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Study of the distributed hydrologic response of the Claduègne catchment (Ardèche), prone to flash floods, using dense networks of rain and water level gauges

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- Study site (fig. 1):**
- 13 catchments
 - 0.17-42 km²
 - 2 geologies (basalt & sedimentary)
 - 205-838 m a.s.l.
 - P = 1030 mm/a

1. Study site & data 2. Methodology

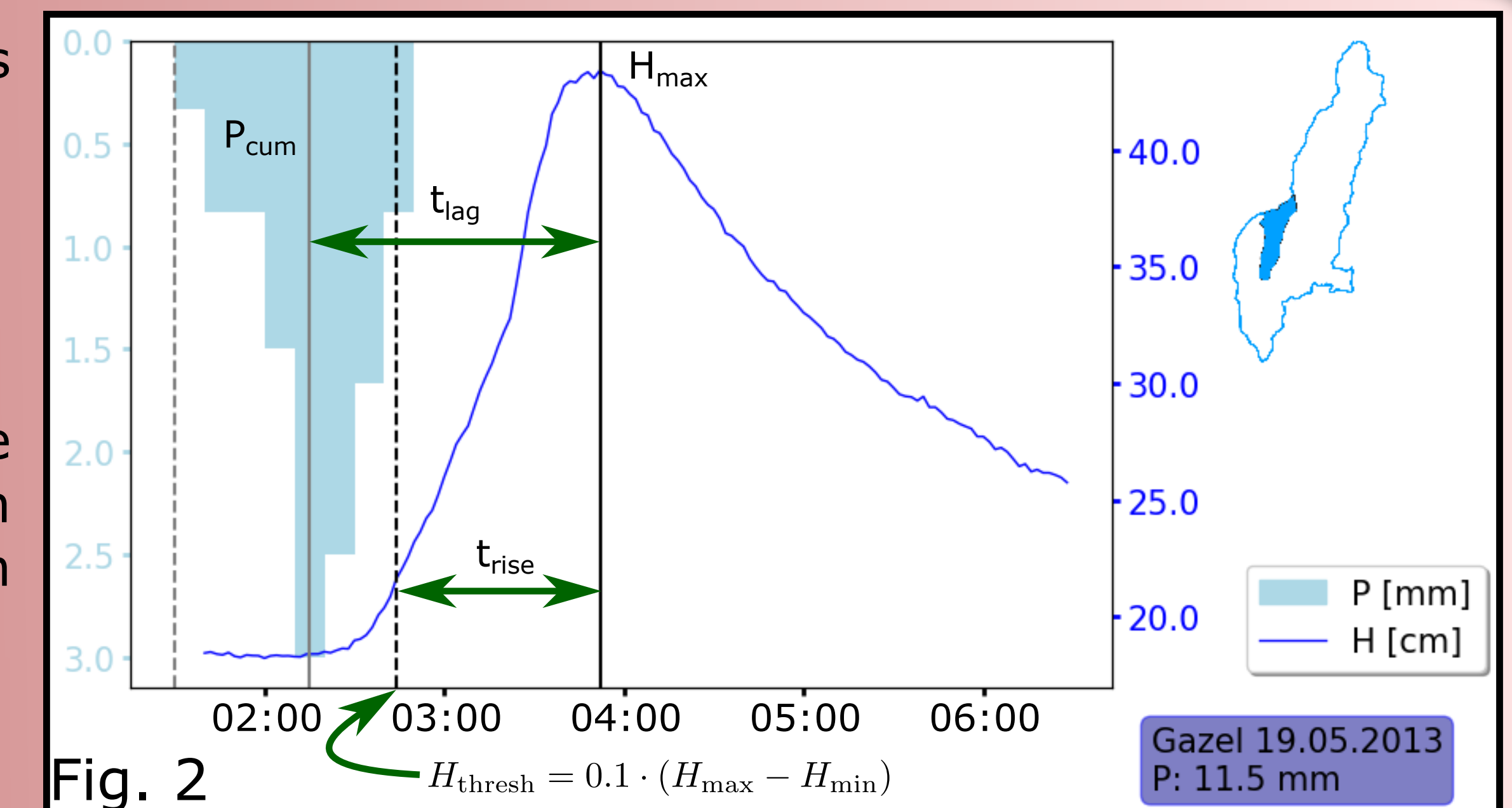
- Time series data (2012-2015; Nord et al., 2017):**
- Water level H & water temperature T_W (13/13)
 - Electric conductivity EC (6/13)
 - Discharge Q (5/13)
 - 2 operational rain gauges, 6 research rain gauges

