campingrovies

3-9 July 2023

National Technical University of Athens

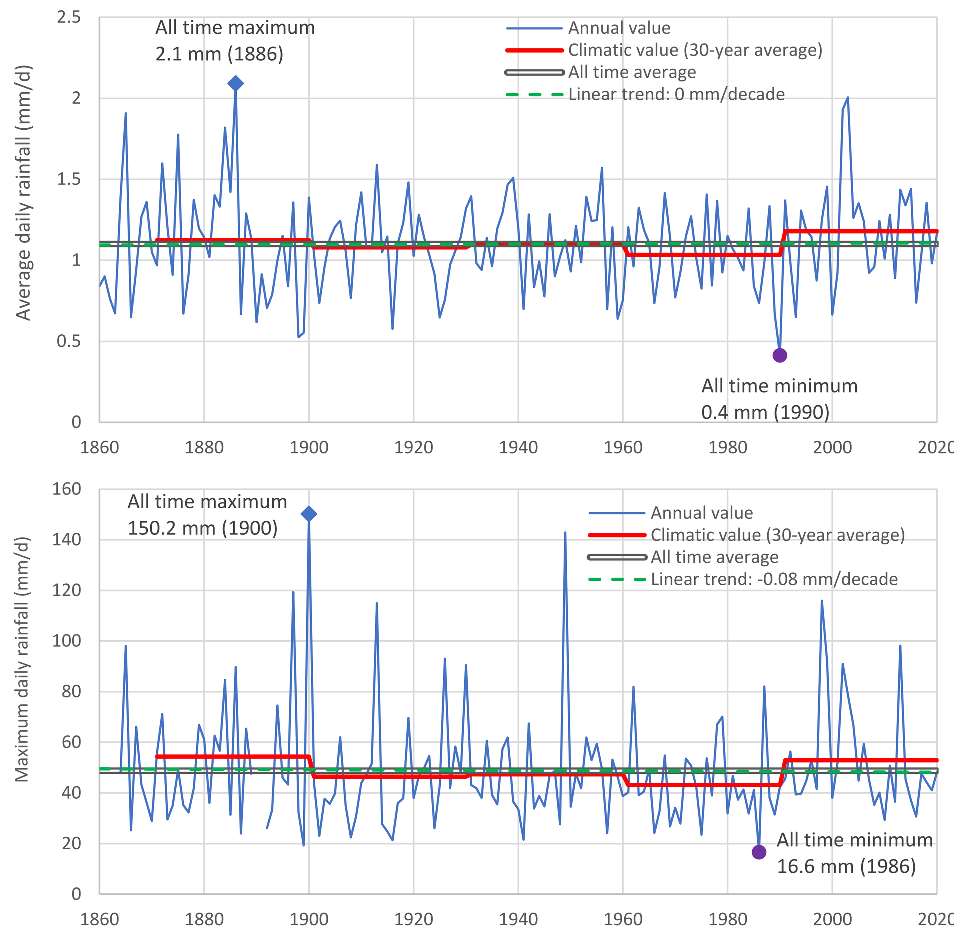
School of Civil Engineering

ADDOPTML
Optimized 3D printed structures

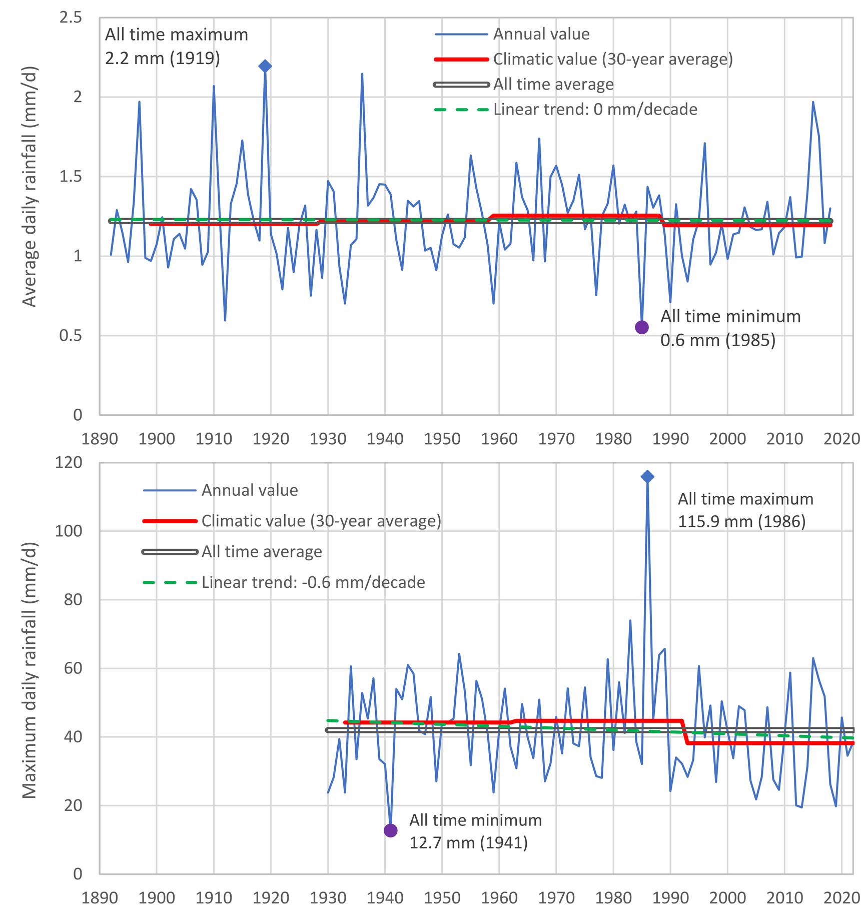
A cool look at rainfall climatic changes in Greece and worldwide

T. Iliopoulou and D. Koutsoyiannis

In the context of implementing the European Flood Directive in Greece, a large set of rainfall data was compiled for the entire country. This set included ground rainfall data as well as non-conventional data from reanalyses and satellites. This dataset was also investigated from a climatic perspective using the longest of the data records to assess whether or not they support the climate crisis doctrine. Monte Carlo simulations, along with stationary Hurst–Kolmogorov (HK) stochastic dynamics, were also employed to compare data with theoretical expectations. Rainfall extremes are proven to conform with the statistical expectations under stationarity. The only notable climatic events found are the clustering (reflecting HK dynamics) of water abundance in the 1960s and dry years around 1990, followed by a recovery from drought conditions in recent years.

