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Uncertainties and their interaction in flood hazard assessment with climate change

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Supplementary Information

Table S1 Range of hydrological parameters of GR4J model

Parameter	description	L	U
X1	production store capacity [mm]	200	300
X2	Inter-catchment exchange coefficient [mm/d]	0	5
X3	routing store capacity [mm]	10	80
X4	unit hydrograph time constant [d]	0	5

Table S2 in table format of Figure 12

		Main Factors [%]				Interaction of Main factors [%]					
Catchment	RP [yrs]	CM	BC	DM	HP	CM*BC	CM*DM	CM*HP	BC*DM	BC*HP	DM*HP
Blackwater	100	36.5	20	27.5	5	5	4	2	0	0	0
	50	33	19	23	7	7	6	3.5	0.5	1	0
	10	36.33	20.67	23.83	4.83	5.83	5	3	0.17	0.33	0
Boyne	100	22.5	30	25.5	9	5.5	4	3.5	0	0	0
	50	19	33	23	7	8	5	3.5	1	0.5	0
	10	20.75	31.5	24.25	8	6.75	4.5	3.5	0.5	0.25	0
Newport	100	22.5	16	36.3	5.5	7.4	8	4.3	0	0	0
	50	25	19	35	5	5	6	3.5	1	0.5	0
	10	28	20.83	30.67	4.83	5.17	6.5	3.5	0.33	0.17	0
Slaney	100	39.5	22.7	21	5.5	5	4.5	1.8	0	0	0
	50	37.5	23.5	16.5	7.2	5.5	5	3.4	1.3	0.1	0
	10	35.2	23.5	20	5.8	5.3	5.15	3.2	1.5	0.32	0.03

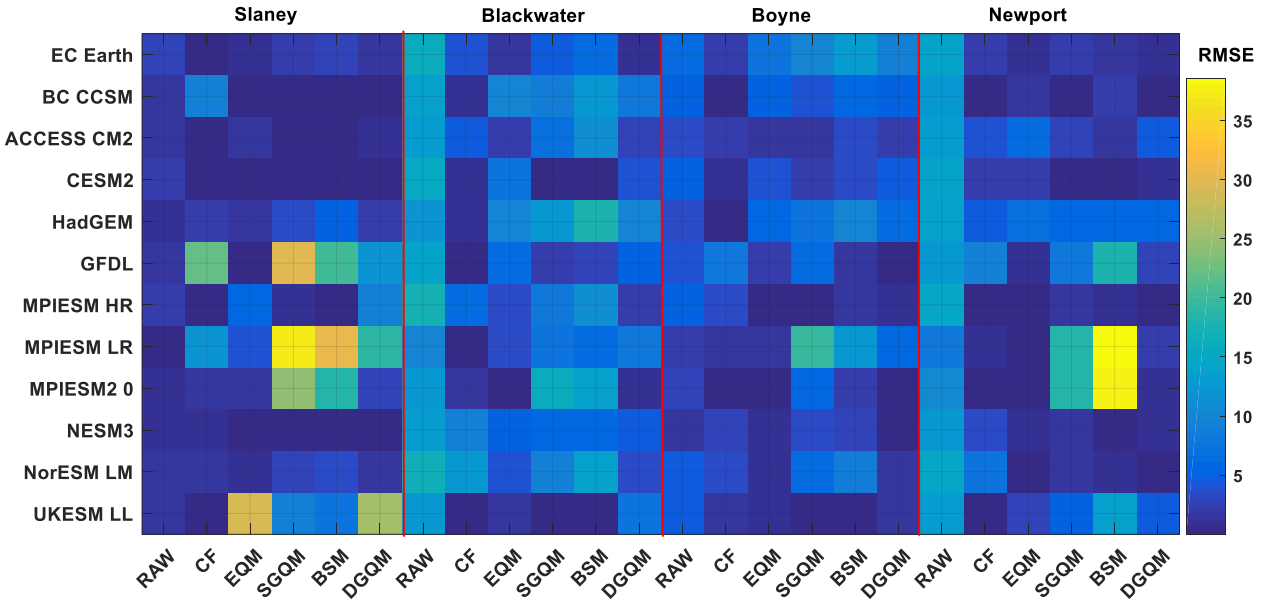

Figure S1. Root Mean Square Error (RMSE) of corrected annual maximum precipitation using five bias correction methods applied to 12 CMIP6 GCMs. The y-axis indicates each climate model and x-axis represents each climate bias correction method.

