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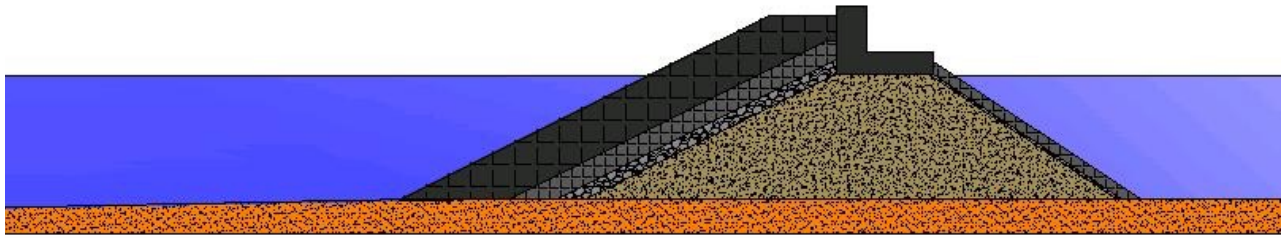
Example 2

Regular wave interaction with a rubble-mound breakwater



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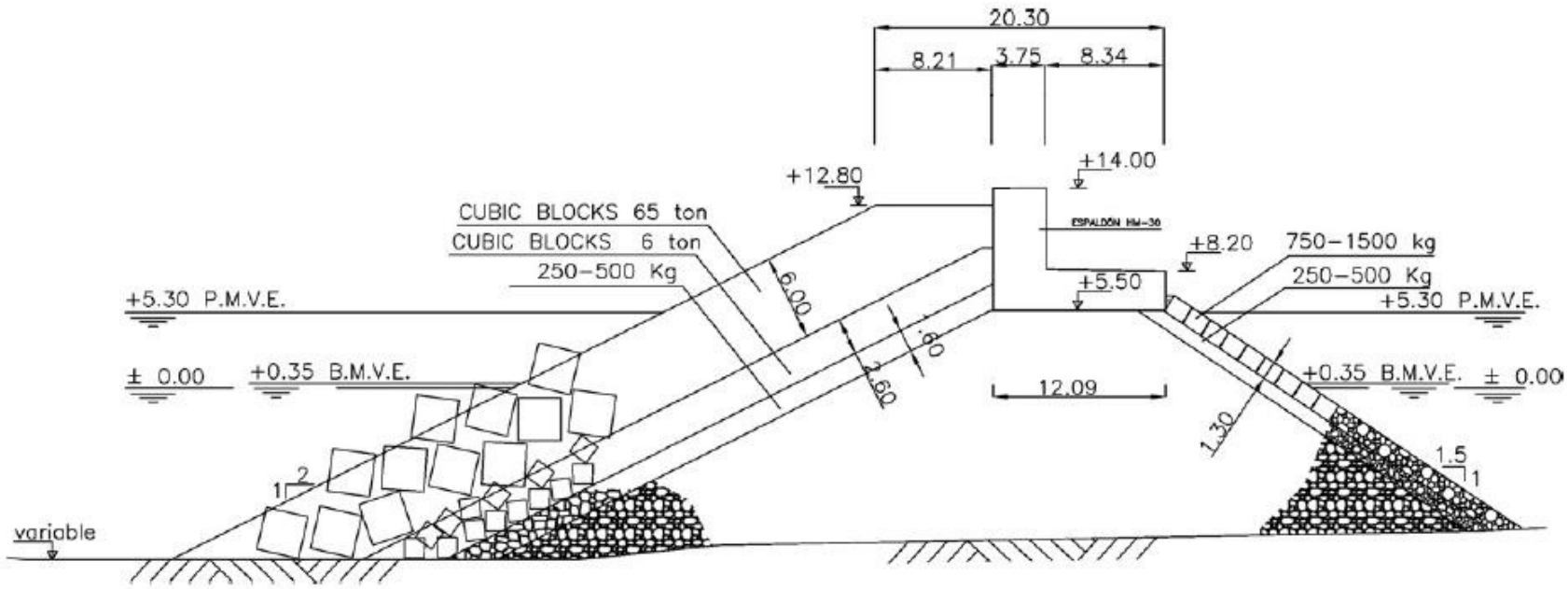
Study of a Rubble mound Breakwater

In this example the interaction of a **regular wave train** with a rubble-mound breakwater is considered.



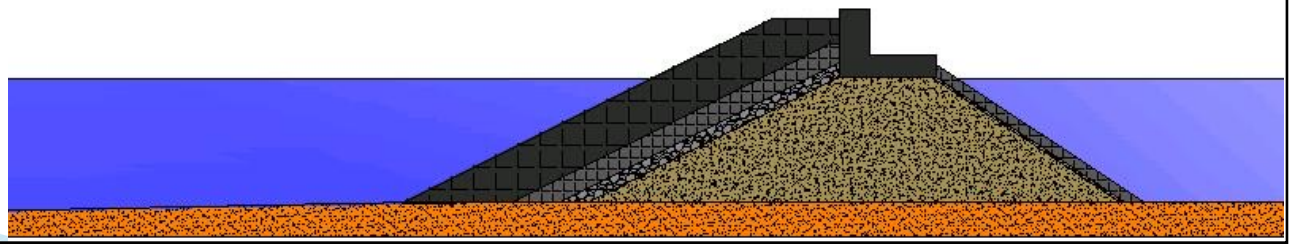
The bottom has a uniform slope 1:50 in front of the breakwater. The breakwater is assumed to be founded on a horizontal bottom.

Study of a Rubble mound Breakwater

The breakwater is tested considering **regular wave conditions** with a wave height equal to **10m** and a wave period of **14s**.

The purpose of this example is to study the interaction between regular waves and a rubble-mound breakwater. Different functional variable will be analyzed:

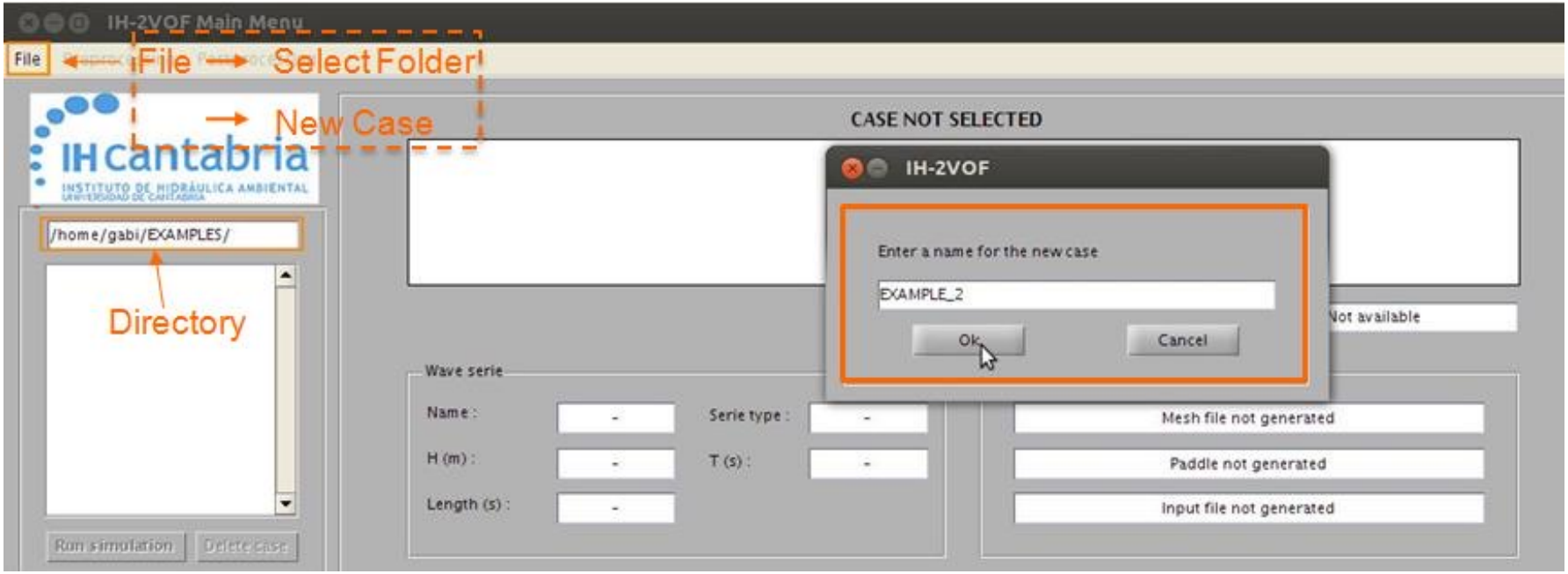
- Wave run-up
- Overtopping discharge
- Wave induced forces on the crown-wall



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

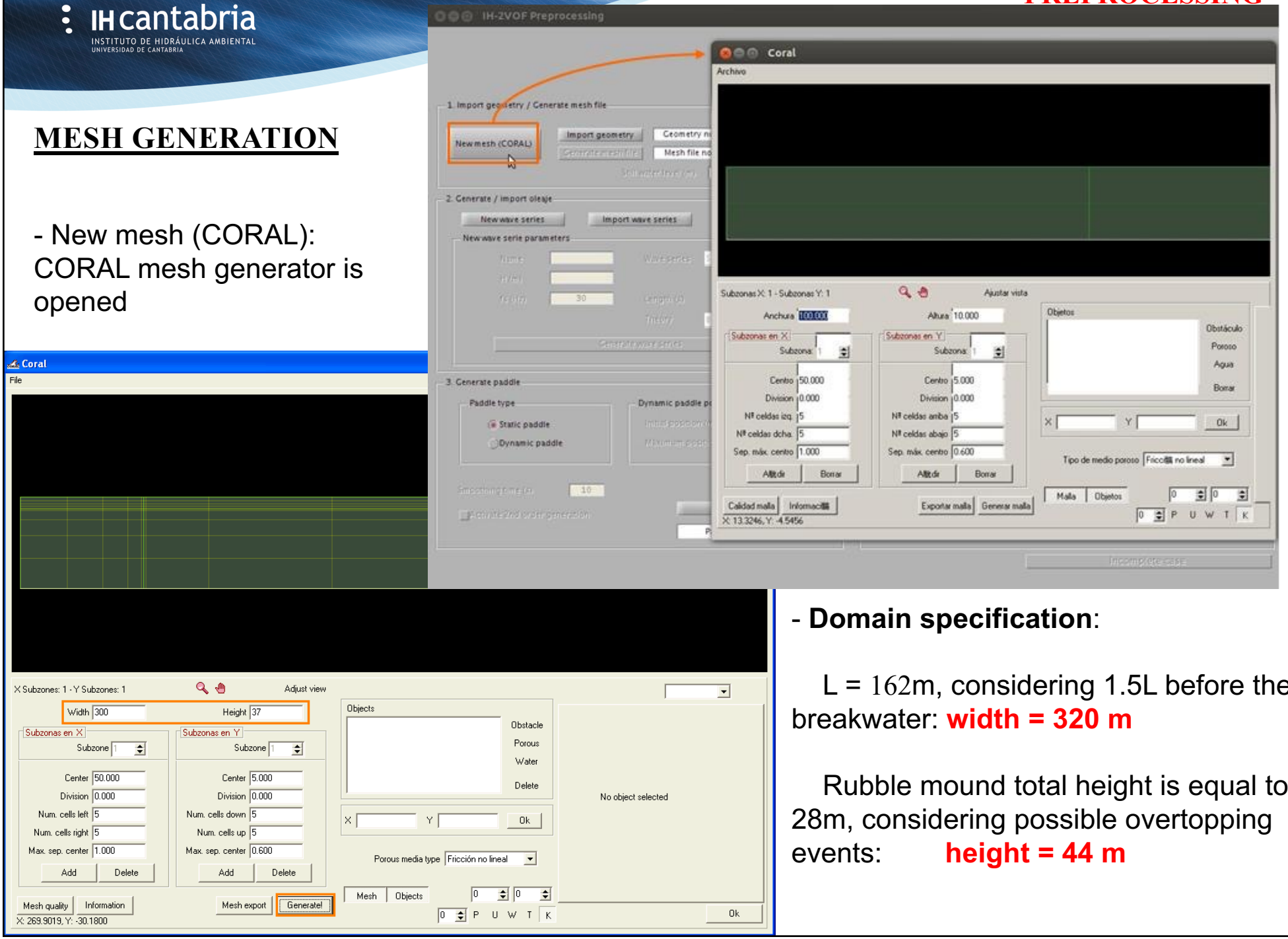
-OVERTOPPING

-PRESSURE

-DRAWFAST

MESH GENERATION

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



- **Domain specification**:

