Quantification des flux d'eau et de chaleur au sein du bassin des Avenelles par une approche croisant investigations hydrogéophysiques et modélisation numérique

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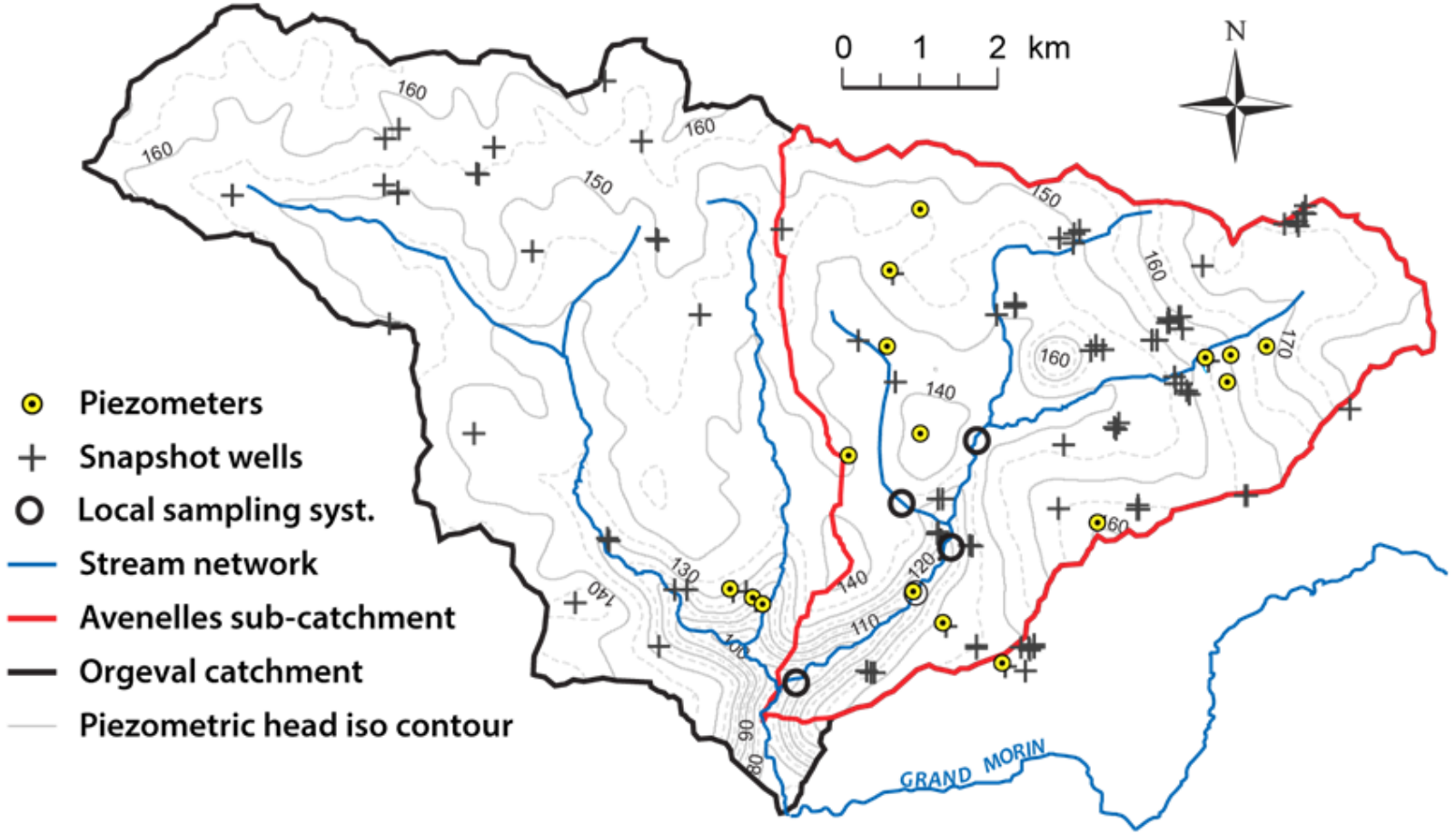
1 MINES ParisTech

2 metis UMR 7619

3 GEOSCIENCES Rennes

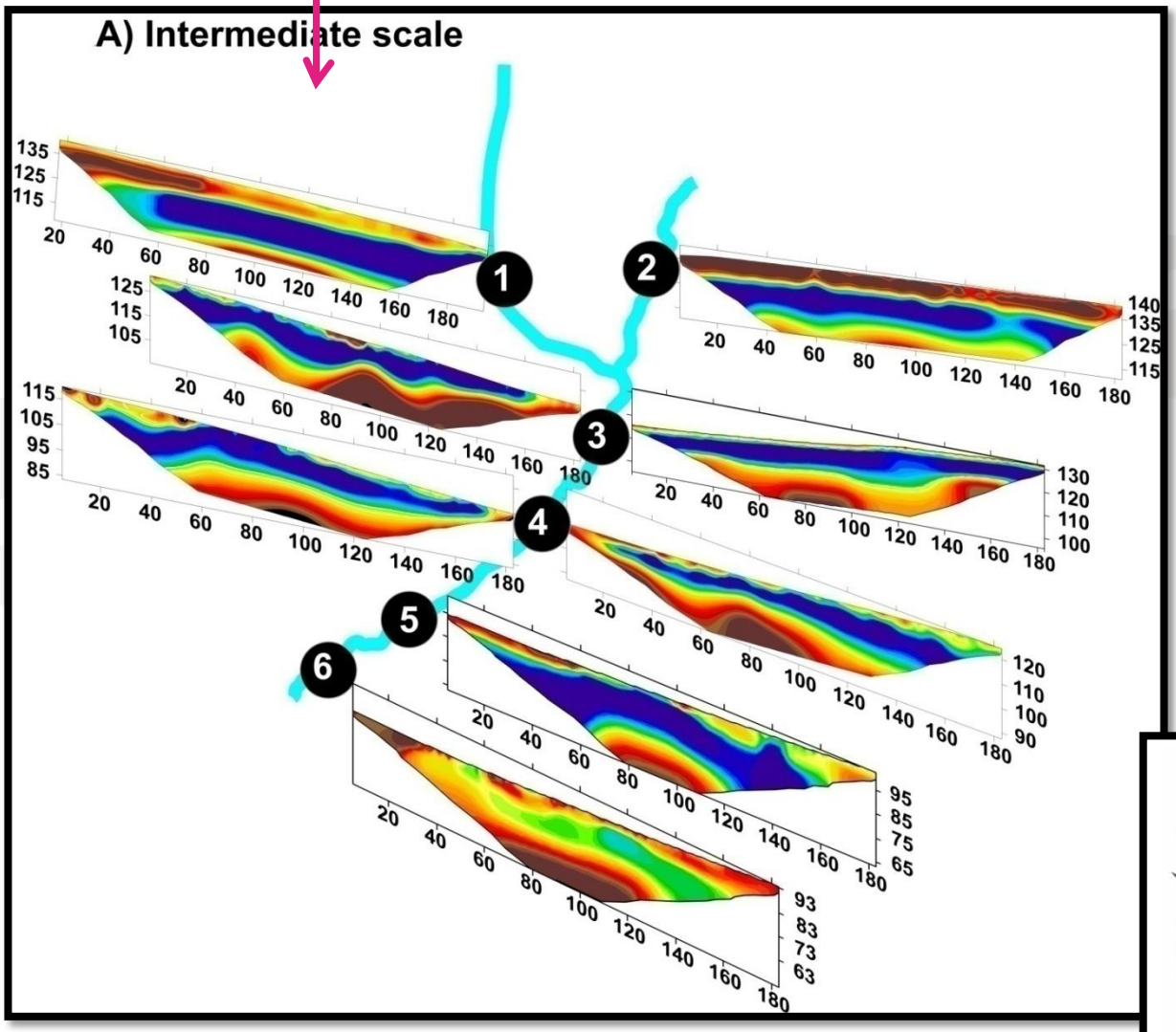
Orgeval experimental basin:

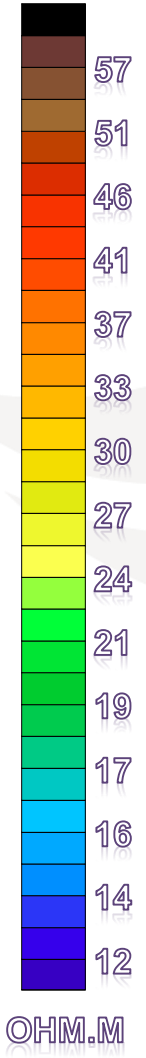
+ dense hydrological monitoring network

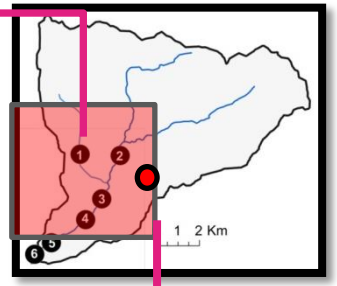


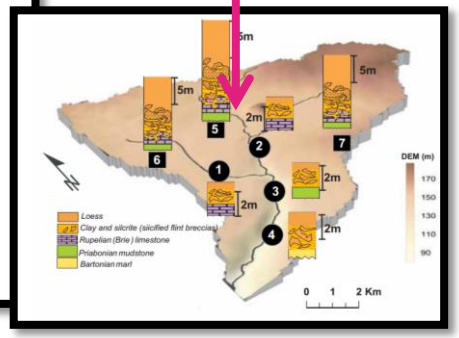
> but still need a description of the geological structure(s) and possible connections between the stream network and « aquifer units »

