), and Root-Mean-Squared Error ($RMSE$). Only data with SWE values greater than 10 mm are included in the comparison.

Cross validation: Colorado

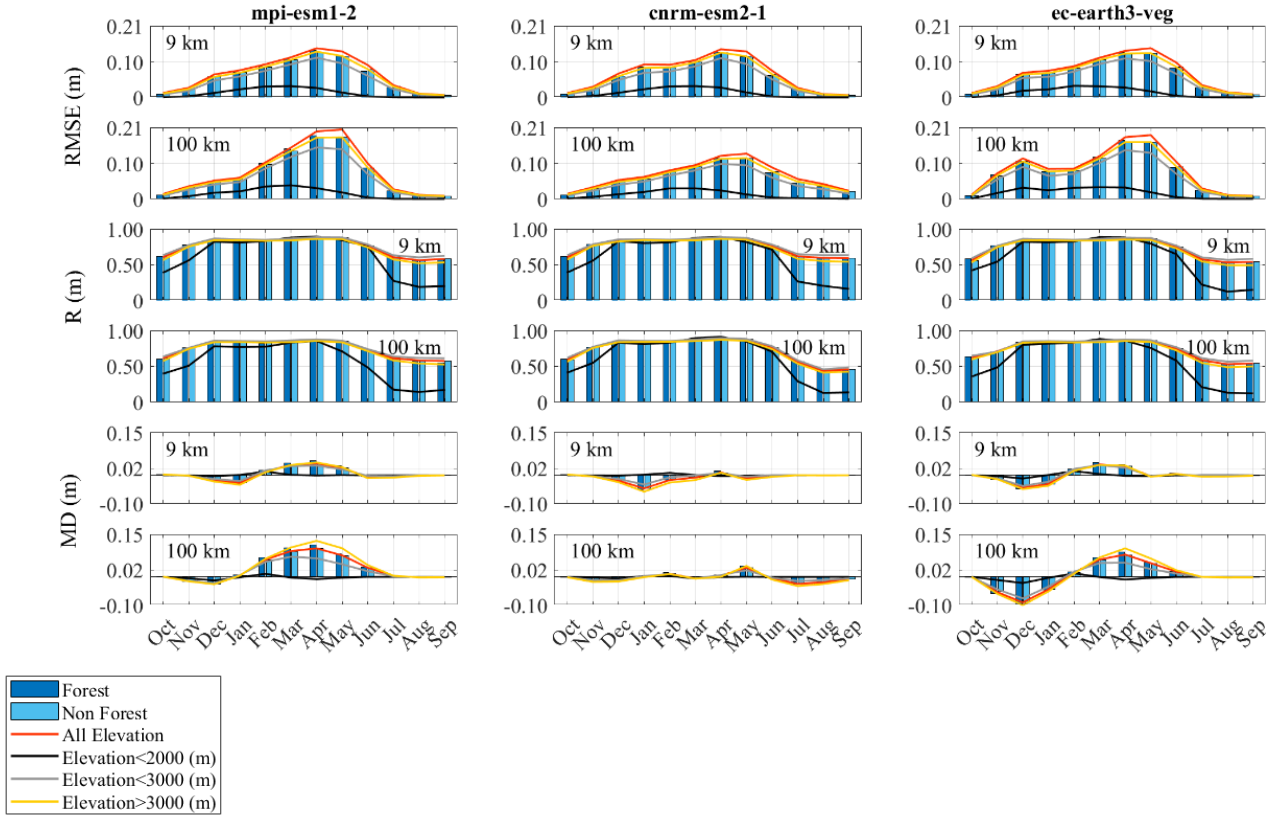


Fig. S10. Accuracy assessment of downscaling cross-validation over the six-year period from 2005 to 2010, conducted in Colorado. Column titles indicate the results for downscaled SWE (SWE) using respective climate models as estimators. '9 km' and '100 km' refer to the resolutions of the climate data. 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.

