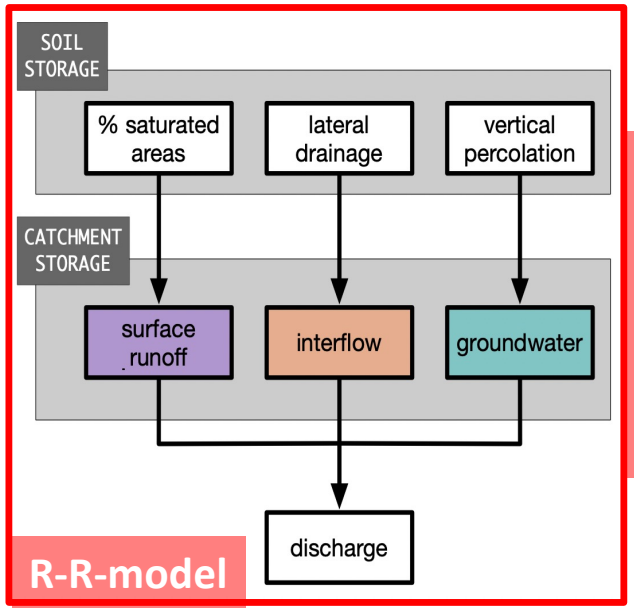
Deciphering streamflow composition during drought

Model simulations as benchmark for advanced hydrograph separation

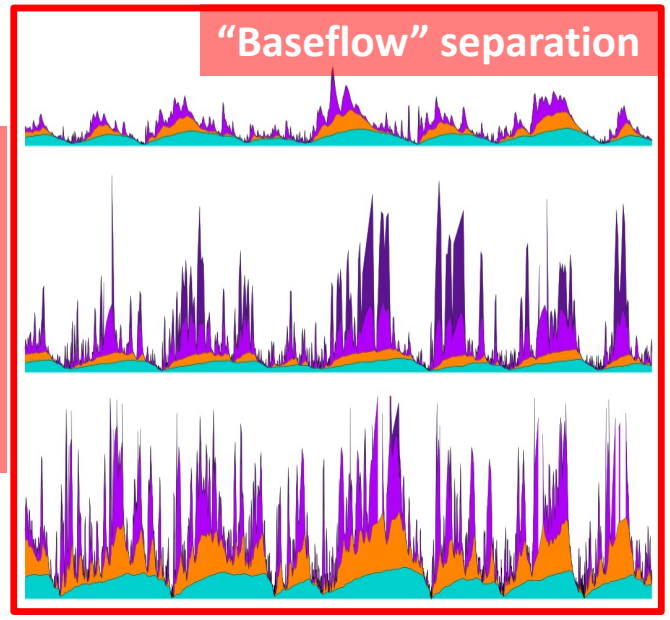
Michael Stölzle and Kerstin Stahl

Faculty of Environment and Natural Resources, University Freiburg, Germany
michael.stoelzle@hydro.uni-freiburg.de

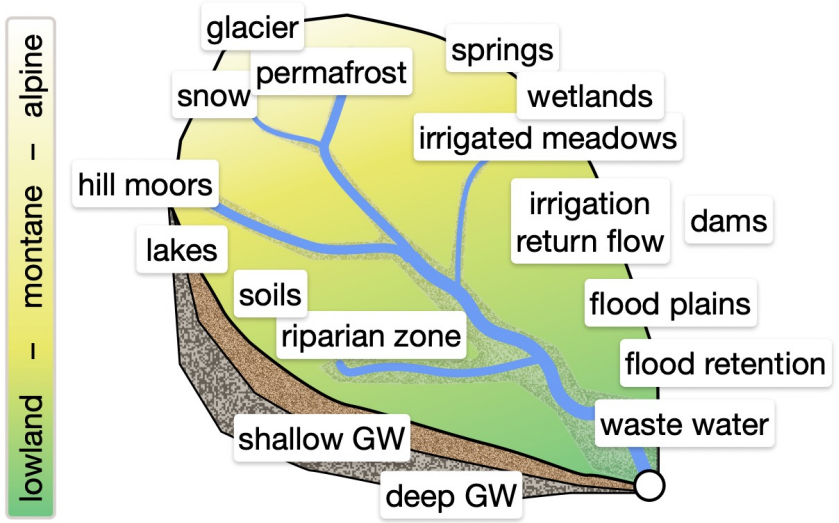
27 May 2022 | #EGU22-1935 | HS2.4.4 |Hydrological extremes: From droughts to floods



Could we separate the same contributions from streamflow as modelled in different model storages?