- Event selection algorithm:**
- Rain intensity $[I]$
 - Cumulated $P [P_{cum}]$
 - Q recession
- 1383 events

Event analysis
Characterization of event dynamics using the indicators shown in fig. 2:

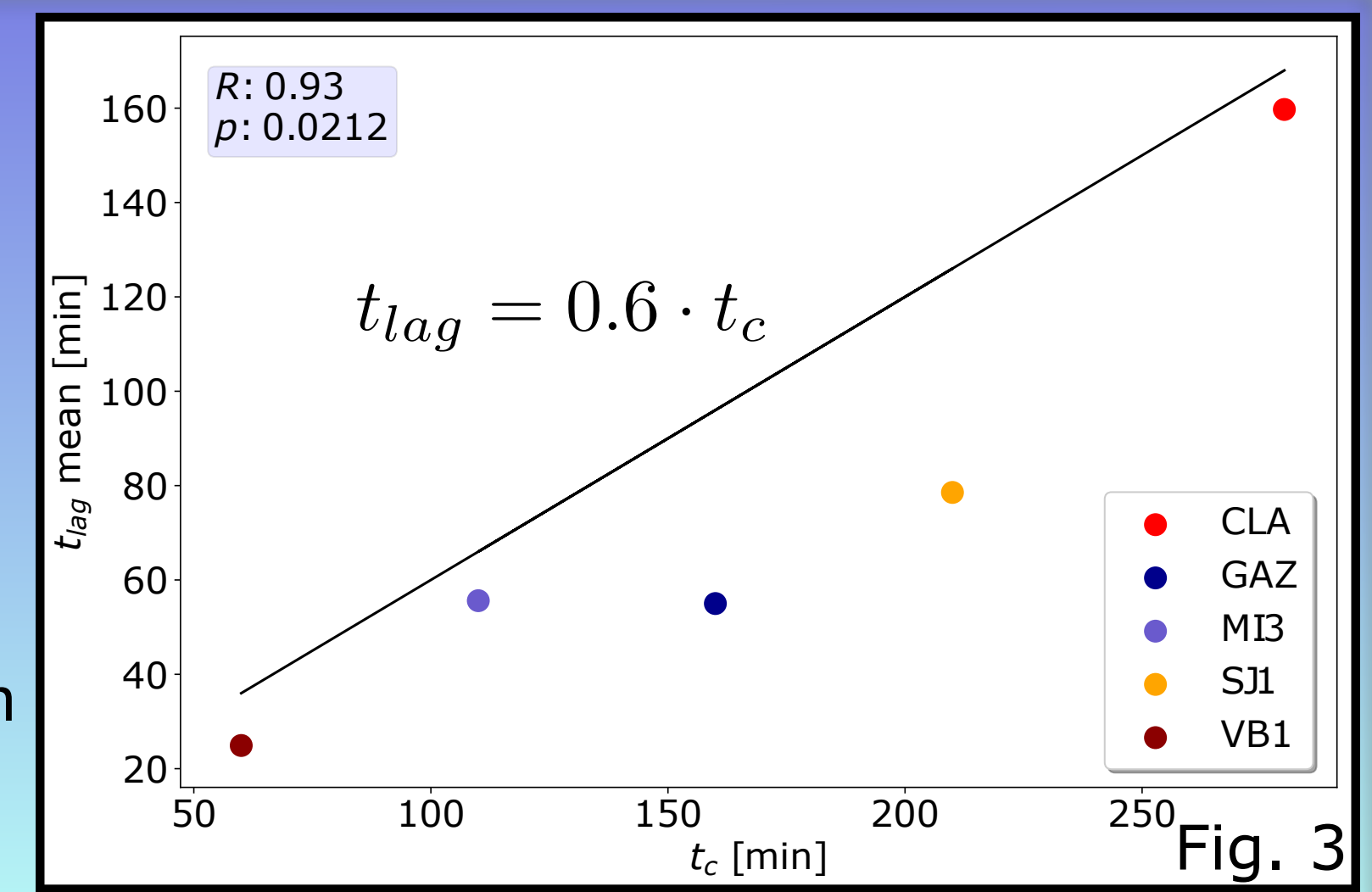
- Total event precipitation P_{cum}
- Time of rise t_{rise}
- Lag time t_{lag}
- Max. water level H_{max}

Characteristic times were normalized by a linear relation with catchment length to make them intercomparable.

