Supplement of

Management Scenarios of the Grand Ethiopian Renaissance Dam and Their Impacts Under Recent and Future Climates

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Table S 1: GERD data

Parameter	Value (IPoE 2013)
Distance to border [km]	20
Dam height [m]	145
Lake (FSL) [masl]	640
Lake (MOL) [masl]	590
Lake area (FSL) [km^2]	1,874
Lake area (MOL) [km^2]	606
Lake length (FSL) [km]	246
Total storage [10^9 m^3]	74.01
Active storage [10^9 m^3]	59.22
Dead storage [10^9 m^3]	14.79
Cap. design flow [m^3/s]	4,305
Max. net head [m]	133
Plant factor	0.31
Capacity [MW]	6,000

Table S 2: Climate models

ESM	RCM	Correction
GFDL-ESM2M		BC
HadGEM2-ES		BC
MIROC-ESM-CHEM		BC
NorESM1-M		BC
GFDL-ESM2M	RCA4	UC
ICHEC-EC-EARTH	HIRHAM5	BC
ICHEC-EC-EARTH	RACMO22T	BC
ICHEC-EC-EARTH	RCA4	BC
MPI-M-ESM-LR	RCA4	BC
NorESM1-M	RCA4	UC

Table S 3: HPP statistics during operation (1961–1980); wet period

Scenario	HPP	SD_{HPP}	CV_{HPP}	*Firm yield* [MW]		
	[GWh^{-a} (MW)]	[MW]		EP_{90}	EP_{95}	EP_{99}
eco_mgt_01	13,860 (1,357)	720	46	818	761	610
eco_mgt_02	12,526 (1,218)	708	49	722	641	496
eco_mgt_03	9,975 (955)	673	59	499	422	290
hpp_1500MW_01a	14,252 (1,342)	527	32	1,096	1,019	818
hpp_1500MW_02a	11,993 (1,155)	181	13	915	822	665
hpp_1500MW_03a	9,885 (945)	222	20	687	603	390
hpp_1500MW_01b	14,188 (1,346)	200	12	1,081	971	723
hpp_1500MW_02b	12,191 (1,183)	188	13	905	787	600
hpp_1500MW_03b	9,932 (952)	268	24	641	550	352
hpp_1700MW_01	13,675 (1,332)	198	13	1,039	971	816
hpp_1700MW_02	12,303 (1,200)	216	15	925	832	675
hpp_1700MW_03	9,859 (943)	251	22	678	581	402
hpp_1800MW_01	12,213 (1,176)	639	46	87	39	0
hpp_1800MW_02	11,541 (1,112)	691	52	42	0	0
hpp_1800MW_03	10,183 (973)	771	66	0	0	0

Table S 4: HPP statistics during operation (1981–1999); dry period

Scenario	*HPP*	SD_{HPP}	CV_{HPP}	*Firm yield* [MW		
	[GWh^{-a} (MW)]	[MW]		EP_{90}	EP_{95}	EP_{99}
eco_mgt_01	11,885 (1,357)	695	51	869	779	585
eco_mgt_02	10,674 (1,218)	678	56	736	645	496
eco_mgt_03	8,363 (955)	634	66	494	402	329
hpp_1500MW_01a	11,759 (1,342)	329	24	1,140	966	792
hpp_1500MW_02a	10,117 (1,155)	255	22	836	732	666
hpp_1500MW_03a	8,278 (945)	265	28	626	529	413
hpp_1500MW_01b	11,793 (1,346)	274	20	1,123	928	770
hpp_1500MW_02b	10,362 (1,183)	276	23	850	739	639
hpp_1500MW_03b	8,337 (952)	310	33	586	488	396
hpp_1700MW_01	11,665 (1,332)	265	20	1,069	979	781
hpp_1700MW_02	10,510 (1,200)	268	22	939	832	675
hpp_1700MW_03	8,264 (943)	275	29	661	548	460
hpp_1800MW_01	10,302 (1,176)	744	63	100	40	0
hpp_1800MW_02	9,738 (1,112)	770	69	53	0	0
hpp_1800MW_03	8,525 (973)	813	84	0	0	0

