Local Tsunami Warnings:
Can the U.S. do it?

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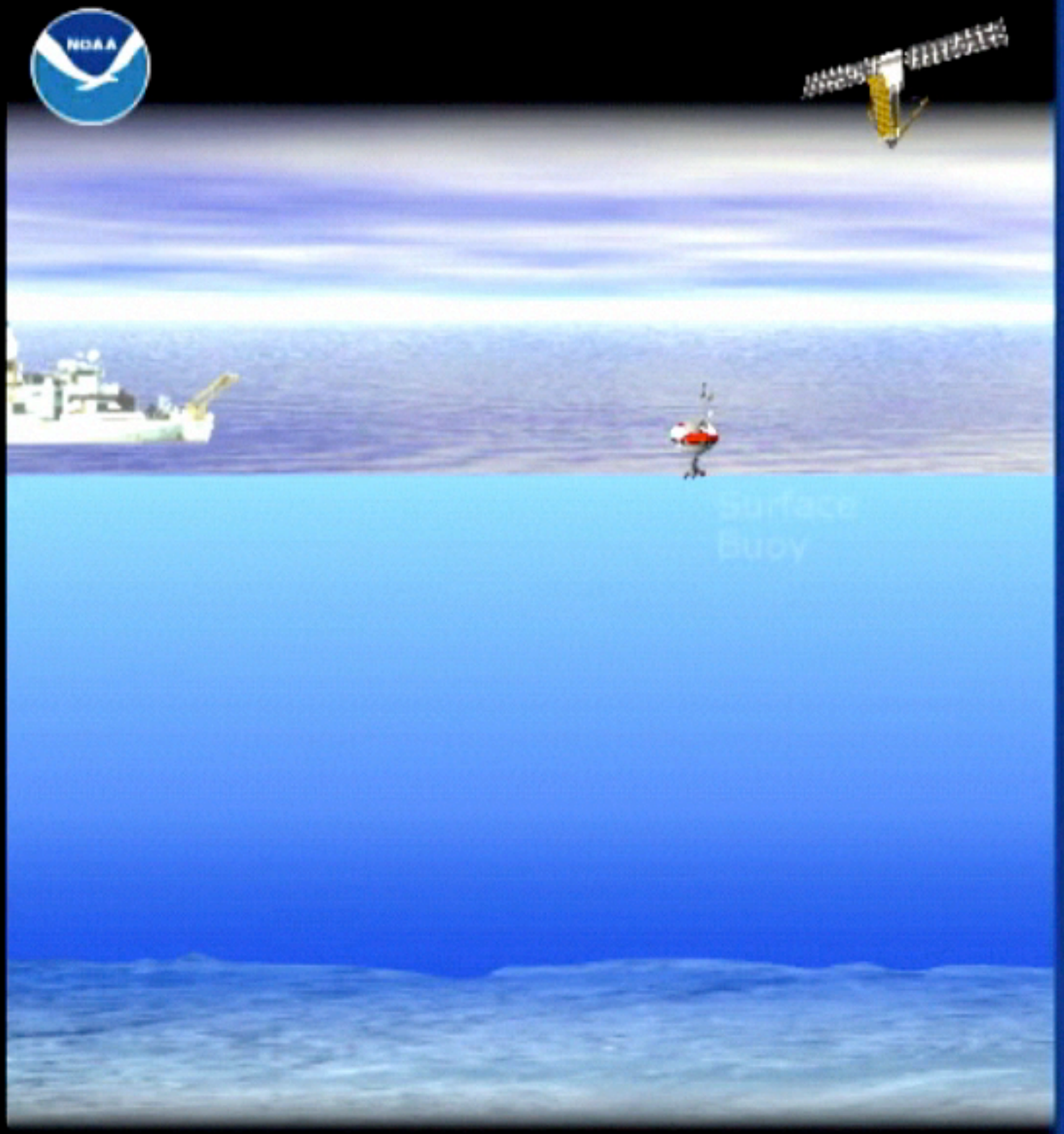
Tsunami Warning and Education Act (2006)

- Tsunami Mitigation - NOAA, States, FEMA
- Tsunami Warnings - NOAA, USGS
- Tsunami Research - NOAA, NSF
- International Cooperation - NOAA, USAID

U.S. Response (Policy)

Tsunami Warning and Education Act (2006)

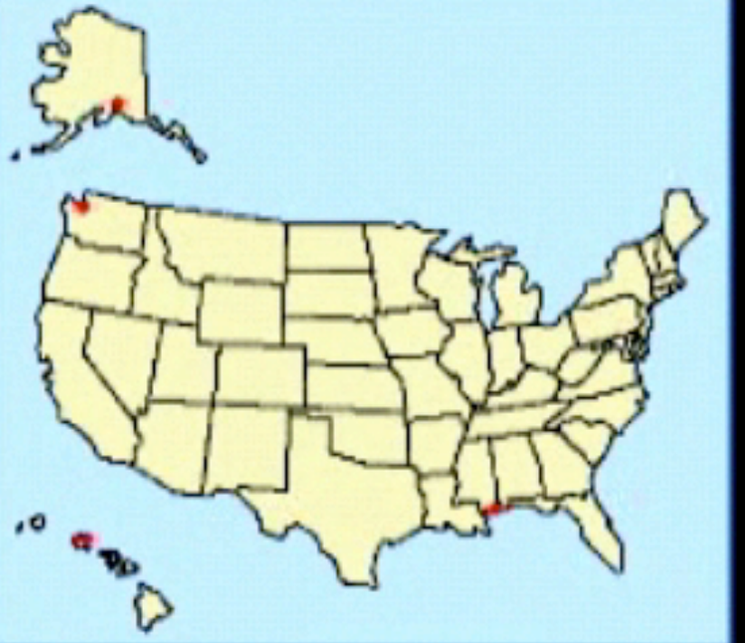
- Tsunami Mitigation - NOAA, States, FEMA
- **Tsunami Warnings - NOAA, USGS**
- **Tsunami Research - NOAA, NSF**
- **International Cooperation -**



