A grid generator for OPENCoastS powered by OCSMesh

André B. Fortunato, Ricardo Martins, Anabela Oliveira, Gonçalo Jesus, Marta Rodrigues, Alberto Azevedo, Alphonse Nahon
LNEC – Laboratório Nacional de Engenharia Civil, Portugal

Soroosh Mani*, Ed Myers, Saeed Moghimi
NOAA – National Oceanographic and Atmospheric Administration, USA
* also affiliated with Spatial Front Inc., USA

2023 NOAA SCHISM workshop
July 19-20, 2023

EGI-ACE receives funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 101017567.

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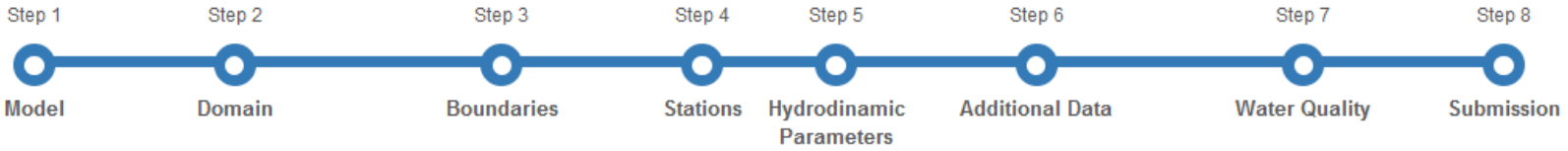
Outline

- Motivation and goals
- The building blocks
  - OCSMesh v. 1.3.4
  - JIGSAW
  - NICEGRID v. 5
- Grid generation with OPENCoastS
- Examples
- Summary and outlook

Motivation

- OPENCoastS empowers users to generate and operate coastal forecast systems powered by SCHISM
- The user is guided through eight steps that let him create his own forecast for any domain



- Current capabilities include 2D and 3D hydrodynamics, waves, and water quality (generic tracer and fecal indicator bacteria)
- OPENCoastS targets both experienced modelers and technicians without previous modeling experience
- For most users, providing a grid of their domain of choice is the major difficulty in adopting OPENCoastS

Goals

- Foster the adoption of OPENCoastS by non-experienced modelers by:
  - Providing users with an online grid generator that is simple and intuitive
  - Generating both horizontal and vertical grids for SCHISM
  - Providing easy access to online bathymetric and coastline data

- Users should be able to generate an operational grid in less than 30 minutes

The building blocks

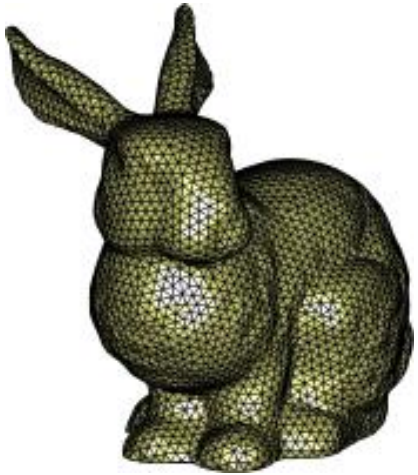
OCSMesh

- Mesh preparation tool for generating inputs and cleaning up outputs for the mesh engine (Jigsaw)
- Designed to be user-friendly and interoperable with common Python GIS packages
- Supports multiple methods of defining the domain and sizing function of the mesh
- Supports mesh sizing function manipulation based on predefined shapes or extracted contours from bathymetry
- Originally developed by Jaime R. Calzada (VIMS), currently developed and maintained by Soroosh Mani (NOAA, SFI)

The building blocks

JIGSAW (www.giss.nasa.gov/tools/jigsaw)

- Unstructured mesh generator and tessellation library called by OCSMesh
- Designed to generate high-quality triangulations and polyhedral decompositions of general planar, surface and volumetric domains
- Includes refinement-based algorithms for the construction of new meshes, and optimization-driven techniques for the improvement of existing grids
- Developed by Darren Engwirda et al.