Description de l'hydrosystème
=> reconnaissances géophysiques et géologiques classiques

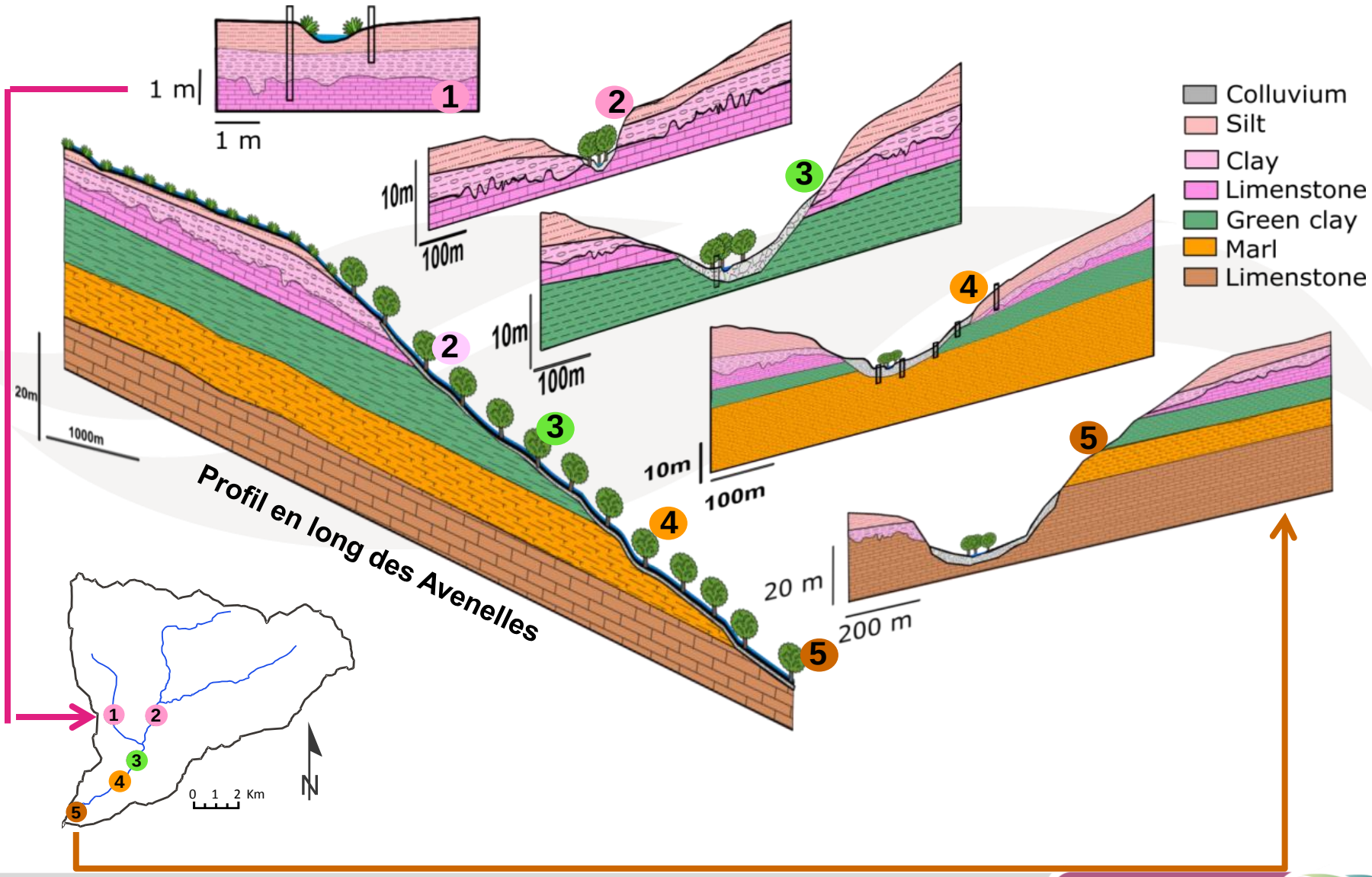






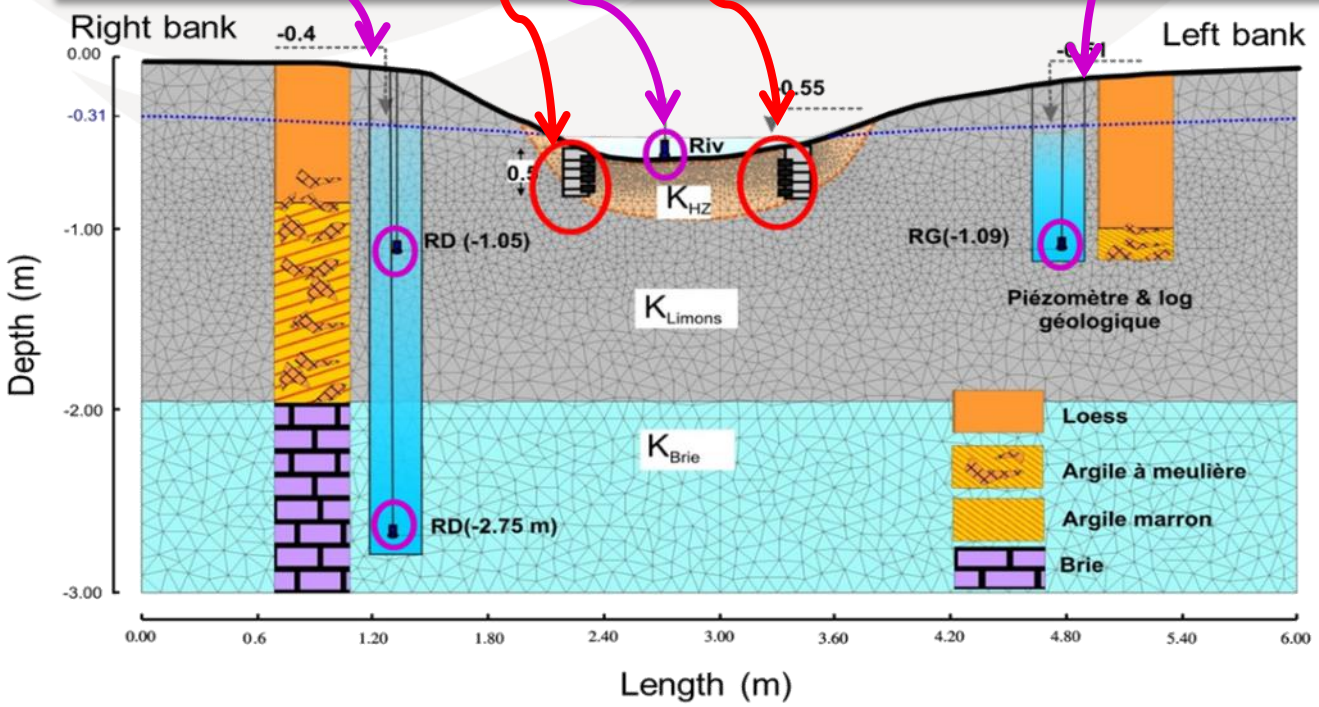


Structures géologiques et connectivités
=> points stratégiques d'observation



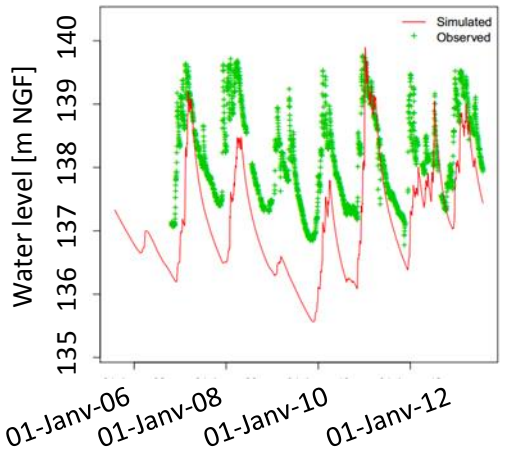
Mouhri et al., QUAE 2013

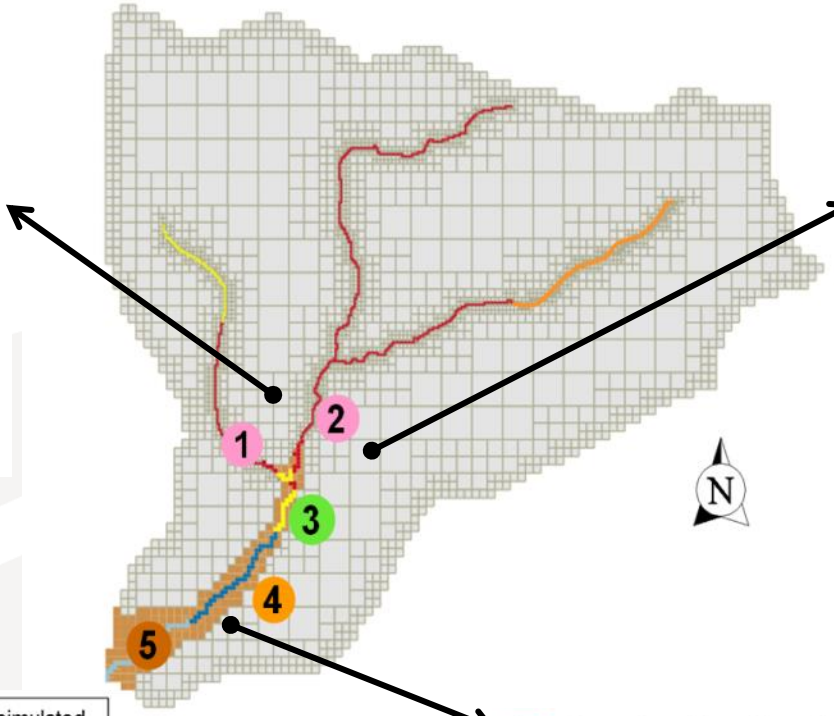
Dynamique de l'hydrosystème
=> observation continue et haute fréquence

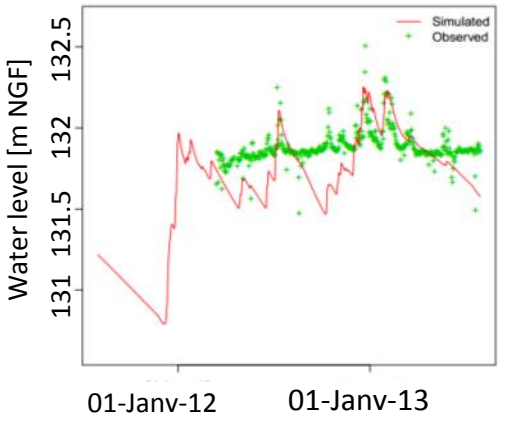


- Time step : 15 min
