Climate elasticity of low-flows

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HYDRO

SMHI INRAE

Presentation

- **Introducing the climate elasticity of flow**

- **Comparative elasticity of annual flows (QA) and low-flows (QMNA)**
  - A study on 564 French catchments
  - QMNA: annual minimum monthly flow
  - QA: annual average flow

Elasticity plot: a simple and sensible sensitivity analysis tool

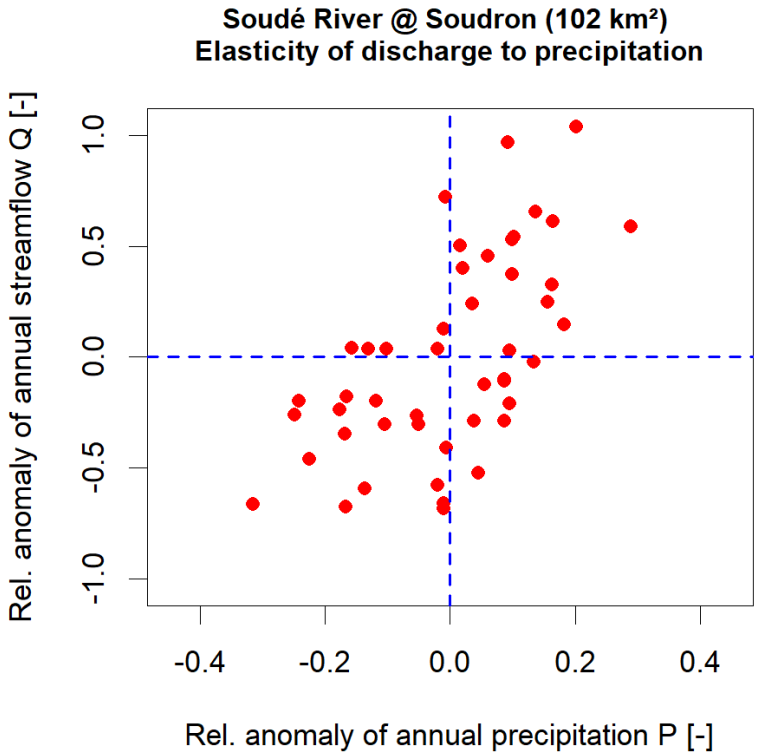
- Precipitation elasticity of streamflow:

$$\frac{Q_n - \bar{Q}}{\bar{Q}} = \varepsilon_{Q/P} \frac{P_n - \bar{P}}{\bar{P}}$$

