NOAA TSUNAMI FORECAST DEVELOPMENT

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TSUNAMI FORECAST

Real-time:

- Event-specific
- Real-time event assessment
- Real-time impact assessment before tsunami arrival

Long-term:

- Site-specific
- Probable Maximum Tsunami
- Multiple scenarios for PTHA
- Comprehensive Hazard Assessment

![Map and data graphs related to tsunami forecast](image)
LONG-TERM FORECAST: HAZARD ASSESSMENT

Maximum Inundation Depth Zones

- Zones:
  - Low (0 - 0.5 m)
  - Medium (0.5 - 2 m)
  - High (>2 m)

Projection: State Plane Coordinate System
- Zone: 5602 (Washington State)
- X/Y Units: Feet
- Horizontal Datum: NAD83
- Vertical Datum: Mean High Water

Maximum Current Speeds

- Speeds:
  - 0 - 1
  - 1 - 2
  - 2 - 3
  - 3 - 5
  - 5 - 10
  - 10 - 15
  - 15 - 20
  - 20 - 30
  - No Data

Projection: State Plane Coordinate System
- Zone: 5602 (Washington State)
- X/Y Units: Feet
- Horizontal Datum: NAD83
- Vertical Datum: Mean High Water

2002 Seattle Tsunami Inundation Modeling Project
PROBABILISTIC ASSESSMENT
THE CHALLENGE:
REAL-TIME
MODEL FORECAST
TSUNAMI REAL-TIME DETECTION

Deep-ocean Assessment and Reporting for Tsunamis (DART)
NOAA Tsunami Forecast

Detection
- Tsunameters

Inversion
- Model database

Coastal forecast
- Flooding forecast

Verification
- Tsunami events

Forecast tests:
- 17 real-time tests
- 13 data tests
- Over 30 global test events
MARCH 11, 2011
JAPAN TSUNAMI

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WORST TSUNAMI IN JAPAN HISTORY
SOME FACTS

- Vast majority of damage is due to the tsunami
- Possibly the worst tsunami in Japan (1896 Sanriku, 22,000 deaths)
- Estimates of over 20,000 dead
- Estimates of over $250B damage
- Substantial impact in US (flooding, people killed, tens of millions of damage)
- Flooding and damage in Chile 22 hrs after earthquake
- Assessments of damage around the Pacific continues
- Second worst ever NPP incident caused by the tsunami
# Japanese Historical Tsunamis

<table>
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<th>Year</th>
<th>Earthquake Magnitude</th>
<th>Number of Deaths</th>
<th>Water Height (m)</th>
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<td>1933</td>
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<td>2011</td>
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PICTURES SOLD AFTER 1896 TSUNAMI

From field guide, 3rd International Tsunami Field Symposium, April, 2010, Tohoku University, Sendai
Trip leaders: Nobuo Shuto, Fumihiko Imamura
BOUGASAWA AREA

Credit: N. Shuto and F. Imamura
Tsunami recorded at Japanese sea level stations

東北～関東の太平洋沿岸

< 2011/3/11 14:00 -- 2011/3/12 10:40 >

Scale: This length is 5 meter

Aomori
Mutsu-Sekinehama
Mutsu-Ogawara
Hachinohe
Kuji Harbor
Miyako
Kamaishi
Ofunato
Ayukawa, Ishinomaki
Sendai Harbor
Souma
Onahama, Iwaki
Oarai
Kashima Harbor
Choshi
Mera, Tateyama
The city of Yagawahama in Miyagi in 2007 and after the earthquake. (Photo: Google Inc./Bloomberg)
Kamiashi City

Before

After

Kamaishi Video
Kamaishi City
Kamiashi City Seawall
Sendai
Inverting tsunami source from DART buoy measurements
Crescent City: 2.5 m
• Port San Luis: 2.0 m
• 1 casualty
• 40 - 50 million $
  damages

Constitucion: 2.0 m

Kahului: 2.1 m
• Hilo: 1.2 m
• Flooding and harbor damages

Shemya: 1.6 m

Tonga: 1.2 m
• PNG: 1.1 m
• Flooding and damages

Arica: 2.5 m

Constitucion: 2.0 m
MODEL FORECAST
MODEL FORECAST
DISCUSSION

- PMEL Forecast Method performed “better than expected”
  - DART data was the first and only tsunami data for hours after the earthquake
  - Quality of DART data in the near-filed led to a robust forecast quickly
  - Model forecast performed well
  - ISSUE: tide predictions are necessary for accurate inundation predictions

- Implications for Local (near-field) forecast

- Increasing interest in site-specific forecasts (NRC, NAVY, Local EM, International...)

- What is the role of warning and forecast for near-field coastlines?