

Supporting Information

Enhanced Evaluation of hourly and Daily Extreme Precipitation in Norway from Convection-Permitting Models at Regional and Local Scales

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Table S1. The information for the ten hourly rain gauges.

Name	Station ID	Longitude (°E)	Latitude (°N)	Elevation(m)	Region
Østre Toten - Apelsvoll	SN11500	10.8695	60.7002	264	East
Ås - Rustadskogen	SN17870	10.8107	59.6703	120	East
Kise in Hedmark	SN12550	10.8055	60.7733	128	East
Løken i Volbu	SN23500	9.063	61.122	521	East
Kvithamar	SN69150	10.8795	63.4882	27	Middle
Tjøtta	SN76530	12.4255	65.8295	21	Middle
Stryn - Kroken	SN58900	6.5585	61.9157	208	West
Fureneset	SN56420	5.0443	61.2928	7	West
Særheim	SN44300	5.6508	58.7605	87	South
Tromsø - Holt	SN90400	18.9095	69.6538	20	North

Table S2. The information for the 192 daily rain gauges.

ID	Name	Longitude (°E)	Latitude (°N)	Elevation (m)	ID	Name	Longitude (°E)	Latitude (°N)	Elevation (m)
SN420	HEGGERISET -	11.9963	61.6848	481	SN98550	VARDØ RADIO	31.0962	70.3707	10
SN78370	BJERKA - VALLA	13.8067	66.1415	20	SN47090	SKJOLD - FRØVIK	5.6257	59.5033	5
SN47820	EIKEMO	6.2786	59.8594	178	SN69960	BURAN	11.5436	63.7199	182
SN82290	BODØ VI	14.3816	67.2723	16	SN44480	SØYLAND I GJESDAL	5.9817	58.6855	263
SN32780	HØIDALEN I SOLUM	9.2668	59.1444	113	SN810	TUFSINGDAL - MIDTDAL	11.732	62.2776	687
SN63580	ÅNGÅRDSVATNET	9.1967	62.6708	596	SN50150	HATLESTRAND	5.9032	60.045	45
SN43810	MAUDAL	6.3675	58.7645	311	SN78350	BARDAL	13.3917	66.2178	39
SN42520	RISNES I FJOTLAND	6.9443	58.6577	348	SN52860	TAKLE	5.3813	61.0272	38
SN67150	LEINSTRAND	10.2733	63.3281	13	SN24960	GOL - STAKE	8.9478	60.7188	542
SN78250	LEIRFJORD	12.9097	66.0668	53	SN34900	POSTMYR I DRANGEDAL	8.7687	59.2647	464
SN42810	TONSTAD - NETTFED	6.709	58.6642	55	SN76100	ØKSNINGØY	12.3745	65.1245	24
SN36490	BØYLEFOSS	8.717	58.5967	63	SN82530	KJERRINGØY - OS	14.8402	67.5385	15
SN68270	LØKSMYR	10.4369	63.2315	173	SN25100	HEMSEDAL - HØLTO	8.5285	60.8703	648
SN46150	SAND I RYFYLKE II	6.276	59.4791	25	SN730	VALDALEN	12.1722	62.0758	794
SN8720	ATNSJØEN	10.1398	61.8902	749	SN72650	OVERHALLA - UNNSET	11.8397	64.4815	26
SN70820	UTGÅRD	11.729	64.1163	50	SN61040	HILDRE	6.3187	62.6017	13
SN47450	STRAUMØY	5.4335	59.6532	36	SN52930	BREKKE I SOGN	5.425	60.9585	240
