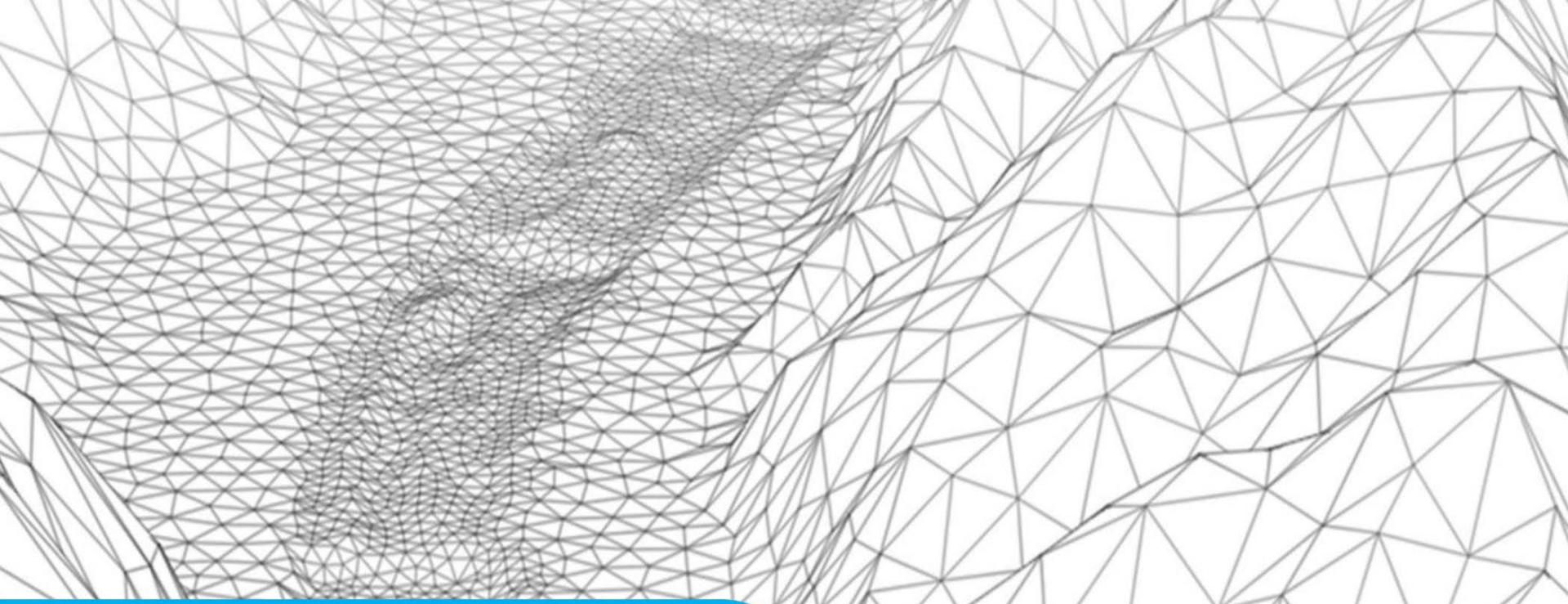


Hydraulic tools: Introduction to Iber 2D

Erasmus+ Programme Cooperation Partnerships
2022-1-FR01-KA220-HED-000089658
HydroEurope

