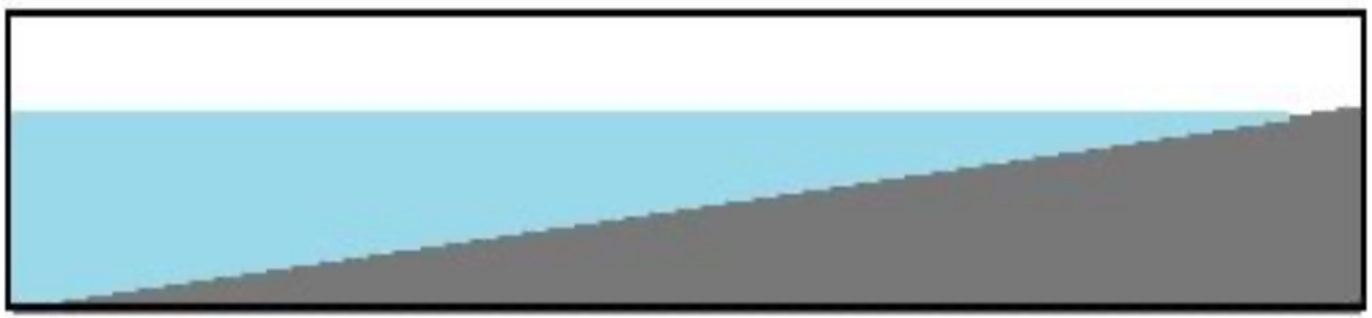
Example 1

Study of a Solitary wave run-up



Maria Maza (mazame@unican.es)

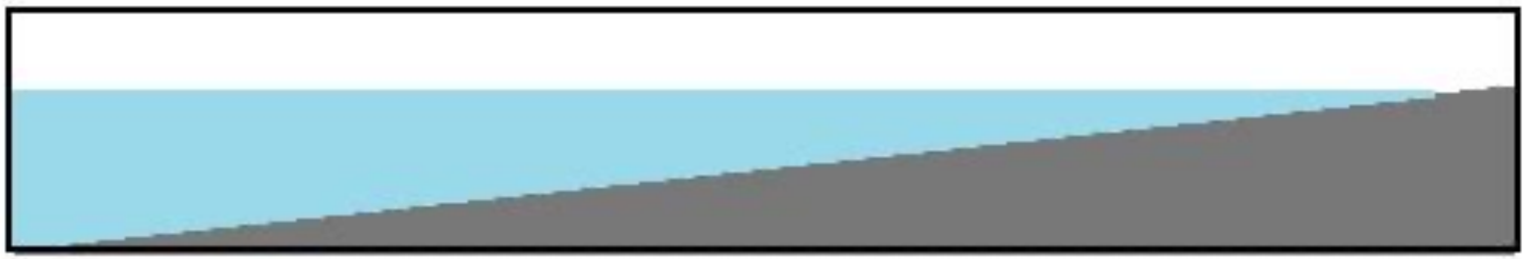
Study of a solitary wave run-up and run-down on a beach

The mechanisms of solitary wave run-up and run-down on a beach are studied.

The selected test problem is a breaking solitary wave run-up on a mild slope. The detailed laboratory setup for the breaking solitary wave study is referred to Synolakis (1986).

A uniform slope 1:0.05 constitutes the unique obstacle considered in this case.

Water depth is equal to 0.25m and a **solitary wave** with a wave height equal to **0.07m** is considered. Grimshaw theory is selected to reproduce this solitary wave.

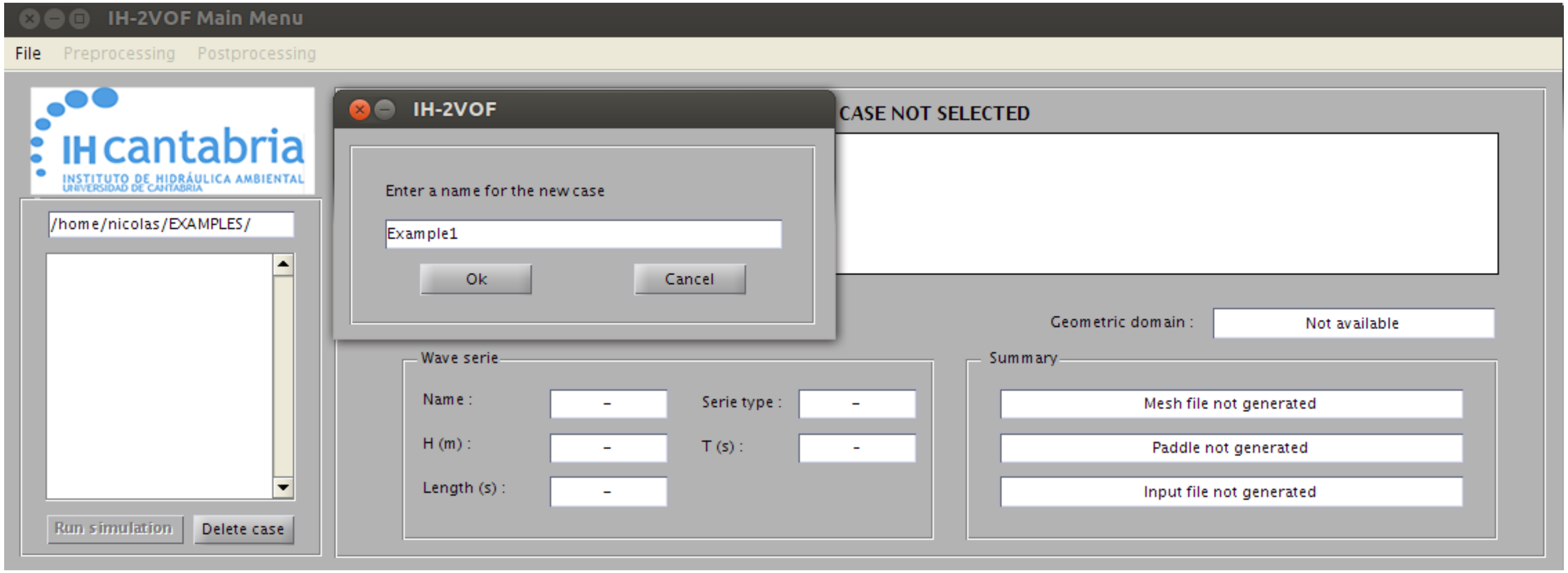


- **Objectives**: Study the run-up and run-down of a solitary wave on a beach

CREATE NEW CASE

-Select directory, Select Folder

- Create New Case



STEPS

-- PREPROCESSING--

-MESH GENERATION

-SECTION 1: “IMPORT GEOMETRY/GENERATE MESH FILE”

-SECTION 2: “GENERATE/IMPORT WAVE CONDITIONS”

-SECTION 3: “GENERATE PADDLE”

-SECTION 4: “GENERATE INPUT FILE”