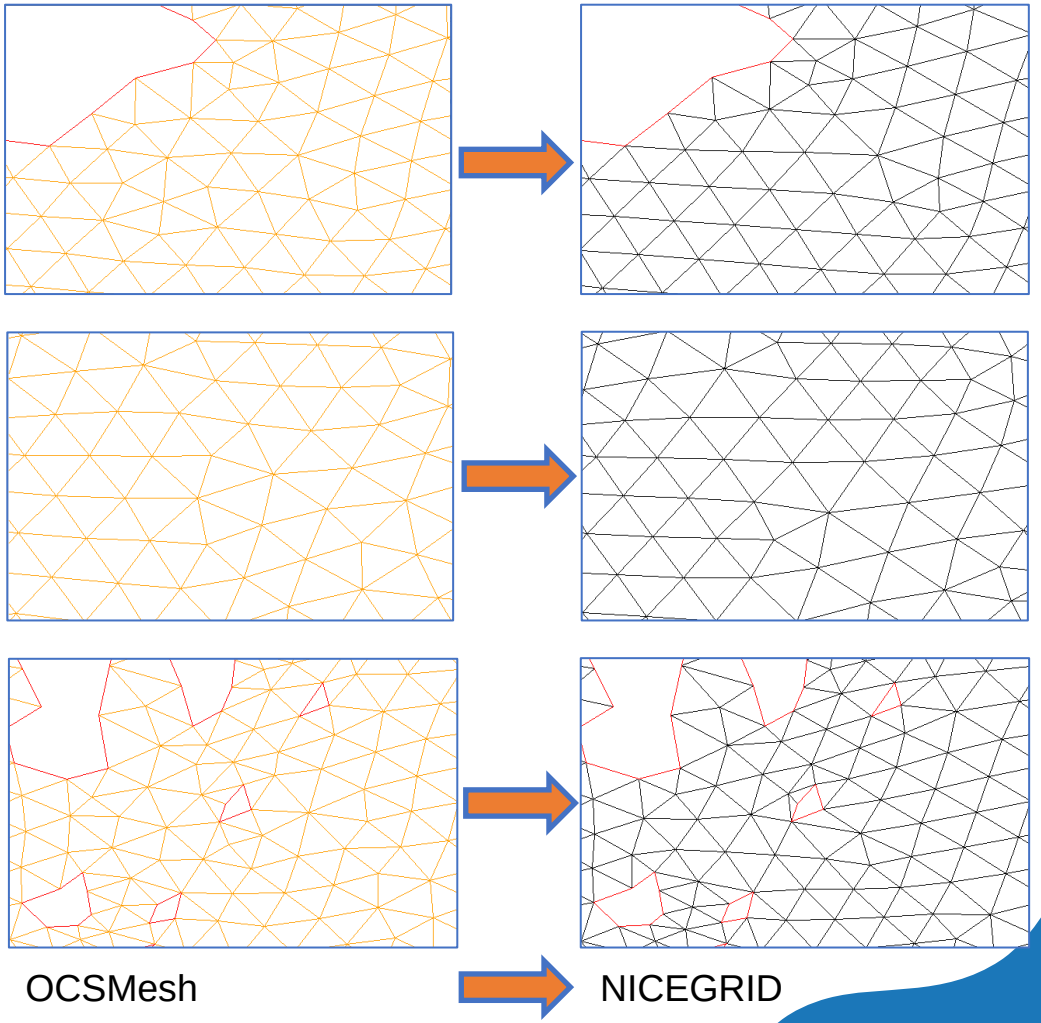
The building blocks

NICEGRID

NICEGRID automatically improves grids by reducing element skewness.

Main operations:

- Adding and removing nodes
- Changing connections between nodes
- Adjusting the position of internal nodes, and of nodes along straight boundaries

