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Supplement of

Multi-centennial precipitation reconstructions for Dublin: comparing documentar instrumental and circulation-based approaches

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Supplement

1930-1994	Lasso						Random Forest						Ensemble				
Month/Season	RMSE (mm)	Pearson's R	Spearman's ρ	MAE (mm)	PBIAS (%)	Weight	RMSE (mm)	Pearson's R	Spearman's ρ	MAE (mm)	PBIAS (%)	Weight	RMSE (mm)	Pearson's R	Spearman's ρ	MAE (mm)	PBIAS (%)
Jan	19.92	0.82	0.80	15.14	0.22	0.57	23.04	0.74	0.74	17.86	0.38	0.43	20.51	0.80	0.79	15.80	0.29
Feb	17.38	0.85	0.87	13.37	0.57	0.58	20.61	0.79	0.82	16.38	0.00	0.42	18.04	0.84	0.86	13.99	0.33
Mar	19.36	0.77	0.71	15.78	-0.88	0.56	21.86	0.70	0.68	17.39	-0.19	0.44	20.16	0.75	0.71	16.29	-0.58
Apr	14.90	0.78	0.80	11.03	1.04	0.57	17.05	0.71	0.72	13.21	2.78	0.43	15.42	0.77	0.78	11.71	1.79
May	21.84	0.76	0.79	16.56	-0.40	0.59	26.18	0.63	0.66	19.27	0.36	0.41	22.91	0.74	0.76	16.58	-0.09
Jun	22.38	0.72	0.72	17.83	-0.38	0.54	24.02	0.67	0.67	18.33	2.64	0.46	22.74	0.71	0.72	17.77	1.03
Jul	21.74	0.73	0.75	17.30	-0.78	0.53	22.89	0.69	0.73	18.85	-0.43	0.47	22.10	0.72	0.73	17.98	-0.61
Aug	22.69	0.76	0.77	18.31	0.14	0.53	24.03	0.74	0.74	19.79	1.26	0.47	22.85	0.76	0.77	18.66	0.66
Sep	25.99	0.72	0.75	20.76	-0.28	0.53	27.37	0.68	0.67	22.37	-1.14	0.47	26.11	0.71	0.72	20.98	-0.69
Oct	24.80	0.78	0.79	18.83	1.10	0.54	26.66	0.73	0.73	20.74	0.65	0.46	25.15	0.77	0.78	19.08	0.89
Nov	25.37	0.73	0.75	19.09	0.47	0.52	26.29	0.70	0.71	20.06	-0.46	0.48	25.39	0.73	0.76	18.93	0.02
Dec	24.45	0.73	0.70	19.17	-1.12	0.54	26.55	0.67	0.67	19.88	-0.46	0.46	24.38	0.73	0.71	18.13	-0.82
Annual	81.55	0.70	0.70	65.63	-0.03	-	85.62	0.66	0.67	67.39	0.36	-	81.30	0.69	0.70	64.98	0.14
Winter	39.50	0.80	0.79	30.96	-0.24	-	44.97	0.73	0.73	34.52	-0.13	-	40.78	0.78	0.77	31.42	-0.18
Spring	33.92	0.76	0.75	25.39	-0.12	-	36.69	0.72	0.72	27.49	0.91	-	34.23	0.76	0.75	25.24	0.32
Summer	41.23	0.74	0.76	31.23	-0.32	-	42.62	0.71	0.75	31.73	1.13	-	41.15	0.74	0.76	31.00	0.36
Autumn	45.33	0.72	0.72	36.26	0.43	-	50.72	0.64	0.63	39.80	-0.31	-	46.99	0.69	0.68	37.18	0.08
MJJA	45.29	0.77	0.74	35.73	-0.34		48.80	0.73	0.73	37.73	0.94		45.62	0.77	0.77	36.03	0.25

Table S1 Out-of-fold (OOF) blocked cross-validation skill metrics for the monthly statistical reconstructions over the calibration period 1930-1994 in the SA9 domain. Model performance is reported for LASSO and Random Forest models using root mean square error (RMSE), Pearson's correlation coefficient (R), Spearman's rank correlation coefficient (ρ), mean absolute error (MAE) and percent bias (PBIAS). Ensemble predictions are derived from a weighted combination of the two models, with weights computed from inverse-squared RMSE values and normalised within each month.

