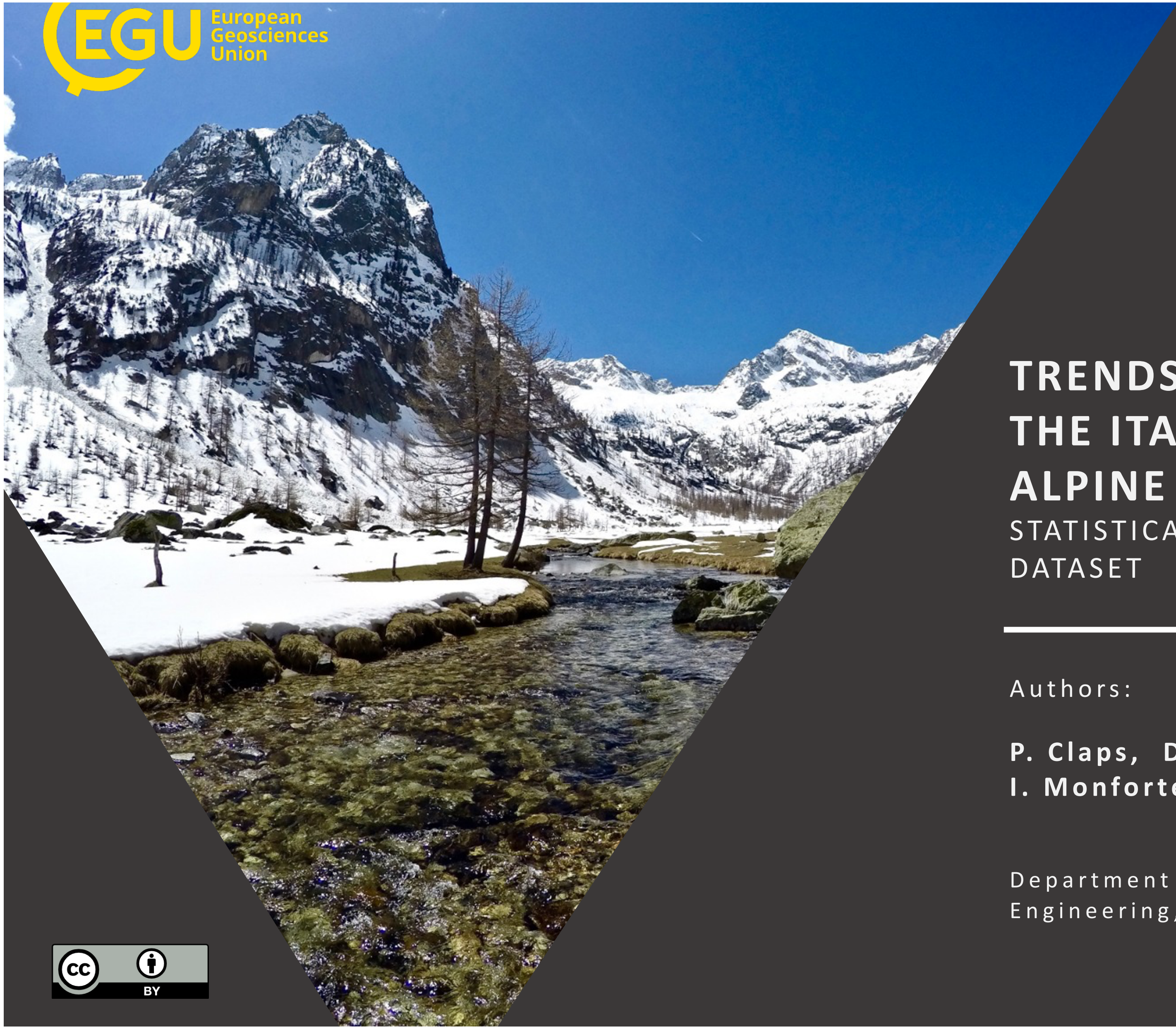

TRENDS IN FLOOD QUANTILES OF THE ITALIAN AND AUSTRIAN ALPINE BASINS:

STATISTICAL TESTING ON A COMPREHENSIVE DATASET

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INTRODUCTION

- In mountain basins, global warming directly affects the alternance of snow deposition and melting:
  Is this already changing runoff regimes?

