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Quantifying the impacts of climate change on streamflow dynamics of two major rivers of Northern Lake Erie basin, Canada

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Table S1. Frequency (daily) and time series (monthly) based statistics for precipitation of observation, raw CanRCM4, and bias corrected (using four methods) CanRCM4 dataset during a period of 1980-1993 at a pixel near the outlet of Grand river basin.

Statistics	Obs	Raw	LS	LI	PT	DM
Frequency Based Statistics						
Mean (mm)	2.54	2.42	2.54	2.54	2.54	2.46
Median (mm)	0.00	0.15	0.17	0.00	0.45	0.00
Standard Deviation (mm)	5.21	6.86	7.22	7.32	5.21	5.93
Coefficient of Variation (-)	2.05	2.84	2.84	2.88	2.05	2.41
90^{th} Percentile (mm)	8.13	6.55	6.63	6.68	7.32	6.86
Probability of Wet Days (%)	48.83	79.25	79.25	48.08	79.25	48.08
Intensity of Wet Days (mm/day)	5.20	3.05	3.20	5.28	3.20	5.11
Time-Series Based Statistics						
Coefficient of Determination - R^2	-	0.08	1.00	1.00	1.00	0.99
Percentage Bias - PBIAS(%)	-	4.75	–0.08	–0.07	–0.08	3.11
Nash-Sutcliffe Efficiency—NSE	-	–0.21	1.00	1.00	1.00	0.95
Mean Absolute Error—MAE (mm)	-	13.37	0.07	0.06	0.07	2.41
LS: Linear Scaling; LOCI: Local Intensity Scaling; DM: Distribution Mapping						

Table S2. Frequency (daily) and time series (monthly) based statistics for maximum temperature of observation, raw CanRCM4, and bias corrected (using three methods) CanRCM4 dataset during a period of 1980-1993 at a pixel near the outlet of Grand river basin.

Statistics	Obs	Raw	LS	VS	DM
Frequency based					
Mean (°C)	12.54	16.07	12.62	12.62	12.62
Median (°C)	13.17	15.19	12.38	12.80	13.19
Standard Deviation (°C)	11.76	13.00	11.51	11.34	11.34
Coefficient of Variation (-)	0.94	0.81	0.91	0.90	0.90
90^{th} Percentile (°C)	27.07	33.90	28.12	27.32	27.26
10^{th} Percentile (°C)	–2.46	0.29	–1.92	–2.60	–2.29
Time Series based					
Coefficient of Determination—R^2	-	0.91	0.93	0.94	0.93
Percentage Bias—PBIAS(%)	-	–28.34	–0.73	–0.73	–0.73
Nash-Sutcliffe Efficiency—NSE	-	0.83	0.93	0.94	0.93
Mean Absolute Error—MAE (mm)	-	1.95	1.04	0.89	0.98

LS: Linear Scaling; VS: Variance Scaling; DM: Distribution Mapping

Table S3. Projected future changes in mean monthly precipitation, mean temperature, evapotranspiration and soil water storage averaged for sub-basins upstream of four stations.