D.A.R.T. II

Deep ocean
Assessment and
Reporting of
Tsunamis

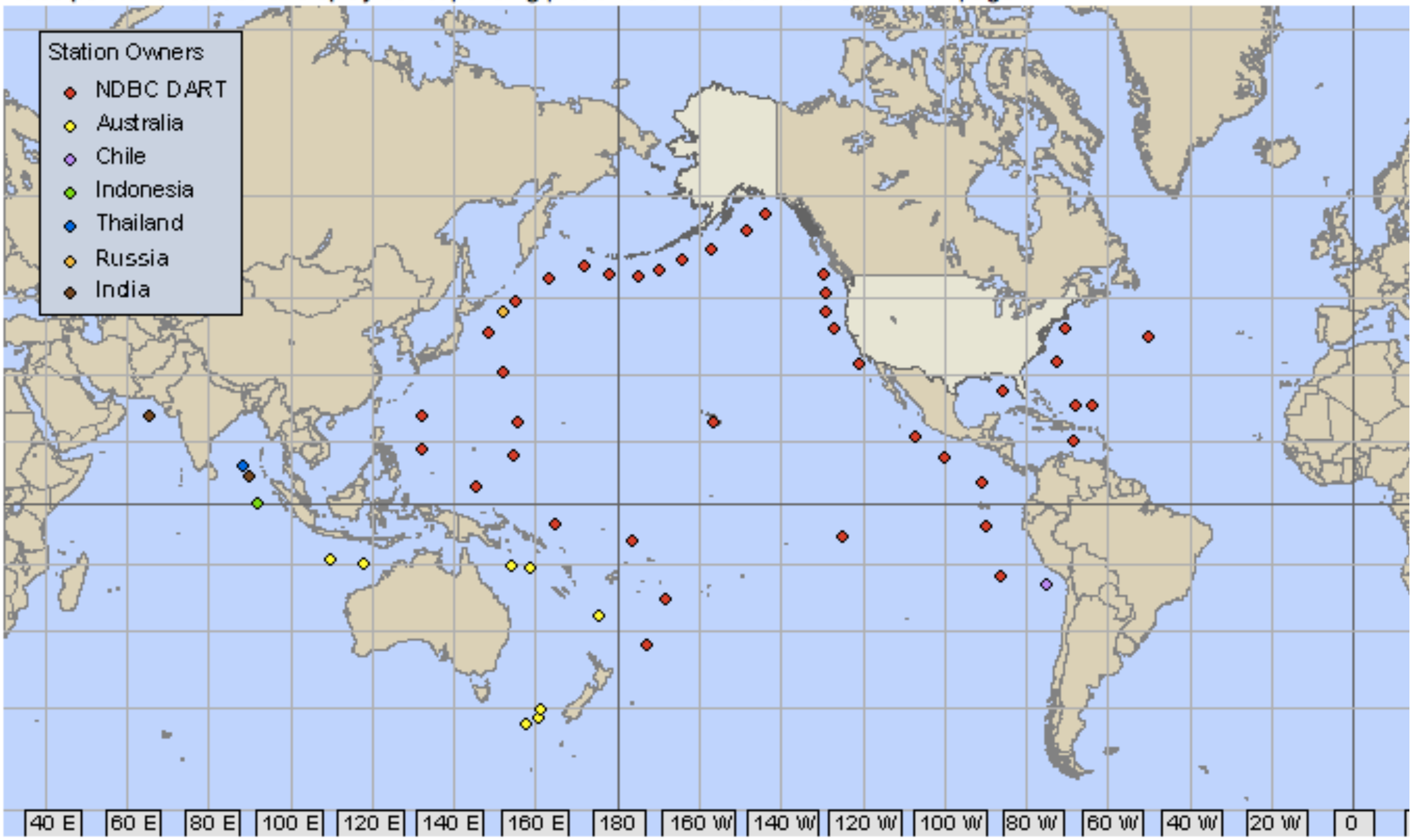
Tsunami Warning Centers

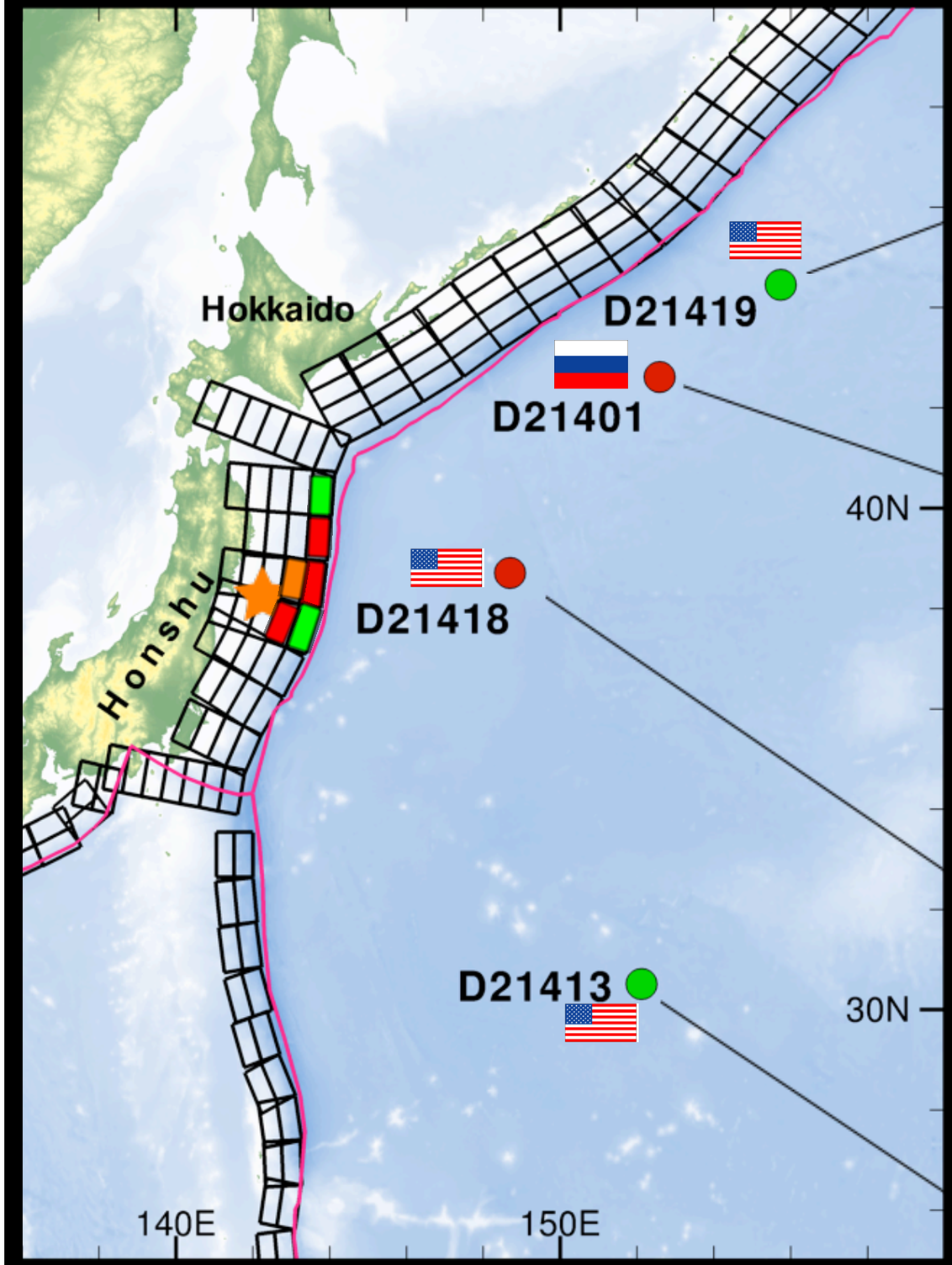


WCATWC (AK)
PMEL (WA)
PTWC (HI)
NDBC (MS)

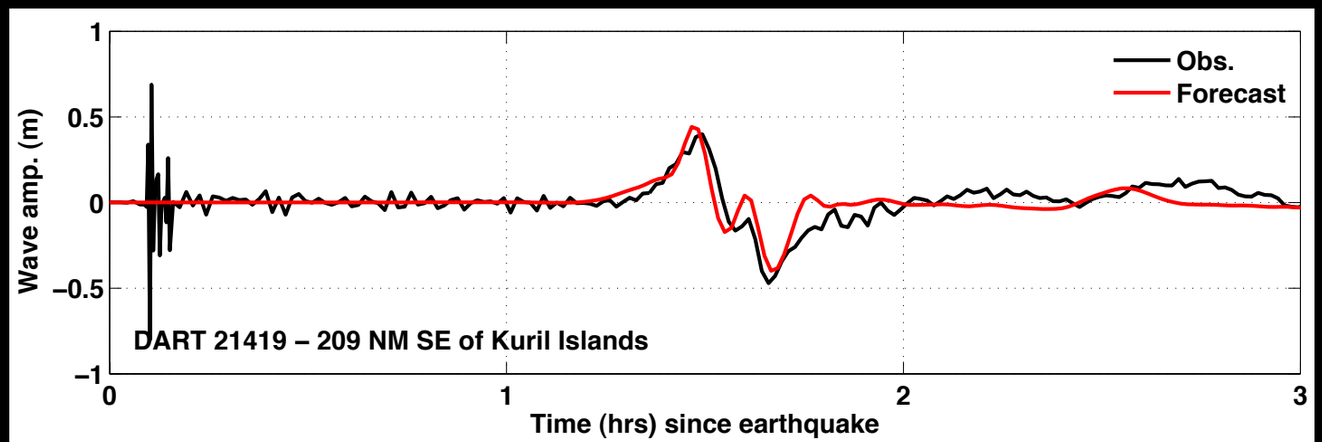
Global Tsunameter Network
Shared Data Provided by NOAA/NDBC
February 20, 2012

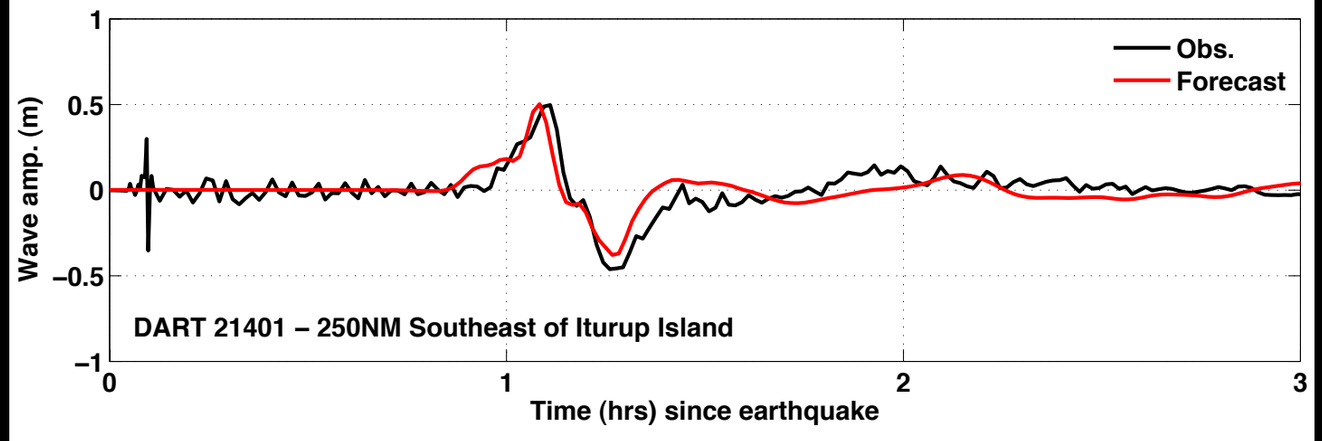
Place pointer on station to display corresponding plot or click on station to view station page.