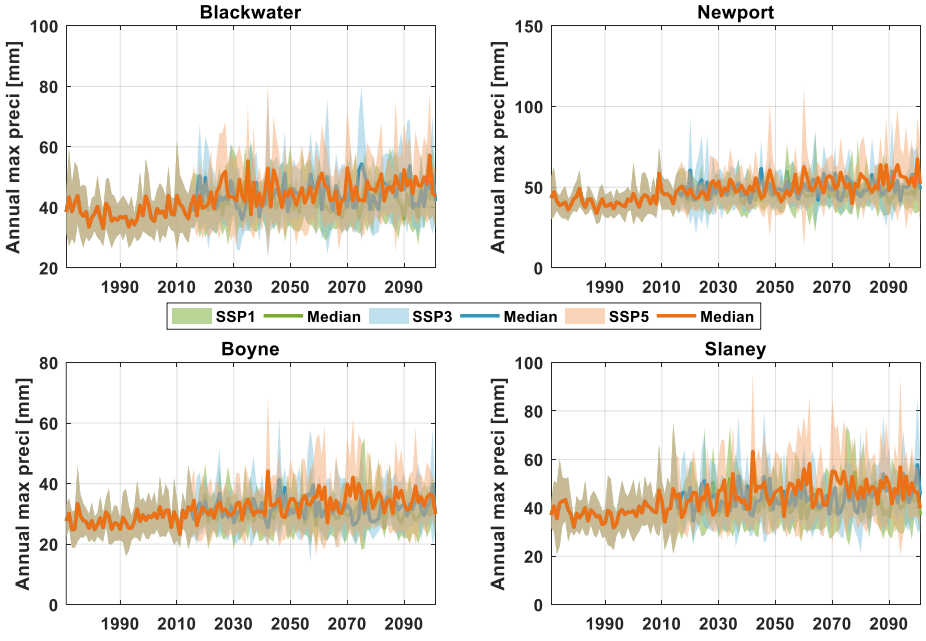

Figure S2. Projected annual maximum daily precipitation as simulated by 12 CMIP6 GCMs forced with SSP126, SSP370 and SSP585 for each catchment for the period 1976-2100. The orange, blue and green shaded areas represent the model ensemble spread (95% confidence interval) for SSP585, SSP370 and SSP126, respectively. The solid lines represent the ensemble median for each SSP scenario.

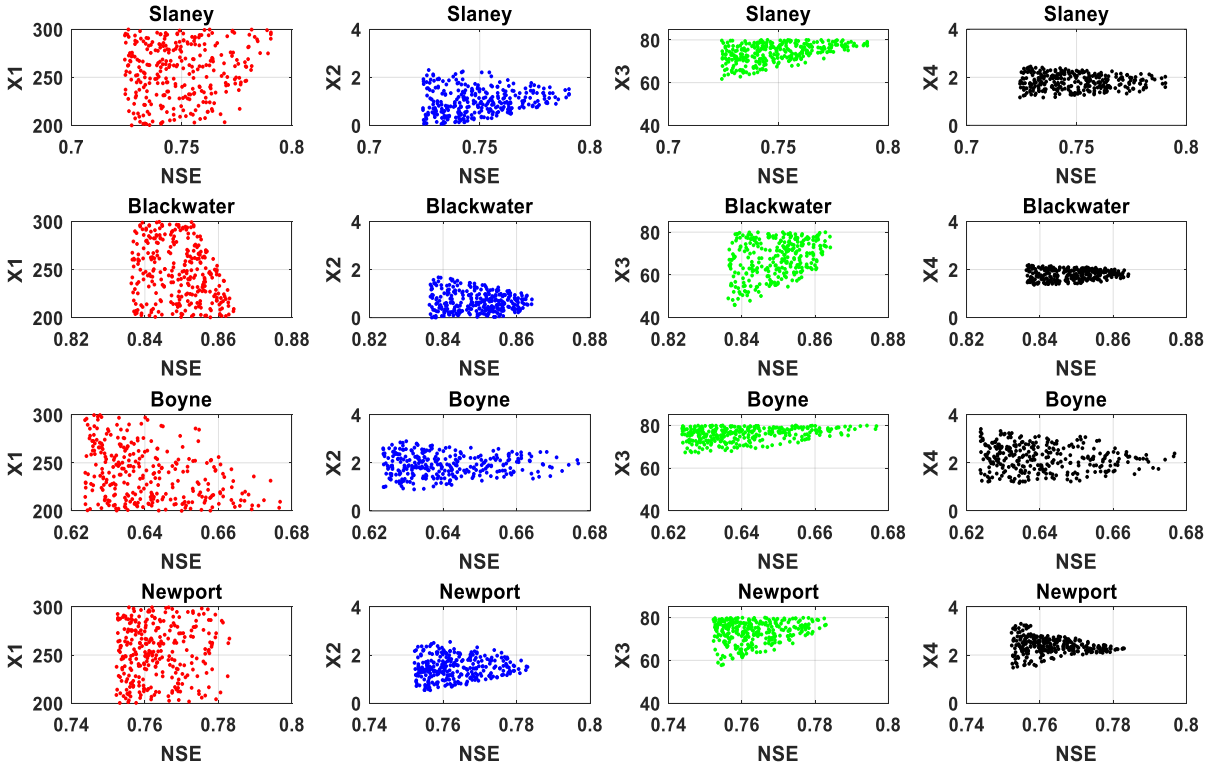

Figure S3. Behavioural parameter sets for the GR4J model for each catchment and their respective NSE objective function distribution. The red (X1 parameter), blue (X2 parameter), green (X3 parameter) and black (X4 parameter) dots represent the best values of the NSE objective function for respective GR4J model parameter values.