Variables	Emission Scenarios/Periods	Location	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Precipitation Changes (%)	RCP4.5 Mid-century	a	–12	14	3	2	16	16	7	–27	14	0	–3	–9
		b	–9	5	11	20	22	0	17	–34	1	–8	–10	–11
		c	–9	17	8	19	15	–1	1	–32	3	4	–19	–10
		d	–6	23	12	32	23	–7	15	–36	0	–8	–14	–9
	RCP8.5 Mid-century	a	–13	-2	14	14	21	–24	–6	30	–10	19	6	–17
		b	–7	-6	20	23	36	–14	–14	0	–23	18	–1	–20
		c	–3	3	15	24	55	–12	–14	–14	–24	28	–5	–16
		d	1	9	23	34	63	–18	–13	–21	–25	18	–2	–19
	RCP4.5 End-century	a	–12	21	24	11	-8	54	–37	30	–14	25	8	2
		b	–7	16	31	34	27	40	–34	4	–26	29	1	–4
		c	–3	21	16	34	26	7	–37	–15	–23	37	–1	0
		d	1	31	26	45	54	0	–28	–13	–29	29	0	-1
	RCP8.5 End-century	a	4	37	12	8	–35	3	2	–20	12	21	0	8
		b	4	26	17	33	–25	13	–17	–30	-2	19	–10	6
		c	3	24	9	33	–13	13	–17	–34	-2	24	–16	8
		d	6	42	14	50	–10	14	–21	–36	–1	20	–11	9
Average Temperature Changes (°C)	RCP4.5 Mid-century	a	4.5	7.0	6.9	7.2	4.9	2.4	2.4	–0.1	–2.1	0.2	0.1	0.0
		b	4.5	6.5	6.1	6.8	4.5	2.2	2.2	–0.3	-2.2	0.0	–0.2	–0.3
		c	4.4	6.0	5.6	6.6	4.3	2.1	2.2	–0.4	–2.3	–0.1	–0.3	–0.3
		d	4.5	6.0	5.6	6.8	4.4	2.2	2.5	-0.1	–2.1	0.0	–0.2	–0.2
	RCP8.5 Mid-century	a	4.7	6.2	7.5	7.3	5.6	3.5	3.0	0.1	–0.6	–0.6	1.0	1.1

		b	4.5	5.5	6.8	6.9	5.2	3.3	2.8	0.0	–0.7	–0.7	0.7	0.6
		c	4.5	5.0	6.3	6.7	5.0	3.2	2.7	–0.1	–0.8	–0.9	0.5	0.5
		d	4.6	4.9	6.3	6.8	5.1	3.3	3.0	0.1	–0.7	–0.8	0.6	0.7
	RCP4.5 End-century	a	7.1	9.3	10.8	10.2	6.3	3.1	2.4	–1.1	–2.7	–1.5	–0.5	0.4
		b	6.8	8.5	10.1	9.7	6.0	2.9	2.3	–1.2	–2.9	–1.8	–0.8	0.3
		c	6.6	7.9	9.5	9.5	5.7	2.7	2.5	–1.3	–3.0	–2.0	–0.9	0.2
		d	6.7	7.9	9.5	9.6	5.8	2.8	2.8	–1.0	–2.8	–1.9	–0.8	0.2
	RCP8.5 End-century	a	8.1	9.6	13.7	14.0	9.2	6.6	5.6	1.9	0.5	–0.1	0.3	5.8
		b	7.7	8.7	13.1	13.3	8.9	6.3	5.4	1.7	0.3	–0.3	–0.1	5.5
		c	7.5	8.1	12.6	13.1	8.6	6.1	5.3	1.5	0.2	–0.4	–0.3	5.4
		d	7.7	8.0	12.5	13.2	8.5	6.1	5.6	1.8	0.3	-0.3	–0.2	5.5
ET Changes (%)	RCP4.5 Mid-century	a	255	254	113	48	29	9	10	2	–7	6	23	26
		b	200	202	89	46	36	12	3	–16	–16	–1	23	20
		c	152	177	71	43	40	10	–2	–25	-18	–2	25	16
		d	169	175	75	45	39	9	–8	–26	–18	–1	24	12
	RCP8.5 Mid-century	a	234	253	115	45	37	11	9	7	9	3	35	53
		b	197	198	84	44	42	12	–2	–12	–4	–5	37	40
		c	154	171	67	42	41	12	–6	–25	–13	–9	30	33
		d	162	161	72	43	43	6	-10	-23	–10	–10	28	25
	RCP4.5 End-century	a	394	338	145	66	43	11	10	–4	2	–2	16	35
		b	301	247	107	62	49	13	–5	–27	–12	–7	21	33
		c	224	218	84	64	52	8	–19	–41	–20	–8	18	26
		d	235	213	91	64	52	4	–25	–41	–20	–11	13	18
	RCP8.5 End-century	a	416	377	175	83	50	7	4	–23	–20	–11	18	102