We don’t know the true baseflow of a catchment!



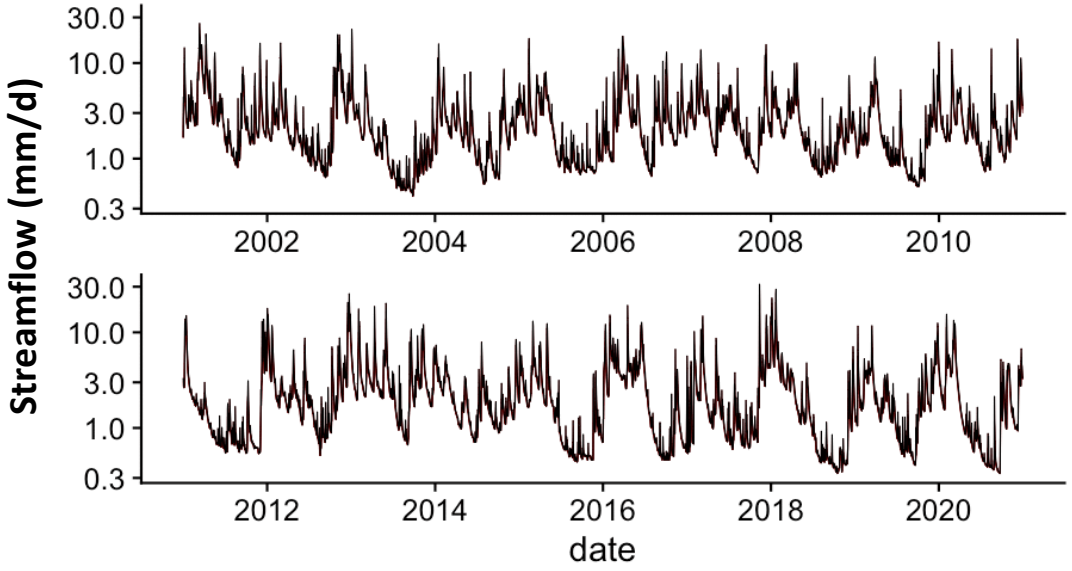
We know that contributions from different delayed sources shape the hydrographs and the pace of recession:

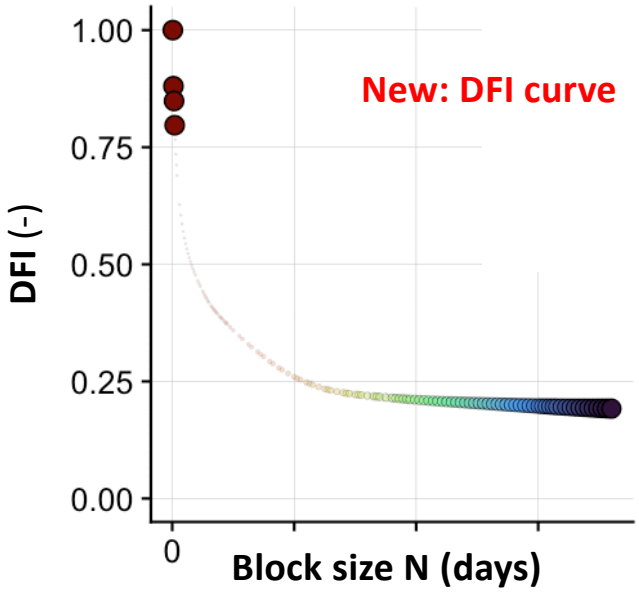
~~Baseflow~~ Delayed flow separation with streamflow minima on different time scales