Table S 5: Average annual precipitation and temperature changes in the UBN projected by the climate model ensemble

	1970–1999	2030–2059			2030–2059		
	ave	ave	change	change	ave	change	change
	mm	mm	mm	%	mm	mm	%
P median	1364.5	1418.7	54.2	4.0	1433.6	69.1	5.1
P ave	1364.9	1403.6	38.7	2.8	1433.4	68.5	5.0
T median	22.7	24.6	1.9	–	27.2	4.5	–
T ave	22.6	24.3	1.7	–	26.8	4.2	–

P=precipitation; T=temperature; median=multi-model median; ave=multi-model mean

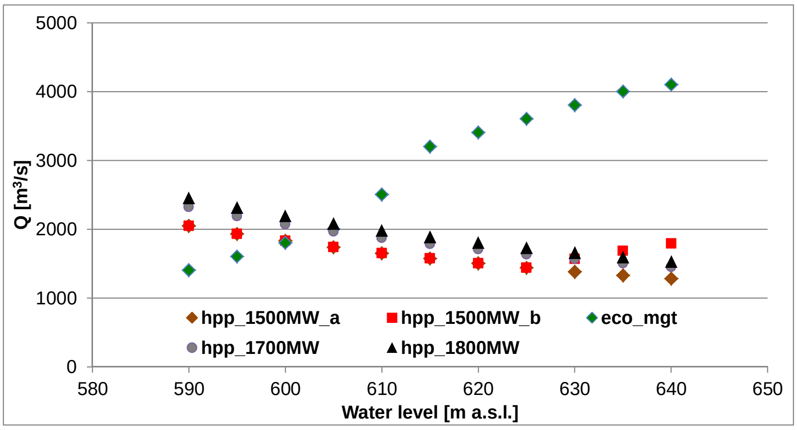

Figure S 1: GERD rule curves of the different operation scenarios

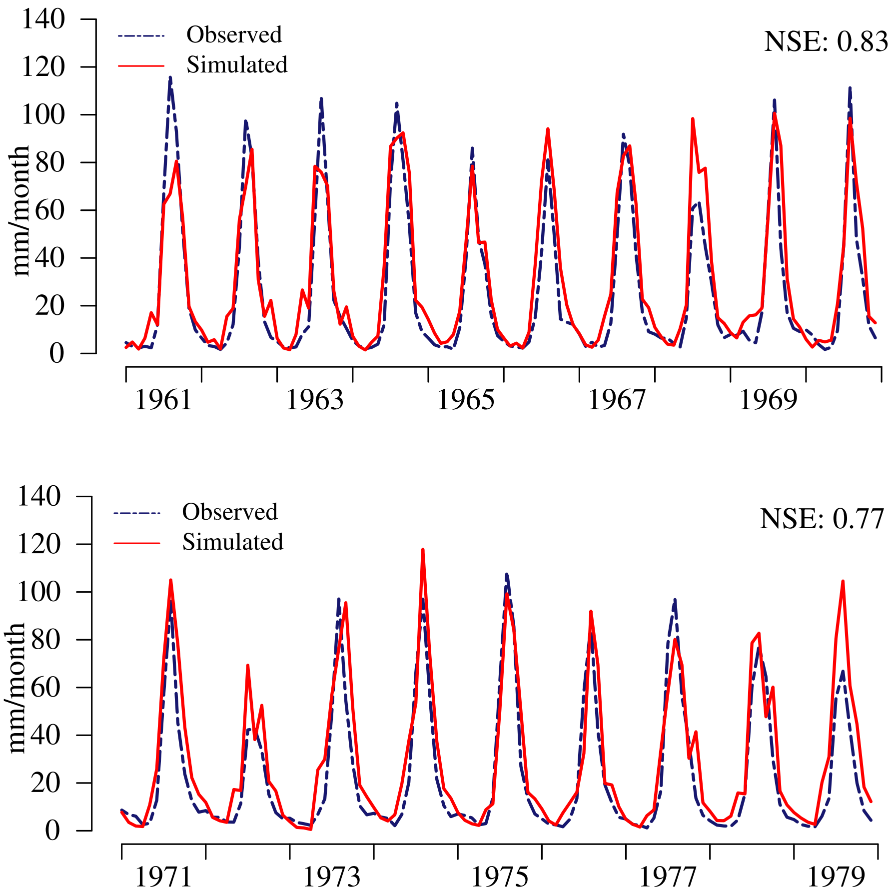

Figure S 2: SWIM model performance in the 1960s and 1970s at gauge El Diem

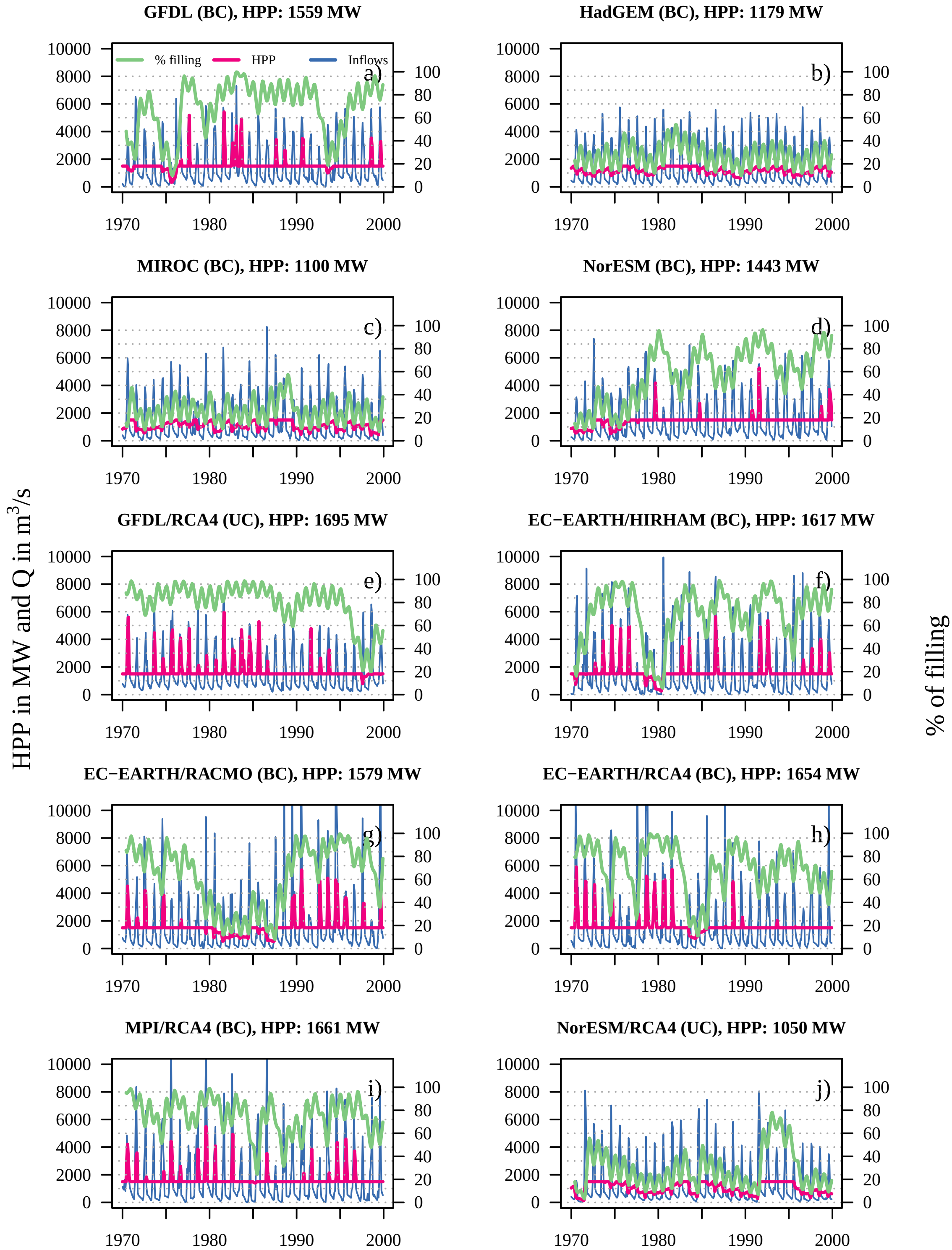

Figure S 3: Reservoir filling, inflows, and HPP simulated with climate model input in the reference period and operation scenario hpp_1500MW_01a (low seepage rate)

