Introduction to modeling tsunamis with GeoClaw

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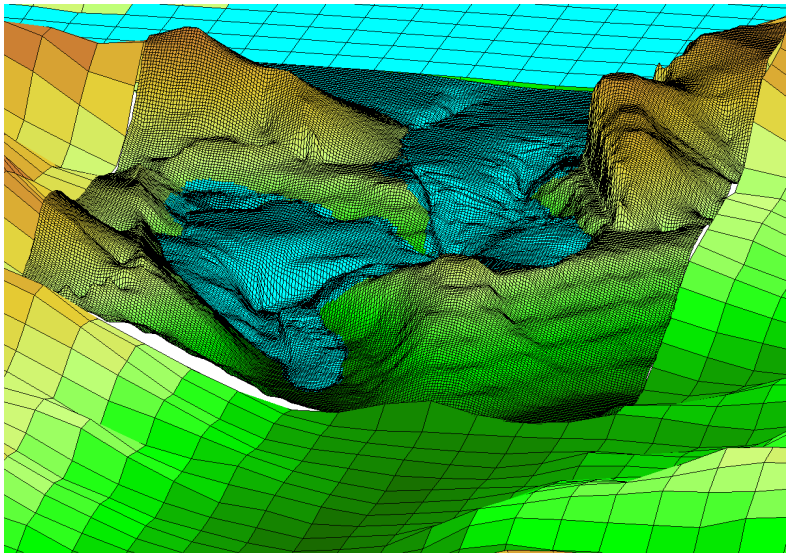
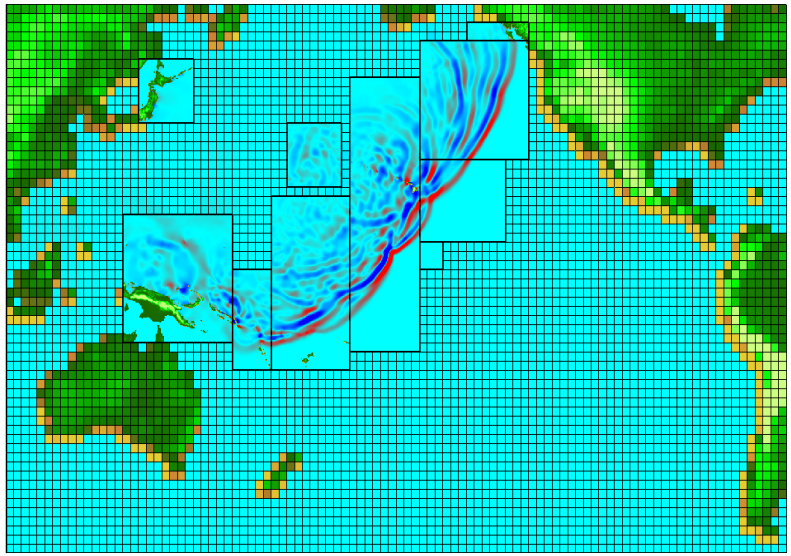
PASI, Valparaiso, Chile, Jan. 2013





Overview

1. Preview of GeoClaw (shallow free-surface flows)
2. Depth-averaged models
3. Tsunamis and the shallow water equations
4. Hyperbolic systems
5. Finite volume methods and adaptive mesh refinement

Shallow free-surface environmental flows

A class of related shallow free-surface flows characterized by a fluid or variable granular-fluid mixture flowing over variable topography.

- tsunami propagation and inundation;
- storm surges;
- overland/fluvial flooding, dam and levee breaches etc.;
- sediment erosion, deposition and transport;
- landslides, mudslides, lahars and debris flows;
- dry granular (or snow) avalanches;

Shallow free-surface environmental flows

Common mathematical features and computational challenges:

- flow is shallow relative to length-scales;
- often modeled with depth-averaged models (PDEs in 2D);
- flow moves over complex topography or bathymetry;
- domain is of varying bounded extent (moving wet/dry front);
- dynamics are often a small perturbation to a steady state
- feature evolving multiple spatial scales.