		b	314	274	130	82	58	2	–11	–42	–30	–15	18	79
		c	234	233	104	80	66	0	–18	–52	–31	–14	15	61
		d	263	240	110	80	59	–6	–20	–52	–29	–14	12	66
Soil Water Changes (%)	RCP4.5 Mid-century	a	–11	–22	–15	–3	–12	–10	–18	–31	–13	–8	–6	–6
		b	–17	–26	–13	-1	–12	–22	–22	–37	–14	–9	–11	–7
		c	–18	–25	–10	2	–11	–32	–26	–34	–10	–5	–9	–4
		d	–17	–26	–13	0	–16	–39	–33	–37	–4	3	–5	–1
	RCP8.5 Mid-century	a	–11	–15	–16	0	–9	–26	–40	–24	–18	–6	–5	–9
		b	–18	–22	–15	0	–13	–32	–44	–28	–25	–5	–7	–13
		c	–19	–23	–11	2	–12	–34	–46	–34	–28	0	–3	–12
		d	–16	–23	–14	0	–20	–41	–46	–26	–21	8	–1	–9
	RCP4.5 End-century	a	–18	–25	–17	–2	–19	–11	–40	–9	–14	–2	–4	–3
		b	–23	–29	–17	–1	–22	–19	–50	–18	–22	1	–6	–8
		c	–25	–29	–14	2	–23	–35	–55	–22	–23	8	–3	–6
		d	–25	–30	–18	1	–31	–40	–60	–23	–18	12	–1	–2
	RCP8.5 End-century	a	–18	–25	–20	–9	–37	–37	–41	–32	–13	–7	–8	–13
		b	–23	–29	–20	–12	–51	–46	–50	–31	–9	0	–8	–14
		c	–25	–28	–18	–11	–52	–47	–48	–21	0	9	–7	–13
		d	–25	–30	–22	–14	–59	–51	–47	–15	6	11	–5	–13

a: u/s of Grand river near Marsville; b: u/s of Grand river at Brantford; c: u/s of Thames river at Ingersoll; d: u/s of Thames river at Thamesville

Table S4. Projected future changes in mean monthly streamflow at four stations.

Streamflow Gauging station	Emission Scenarios/Periods	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Grand river near Marsville	RCP4.5 Mid-century	42	83	–47	–63	43	28	170	–38	–20	–10	–17	–19
	RCP8.5 Mid-century	8	20	–39	–60	30	12	72	119	–63	-3	-6	9

	RCP4.5 End-century	70	71	–48	–72	–17	110	120	–23	–4	14	19	30
	RCP8.5 End-century	104	73	–51	–72	–60	–77	20	–57	–45	71	20	26
Grand river at Brantford	RCP4.5 Mid-century	–5	73	–37	–47	4	–17	37	–38	–33	–37	–29	–30
	RCP8.5 Mid-century	–19	15	–28	–47	20	–18	–43	–44	–64	–27	–22	–14
	RCP4.5 End-century	10	61	–30	–52	25	31	–6	–23	–43	–14	7	13
	RCP8.5 End-century	36	62	-40	–53	–31	–49	–51	–68	–51	16	4	0
Thames river at Ingersoll	RCP4.5 Mid-century	–24	11	–42	–27	41	11	10	–27	–28	–56	–56	–41
	RCP8.5 Mid-century	–33	–23	–37	–24	140	1	–11	–41	–60	–60	–51	–36
	RCP4.5 End-century	–18	–2	–36	–32	144	34	5	–22	–48	–39	–31	–7
	RCP8.5 End-century	3	6	–43	–26	33	–15	–33	–47	–47	–10	–22	–16
Thames river at Thamesville	RCP4.5 Mid-century	–6	24	–42	-43	17	–1	0	–50	–17	–15	–21	–21
	RCP8.5 Mid-century	–6	7	–37	–41	115	–3	–22	–53	–61	–4	–3	–12
	RCP4.5 End-century	6	16	–42	–50	55	1	–30	–37	–40	16	14	17
	RCP8.5 End-century	23	12	–49	–49	–12	–38	–42	–59	–20	56	7	7

