



Supplement of

Does dynamically modeled leaf area improve predictions of land surface water and carbon fluxes? Insights into dynamic vegetation modules

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S.1 Effect of vegetation dynamics on model performance of GPP and soil moisture

The following Taylor diagrams show the shift in model performance when activating dynamic vegetation for gross primary production (GPP) and soil moisture (SM).

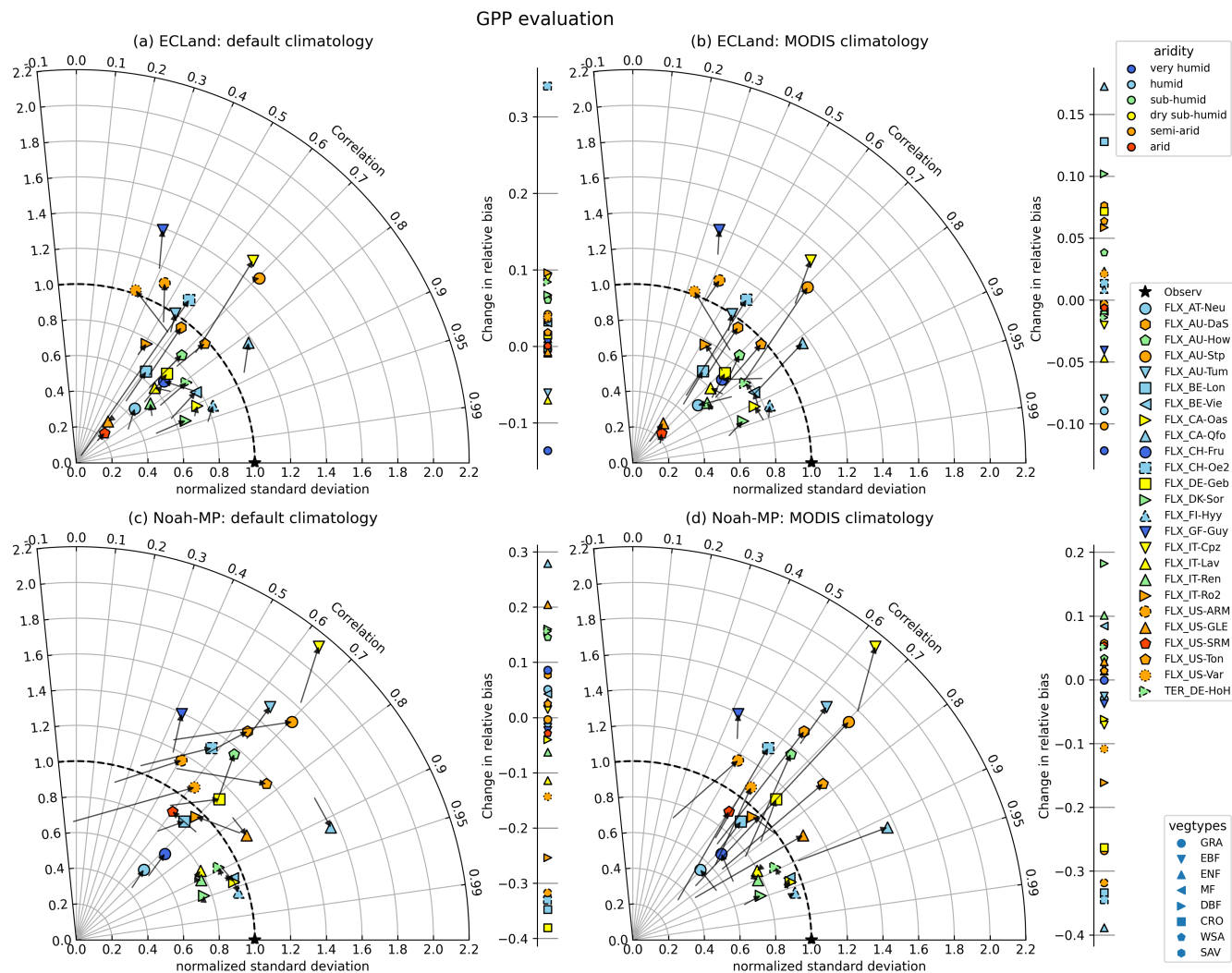


Figure S1. Change of model quality metrics for GPP prediction when switching on dynamic vegetation for all included sites and by using *default climatology* (left) or *MODIS climatology* (right). The star ("Observ") marks the location of the perfect correlation between observation and model and perfect agreement between observed and modelled variance. The model performance of the static runs can be read from the start of each arrow. The point colors indicate the site aridity (top right legend). Vegetation types are symbolized by different marker types (bottom right legend).

