Institute of Geophysics
Polish Academy of Sciences

XLII
International School of Hydraulics
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Assessment of Trends in the Polish Annual Peak Flow Data

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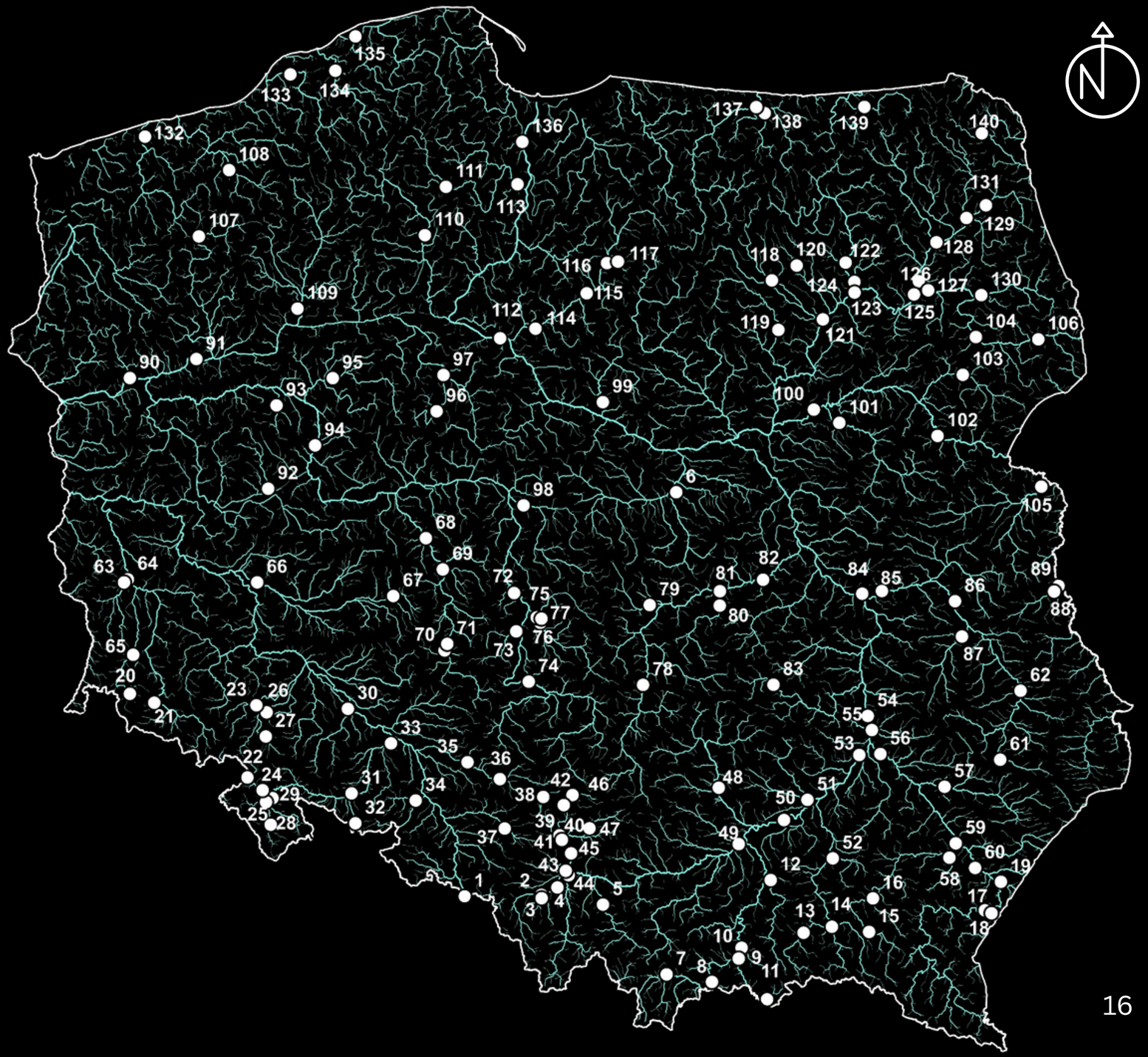
Motivation

- The downstream impact of hydrotechnical structures influences peak flow values for many gauging stations on rivers around the world and in Poland.
- A trend in the river flow is a continued change that occurs over time.
- Changes in the trend of the flood peak produce challenges when assessing and managing flood risk. Because when a trend is detected, it is likely to continue in the future
- The use of historical flood peak observations is an important element to obtain a clear understanding of what the future will hold

Study Area and Data

- Annual Peak flow data from 1951-2022/23 were considered for 140 gauging stations.

