TEST CASE ON BENGKULU TSUNAMI 2007 EVENT USING TSUNAFLASH

Widodo S. Pranowo[1,2,3,4] (Ph.D Student) and Joern Behrens[1,4] (Supervisor)

[1]Alfred Wegener Institute (AWI) for Polar & Marine Research, Bremerhaven, Germany

[2]United Nations University – Institute for Environment and Human Security (UNU-EHS), Bonn, Germany

[3]Agency for Marine and Fisheries Research, Ministry of Marine Affairs & Fisheries of The Rep. of Indonesia

[4]University of Bremen, Faculty of Mathematics and Informatics, Bremen, Germany

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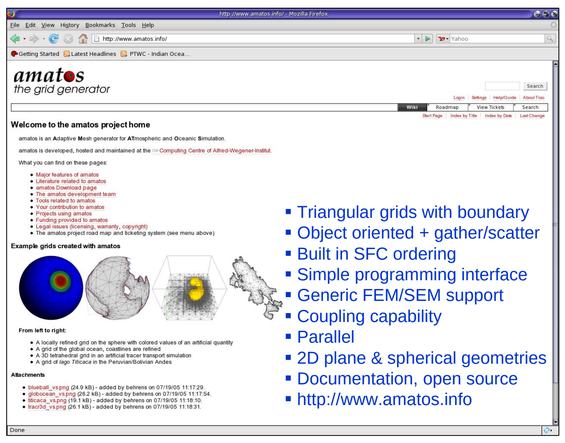
1. INTRODUCTION

After **TsunAWI** (Tsunami unstructured mesh (yet non-adaptive) finite element model developed at Alfred Wegener Institute), by Behrens, *et al.* (2006 - 2008)**,** succeed be launched as operational model in the GITEWS framework (Behrens, 2008; Harig et al., 2008), A new development uses adaptive mesh refinement to improve computational efficiency and accuracy. This new approach is called **TsunaFLASH**.

Experiments using diverse initial conditions were presented in the International Conference on Tsunami Warning 2008 (Pranowo et al., 2008). Even though the refinement is still not well performed and there are also problems with stability, this new approach is promising.

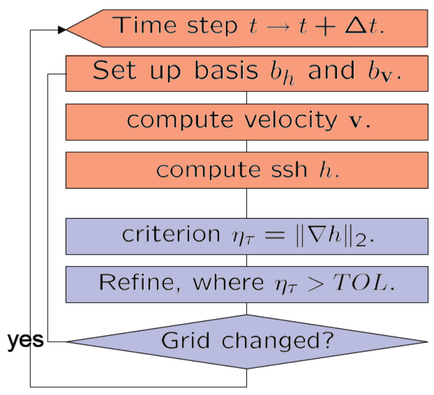
2. METHODS

AMATOS (Adaptive Mesh generator for ATmosphere and Ocean Simulation) by Behrens, *et al*. (2006) is employed for generating triangle mesh, and General Mesh Viewer (GMV) Ver. 4.5 (from Los Alamos National Laboratory, USA) is used for visualization.

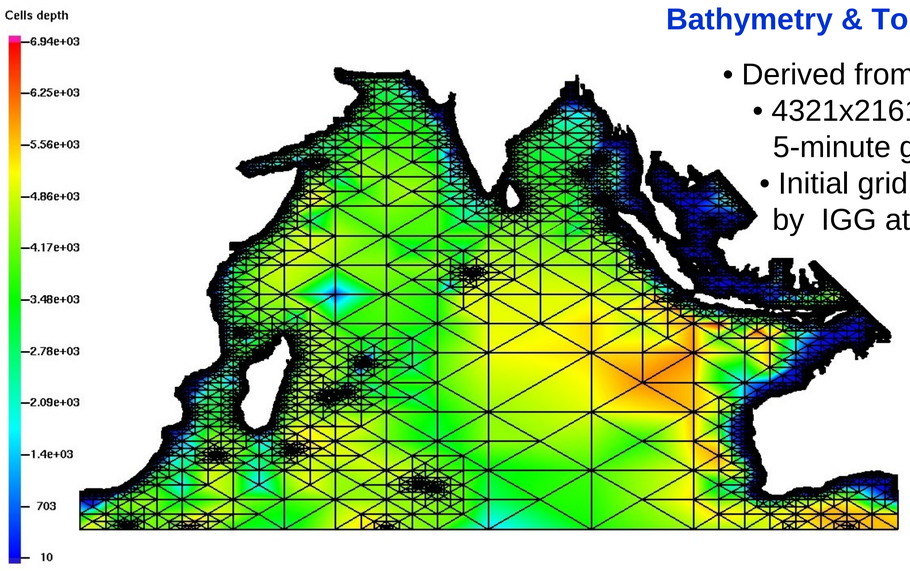


- Triangular grids with boundary
- Object oriented + gather/scatter
- Built in SFC ordering
- Simple programming interface
- Generic FEM/SEM support
- Coupling capability
- Parallel
- 2D plane & spherical geometries
- Documentation, open source
- http://www.amatos.info