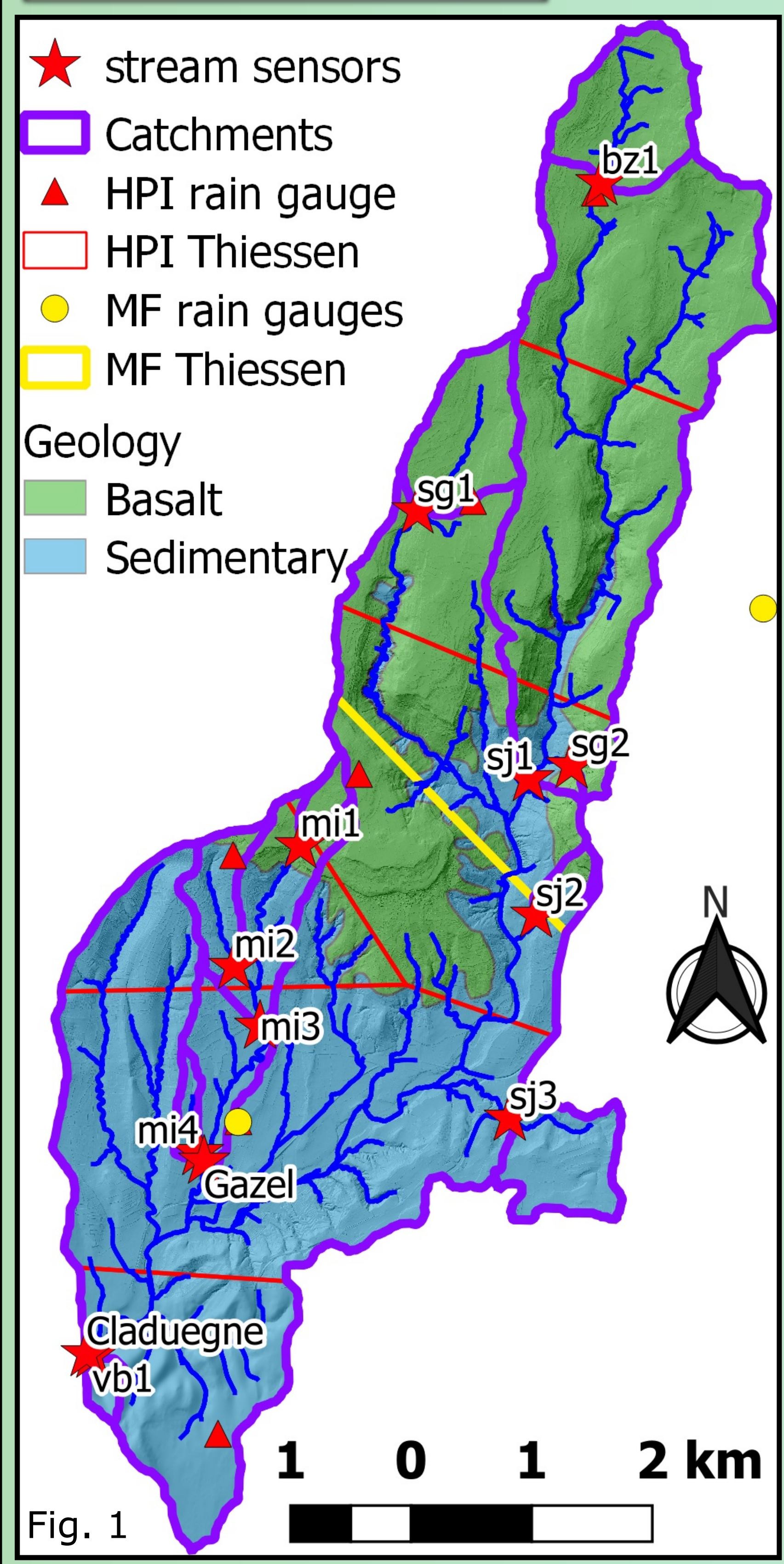