- Annual peak flow data is used to estimate the flood quantile i.e. the estimates volume of water related to a certain return period which is used to construct the hydrotechnical structures.



Autocorrelation

- Autocorrelation is when the peak flow in one year may be influenced by the conditions of the previous year(s).

  eg: If the soil is saturated with water during winter, it will react differently to rain than if it were dry.

- The presence of correlation in the time series will lead to errors in the proper identification of significant trends.

Mann Kendall (MK) test

- The Mann-Kendall(MK) test is the most widely used non-parametric test to detect the presence of temporal trends in the peak flow data
- Null Hypothesis: No Trend
- Alternative Hypothesis: Trend exists

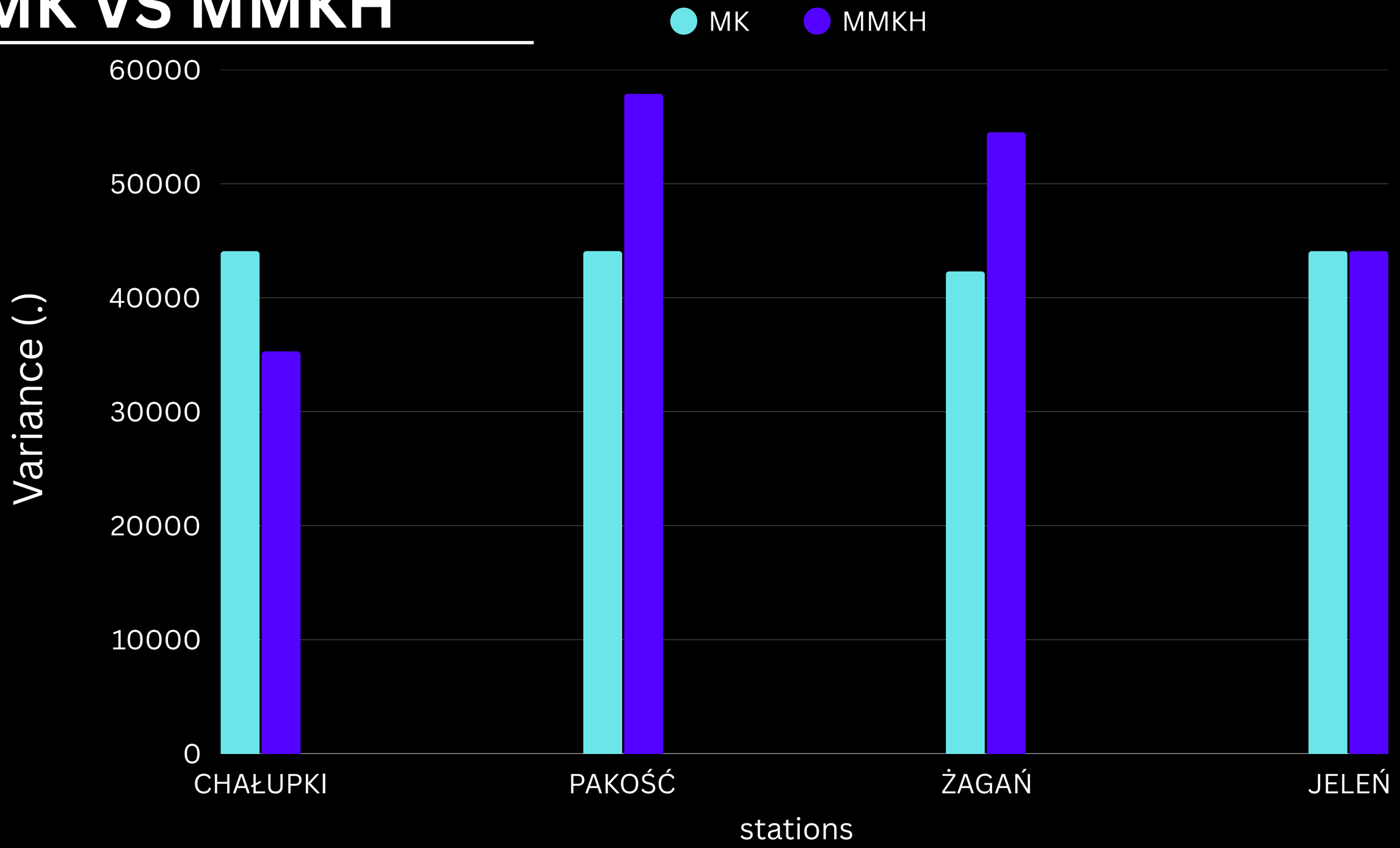
Modified Mann Kendall (MMKH) test

- The main disadvantage of using the MK test is that the results can be affected by autocorrelation i.e. the data values are not independent