- For the flood regime, would it help to have a ‘correctly stratified’ dataset that allows us to check the existence of empirical changes?

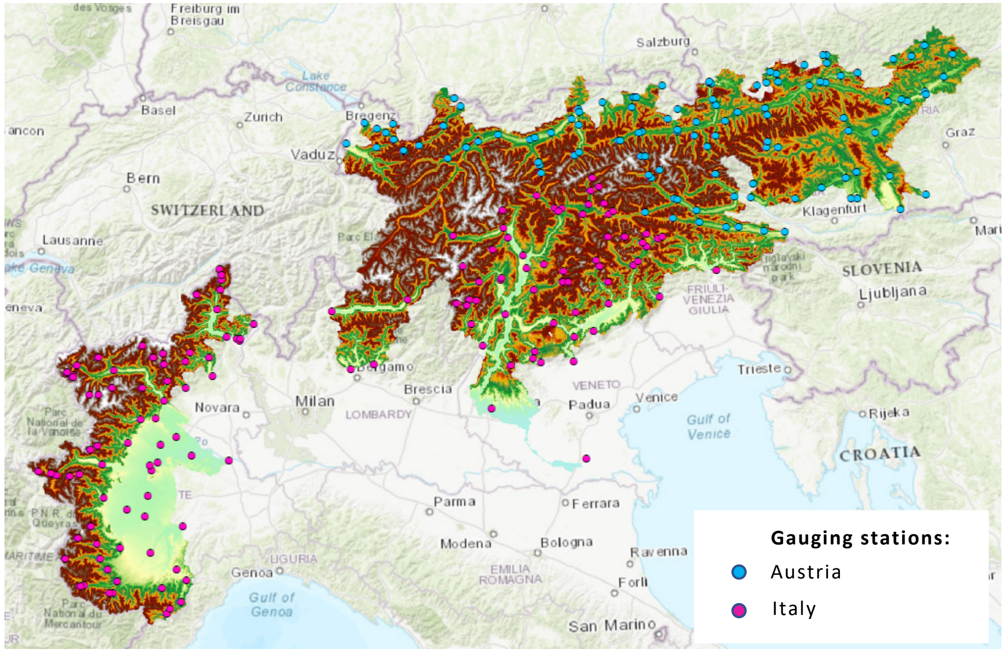
- Are there valuable statistical tools that drive the empirical findings to consensus, so to start with the ‘Attribution’ Phase?

DATA SET: 259 ‘MOUNTAIN’ BASINS

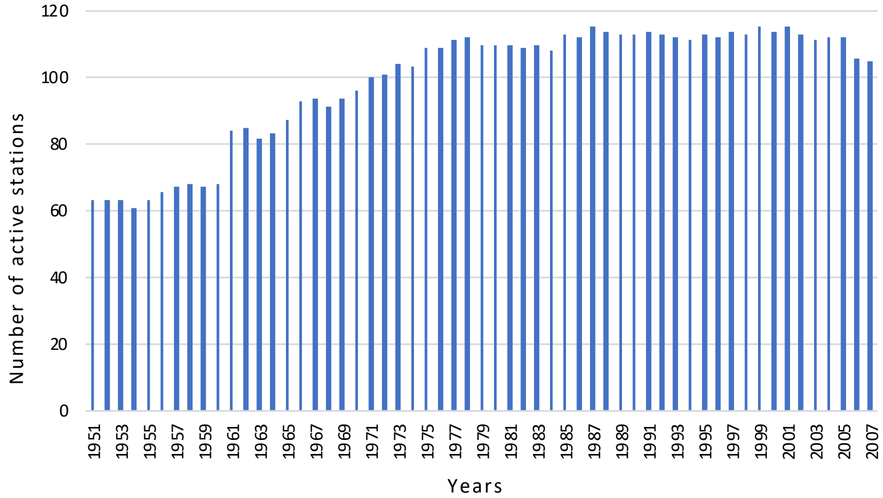
Northen Italy and entire Austria annual maximum data

Basin selection:

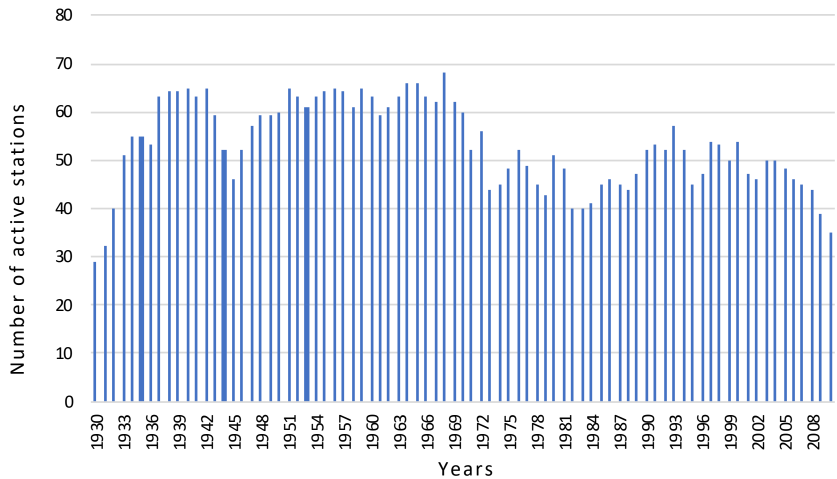
- Catchments mean elevation > 1000 m a.s.l.
- Minimum 10 years of observation for each station
- No lakes or major hydraulic works upstream the gauging stations



AUSTRIA: **119 catchments** *(Parajka, 2015)*

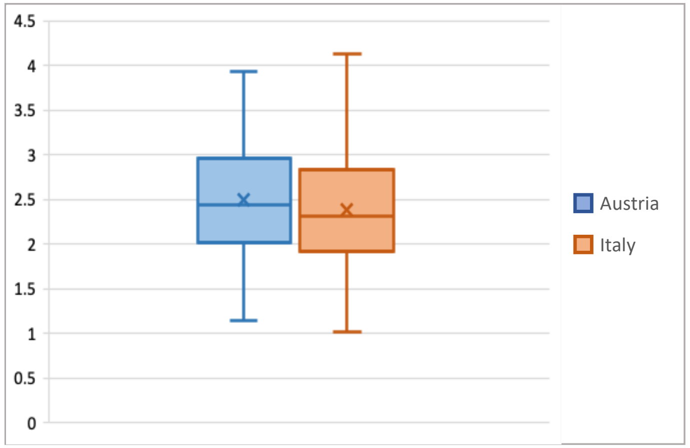


ITALY: **140 catchments** *(Apostolo, 2019)*

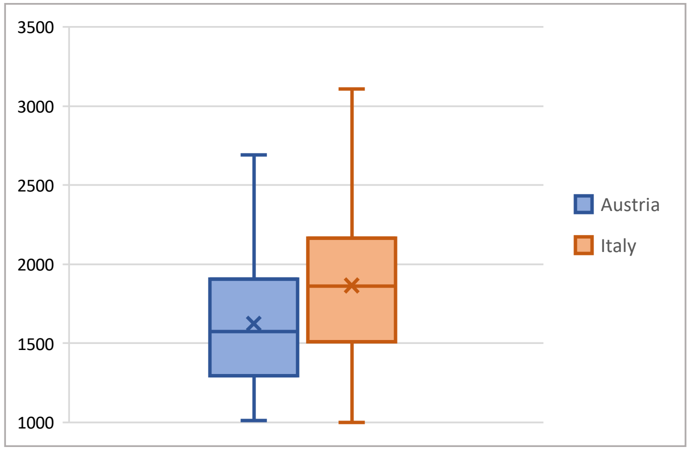


CATCHMENTS CHARACTERISTICS

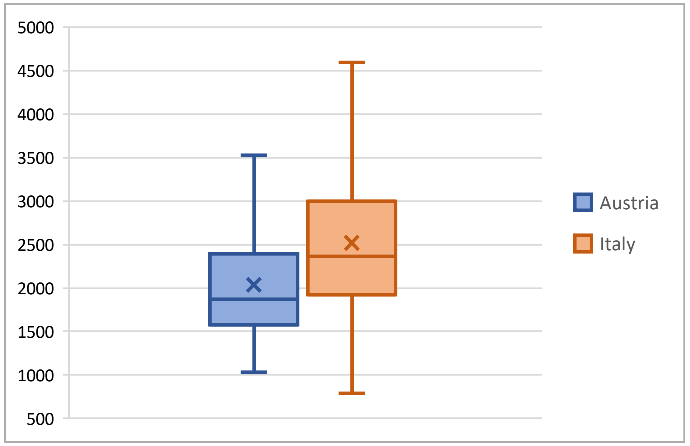
LOG(Area) (LOG(km^2))



