Supplement of

Multiannual and seasonal variability of Vistula River flows from 1953 to 2022 in the context of meteorological conditions

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Table S1. Trends in average annual precipitation for the periods 1953–1987, 1988–2022 and 1953–2022

Years	Z	P-value	Tau	Sen's slope
		Bielsko-Biała		
1953-1987	-1.505350	0.132234	-0.179830	-3.680950
1988-2022	0.553912	0.579639	0.067227	1.433333
1953-2022	-0.856780	0.391565	-0.070390	-0.644680
		Lublin		
1953-1987	-0.340830	0.733228	-0.042020	-0.850000
1988-2022	0.426043	0.670077	0.052100	0.700000
1953-2022	0.740170	0.459197	0.060870	0.479410
		Warsaw		
1953-1987	0.738474	0.460226	0.089076	1.390000
1988-2022	1.093621	0.274121	0.131092	1.800000
1953-2022	1.769333	0.076838	0.144928	1.055263
		Toruń		
1953-1987	0.951592	0.341304	0.114286	2.028571
1988-2022	1.249726	0.211400	0.149580	2.481250
1953-2022	1.272501	0.203195	0.104348	0.861818

Table S2. Trends in the annual average air temperature for the periods 1953–1987, 1988–2022 and 1953–2022

Years	Z	P-value	Tau	Sen's slope
		Bielsko-Biała		
1953-1987	0.113811	0.909388	0.015126	0.000000
1988-2022	3.333911	0.000856	0.394958	0.042857
1953-2022	5.840257	5.21E-09	0.477019	0.033333
		Lublin		
1953-1987	-2.007060	0.044743	-0.238660	-0.035710
1988-2022	3.063727	0.002186	0.363025	0.042857
1953-2022	4.137749	3.51E-05	0.337888	0.024000
		Warsaw		
1953-1987	-0.413550	0.679200	-0.050420	-0.005560
1988-2022	3.318204	0.000906	0.393277	0.050000
1953-2022	5.603098	2.11E-08	0.457557	0.035714
		Toruń		
1953-1987	0.327283	0.743454	0.040336	0.006667
1988-2022	2.175820	0.029569	0.258824	0.030392
1953-2022	5.540055	3.02E-08	0.452588	0.033333

Table S3. Linear regression trends of mean annual flows for 1953–1987, 1988–2022 and 1953–202x

Years	**Y=ax+b**	**R^2**
	Nowy Bieruń	
1953-1987	y = 0.0030x + 21.178	R^2 = 0.00003
1988-2022	y = 0.1499x + 18.447	R^2 = 0.05740
1953-2022	y = 0.0172x + 20.576	R^2 = 0.00330
	Szczucin	
1953-1987	y = 0.3334x + 231.95	R^2 = 0.0047
1988-2022	y = 0.5425x + 219.10	R^2 = 0.0077
1953-2022	y = -0.0853x + 236.44	R^2 = 0.0009
	Sandomierz	
1953-1987	y = 0.1362x + 290.84	R^2 = 0.0005
1988-2022	y = 0.8784x + 267.76	R^2 = 0.0134
1953-2022	y = -0.0817x + 291.33	R^2 = 0.0006
	Annopol	
1953-1987	y = 0.2169x + 439.56	R^2 = 0,00050
1988-2022	y = 0.0841x + 413.14	R^2 = 0.00006
1953-2022	y = -0.5800x + 449.65	R^2 = 0.01310
	Dęblin	
1953-1987	y = 0.0161x + 509.26	R^2 = 0.000002
1988-2022	y = -0.0512x + 480.54	R^2 = 0.000020
1953-2022	y = -0.6461x + 517.52	R^2 = 0.013700
	Warszawa Nadwilanówka	
1953-1987	y = 0.1981x + 580.230	R^2 = 0.0003
1988-2022	y = -0.2133x + 566.04	R^2 = 0.0003
1953-2022	y = -0.4648x + 589.50	R^2 = 0.0053
	Toruń	
1953-1987	y = 3.7877x + 948.99	R^2 = 0.0294
1988-2022	y = -0.8467x + 928.87	R^2 = 0.0017
1953-2022	y = -1.8517x + 1031.1	R^2 = 0.0288
	Tczew	
1953-1987	y = 6.0077x + 976.23	R^2 = 0.0704
1988-2022	y = -1.1677x + 1006.8	R^2 = 0.0034
1953-2022	y = -1.5086x + 1088.6	R^2 = 0.0189

Table S4. Trends in mean annual flows of the Vistula River in 1953–1987, 1988–2022 and 1953–2022