SN31080	TESSUNGDALEN -	8.7033	60.1293	762	SN52170	EKSINGEDAL	6.1469	60.8028	450
SN48500	ROSENDAL	6.02637	59.9913	75	SN31410	RJUKAN	8.6663	59.88	258
SN33250	RAULAND	8.0317	59.7057	719	SN60500	TAFJORD	7.4218	62.2305	11
SN66620	RENNEBU - RAMSTAD	9.8354	62.864	223	SN93900	SIHCCAJAVRI	23.5387	68.7553	382
SN82840	STYRKESNES - HESTVIKA	15.4953	67.5258	27	SN60400	NORDDAL	7.2392	62.2477	28
SN770	ELLEFSPLASS	11.4525	62.204	713	SN32850	KVITESEID - MOEN	8.473	59.4058	76
SN57810	SVELGEN II	5.2983	61.7707	16	SN38380	DOVLAND	8.0392	58.5234	259
SN96970	SIRBMA	27.4018	70.0185	51	SN92350	NORDSTRAUM I	21.8958	69.8362	20
SN76250	SØMNA - STEIN	12.1643	65.2965	19	SN14050	SJOA	9.5562	61.6757	330
SN13420	VENABU	10.1082	61.6513	930	SN73500	NORDLI - HOLAND	13.718	64.4458	433
SN40420	BYKLE - KULTRAN	7.3438	59.3505	594	SN43010	EIK - HOVE	6.5045	58.507	65
SN88660	BOTNHAMN	17.9175	69.5212	6	SN41550	LJOSLAND - MONEN	7.3501	58.7878	504
SN12600	VEA	10.6791	60.953	161	SN41770	LINDESNES FYR	7.048	57.9815	16
SN38800	TOVDAL	8.2295	58.7938	220	SN83300	STEIGEN	15.1123	67.923	31
SN71550	ØRLAND III	9.6105	63.7045	10	SN18700	OSLO - BLINDERN	10.72	59.9423	94
SN75020	OTTERØY	11.2806	64.5228	36	SN59900	SÆBØ	6.4657	62.2027	21
SN44760	IMS	5.9672	58.9055	2	SN55670	VEITASTROND	7.034	61.4783	172
SN77850	SUSENDAL	14.2457	65.3675	498	SN63530	HAFSÅS	8.9773	62.5095	698
SN31570	MØSVATN - HAUG	8.1342	59.8143	945	SN73250	SØRLI	13.765	64.2432	370
SN100	PLASSEN	12.5039	61.1349	333	SN3780	IGSI I HOBØL	11.0468	59.636	144
SN37230	TVEITSUND	8.5187	59.0257	252	SN88100	BONES I BARDU	18.2442	68.6457	230
SN92910	SOPNESBUKT	22.3243	70.0518	8	SN52990	ORTNEVIK	6.134	61.1095	4
SN60990	VIGRA	6.115	62.5617	22	SN58480	OLDEDALEN	6.8088	61.694	44
SN44560	SOLA	5.637	58.8843	7	SN63750	MJØEN	9.6591	62.574	512
SN80610	MYKEN	12.486	66.7628	17	SN20520	LUNNER	10.5753	60.295	372
SN22730	HEDAL I VALDRES II	9.7238	60.6197	474	SN36560	NELAU	8.63	58.6582	142
SN79480	MO I RANA III	14.1542	66.307	41	SN53130	FRESVIK	6.9345	61.0688	32
SN39220	MESTAD I ODDERNES	7.89	58.2153	151	SN48450	HUSNES	5.7694553	59.8641203	13
SN89350	BARDUFOSS	18.5437	69.0577	76	SN10600	AURSUND	11.4534	62.6737	685
SN1230	HALDEN	11.388	59.1223	3	SN24600	GRIMELI I KRØDSHERAD	9.5958	60.137	367
SN53160	JORDALEN - NÅSEN	6.7243	60.9004	614	SN4780	GARDERMOEN	11.0802	60.2065	202

