

# Tsunami

**A Plenary Presentation for  
Ocean Observations 200**

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*USA/NOAA*

**dian Ocean - Kenneth Jarrott & Rick Bai**

**cific Ocean- Filomena Nelson**

**E Atlantic and Mediterranean Sea - Stefa**

**ibbean Sea- Christa von Hillebrandt**

**lobal - Peter Koltermann**

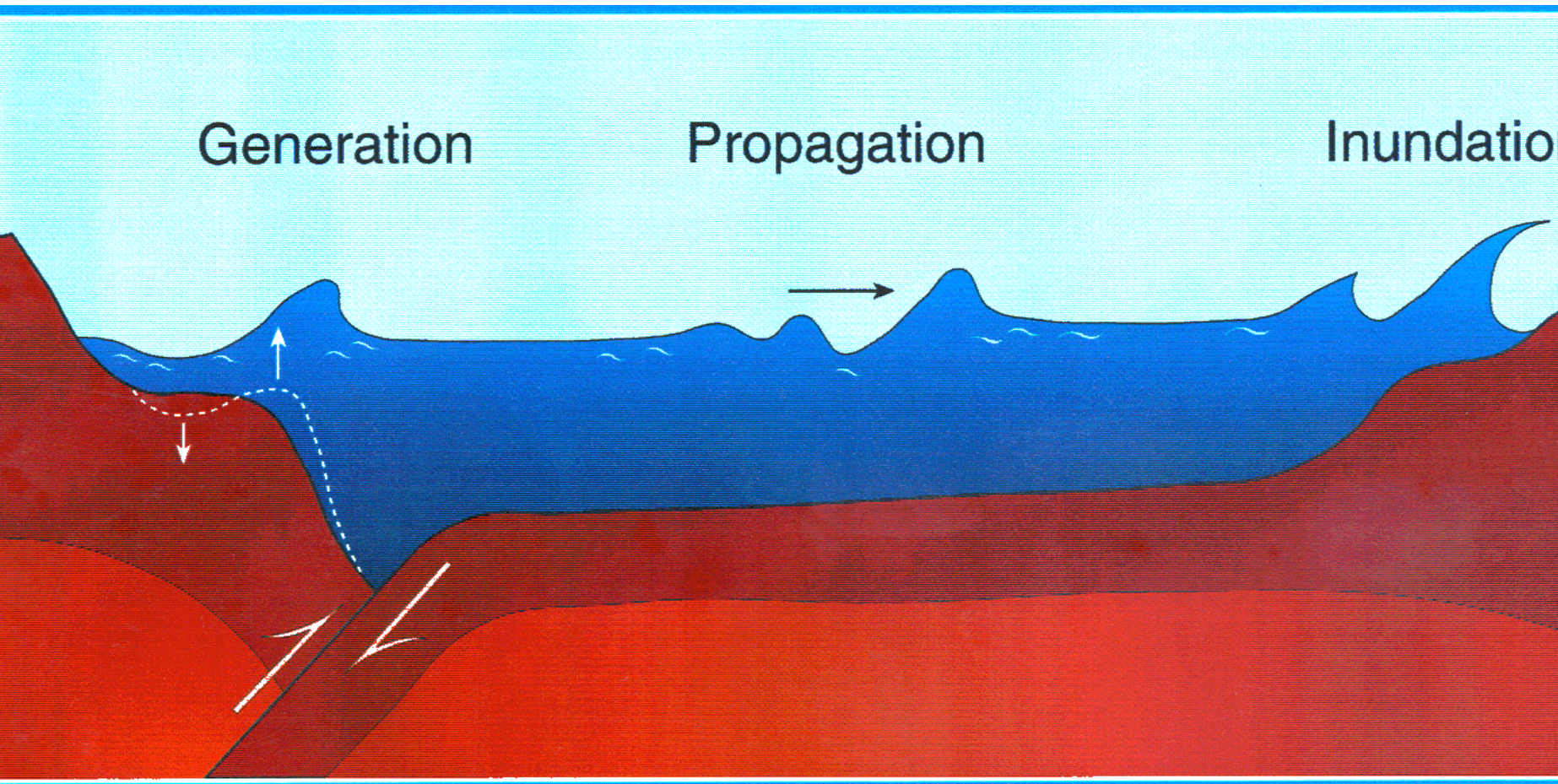
# Outline

- **What is a tsunami?**
- **History of Tsunami Warning System**
- **Existing Tsunami Warning Capabili**
- **Summary & Future Challenges**