1930-1994	Lasso						Random Forest						Ensemble				
Month	**RMSE (mm)**	**Pearson's R**	**Spearman's ρ**	**MAE (mm)**	**PBIAS (%)**	**Weight**	**RMSE (mm)**	**Pearson's R**	**Spearman's ρ**	**MAE (mm)**	**PBIAS (%)**	**Weight**	**RMSE (mm)**	**Pearson's R**	**Spearman's ρ**	**MAE (mm)**	**PBIAS (%)**
Jan	33.65	0.80	0.79	26.67	-0.75	0.57	38.97	0.72	0.71	31.43	0.31	0.43	35.11	0.78	0.76	28.09	-0.30
Feb	26.74	0.85	0.87	20.72	0.26	0.59	31.95	0.77	0.80	25.00	-0.06	0.41	27.71	0.83	0.85	22.10	0.13
Mar	31.00	0.77	0.71	25.15	-0.24	0.56	34.75	0.70	0.67	28.69	-0.35	0.44	32.28	0.75	0.71	26.64	-0.29
Apr	22.81	0.78	0.77	17.52	0.96	0.55	25.20	0.72	0.71	19.78	-0.52	0.45	23.25	0.77	0.75	18.23	0.29
May	30.25	0.79	0.82	22.56	-0.08	0.57	34.76	0.72	0.73	25.07	0.26	0.43	31.06	0.78	0.80	22.21	0.07
Jun	25.59	0.77	0.76	20.65	-0.40	0.56	28.73	0.70	0.69	22.55	1.95	0.44	26.22	0.76	0.75	21.16	0.64
Jul	24.89	0.82	0.84	19.63	-1.99	0.55	27.74	0.76	0.78	22.31	0.04	0.45	24.96	0.81	0.84	19.64	-1.09
Aug	32.68	0.77	0.82	25.43	0.27	0.50	32.79	0.77	0.82	25.22	1.25	0.50	31.82	0.79	0.83	24.62	0.76
Sep	32.70	0.78	0.79	26.84	-0.18	0.56	36.92	0.71	0.68	31.21	-0.87	0.44	33.56	0.77	0.76	28.11	-0.48
Oct	36.62	0.75	0.78	27.78	0.10	0.53	38.64	0.71	0.72	30.14	0.56	0.47	35.47	0.77	0.79	27.20	0.31
Nov	38.41	0.73	0.75	29.17	0.04	0.53	40.47	0.69	0.67	32.15	-0.64	0.47	38.58	0.72	0.73	29.84	-0.28
Dec	35.67	0.77	0.76	29.25	-0.13	0.57	41.46	0.67	0.65	34.35	-0.55	0.43	37.13	0.75	0.72	30.22	-0.31
Annual	128.11	0.67	0.66	102.93	-0.18	-	134.55	0.63	0.63	107.92	0.05	-	127.48	0.67	0.66	102.24	-0.08
Winter	60.45	0.82	0.83	49.58	-0.59	-	72.23	0.73	0.73	58.77	-0.44	-	64.36	0.79	0.81	53.20	-0.52
Spring	52.68	0.77	0.76	39.54	0.17	-	54.18	0.76	0.75	39.65	-0.21	-	52.15	0.78	0.78	38.52	0.00
Summer	51.04	0.78	0.79	38.98	-0.68	-	50.85	0.77	0.80	37.36	1.05	-	49.08	0.79	0.80	36.68	0.11
Autumn	69.29	0.70	0.70	55.42	-0.01	-	77.45	0.61	0.58	61.80	-0.31	-	70.90	0.68	0.68	56.17	-0.15
MJJA	56.42	0.80	0.77	43.94	-0.53	-	59.97	0.77	0.77	45.56	0.85	-	55.26	0.81	0.81	43.69	0.10

Table S2 Out-of-fold (OOF) blocked cross-validation skill metrics for the monthly statistical reconstructions over the calibration period 1930-1994 in the SA-upland domain. Model performance is reported for LASSO and Random Forest models using root mean square error (RMSE), Pearson's correlation coefficient (R), Spearman's rank correlation coefficient (ρ), mean absolute error (MAE) and percent bias (PBIAS). Ensemble predictions are derived from a weighted combination of the two models, with weights computed from inverse-squared RMSE values and normalised within each month.

Domain	Model	Cal/Val	Period	RMSE (mm)	Pearson's R	MAE (mm)	PBIAS (%)
SA9	Early calibration - Late validation	calibration	1930-1965	68.71	0.54	54.62	>0.01
		validation	1966-2000	62.71	0.55	48.57	4.65
	Late calibration - Early validation	calibration	1966-2000	62.66	0.55	47.70	>0.01
		validation	1930-1965	70.94	0.54	55.65	-3.87
SA-upland	Early calibration - Late validation	calibration	1930-1965	90.13	0.52	73.19	>0.01
		validation	1966-2000	85.64	0.54	68.59	5.06
	Late calibration - Early validation	calibration	1966-2000	88.45	0.54	70.64	>0.01
		validation	1930-1965	97.45	0.52	80.34	-3.61

Table S3 Robustness estimates for the calibration period for the SA9 (top) and SA-upland (bottom) rainfall reconstruction using a true split-period approach, based on the tree-ring $\delta^{18}O$-based reconstruction. Two configurations are shown: calibration over 1930-1965 with verification over 1966-2000, and its reverse arrangement. Model performance is evaluated using root mean square error (RMSE), Pearson's correlation coefficient (R), mean absolute error (MAE) and percent bias (PBIAS), computed from paired observed and reconstructed values within each verification period.

		SA9						SAupland					
		Ensemble		Jenkinson		Observed		Ensemble		Jenkinson		Observed	
	Rank	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)
Wettest	1	**1872**	1153.27	**1872**	1154.17	1960	1208.93	**1872**	1660.34	**1872**	1638.94	1960	1768.61
	2	**1903**	1122.18	**1960**	1133.33	1958	1159.96	1924	1632.35	**1960**	1609.35	1872	1687.71
	3	**1924**	1096.77	1928	1128.8	1872	1158.39	**1903**	1630.54	**1928**	1602.92	1882	1685.83
	4	1927	1096.4	**1903**	1110.68	1916	1137.06	**1960**	1586.84	**1903**	1577.19	1966	1680.39
	5	**1960**	1090.16	**1958**	1106.15	1882	1132.84	**1930**	1586.51	**1958**	1570.76	1958	1626.59
	6	**1877**	1080.06	**1877**	1105.25	1900	1128.88	1927	1577.51	**1877**	1569.47	1877	1624.63
	7	**1930**	1077.94	**1924**	1092.57	1966	1126.04	1951	1543.36	1924	1551.46	1946	1619.84
	8	**1958**	1063.09	**1954**	1074.45	1930	1109.67	1912	1538.36	**1954**	1525.73	1930	1586.8
	9	1951	1060.72	**1966**	1055.42	1877	1105.93	**1958**	1528.91	**1966**	1498.72	1947	1568.63
	10	**1910**	1043.5	**1882**	1052.7	1946	1100.82	1866	1518.27	**1882**	1494.86	1876	1554
	11	**1916**	1042.48	1938	1048.17	1947	1089.29	**1966**	1516.16	1938	1488.43	1965	1553.6
	12	1912	1038.91	**1948**	1043.64	1910	1075.85	**1877**	1508.8	**1948**	1481.99	1928	1550.84
	13	1866	1038.05	**1930**	1039.12	1924	1068.04	**1928**	1492.29	**1930**	1475.56	1900	1532.24
	14	**1966**	1031.56	**1965**	1030.96	1876	1066.89	**1882**	1491.58	**1965**	1463.98	1897	1512.36
	15	**1882**	1029.09	**1900**	1030.06	1954	1055.99	**1910**	1487.87	**1900**	1462.7	1954	1490.82
	16	1928	1028.06	**1947**	1023.71	1897	1052.97	1950	1486.69	**1947**	1453.69	1875	1480.57
	17	**1965**	1027.51	**1916**	1021	1965	1050.03	**1965**	1477.8	1916	1449.83	1910	1480.54
	18	**1954**	1025.44	**1946**	1016.47	1948	1037.74	**1954**	1469.54	**1946**	1443.4	1977	1474.65
	19	1891	1020.18	**1897**	1015.56	1931	1036.82	**1946**	1464.8	**1897**	1442.11	1948	1472.72
	20	1950	1017.93	1950	1011.94	1903	1030.08	1916	1460.58	1950	1436.97	1903	1468.65