Adaptive Time Step in TsunaFLASH



Bathymetry & Topography



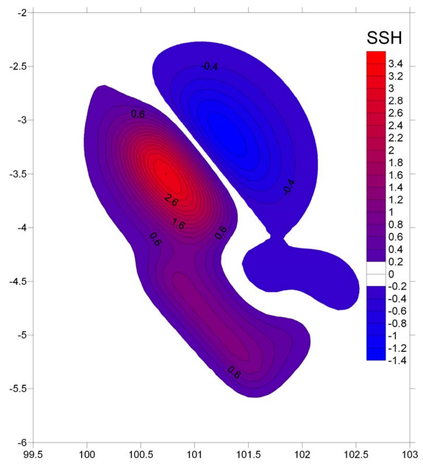
- Derived from ETOPO5
- 4321x2161 matrix of 5-minute grid values
- Initial grid was done by IGG at AMATOS

Initial Grid

TOTAL GRID LEVELS	20
GRID DIMENSION	2
ELEMENT VERTICES	3
NUMBER OF NODES	21393
NUMBER OF EDGES	56189
NUMBER OF ELEMENTS	34740

Initial Condition

Recreate tsunami excitation of Mw 8.4 ($Mo = 4.2 \times 10^{21}$ Nm) based on Lorito et al. (2008) using 39 ruptures in RuptGen (Babeyko, 2007) resulting Mw 8.37 ($Mo = 4.5231 \times 10^{21}$ Nm) with max. uplift = 3.21 m, max. depression = -1.35 m.

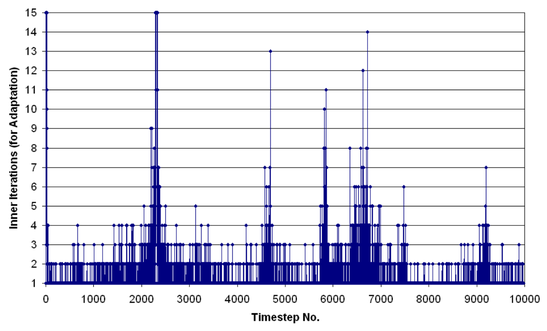


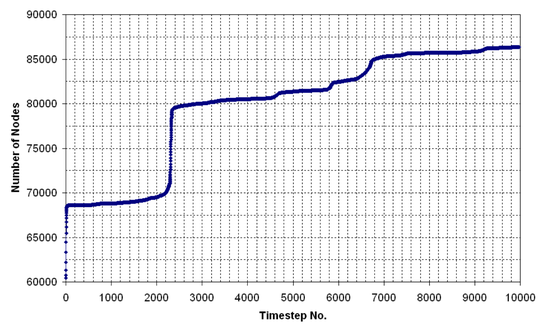
Parameters

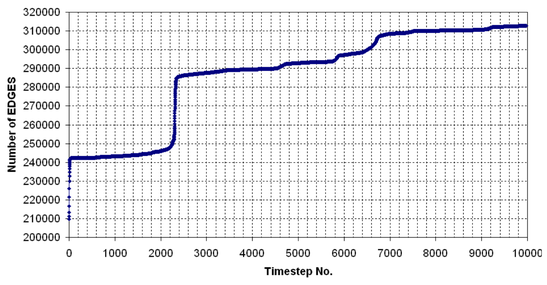
FINE_GRID_LEVEL	9
COARSE_GRID_LEVEL	2
TOLERANCE_OF_REFINEMENT	0.07
TOLERANCE_OF_COARSENING	0.05

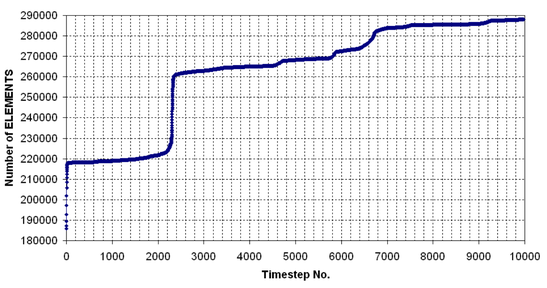
3. RESULTS

During the simulation, the refinement shows the fluctuation of inner iteration for adaptation; and the number of elements, edges and nodes are significantly increasing.