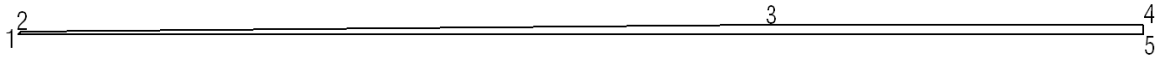
L = 162m, considering 1.5L before the breakwater: **width = 320 m**

Rubble mound total height is equal to 28m, considering possible overtopping events: **height = 44 m**

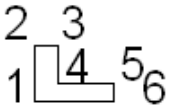
MESH GENERATION: Defining the elements

Introduce obstacles:

-Bathymetry

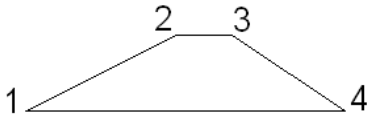


-Crown wall

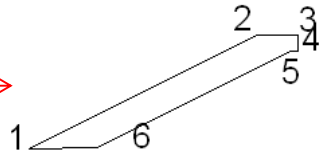


Introduce porous media:

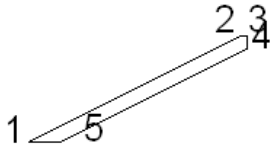
- Core:

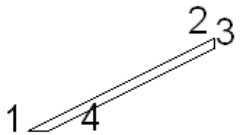


- Armor layer:

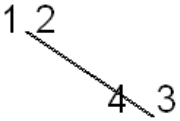


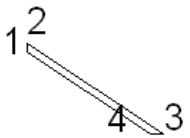
- Under layers:



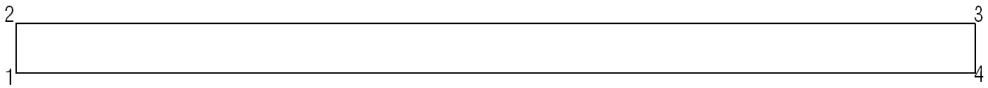


- Leeward layers:





Introduce water body:



MESH GENERATION: Defining the elements

Introduce porous media properties:

Characteristic	Core	Under layer 2	Under layer 1	Armor layer	Leeward layer 2	Leeward layer 1
Porosity	0.20	0.30	0.35	0.40	0.25	0.30
Linear friction coef.	200	200	200	200	200	200
Non-Linear friction coef.	0.80	1.00	1.10	1.1	1	1.00
Added mass coef.	0.34	0.34	0.34	0.34	0.34	0.34
D50	0.30	0.61	1.37	3.00	0.40	0.60

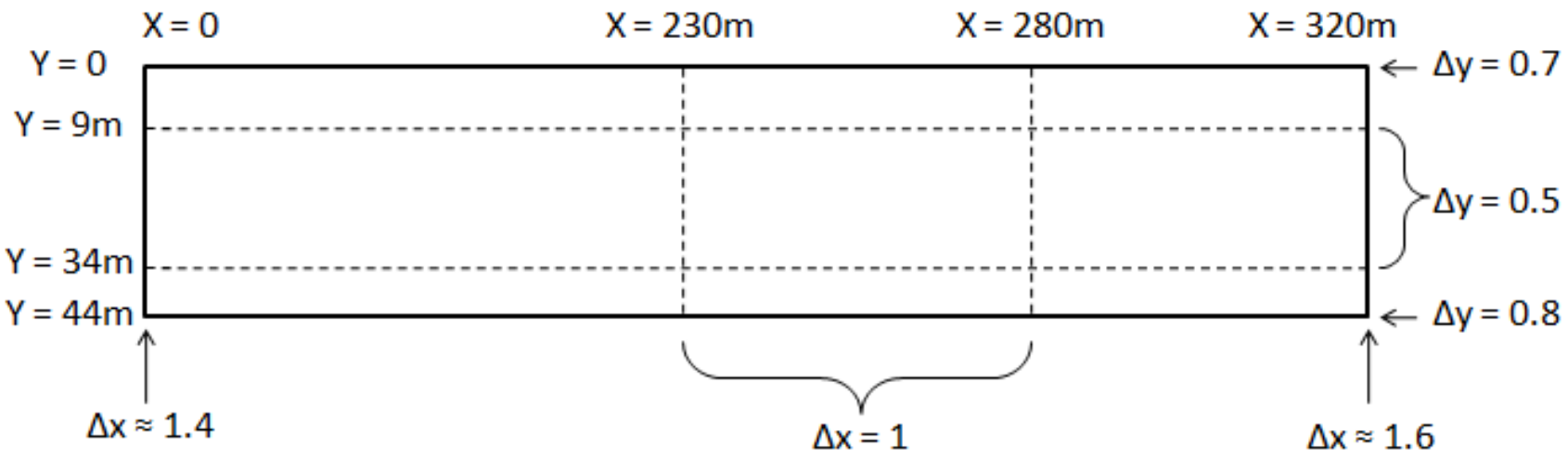
MESH GENERATION: Spatial discretization

- A variable grid is chosen to mesh the domain.

- The maximum resolution zone is placed around the breakwater.

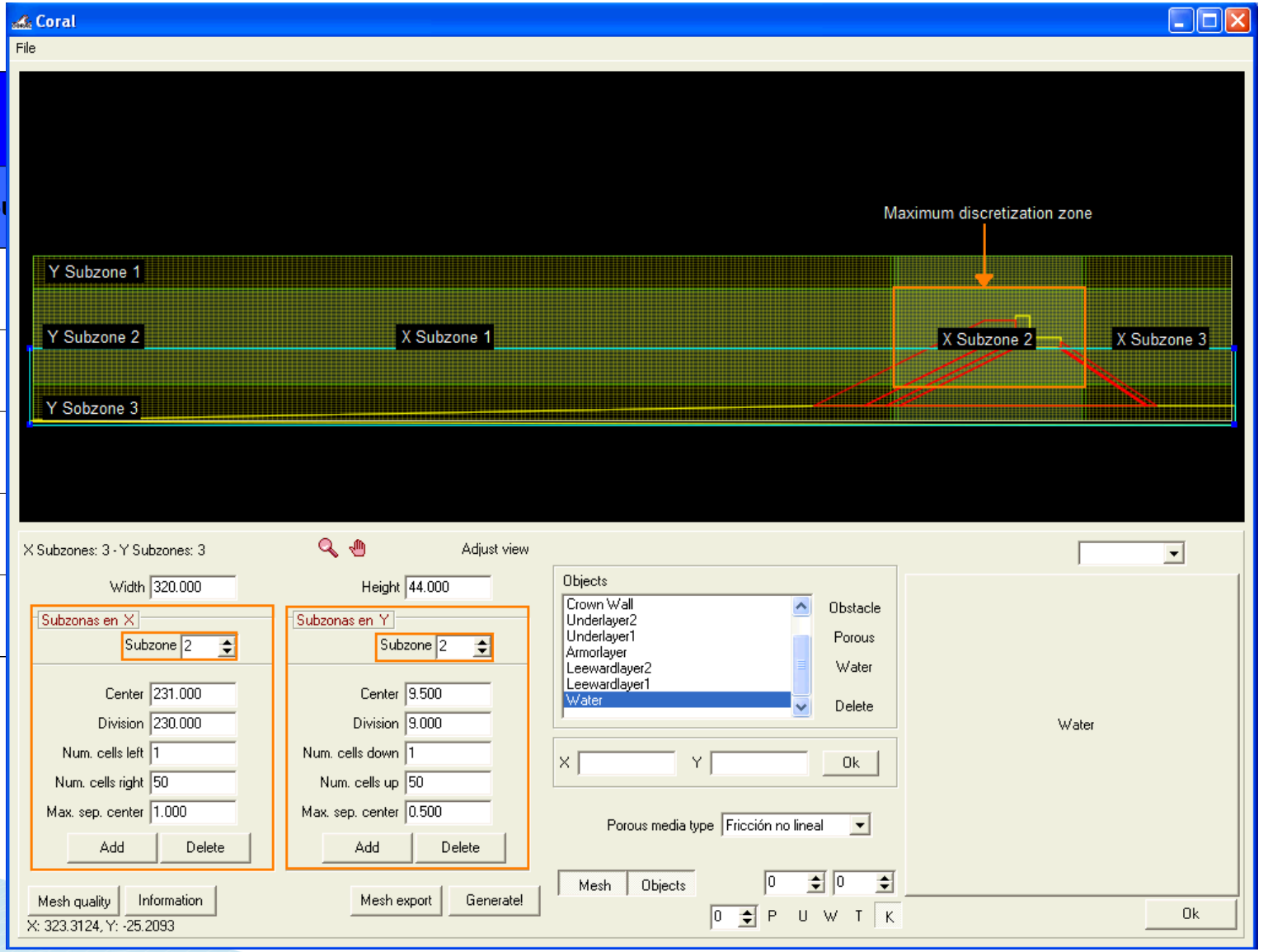
-The tested wave height will be 10 m → Δy =1m. As overtopping events are expected in this case, a small vertical discretization is considered → Δy = 0.5m.

- An aspect ratio equal to Δx/Δy = 2 is selected which means Δx = 1m.



