



- **The Northwest Association of Networked Ocean Observing Systems (NANOOS) interactive tsunami evacuation maps**

- John A. Barth<sup>1</sup>, Jonathan Allan<sup>2</sup>, Craig Risien<sup>1</sup>, Jan A. Newton<sup>3</sup> and NANOOS Colleagues

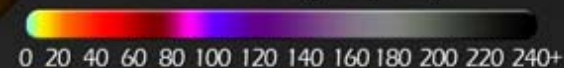
<sup>1</sup>CEOAS, Oregon State University

<sup>2</sup>Oregon Dept. of Geology & Mineral Industries

<sup>3</sup>University of Washington

Graphic courtesy NOAA / PMEL / Center for Tsunami Research

Wave Height (cm)



# Distant\* earthquake and tsunami

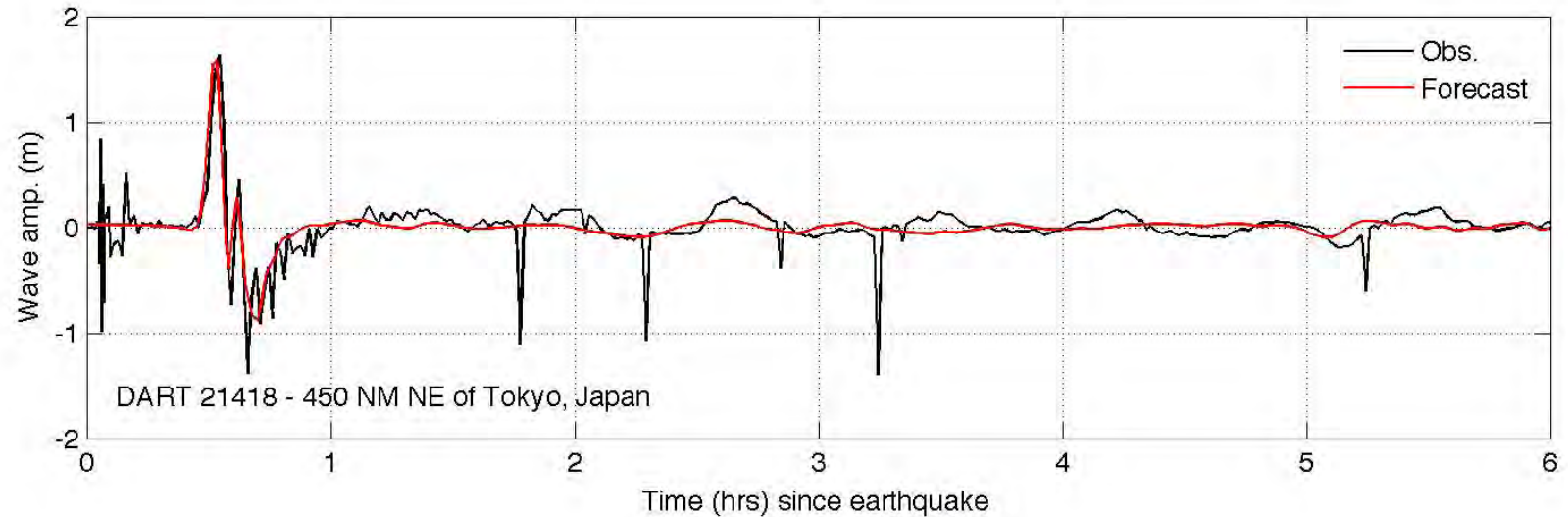
\*Distant to North America

## Great East Japan Earthquake and Tsunami

- Struck on March 10, 2011 at 9:46:23PM U.S. Pacific Time
- Magnitude ~9.0 approximately 129km off the city of Sendai in Honshu, Japan
- Produced a catastrophic tsunami with local inundation heights as great as ~30m and which propagated across the entire Pacific basin

# Distant earthquake and tsunami

## Deep-ocean Assessment and Reporting of Tsunamis (DART) Buoys



Honshu (northeastern Taiheiyou) tsunami, 11 March 2011



NOAA Center for Tsunami Research

This graphic shows the peak tsunami wave at DART Station 21418 located 470nm northeast of Tokyo. At 1.8m, this is the largest peak wave recorded by DART.

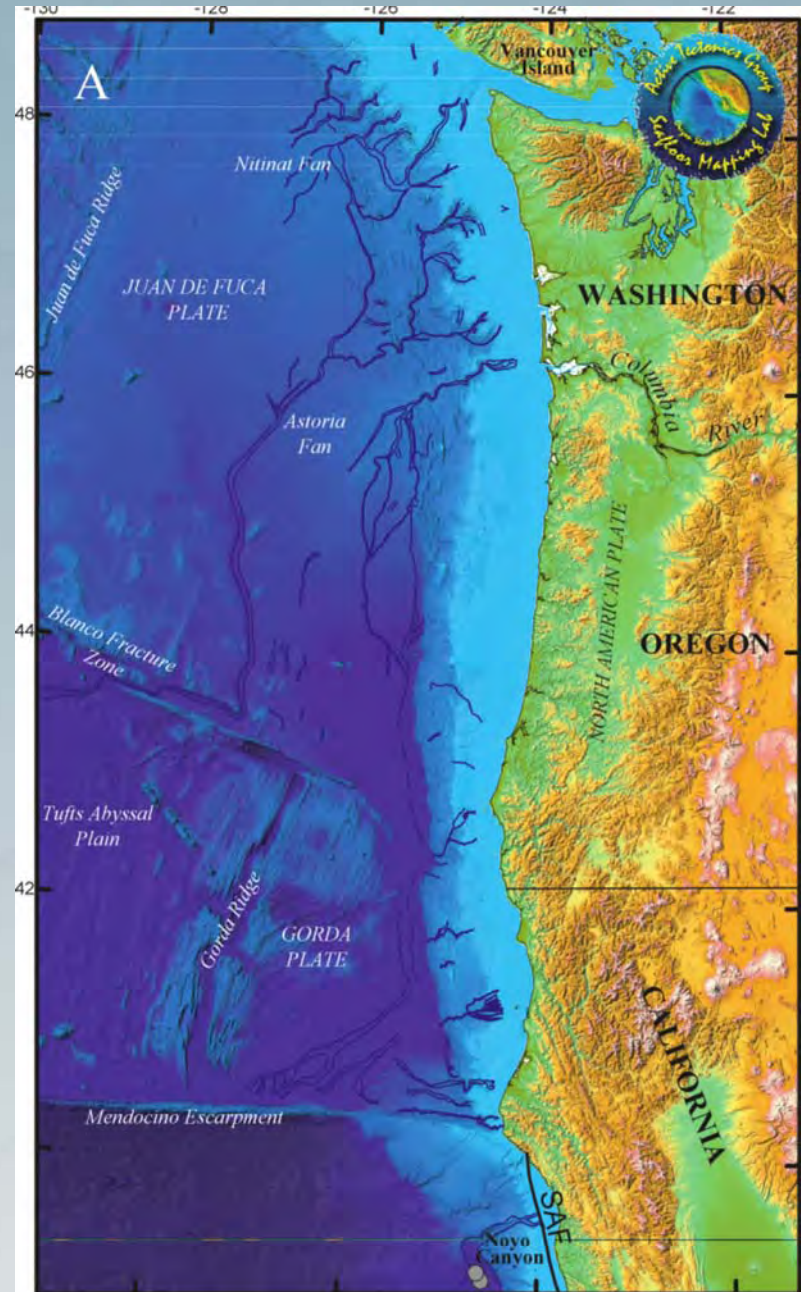
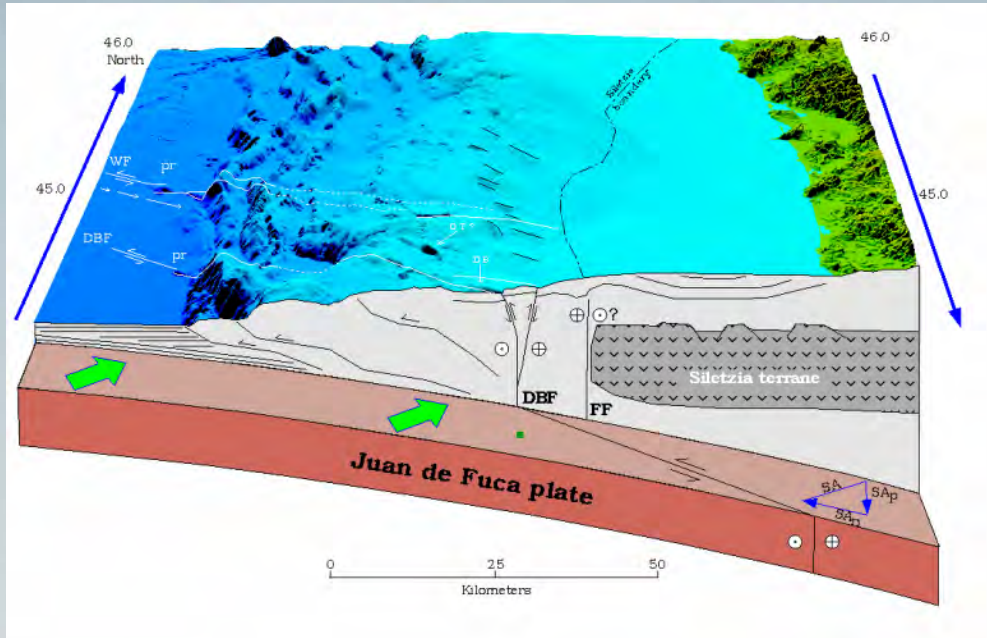
# Distant earthquake and tsunami