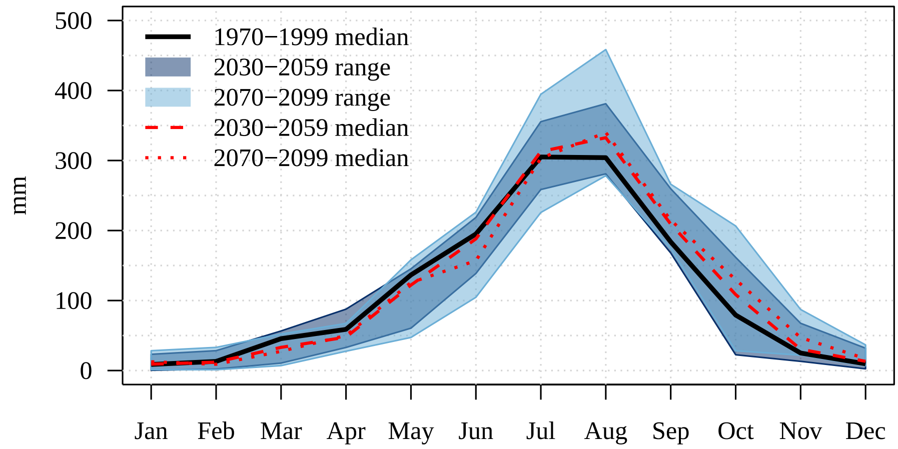

Figure S 4: Precipitation changes projected by the model ensemble

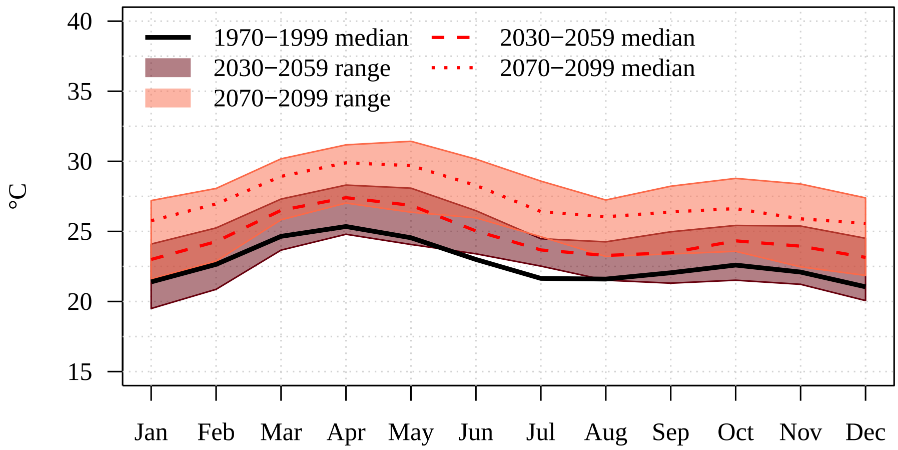

Figure S 5: Temperature changes projected by the model ensemble