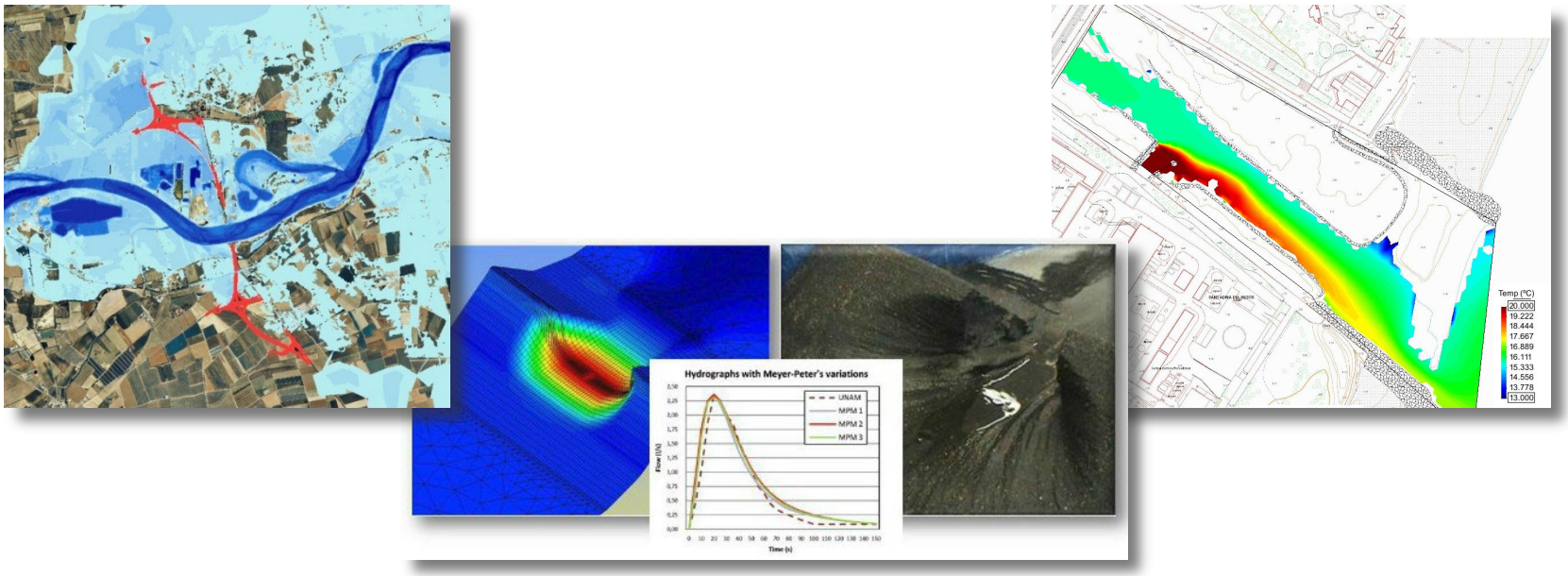
WP2: Uncertainty in Advanced Hydrological and Hydraulic Modelling
WP3: Climate Change Impacts on Flash Floods

Case of study La Tordera catchment

Author: Marcos Sanz Ramos
Universitat Politècnica de Catalunya, Barcelona
email: marcos.sanz-ramos@upc.edu

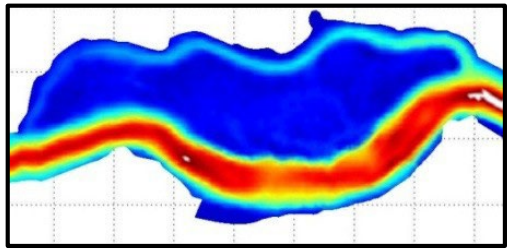
What's Iber?

- Iber is a two-dimensional software for simulation of:
  - Free surface flow (hydrodynamics)
  - Morphodynamics and sediment transport processes
  - Water quality processes



What's Iber?

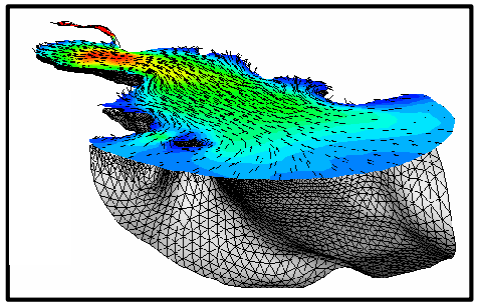
- Currently, Iber has three computational modules:



HYDRODINAMICS

Velocity

Depth



SEDIMENT TRANSPORT

Suspension load

Bed load

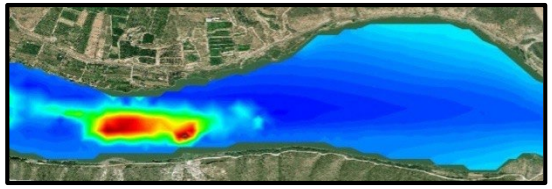
TURBULENCE

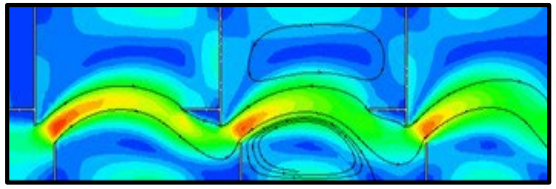
Turbulent viscosity

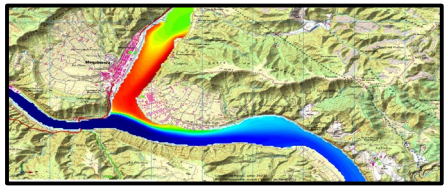
Turbulent and dissipation energy

WATER QUALITY

Transportation, reaction and degradation of pollutants







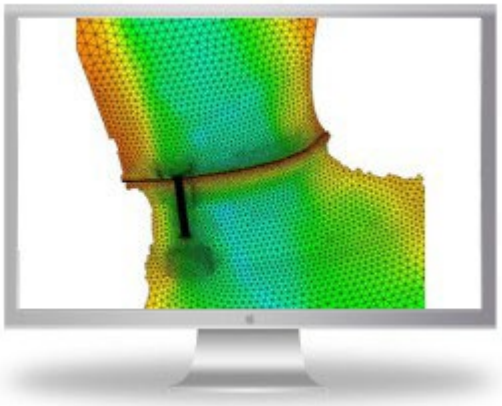
What's Iber?