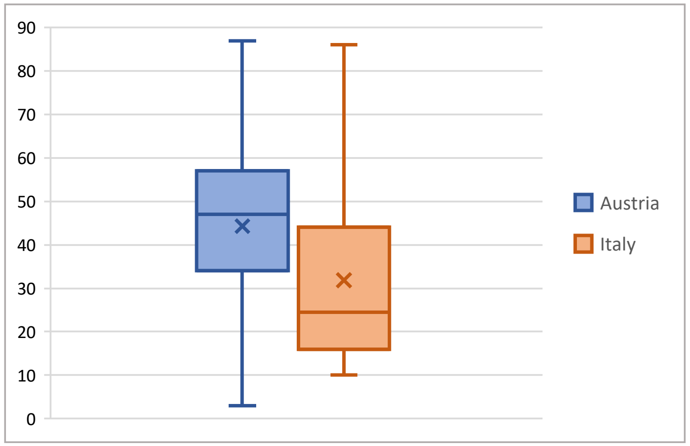
Mean elevation (m a.s.l.)



Elevation difference (z_{max}-z_{min})



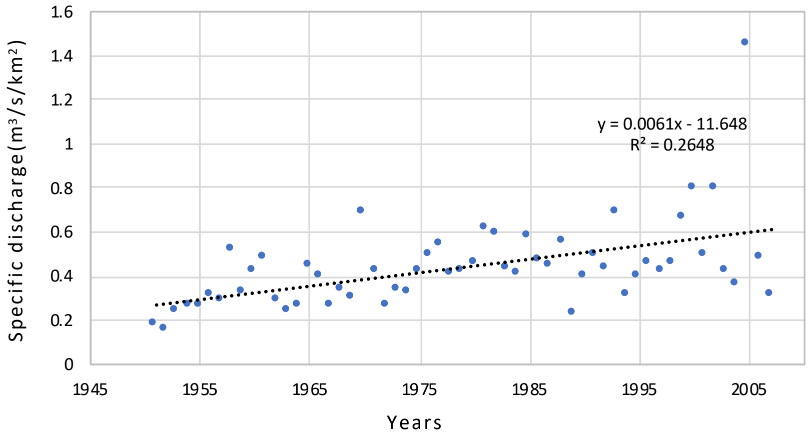
N°observations of annual max discharge



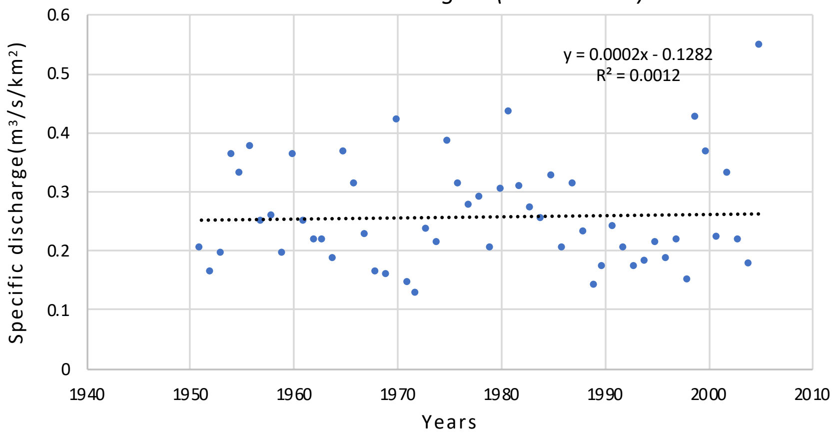
INDIVIDUAL SERIES TREND ANALYSIS

AUSTRIA

Statistically significant trend
Station: Steeg (ID 201012)

