



# T-UGOm

## progress, application and testing

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# T-UGOm

Fully nonlinear (3D baroclinic) mks

C++ modular Open Source

Full tide (gravitational, loading, self attraction)

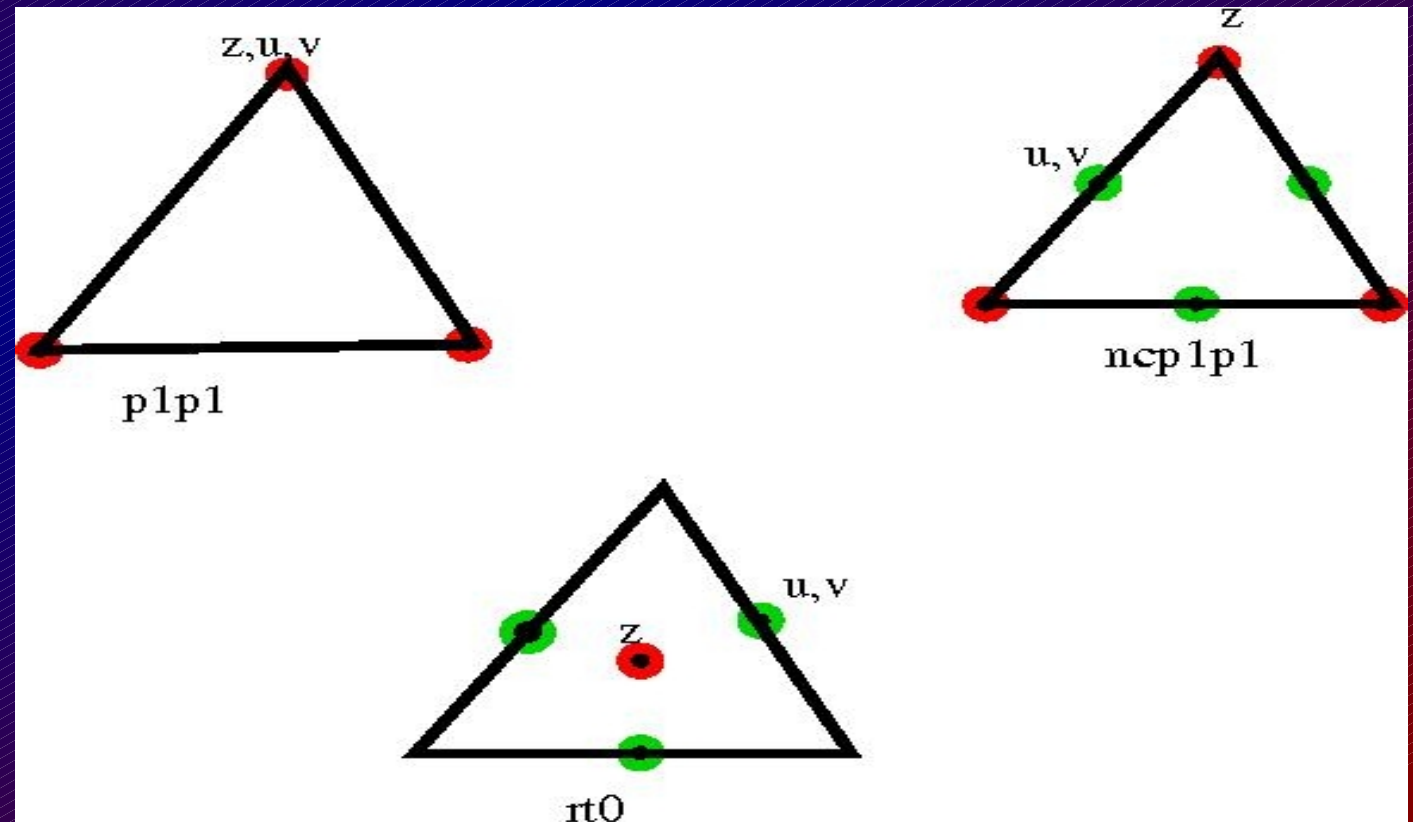
Foreman tidal generation and analysis

Full meteorological forcing

2D modes - P1-P1 (lumped and exact), ncP1-P1, ncP1-P0 (rt0)

P1-P2, ncP1-P2

GUI input file creator



# T-UGOm

Drying shallow areas

Boundary conditions

elevation

Flather

Orlanski

current (transport)

Sommerfeld

Turbulence

Constant

Mellor-Yamada 2.5

Galperin

GASpAR (NCAR/UCAR)  $k-\epsilon$ ,  $k-\omega$

Horizontal Eddy viscosity

Constant

Smagorinsky

# T-UGOm

Solvers – run time callable – all Open Source

Domestic (built in ) + SpDomstic (sparse)

Libraries module (itself attached as a library)

ATLAS (Automatically Tuned Linear Algebra Package)

U Tennessee, sourceforge

optimizes

BLAS (Basic Linear Algebra Subroutines)

LAPACK (Linear Algebra PACKage)

UMFPACK (Unsymetric MultiFrontal sparse LU factorization  
PACKage) U Florida

Parallelization MUMPS and/or METIS in progress

T-UGOm/WW3 Unstructured coupling

PhD starting October (Lyard, Arduin co-supervisors)

```
% Keyword input file for tUGOm 2.0 and later. The suggested suffix is .intg
%
% Extra characters to the right of the input value(s) are ignored.
%
% Lines beginning with "%" are copied directly to the echo file
% in the section where they occur in input and are ignored
% for input.
%
#model
    rootname          = sq1g      // comment 1
    time_step         = 6.        xy comment 2
    sub_time_step     = 2.
    bel_file          = sq1g.bel
    output_path       = ncp1p1
    solver_type       = UMFPACK
##
```

#tide

tide\_flag = TRUE  
tidal\_BC = TRUE  
BC\_tide\_file = Z0.obc

##

#fe\_archive

OnOffFlag = TRUE  
archive\_interval = 1800.  
horizontal\_currents = FALSE  
vertical\_velocity = FALSE

##

#sample\_points

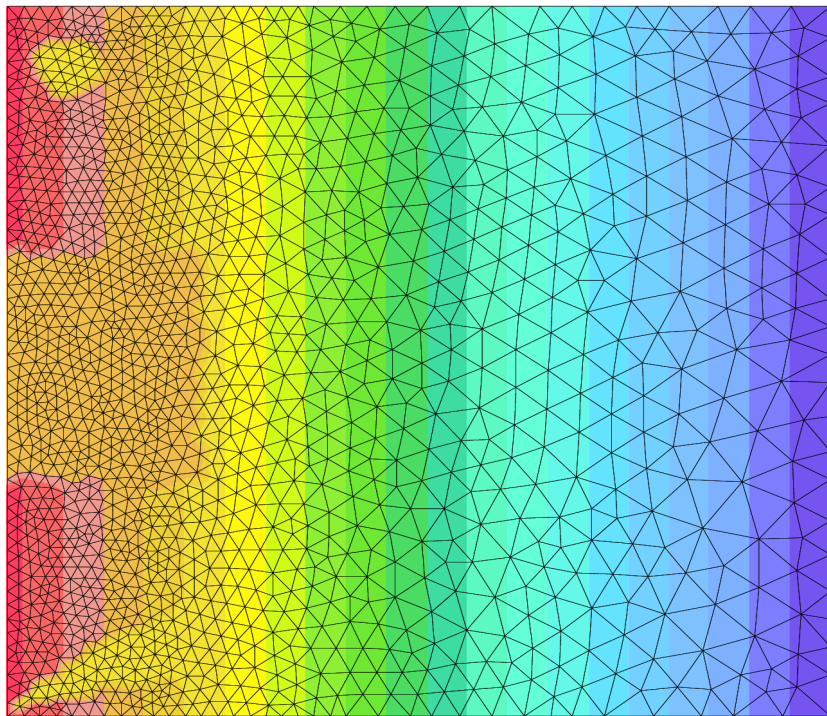
OnOffFlag = TRUE  
save\_interval = 600.

##

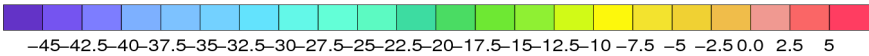
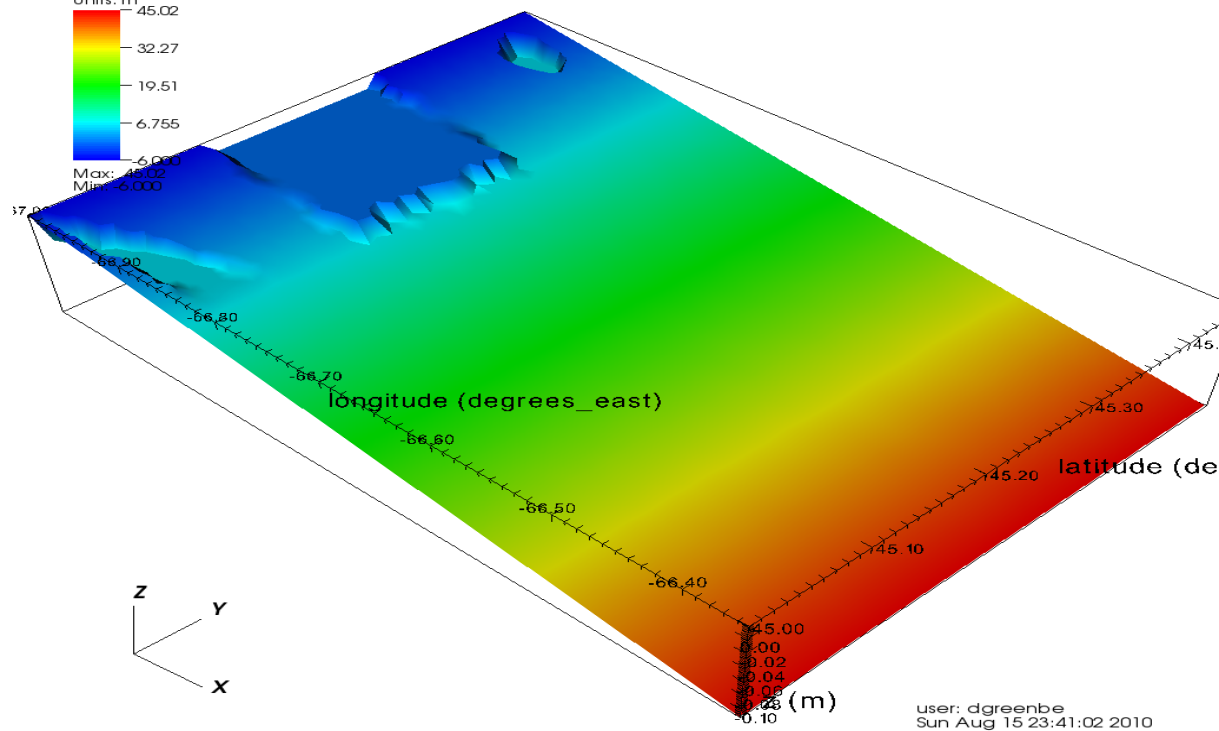
#analysis

OnOffFlag = TRUE  
harmonic\_start = 1.  
compute\_interval = 1.00

##

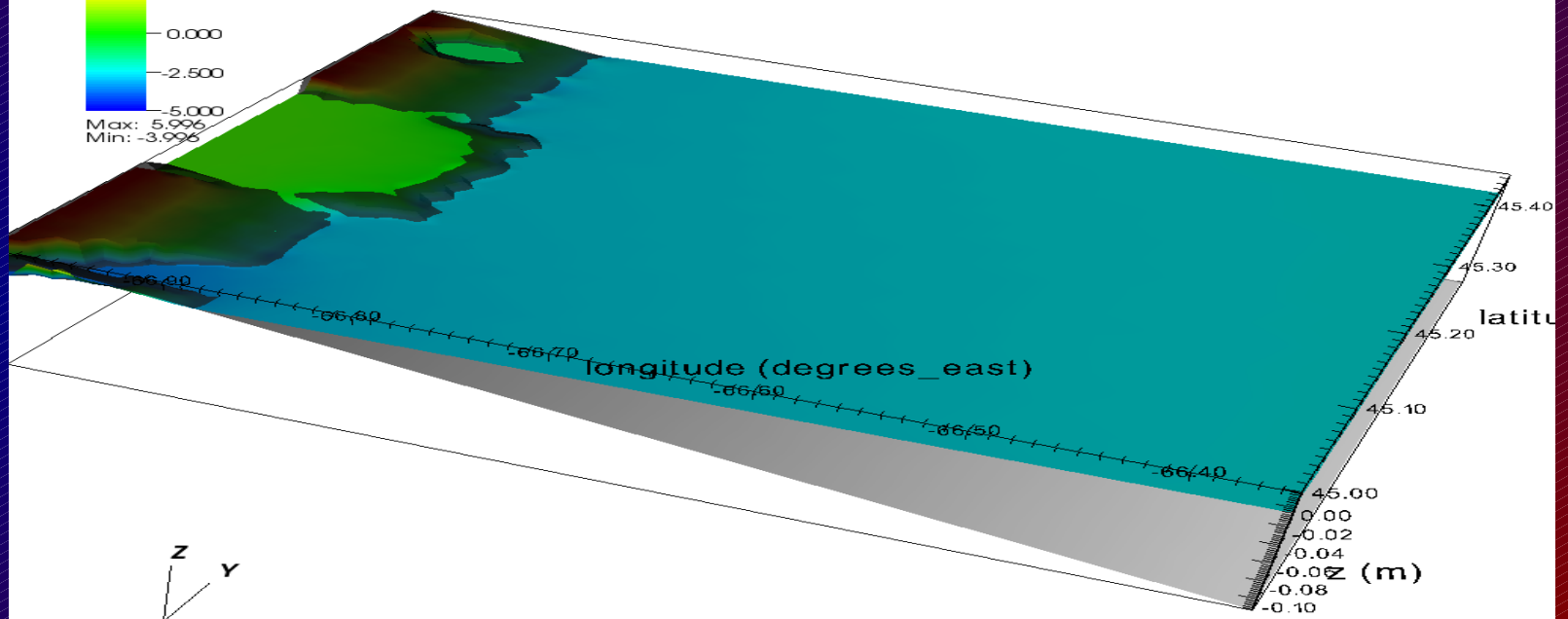


DB: state0000.silo  
 Cycle: 0 Time:0  
 Pseudocolor  
 Var: bathymetry  
 Units: m  
 45.02  
 32.27  
 19.51  
 6.755  
 -6.000  
 Max: 45.02  
 Min: -6.000



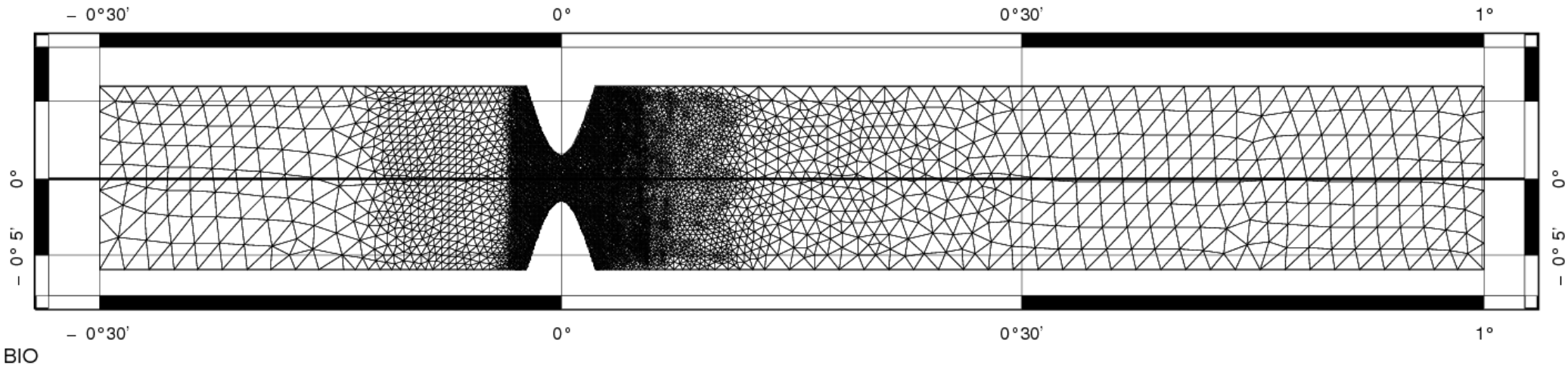
user: dgreenbe  
 Sun Aug 15 23:41:02 2010

DB: state0127.silo  
 Cycle: 127 Time:1.32292  
 Pseudocolor  
 Var: elevation  
 Units: m  
 5.000  
 2.500  
 0.000  
 -2.500  
 -5.000  
 Max: 5.996  
 Min: -3.996