Years	Z	P-value*	Tau	Sen's slope
Nowy Bieruń				
1953–1987	-0.156230	0.875851	-0.020170	-0.020670
1988–2022	1.420143	0.155566	0.169748	0.195240
1953–2022	0.207859	0.835339	0.017391	0.007576
Szczucin				
1953–1987	-0.028400	0.977341	-0.005040	-0.032230
1988–2022	0.482849	0.629203	0.058824	0.554732
1953–2022	-1.034210	0.301038	-0.084890	-0.316750
Sandomierz				
1953–1987	0.028403	0.977341	0.005042	0.122806
1988–2022	0.766877	0.443154	0.092437	0.635749
1953–2022	-0.699610	0.484169	-0.057560	-0.230080
Annopol				
1953–1987	0.227223	0.820250	0.028571	0.461095
1988–2022	-0.227220	0.820250	-0.028570	-0.277310
1953–2022	-1.389090	0.164806	-0.113870	-0.735560
Dęblin				
1953–1987	0.227223	0.820250	0.028751	0.382375
1988–2022	-0.142010	0.887069	-0.018490	-0.257840
1953–2022	-1.257280	0.208654	-0.103110	-0.732160
Warszawa Nadwilanówka				
1953–1987	0.284029	0.776388	0.035294	0.793205
1988–2022	-0.198820	0.842404	-0.025210	-0.366070
1953–2022	-0.973370	0.330367	-0.079920	-0.604930
Toruń				
1953–1987	0.681669	0.495448	0.082353	3.798741
1988–2022	-0.568060	0.569996	-0.068910	-1.080200
1953–2022	-1.612150	0.106929	-0.132090	-2.214430
Tczew				
1953–1987	1.249726	0.211400	0.149580	5.679232
1988–2022	-0.369240	0.711951	-0.045380	-1.770260
1953–2022	-1.277550	0.201407	-0.104760	-1.627360