-- POSTPROCESSING--

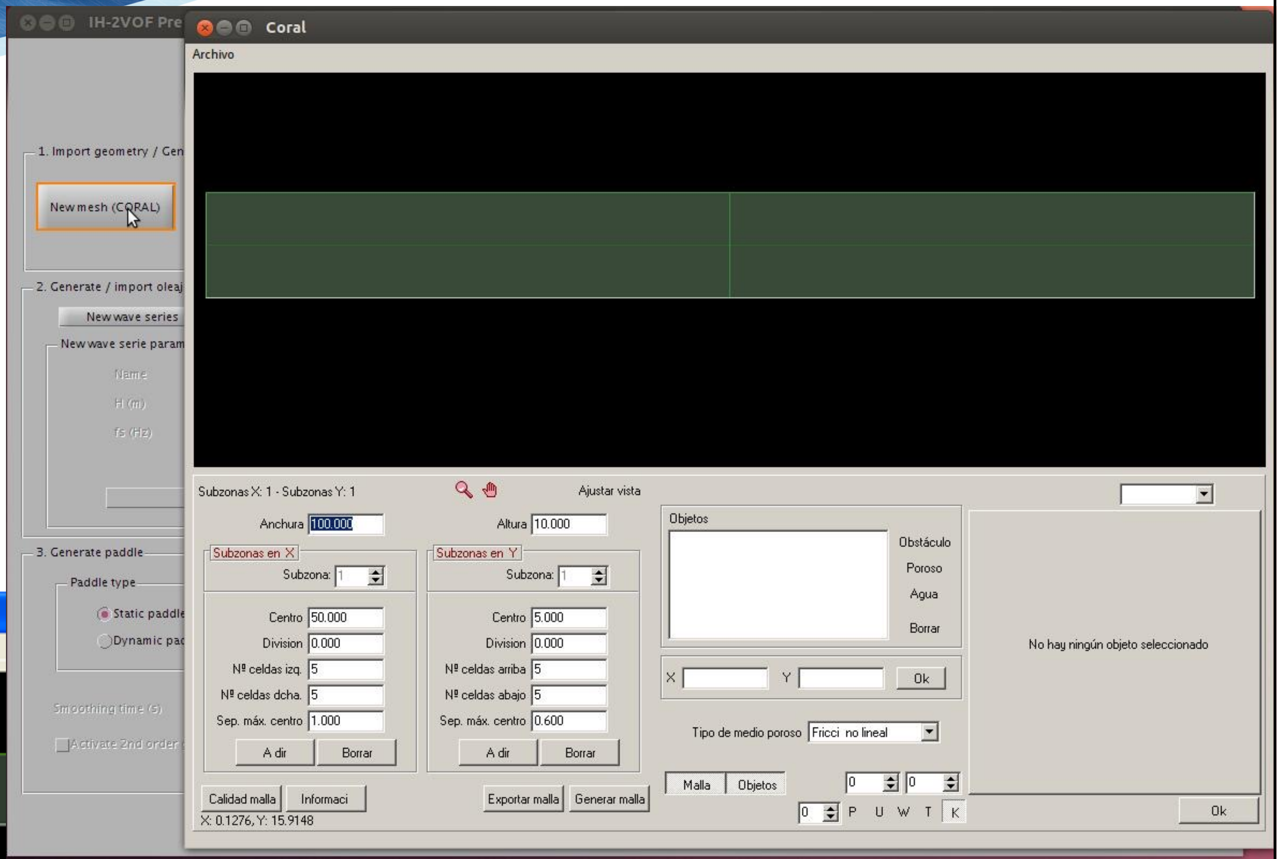
-WAVE GAUGES

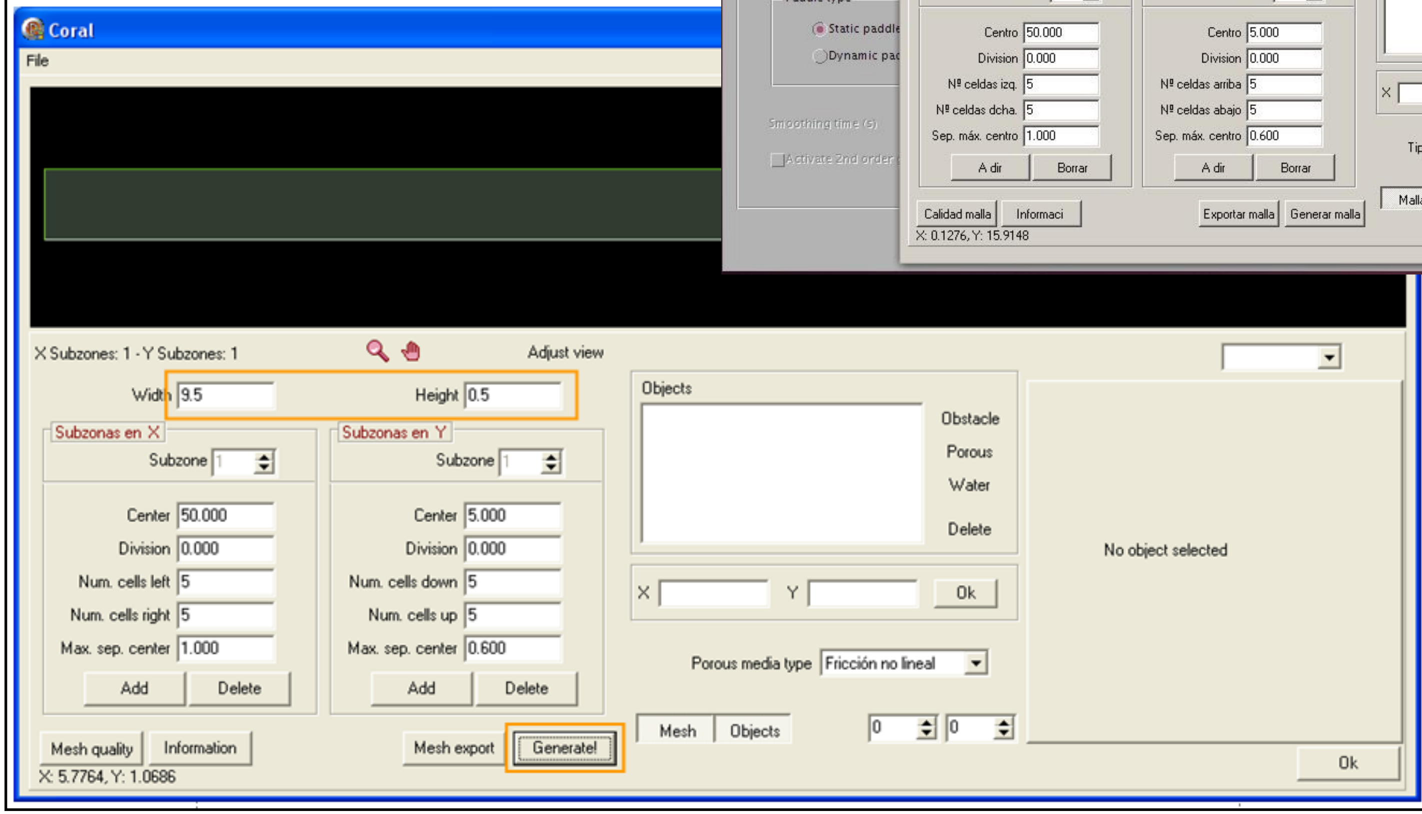
-RUN UP

-DRAWFAST

MESH GENERATION

-New mesh (CORAL): CORAL mesh generator is opened





- Domain specification

Width = 9.5m

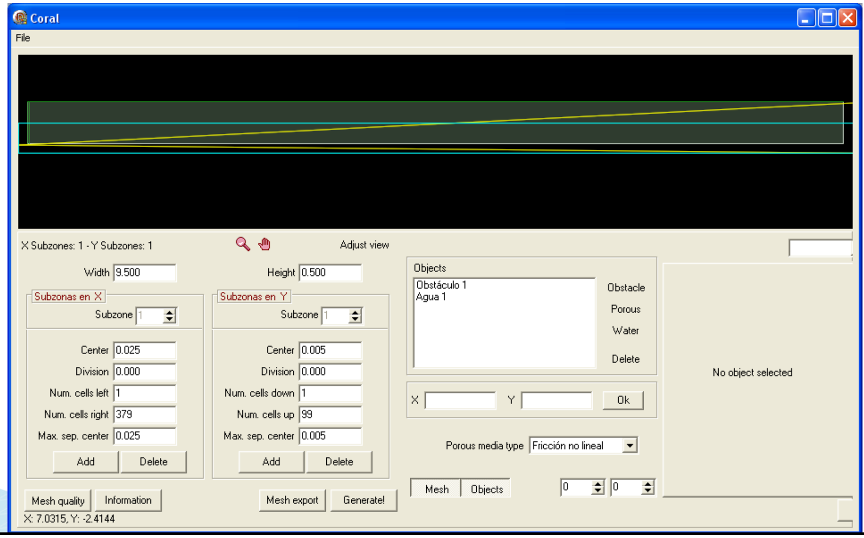
Height = 0.5m

MESH GENERATION: Defining the elements

Introduce the element obstacle which represents the bathymetry (1:20 bottom slope)

Introduce the element water (0.25 m working water depth)

Element	Vertices	X Coordinate	Y Coordinate
Bathymetry	1	-0.1	-0.005
	2	9.6	0.4836
	3	9.6	-0.1
Water	1	-0.1	-0.1
	2	-0.1	0.25
	3	10.6	0.25
	4	10.6	-0.1



<u>MESH GENERATION</u>: Spatial discretization

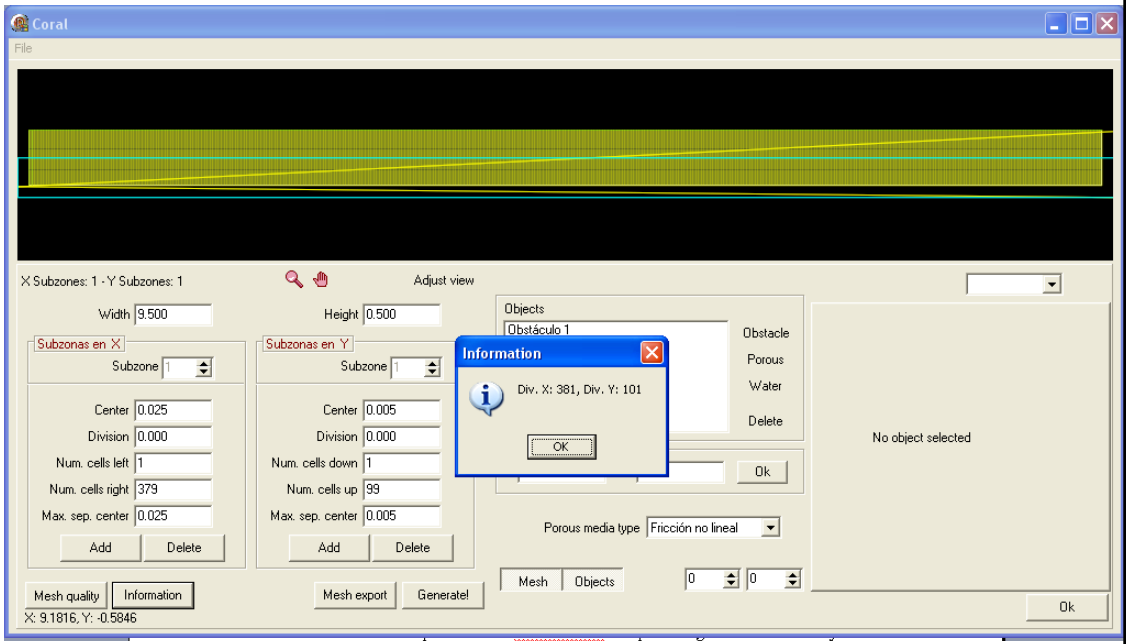
Uniform grid system in both the horizontal and the vertical directions

At least 10 cells per wave height! (H=0.07 m)
Δy = 0.005 m

Limit the aspect ratio $\Delta x/\Delta y$!
Δx = 0.025 m

$\Delta x/\Delta y$=5, it is a bit large value…
However… long wave regime (horizontal velocities>>vertical velocities)
==> $\Delta x/\Delta y$=5 is ok!

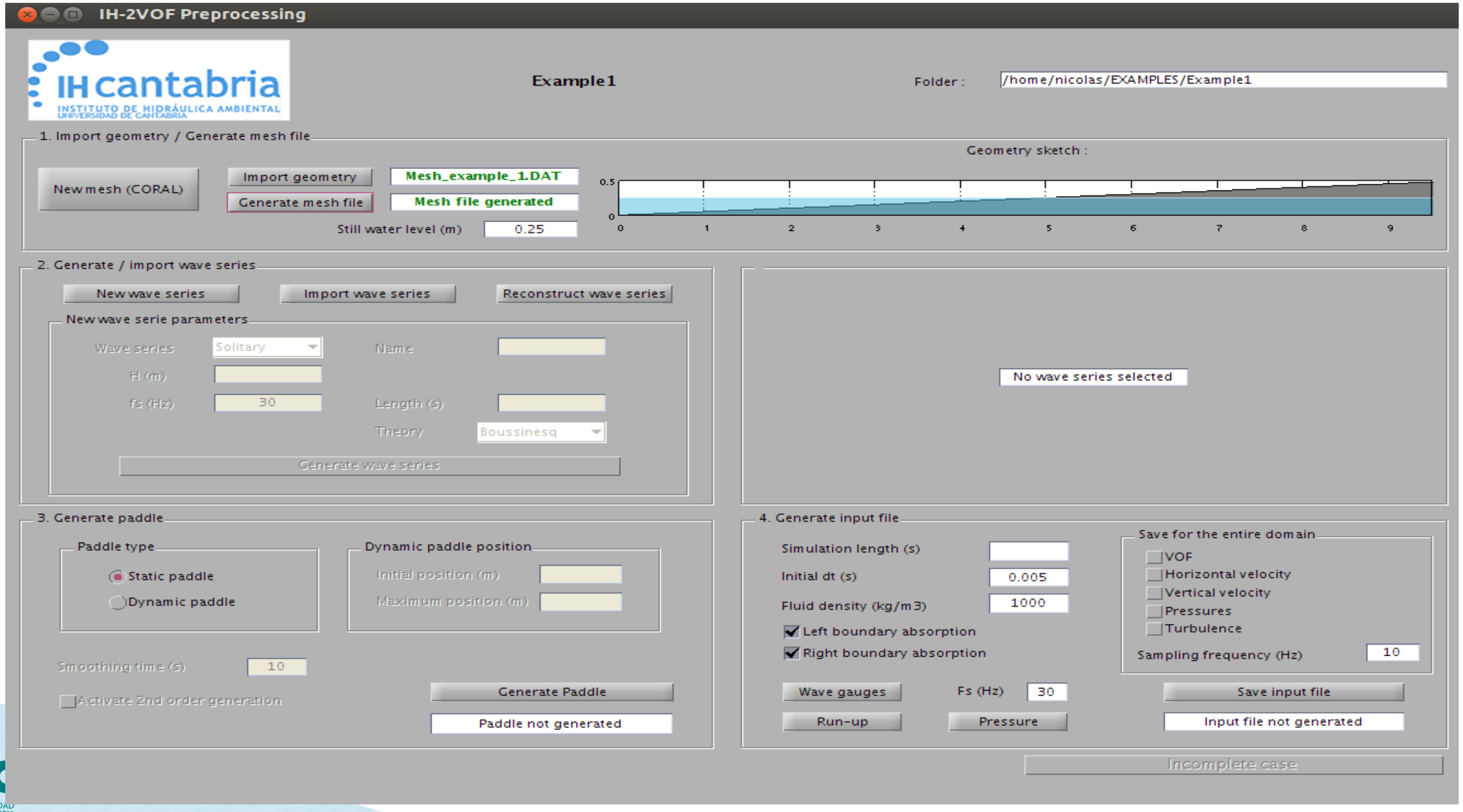
total number of cells in the numerical domain = 381 x 101



