VARIABILITY OF MAXIMUM RIVER FLOW QUANTILES IN THE UPPER VISTULA RIVER BASIN, POLAND

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Research questions:

How does the long-term variability of extreme river flow quantiles in the Upper Vistula basin look like?

Is this variability linked with climatic drivers such as NAO, SCAND, etc.?

MOTIVATION, STUDY AREA, DATA, METHODS

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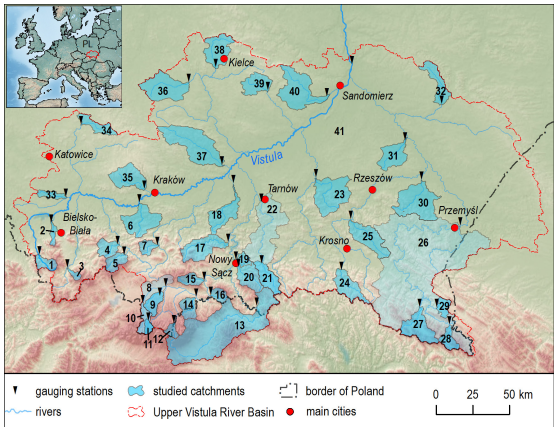

41 catchments

The region of the **Upper Vistula** river basin (50 700 km^2) possesses the largest water resources of any region of Poland.

It is very flood-prone.

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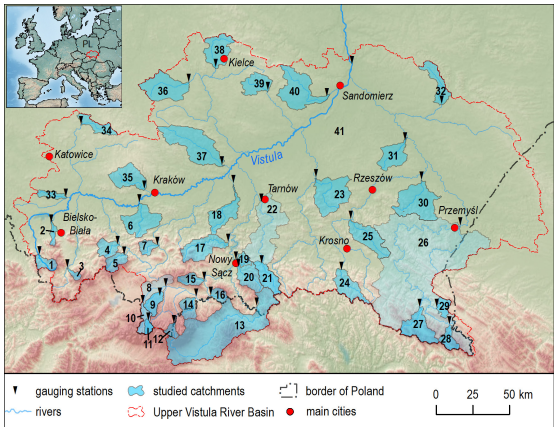

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- the **Quantile Perturbation Method (QPM)** $\Rightarrow$ the series of **anomalies**, both for maxima river flows (winter, summer, annual) and climatic indices.
  In a subseries extracted from the entire series, **anomaly is the average relative change of quantiles** of the same return period as in the main series. The subseries is shifted along the main series.

QPM acts as a filter to enhance the multidecadal signal.

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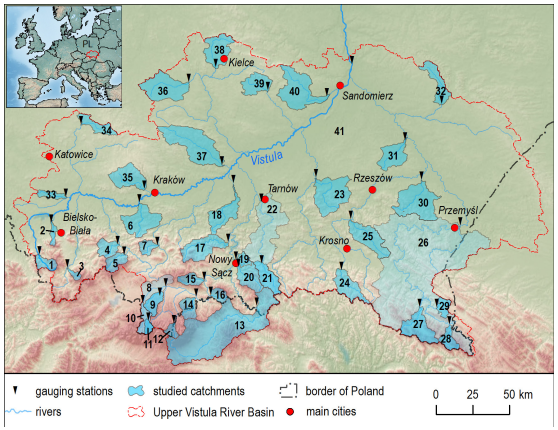

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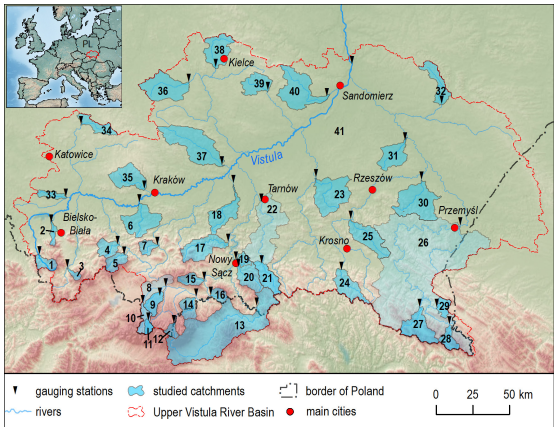