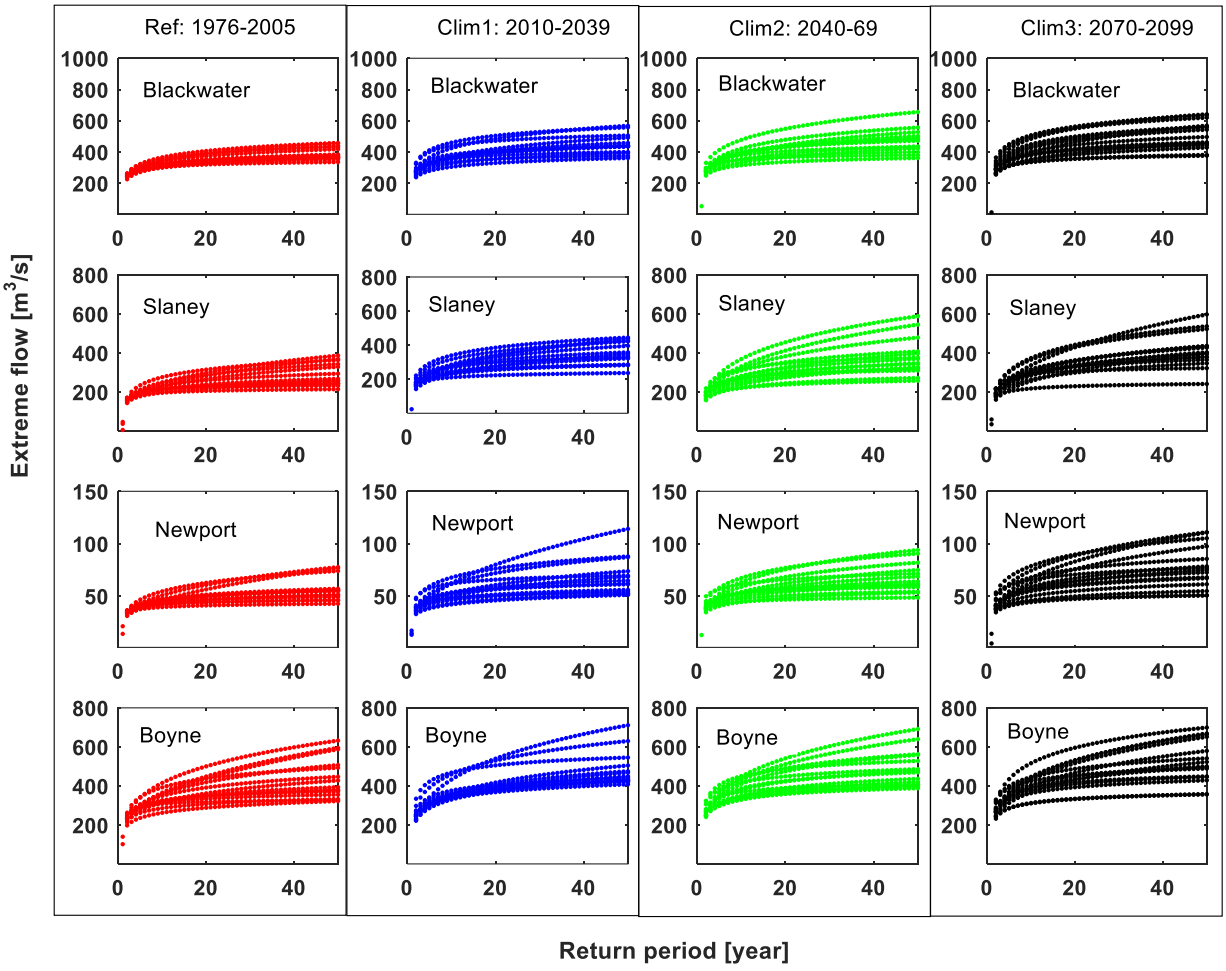

Figure S4. Flood frequency curves using GEV distribution model at different return periods for the reference period (1976-2005), the 2020s (2010-2039), the 2050s (2040-2069) and the 2080s (2070-2099) in each of the four study catchments. Each colour represents each climate period, red for reference period, blue very near future, green near future and black far future. Each line in each colour represent single climate model simulated from the best hydrological parameter set and DGQM bias correction.