A dam-reservoir module for a semi-distributed hydrological model

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A DAM-RESERVOIR MODULE FOR A SEMI-DISTRIBUTED HYDROLOGICAL MODEL

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We proposed a dam module that can easily be implemented in a semi-distributed hydrological model. Without any additional parameter, impact of dams can be considered in space and at daily time step. It opens perspectives for estimating natural streamflow and may benefit from satellite images.

A dam module without additional parameter

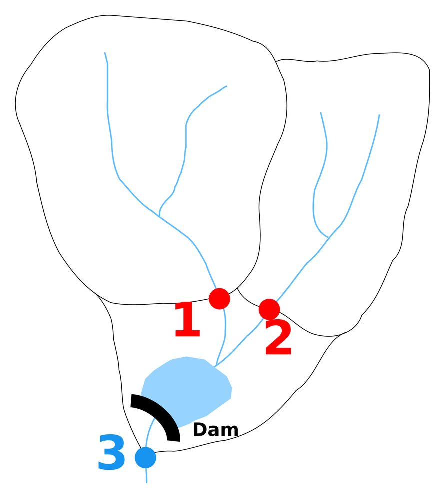
It is is derived from the work of *Payan et al. (2008)* who proposed a dam module for lumped hydrological model. It requires an additional forcing data:

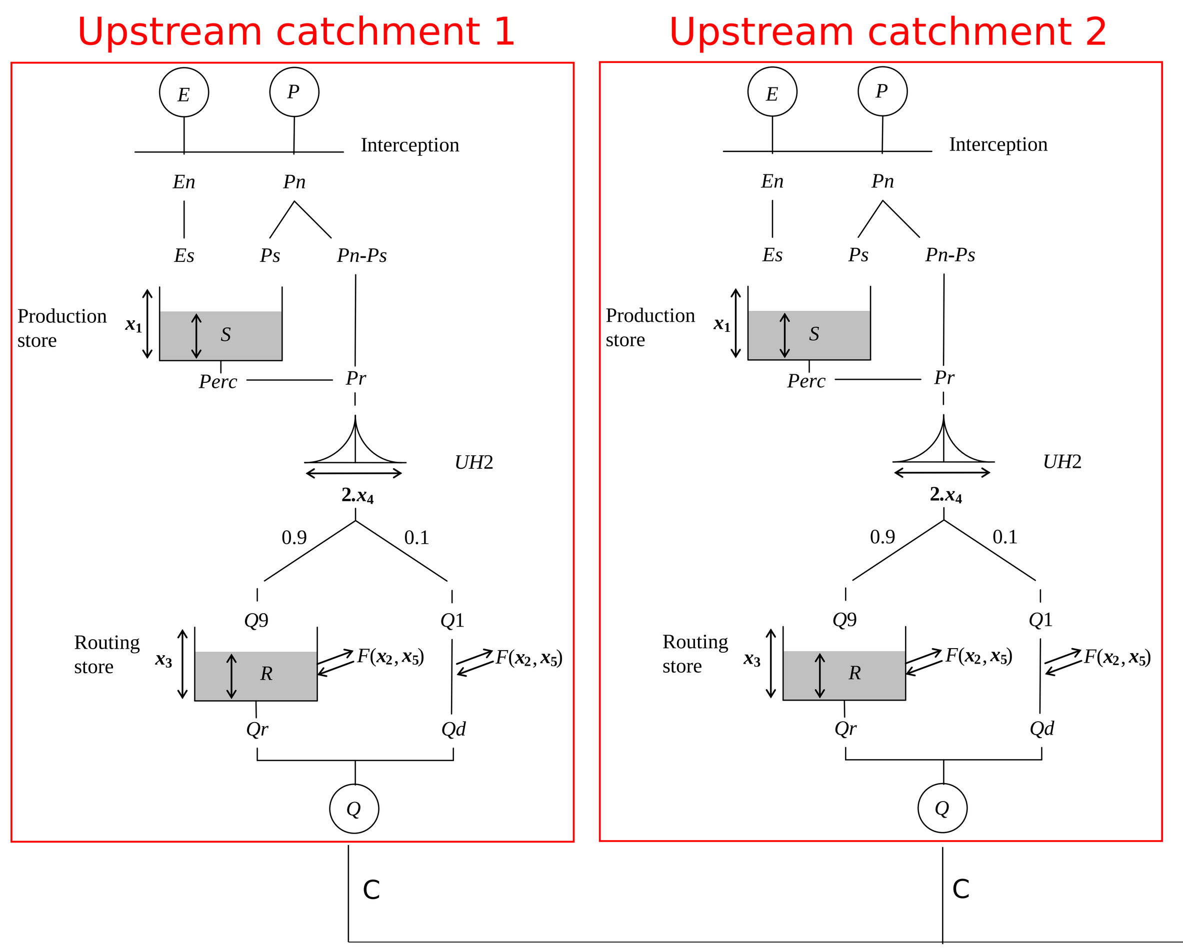
- ΔV: the **variation of the water volume stored by the dam**