## Warnings and Tsunami arrival times on the U.S. West Coast

- Twelve minutes after the earthquake, the U.S. West Coast/Alaska (WCATWC) and Pacific tsunami centers issued a tsunami “information statement”
  - At 12:26AM PST – tsunami advisory for Alaska and most of west coast
  - By 12:51AM PST – upgraded to tsunami warning allowing adequate time for preparation
- First tsunami arrival at Port Orford, OR, 9.6 hours after the earthquake
- DART, a vital IOOS<sup>®</sup> component, provided critical information that permitted adequate warnings

# Local earthquake and tsunami

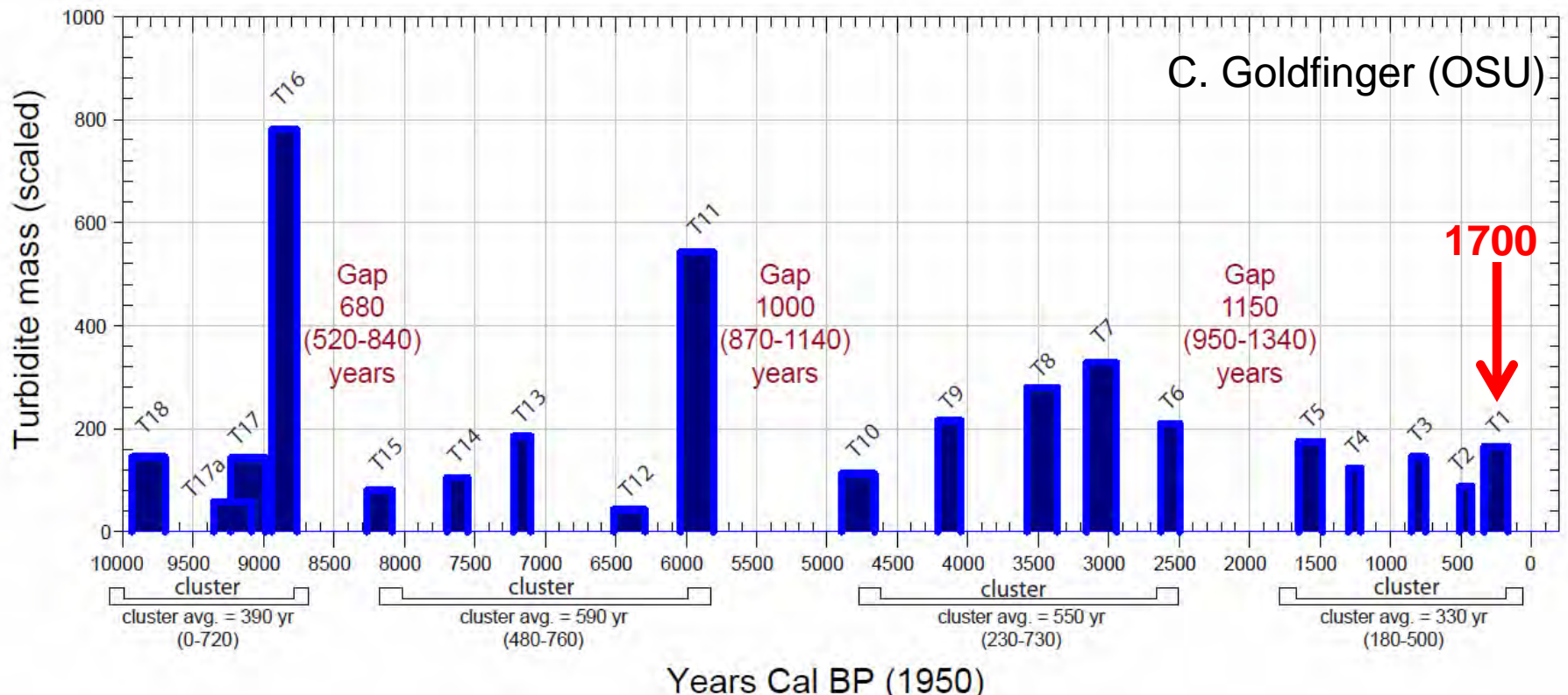
## The Cascadia Subduction Zone



C. Goldfinger (OSU)

# Local earthquake and tsunami

By studying ocean sediments, Cascadia zone great earthquakes (~9.0) occur about every 300-500 years, but sometimes there are ~1000 year gaps

