

Tsunami Forecast: Connecting Science with Warning Operations

Vasily Titov

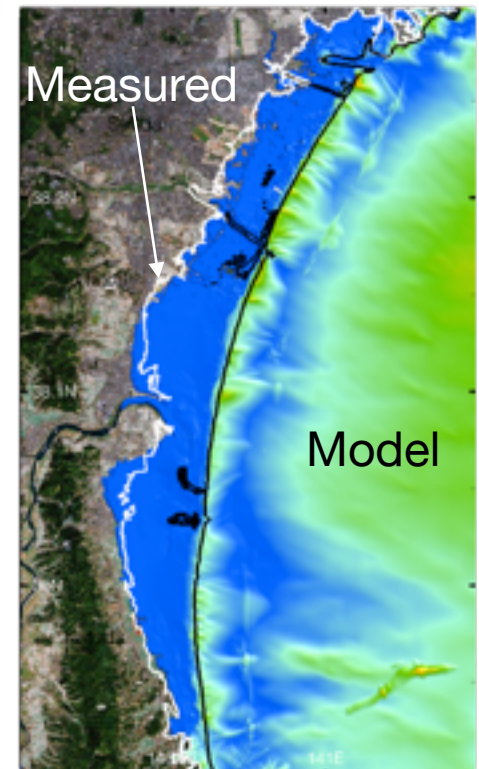
NOAA Center for Tsunami Research

Tsunami Forecast Challenges

Forecast Speed

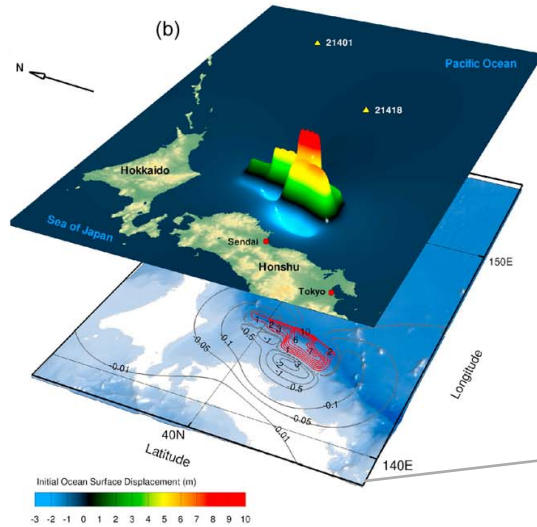


Forecast Accuracy

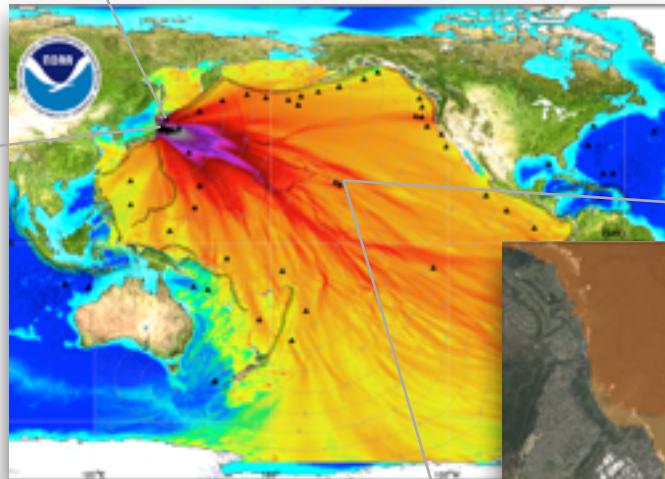


Tsunami Forecast

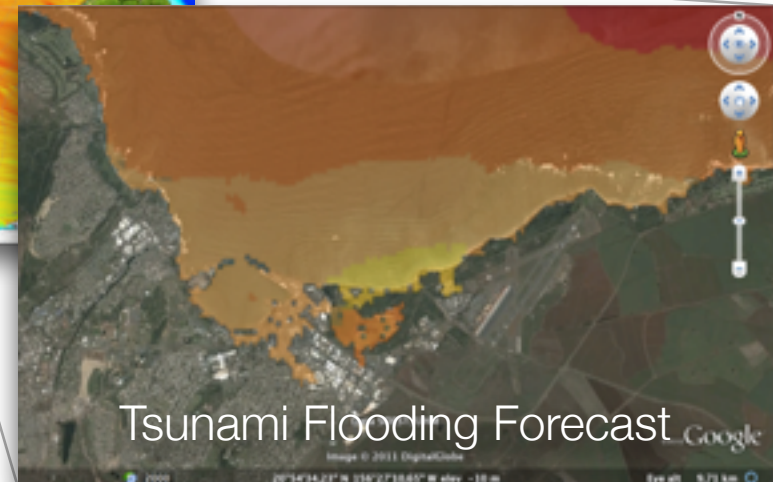
Tsunami Source



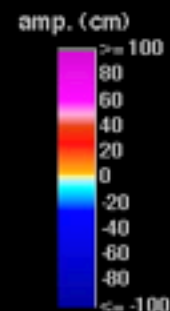
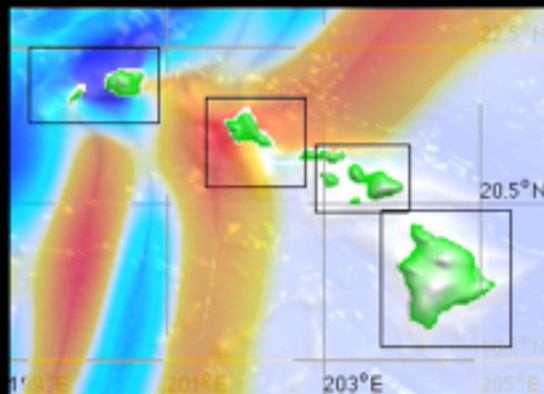
Propagation