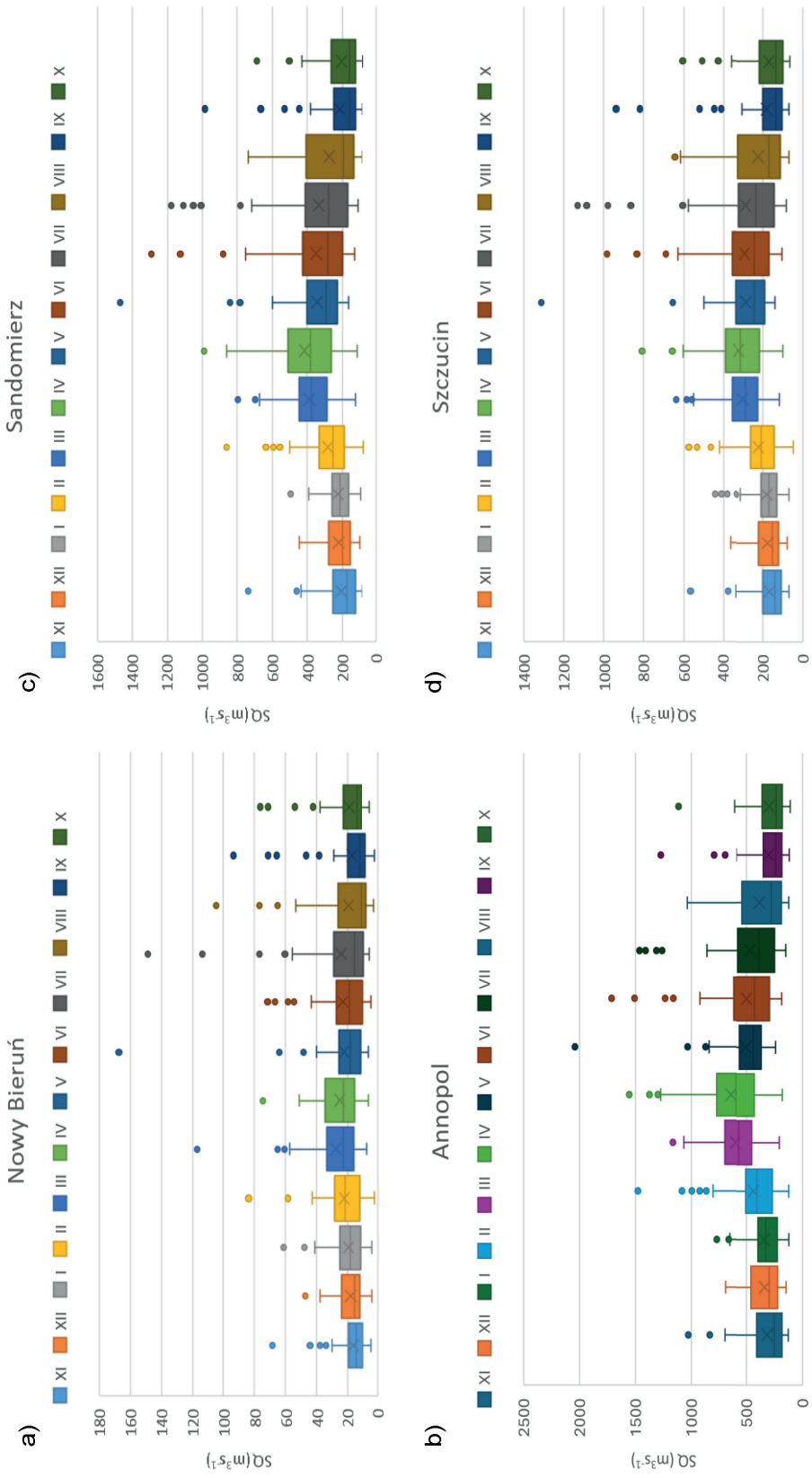

Fig. S1. Mean monthly flows of the Vistula River in the hydrological years 1953–2022 at hydrological stations: Nowy Bieruń (a), Szczucin (b), Annopol (c), Dęblin (d), Sandomierz (e), Warsaw (f), Toruń (g) and Tczew (h) (continiuation on the next page)

