# Multiscale Persistence in Rainfall and Streamflow: Role of Rainfall and Catchment Characteristics

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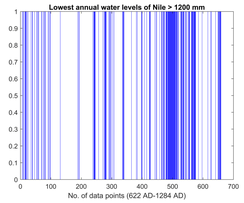
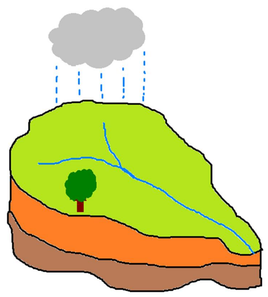
## Introduction

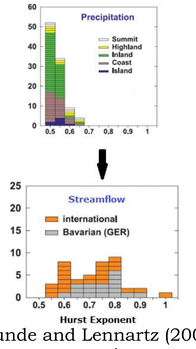
Persistence of a process refer to the tendency of temporal clustering of low/high values of a variable.




It is measured by Hurst Exponent and influences the inter-arrival times and mechanism of extreme events.

## Motivation and Objectives



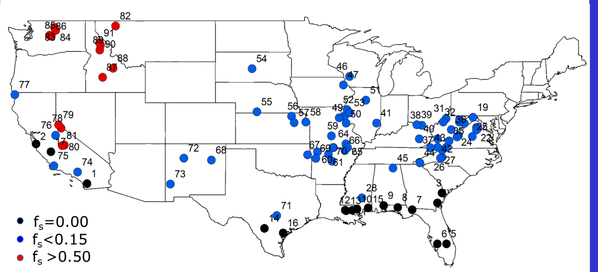



Bunde and Lennartz (2005)

- To identify relationship between persistence of streamflow and precipitation.
- To investigate the effect of catchment spatial scales on streamflow persistence.

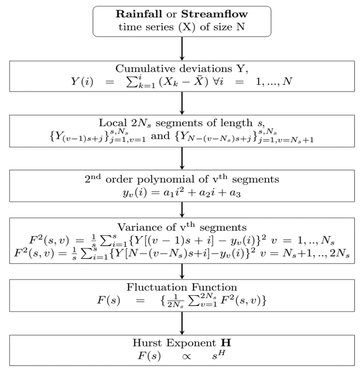
## Data and Study Area

- MOPEX (Model Parameter Estimation Project) datasets of daily rainfall and streamflow are used (Schaake et al., 2006).
- Near-natural catchments are selected with varying fraction of precipitation falling as snow ($f_s$) (Berghuijs et al., 2014).

