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Exploring the ability of LSTM-based hydrological models to simulate streamflow time series for flood frequency analysis

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Table S1: Summary statistics of catchment descriptors used as inputs to the LSTM models in this study.

Descriptor	Summary	Minimum	Median	Maximum
Geographic descriptors				
Area [km^2]	Drainage area at the outlet	44	980	21338
Slope [m/m]	Average slope of the catchment	0.57	4.23	11.35
Elevation [m]	Average elevation of the catchment	91	387	864
Aspect [°]	Average orientation of the catchment[1]	14.3	190	359
Gravelius index [-]	Index representing the compactness of the catchment, with 1 representing a perfect circle and stretched catchments having larger values	1.36	2.14	3.68
Perimeter [km]	Length of the perimeter of the catchment	32	226	1779
Centroid latitude [°N]	Latitude coordinate of the centroid of the catchment	44.89	47.52	52.34
Centroid longitude [°W]	Longitude coordinate of the centroid of the catchment	-78.56	-71.52	-58.10
Land-use descriptors				
Crops [%]	Fraction of the surface covered by crops	0.0	1.3	53.9
Forests [%]	Fraction of the surface covered by forests	31.6	84.2	95.8
Grass [%]	Fraction of the surface covered by grass	0.1	1.0	7.6
Shrubs [%]	Fraction of the surface covered by shrubs	0.0	1.0	14.7
Water [%]	Fraction of the surface covered by water	0.0	3.9	12.7
Wetlands [%]	Fraction of the surface covered by wetlands	0.0	0.5	16.5
Urban [%]	Fraction of the surface covered by urban areas	0	1.2	11.2
Hydrometeorological descriptors				
Mean pr [mm/d]	Average daily precipitation	2.6	3.3	4.0
Mean PET [mm/d]	Average daily potential evapotranspiration	1.0	1.4	1.8
Mean SWE [mm/d]	Average daily snow water equivalent	0.009	0.037	0.094
Aridity index [-]	Ratio of precipitation to evapotranspiration	0.32	0.43	0.55
Snow fraction [%]	Fraction of precipitation falling as snow on average	17.7	28.1	40.7
High pr frequency [d/y]	Frequency of days having more than 5x the mean daily precipitation	2.9	4.2	5.2
High pr duration [d]	Average duration of consecutive high precipitation days	1.07	1.09	1.13
Low pr frequency [d/y]	Frequency of days with < 1 mm of daily precipitation	46.0	54.0	61.3
Low pr duration [d]	Average duration of consecutive low precipitation days	2.35	2.71	3.04

[1] *Note that the aspect is a direction and thus 0 and 360 are equivalent.*