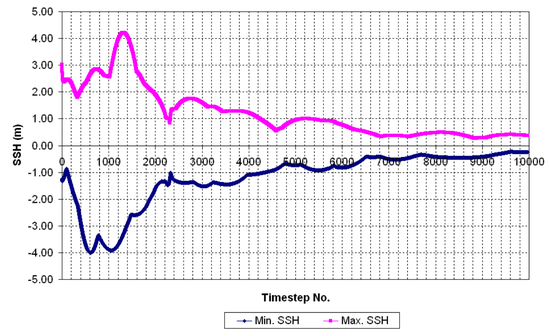




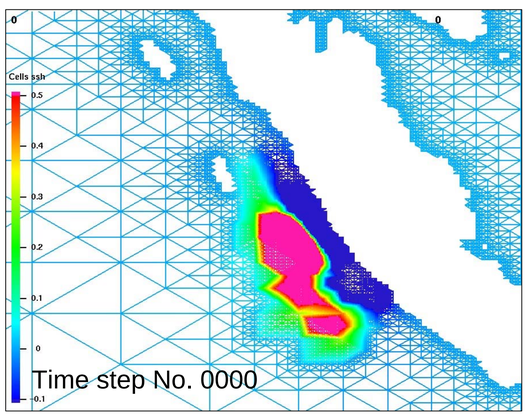


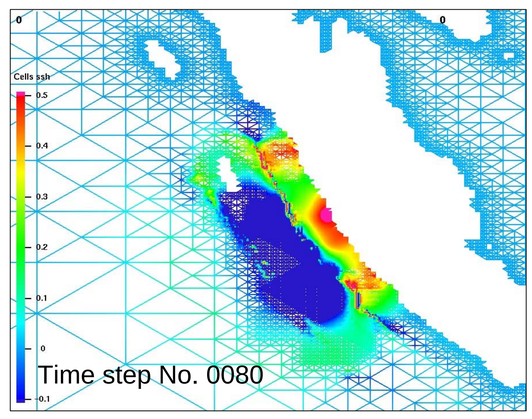


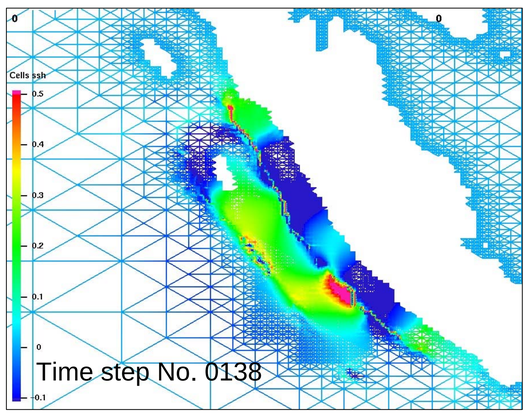
The global max. and min. of sea surface height are stable:

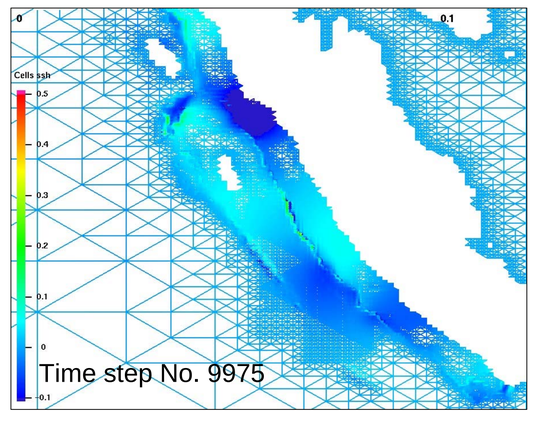


Grid + SSH appearances









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Widodo S. Pranowo • AWI: Am Handelshafen 12 Bremerhaven 27570 • Ph: +49(471)4831-1116 • Fx: +49(471)4831-1590 • E-mail: Widodo.Pranowo@awi.de • Web: http://www.awi.de