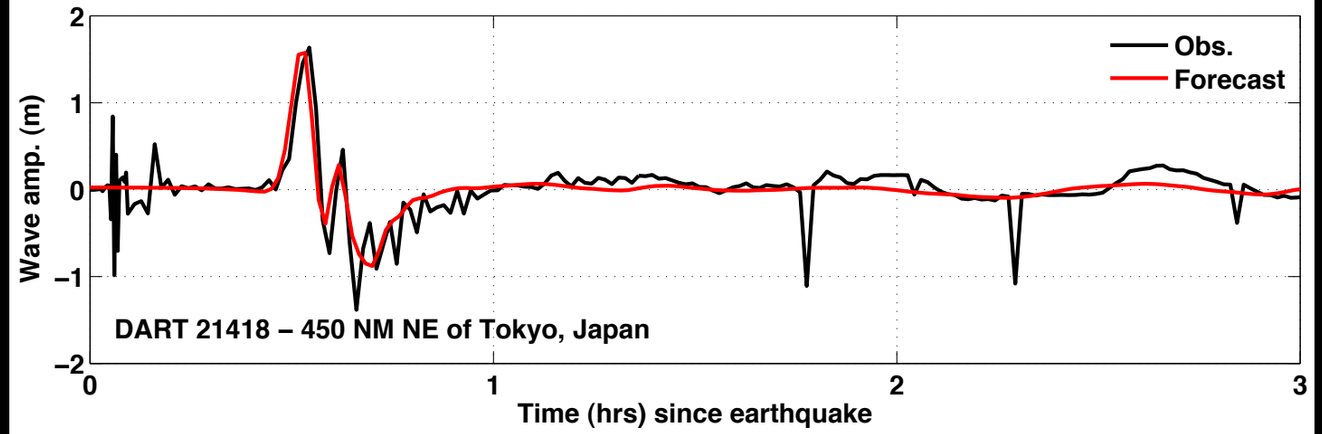


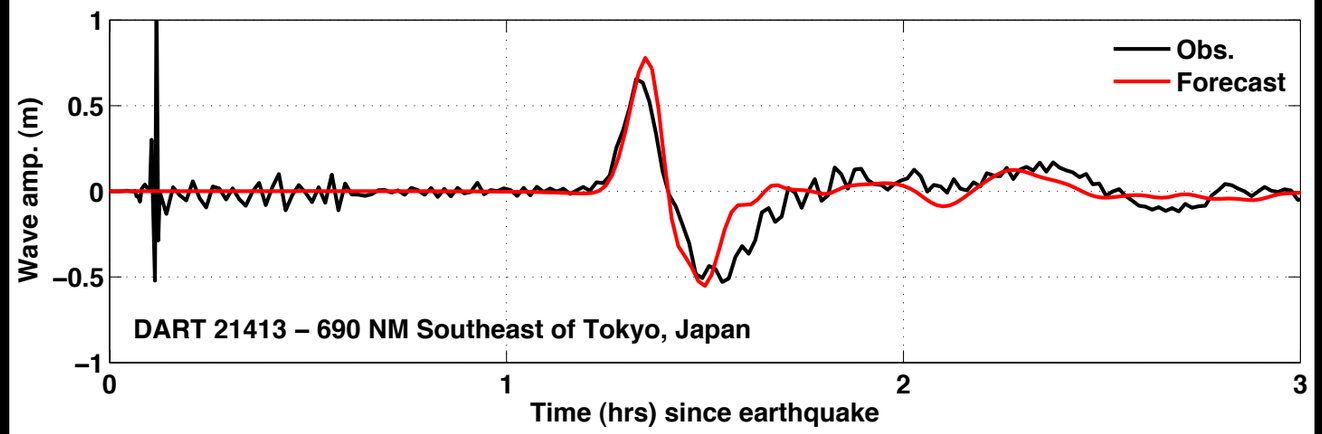


Inverting tsunami source from DART buoy measurements



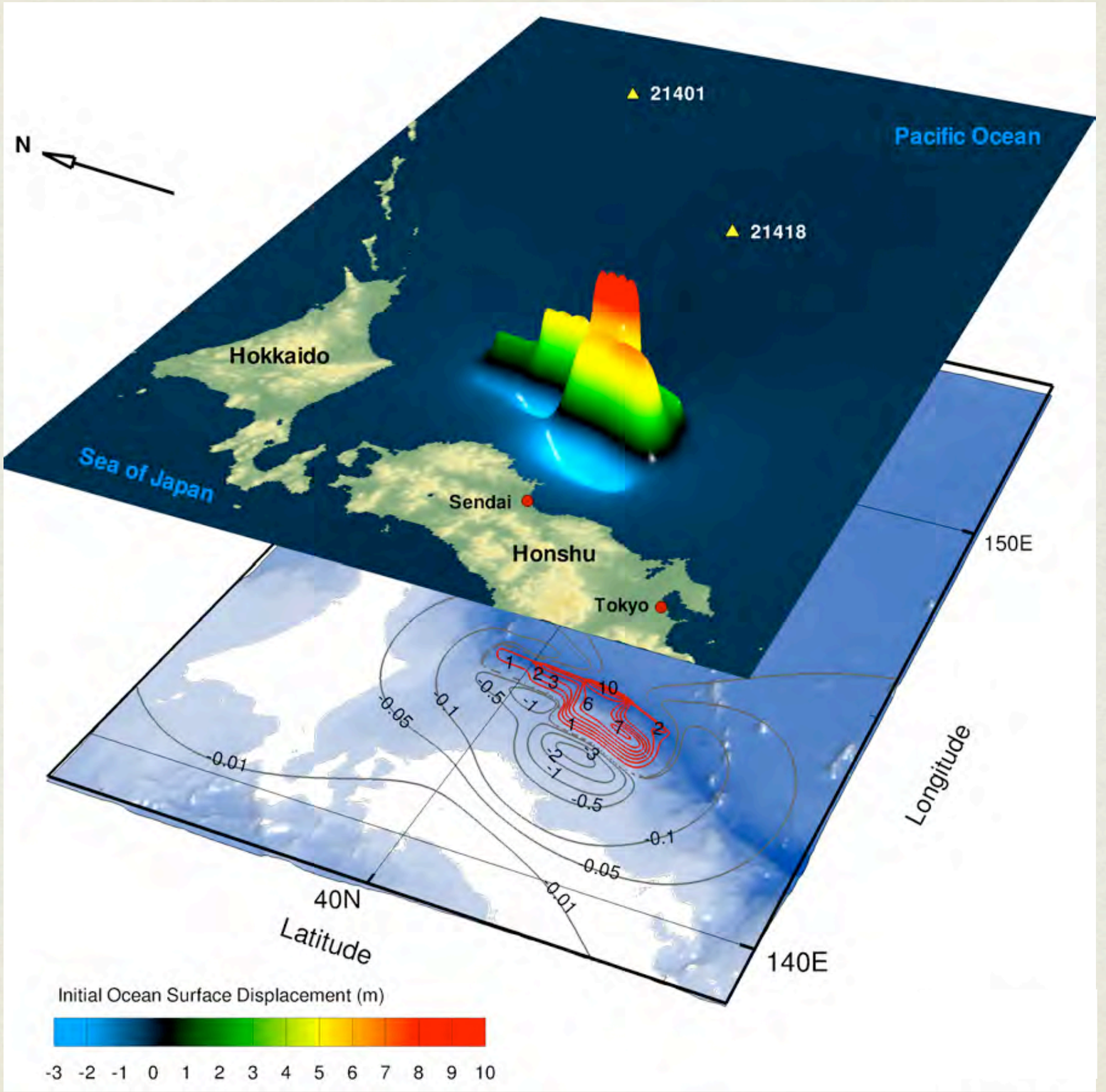




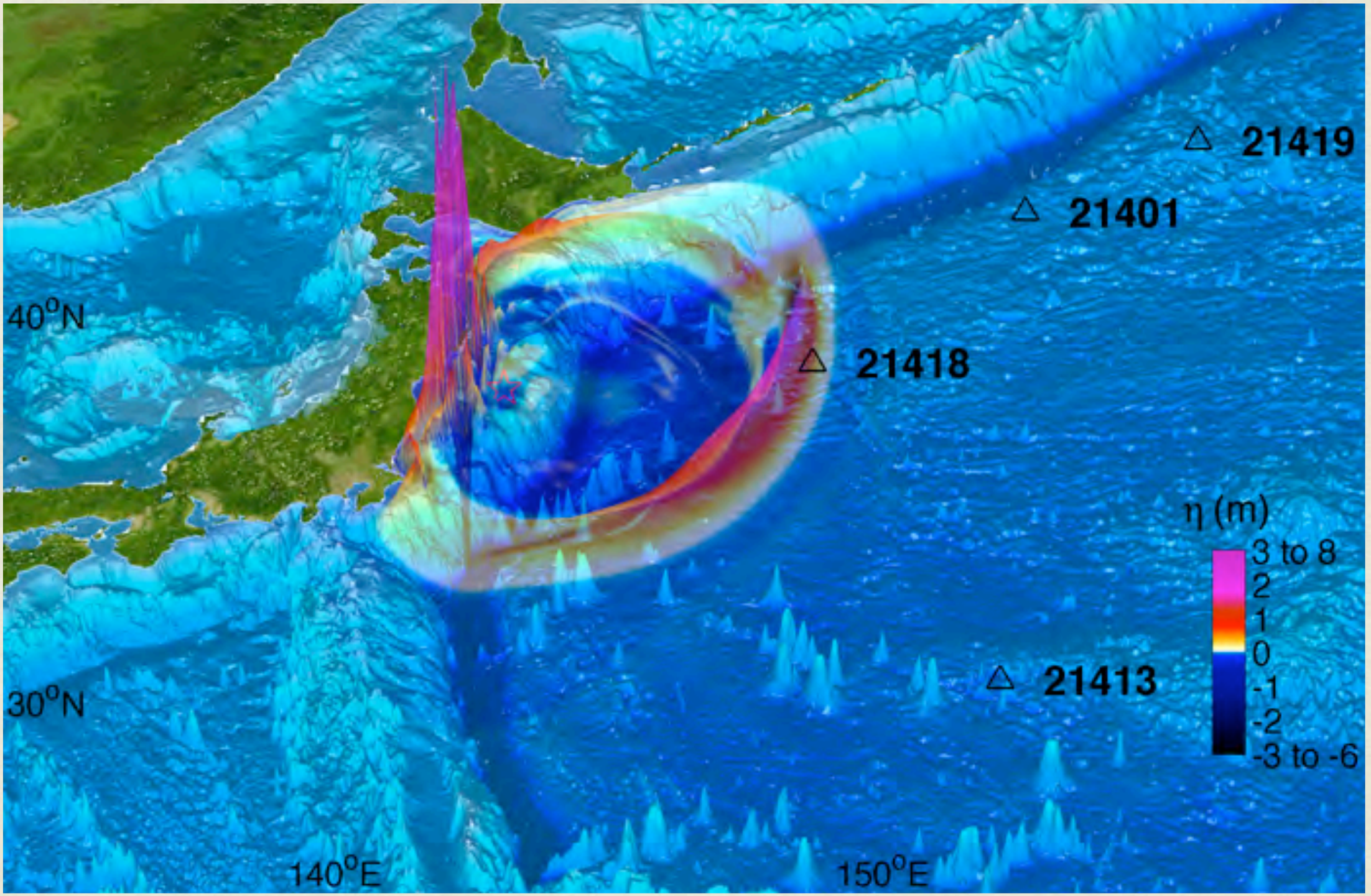


Honshu (northeastern Taiheiyou) tsunami, 11 March 2011

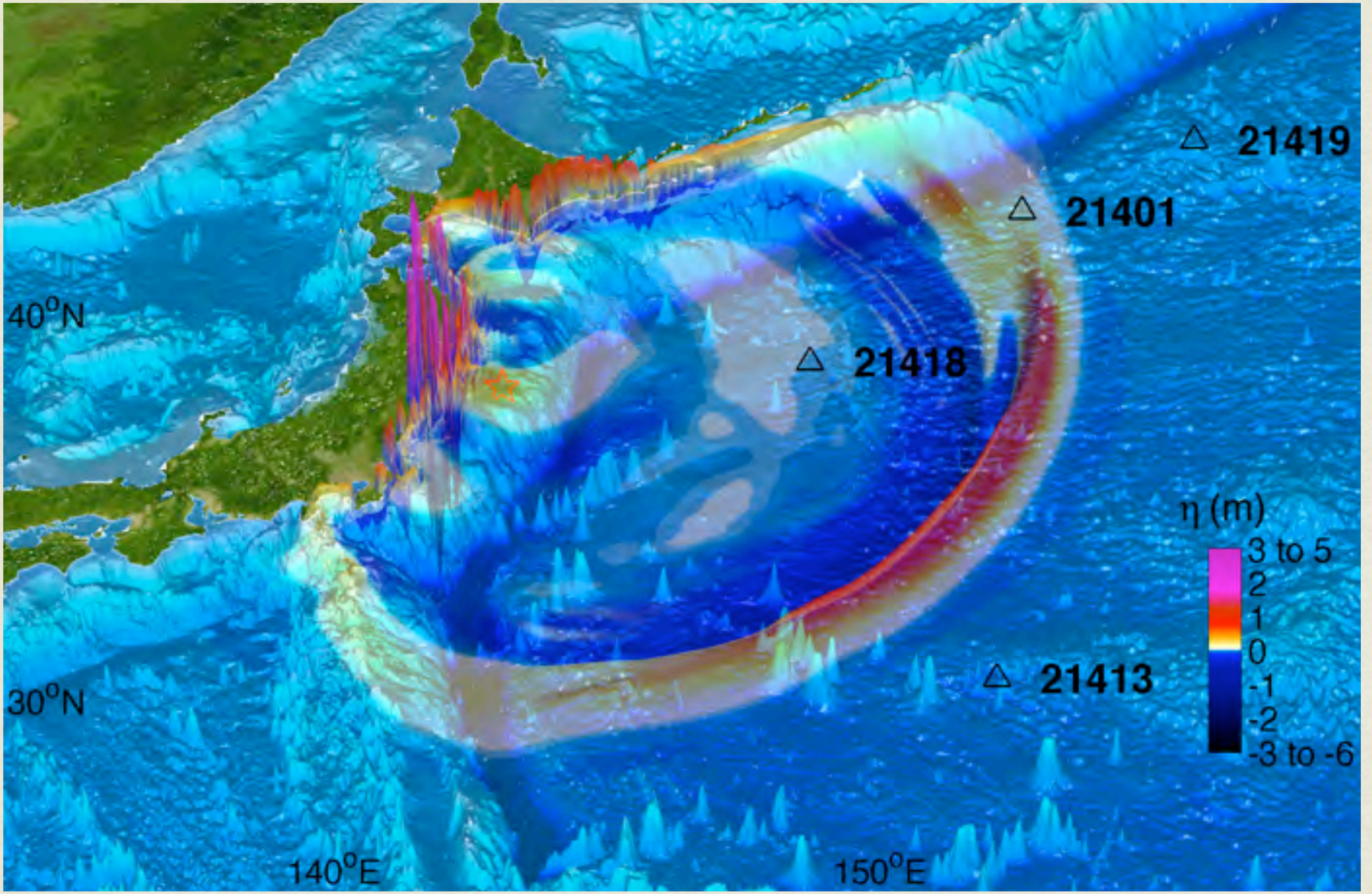
NOAA Center for Tsunami Research


21401
21418
Pacific Ocean
N
Hokkaido
Sea of Japan
Sendai
Honshu
Tokyo
150E
Longitude
40N
Latitude
140E
-0.01
-0.05
-0.1
-0.5
-1
1
2
3
10
6
-2
-3
0.05
Initial Ocean Surface Displacement (m)
-3 -2 -1 0 1 2 3 4 5 6 7 8 9 10