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Table S2: List of HYDROTEL recalibrated parameters

ID	Parameter
1	Depth of the first soil layer
2	Depth of the second soil layer
3	Recession coefficient
4	Melting temperature threshold in a coniferous forest
5	Melting temperature threshold in a deciduous forest
6	Melting temperature threshold in an open area
7	Maximum melt rate in a coniferous forest
8	Maximum melt rate in a deciduous forest
9	Maximum melt rate in an open area
10	PET multiplicative coefficient
11	Threshold temperature for rain to snow
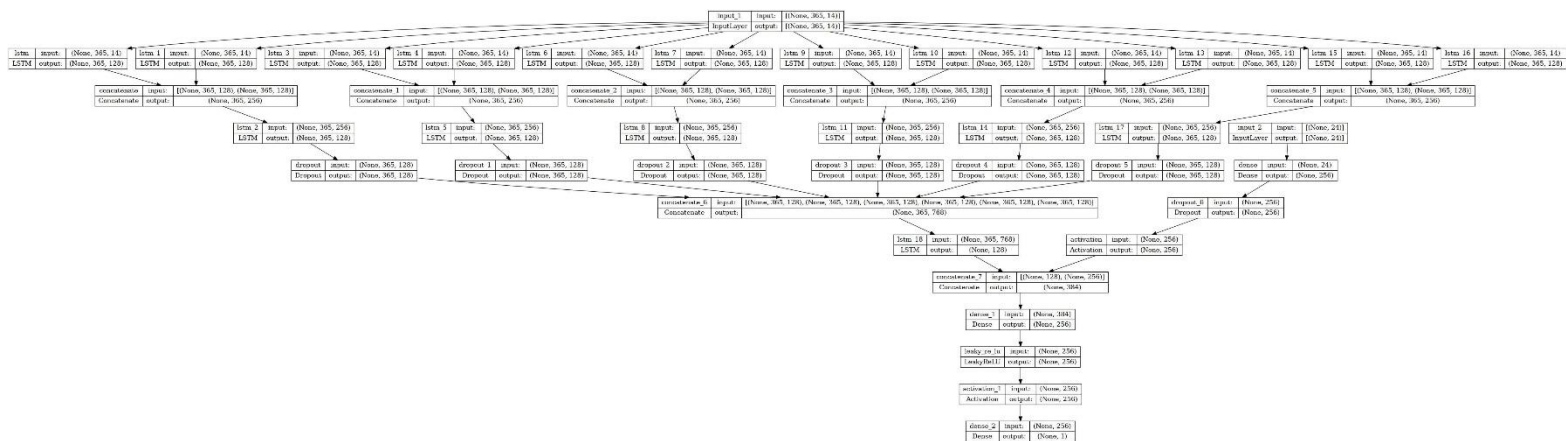
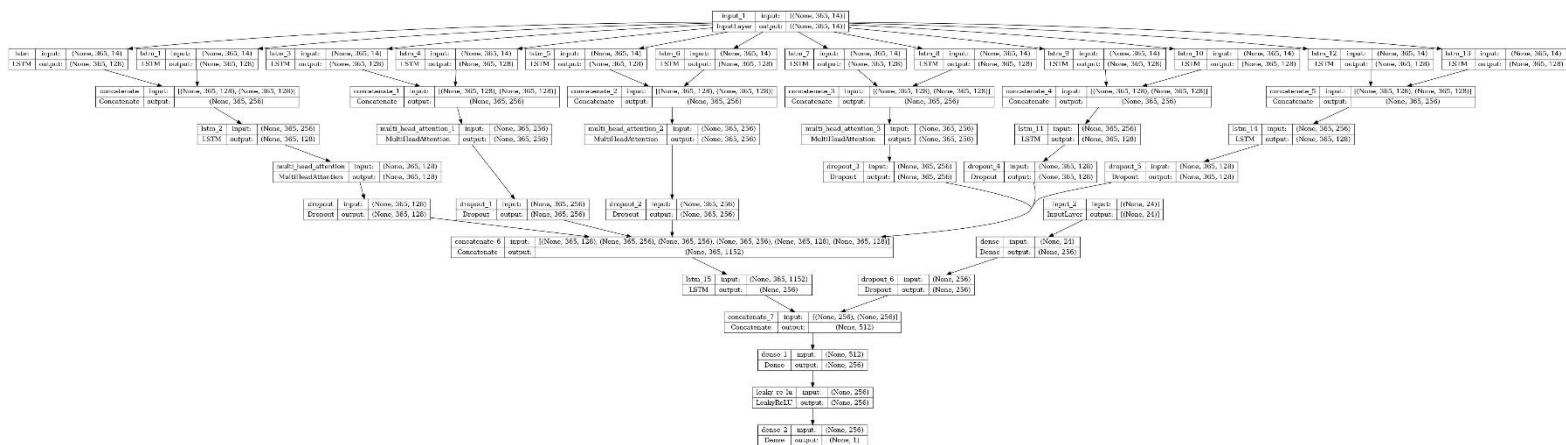**Figure S1: General LSTM-based model structure developed and implemented, referred to as LSTM-Base in this study.**

Figure S2: Same as Figure S1 but including the multihead attention.
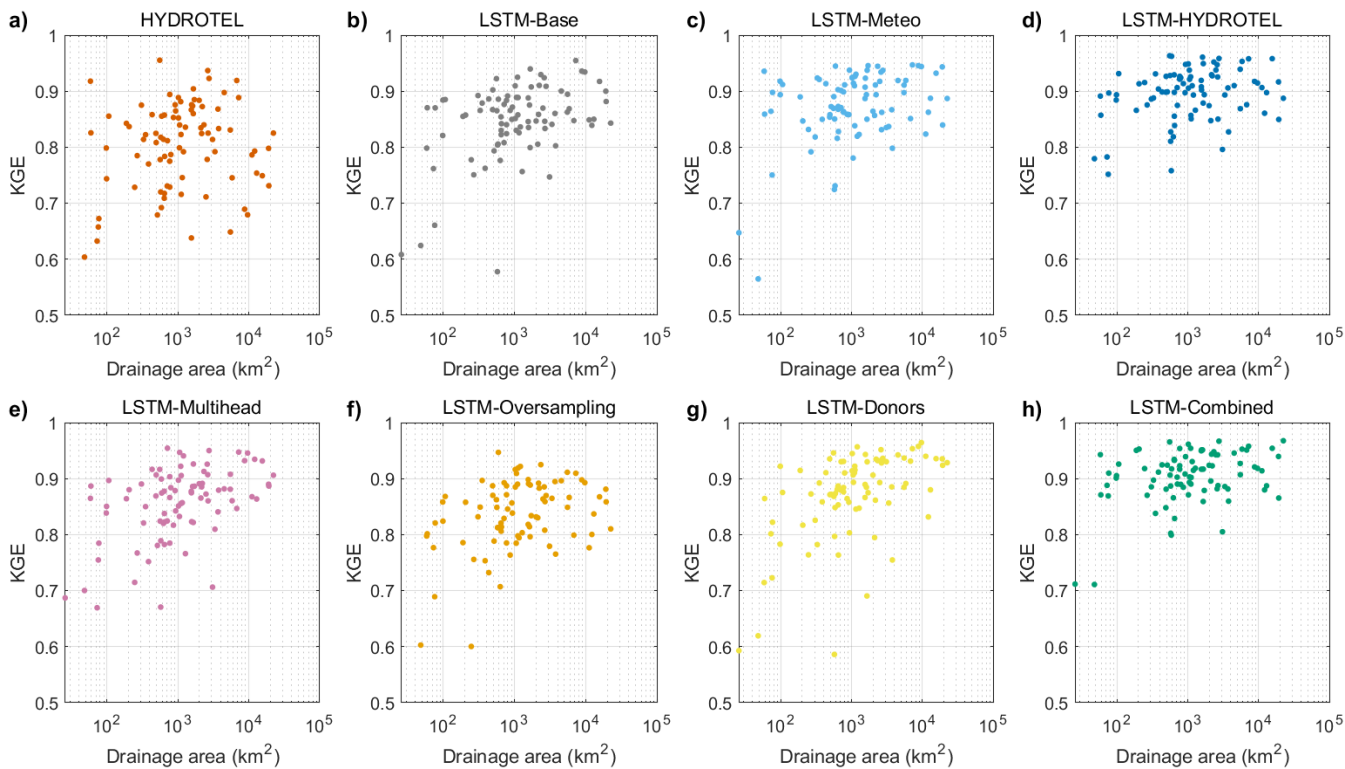
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Figure S3: KGE scores for each of the 8 models on the 88 catchments as a function of the catchment drainage area.
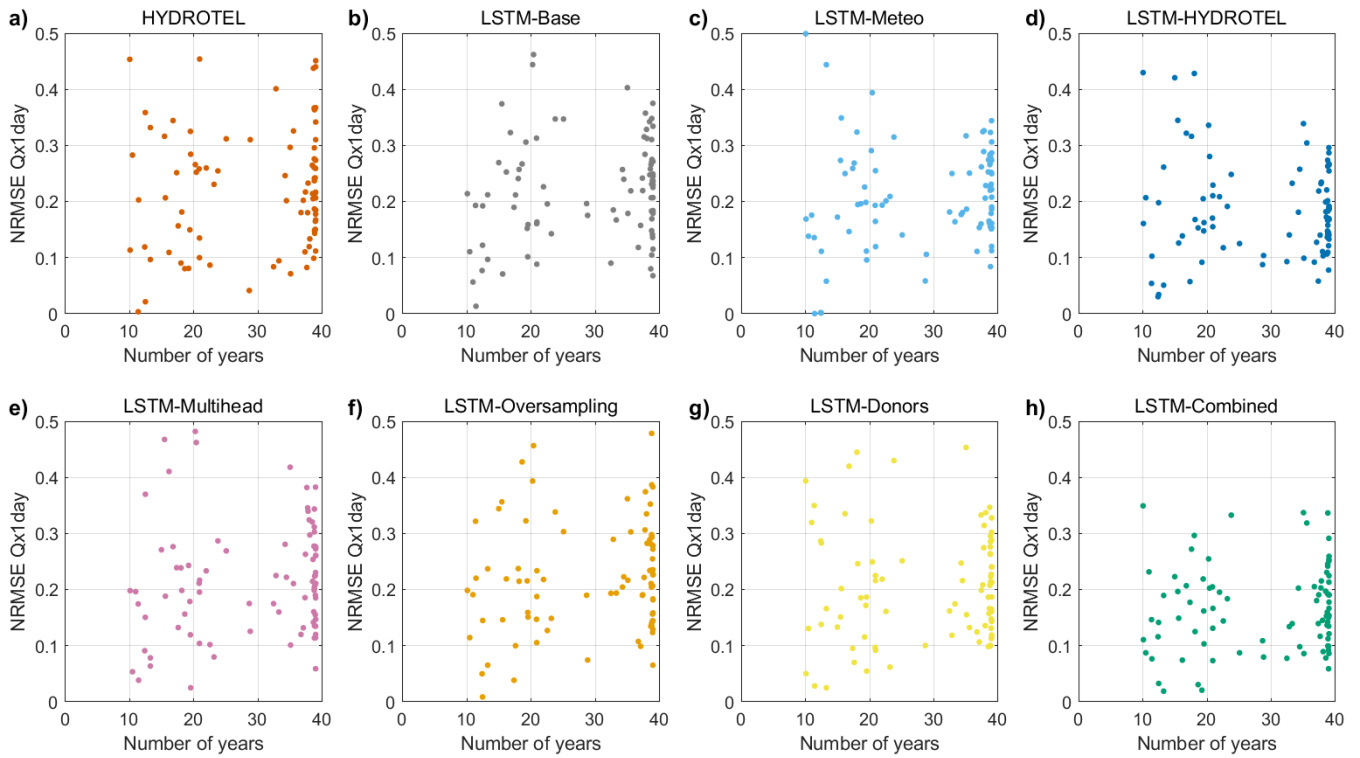
Figure S4: NRMSE of Qx1day scores for each of the 8 models on the 88 catchments as a function of the number of years.