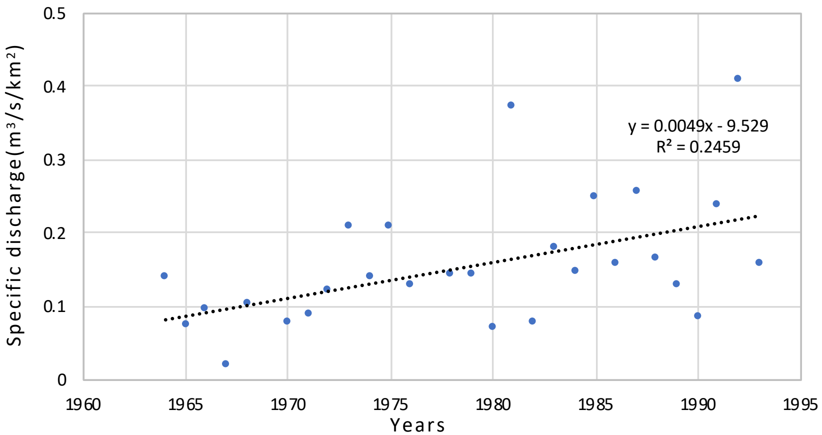


no-trend
Station: Gisingen (ID 200147)

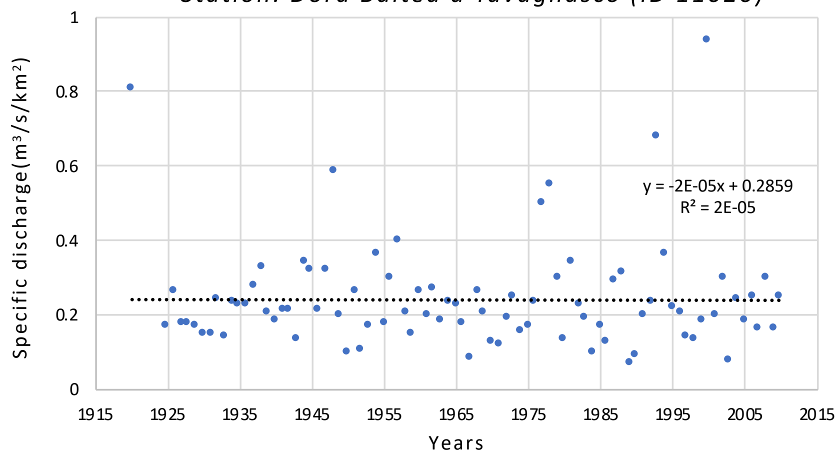


ITALY

Statistically significant trend
Station: Po Palazzolo Vercellese (ID 11194)