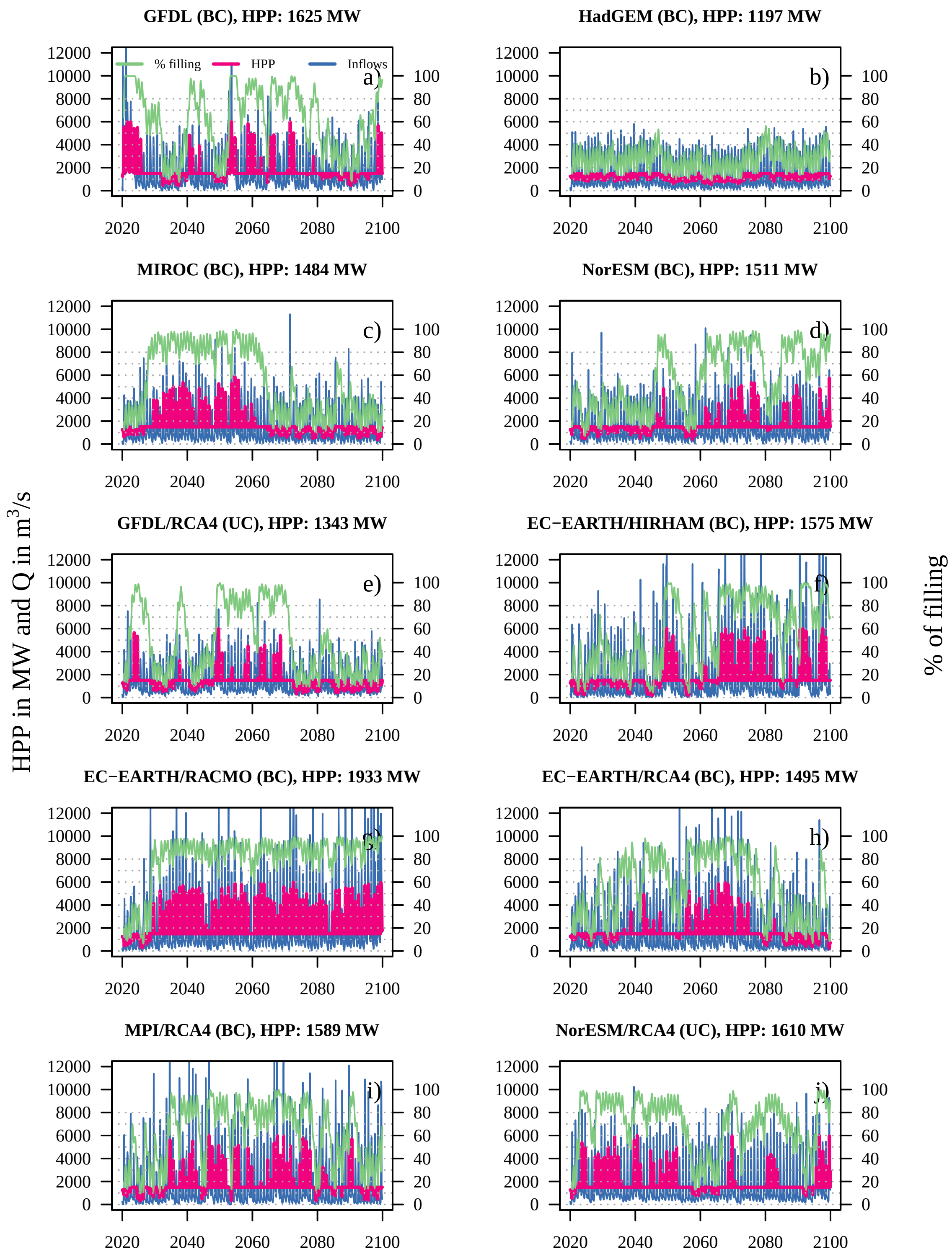

Figure S 6: Operation scenarios under climate change projections and operation scenario hpp_1500MW_01a (low seepage rate)