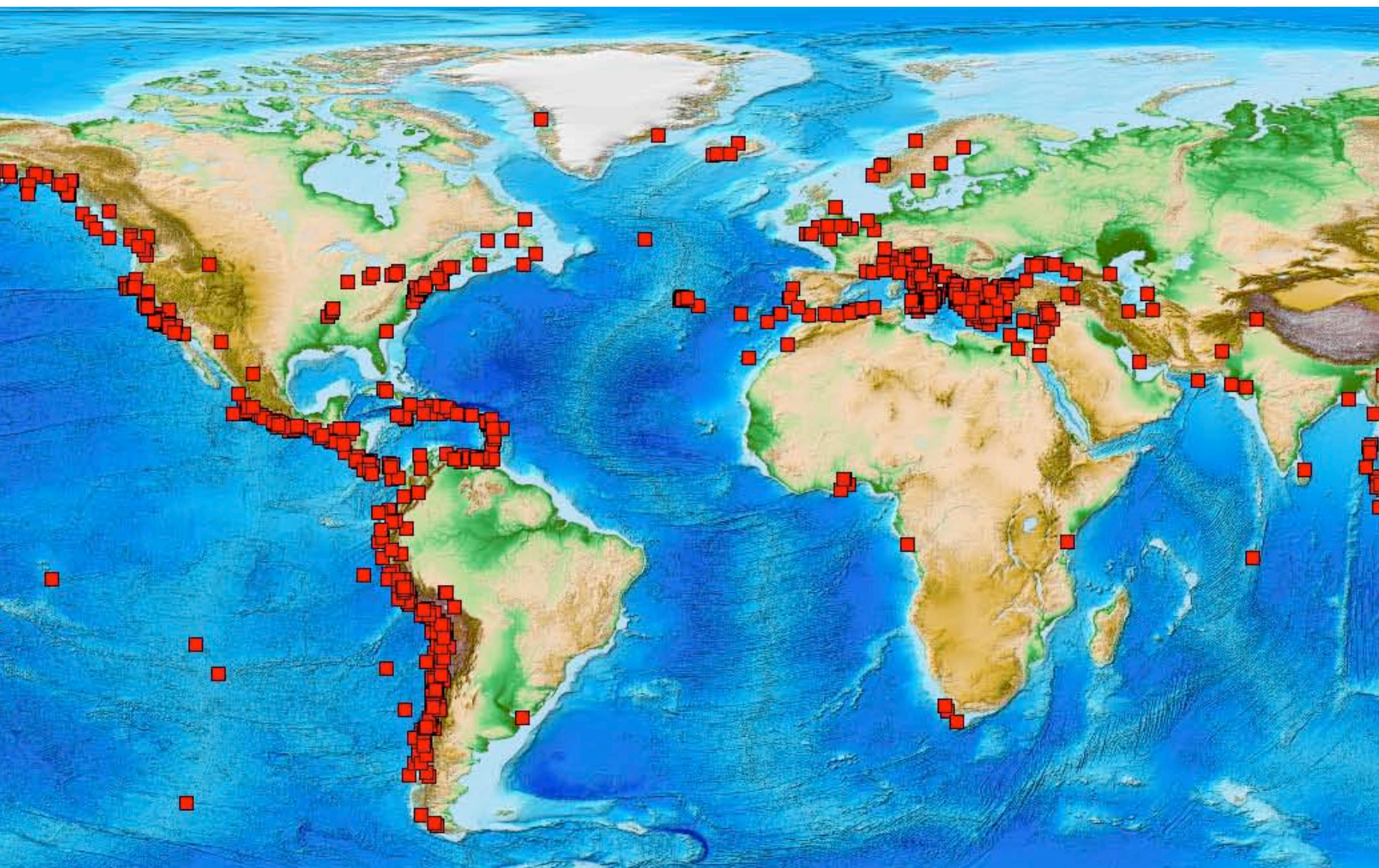
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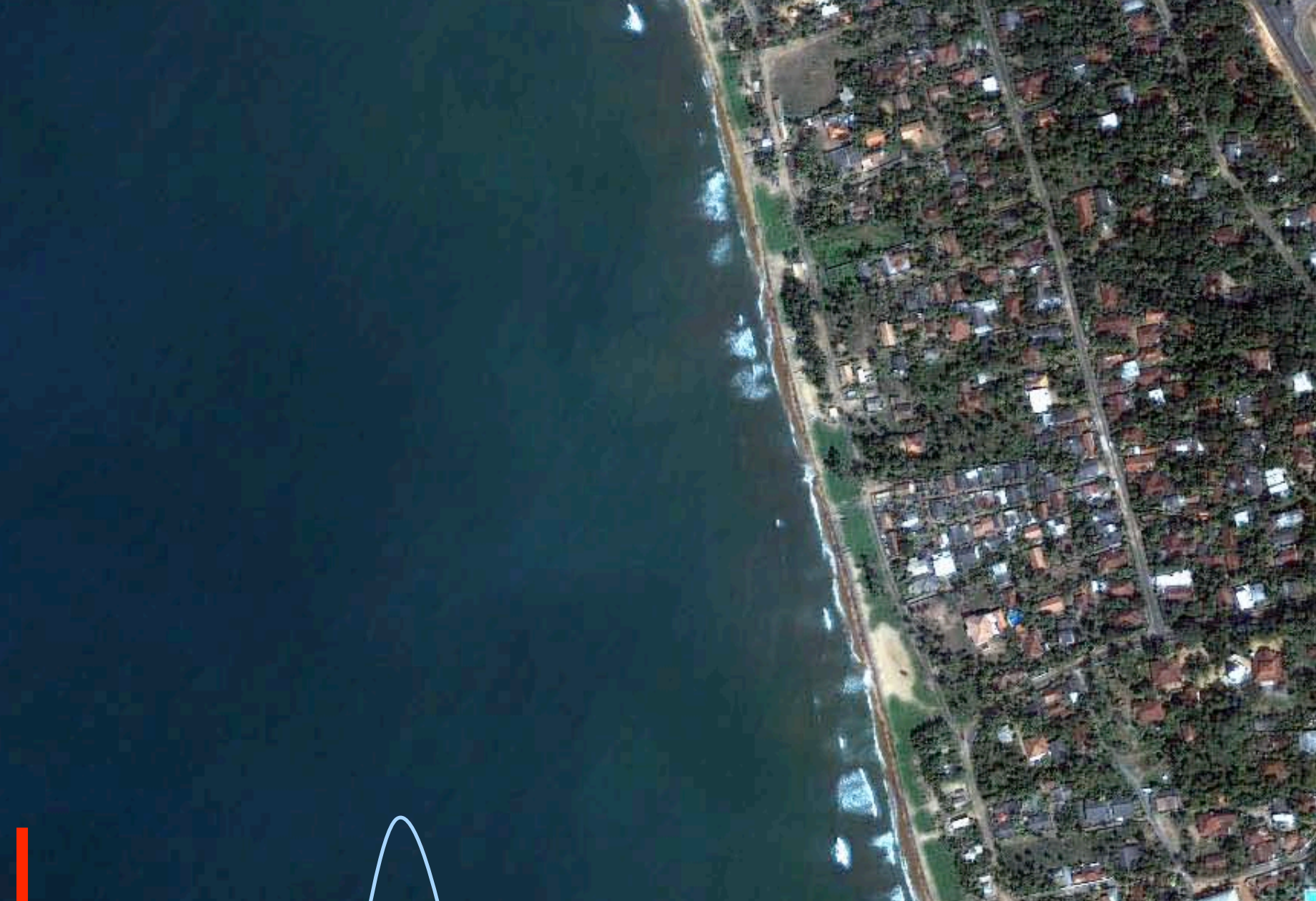
# Stages of Tsunami Evolution









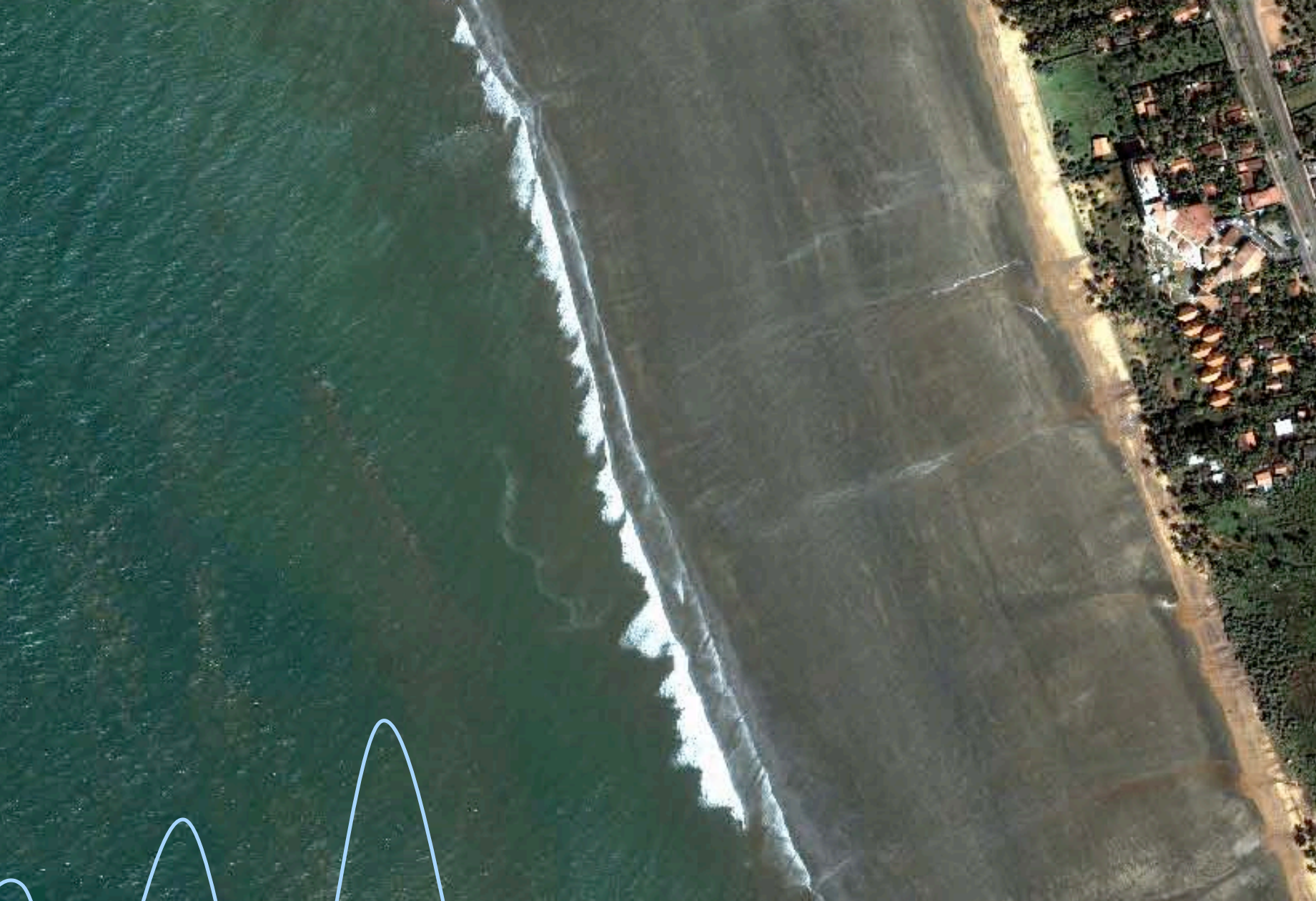












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# **1946 Alaska Tsunami: Reaction**