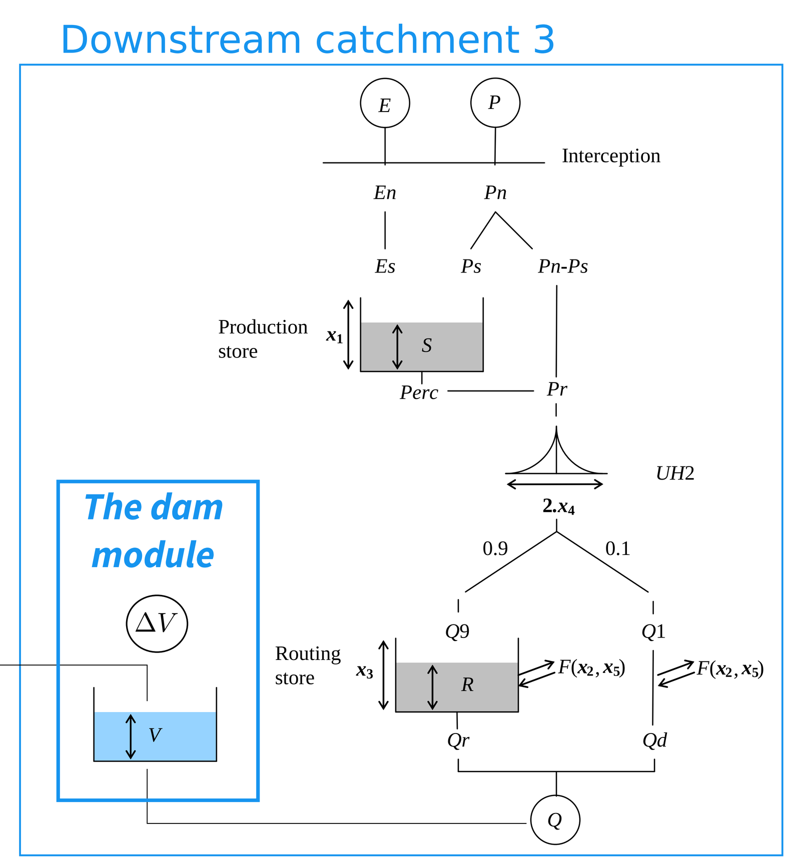
This time series is directly impacting the subcatchment where the dam is located:

- when $\Delta V > 0$ this volume is retrieved from upstream discharge contributions
- when $\Delta V < 0$ this volume is added to the outflow of the subcatchments.