Table S4a Top 20 wettest years (1865-1977) for observations and reconstructions. Years highlighted by bold are extreme years present in both the Jenkinson and statistical reconstructions' top 20.

		SA9						SAupland					
		Ensemble		Jenkinson		Observed		Ensemble		Jenkinson		Observed	
	Rank	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)
Driest	1	**1921**	673.58	**1887**	647.75	1887	559.75	**1921**	988.08	**1887**	919.81	1887	718.29
	2	1973	739.42	**1933**	689.42	1971	682.73	**1887**	1023.07	**1933**	978.99	1971	898.75
	3	**1887**	741.07	**1893**	695.76	1893	685.13	1973	1035.45	**1893**	988	1884	945.18
	4	**1949**	757.23	**1971**	719.32	1933	688.9	**1975**	1078.82	**1971**	1021.44	1873	946.06
	5	**1975**	758.89	**1953**	770.05	1884	720.54	**1949**	1093.41	**1953**	1093.48	1870	994.85
	6	**1971**	761.56	**1975**	775.49	1922	724.34	**1933**	1099.82	**1975**	1101.2	1921	1002.36
	7	**1870**	766.43	**1952**	779.11	1949	726.2	**1971**	1102.76	**1952**	1106.35	1922	1009.13
	8	**1933**	766.51	**1870**	781.83	1953	726.69	**1870**	1115.83	**1870**	1110.21	1933	1021.02
	9	**1953**	785.08	1941	783.64	1975	733.45	**1953**	1129.92	1941	1112.78	1949	1023.62
	10	1976	788.3	**1921**	788.17	1873	743.12	**1905**	1151.42	**1921**	1119.21	1917	1038.97
	11	1956	800.48	**1969**	794.51	1870	748.28	1955	1157.18	**1969**	1128.22	1893	1040.76
	12	1955	804.95	**1905**	797.23	1921	754.79	1976	1161.66	**1905**	1132.08	1975	1050.12
	13	**1905**	817.73	1955	808.1	1945	760.96	1956	1166.54	1955	1147.52	1953	1050.17
	14	1962	829.42	1919	815.35	1952	765.73	1896	1172.64	**1919**	1157.81	1905	1055.14
	15	1896	832.88	**1885**	819.88	1905	768.38	1874	1199.22	**1885**	1164.24	1885	1072.53
	16	**1945**	834.85	1889	820.78	1906	776.63	1944	1200.97	1889	1165.53	1869	1077.32
	17	1944	841.14	**1922**	823.5	1961	787.72	1964	1202.97	**1922**	1169.39	1919	1087.57
	18	1964	847.33	1902	823.5	1904	793.12	**1969**	1211.33	1902	1169.39	1969	1092.94
	19	1959	850.66	1909	832.56	1969	794.41	1962	1212.76	1906	1182.25	1935	1098.78
	20	1899	851.32	**1906**	832.56	1885	800.38	**1952**	1219.92	1909	1182.25	1952	1105.85

Table S4b Top 20 driest years (1865-1977) for observations and reconstructions. Years highlighted by bold are extreme years present in both the Jenkinson and statistical reconstructions' top 20.

Series	Model vs Obs.	Type	Numerator	Denominator	JI
ANN	Jenk vs Obs.	Wettest	16	24	0.67
ANN	Jenk vs Obs.	Driest	14	26	0.54
ANN	Ens vs Obs.	Wettest	13	27	0.48
ANN	Ens vs Obs.	Driest	10	30	0.33
DJF	Jenk vs Obs.	Wettest	15	25	0.60
DJF	Jenk vs Obs.	Driest	14	26	0.54
DJF	Ens vs Obs.	Wettest	14	26	0.54
DJF	Ens vs Obs.	Driest	13	27	0.48
MAM	Jenk vs Obs.	Wettest	14	26	0.54
MAM	Jenk vs Obs.	Driest	13	27	0.48
MAM	Ens vs Obs.	Wettest	10	30	0.33
MAM	Ens vs Obs.	Driest	12	28	0.43
JJA	Jenk vs Obs.	Wettest	15	25	0.60
JJA	Jenk vs Obs.	Driest	15	25	0.60
JJA	Ens vs Obs.	Wettest	12	28	0.43
JJA	Ens vs Obs.	Driest	12	28	0.43
SON	Jenk vs Obs.	Wettest	11	29	0.38
SON	Jenk vs Obs.	Driest	16	24	0.67
SON	Ens vs Obs.	Wettest	10	30	0.33
SON	Ens vs Obs.	Driest	14	26	0.54
MJJA	Jenk vs Obs.	Wettest	15	25	0.60
MJJA	Jenk vs Obs.	Driest	16	24	0.67
MJJA	Ens vs Obs.	Wettest	12	28	0.43
MJJA	Ens vs Obs.	Driest	12	28	0.43
MJJA	Trees vs Obs.	Wettest	11	29	0.38
MJJA	Trees vs Obs.	Driest	9	31	0.29

Table S5 Jaccard Index (JI) scores for the agreement between reconstructed and observed rainfall in identifying the top 20 wettest and driest years in SA9 across annual and seasonal aggregations. Results are shown for the Jenkinson reconstruction, statistical ensemble (ENS), and $\delta^{18}O$ based reconstruction (MJJA only), all compared against observations over the period 1865-1977. The numerator represents the number of years common to both the reconstruction and observed top-20 lists (intersection), while the denominator represents the total number of unique years across both lists (union). JI values range from 0 (no overlap) to 1 (complete agreement), with higher values indicating greater consistency in the identification of extreme years.