Impact



NCTR

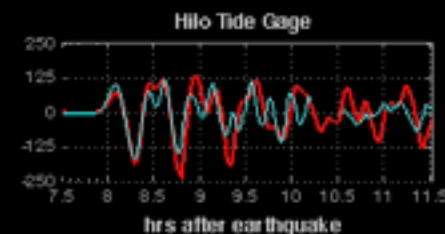
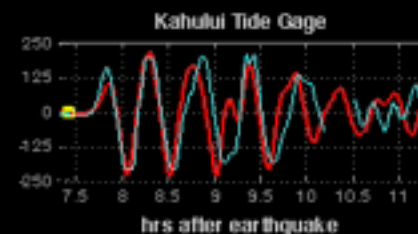
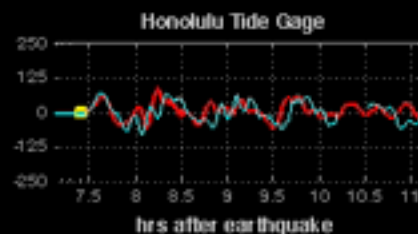
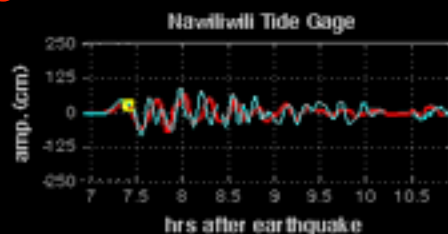
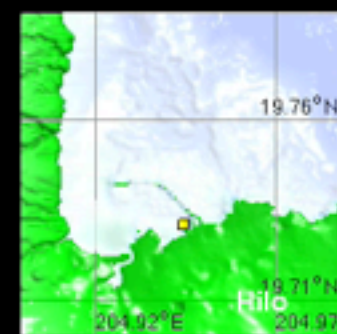
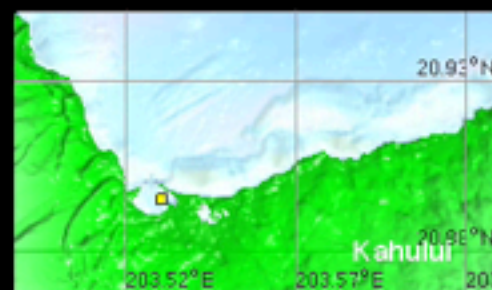
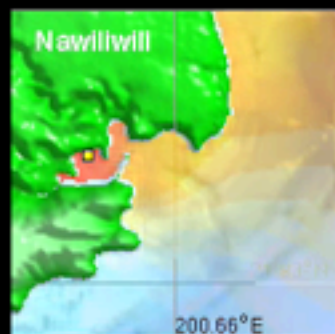
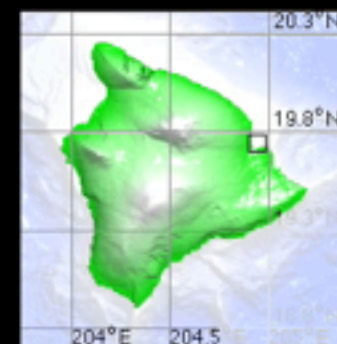
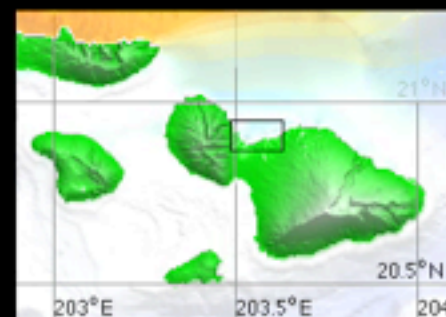
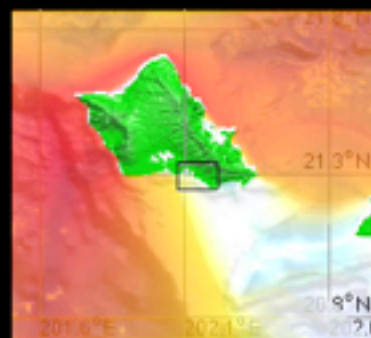
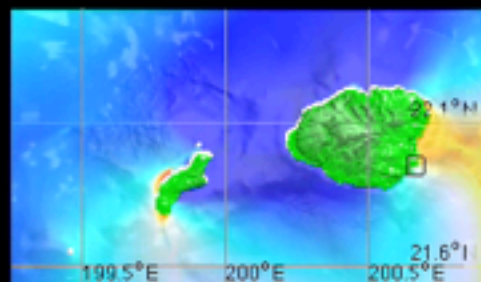


Japan Tsunami

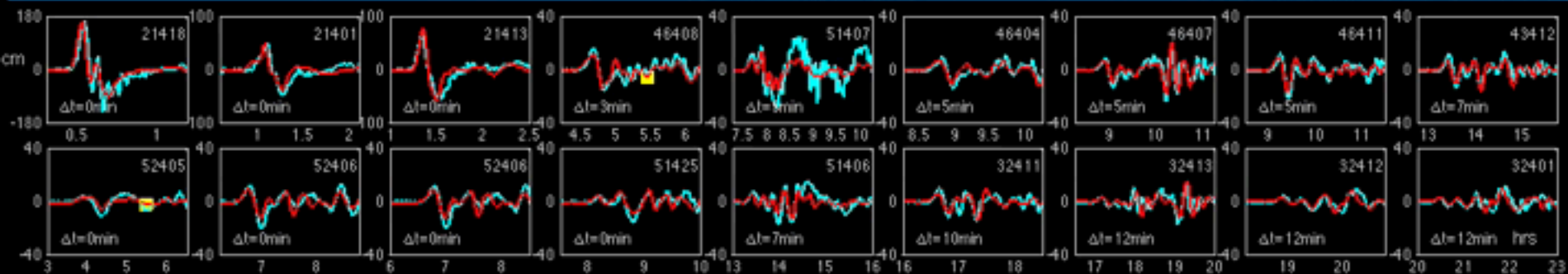
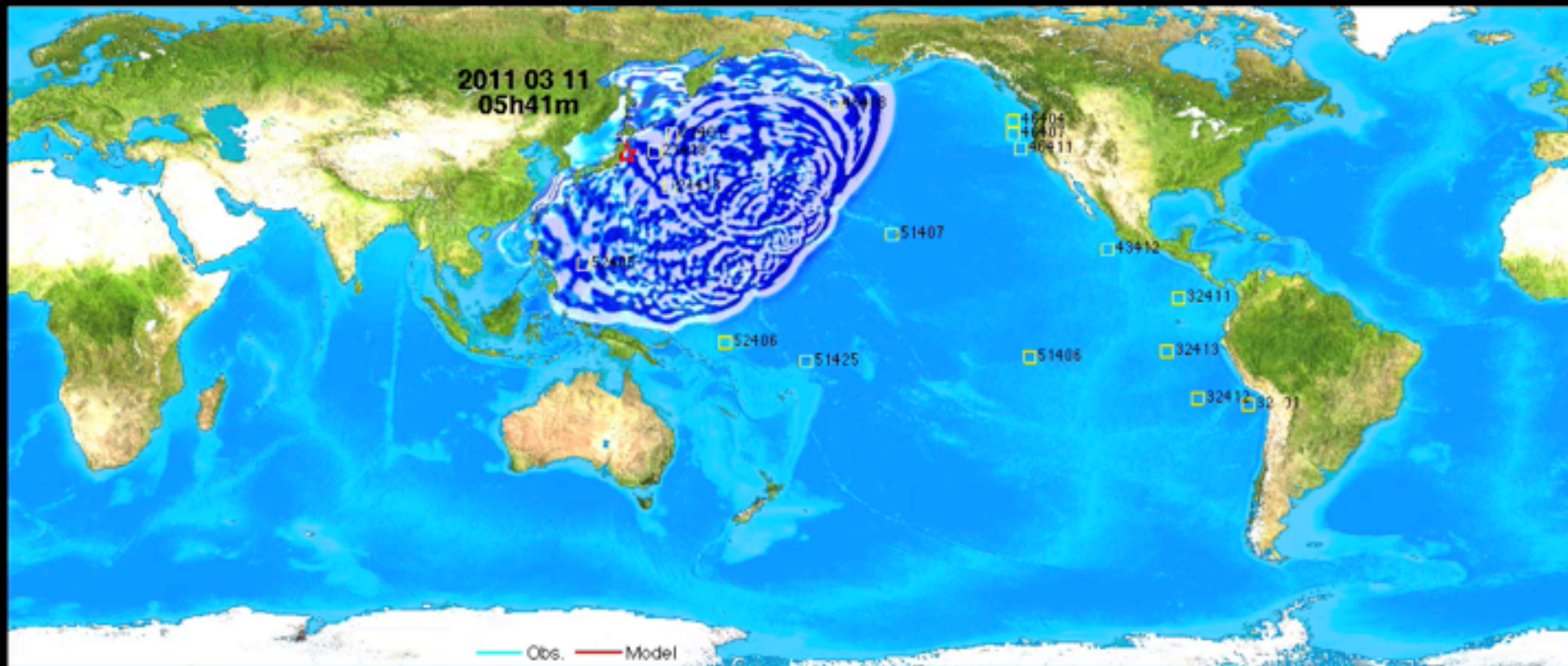
2011 03 11 05:46:23 UTC