- Time series : 5 years

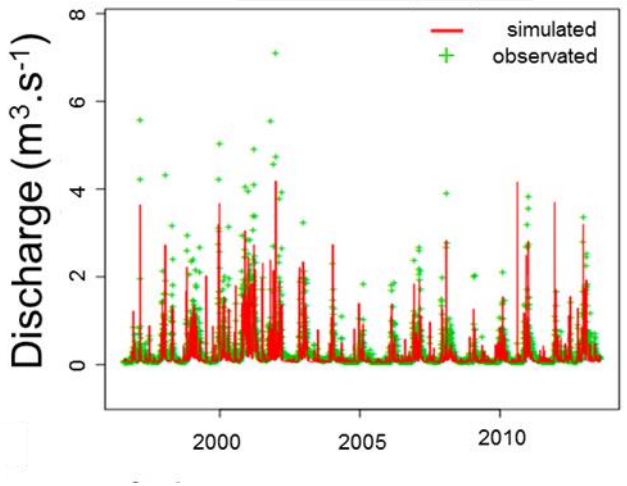
Observation continue et haute fréquence
=> modélisation des flux à l'échelle du bassin

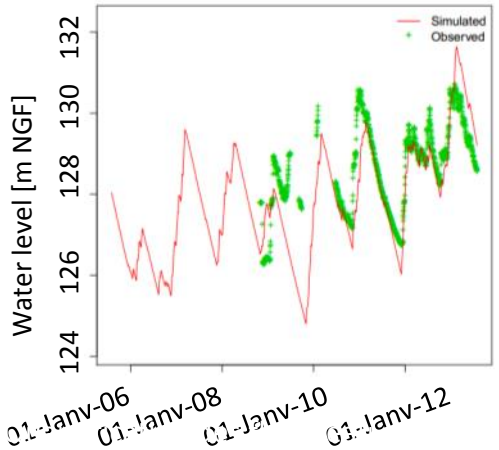






Losing (up to 36 L/s/Km)
Slightly Losing (up to 10 L/s/Km)
Equilibrium (-2 L/sLKm to 2 L/s/Km)
Slightly gaining (up to 10 L/s/Km)
Gaining (up to 12 L/s/Km)
+ Observation
– Simulation





Discharge :

RMSE ($m^3.s^{-1}$) =0.28

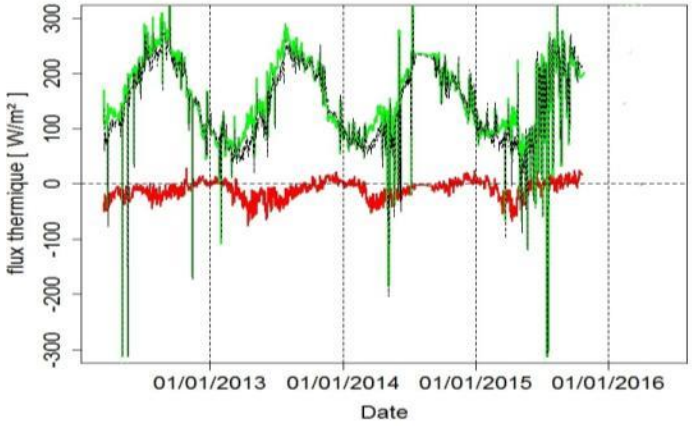
NASH = 0.62

11 piezometers :

