

Croatian Karst River Flows: Insights from Hurst Exponent Analysis

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INTRODUCTION & AIM

- Long-term persistence and Hurst-Kolmogorov dynamics (HK) methods were employed.
- Analysis of water level data from two hydrological stations of Croatian karst rivers: Zamost 2 on the Čabranka River and Brod na Kupi on the Kupa River.
- Using climacograms and analysis across different time scales, the existence of the Hurst phenomenon in these systems is investigated and the implications of these results for the understanding of hydrological processes are discussed.

METHOD

Hurst Parameter (H): A quantitative measure of long-term dependence in time series.

- $H = 0.5$: Random process (no memory).
- $H > 0.5$: Persistent behavior (high follows high, low follows low).
- $H < 0.5$: Antipersistent behavior (values alternate rapidly).

Hurst Parameter (H) Estimation:

- Climacogram: Used to express dependence in HK dynamics.
- Variance Relationship: Variance of aggregated values ($\gamma(k)$) follows (Dimitriadis et al., 2021):

$$\gamma(k) = \frac{\lambda}{\left(k/\alpha\right)^{2(1-H)}}$$

- $\gamma(k)$ is variance of the mean values of blocks of size k
- λ and α are process intensity and time scale parameters, respectively
- λ i α are constants. The relation further reduces to: $\gamma(k) \propto k^{-2(1-H)}$
- In a log-log plot, this becomes:

$$\log(\gamma(k)) = s \cdot \log(k/\alpha) + C$$

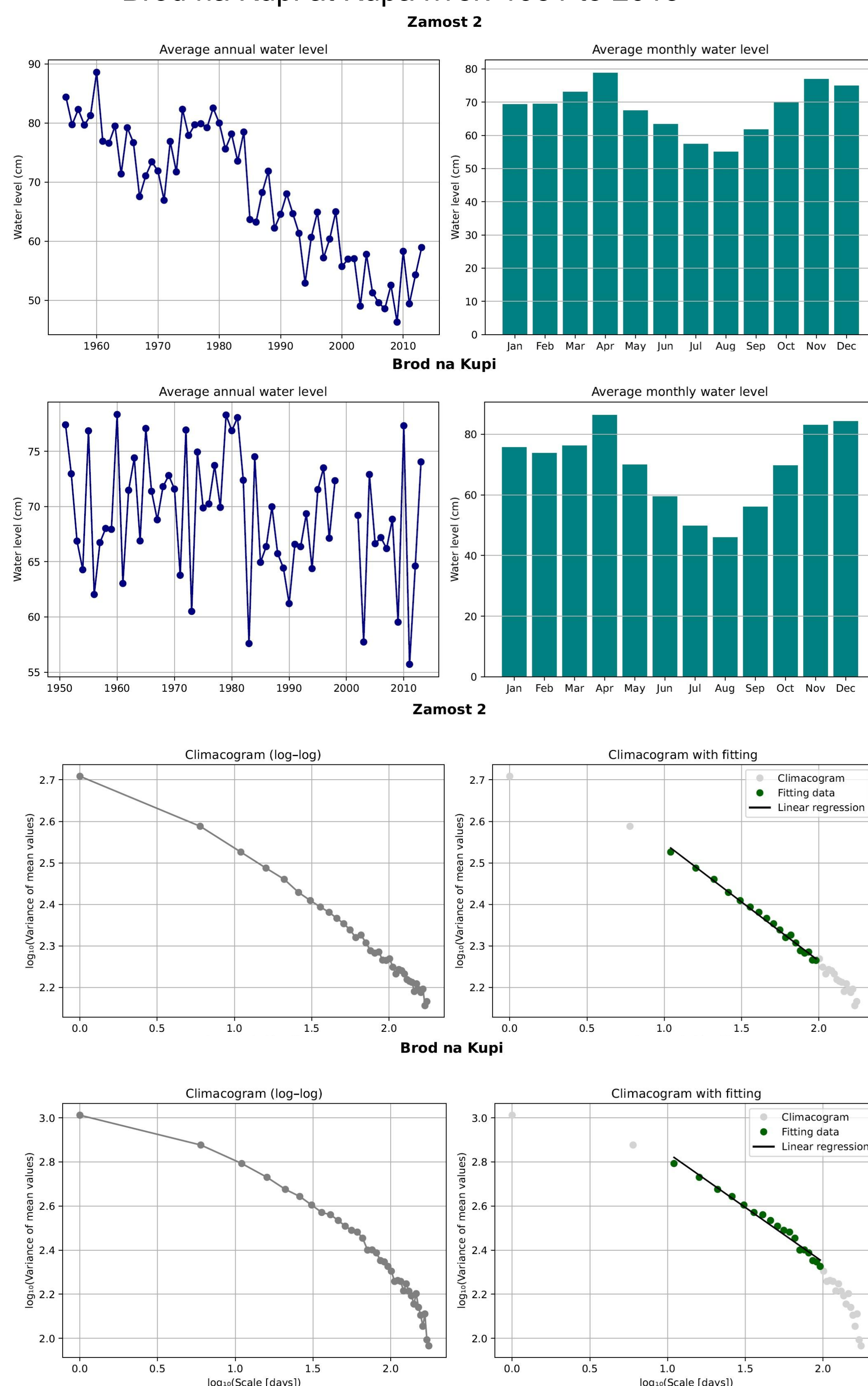
$$s = -2(1 - H), c = \text{constant}$$

- H can be estimated from the slope (s) of the log-log plot of variance vs. time scale using:

$$H = 1 + \frac{s}{2}$$

RESULTS & DISCUSSION

- Daily water level uninterrupted data used:
 - Zamost 2 on Čabranka river: 1955 to 2013
 - Brod na Kupi at Kupa river: 1951 to 2013



CONCLUSION

	Zamost 2	Brod na Kupi
H	0.858	0.752
R ²	0.993	0.980

FUTURE WORK / REFERENCES

Dimitriadis, P.; Iliopoulou, T.; Sargentis, G.-F.; Koutsoyiannis, D. Spatial Hurst–Kolmogorov Clustering. Encyclopedia 2021, 1, 1010–1025. <https://doi.org/10.3390/encyclopedia1040077>