DFI-Method: From single BFI index to DFI curve

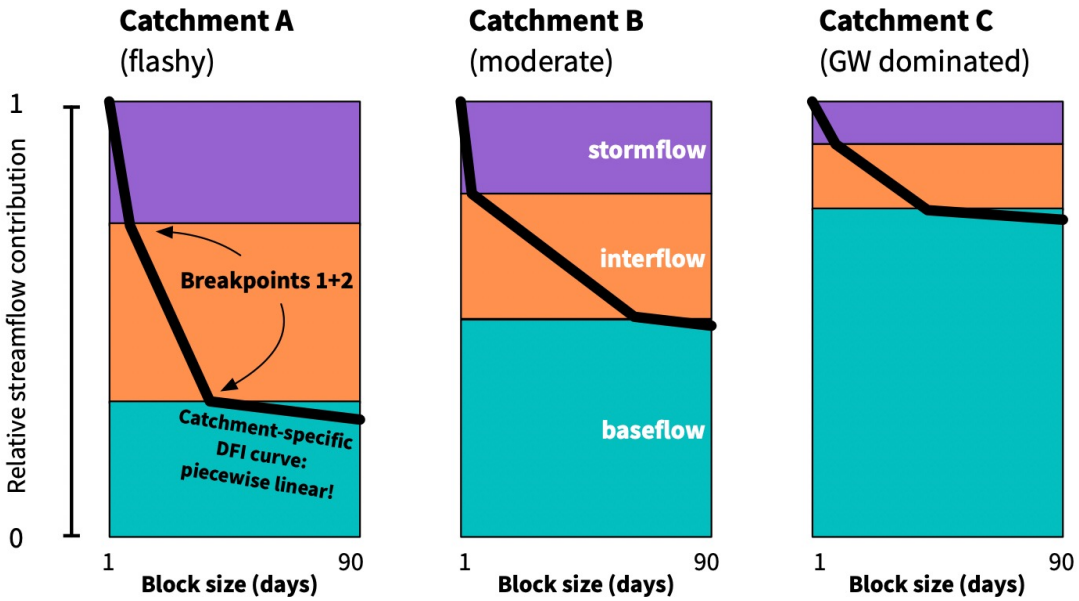
1. BFI = 5 days minima (1 value)
2. DFI = 1-90 days minima (90 values)
3. DFI-curve = DFI_1, DFI_2, DFI_3,… DFI_{89}, DFI_{90}

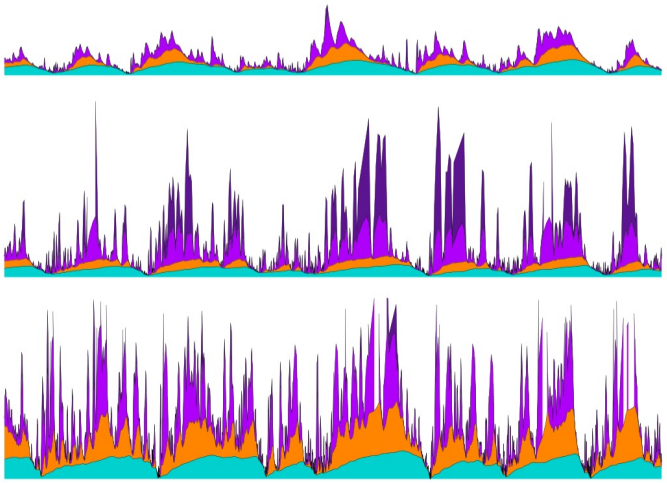
$$BFI = \frac{\sum Q_{bas}}{\sum Q_{obs}}$$