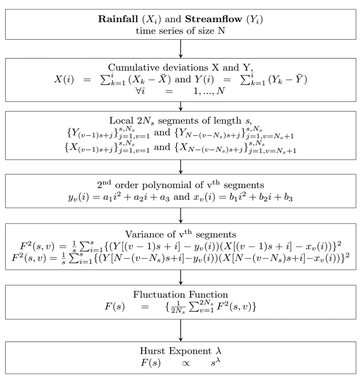



## Methodology

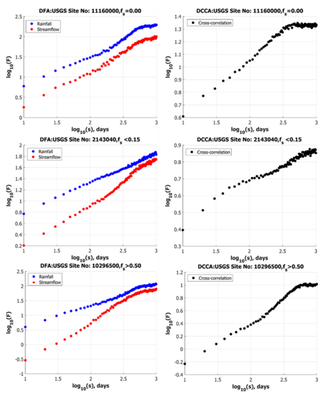
### Detrended Fluctuation Analysis




### Detrended Cross Correlation Analysis

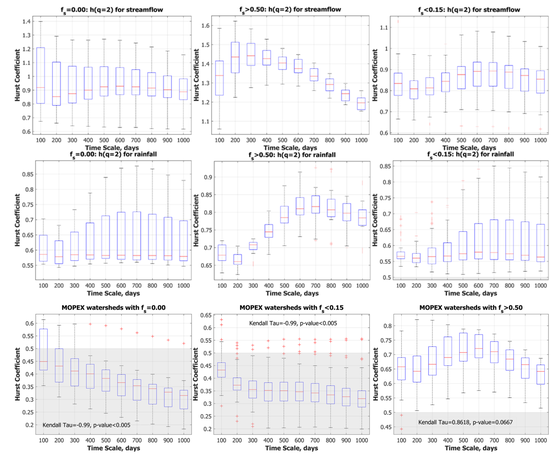



## Estimation of Hurst Exponents



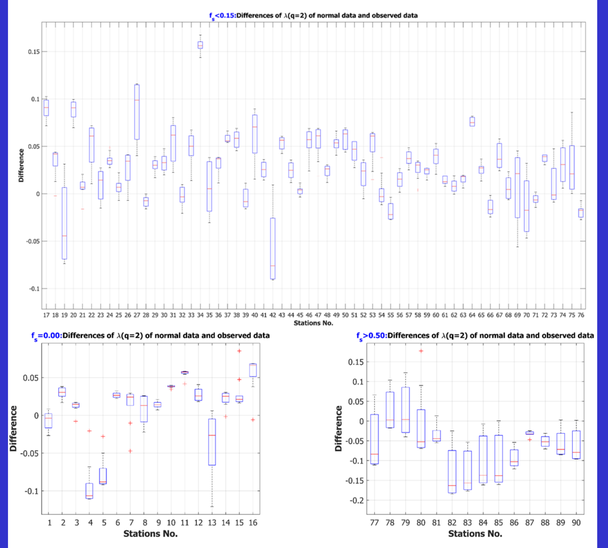

The slope of the plots gives the magnitude of the Hurst Coefficient of rainfall and streamflow and their joint behavior that describes the state of persistence at different time scales.

## Temporal Evolution of Persistence



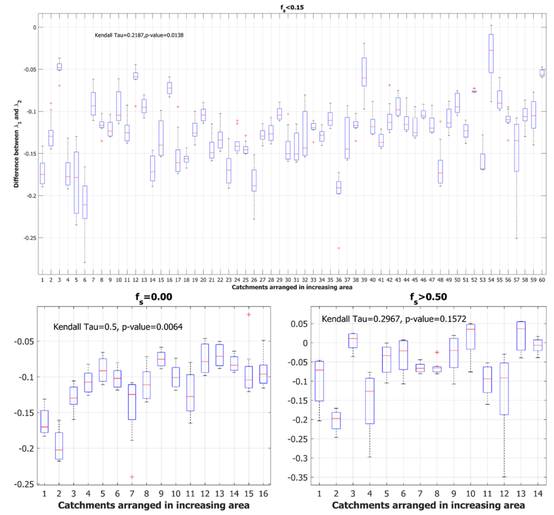

- Negative correlation suggests that factors other than rainfall govern the streamflow persistence at multiple time scales.
- Runoff generation mechanism plays an important role in persistence of streamflow.

## Effect of the rainfall amounts on the cross-correlation structure




- Difference between Hurst Exponents of joint behavior indicates effect of rainfall amount on joint behavior.
- Difference less than 0.5 suggest no influence of rainfall amount.

## Effect of catchment size on persistence of streamflow




The persistence of streamflow is dependent on catchment size as higher degree of self organization occurs between different catchment state variables.

## Conclusions

- The degree of persistence of rainfall and streamflow and their joint behaviour shows a dynamic evolution across temporal scales.
- The state of persistence of cross-correlation structure across multiple space and time scales are not controlled by the amount of rainfall.
- The contribution of the catchment related processes to the persistence of the streamflow increases with the increasing catchment area.

## References


- Berghuijs, W. R., Woods, R. A., & Hrachowitz, M. (2014). A precipitation shift from snow towards rain leads to a decrease in streamflow. Nature Climate Change, 4(7), 583.
- Bunde, A., & Lennartz, S. (2012). Long-term correlations in earth sciences. Acta Geophysica, 60(3), 562-588.
- Schaake, J., Cong, S., & Duan, Q. (2006). The US MOPEX data set. IAHS publication, 307(9).