Predicting the flow in the floodplains with evolving land occupations during extreme flood events

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FLOWRES PROJECT (2015 - 2018)

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Context

+ Increasing human settlements over the floodplains
+ Climate change: impact on the return period *T* of extreme floods (*e.g.* Hirabayashi *et al.*, 2013)
+ European Flood Directive: assessing the **flow depths** and **velocities** for extreme event scenarios (*T* > 1000-year)
+ Protection of nuclear installations against flooding events with *T* = 10000-year, cf. report n°3 of ASN (2013)
+ **No field data** for such periods *T* to validate the models
+ Still largely unexplored physical processes for such *T*

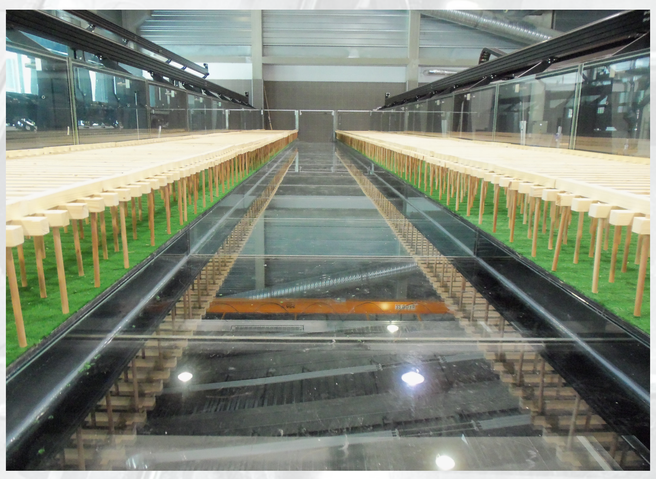
Ochlockonee River, 1975. Picture taken by J.C. Rosenau

Objective

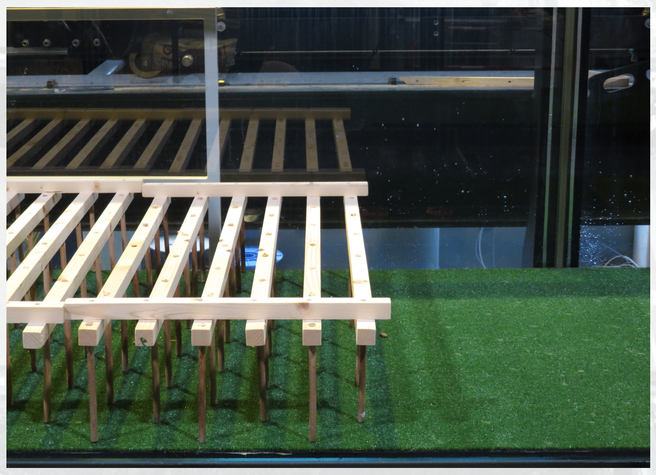
To improve the flood hazard assessment (flow depths and velocities) in floodplains by:

1) investigating in laboratory flumes the hydrodynamic processes associated with extreme flood flows for **various flow rate magnitudes** (*T* ranging from 100 to 10000-year) and **various land occupations**, and notably, the FLOW RESistance in the presence of **meadows**, **trees**, and **houses** (called "roughnesses")

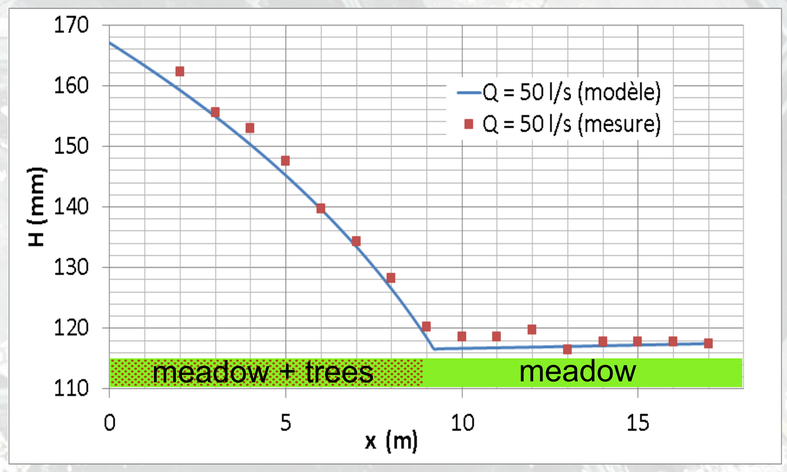
2) assessing if the existing modeling practices that are used for *T* ~ 100-year are still valid to predict the floodplain flow for *T* > 1000-year



Flume at Irstea-Lyon (18m x 3m), floodplains covered by dense meadow and trees (PhD of V. Dupuis)



Longitudinal roughness transition "trees + meadow (9m) / meadow (9m)"



Flow depth H versus downstream distance x. Transition "trees + meadow / meadow". 1D model against measurements

Methodology

1) **Experimental investigation** into the effects of longitudinal and lateral transitions in roughness, of vertical transition from emergence to low submergence of the roughness elements, of interspersed families of roughness elements

2) **Comparison experimental data / numerical modelling (1D to 3D)**. The classical methodologies to model flow resistance will be evaluated and improved to better capture the physics irrespective of the return period *T*

3) **The codes and methods will be applied to the floods at Besançon**. Events with *T* = 100, 1000 and 10000-year will be simulated with both classical and improved methods, and uncertainties on flow depths and velocities will be estimated.

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