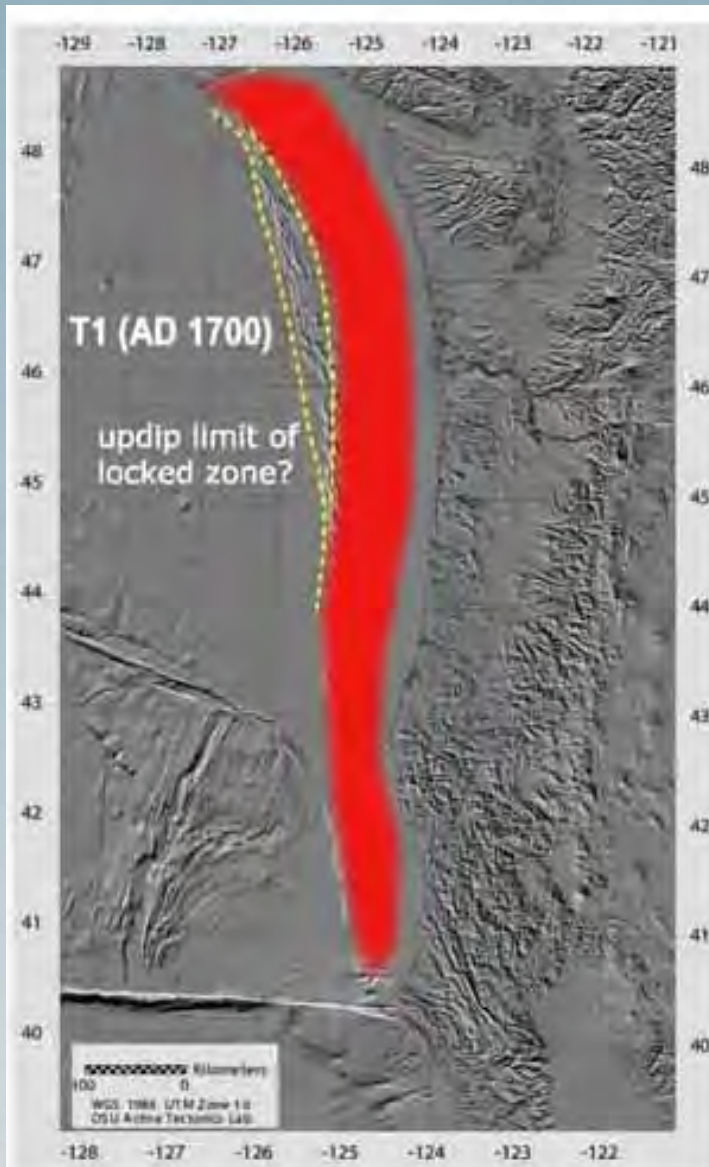


# Local earthquake and tsunami

Noted by Native Americans



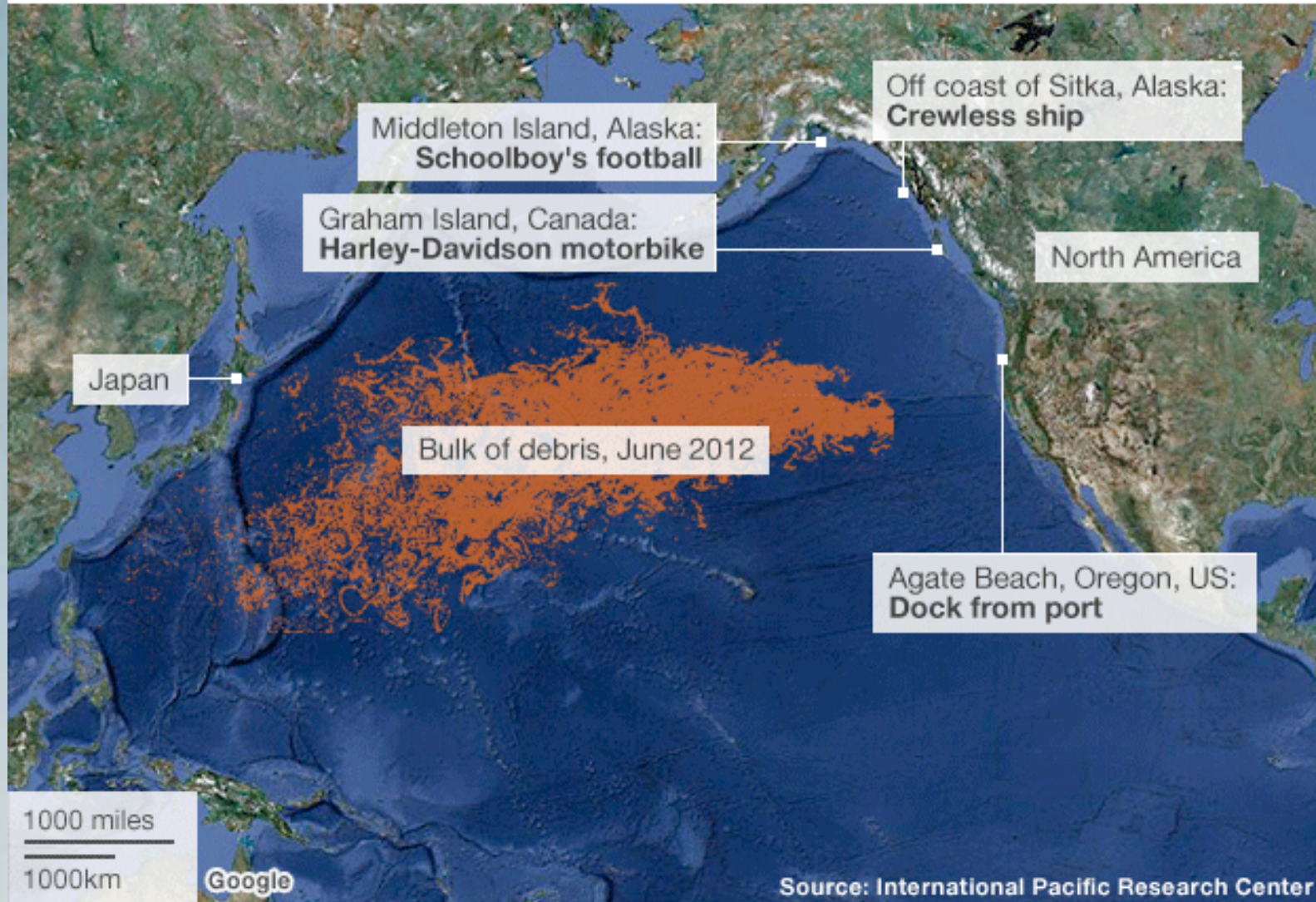
Corroborated by Japanese records



C. Goldfinger (OSU)

# Japan Tsunami Marine Debris

How far the Japanese tsunami debris has spread



from 8 Oct 2012 BBC Magazine and radio cast  
<http://www.bbc.co.uk/news/magazine-19812373>