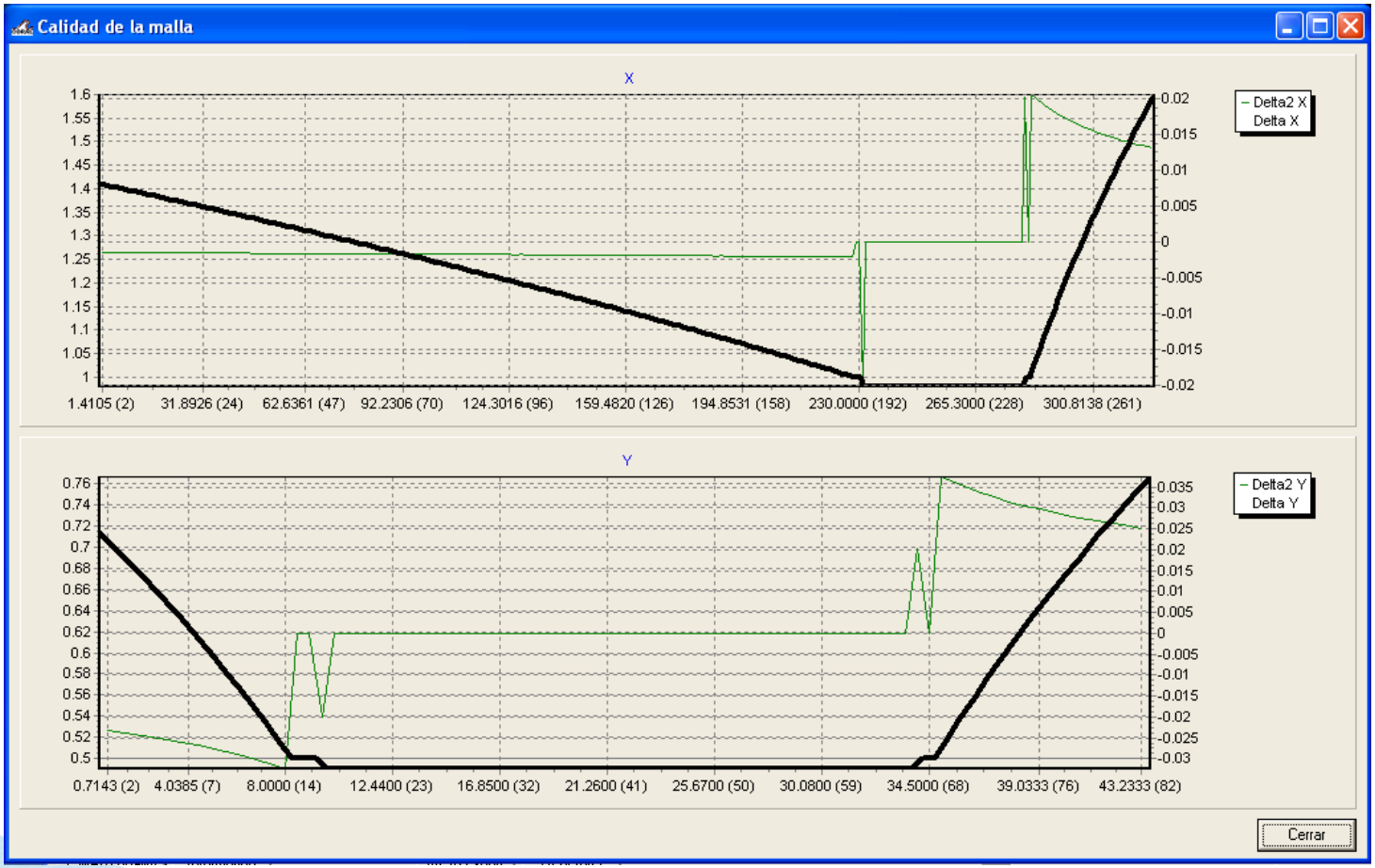
MESH GENERATION: Spatial discretization

Center	
Division	
Num. cells left	
Num. cells right	
Max. sep. center	



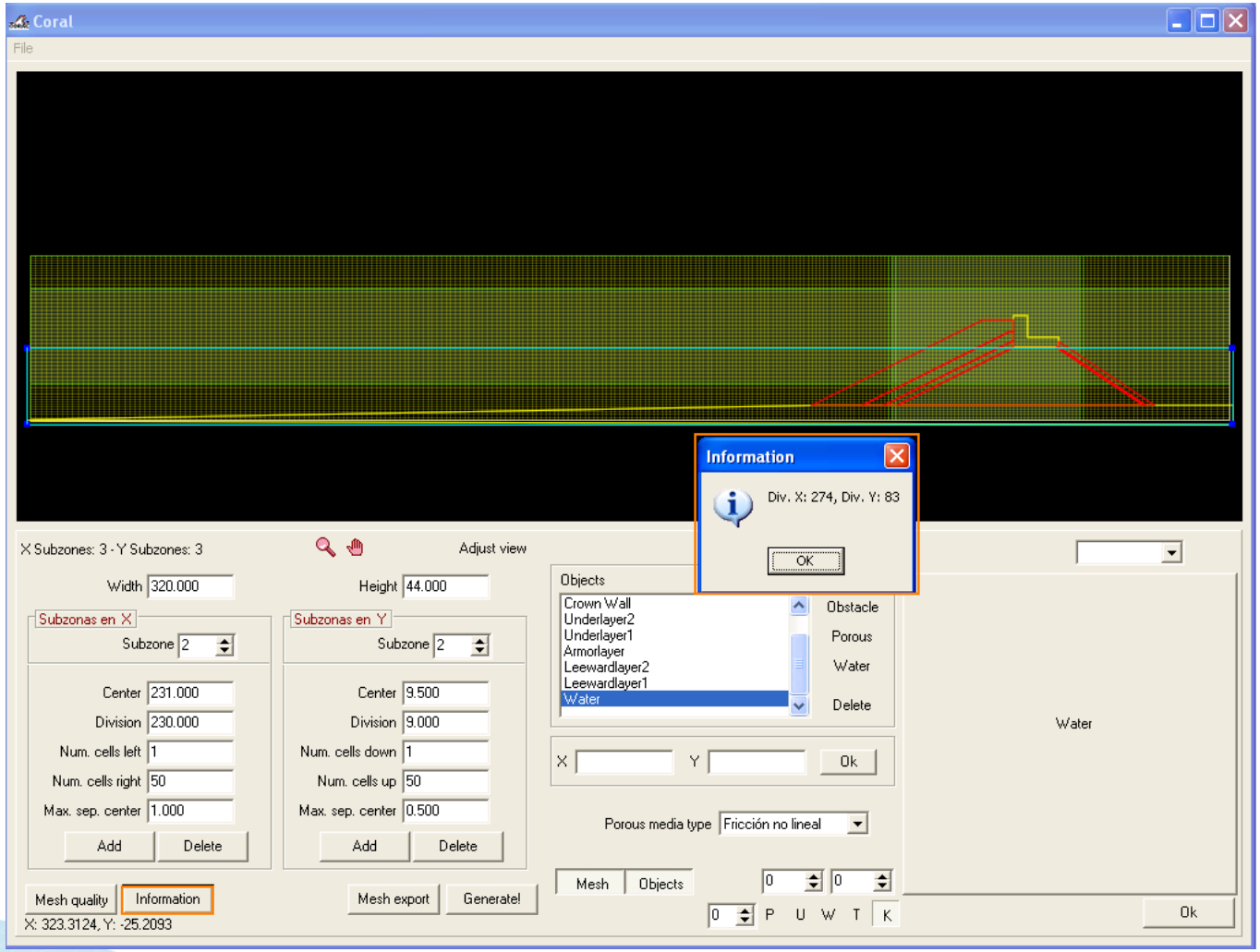
MESH GENERATION: Mesh quality

By pressing button “Mesh quality”:



MESH GENERATION: Mesh info

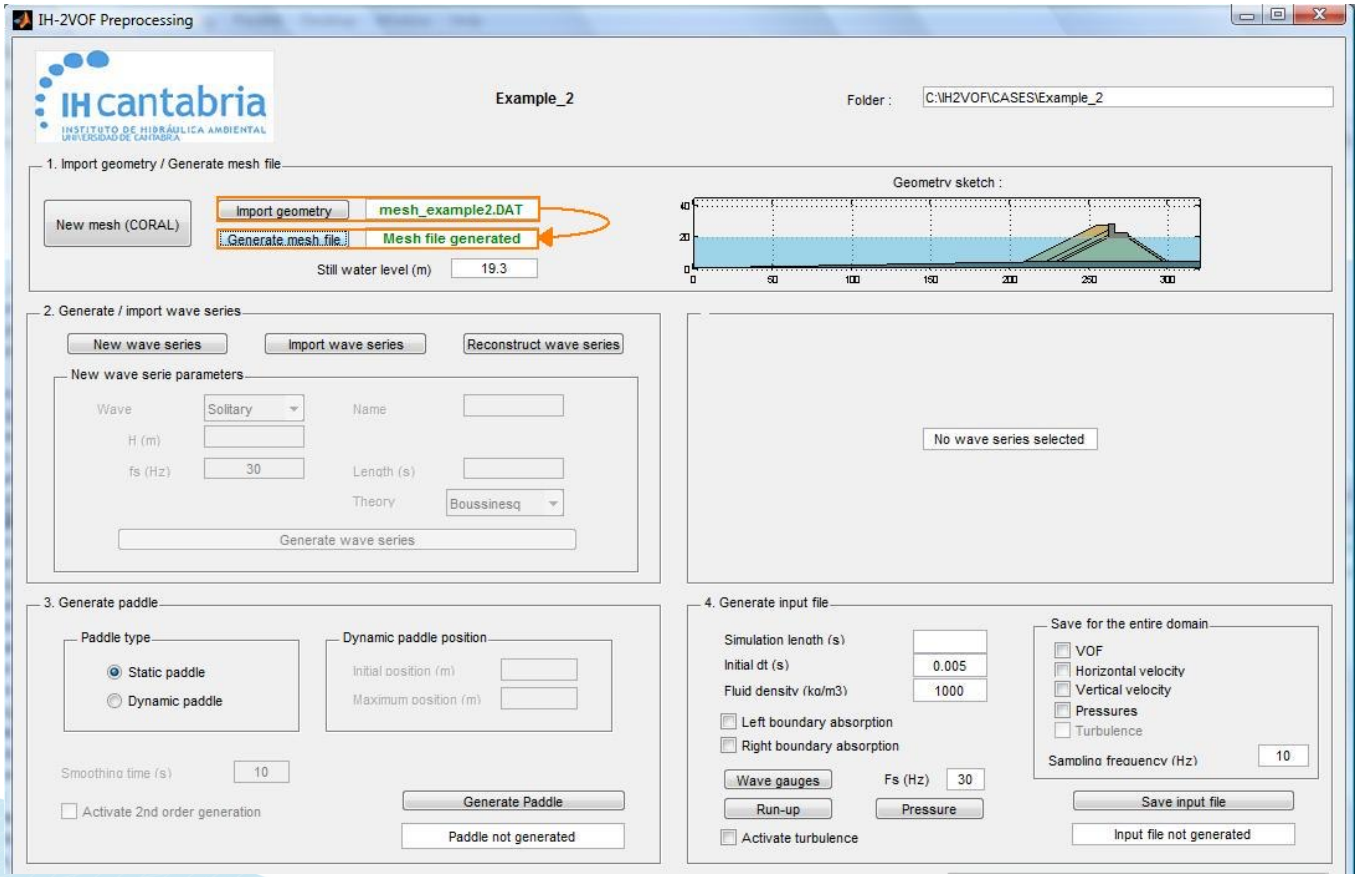
By pressing button “Information”:



SECTION 1 : "IMPORT GEOMETRY/GENERATE MESH FILE"