RMSE 0.12 – 1.15 m

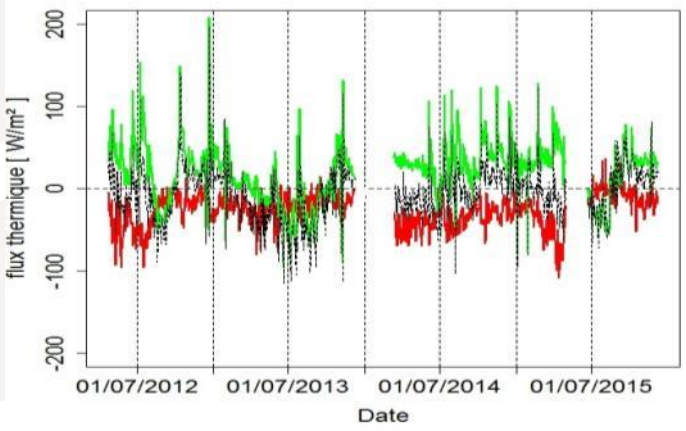
Biais -0.95 – 0.7 m

Exemple des flux thermiques locaux
=> hétérogénéité des processus

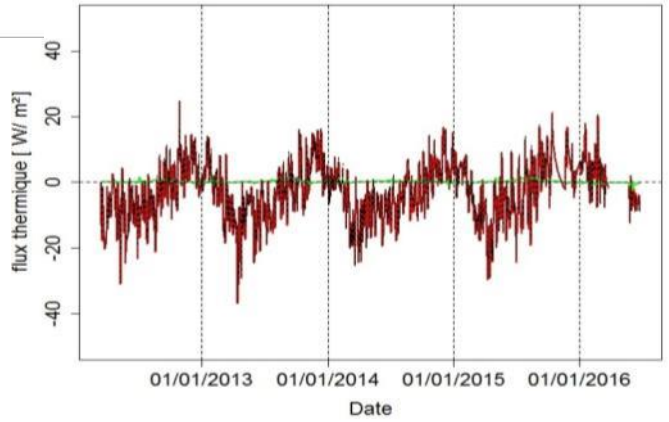


2 Advective station

3 Intermittent exchanges



4 Conductive station

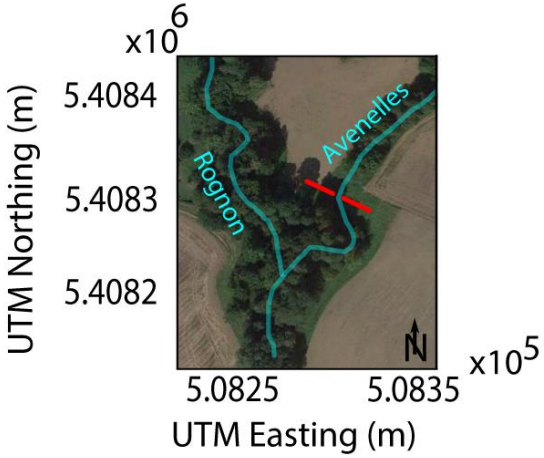


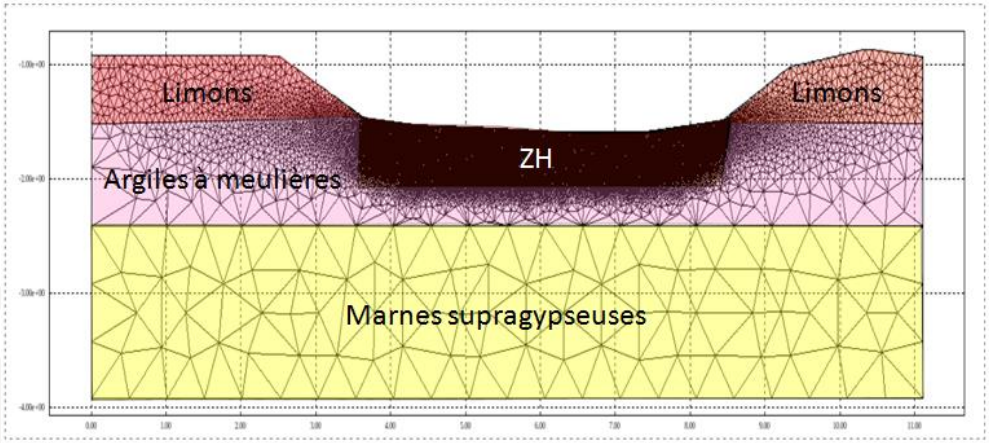
Conductive flux

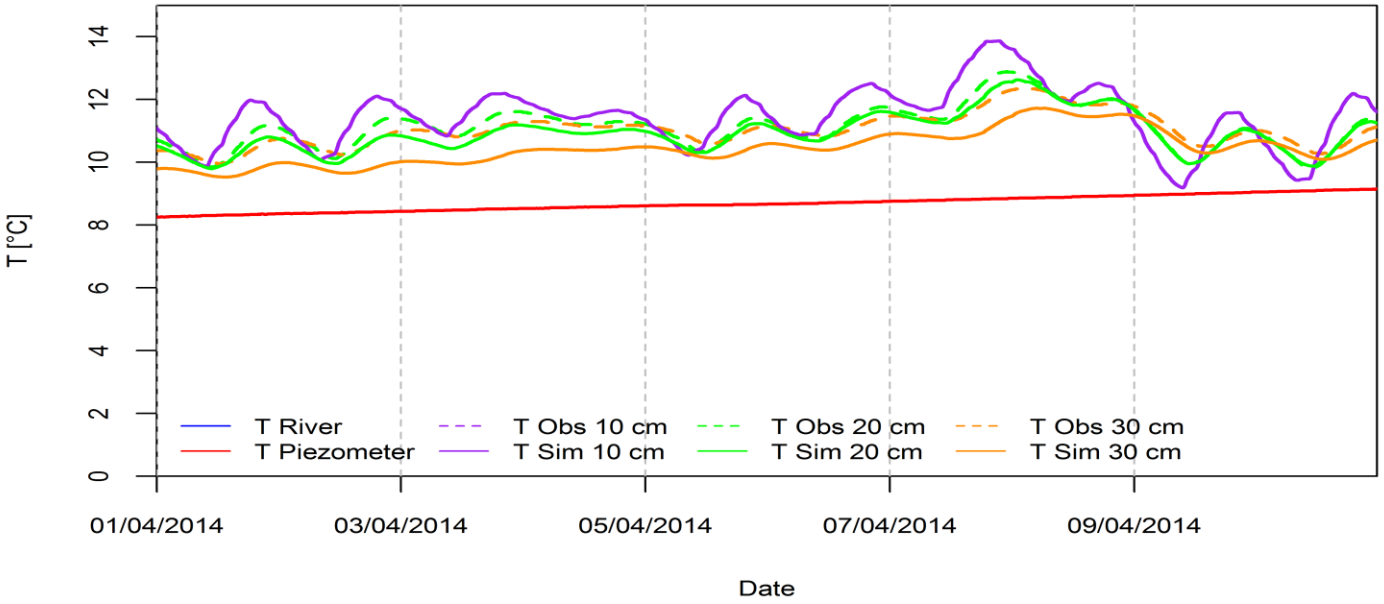
Advective flux

Total flux

Mais les paramètres définis à l'échelle du bassin n'expliquent les observables collectés localement : exemple Aval Avenelles

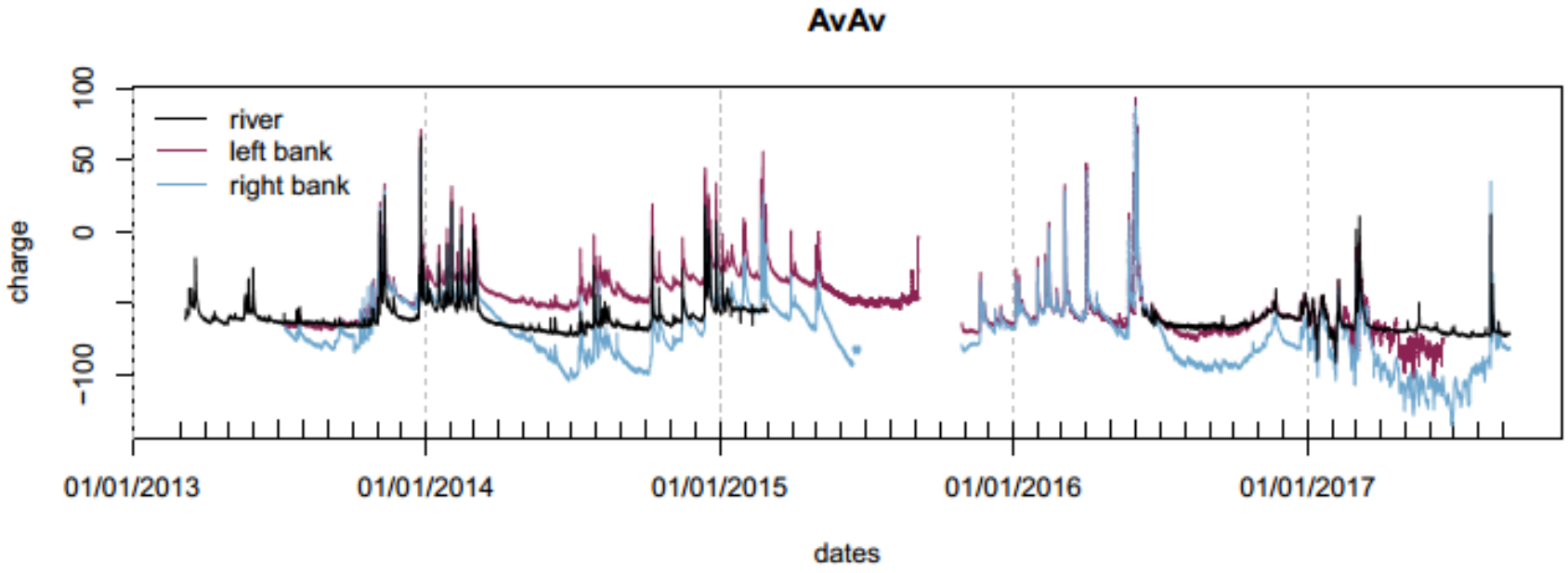






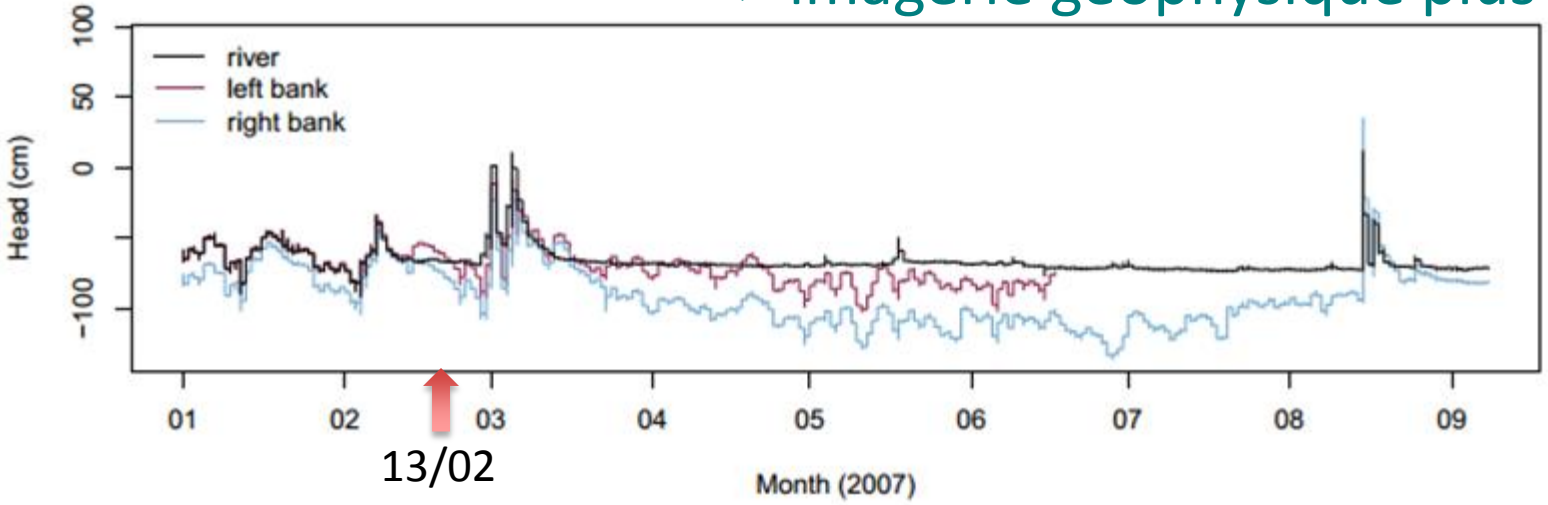
A. Berrhouma (thèse Mines ParisTech 2014-2018)

