# Feedback from reservoir sedimentation
## on the flow pattern in rectangular reservoirs


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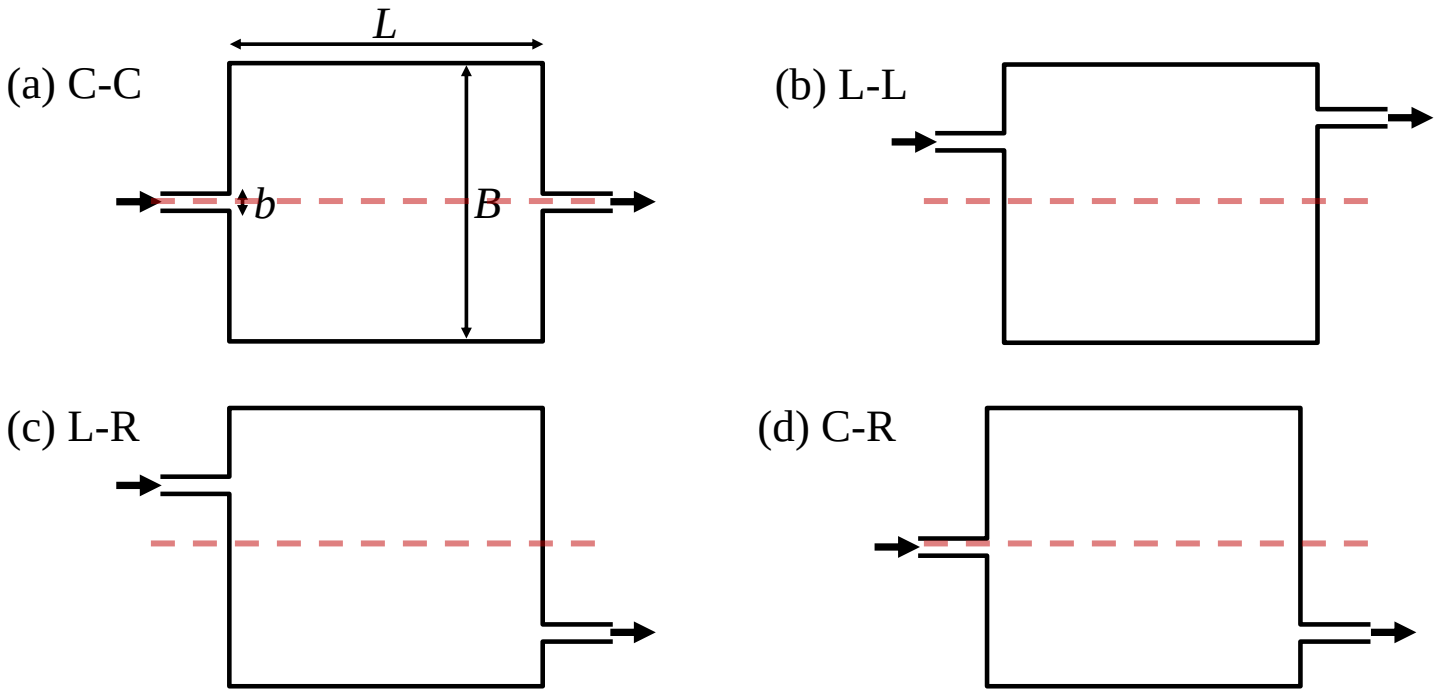
# How does the location of inlet and outlet channels affect flow and sedimentation in rectangular reservoirs?



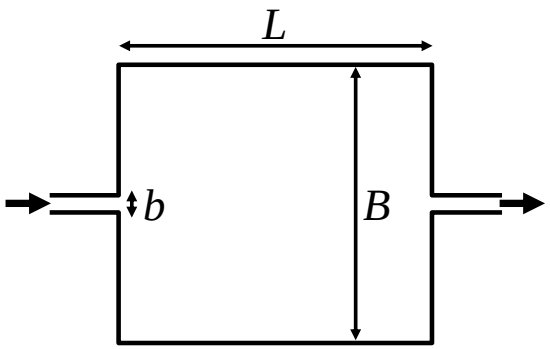

Influence on …

- the velocity field?
- the trapping efficiency?
- the location of deposits?