07h23m31s

— forecast
— observation



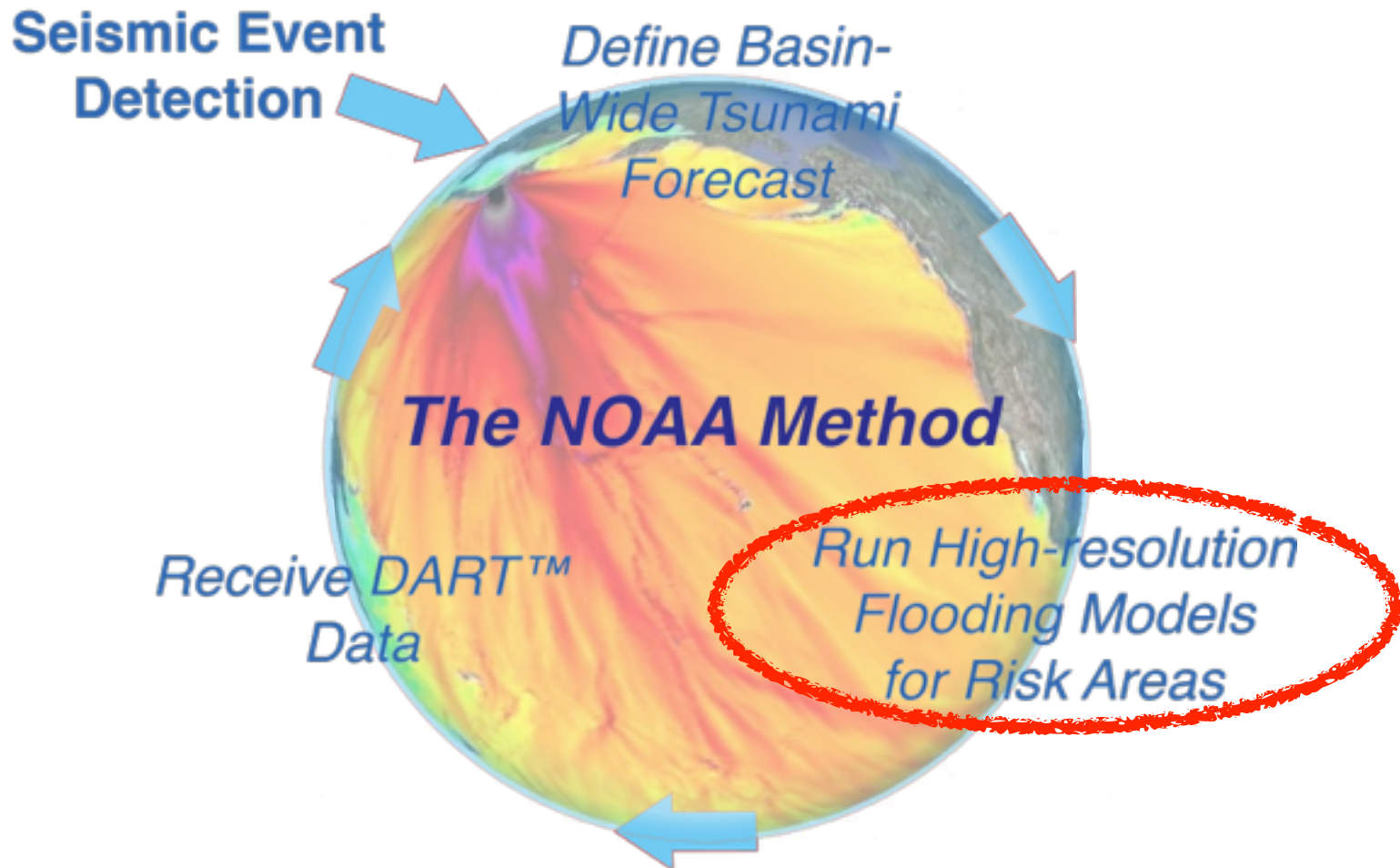
Global Propagation – 2011 Japan Tsunami



DART stations

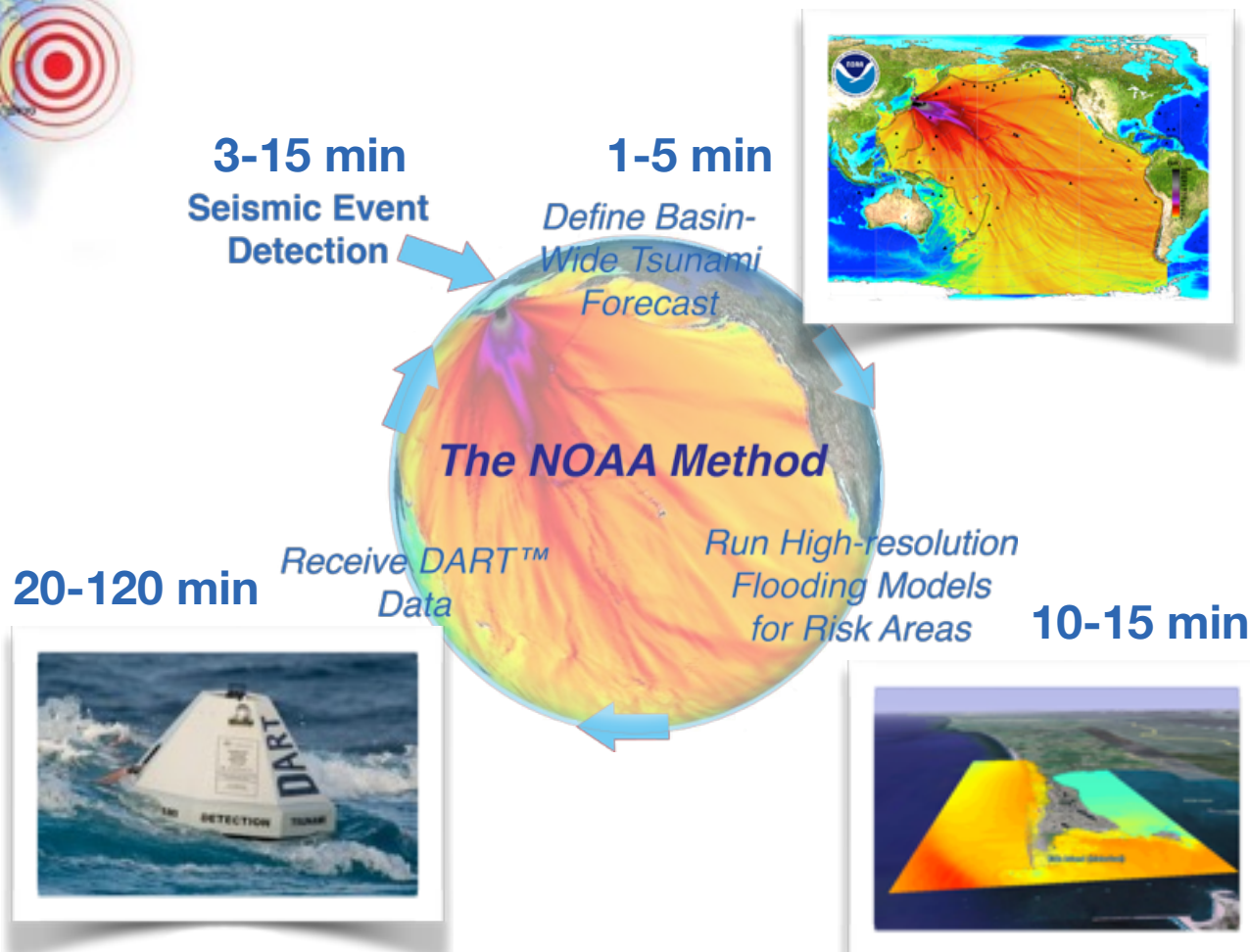