(a) 0.5 hour



(b) 1 hour



Shemya: 1.6 m

- Crescent City: 2.5 m
- Port San Luis: 2.0 m
- 1 casualty
- 40 - 50 million $ damages

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

- PNG: 1.1 m
- Flooding and damages

Tonga: 1.2 m

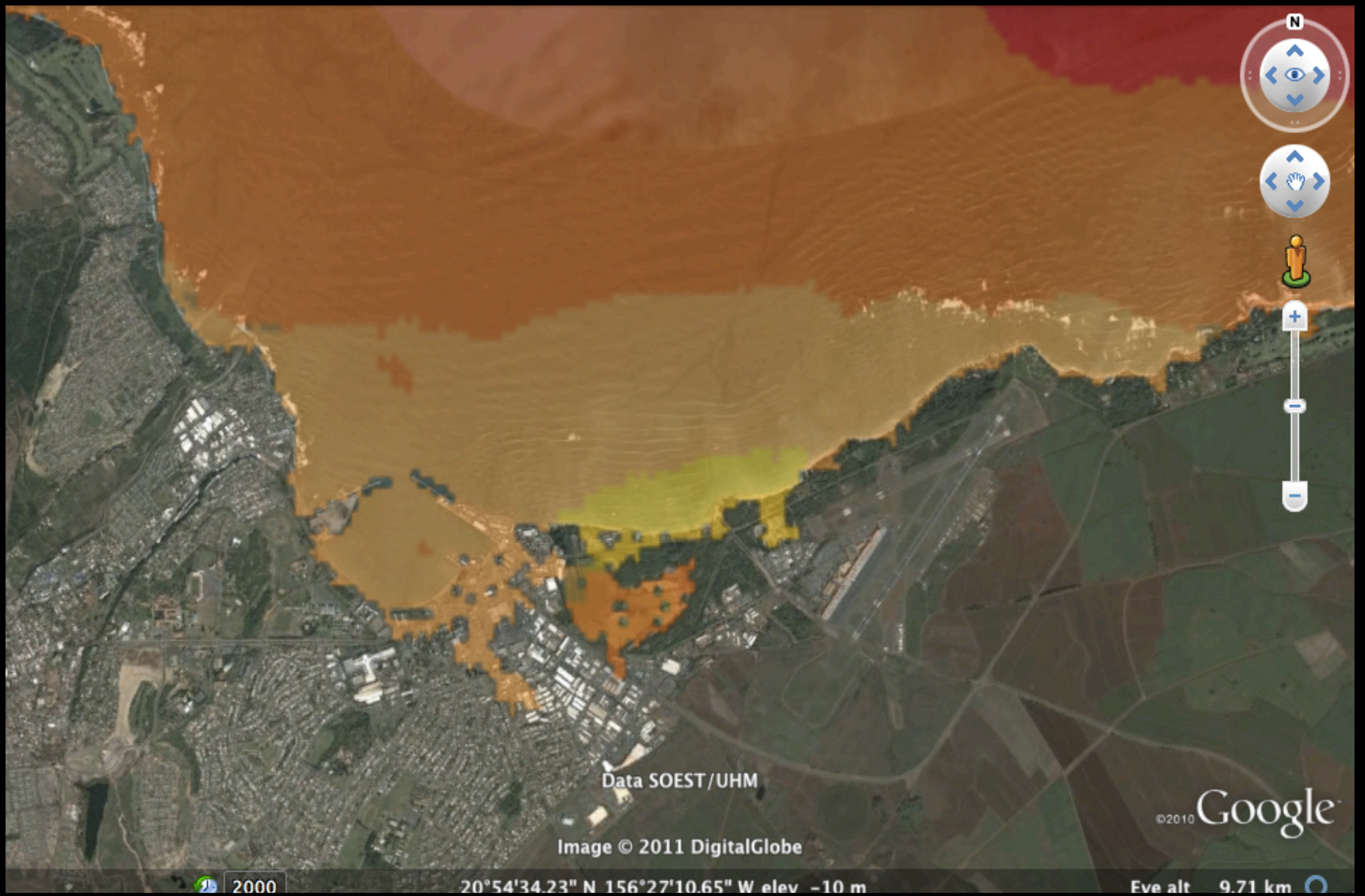
Arica: 2.5 m

Constitucion: 2.0 m

(cm)
>=240
220
200
180
160
140
120
100
80
60
40
20
0

120°E
180°
120°W
60°W

Kahului tsunami forecast



Kahului tsunam

Data SOEST/UHM

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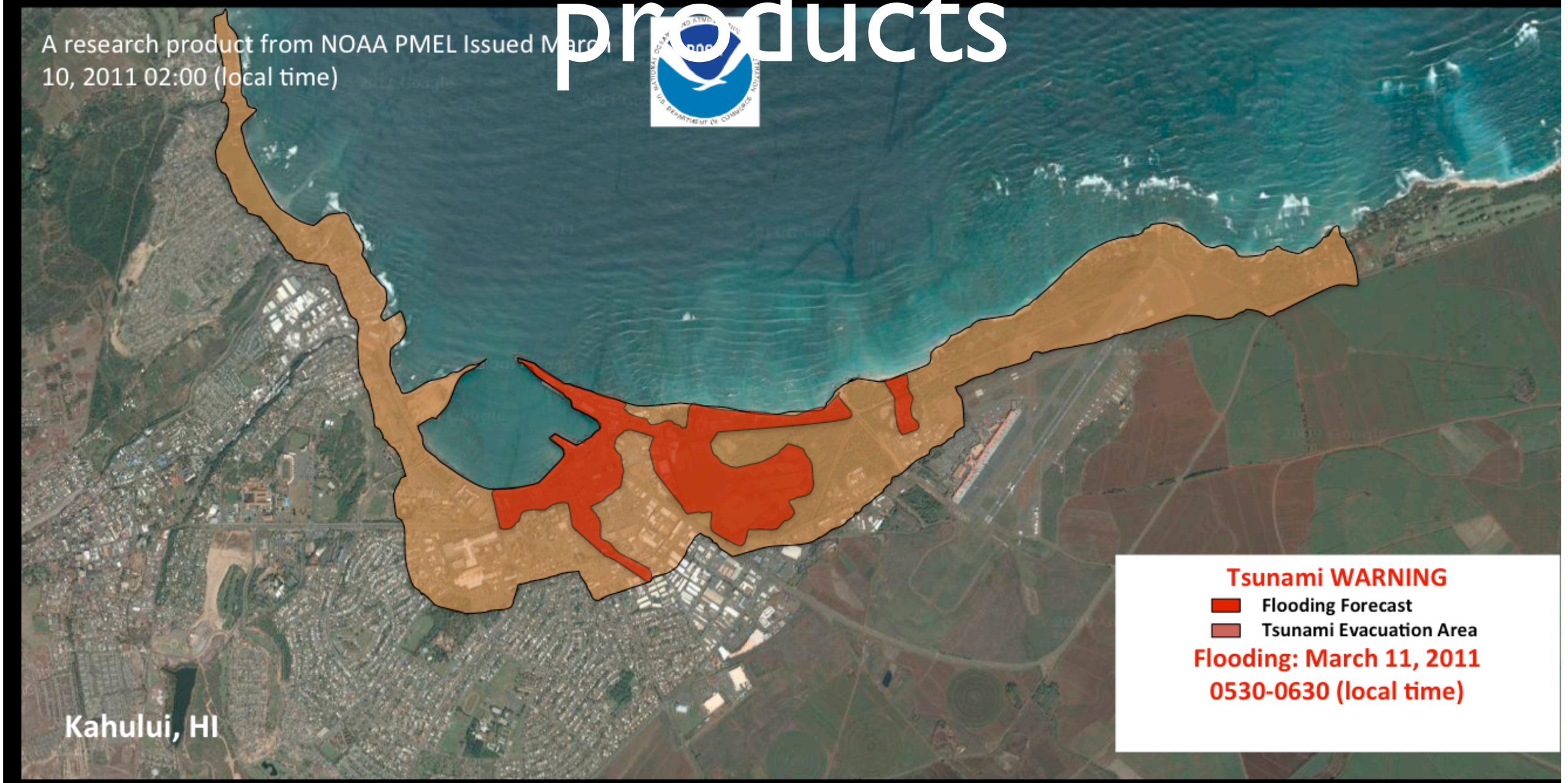
Image © 2011 DigitalGlobe