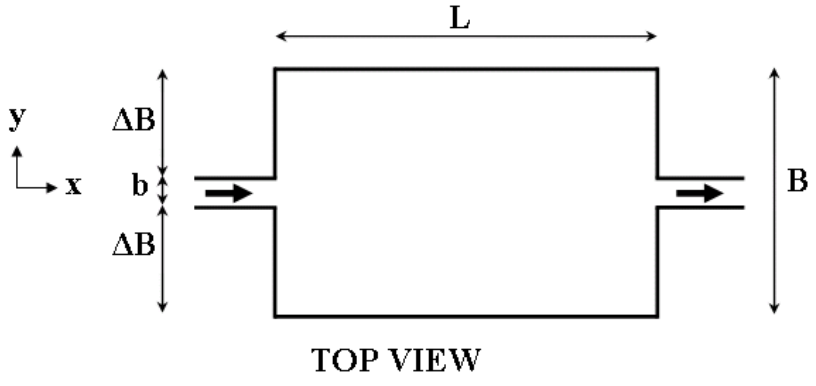
# Does it matter?
# It does, at least from two different perspectives

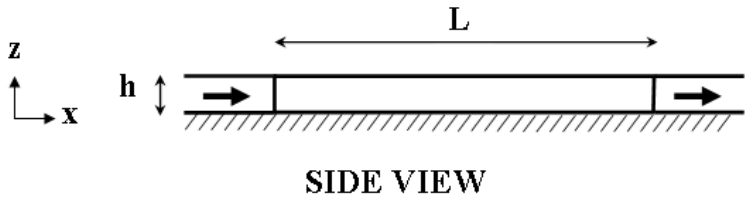
Rectangular shallow reservoirs are

- **idealized** configurations, providing a better insight into individual processes
- **common** structures in hydraulic engineering and urban drainage



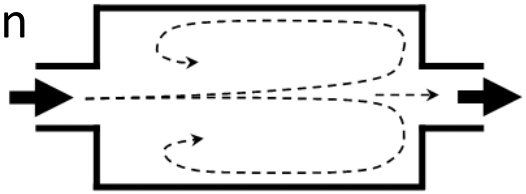
# Despite the simple geometry, complex flow fields develop and strongly affect sediment transport and deposition