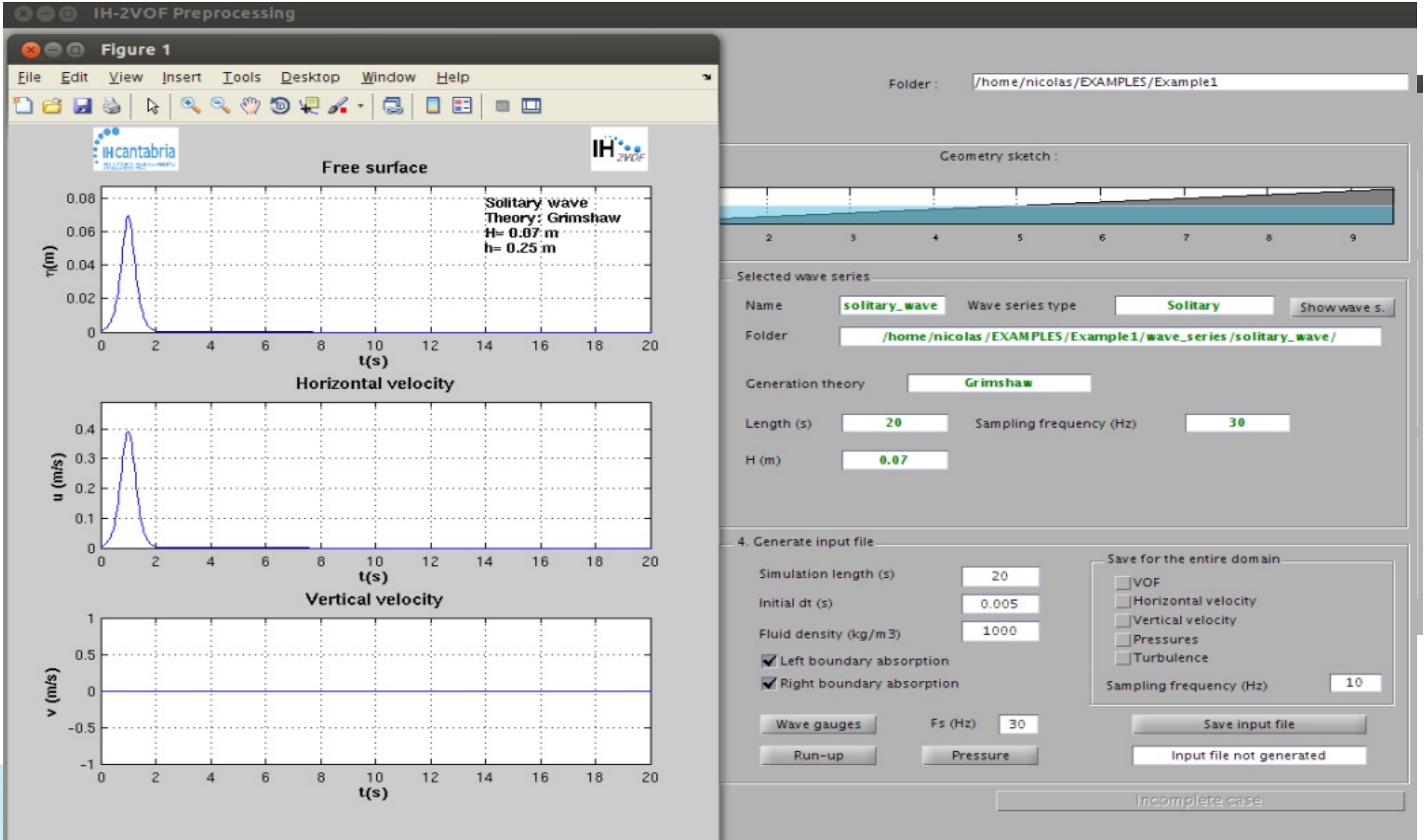
SECTION 1 : "IMPORT GEOMETRY/GENERATE MESH FILE"

-Saving the generated mesh its *".dat"* file appears in green in the GUI .

-Mesh characteristics are exported to a ***"Mesh.mes"***



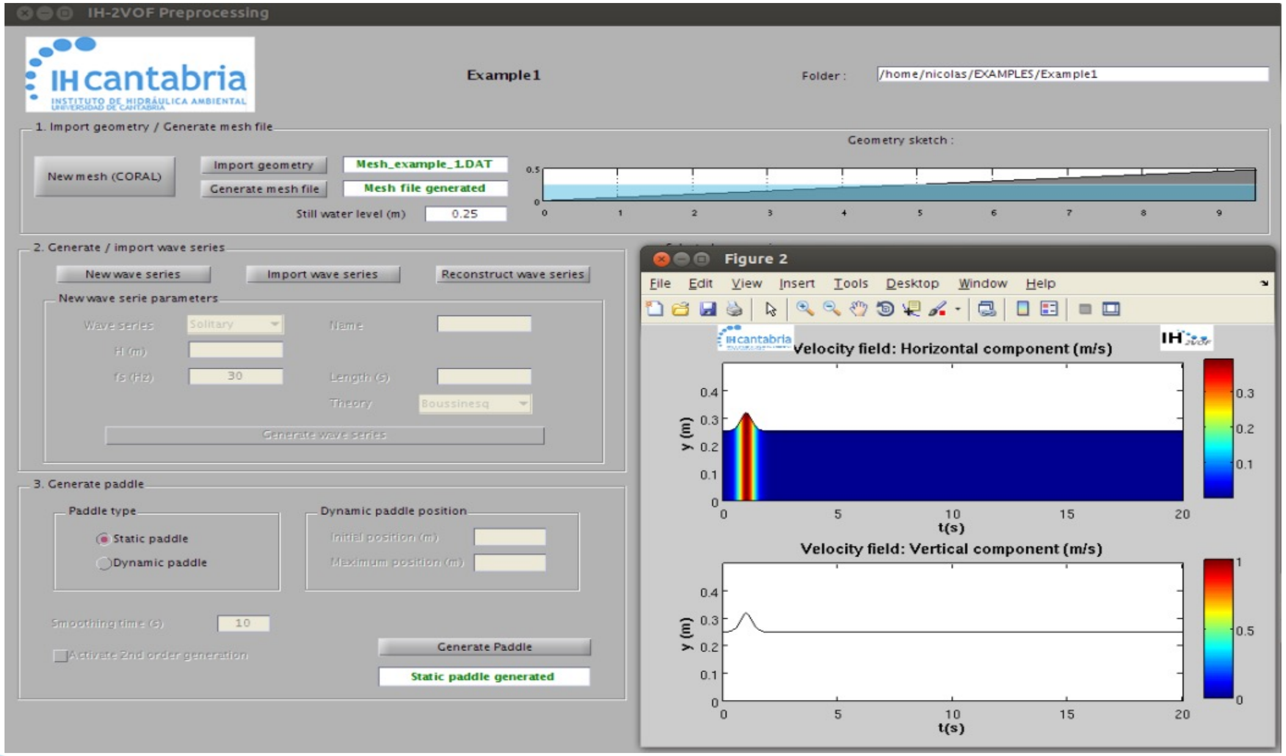
SECTION 2 : “GENERATE/IMPORT WAVE CONDITIONS”



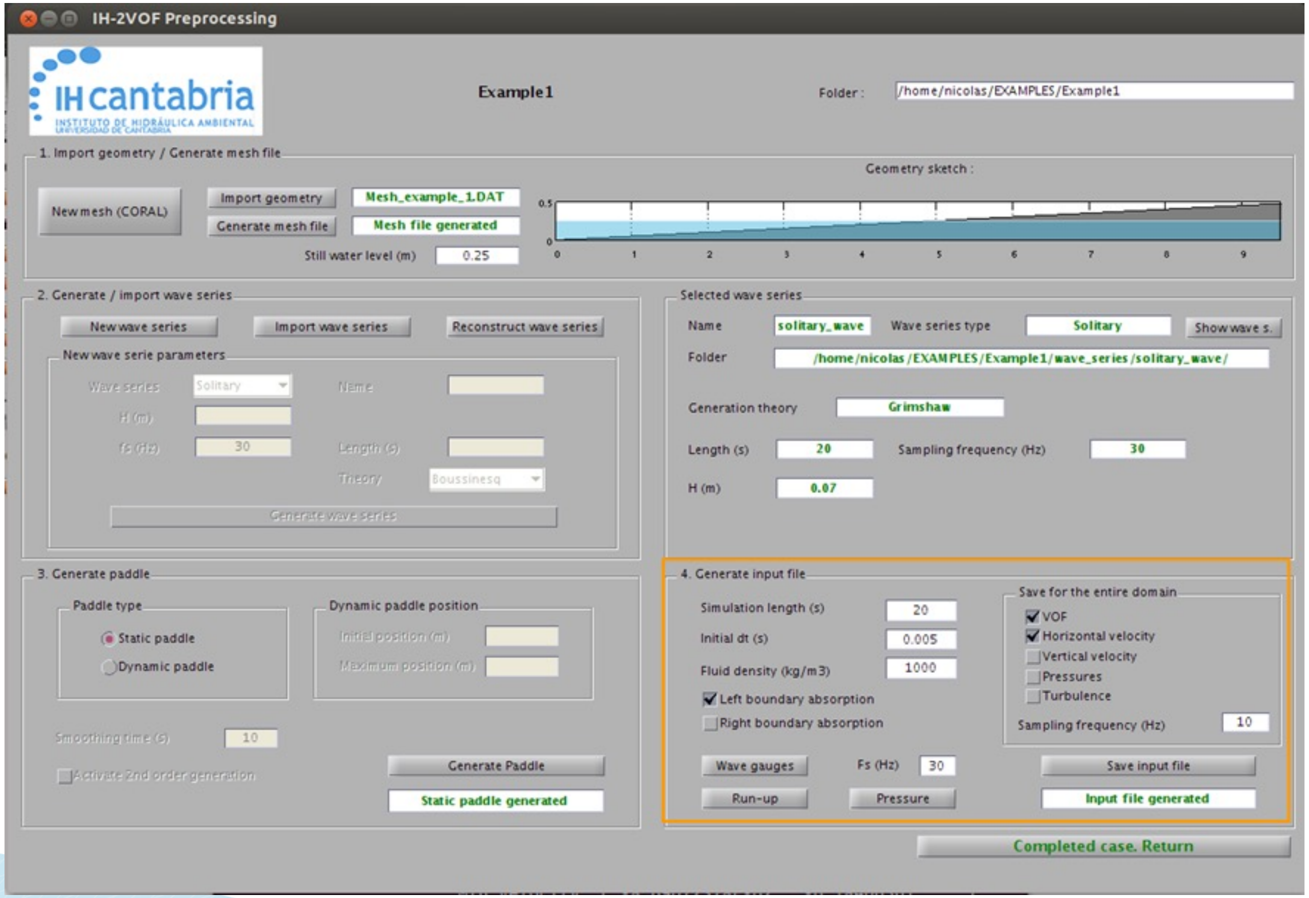
SECTION 3 : "GENERATE PADDLE

Static wave paddle

Both the mean velocities and free surface displacement are specified on the inflow boundary based on the selected analytical solution



