EGU General Assembly 2022

HS2.3.8 *EGU22-6847*

How does baseflow contribution affect catchment C-Q relationships?

A continental synthesis using a Bayesian Hierarchical Model

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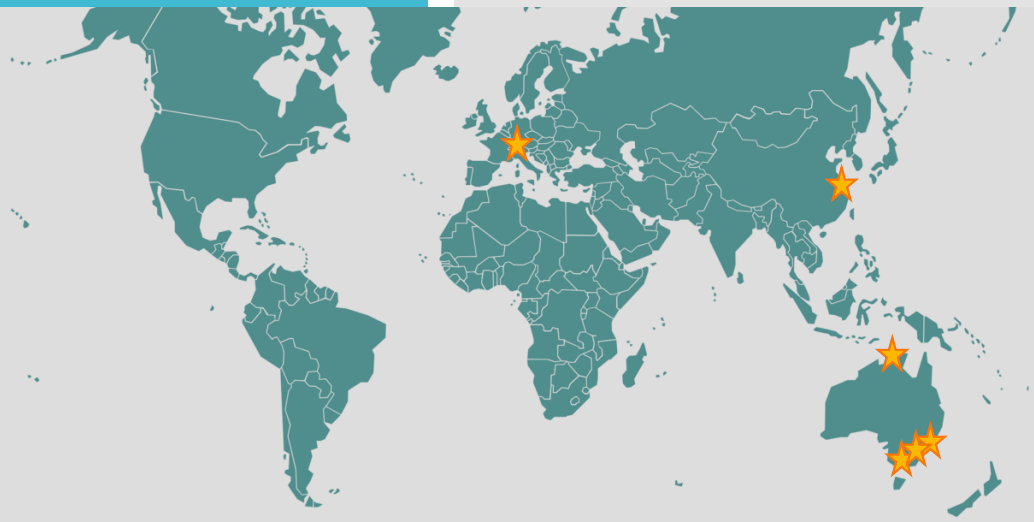