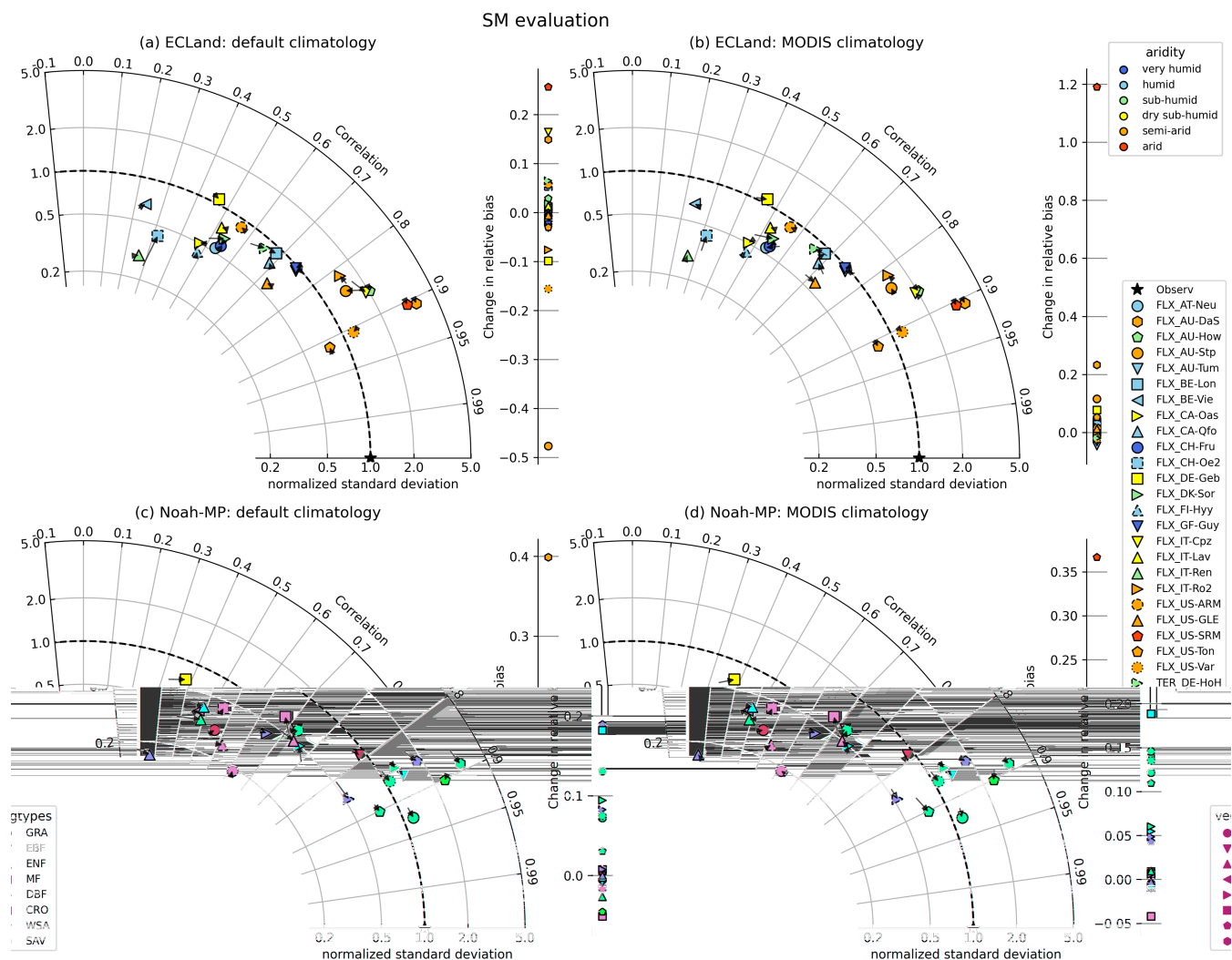


Figure S2. Same as before but for soil moisture.

