

February, 2016

NTHMP

Warning Coordination
Subcommittee Meeting

Agenda

- Introductions
- WCS
 - 2015-Action Item Review
 - Strategic Plan Tasks
 - TOR Update
- 2015 tsunami alerts
 - January - Alaska
 - September – Chile
 - CA Survey
 - Should Watch be issued?
 - Should impact estimates be provided prior to tsunami being recorded anywhere?
 - Review/Lessons Learned
 - Web Site
 - TWeb

Agenda

- TWC Products
 - PTWC update
 - WEA Polygons
 - Auto EAS status
 - EAS activation for advisories
 - BC Notification project
 - Brainstorming on new graphical/mobile products
- Exercises
 - Monthly Comms tests and false alarms – Use Live Code???
 - 2016 National exercises
 - 2016 ETE Comms tests
 - Others?
 - 2017 plans

Agenda

- Training
 - COMET Module update
 - NTWC TWS training plans
- IT Mod. Update
- Tsunami Research Advisory Council projects impacting TWCs
- Meteotsunami forecast protocol
- New Action Items

Reviews

- Action Item Review
- WCS Strategic Plan Tasks
- WCS Terms of Reference

2015 Tsunami Alerts

- Alaska – January, 2016
 - Response
 - 2.5 minutes – $M=6.4$; no tsunami danger
 - 9 minutes – $M=7.1$; no tsunami danger (depth)
 - Impact
 - No casualties
 - Significant damage on Kenai Peninsula
 - Some damage in Anchorage and Mat-Su Valley
 - Power outage at NTWC; UPS worked well
 - Lessons
 - Initial magnitude determination

2015 Tsunami Alerts

- Chile – September, 2015
 - Response
 - PTWC – initial threat message for Peru and Chile
 - Watch for HI
 - American Samoa/Guam
 - NTWC – Tsunami Information Stmt. – potential threat
 - About 3 hours into event, Advisory issued for part of CA
 - Cancelled about 17 hours later



**U.S. National Oceanic and Atmospheric Administration
National Weather Service
Pacific Tsunami Warning Center, Ewa Beach, Hawaii**