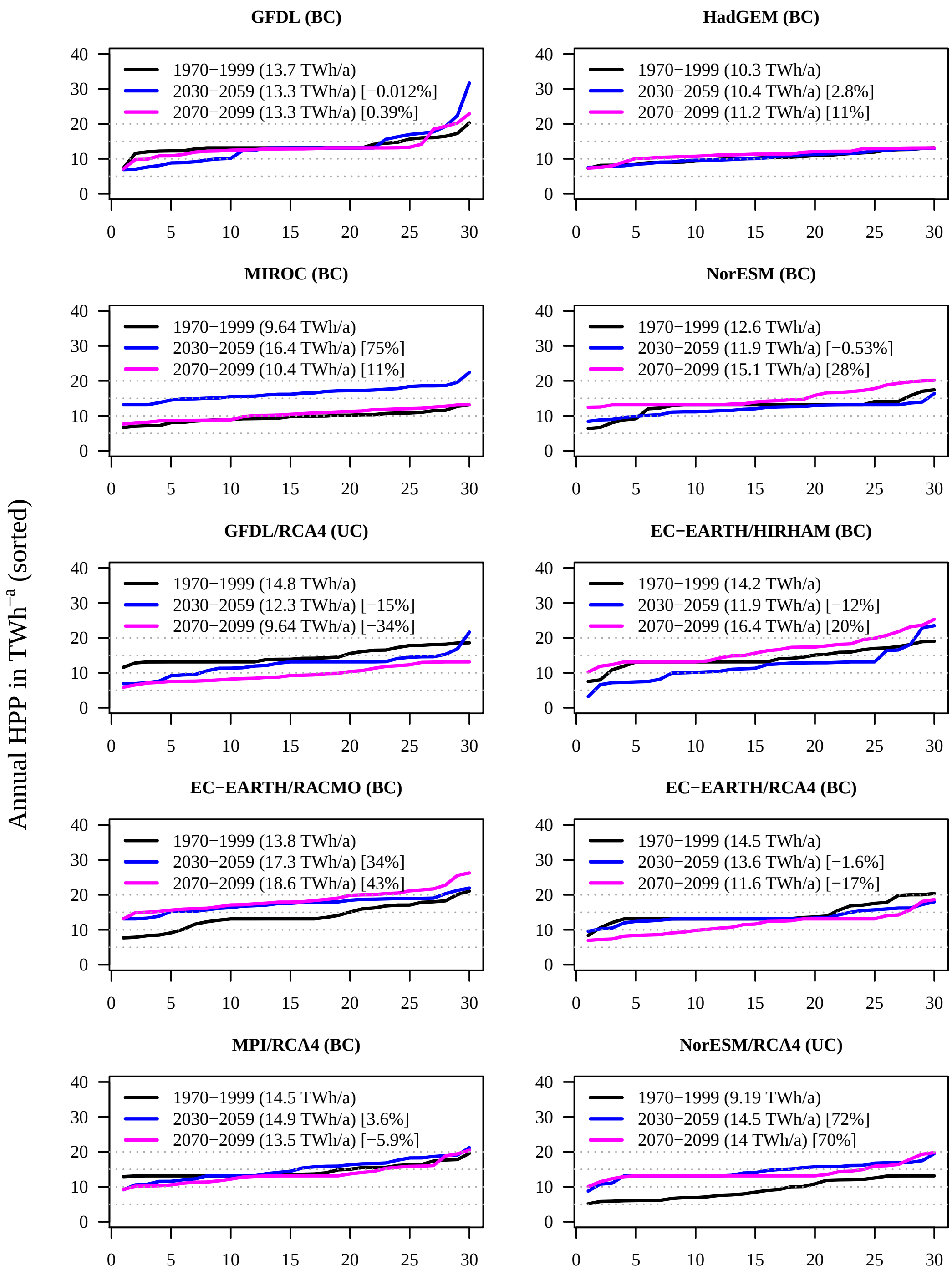

Figure S 7: Sorted annual HPP in TWh^{-a} of the three 30-years periods and operation scenario hpp_1500MW_01a (low seepage rate), in brackets the mean annual production and in square brackets the change signal