XI JORNADA DE JÓVENES INVESTIGADORES DEL I3A

Finite Volume Non-Hydrostatic Pressure (NHP) Model for the Simulation of Landslides

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INTRODUCTION

A Finite Volume (FV) numerical scheme previously designed for the hydrostatic Shallow Water Equations (SWE) [1] is extended to compute dispersive waves characterized by non-hydrostatic pressure (NHP) [2,3]. These waves are usually generated by landslides.

MATHEMATICAL MODEL

- Mass and momentum conservation equations (SWE).
- NHP terms.
- Clossure relation in terms of continuity equation.

$$\frac{\partial h}{\partial t}+\frac{\partial (hu)}{\partial x}=0 \qquad \text{SWE}$$

$$\frac{\partial (hu)}{\partial t}+\frac{\partial}{\partial x}\left(hu^2+\frac{1}{2}gh^2\right)+gh\frac{\partial z_b}{\partial x}=\underbrace{-\frac{1}{2}\left(h\frac{\partial p_{nh}}{\partial x}+p_{nh}\frac{\partial (h+2z_b)}{\partial x}\right)}_{\text{Non-hydrostatic terms}}$$

NHP

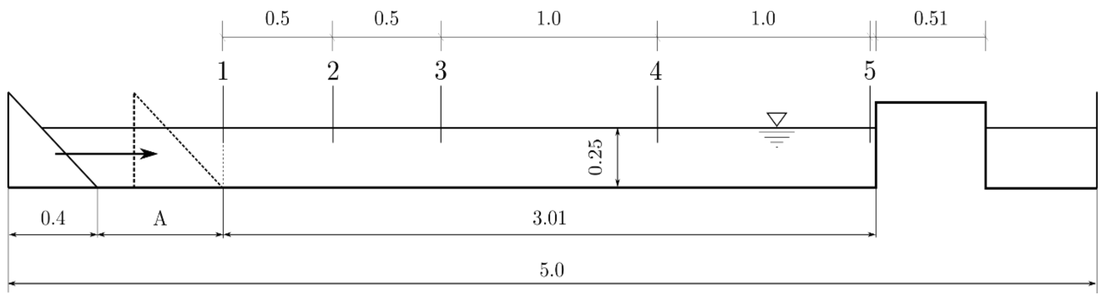
$$\frac{\partial w}{\partial t}+\frac{\partial (wu)}{\partial x}=\frac{p_{nh}}{h}$$

$$h\frac{\partial (hu)}{\partial x}+2hw+(hu)\frac{\partial}{\partial x}(h+2z_b)=0$$

CONTINUITY EQ.

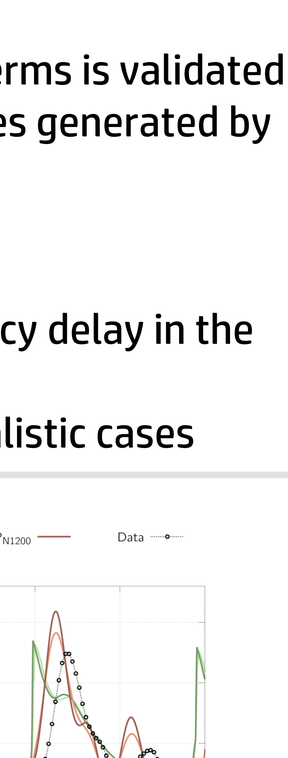
LANDSLIDE EXPERIMENTAL MODEL [4]

- Inlet: waves generated by a piston $z_b(t)=f(t)$
- Outlet: obstacle and closed boundary (q=0)
- Measurements: water depth time evolution in probes



