Landslide Generated Tsunami

Dr. Hermann M. Fritz
Georgia Institute of Technology, Savannah
What does a fresh landslide scar look like?

Guaitara, Colombia 2003
Lake Uri, Switzerland

Blasting triggered 20,000 m³ of Limestone, 1992
Experimental set-up

- pneumatic landslide generator ◊ controlled initial conditions
- 2 laser distance sensors LDS ◊ slide profiles $\xi(t)$
- 7 capacitance wave gauges CWG ◊ wave profiles $\eta(t)$
- digital particle image velocimetry PIV ◊ velocity vector fields $v_p$
Slide-Granulate (PP-BaSO$_4$)

- $d_g = 4$ mm
- $\rho_g = 2.64$ t/m$^3$
- $n = 39$ %
- $\rho_s = 1.62$ t/m$^3$
- $\phi' = 43^\circ$
- $\delta = 24^\circ$

Slide profiles
Impact Experiment

\[ F = 3.1, \quad m_s = 108 \text{ kg}, \quad h = 450 \text{ mm} \]
raw PIV-sequence

Total area of view (AOV) = 1.6 m  0.8 m
2 adjacent AOV’s from repeated runs mounted

F = 1.9,  m_s = 108 kg,  h = 450 mm
Outward collapsing crater: $v_{px}, v_{pz}$

$F = 3.2, \ V = 0.79, \ S = 0.31, \ h = 0.3 \text{ m}$
Comparison with wave theory

Observed wave profiles

Recommended ranges after Le Méhauté (1976)
Wave celerity

1. trough

\[ c_1 = \sqrt{gh} \left(1 + \frac{a}{2h}\right) \]

\[ \approx \sqrt{g(h + a)} \]

2. wave crest

\[ c_2 = \sqrt{gh} \left(1 + \frac{a}{2h}\right) \]

\[ \approx \sqrt{g(h + a)} \]
Lituya Bay, devastation 1958

Country: BBC, Horizon “Megatsunami”
530m Tsunami Wave Run-up
3D-Subaerial / Submarine Landslide Tsunami Generator

NSF NEES Sponsored II-Project
Initial Mechanisms of Tsunamigenic Landslides

Shear Band Propagation

Puzrin and Germanovich, GT (2004)
3D Landslide Tsunami Experiments at OSU-NEES facility

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Questions ?