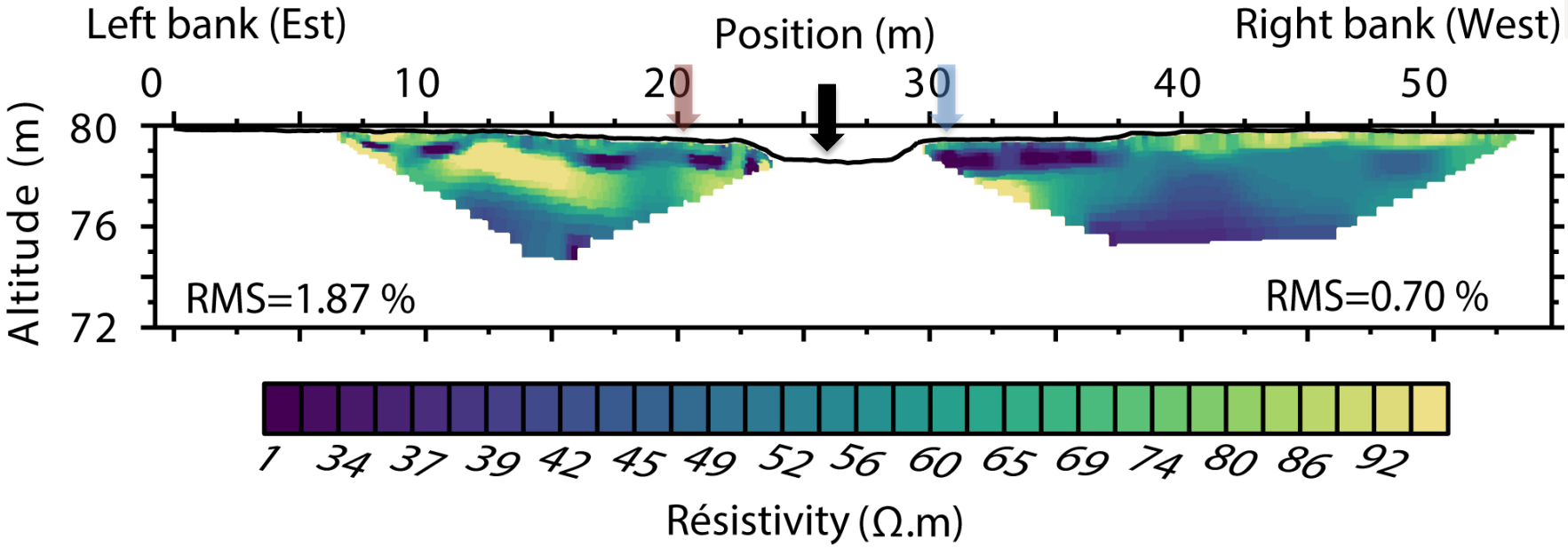
Exemple: différences entre piézométries pour une même station



La structure locale est elle bien définie?

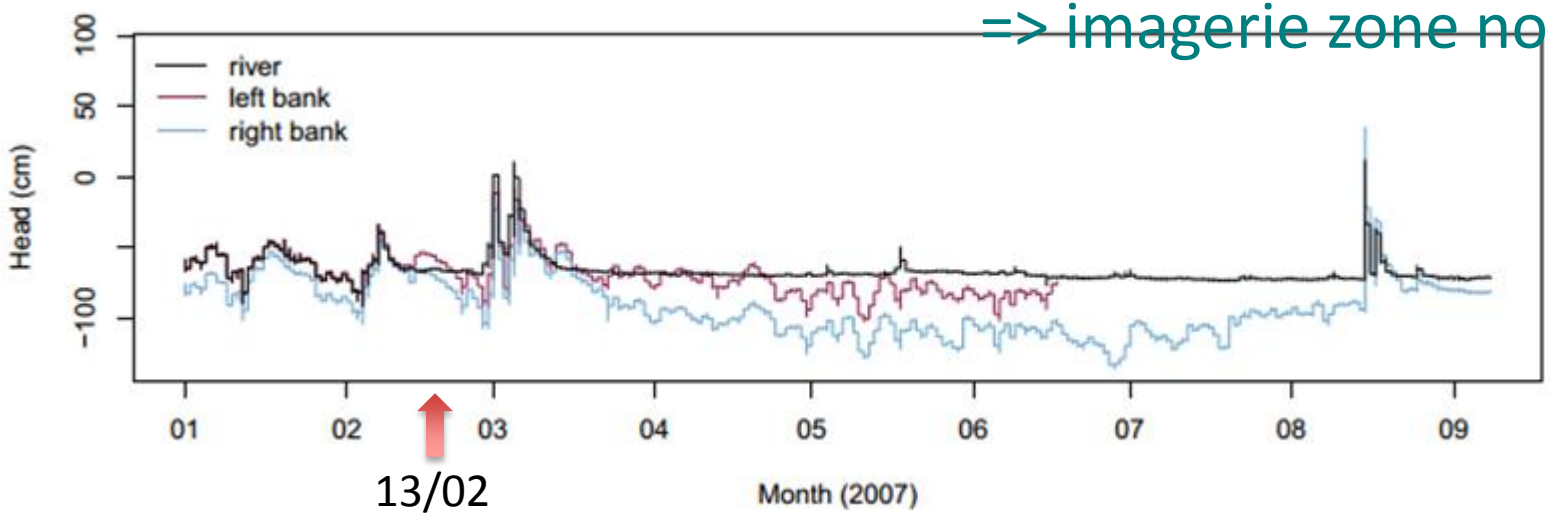
Hétérogénéités spatiales du modèle local
=> imagerie géophysique plus détaillée

