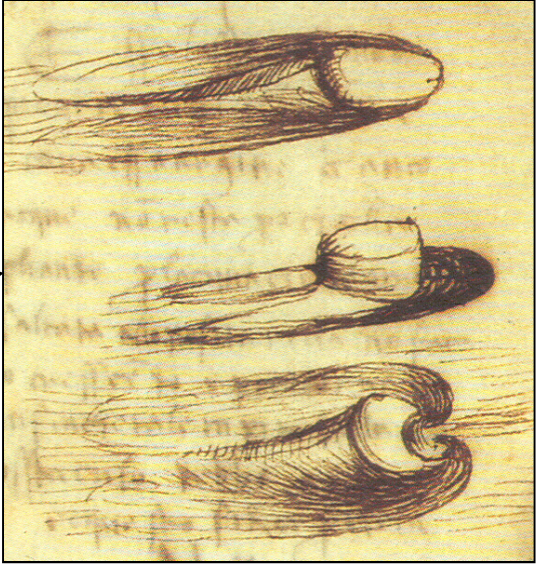


Reconnaissance Partners Perspectives: Tsunami

Harry Yeh
Oregon State University

The Cordex Leicester of Leonardo da Vinci: *Folio 24 r*



Tsunami Scours

FEMA55: Coastal Construction Manual

11.6.11.3 Localized Scour (Tsunami Conditions)

Dames and Moore, in *Design and Construction Standards for Residential Construction in Tsunami-Prone Areas of Hawaii* (1980), suggest that scour depth depends on soil type and that scour depths in areas up to 300 feet from the shoreline can be determined as a percentage of the stillwater depth d_s , as shown in Table 11.5.

Soil Type	Expected Depth (% of d_s)
Loose sand	80%
Dense sand	50%
Soft silt	50%
Stiff silt	25%
Soft clay	25%
Stiff clay	10%

Tsunami Scours

- Field observation stimulates research activities.
- Research outcomes guide the field investigation.

Scour Formation: 2004 Indian Ocean Tsunami



Runup height 4.1 m
Inundation depth 0.95 m above the floor;
Scour depth **1.2 m**
Scour span 5.0 m.