- Positivie serial correlation series increases the variance of the MK test, this increases the probability of detecting a significant trend, whereas infact none may exist

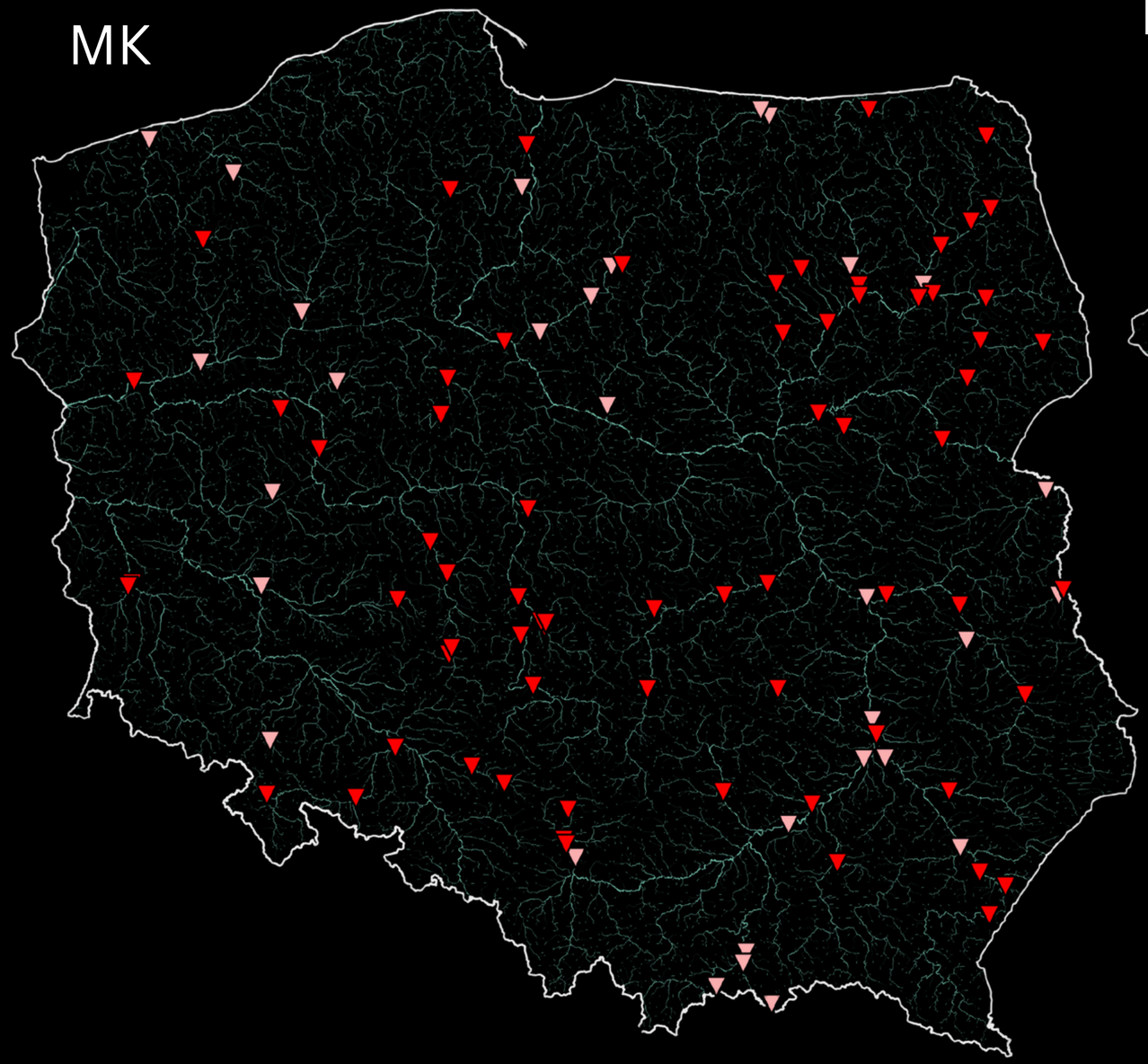
- The modification of the MK test is based on the assumption that data are autocorrelated; therefore, the data are initially detrended, and the effective sample size is calculated using the rank of significant serial correlation coefficients which are then used to correct the inflated or deflated variance of the test statistics