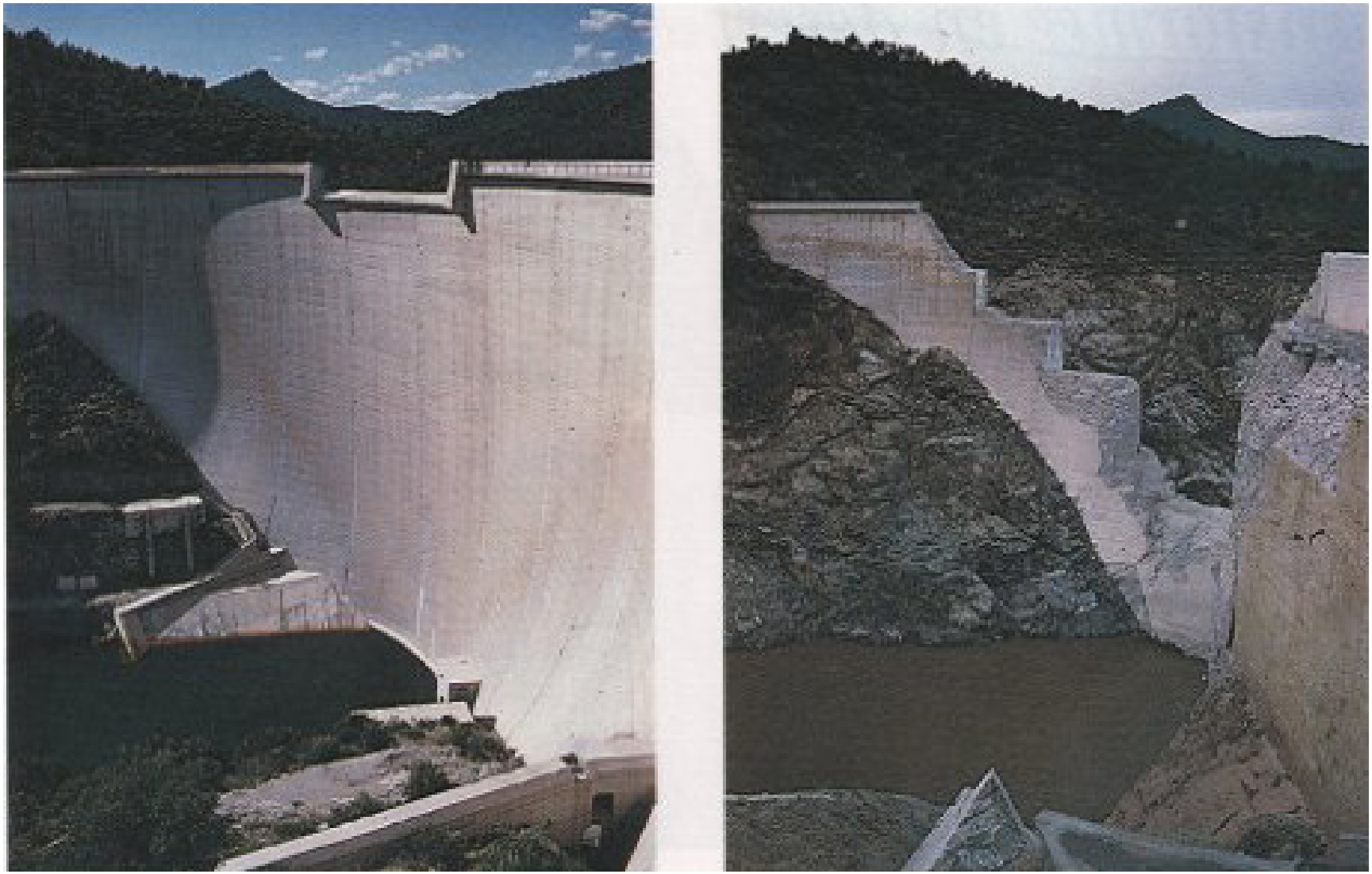
GeoClaw

GeoClaw is open-source finite-volume software (subset of Clawpack)

- Framework to accommodate commonalities of inundating free-surface flows;
- Adaptive mesh refinement for multiscale nature of geophysical flows;
- algorithms to capture moving inundation fronts over topography;
- Dynamic processing of topography data sets facilitates use of increasingly available high-resolution DEMs;