# Squeeze 1

Squeeze 1 grid

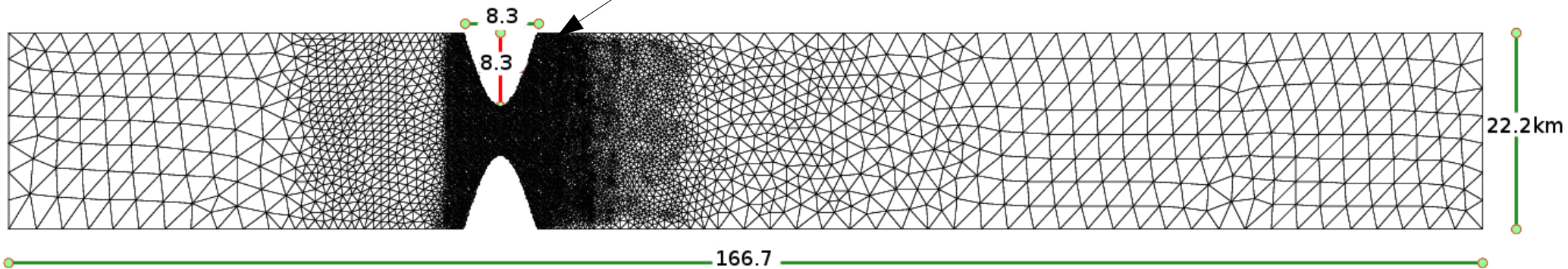


Depth 50 m

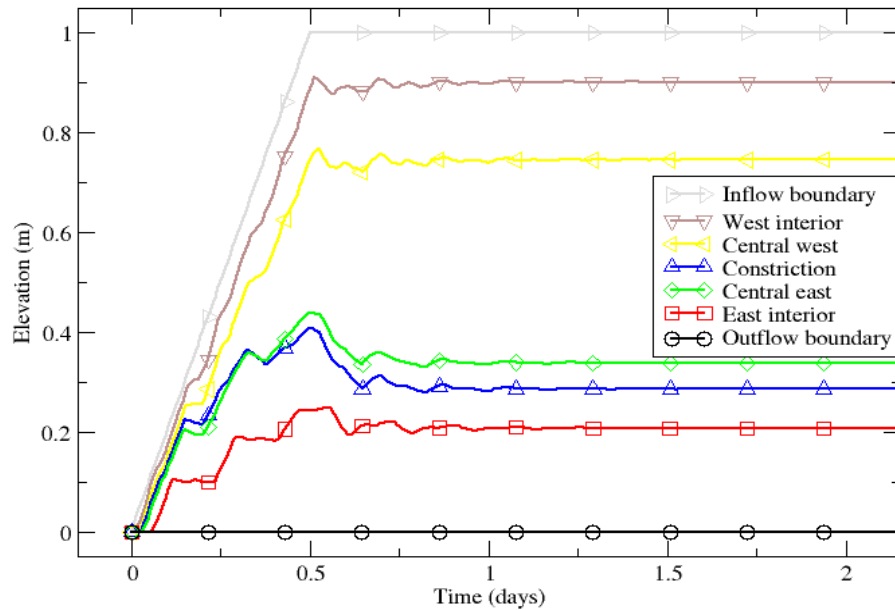
Set at Equator

1.5° longitude x 0.2° latitude - 166.7 km x 22.2 km

Gap 5.5 km







## Bernoulli Speed

$$\frac{v^2}{2} = g \Delta Z$$

$$v = 4.4 \text{ m/s}$$

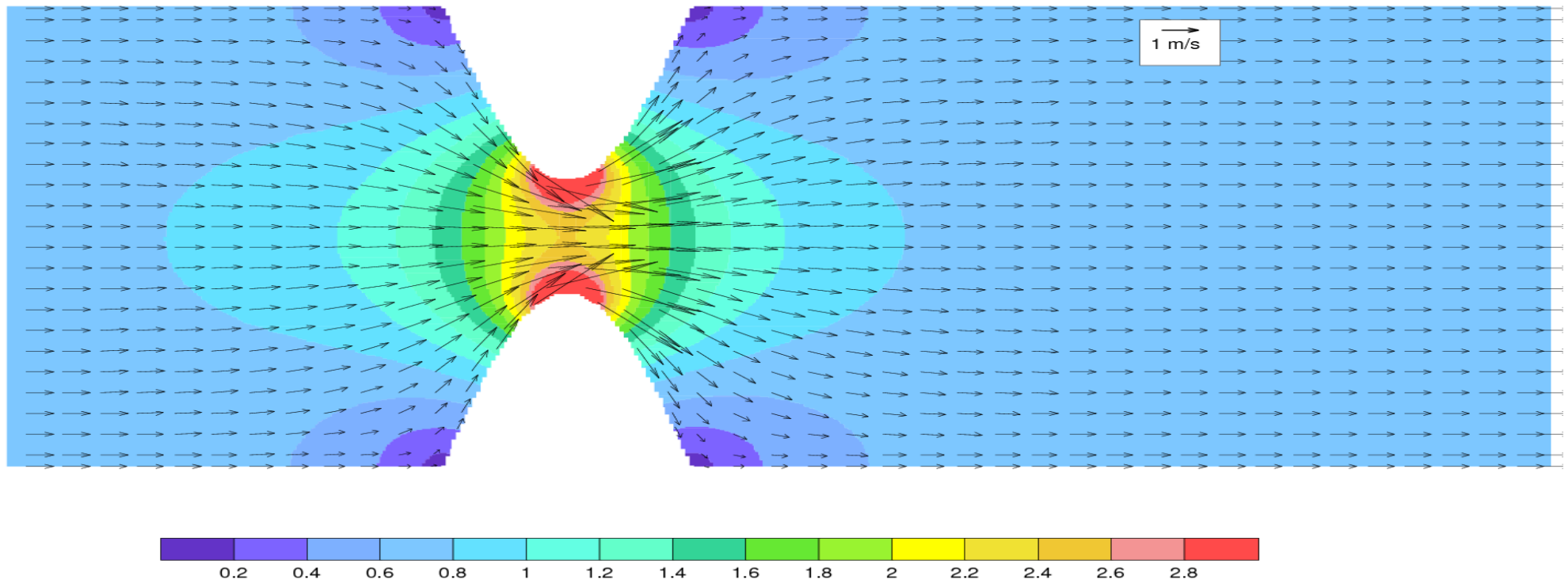
West Z Ramp to 1 m in 12 hours

East Z fixed at 0 m

Steady after 1 day

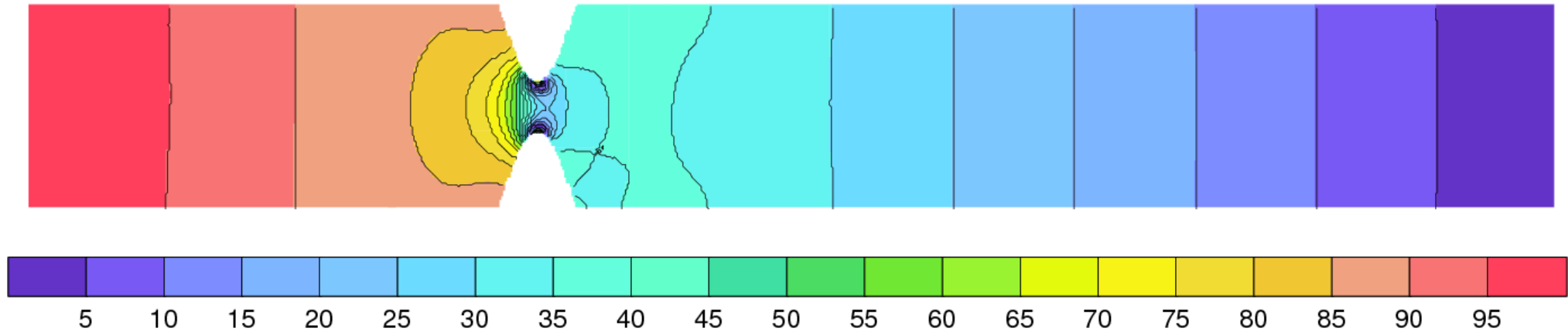
Run for 2 days

Sometimes, the elevation at the constriction is drawn down by the Bernoulli effect.



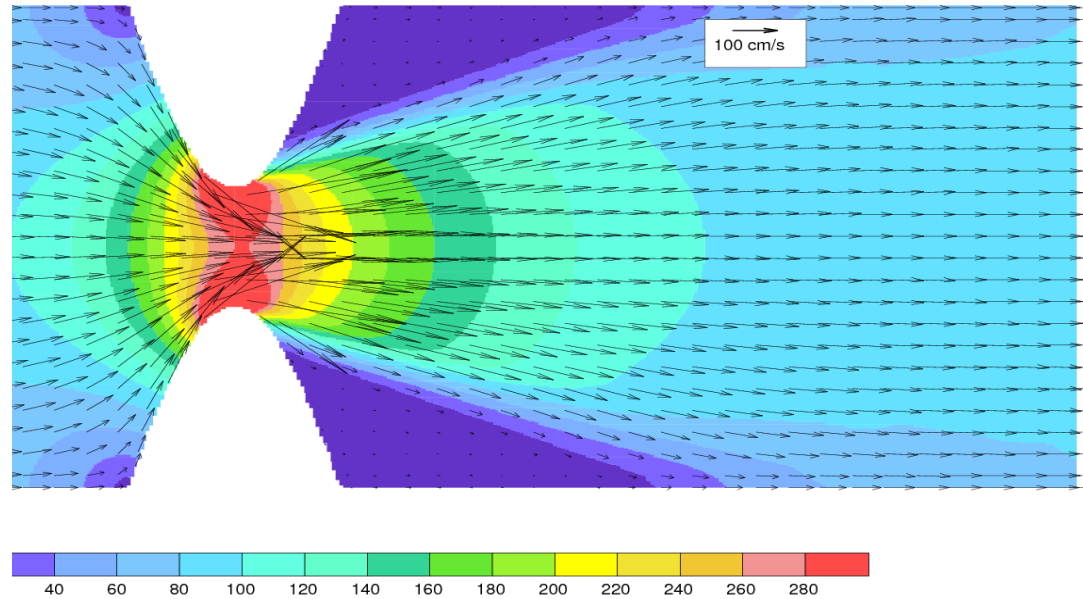
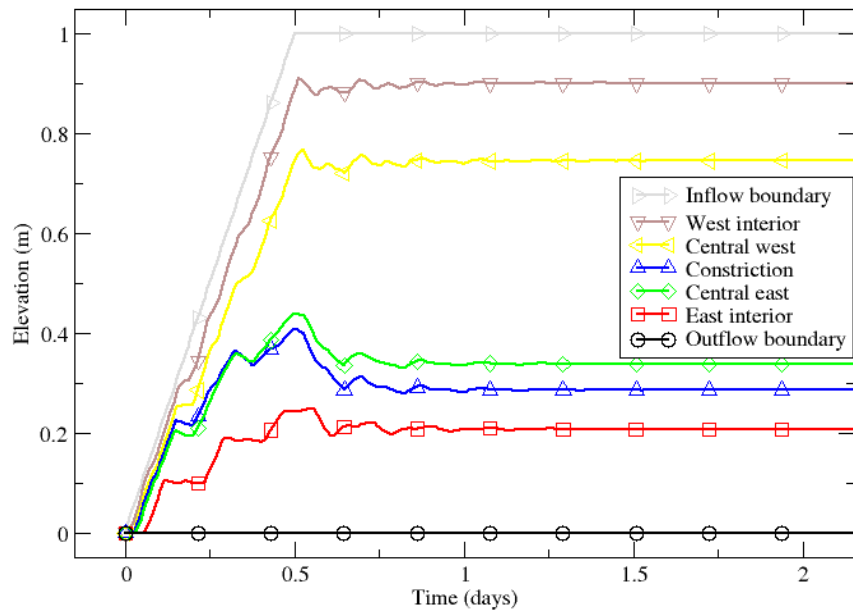
Fundy6 -  
3 levels

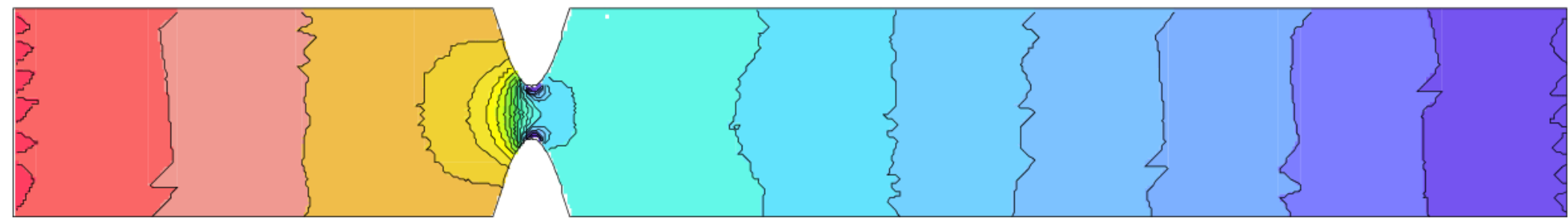
Linear harmonic  
Cartesian



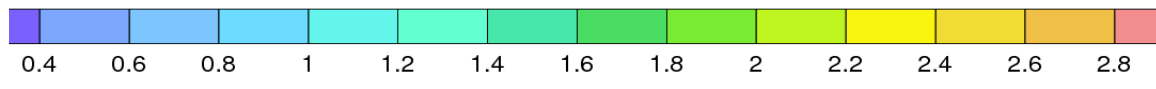
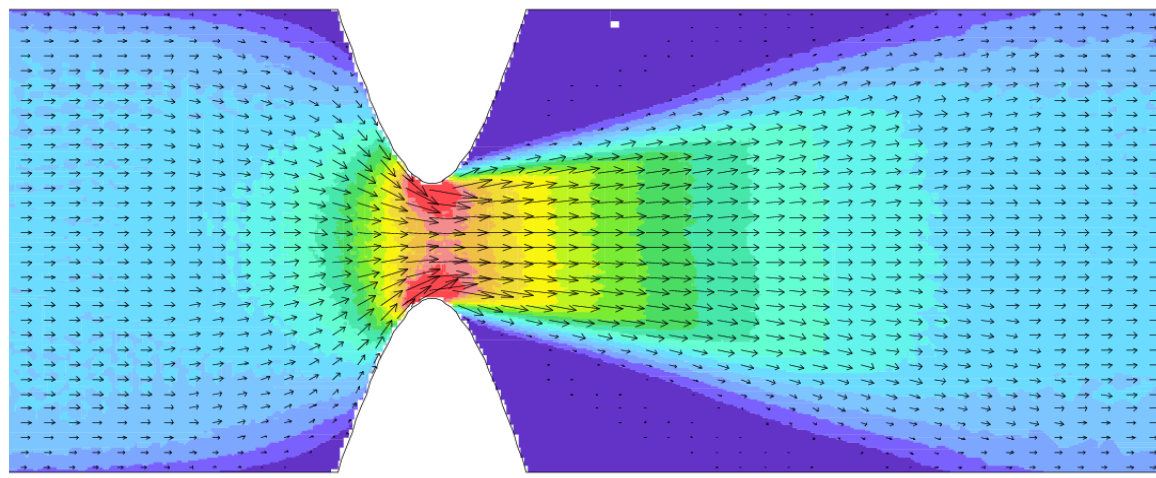
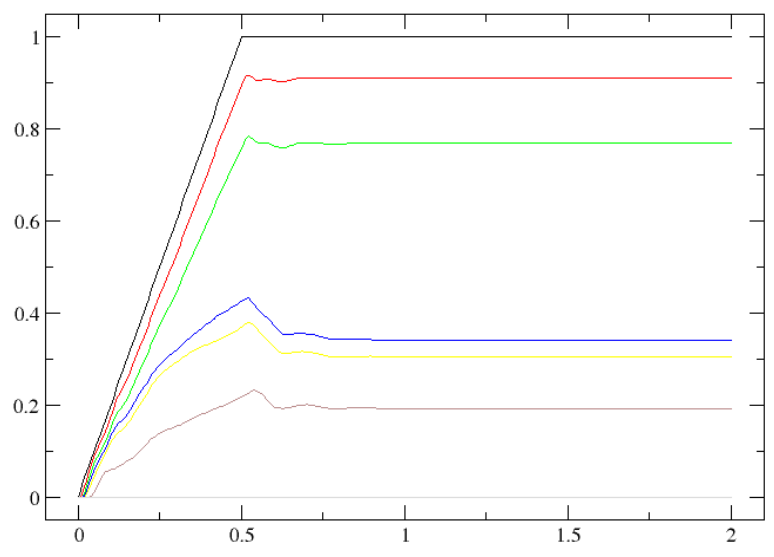
T-UGOm  
2D P1-P1  
Spherical-Polar

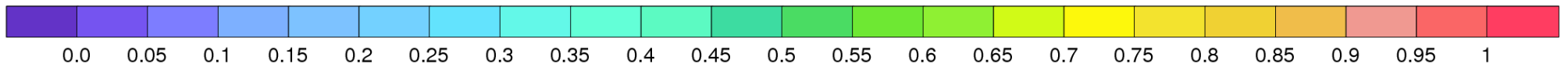
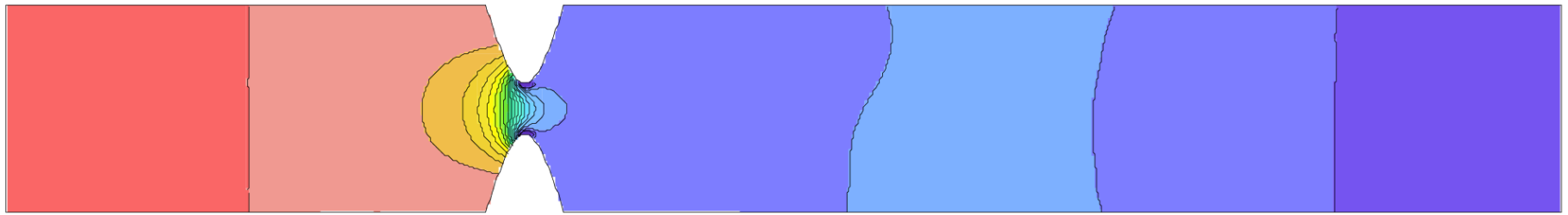
T-UGOm  
ncp1p1  
same