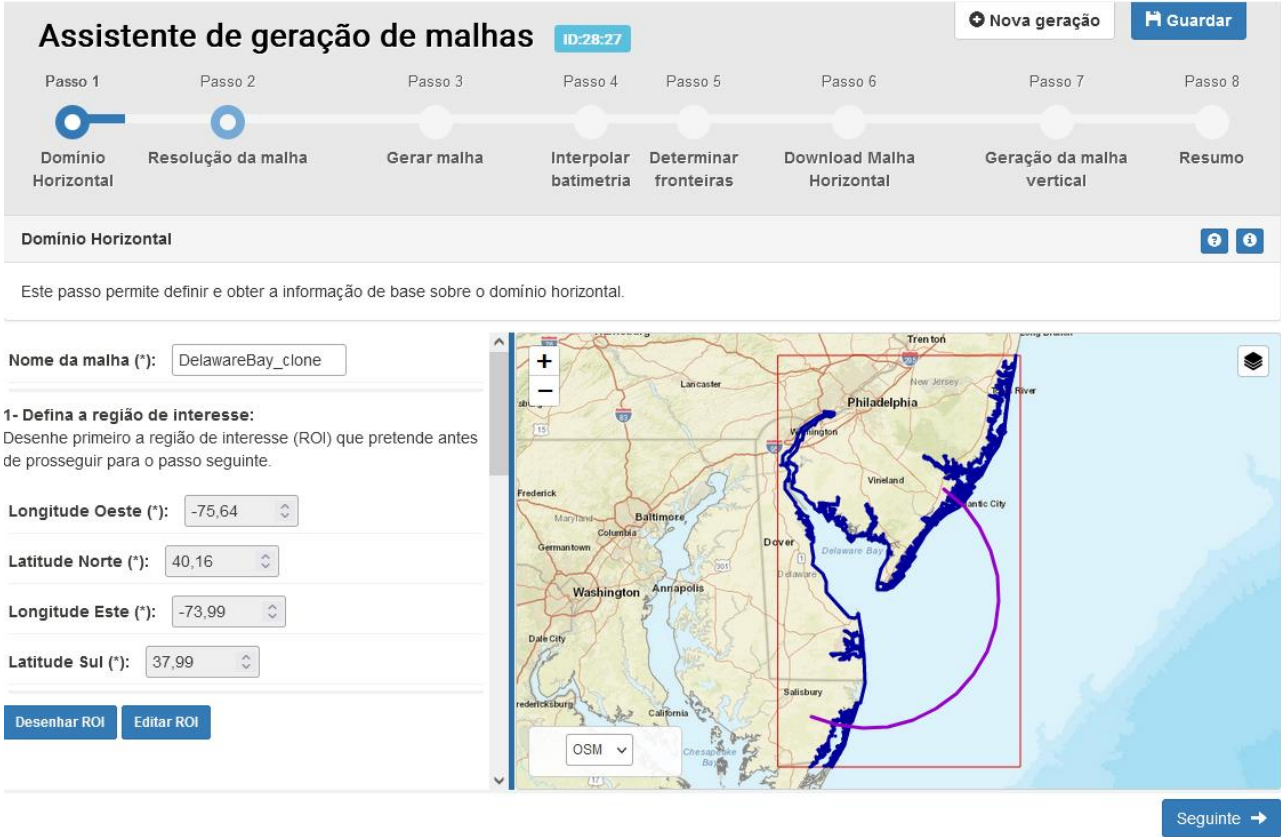


Generating a grid in OPENCoastS

Step 1 – Horizontal domain

Define:

1. Region of interest
2. Bathymetric source(s)
3. Landward limits
4. Water boundaries



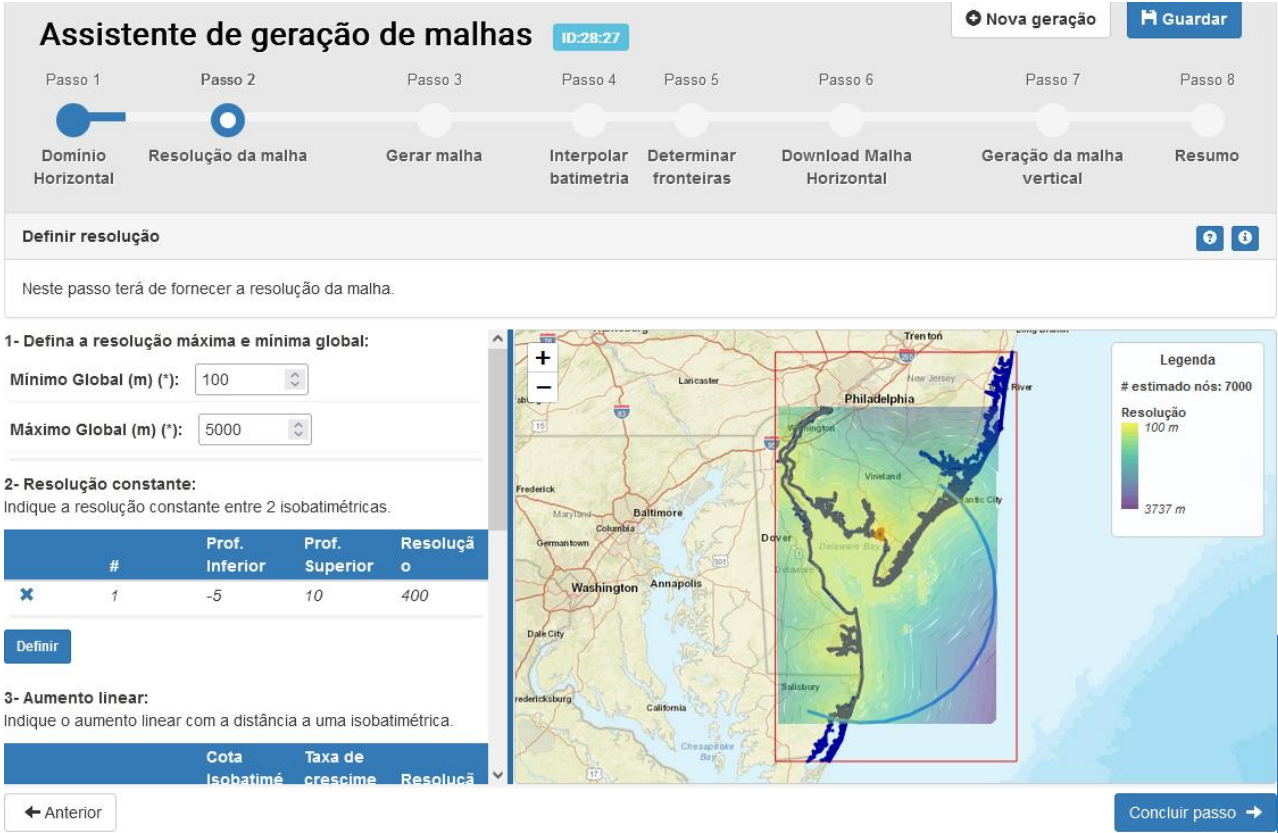
Generating a grid in OPENCoastS

Step 2 – Grid resolution

Define

1. Max and min resolutions
2. Constant resolution between two isobaths
3. Constant resolution along an isobath and linear increase away from it
4. Constant resolution in polygon and linear increase away from it

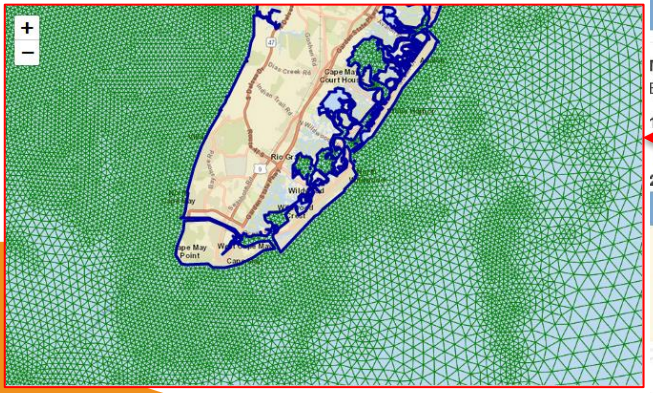
Other OCSMesh options are not implemented yet