$$anomaly(Q) = \varepsilon_{Q/P} anomaly(P)$$

index n for year

ε represents the elasticity index

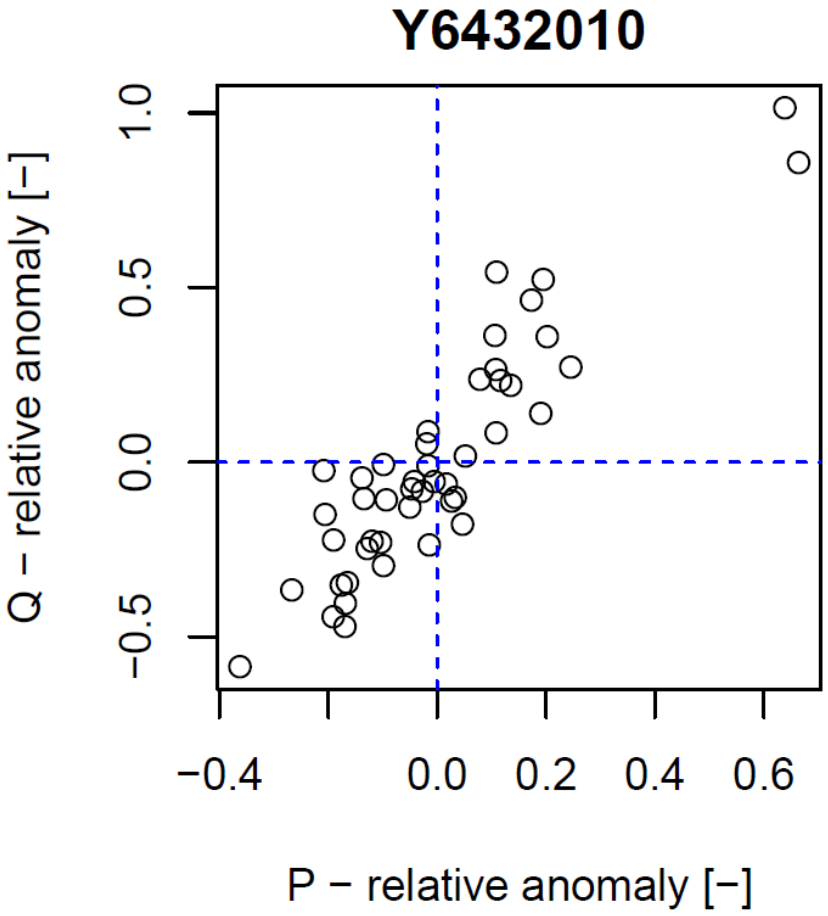


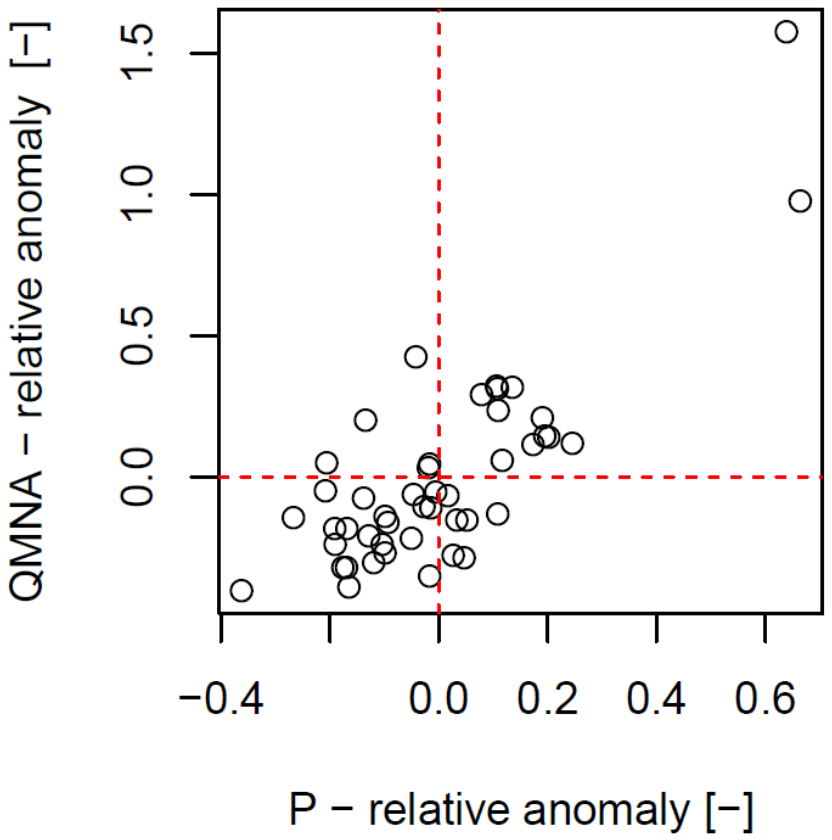
each red dot corresponds to a hydrological year

Elasticity of Q and QMNA:

A diversity of behaviour

High correlation for both Q and QMNA

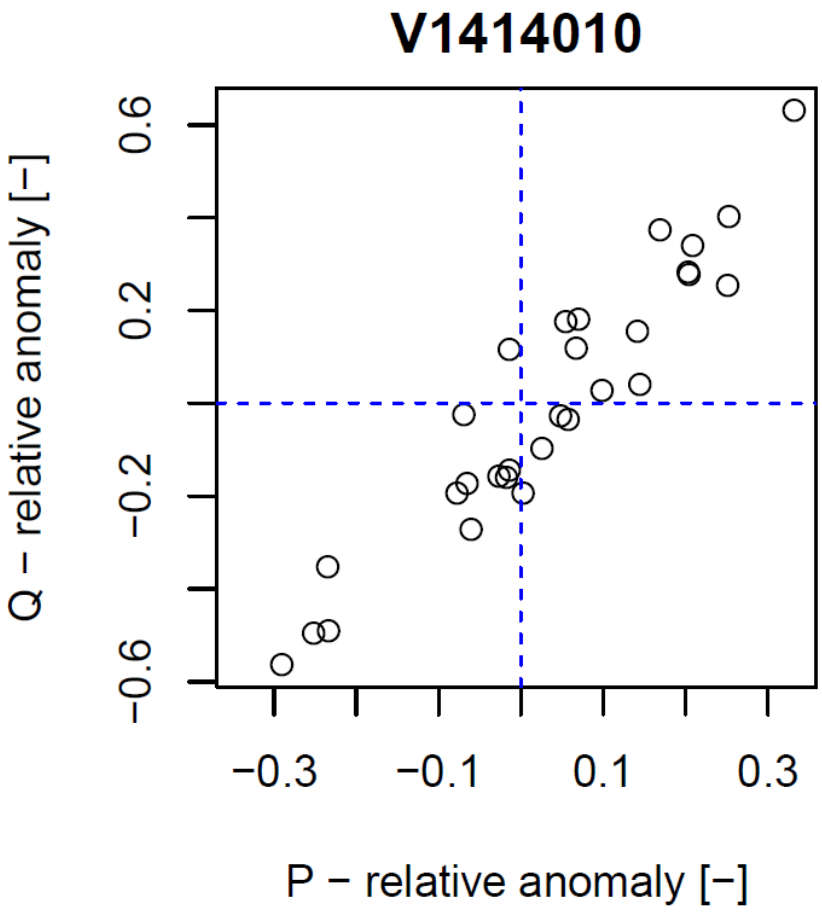


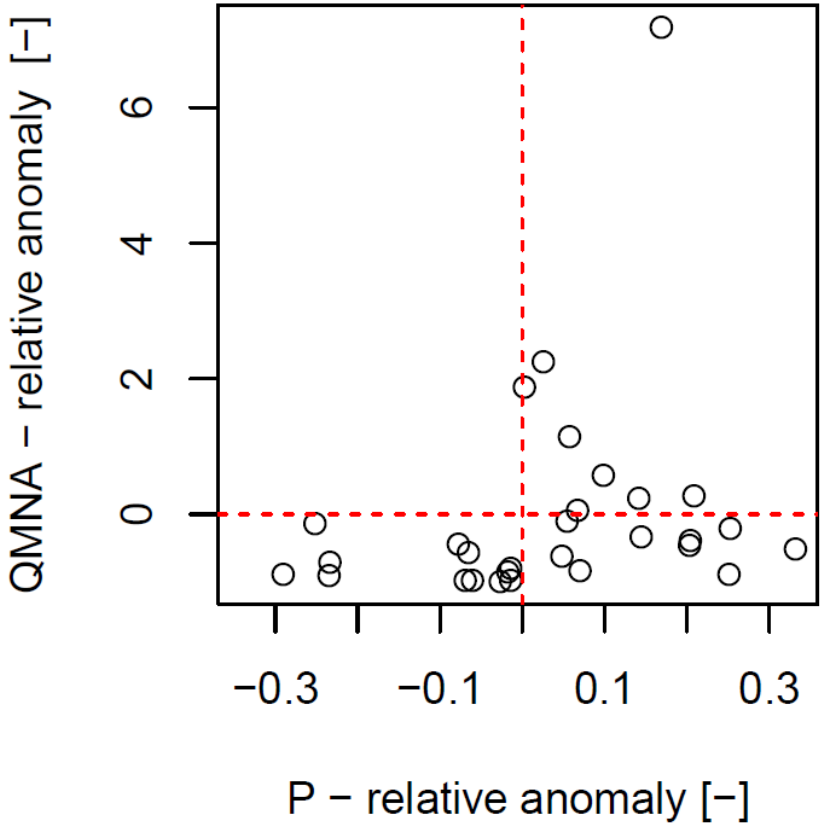


- **Q and QMNA show high correlation with annual precipitation**

Le Var @ Malaussène

High correlation for Q and poor correlation for QMNA

