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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1. Study site & data

Study site (fig. 1):

- 13 catchments
- 0.17-42 km^2
- 2 geologies (basalt & sedimentary)
- 205-838 m a.s.l.
- $\mathrm{P} = 1030\,\mathrm{mm/a}$

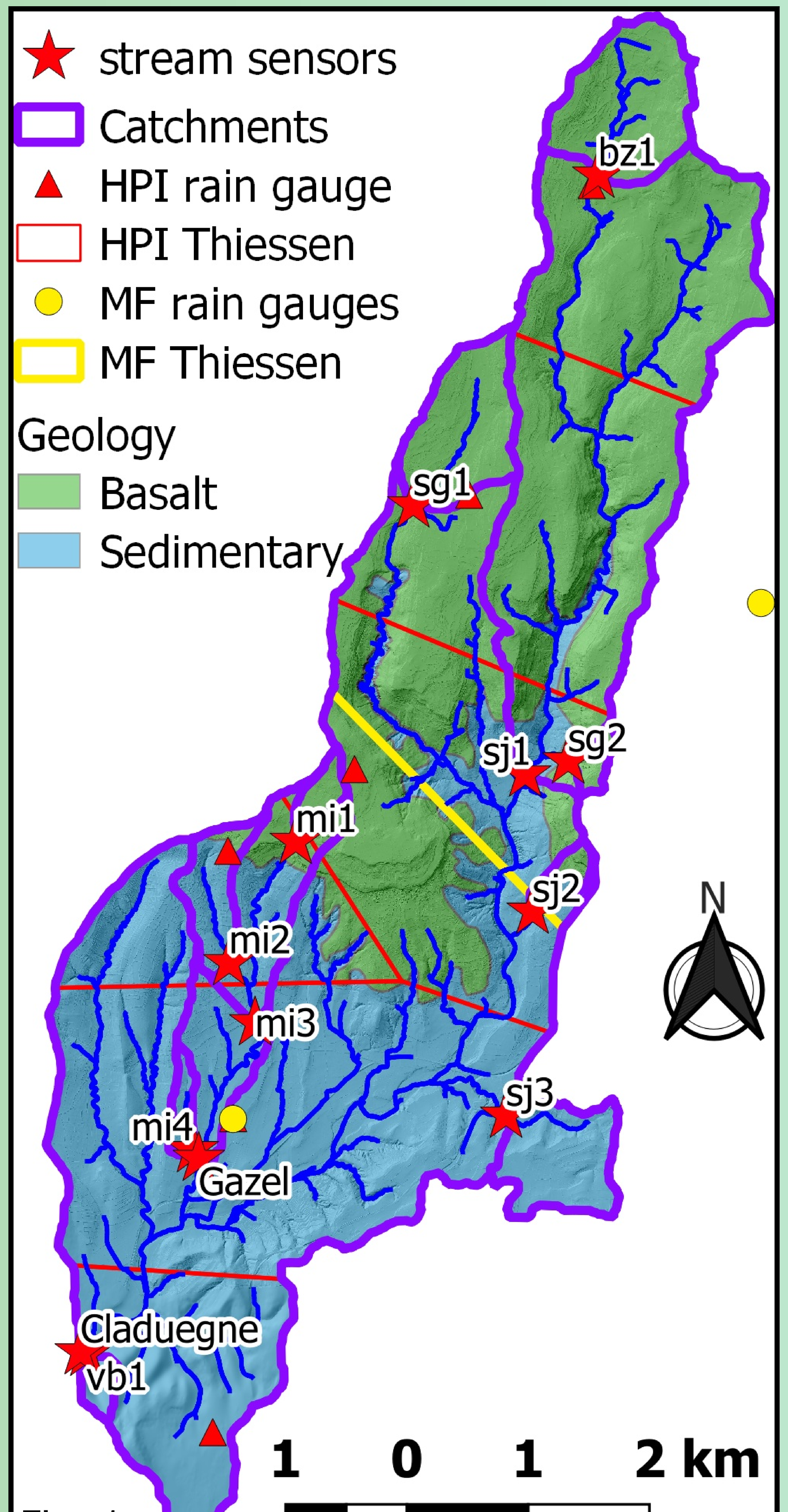

Fig. 1

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

2. Methodology

Event selection algorithm:

- Rain intensity $[I]$
- Cumulated P $[P_{cum}]$
- Q recession

$\rightarrow$ 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.