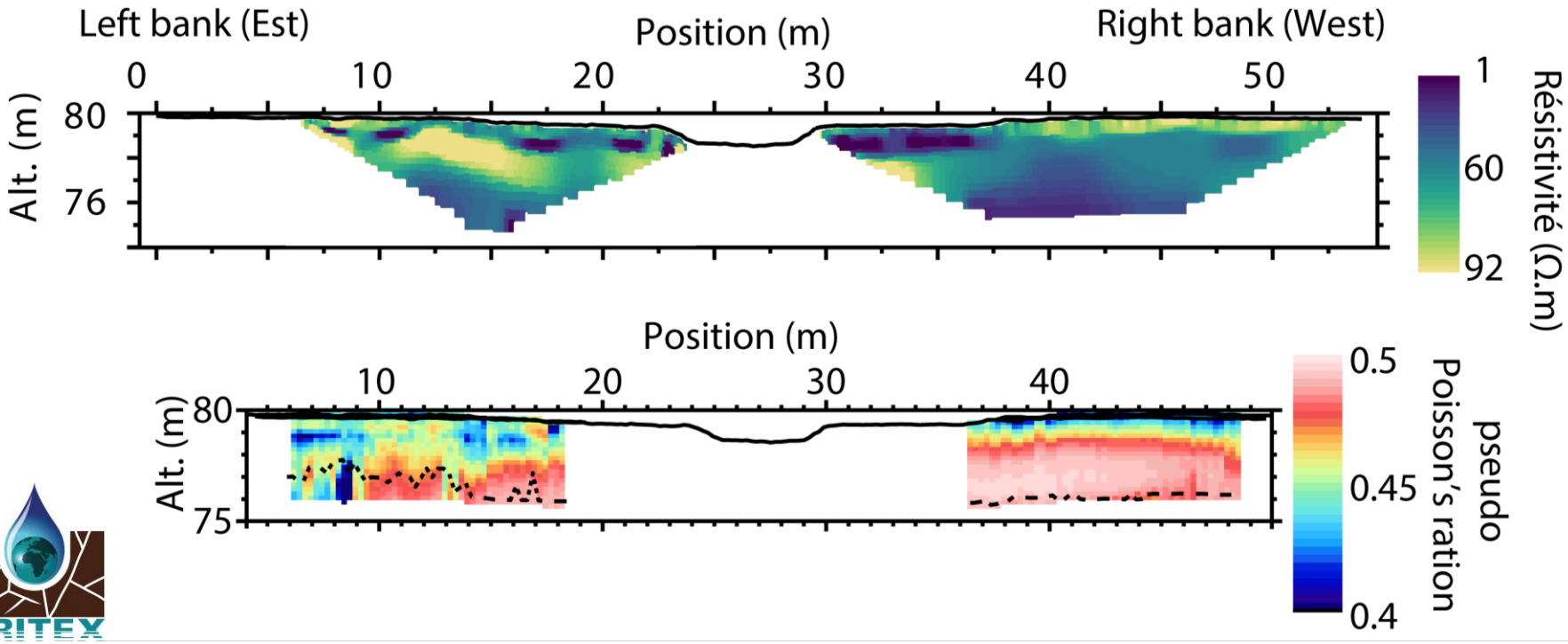




S. Schneider (M2 Rennes 2017)

Hétérogénéités spatiales du modèle local
=> imagerie zone non saturée





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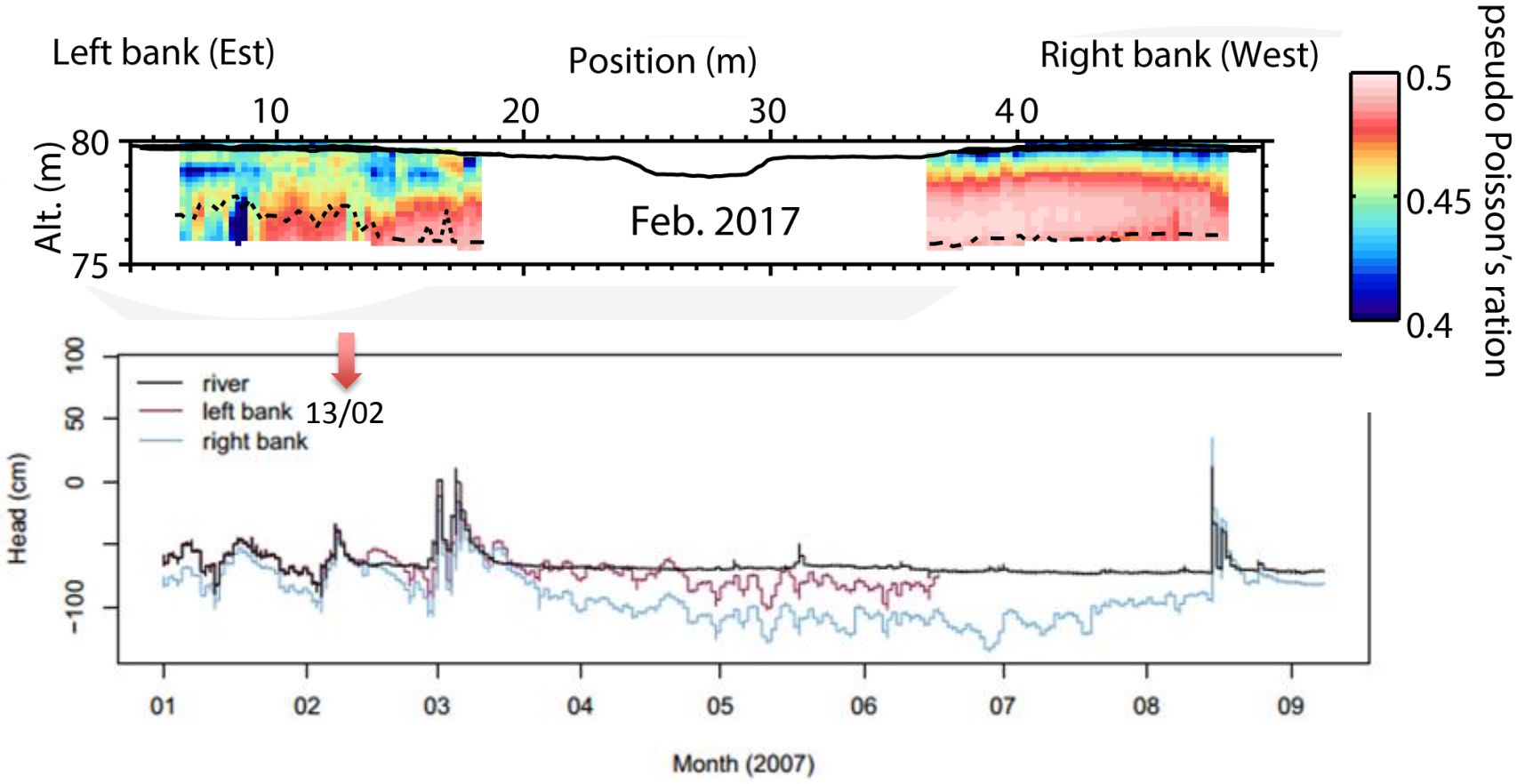
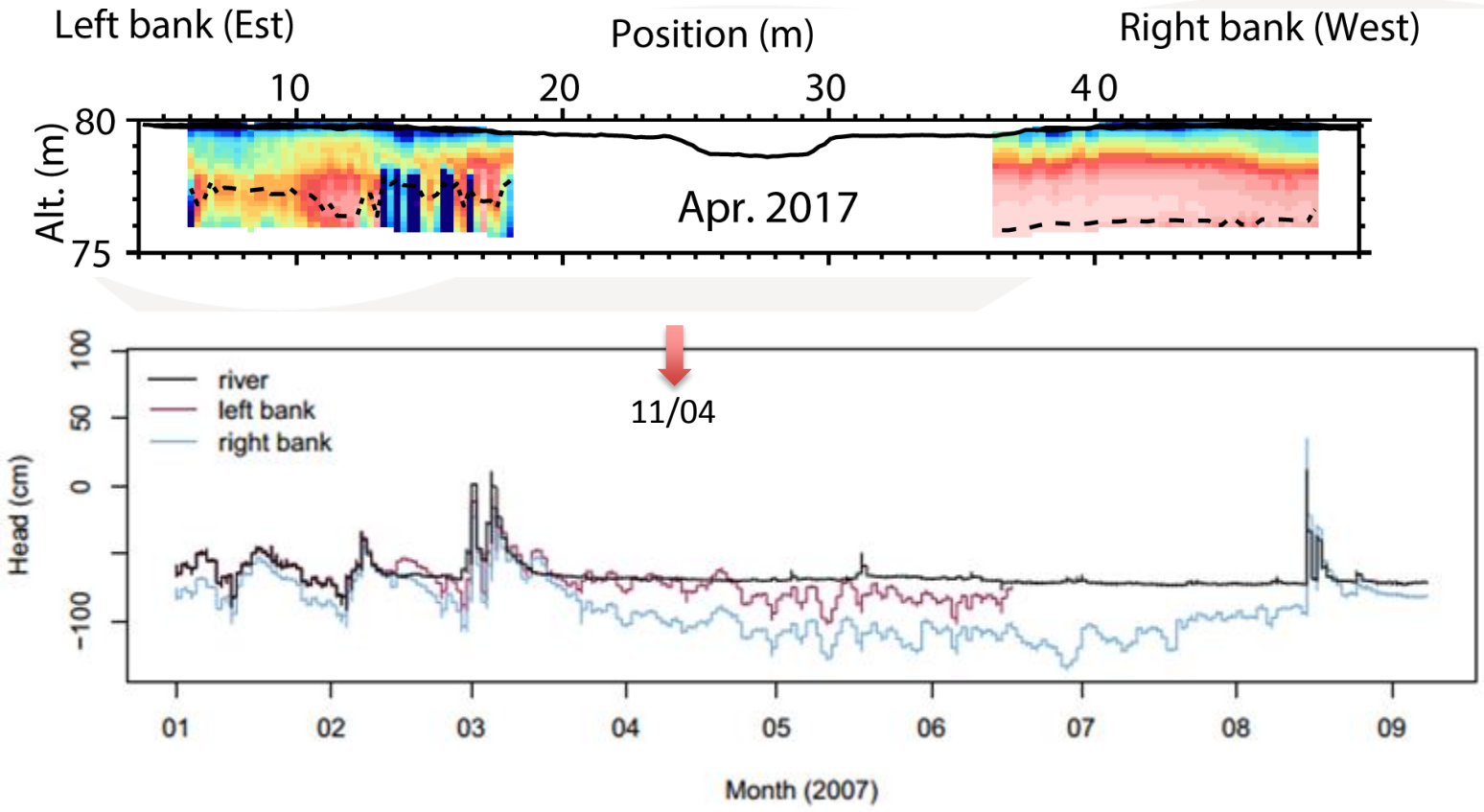
Variation spatiales et temporels du modèle local
=> héterogéneités + zone non saturée + « time-lapse »



M. Dangeard (thèse UPMC 2015-2018)

Variation spatiales et temporels du modèle local
=> héterogéneités + zone non saturée + « time-lapse »