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

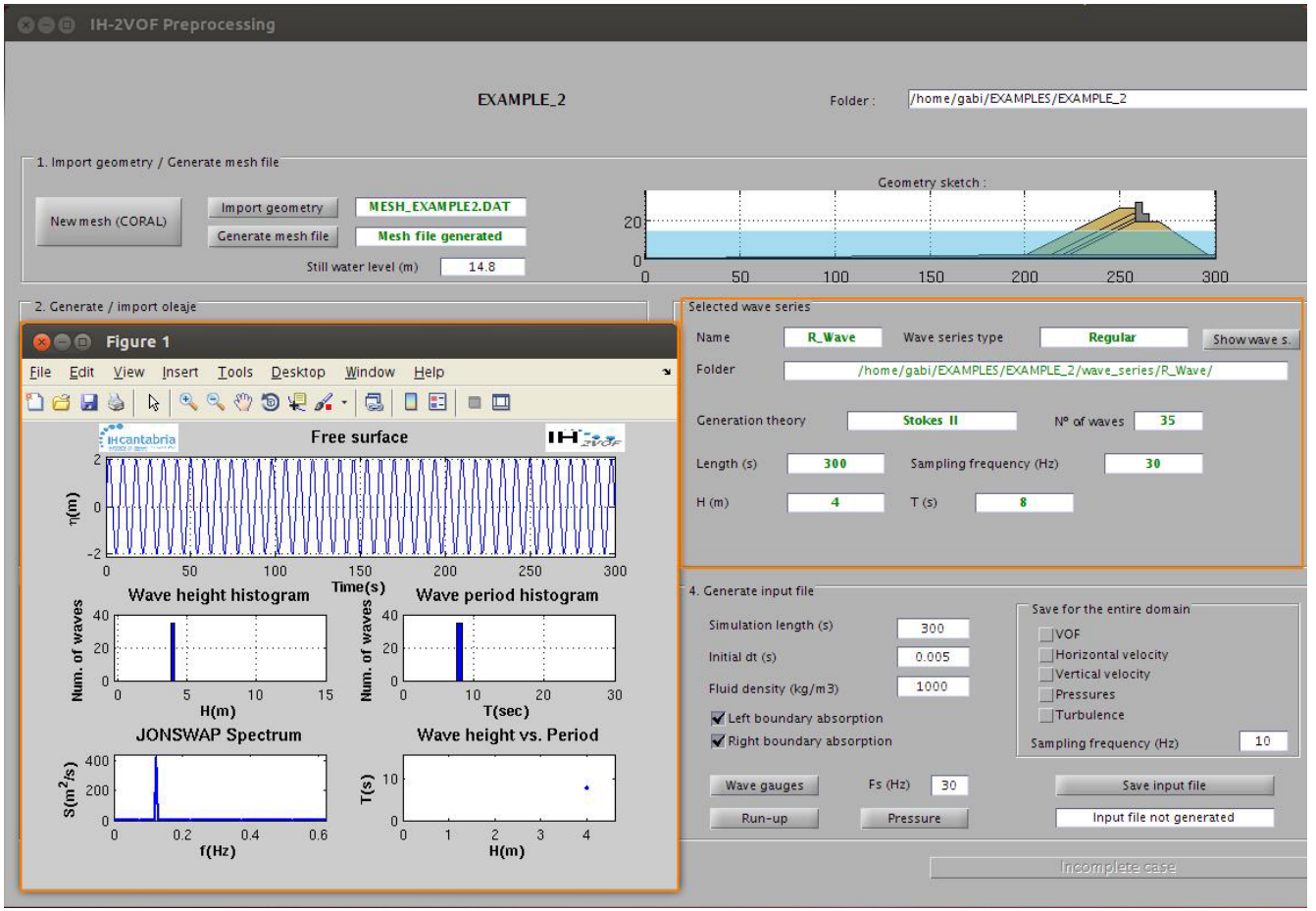
-Mesh characteristics are exported to a ***"Mesh.mesh"***



SECTION 2 : "GENERATE/IMPORT WAVE CONDITIONS"

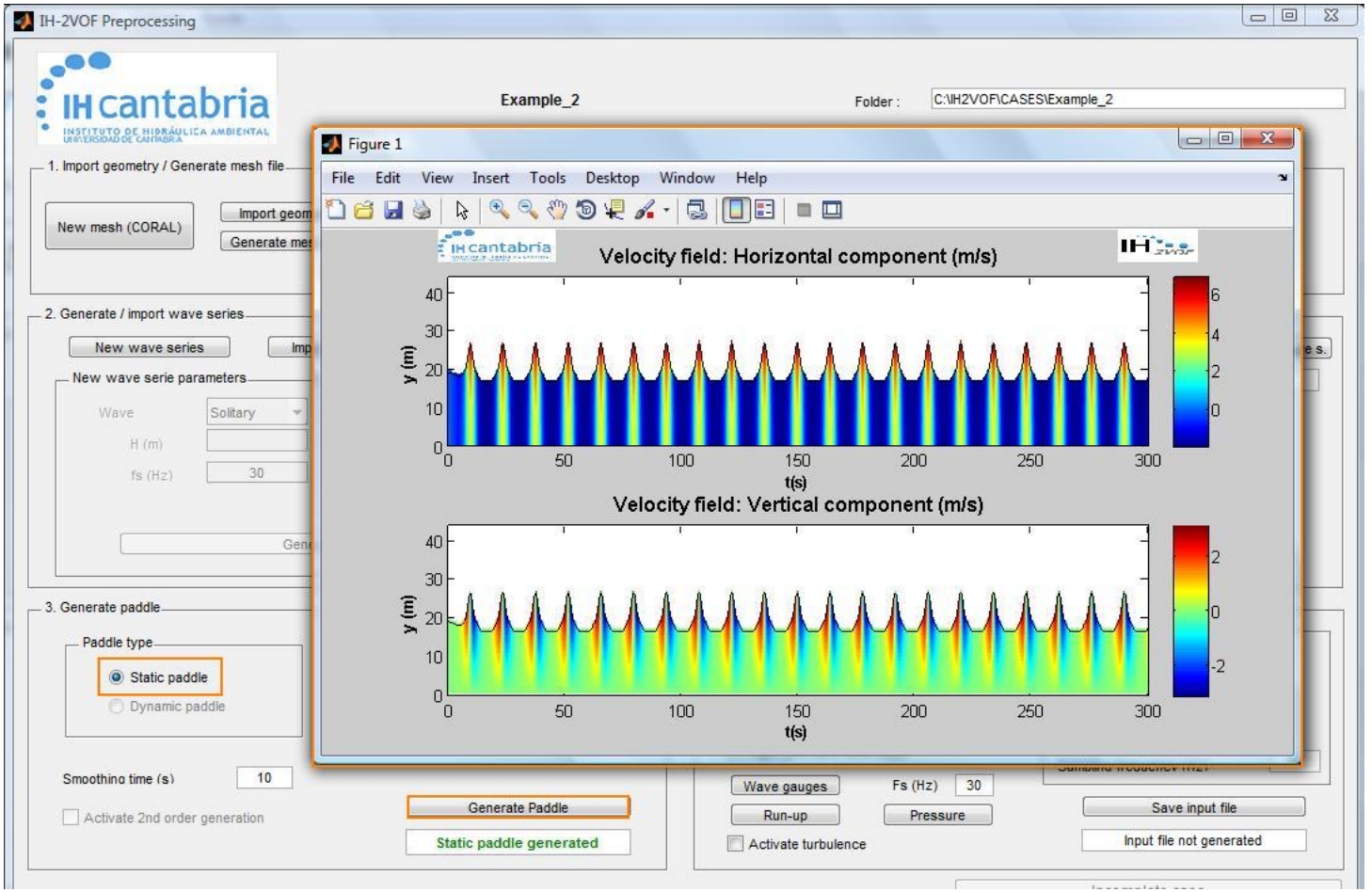
- Wave series: Regular
- H = 10 m high
- T = 14 s
- Time series 200 s long
- Stokes V

Generate wave series

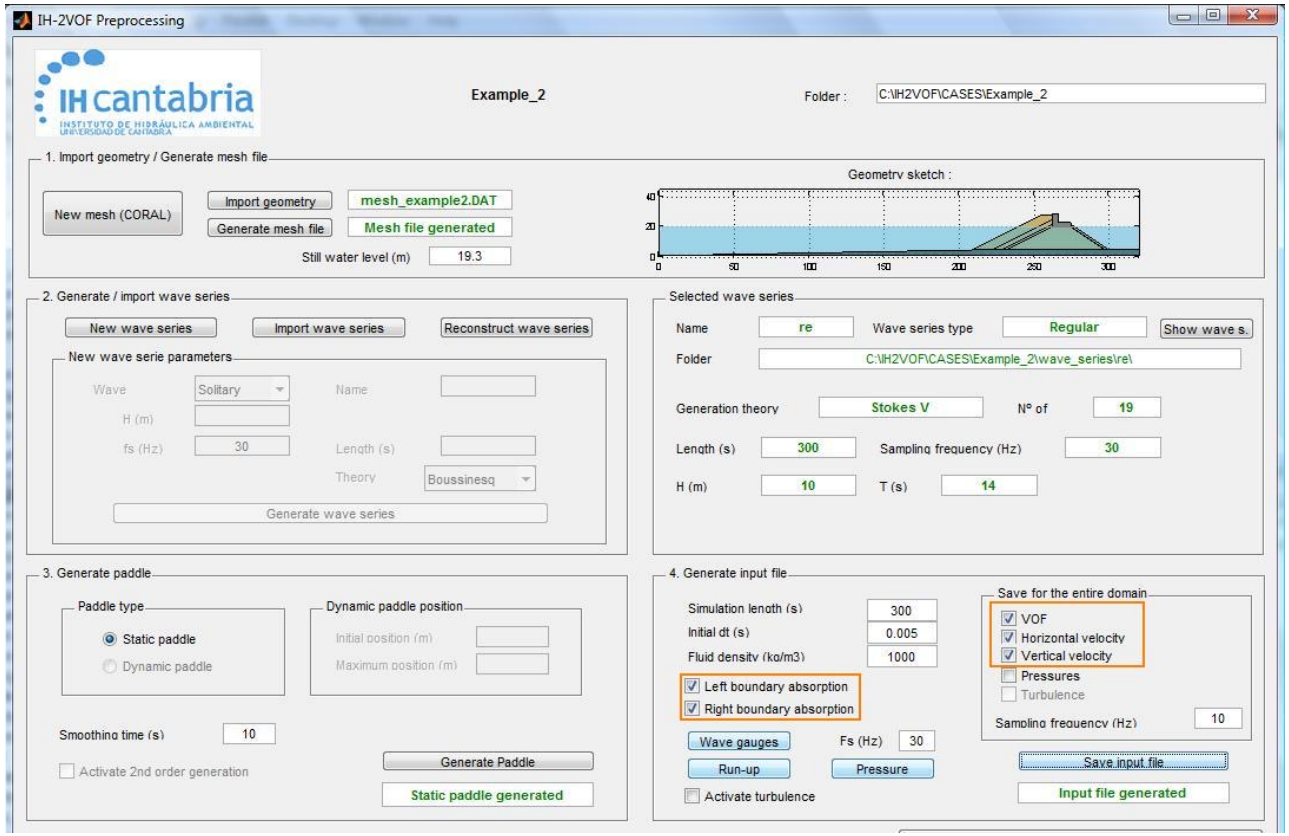


SECTION 3 : "GENERATE PADDLE

-Static wave paddle



SECTION 4 : "GENERATE INPUT FILE"



- Simulation length = 200 s

- Initial dt = 0.005 s (por defecto)

- Left and right boundary absorption are activated

- VOF, horizontal and vertical velocity fields are saved

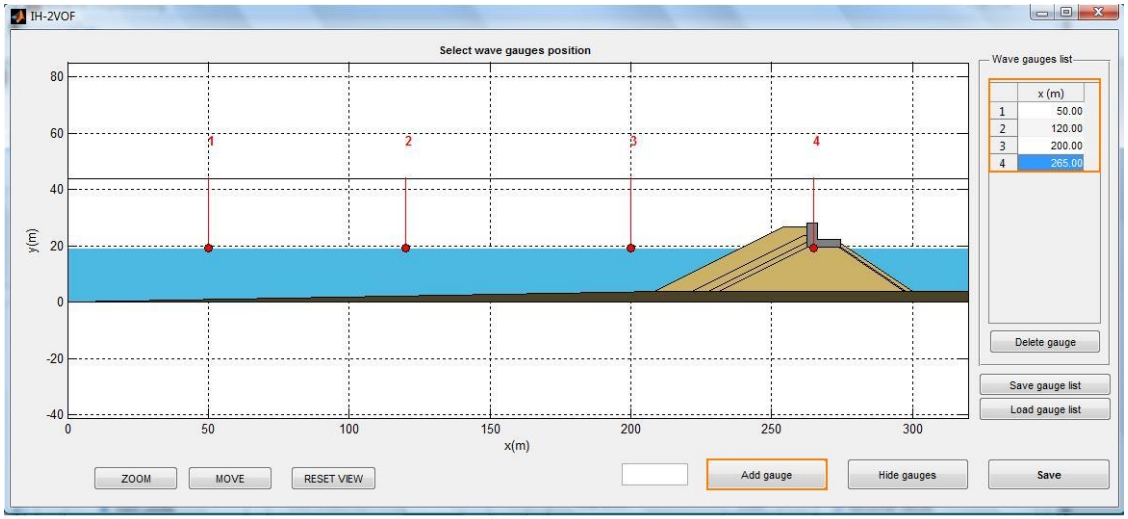
SECTION 4 : "GENERATE INPUT FILE" – *Wave gauges*

