Rainfall and runoff trends and their relation – a case study in Lower Saxony

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Outline

1. Motivation/ Objectives
2. Methods
3. Study region & data
4. Results
5. Conclusions

1. Motivation & Objectives

Analysis of past developments is usually the first step for prediction in climate impact studies.

1. Trend analysis for precipitation (P) and runoff (Q) focussing on extremes
2. Analysis of correspondence between P trends and Q trends
3. Discrimination between climate impacts and other anthropogenic impacts

2. Methods

Mann-Kendall trend test → significance

Slope of regression line → magnitude

pq90 – 90%-quantile from daily P (P>1mm/d)
px5d – maximum 5-day P sum
pnl90 – no. of events > long term 90%-quantil
pxcdd – max. no. of consecutive dry days (P<0.1)

} **P indices**

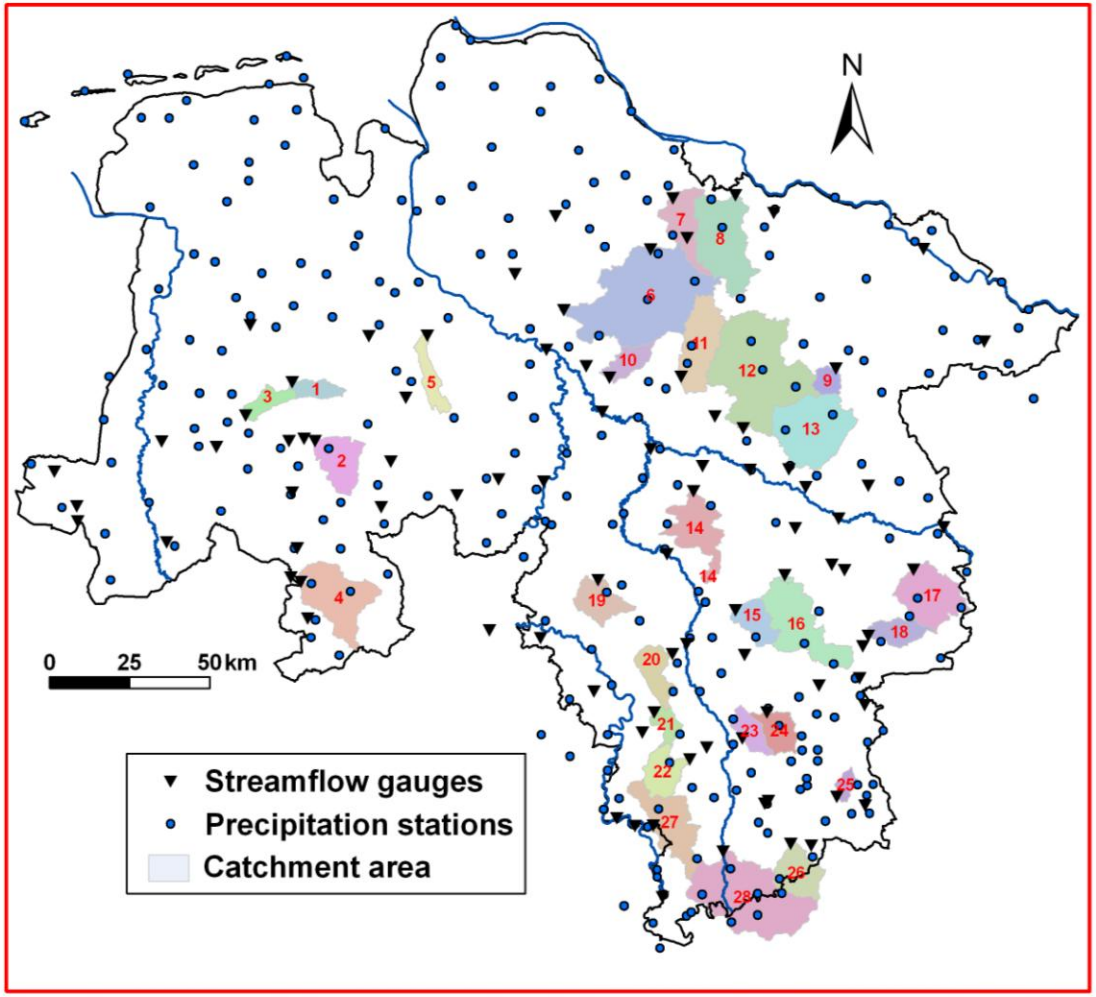
HQ - peak flows
nQ75 – no. of events > 75%-quantile of HQ
MQ - mean daily flow
NM7Q – lowest mean daily flow over 7 days