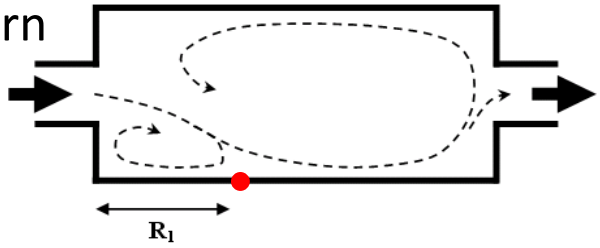

”Short” reservoirs

S0 pattern



Intermediate length

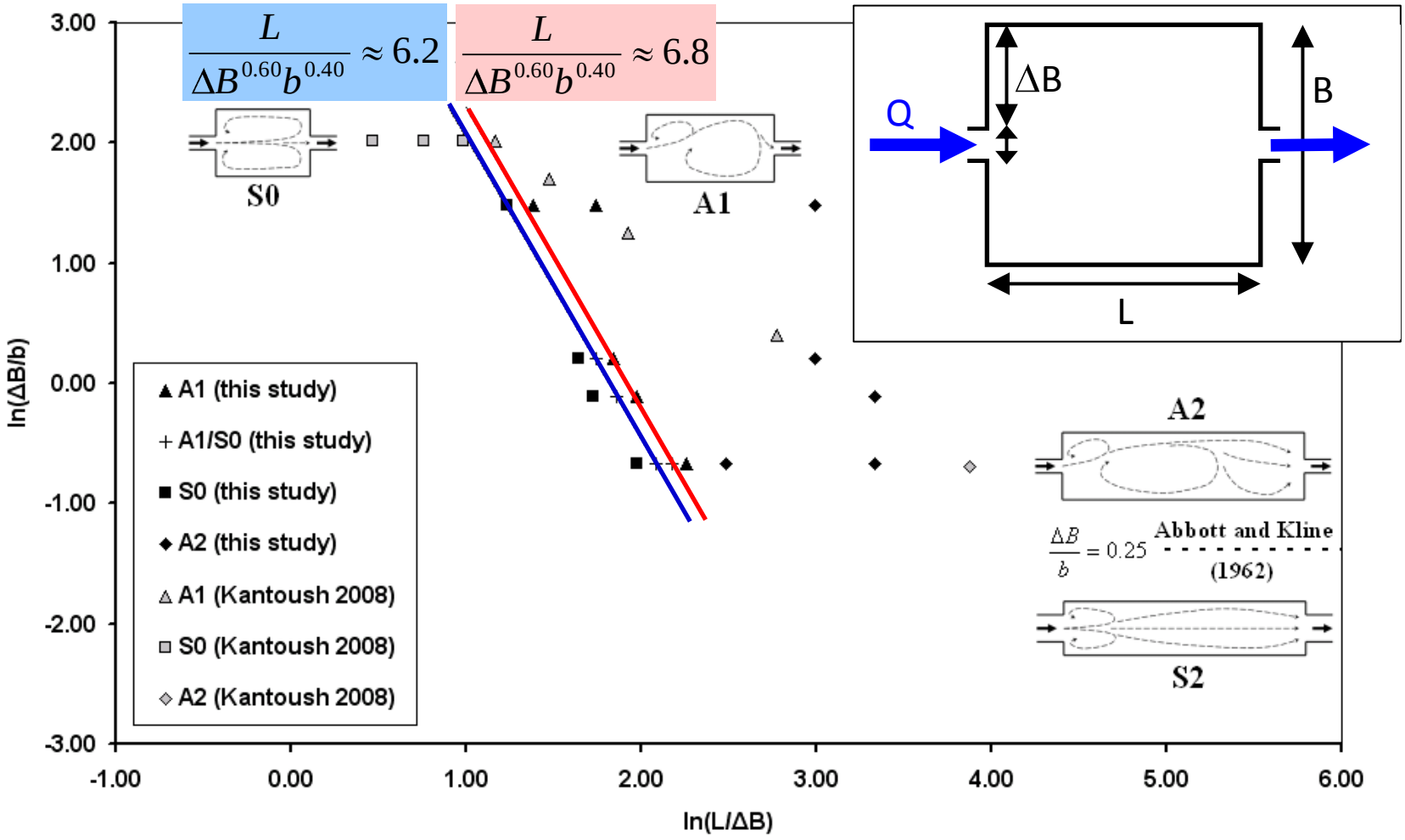
A1 pattern




”Long” reservoirs A2 pattern


Dewals et al. (2008) in *Environmental Fluid Mechanics*

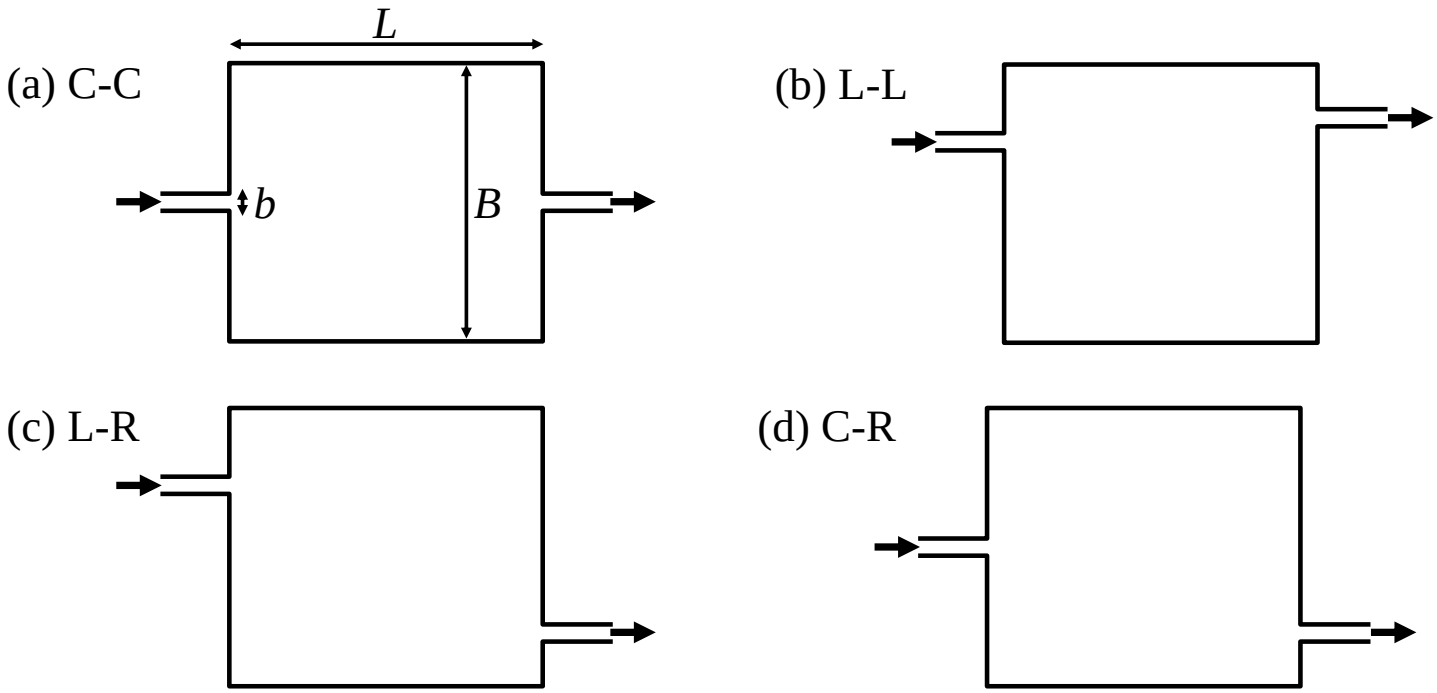
# The typology of flow patterns developing as a function of the reservoir geometry highlights **bi-stable** flow fields