Sri Lanka: photo by Patrick Lynett
Scour depth \approx **2.0 m**

The 2004 Indian Ocean Tsunami: India

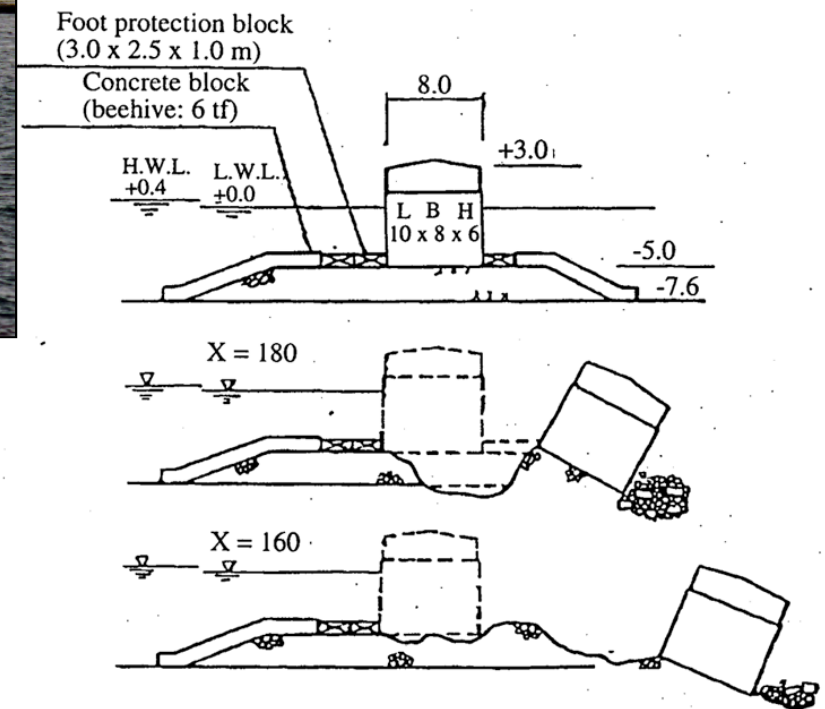


Foundation Failure: the 1993 Okushiri Tsunami



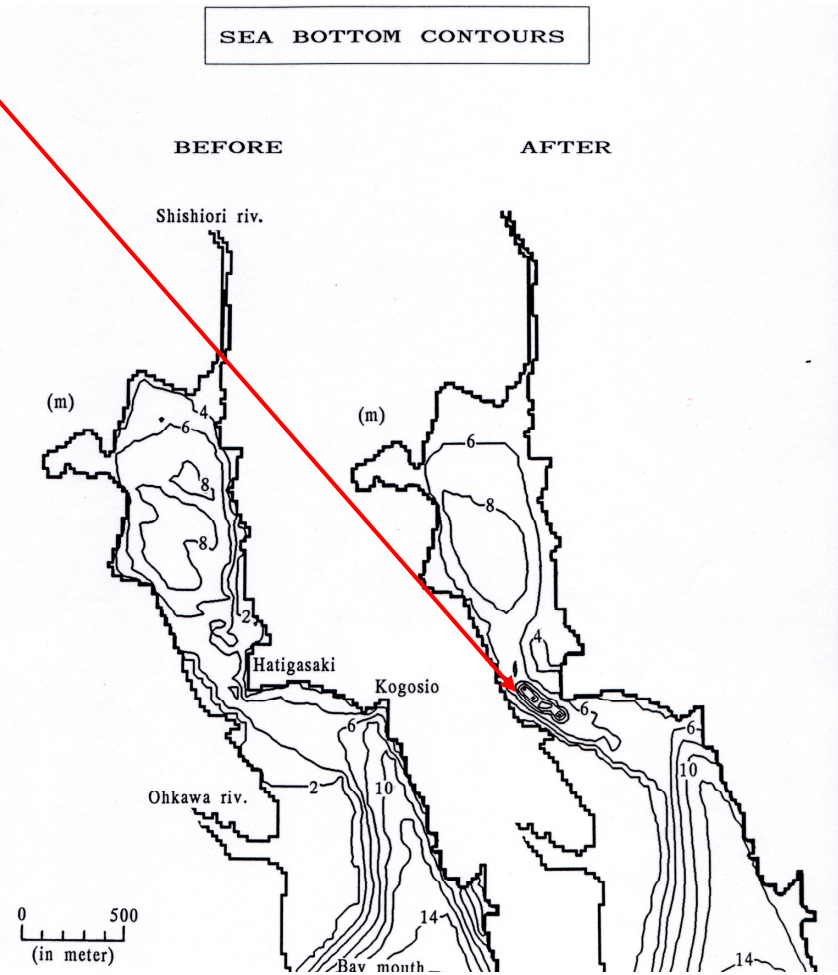
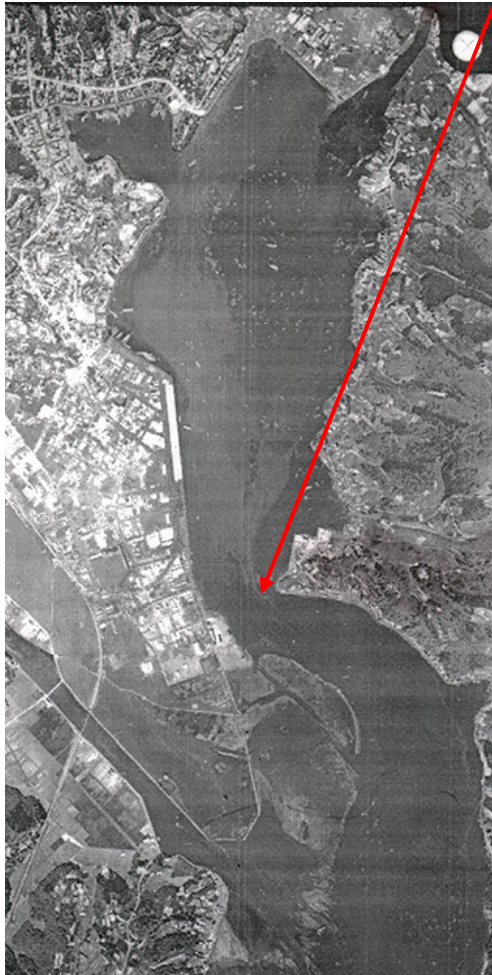
Scour depth: **4 m**