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

Gauge	X(m)
1	50
2	120
3	200
4	265

Press the button *Wave gauges - Add gauge*

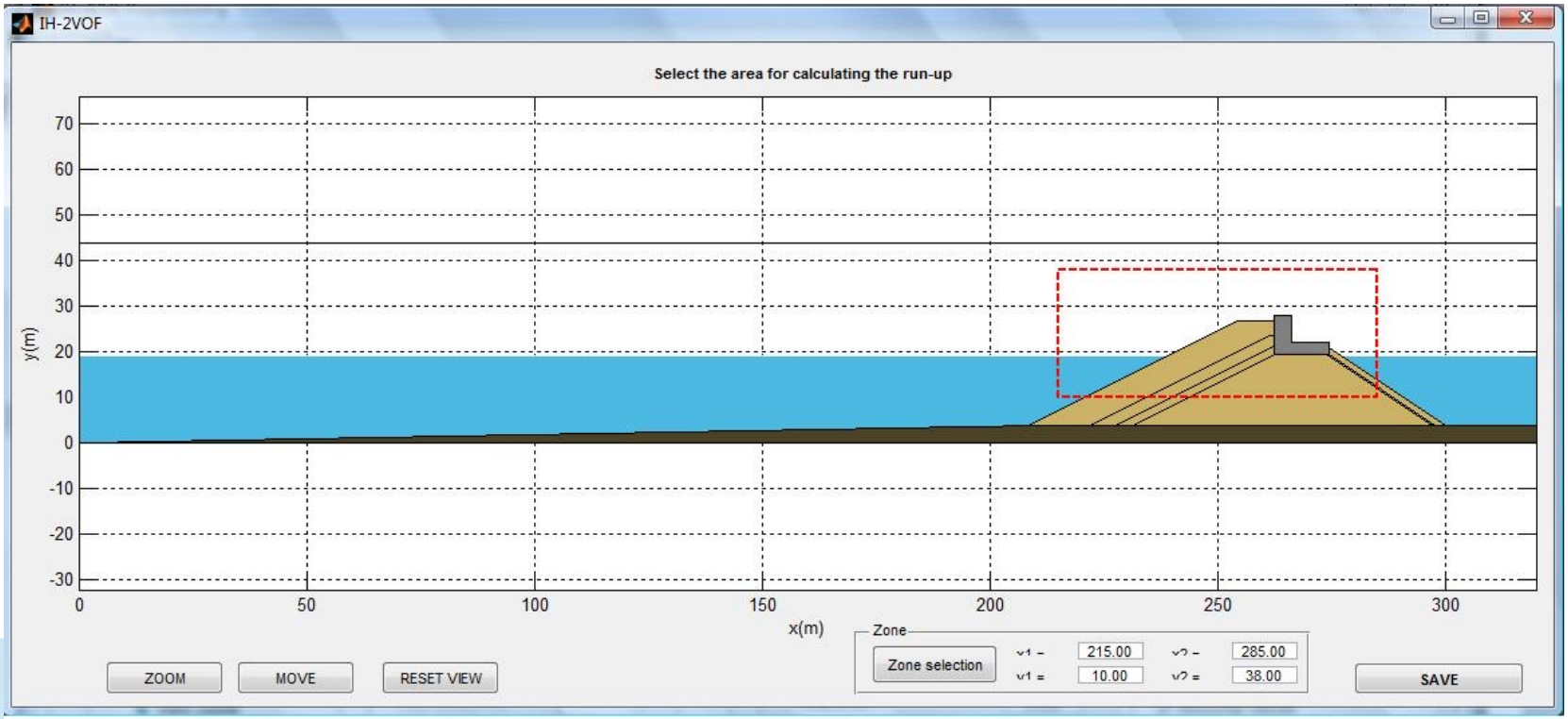
Gauges positions are specified



SECTION 4 : "GENERATE INPUT FILE" – *Run-up*

Press the button *Run-up*

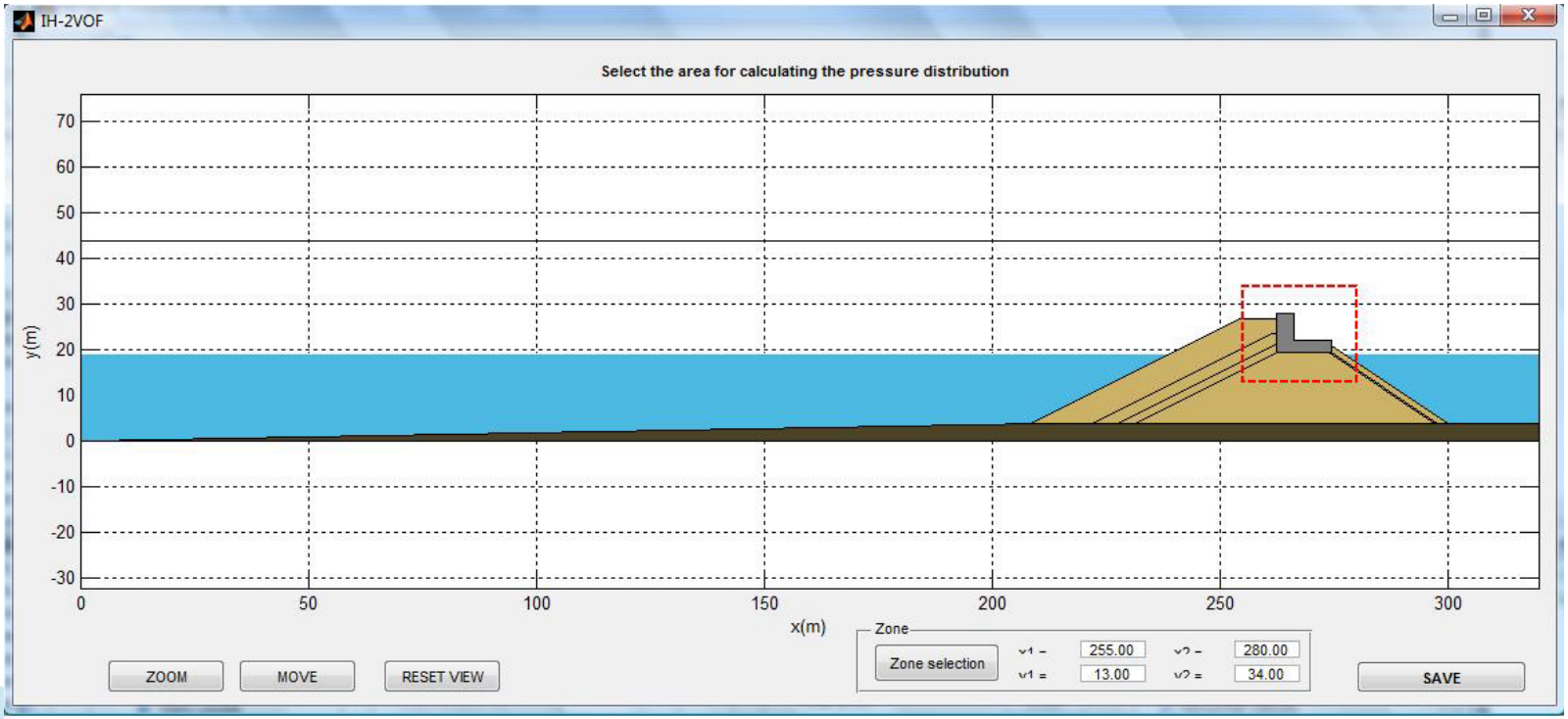
The area where run-up is calculated is selected specifying two vertices



SECTION 4 : "GENERATE INPUT FILE" – *Pressure*

Press the button *Pressure*

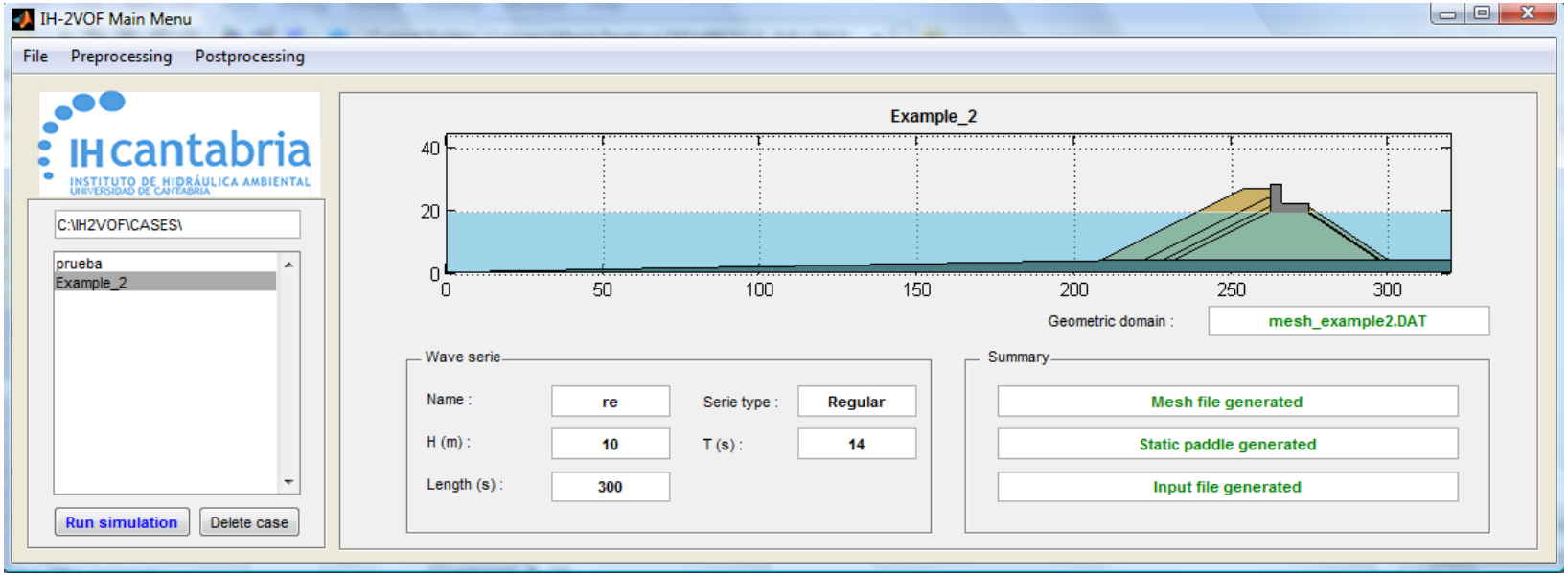
The area where pressure is calculated is selected specifying two vertices