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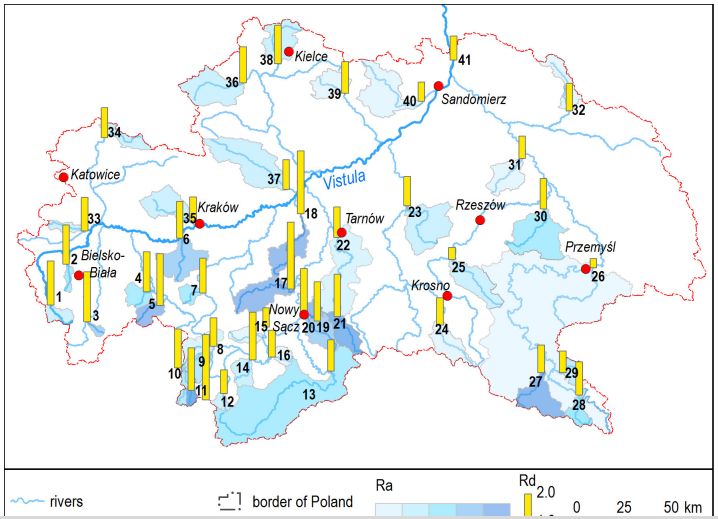
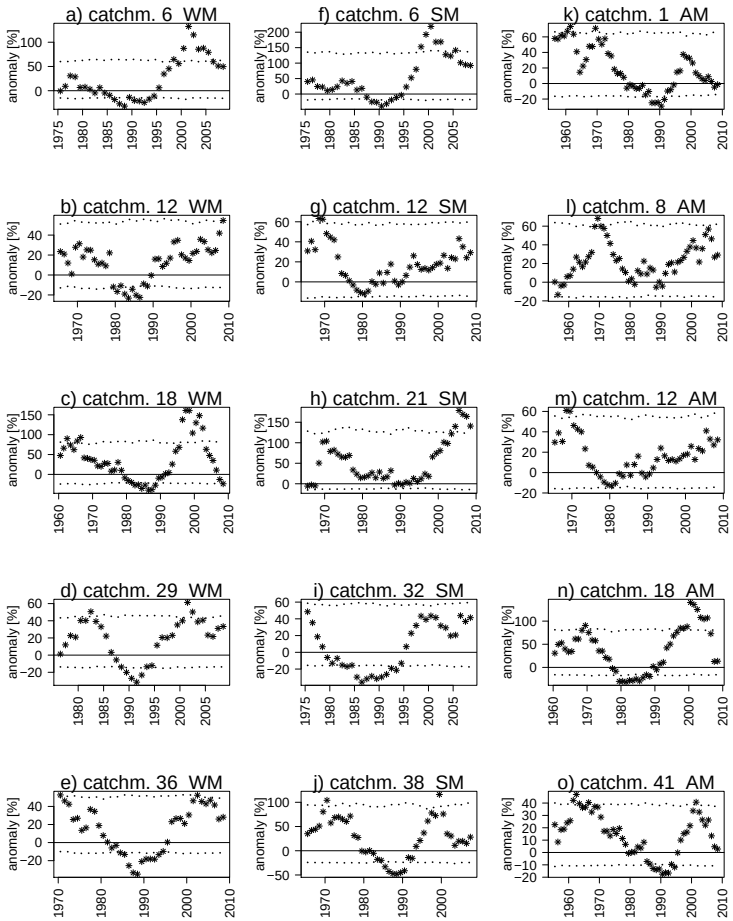
  Oscillatory characteristics:
  - mean period length,
  - part of explained variance of the multidecadal comp.,
  - part of unexplained variance.

RESULTS

- **oscillating** pattern with clusters **of high and low flows** in most catchments.
  Anomalies positive in: late 1960s, the 1970s, late 1990s,
  negative in: the 1980s, early 1990s, the 2000s,
- **spatial heterogeneity of the summer anomalies:** very high in south and south-west, moderate in east and north,
- high level of **unexplained variance** in the entire basin, a **very high level in south** and **south-west**,

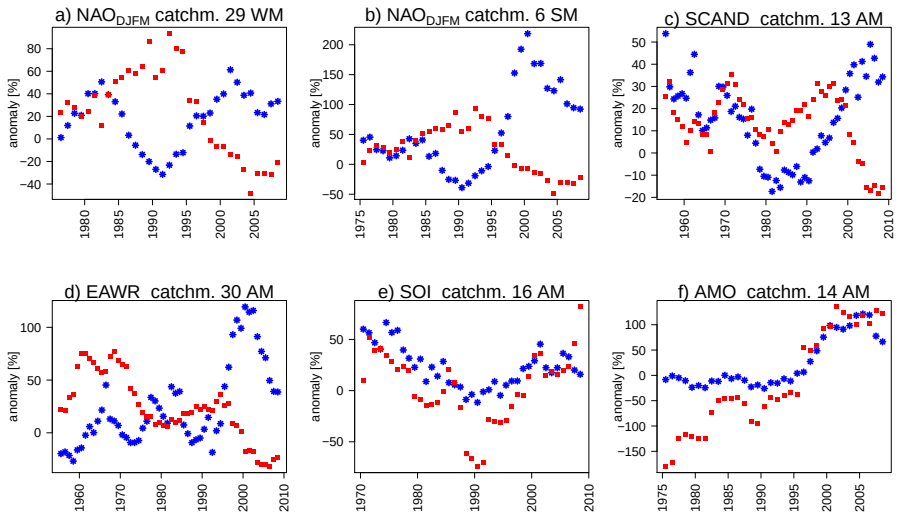




Extreme quantile anomalies (thick, black markers) and the 90% confidence limits of the anomalies (thin, dotted line) versus period of observation.

RESULTS (CONT.)

- significant **correlation** between **river flow** and **climatic indices** anomalies + **similarity** between mean **periods** $\Rightarrow$
  the oscillating pattern is partly forced by the climatic indices:
  NAO, SCAND, EAWR, NCP, and ENSO (to a lesser extend).
- the influence of climatic drivers is **masked by the high variability** of local climatic factors in the **south and south-west**.



Anomaly of river discharge (blue stars) and anomaly of CI (red squares) versus period of observation.