Capsized breakwater due to foundation failure at Aonae Port, Japan

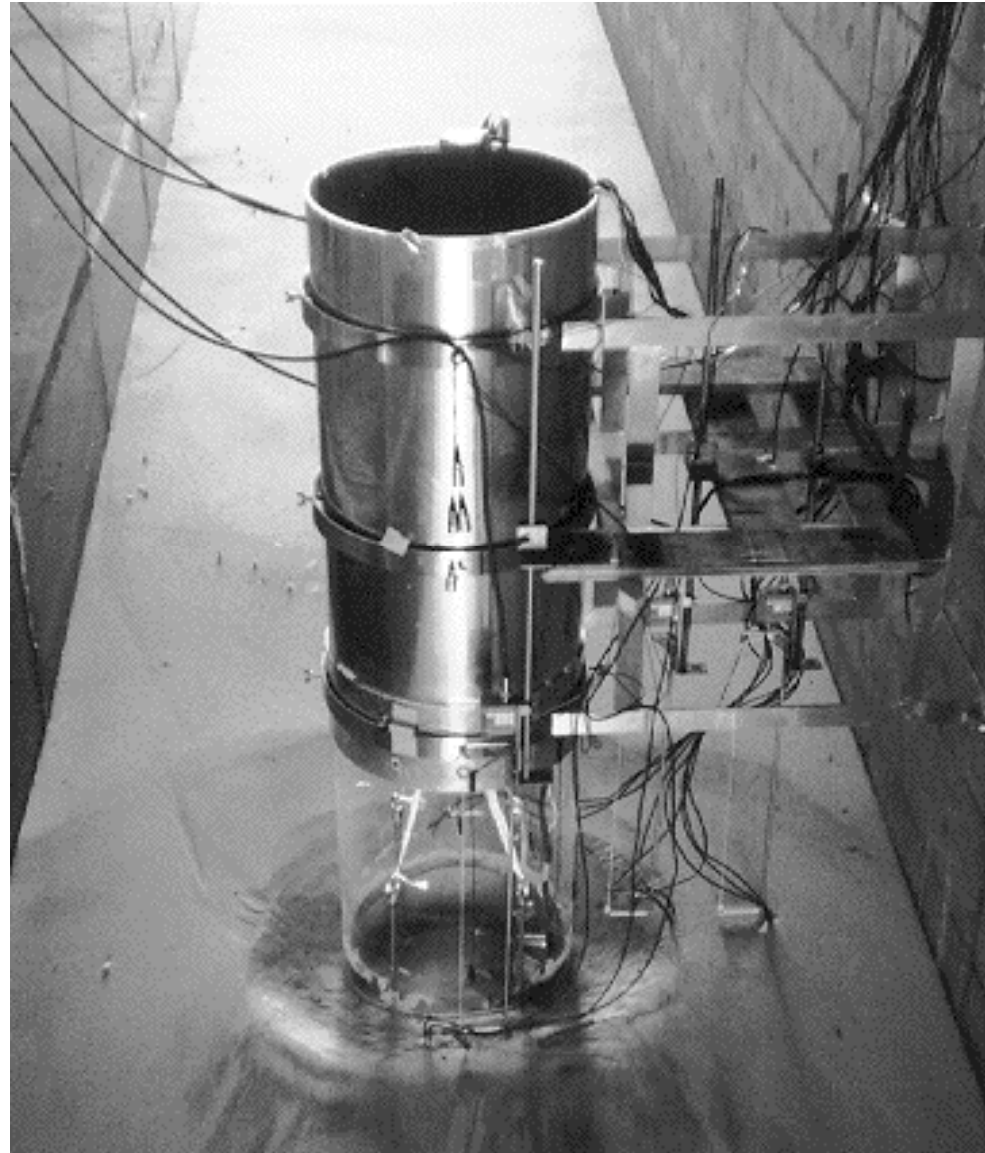


Scour Hole in the Harbor of Kesen-numa, Japan: the 1960 Chile Tsunami

Scour hole more than **8 m** deep at the entrance to the port.



After Takahashi et al. (1992)

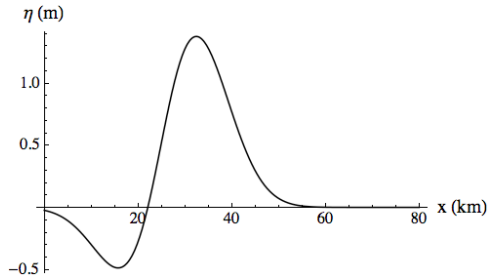


QuickTime™ and a
Video decompressor
are needed to see this picture.

Tsunami Scours

- Maximum scour occurs during the (runup/drawdown) process
⇒ need to examine core samples in tsunami scours.
- Traditional shear stress modeling (Shields) does not predict rapid scour at the end of drawdown
⇒ momentary liquefaction plays a role in tsunami scours.

