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Which hydrological activity in weathered bedrock during flash floods?
The case of Mediterranean catchments

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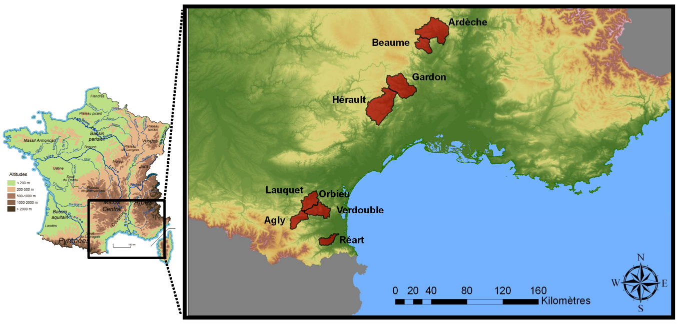
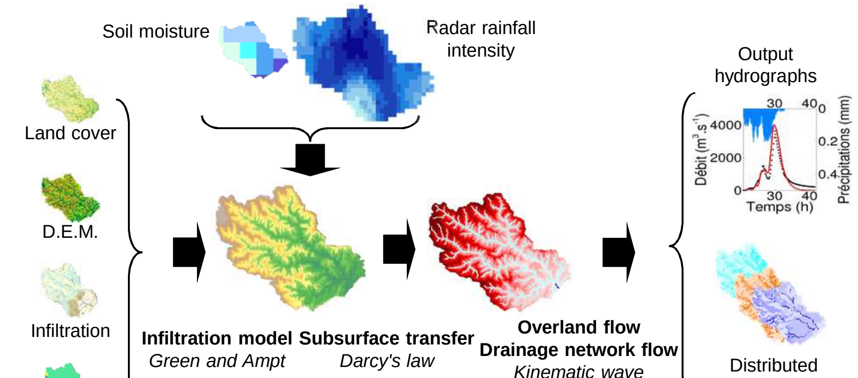
Objectives

- Assessing hydrological dynamic into weathered rock layer with:
  - hydrological modeling: MARINE (Roux et al., 2011)
  - baseflow separation (Eckhardt, 2005)
- Case study: 8 catchments of French mediterranean area



MARINE model description



$$\frac{\partial I}{\partial t}=K\left(1+\frac{(\theta_s-\theta_0)S_f}{I}\right)$$

$$Q_{out}=T(\theta)\,grad(h)\,dx \qquad T(\theta)=T_0\exp\left(-\frac{\theta_s-\theta}{m}\right)$$

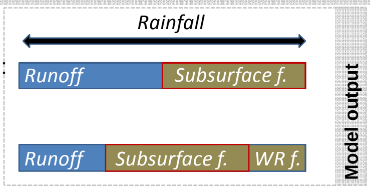
$$\frac{\partial h}{\partial t}+\frac{\sqrt{S_0}}{n}\frac{5}{3}h^{2/3}\frac{\partial h}{\partial x}=p-i$$

A physical process oriented model with 5 parameters to calibrate (□ , soil depth: C_Z)

Estimation of flow and storage into weathered rock layers through MARINE modeling

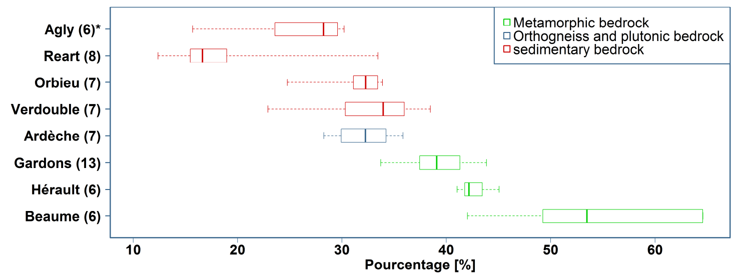
2 hydrological model processing :

- MARINE forcing with soil depth from BD-sol: subsurface flow estimations
- MARINE forcing with likehood calibration: flow into weathered rock layers (*WR F.*) estimations



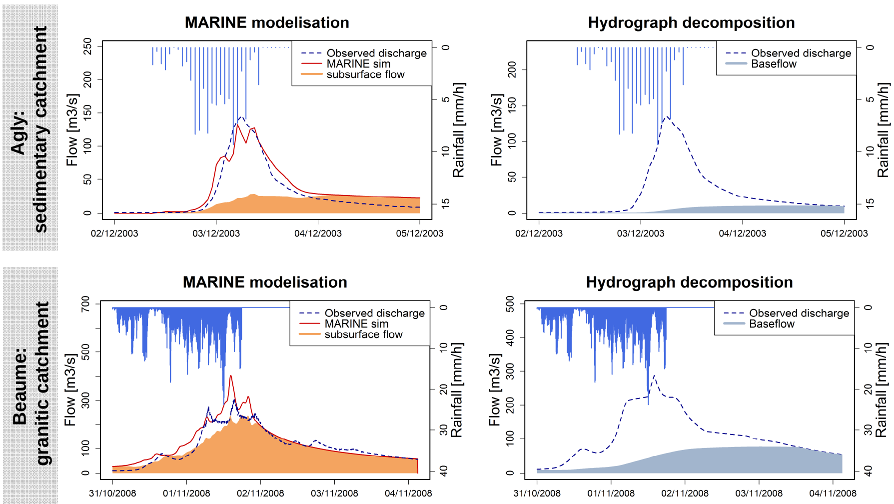
Correction coefficient of soil depth

- **Significant hydrological dynamic into deep layers during flash flood**
- **Groundwater behavior specific to rock layer**



% of flow through deep horizons: estimation on several flash flood events
(* number of events)

Hydrograph decomposition (Eckhardt, 2005)



Using 2 parameters recursive filter to assess baseflow

$$b_t=\frac{(1-BFI)\cdot a\cdot b_{t-1}+(1-a)\cdot BFI\cdot y_t}{1-a\cdot BFI}$$

b_t : baseflow at time t
y_t : streamflow at time t
BFI : baseflow index
a : recession constant

Recession constants are computed making recession analysis. The BFI parameter is fixed to 0.8 as (Eckhardt, 2005) suggests.

- **Significant baseflow during flash flood : it represents between 10 % and 46 % of the flash flood streamflow volumes (statistic achieved with 14 events)**
- **There isn't any correlation between baseflow contribution and catchment geology, because of the fixed BFI parameter to apply the decomposition method**

Conclusion & Perspectives

Flows through deep horizons were estimated to represent up to 29 % and 46% of the total hydrograph according to MARINE hydrological modelling and hydrograph decomposition respectively. These results are consistent with previous studies (Vannier et al, 2013) that underline hydrological activity into weathered bedrock layers with significant contribution to flash flood processing.

Similar results are provided by both independent hydrological modeling and hydrograph decomposition methods, that give them consistency.

For more accurate results the hydrological model should detail subsurface flows and flows into deeper horizons with appropriate physical modeling. Hydrograph decomposition could help to find different flow contributions. The method has to be improved, by calibrating BFI parameter and computing the recession constant by focusing on flash flood events.

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