DFI-Method: Multiple, catchment-specific contributions

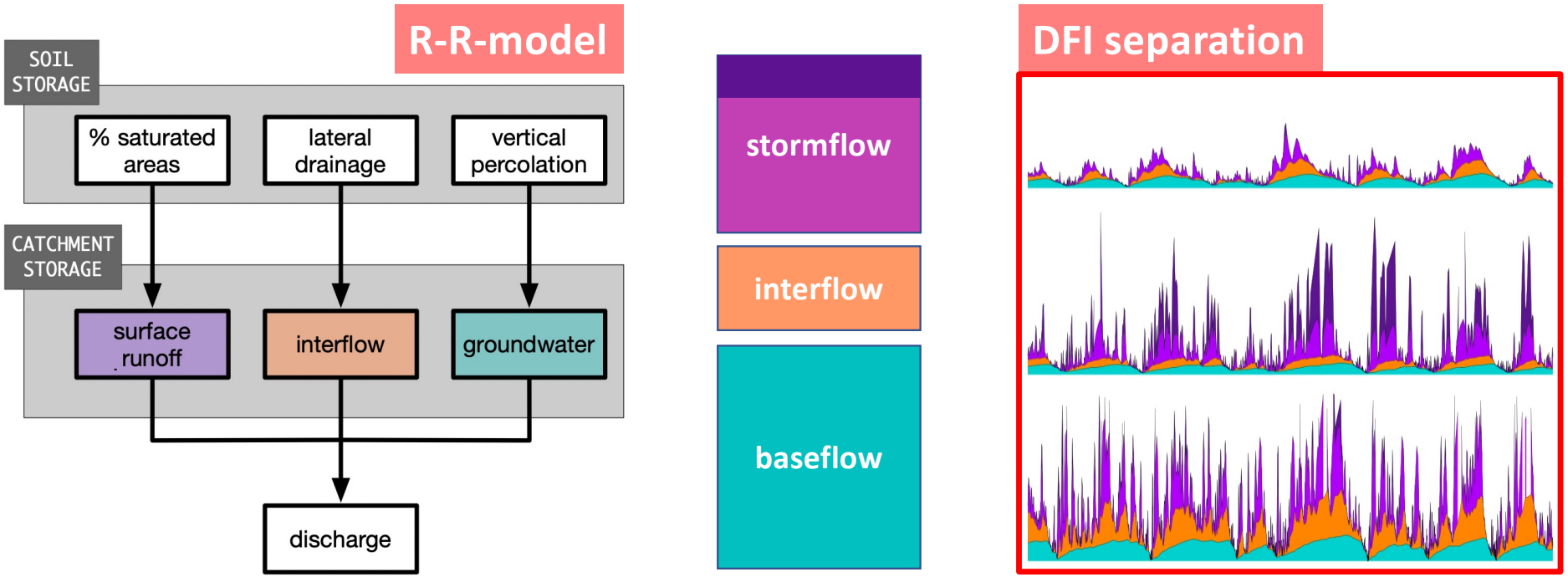




Advantages:

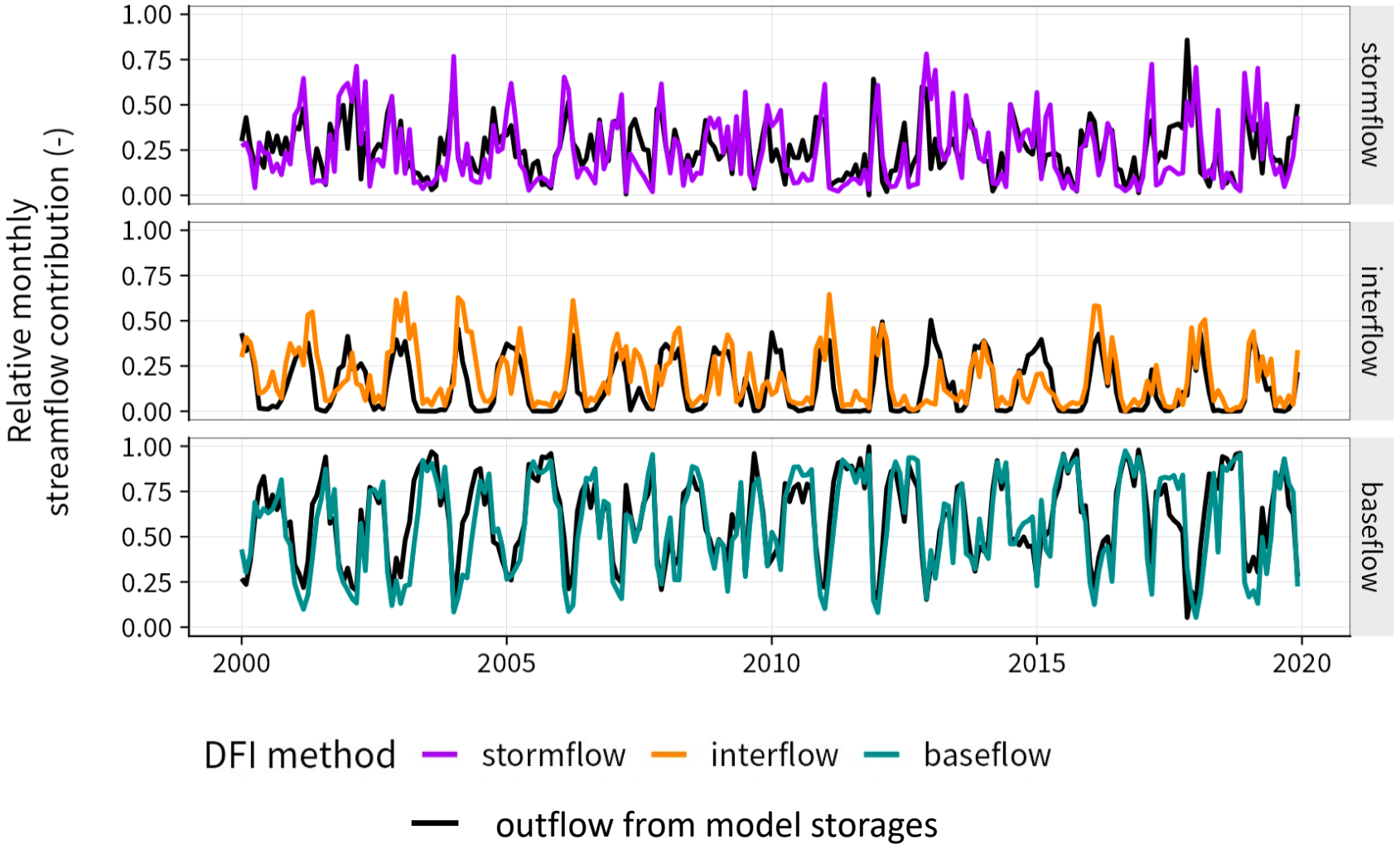
- Separation of multiple components with DFI-curve and breakpoints
- Method is based on streamflow data (no precipitation data)
- Method is fast, objective and catchment-specific