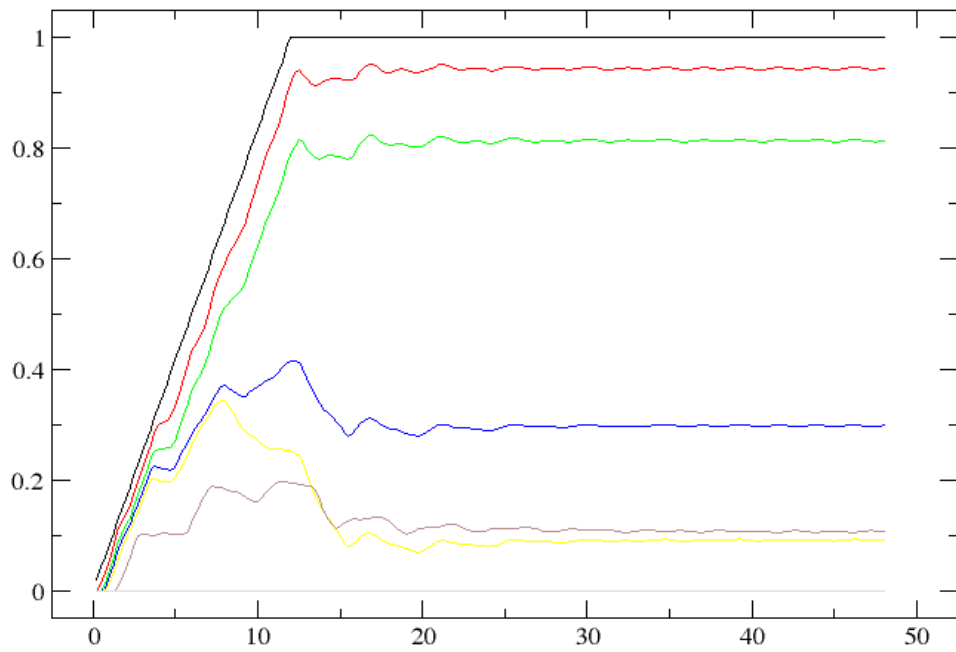


# T-UGOm RT0

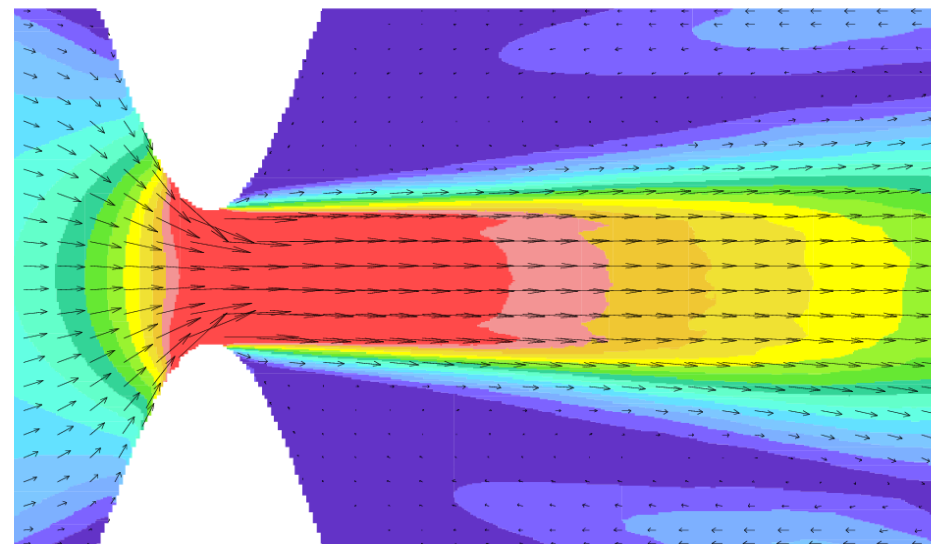




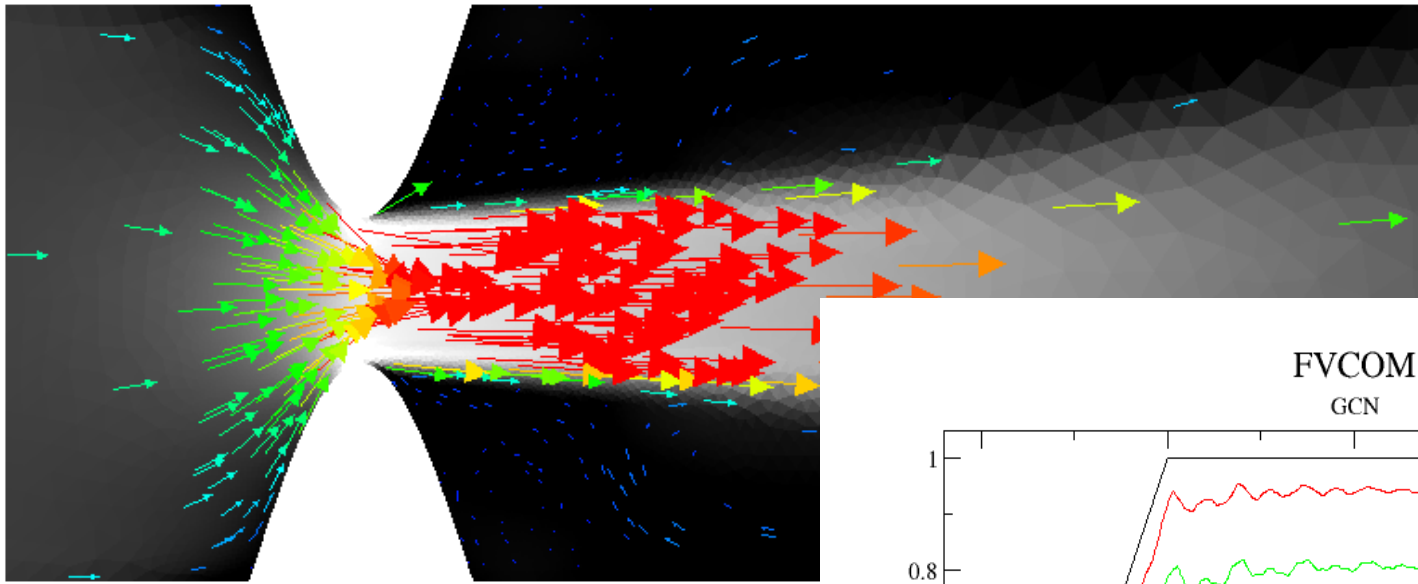
Quoddy



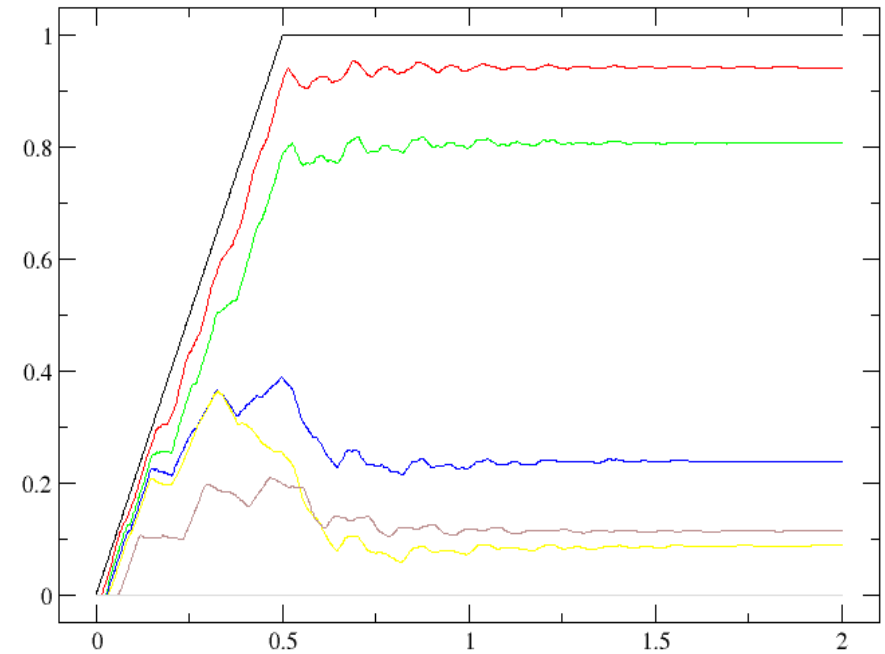
Quoddy5 -  
3 levels, Cartesian



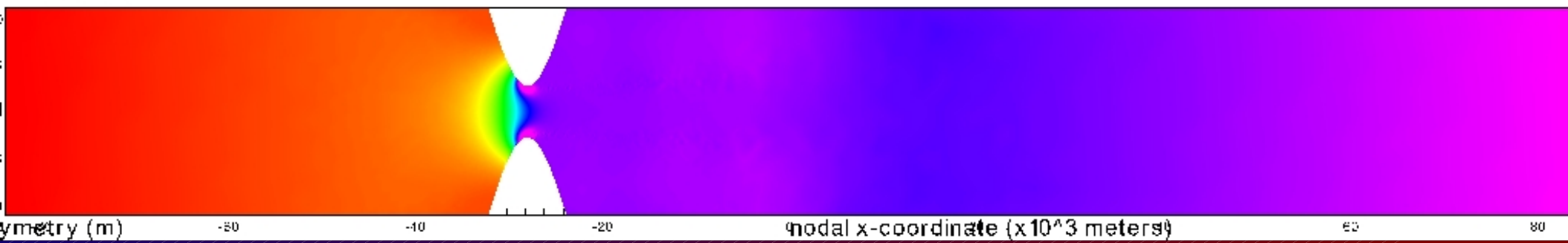
Vector  
Var: BAfluv  
Units: meters.s-1  
3.000  
2.250  
1.500  
0.750  
0.000  
Max: 5.410  
Min: 0.001217



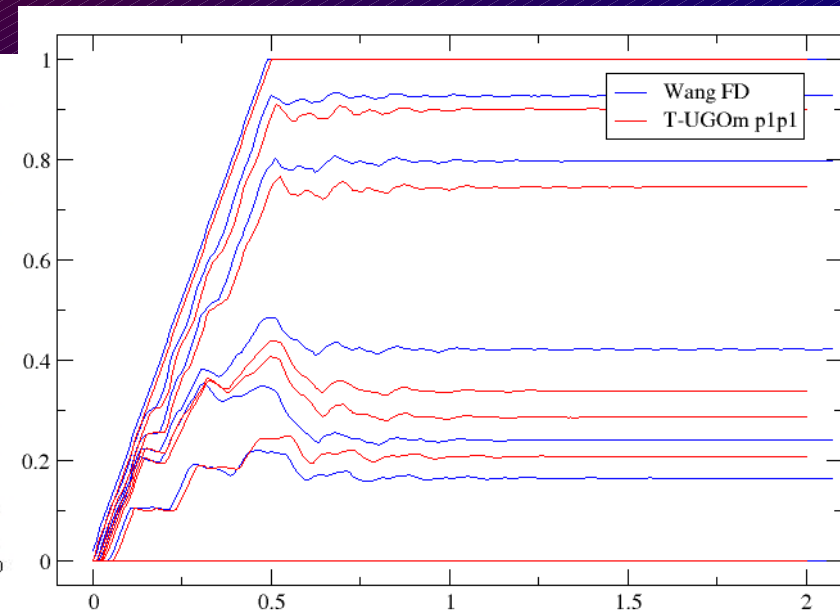
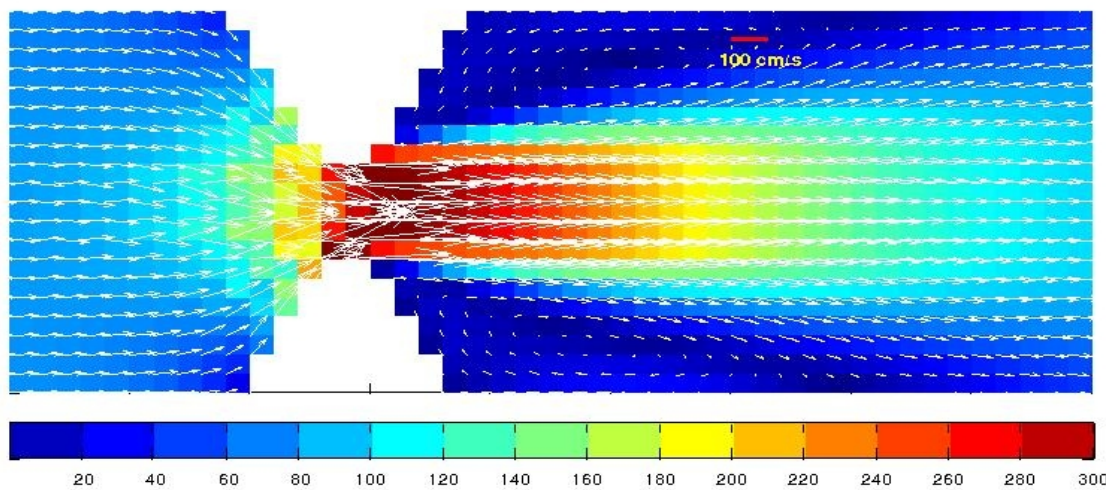
FVCOM  
GCN



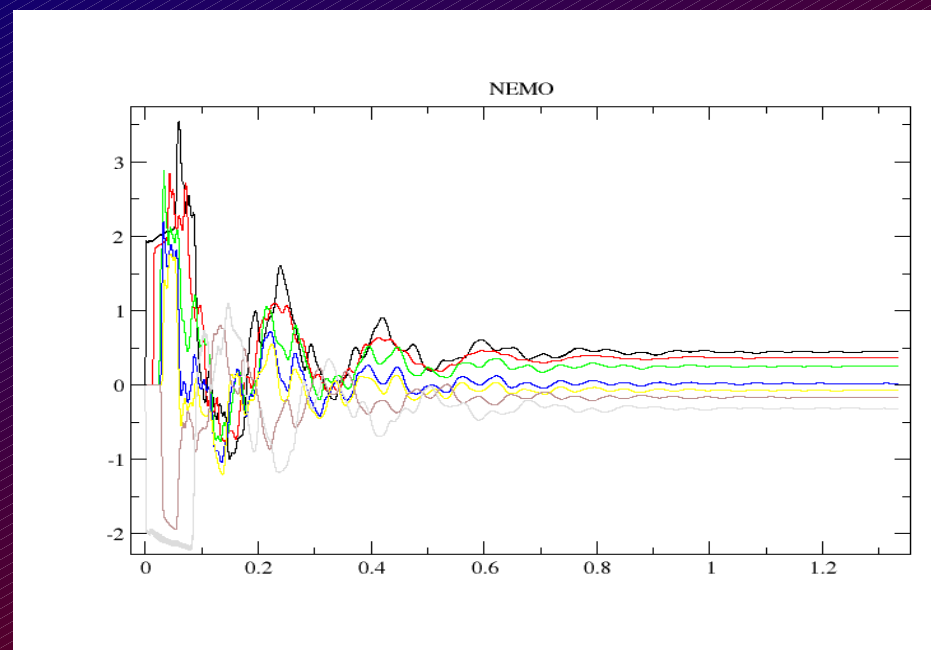
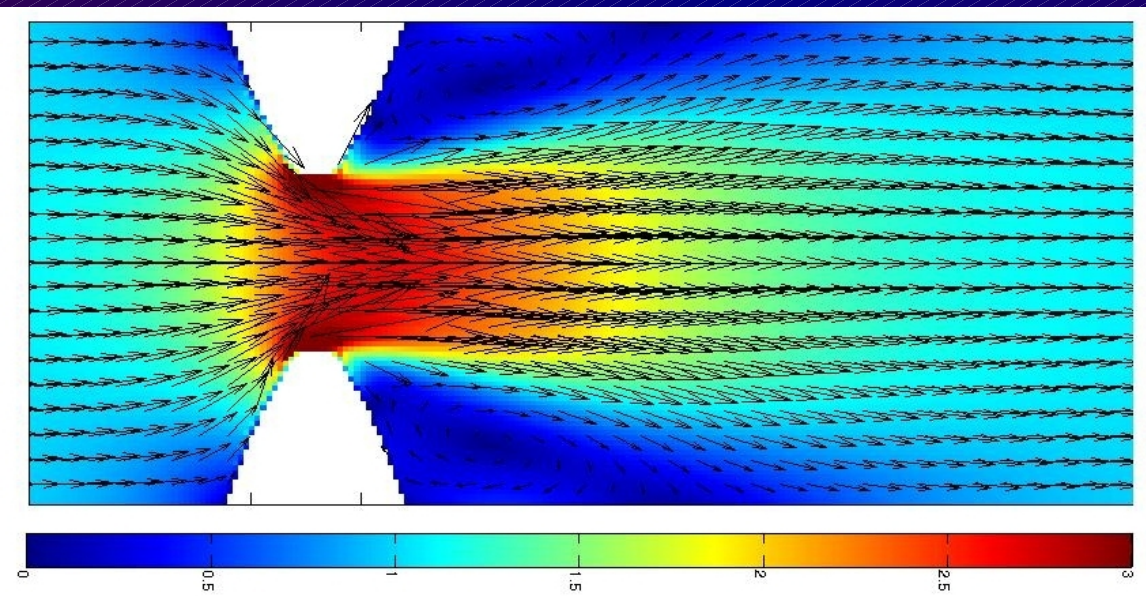
1.000  
0.7500  
0.5000  
0.2500  
0.000  
Max: 1.000  
Min: -1.031

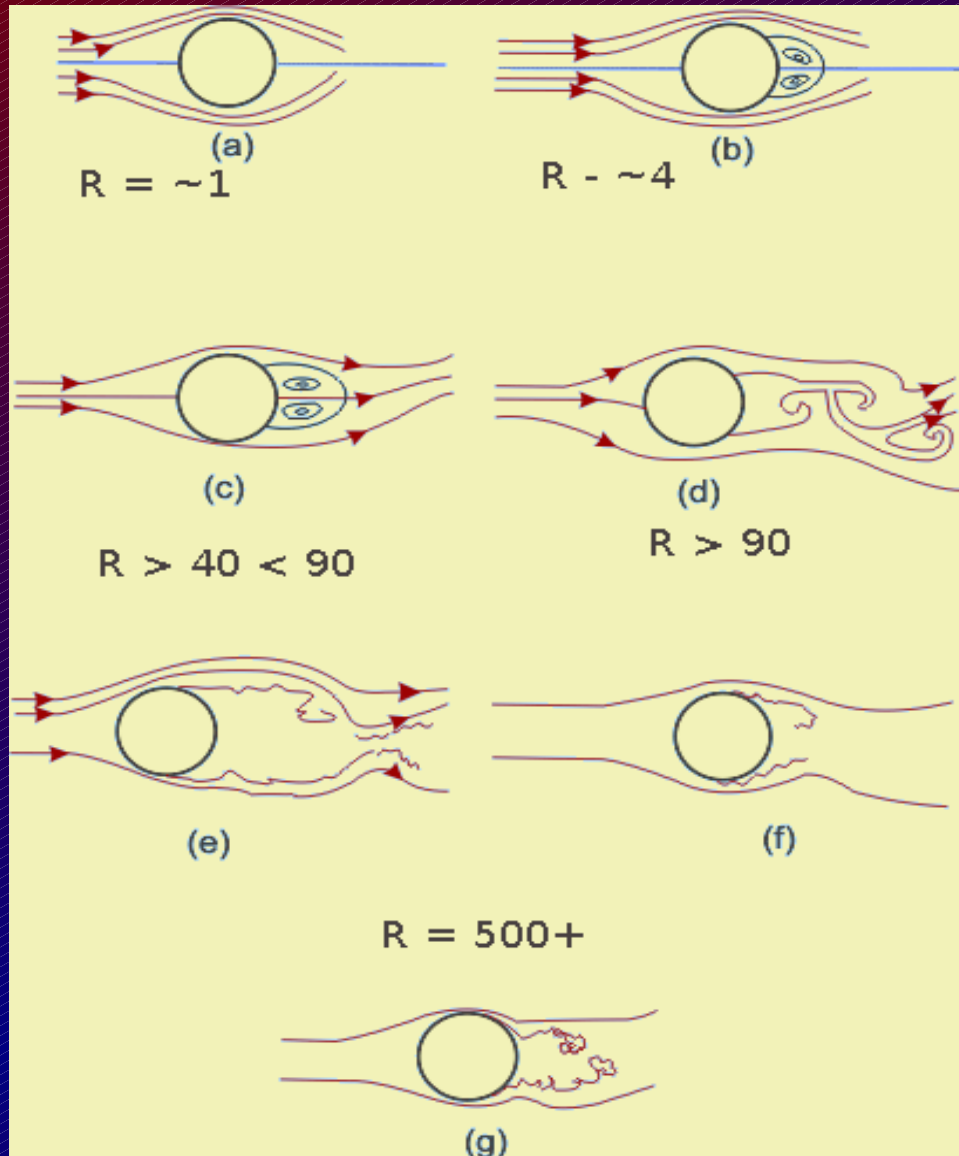


# 1 km FD mesh (Wang)



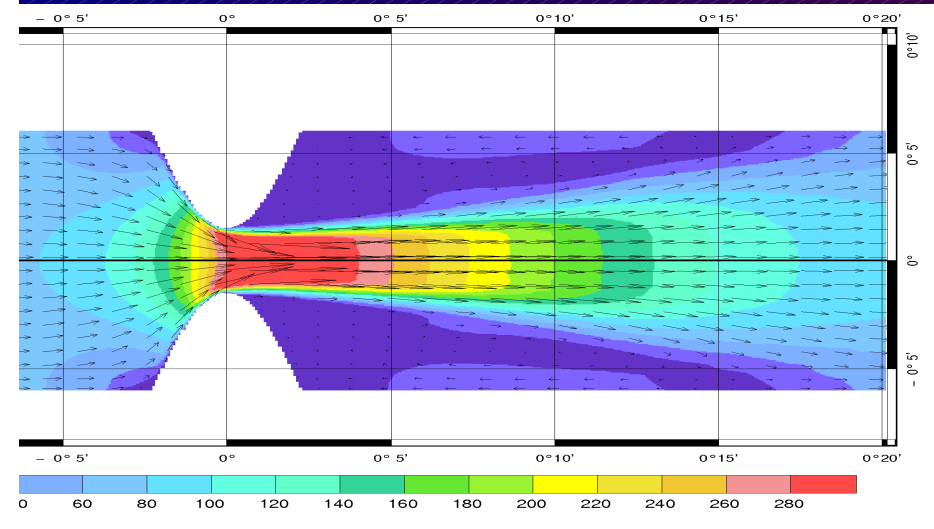
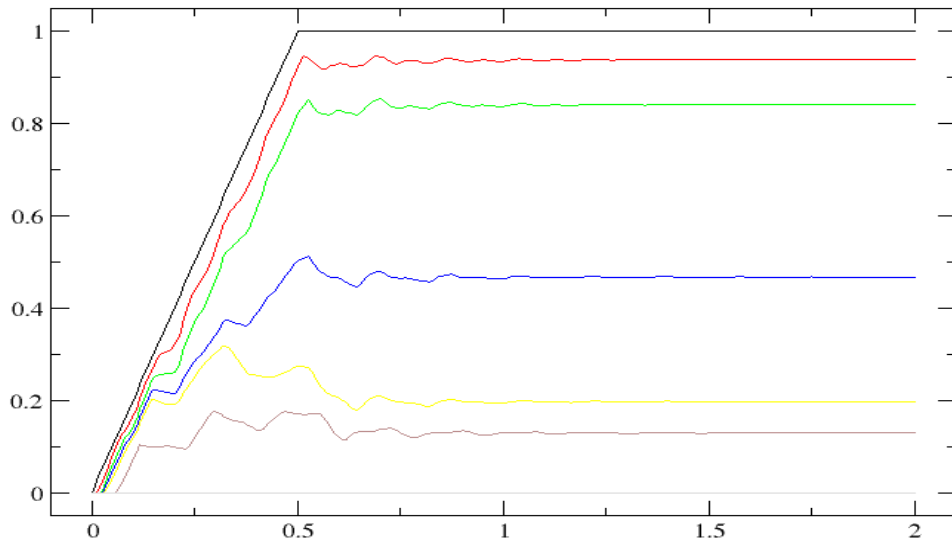
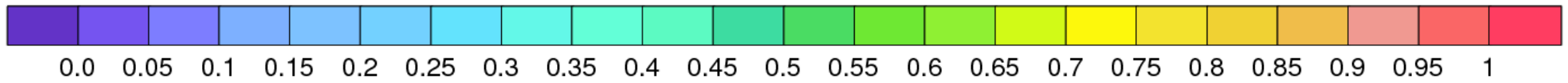
# OPA/NEMO