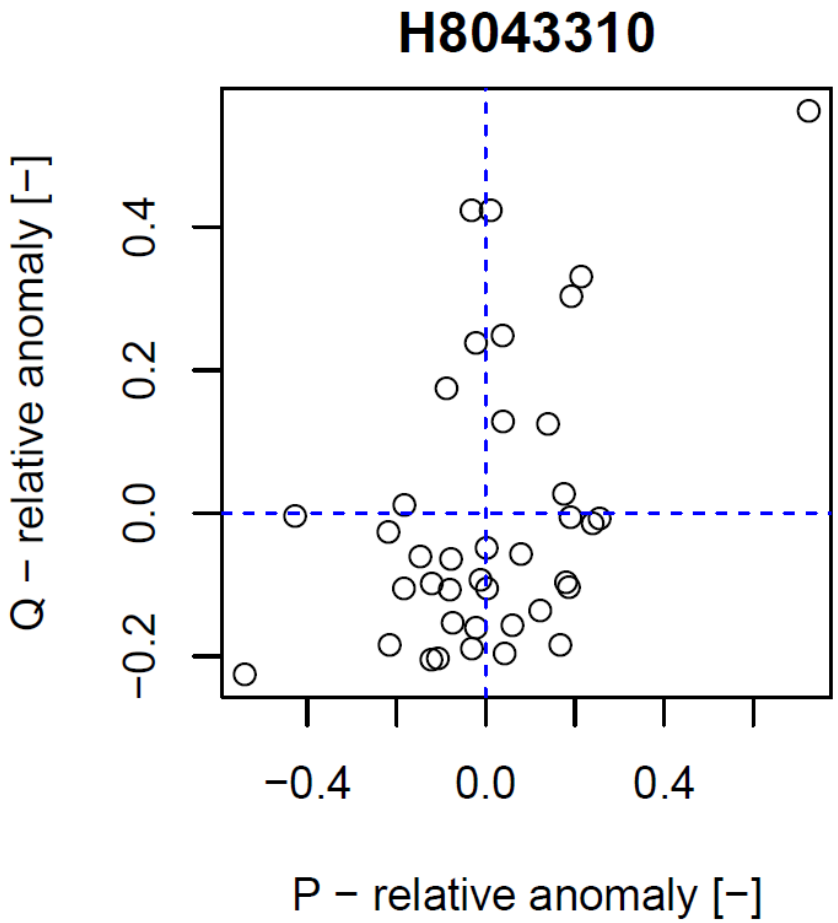


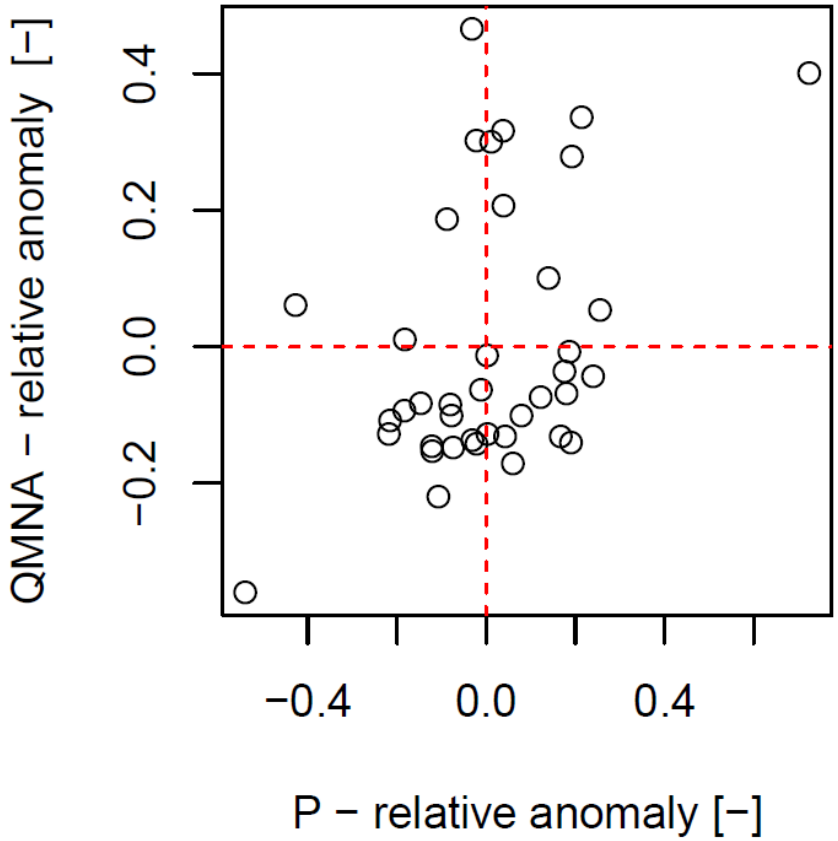


- **QMNA shows no correlation with annual precipitation while Q does**

***Le Seran @ Belmont-Luhézieu*: an almost ephemeral catchment leaking to regional