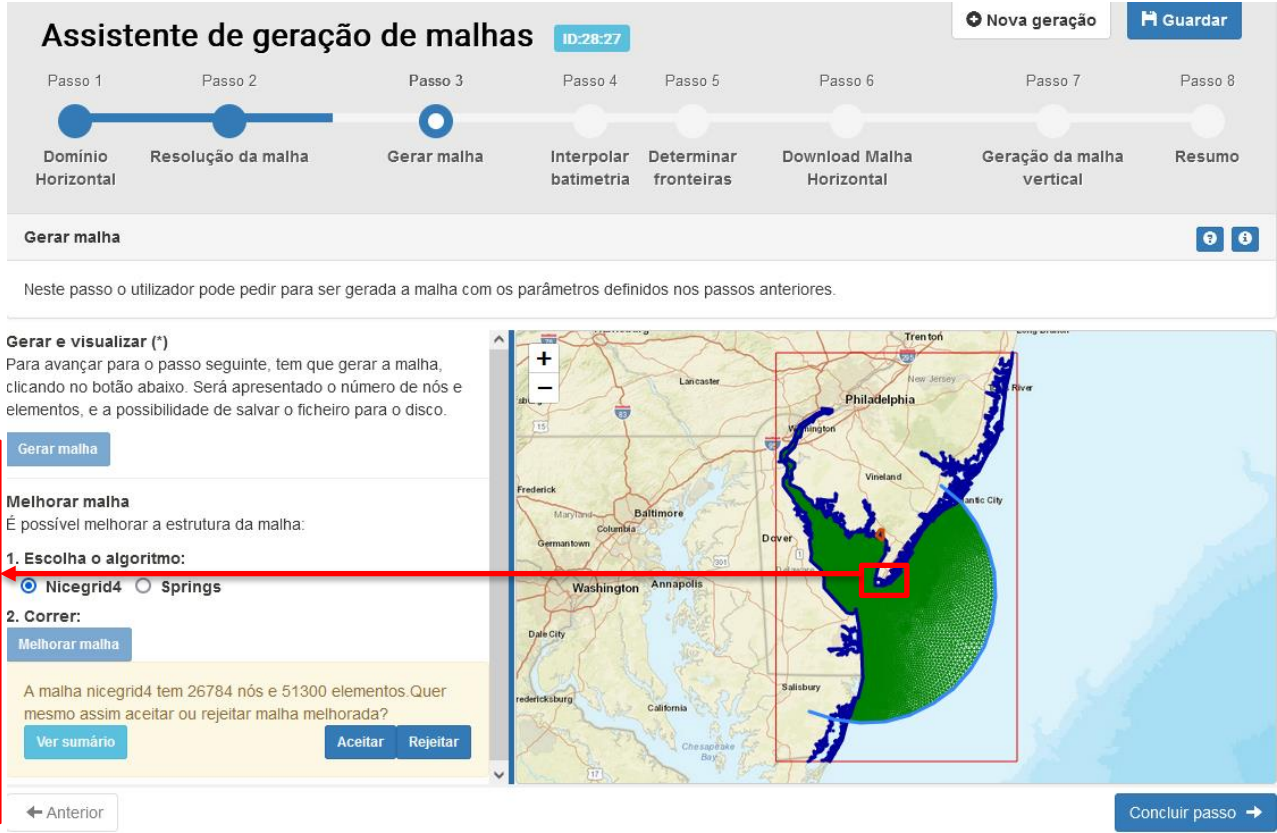


Generating a grid in OPENCoastS

Step 3 – Generate horizontal grid

1. Generate the grid with OCSMesh & JIGSAW
2. Improve the grid with NICEGRID

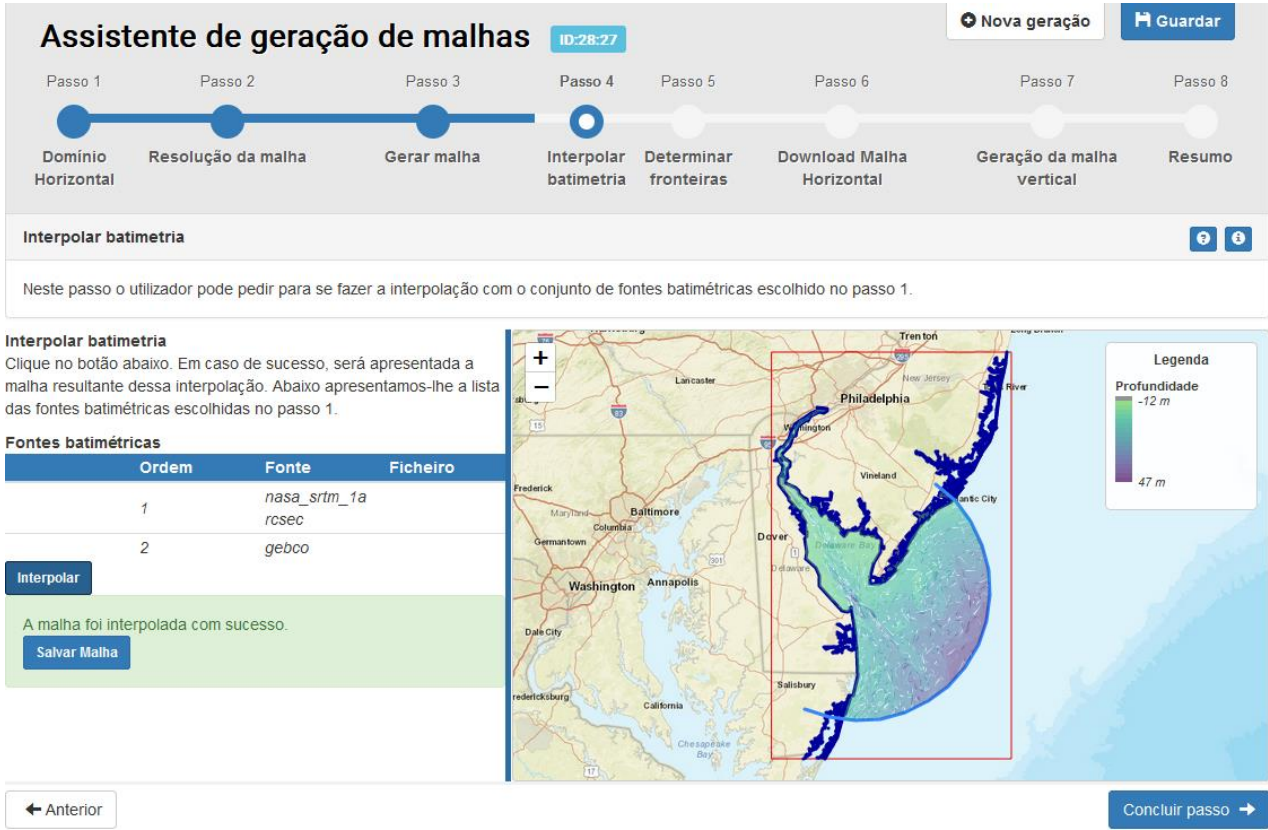




Generating a grid in OPENCoastS