— Observation
— Forecast (MOST)

Tsunami Flooding Forecast Sequence



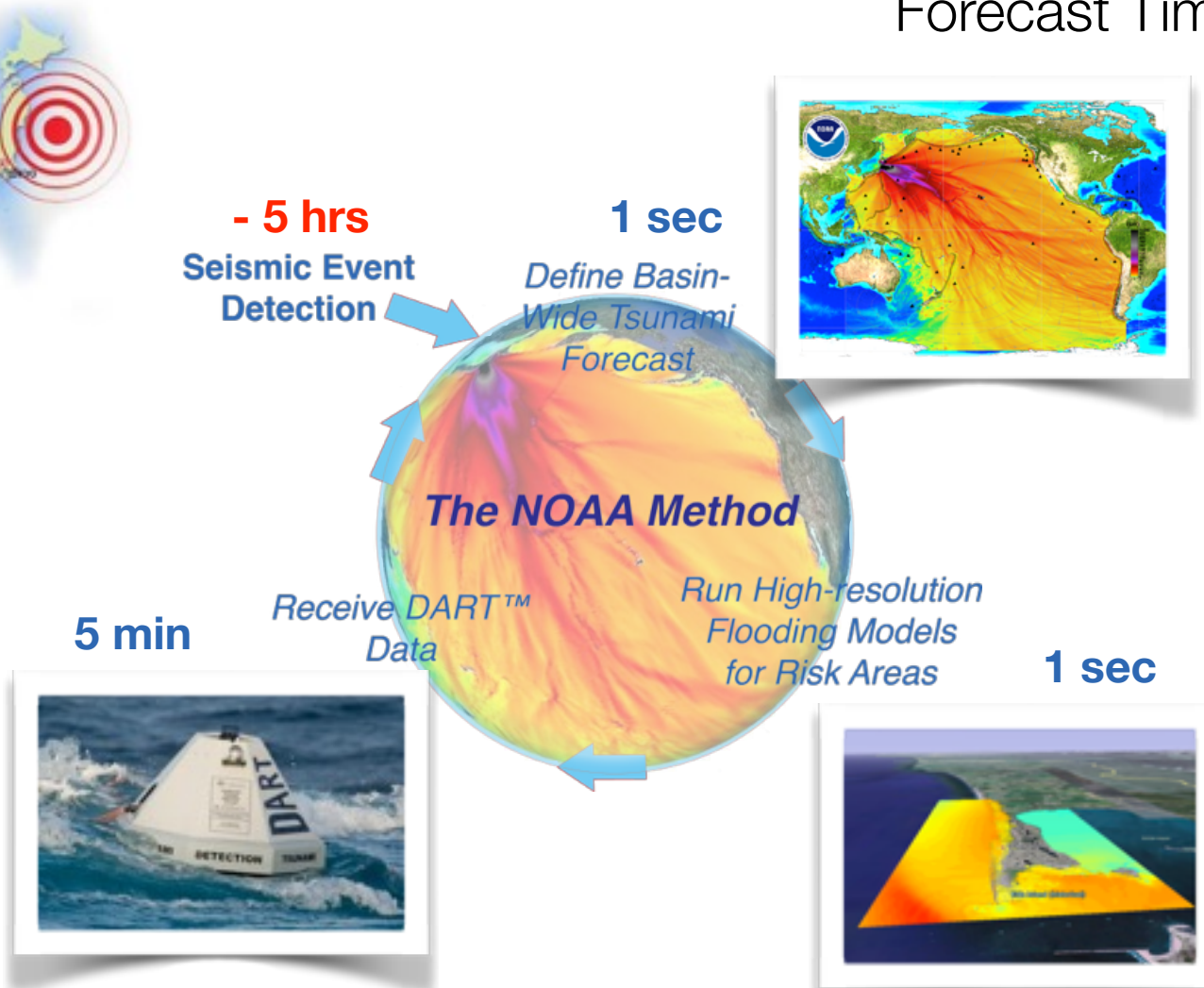
Tsunami Flooding Forecast Timing (today)

