EVALUATING THE VALUE OF YOUNG WATER FRACTIONS FOR DETERMINING WATER TRANSIT TIMES IN DIVERSE CATCHMENTS

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Hello I'm Arianna, an Environmental Engineer pursuing a PhD in Hydrogeology.
My research interests lie in modeling water quantity under extreme events, which can have a severe impact on pollutants export.
My goal as a young scientist is to contribute to society and scientific community in developing water management strategies.

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1. PROBLEM STATEMENT

- The time spent by a water parcel in a catchment from its entry, as precipitation (P), to its exit, as streamflow (Q), is called **water transit time (TT)**
- TT is typically modelled with observations of tracers concentrations naturally occurring in the water (e.g. $\delta^{18}O$)
- However, modelling is subject to uncertainty, and tracer sampling can be laborious, costly and limited to well-equipped areas only

2. MOTIVATION

- Water TTs describe hydrological functioning and pollutants mobilization in catchments
- These aspects are crucial to implement the best strategies for water protection and management

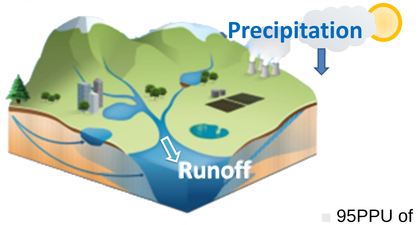


Figure credits: *Garanja et al., 2020, Sci Rep*

3. OUR QUESTION

- Can we use alterative methods to infer water TTs by reducing model uncertainty and overcoming economic/management issues of sampling?

4. OUR SOLUTION

- **Young water fraction (F_{yw})**, the fraction of water precipitated in the past 2-3 months
- F_{yw} can be estimated from sparse and irregular observed tracer data spanning short periods of time

5. METHODS

1.

MEASURED INPUT: Sparse $\delta^{18}O_P$ and $\delta^{18}O_Q$ → Sine-wave fitting of tracer data → SAMPLE-BASED OUTPUT: F_{yw}^{sb}

2.

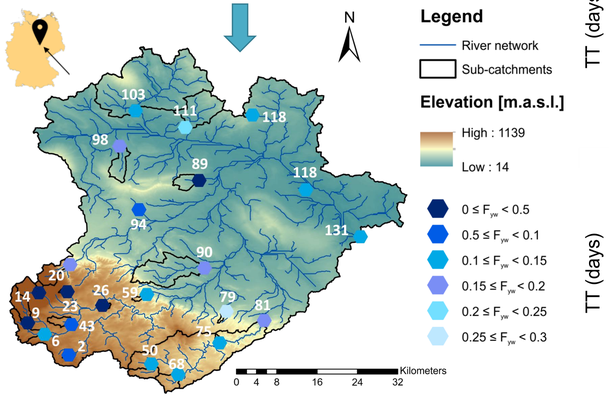
MEASURED INPUT: P, Q, ET, $\delta^{18}O_P$ and $\delta^{18}O_Q$ → StorAge Selection (SAS) functions → SIMULATED PRIOR OUTPUT: F_{yw}^{SAS} water TT

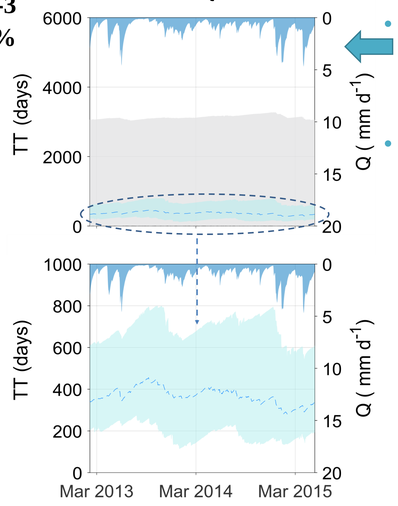
3.

Comparison between F_{yw}^{sb} and F_{yw}^{SAS} → SIMULATED POSTERIOR OUTPUT: water TT

6. RESULTS

- From **1.** : Q composed of **water less than 2-3 months old** is approximately between **0% and 30% of the total Q** across 23 sites in Central Germany





- From **2.** and **3.** : **simulated water TT** constrained with F_{yw}^{sb} (i) have a **narrower uncertainty** than water TT simulated with SAS functions, (ii) are more **highly dynamic** and (iii) with a **mean TT of 1,6 years** across the 23 sites
- Relatively large of F_{yw}^{sb} (≥0.1) yield TTs with less uncertainty compared to small F_{yw}^{sb} (≤0.04) due to the difficulty in determining very old TT with $\delta^{18}O$

7. TAKE HOME MESSAGES

- Information on **F_{yw} largely reduces uncertainty in simulated water TTs**
- To reduce model uncertainty, it is **advisable to rely on relatively large F_{yw}^{sb}** than small F_{yw}^{sb}
- **Practical and cost-effective** use of **F_{yw}^{sb}** can be exploited to **tackle issues in ungauged basins** and **boost the understanding of water quality status**