Series	Model vs Obs.	Type	Numerator	Denominator	JI
ANN	Jenk vs Obs.	Wettest	16	24	0.67
ANN	Jenk vs Obs.	Driest	14	26	0.54
ANN	Ens vs Obs.	Wettest	13	27	0.48
ANN	Ens vs Obs.	Driest	11	29	0.38
DJF	Jenk vs Obs.	Wettest	13	27	0.48
DJF	Jenk vs Obs.	Driest	14	26	0.54
DJF	Ens vs Obs.	Wettest	13	27	0.48
DJF	Ens vs Obs.	Driest	13	27	0.48
MAM	Jenk vs Obs.	Wettest	14	26	0.54
MAM	Jenk vs Obs.	Driest	13	27	0.48
MAM	Ens vs Obs.	Wettest	13	27	0.48
MAM	Ens vs Obs.	Driest	13	27	0.48
JJA	Jenk vs Obs.	Wettest	16	24	0.67
JJA	Jenk vs Obs.	Driest	15	25	0.60
JJA	Ens vs Obs.	Wettest	14	26	0.54
JJA	Ens vs Obs.	Driest	13	27	0.48
SON	Jenk vs Obs.	Wettest	12	28	0.43
SON	Jenk vs Obs.	Driest	14	26	0.54
SON	Ens vs Obs.	Wettest	12	28	0.43
SON	Ens vs Obs.	Driest	10	30	0.33
MJJA	Jenk vs Obs.	Wettest	13	27	0.48
MJJA	Jenk vs Obs.	Driest	16	24	0.67
MJJA	Ens vs Obs.	Wettest	13	27	0.48
MJJA	Ens vs Obs.	Driest	16	24	0.67
MJJA	Trees vs Obs.	Wettest	9	31	0.29
MJJA	Trees vs Obs.	Driest	10	30	0.33

Table S6 Jaccard Index (JI) scores for the agreement between reconstructed and observed rainfall in identifying the top 20 wettest and driest years in SA-upland across annual and seasonal aggregations. Results are shown for the Jenkinson reconstruction, statistical ensemble (ENS), and $\delta^{18}O$ based reconstruction (MJJA only), all compared against observations over the period 1865-1977. The numerator represents the number of years common to both the reconstruction and observed top-20 lists (intersection), while the denominator represents the total number of unique years across both lists (union). JI values range from 0 (no overlap) to 1 (complete agreement), with higher values indicating greater consistency in the identification of extreme years.

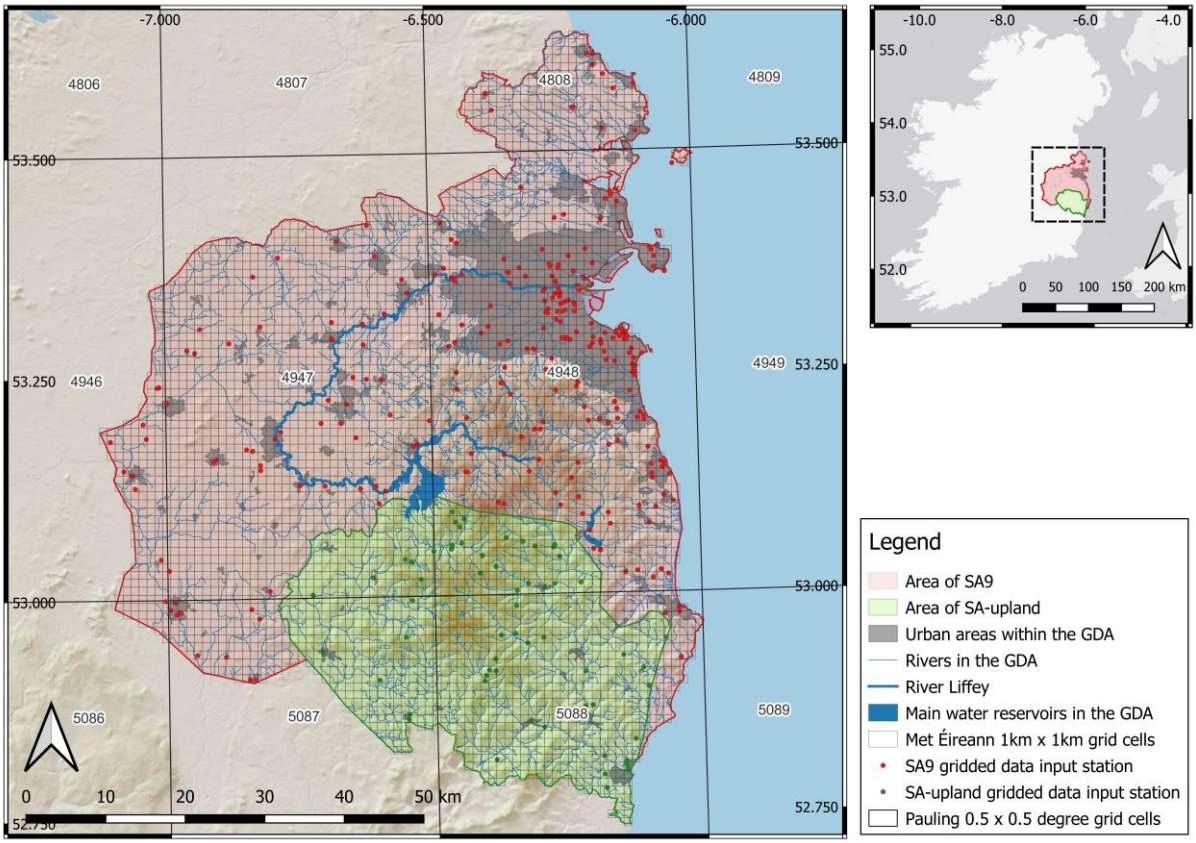


Figure S1 Supplementary map showing the spatial datasets used in this study. The map displays the Met Éireann 1 km × 1 km gridded rainfall cells, the locations of contributing rainfall stations, and the 0.5° × 0.5° Pauling et al. (2006) gridded precipitation cells extracted (4947 and 4948) for independent comparison with the reconstructed seasonal rainfall series. The SA9 and SA-upland study domains, major rivers, reservoirs and urban areas are also shown.