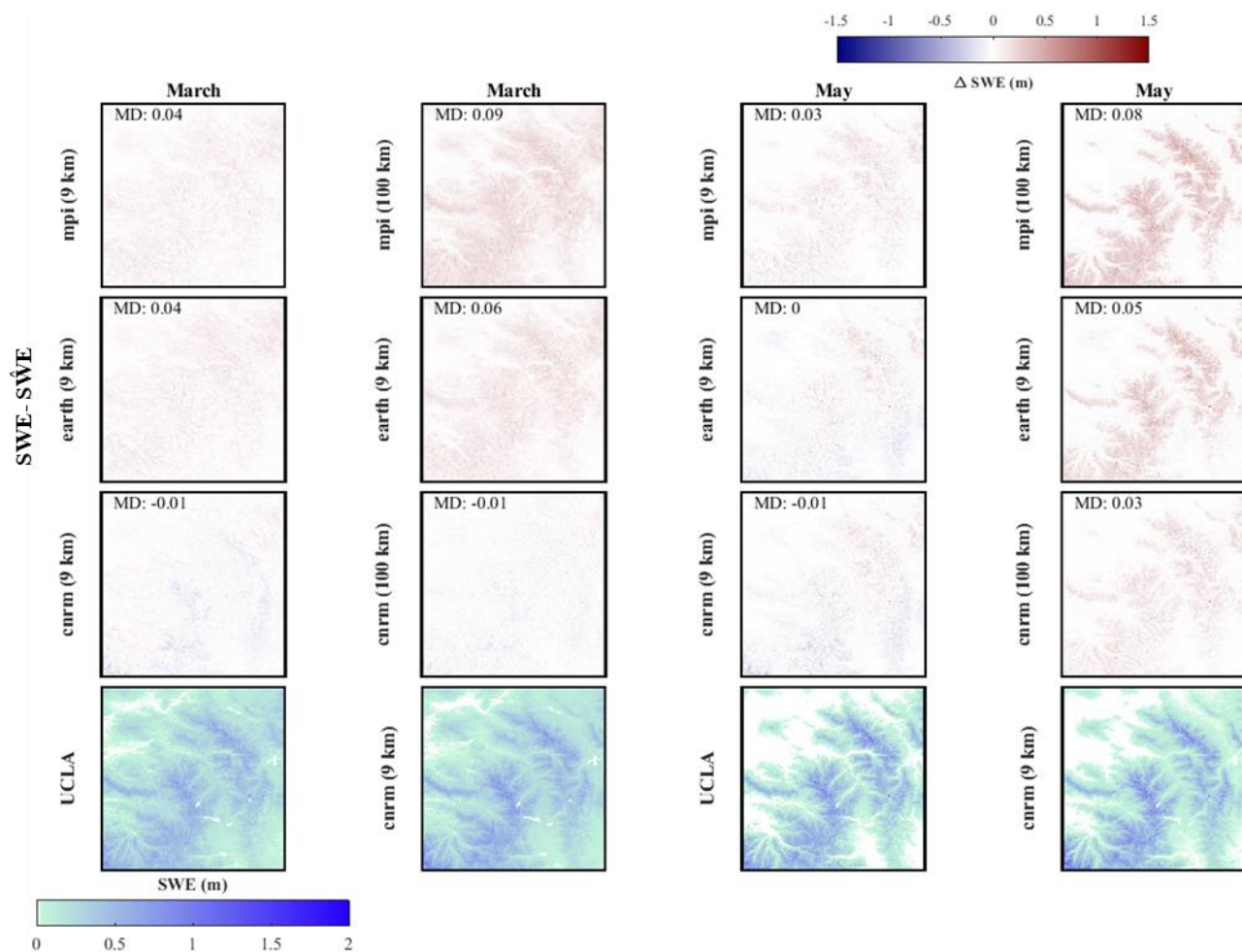


Fig. S11. Spatial assessment of the downscaling. The first three rows represent the mean difference between UCLA SWE and downscaled SWE (SWE-SWE) over Colorado throughout the 6-year testing period (2005-2010) for two different months (March and May). The last row represents the averaged reference SWE (UCLA SWE) or averaged downscaled SWE (SWE) throughout the 6-year testing period (2005-2010) for two different months (March and May). The evaluation metric includes Mean Difference (MD).

Table S6. Comparison of downscaled SWE (S $\hat{W}$ E) 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	0.00	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
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	0.01	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
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
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
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
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
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
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
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
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
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		
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
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
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