S.2 Relative bias tables

- Relative biases for all model runs are summarized in tables in following order: leaf area index (LAI), net ecosystem exchange (NEE), gross primary production (GPP), latent heat flux, evaporative fraction and soil moisture.

Table S1. Relative bias for LAI. The word climatology is shortened with clim.. MODIS single refers to the MODIS single-year setup.

ECLand						Location	Noah-MP					
default clim.		MODIS clim.		MODIS single			default clim.		MODIS clim.		MODIS single	
static	dynamic	static	dynamic	static	dynamic		static	dynamic	static	dynamic	static	dynamic
-68%	-77%	-28%	-73%	-31%	-73%	AT-Neu	-54%	-14%	5%	-14%	0%	-14%
0%	22%	-24%	20%	-42%	19%	AU-DaS	-54%	51%	-9%	51%	-3%	51%
-7%	0%	-17%	-1%	-17%	-1%	AU-How	-75%	27%	-3%	27%	-1%	27%
153%	-24%	-51%	-36%	-50%	-36%	AU-Stp	176%	231%	-4%	231%	-5%	231%
-31%	-74%	-1%	-72%	0%	-71%	AU-Tum	0%	-5%	0%	-5%	1%	-5%
29%	51%	-7%	48%	-10%	47%	BE-Lon	-28%	110%	3%	110%	0%	110%
-26%	-19%	-16%	-18%	-15%	-18%	BE-Vie	3%	9%	-6%	9%	-6%	9%
-4%	-10%	-12%	-11%	-14%	-11%	CA-Oas	-3%	-7%	-3%	-7%	-5%	-10%
51%	52%	-17%	47%	-17%	47%	CA-Qfo	200%	92%	-7%	92%	-7%	92%
-19%	-67%	-35%	-67%	-34%	-67%	CH-Fru	-44%	-3%	-5%	-3%	-4%	-3%
-95%	141%	-10%	148%	-10%	148%	CH-Oe2	6%	146%	0%	146%	0%	146%
56%	30%	-8%	26%	-11%	26%	DE-Geb	-20%	99%	3%	99%	-1%	99%
-52%	-32%	-20%	-30%	-10%	-29%	DE-HoH	-45%	-16%	-9%	-16%	0%	-16%
21%	44%	-11%	42%	-11%	42%	DK-Sor	13%	62%	-1%	62%	-1%	61%
-8%	-9%	-16%	-10%	-15%	-10%	FI-Hyy	62%	-11%	-6%	-11%	-5%	-10%
-5%	-16%	4%	-16%	1%	-16%	GF-Guy	-7%	4%	5%	4%	3%	4%
-32%	-9%	5%	-7%	-1%	-7%	IT-Cpz	57%	21%	5%	21%	0%	20%
32%	-22%	0%	-24%	-3%	-24%	IT-Lav	109%	14%	12%	14%	8%	14%
2%	-9%	-15%	-9%	-14%	-9%	IT-Ren	129%	29%	-5%	29%	-4%	29%
78%	-1%	-13%	-7%	-14%	-8%	IT-Ro2	-38%	22%	0%	22%	-2%	22%
-9%	-51%	-36%	-53%	-36%	-53%	US-ARM	12%	144%	1%	144%	-3%	144%
266%	152%	-14%	135%	-16%	135%	US-GLF	872%	348%	-3%	348%	-5%	348%
182%	231%	-13%	221%	-14%	220%	US-SRM	365%	186%	-6%	186%	-1%	186%
149%	87%	-15%	77%	-14%	77%	US-Ton	38%	93%	-3%	93%	0%	93%
18%	-57%	-40%	-61%	-40%	-61%	US-Var	-2%	100%	-2%	100%	-1%	100%

Table S2. Relative bias for NEE. Note that a positive bias in NEE means an underestimation of carbon uptake by the ecosystem. Abbreviations in the headings are as before.