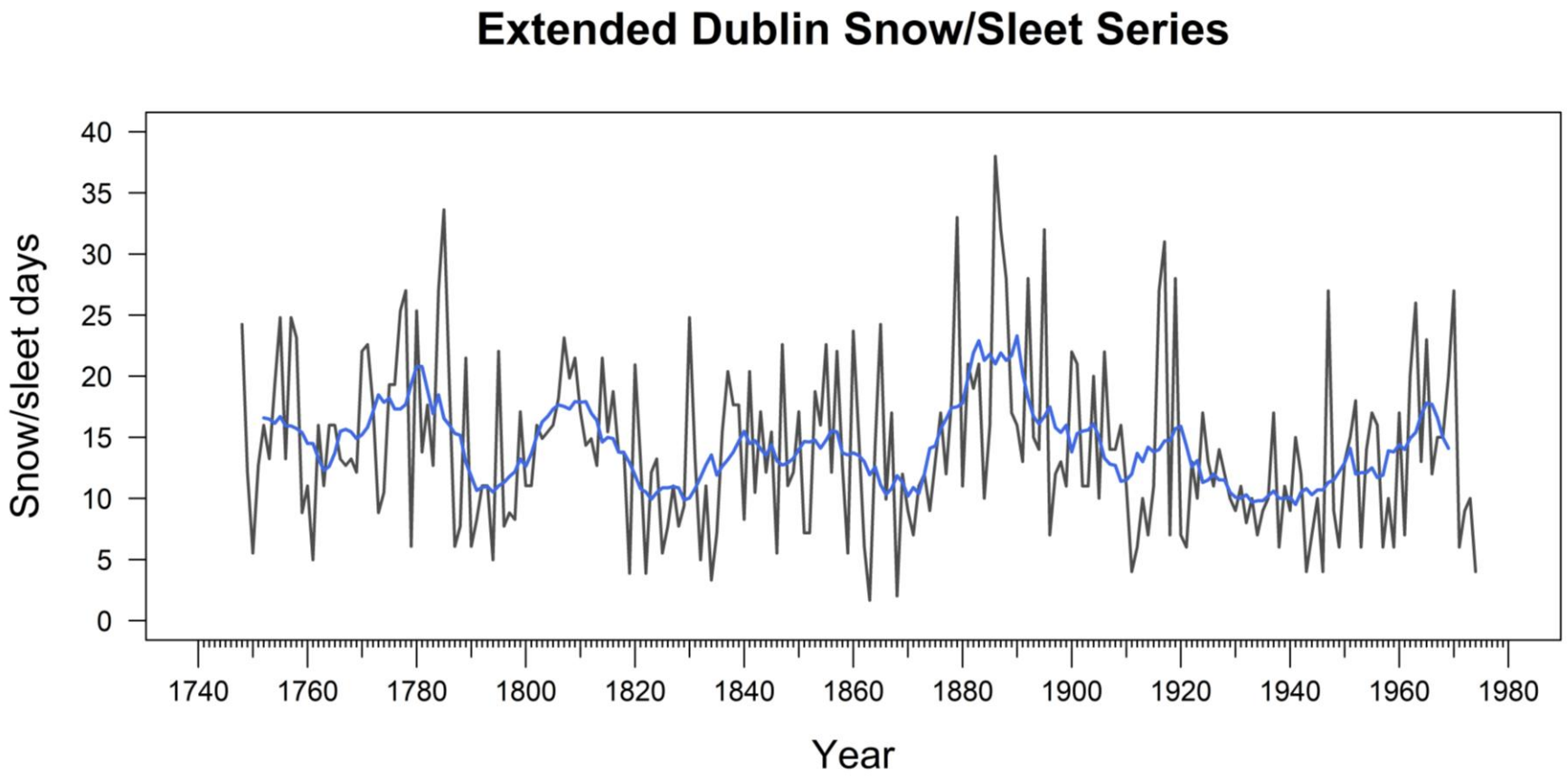


Figure S2 Extended Dublin Snow and Sleet (DSS) series (1748-1974). Annual number of days with snow and/or sleet (black), with 10-year running mean (blue).