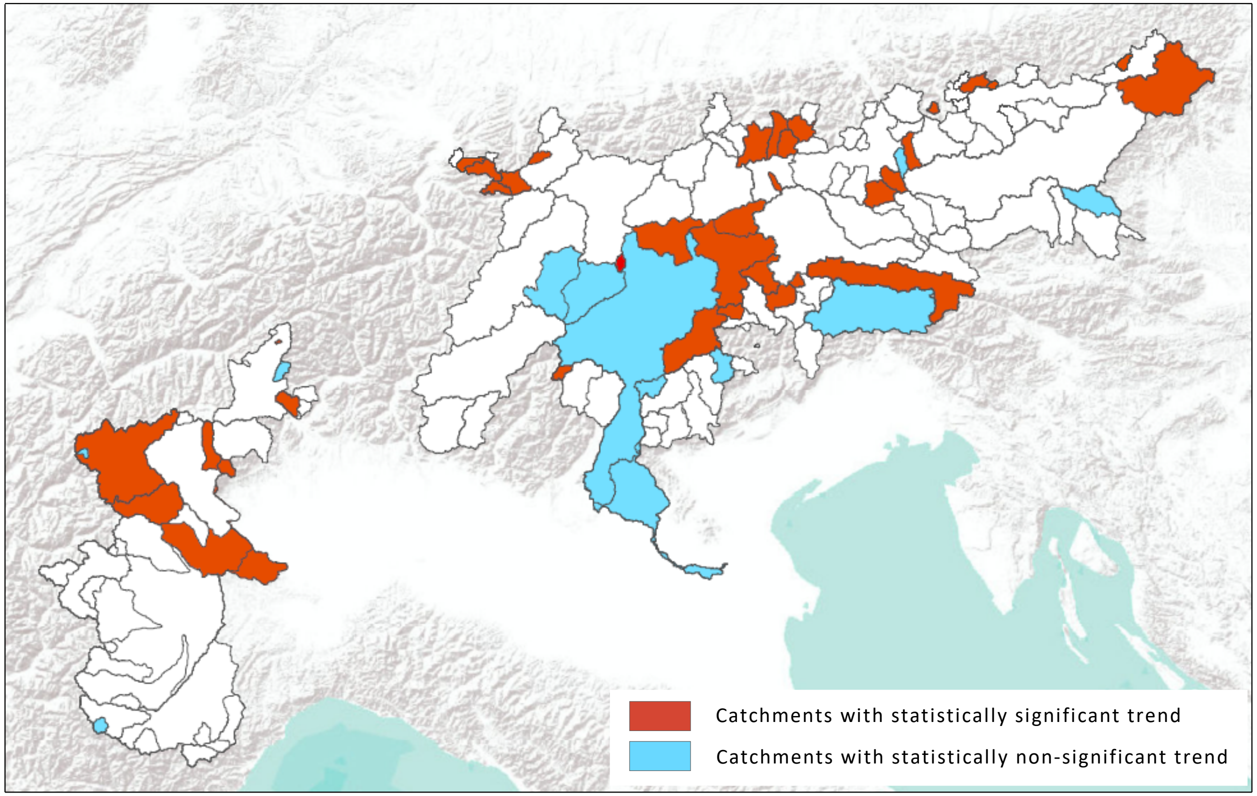


no-trend
Station: Dora Baltea a Tavagnasco (ID 11020)



INDIVIDUAL SERIES TRENDS: MANY ARE NON SIGNIFICANT

Linear regression – Ordinary Least Squares (OLS)



AUSTRIA

Trend	Statistically significant trend	Statistically non-significant trend
Positive	19	64
Negative	2	34

ITALY

Trend	Statistically significant trend	Statistically non-significant trend
Positive	18	51
Negative	10	61

The statistical significance of trend is validated by the **Student's t-test** related to slope.

A WIDE-AREA TREND ANALYSIS TOOL: LINEAR QUANTILE REGRESSION

The **univariate quantile regression model equation** for the τth quantile is:

$$Q_\tau(y_i) = \beta_0(\tau) + x_{i1}\,\beta_1(\tau) + u_i(\tau)$$

where $\beta_0(\tau)$ is the intercept, $\beta_1(\tau)$ is the slope of the regression line and $u_i(\tau)$ is the error term.

$\beta_0(\tau)$ and $\beta_1(\tau)$ are obtained by **OLS estimation** for **selected quantiles τ**

Quantiles **τ are computed on all data available for each value of the independent variable.**

Here, X=TIME

Discharge values are made **non dimensional,** to allow ranking of values coming from different stations

