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Hydrological data interpolation using entropy

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APPENDIX B

Table B.1 Entropy calculations and statistics at the target gauge D1H003 (30 % missing annual mean flows) using the base gauge D1H009

	Description	T (napiers)	DIT(-)	RMSEp (Mm^3)	RMEp	EV	Ratio Variance	Ratio Mean
ANN Techniques	BP (sigmoid hidden layer)	1.649	0.2596	73.028	0.192	-0.0910	1.0620	1.0213
	McL1BP	1.588	0.2500	74.210	0.197	0.0914	1.0630	1.0200
	GenerBP (sigmoid hidden layer), s = 2	1.651	0.2600	73.0665	0.191	-0.0915	1.0614	1.0215
	QBP (hyperbolic tangent hidden layer), acc = 0.025, lr = 0.25, Weight Cond	1.733	0.2728	65.727	0.170	-0.0558	1.0644	1.0134
	VLR (sigmoid hidden layer)	1.713	0.2696	67.033	0.1764	-0.0672	1.0586	1.0161
EM Techniques	Standard EM	1.870	0.2943	63.075	0.150	-0.0786	1.0451	1.0186
	MEM1 (u = 0.95)	1.870	0.2943	63.075	0.150	-0.0786	1.0451	1.0186
	MEM2, u = 0.95, lr = 0.001	1.876	0.2953	62.507	0.1486	-0.0744	1.046	1.018
	MEM3	1.871	0.2945	63.029	0.150	-0.0790	0.992	0.9775
	ECM1-2	1.870	0.2943	63.075	0.150	-0.0786	1.0451	1.0186
	ECME1-2 (k = 3), 3 (u = 0.90)	1.870	0.2943	63.075	0.150	-0.0786	1.0451	1.0186

Table B.2 Entropy calculations and statistics at the target gauge D1H003 (13.4% missing annual maximum flows) using the base gauge D1H009

	Description	T (napiers)	DIT	RMSEp (Mm^3)	RMEp	EV	Ratio Variance	Ratio Mean
ANN Techniques	BP (sigmoid hidden layer)	1.953	0.2610	264.77	0.215	-0.0997	1.0040	1.012
	ML1BP (sigmoid hidden layer)	1.939	0.2257	224.827	0.2267	-0.0619	1.012	1.008
	QBP (sigmoid hidden layer), acc = 0.015, lr = 0.85, Weight Cond	2.009	0.2890	234.933	0.2077	-0.0647	1.037	1.008
	GoldnSBP (sigmoid hidden layer), lr = 0.25	1.955	0.2813	263.51	0.215	-0.099	1.044	1.011
	VLR (sigmoid hidden layer)	2.022	0.2910	226.576	0.2054	-0.0628	1.0317	1.0078
EM Techniques	Standard EM	2.037	0.2931	215.837	0.2005	-0.0574	1.0258	1.0072
	MEM1	2.037	0.2931	215.837	0.2005	-0.0574	1.0258	1.0072
	MEM, Option 2, u = 0.89, lr = 0.001	2.040	0.2936	214.412	0.2000	-0.0548	1.025	1.0067
	MEM3	2.037	0.2931	215.538	0.200	-0.0574	1.0254	1.0072
	ECM1-2	2.037	0.2931	215.837	0.2005	-0.0574	1.0258	1.0072
	ECME1-2-3	2.037	0.2931	215.837	0.2005	-0.0574	1.0258	1.0072

Table B.3 Entropy calculations and statistics at the target gauge D1H003 (20% missing annual maximum flows) using the base gauge D1H009