ECLand						Location	Noah-MP					
default clim.		MODIS clim.		MODIS single			default clim.		MODIS clim.		MODIS single	
static	dynamic	static	dynamic	static	dynamic		static	dynamic	static	dynamic	static	dynamic
-21%	-20%	-34%	-22%	-33%	-22%	AT-Neu	-19%	-23%	-25%	-23%	-24%	-23%
67%	62%	69%	62%	72%	62%	AU-DaS	-9%	-6%	-11%	-6%	-11%	-6%
70%	65%	68%	65%	68%	65%	AU-How	8%	14%	0%	14%	1%	14%
57%	59%	65%	60%	65%	60%	AU-Stp	22%	2%	22%	2%	22%	2%
-2%	2%	-3%	2%	-3%	2%	AU-Tum	-34%	-32%	-34%	-32%	-33%	-32%
-6%	-6%	-3%	-6%	-3%	-6%	BE-Lon	-12%	-17%	-16%	-17%	-16%	-17%
18%	16%	15%	16%	15%	16%	BE-Vie	-6%	-6%	-5%	-6%	-5%	-7%
-6%	-6%	-5%	-5%	-5%	-5%	CA-Oas	-23%	-9%	-22%	-9%	-21%	-10%
-1%	-2%	10%	-1%	11%	-1%	CA-Qfo	-32%	-31%	-22%	-31%	-22%	-31%
-17%	-6%	-15%	-6%	-15%	-6%	CH-Fru	-2%	-6%	-6%	-6%	-6%	-6%
5%	-20%	-9%	-20%	-9%	-20%	CH-Oe2	-20%	-26%	-21%	-26%	-21%	-26%
-7%	-7%	-4%	-7%	-4%	-7%	DE-Geb	-15%	-18%	-19%	-18%	-18%	-18%
7%	3%	3%	3%	2%	3%	DE-HoH	-16%	-6%	-21%	-6%	-21%	-6%
-1%	-4%	0%	-4%	0%	-4%	DK-Sor	-20%	-7%	-19%	-7%	-19%	-9%
5%	6%	6%	6%	6%	6%	FI-Hyy	-3%	-4%	-6%	-4%	-6%	-6%
13%	14%	13%	14%	14%	14%	GF-Guy	-62%	-54%	-62%	-54%	-61%	-54%
15%	10%	7%	9%	8%	9%	IT-Cpz	-40%	-30%	-36%	-30%	-34%	-33%
45%	49%	46%	49%	47%	49%	IT-Lav	30%	32%	32%	32%	33%	32%
20%	20%	20%	20%	20%	20%	IT-Ren	0%	5%	7%	5%	7%	5%
14%	19%	22%	19%	22%	20%	IT-Ro2	-9%	3%	-18%	3%	-17%	3%
-3%	-1%	-1%	-1%	-2%	-1%	US-ARM	-2%	-9%	-2%	-9%	-3%	-9%
-1%	0%	2%	0%	2%	0%	US-GLR	27%	-19%	-7%	-19%	-7%	-19%
60%	59%	59%	59%	59%	59%	US-SRM	-8%	-6%	-3%	-6%	-4%	-6%
10%	8%	15%	9%	15%	9%	US-Ton	-7%	-9%	-8%	-9%	-9%	-9%
-11%	-7%	-9%	-7%	-9%	-7%	US-Var	-4%	-13%	-9%	-13%	-9%	-13%

Table S3. Relative bias for GPP. Abbreviations in the headings are as before.