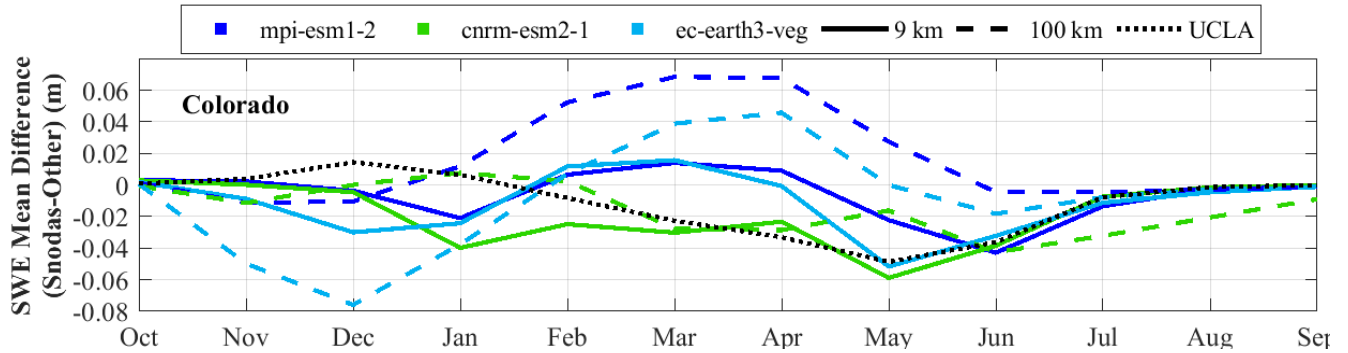


Fig. S12. The average mean difference of SWE over Colorado for the 6-year testing period (2005-2010) compares UCLA SWE (black dotted line) and downscaled SWE ($\hat{SWE}$) data (blue and green lines) against SNODAS. The $\hat{SWE}$ data, derived from different climate models, are represented by distinct colors: light blue for 'ec-earth3-veg', green for 'cnrm-esm2-1', and dark blue for 'mpi-esm1-2'. Solid lines indicate estimates at a 9 km resolution, while dashed lines correspond to a 100 km resolution, distinguishing the spatial resolutions of the climate data.

