Towards optimized Earth Mesh generation

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Context

- Geomesh generation is complex and cumbersome especially in HR global level.
- Several mesh generation solvers exist with significant learning curve needed to utilize properly.
- Different parametrization.
- Multiple mesh types possibly including mixed type meshes.

Challenge

To abstract/integrate/optimize/standarize geomeshes into optimal operational-ready workflows for large scale ocean/coastal numerical simulations.

- multiple mesh generators
- standarized parametrization/metrics
- validation/verification
- Efficient abstraction
- reproducability/versioning

Expected output

- A python package that uses currently available or newly developed upstream packages with APIs to mesh generators fine tuned to geomesh generation for CFD simulations.
- Use of a common data structure (xarray) for portability.
- Integration into a Research-to-Operation workflow.
- parity in features.
- optimized default parametrization.
- maximum efficiency (large meshes/ complex coastlines)

Proof of Concept : pyPoseidon

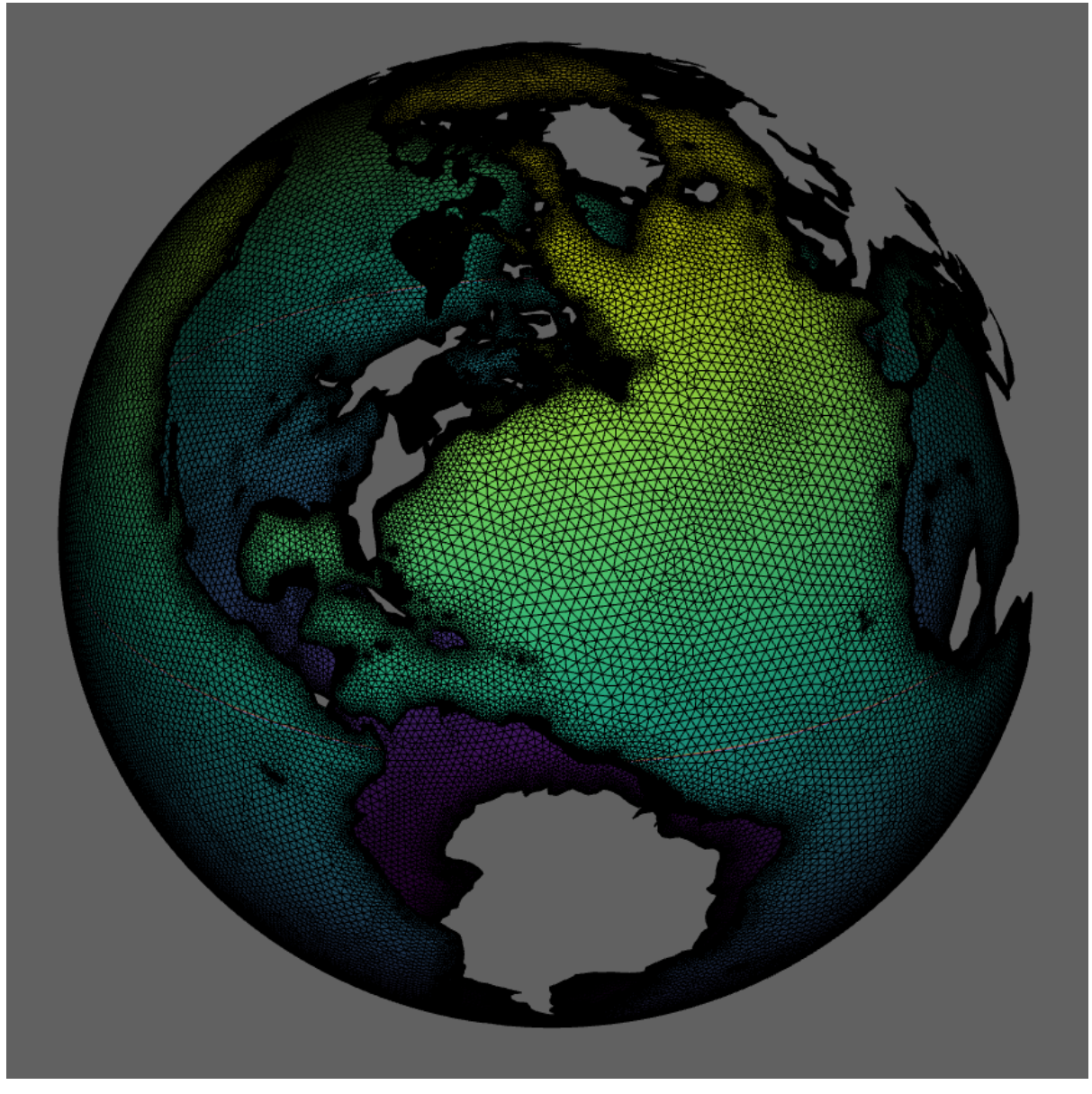
A python framework for Hydrodynamic simulations (https://github.com/ec-jrc/pyPoseidon)