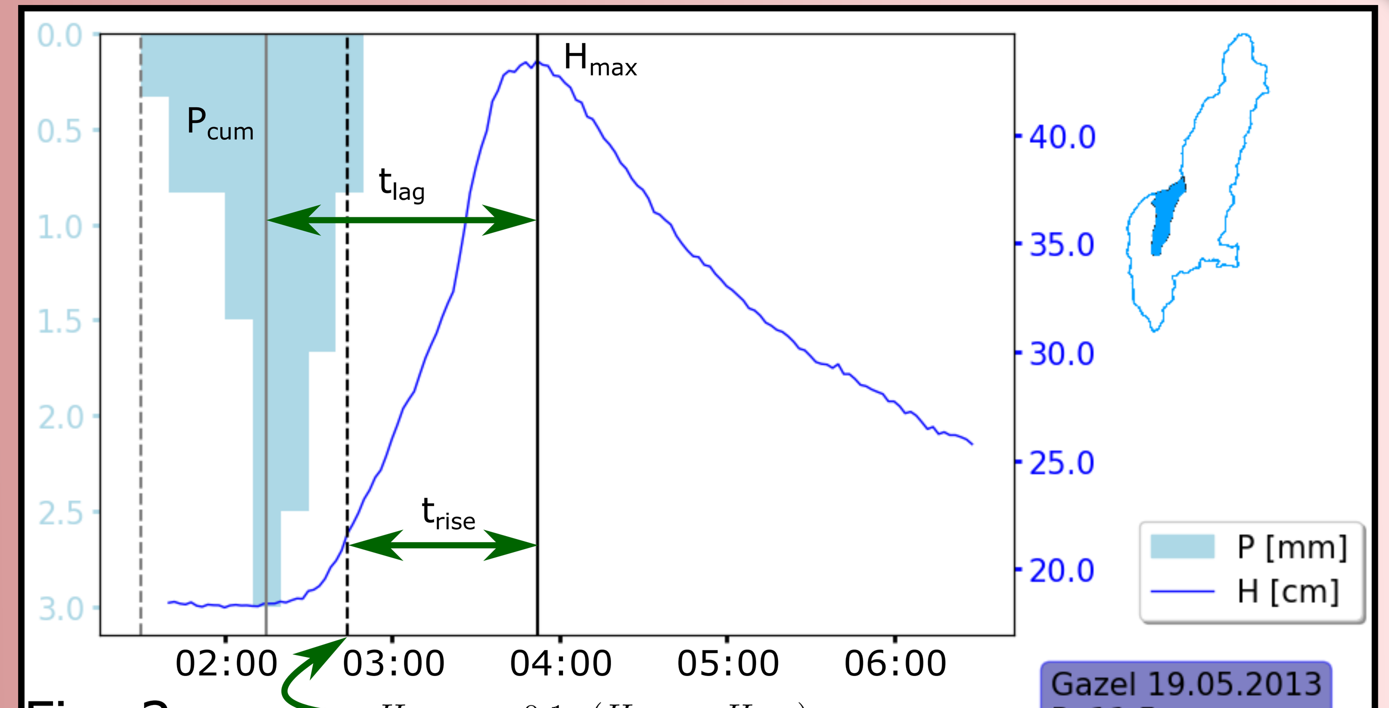

Fig. 2

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] $\rightarrow$ [outlet]
- $\rightarrow$ catchment characteristic
- Estimation needs discharge (Q)
- Fig. 3: for impulsive events: mean(t_{lag})$= 0.6 \cdot t_c$ (USDA-NRCS, 2010)
- $\rightarrow$ impulsive event's mean t_{lag} can be used for catchment characterization