Table S2. Continue.

ID	Name	Longitude	Latitude	Elevation	ID	Name	Longitude	Latitude	Elevation
		(°E)	(°N)	(m)			(°E)	(°N)	(m)
SN16610	FOKSTUGU	9.2862	62.1133	973	SN93700	KAUTOKEINO	23.0335	68.9968	307
SN58320	MYKLEBUST I BREIM	6.6092	61.708	315	SN59250	REFVIK	5.0878	61.9985	3
SN69100	VÆRNES	10.9305	63.4597	12	SN46300	SULDALSVATN	6.809	59.5887	333
SN80740	REIPÅ	13.646	66.9035	9	SN22840	REINLI	9.4905	60.8346	628
SN57940	ÅLFOTEN II	5.6674	61.832	24	SN51250	ØVSTEDAL	5.9647	60.6887	316
SN60620	GRØNNING	7.5135	62.3292	312	SN52750	FRØYSET	5.2108	60.8462	13
SN58780	NORDFJORDEID - NYMARK	6.0392	61.9183	34	SN12550	KISE PA HEDMARK	10.8055	60.7733	128
SN73800	TUNNSJØ	13.6506	64.6837	376	SN54600	MARISTOVA	8.0368593	61.1098838	806
SN56780	SYGNA	5.7265	61.3435	45	SN71810	ÅFJORD - MOMYR	10.523	64.1003	280
SN65230	HEMNE - LENES	9.0115	63.2613	45	SN84190	SKJOMEN - STIBERG	17.5145	68.2075	29
SN56520	HOVLANDSDAL	5.4342	61.232	85	SN57850	DAVIKNES	5.5333	61.8986	78
SN5350	NORD-ODAL	11.558	60.3883	147	SN38600	MYKLAND	8.2888	58.633	245
SN90490	TROMSØ - LANGNES	18.9133	69.6767	8	SN71200	MOSVIK -	10.998	63.8128	39
SN56850	VIKSDALEN I GAULAR	6.1983	61.3262	243	SN11710	EINAVATN	10.6408	60.59505	406
SN75100	LIAFOSS	11.9547	64.8382	44	SN57480	BOTNEN I FØRDE	6.0586	61.5349	237
SN1950	ØRJE	11.6506	59.4829	123	SN37500	FOLDSÆ	8.1517	59.3242	492
SN50540	BERGEN - FLORIDA	5.3327	60.383	12	SN52400	EIKANGER - MYR	5.3742	60.6268	72
SN31660	MOGEN	7.913	60.018	954	SN13140	FÅVANG - TROMSNES	10.1902	61.4567	187
SN9870	BLANKTJERNMOEN I	10.428	62.4343	692	SN61820	ERESFJORD	8.105	62.663	14
SN53700	AURLAND	7.201	60.9027	15	SN14550	PRESTSTULEN	9.0084	61.9225	823
SN80200	LURØY	13.1848	66.3892	115	SN86500	SORTLAND	15.4157	68.7033	3
SN71900	BESSAKER	10.3257	64.2448	12	SN11900	BIRI	10.5954	60.9518	190
SN68420	AUNET	11.5669	63.0556	302	SN41860	KVINESHEI -	6.9821926	58.2431584	317
SN27600	SANDEFJORD	10.2147	59.132	6	SN23720	VANG I VALDRES	8.569	61.124	489
SN25320	ÅL III	8.5609	60.6391	720	SN57390	SKEI I JØLSTER	6.4873	61.5722	205
SN58960	HORNINDAL	6.6502	62.0033	349	SN63100	ØKSENDAL	8.4218	62.6855	47
SN56400	YTRE SOLUND	4.6693	61.007	3	SN57990	GJENGEDAL	5.9468	61.6594	230
SN15480	SKJÅK II	8.4672	61.8777	374	SN97350	CUOVDDATMOHKKI	24.4312	69.3695	286
SN4040	ENEBAKK - BARBØL	11.1535	59.75	164	SN23560	BEITO	8.8557	61.2433	754
SN15430	BØVERDAL	8.2423	61.7195	700	SN55550	HAFSLO	7.1887	61.2925	246
SN70930	SNÅSA - NAGELHUS	12.4393	64.249	107	SN46450	RØLDAL	6.8238	59.8305	388
SN29600	TUNHOVD	8.7511	60.4629	870	SN57660	EIMHJELLEN	5.8157	61.6407	176
SN15660	SKJÅK	8.1706	61.9013	432	SN62900	EIDE PÅ NORDMØRE	7.3896	62.8909	49
SN4740	UKKESTAD	11.051	60.1742	187	SN27800	HEDRUM	9.9641	59.196	31
SN34800	TØRDAL - SUVDØLA	8.7742	59.1482	235	SN90450	TROMSØ	18.9368	69.6537	100
SN16790	LESJA - SVANBORG	8.919	62.1057	551	SN1650	STRØMSFOSS SLUSE	11.6599	59.3006	113
SN42720	BAKKE	6.657	58.4117	75	SN42650	FLEKKEFJORD	6.6498	58.28415	5
SN55730	SOGNDAL - SELSENG	6.9335	61.3348	421	SN24210	SOKNA II	9.9267	60.238	140
SN7660	ÅKRESTRØMMEN	11.2042	61.696	260	SN15730	BRÅTÅ - SLETTOM	7.8955	61.8957	664
SN71280	LEKSVIK - MYRAN	10.6075	63.6856	138	SN53070	VIK I SOGN III	6.5813	61.0728	65
SN68840	STUGUDAL - KÅSEN	11.8626	62.8952	730	SN18160	NORDSTRAND	10.7912	59.873	118
SN6440	VERMUNDSJØEN	12.369	60.6925	276	SN27770	STOKKE - SOLLI	10.2022	59.2752	90
SN60	LINNES	12.499	61.5581	564	SN90650	GRUNNFJORD -	19.573	70.0083	7
SN44800	SVILAND	5.9202	58.8185	230	SN47890	OPSTVEIT	6.0169242	59.8577805	38
SN83520	TØMMERNESET	15.859	67.8918	70	SN62700	HUSTADVATN	7.2436	62.9087	80
SN35090	EIKELAND	9.098	58.8037	42	SN41480	ÅSERAL	7.4128	58.6172	268
SN44520	HELLAND I GJESDAL	6.0135	58.755	288	SN36200	TORUNGEN FYR	8.7893	58.3988	12
SN19710	ASKER	10.4358	59.8558	163	SN56320	LAVIK	5.5413	61.1124	26