# Japan Tsunami Marine Debris

High public interest and concern

Ocean education and outreach



20-m long dock from Misawa, Japan, arrived Newport, Oregon, June 6, 2012

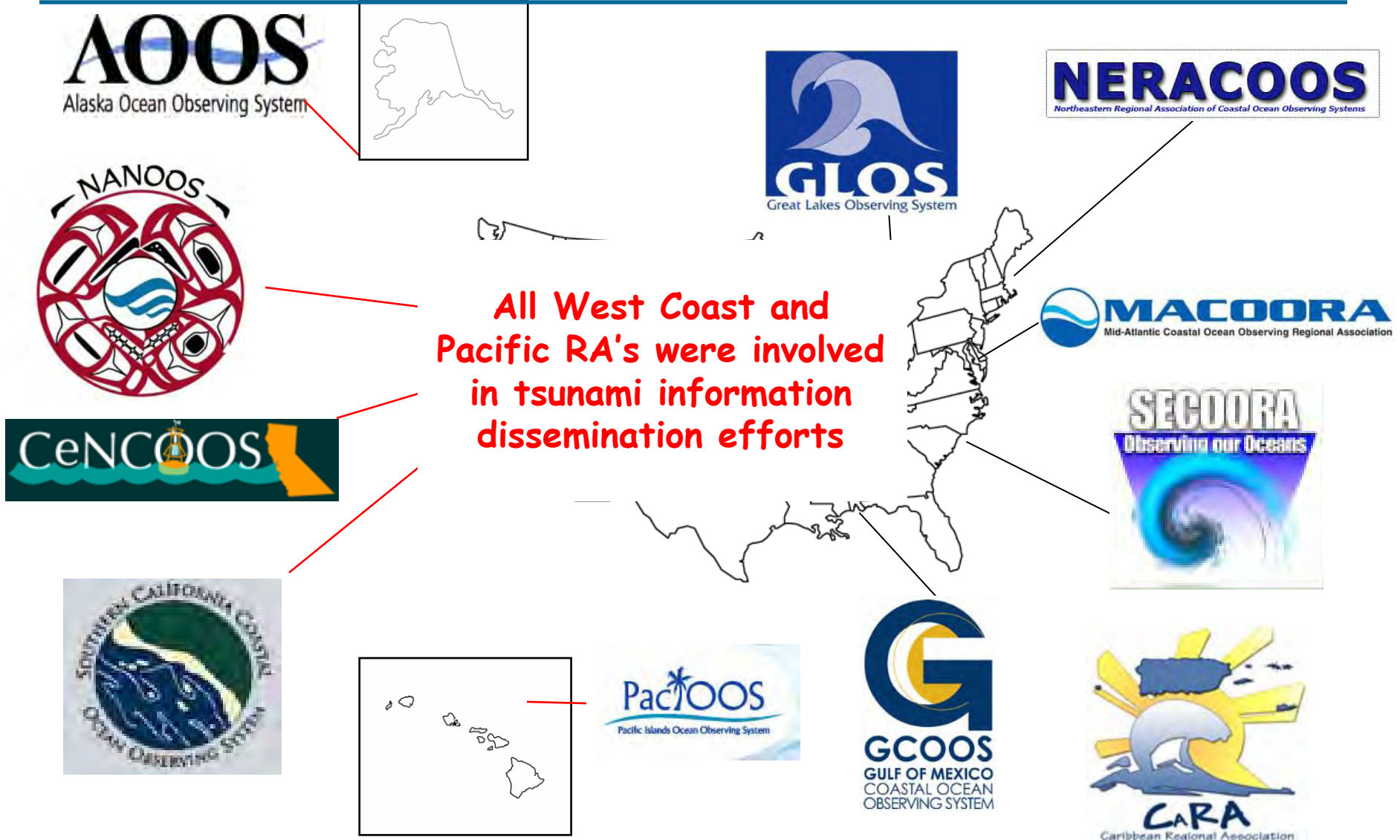




## *Seven goals, one system*

- » Improve predictions of **climate change and weather** and their effects on coastal communities and the nation
- » Improve the safety and efficiency of **maritime operations**
- » Improve forecasts of **natural hazards** and mitigate their effects more effectively
- » Improve **homeland security**
- » Minimize **public health risks**
- » Protect and restore **healthy coastal ecosystems** more effectively
- » Sustain living marine **resources**

# IOOS<sup>®</sup> consists of National and Regional Components





# NANOOS

NORTHWEST ASSOCIATION OF NETWORKED OCEAN OBSERVING SYSTEMS



WASHINGTON - OREGON - NORTHERN CALIFORNIA

## Stakeholder Priorities

NANOOS selected five areas as the highest regional priorities:  
“these issues represent those having the greatest impact on PNW citizenry and ecosystems and, we believe, are amenable to being substantively improved with the development of NANOOS”

- Maritime Operations
- Ecosystem Impacts, including hypoxia and HABs
- Fisheries
- **Mitigating Coastal Hazards**
- Climate, including ocean acidification



# NANOOS Observing Assets

- Funded 100% by NOAA IOOS
- Funded Partially by NOAA IOOS
- Funded 0% by NOAA IOOS



# NANOOS Visualization System

(<http://www.nanoos.org/nvs>)

The screenshot shows a Mozilla Firefox browser window displaying the NANOOS Visualization System (NVS) website. The browser's address bar shows the URL <http://www.nanoos.org/nvs/nvs.php>. The website header features the NVS logo and the text "NANOOS VISUALIZATION SYSTEM". Below the header, there is a navigation menu with "Overview" selected. The main content area contains a welcome message and two prominent buttons: "Click Here to View All Assets" and "Click Here to View Products". A yellow banner below the buttons reads "NEW & NOTEWORTHY". Underneath, a section titled "Asset Additions & Updates" lists recent events, including "CMOP Saturn02" and "PSI Nahcotta", both updated on July 1, 2011. A map of the Pacific Northwest coast is visible on the left side of the page.

NANOOS - NVS - Mozilla Firefox

File Edit View History Bookmarks Tools Help

[http://www.nanoos.org/nvs/nvs.php](#)

Most Visited Getting Started Latest Headlines Customize Links Free Hotmail Web Slice Gallery Windows Marketplace Windows Media Windows

jumar - Google Search NANOOS - NVS Elakha\_Calendar\_11.pdf (applicatio... Oregon Coastal Ocean Observing S...

Log In | Register

# NVS

NANOOS VISUALIZATION SYSTEM

NVS v2.5

Overview

Welcome to the NANOOS Visualization System (NVS), your tool for easy access to data. NVS gathers data across a wide range of assets such as buoys, shore stations, and coastal land-based stations. Never before available downloads and visualizations are provided in a consistent format. You can access plots and data for almost all in-situ assets for the previous 30-day period. Try NVS and let us know what you think.