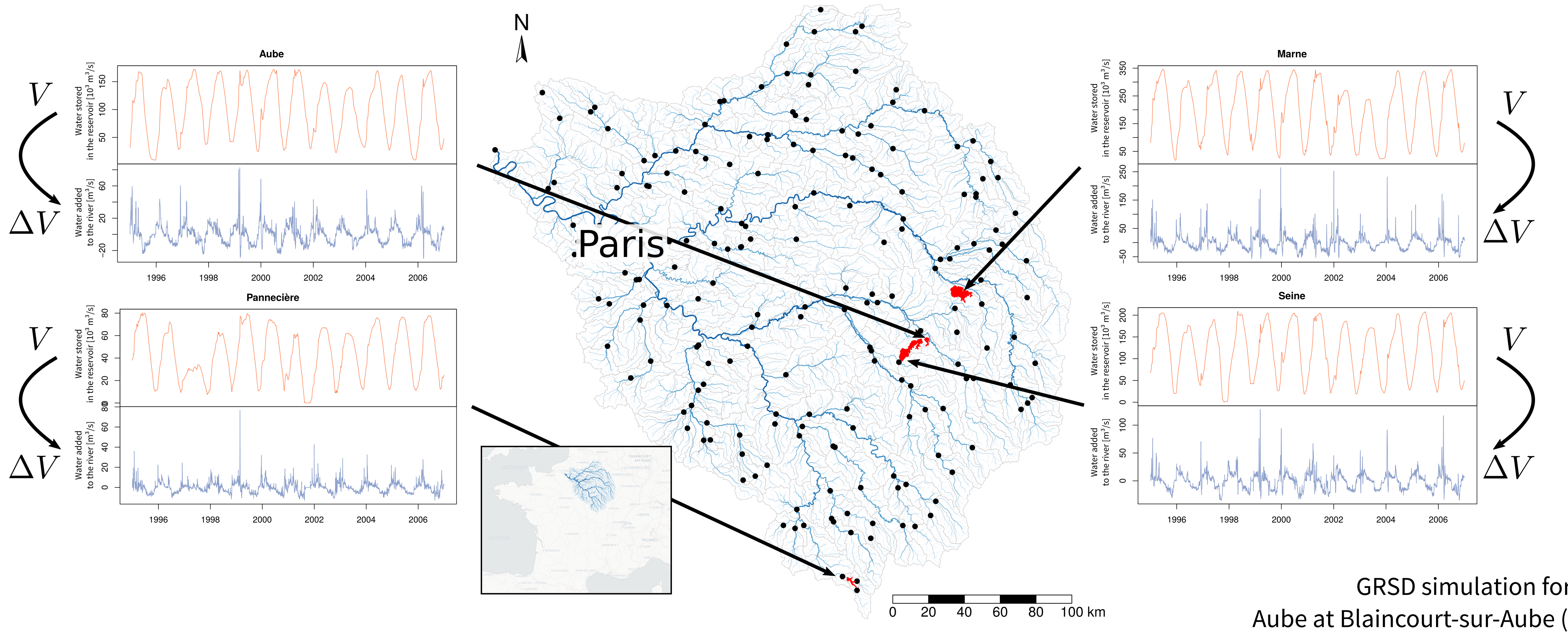
GRSD model structure





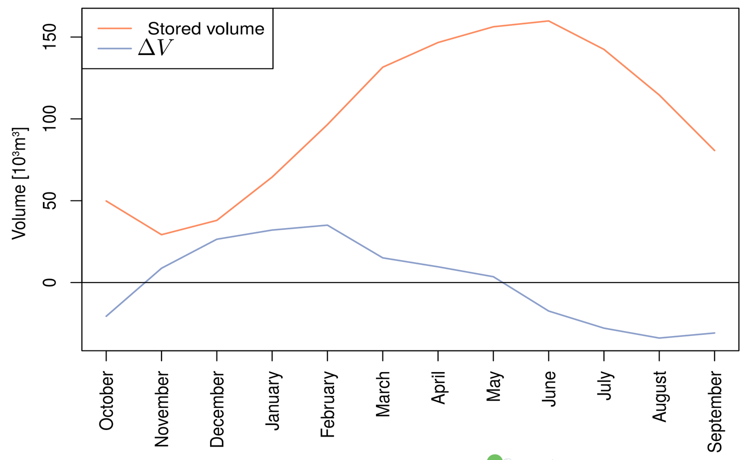


The semi-distributed model GRSD *(de Lavenne et al. 2016)* is based on an implementation of a lumped daily GR5J model (5 parameters) on each subcatchment. GR5J is composed of two stores: a production store (capacity *X1*) and a routing store (capacity *X3*), which is filled by the output of a unit hydrograph (of time base *X4*). Two other parameters, *X2* and *X5*, are used to quantify the inter-catchment groundwater flow. Outflow simulations of upstream catchments are routed downstream using a streamflow celerity (parameter *C*).