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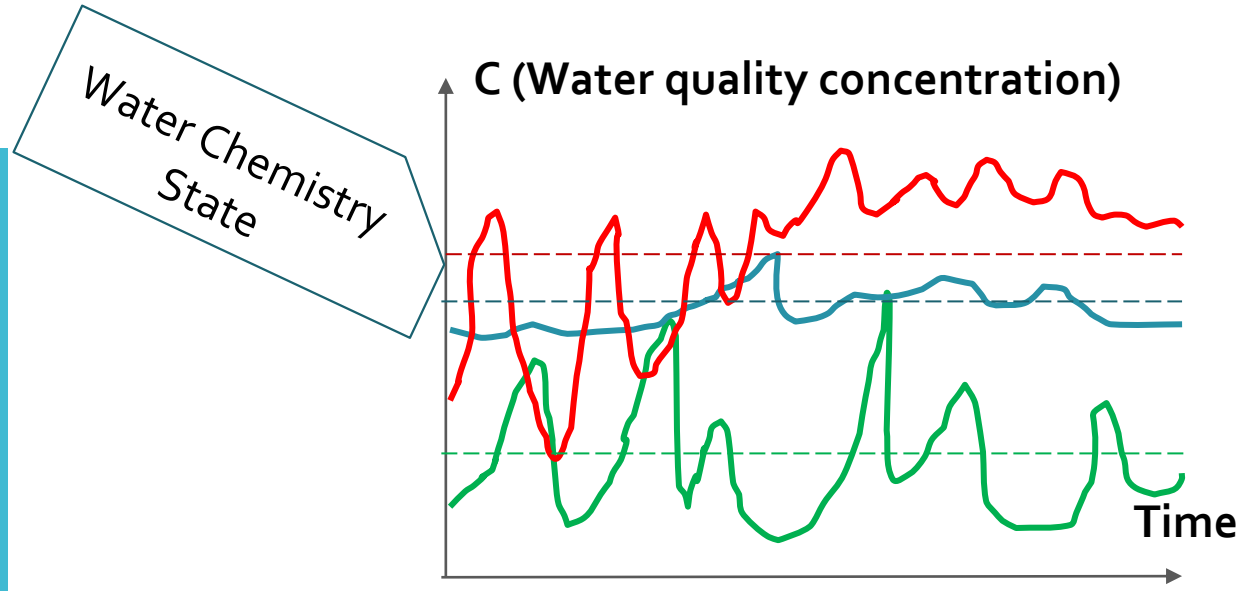
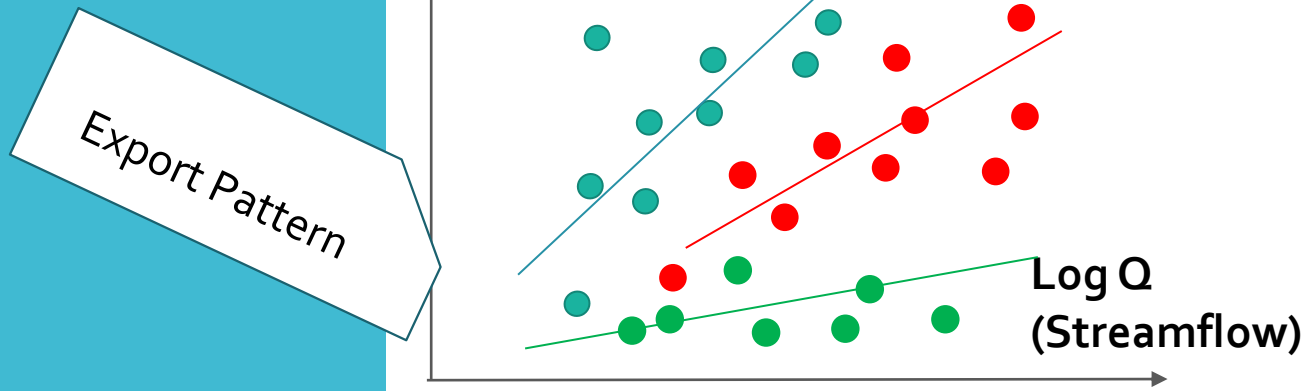
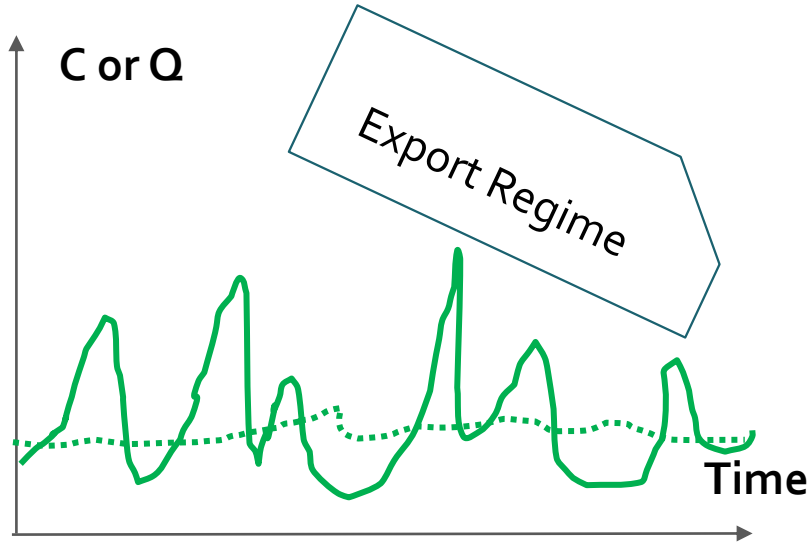
Our focuses: Water chemistry state, export pattern & export regime