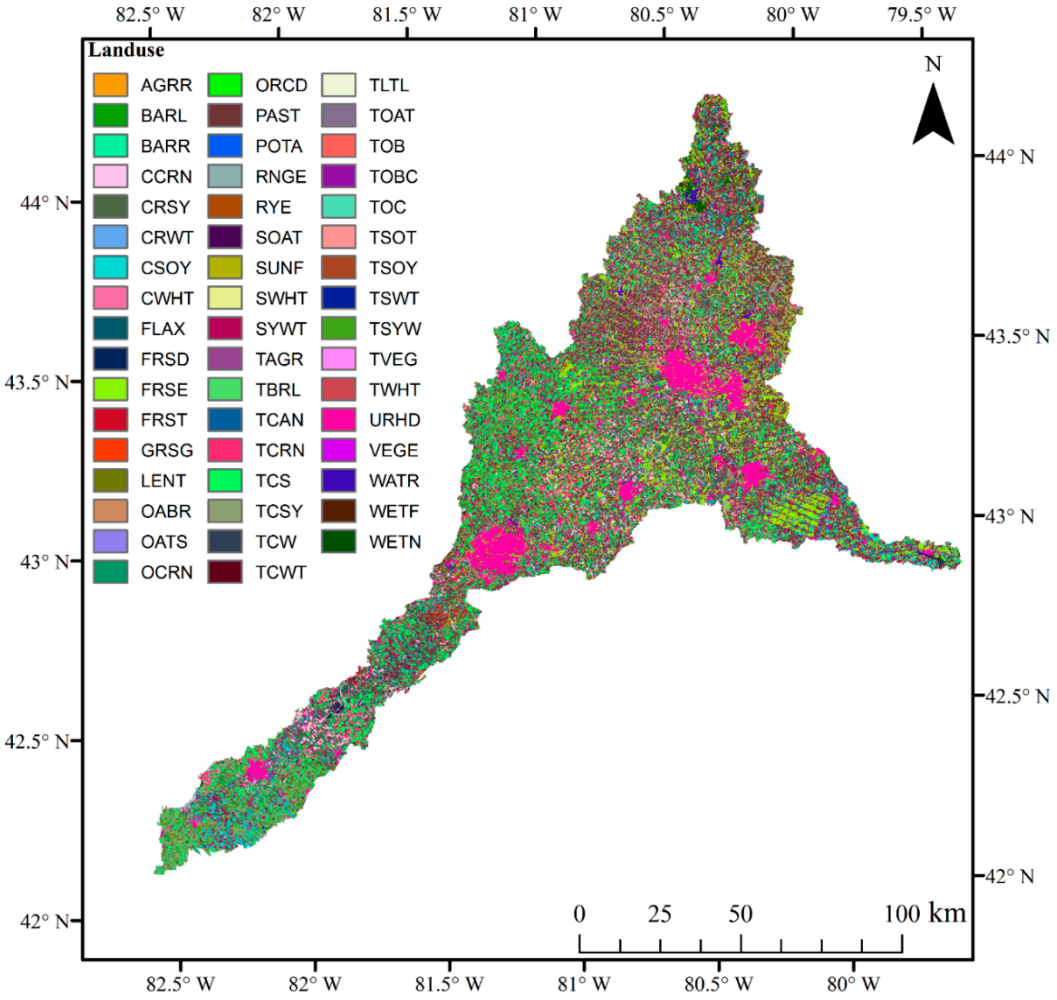

Figure S1. Land use map of the study area. Land use names are presented as in SWAT database.