	Description	T (napiers)	DIT	RMSEp (Mm^3)	RMEp	EV	Ratio Variance	Ratio Mean
ANN Techniques	BP (sigmoid hidden layer)	1.449	0.2085	292.68	0.2765	-0.0319	1.09	1.009
	ML1BP (sigmoid hidden layer)	1.438	0.2069	262.18	0.2689	0.0101	1.066	0.998
	GenerBP (sigmoid hidden layer), s=5	1.392	0.2003	253.246	0.2265	-0.0533	1.10	1.01
	QBP (sigmoid hidden layer), acc = 0.015, lr = 0.85, Weight Cond	1.482	0.2133	266.18	0.2682	-0.0043	1.083	1.001
	GoldBP(sigmoid hidden layer), lr = 0.25	1.444	0.2078	297.62	0.2781	-0.0374	1.1	1.01
	VLR (sigmoid hidden layer)	1.482	0.2132	265.412	0.2677	-0.0050	1.082	1.000
EM Techniques	Standard EM	1.605	0.2310	233.584	0.2552	-0.0141	1.0642	1.0022
	MEM1	1.605	0.2310	233.584	0.2552	-0.0141	1.0642	1.0022
	MEM2, u = 0.89, lr = 0.001	1.604	0.1867	233.205	0.2544	-0.0107	1.065	1.001
	MEM3	1.606	0.1869	233.16	0.2553	0.2553	1.0636	1.0022
	ECM1-2	1.605	0.2310	233.584	0.2552	-0.0141	1.0642	1.0022
	ECME1-2-3	1.605	0.2310	233.584	0.2552	-0.0141	1.0642	1.0022

Table B.4 Entropy calculations and statistics at the target gauge D1H003 (30% missing annual maximum flows) using the base gauge D1H009

	Description	T (napiers)	DIT	RMSEp (napiers)	RMEp	EV	Ratio Variance	Ratio Mean
ANN Techniques	BP (sigmoid hidden layer)	1.385	0.1993	259.141	0.2306	-0.0598	1.1089	1.0158
	McL1BP (hyperbolic tangent hidden layer)	1.310	0.1885	292.314	0.183	0.0124	1.2043	0.996
	GenerBP (sigmoid hidden layer), s=5	1.384	0.1992	252.998	0.233	-0.0573	1.098	1.0152
	QBP(sigmoid hidden layer), acc = 0.015, lr = 0.85, Weight Cond	1.424	0.2049	236.242	0.2168	-0.0317	1.0906	1.0086
	GoldSBP(sigmoid hidden layer), lr = 0.25	1.392	0.2003	253.246	0.2265	-0.0532	1.1031	1.014
	VLR (sigmoid hidden layer)	1.425	0.2050	229.164	0.2151	-0.0265	1.0786	1.0072
EM Techniques	Standard EM	1.527	0.2197	206.114	0.2268	-0.0452	1.033	1.012
	MEM1	1.527	0.2197	206.114	0.2268	-0.0452	1.033	1.012
	MEM2, u = 0.89, lr = 0.001	1.529	0.2200	204.949	0.225	-0.049	1.0329	1.011
	MEM3	1.528	0.2199	205.94	0.2272	-0.0453	1.0312	1.0121
	ECM1-2	1.527	0.2197	206.114	0.2268	-0.0452	1.033	1.012
	ECME1-2-3	1.527	0.2197	206.114	0.2268	-0.0452	1.033	1.012

Table B.5 Entropy calculations and statistics at the target gauge D1H009 (13.4% missing annual maximum flows) using the base gauge D1H003

	Description	T (napiers)	DIT	RMSEp (Mm^3)	RMEp	EV	Ratio Variance	Ratio Mean
ANN Techniques	BP (sigmoid hidden layer)	1.816	0.2613	236.58	0.1412	0.1139	1.0308	0.9841
	McL1BP (Hyperbolic tangent hidden layer)	2.001	0.2879	185.33	0.1559	0.0620	1.0185	0.9918
	QBP(sigmoid hidden layer), acc = 0.015, lr = 0.85, Weight Cond	1.953	0.2810	204.916	0.1670	0.0313	1.0485	0.9959
	GoldSBP(sigmoid hidden layer), lr = 0.25	1.822	0.2622	234.638	0.1381	0.1112	1.03152	0.9845
	VLR (sigmoid hidden layer)	1.968	0.2832	200.642	0.1633	0.0326	1.0466	0.996
EM Techniques	Standard EM	1.999	0.2877	194.061	0.1498	0.0348	1.0258	1.0072
	MEM1	1.999	0.2877	194.061	0.1498	0.0348	1.0258	1.0072
	MEM2, u = 0.89, lr = 0.001	1.996	0.2872	194.389	0.1479	0.0371	1.0257	1.0069
	MEM3	2.000	0.2878	193.703	0.1500	0.0350	1.0455	0.9955
	ECM1-2	1.999	0.2877	194.061	0.1498	0.0348	1.0258	1.0072
	ECME1-2-3	1.999	0.2877	194.061	0.1498	0.0348	1.0258	1.0072