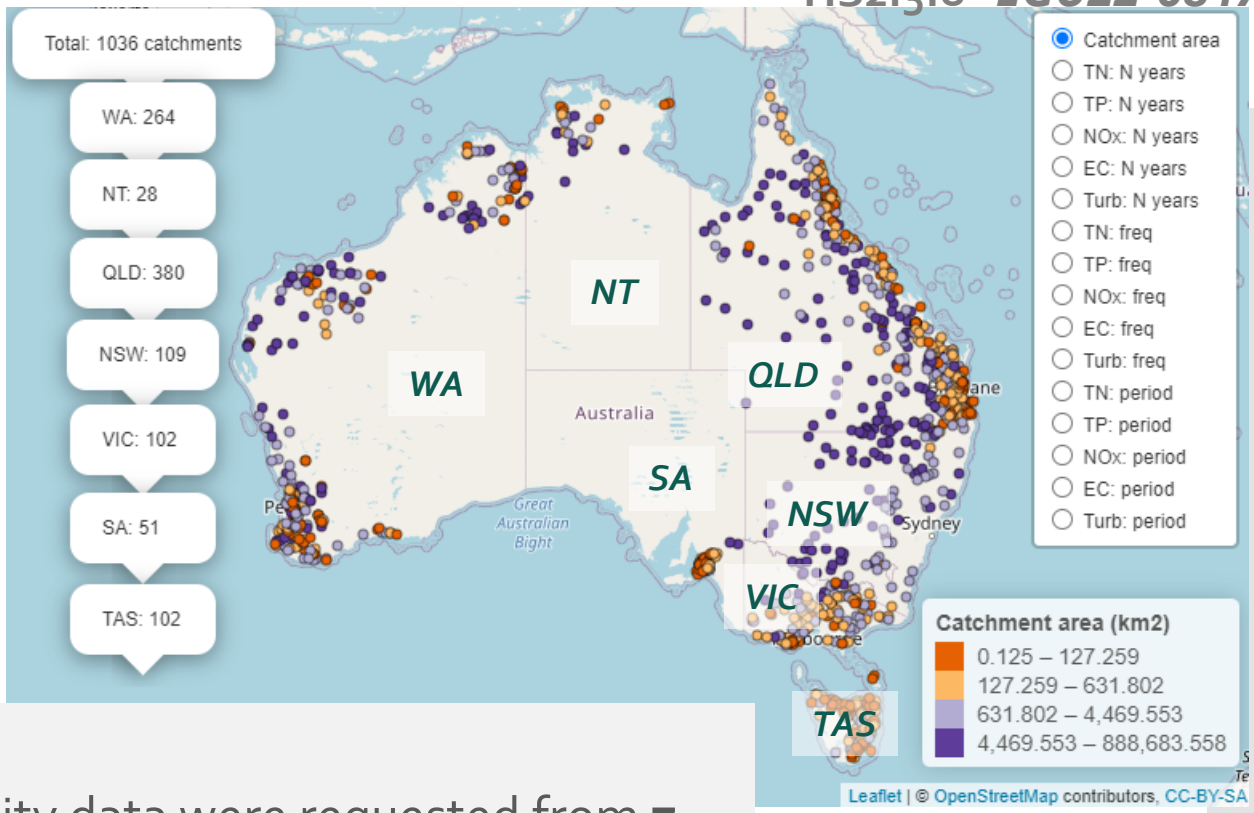




$$\log(C_{site,time}) = \alpha_{site} + \beta_{site}\log(Q_{site,time})$$

$$CV_C/CV_q$$

The Australian National Water Quality Dataset



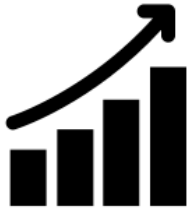
- Stream water quality data were requested from **7 Australian state agencies who hold the data**.
- We collated individual state's data as a **National Water Quality Dataset**.
- **Quality control** was performed using data quality codes, flags and any metadata on detection limit provided by individual state agencies.

Overarching Question:
How does Australian river water quality vary ***over space-time?***

Q1. What are the **links between climate zones and river water quality**?
https://doi.org/10.1002/hyp.14423

Q2. How does **flow regime (baseflow contribution)** affect the export pattern?
https://doi.org/10.5194/hess-26-1-2022
*(*this presentation, EGU22-6847)*

Q3. What are the main **landscape and climatic factors** that drive differences in water quality?
https://doi.org/10.1002/essoar.10510878.1
*(*last presentation by Shuci Liu, EGU22-11003)*



Q4. How does water quality **vary across time**? (WIP)

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RESEARCH ARTICLE

WILEY

The influence of climate on water chemistry states and dynamics in rivers across Australia

Anna Lintern[1] | Shuci Liu[2,3] | Camille Minaudo[4] | Rémi Dupas[5] | Danlu Guo[2] | Kefeng Zhang[6] | Ulrike Bende-Michl[2] | Clément Duvert[7,8]

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Hydrology and Earth System Sciences
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Synthesizing the impacts of baseflow contribution on concentration–discharge (C–Q) relationships across Australia using a Bayesian hierarchical model

Danlu Guo[1], Camille Minaudo[2], Anna Lintern[3], Ulrike Bende-Michl[1,4], Shuci Liu[1,5], Kefeng Zhang[6], and Clément Duvert[7,8]