Spatial variation of 'enhanced' scour depth



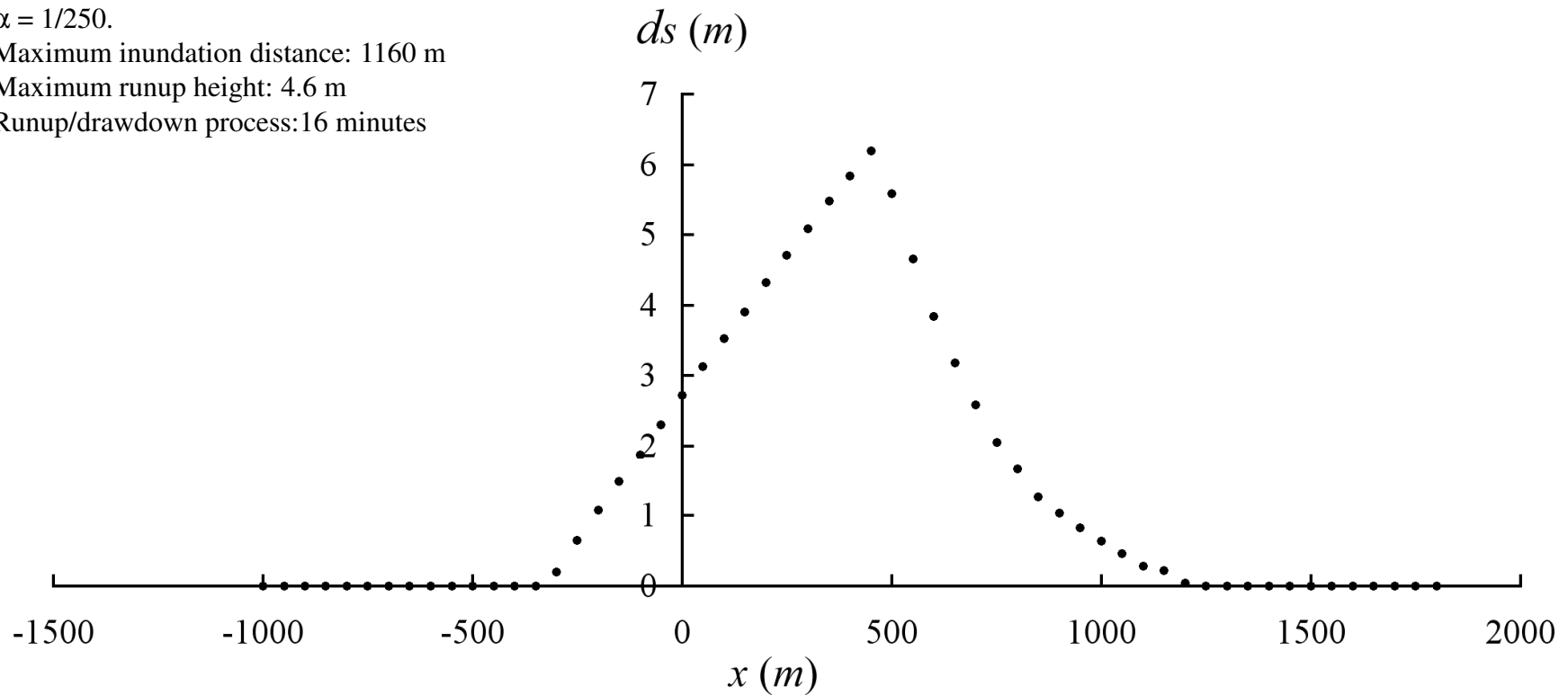
$$\Lambda(d_s) = \frac{\Delta p}{\gamma_b d_s} \left(1 - 4i^2 \operatorname{erfc} \left[\frac{d_s}{2\sqrt{c_v \Delta T}} \right] \right)$$

$\alpha = 1/250$.