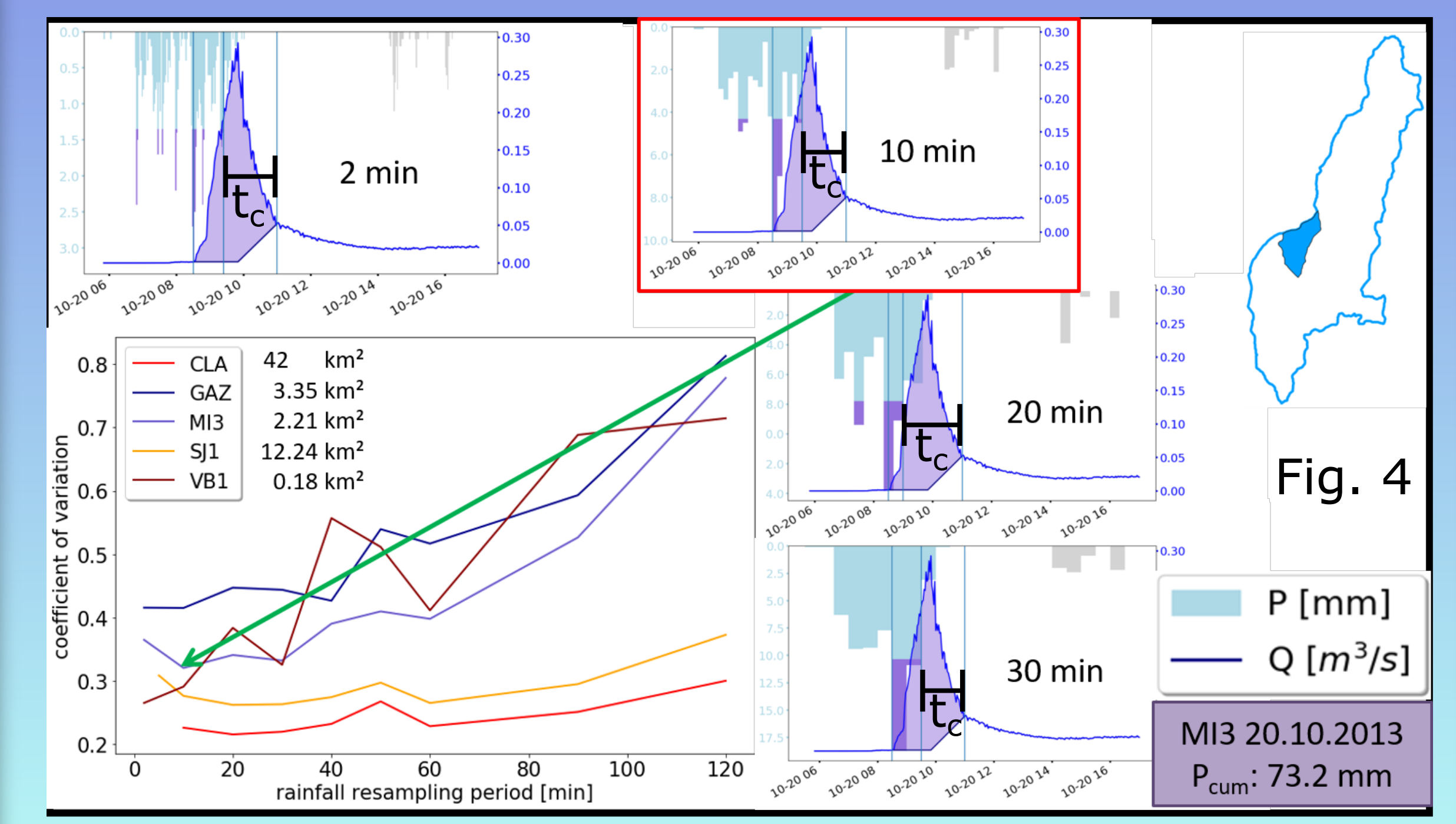