Tohoku Tsunami: Inundation modeling for Hilo

Overland flooding: Malpasset dam, France 1959



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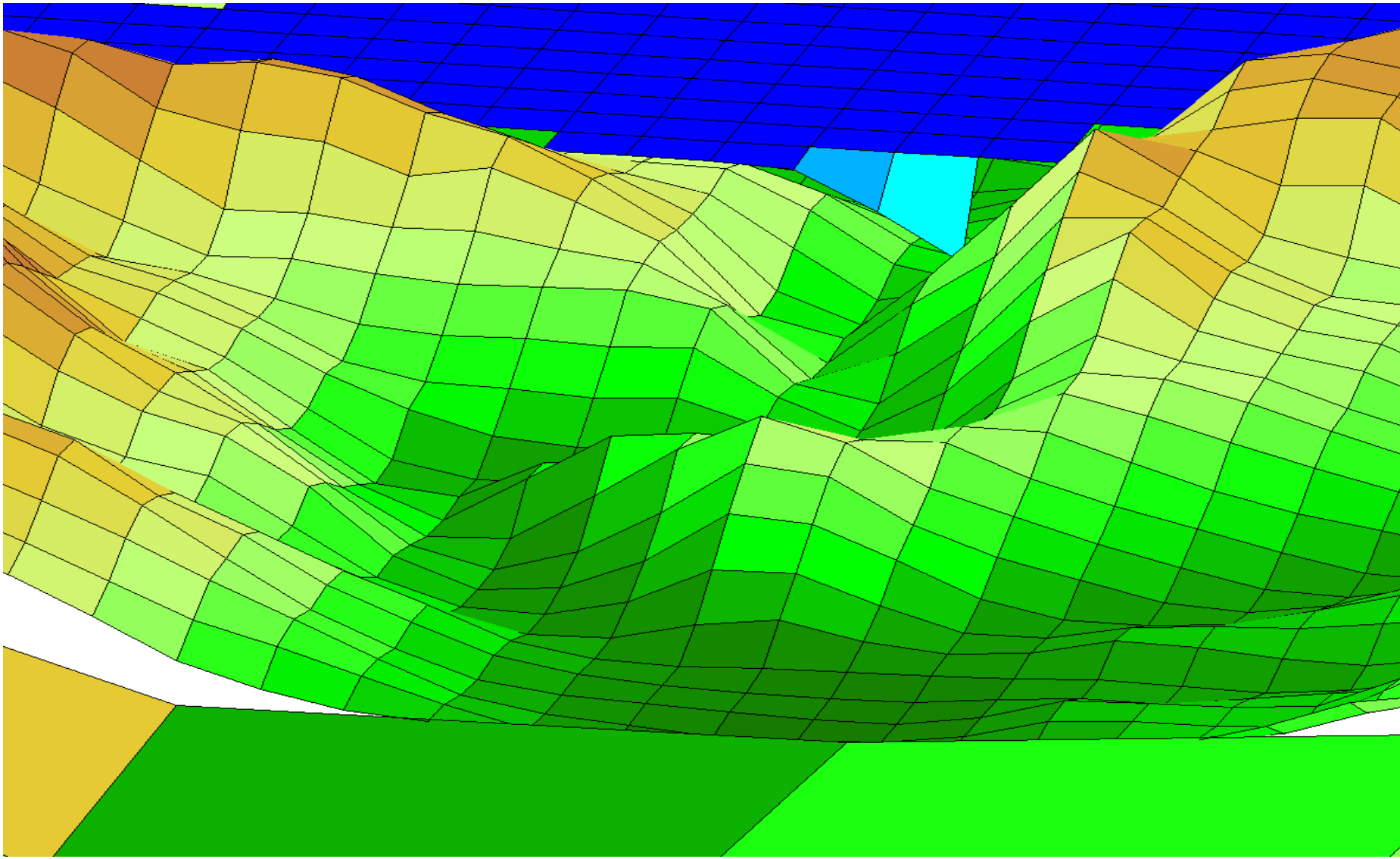

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