XII JORNADA DE JÓVENES INVESTIGADORES DEL I3A

Two-layer model for the numerical simulation of oil spills over coastal flows

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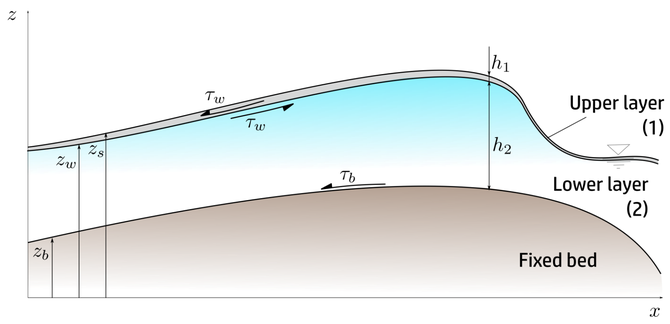
INTRODUCTION

1D model is implemented for the resolution of unsteady oil spills in coastal flows solving both layers (oil and water) coupled by means of the interface friction stress.



METHODOLOGY

- Assumption of a very thin oil slick.
- Finite volume discretization of the unsteady hyperbolic system.
- Stable and conservative numerical scheme focused on wet-dry treatment.
- Upwind treatment of the source terms

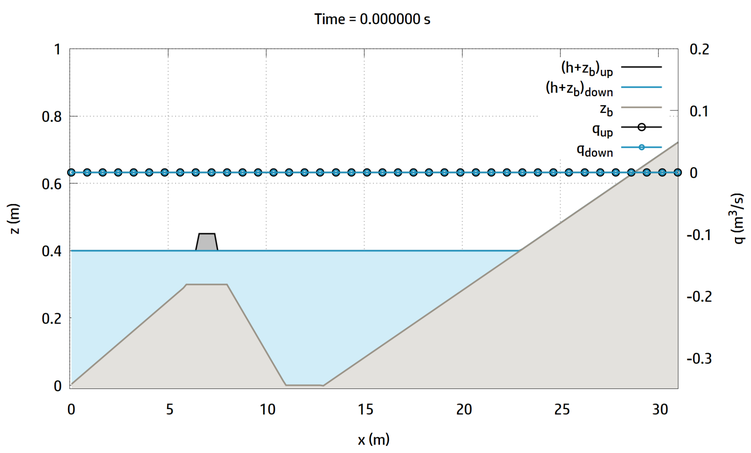
$$\left.\begin{aligned}\frac{\partial h_1}{\partial t}+\frac{\partial (h_1u_1)}{\partial x}=0\\ \frac{\partial (h_1u_1)}{\partial t}+\frac{\partial}{\partial x}\left(h_1{u_1}^2+\frac{1}{2}g{h_1}^2\right)=-gh_1\frac{\partial z_{w1}}{\partial x}-\frac{\tau_w}{\rho_1}\end{aligned}\right\}\ \text{UPPER LAYER}$$

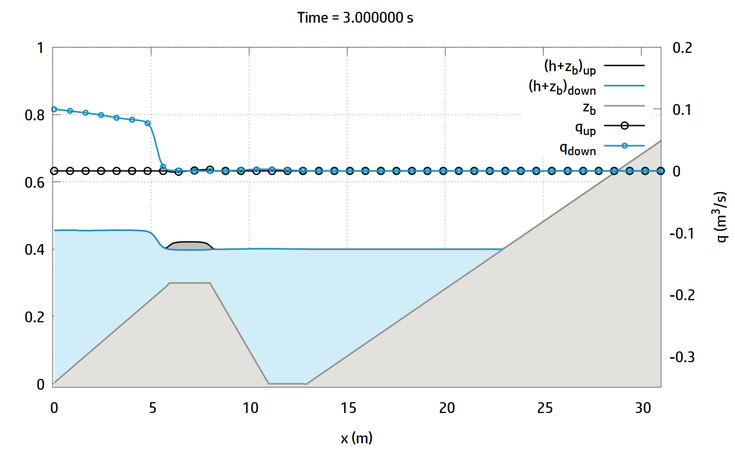
$$\left.\begin{aligned}\frac{\partial h_2}{\partial t}+\frac{\partial (h_2u_2)}{\partial x}=0\\ \frac{\partial (h_2u_2)}{\partial t}+\frac{\partial}{\partial x}\left(h_2{u_2}^2+\frac{1}{2}g{h_2}^2\right)=-gh_2\frac{\partial z_{b2}}{\partial x}+\frac{\tau_b}{\rho_2}+\frac{\tau_w}{\rho_2}\end{aligned}\right\}\ \text{LOWER LAYER}$$

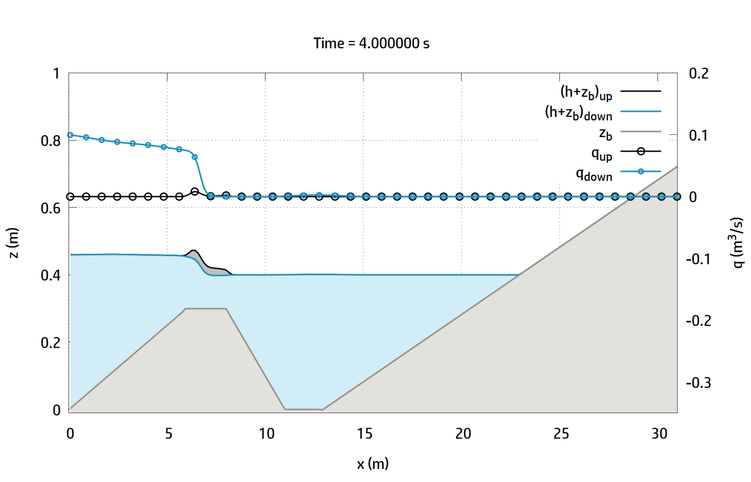
MODEL APPLICATION

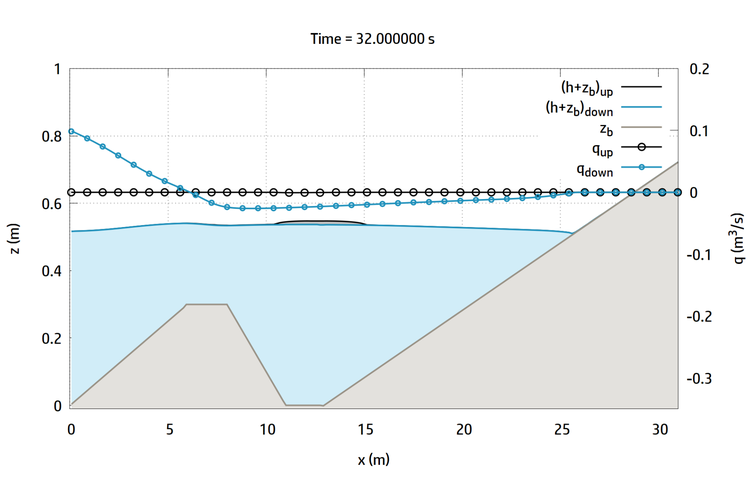
Local oil spill near the coast
Lake-at-rest initial condition in water and inlet boundary condition: Q_{in}=0.1 m^3/s
Oil is transported towards the shore line
Wet-dry treatment controlled for all cases:

- Upper layer over lower layer
- Lower layer over bottom
- Upper layer over bottom









CONCLUSIONS

Promising results for the simulation of 1D thin oil spills propagating over coastal flow with an explicit 1st order upwind numerical scheme.

FUTURE WORK

- Non-hydrostatic pressure in the water layer
- Extension to 2D realistic models

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