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Hydrological change versus climate change

### Long-term properties of annual maximum daily river discharge worldwide

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**1. Abstract**  
We use a database of annual maximum daily discharge time series (World Catalogue of Maximum Observed Floods, WMOF, 2003) and extract those with length greater than 50 years. We analyze extreme floods at several stations worldwide focusing on the long-term properties of the time series including trends and persistence (also known as Hurst-Kolmogorov behavior) which characterizes the temporal streamflow variability across various scales. The analysis allows drawing conclusions, which have not been given the ongoing and intensifying discussions about streamflow amplification of extreme phenomena.

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**2. Motivation**  
Floods are a threat not only for technical works, but also for human life. In fact, they cause more deaths than any other natural disaster. According to our research, the frequency and consequences from floods have been increased by the anthropogenic climate change. In this context, we investigate whether the argument that the observed data of annual maximum daily discharge from several of the world's longest rivers are relatively intact river basins are representative results. More a high and consistent global trend is required as a basis for our research.

**Statistical indices derived from three different approaches to the general increasing discharge trend (after 1970) when the effects of climate change are investigated:**

**4. Statistical indices (1)**  
Trends are analyzed by the Sen's slope estimator (SES) for the total length of the time series as well as for the period after 1970. The results are highly dependent on the number of observations (n) and the intercorrelation between consecutive periods. The comparison is based on a standardized trend index (TI) divided by the standard deviation of each corresponding period.

**7. Results for climatic means and standard deviations**  
P1-P1: There is no apparent change between the two periods. (Note that only a few stations had available data for both these periods, which is sufficient to conduct most of the test.)  
P2-P2: Percentage of decreasing and increasing values are almost equal.  
P3-P3: Most of the mean values and standard deviations of the river discharge are decreasing.  
There is a decreasing trend in both mean values and standard deviations of the river discharge.

**10. Mean value difference between the last 2 periods,  $\Delta m$**   
World map showing the mean value difference between the last two periods.

**11. Hurst - Kolmogorov behavior**  
A Hurst analysis showed that the stationarity of time series is not confirmed. In other words, the time series are not stationary. The Hurst-Kolmogorov behavior is confirmed. There is a low Hurst index (H < 0.5) which indicates that the time series are not stationary. The Hurst-Kolmogorov behavior is confirmed.

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Από αριστερά προς τα δεξιά: Δημήτρης Κουτσογιάννης, Γρηγόρης Βαγγελίδης, Δημήτρης Μπουζιώτας, Δημοσθένης Τσακνιάς, Νίκος Μαστραντωνάς, Σίμων Παπαλεξίου