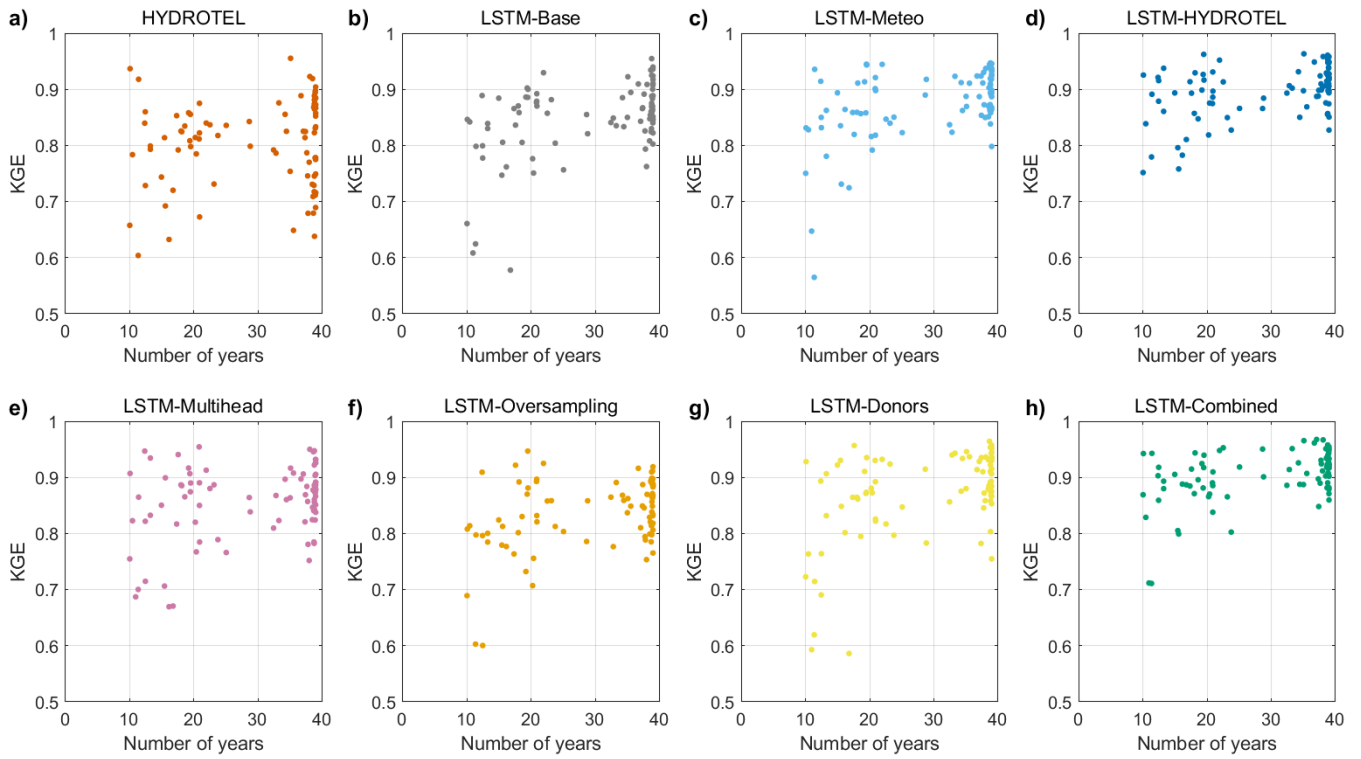
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Figure S5: KGE scores for each of the 8 models on the 88 catchments as a function of the number of years.