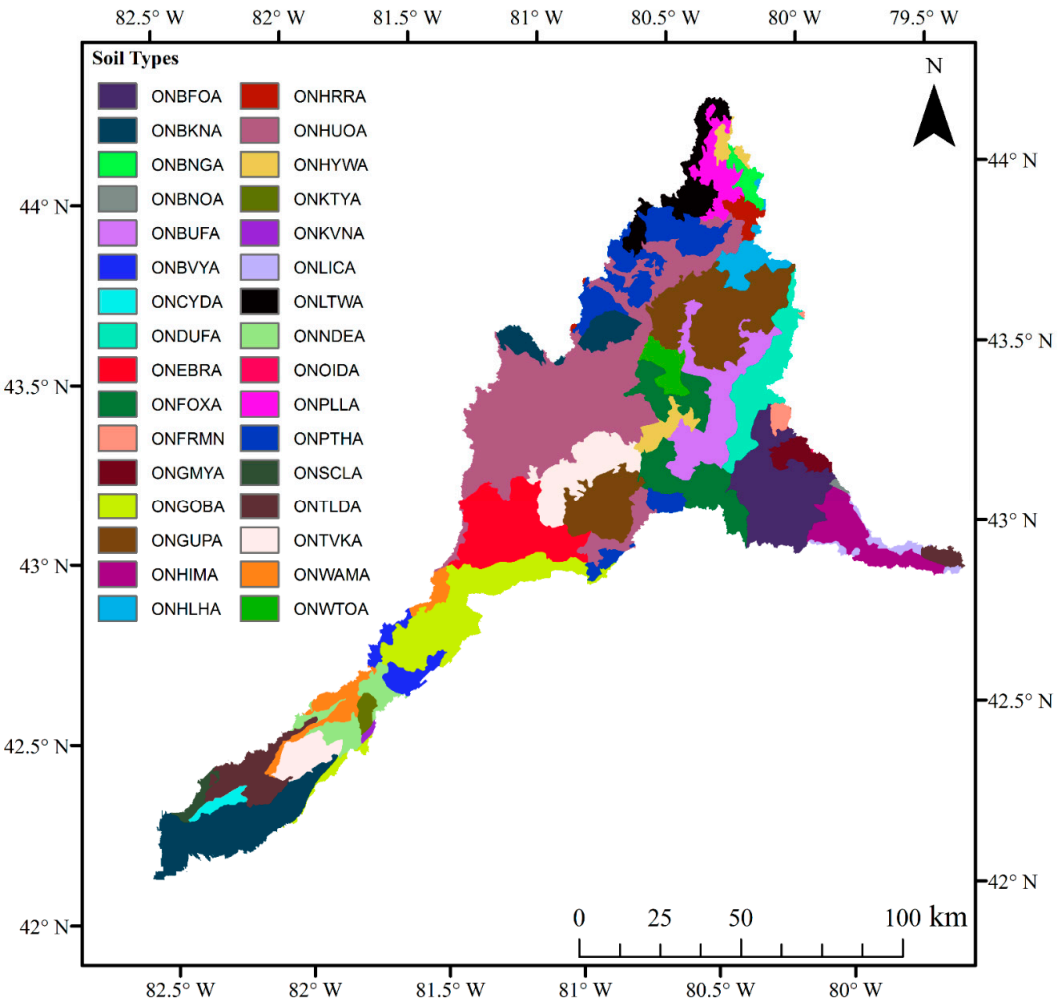

Figure S2. Different soil types in the study area. Soil names are presented as in Ontario Ministry of Agriculture, Food and Rural Affairs.