Forecast Time > 30min



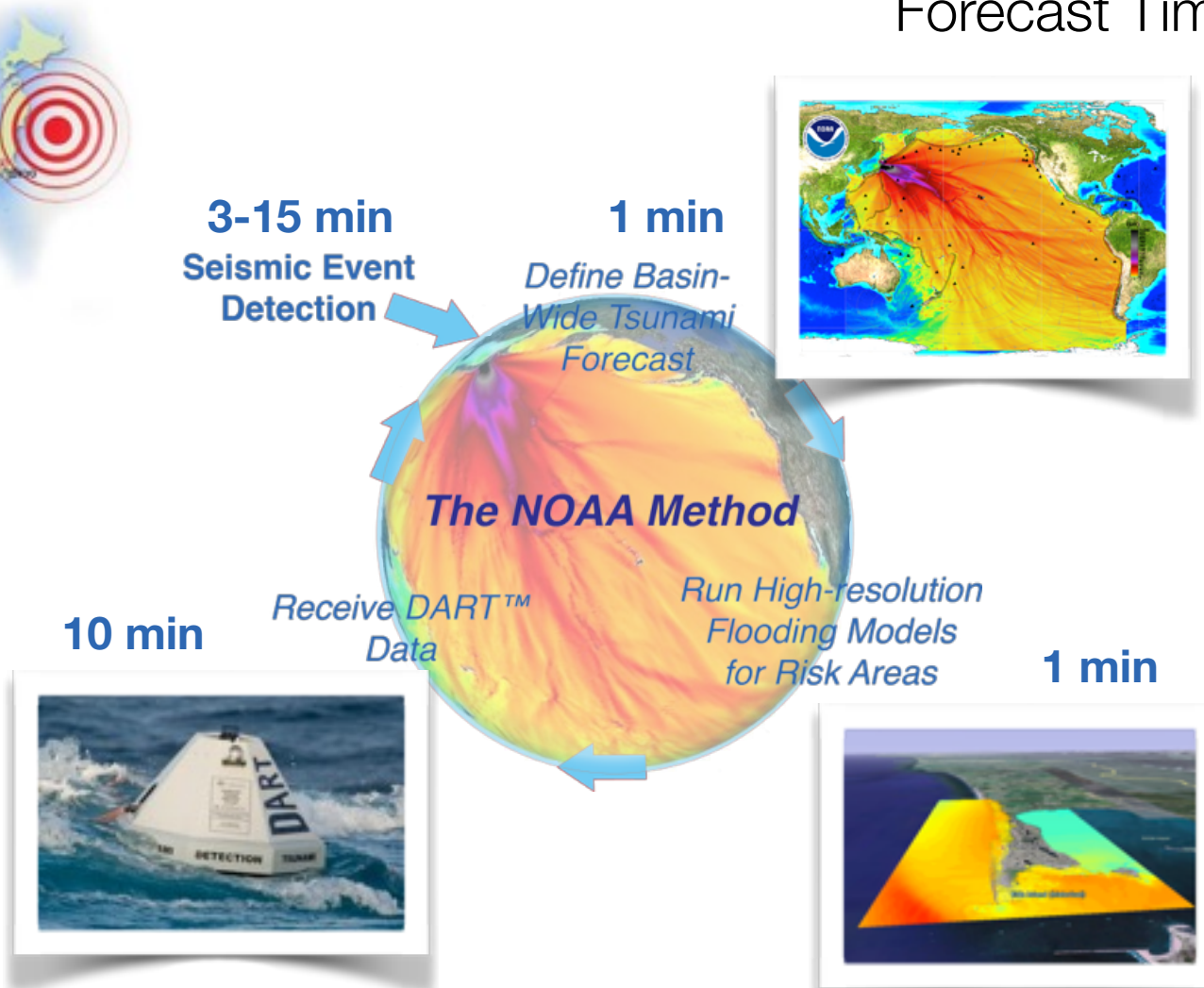
Tsunami Flooding Forecast Timing (ideal)

Forecast Time < 0 hr

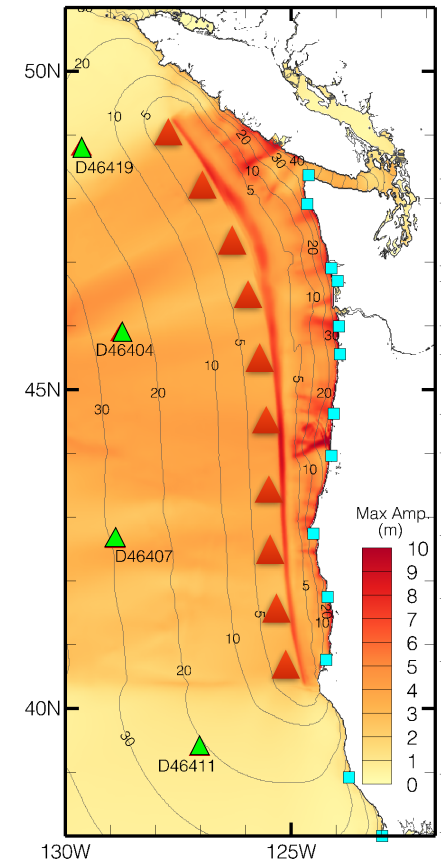
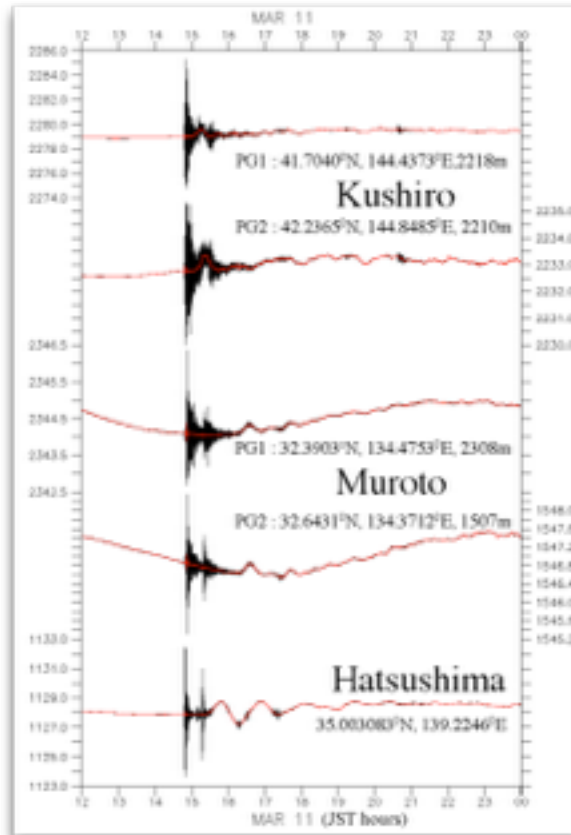
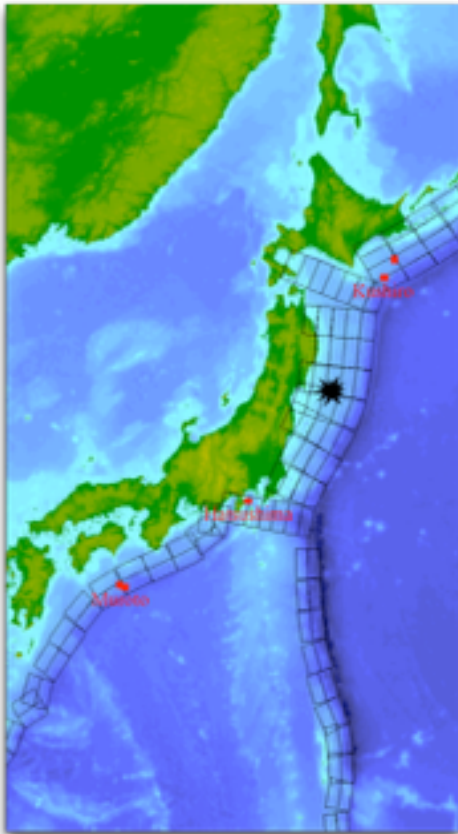