**Seismic detection of large earthquakes**

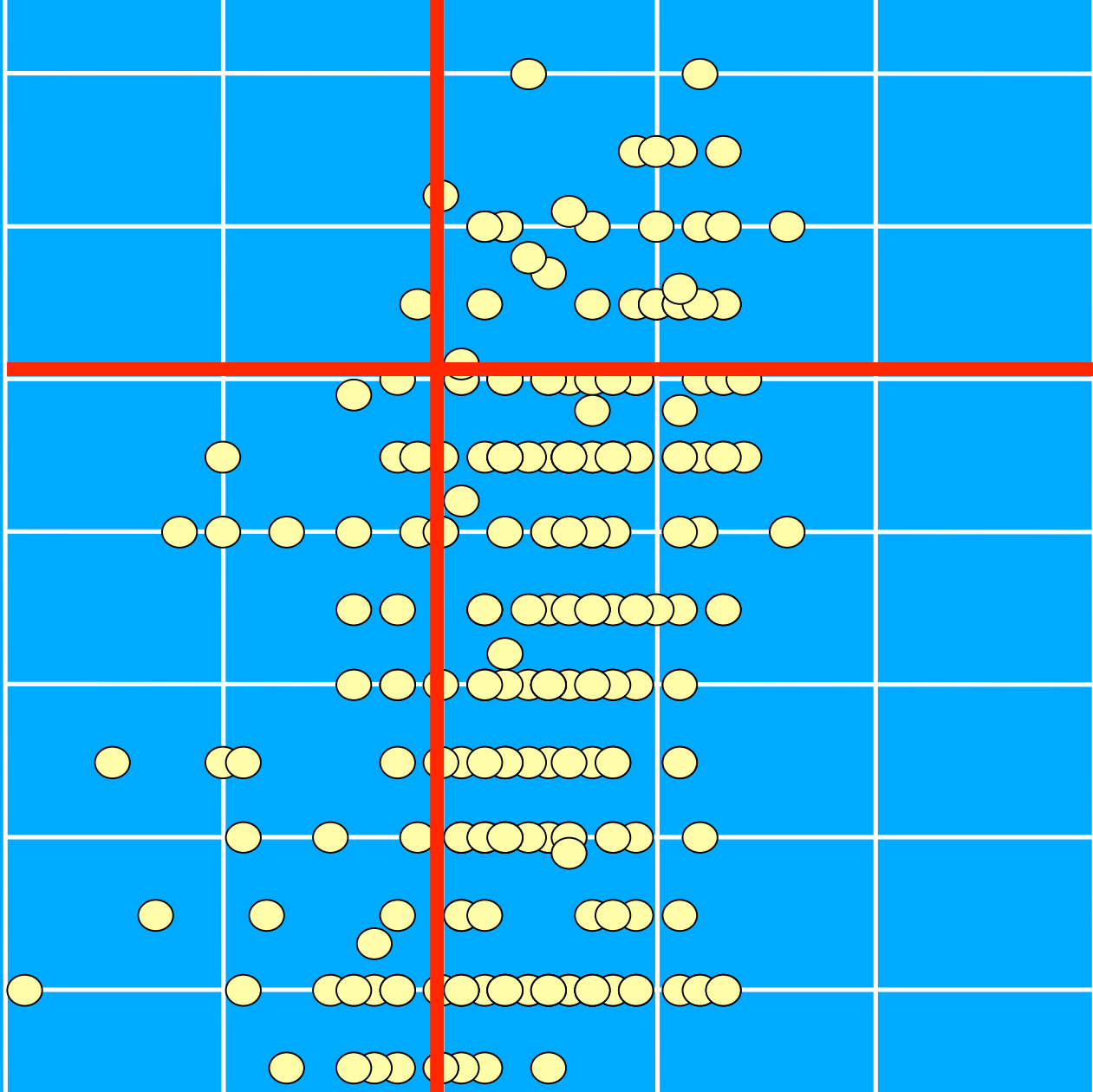
**Results in saving lives,**

**but over-warning 90% of time  
distant tsunamis**

Tsunami Intensity



4  
3  
2  
1  
0  
-1  
-2



# History of Tsunami Warning §

## 1960 Chilean Tsunami: **Reaction**

Seismic detection of large earthquake  
+ tide gauge observations of tsunami

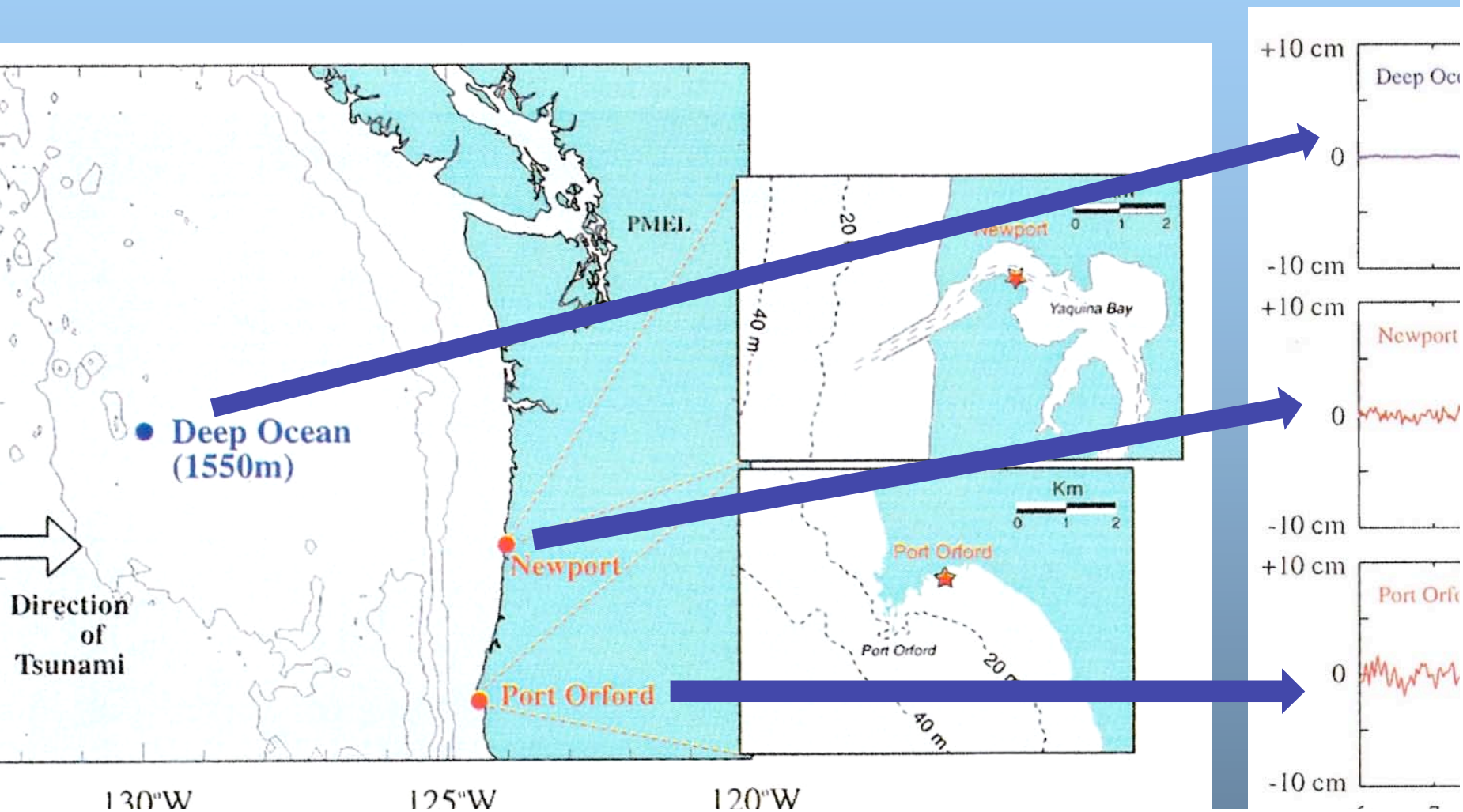