 [Click Here to View All Assets](#)  [Click Here to View Products](#)

## NEW & NOTEWORTHY

### Asset Additions & Updates [View Last 3 Months](#)

-  **CMOP Saturn02** *Updated on 7 Jul 2011*  
Mooring went offline in mid June and was restored to service on July 1.
-  **PSI Nahcotta** *Updated on 6 Jul 2011*  
Mooring went offline in mid June and was restored to service on July 1; NVS ingestion was restored on July 6.
-  **USCS Eluba Source** *Added on 30 Jun 2011*

# NANOOS Mobile Application

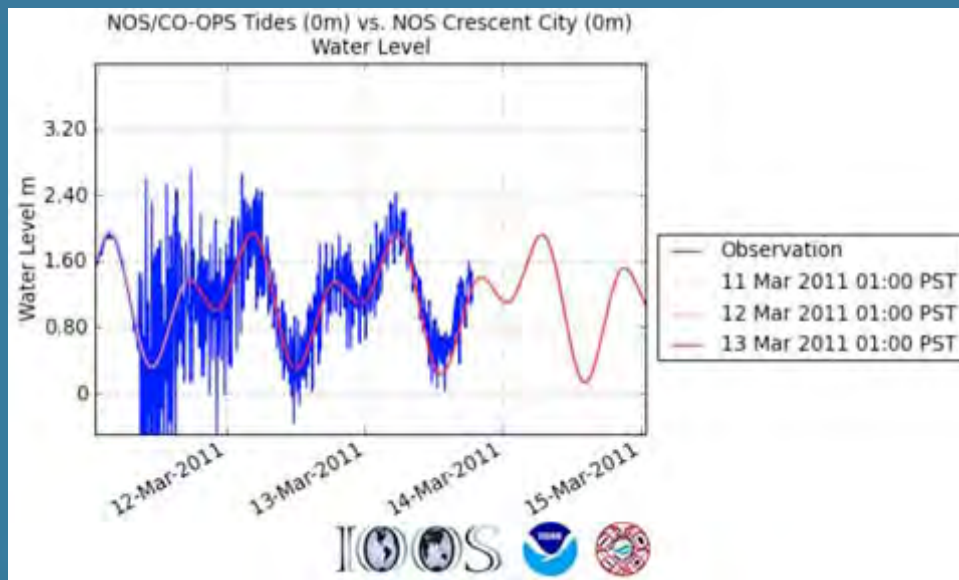
- NANOOS has developed a no-cost mobile application (app) for iPhone and Android devices that provides mobile equipment-specific access to NVS.



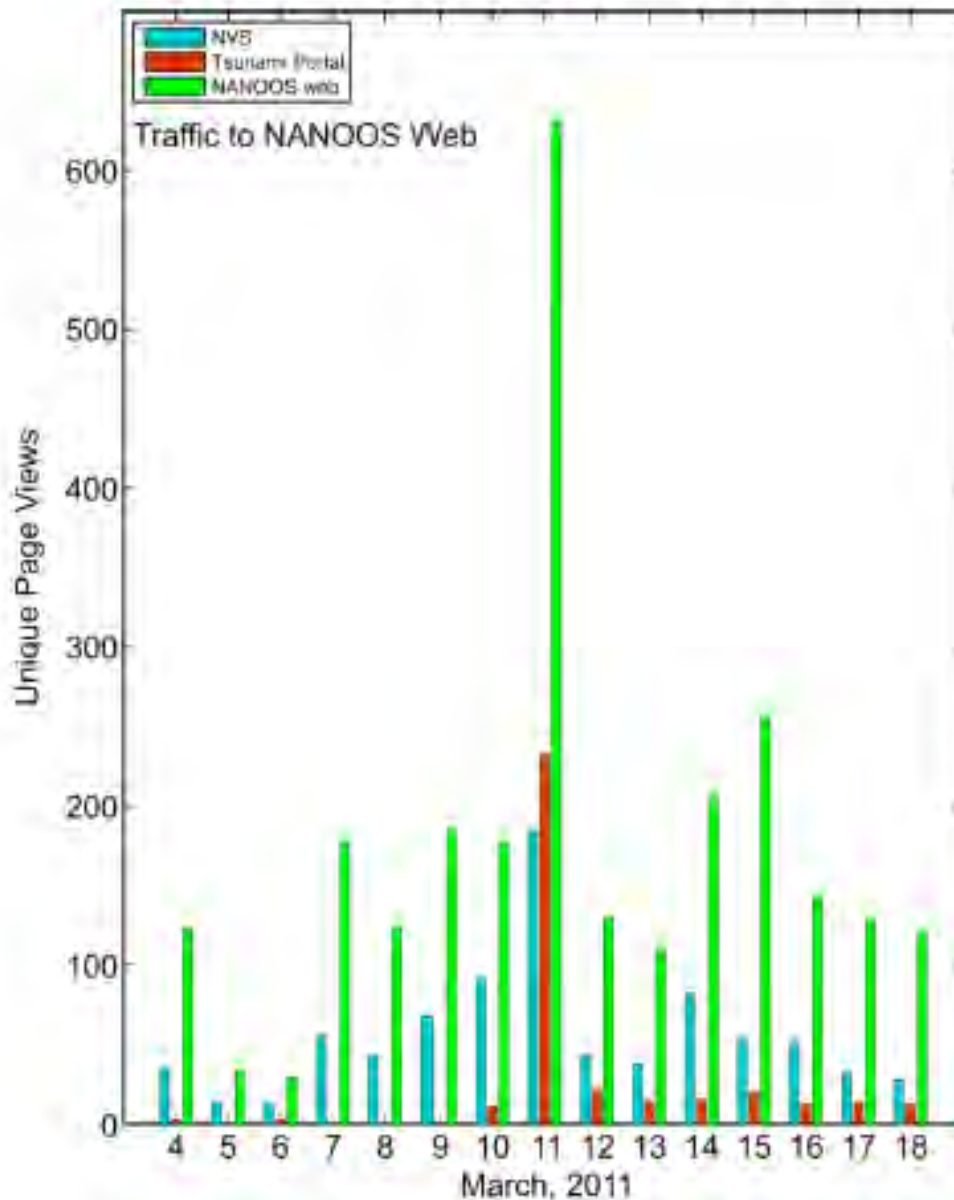
- Allows access to NVS by users not having access to a web browser or internet access (e.g., scientists, fishers, boaters, first responders, etc.)

# NANOOS Response to the Tsunami

- The NANOOS Visualization System (NVS) aggregated, displayed, and served near real-time via NVS
- An online tsunami hazard portal, displaying evacuation maps based on the maximum extent of inundation was provided