Tsunami Flooding Forecast Timing (practical future)

Forecast Time < 15 min

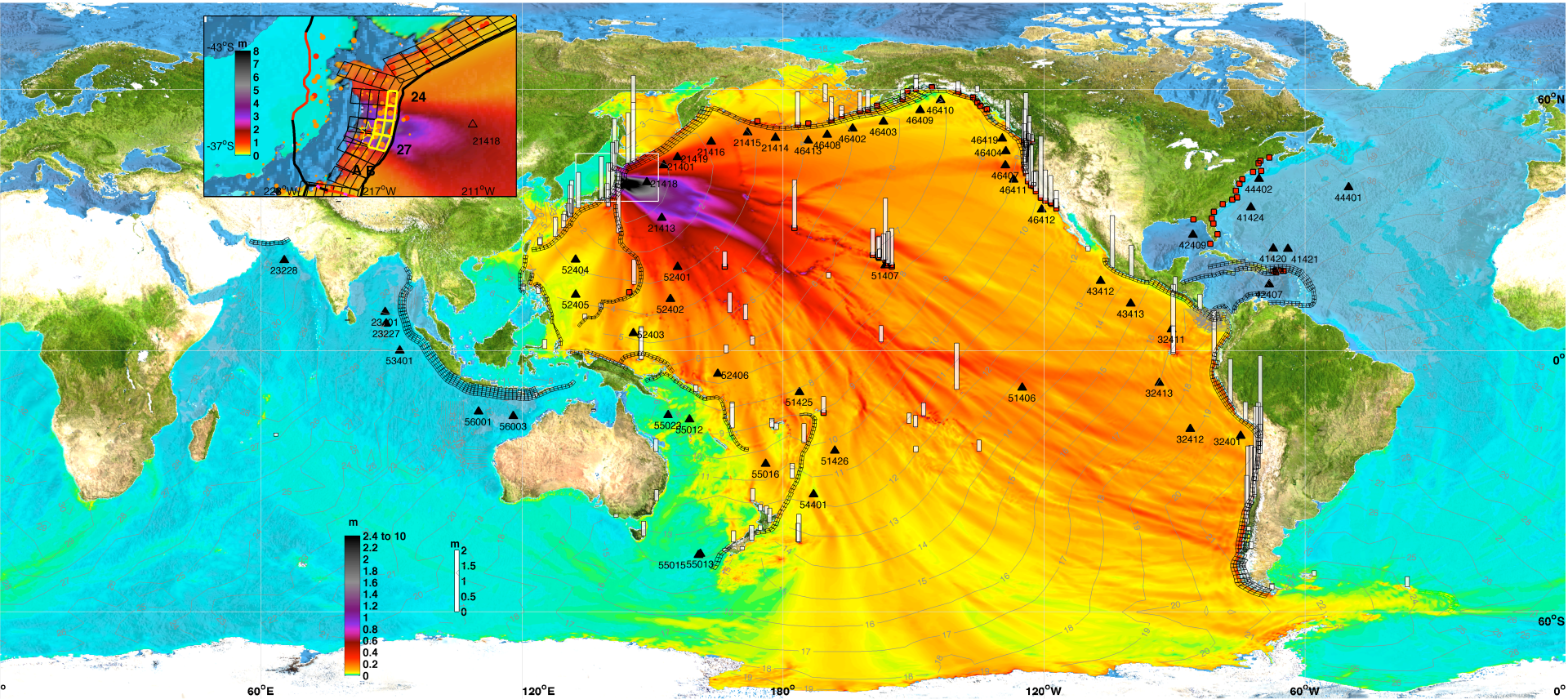


Faster Tsunami Detection



- Existing DART Systems
- New Generation DART 4G

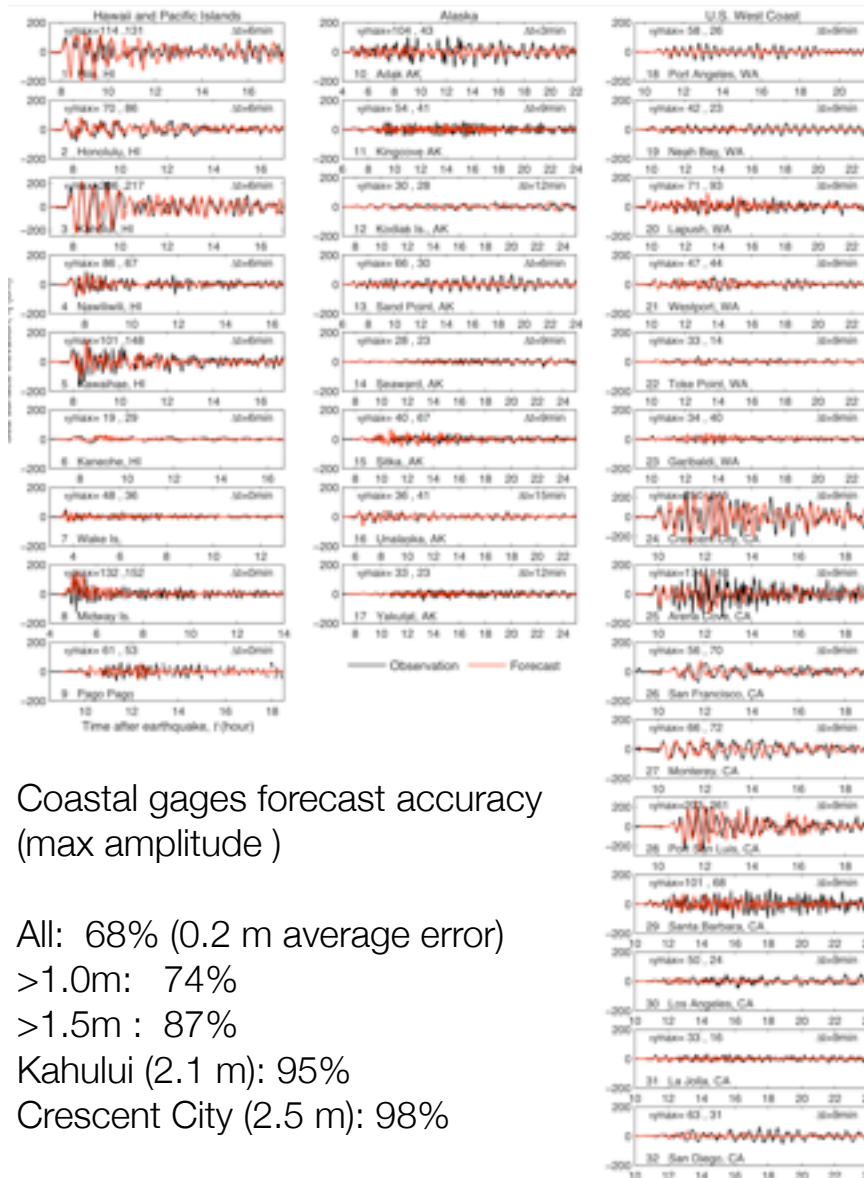
The 2011 Japan Tsunami



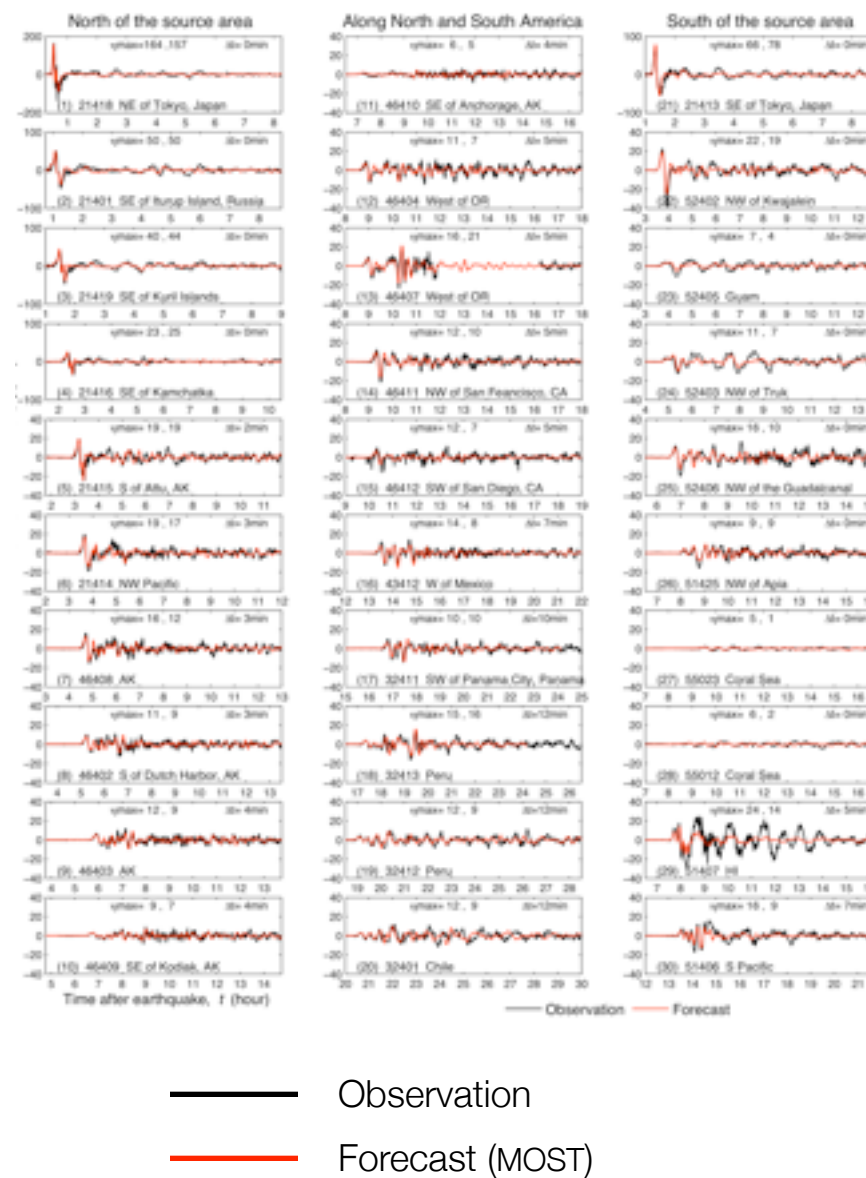
Forecast based on 2 DART