SUMMARY

All the variables are defined
The input file is saved

➔the case is ready to be simulated



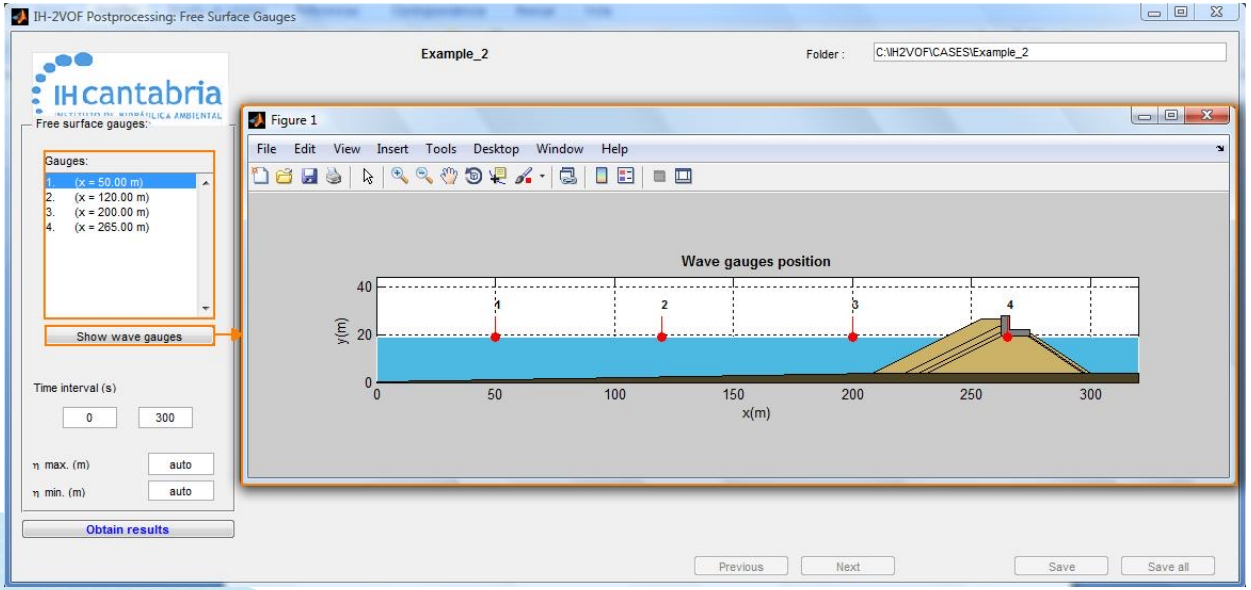
The simulation which will starts by pressing the button *Run simulation*

POSTPROCESSING

In the present example different aspects are analyzed:
- Free surface evolution
- The energy spectra evolution
- The run-up
- The overtopping
- Pressure around the crown-wall
- Visual analysis

WAVE GAUGES – Time series

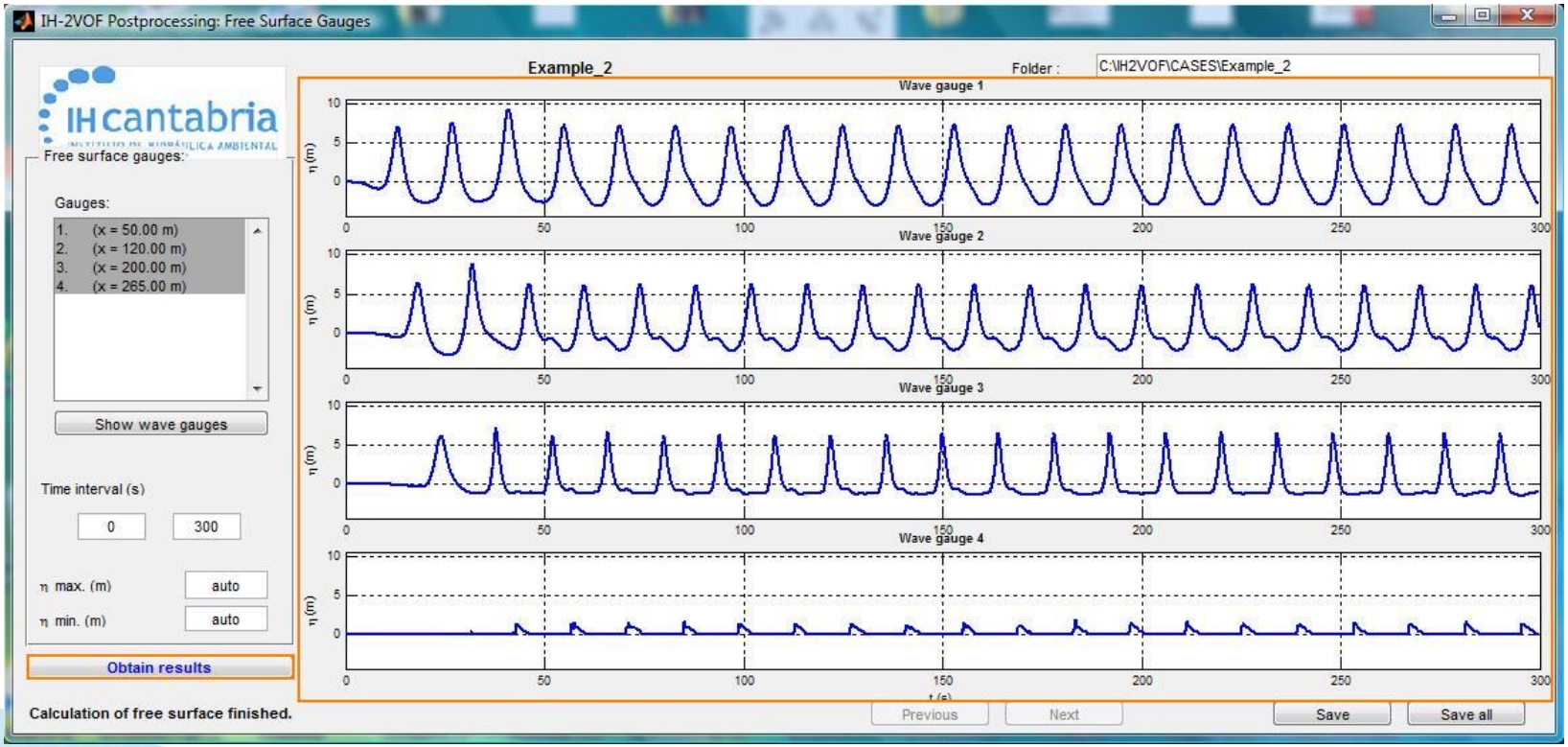
Postprocessing → *Free surface gauges* → *Show wave gauges*



WAVE GAUGES – Time series

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

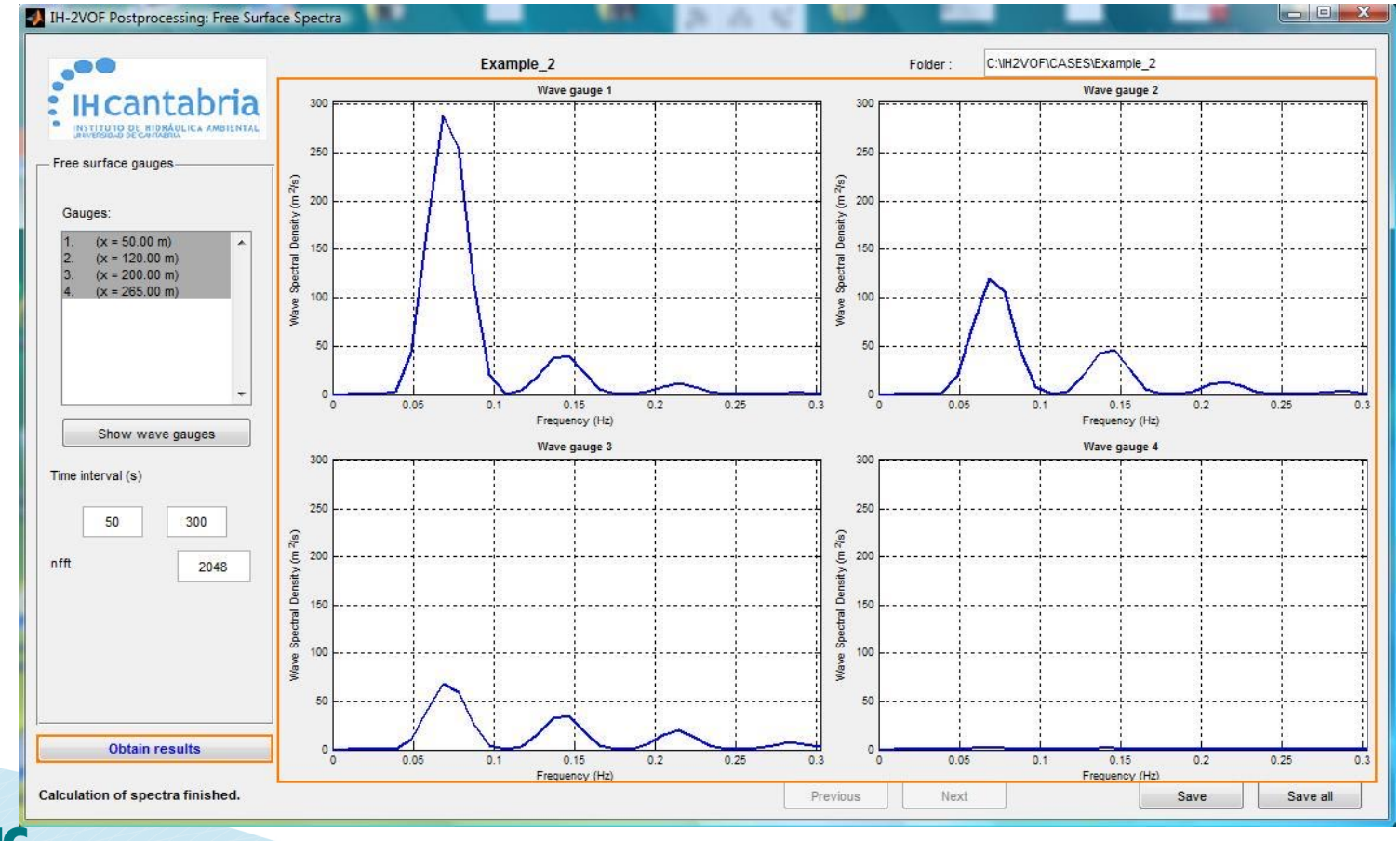
Postprocessing → *Free surface gauges* → *Time Series* → *Obtain results*



WAVE GAUGES – Spectra

- Energy spectra associated to each one of the selected gauges before the simulation can be obtained