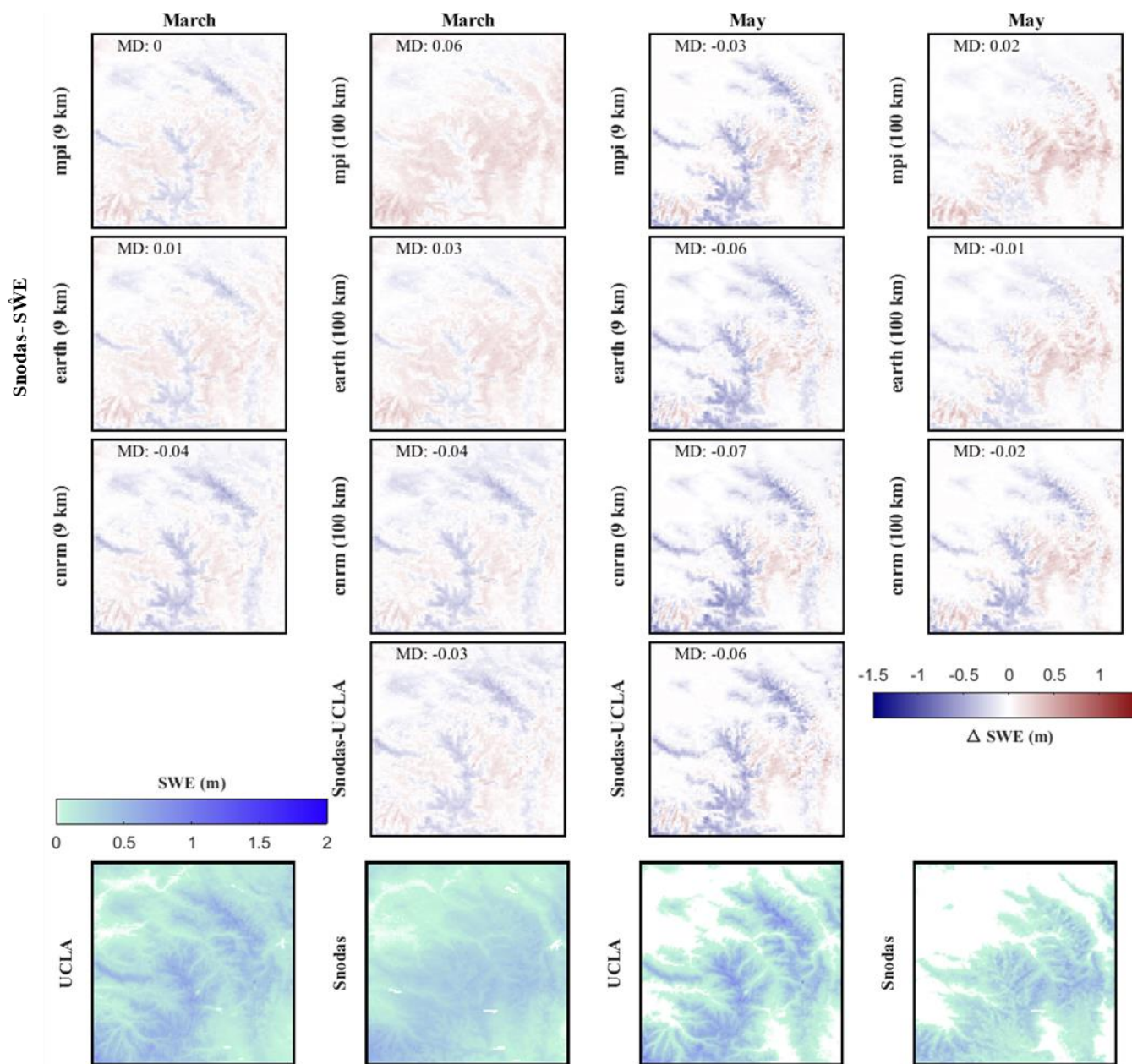


Fig. S13. Comparison with SNODAS data. The first four rows present the average difference between SNODAS and downscaled SWE (SWE) or UCLA SWE (SNODAS-SWE or SNODAS-UCLA) over Colorado for March and May during the 6-year testing period (2005-2010). The last row compares the average UCLA SWE or SNODAS SWE over Colorado for March and May during the same 6-year testing period (2005-2010). The evaluation metric includes Mean Difference (MD).

Table S7. Comparison of downscaled SWE (SWE) 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	0.04
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	0.06
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	0.09	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
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
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
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
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
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
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		
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		
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	0.03		

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	0.01	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	0.01	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

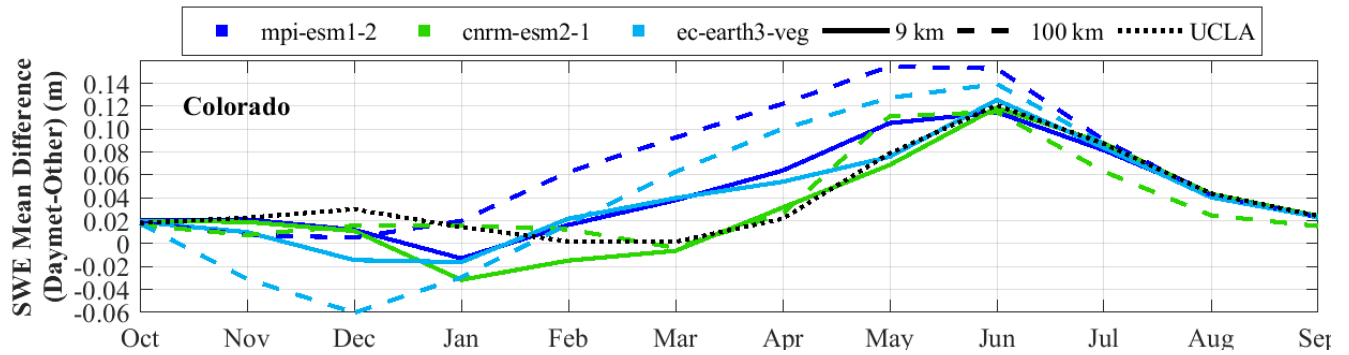


Fig. S14. Same as Fig. S12, but for comparison against the Daymet data.