Dufresne, M, Dewals, B, Erpicum, S, Archambeau, P, & Pirotton, M. (2010). Classification of flow patterns in rectangular shallow reservoirs. *Journal of Hydraulic Research*, 48(2), 197-204.

# How does the location of inlet and outlet channels affect flow and sedimentation in rectangular reservoirs?

Length $L$ = 4.5 m
Width $B$ = 4 m
Depth = 0.2 m
Discharge = 7 l/s




Influence on …

- the velocity field?
- the trapping efficiency?
- the location of deposits?

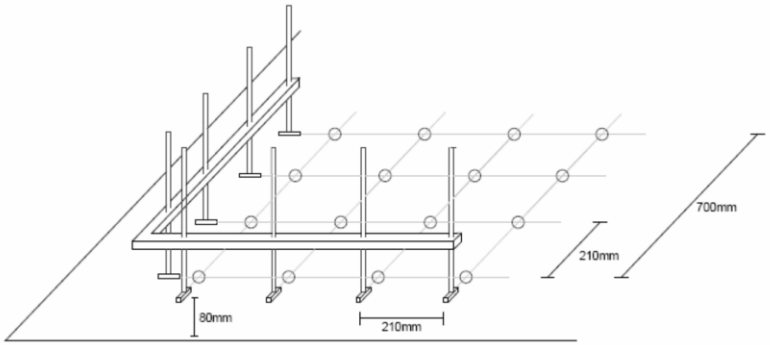
Measure velocity field

Measure deposits thickness

+ numerical simulations

# Flow velocity was measured throughout the reservoir

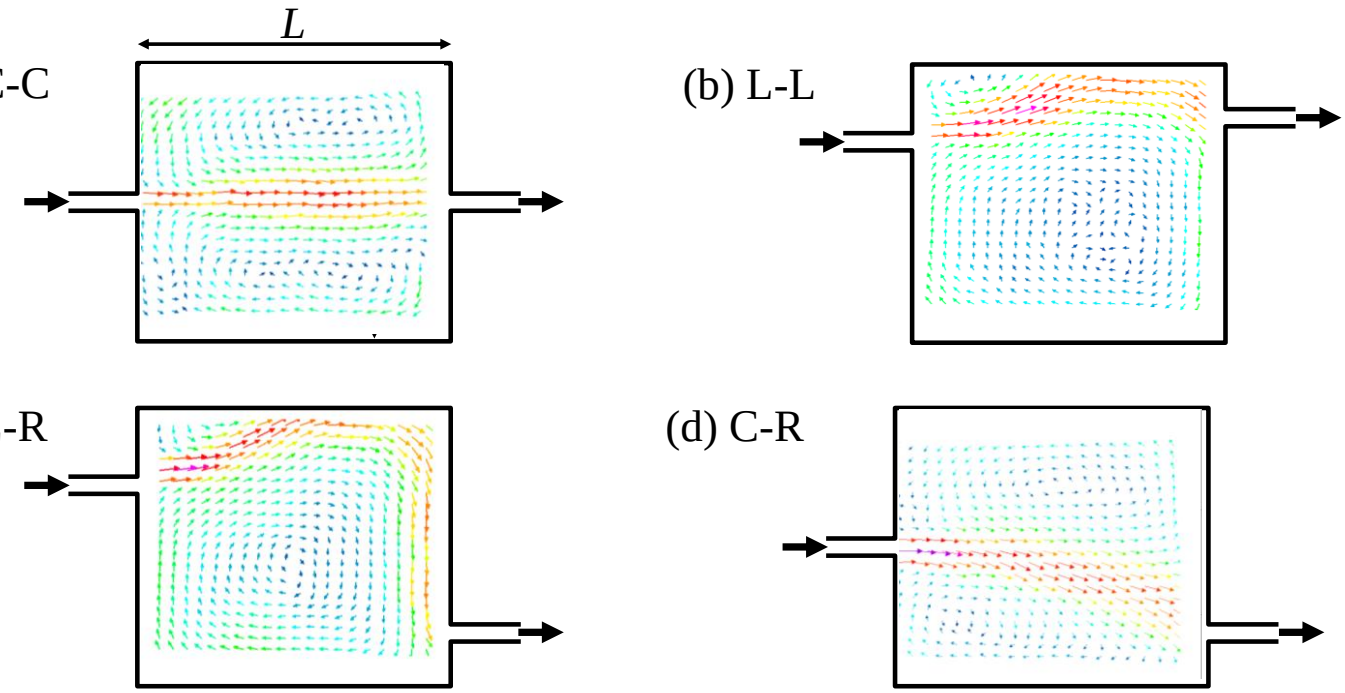
Square grid formed by eight UVP transducers