Maximum inundation distance: 1160 m

Maximum runup height: 4.6 m

Runup/drawdown process: 16 minutes



Observed Scour Depths



Scour depth 1.2 m



Scour depth: 4 m



Scour depth 2.0 m

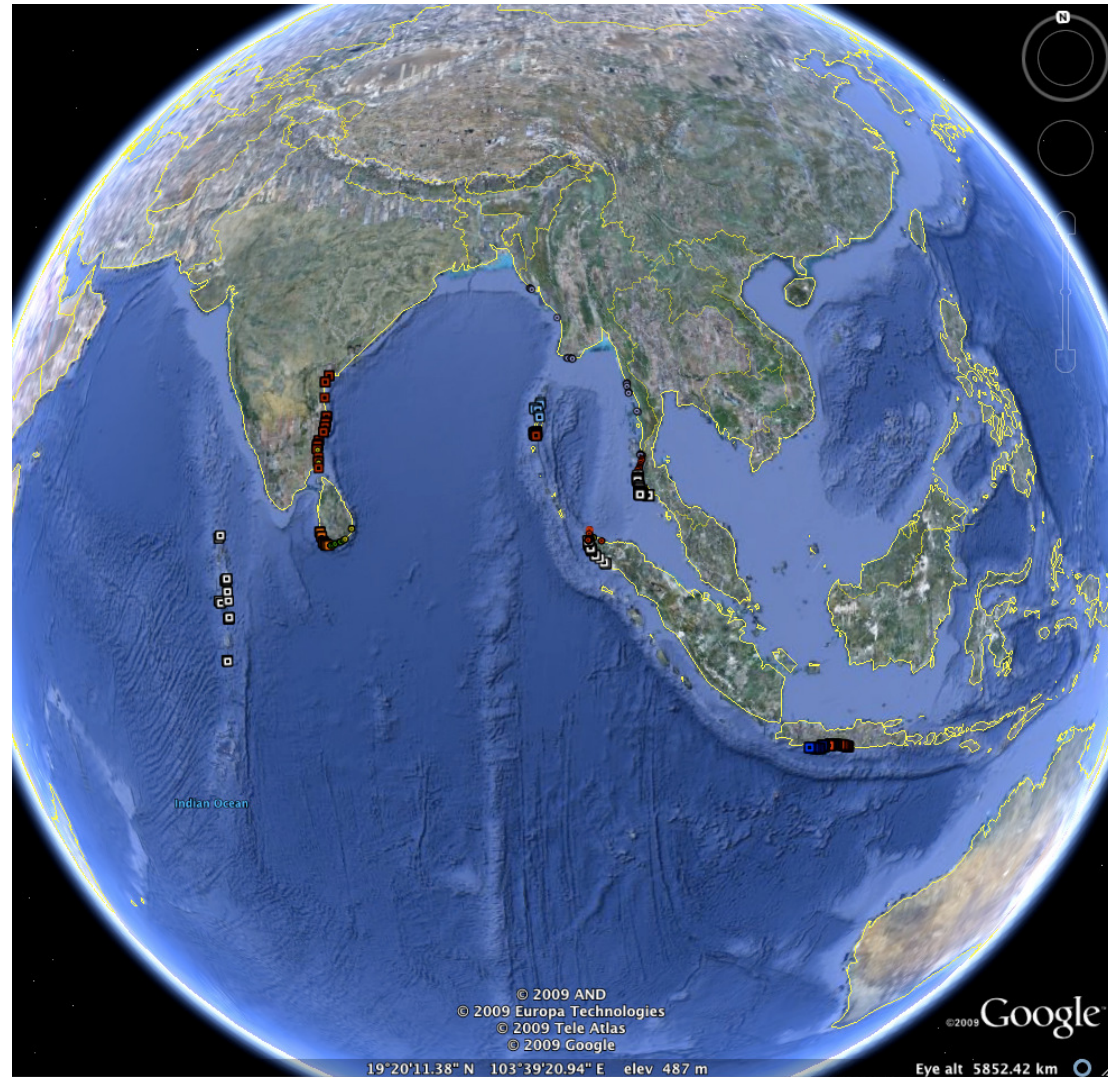


Scour depth: 8 m

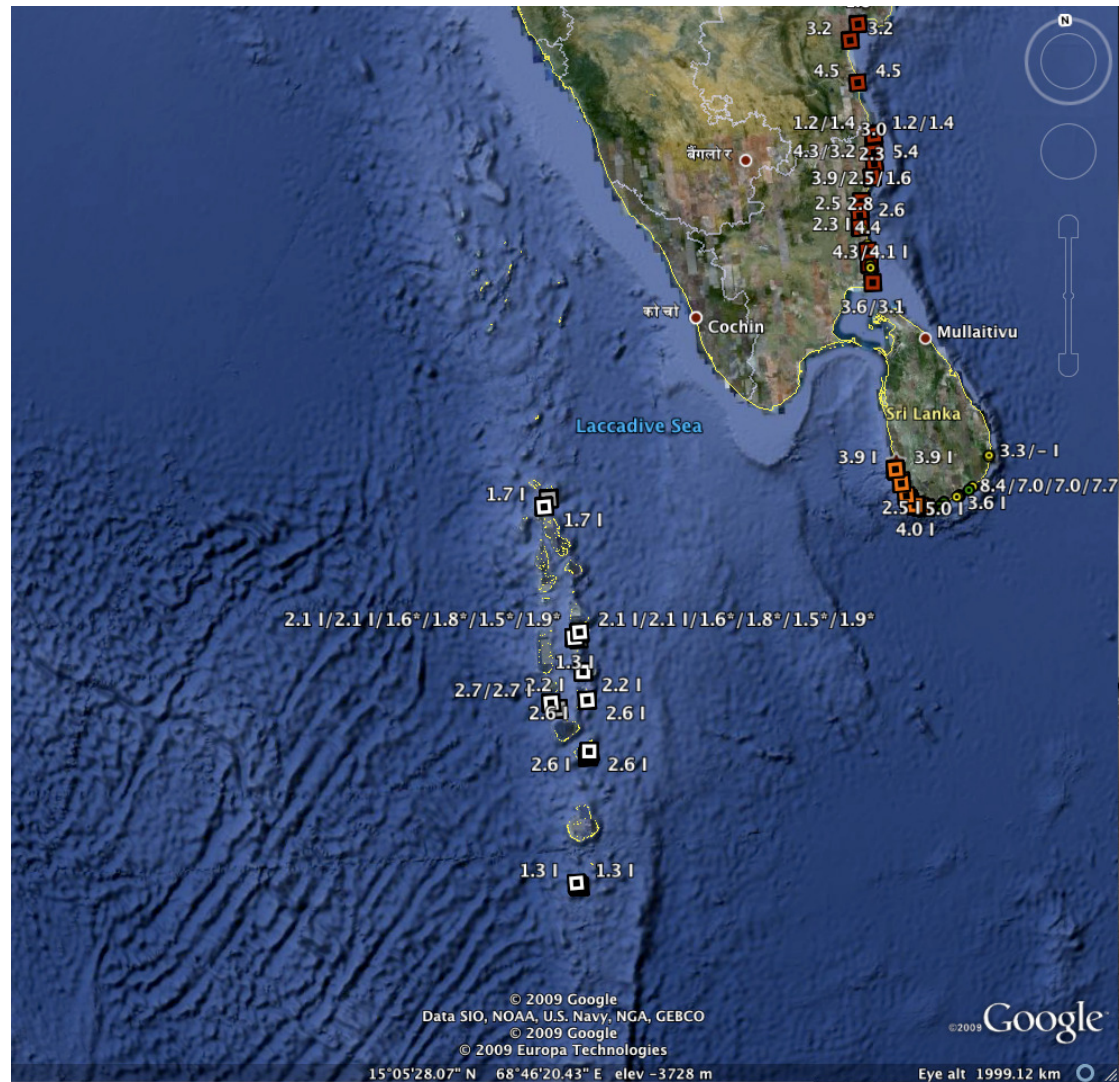
Tsunami Reconnaissance Data Repository

- IUGG/UNESCO Tsunami Commission.