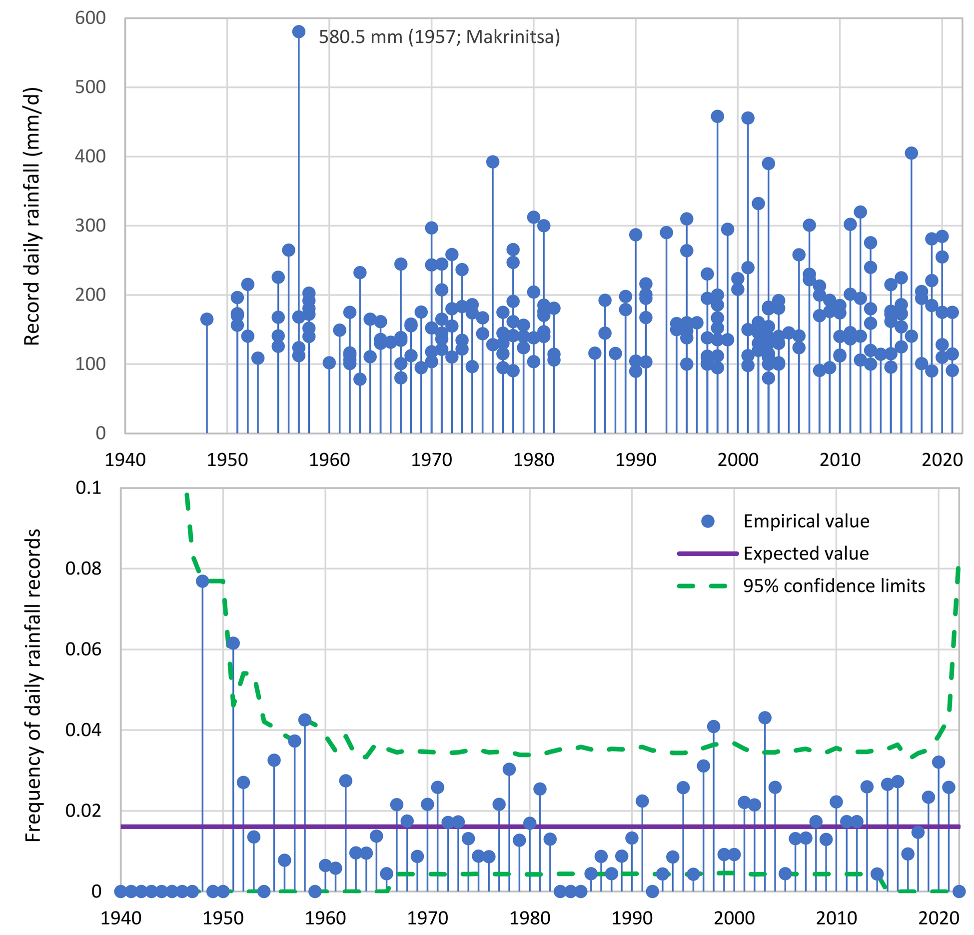


Time series of daily precipitation series in Athens, at the Hill of Nymphs station of the National Observatory of Athens (average daily values start in 1860 with a total length of 161 years; daily and maximum daily values start in 1864 with a total length of 155 years). The graph also shows (a) the high and low records, (b) the climatic values (30-year averages), and (c) the fitted linear trends. (Upper): average daily rainfall; (lower): maximum daily rainfall.