$V_{nd} = V / V_{res}$

16
13
10
7
4
1

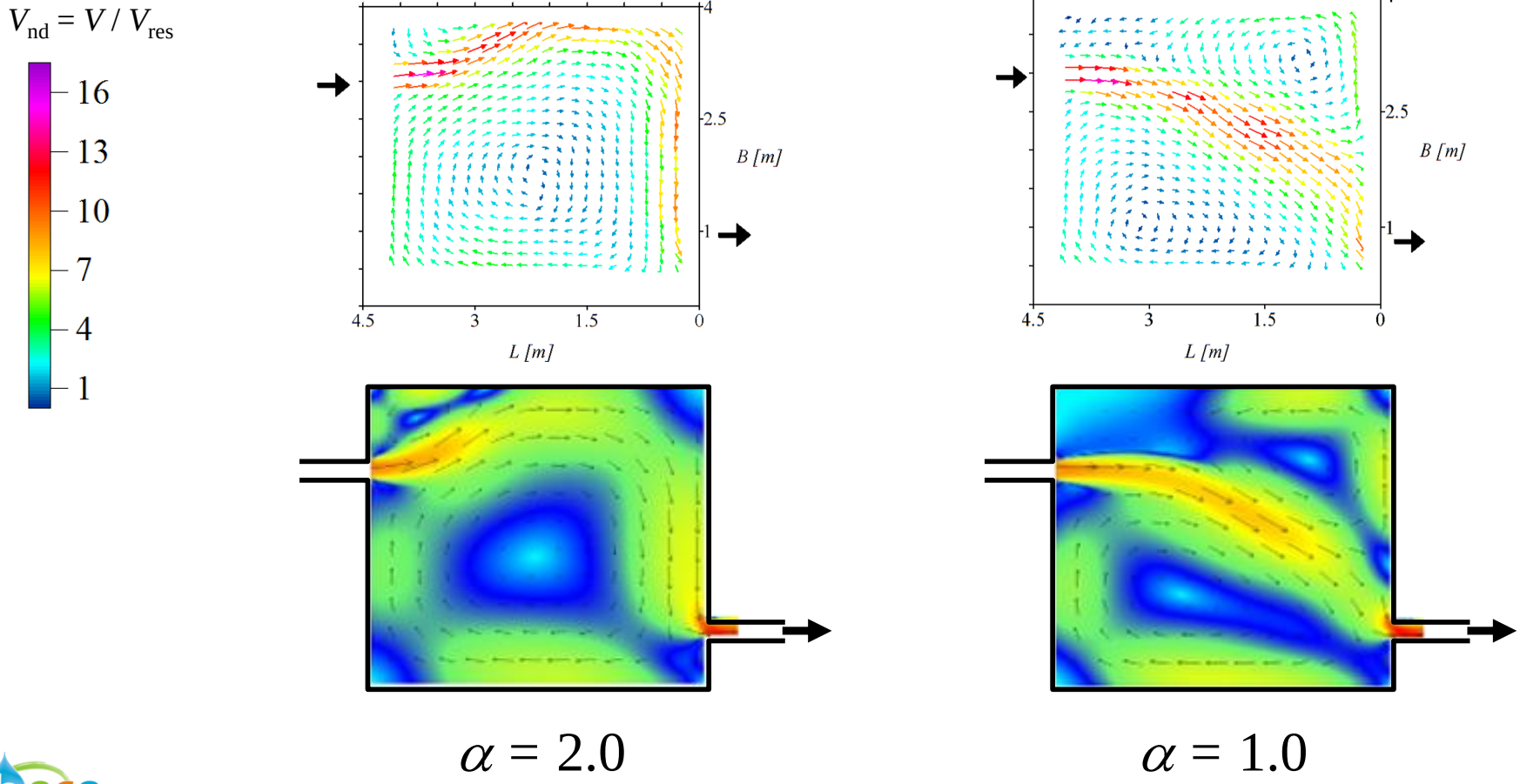
$V$ = velocity
$V_{res}$ = plug flow velocity