**Results in saving lives,**

**but over-warning 75% of time**

**distorted tsunami**



# Measurements of Tsunamis



Key technologies:

Bi-directional coms

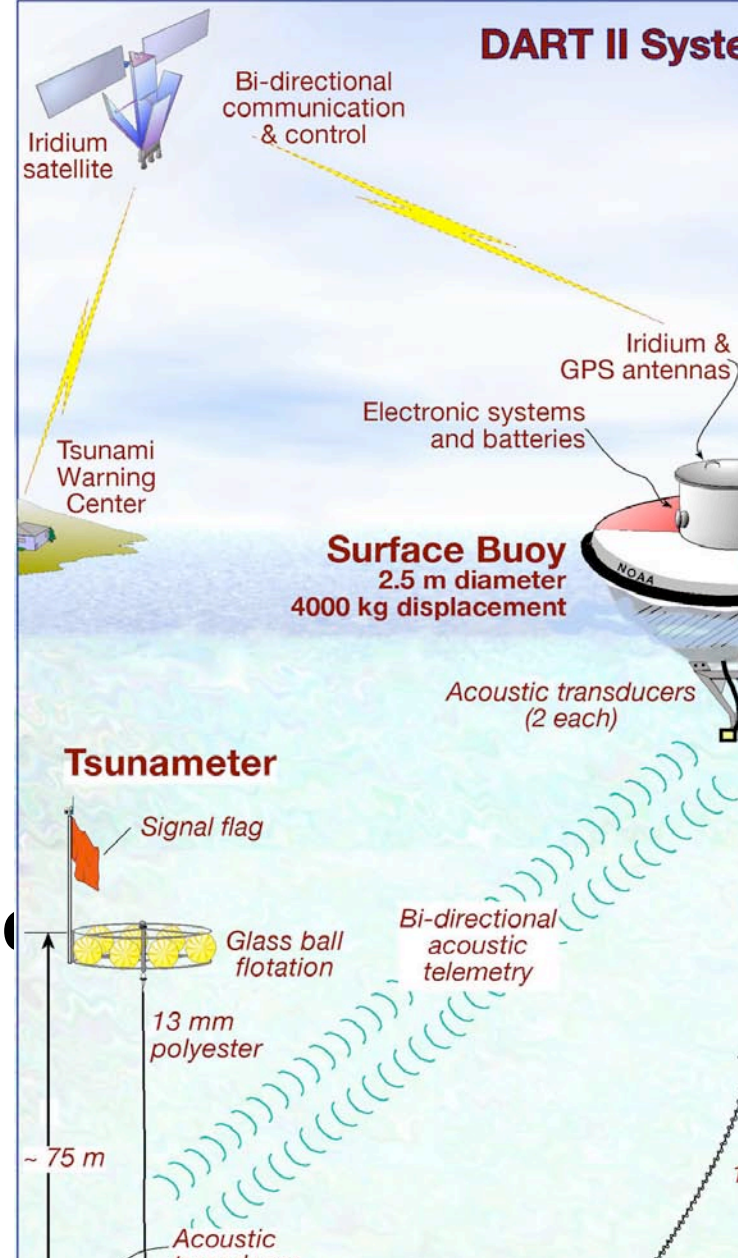
Tsunami Detection Algorithm

Backup systems

Worldwide deployable

Plug-in to existing warning center infrastructure

Optional MET sensor



# History of Tsunami Warning

## 2004 Indian Ocean Tsunami: **Reaction**

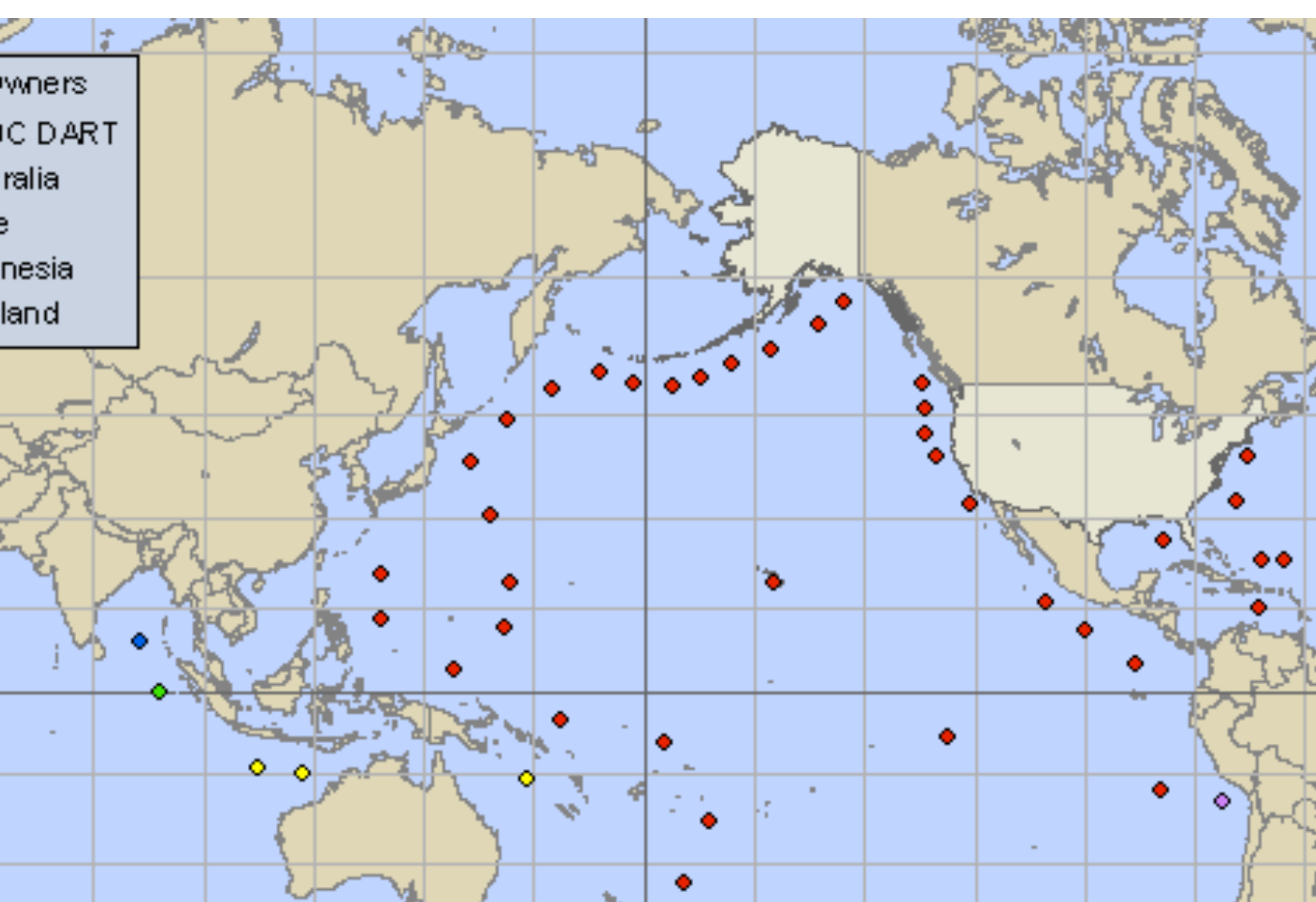
**Seismic detection of large earthquakes**