ECLand						Location	Noah-MP					
default clim.		MODIS clim.		MODIS single			default clim.		MODIS clim.		MODIS single	
static	dynamic	static	dynamic	static	dynamic		static	dynamic	static	dynamic	static	dynamic
-25%	-25%	-15%	-23%	-15%	-24%	AT-Neu	-25%	-20%	-17%	-20%	-17%	-20%
-38%	-31%	-39%	-31%	-42%	-31%	AU-DaS	-24%	-16%	-22%	-16%	-21%	-16%
-44%	-38%	-41%	-38%	-42%	-38%	AU-How	-33%	-18%	-22%	-18%	-22%	-18%
16%	12%	0%	10%	0%	10%	AU-Stp	30%	30%	-3%	30%	-4%	30%
-8%	-14%	-6%	-14%	-6%	-14%	AU-Tum	21%	23%	21%	23%	20%	23%
-8%	-5%	-18%	-6%	-19%	-6%	BE-Lon	-7%	42%	9%	42%	7%	42%
-27%	-24%	-23%	-24%	-24%	-24%	BE-Vie	-7%	-3%	-11%	-3%	-11%	-3%
-13%	-14%	-13%	-14%	-15%	-14%	CA-Oas	4%	8%	2%	8%	0%	5%
-4%	-3%	-21%	-4%	-22%	-4%	CA-Qfo	69%	41%	2%	41%	1%	41%
-15%	-29%	-17%	-29%	-17%	-29%	CH-Fru	-32%	-23%	-23%	-23%	-23%	-23%
-49%	15%	-17%	16%	-17%	16%	CH-Oe2	-2%	35%	-1%	35%	-1%	35%
-6%	-5%	-12%	-5%	-13%	-5%	DE-Geb	4%	42%	16%	42%	13%	42%
-25%	-17%	-15%	-16%	-13%	-16%	DE-HoH	-16%	0%	-5%	0%	-4%	0%
-34%	-27%	-38%	-27%	-38%	-27%	DK-Sor	-27%	-11%	-29%	-11%	-29%	-11%
-25%	-25%	-26%	-25%	-27%	-25%	FI-Hyy	10%	-8%	-10%	-8%	-10%	-8%
-12%	-12%	-8%	-12%	-10%	-12%	GF-Guy	-2%	4%	0%	4%	-1%	4%
-22%	-13%	-10%	-12%	-12%	-12%	IT-Cpz	16%	14%	7%	14%	5%	13%
-51%	-58%	-53%	-58%	-54%	-58%	IT-Lav	-17%	-29%	-30%	-29%	-32%	-29%
-39%	-40%	-39%	-40%	-39%	-40%	IT-Ren	4%	-11%	-21%	-11%	-21%	-11%
11%	-1%	-9%	-3%	-9%	-3%	IT-Ro2	-5%	30%	14%	30%	14%	30%
12%	9%	8%	8%	10%	8%	US-ARM	7%	38%	7%	38%	7%	38%
-22%	-23%	-25%	-23%	-25%	-23%	US-GLE	33%	13%	-15%	13%	-16%	13%
-23%	-23%	-22%	-23%	-22%	-23%	US-SRM	2%	5%	-11%	5%	-10%	5%
-7%	-5%	-11%	-5%	-11%	-5%	US-Ton	-6%	3%	-5%	3%	-5%	3%
12%	8%	9%	7%	9%	7%	US-Var	-1%	16%	5%	16%	5%	16%

Table S4. Relative bias for latent heat flux. Abbreviations in the headings are as before.

ECLand						Location	Noah-MP					
default clim.		MODIS clim.		MODIS single			default clim.		MODIS clim.		MODIS single	
static	dynamic	static	dynamic	static	dynamic		static	dynamic	static	dynamic	static	dynamic
-27%	-31%	-13%	-28%	-13%	-28%	AT-Neu	-25%	-19%	-21%	-19%	-22%	-19%
-27%	-18%	-30%	-18%	-37%	-19%	AU-DaS	-14%	-13%	-12%	-13%	-12%	-13%
-53%	-49%	-51%	-48%	-51%	-48%	AU-How	-43%	-43%	-40%	-43%	-40%	-43%
2%	-1%	-3%	-1%	-3%	-1%	AU-Stp	8%	-1%	-3%	-1%	-4%	-1%
-11%	-17%	-7%	-17%	-7%	-17%	AU-Tum	5%	7%	4%	7%	4%	7%
-16%	-14%	-22%	-14%	-24%	-14%	BE-Lon	-3%	0%	-3%	0%	-4%	0%
-27%	-20%	-19%	-20%	-20%	-20%	BE-Vie	-5%	1%	-4%	1%	-4%	1%
-9%	-9%	-9%	-9%	-10%	-10%	CA-Oas	3%	8%	4%	8%	3%	7%
-22%	-21%	-35%	-22%	-36%	-22%	CA-Qfo	-36%	-36%	-38%	-36%	-38%	-36%
-21%	-28%	-22%	-29%	-22%	-29%	CH-Fru	-30%	-25%	-29%	-25%	-29%	-25%
-65%	-1%	-25%	0%	-25%	0%	CH-Oe2	3%	9%	2%	9%	2%	9%
8%	3%	-5%	2%	-8%	2%	DE-Geb	-2%	5%	-1%	5%	-1%	5%
-41%	-33%	-30%	-32%	-29%	-32%	DE-HoH	-12%	-8%	-11%	-8%	-10%	-8%
-37%	-29%	-36%	-29%	-37%	-29%	DK-Sor	-19%	-12%	-21%	-12%	-21%	-12%
-22%	-21%	-22%	-21%	-22%	-21%	FI-Hyy	-34%	-32%	-35%	-32%	-35%	-32%
-31%	-36%	-26%	-35%	-30%	-36%	GF-Guy	-17%	-15%	-17%	-15%	-16%	-15%
-21%	-8%	-1%	-7%	-3%	-7%	IT-Cpz	17%	16%	16%	16%	14%	14%
-40%	-46%	-42%	-47%	-43%	-47%	IT-Lav	-50%	-47%	-50%	-47%	-50%	-47%
-41%	-41%	-41%	-41%	-41%	-41%	IT-Ren	-43%	-41%	-43%	-41%	-43%	-41%
-30%	-38%	-39%	-39%	-39%	-39%	IT-Ro2	-9%	-6%	-8%	-6%	-8%	-6%
6%	4%	7%	4%	6%	4%	US-ARM	6%	11%	7%	11%	6%	11%
-62%	-64%	-68%	-64%	-68%	-64%	US-GLE	-54%	-63%	-73%	-63%	-73%	-63%
-22%	-21%	-27%	-21%	-26%	-22%	US-SRM	-20%	-19%	-21%	-19%	-21%	-19%
-5%	-12%	-19%	-13%	-19%	-13%	US-Ton	-8%	-7%	-10%	-7%	-10%	-7%
29%	28%	29%	27%	28%	27%	US-Var	21%	23%	17%	23%	17%	22%