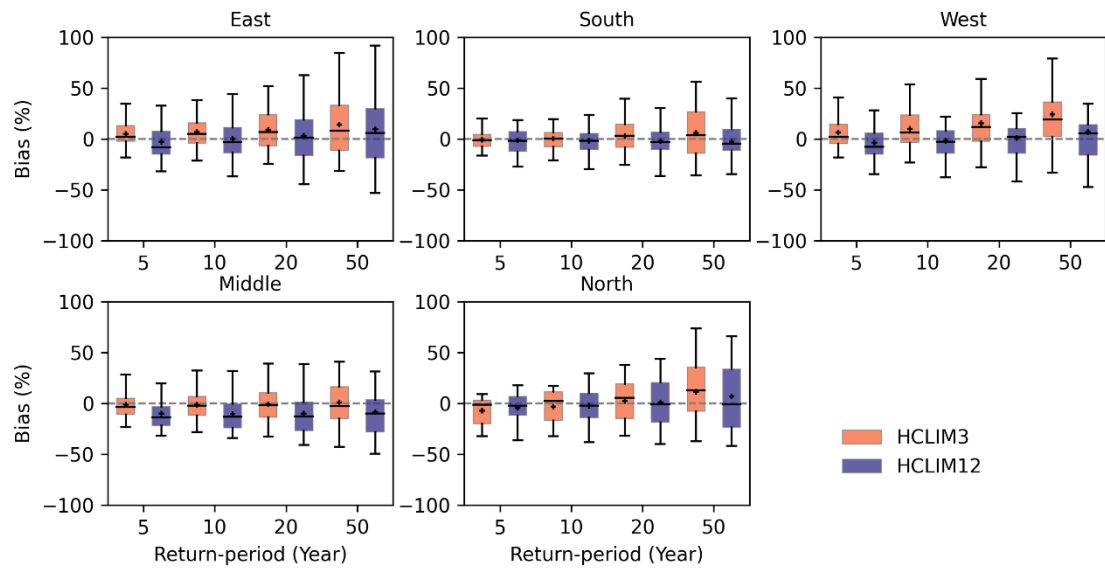


Figure S1: Bias of return-levels in the present-day for HCLIM3 and HCLIM12 relative to observation for 5-, 10-, 20-, and 50-year return periods in the 192 daily rain-gauges. Return periods of 5-, 10-, 20-, and 50-year are calculated on the basis of station-scale GEV. The bias of return-levels for 192-rain-gauges are statistics by regions.