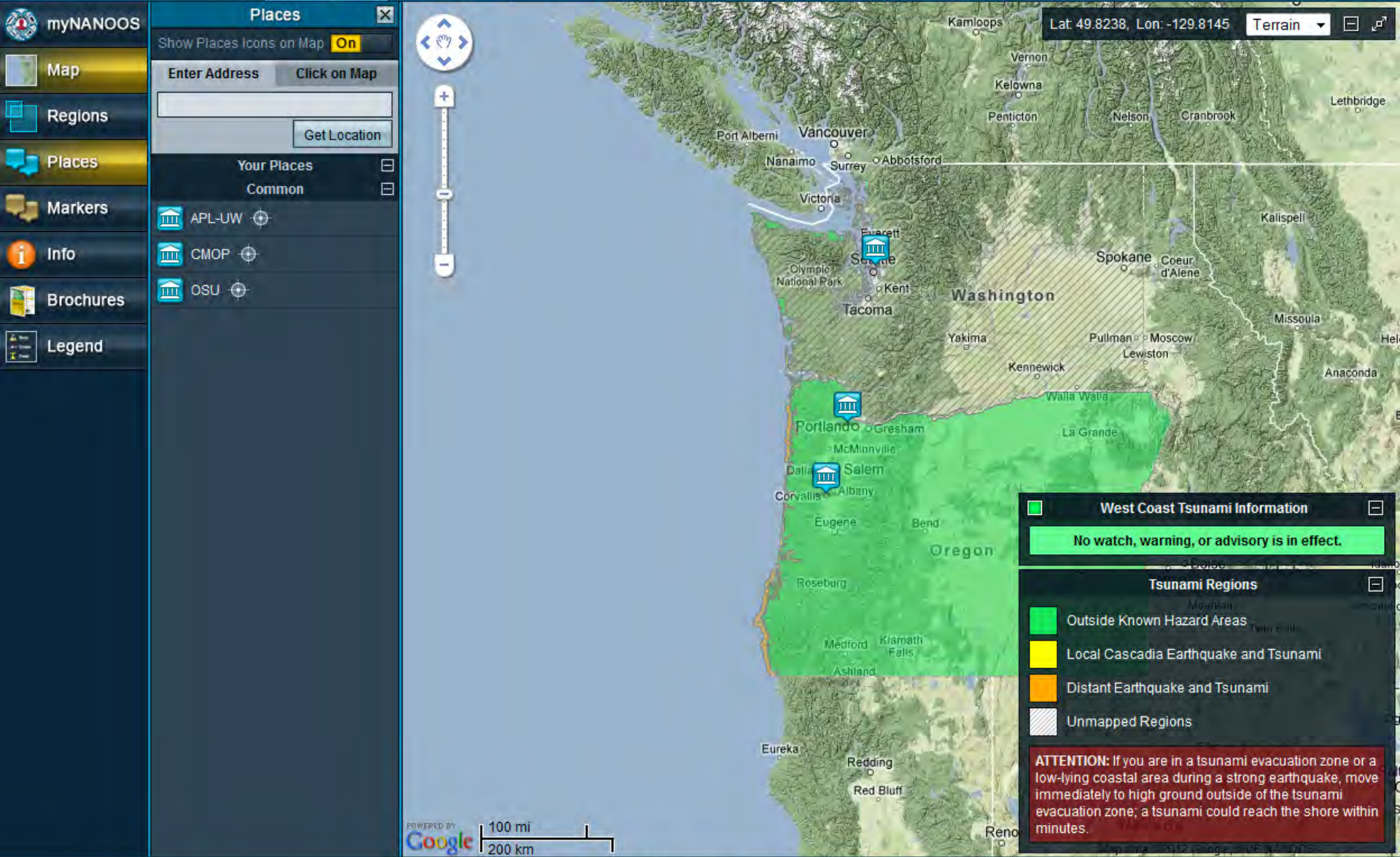


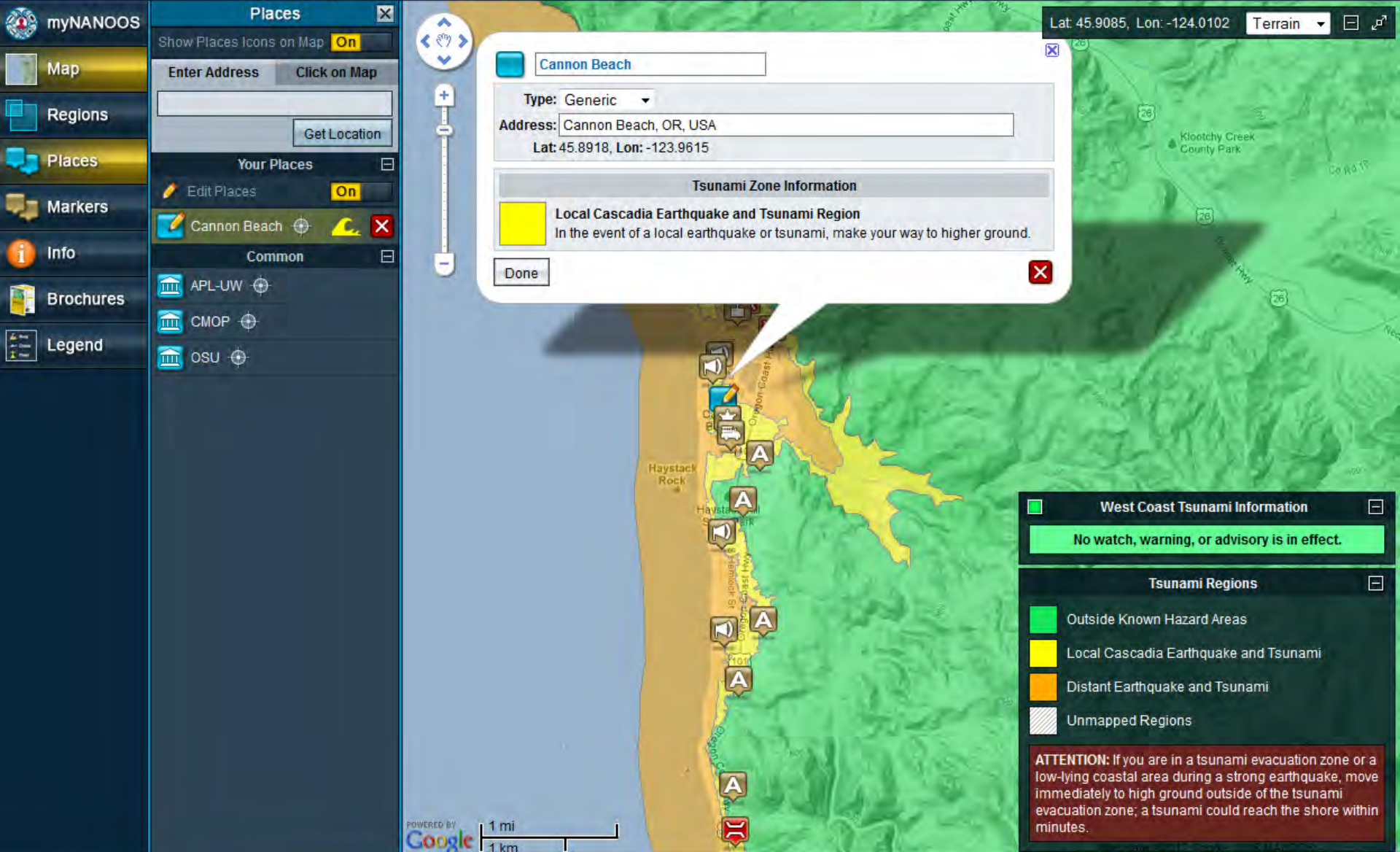




**March 2011 Great East Japan Earthquake and tsunami generated lots of web traffic to the NANOOS site**

**Motivated need for more efficient system and mobile phone app**







- myNANOOS
- Map
- Regions
- Places
- Markers
- Info
- Brochures
- Legend

### Places

Show Places Icons on Map  On

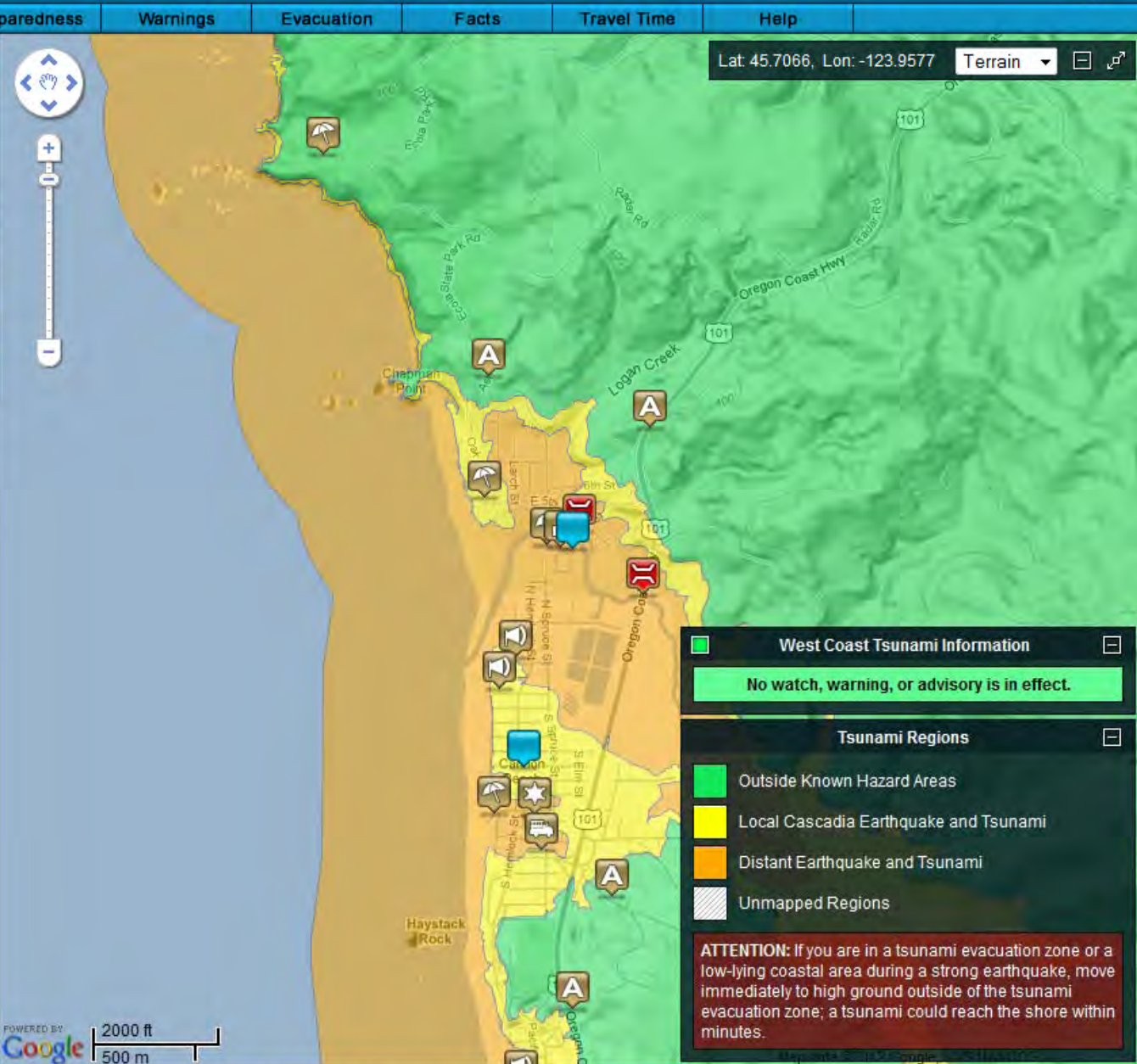
Enter Address  Click on Map

Your Places

- Cannon Beach, OR
- CB School

Common

- APL-UW
- CMOP
- OSU