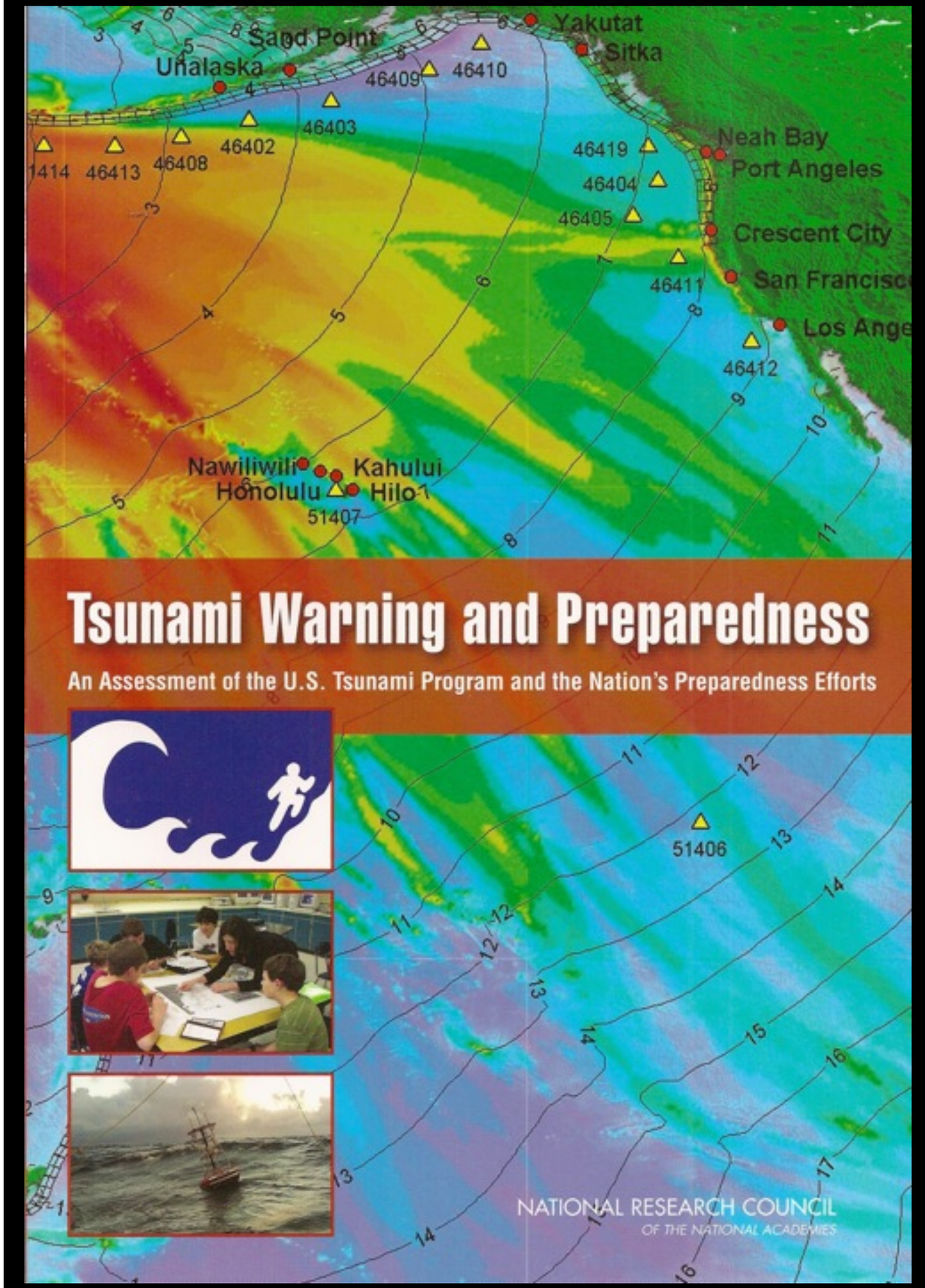
2000

20°54'34.23" N 156°27'10.65" W elev -10 m

Eye alt 9.71 km

tsunami flooding forecast products

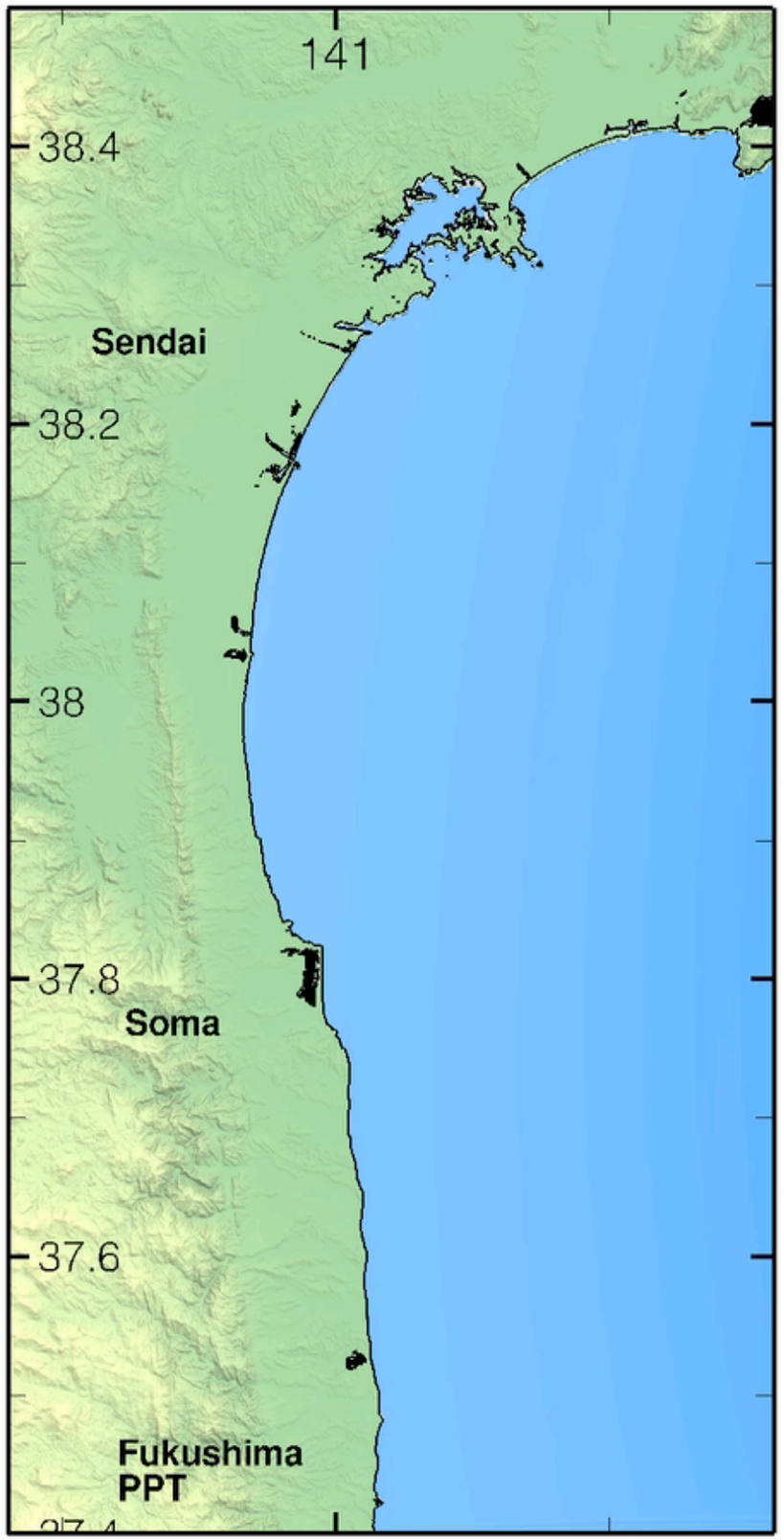


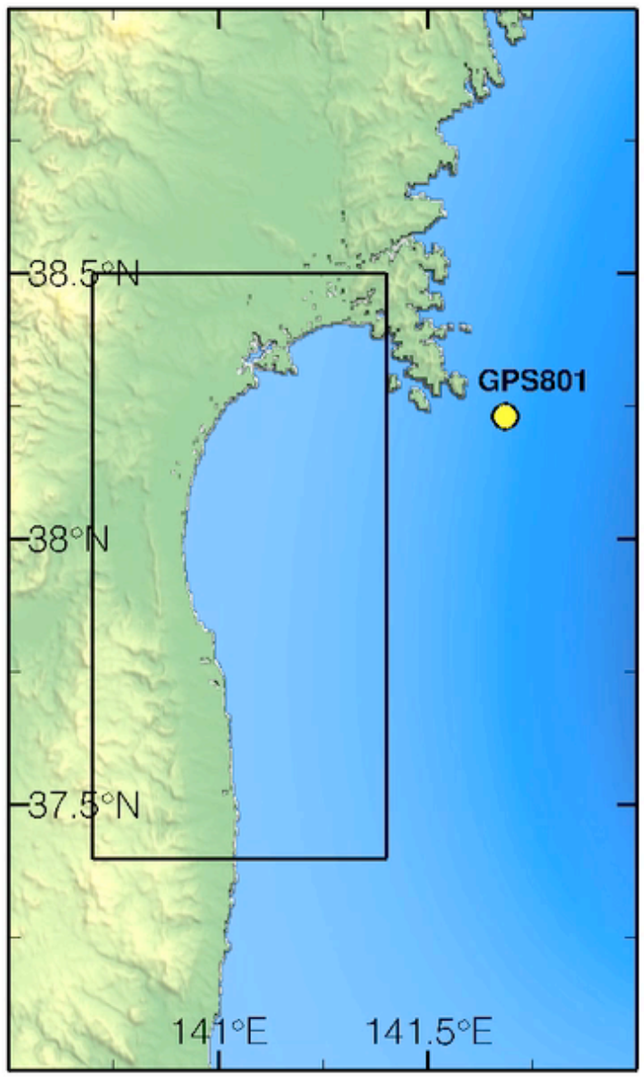


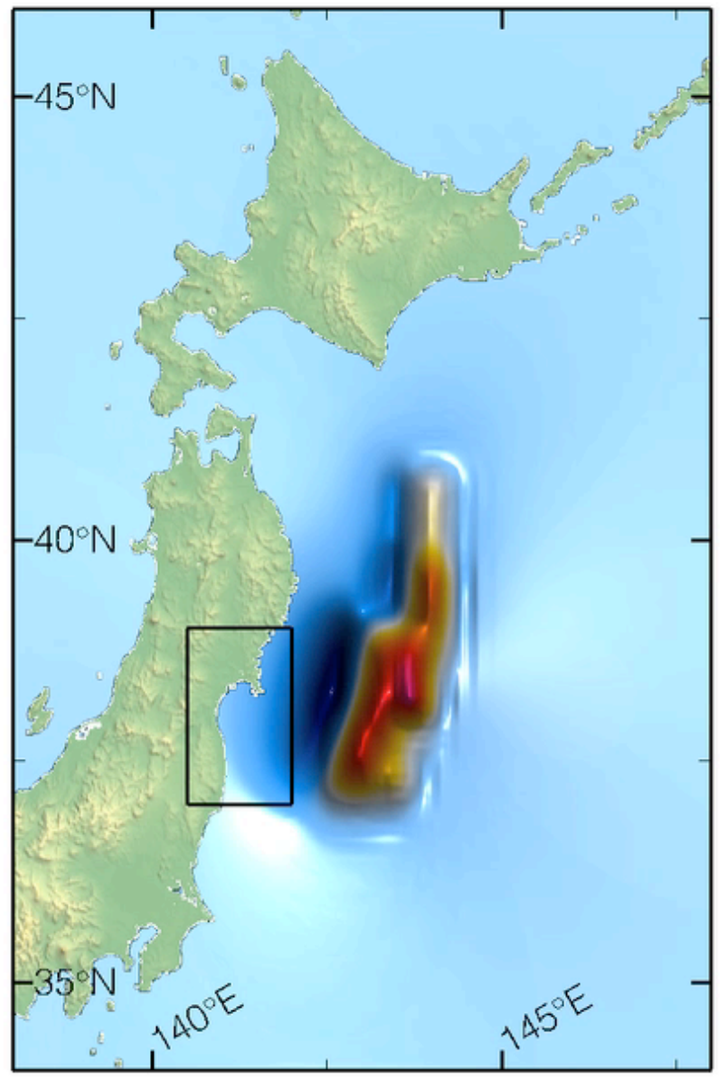
Key Finding

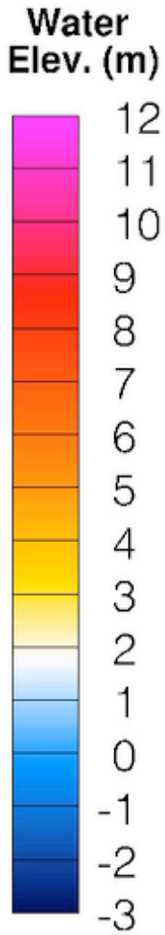
Current capabilities are still not sufficient for local tsunami

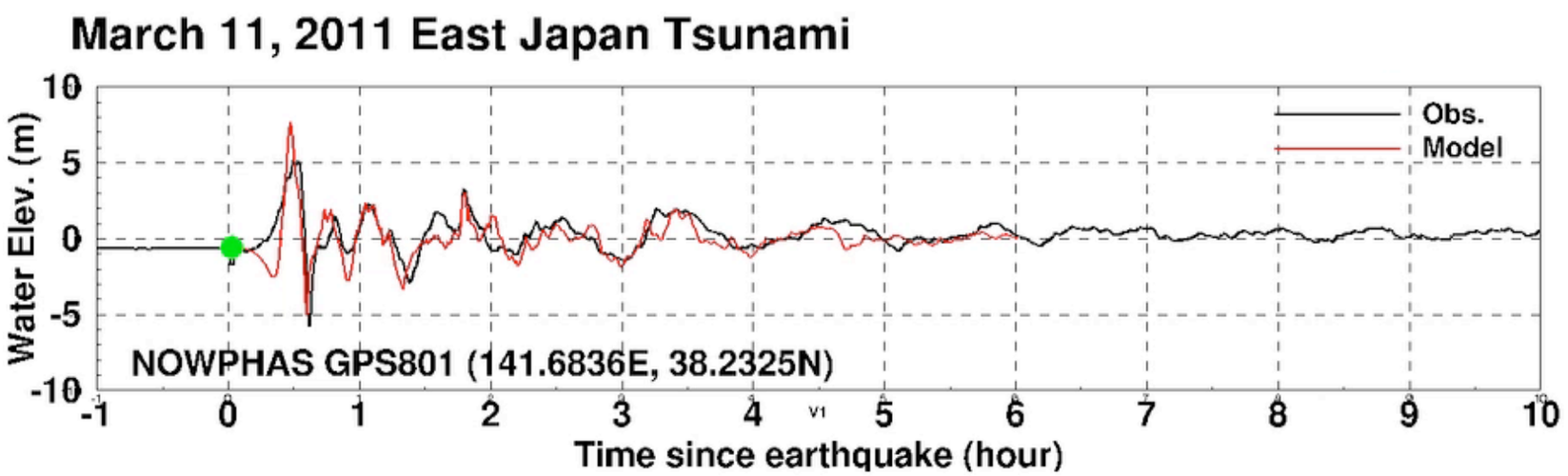
Local Tsunami Hindcast for the March 11, 2011 Japanese Tsunami