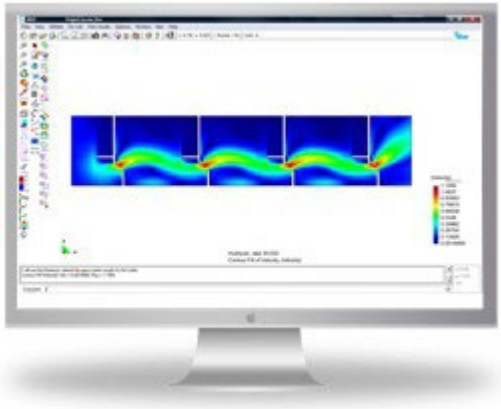
- Iber was developed by the Water and Environmental Engineering Group, GEAMA (University of A Coruña) and the FLUMEN Institute (Polytechnic University of Catalonia, UPC, and International Centre for Numerical Methods in Engineering, CIMNE).

- Iber was initially sponsored by the Centre for Hydrographic Studies (CEDEX) within the framework of a Cooperation Agreement between CEDEX and the Dirección General del Agua (Spanish Water Resources Management Department).

What's Iber?

- Iber model is based on GiD interface, a software of pre- and post-process that help's Iber to prepare the whole model, launch the simulation, show the results and is compatible with GIS.





- Iber can be downloaded for free from (Windows OS):

www.iberaula.com

- In this website there is more information about the software, publications, papers, forums, training activities, etc.

Capabilities of Iber

- Iber is:
  - Hydrodynamic mathematical model based on the **2D Saint Venant equations**

$$\frac{\partial h}{\partial t}+\frac{\partial q_x}{\partial x}+\frac{\partial q_y}{\partial y}=0$$

$$\frac{\partial q_x}{\partial t}+\frac{\partial}{\partial x}\left(\frac{q_x^2}{h}+g\frac{h^2}{2}\right)+\frac{\partial}{\partial y}\left(\frac{q_x q_y}{h}\right)=-gh\frac{\partial z_b}{\partial x}-\frac{\tau_{b,x}}{\rho}-\frac{\partial}{\partial x}\left(h\,\overline{u_x' u_x'}\right)-\frac{\partial}{\partial y}\left(h\,\overline{u_x' u_y'}\right)$$

$$\frac{\partial q_y}{\partial t}+\frac{\partial}{\partial x}\left(\frac{q_x q_y}{h}\right)+\frac{\partial}{\partial y}\left(\frac{q_y^2}{h}+g\frac{h^2}{2}\right)=-gh\frac{\partial z_b}{\partial y}-\frac{\tau_{b,y}}{\rho}-\frac{\partial}{\partial x}\left(h\,\overline{u_x' u_y'}\right)-\frac{\partial}{\partial y}\left(h\,\overline{u_y' u_y'}\right)$$

  - Based on **explicit finite volume schemes** on structured and unstructured meshes
  - Conservative wetting and drying algorithm
  - **Verified and validated** with analytical solutions, other models, laboratory tests and field measurements
- Iber has:
  - A **user-friendly interface** for pre- and post-processing
  - The capability to **create a model in few steps**
  - A **powerful mesh generator**
  - **GIS, CAD** and more **integration modules** (view, import and export results)

Building the model

- Each model need some conditions or properties in order to solve Saint Venant equations.

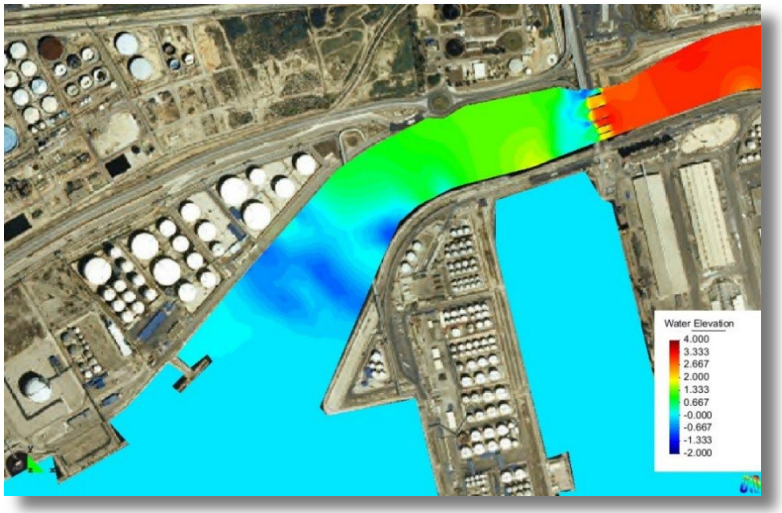
- In Iber it's necessary to define:

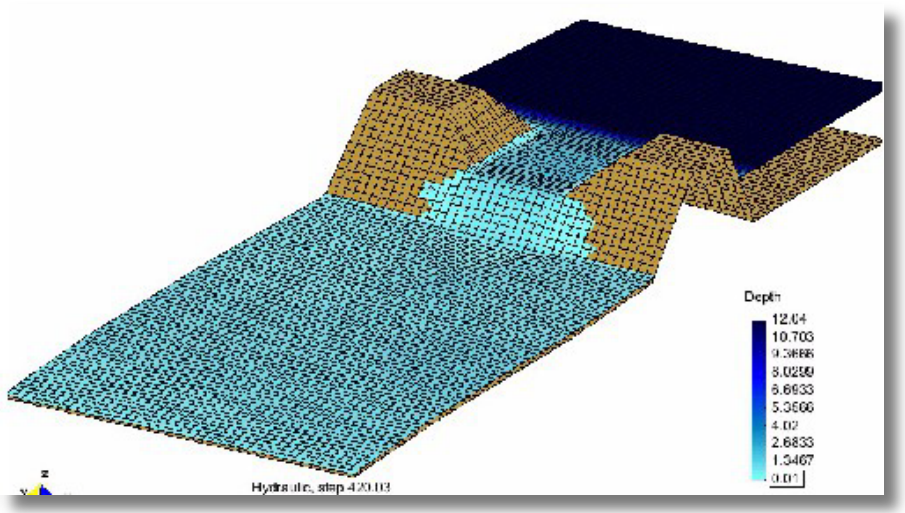
geometry
\+ *roughness*
\+ *initial conditions*
\+ *boundary conditions*

- Solving the equations in each element and each time step, we obtain the evolution of the water depth and water velocity (X and Y direction).

Capabilities of Iber

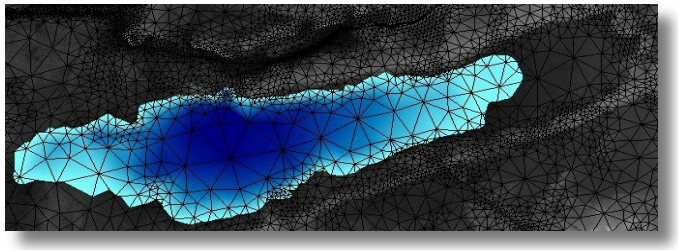
- The model can be used for:
  - Flood inundation modelling
  - Dam break modelling
  - Hydraulic calculation of encroachments
  - Calculation of tidal currents in estuaries
  - Consideration of hazard for flooding studies
  - Turbulence modelling in shallow free surface flows