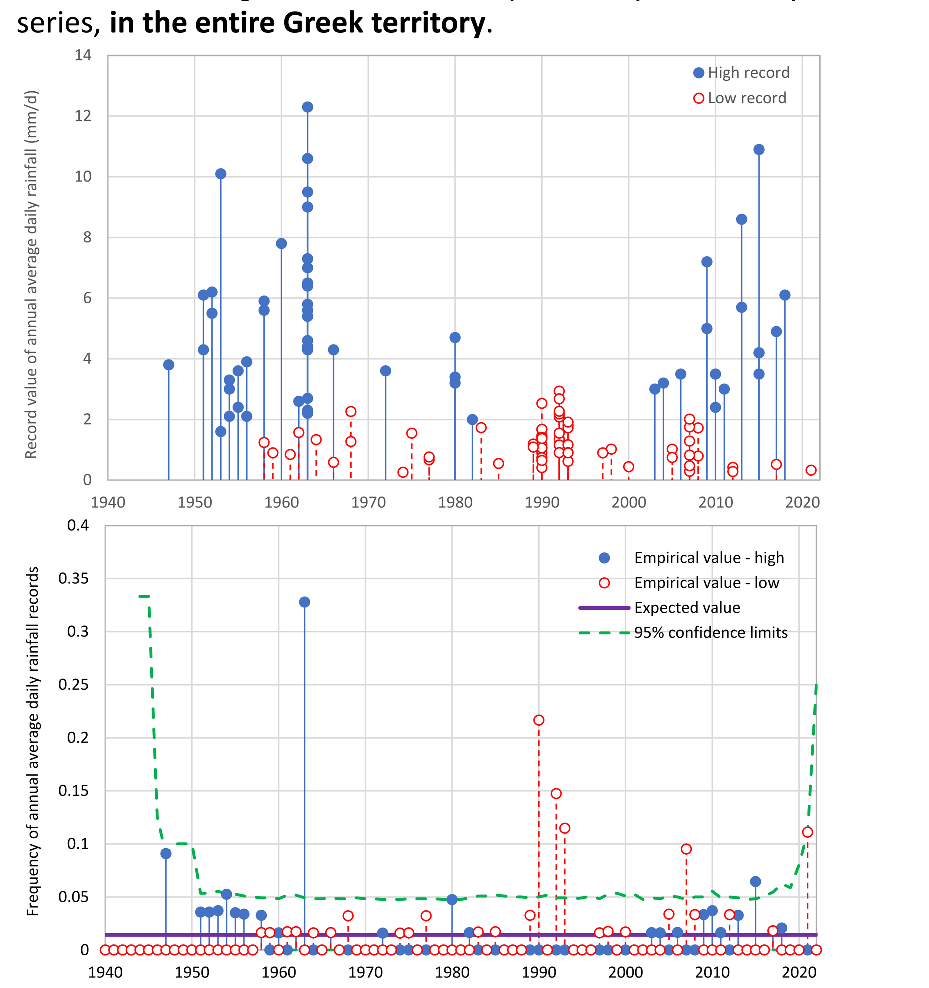


Time series of daily precipitation series in Thessaloniki (average daily values start in 1892 with a total length of 127 years; daily and maximum daily values start in 1930 with a total length of 93 years). The graph also shows (a) the high and low records, (b) the climatic values (30-year averages), and (c) the fitted linear trends. (Upper): average daily rainfall; (lower): maximum daily rainfall.

Records of maximum daily precipitation depth (upper) and **frequency** thereof per year (lower) for the 238 stations with long time series of annual maxima, **in the entire Greek territory.**



High and low records of average daily precipitation depth per year (upper) and **frequency** thereof per year (lower) for the 62 stations with long time series of complete daily or monthly time series, **in the entire Greek territory.**



Findings

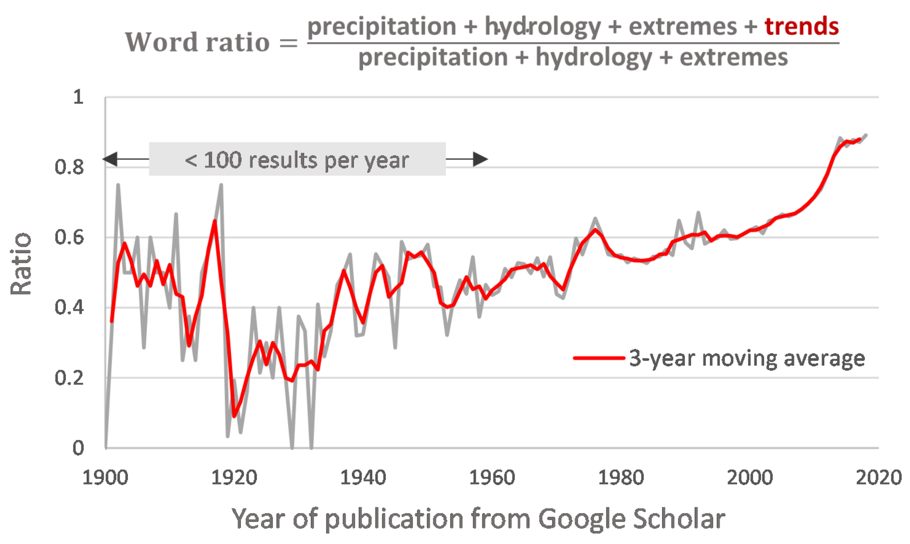
1. The 1950s and early 1960s were particularly wet.
2. This wet season reached its peak but also ended in the hydrological year 1962-63, in which 1/3 of all records of average annual rainfall are gathered.
3. A 20-year climatically neutral period followed until the early 1980s.
4. The climate then entered a 20-year drought, peaking in the five-year period from 1988-89 to 1992-93. It is characteristic that in four of these five years (excluding 1990-91 which was not dry), more than 50% of low records occurred.
5. The last twenty years, after the hydrological year 2002-03, have returned to neutral conditions, although the hydrological years 2006-07 and 2014-15 marked deviations from normality, with a dry and a wet year, respectively.
6. In summary, the most important climatic events are the intensely wet hydrological year 1962-63 and the grouping of dry years shortly before and after 1990, while the alternation of dry and wet periods is notable.