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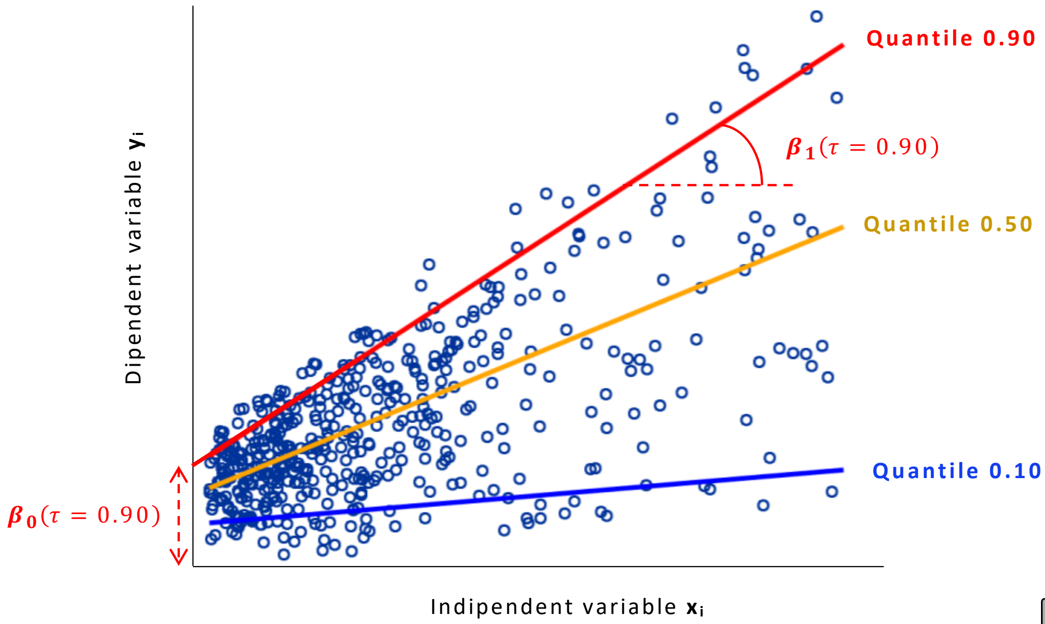
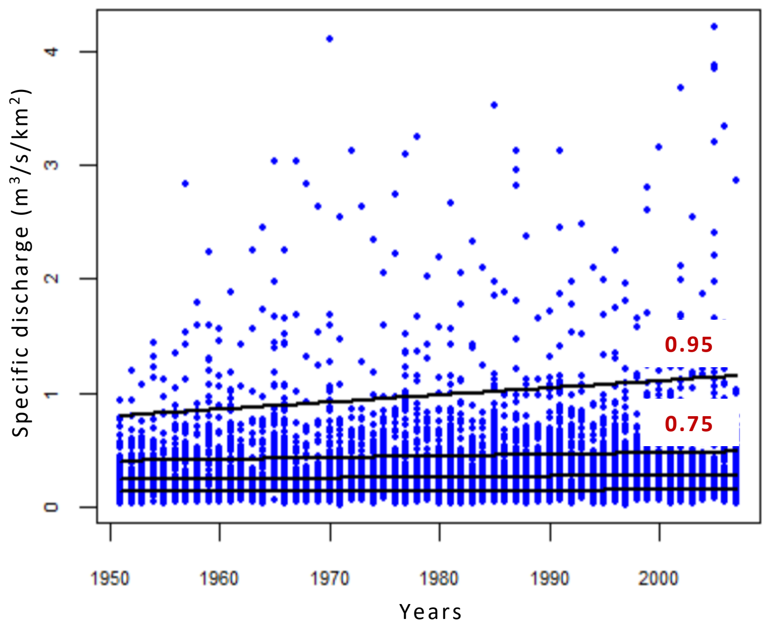


LINEAR QUANTILE TRENDS IN ITALY AND AUSTRIA ALPINE BASINS

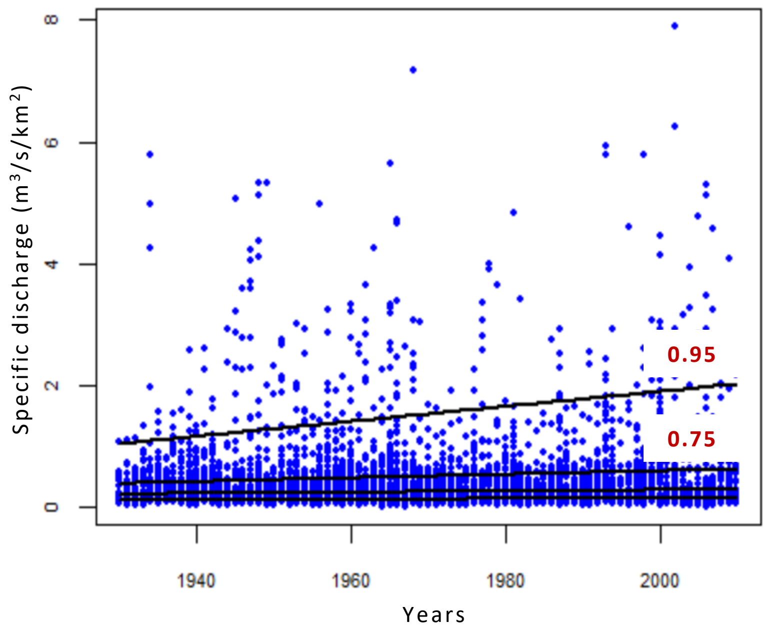
Results

- Quantiles investigated: **0.25**, **0.50**, **0.75**, **0.95**.
- **Student's t-test** again used to check slope significance

AUSTRIA (1951-2007)



ITALY (1930-2010)



RESULTS AND CONCLUSIONS

Are the quantile trends significant?