MK VS MMKH

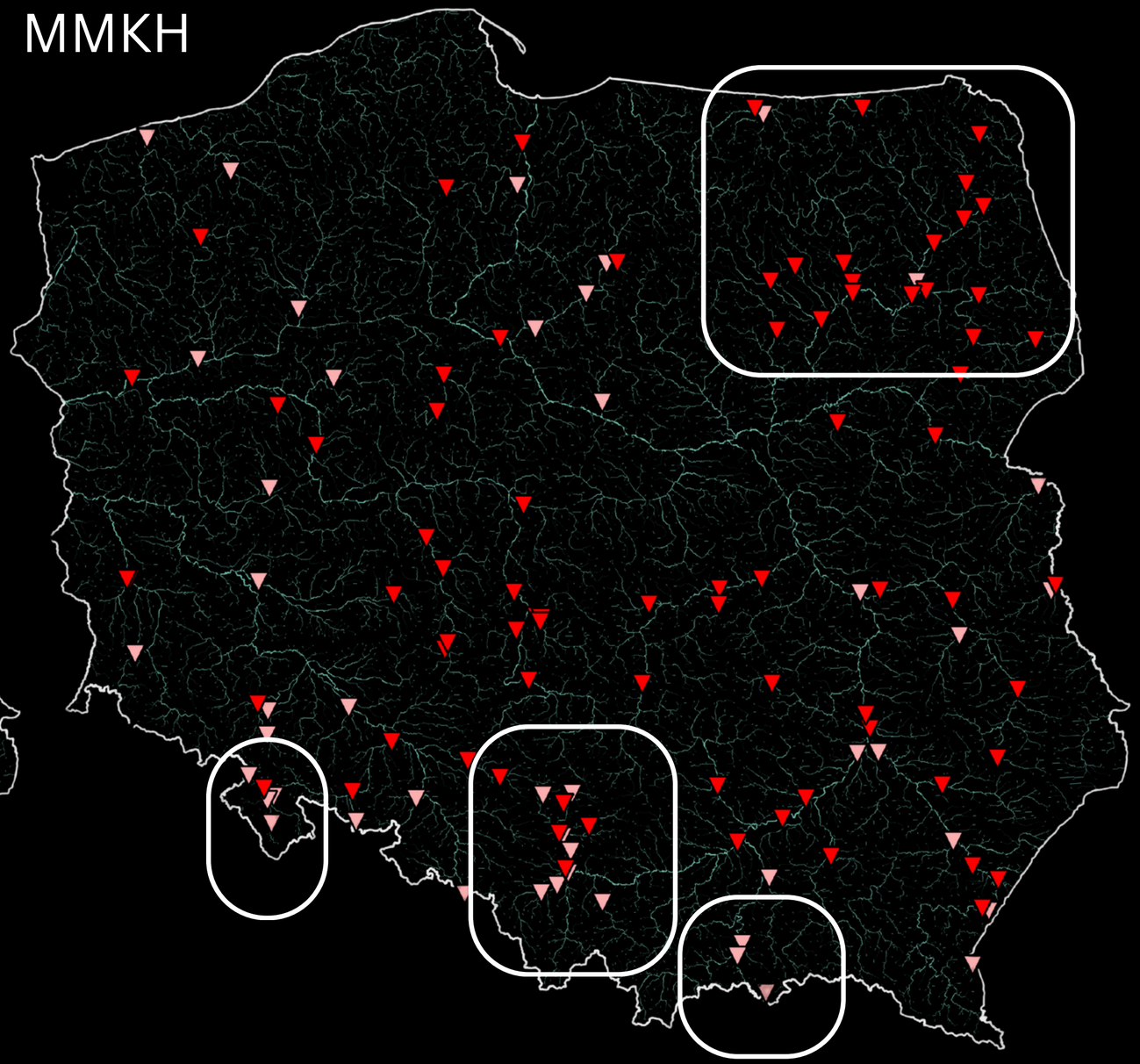

MK
MMKH
60000
50000
40000
30000
20000
10000
0
Variance (.)
CHAŁUPKI
PAKOŚĆ
ŻAGAŃ
JELEŃ
stations

