Pacific and Central America Tsunami Hazards
Tsunami Risk: Methods and Role of Probabilistic Tsunami Hazard Analysis & Tsunami Deposits

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Outline

• Tsunami Sources
  – Probabilistic Tsunami Hazard Analysis

• Tsunami Deposits
  – Modern
  – Paleo
Where do tsunamis occur?

All tsunamis

Most are local/regional tsunamis

Where do tsunamis occur?

All tsunamis

Fewer are distant tsunamis
Tsunami Sources in the region

Determining Tsunami Hazard

**Probabilistic Tsunami Hazard Analysis (PTHA)**

**Considerations:**

- What tsunami sources could impact site?
- Modeling to determine how large impact at site
- What is frequency of each of sources?

Historical, pre-historical & hypothetical events are taken into account.
PTHA: Events taken into account

- **Historical, sources include:**
  - Tide Gauge Observations, Reconnaissance Reports
  - Data catalogues: Tsunami, Earthquake, Volcano, Storms
  - Journal articles, Newspaper reports, Ship’s Logs, Diaries, Personal Accounts

- **Pre-historic, sources include**
  - Tsunami deposits, myths, legends, oral histories

- **Hypothetical, based on**
  - behavior by similar fault zones

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**PTHA Consideration:**
What tsunami sources could impact site?

*Image is of subduction sources, but local sources could included in PTHA*

Images: Gica et al. 2008
PTHA Consideration
Modeling to determine impact at site

Similar sources different impacts

http://ncdr.pmel.noaa.gov/propagation-database.html
PTHA Consideration
What is frequency of each of sources?

Historical records, include:
   – Tide Gauge Observations, Reconnaissance Reports
   – Data catalogues: Tsunami, Earthquake, Volcano, Storms
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Pre-historical records, include:
   – Tsunami deposits, myths, legends, oral histories

Tsunami Deposits

• Modern
  – Examples: Nicaragua, El Salvador

• Paleotsunami
  – Examples: Washington (USA), Thailand
Tsunamis leave geologic records including: sand, boulders, and marine traces.

Tsunami deposits on coast

Tsunami deposits on delta

Images: M.E. M. Arcos

Tsunami Deposits: Methods

Modern tsunami sediment sheets

Martin and Bourgeois, 2012
September 1992 tsunami – off of coast of Nicaragua

B. Higman, et al., 2008.
August 2012 tsunami – off of coast of El Salvador

Phra Thong, Thailand

Tsunami deposits preserved in wet areas (such as swales)
SAND SHEETS preserved beneath marshy swales

Phra Thong, Thailand

Vertical exaggeration x 20

Graph: Brian Atwater, USGS

PIT 5

Dr. Kruawan Jankaew digging for tsunami deposits in Phra Thong, Thailand.

2004 tsunami deposit

Organic soil

Phot by B. Atwater
Naselle River, Willapa Bay, Washington

- Modern tidal marsh
- Decayed spruce stump
- Mud deposited by tides since 1700
- Forest floor in 1700

Magnitude & frequency

- AD 1700
- AD 700
- AD 400
- 500 BC
- 900 BC

(low tide)

Photo: Atwater et al, 2005
Evidence of past tsunamis: Sand deposits

Tsunami sands
A.D. 1700
Subsided marsh along the Niawiakum River, southwest Washington

Tsunami inundates land and goes upstream
Sand deposits left by tsunami

Oral History & Written Records

“Among the signs of danger, the elders warn, is long–lasting shaking moving from west to east, and sand that becomes so loose people walking on the beach sink into it – Elders tell the young they must run to high ground”
Exposure & Sensitivity Analysis

Models simulate:
• arrival time at coast
• height of waves
• distance reached inland
• strength of currents

Exposure and Sensitivity Analysis help identify: population, assets and resources that are in the tsunami hazard zone.

Thank You

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