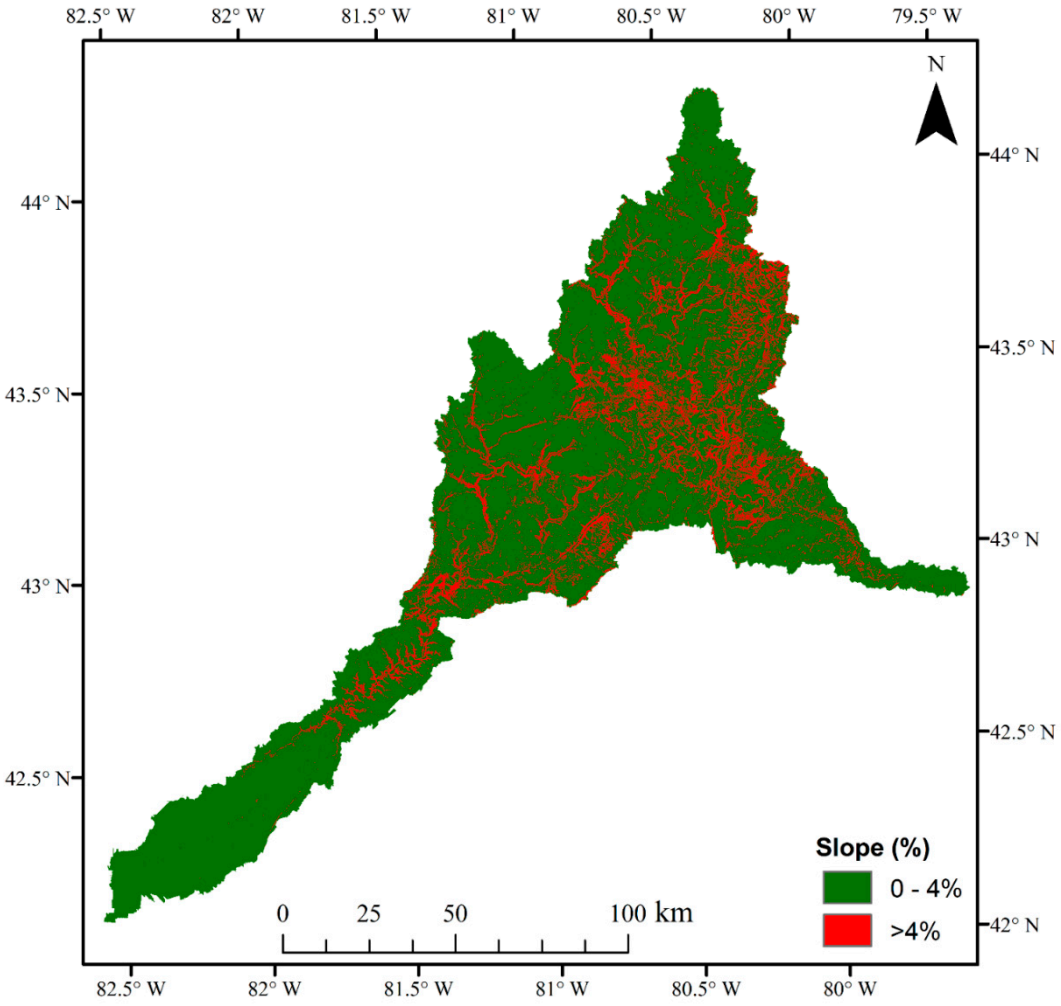

Figure S3. The slope map of the study area.