Step 4 – Interpolate bathymetry

1. Interpolate the bathymetry from the sources specified in Step 1



Generating a grid in OPENCoastS

Step 5 – Determine boundaries

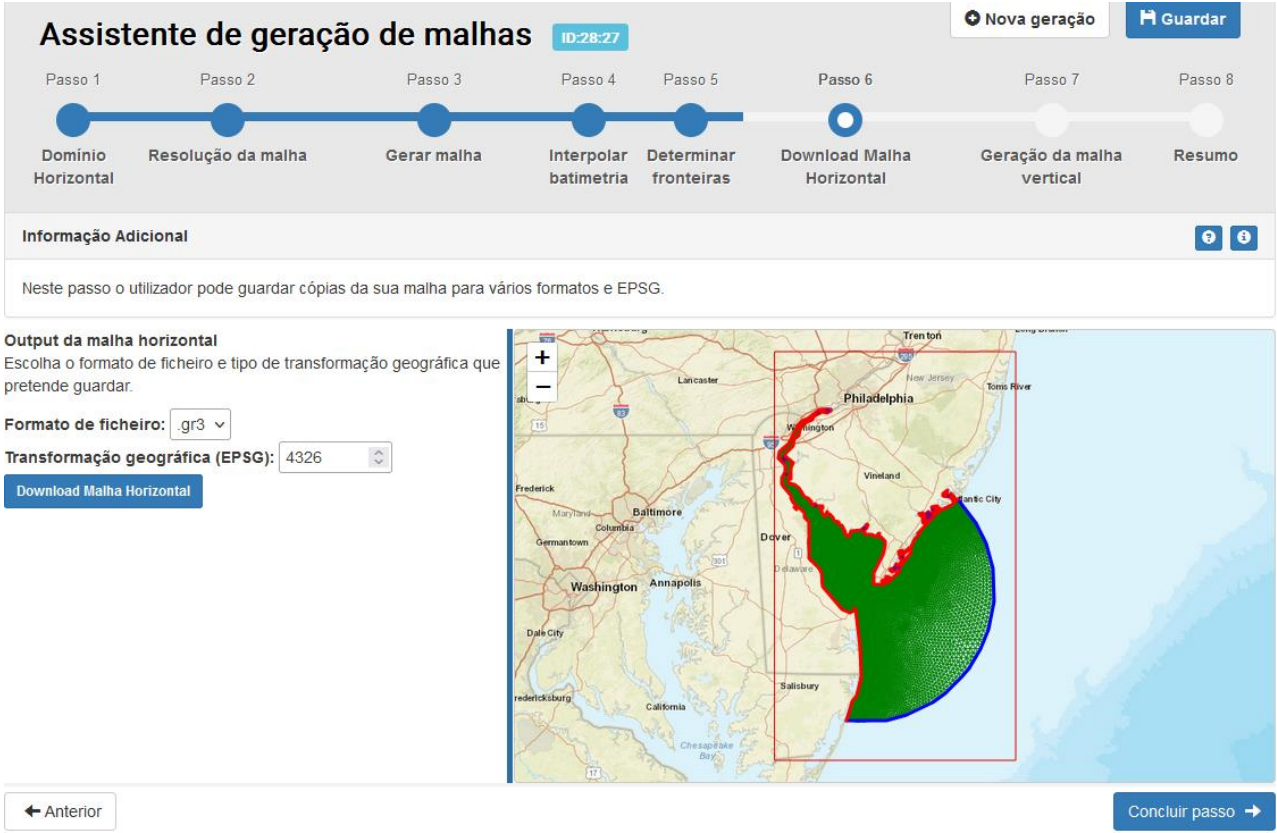
Determine open/closed boundaries by either:

1. Selecting pairs of nodes that define open boundaries
2. Selecting a threshold depth for land boundaries (OCSMesh)

Generating a grid in OPENCoastS

Step 6 – Output horizontal grid

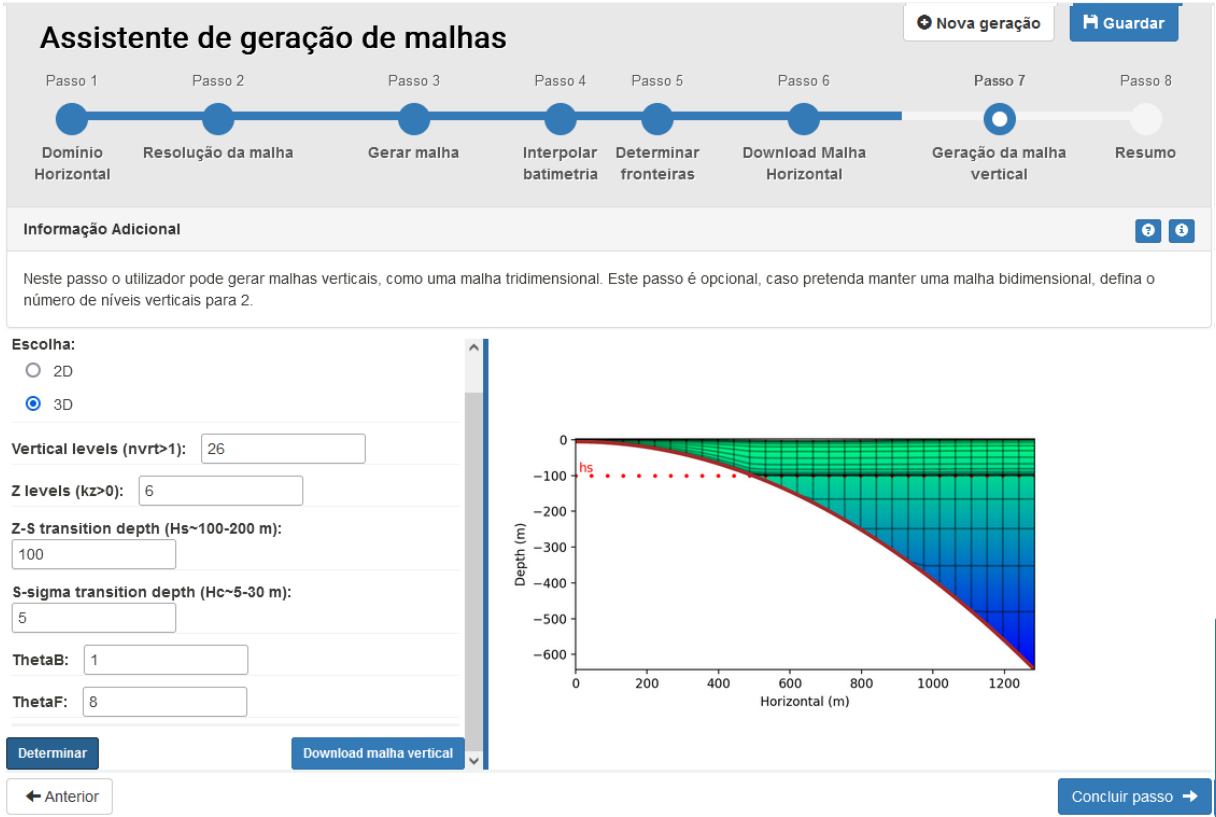
- Select file format and the coordinate system
- Download the horizontal grid to your computer