} **Q indices**

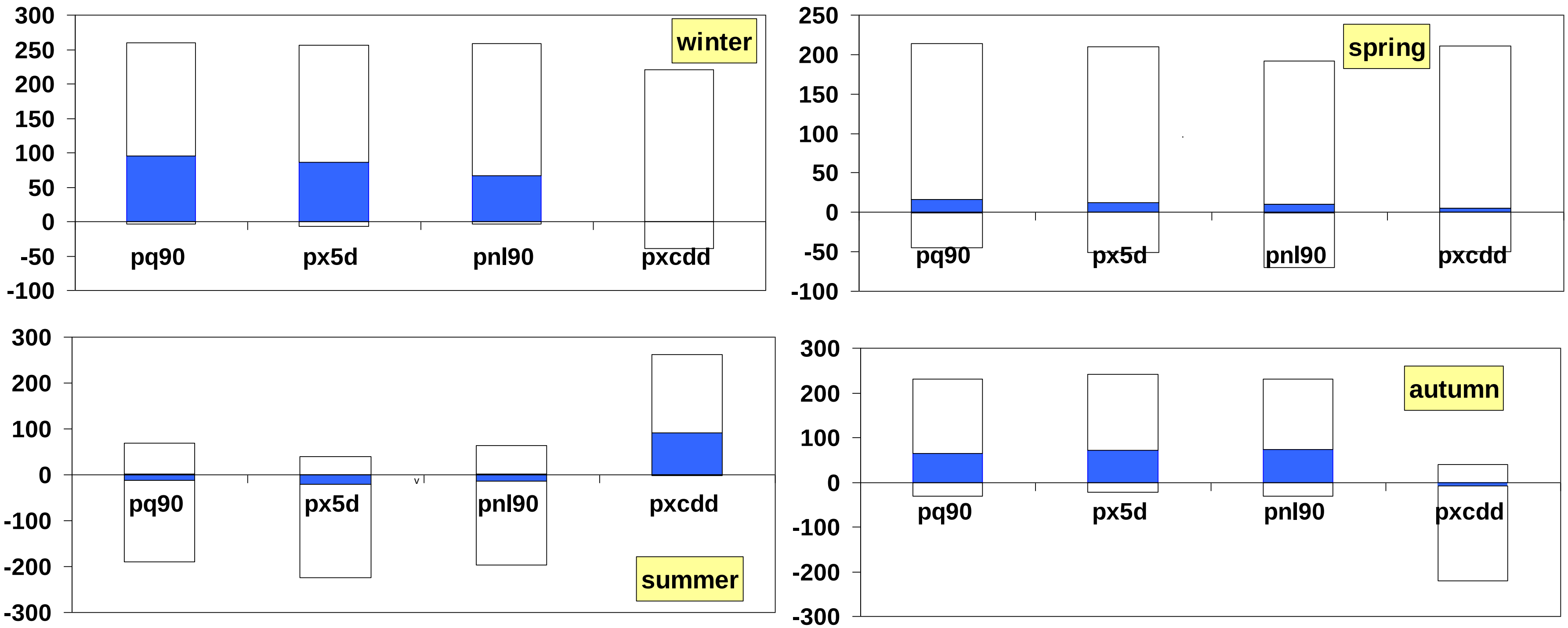
3. Study region & data

- Lower Saxony ~48000 km^2
- 263 daily P-stations (period 1951-2005)
- 88 Q-gauges (daily & peaks) (1966-2005)
- 28 catchments for comparisons areal P and Q trends
- 4 Seasons:

  winter (DJF), spring (MAM), summer (JJA), autumn (SON)