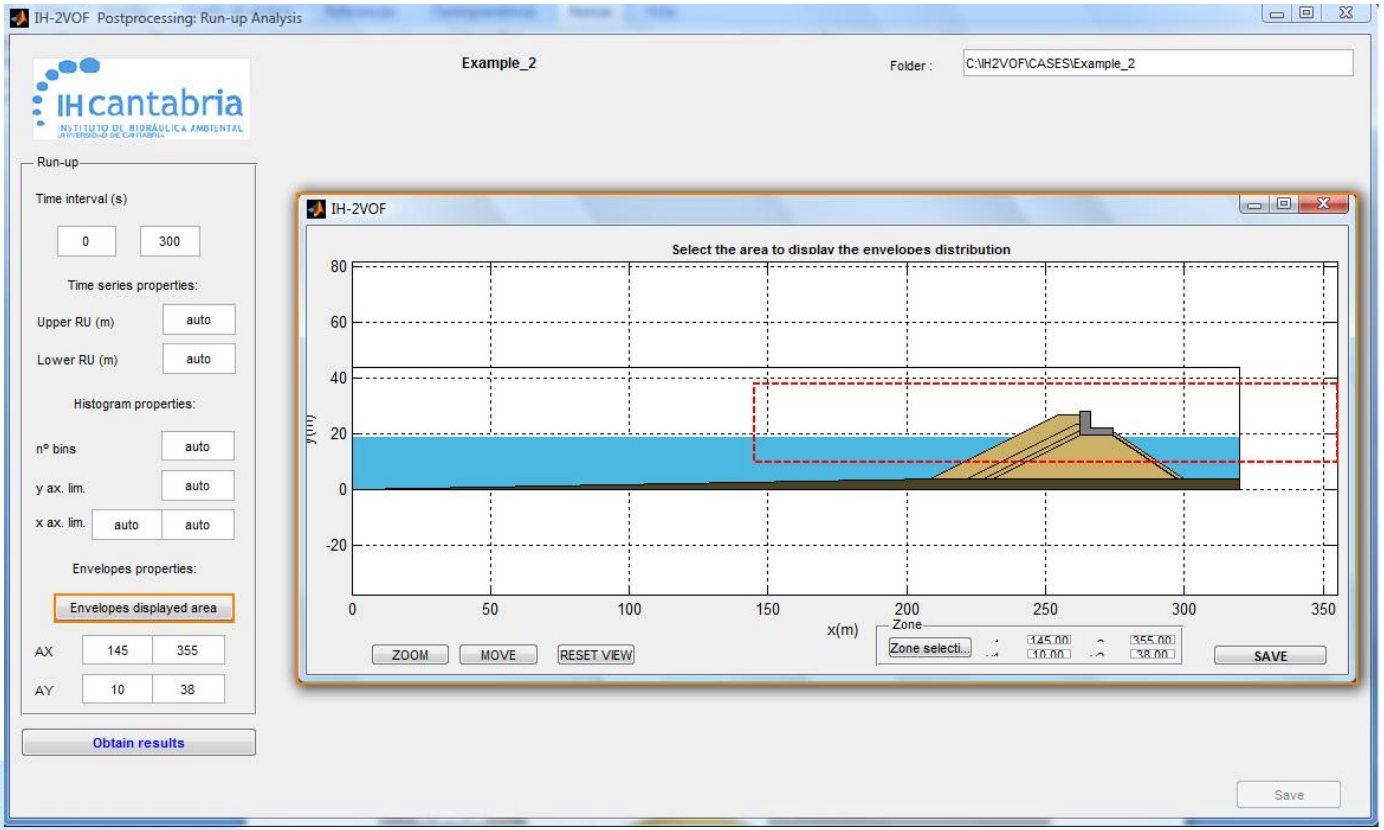
Postprocessing → *Free surface gauges* → *Spectra* → *Obtain results*



RUN UP – Envelopes displayed area

- The run up produced over the structure can be calculated.

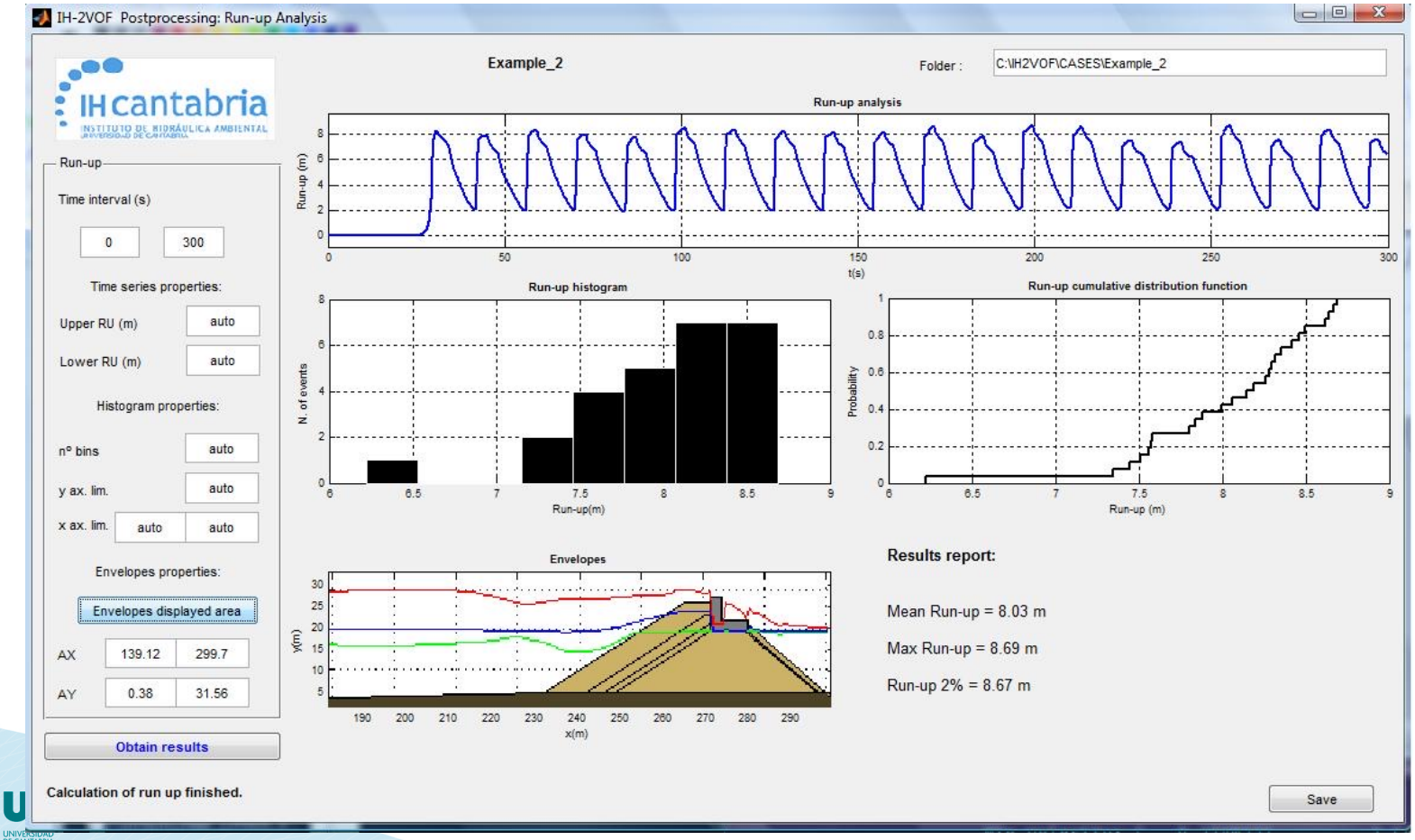
Postprocessing → *Run-up Analysis* → *Envelopes displayed area*



RUN UP – Obtain results

- Run up results shows the run up time series in which the scale can be chosen.

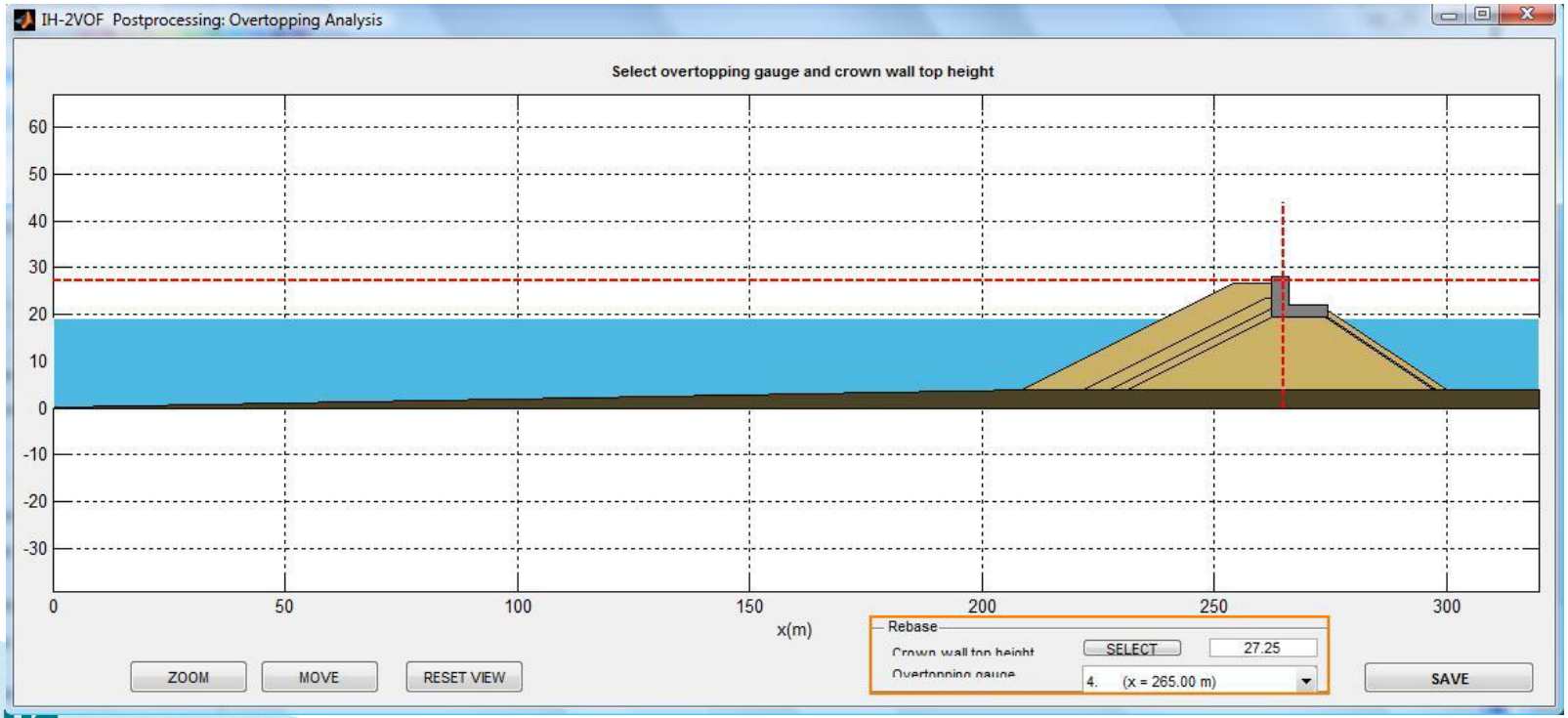
Postprocessing → *Run up analysis* → *Obtain results*



OVERTOPPING– Select overtopping area

-The overtopping produce over the structure is analyzed.
-The gauge where the overtopping is calculated is selected as well as the crown wall top height, as is shown in Figure .