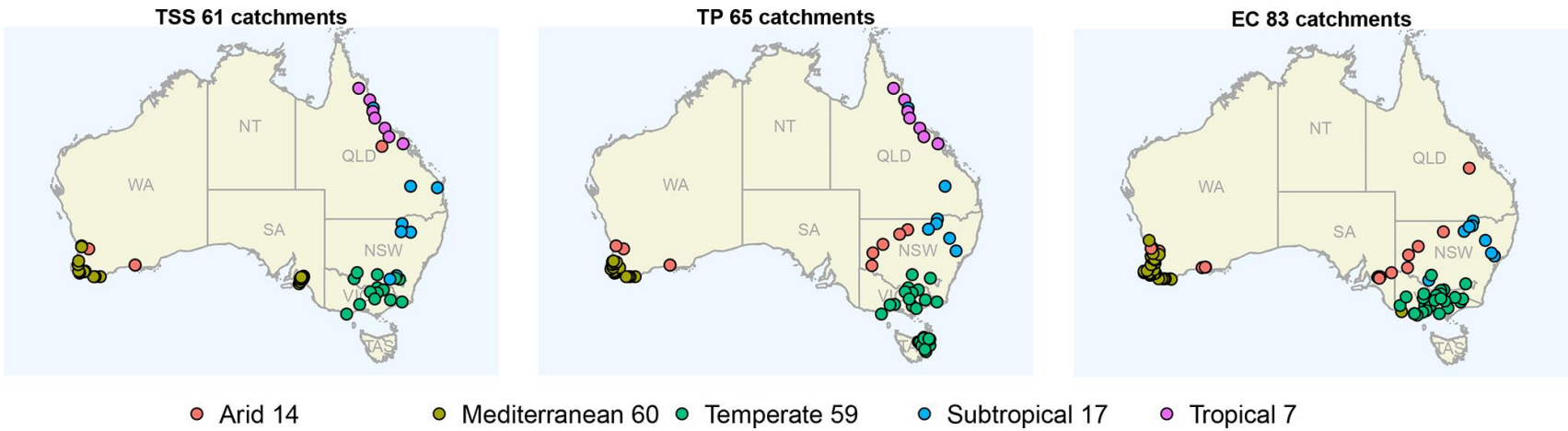
Data used for this study

- **WQ Constituents selection:**

1. *Electrical conductivity (EC)*
2. *Total phosphorus (TP)*
3. *Soluble reactive phosphorus (SRP)*
4. *Total suspended solids (TSS)*
5. *Sum of nitrate and nitrite (NO_x)*
6. *Total nitrogen (TN)*

- **Catchment selection:** 1) >3y monthly WQ samples; 2) >50 CQ pairs; 3) samples covering >75% range of flow quantiles

A total of 251 catchments were selected across 6 constituents



**examples shown for EC, TP and TSS only*

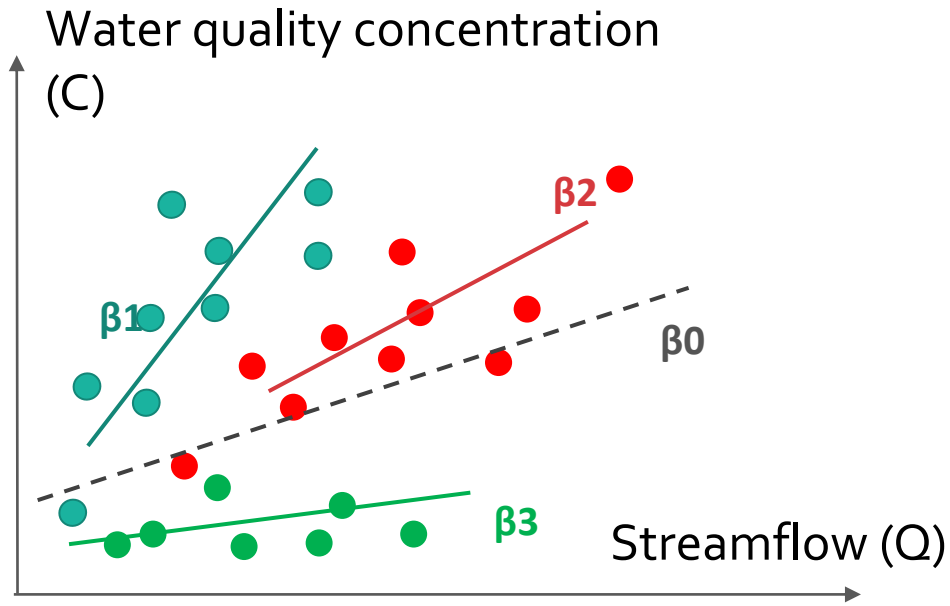
Conceptual model for the impacts of baseflow contribution on catchment export patterns