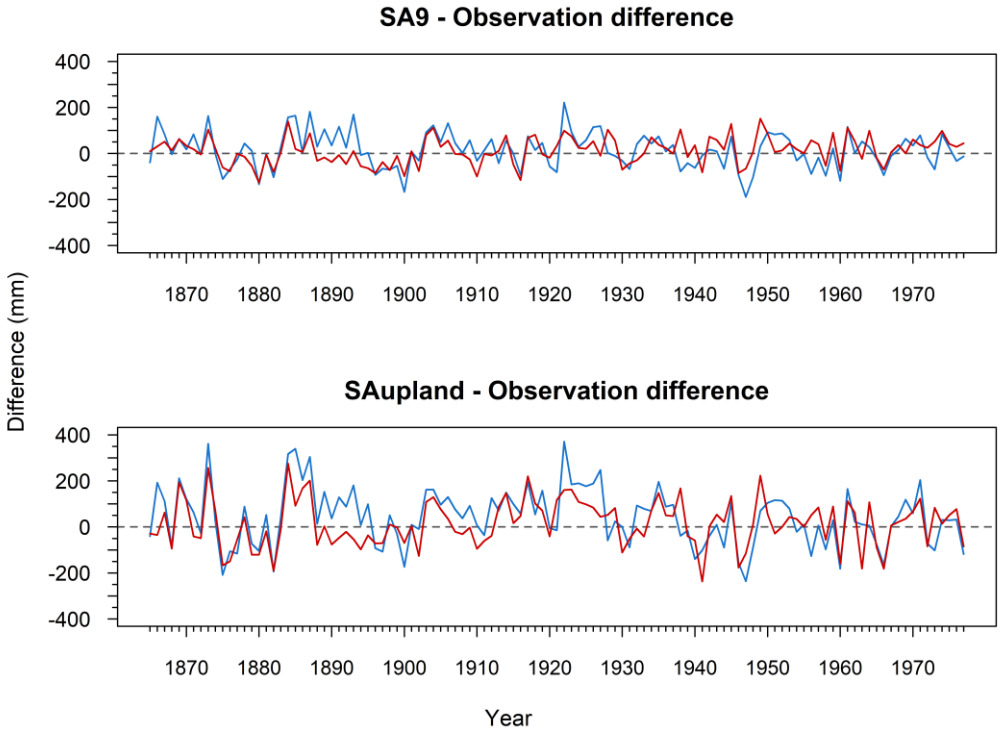


Figure S3 Annual differences between the Statistical Ensemble and Jenkinson reconstructions and observations for SA9 and SA-upland, 1865-1977. Blue and red denote Ensemble minus observed and Jenkinson minus observed rainfall, respectively; positive values indicate reconstructed totals above observations.

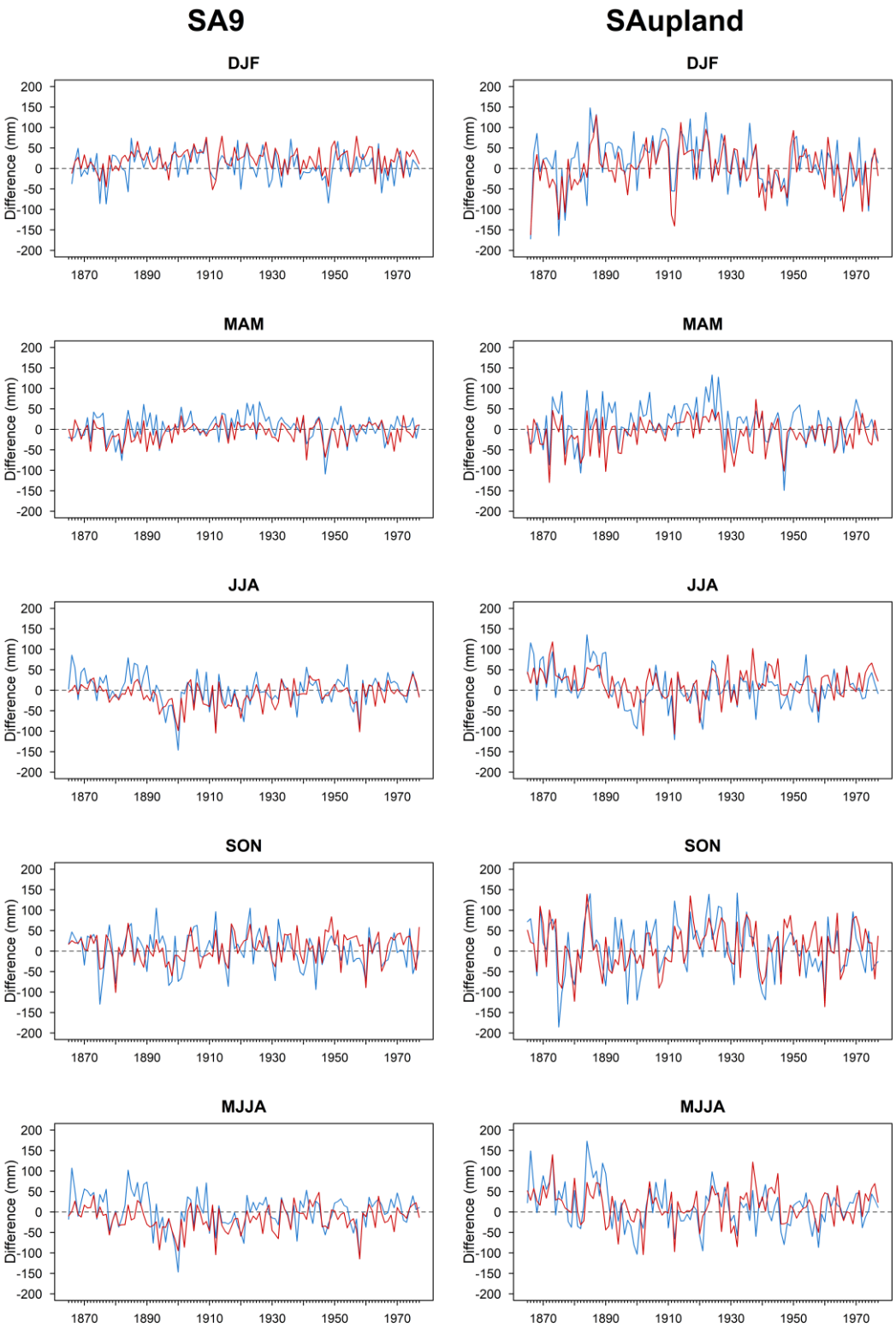


Figure S4 Seasonal differences between the Statistical Ensemble and Jenkinson reconstructions and observations for SA9 and SA-upland, 1865-1977. Blue and red denote Ensemble minus observed and Jenkinson minus observed rainfall, respectively; positive values indicate reconstructed totals above observations. DJF begins in 1866 because winter 1865 is incomplete.