Storage outflows from a model vs. DFI separation

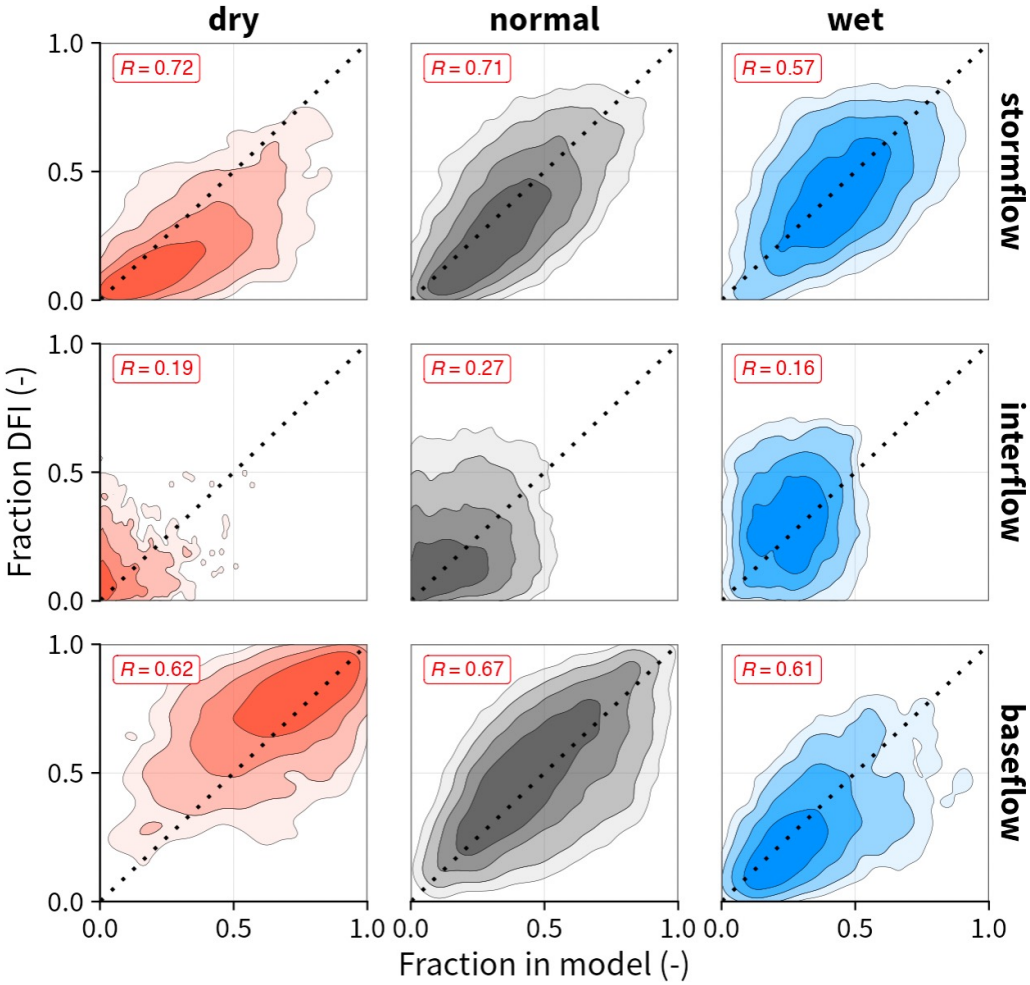


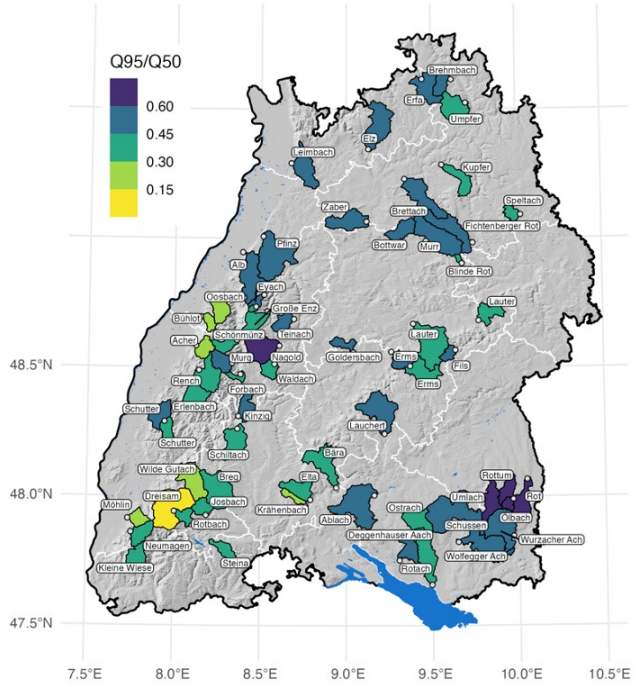
Could we separate the same contributions from streamflow as modelled in different model storages (and vice versa)?

Results: Comparison of components (1 catchment)