- Used a **Bayesian Hierarchical Models (BHM)** to estimate the impacts of baseflow contribution
- Assuming differences in catchment C-Q slopes are only due to **baseflow contribution (represented by baseflow index, BFI)**

$$\log(C_{site,time}) = \alpha_{site} + \beta_{site}\log(Q_{site,time})$$

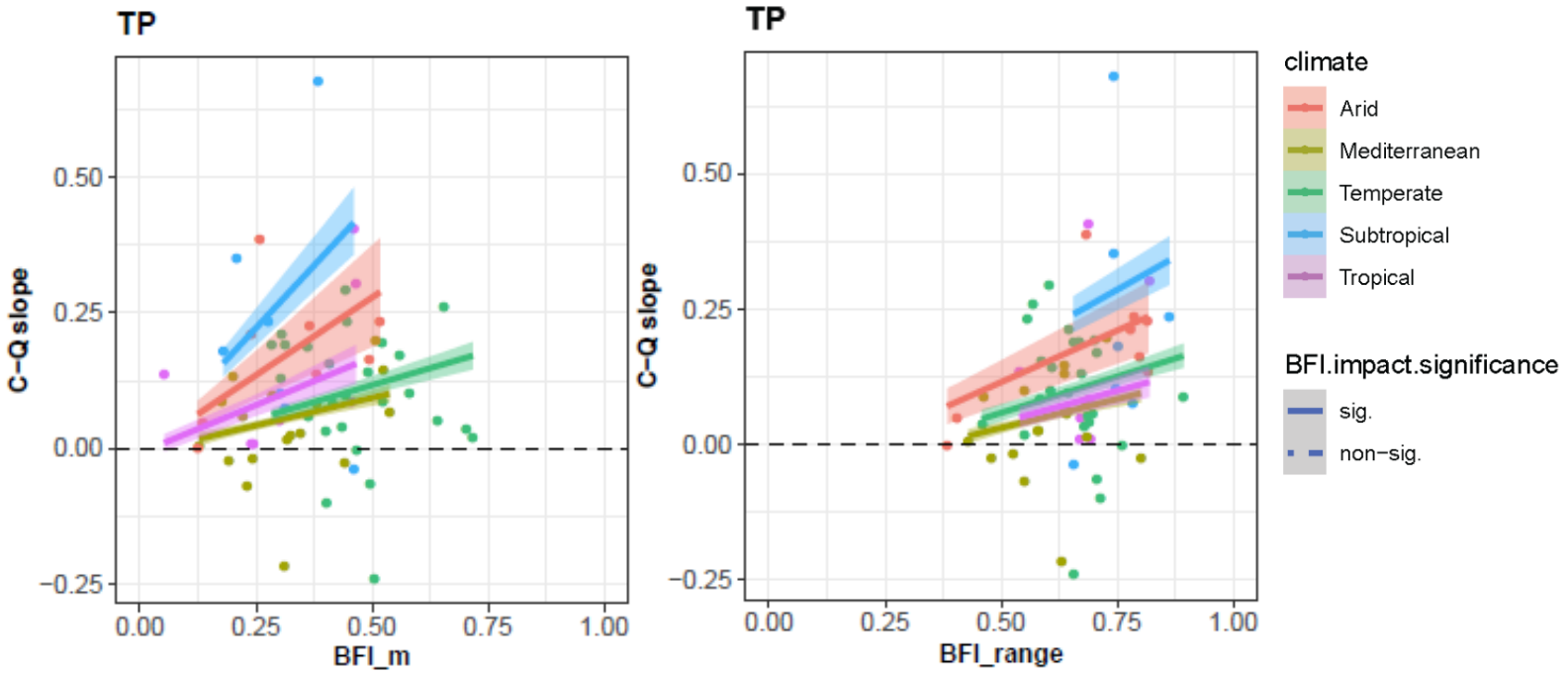
$$= \beta_0 + BFI_{catchment} * effect_{BFI}$$

Median and Range of daily catchment *BFI*



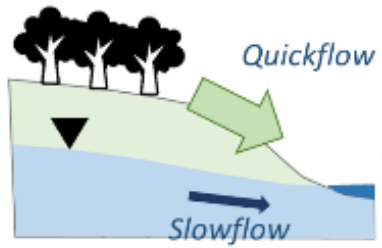
Key finding:
Both the median & range of baseflow contribution significantly impact export patterns