### West Coast Tsunami Information

No watch, warning, or advisory is in effect.

### Tsunami Regions

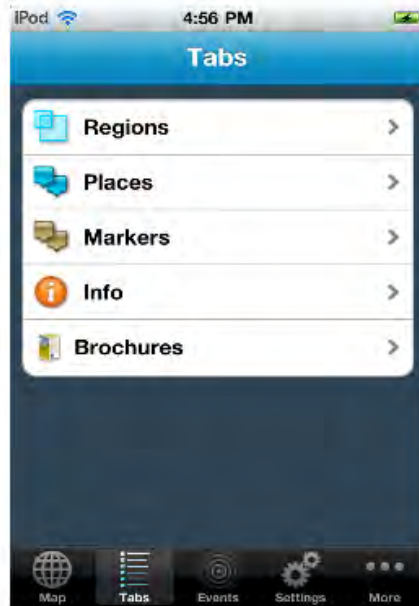
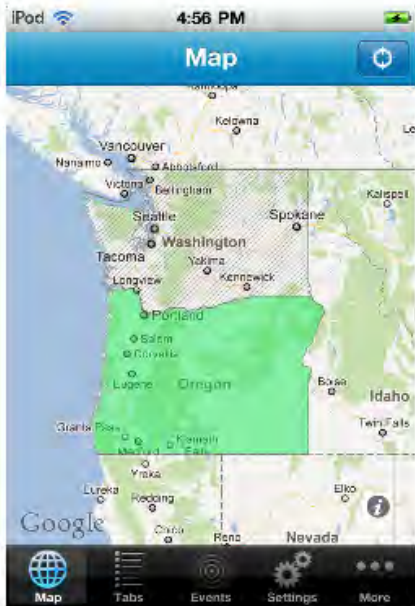
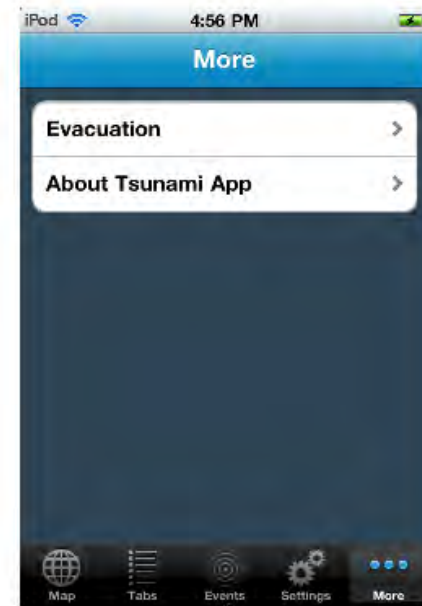
- Outside Known Hazard Areas
- Local Cascadia Earthquake and Tsunami
- Distant Earthquake and Tsunami
- Unmapped Regions

**ATTENTION:** If you are in a tsunami evacuation zone or a low-lying coastal area during a strong earthquake, move immediately to high ground outside of the tsunami evacuation zone; a tsunami could reach the shore within minutes.