- SDSC/NSF Tsunami Data Repository.

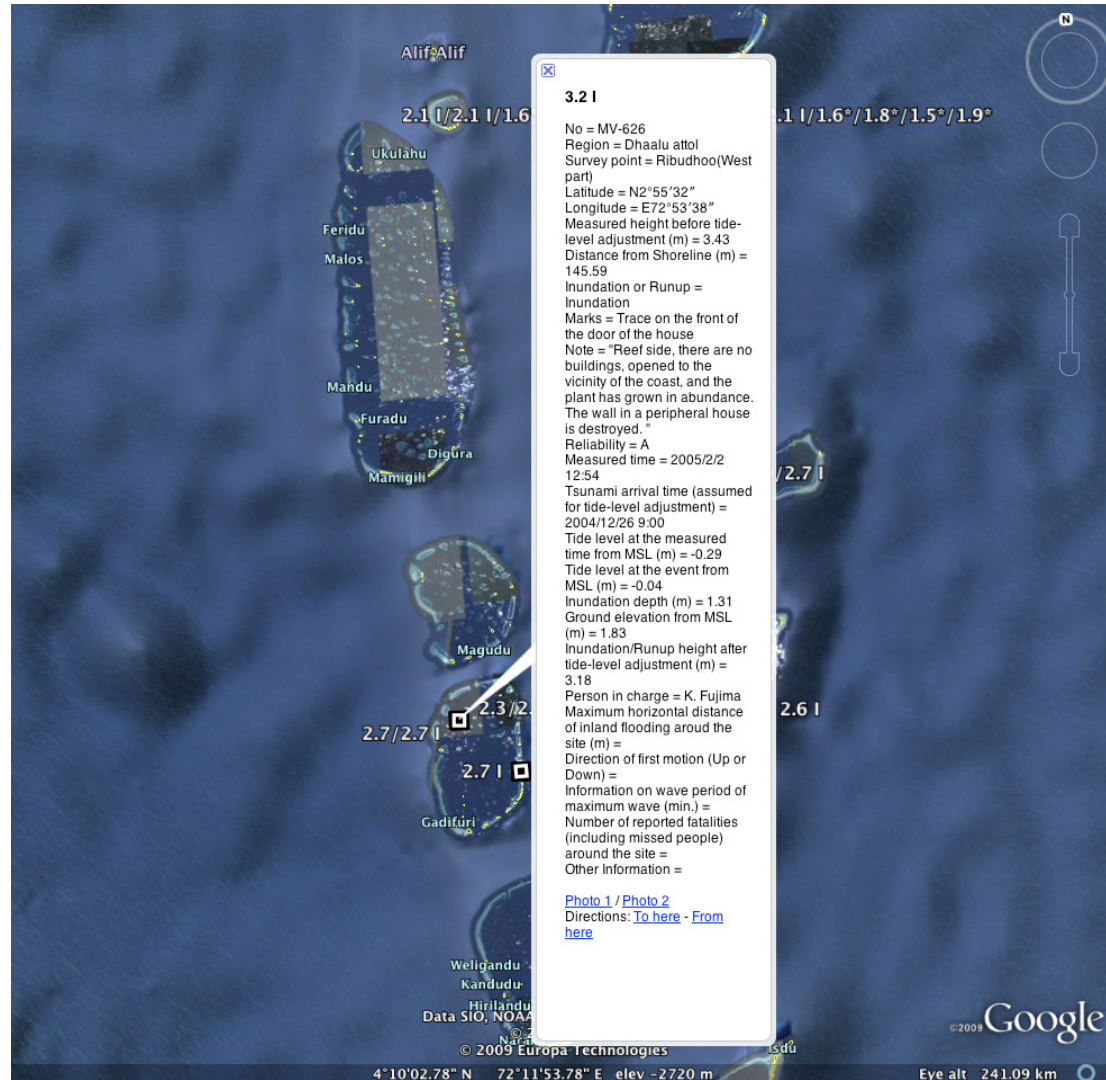
IUGG Tsunami Commission



IUGG Tsunami Commission



IUGG Tsunami Commission



IUGG Tsunami Commission



SDSC/NSF Tsunami Reconnaissance Data Repository

NEES INC NEES IT CENTRAL ACTIVITIES RESEARCH SITES

NEES Tsunami Username Password Login
[Forgot Password](#) | [Register New Account](#)