Reference:

D. Koutsoyiannis, T. Iliopoulou, A. Koukouvinos, N. Malamos, N. Mamassis, P. Dimitriadis, N Tepetidis, and D. Markantonis, In search of climate crisis in Greece using hydrological data: 404 Not Found, *Water*, 15 (9), 1711, doi:10.3390/w15091711, 2023.

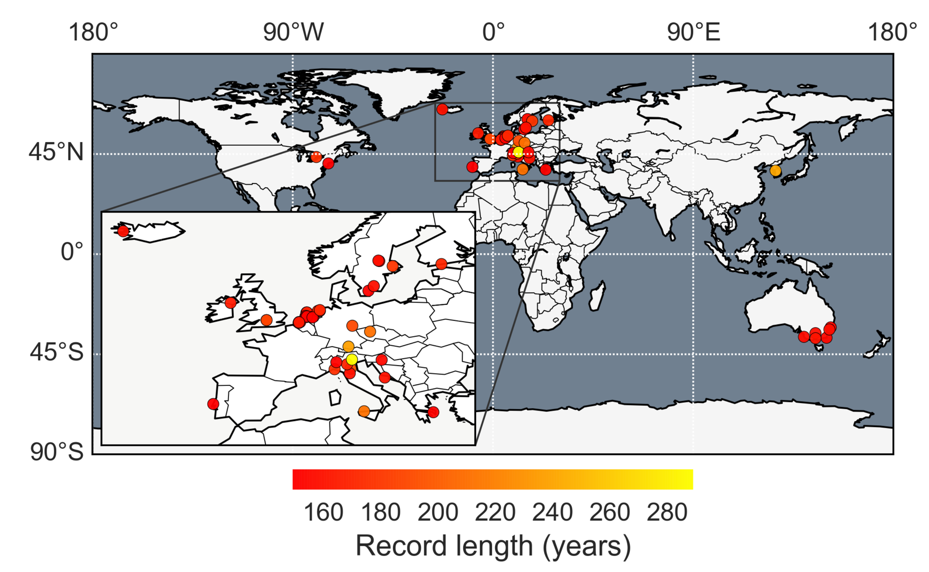
Are trends effective models for future rainfall projections?

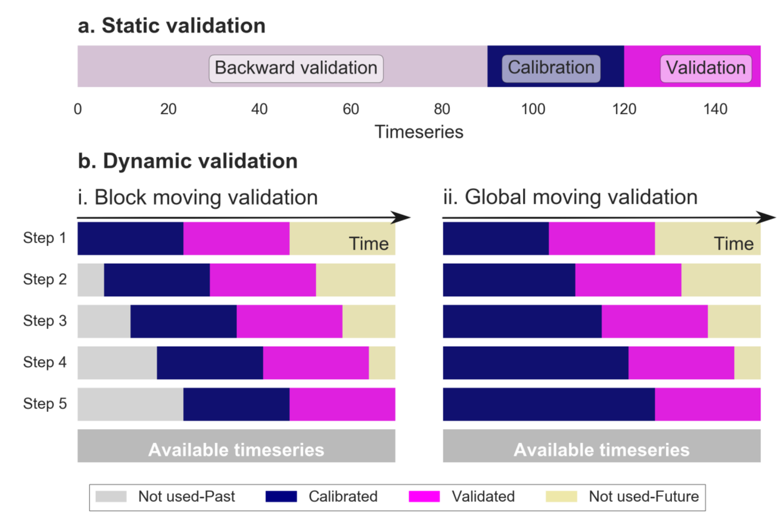
Non-stationarity approaches have been increasingly popular in hydrology, reflecting scientific concerns regarding intensification of the water cycle due to global warming. A considerable share of relevant studies is dominated by the practice of identifying linear trends in data through in-sample analysis. Here, the problem of trend identification is reframed using the out-of-sample predictive performance of trends as the reference point for model selection. A systematic methodological framework is devised in which linear trends are compared to simpler mean models, based on their performance in predicting climatic-scale (30-year) annual rainfall indices, i.e. maxima (AM), totals (AT), wet-day average (WDAV) and probability dry (PD), from long-term daily records. Analysis of empirical records spanning over 150 years of daily data suggests that future long-term variability is better captured using local mean models rather than trends. In line with theoretical findings for persistent processes, it is shown that prediction-wise, simple is preferable to trendy.