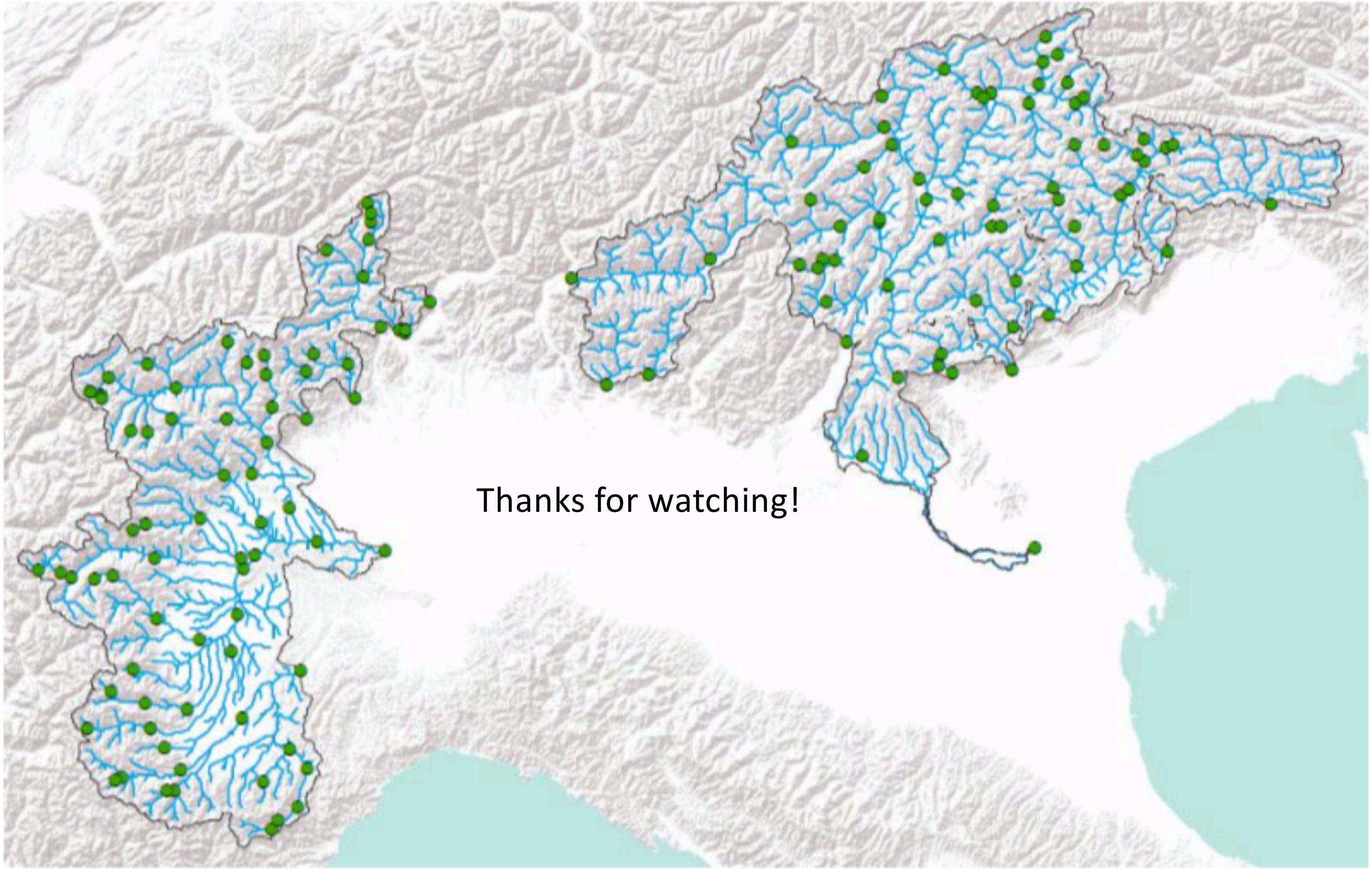
	Quantile 0.25	Quantile 0.50	Quantile 0.75	Quantile 0.95
AUSTRIA	NO	YES ✓	YES ✓	YES ✓
ITALY	YES ✓	YES ✓	YES ✓	YES ✓

Global warming appears to have already affected flood quantiles

Additional attention should be given to human induced changes before providing conclusions on high-elevation basins trends

The quantile trend analysis allows to consider groups of stations having different record lengths, provided the region coverage is stationary over time.

A great alpine area investigation is in order, while considering an «attribution» approach


Thanks for watching!