141
38.4
Sendai
38.2
38
37.8
Soma
37.6
Fukushima
PPT

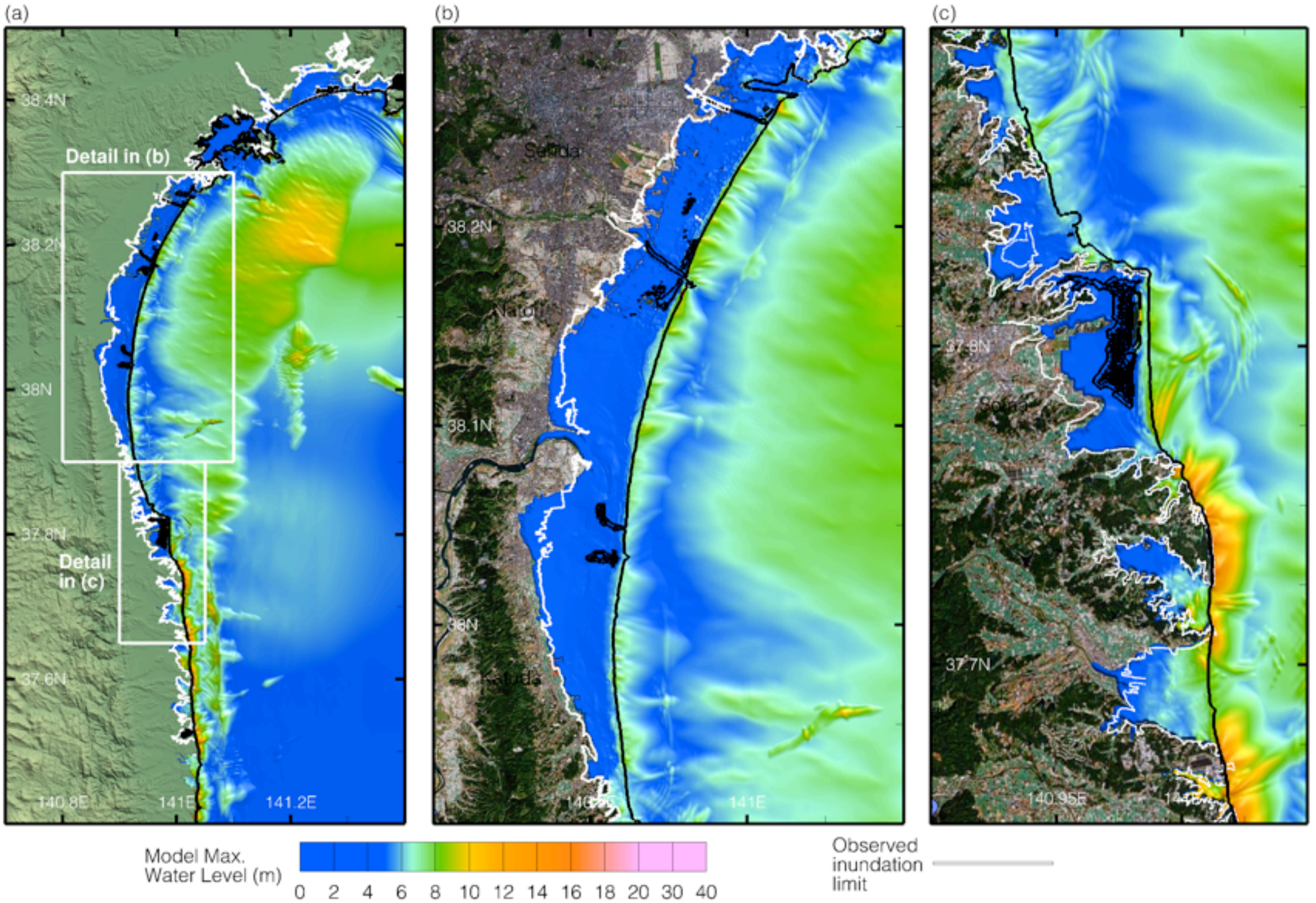

38.5°N
GPS801
38°N
37.5°N
141°E
141.5°E


45°N
40°N
35°N
140°E
145°E

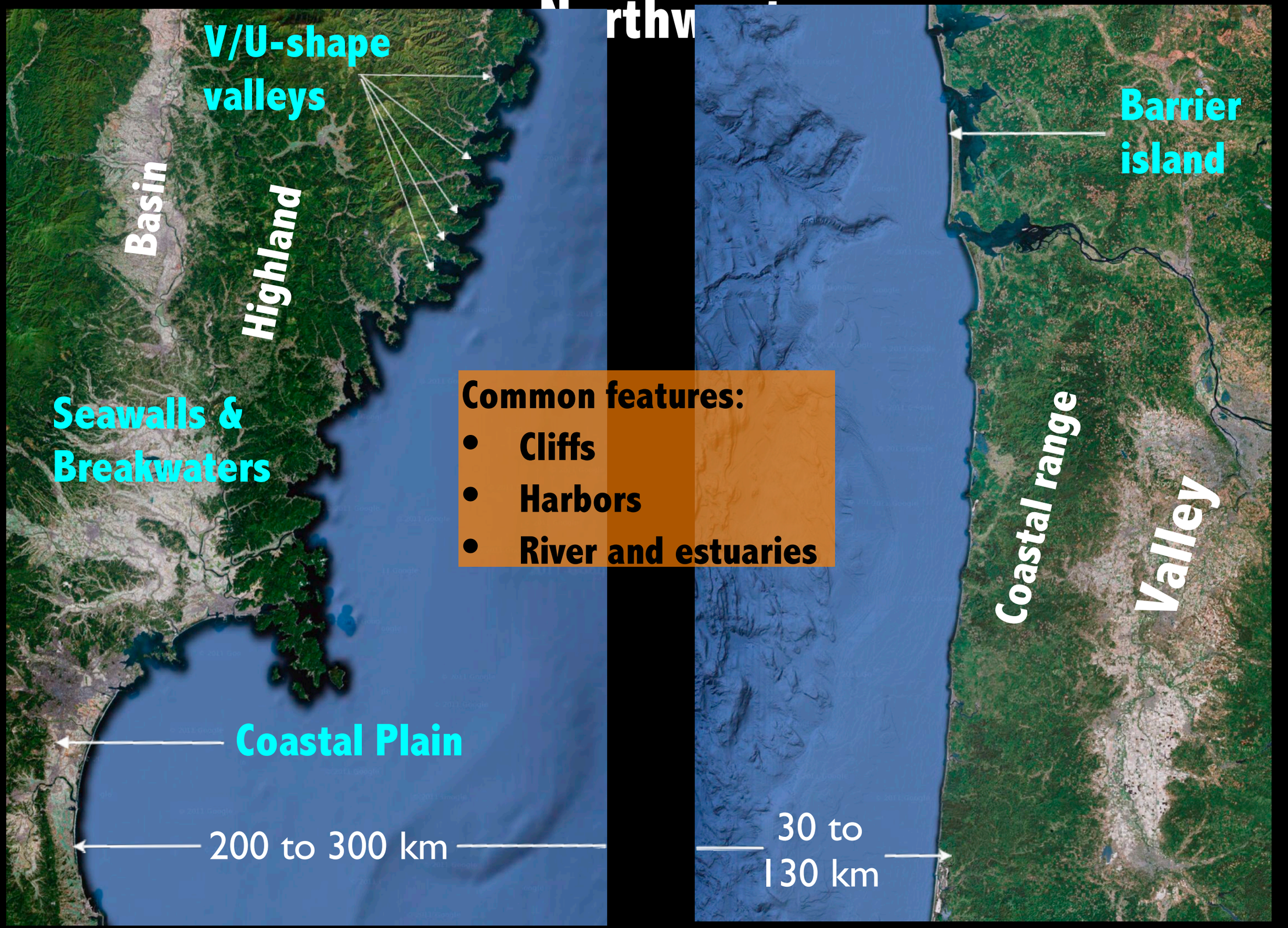

Water
Elev. (m)
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3


March 11, 2011 East Japan Tsunami
Water Elev. (m)
10
5
0
-5
-10
Obs.
Model
NOWPHAS GPS801 (141.6836E, 38.2325N)
-1
0
1
2
3
4
5
6
7
8
9
10
Time since earthquake (hour)

Tsunami Inundation in Soma-Sendai Coast



Coastal Features in East Japan and Pacific Northw



Common features:

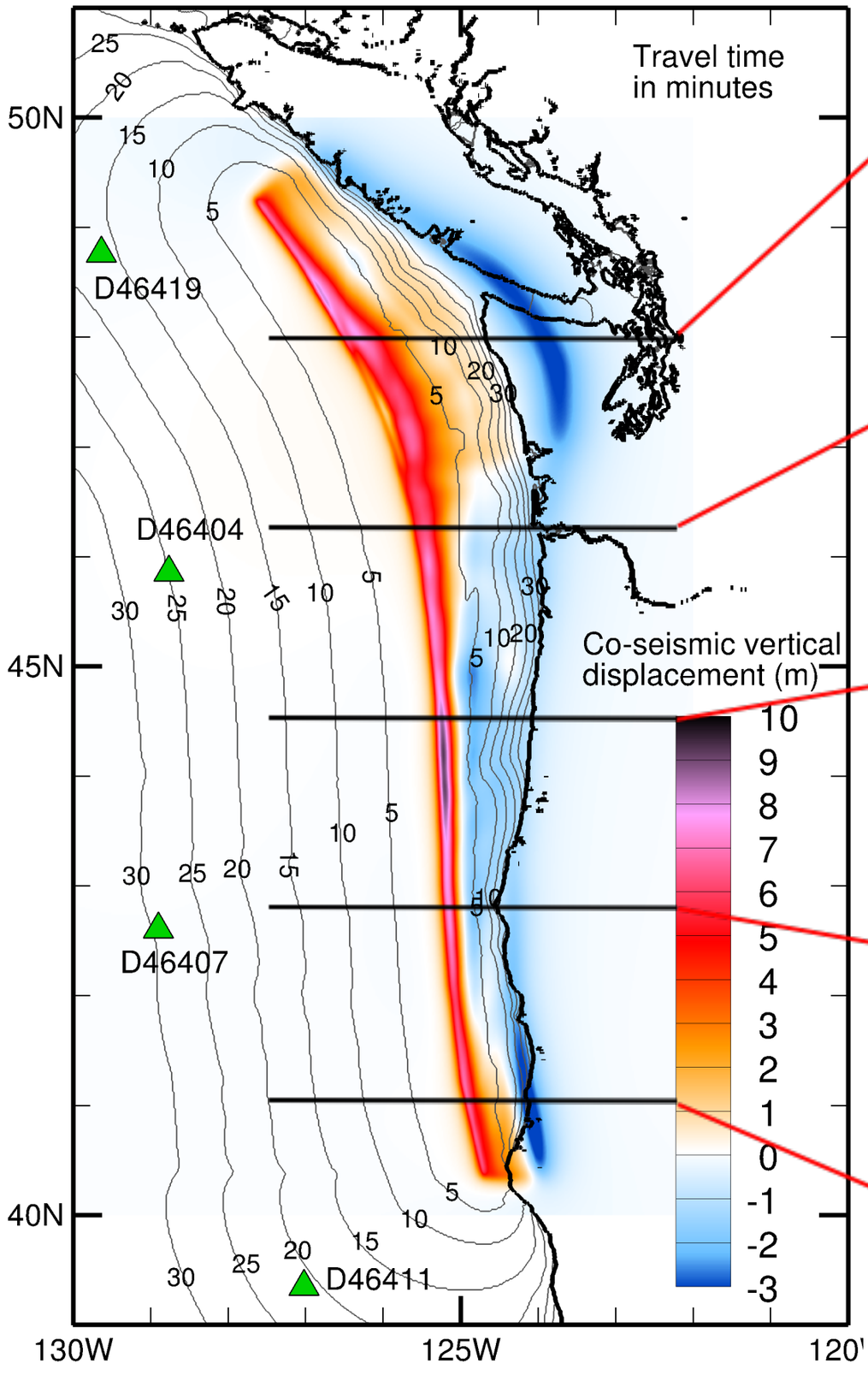
- Cliffs
- Harbors
- River and estuaries

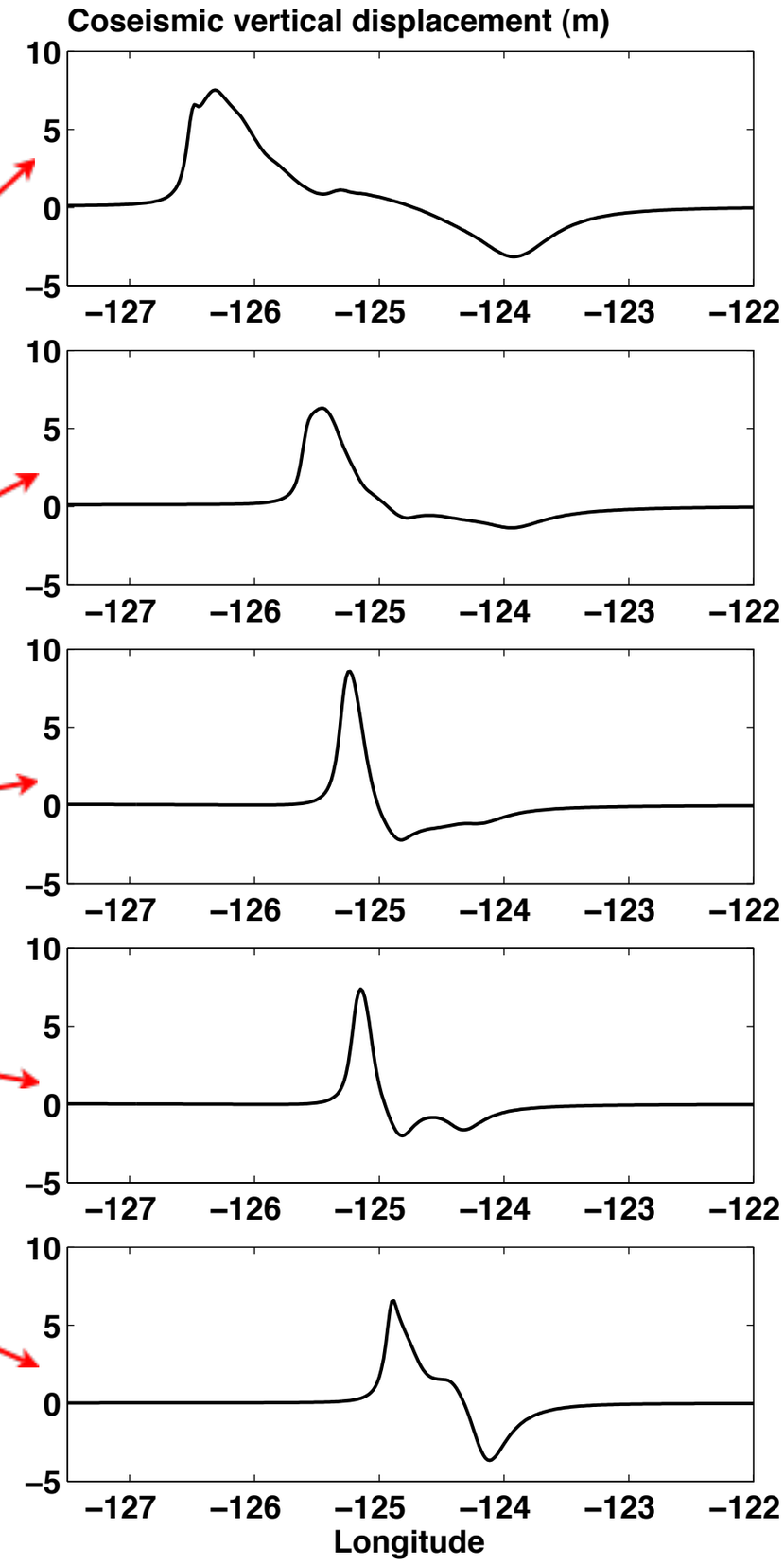
Coast of East Japan

Coast of PNW

Source deformation of a 500-year Cascadia M9.1 earthquake

- Magnitude M9.1
- Adopted from Seaside Pilot Study (Gonzalez et al., 2010)
- Length = 1,100 km
- Constructed using 105 quadrilateral elements with variable width, dip and slip (Fluck et al., 1997; Priest., 1997; Satake et al., 2003)
- Max uplift: 9.2 m
- Max subsidence: 3.7 m
- May not represent the worst-case scenario





Water Level (m)