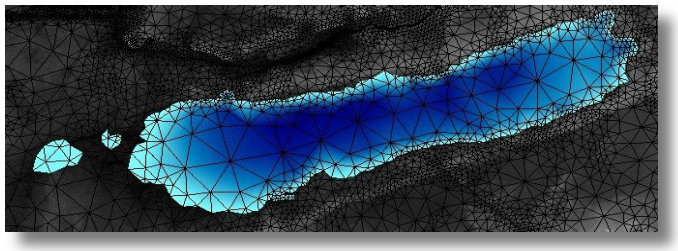


Capabilities of Iber

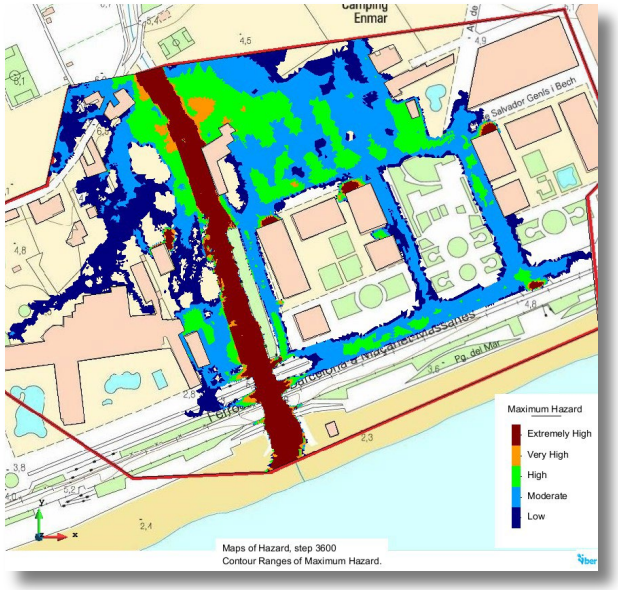
- The model can be used for:
  - Stability of bed sediments
  - Erosion and sedimentation due to transport of non-cohesive sediments
  - Simulation flows through hydraulic structures (bridges, weirs, gates, culverts, lids, etc.)
  - Wind surface stress considerations hydrodynamics
  - Water Quality calculations
  - Hydrological processes simulation



V_{wind}=0 m/s

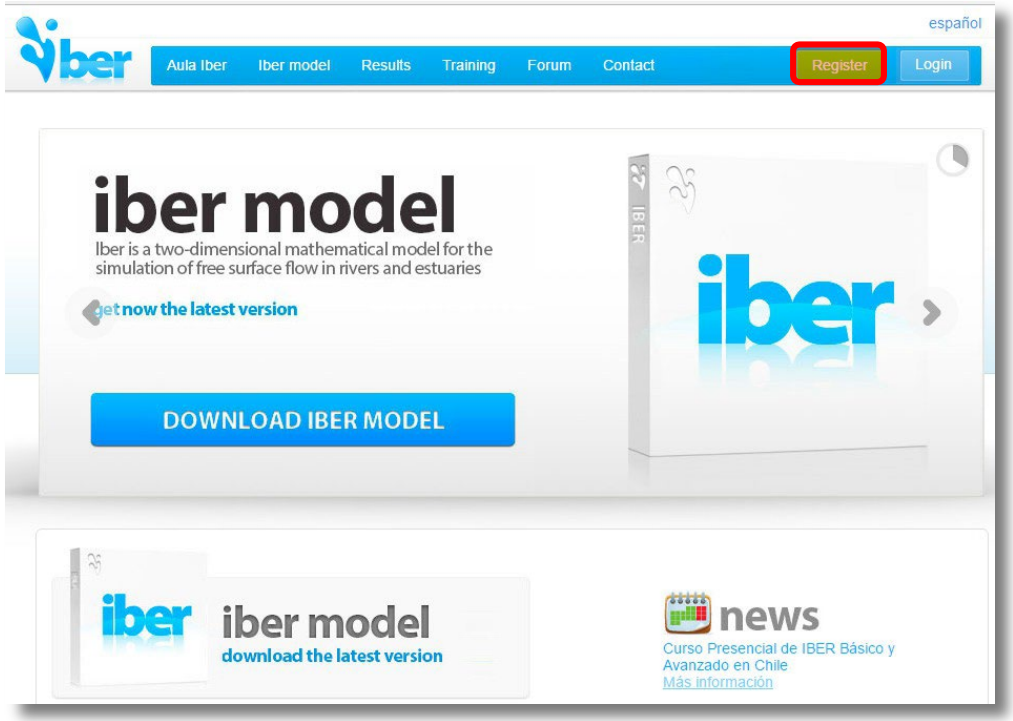


V_{wind}=3 m/s



Installation of Iber

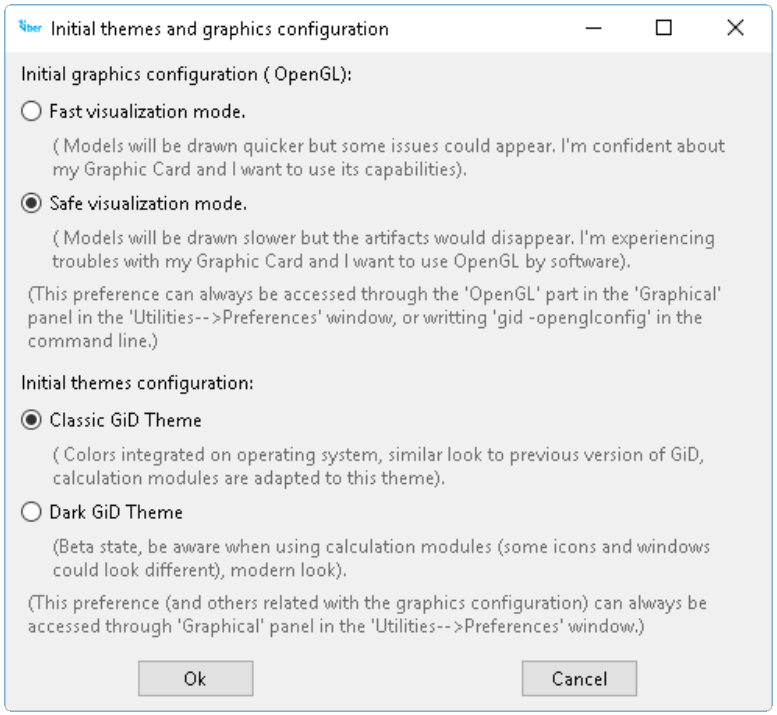
- The setup process is easy and fast.
  - Go to www.iberaula.com
  - Just do the registration process (“Register”) or “Login” if you has already done it