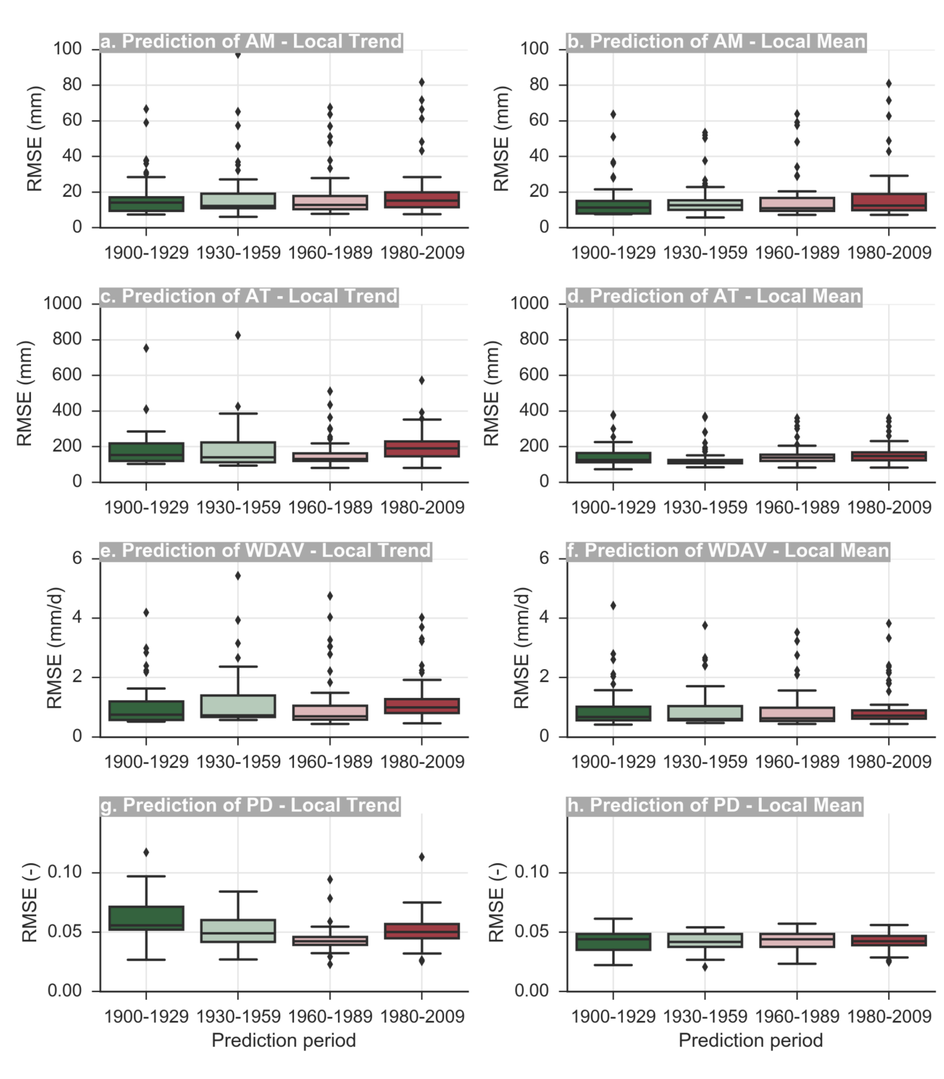
Temporal evolution along with three-year moving average of the ratio of the occurrence of the word 'trends' in Scholar items containing the words 'precipitation', 'hydrology' and 'extremes'

Local trend vs the local mean in projecting annual maxima for the 60 longest rainfall stations.