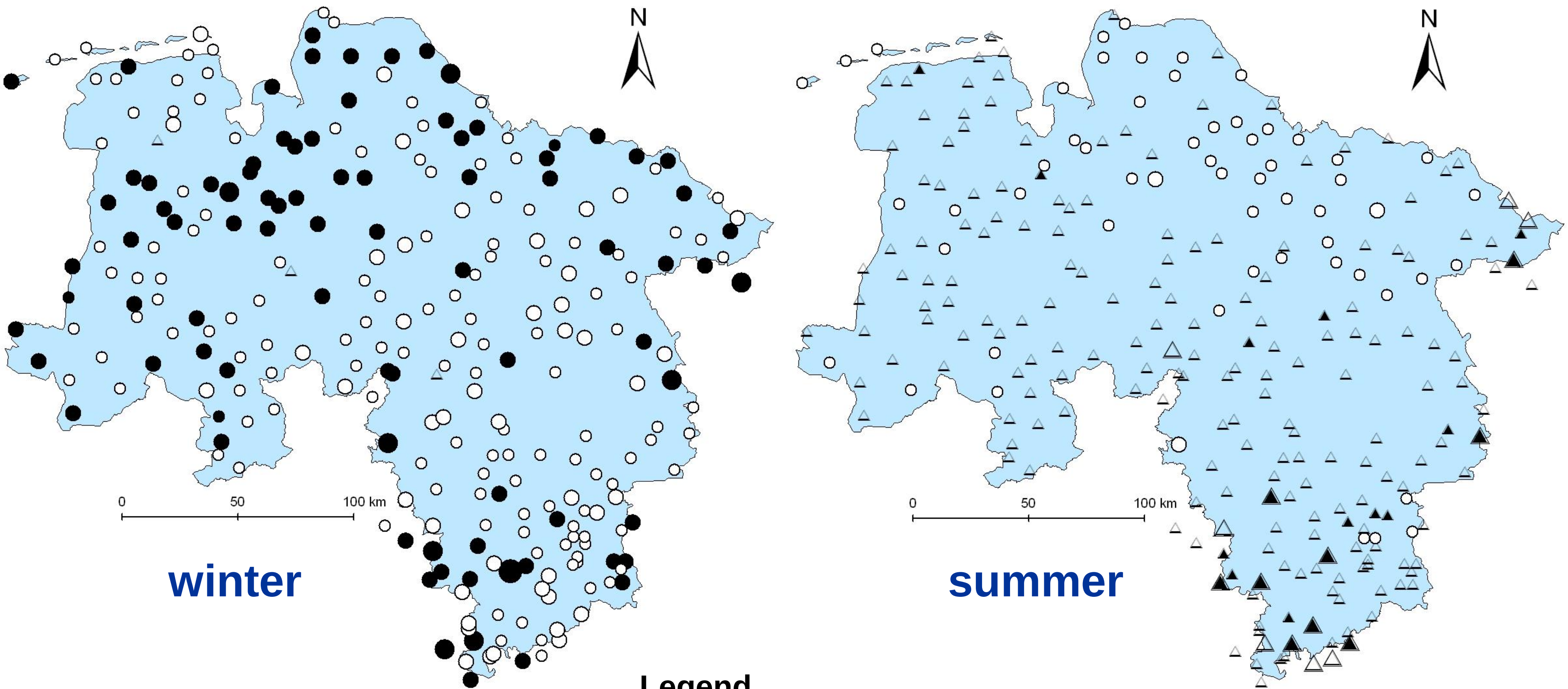


4.1 Results Precipitation



No. of stations with trends (blue indicates significant trends at $\alpha = 0.05$