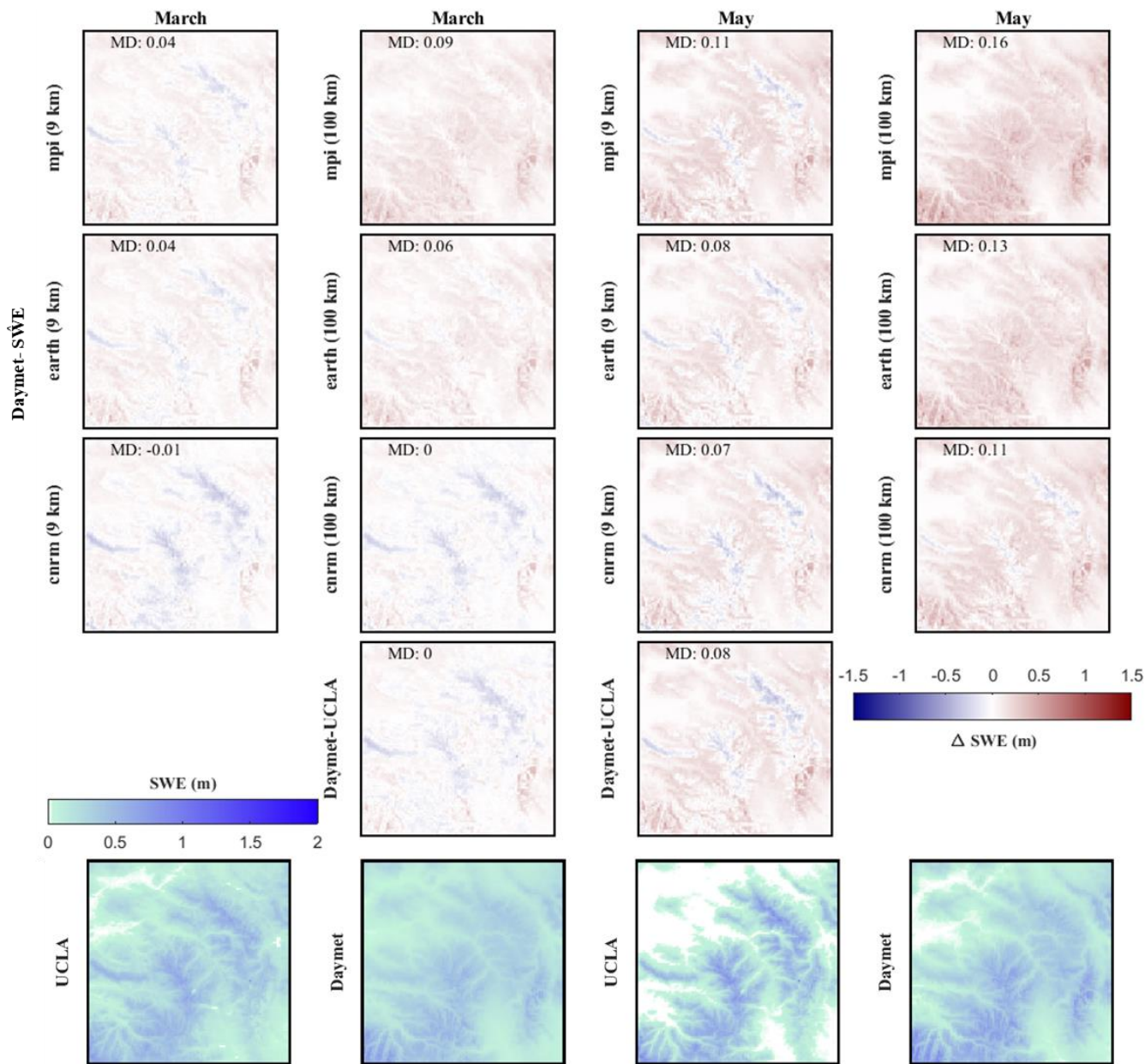


Fig. S15. Same as Fig. S13, but for comparison against the Daymet data.

Table S8. Comparison of downscaled SWE (S_{WE}) 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
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	0.00	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	0.02	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
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
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	0.01	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	0.01	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	0.01	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	0.01	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

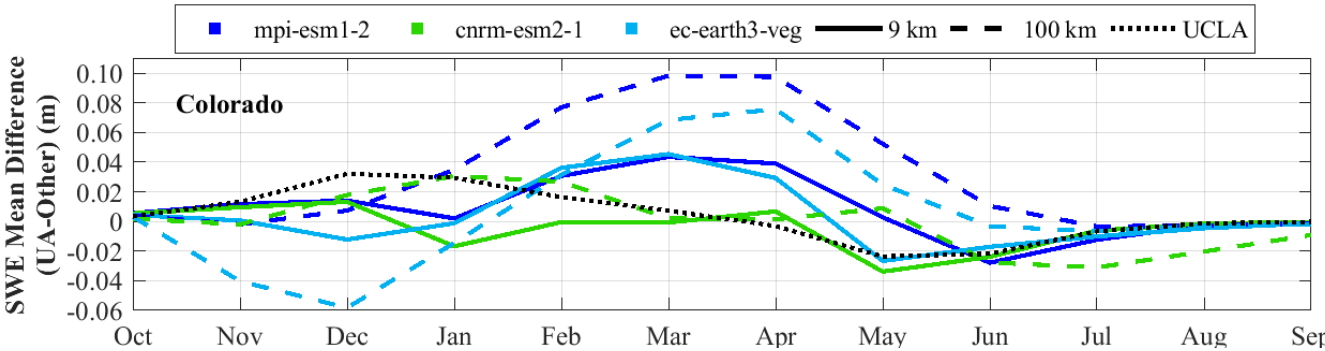


Fig. S16. Same as Fig. S12, but for comparison against the University of Arizona (UA) data.