groundwater**

Poor correlation for both Q and QMNA



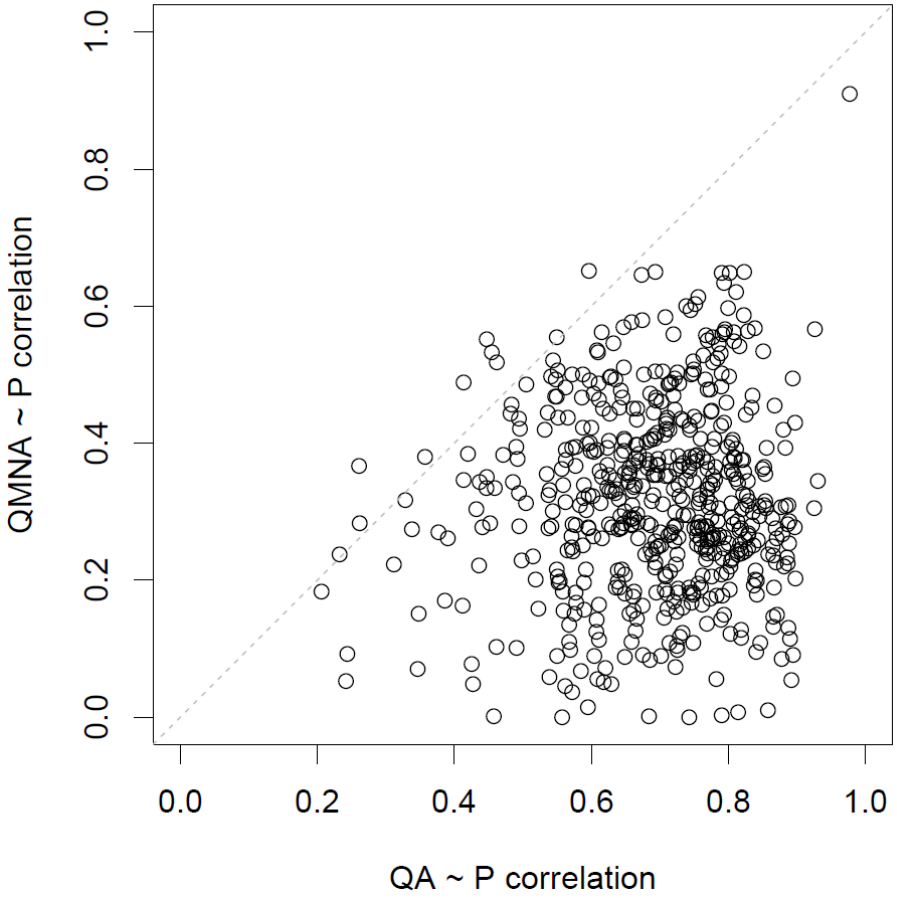


- **Neither Q nor QMNA show a correlation with annual precipitation**

L'Aubette de Magny @ Ambleville : **a groundwater dominated catchment in the Normand chalk area**