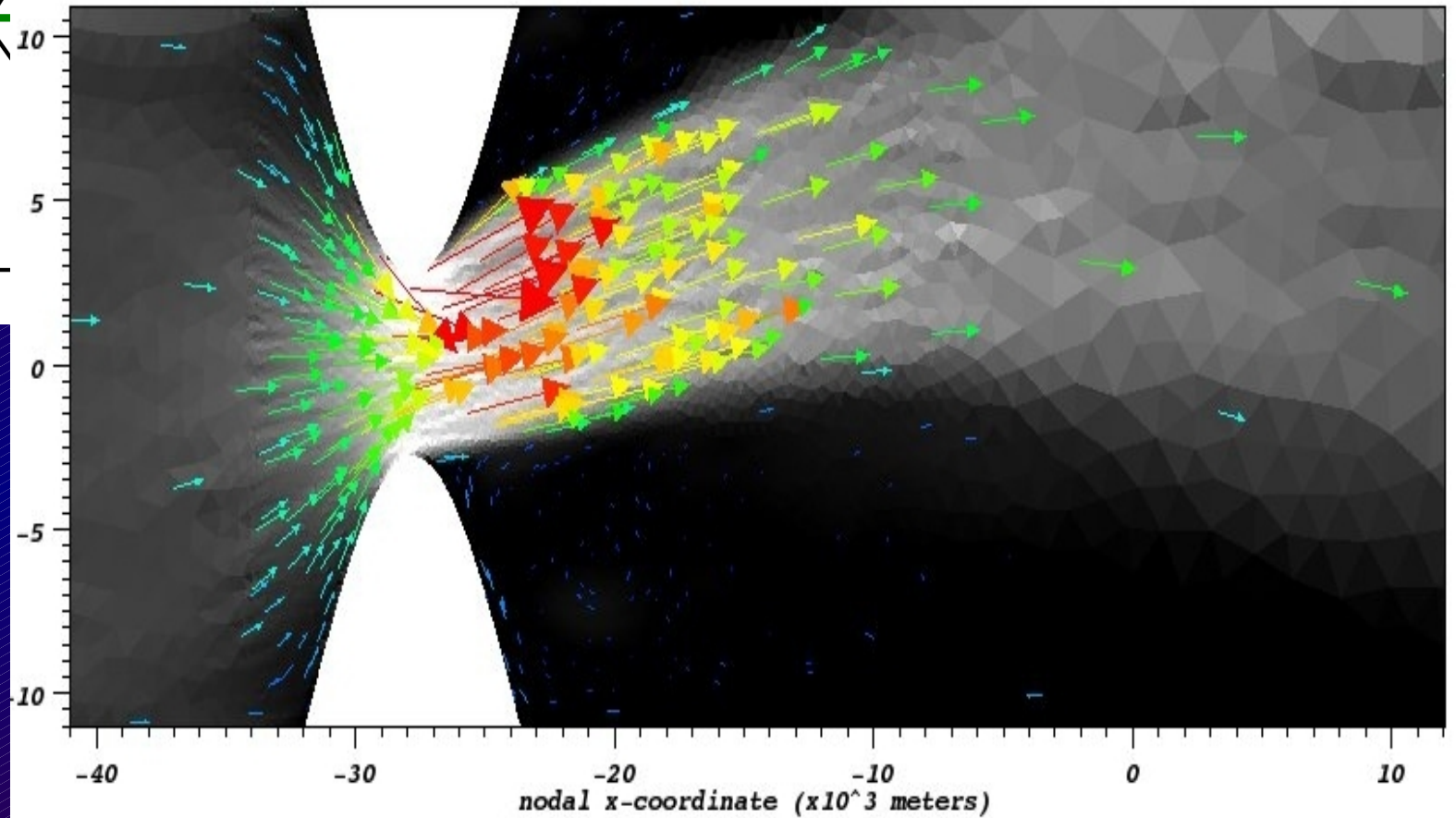
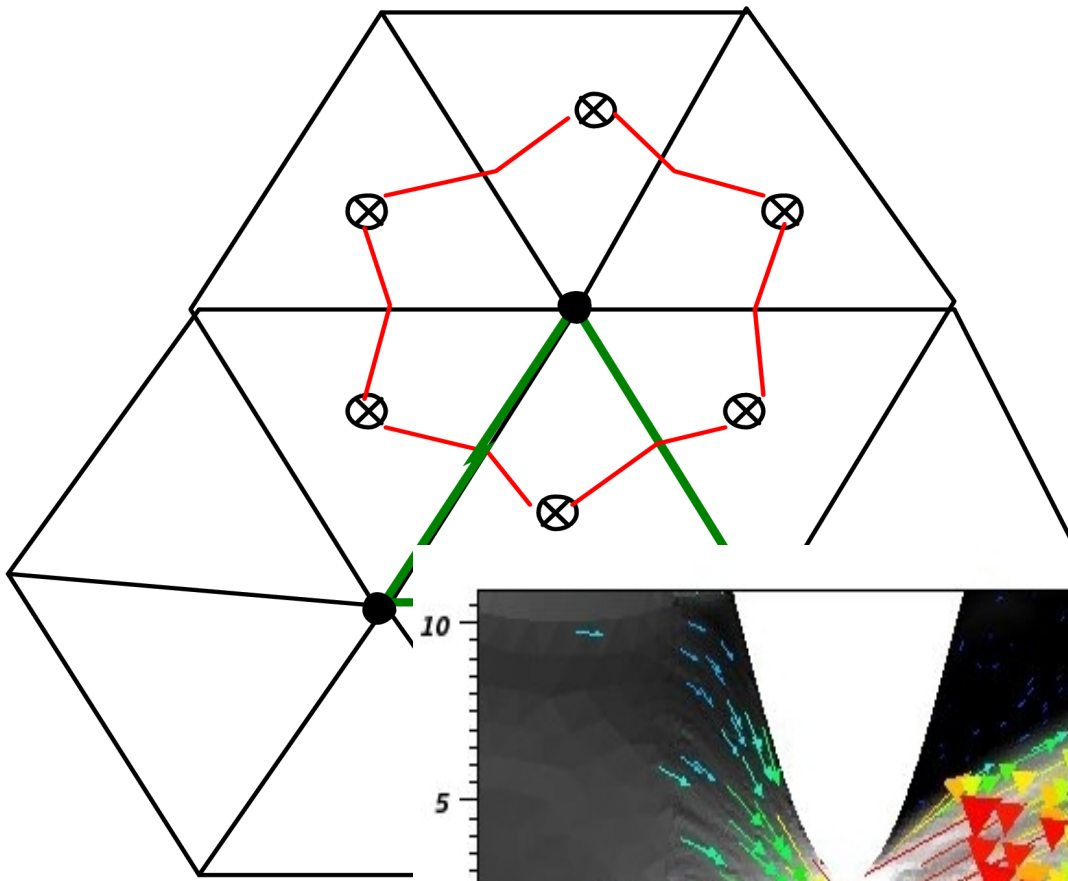
**Reynolds Number**  
ratio inertial/viscous

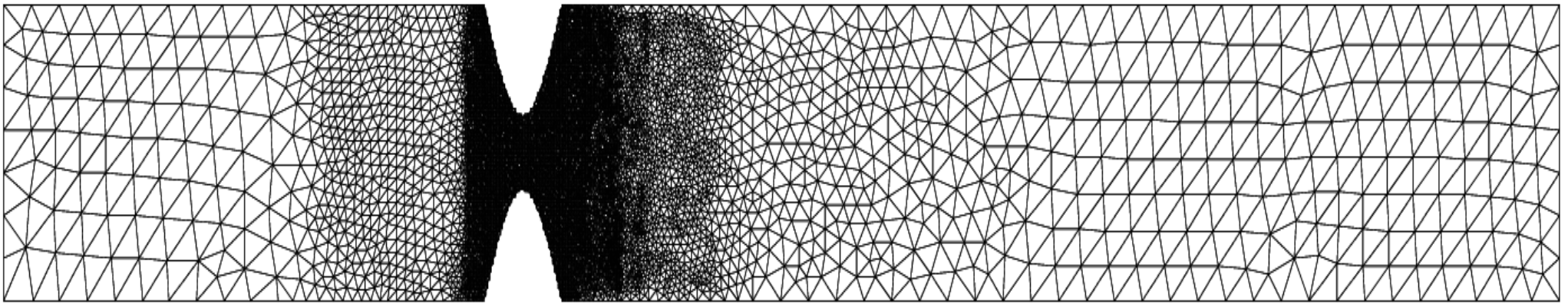




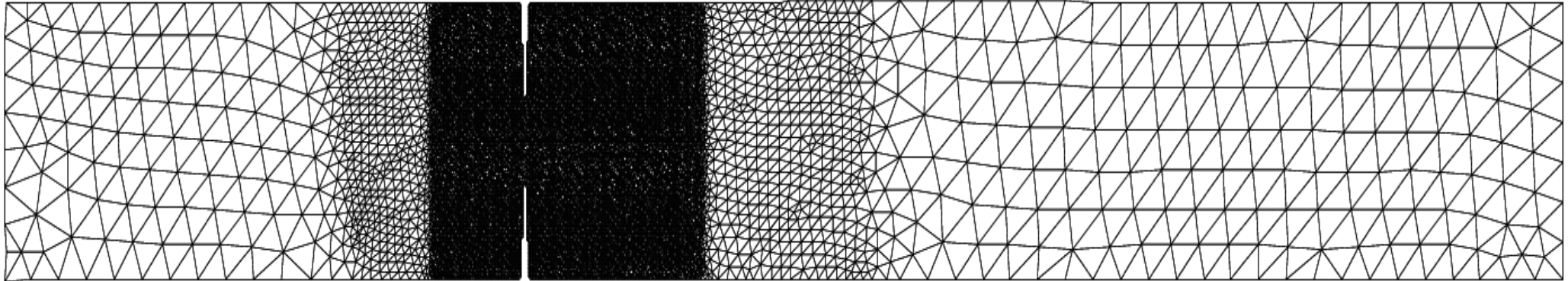
T-UGOm No slip boundary on sides < 250 m

# FVCOM Ghost Cells

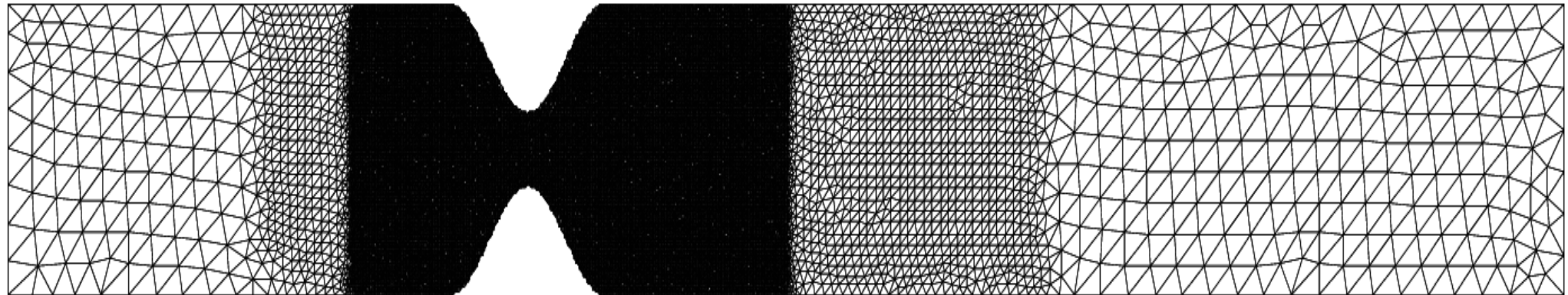




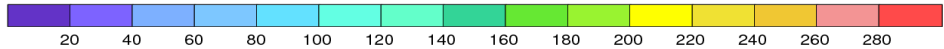
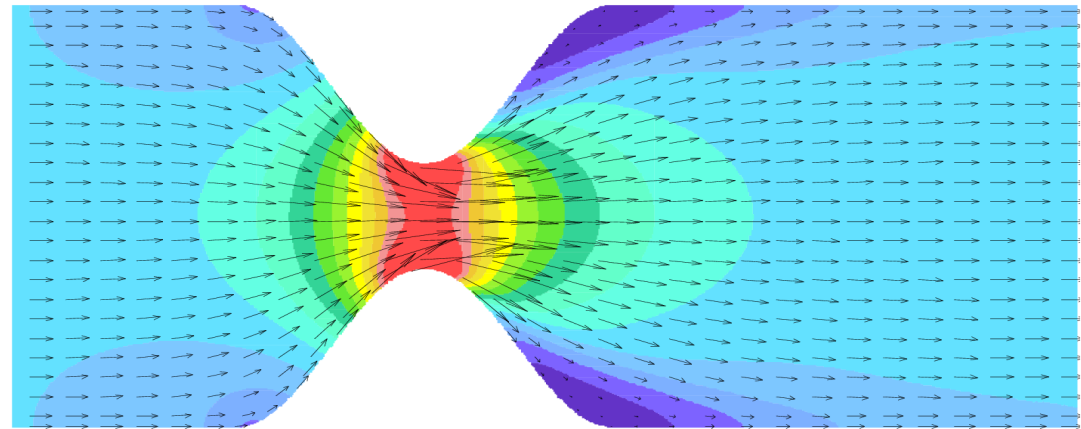
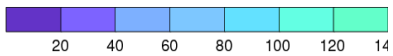
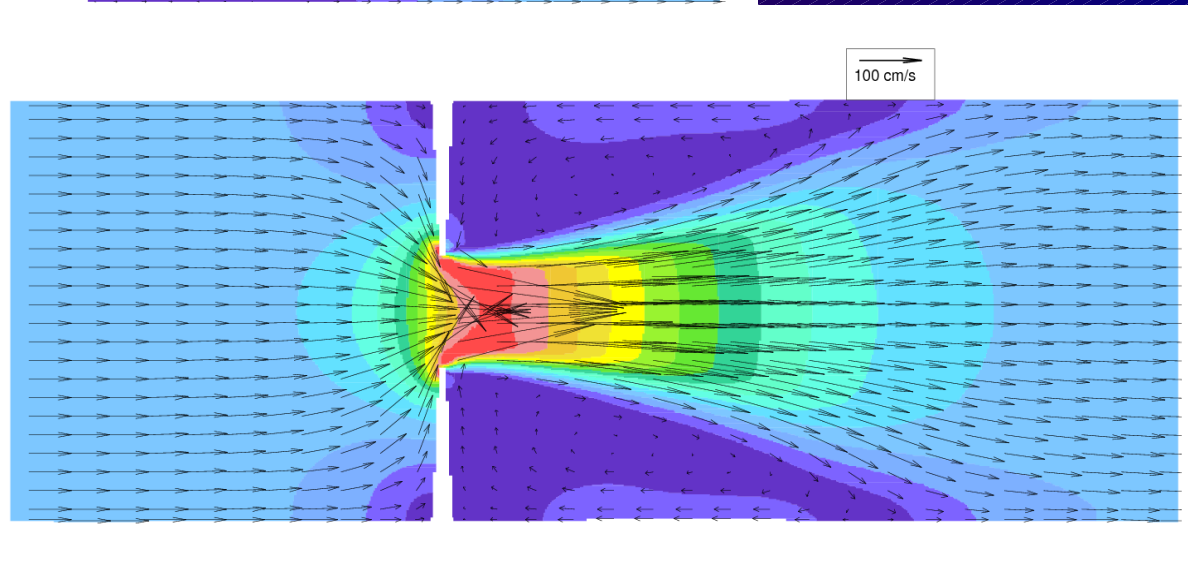
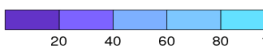
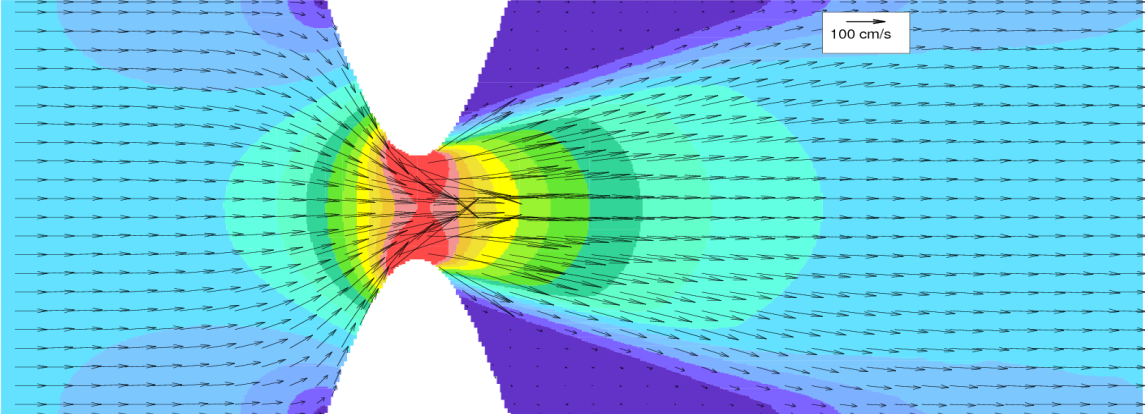
**SQUEEZE 1**