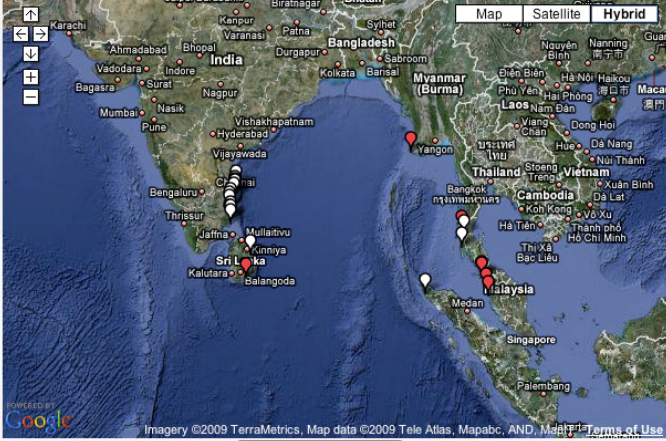
HOME ABOUT **Suggestions or Comments**

Tsunami Reconnaissance Data Repository

Information collected by survey teams immediately after the Indian Ocean Tsunami of Dec. 26, 2004

The data currently stored in the repository were collected with the support of:
National Science Foundation (NSF), Human and Social Dynamics program
NSF Civil, Mechanical and Manufacturing Innovation program
NSF Learning from Earthquake program, via the Earthquake Engineering Research Institute
US Geological Survey
Coasts, Oceans, Ports, and Rivers Institute of the American Society of Civil Engineers
[More...](#)

The teams are still analyzing most data. **Select a white marker** to see example information.




Map Satellite Hybrid

Return to Original Position

Site data is accessible Site data is still private

[Generate summary of contents](#)

©2004-06 NEES Cyberinfrastructure Center | NSF Award CMS-0402490
Support: it-support@nees.org / Toll Free: (866) 260-4100 / Fax: (858) 822-5464
Located at the [San Diego Supercomputer Center](#). Supported by the [National Science Foundation](#).



NEES INC NEES IT CENTRAL ACTIVITIES RESEARCH SITES

NEES Tsunami Username Password Login
[Forgot Password](#) | [Register New Account](#)

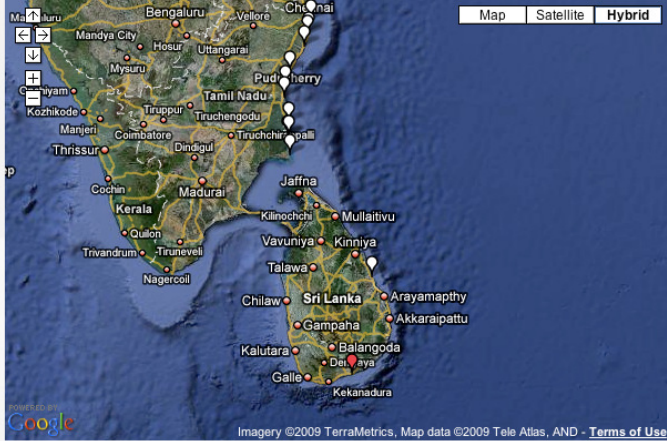
HOME ABOUT **Suggestions or Comments**

Tsunami Reconnaissance Data Repository

Information collected by survey teams immediately after the Indian Ocean Tsunami of Dec. 26, 2004

The data currently stored in the repository were collected with the support of:
National Science Foundation (NSF), Human and Social Dynamics program
NSF Civil, Mechanical and Manufacturing Innovation program
NSF Learning from Earthquake program, via the Earthquake Engineering Research Institute
US Geological Survey
Coasts, Oceans, Ports, and Rivers Institute of the American Society of Civil Engineers
[More...](#)

The teams are still analyzing most data. **Select a white marker** to see example information.




Map Satellite Hybrid

Return to Original Position

Site data is accessible Site data is still private

[Generate summary of contents](#)

©2004-06 NEES Cyberinfrastructure Center | NSF Award CMS-0402490
Support: it-support@nees.org / Toll Free: (866) 260-4100 / Fax: (858) 822-5464
Located at the [San Diego Supercomputer Center](#). Supported by the [National Science Foundation](#).