3.1 How to characterize and link the temporal and spatial dimensions of the hydrological response?

- Time of concentration (t_c):**
- Time runoff takes [hydraulically most distant point] → [outlet]
 - → catchment characteristic
 - Estimation needs discharge (Q)
 - Fig. 3: for impulsive events: $mean(t_{lag}) = 0.6 \cdot t_c$ (USDA-NRCS, 2010)
 - → impulsive event's mean t_{lag} can be used for catchment characterization



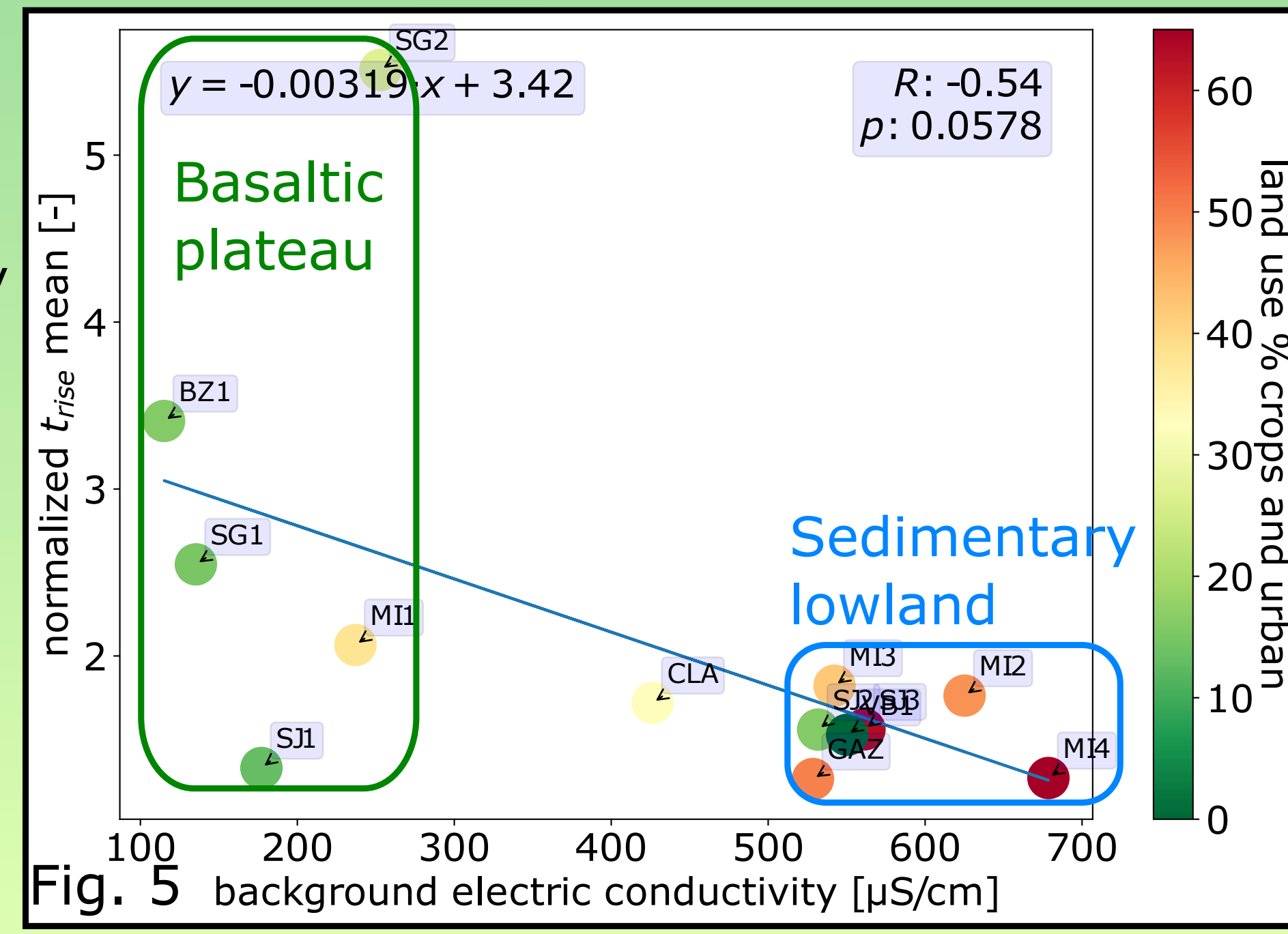
- Importance of the time step:**
- t_c (Φ -method) calculated for different rainfall aggregation time steps Δt
 - Inter-event coefficient of variation lowest for $\Delta t \approx t_c/10$



3.2 What are the main factors influencing the hydrological response?

- Conclusions:**
- Optimal temporal resolution $\approx t_c/10$
 - t_{lag} of impulsive events is a good t_c -proxy
 - t_{lag} normalized by catchment length to compare catchments
 - t_{react} shorter in the sedimentary part
 - Hydrological particularities of SJ1 & SG2
- Perspectives:**
- PhD on fate of pharmaceuticals in Claduègne
 - Geochemistry, isotopes & geophysics → flowpaths

- Main factors:**
- Geology: sedimentary lowland: shorter t_{react}
 - Shorter, more intense rainfall events
 - Erodible soils → steeper slopes & higher drainage density
 - Higher clay percentages
 - SJ1 fast → translatory flow
 - SG2 slow → volcanic scoria → high infiltrability
 - Slope, land use, ...
 - O_2 sat., season, initial humidity, ...



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Molinié, G., Ceresetti, D., Anquetin, S., Creutin, J. D., and Boudevillain, B. 2012: Rainfall regime of a mountainous mediterranean region: Statistical analysis at short time steps, Journal of Applied Meteorology and Climatology, 51, 429-448, <https://doi.org/10.1175/2011JAMC2691.1>.