The case study of the River Seine catchment

Typical seasonal variation of reservoirs (Example of the River Aube)

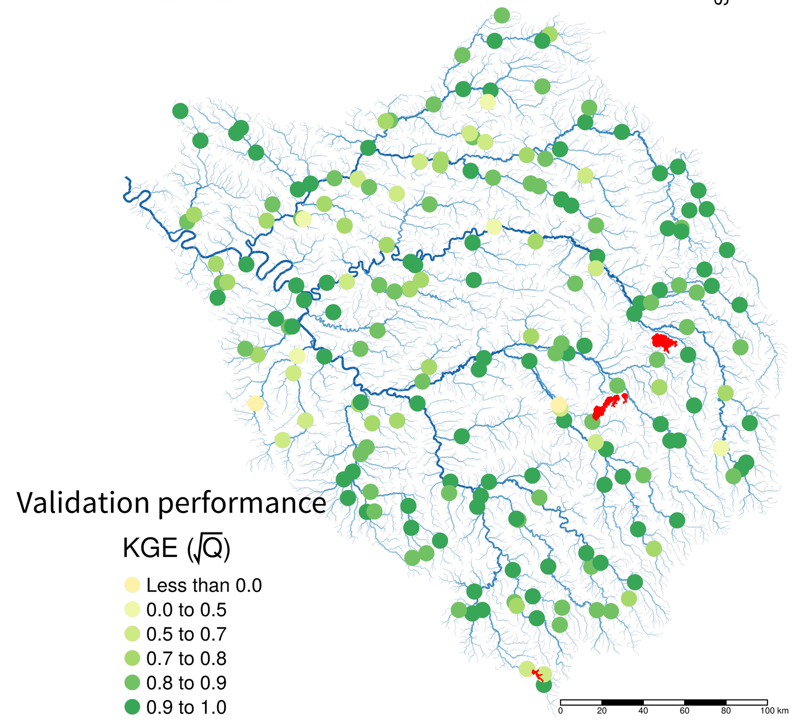


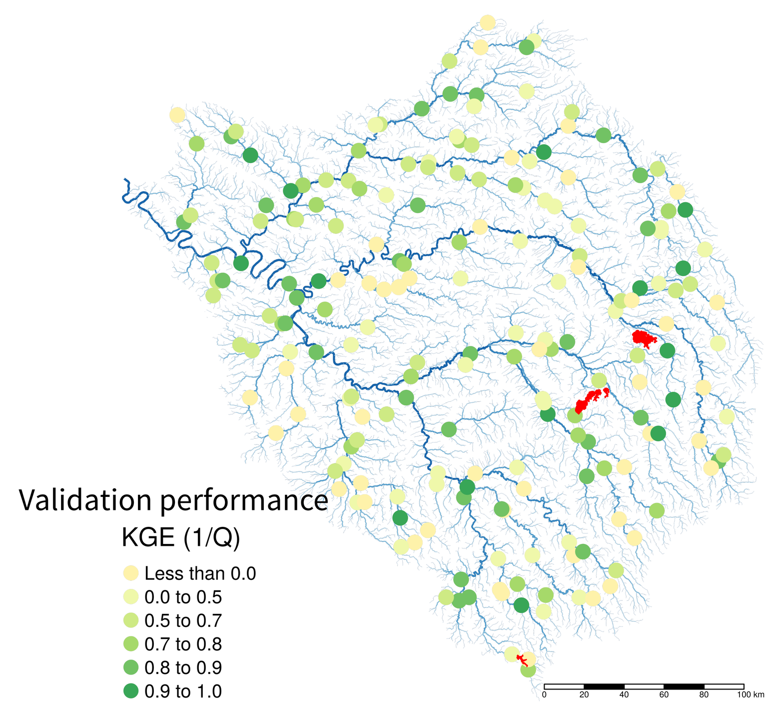
The River Seine is influenced by 4 dams whose aims are low-flow augmentation and flood mitigation.