Negative Trend Results

MK



MMKH

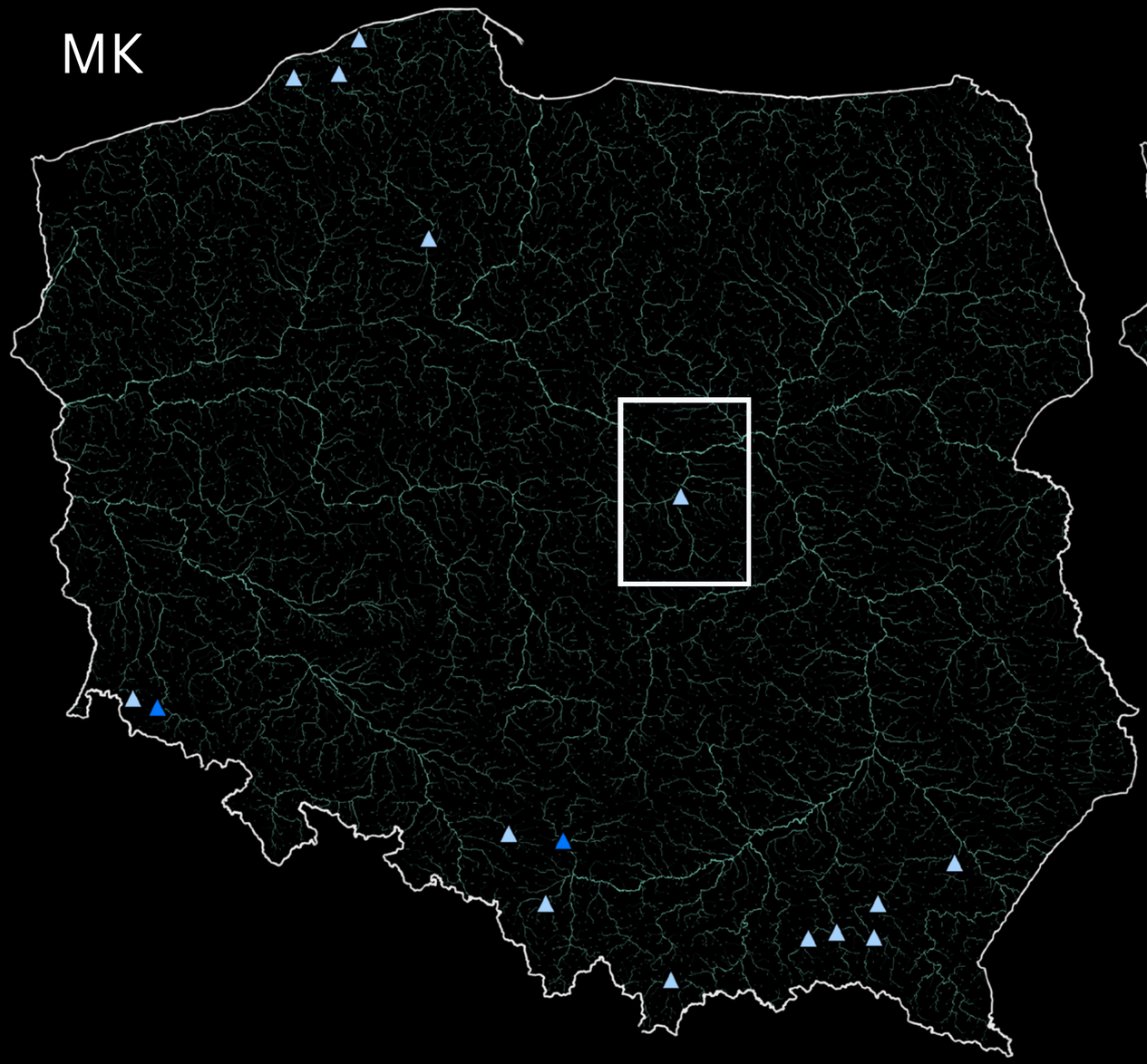


Negative Trend

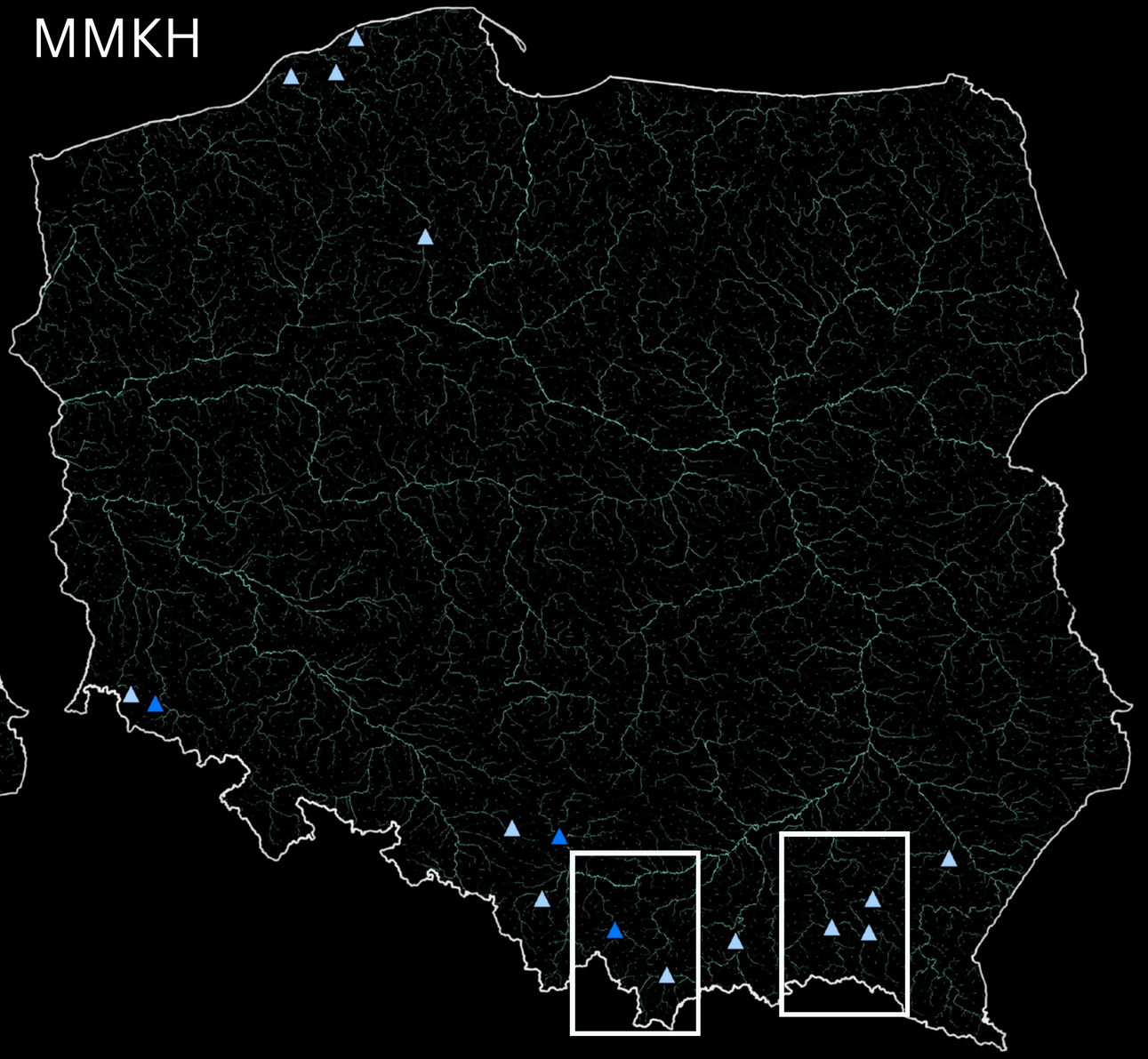
Significant Negative Trend

Positive Trend Results

MK



MMKH



Positive Trend

Significant Positive Trend

Conclusions

- Lag-1 autocorrelation is present in many stations.
- Trend results differ substantially due to the correction of variance by the MMKH test.
- Positive trend is observed at 16 stations of which only 3 are statistically significant trend at the 0.05 significance level.
- Negative trend is observed in the rest of the 124 stations of which 76 stations show a statstically significant trend.
- Out of the 76 stations 32 stations have hydrotechnical structures above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Thank You