measurements

Tsunami Energy Map

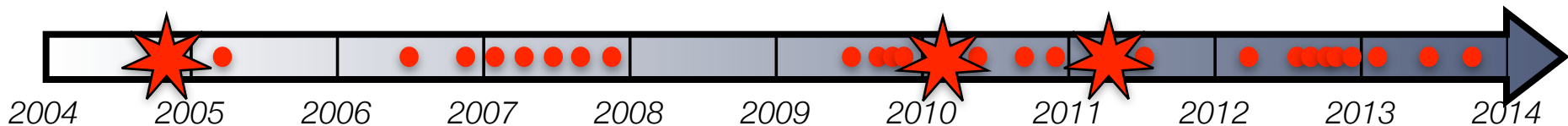
U.S. Tide Gages



DART amplitudes



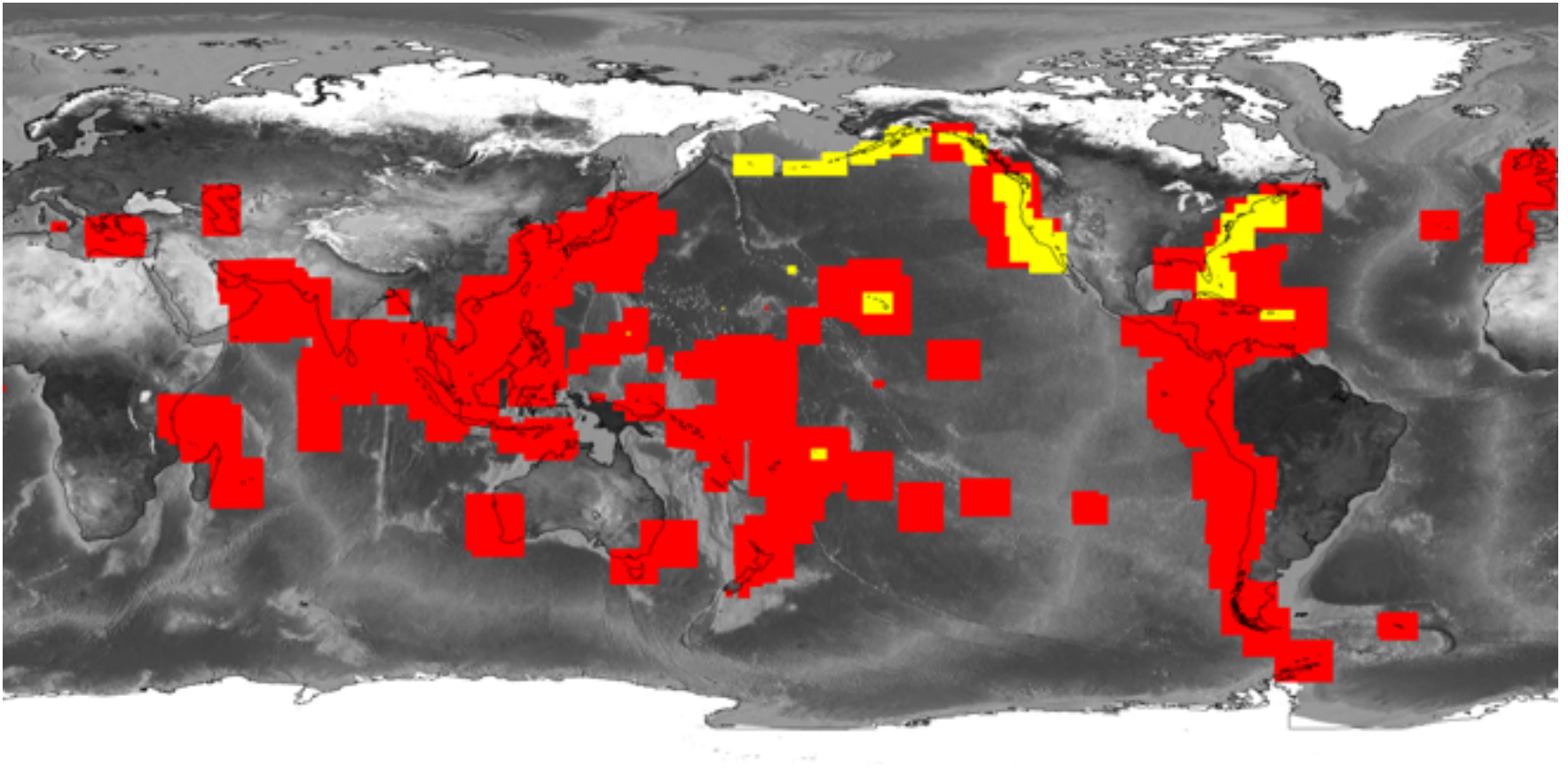
Tang et al. (2012) Direct energy estimation of the 2011 Japan tsunami using deep-ocean pressure measurements. *J. Geophys. Res.*, 117, C08008, doi: 10.1029/2011JC007635