Table S5. Relative bias for evaporative fraction. Abbreviations in the headings are as before.

ECLand						Location	Noah-MP					
default clim.		MODIS clim.		MODIS single			default clim.		MODIS clim.		MODIS single	
static	dynamic	static	dynamic	static	dynamic		static	dynamic	static	dynamic	static	dynamic
-34%	-39%	-21%	-37%	-22%	-37%	AT-Neu	-12%	-10%	-9%	-10%	-9%	-10%
-43%	-36%	-47%	-37%	-53%	-37%	AU-DaS	-40%	-34%	-35%	-34%	-35%	-34%
-49%	-45%	-47%	-45%	-47%	-45%	AU-How	-43%	-40%	-38%	-40%	-38%	-40%
-14%	-18%	-16%	-17%	-17%	-17%	AU-Stp	-1%	-10%	-10%	-10%	-11%	-10%
-50%	-60%	-45%	-60%	-45%	-60%	AU-Tum	-26%	-23%	-27%	-23%	-27%	-23%
-4%	-5%	-10%	-6%	-11%	-6%	BE-Lon	8%	10%	9%	10%	9%	10%
-12%	-10%	-10%	-10%	-10%	-10%	BE-Vie	0%	3%	0%	3%	0%	3%
-4%	-5%	-5%	-5%	-5%	-5%	CA-Oas	-4%	-1%	-4%	-1%	-4%	-1%
-21%	-21%	-32%	-22%	-33%	-22%	CA-Qfo	-33%	-26%	-31%	-26%	-31%	-26%
-8%	-12%	-9%	-12%	-9%	-12%	CH-Fru	-10%	-9%	-10%	-9%	-10%	-9%
-32%	-30%	-18%	-29%	-18%	-29%	CH-Oe2	-4%	-4%	-5%	-4%	-5%	-4%
10%	4%	0%	3%	-2%	3%	DE-Geb	8%	13%	11%	13%	10%	13%
-52%	-46%	-45%	-45%	-43%	-45%	DE-HoH	-27%	-21%	-26%	-21%	-25%	-21%
-14%	-11%	-15%	-11%	-15%	-11%	DK-Sor	-9%	-4%	-10%	-4%	-10%	-4%
-5%	-6%	-6%	-6%	-6%	-6%	FI-Hyy	-11%	-10%	-12%	-10%	-12%	-10%
-73%	-78%	-63%	-78%	-67%	-78%	GF-Guy	-48%	-42%	-47%	-42%	-47%	-42%
-12%	0%	9%	1%	7%	1%	IT-Cpz	34%	34%	33%	34%	32%	33%
-25%	-31%	-28%	-32%	-29%	-32%	IT-Lav	-33%	-30%	-34%	-30%	-34%	-30%
-7%	-8%	-8%	-8%	-8%	-8%	IT-Ren	-13%	-12%	-13%	-12%	-13%	-12%
-7%	-17%	-22%	-18%	-22%	-18%	IT-Ro2	6%	16%	11%	16%	11%	16%
-7%	-9%	-7%	-9%	-8%	-9%	US-ARM	1%	2%	4%	2%	4%	2%
-41%	-44%	-50%	-45%	-50%	-45%	US-GLE	-29%	-26%	-31%	-26%	-31%	-26%
-8%	-7%	-11%	-7%	-11%	-7%	US-SRM	-15%	-9%	-13%	-9%	-13%	-9%
5%	0%	-6%	0%	-6%	0%	US-Ton	1%	3%	3%	3%	3%	3%
8%	2%	7%	2%	6%	2%	US-Var	9%	9%	15%	9%	15%	9%