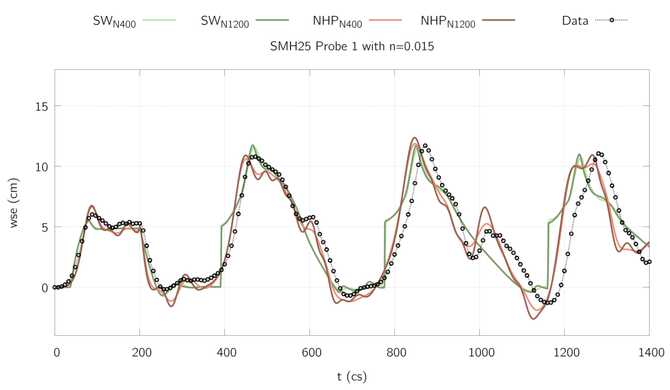
RESOLUTION

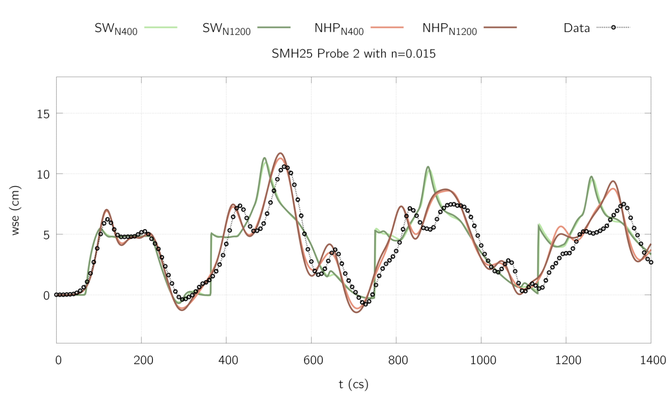
- FV scheme
- Roe-type Solver
- 1st order explicit in time and space
- Fractional step procedure for NHP.
- Iterative resolution.

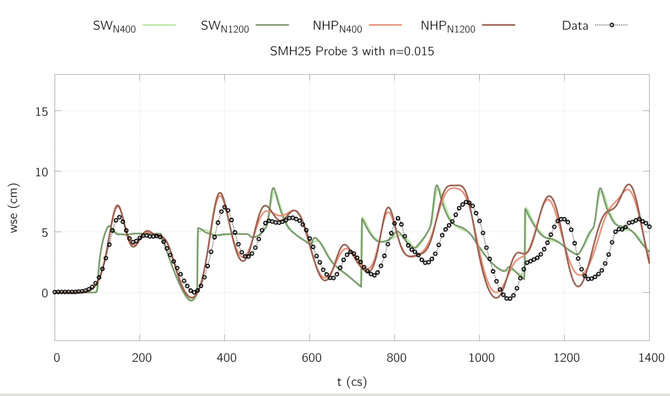


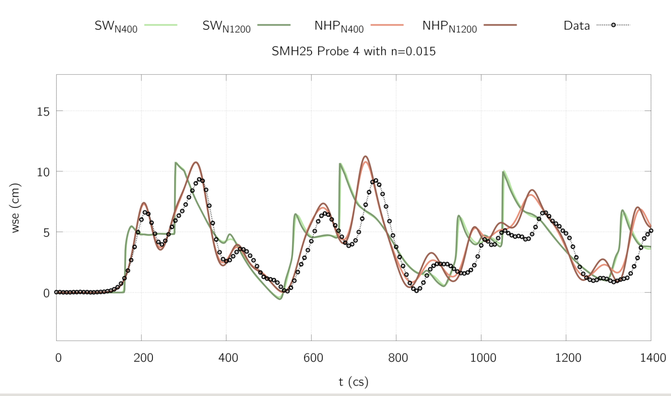
NUMERICAL RESULTS

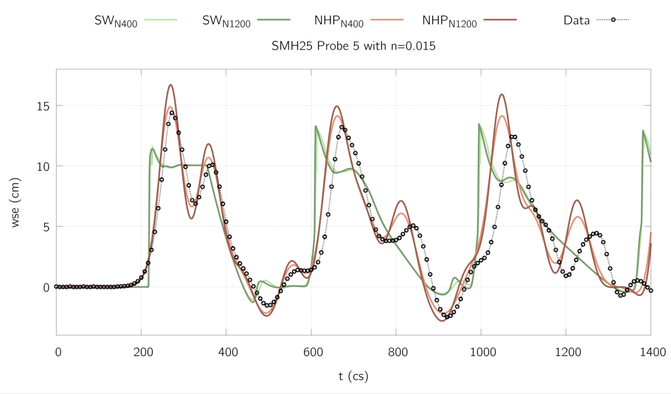
- Experimental data versus SW and SW-NHP numerical results [4].
- Mesh grid sensitivity.
- Piston vel: 29 cm/s
- Max. piston amplitude: 58 cm











CONCLUSIONS

- Promising results for the simulation of 1D dispersive waves generated by a piston movement.
- Necessity of NHP terms is validated to reproduce the waves generated by landslides.

FUTURE WORK

- Analysis of frequency delay in the obstacle impact
- Extension to 2D realistic cases

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