**+ deep ocean detection of tsunami**

**+ tide gauge verification:**

**Results in elimination of over-  
for distant tsunamis**



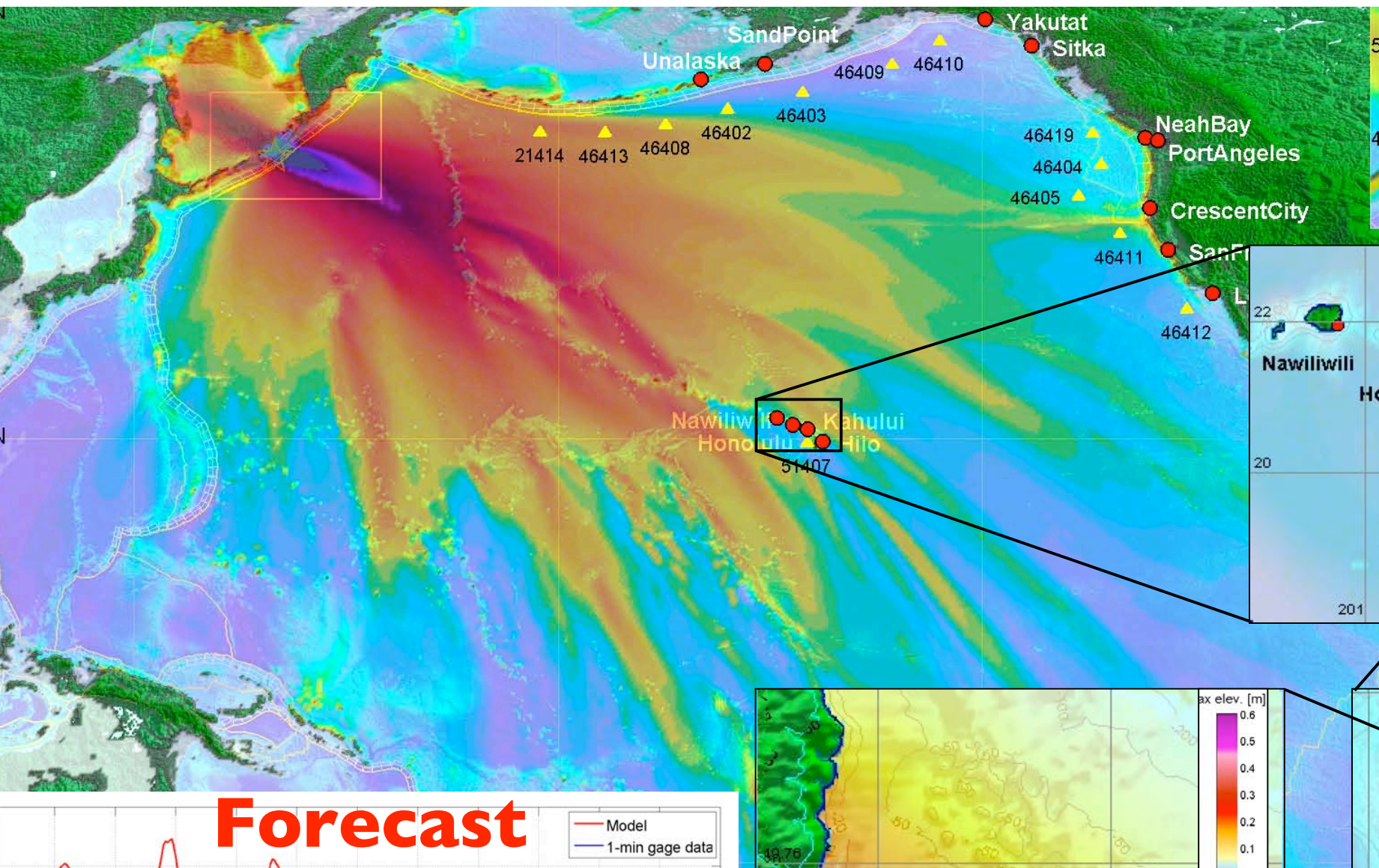


# 2 Cabled Deep-Ocean Tsunami L

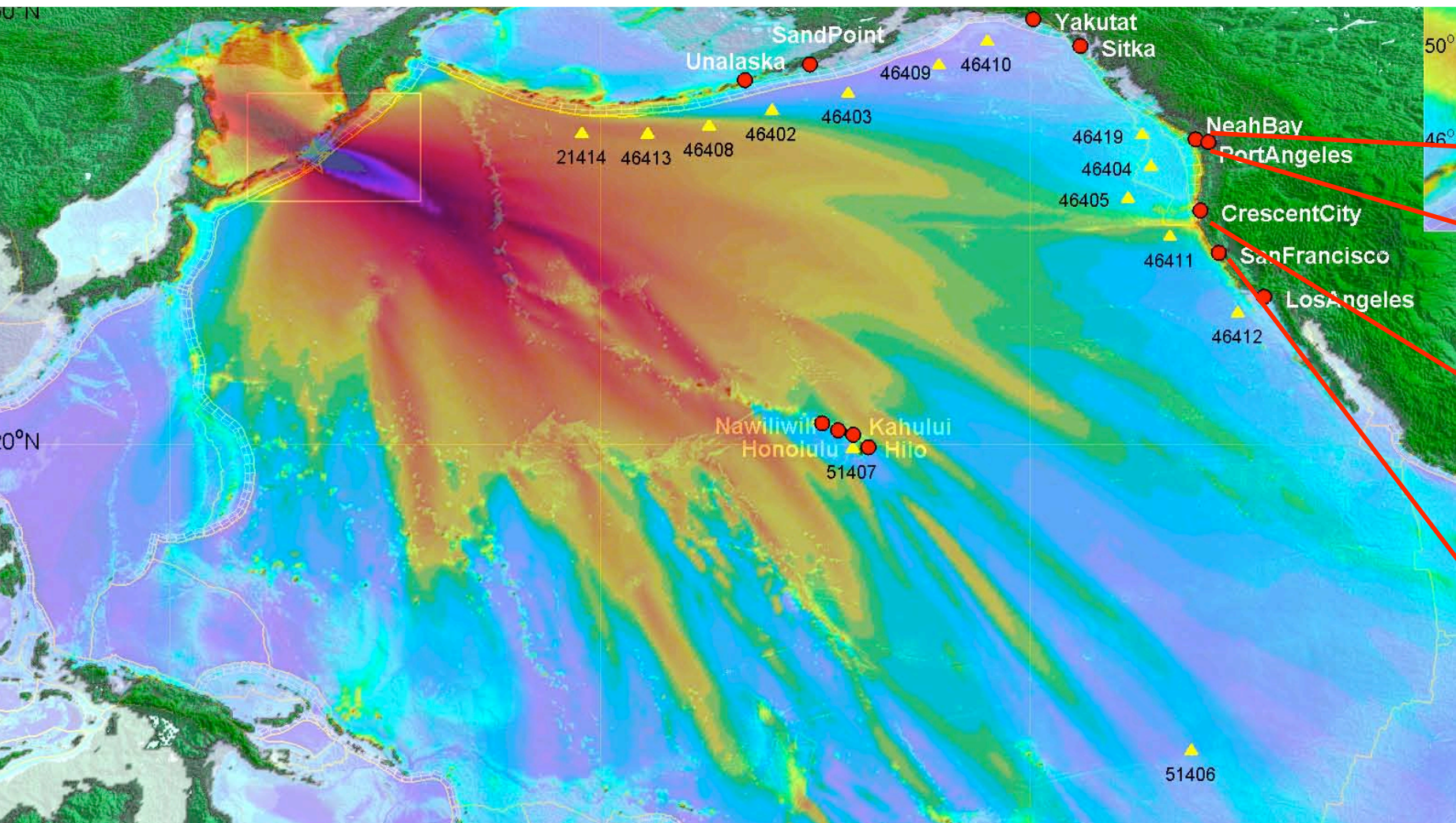


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10:13: 25.0 Earthquake origin time

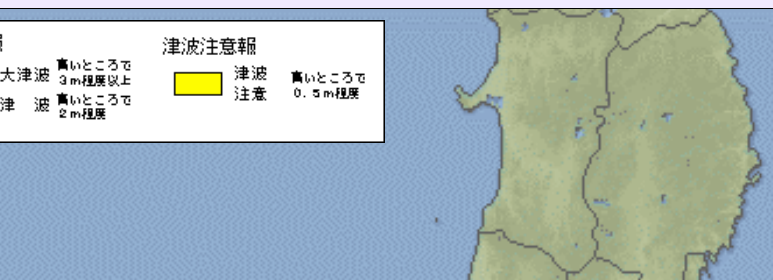
10:13: 29.3 (4.3 s) First earthquake location/magn

10:14 (1.5 min) Tsunami Advisory was issued

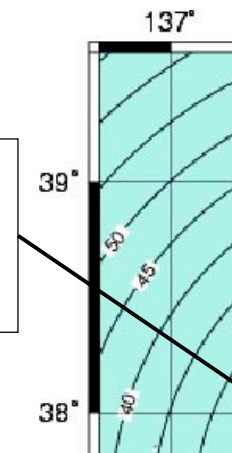
10:16 (2.5 min) Tsunami was observed at Kashiwa