Generating a grid in OPENCoastS

Step 7 – Generate vertical grid

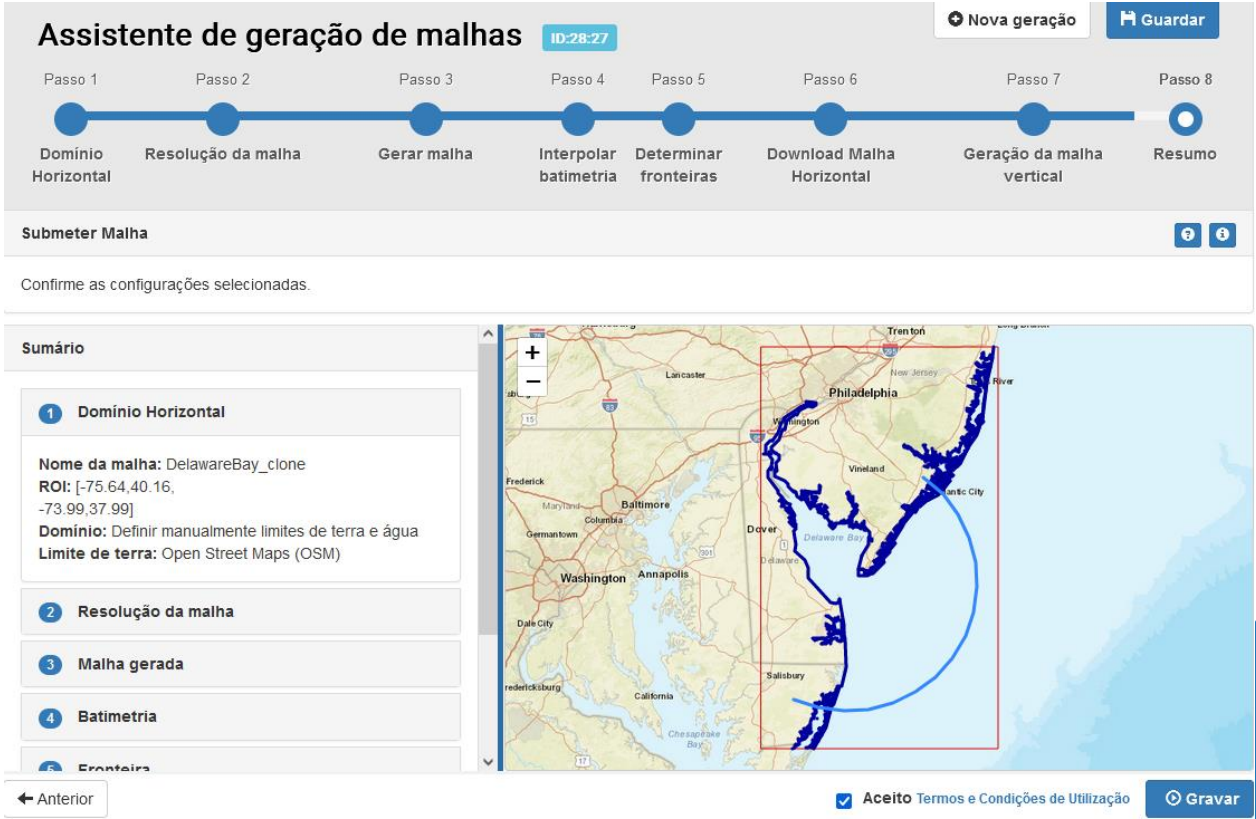
- Generate a 2D or 3D vertical grid
- Define:
  - # of vertical levels
  - # of Z levels
  - hs
  - hc
  - θ_b
  - θ_f
- Visualize the grid
- Download the vertical grid to your computer