12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3

50°N
45°N
40°N
130°W
125°W

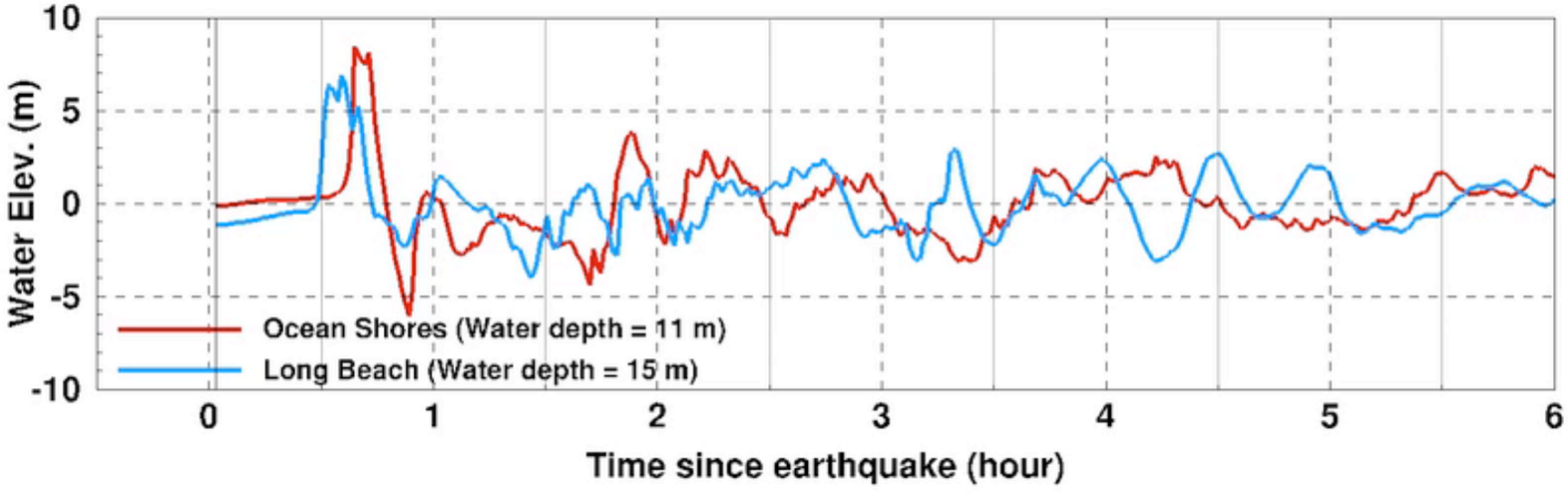
48°N
47°N
46°N
45°N
44°N
125°W
124°W

TIME = 00h 01m 58s

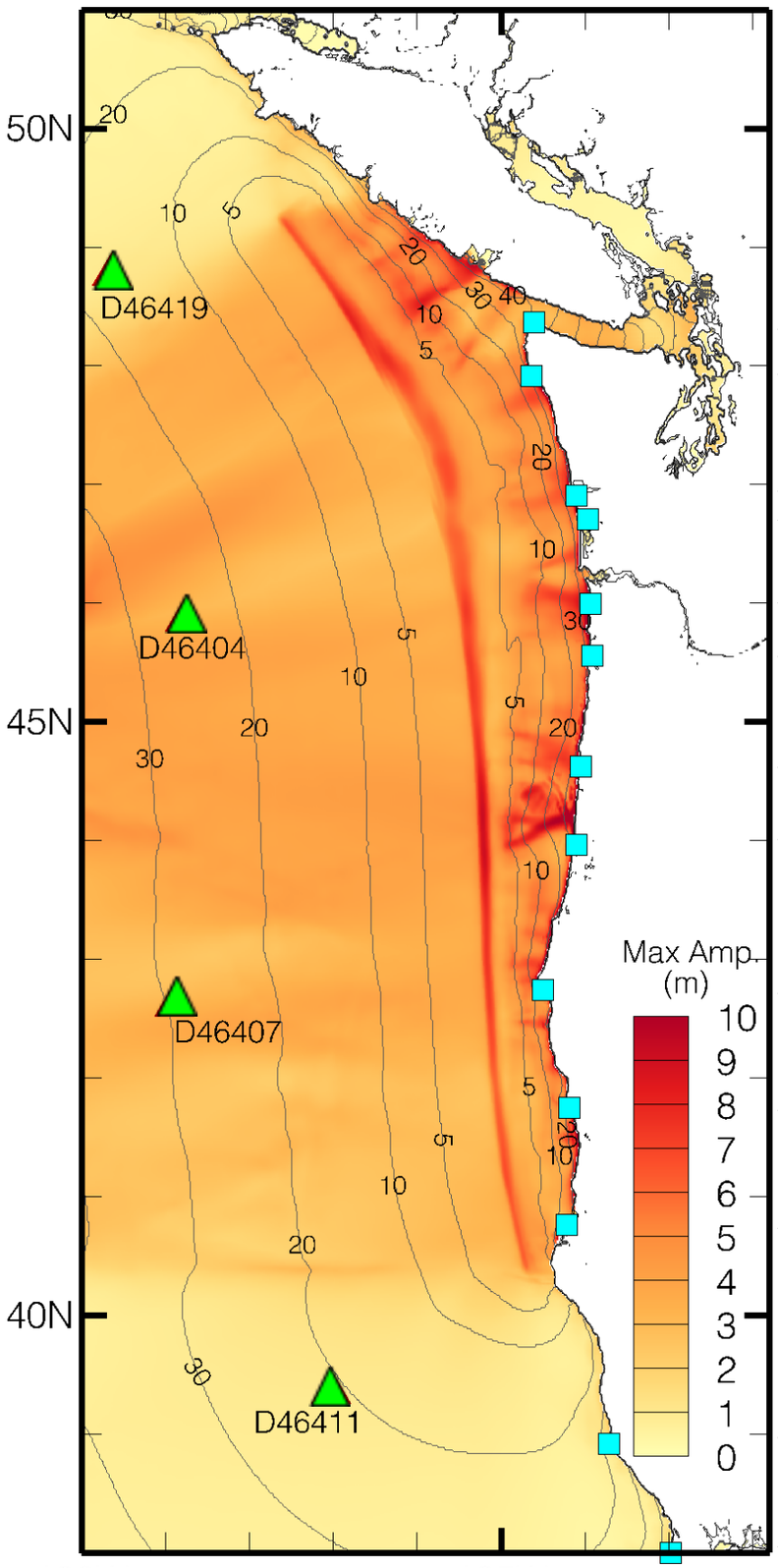
Ocean City
Ocean Shores
North Bay
Grays Harbor
West Port
Ocean Park
Willapa Bay
Long Beach
Seaside

47°N
46.5°N
46°N
124.4°W
124.2°W
124°W

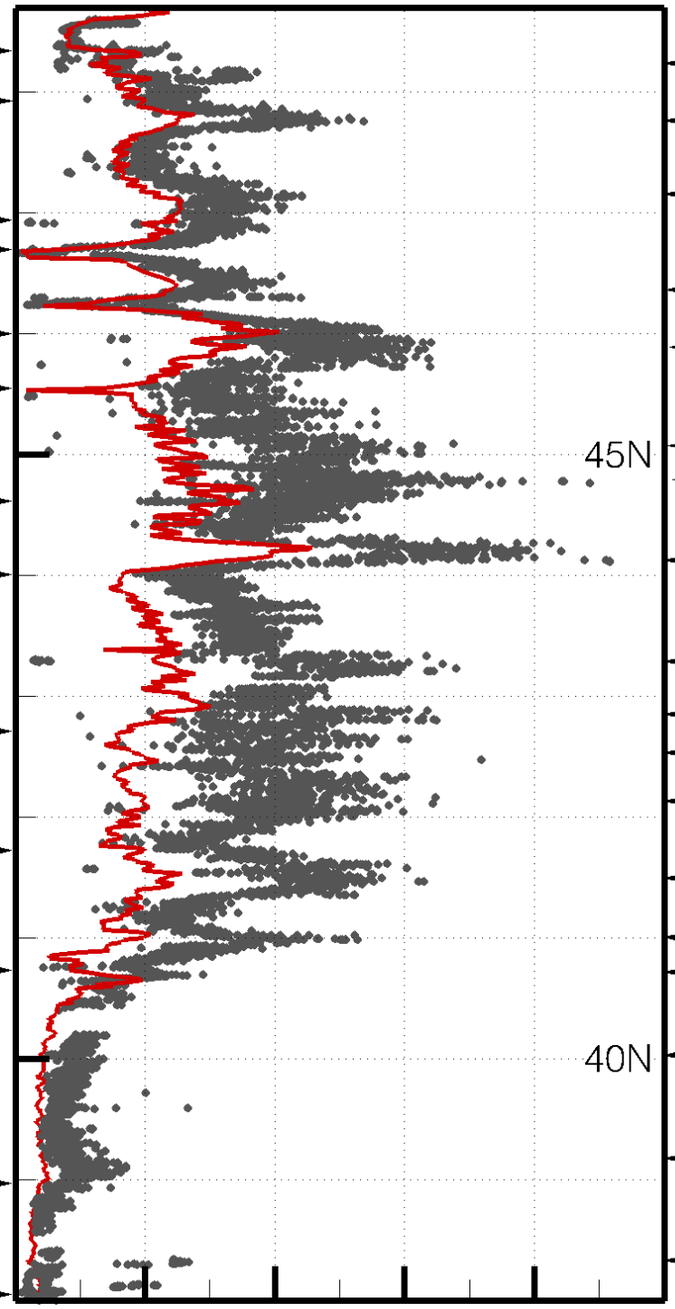
Tsunami in the PNW generated by a 500-year Cascadia M_w 9.0



Modeled Tsunami Max Water Level from a M9.1 Cascadia Event



Neah Bay (11 m)
La Push (19 m)
West Port (19 m)
Toke Pt (14 m)
Seaside (28 m)
Garibaldi (22 m)
Newport (29 m)
Florence (17 m)
Port Orford (25 m)
Crescent City (16 - 20 m)
Eureka (15 m)
Arena Cove (7 m)
Point Reyes (3.6 m)



19 m, Ozette River, WA
27 m, Jefferson Cove, Jefferson City, WA
22 m, Copalis River, Grays Harbor County, WA
20 -22 m, Long Beach Peninsula, OR
32 m, Cannon Beach, OR
34 m, Harts Cove, OR
44 m, South of Cape Foulweather, OR
46 m, Haceta Head, OR
31 - 34 m, Sacchi Beach, OR
32 m, Floras Lake - Garrison Lake, OR
36 m, Otter Point, OR
28 - 32 m, China Beach, OR
30 - 32 m, Redwoods Coast, OR
26 m, Clam Beach, CA
13 m, Humboldt Bay, CA
7 m , Lost Coast, CA
8.6 m, Mendocino to Arena Cove, CA
13 m, Bogeda Bay, CA

Impact of Cascadia Tsunami

- More than 200,000 people at risk
- Untold human pain and suffering

Local Tsunami Warnings

- **0-30 minutes**
  Education, Preparedness, and Practice

- **30 minutes +**
  Tsunami flooding forecast is now technically feasible

For More Information, Contact

eddie.bernard@comcast.net