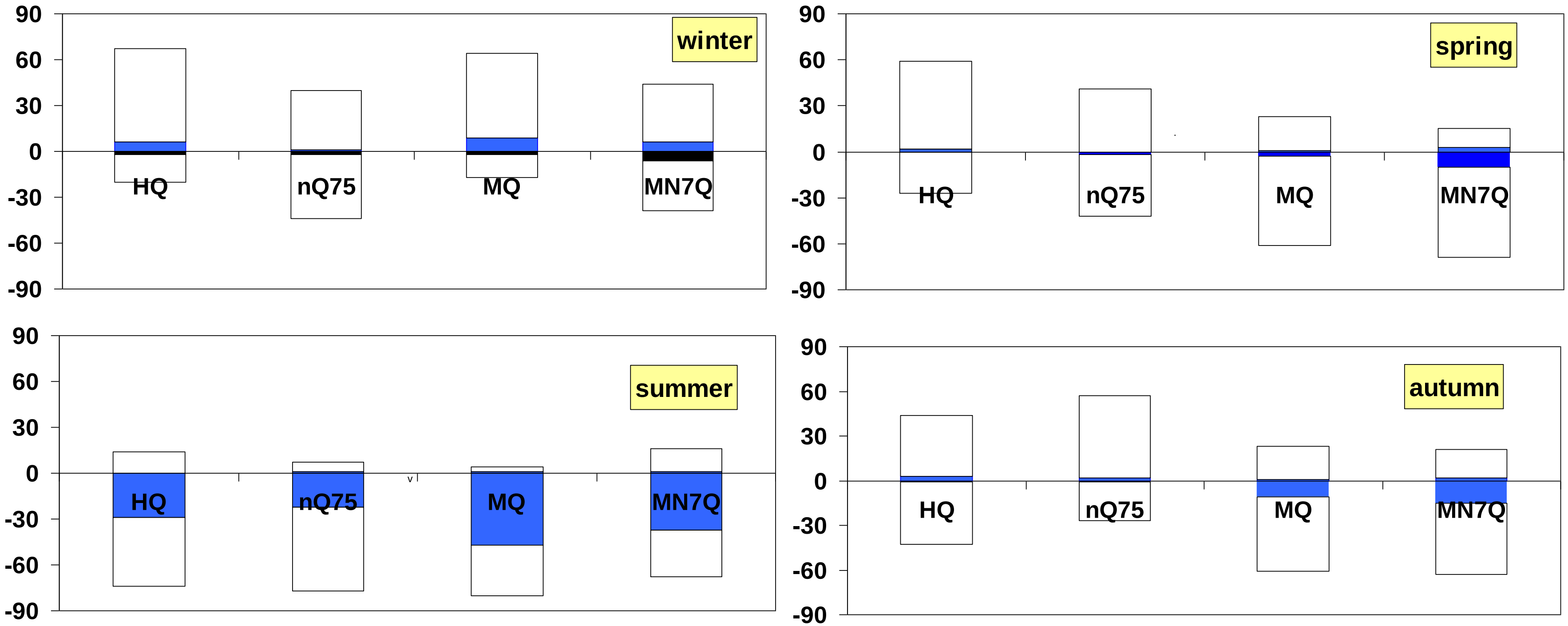
Maximum 5 day precipitation sum (Px5d)



Legend

- x < -30 %
- -30% < x < 0%
- 0% < x < 30%
- 30% < x < 60%
- 60% < x < 90%
- 90% < x