Table B.6 Entropy calculations and statistics at the target gauge D1H009 (20% missing annual maximum flows) using the base gauge D1H003

	Description	T (napiers)	DIT	RMSEp (Mm^3)	RMEp	EV	Ratio Variance	Ratio Mean
ANN Techniques	BP (sigmoid hidden layer)	1.498	0.2156	262.51	0.2256	0.1510	1.077	0.974
	McL1BP (sigmoid hidden layer)	1.682	0.2420	192.163	0.2827	0.0733	1.021	0.9884
	GenerBP (sigmoid hidden layer), s=5	1.300	0.1871	257.87	0.2204	0.1074	1.163	0.969
	QBP (sigmoid hidden layer), acc = 0.015, lr = 0.85, Weight Cond	1.650	0.2374	198.53	0.3065	0.0504	1.0397	0.992
	GoldSBP (sigmoid hidden layer), lr = 0.25	1.517	0.2188	250.13	0.247	0.1439	1.040	0.976
	VLR (sigmoid hidden layer)	1.540	0.2216	244.36	0.2400	0.1424	1.037	0.9760
EM Techniques	Standard EM	1.711	0.2462	194.657	0.2404	0.0613	1.0515	0.9904
	MEM1	1.711	0.2462	194.657	0.2404	0.0613	1.0515	0.9904
	MEM2, u = 0.89, lr = 0.001	1.708	0.2458	195.615	0.2372	0.0643	1.052	0.99
	MEM3	1.711	0.2462	194.31	0.2416	0.0611	1.051	0.990
	ECM1-2	1.711	0.2462	194.657	0.2404	0.0613	1.0515	0.9904
	ECME1-2-3	1.711	0.2462	194.657	0.2404	0.0613	1.0515	0.9904

Table B.7 Entropy calculations and statistics at the target gauge D1H009 (30% missing annual maximum flows) using the base gauge D1H003

	Description	T (napiers)	DIT	RMSEp (Mm^3)	RMEp	EV	Ratio Variance	Ratio Mean
ANN Techniques	BP (sigmoid hidden layer)	1.237	0.1780	281.801	0.225	0.1304	1.1780	0.9617
	McL1BP (hyperbolic tangent hidden layer)	1.479	0.2128	191.358	0.252	0.0545	1.080	0.985
	GenerBP (sigmoid hidden layer), s=5	1.285	0.1849	268.782	0.2112	0.1207	1.1878	0.9649
	QBP (sigmoid hidden layer), acc = 0.015, lr = 0.85, Weight Cond	1.378	0.1983	226.932	0.2787	0.0328	1.1465	0.9911
	GoldSBP (sigmoid hidden layer), lr = 0.25	1.300	0.1871	257.873	0.2204	0.107	1.163	0.9691
	VLR (sigmoid hidden layer)	1.416	0.2038	229.203	0.2305	0.0392	1.169	0.9893
EM Techniques	Standard EM	1.430	0.2058	231.94	0.2178	0.0428	1.1834	0.988
	MEM1	1.430	0.2058	231.94	0.2178	0.0428	1.1834	0.988
	MEM2, u = 0.89, lr = 0.001	1.427	0.2053	232.429	0.2170	0.0457	1.183	0.987
	MEM3	1.431	0.2059	231.250	0.218	0.0428	1.182	0.9882
	ECM1-2	1.430	0.2058	231.94	0.2178	0.0428	1.1834	0.988
	ECME1-2-3	1.430	0.2058	231.94	0.2178	0.0428	1.1834	0.988