Courtesy of Kenji Satake, University of Tokyo

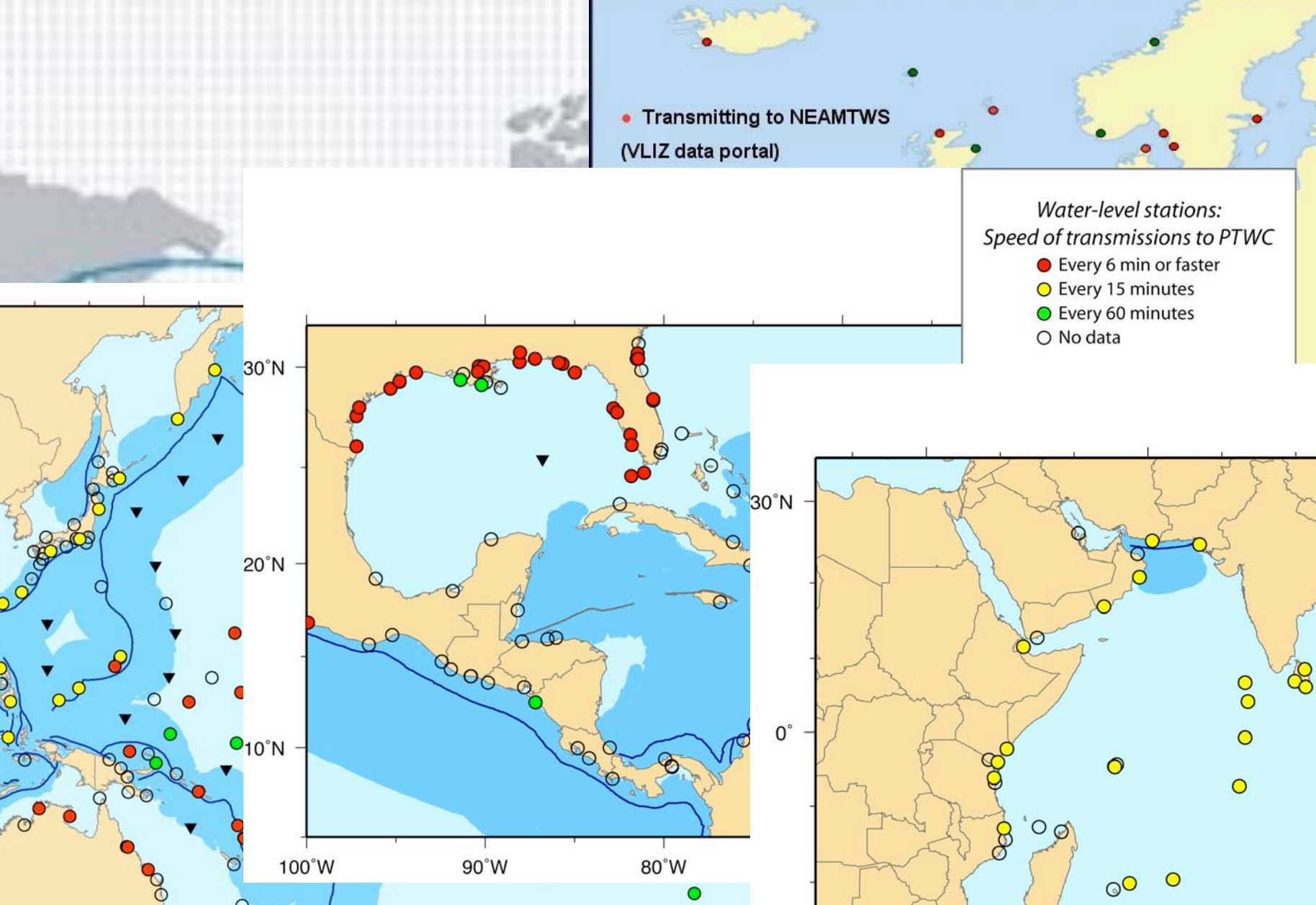
## Tsunami Warning



Kashiwazaki (6U):  
lead time 0 s

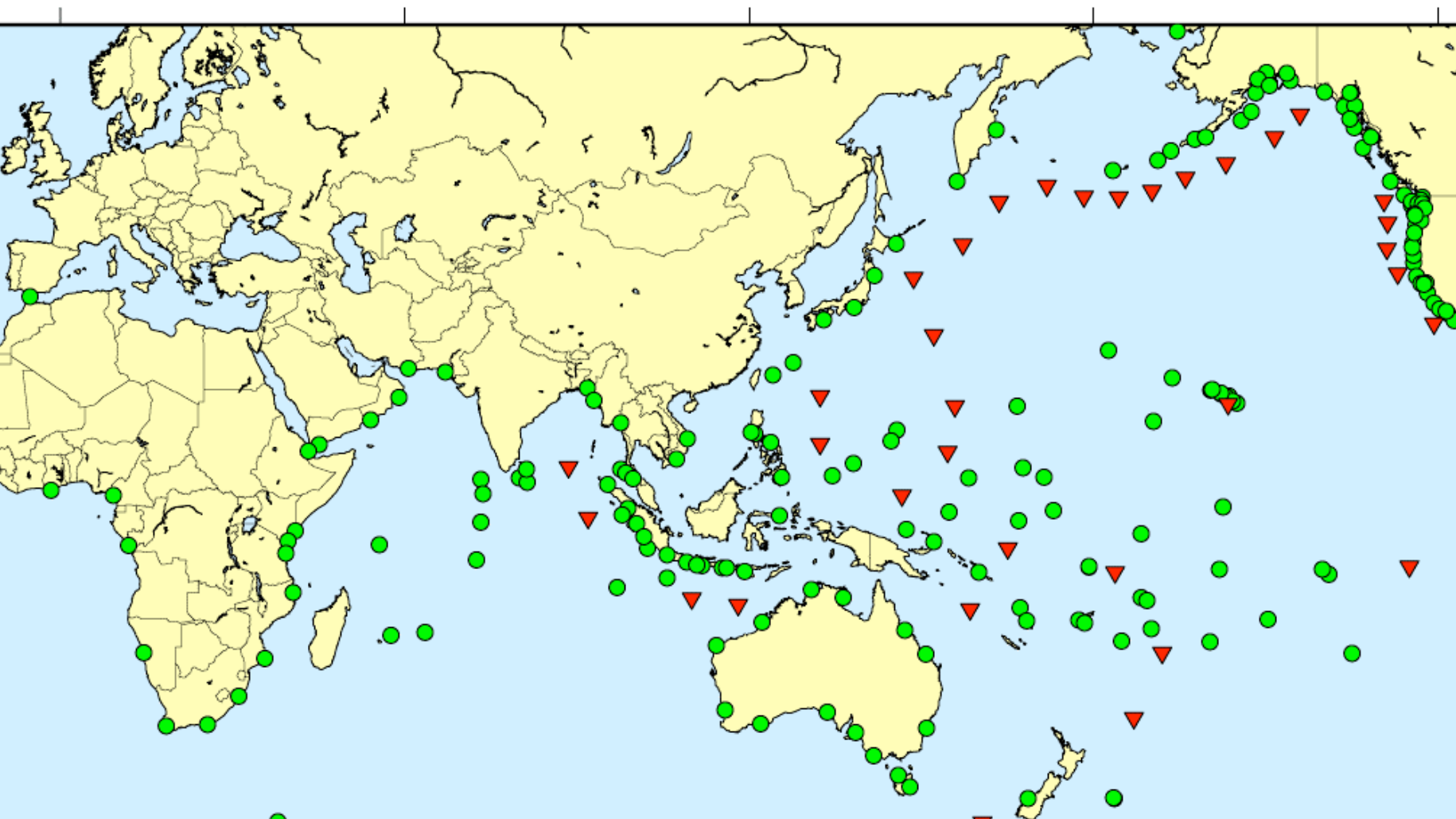








# Interoperable Regional Effo





- **Tsunami Warning Systems have evolved regional end-to-end systems with global standards and guidelines**