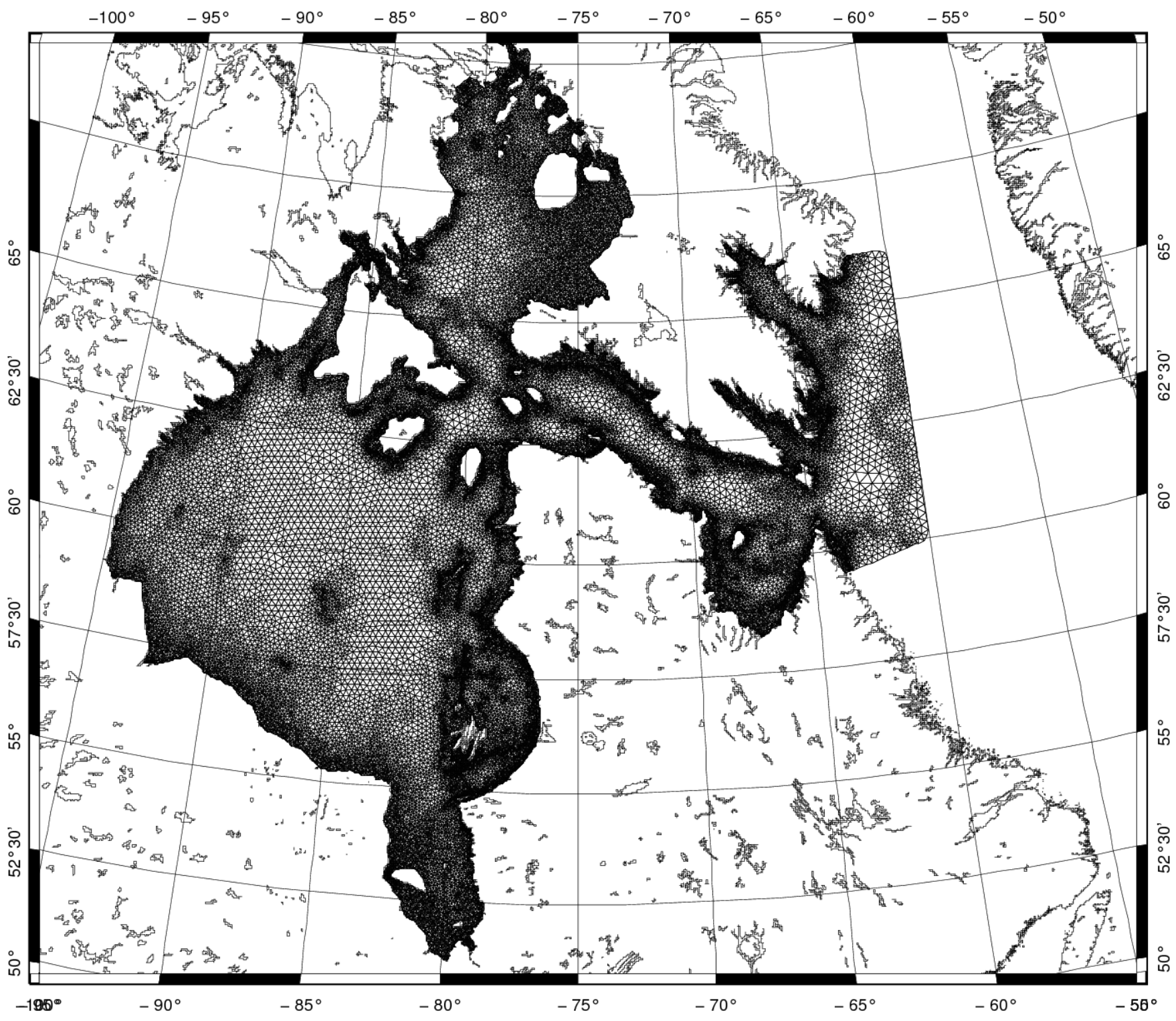


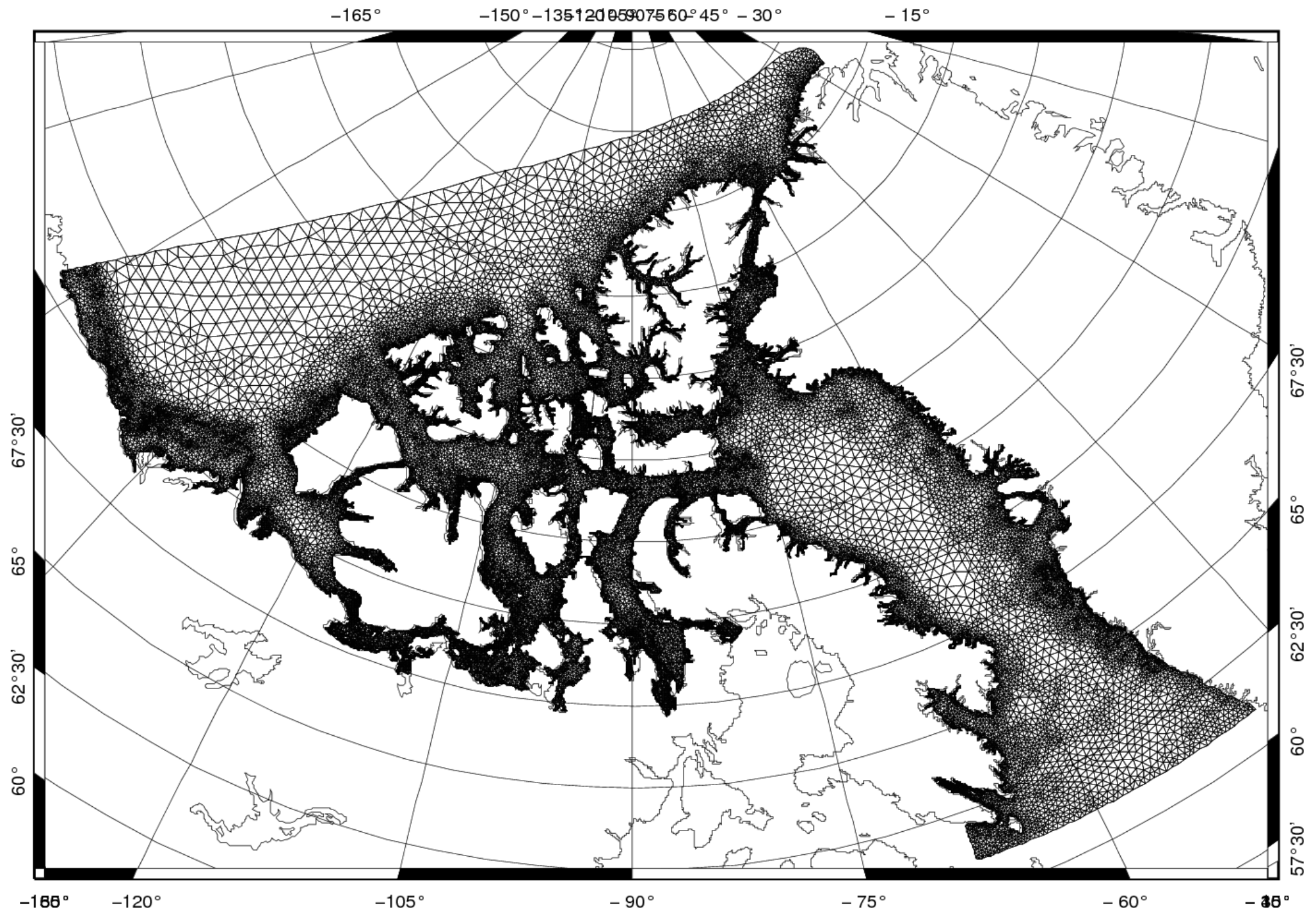
**SQUEEZE 2**

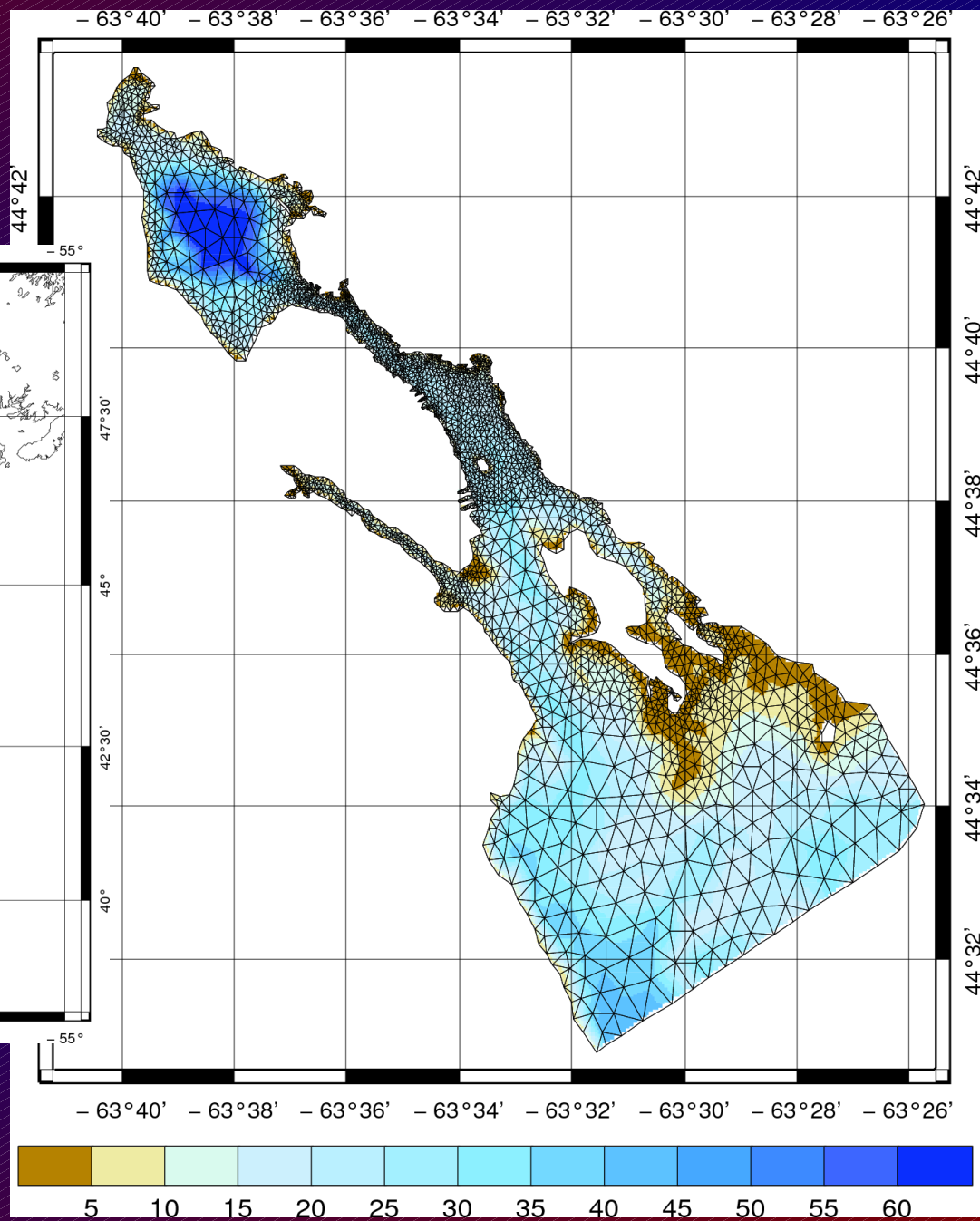
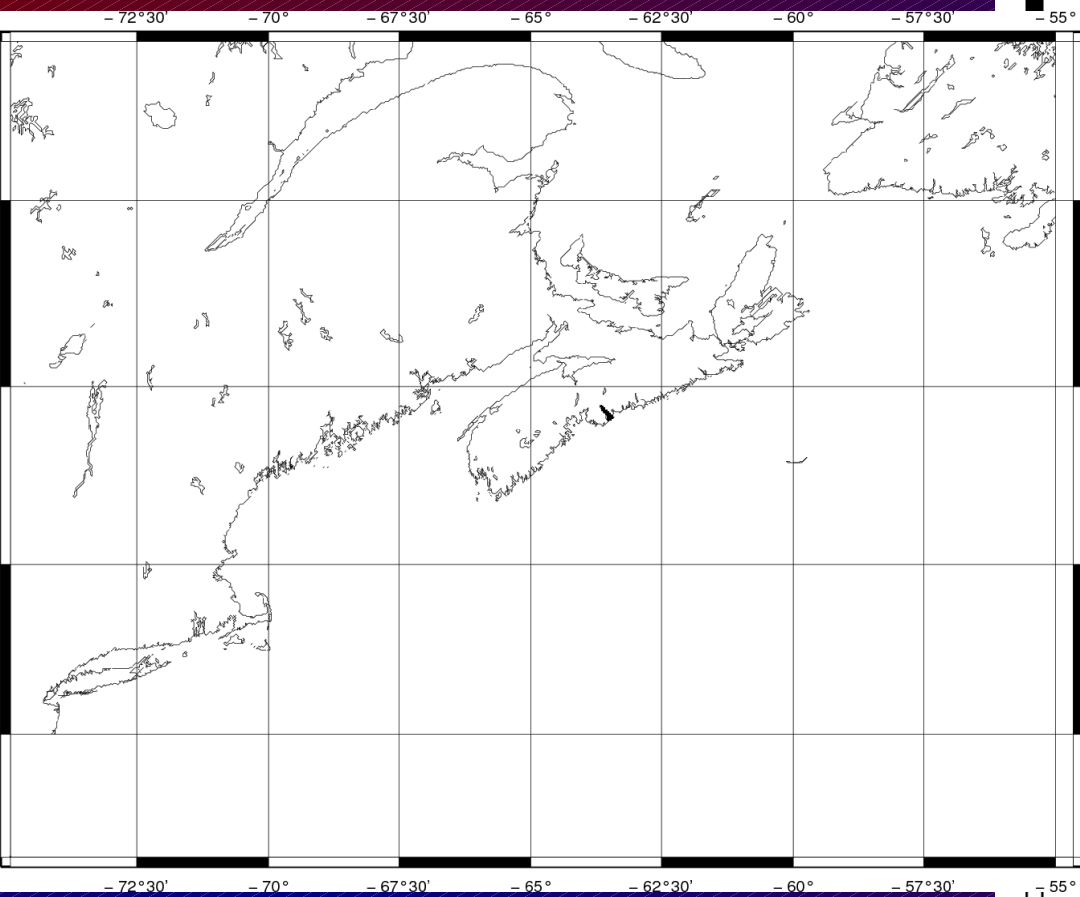


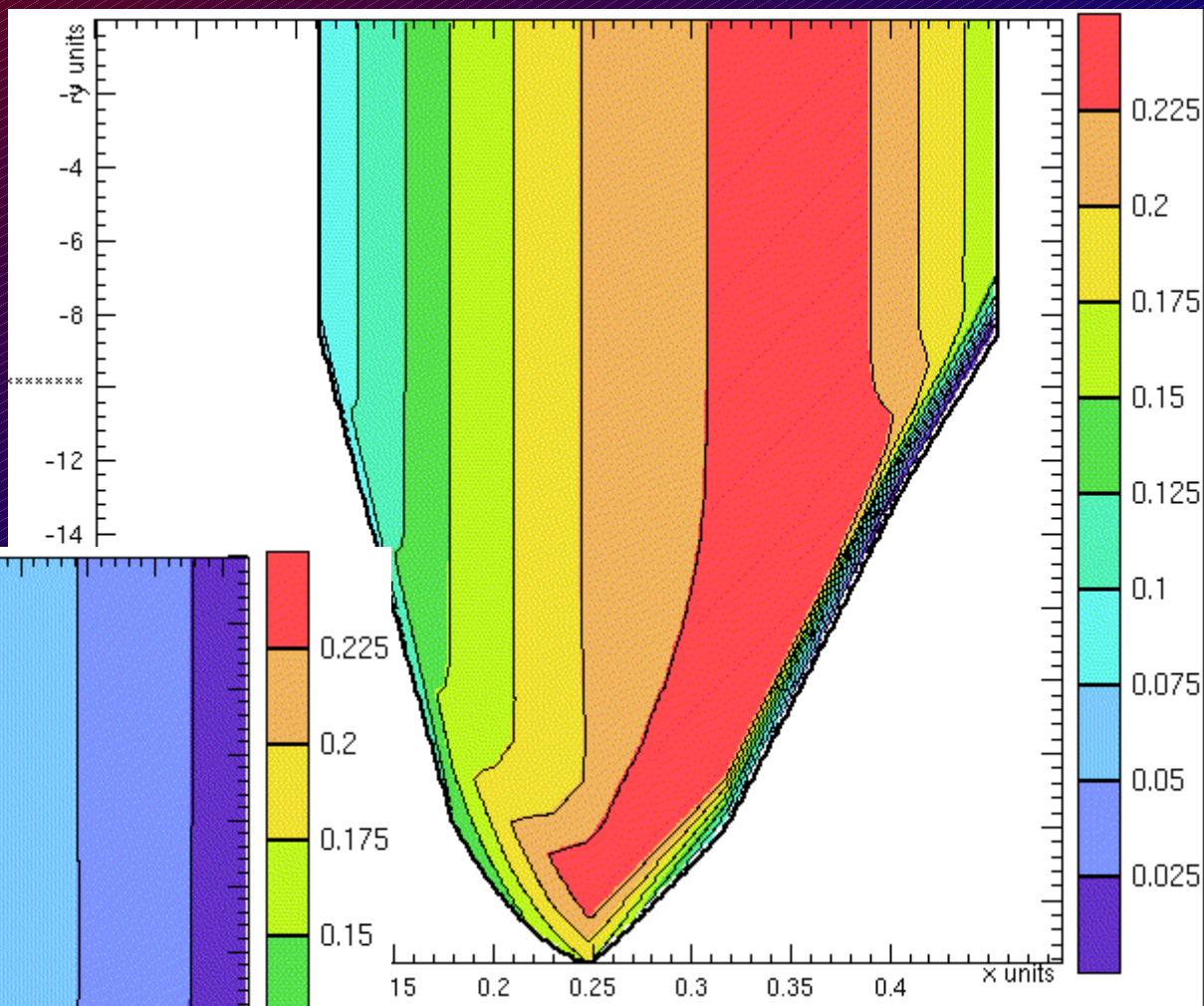
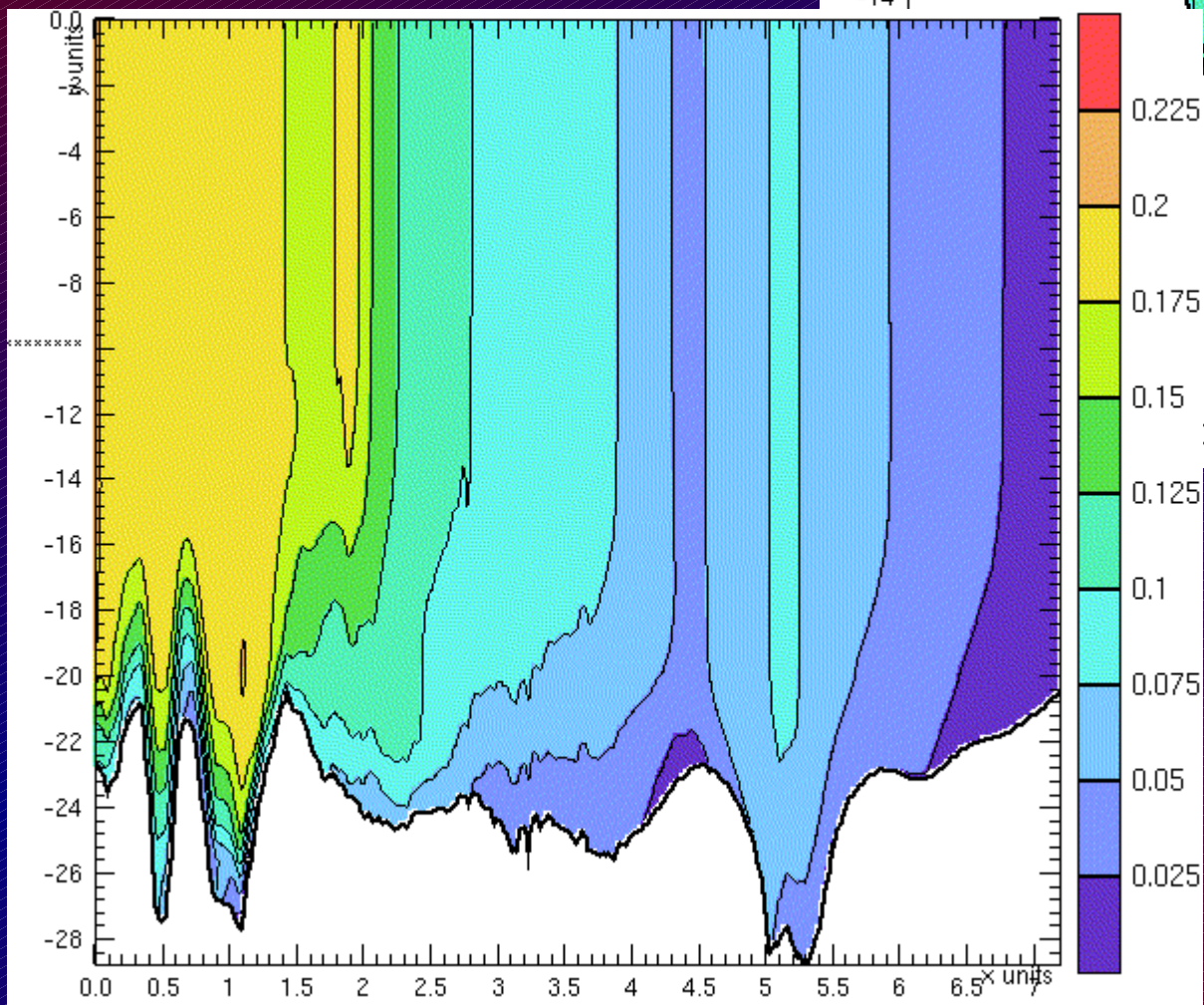
**SQUEEZE 3**