Observed & modelled C-Q slopes (vary with BFI) at catchments analysed for TP



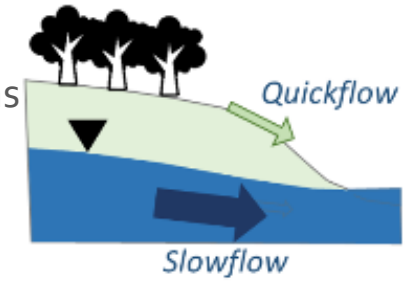
Low median BFI, low variation

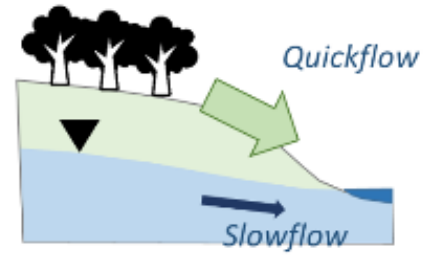
- Small ranges of flow conditions
- **Flat C-Q slopes**



High median BFI, highly variable

- Wide range of flow conditions and export pathways
- **Steep C-Q slopes**





Acknowledgment

- Australian Government agencies for supplying the WQ monitoring data and metadata:

VICTORIA State Government | Environment, Land, Water and Planning

Queensland Government Department of Environment and Science

Government of Western Australia Department of Water and Environmental Regulation

WaterNSW

Queensland Government Department of Resources

Government of South Australia Department for Environment and Water

Tasmania DEPARTMENT of PRIMARY INDUSTRIES, PARKS, WATER and ENVIRONMENT

NORTHERN TERRITORY GOVERNMENT | Department of Environment, Parks and Water Security

- Professor Andrew Western (University of Melbourne) for providing suggestions on study design
- Ms Natalie Kho for assistance in data pre-processing
- Last but not least, the traditional owners of the waterways from where the water quality and flow data were collected.

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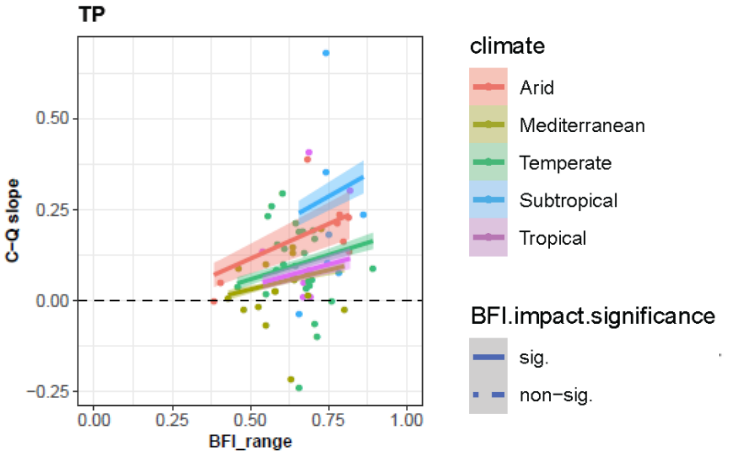
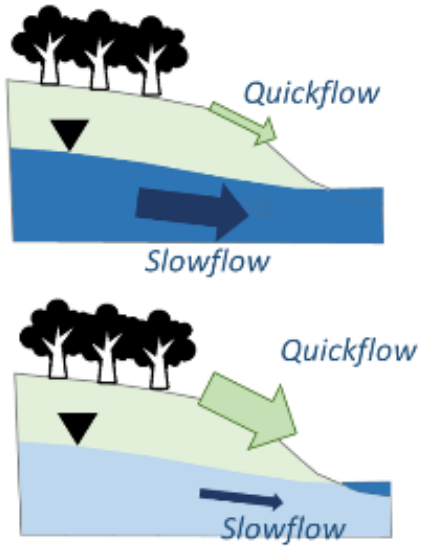
Take-home messages





- Baseflow contribution has significant effects on export patterns (C-Q slopes).
- Mobilisation for sediments/nutrients are enhanced at catchments with higher and more highly variable baseflow contributions, highlighting the potential importance of different dominant flow pathways.
- This result has key implications for developing for WQ management/mitigation strategies.

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