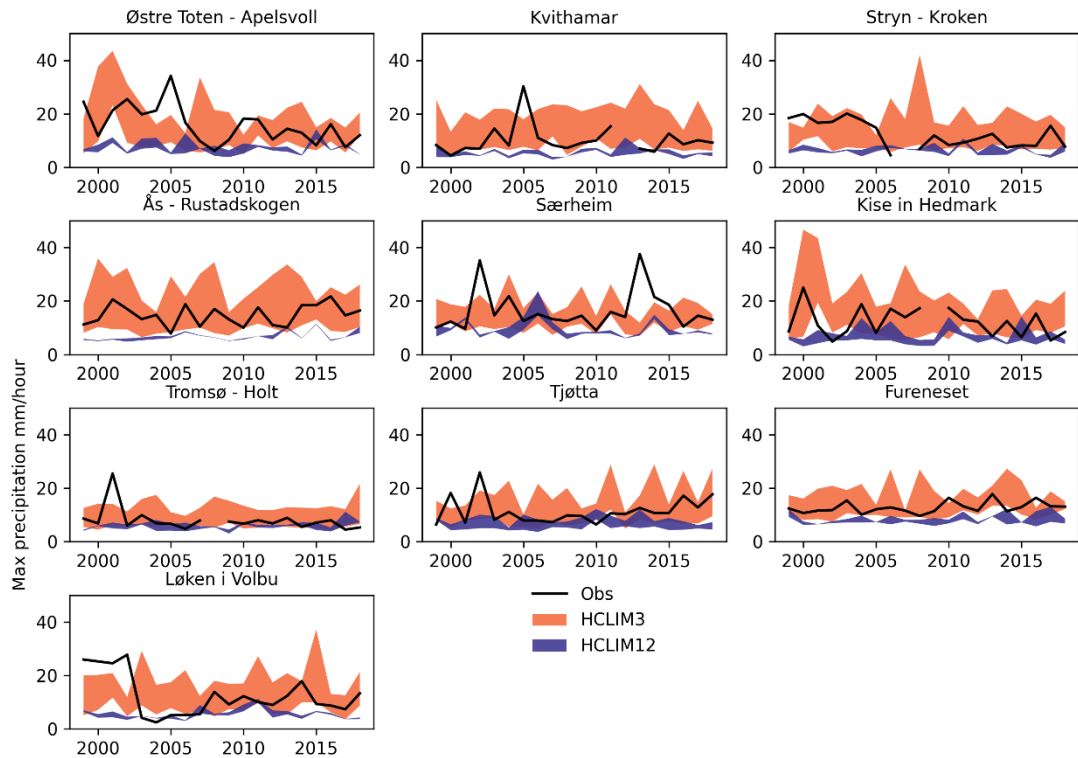


Figure S2: Time evolution of annual maximum hourly precipitation from observation, HCLIM3 and HCLIM12 during 1999-2018 at 10 hourly rain-gauges. Grids within a 12 km radius of each station are extracted for HCLIM3 and HCLIM12 to calculate the range band.

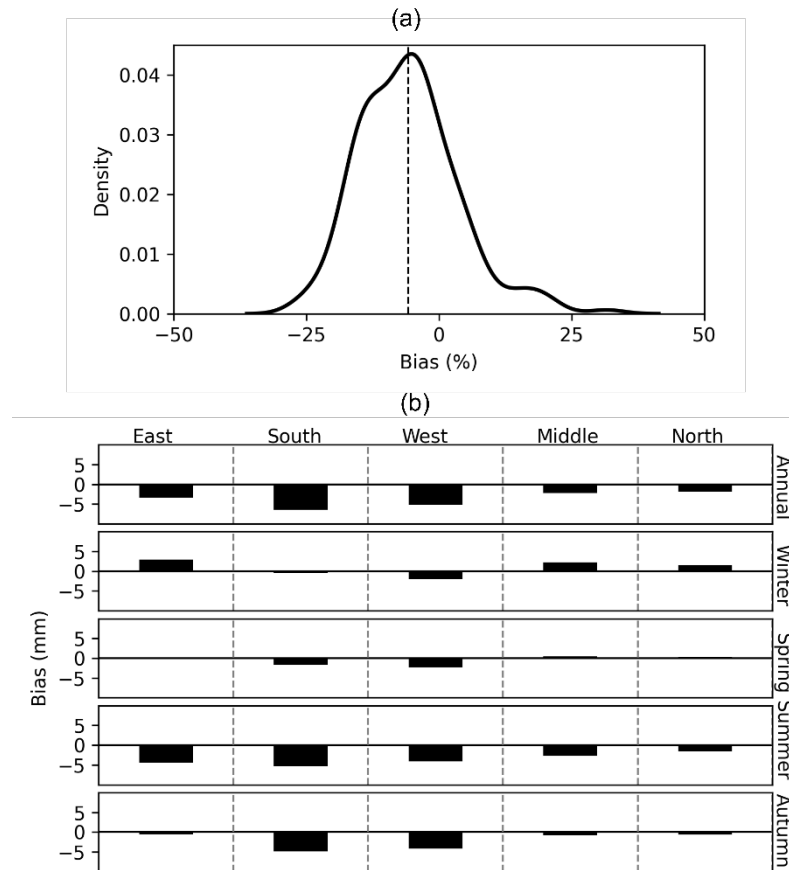


Figure S3: (a) Density distribution of bias for Rx1d between SeNorge and daily in-situ observations from 194 stations during 1999-2018; (b) the percentage difference of seasonal Rx1d between SeNorge and daily in-situ observations across the five regions. The bias is calculated as the SeNorge minus daily in-situ observations at each station.