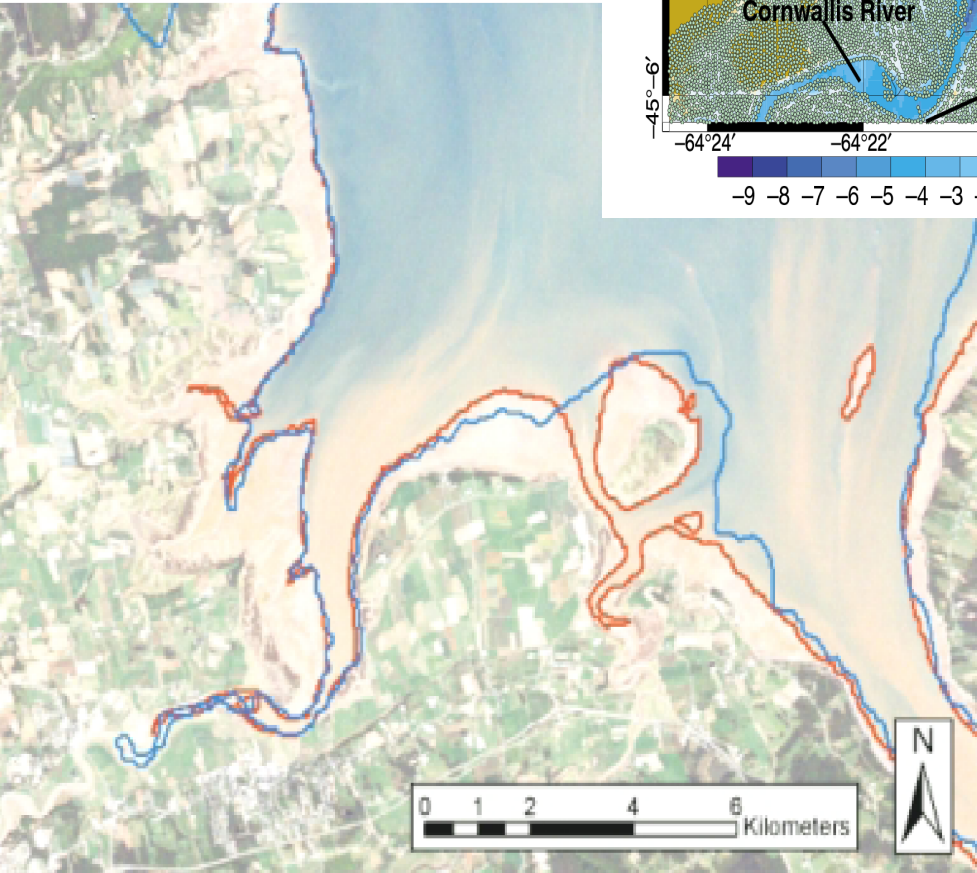
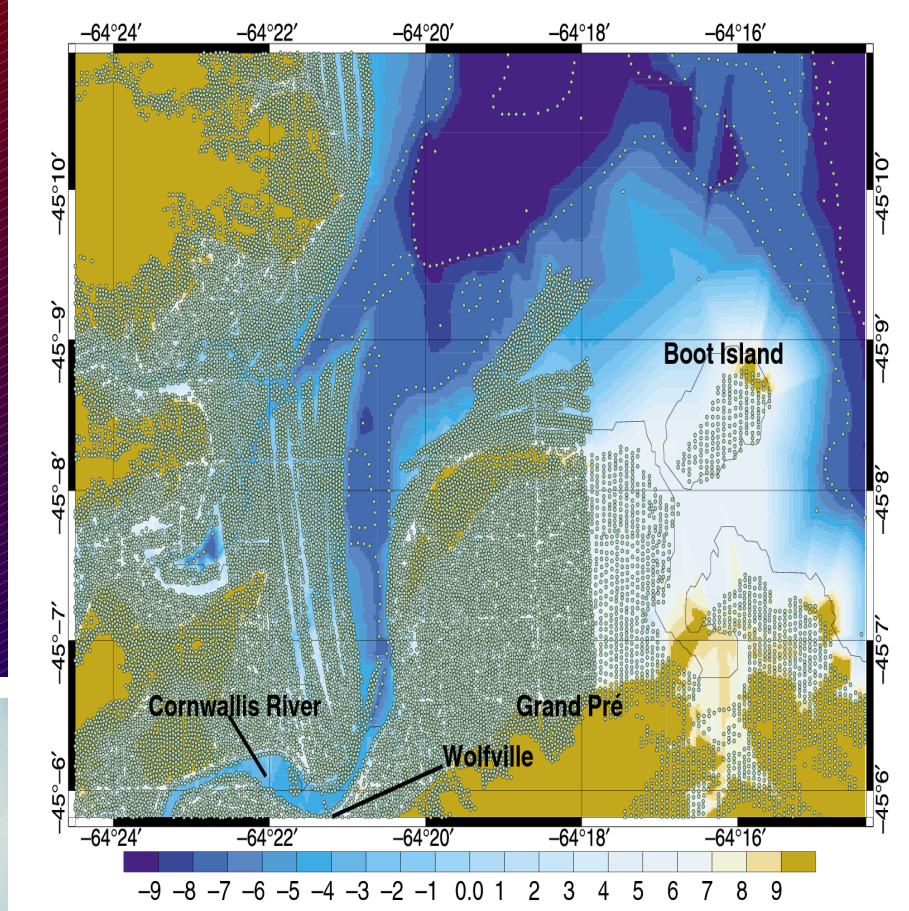


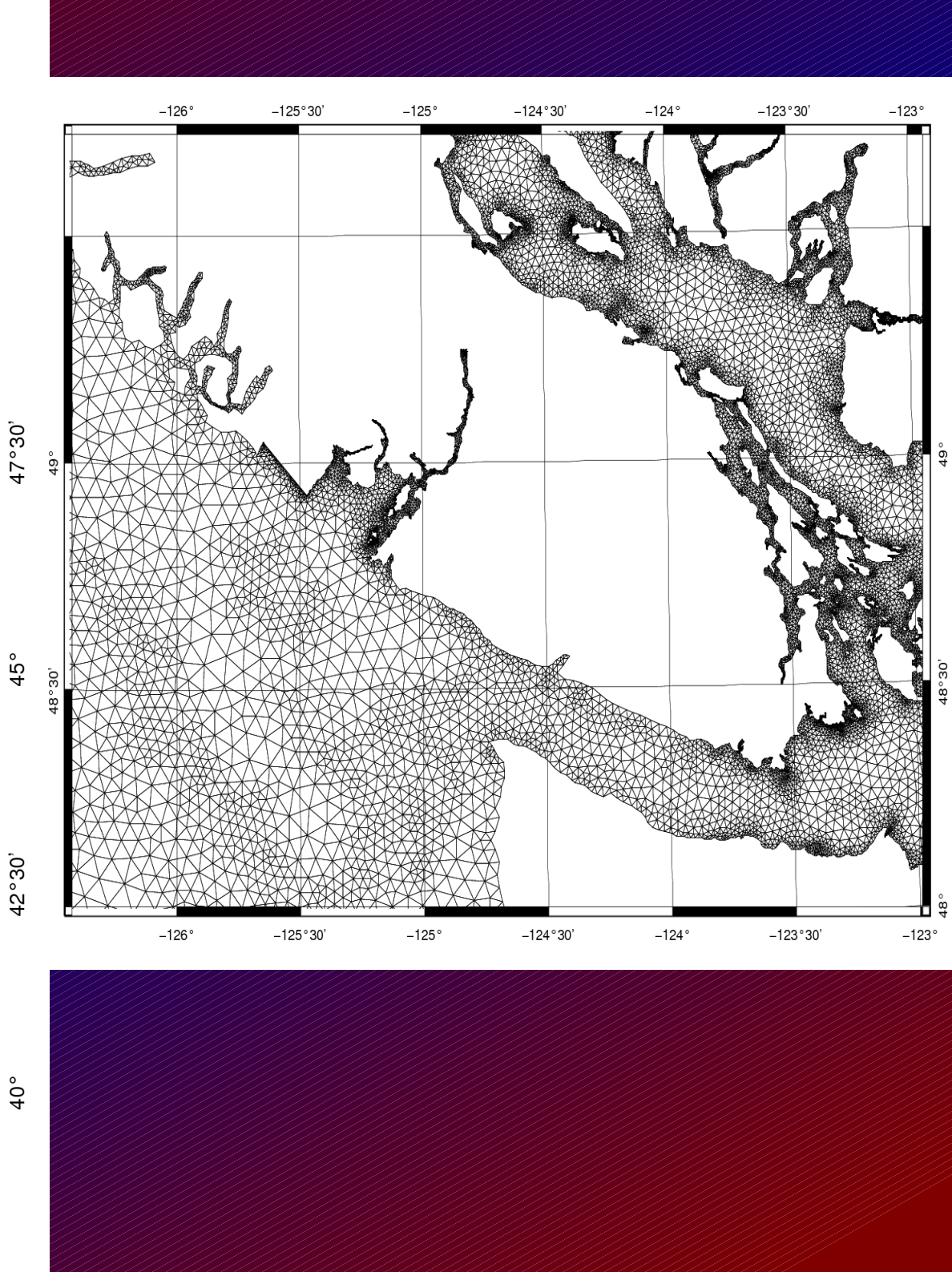
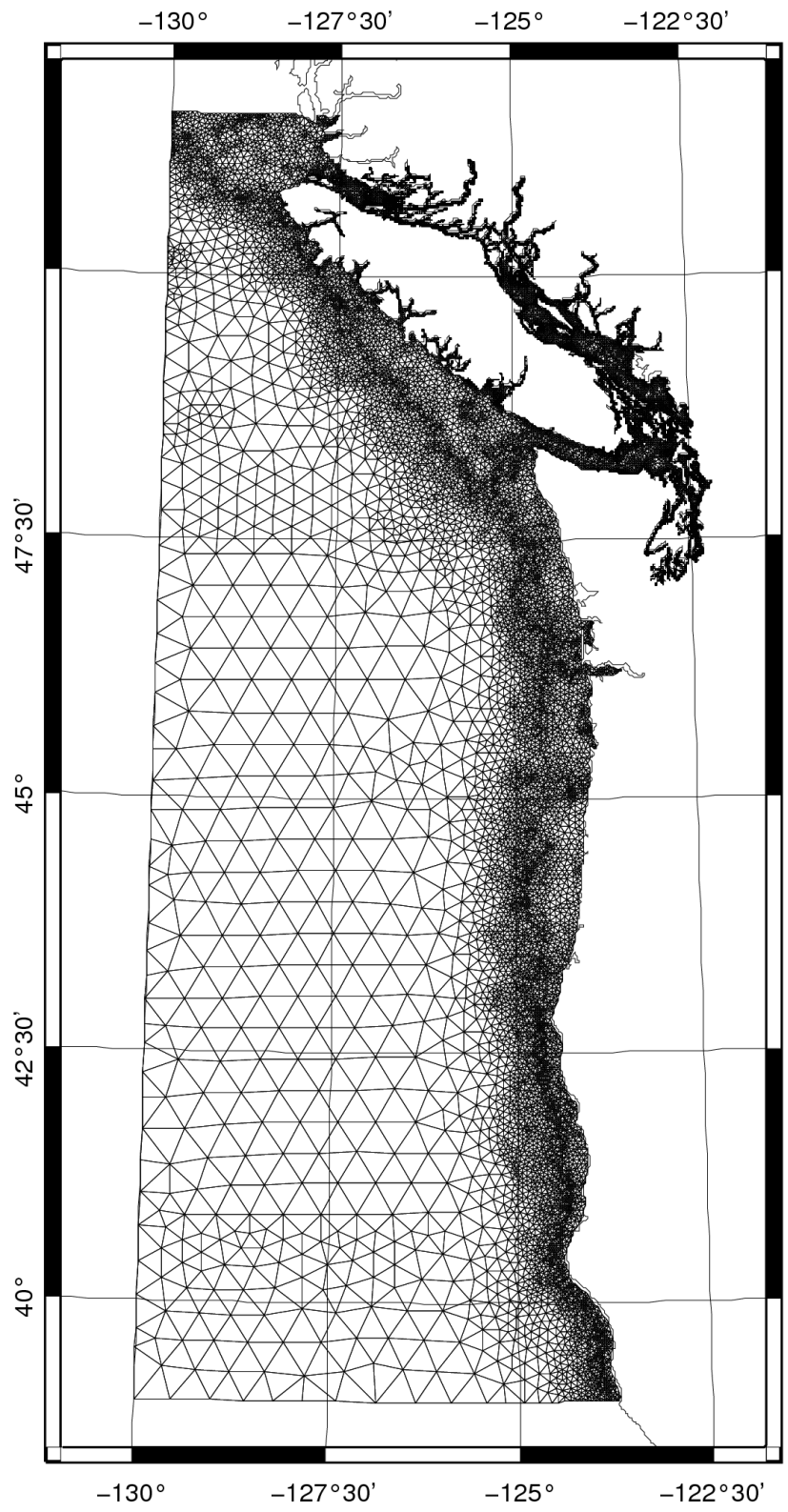


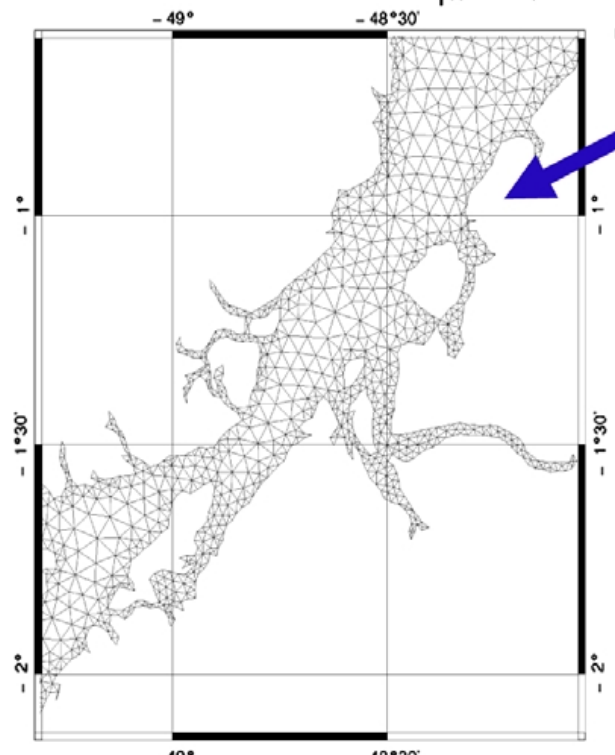
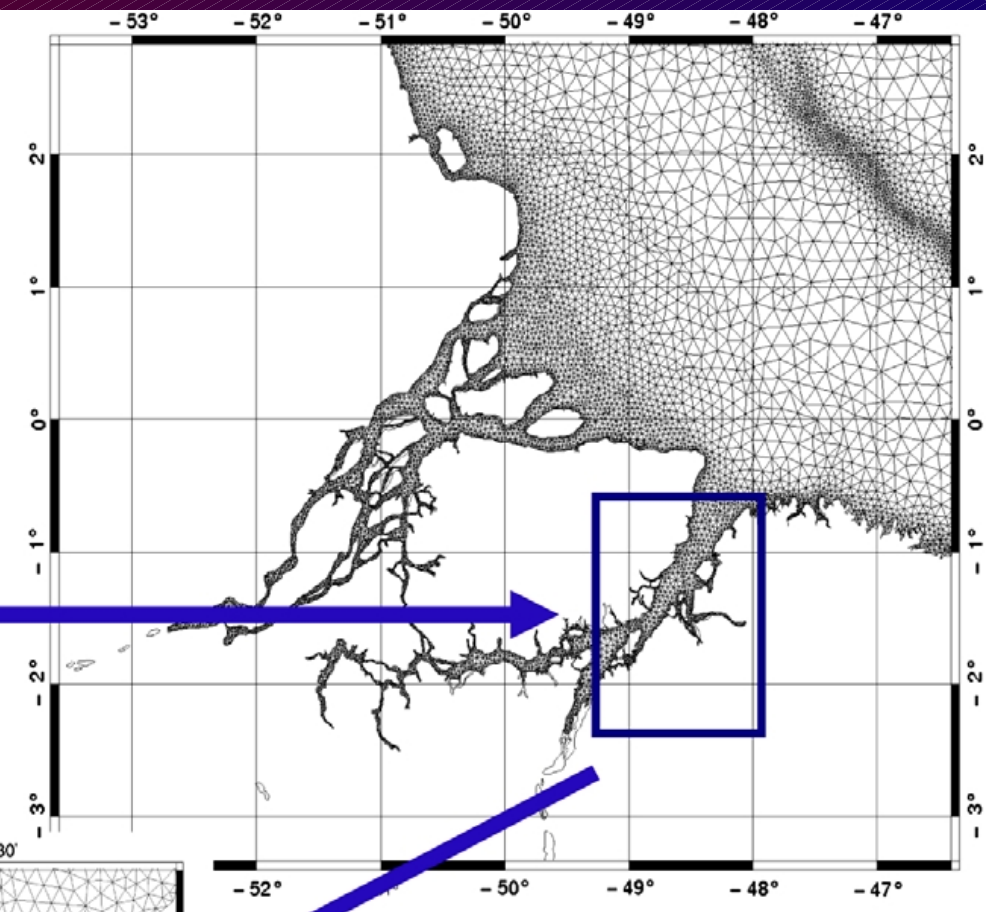
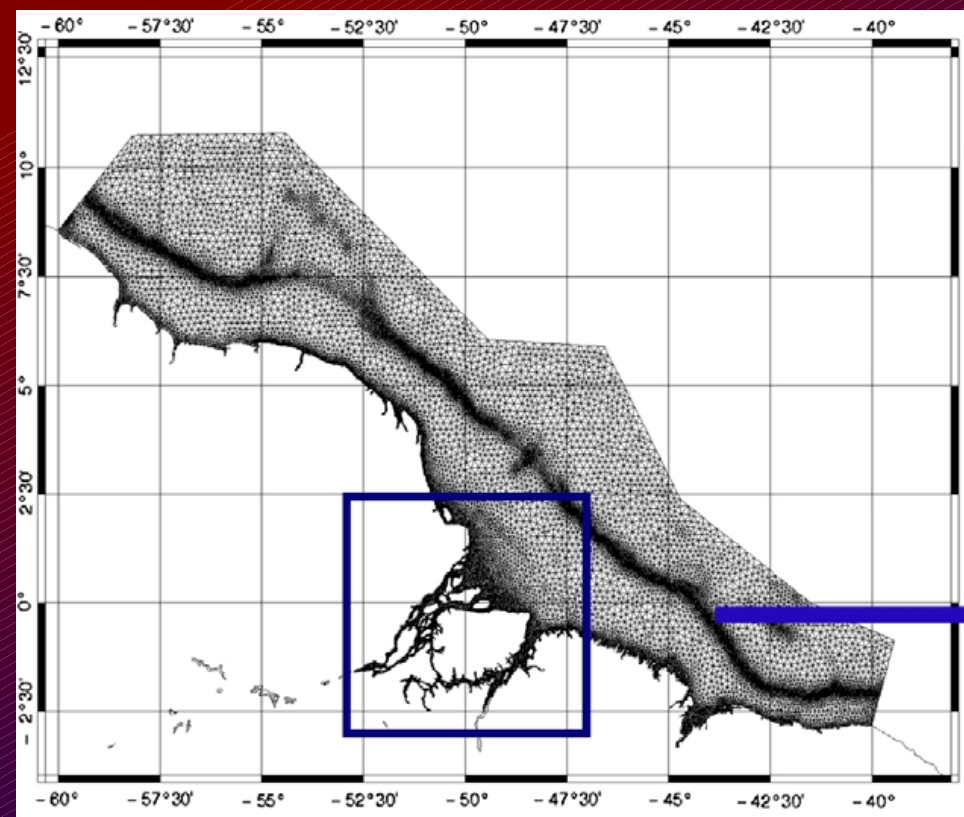