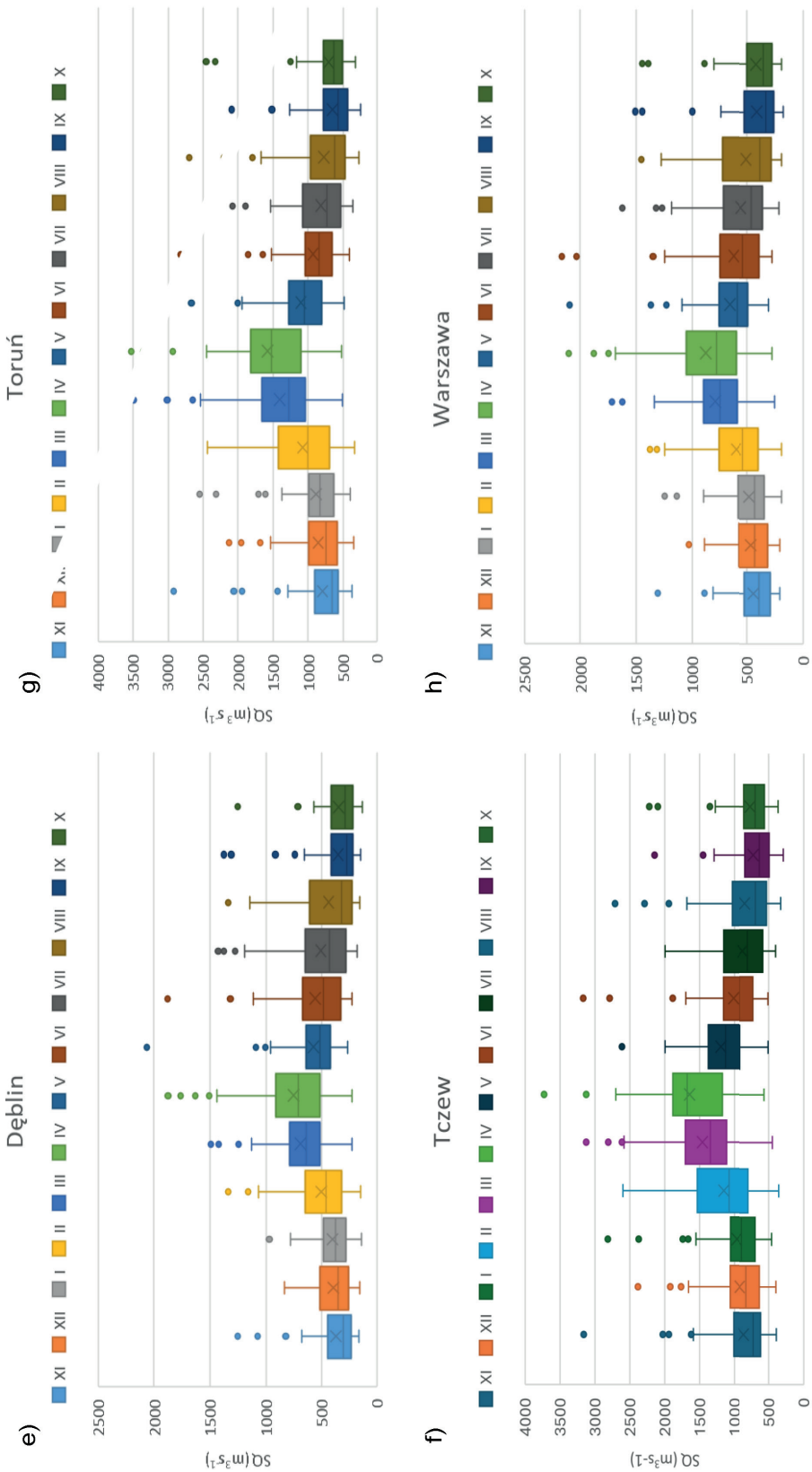

Fig. S1. continuation

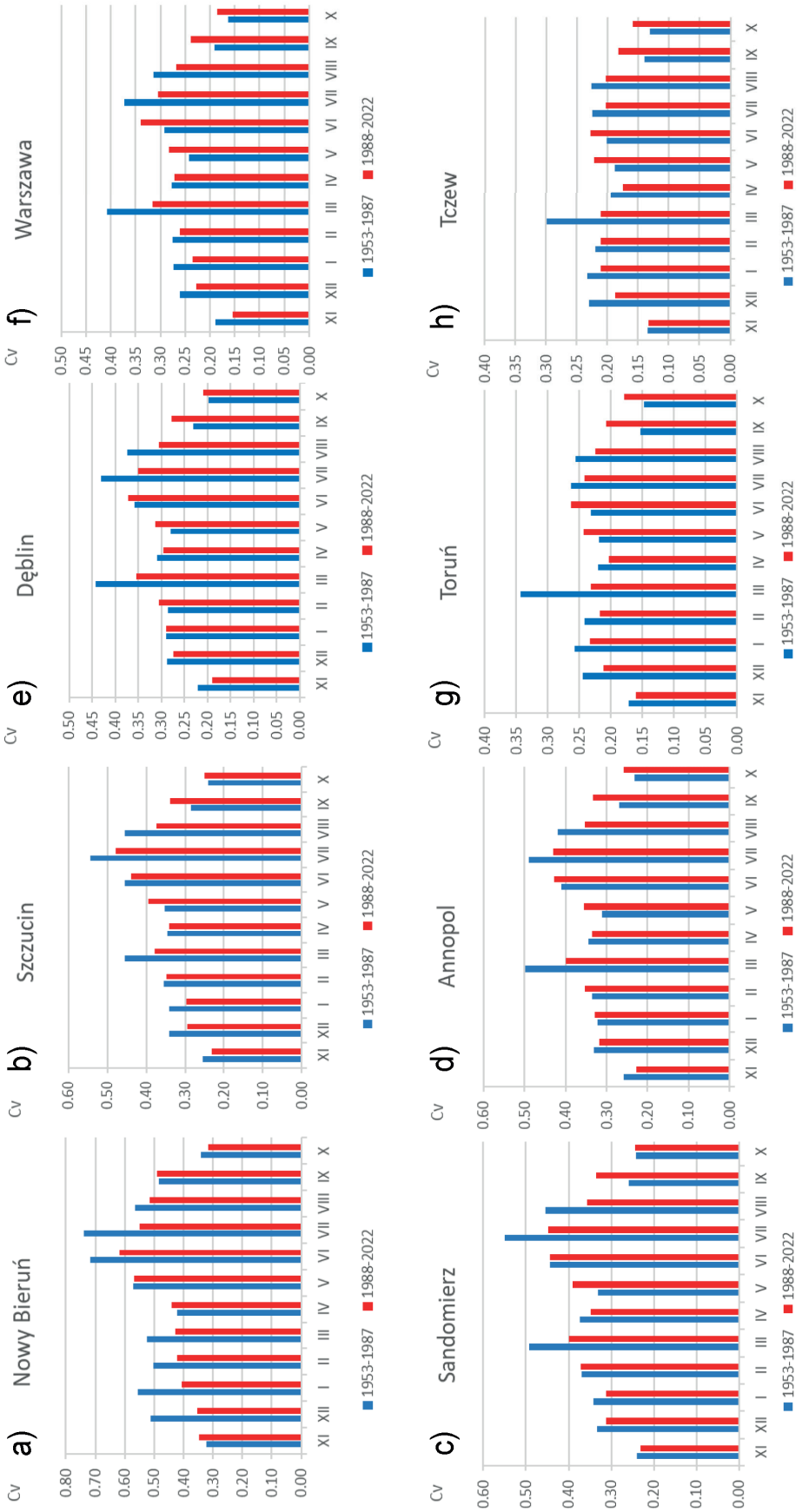

Fig. S2. Monthly variability of Vistula flows (Cv) at selected hydrological stations in two comparable periods, 1953–87 and 1988–2022 at hydrological stations: Nowy Bieruń (a), Szczucin (b), Annopol (c), Dęblin (d), Sandomierz (e), Warsaw (f), Toruń (g) and Tczew (h). Explanations as in Fig. 9