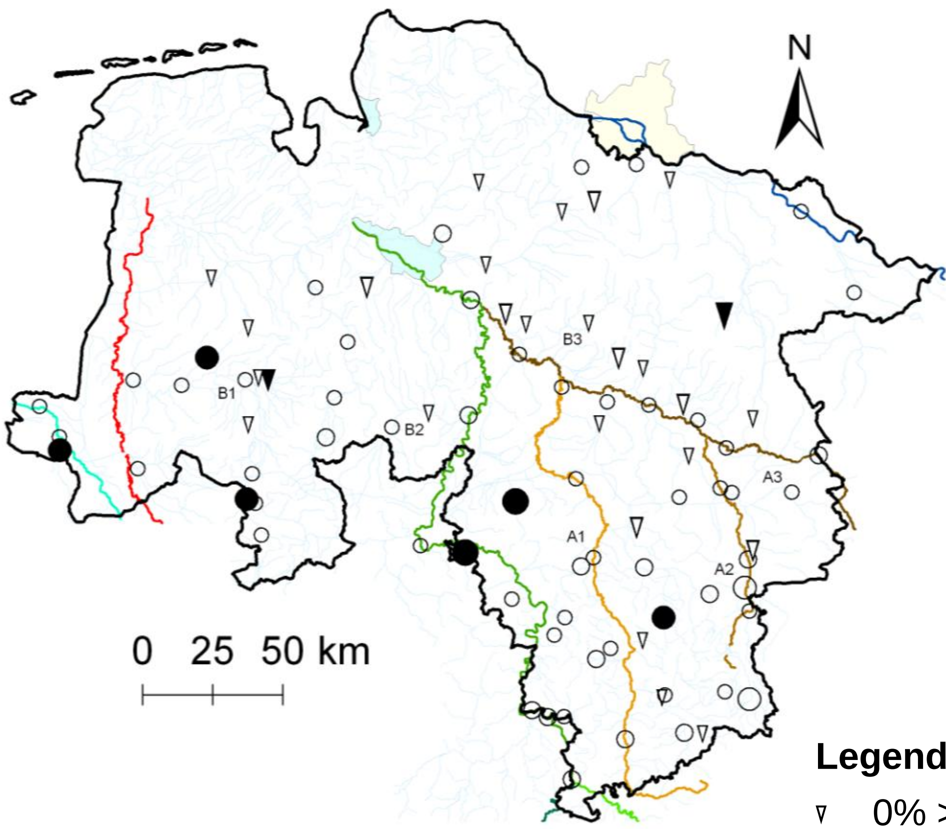
4.2 Results Runoff



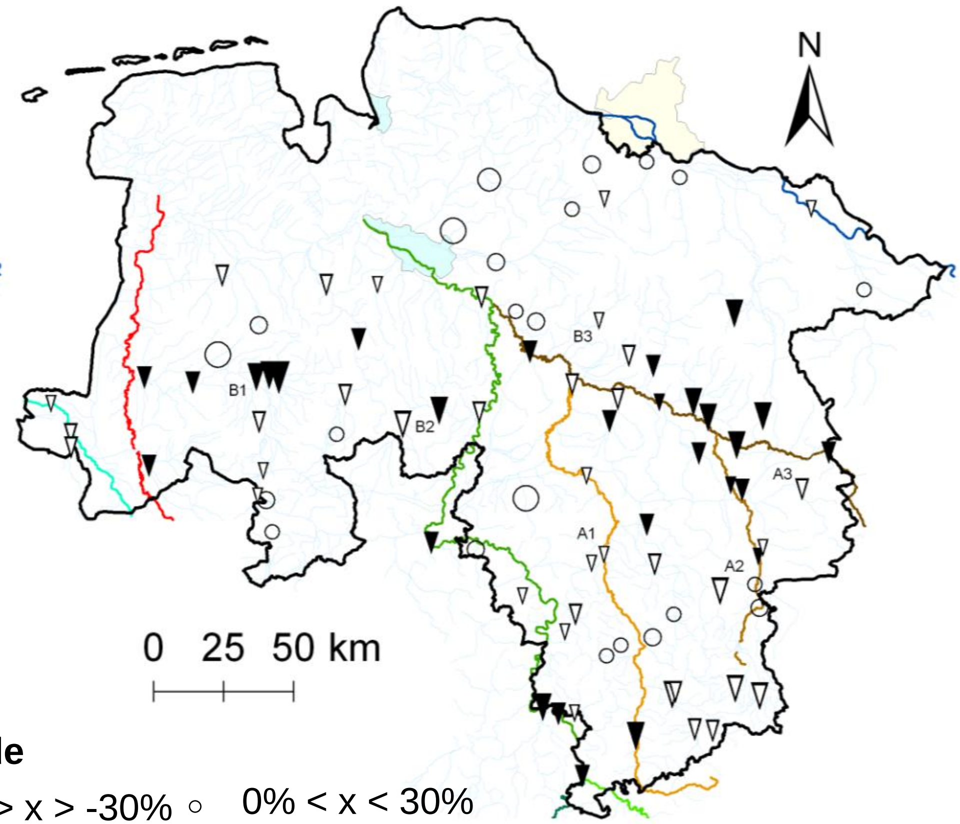
No. of gauges with trends (blue indicate significant trends at α = 0.05