Generating a grid in OPENCoastS

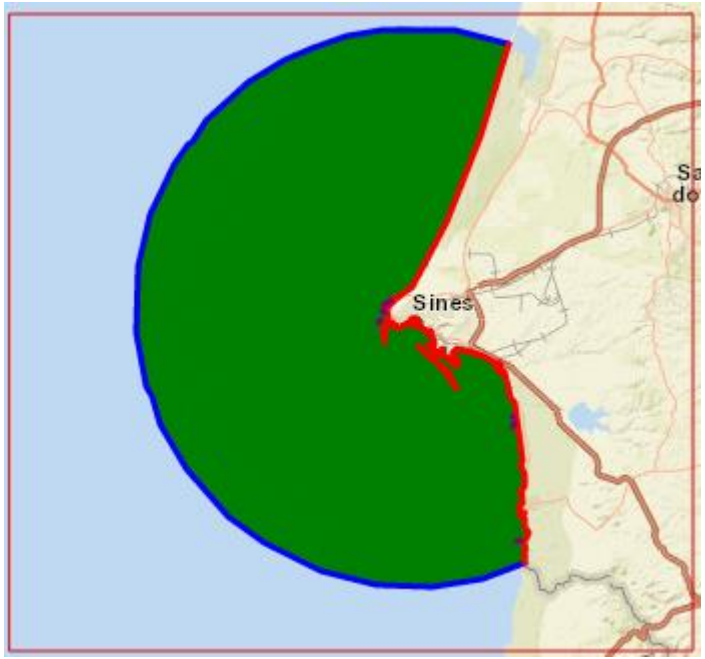
Step 8 - Summary

- Review your choices
- Archive the grid in OPENCoastS for future use and change



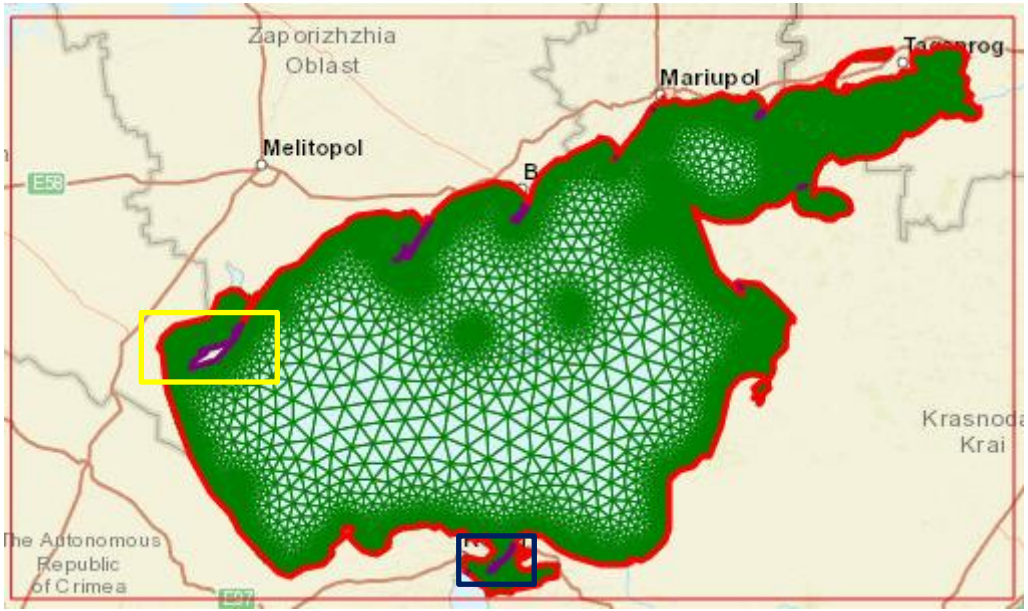
Examples

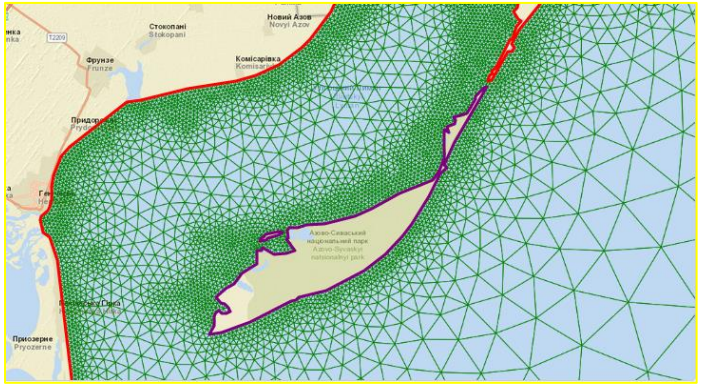
Sines harbor

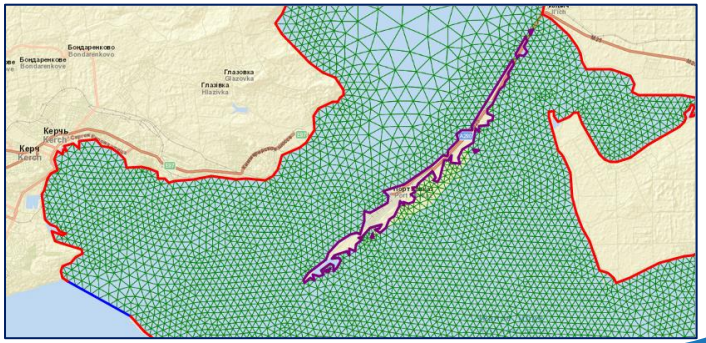


Examples

Azov Sea

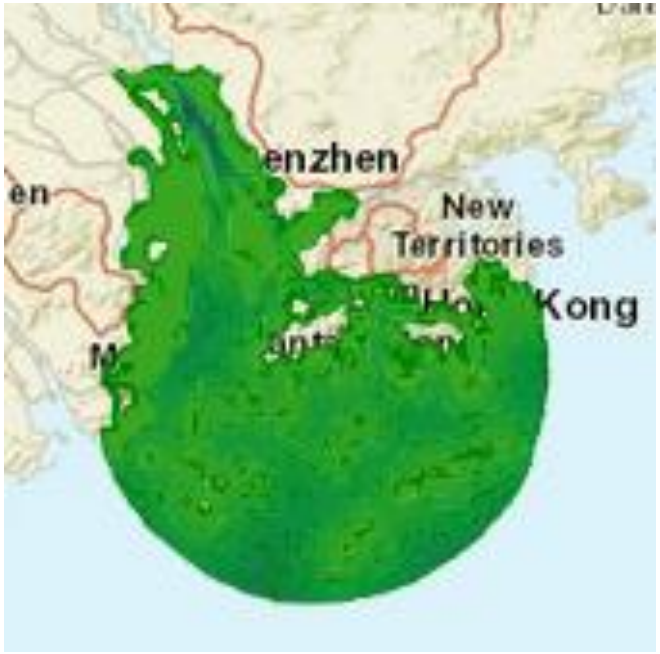






Examples

Pearl River estuary (Macao and Hong Kong)



Summary

- Key features
  - Offers easy and intuitive grid generation
  - Generates both horizontal (triangular) and vertical (S-Z) grids
  - Provides open access data:
    - Topography/bathymetry (gebco, SRTM 1-arcsec, emodnet)
    - Coastline (open street map, emodnet MHW)
  - Grids are smooth, although not necessarily the most eficient
  - Grids can be cloned and changed

- Ongoing and future developments
  - Bug fixes, improvements and robustness
  - English interface
  - Public deployment
  - Include more features from OCSmesh
  - Improve estimate of the number of nodes

Thank you for your attention!

Questions? Comments?