Table S6. Relative bias of soil moisture. Abbreviations in the headings are as before.

ECLand						Location	Noah-MP					
default clim.		MODIS clim.		MODIS single			default clim.		MODIS clim.		MODIS single	
static	dynamic	static	dynamic	static	dynamic		static	dynamic	static	dynamic	static	dynamic
1%	2%	-5%	1%	-4%	1%	AT-Neu	-10%	-11%	-11%	-11%	-10%	-11%
695%	680%	704%	681%	711%	681%	AU-DaS	481%	441%	455%	441%	456%	441%
196%	193%	198%	193%	198%	193%	AU-How	129%	110%	114%	110%	114%	110%
116%	163%	180%	169%	179%	169%	AU-Stp	62%	54%	66%	54%	66%	54%
54%	57%	52%	57%	52%	57%	AU-Tum	29%	28%	29%	28%	29%	28%
10%	9%	13%	9%	14%	9%	BE-Lon	-8%	-13%	-8%	-13%	-8%	-13%
37%	36%	36%	36%	36%	36%	BE-Vie	7%	7%	7%	7%	7%	6%
131%	133%	133%	133%	133%	134%	CA-Oas	73%	65%	71%	65%	71%	66%
84%	83%	86%	83%	86%	83%	CA-Qfo	97%	96%	95%	96%	95%	96%
-33%	-32%	-33%	-32%	-33%	-32%	CH-Fru	-44%	-44%	-44%	-44%	-44%	-44%
53%	47%	50%	47%	50%	47%	CH-Oe2	29%	28%	29%	28%	29%	28%
82%	92%	101%	93%	102%	93%	DE-Geb	45%	27%	45%	27%	46%	27%
161%	154%	152%	154%	150%	153%	DE-HoH	109%	101%	106%	101%	105%	101%
80%	78%	80%	78%	80%	78%	DK-Sor	12%	11%	11%	11%	11%	11%
51%	50%	51%	50%	50%	50%	FI-Hyy	-3%	-4%	-3%	-4%	-4%	-5%
251%	253%	250%	253%	251%	253%	GF-Guy	159%	159%	160%	159%	160%	159%
246%	230%	228%	229%	230%	239%	IT-Cpz	124%	125%	124%	125%	123%	124%
-87%	-85%	-86%	-85%	-86%	-85%	IT-Lav	-25%	-25%	-25%	-25%	-25%	-25%
-42%	-42%	-42%	-42%	-42%	-42%	IT-Ren	-11%	-11%	-11%	-11%	-11%	-12%
75%	83%	84%	83%	83%	83%	IT-Ro2	25%	16%	22%	16%	22%	16%
-7%	-1%	-2%	0%	-2%	0%	US-ARM	14%	1%	16%	1%	16%	1%
48%	48%	50%	49%	50%	49%	US-GLE	36%	38%	39%	38%	39%	38%
455%	429%	552%	433%	552%	433%	US-SRM	298%	303%	339%	303%	338%	303%
36%	39%	45%	40%	45%	40%	US-Ton	6%	3%	14%	3%	14%	3%
58%	74%	72%	74%	72%	74%	US-Var	60%	53%	66%	53%	66%	53%