SECTION 4 : "GENERATE INPUT FILE"



- Simulation length = 20 s

- Initial dt = 0.005 s

-Absorption on at the left boundary only!

 - VOF and horizontal velocity fields are saved

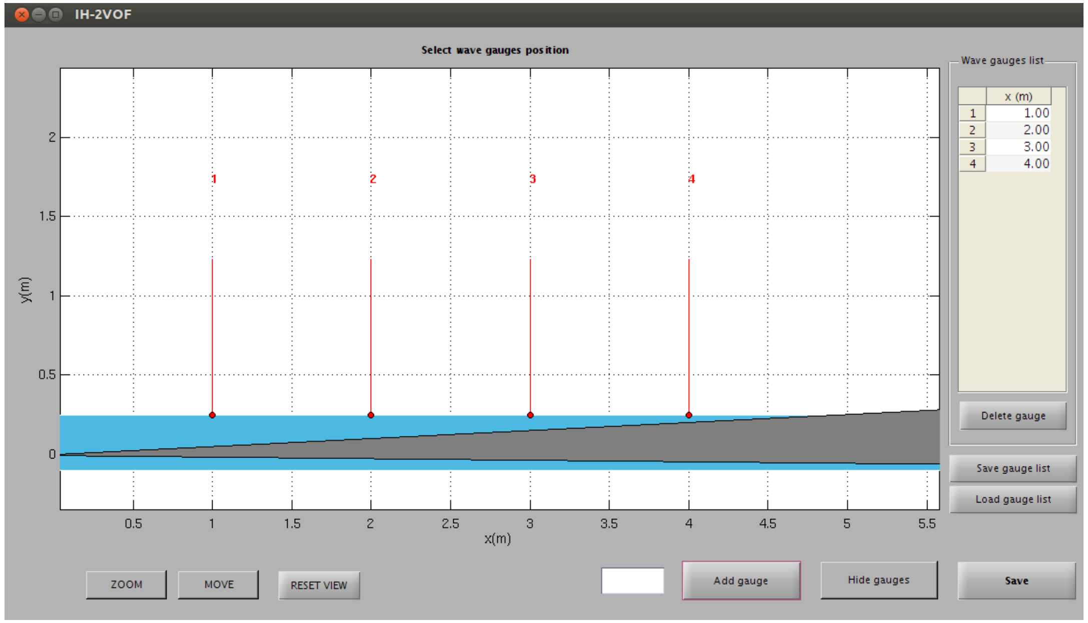
<u>SECTION 4 : "GENERATE INPUT FILE"</u> – *Wave gauges*

Different wave gauges are disposed in the domain to measured the wave conditions and overtopping.

Gauge	X(m)
1	1
2	2
3	3
4	4

Press the button *Wave gauges - Add gauge*

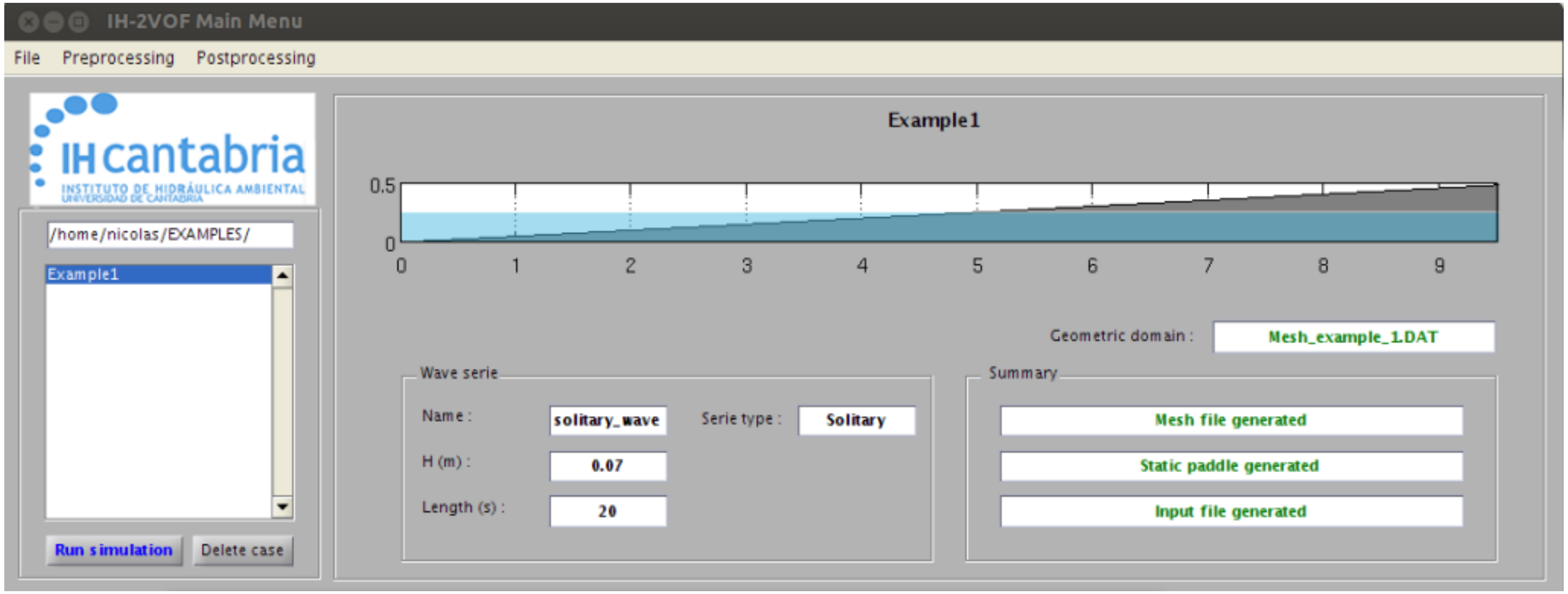
Gauges positions are specified



SUMMARY

All the variables are defined
The input file is saved

➔the case is ready to be simulated



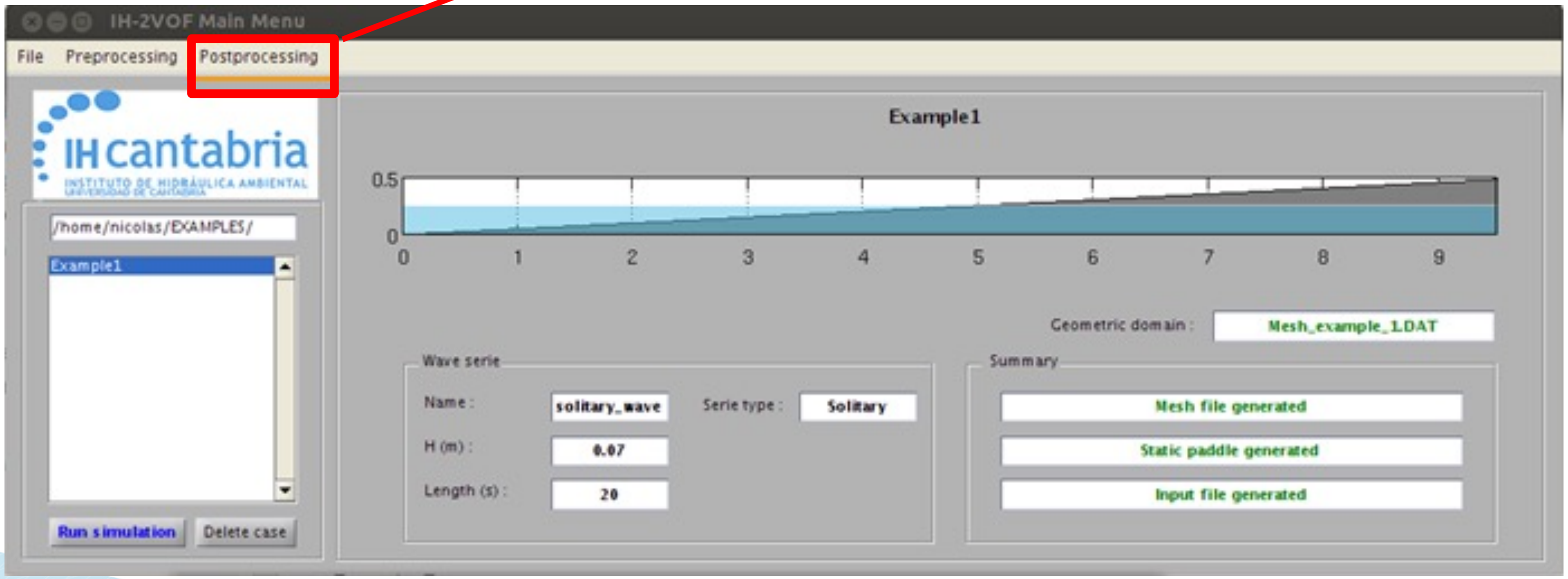
The simulation which will starts by pressing the button *Run simulation*

POSTPROCESSING

In the present example different aspects are analyzed:

- Free surface evolution
- Visual analysis
- Validation with laboratory data

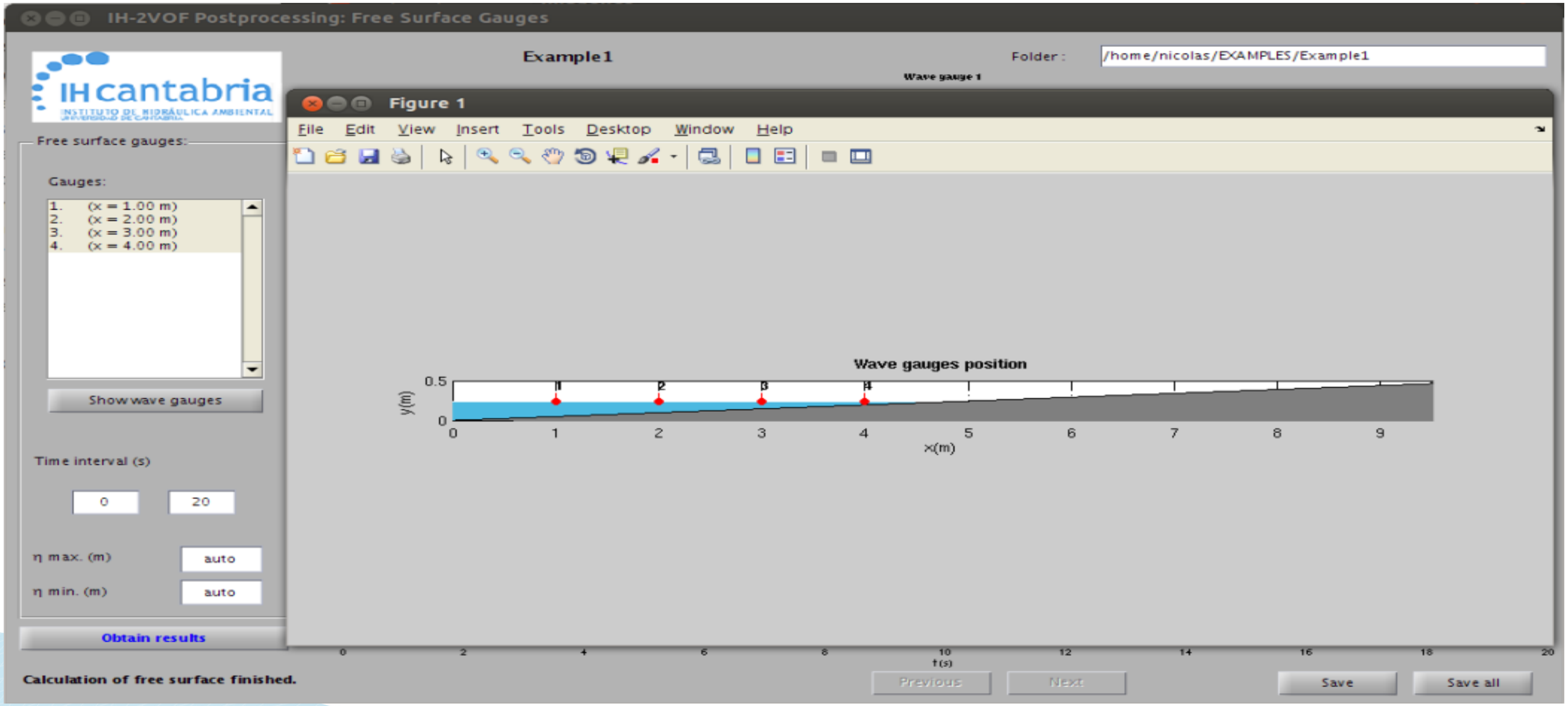
Click *"Postprocessing"*



WAVE GAUGES – Show wave gauges

- 4 wave gauges were disposed along the domain.

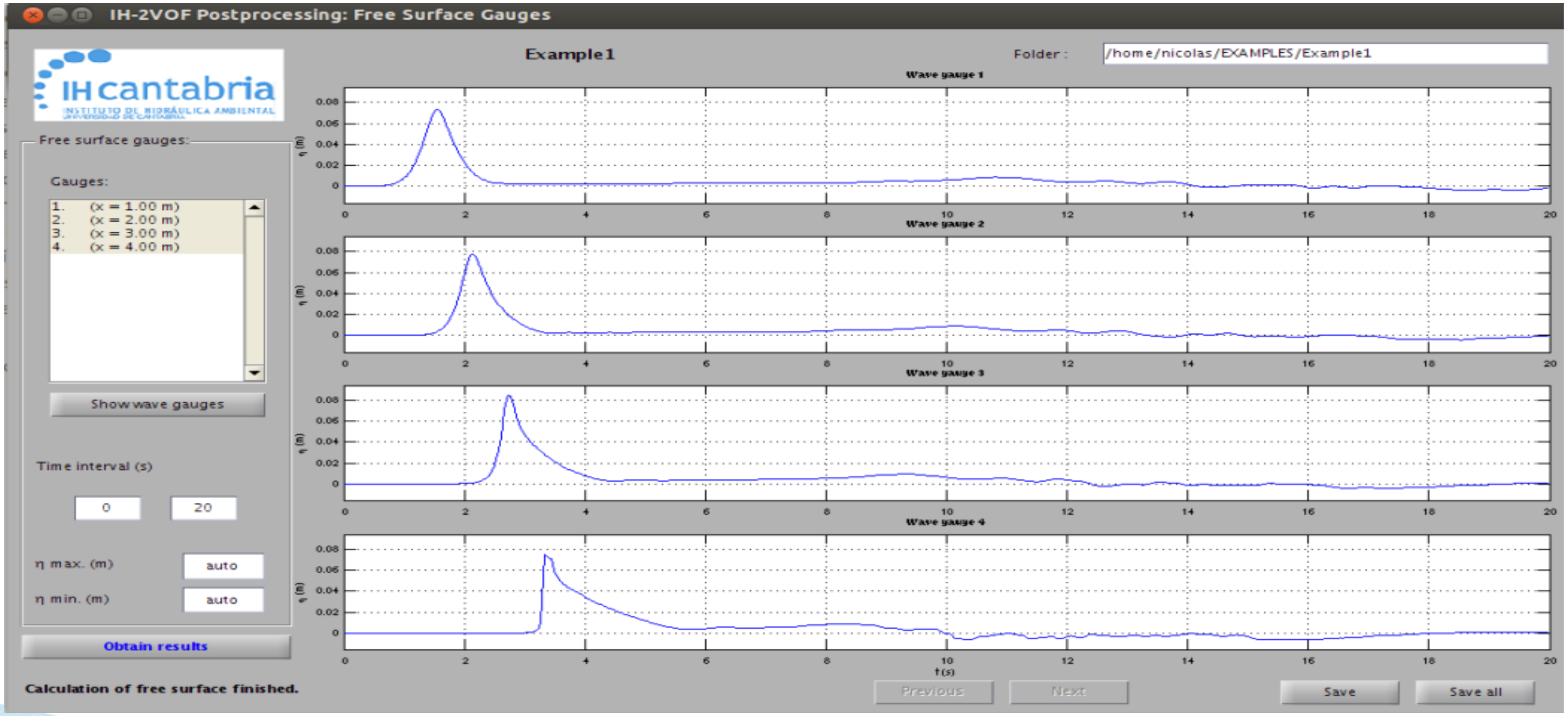
Postprocessing → *Free surface gauges* → *Show wave gauges*



WAVE GAUGES – Time series

-Results of the free surface elevation are obtained by pressing the button

Postprocessing → *Free surface gauges* → *Time Series* → *Obtain results*

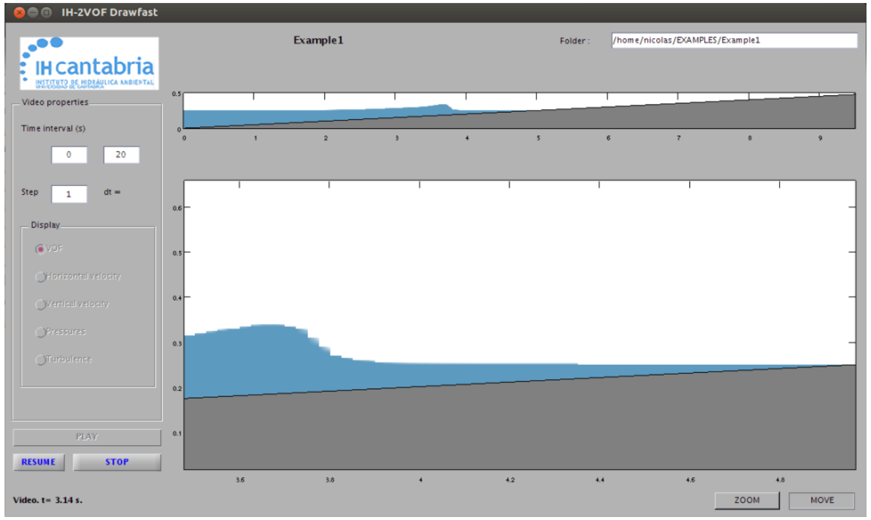


DRAWFAST

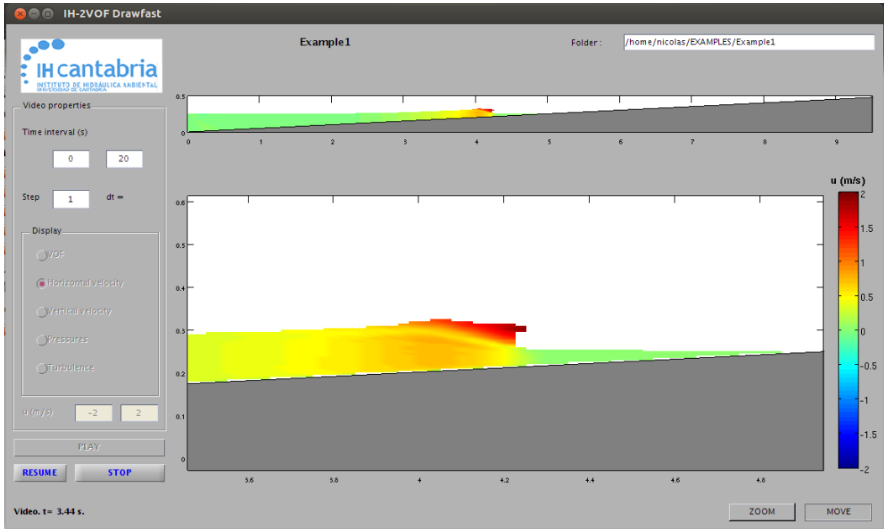
- A video of the different variables chosen before the simulation can be seen.