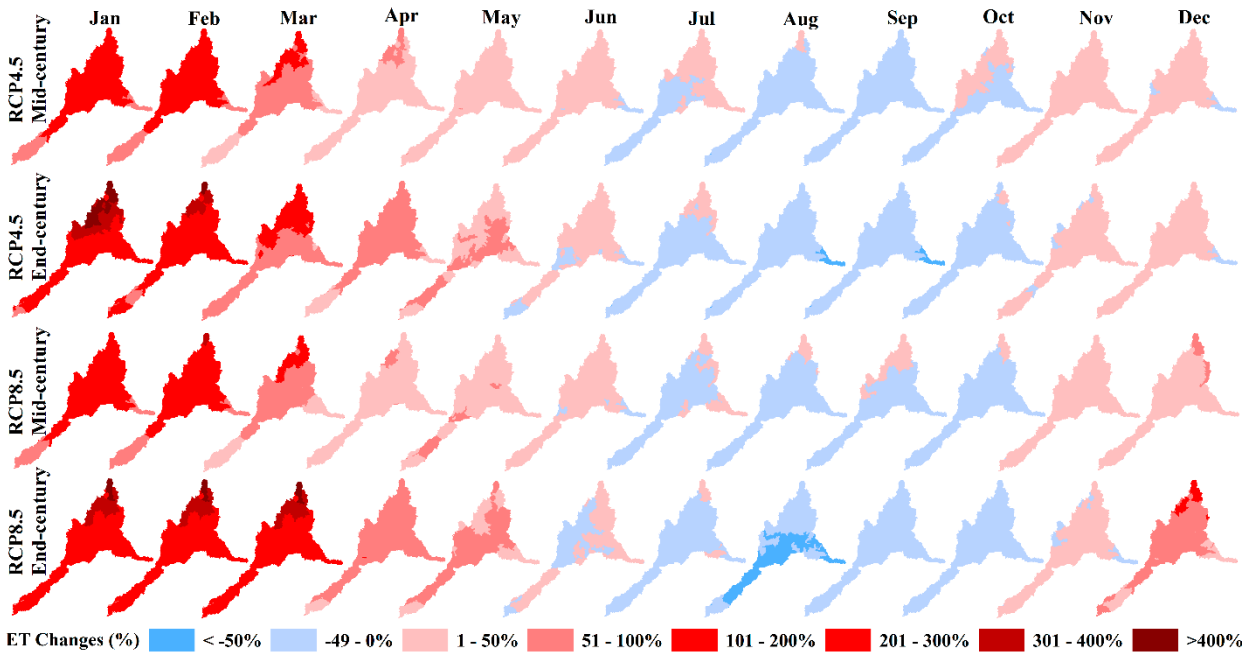

Figure S4. Changes in green water flow (Evapotranspiration—ET) in different future periods and for different emission scenarios, compared to base period.

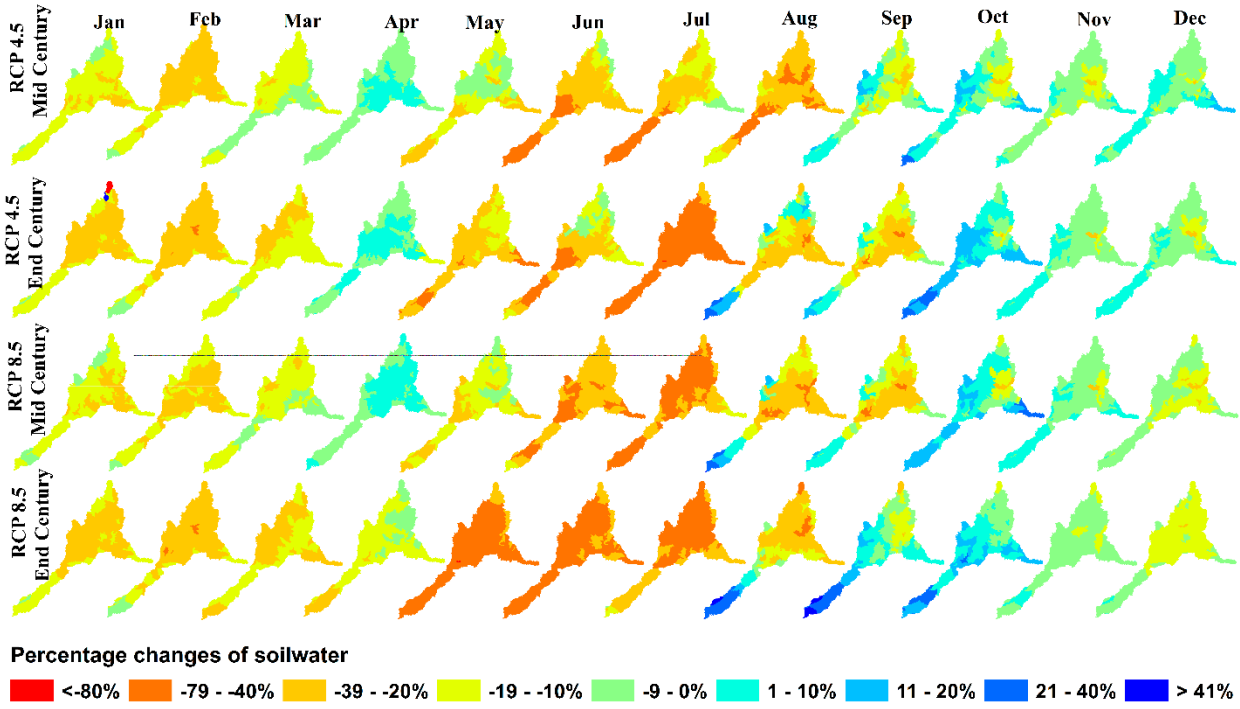

Figure S5. Changes in green water storage (Soil Water) in different future periods and for different emission scenarios, compared to base period.