Tsunami Reconnaissance Data Repository

NEES INC NEES IT CENTRAL ACTIVITIES RESEARCH SITES

NEES Tsunami

Username Password Login

[Forgot Password](#) | [Register New Account](#)

HOME ABOUT **Suggestions or Comments**

Tsunami Reconnaissance Data Repository

Information collected by survey teams immediately after the Indian Ocean Tsunami of Dec. 26, 2004

The data currently stored in the repository were collected with the support of:
 National Science Foundation (NSF), Human and Social Dynamics program
 NSF Civil, Mechanical and Manufacturing Innovation program
 NSF Learning from Earthquake program, via the Earthquake Engineering Research Institute
 US Geological Survey
 Coasts, Oceans, Ports, and Rivers Institute of the American Society of Civil Engineers
[More...](#)

The teams are still analyzing most data. **Select a white marker** to see example information.

Map Satellite Hybrid

Team: **ITST-Lynett (public)**
 Site: **Sri Lanka**
 Country: Sri Lanka

Return to Original Position

Site data is accessible Site data is still private

Generate [summary of contents](#)

©2004-06 NEES Cyberinfrastructure Center | NSF Award CMS-0402490
 Support: it-support@nees.org / Toll Free: (866) 260-4100 / Fax: (858) 822-5464
 Located at the *San Diego Supercomputer Center*, Supported by the *National Science Foundation*.

NEES SDSC

NEES INC NEES IT CENTRAL ACTIVITIES RESEARCH SITES

NEES Tsunami

Username Password Login

[Forgot Password](#) | [Register New Account](#)

HOME ABOUT **Suggestions or Comments**

Tsunami Data Repository

Available Information

Event: Indian Ocean Tsunami (26 Dec 2004)
 Team: **ITST-Lynett (public)**
 Location: **Sri Lanka Sri Lanka**

General Site Configuration

Description

- [\[Photo\] Mud lines on a destroyed building in Kinnaya](#)
- [\[Photo\] A lone building](#)
- [\[Photo\] Scour hole left by the tsunami](#)
- [\[Table\] Run-up data](#)

Hydrodynamic Data

Run-up Heights

- [\[Photo\] Mud lines on a destroyed building in Kinnaya](#)
- [\[Table\] Run-up data](#)

Extent of Inundation

- [\[Photo\] Mud lines on a destroyed building in Kinnaya](#)
- [\[Table\] Run-up data](#)

Flow

- [\[Photo\] Scour hole left by the tsunami](#)

Geological Data

Geomorphological Changes

- [\[Photo\] Scour hole left by the tsunami](#)

Engineering Data

Structural Damage

- [\[Photo\] Mud lines on a destroyed building in Kinnaya](#)
- [\[Photo\] A lone building](#)

Biological Data

Flora

- [\[Photo\] Mud lines on a destroyed building in Kinnaya](#)

©2004-06 NEES Cyberinfrastructure Center | NSF Award CMS-0402490

NEES SDSC

Tsunami Reconnaissance Data Repository

Tsunami Data Repository Archive Photo

image1.JPG

Sri Lanka, Sri Lanka (ITST-Lynett (public)): Patrick Lynett
10 Jan 2005 - E81.19206 N8.492397

Phil Liu measures the mud lines on a destroyed building in Kinnaya. The house, located roughly 300 m from the shoreline, has water marks to nearly five meters above sea level. The front of the house survived, but the back of house is completely blown out. A palm tree has been knocked over in the foreground, and rubble from destroyed houses covers the ground



Tsunami Reconnaissance Data Repository

Tsunami Data Repository Survey Site Information


Event: Indian Ocean Tsunami (26 Dec 2004)
Team: **ITST-Lynett (public)**
Location: Sri Lanka, Sri Lanka

Units	Latitude				Longitude		
	Degrees	Minutes	Seconds	N/S	Degrees	Minutes	Seconds
Decimal Degrees	8.013957			N	81.48953		
Degrees/Decimal Minutes	8	0.8374		N	81	29.3718	
Degrees/Minutes/Seconds	8	0	50.2440	N	81	29	22.308

Types of Data Uploaded ([view possible categories](#))

- General Site Configuration
- Description
- Hydrodynamic Data
- Geological Data
- Engineering Data
- Biological Data

©2004-06 NEES Cyberinfrastructure Center | NSF Award CMS-0402490
 Support: it-support@nees.org / Toll Free: (866) 260-4100 / Fax: (858) 822-5464
 Located at the [San Diego Supercomputer Center](#). Supported by the [National Science Foundation](#).



[Forgot Password](#) | [Register New Account](#)

HOME
ABOUT
Suggestions or Comments

Tsunami Data Repository

Generate Summary Report

Include information on

- Public entries only
- Private entries only
- All (public and private) entries

Data items - Show a list for how many items are available for each

- Site
- Metadata Category
- Metadata Subcategory
- Type (photo, table, etc)
- Team

Show information for

Countries:

Sites:

Teams:

Sites - Show a list of sites and countries visited

Teams - Show a list of teams and the sites each team visited

©2004-06 NEES Cyberinfrastructure Center | NSF Award CMS-0402490
 Support: it-support@nees.org / Toll Free: (866) 260-4100 / Fax: (858) 822-5464
 Located at the [San Diego Supercomputer Center](#). Supported by the [National Science Foundation](#).