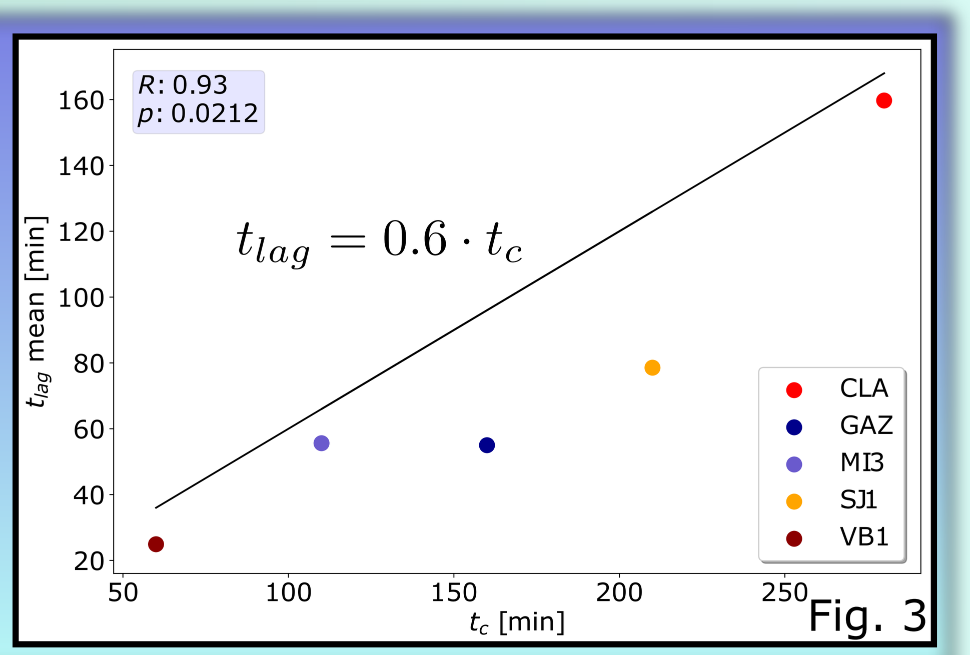

Fig. 3

Importance of the time step:

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

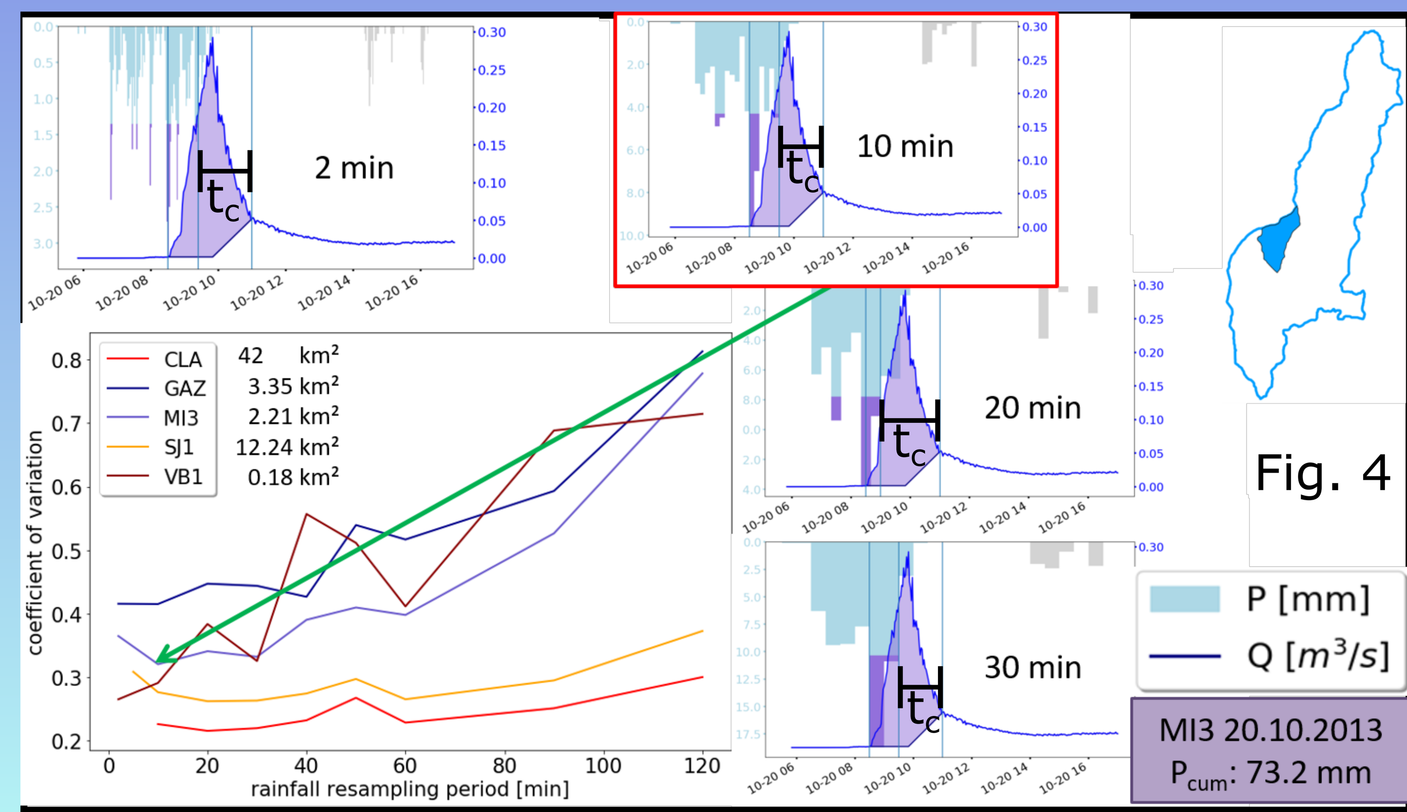

Fig. 4

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 pharmaceutics in Claduègne
- Geochemistry, isotopes & geophysics $\rightarrow$ flowpaths

Main factors:

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

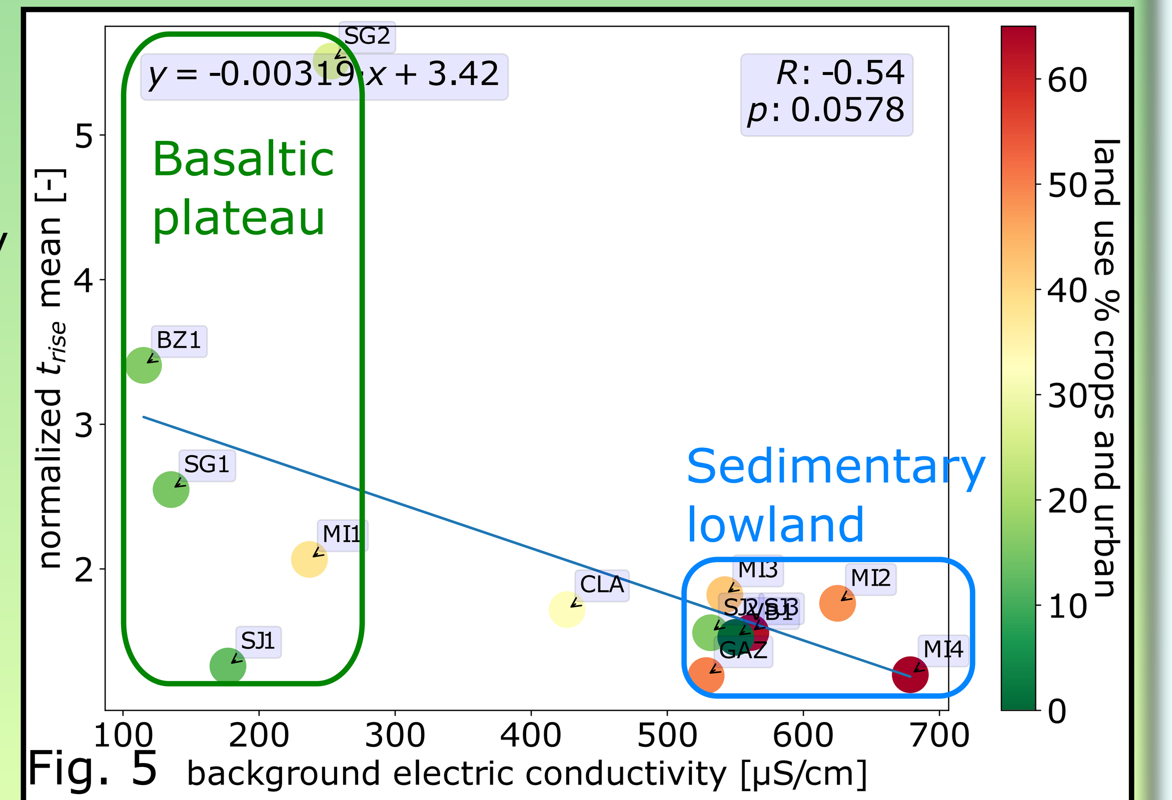

Fig. 5

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