# A simple turbulence closure was first tested: algebraic model based on Elder formula ($\nu_t = \alpha\, h\, u_*$)

Without sediments

With sediments

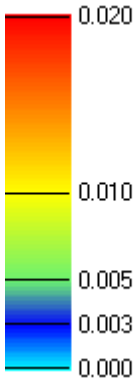



$\alpha = 2.0$

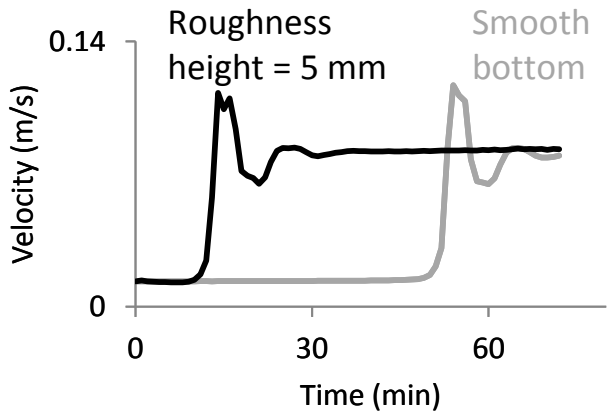
$\alpha = 1.0$

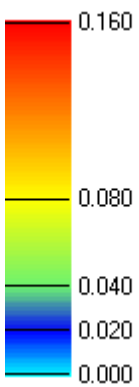
# As bottom topography varies according to measurements, the computed velocity profile changes after 30 to 60 min

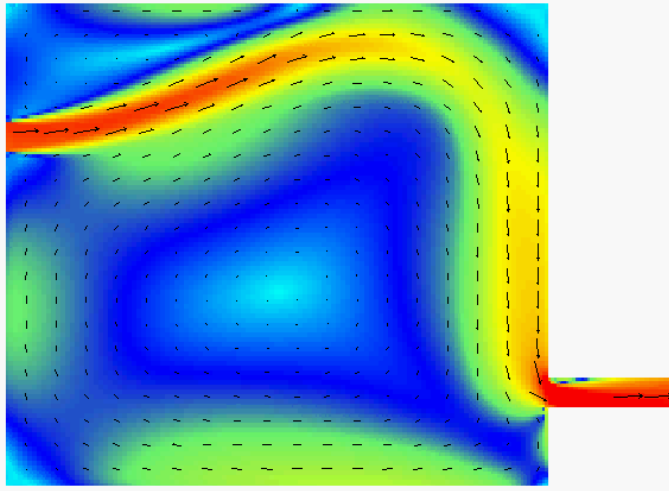
**Forced** evolution of the bottom topography [m]
(based on measurements)




**Simulated** velocity field [m/s]



# Conclusions

Four configurations of inlet and outlet channels locations (on opposite sides of the reservoir) have been tested

**Trapping efficiency does not vary significantly** (≈10%)

In one geometric configuration, a **change in the stable flow field** was observed when sediments were supplied

**Numerical simulations** based on a two length-scale depth-averaged $k$-$\varepsilon$ model **simulate accurately** the measured velocity fields

They reproduce the change of flow pattern as a result of

- sediment deposits
- and increased bottom roughness