River	Lake	Volume [hm³]	Surface area [km²]	Catchment area [km²]
Yonne	Pannecière	80	5.2	220
Seine	Orient	208	23	2380
Aube	Temple & Amance	170	23.2	1650
Marne	Der-Chantecoq	349	48	2900

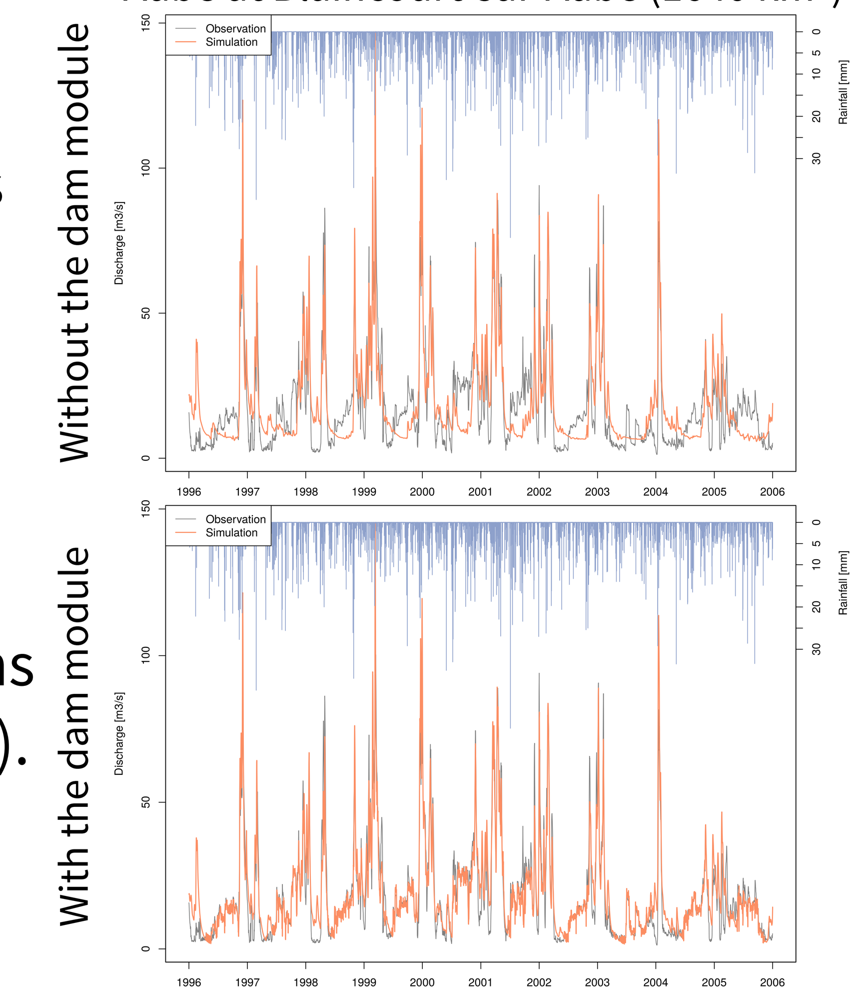
Model implementation :

- 375 subcatchments including 198 gauged stations for sequential calibration (upstream to downstream).
- Daily gridded meteo and discharge databases.
- High improvement of simulated discharge.





GRSD simulation for Aube at Blaincourt-sur-Aube (1640 km²)



Conclusion and perspectives

- With the dam module implemented, GRSD is able to reproduce influenced streamflow with a good performance and robustness.
- In comparison with the work of *Payan et al. (2008)* the dam is now localised inside the catchment: better catching of its impact and better dealing with larger catchments.
- Perspectives for better estimation of natural streamflow *(Poster EGU2017-6403)*.
- The SWOT *(Surface Model and Ocean Topography)* satellite mission opens perspectives for estimating ΔV at any ungauged reservoir.

References :

- *de Lavenne, A. et al. (2016) Spatial variability of the parameters of a semi-distributed hydrological model PIAHS, 373, pp. 87–94. 2016.*
- *Payan, J.L. et al. (2008) How can man-made water reservoirs be accounted for in a lumped rainfall-runoff model? Water Resour. Res., 44, W03420*

EGU General Assembly 2017 – 23-28 April 2017 – Vienna – EGU2017-8956