- **Real Time Tsunami Forecasts are now possible for distant and local tsunamis**
- **Future challenges:**

**Complete Global Warning System Through**

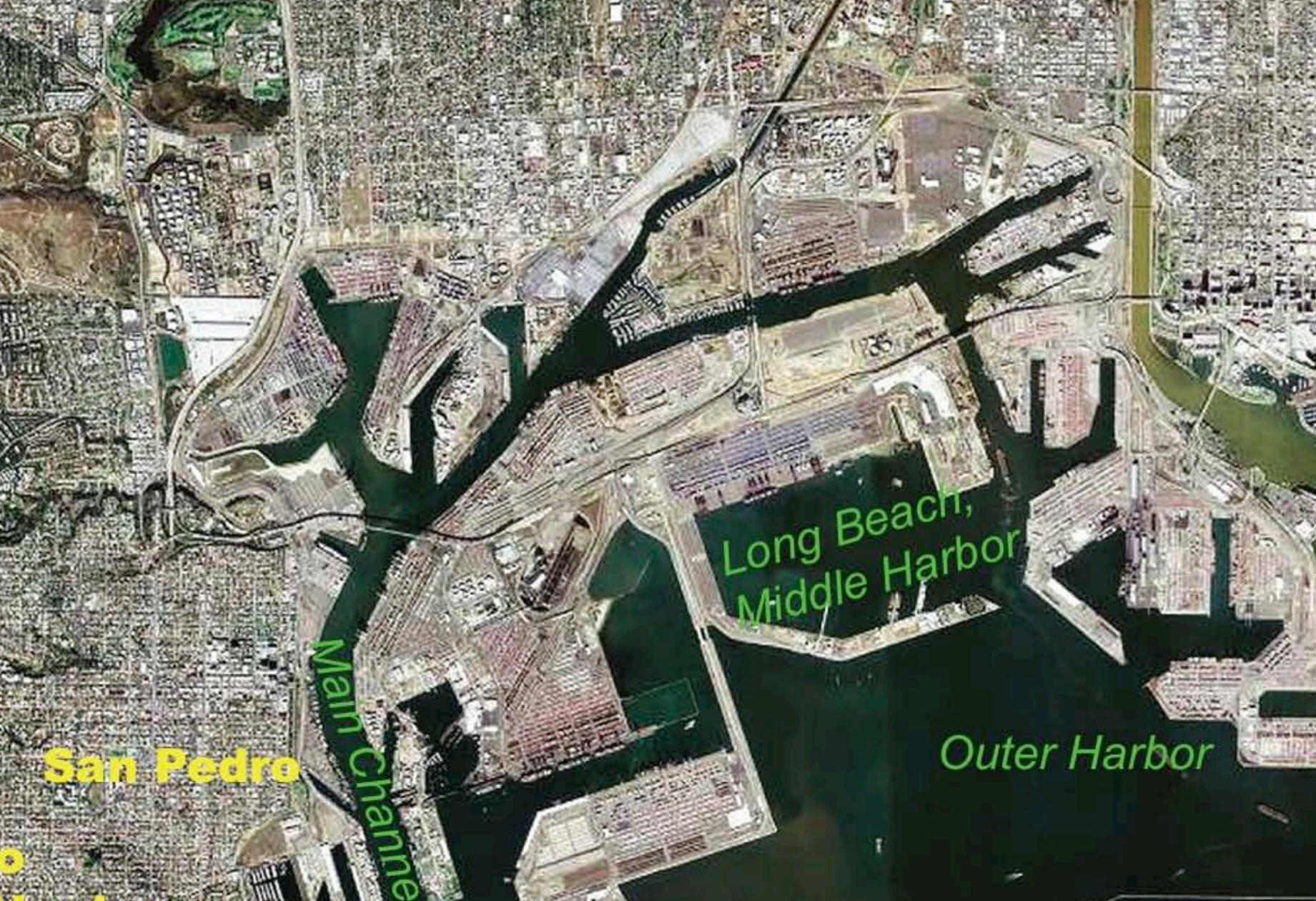
- **Interoperable Regional Tsunami Warning Systems**
- **Ongoing Outreach and Educational Programs**