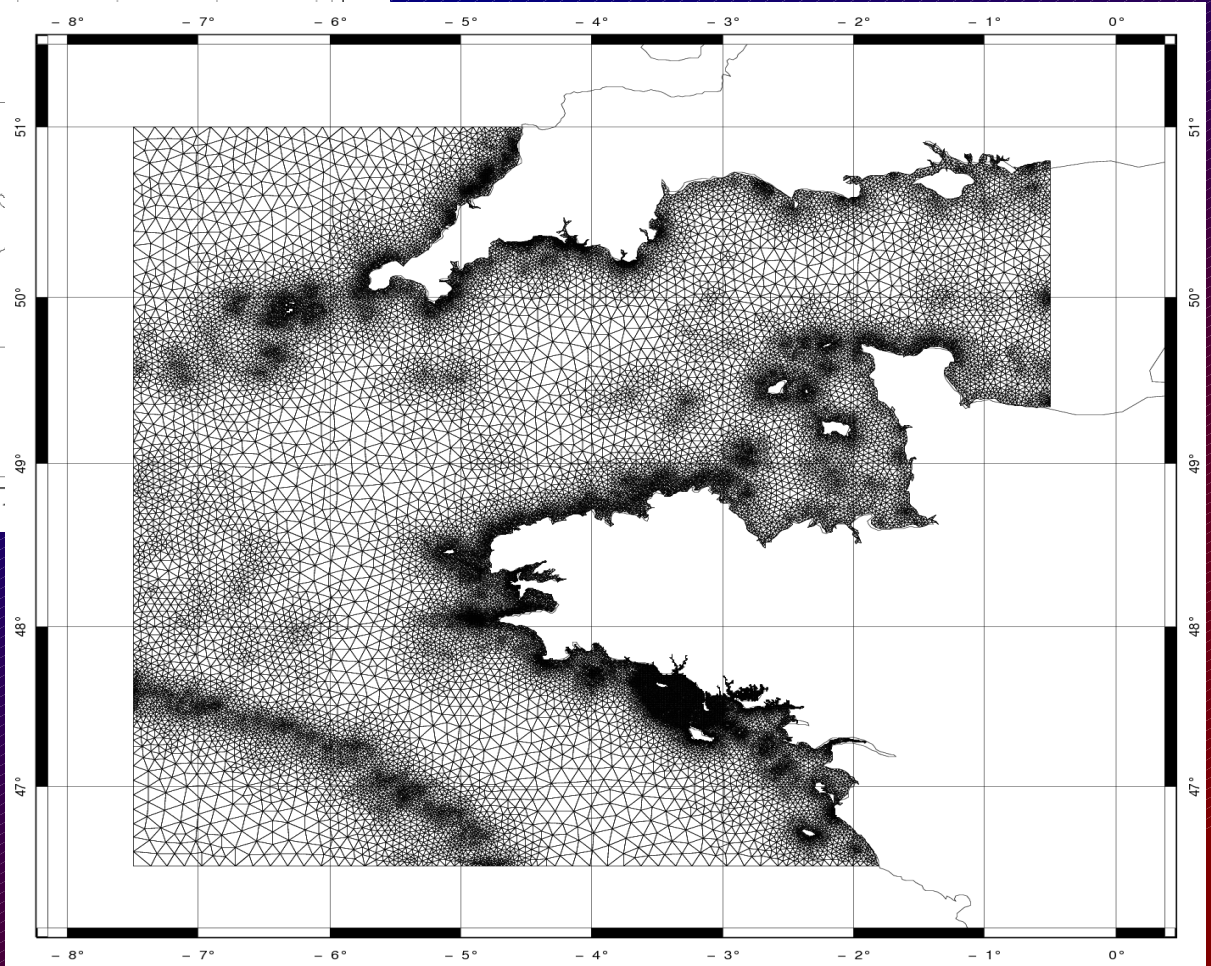
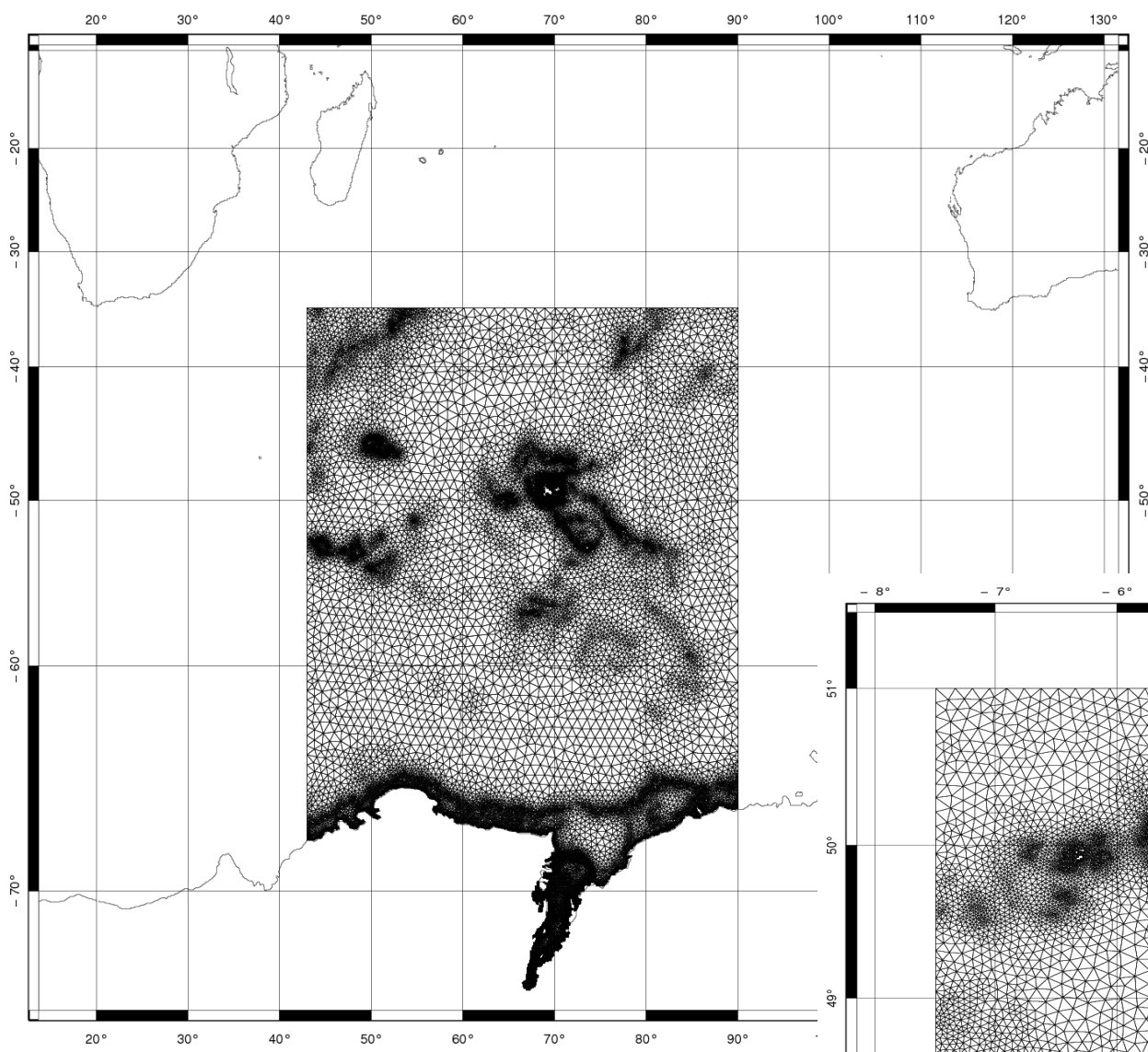


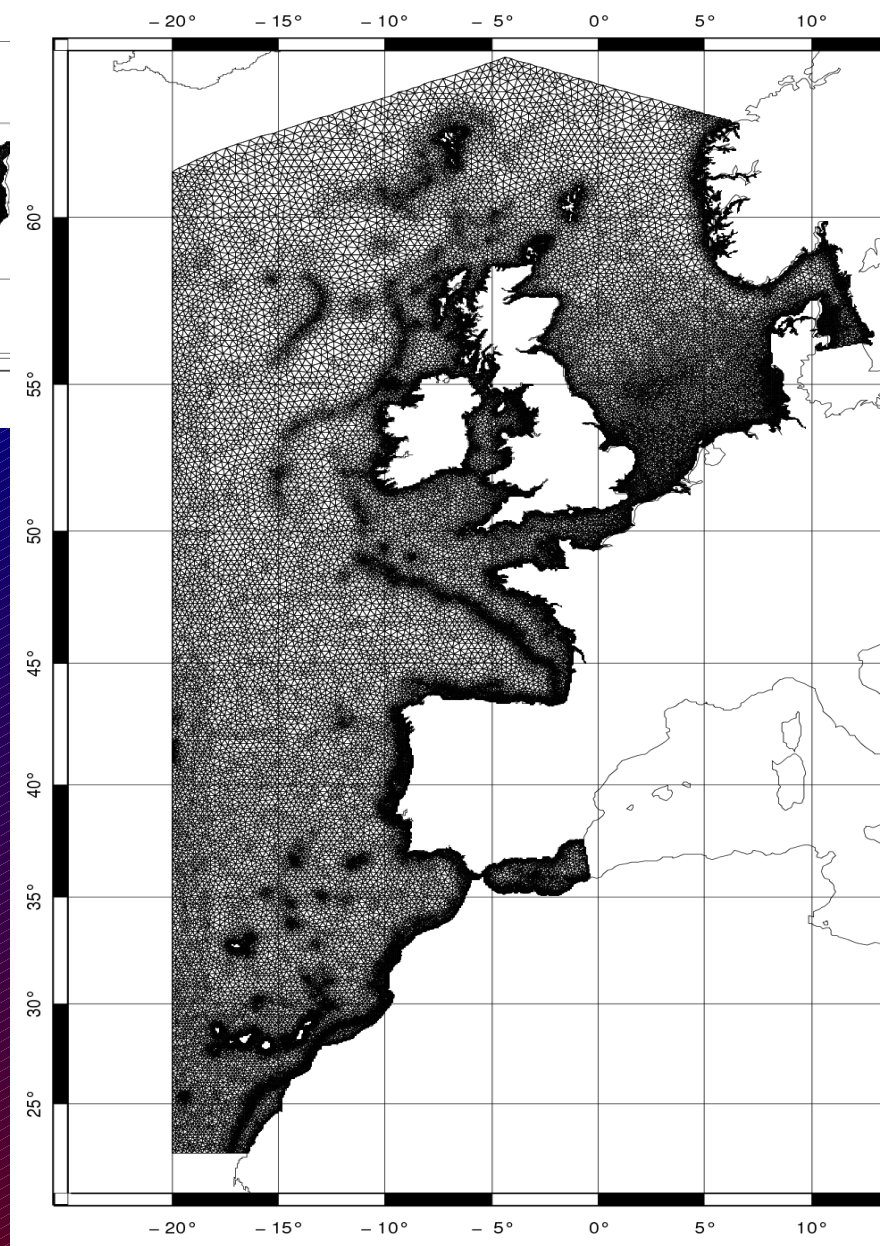
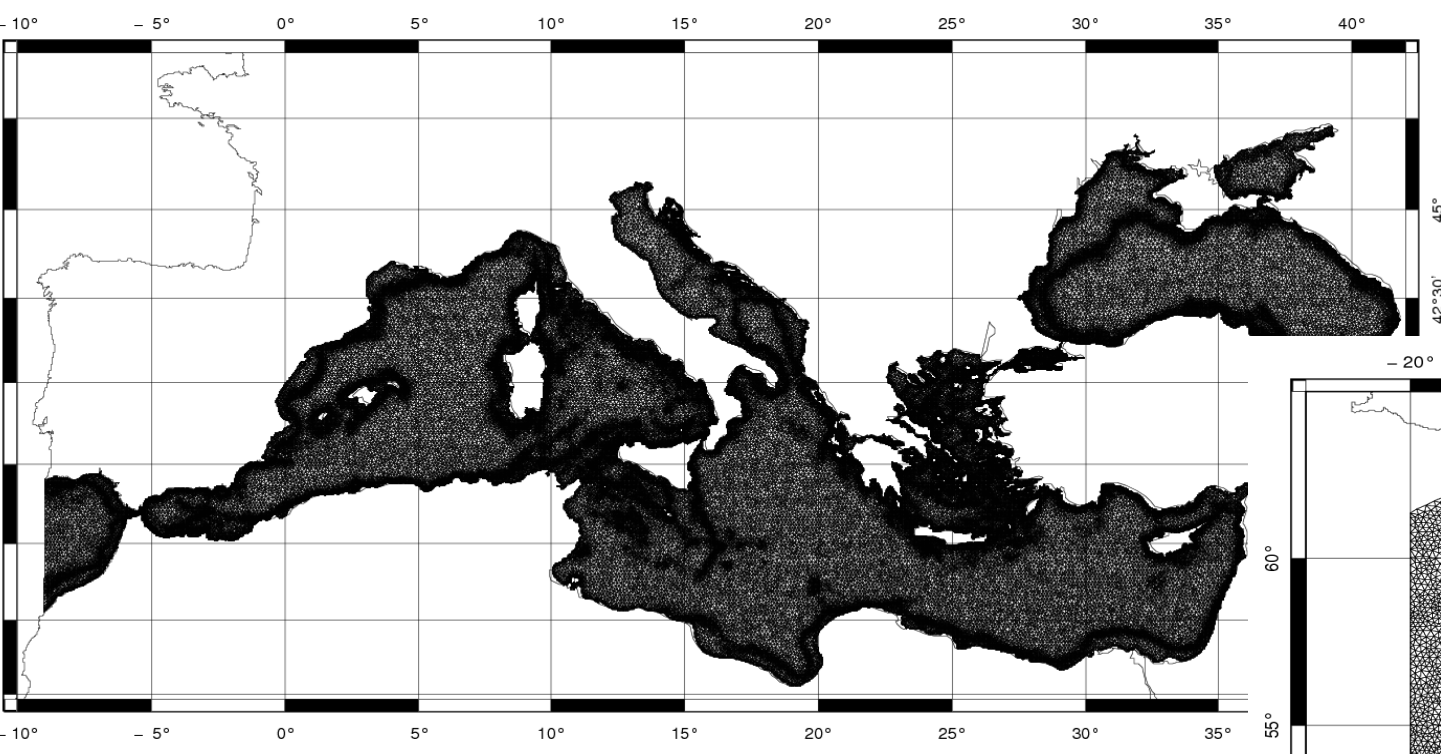