-Choose the initial time, final time and time step

-The lower panel allows a zoom of the area of interest



VOF drawfast



Horizontal Velocity drawfast

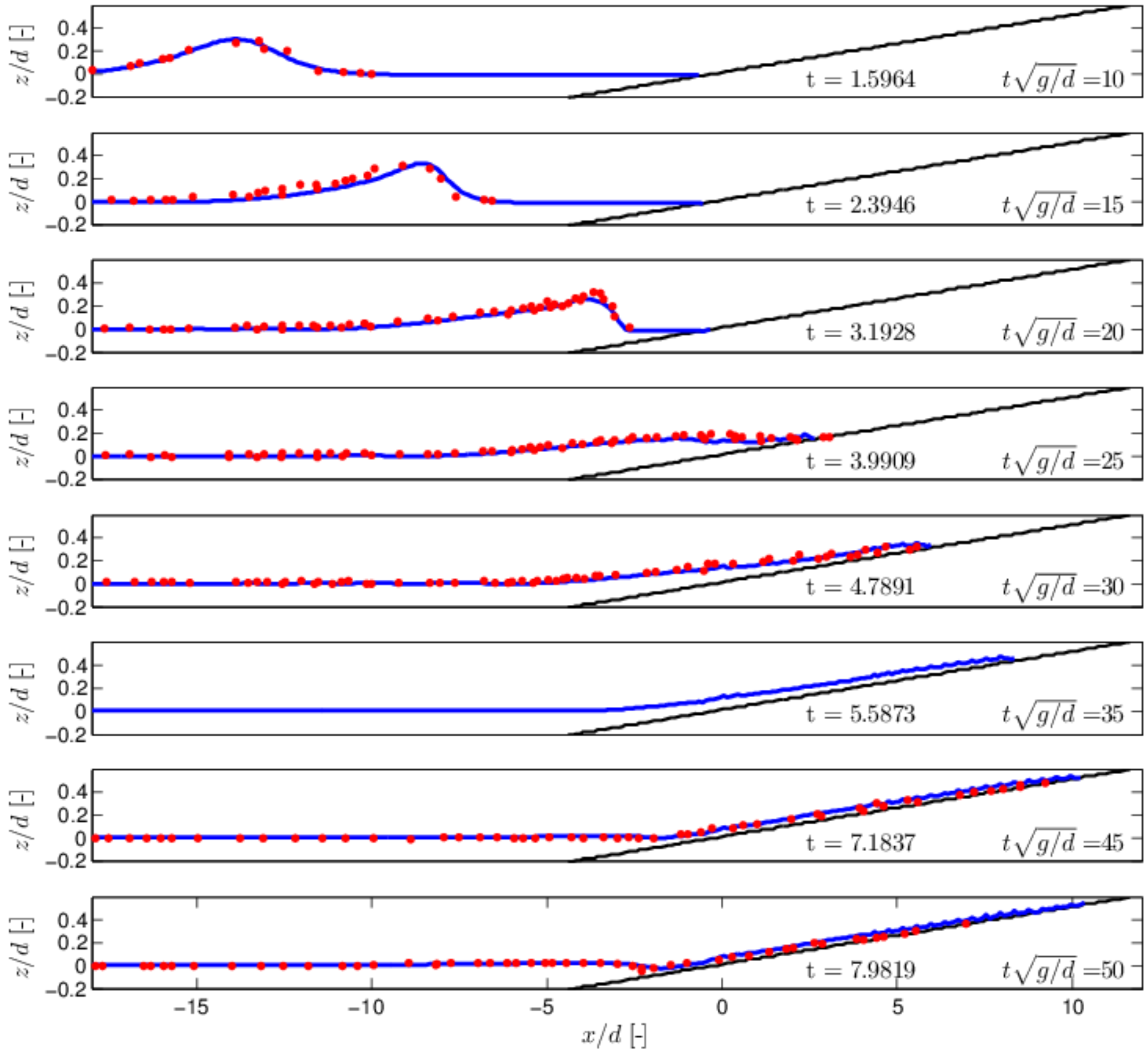
VALIDATION

Validation against laboratory data (Synolakis 1986)

The length scale is normalized by the still water depth *d*

The time scale is normalized by t(g/d)^1/2

Use the matlab script validation_example1.mat to generate the plot



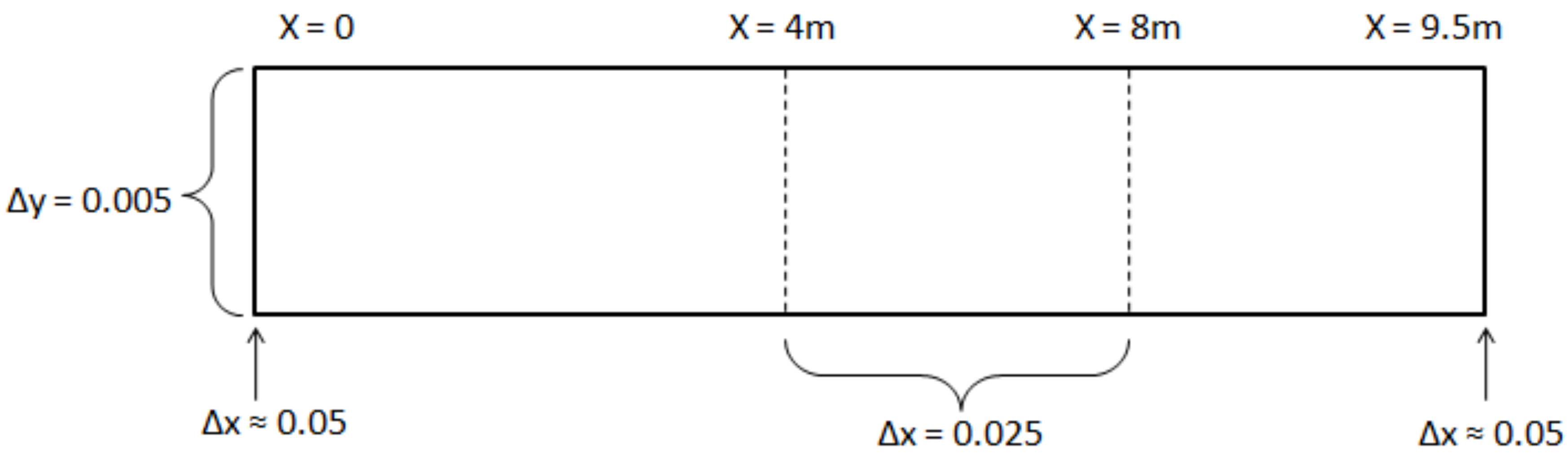
numerical results (blue line) and laboratory data (red circles)

Run-up produce by a regular wave train

The same geometry studied in order to test **regular wave conditions** over uniform slope.

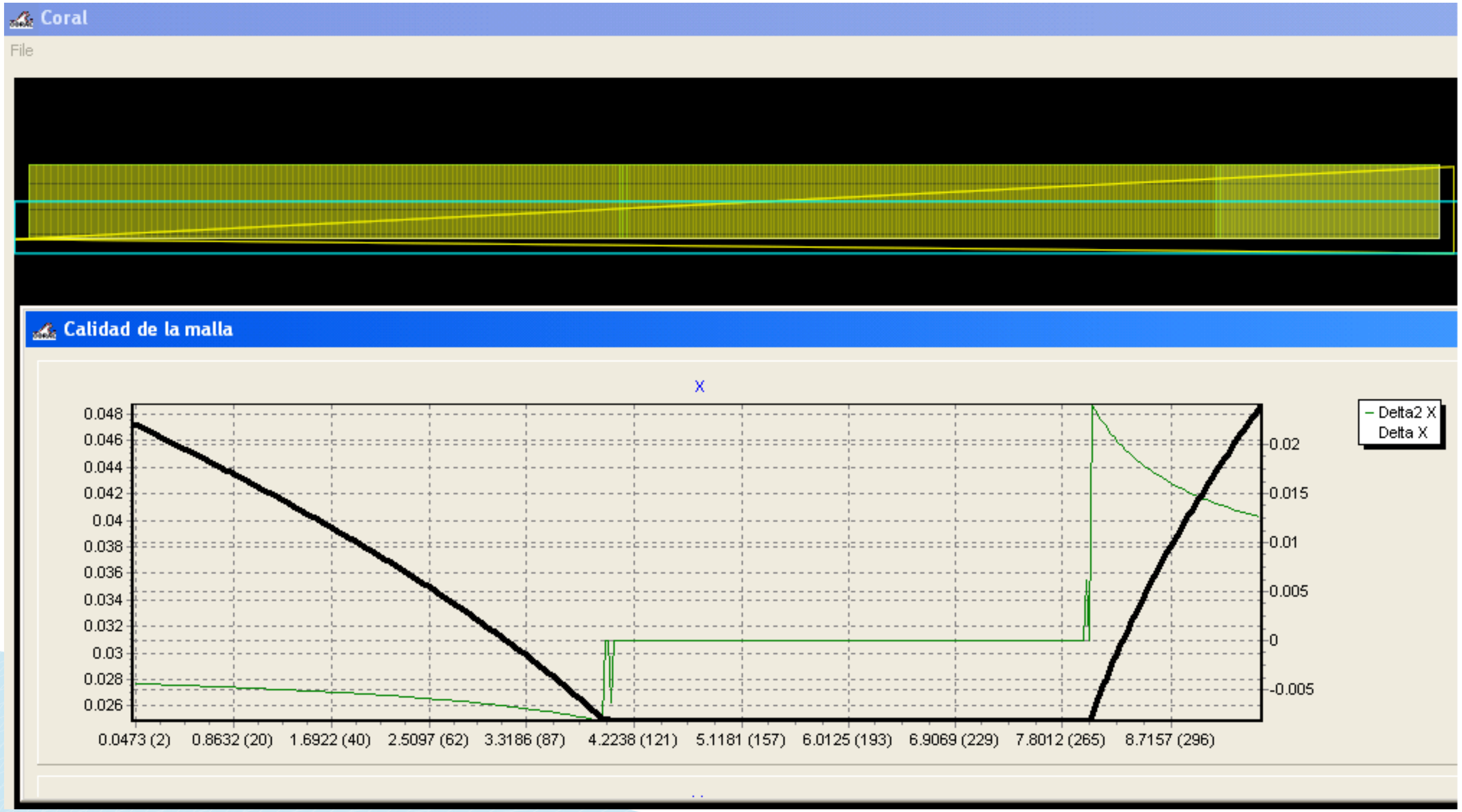
In this case, the run-up produced by a **regular wave train** with wave height equal to **0.10m** and a wave period of **1.5s** is analysed.