  - In **Iber model >> Download**, you can find the models and the manuals

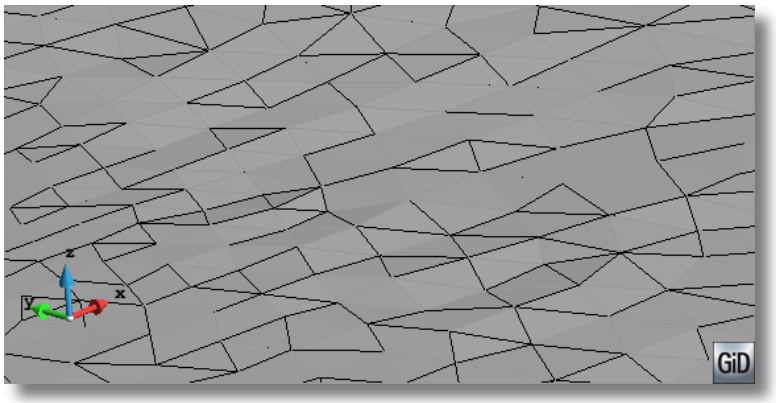
NOTE: Iber can be used in Windows OS (32 and 64 bits)

- The setup process is easy and fast.
  - After the installation process, it is necessary to configure the graphical properties

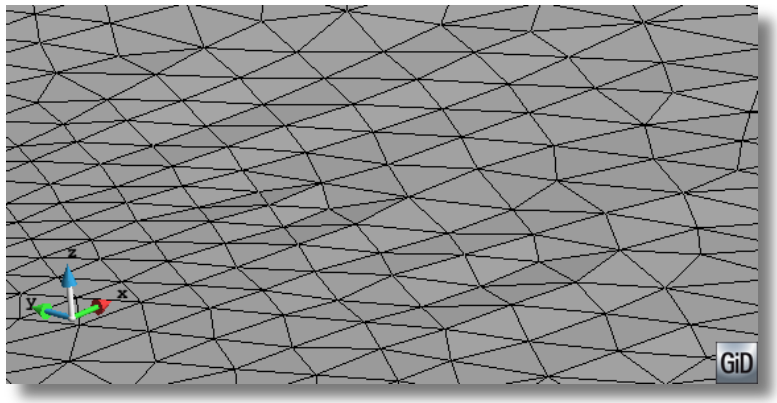


  - If you are not sure about your GPU capabilities, you can change it by Start >> Programs >> Iber >> Iber safe mode

- The setup process is easy and fast.
  - If the visualization of the elements is similar than shown in the left image, it is necessary to change the configuration of the graphics (Start >> Programs >> Iber >> Iber safe mode).