In [ ]:

```
import pyposeidon.mesh as pm
import geopandas as gp

w = gp.read_file('./data/ocean.zip')

## Global test
mesh = pm.set(
    type='tri2d',
    geometry='global',
    coastlines = w,
    mesh_generator = 'gmsh',
    rpath = './global/',
    dem_source='./data/dem.nc',
    resolution_min=0.001,
    resolution_max=.03,
    use_bindings=False, #set this to True for gmsh python bindings
    DistMin=.0, DistMax=.1, SizeMin=.005, SizeMax=.02, MeshSizeMin=.001,MeshSizeMax=0.05, # GMSH additional settings
              )
```

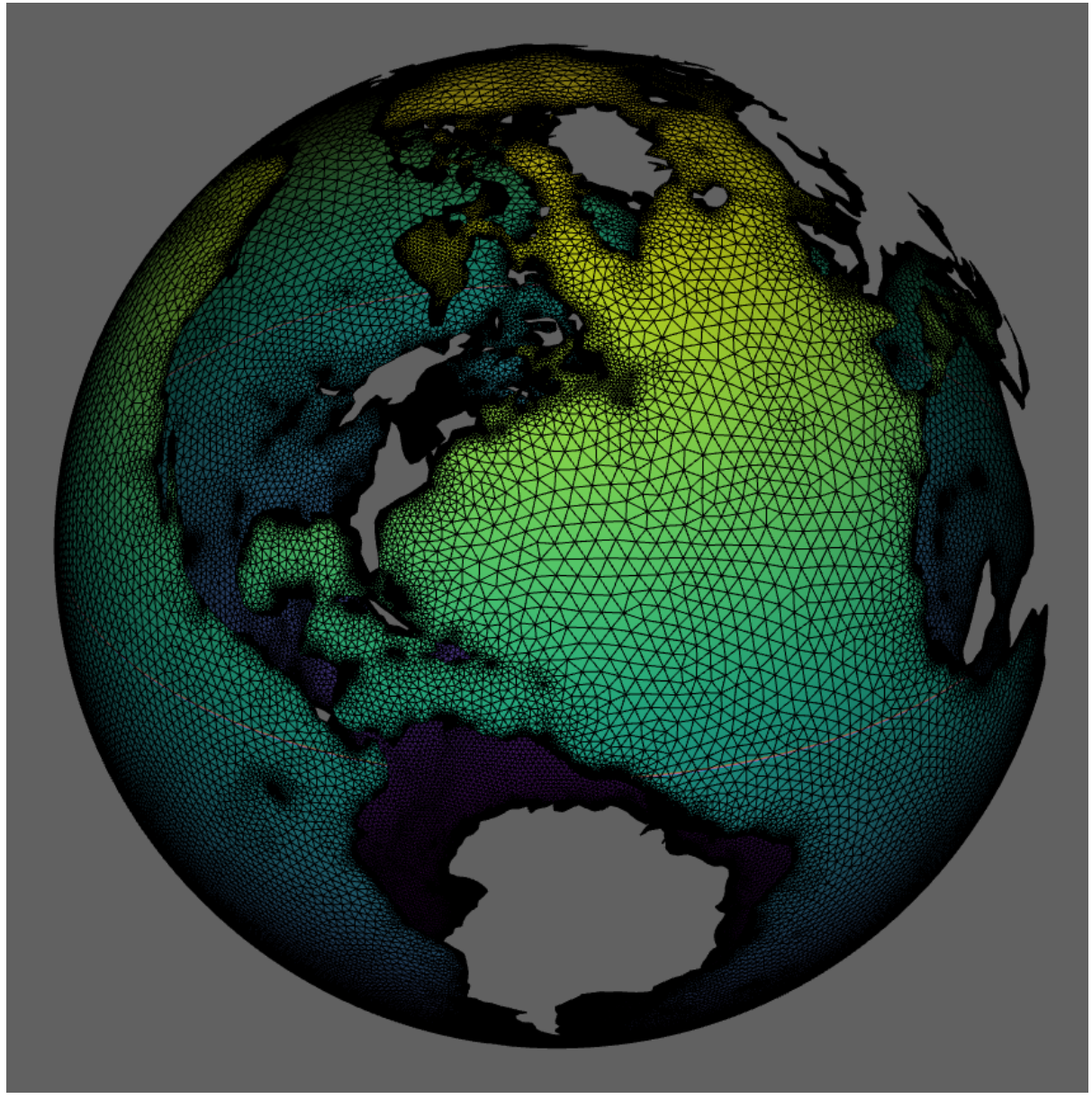


In [ ]:

```
import pyposeidon.mesh as pm
import geopandas as gp

w = gp.read_file('./data/ocean.zip')

## Global test
mesh = pm.set(
    type='tri2d',
    geometry='global',
    coastlines = w,
    mesh_generator = 'jigsaw',
    rpath = './global/',
    dem_source='./data/dem.nc',
    resolution_min=0.001,
    resolution_max=.03,
    use_bindings=False, #set this to True for jigsaw python bindings (not available yet)
    dhdx=0.15, imax=100 # JIGSAW additional settings
              )
```



In [ ]:

```
#validate against solver
mesh.validate(rpath='./val/')
#verify against boundaries
mesh.verify(coastlines=w)
# save to file
mesh.to_file('hgrid.gr3')
```