Wani, OA, Mahdi, SS, Yeasin, M, Kumar, SS, Gagnon, A, Danish, F, Al-Ansari, N, El-Hendawy, S and Mattar, MA

Predicting Rainfall Using Machine Learning, Deep Learning, and Time Series Models Across an Altitudinal Gradient in the North-Western Himalayas

http://researchonline.ljmu.ac.uk/id/eprint/24682/

Article

Table 1S: Model parameters and model information

Machine learning models											
Locations	ANN				RF				SVM		
L1	Lags of independent variables	Hidden Layers	Learning Rate	sigma^2	Number of trees	No. of variables tried at each split	Mean of squared residuals	% Var explained	SVM-Type	SVM-Kernel	Number of Support Vectors
L2	10	13	0.0097	0.0029	500	19	0.000241111	93.02	eps-regression	radial	582
L3	10	12	0.0083	0.01094	500	18	0.000647311	95.35	eps-regression	radial	611
L4	9	12	0.0099	0.008042	500	18	0.000649312	93.54	eps-regression	radial	554
L5	12	11	0.0096	0.002973	500	20	0.000198448	94.25	eps-regression	radial	553
L6	11	15	0.0088	0.006004	500	22	0.000731267	91.35	eps-regression	radial	540

Deep Learning

Locations	LSTM			Bidirectional LSTM			Deep LSTM		GRU			RNN		
	Lag of Dependent variables	Lags of independent variables	LSTM Layers	Lag of Dependent variables	Lags of independent variables	Bi-LSTM Layers	Lag of Dependent variables	Lags of independent variables	Lag of Dependent variables	Lags of independent variables	GRU Layers	Lag of Dependent variables	Lags of independent variables	RNN Layers
L1														
L2	21	10	35	21	10	33	21	10	21	10	39	21	10	41
L3	20	10	29	20	10	21	20	10	20	10	33	20	10	39
L4	20	9	27	20	9	26	20	9	20	9	36	20	9	43
L5	22	12	31	22	12	30	22	12	22	12	34	22	12	28
L6	24	11	30	24	11	33	24	11	24	11	33	24	11	35

Time Series modelling					
Locations	ARIMA			TBATS	
	sigma^2 estimated	log likelihood	aic	Sigma	AIC
L1	0.003611	2300.8	-4551.61	0.0578155	2835.556
L2	0.01106	1377.02	-2702.05	0.1157039	5143.185
L3	0.008302	1614.42	-3170.84	0.09907659	4630.288
L4	0.004012	2213.92	-4379.83	0.05814985	2854.62
L5	0.007791	1665.71	-3279.43	0.08717039	4211.026
L6	0.009172	1532.05	-3008.11	0.0845677	4326.677

Table 2S: Location and model wise model accuracy

Model	L1				L2				L3			
	Train Bias	Test Bias	Train R2	Test R2	Train Bias	Test Bias	Train R2	Test R2	Train Bias	Test Bias	Train R2	Test R2
ANN	17.32	16.88	0.16	0.10	18.81	24.06	0.16	0.10	12.45	12.77	0.16	0.10
ARIMA-X	20.67	38.37	0.15	0.15	23.08	22.34	0.25	0.19	15.82	14.34	0.22	0.15
Bidirectional LSTM	17.50	20.01	0.47	0.48	18.27	19.03	0.54	0.54	14.59	15.09	0.42	0.49
Deep LSTM	18.63	20.67	0.47	0.46	19.30	20.85	0.26	0.27	11.07	11.99	0.46	0.49
GRU	19.48	21.93	0.49	0.51	26.32	24.94	0.50	0.49	15.93	16.34	0.45	0.50
KNN	17.52	16.87	0.19	0.14	21.22	21.22	0.17	0.10	13.54	13.95	0.13	0.11
LSTM	14.64	15.35	0.97	0.95	13.08	13.59	0.95	0.94	11.03	11.29	0.94	0.94
RF	18.45	19.74	0.12	0.11	22.32	23.03	0.09	0.09	13.85	14.21	0.14	0.15
RNN	14.02	15.12	0.97	0.97	12.68	13.12	0.95	0.94	11.73	11.93	0.94	0.94
SVR	17.93	21.09	0.10	0.07	21.47	22.46	0.18	0.17	13.31	14.45	0.13	0.14
TBATS	21.21	21.61	0.17	0.11	24.47	27.09	0.14	0.10	14.86	14.82	0.12	0.10
Model	L4				L5				L6			
	Train Bias	Test Bias	Train R2	Test R2	Train Bias	Test Bias	Train R2	Test R2	Train Bias	Test Bias	Train R2	Test R2
ANN	19.32	17.63	0.17	0.14	19.63	22.64	0.28	0.19	15.83	16.70	0.15	0.13
ARIMA-X	23.90	35.78	0.07	0.11	24.80	19.69	0.24	0.19	19.32	21.30	0.40	0.31
Bidirectional LSTM	24.26	25.48	0.49	0.60	22.89	24.14	0.69	0.66	18.70	19.54	0.45	0.40
Deep LSTM	20.72	22.94	0.47	0.53	22.25	24.81	0.72	0.70	17.75	18.01	0.63	0.61
GRU	20.80	21.04	0.56	0.65	20.46	22.95	0.70	0.67	15.58	15.77	0.67	0.65
KNN	20.72	22.12	0.14	0.12	21.51	23.29	0.30	0.11	16.35	18.37	0.21	0.10
LSTM	13.66	14.22	0.98	0.98	14.97	17.03	0.95	0.95	14.07	15.57	0.94	0.94
RF	22.02	22.55	0.11	0.10	22.90	22.55	0.34	0.26	17.67	18.36	0.24	0.25
RNN	14.42	14.71	0.98	0.99	14.87	16.97	0.96	0.96	15.64	17.01	0.94	0.96
SVR	21.76	23.63	0.10	0.10	21.93	22.37	0.31	0.24	17.15	18.79	0.22	0.23
TBATS	26.06	23.69	0.10	0.10	26.48	25.00	0.18	0.10	21.84	22.82	0.14	0.10