Overall behavior

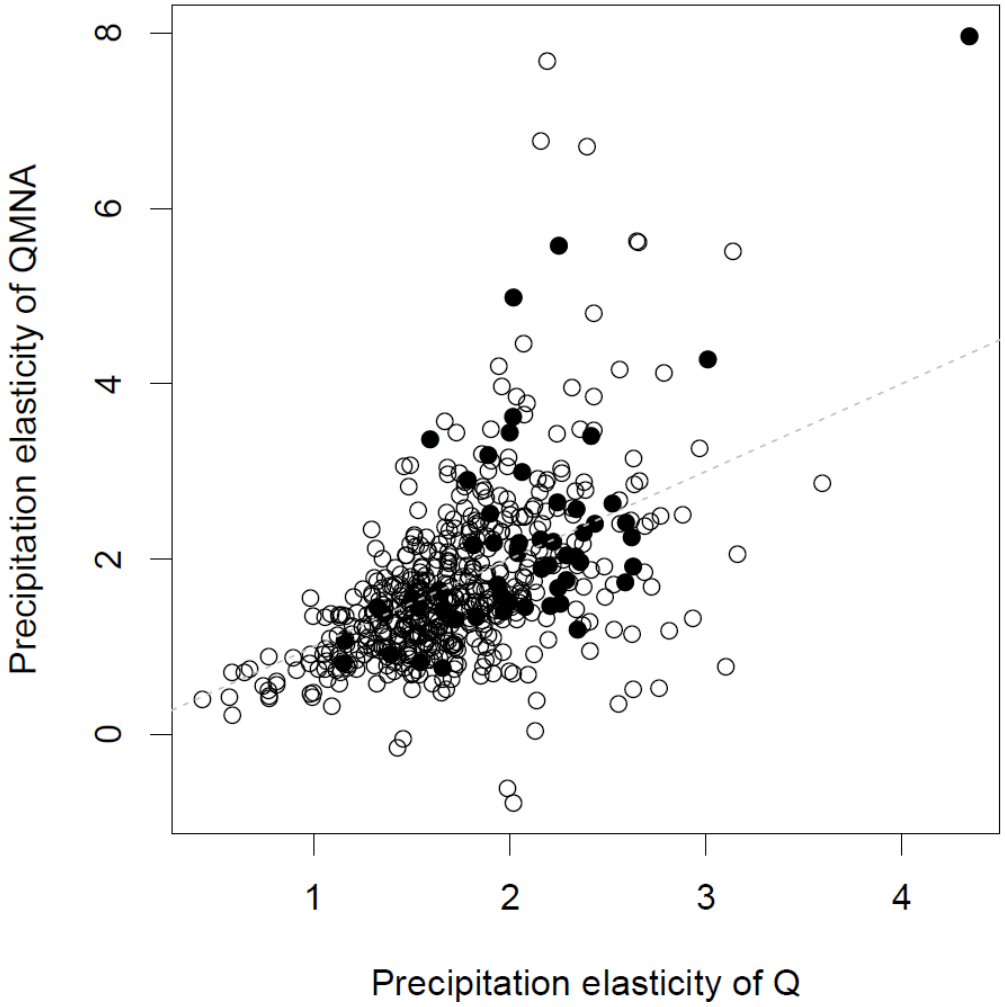
Comparison of R^2 values describing the quality of the correlation between QA & P and QMNA &P



Average streamflow (Q) is much better correlated to precipitation than low-flows (QMNA)

Overall behavior

Comparison of precipitation elasticity values : ε_{QMNA} vs ε_{Q}



QMNA- and Q- elasticities follow the same trend

(the black dots represent catchments where the correlations are strongest: $R^2 > 0.5$ for both Q and QMNA)

Conclusions and perspective

- Elasticity: an extremely accessible concept to investigate the sensitivity of flow to climatic variations
- The differences between average streamflow and low-flow elasticity offer interesting perspectives to classify catchments
- Perspective
  - ➲ introducing catchment memory
  - ➲ sensitivity to P aggregated on various lengths

- References

Andréassian, V., L. Coron, J. Lerat, and N. Le Moine. 2016. Climate elasticity of streamflow revisited – an elasticity index based on long-term hydrometeorological records. Hydrology and Earth System Sciences, 20, 4503–4524, doi:10.5194/hess-20-4503-2016

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