		SA9				SAupland			
		Ensemble		Jenkinson		Ensemble		Jenkinson	
	Rank	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)	Year	Annual totals (mm)
Wettest	1	**1960**	1208.9	**1960**	1208.9	**1960**	1768.6	**1960**	1768.6
	2	**2002**	1181.8	**2002**	1181.8	**2009**	1753.4	**2009**	1753.4
	3	**1958**	1160	1768	1179.5	**1872**	1687.7	**1872**	1687.7
	4	**1872**	1158.4	**1958**	1160	**1882**	1685.8	**1882**	1685.8
	5	**1916**	1137.1	**1872**	1158.4	**1966**	1680.4	**1966**	1680.4
	6	**1882**	1132.8	1852	1141.2	**1958**	1626.6	1768	1675
	7	**2009**	1130.8	**1916**	1137.1	**1877**	1624.6	**1958**	1626.6
	8	**1900**	1128.9	**1882**	1132.8	**1946**	1619.8	**1877**	1624.6
	9	1966	1126	**2009**	1130.8	2002	1617.8	1852	1620.6
	10	1848	1114.2	**1900**	1128.9	2014	1612	**1946**	1619.8
Driest	1	**1887**	559.7	**1887**	559.7	**1887**	718.3	**1887**	718.3
	2	**1971**	682.7	1788	584.3	**1971**	898.7	1788	829.8
	3	**1893**	685.1	1740	651.4	**1884**	945.2	**1971**	898.7
	4	**1933**	688.9	**1971**	682.7	**1873**	946.1	1740	925
	5	1884	720.5	1747	684.9	**1870**	994.9	**1884**	945.2
	6	1922	724.3	**1893**	685.1	1921	1002.4	**1873**	946.1
	7	1834	724.8	1803	688.5	1922	1009.1	1747	972.6
	8	1949	726.2	**1933**	688.9	1933	1021	1803	977.7
	9	1953	726.7	1741	692.1	1949	1023.6	1741	982.8
	10	2001	729.8	1855	720.2	1917	1039	**1870**	994.9

Table S7 Top 10 wettest and driest years in the appended Ensemble and Jenkinson rainfall products for the SA9 and SA-upland domains. The Ensemble product spans 1748-2024 and the Jenkinson product spans 1711-2024; both incorporate the same gridded observed rainfall from 1865 onwards. Wettest and driest years were ranked separately within each domain and product. Years in bold occur in the corresponding top-10 list for both products within the same domain.

		SA9				SAupland			
		Ensemble		Jenkinson		Ensemble		Jenkinson	
Season	Rank	Year	Seasonal total (mm)	Year	Seasonal total (mm)	Year	Seasonal total (mm)	Year	Seasonal total (mm)
DJF	1	**1877**	438.3	**1877**	438.3	**2016**	708.8	**2016**	708.8
	2	**2016**	432.5	**2016**	432.5	**1877**	666	**1877**	666
	3	**2014**	404.7	1764	416.1	**2014**	653	**2014**	653
	4	**1994**	395.2	1834	408.1	**1966**	645.9	**1966**	645.9
	5	**1915**	376.4	**2014**	404.7	**1912**	614.4	**1912**	614.4
	6	**1995**	375.7	**1994**	395.2	**1974**	610.3	**1974**	610.3
	7	**1869**	366.4	**1915**	376.4	**1994**	601.6	**1994**	601.6
	8	**1912**	364.9	**1995**	375.7	**1866**	595.7	**1866**	595.7
	9	1948	362.7	**1869**	366.4	1960	570.3	1764	590.9
	10	1966	350.3	**1912**	364.9	1869	549	1834	579.5
MAM	1	**1947**	390.3	**1947**	390.3	**1947**	559.5	**1947**	559.5
	2	**1981**	298.5	1715	317.4	**1981**	453.3	**1981**	453.3
	3	**1877**	289	1782	299.2	**1993**	450.1	1715	450.7
	4	**1993**	286.7	**1981**	298.5	**1877**	421.1	**1993**	450.1
	5	**1882**	283.9	**1877**	289	**1983**	413.1	1782	424.8
	6	1983	278.4	**1993**	286.7	1751	406.4	**1877**	421.1
	7	1751	275.6	1818	284.8	**1931**	403.6	**1983**	413.1
	8	1916	274.9	**1882**	283.9	**1882**	402.6	1818	404.5
	9	1913	272.1	1756	282.2	1994	398	**1931**	403.6
	10	1979	270	1755	281.6	1979	397.9	**1882**	402.6

Table S8a Top 10 wettest seasons in the appended Ensemble and Jenkinson rainfall products for the SA9 and SA-upland domains. Results are shown for winter (DJF) and spring (MAM). The Ensemble product spans 1748-2024 and the Jenkinson product spans 1711-2024; both incorporate the same gridded observed rainfall from 1865 onwards. Winter is assigned to the year containing January and February. Years in bold occur in the corresponding seasonal top-10 list for both products within the same domain.

		SA9				SAupland			
		Ensemble		Jenkinson		Ensemble		Jenkinson	
Season	Rank	Year	Seasonal total (mm)	Year	Seasonal total (mm)	Year	Seasonal total (mm)	Year	Seasonal total (mm)
JJA	1	**1958**	427.8	**1958**	427.8	**2012**	603.9	**2012**	603.9
	2	**2012**	419.4	**2012**	419.4	**1912**	546.7	**1912**	546.7
	3	**1912**	414	**1912**	414	**2008**	527.2	**2008**	527.2
	4	**2008**	401.2	**2008**	401.2	**1958**	514.8	**1958**	514.8
	5	**2007**	382.9	**2007**	382.9	**1879**	479.5	1768	512.5
	6	**1900**	377.7	**1900**	377.7	2009	470.4	1817	502.8
	7	**1879**	354	1768	360.9	1910	446.4	1712	487.6
	8	**1910**	344.5	1817	354.1	1927	427	1861	487.5
	9	1985	333.9	**1879**	354	1946	422.3	1763	484.8
	10	1927	321.5	**1910**	344.5	1848	421.3	**1879**	479.5
SON	1	**1960**	448.3	**1960**	448.3	**1960**	645.8	**1960**	645.8
	2	**1875**	411.7	**1875**	411.7	**2022**	599.4	**2022**	599.4
	3	**1944**	398.3	1773	409.1	**1875**	597.4	**1875**	597.4
	4	**2002**	389.9	**1944**	398.3	**1982**	588.5	**1982**	588.5
	5	**1916**	384.5	1794	393.8	**2009**	574.6	1773	580.9
	6	**2019**	383.6	1712	391.6	**2000**	568.9	**2009**	574.6
	7	2000	382.6	**2002**	389.9	**1954**	562.1	**2000**	568.9
	8	2022	377.7	1716	385.9	1876	545.7	**1954**	562.1
	9	1982	372.8	**1916**	384.5	2002	543.2	1794	559.2
	10	1954	365.9	**2019**	383.6	1940	540.8	1712	556.1