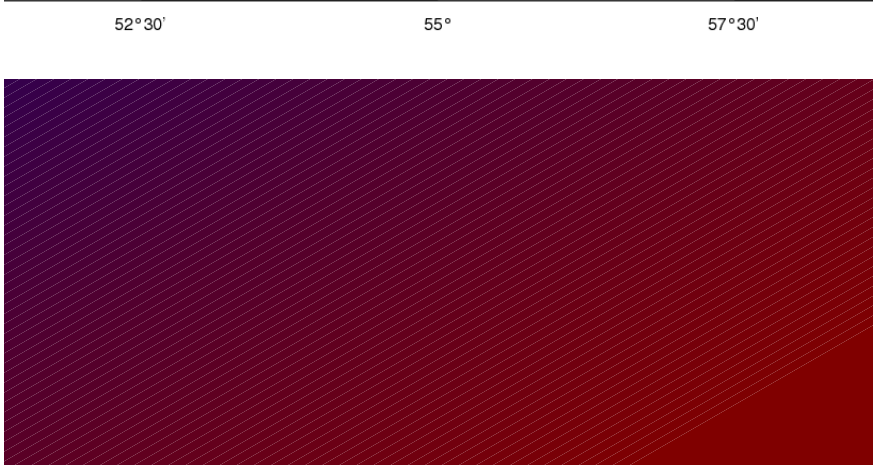
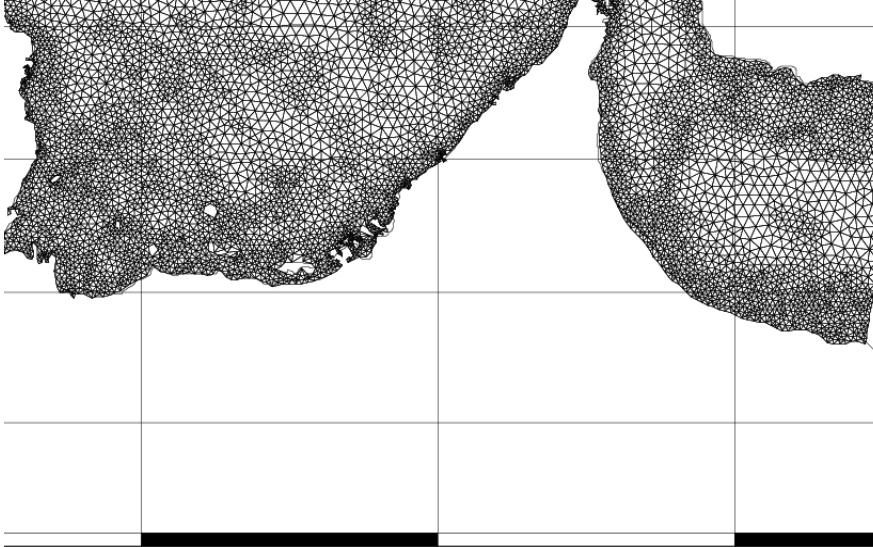
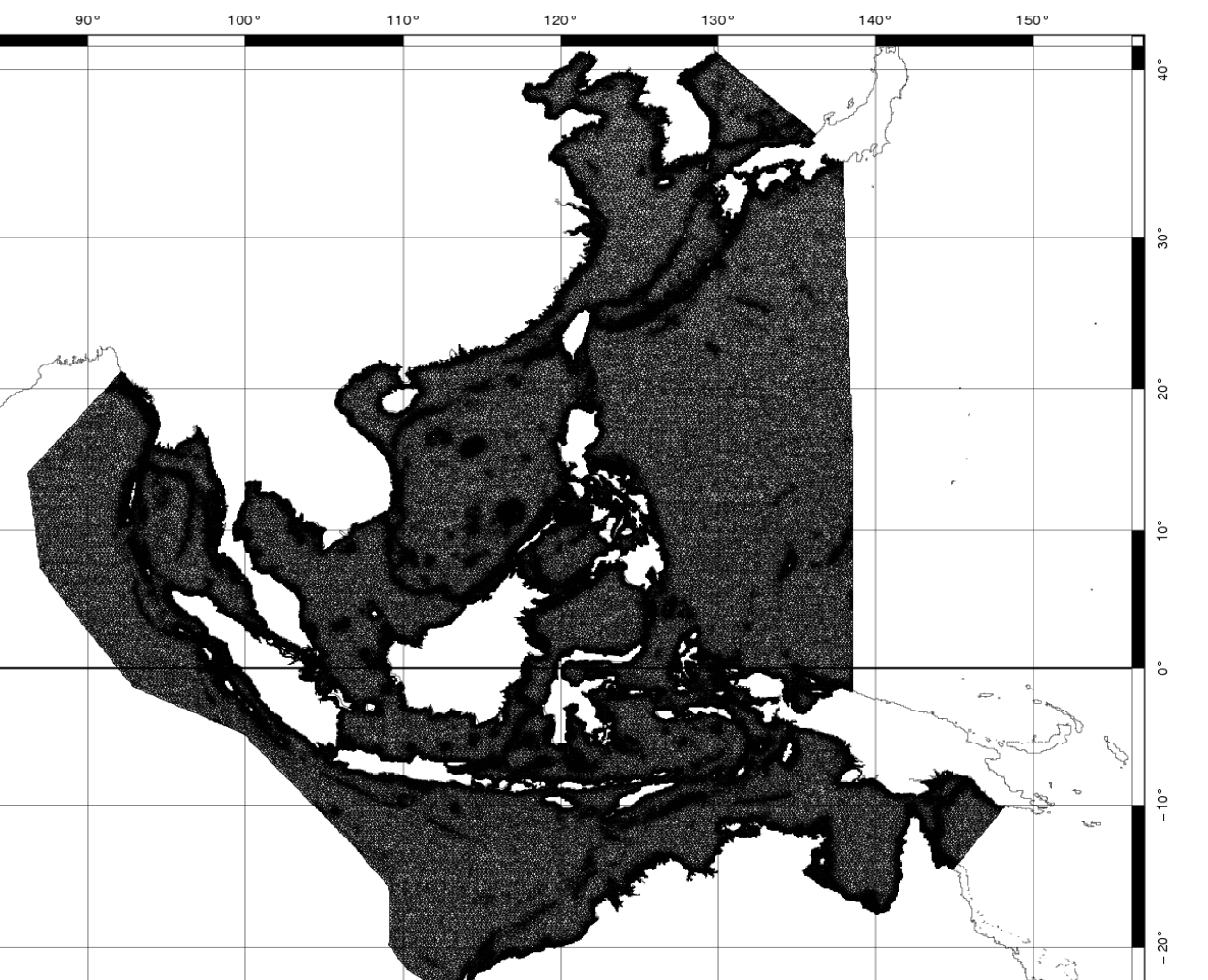
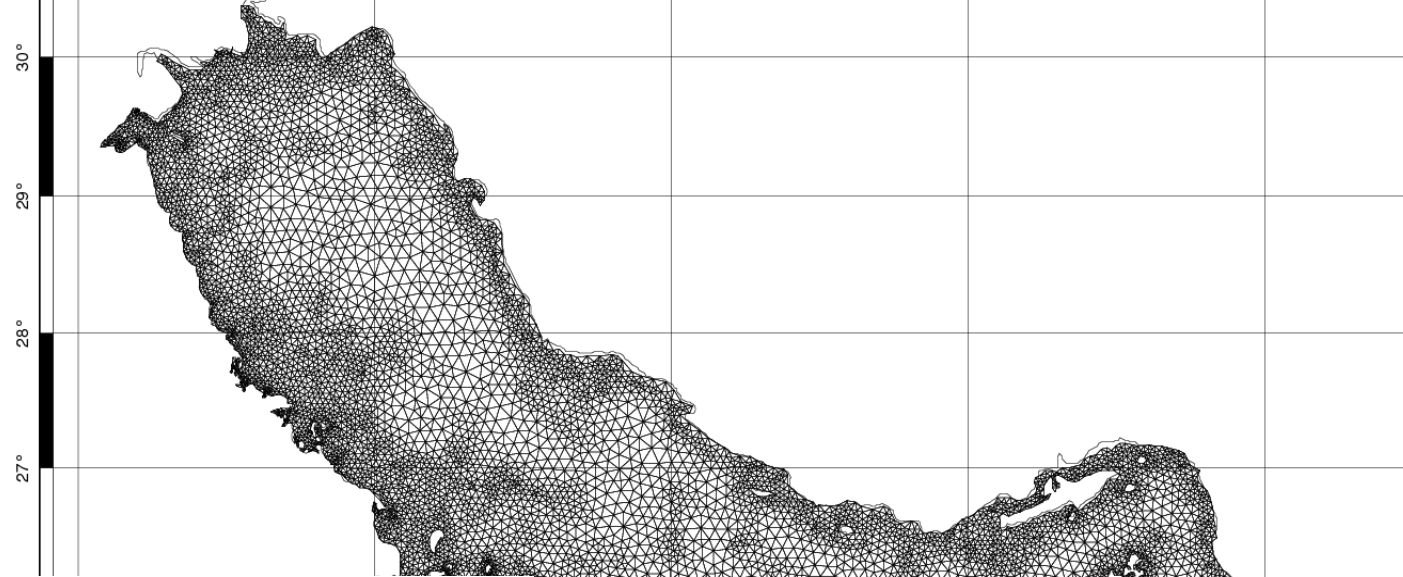


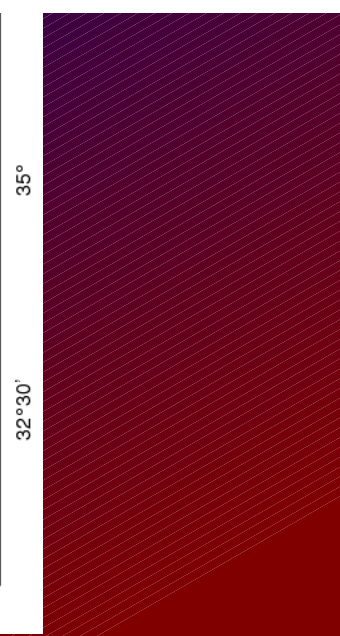
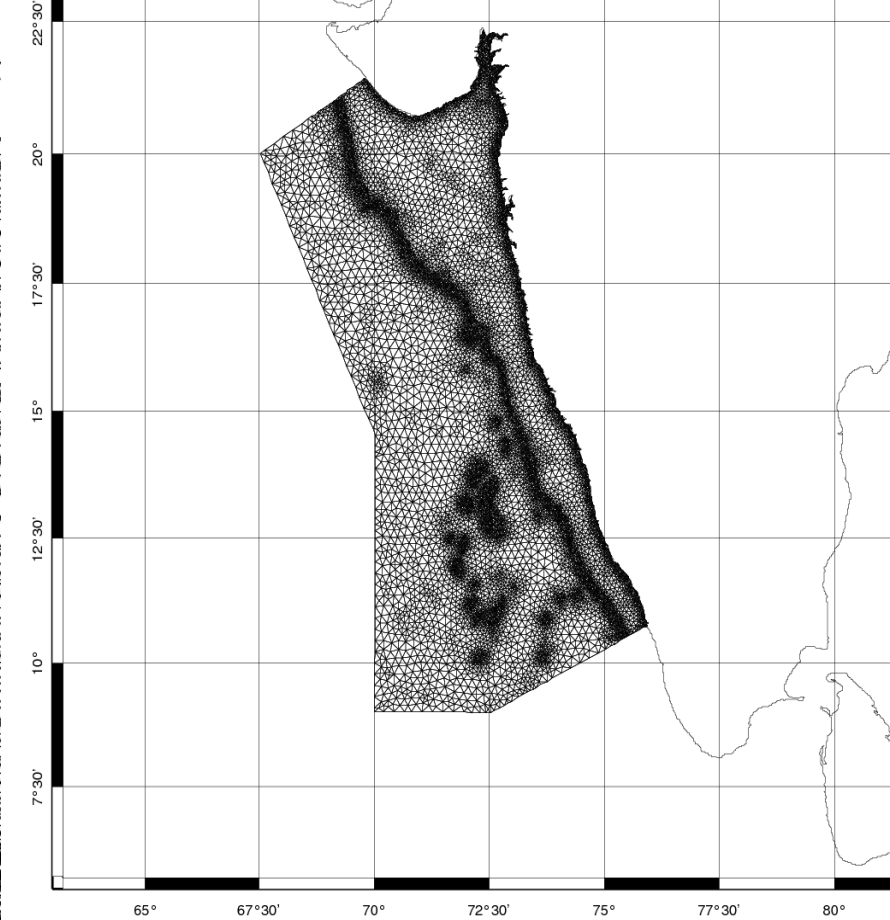
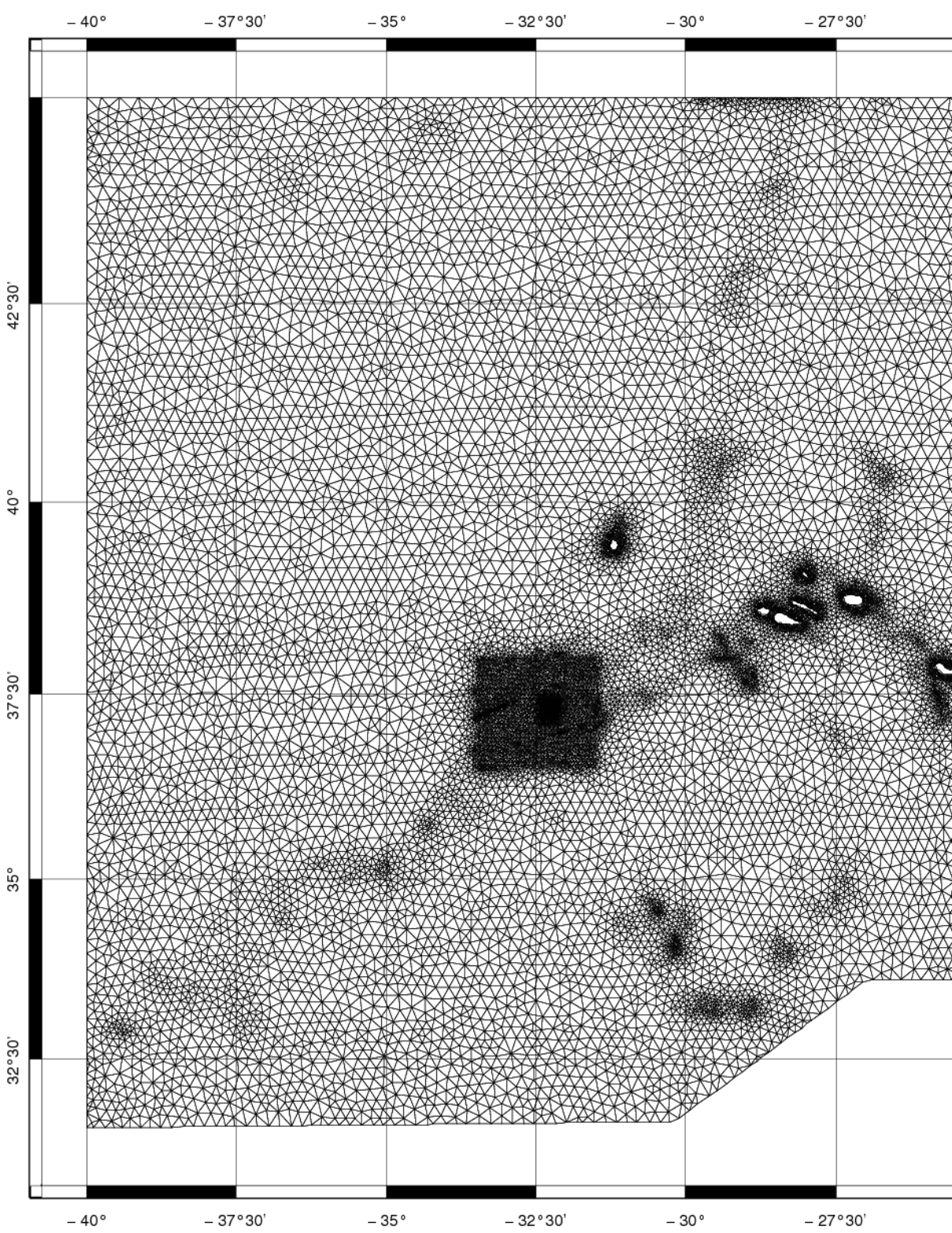


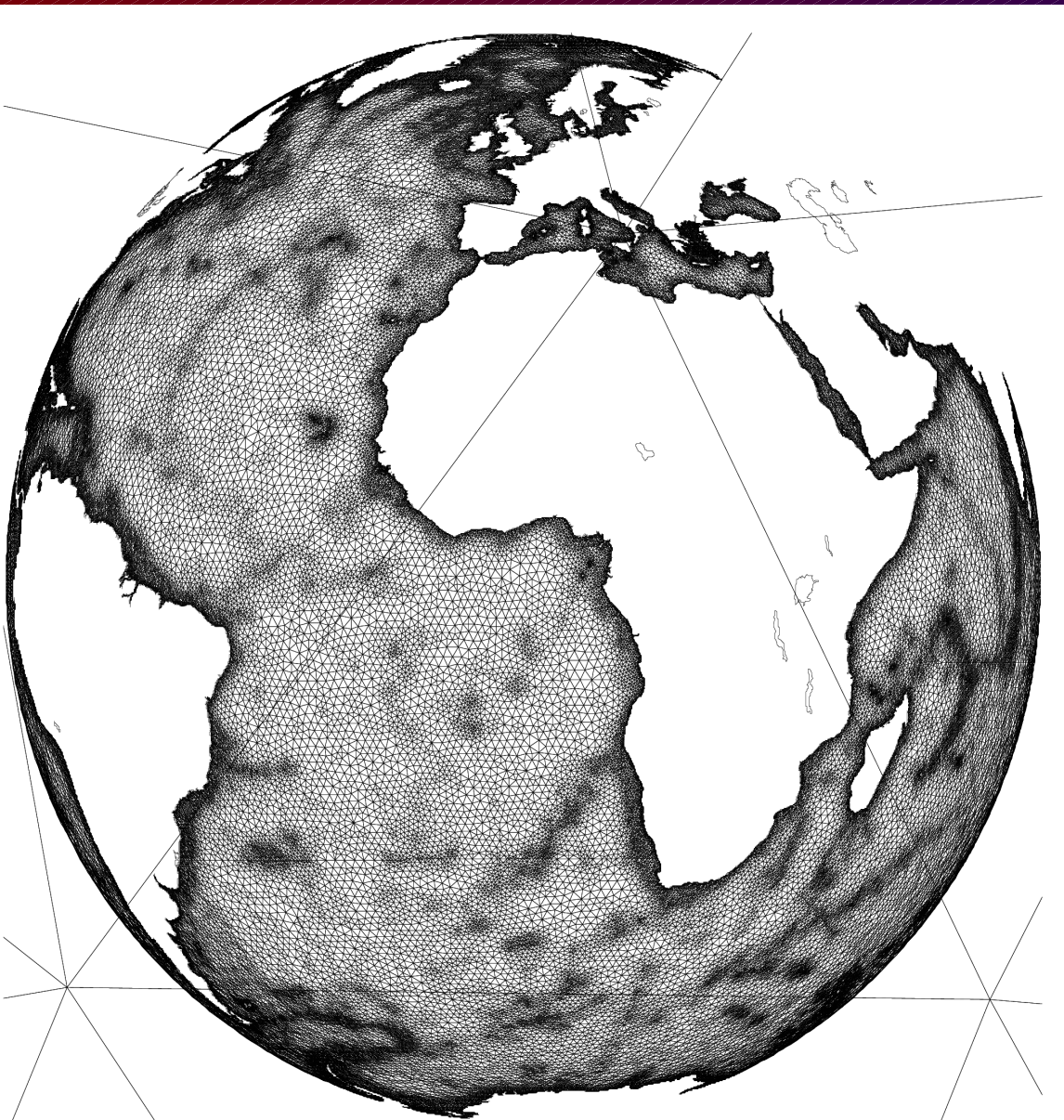
Amazon  
Tides











**Tides with assimilation**  
**Storm surge**  
**Detiding satellite data**  
**Mission design**

**Global and Basin scale:**  
**Internal tide generation**  
**areas**



# T-UGOm

Flexible I/O with defaults allowing minimal specification

Active development

Serious testing in progress

Several successful applications

Graphics/analysis/diagnostic tools available/built in

Open source

*FE/FV Model input files (grid and run parameters) can be provided for all triangular models mentioned, just ask. Model code can be provided for Fundy, Quoddy and T-UGOm. For FVCOM model code, contact Changsheng Chen <c1chen@umassd.edu>. Contact Zeliang Wang about OPA/Nemo and his model.*

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Most stable:- davidgreenberg@alumni.uwaterloo.ca