Mesh view in wrong visualization mode

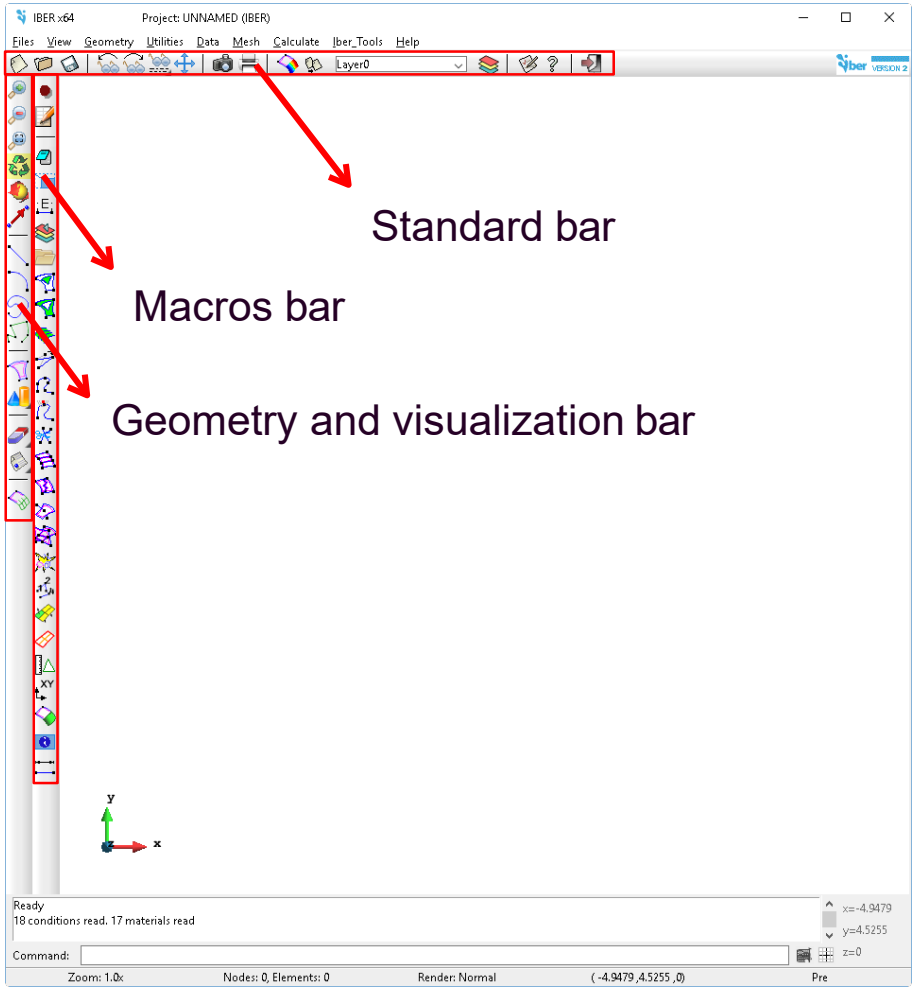


Mesh view in correct visualization mode

NOTE: the visualization mode is not used for the calculation, it is only the representation of the spatial discretisation