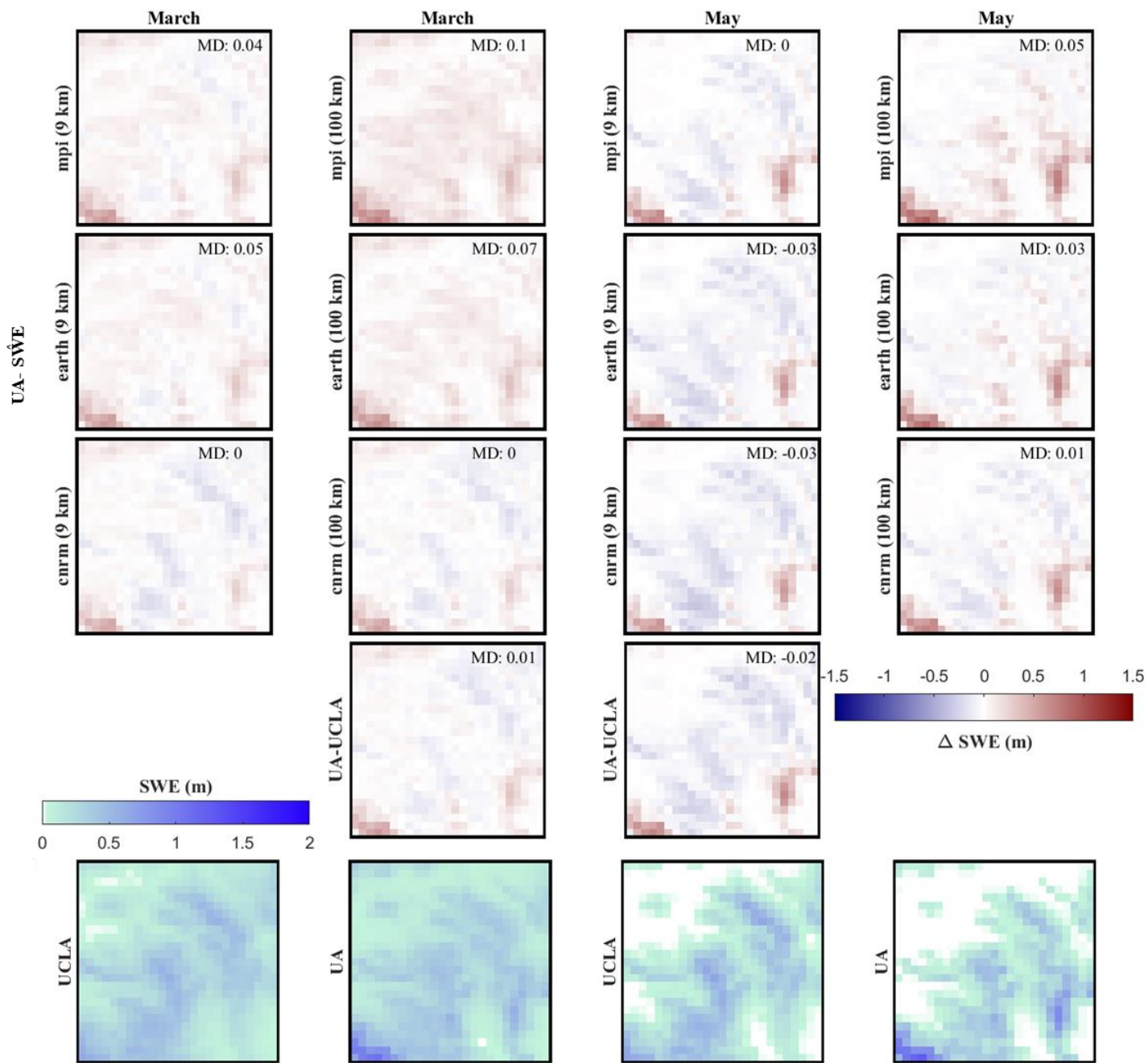


Fig. S17. Same as Fig. S13, but for comparison against the University of Arizona (UA) data.