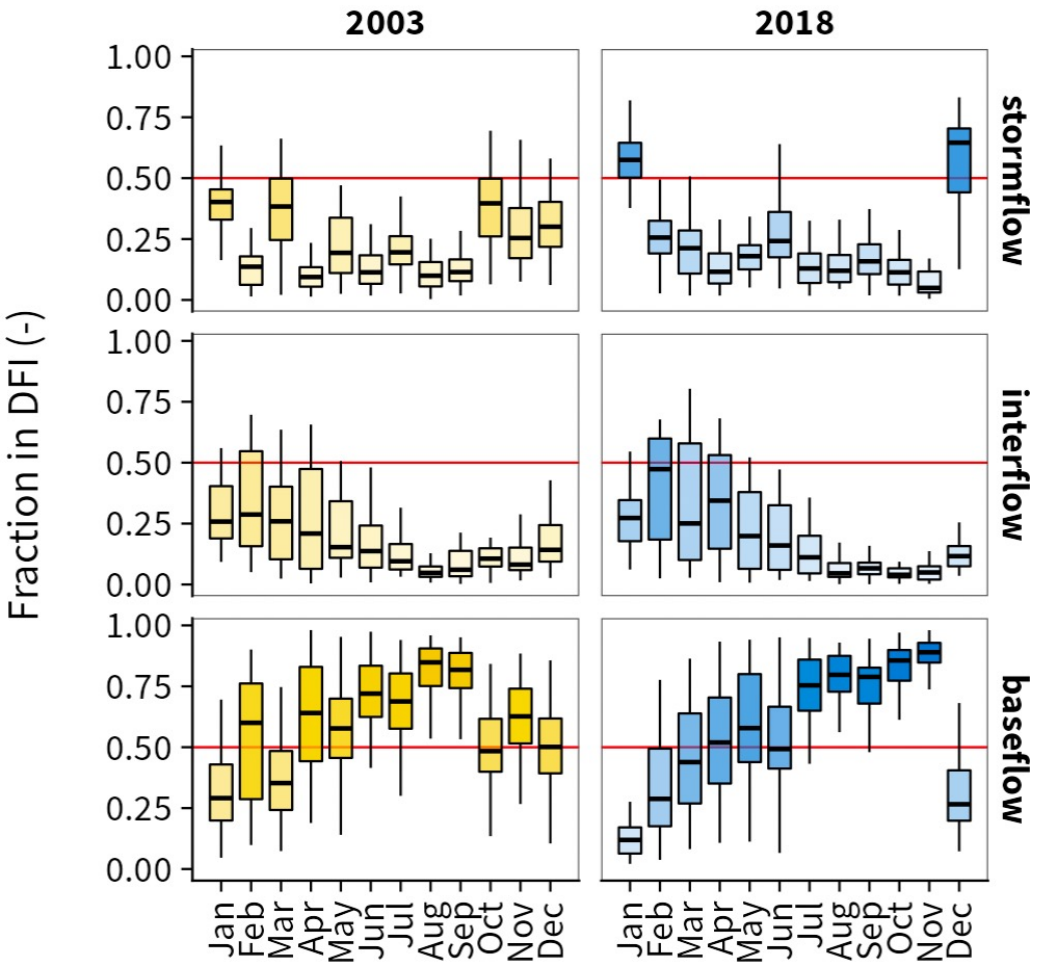


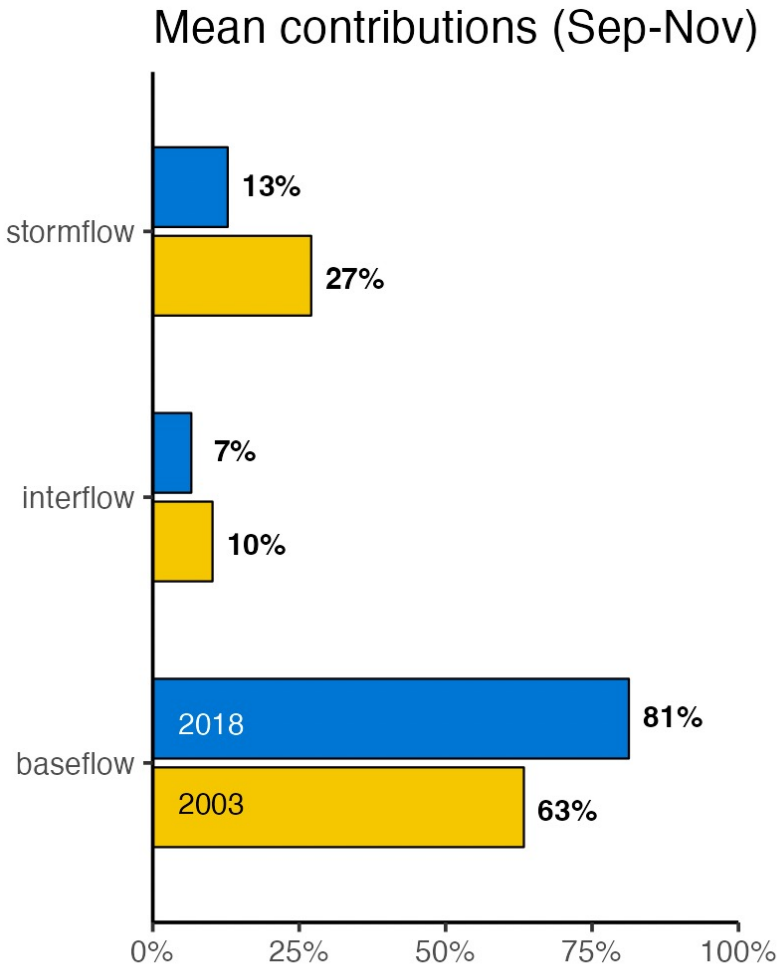
Results: Performance of the DFI method (50 catchments)





Results: Components during drought events





Conclusions

1. DFI-separation is able **to quantify the same streamflow contributions** as released from model storages (and vice versa).
2. Results (e.g., % baseflow, % interflow) are highly relevant for water managers before, during and after drought events!
   → waster water, hydro power, irrigation, environmental flow requirements.

Thank you for your attention!