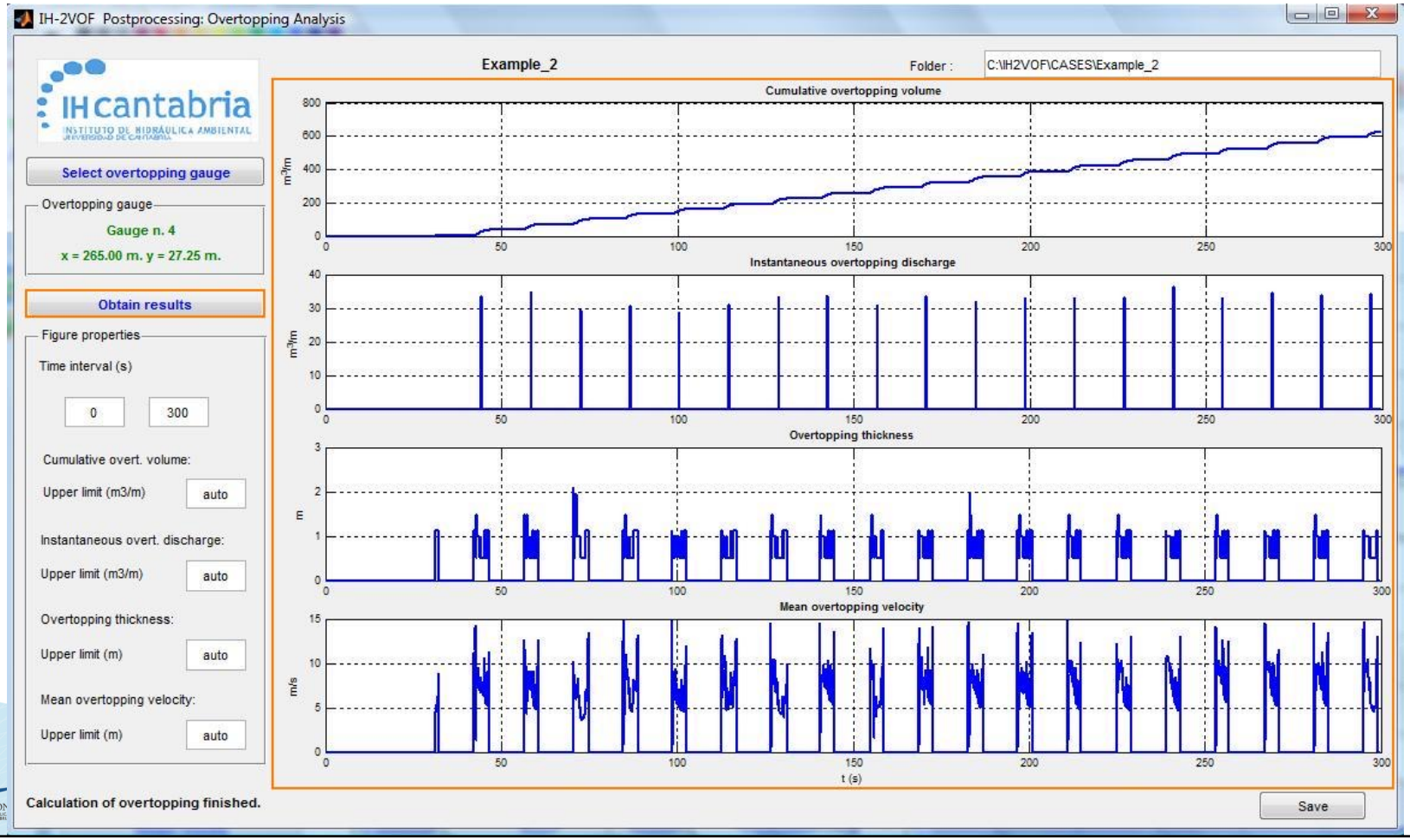
Postprocessing → *Overtopping Analysis* → *Select overtopping area*



OVERTOPPING– Obtain results

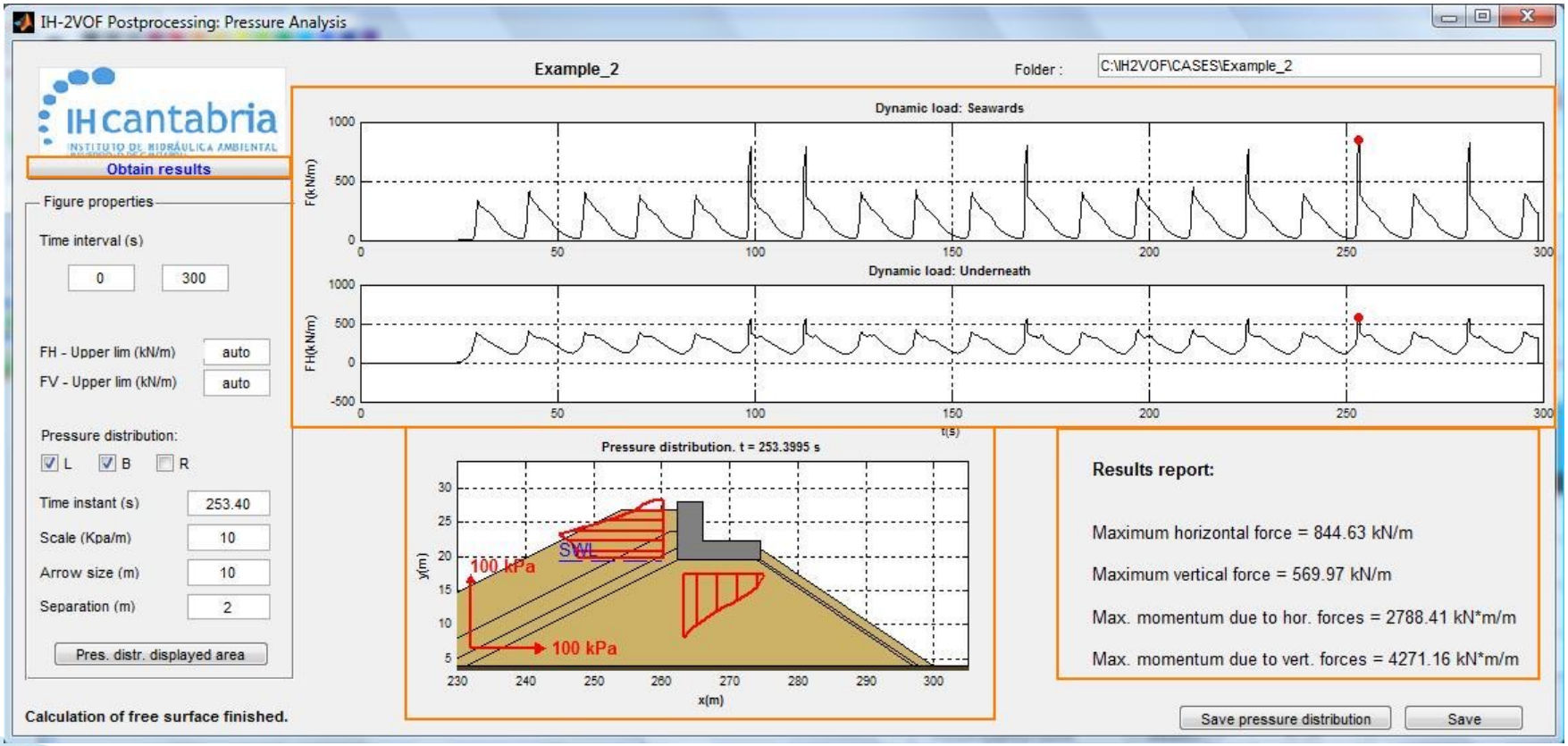
Postprocessing → *Overtopping Analysis* → *Obtain results*

Pressing the button *Obtain results:*
- The cumulative overtopping volume.
- The instantaneous overtopping discharge.
- Overtopping thickness and the mean overtopping velocity



PRESSURE– Obtain results

Postprocessing → *Pressure analysis* → *Obtain results*

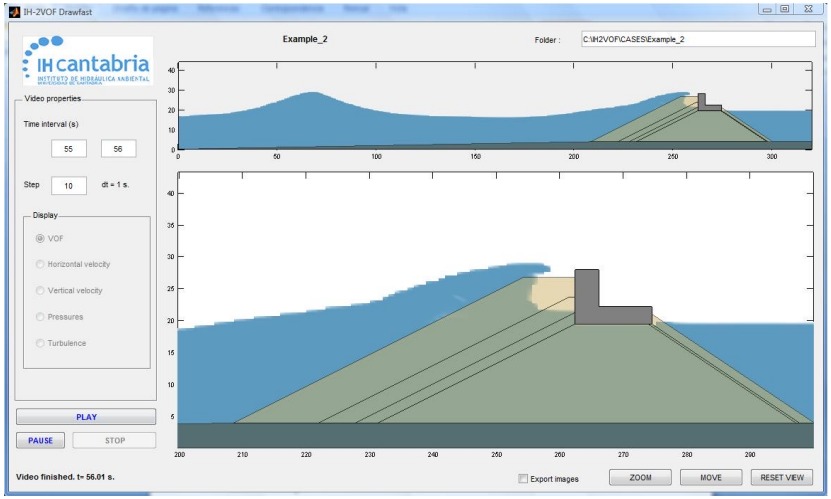


DRAWFAST

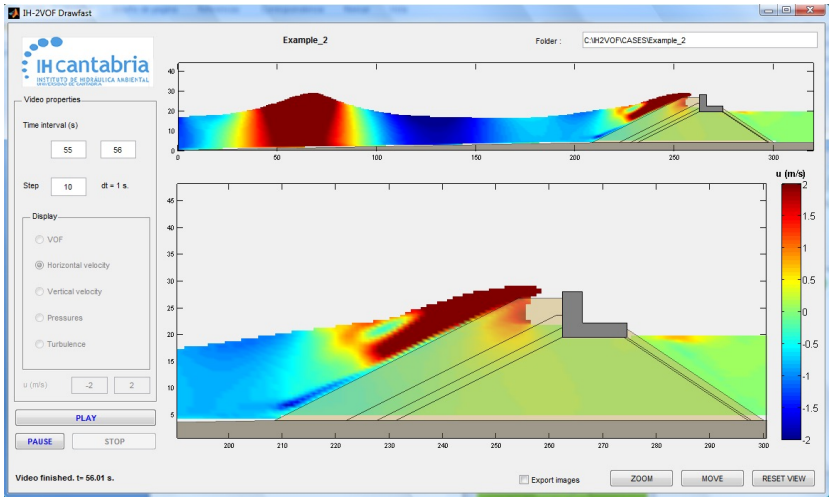
- A video of the different variables chosen before the simulation can be seen.

-Choose the initial time, final time and time step

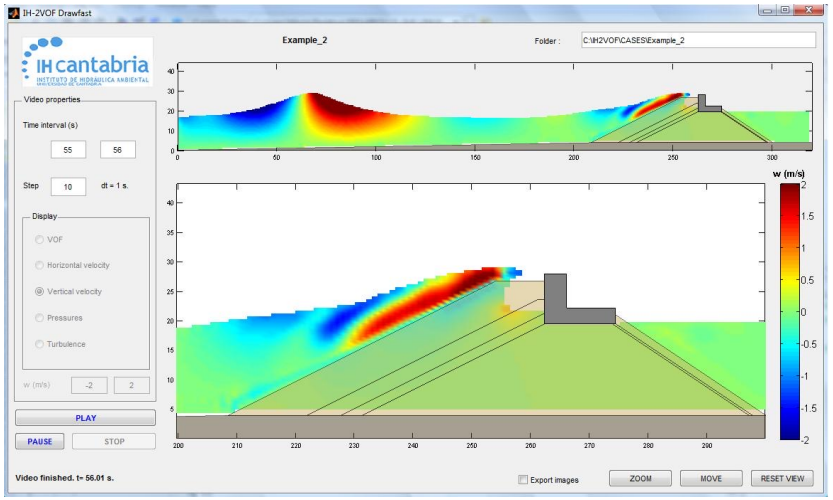
-The lower panel allows a zoom of the area of interest



VOF drawfast



Horizontal Velocity drawfast



Vertical Velocity drawfast

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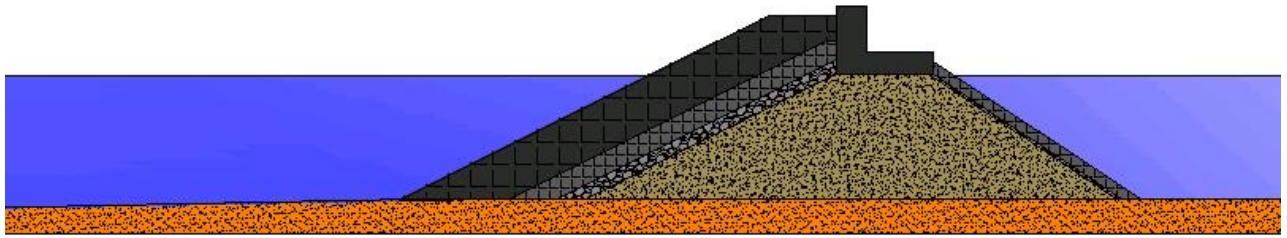
Example 2

Regular wave interaction with a rubble-mound breakwater



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