Source Location	Date	No. of Forecasts	Overall	Lead time (hr)
Alaska	11/17/2003	1	> 95%	3
California	06/14/2005	1	Amplitudes below noise	0
Tonga	05/03/2006	8	> 70%	3
Kuril Is.	11/15/2006	12	> 85%	2
Nicobar Is.	01/08/2007	Offshore only		
Kuril Is.	01/13/2007	15	> 85%	2
Solomon Is.	04/01/2007	7	Amplitudes below noise	3
Peru	08/15/2007	16	> 95%	6
Sumatra	09/12/2007	1	> 90%	1
Chile	11/14/2007	4	Amplitudes below noise	10
Tonga	03/19/2009	5	Amplitudes below noise	4
New Zealand	07/15/2009	6	Amplitudes below noise	7
Andaman Is.	08/10/2009	Offshore only		
Samoa	09/29/2009	15 + near-field	> 75%	3.5
Vanuatu	10/07/2009	Offshore only		
Solomon Is.	01/03/2010	near-field modeling		
Chile	02/27/2010	23 + near-field	83%	3.5

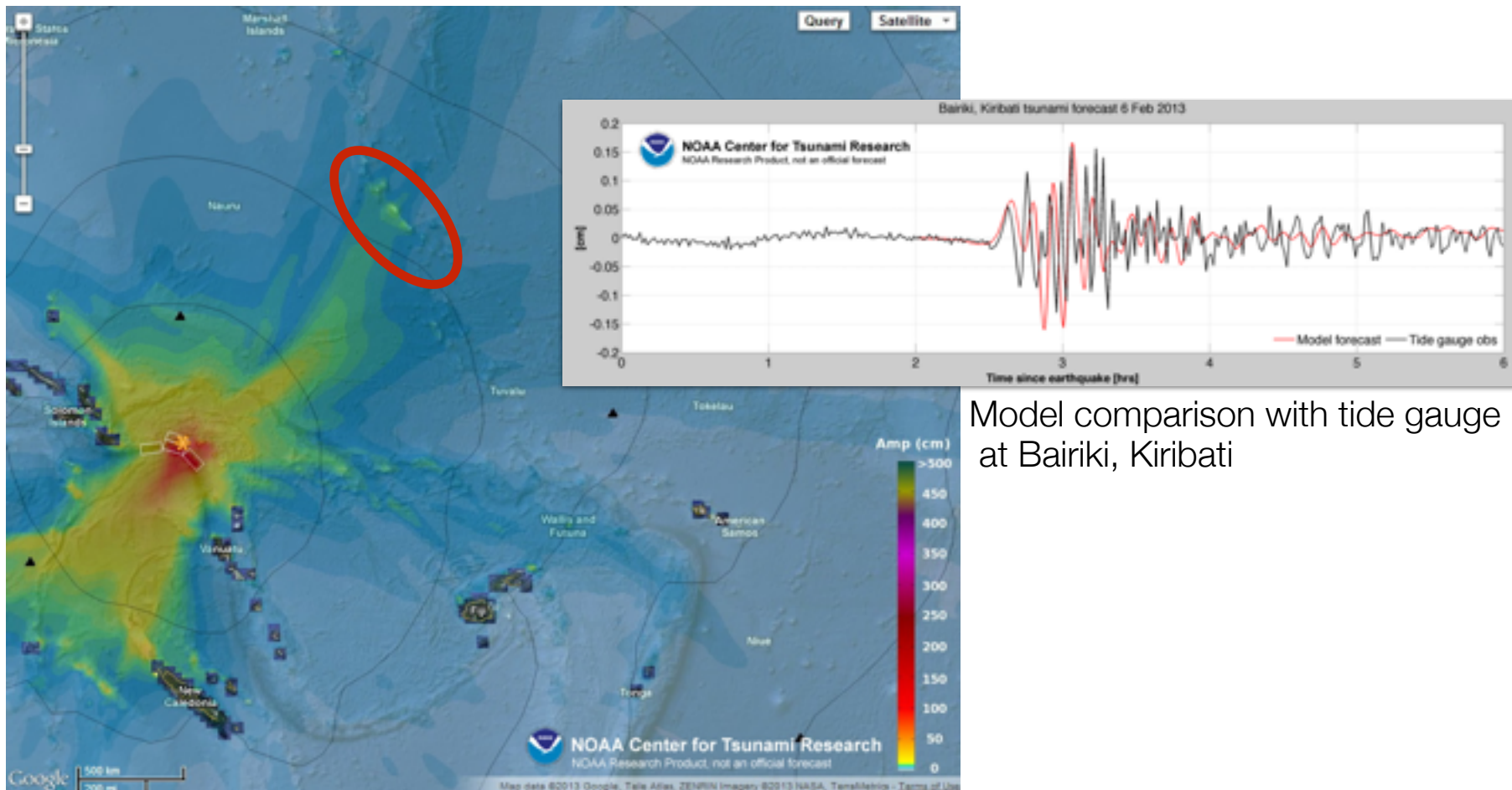
Bathymetry Data?

- NOAA forecast models developed during 2005-2015
- ComMIT training grids developed during 2005-2015



ComMIT training grid results

Solomon Islands Tsunami, February 6, 2013



Fast and Accurate Tsunami Flooding Forecast

Forecast Time < 15 min