Peak runoff (HQ)

winter



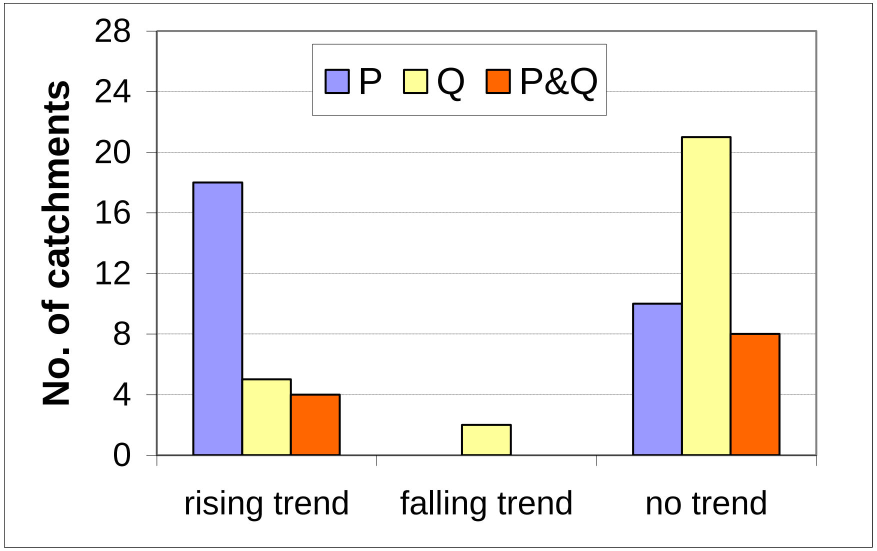
summer



Legende

▿ 0% > x > -30%	○ 0% < x < 30%
▿ -30% > x > 0%	○ 30% < x < 60%
▿ -60% > x > -90%	○ 60% < x < 90%
▿ -90% > x	○ 90% < x

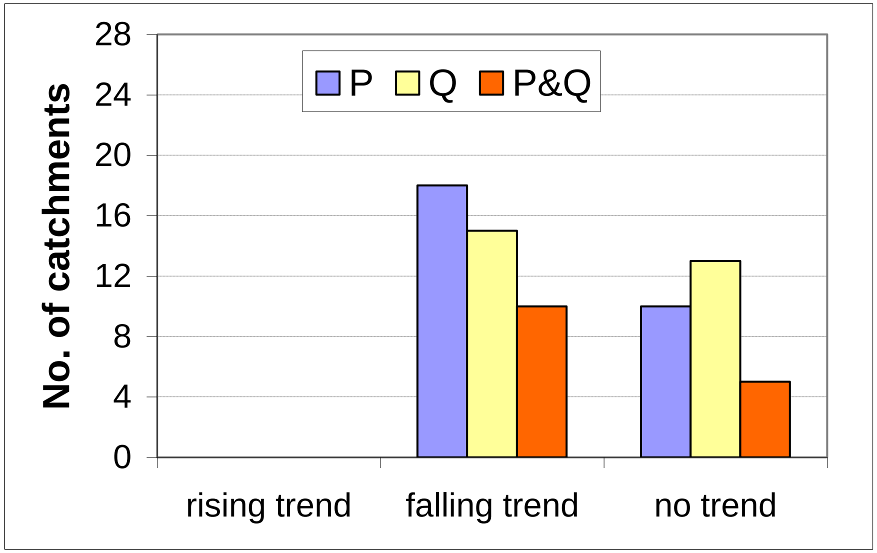
4.3 Comparison for 28 catchments



Significant trends in winter (DJF):

90% quantile of precipitation (P) vs. peak flow (Q)

($\alpha = 0.10$)



Significant trends in summer (JJA):

Max dry duration (P)*1 vs. mean low flow over 7 days (Q)

($\alpha = 0.10$)

*1 Max. dry duration trend is rising means precipitation trend is falling

Why differences in P – Q trends?

1. Data issues
2. Catchments attenuate the P signal
3. Human interventions

} **Hypotheses**

Hydrological modelling

- Assumptions: a) Data issues solved, b) Model can simulate trends
- Modelling with time invariant conditions (par's, land use) should help to discriminate between 2. and 3.

} **Intended procedure**

5. Conclusions

1. Significant trends for rainfall have shown wetter conditions in winter and longer dry periods in summer
2. Significant trends for runoff occur mainly in summer and are decreasing for all indices
3. Correspondence of runoff trends to rainfall trends is about 55% for decreasing low flows in summer and only 20% for increasing flood flows in winter
4. Further research is necessary to find reasons for non-correspondence and to discriminate for trend causes

Thank you for your attention!

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