Table S8b Top 10 wettest seasons in the appended Ensemble and Jenkinson rainfall products for the SA9 and SA-upland domains. Results are shown for summer (JJA) and autumn (SON). The Ensemble product spans 1748-2024 and the Jenkinson product spans 1711-2024; both incorporate the same gridded observed rainfall from 1865 onwards. Winter is assigned to the year containing January and February. Years in bold occur in the corresponding seasonal top-10 list for both products within the same domain.

		SA9				SAupland			
		Ensemble		Jenkinson		Ensemble		Jenkinson	
Season	Rank	Year	Seasonal total (mm)	Year	Seasonal total (mm)	Year	Seasonal total (mm)	Year	Seasonal total (mm)
DJF	1	**1964**	90.5	**1964**	90.5	**1891**	170	1716	144.1
	2	**1891**	104.3	1716	101.5	**1964**	186.5	1766	162.1
	3	**1905**	130.8	**1891**	104.3	**1992**	198.5	1814	165.4
	4	**1888**	134.7	1766	114.2	1905	204.4	**1891**	170
	5	**1907**	135.7	1814	116.5	1907	207.2	1740	171
	6	1953	135.7	1740	120.4	1934	211.6	1785	175.6
	7	1992	137.1	1785	123.6	1932	215	**1964**	186.5
	8	1934	141.3	**1905**	130.8	1953	216.8	1748	193.5
	9	2006	143.8	**1888**	134.7	1917	217.5	**1992**	198.5
	10	1909	144	**1907**	135.7	1888	219.8	1784	199.3
MAM	1	**2020**	81.3	1785	64.2	**1893**	112.7	1785	91.2
	2	**1893**	87.4	1741	65.1	**1938**	113	1741	92.4
	3	**1990**	91.6	**2020**	81.3	**1990**	123.1	**1893**	112.7
	4	**1944**	97.9	**1893**	87.4	**2020**	125.9	**1938**	113
	5	**2011**	101.4	1742	88.4	**1887**	126	**1990**	123.1
	6	1938	101.7	1731	88.8	1997	142.4	1742	125.5
	7	1929	105.9	**1990**	91.6	1915	150.6	**2020**	125.9
	8	1785	110.1	1760	96.6	1929	152.2	**1887**	126
	9	1875	110.4	**1944**	97.9	1834	157.1	1731	126.1
	10	1834	111.2	**2011**	101.4	2011	157.6	1760	137.1

Table S9a Top 10 driest seasons in the appended Ensemble and Jenkinson rainfall products for the SA9 and SA-upland domains. Results are shown for winter (DJF) and spring (MAM). The Ensemble product spans 1748-2024 and the Jenkinson product spans 1711-2024; both incorporate the same gridded observed rainfall from 1865 onwards. Winter is assigned to the year containing January and February. Years in bold occur in the corresponding seasonal top-10 list for both products within the same domain.

		SA9				SAupland			
		Ensemble		Jenkinson		Ensemble		Jenkinson	
Season	Rank	Year	Seasonal total (mm)	Year	Seasonal total (mm)	Year	Seasonal total (mm)	Year	Seasonal total (mm)
JJA	1	**1995**	84.4	1800	69	**1869**	93.1	**1869**	93.1
	2	**1975**	87.5	**1995**	84.4	**1870**	111.5	1800	97.9
	3	**1869**	89.8	**1975**	87.5	**1995**	113.8	**1870**	111.5
	4	**1976**	93.8	**1869**	89.8	**1975**	114.1	**1995**	113.8
	5	**1913**	98.5	**1976**	93.8	**1976**	118.1	**1975**	114.1
	6	**1870**	101.6	**1913**	98.5	**1913**	123.9	**1976**	118.1
	7	**2018**	106.1	**1870**	101.6	**1887**	135.1	**1913**	123.9
	8	1818	107.2	**2018**	106.1	1800	137.6	**1887**	135.1
	9	**1887**	110	**1887**	110	1818	137.8	**2018**	145.7
	10	1800	120.6	1847	113	**2018**	145.7	1885	146.6
SON	1	**1922**	124.9	**1922**	124.9	**1884**	150.4	**1884**	150.4
	2	**1912**	125.1	**1912**	125.1	**1922**	178.4	**1922**	178.4
	3	**1893**	131.8	1805	131.2	**1969**	185	**1969**	185
	4	**1884**	135.9	**1893**	131.8	**1912**	189.3	1805	186.3
	5	**1904**	144.7	**1884**	135.9	**1978**	204	**1912**	189.3
	6	**2007**	149.5	1784	139.2	**2007**	213.1	1784	197.6
	7	1971	157.5	1713	143.3	1851	219.2	1713	203.5
	8	1985	158.3	**1904**	144.7	1919	219.5	**1978**	204
	9	1969	158.5	1788	144.9	2016	219.6	1788	205.8
	10	1978	160.6	**2007**	149.5	1971	227.5	**2007**	213.1

Table S9b Top 10 driest seasons in the appended Ensemble and Jenkinson rainfall products for the SA9 and SA-upland domains. Results are shown for summer (JJA) and autumn (SON). The Ensemble product spans 1748-2024 and the Jenkinson product spans 1711-2024; both incorporate the same gridded observed rainfall from 1865 onwards. Winter is assigned to the year containing January and February. Years in bold occur in the corresponding seasonal top-10 list for both products within the same domain.