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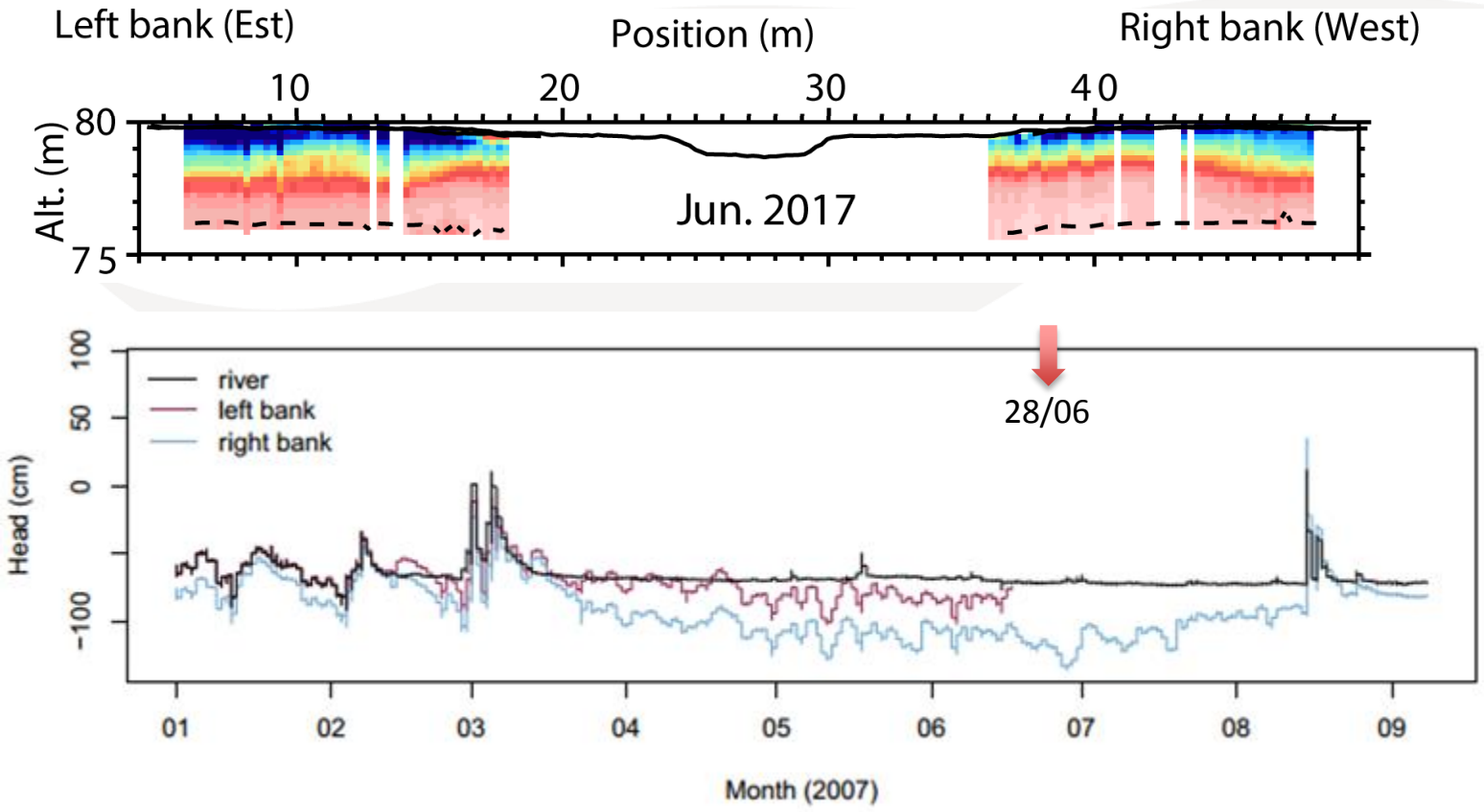

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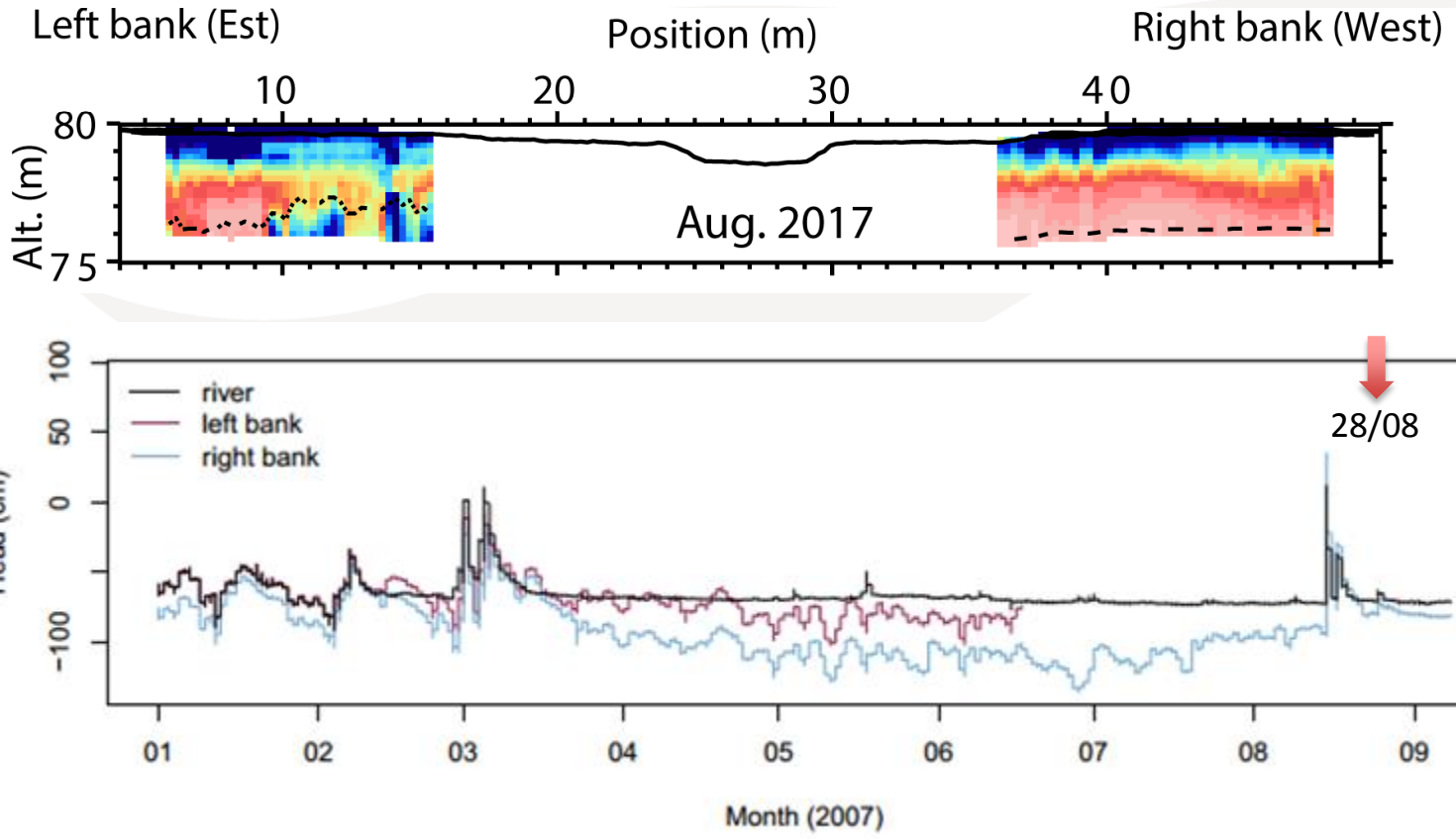
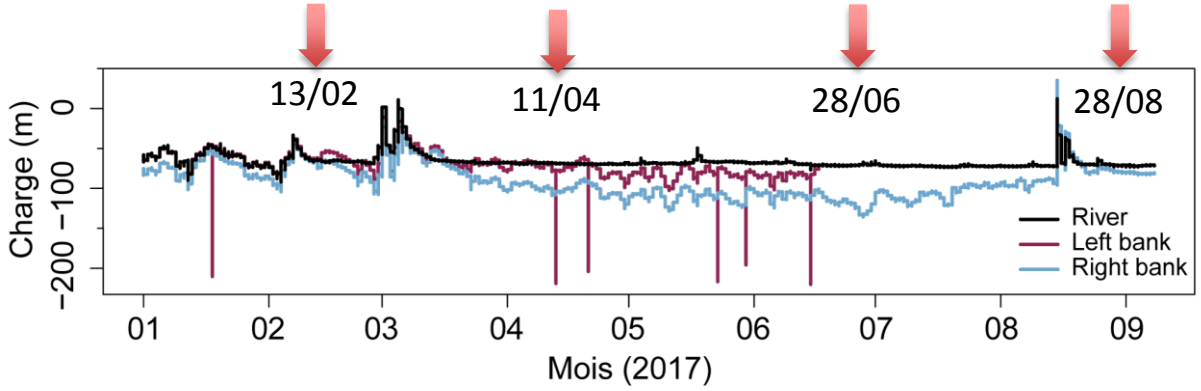
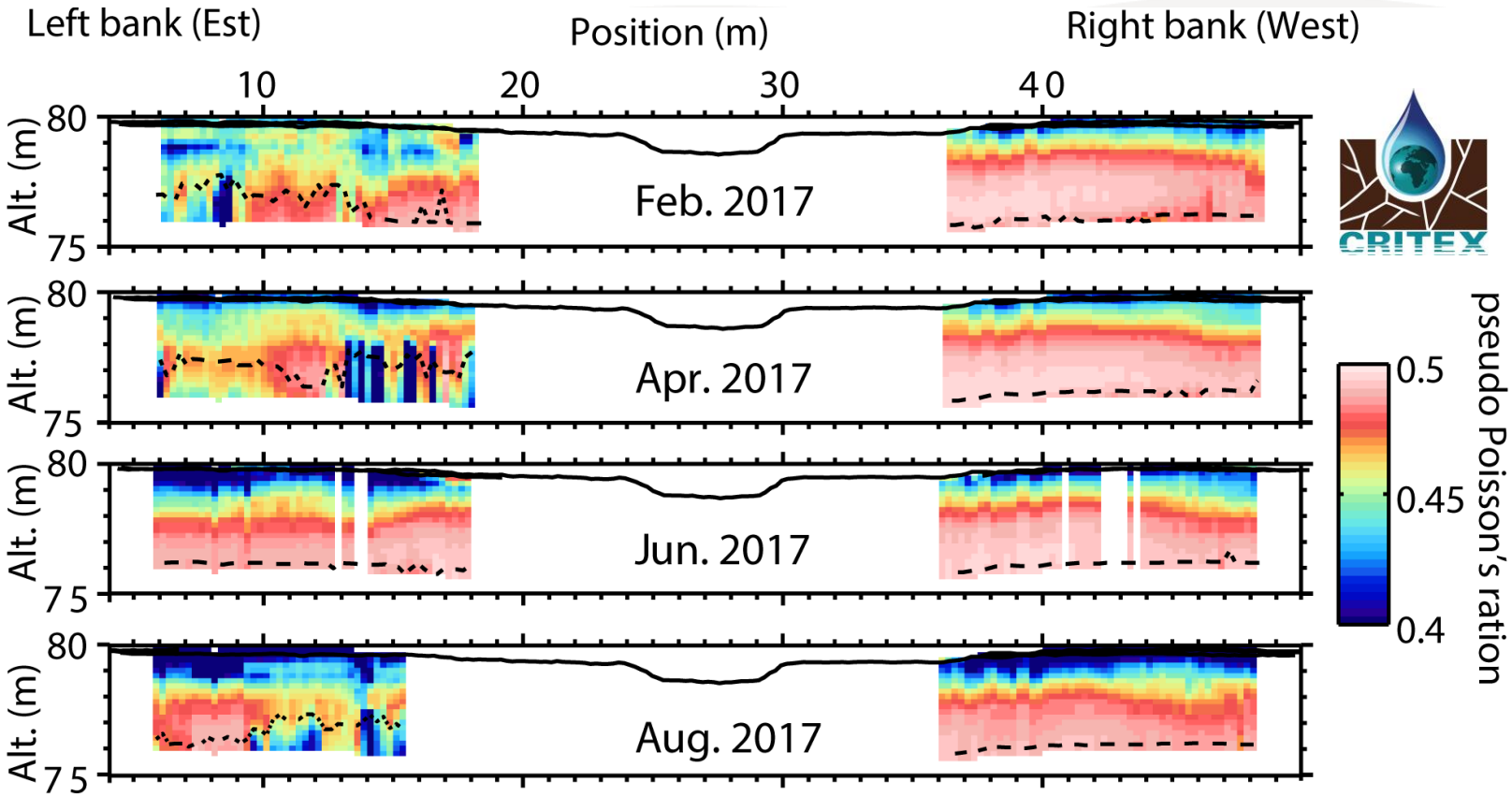