A **variable mesh grid** is considered:



Generated mesh

	X Direction			Y Direction
	Subzone 1	Subzone 2	Subzone 3	Subzone 1
Center	3.975	4.025	8.025	0.005
Division	0	4	8	0
Num. cells left	110	1	1	1
Num. cells right	1	160	40	99
Max. sep.center	0.025	0.025	0.025	0.005



Mesh quality

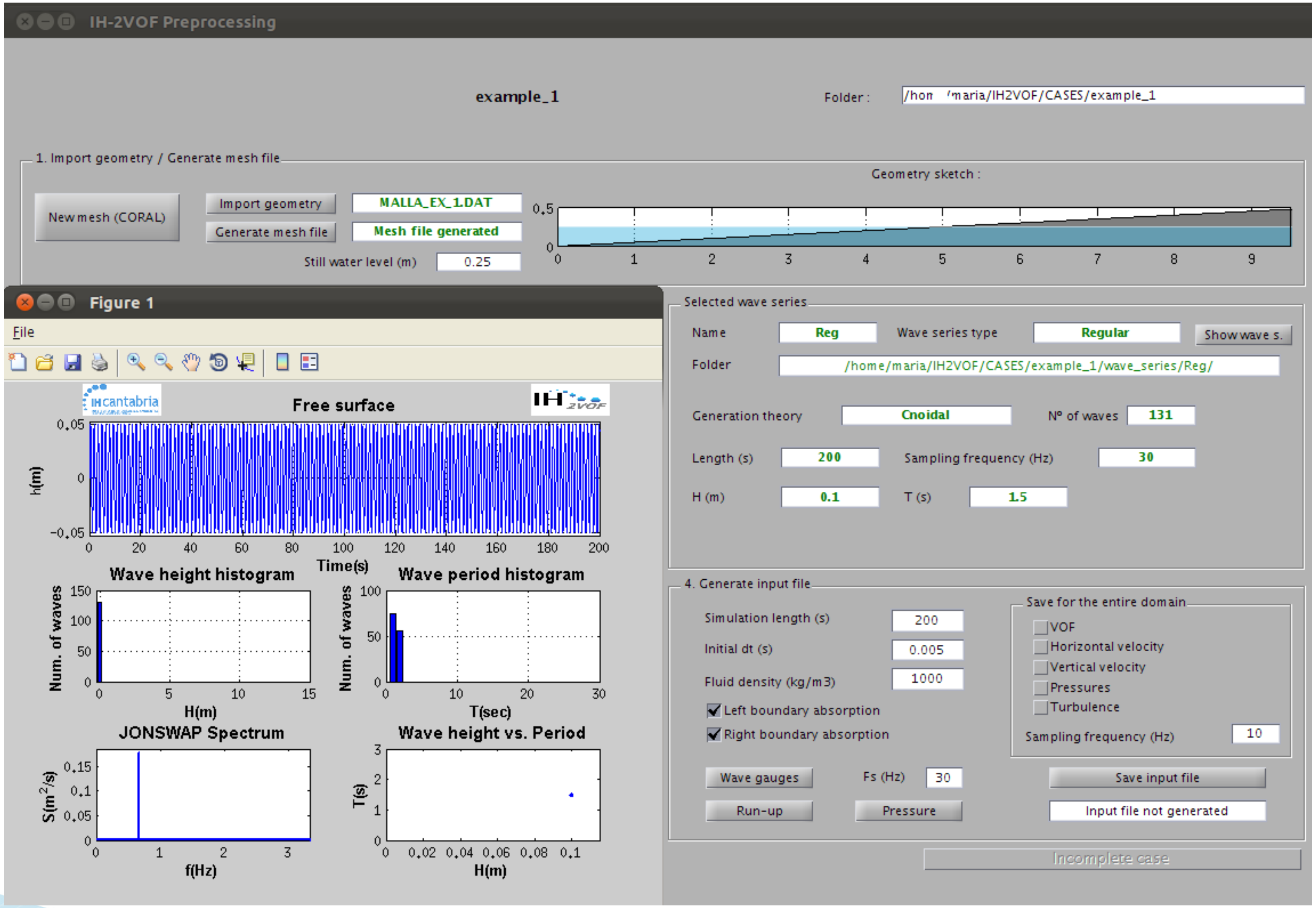
GENERATE WAVE CONDITIONS

Regular wave

H = 0.10m

T = 1.5s

Cnoidal theory

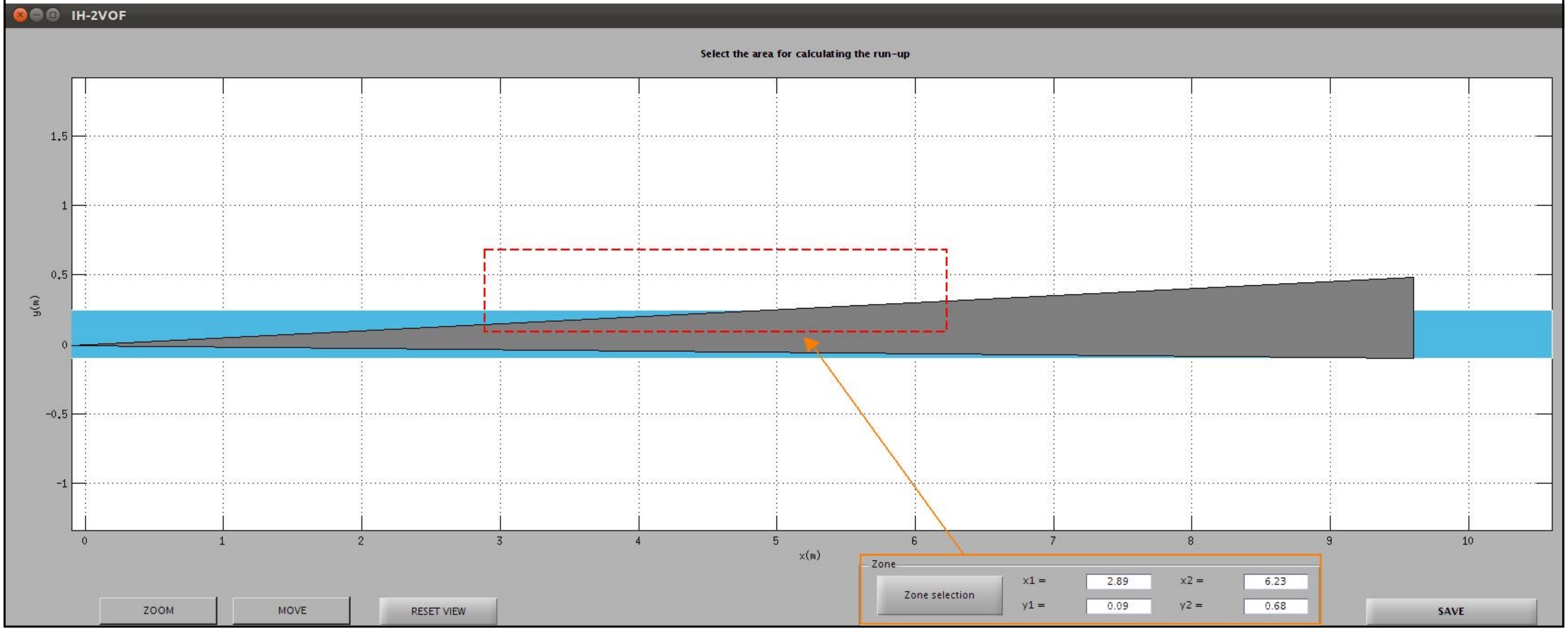


INPUT FILE

-Wave gauges

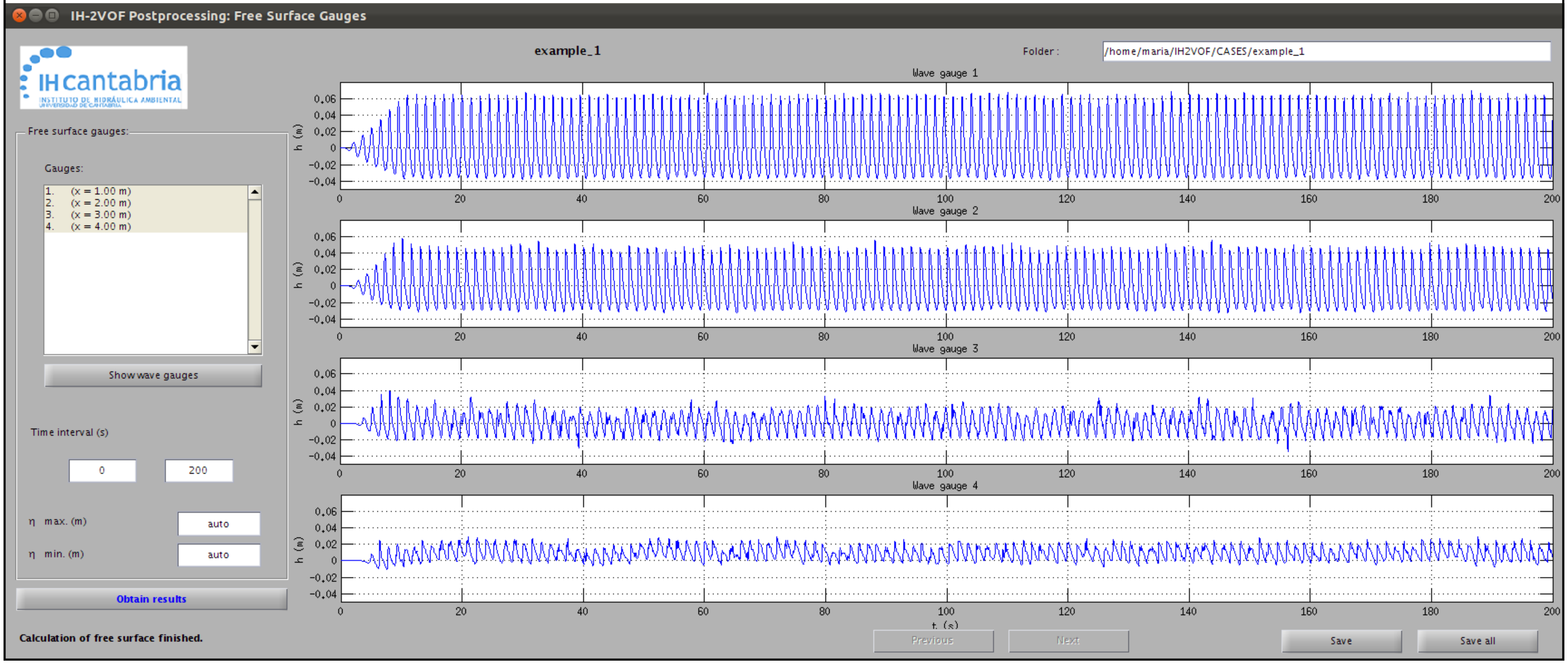
-Wave run-up

Gauge	X(m)
1	1