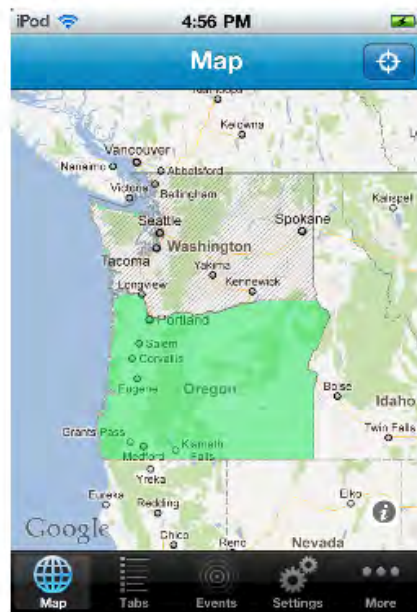
# NANOOS tsunami evacuation zone mobile phone app

*TsunamiEvac-NW*,  
iTunes or Android



# NANOOS tsunami evacuation zone mobile phone app

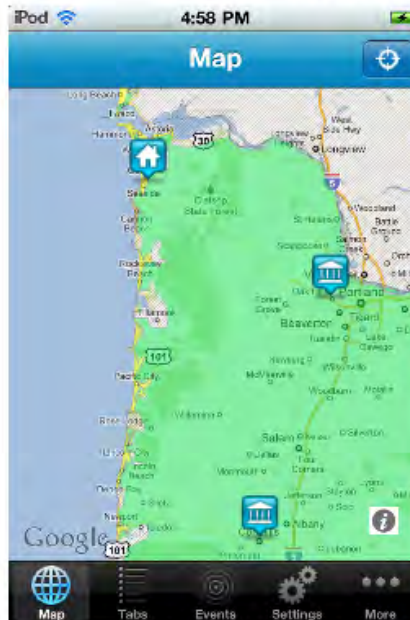
*TsunamiEvac-NW*, iTunes or Android



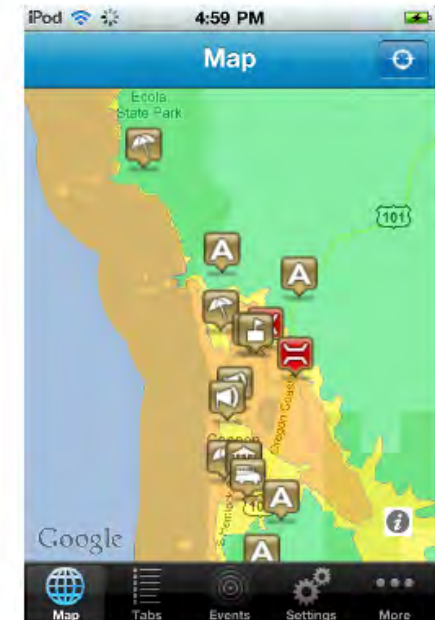
Legend



Places

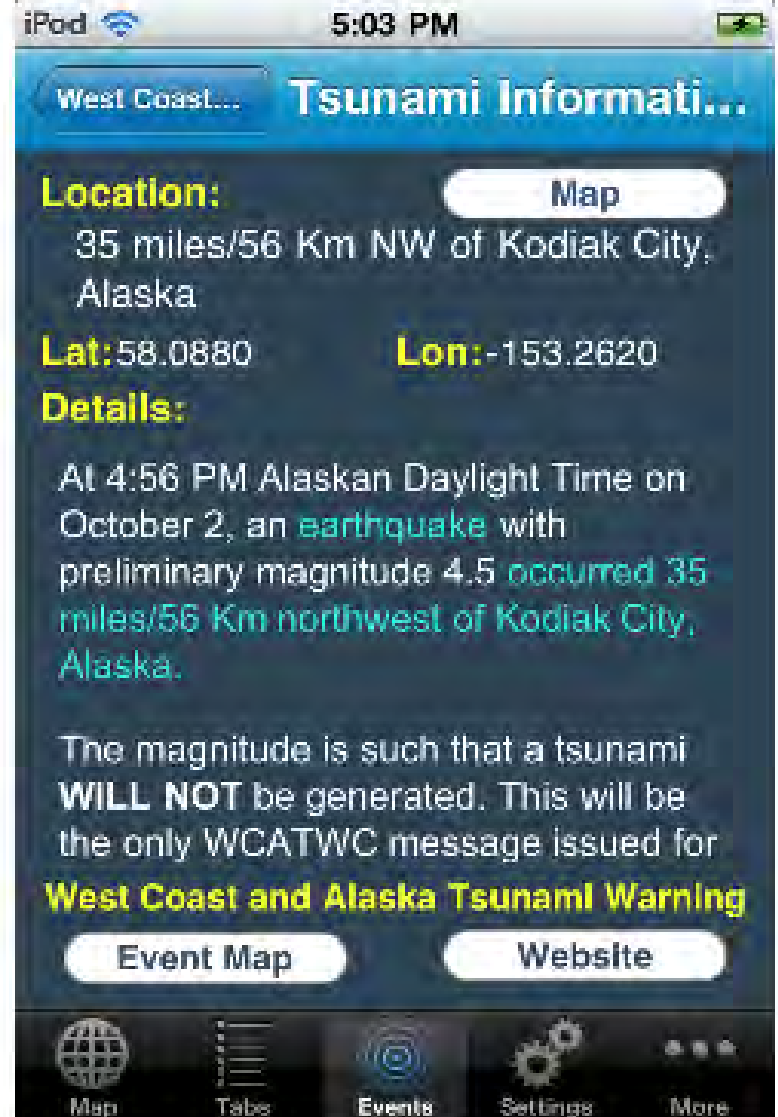


Marks

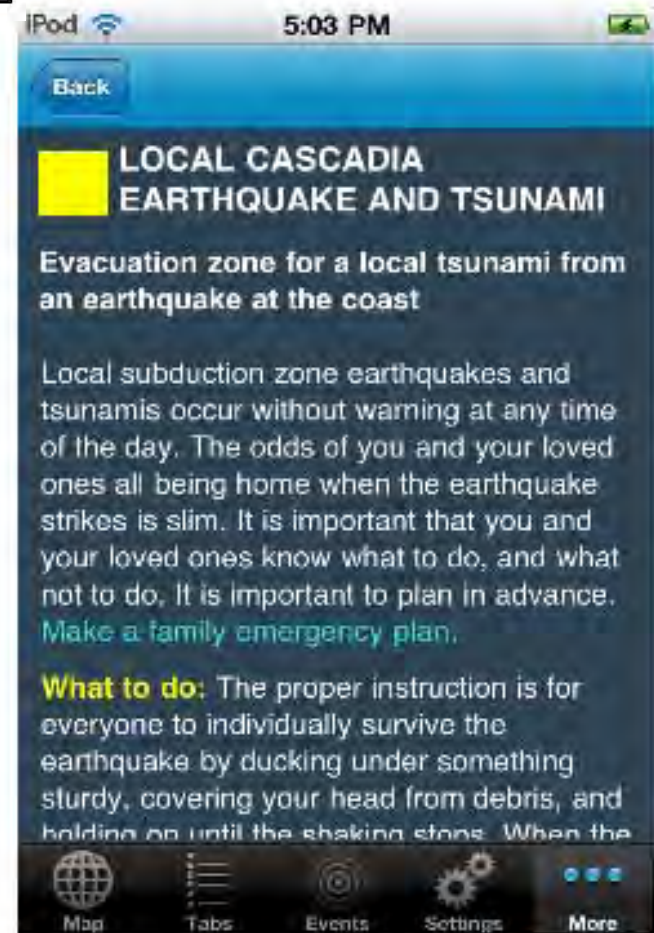
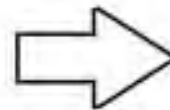


# Cannon Beach, Oregon









# Summary

- Continued need for education about natural hazards
- Distant and local origin for tsunamis
- Web-based tsunami education and mapping tools
- Allows user to find their location relative to predicted inundation and to plan accordingly
- Social networking technologies reach audiences
- Mobile phone App allows delivery of important information to mobile society



Washington Military Department

Emergency Management Division