M. Dangeard (thèse UPMC 2015-2018)

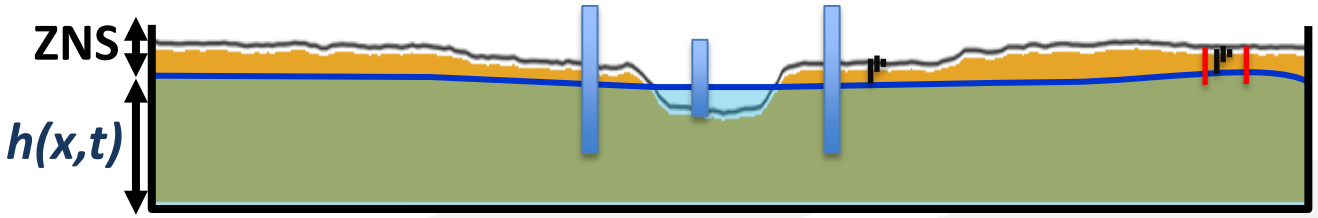
Hétérogénéités spatiales et temporelles





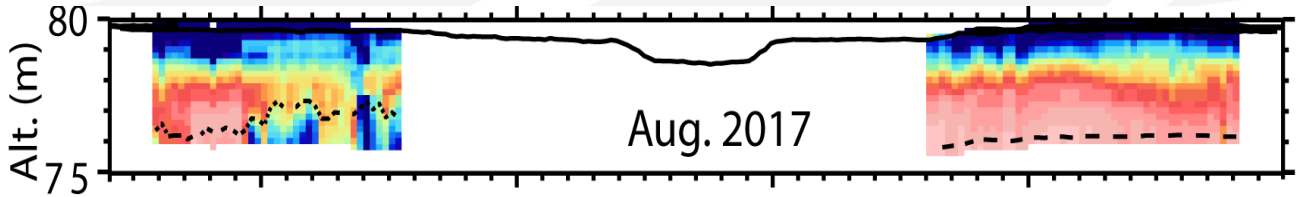
M. Dangeard (thèse UPMC 2015-2018)

Approche « time-lapse », multi-mesures + zone non saturée => conditions aux limites et paramètres locaux pour le modèle hydrodynamique

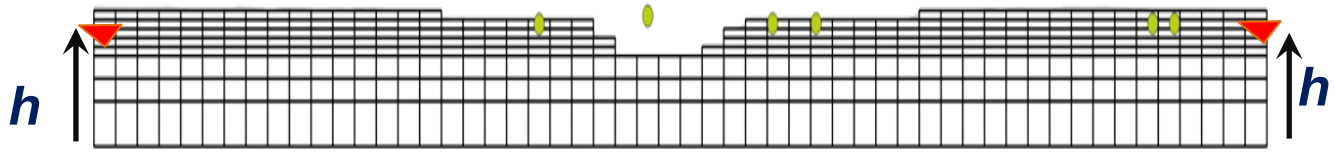


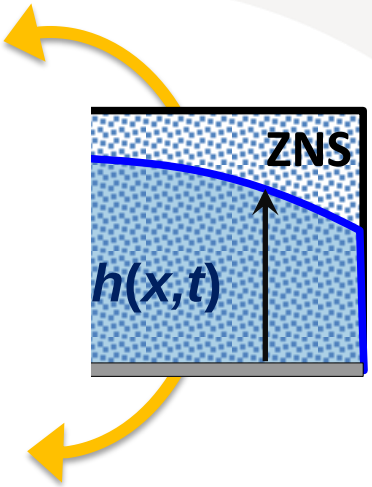
MOLONARI,
Sondes Tres
Tensiomètres
ERT

Time-lapse Sismique

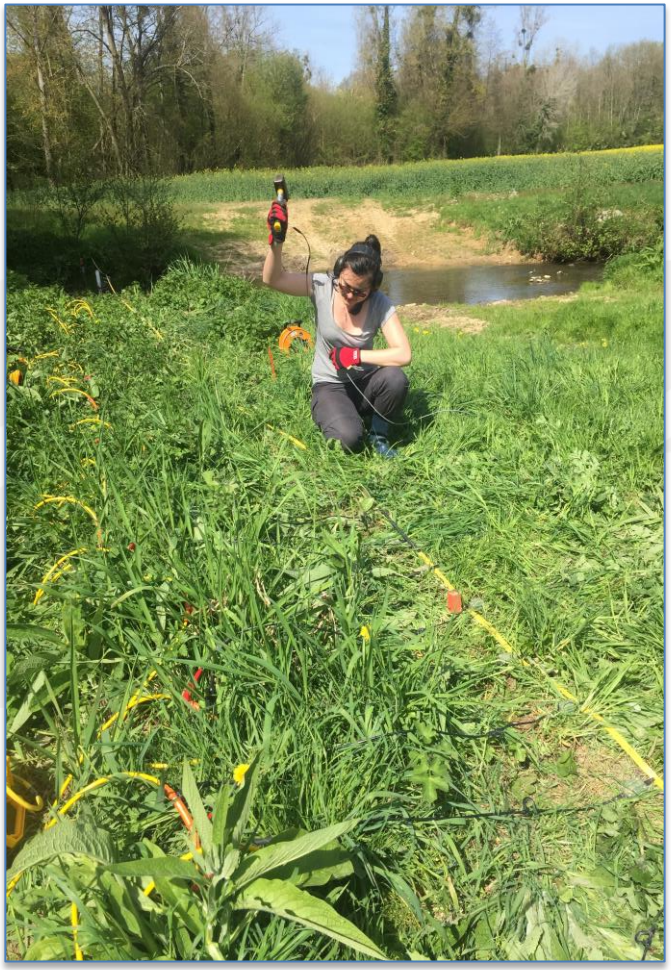


Modèle écoulement à saturation variable





Merci de votre attention



PiREN Seine

> on a much larger scale ?
(& time-lapse)

> on a much smaller scale ?
(& time-lapse)

PiREN Seine

ask Fayçal !