**San Pedro**

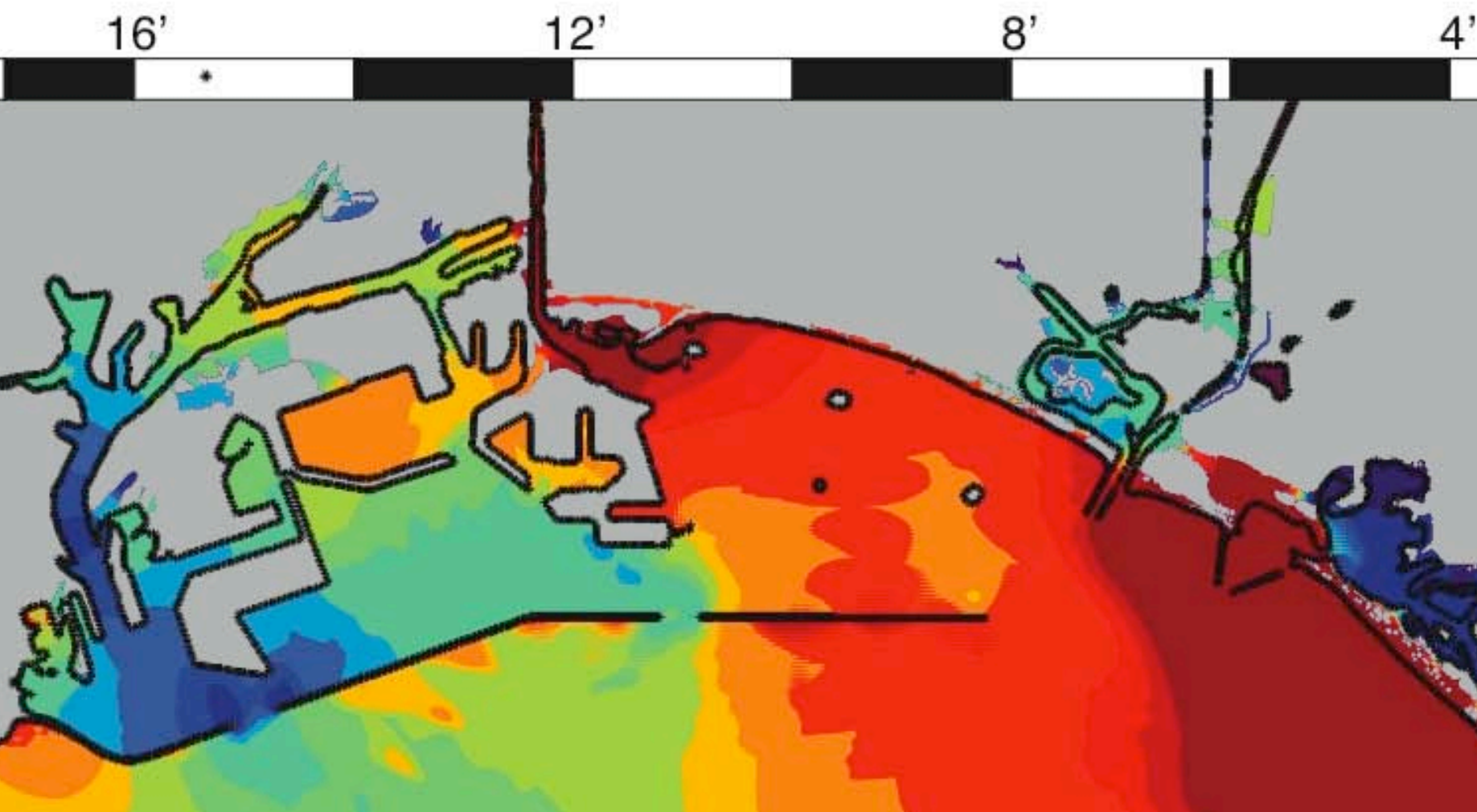
Main Channel

Long Beach,  
Middle Harbor

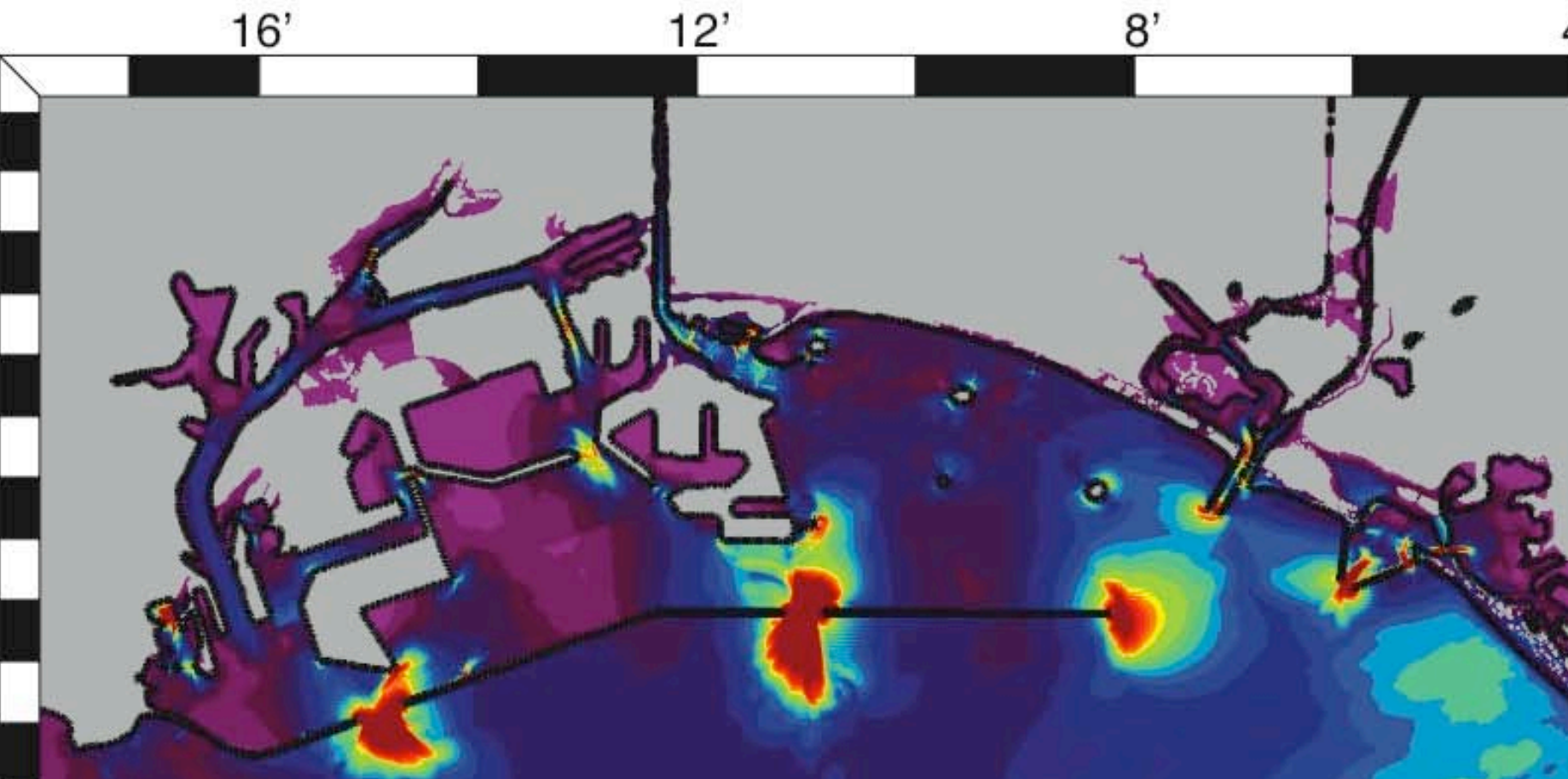
Outer Harbor



# *simulated tsunami maximum am*



# *simulated tsunami maximum cu*





# *simulated tsunami*