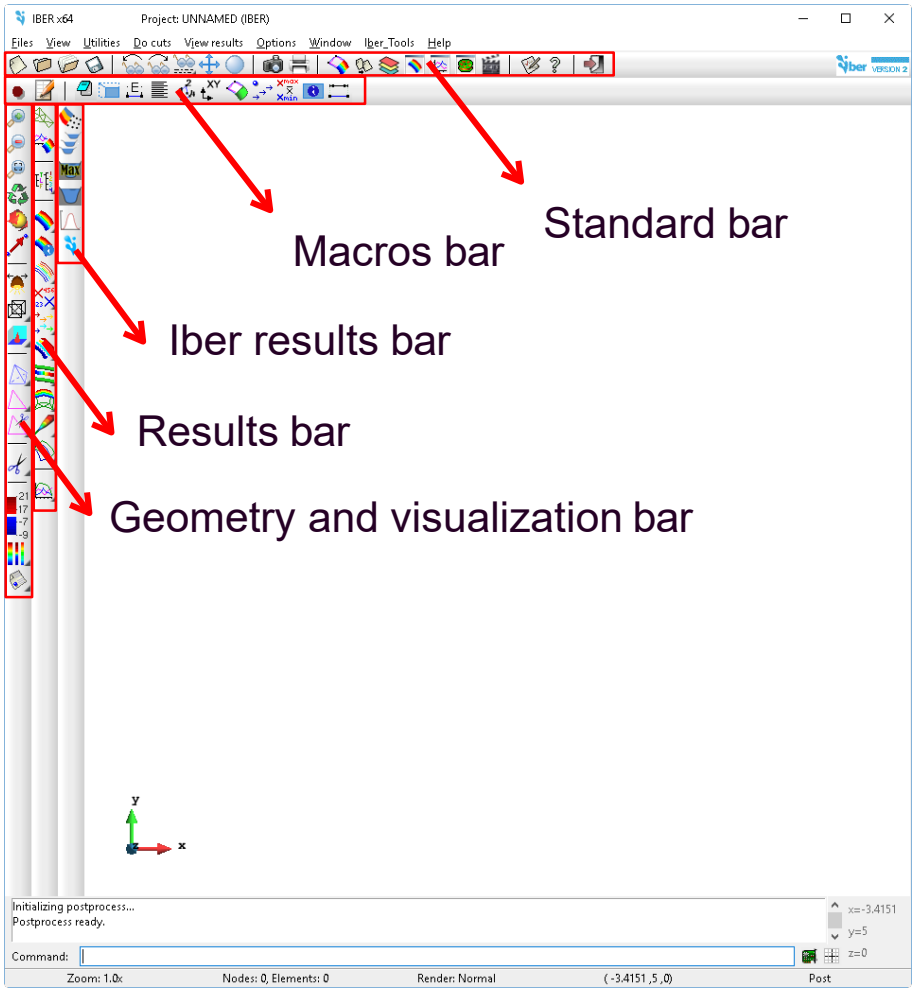
Interface

- The interface of Iber is adapted between pre- and post-process.
- In the **pre-process**:
  - It is possible to create the geometry or the mesh, manually or automatically
  - Define all hydraulic conditions (boundary, internal, mesh criteria, roughness definition, activation and definition of different modules, etc.)
  - Define the problem data
  - The are different menus:
    - 3 toolbars
    - Geometric/mesh menu
    - Data menu
    - Iber tools menu



Interface

- The interface of Iber is adapted between pre- and post-process.
- In the **post-process**:
  - View the results (maps, graphs, animations, etc.)
  - Import and export results (graphs, values, raster, etc.)
  - The are different menus:
    - 5 toolbars (one of them is defined for Iber analysis)
    - Do cuts menu (hydrographs, etc.)
    - Options and View results menu
    - Windows menu



NOTE: it is not necessary to wait for the end of the simulation to see the results calculated from the beginning.

Computation structure

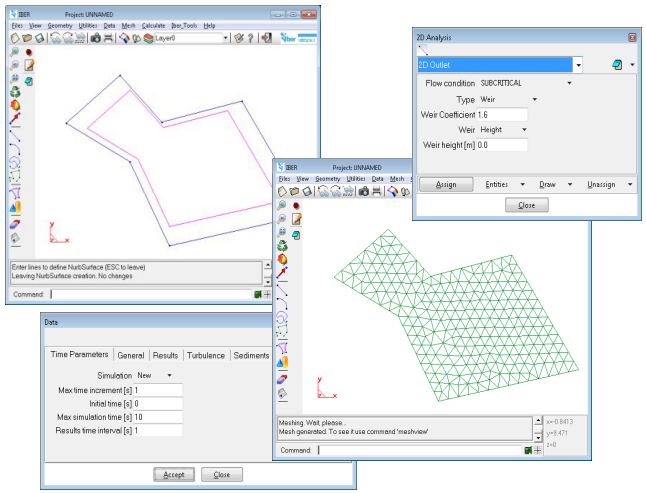
- The methodology to create a model, launch the simulation and view the results is:

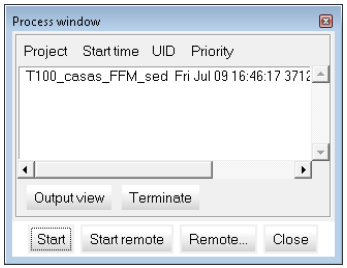
Pre-process → **Simulation** → **Post-process**

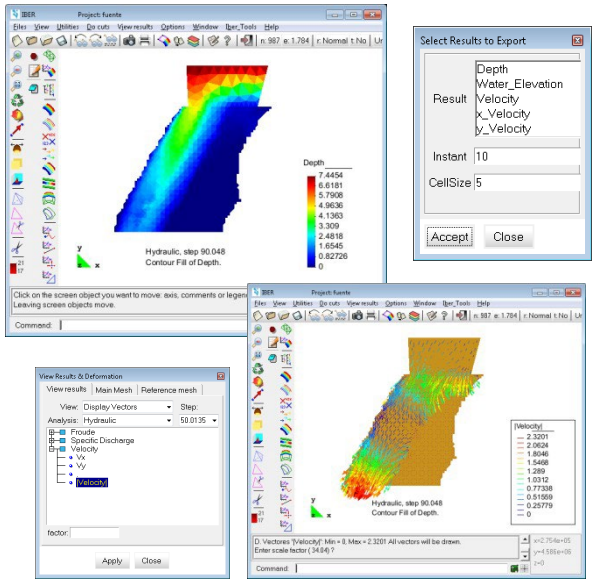
Geometry definition, problema data, mesh critera…

Solve the problem

Viewing the results







- More about Iber model in:
  - Official website **www.iberaula.es**
    - Capabilities of the current version and new developments
    - Publications (papers, reviews, etc.)
    - Projects simulated in Iber
    - Training (classroom and online courses)
    - Forum (place where other users ask and answer doubts of Iber model)
  - Group of LinkedIn
  - YouTube Channel