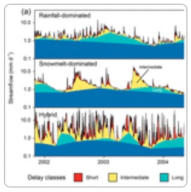
Paper with detailed method:

Research article

25 Feb 2020

Beyond binary baseflow separation: a delayed-flow index for multiple streamflow contributions

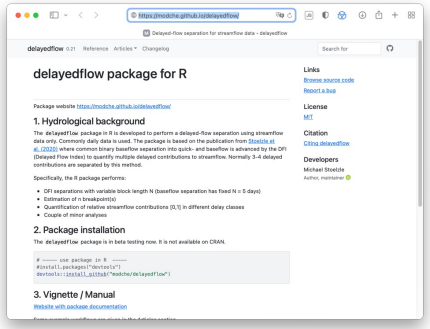
Hydrology and Earth System Sciences



Michael Stoelzle[1,*], Tobias Schuetz[2], Markus Weiler[1], Kerstin Stahl[1], and Lena M. Tallaksen[3]

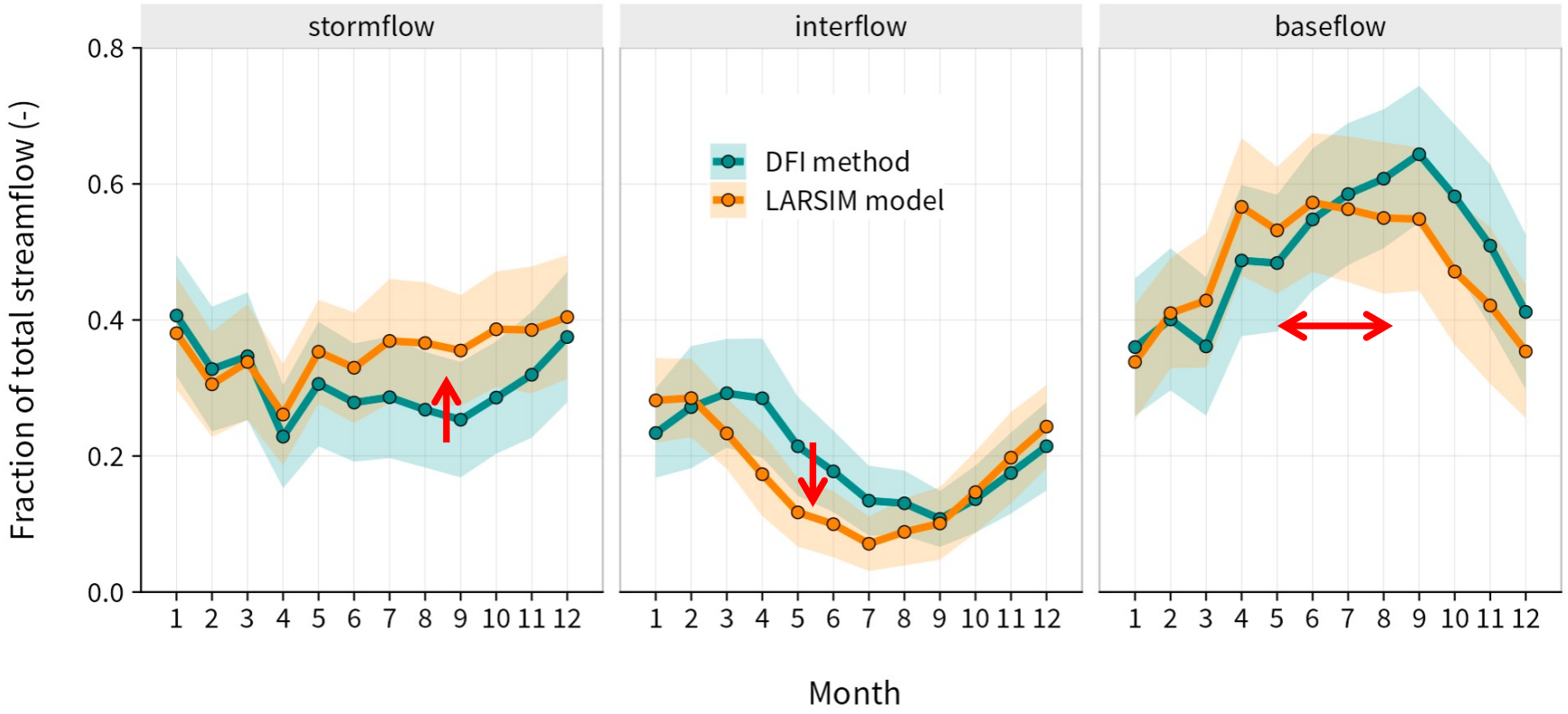
michael.stoelzle@hydro.uni-freiburg.de

R package delayedflow



https://modche.github.io/delayedflow/

Discussion: Differences in Mean Monthly Contributions



Trade-off I:
Stormflow vs. Interflow

Trade-off II:
Winter vs. summer season