2	2
3	3
4	4

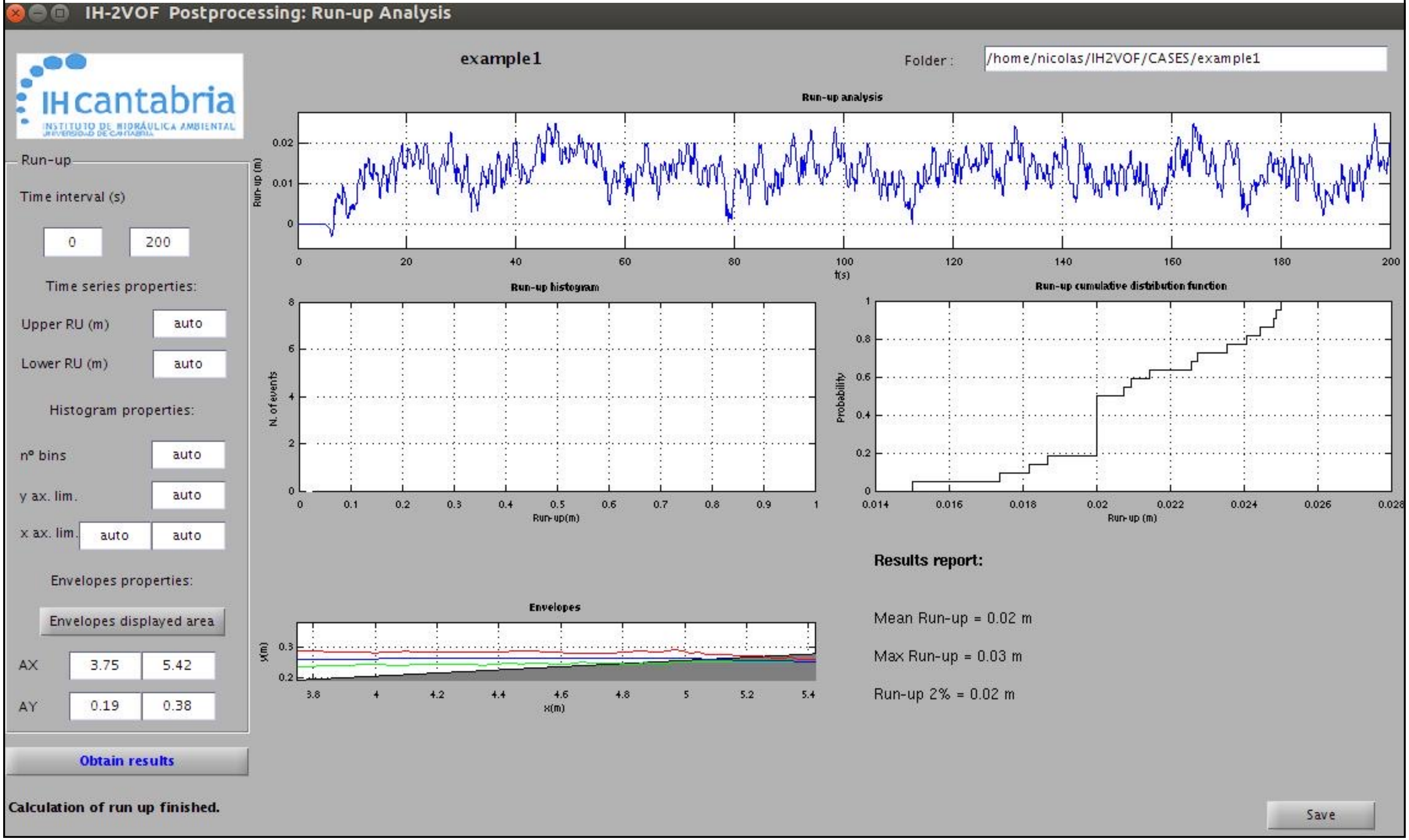


POST-PROCESSING: Wave gauges

Postprocessing → *Free surface gauges* → *Time Series*

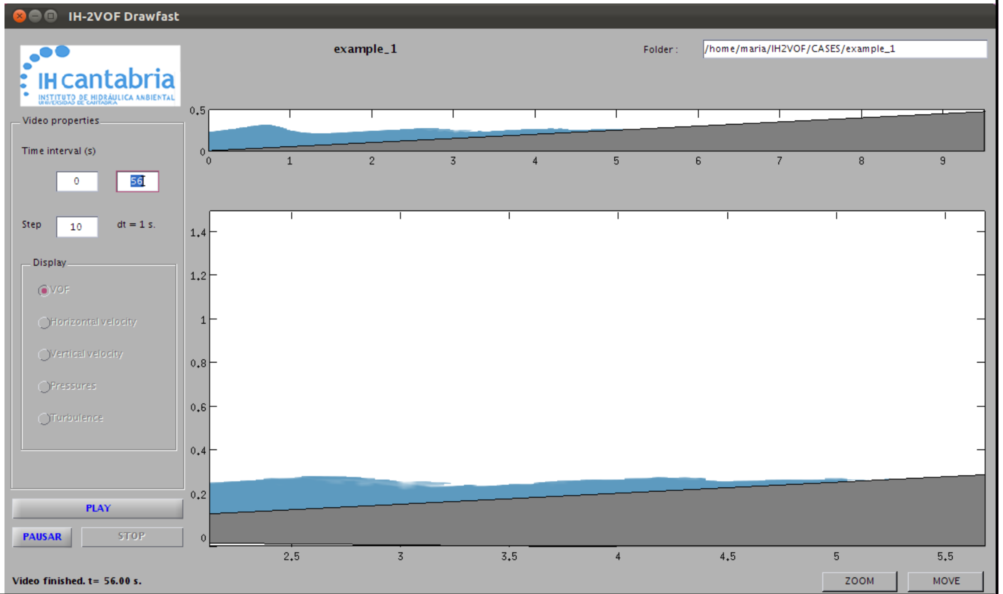


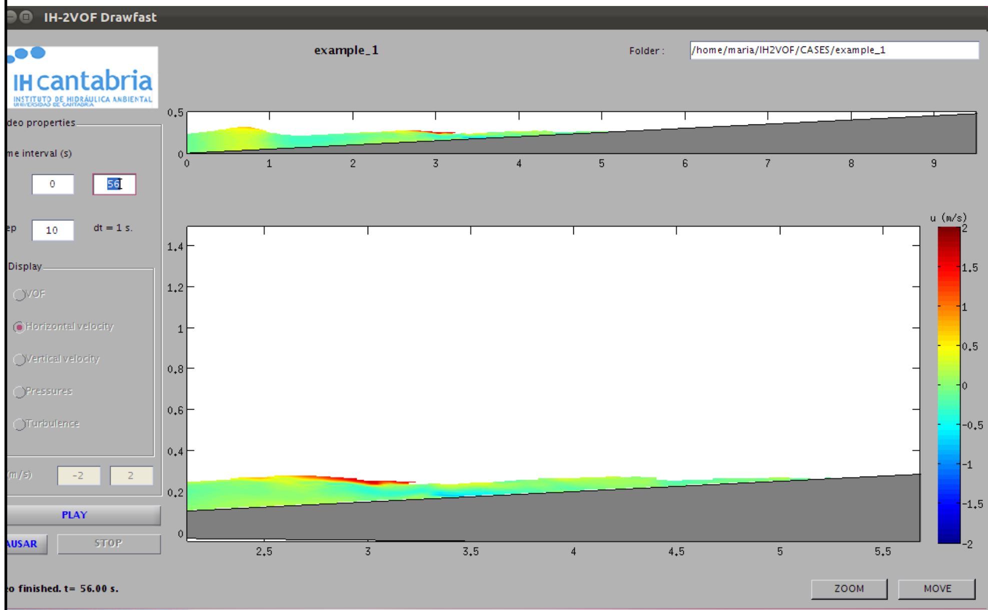
POST-PROCESSING: Run-up Analysis

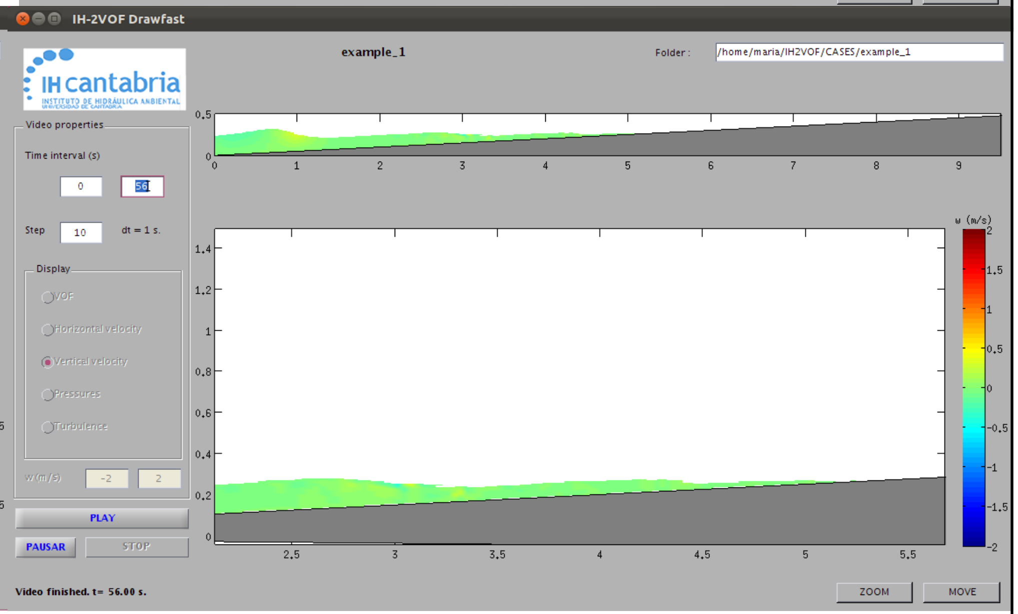


POST-PROCESSING: Drawfast

VOF drawfast
Horizontal velocity Drawfast
Vertical velocity Drawfast

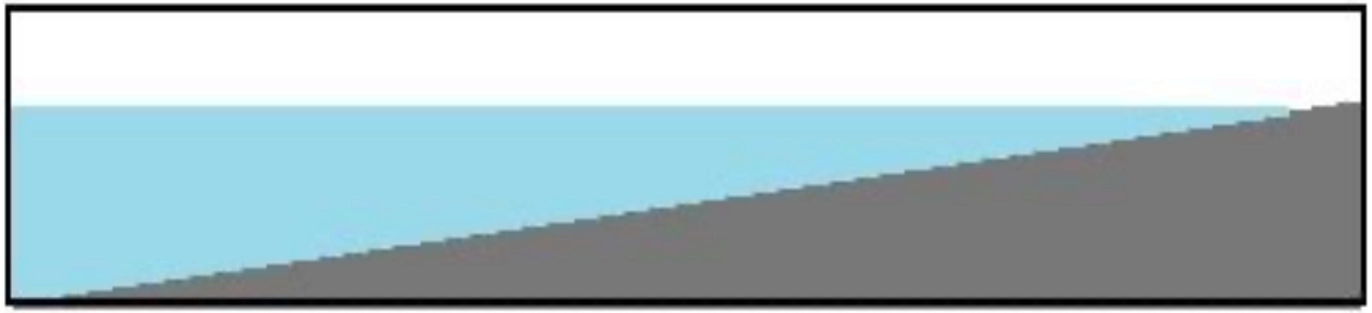






Example 1

Study of a Solitary wave run-up



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