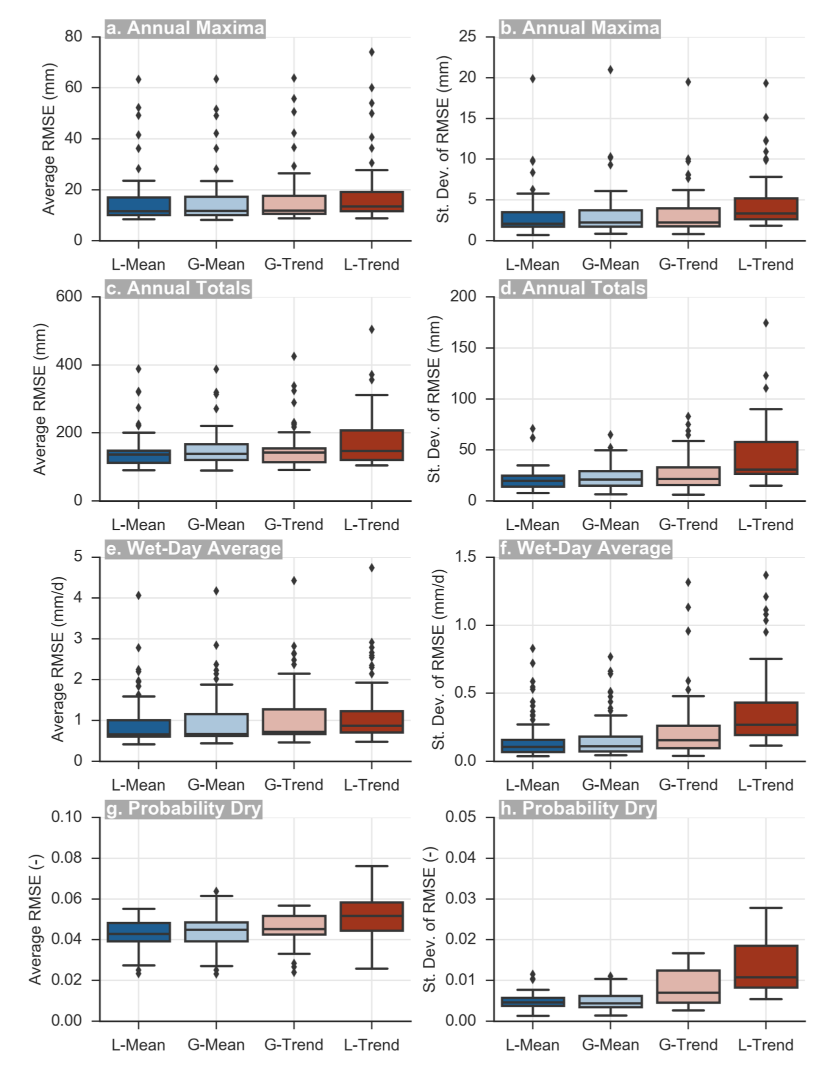




Boxplots of the RMSE distribution from the static validation application to the stations with data in all four prediction periods, 1900-1929, 1930-1959, 1960-1989, 1980-2009, for the local mean (L-Mean) and local trend (L-Trend) models, for all rainfall indices.



Boxplots of the average RMSE and standard deviation of RMSE as estimated for each station from moving window application of the local (L-) mean, global (G-) mean and local (L-) and global (G-) trend for all the indices.



Findings

Future rainfall variability is on average better predicted by mean models, as local trend models identify features of the process that are unlikely to survive the end of the calibration sample, either being extreme observations, or 'trend-like' behaviour.

➢ This empirical finding suggests that the large inherent variability present in the rainfall process makes the practice of extrapolating local features in the long-term future dubious, especially when the complexity of the latter increases.

➢ Prediction-wise, it is shown that simple is preferable to trendy.

Reference:

T. Iliopoulou, and D. Koutsoyiannis, Projecting the future of rainfall extremes: better classic than trendy, *Journal of Hydrology*, 588, doi:10.1016/j.jhydrol.2020.125005, 2020.