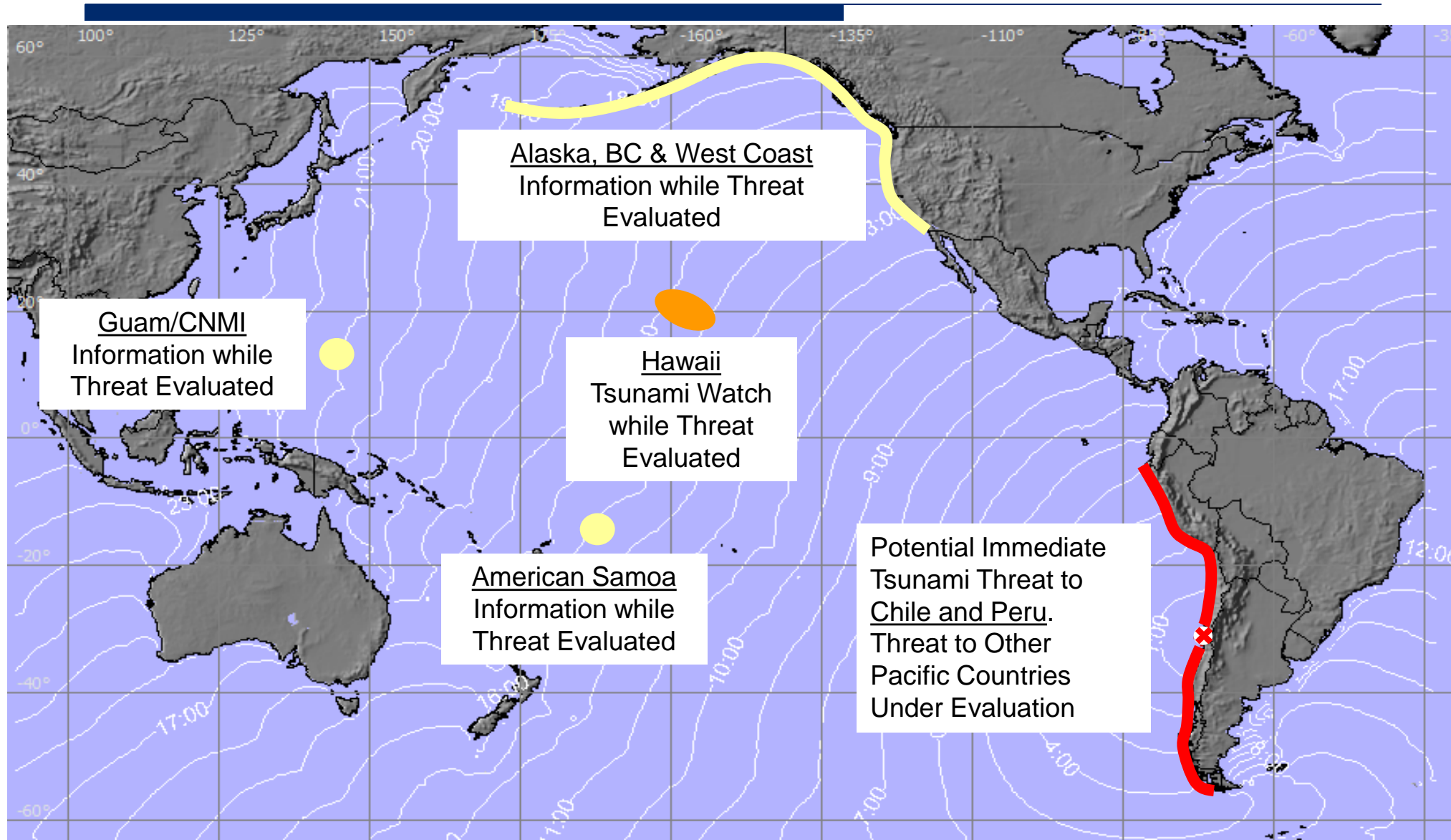


Chile Tsunami of September 16-17, 2015

**Charles McCreery
Director, PTWC**

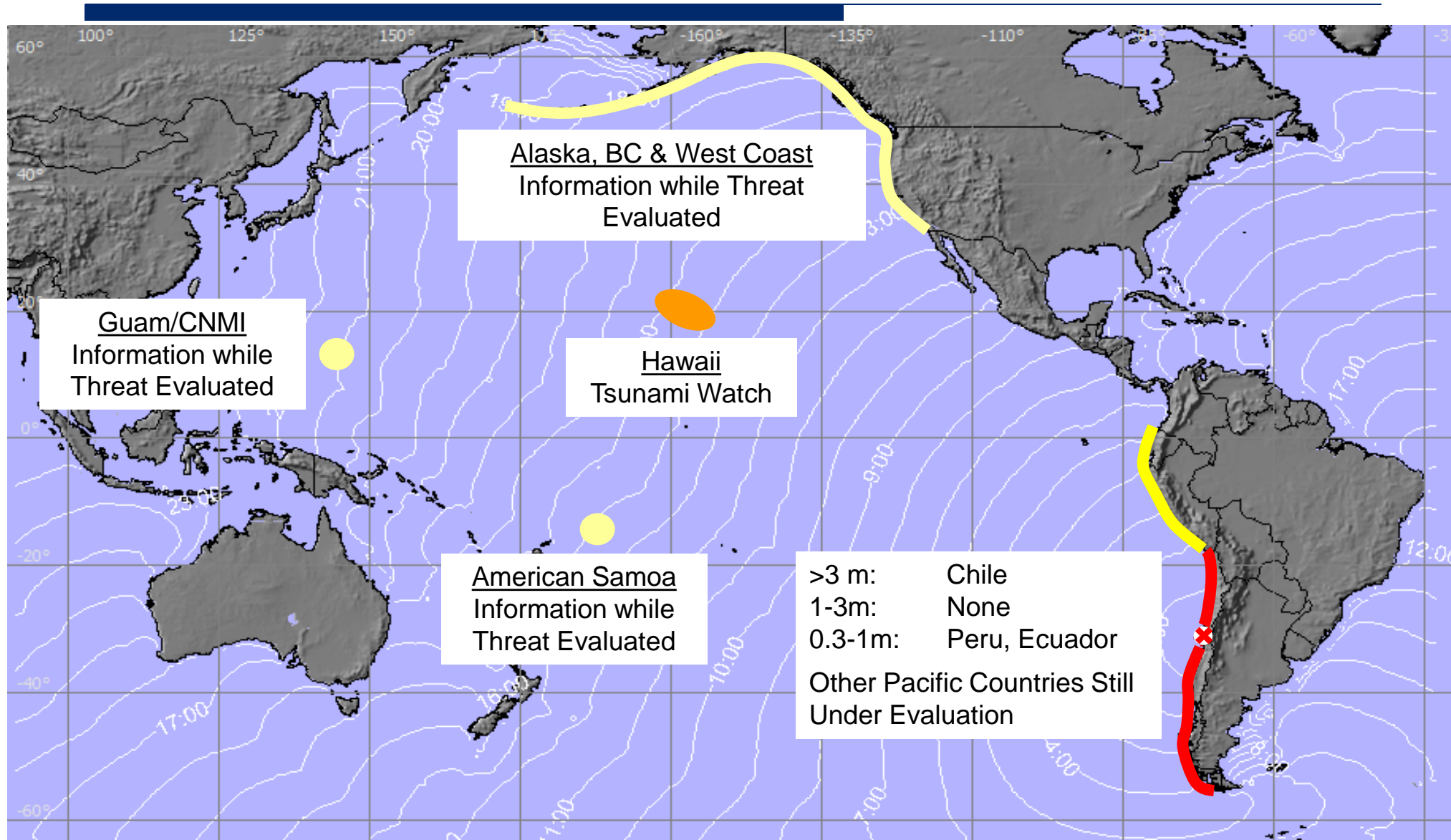
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Initial TWC Products Issued

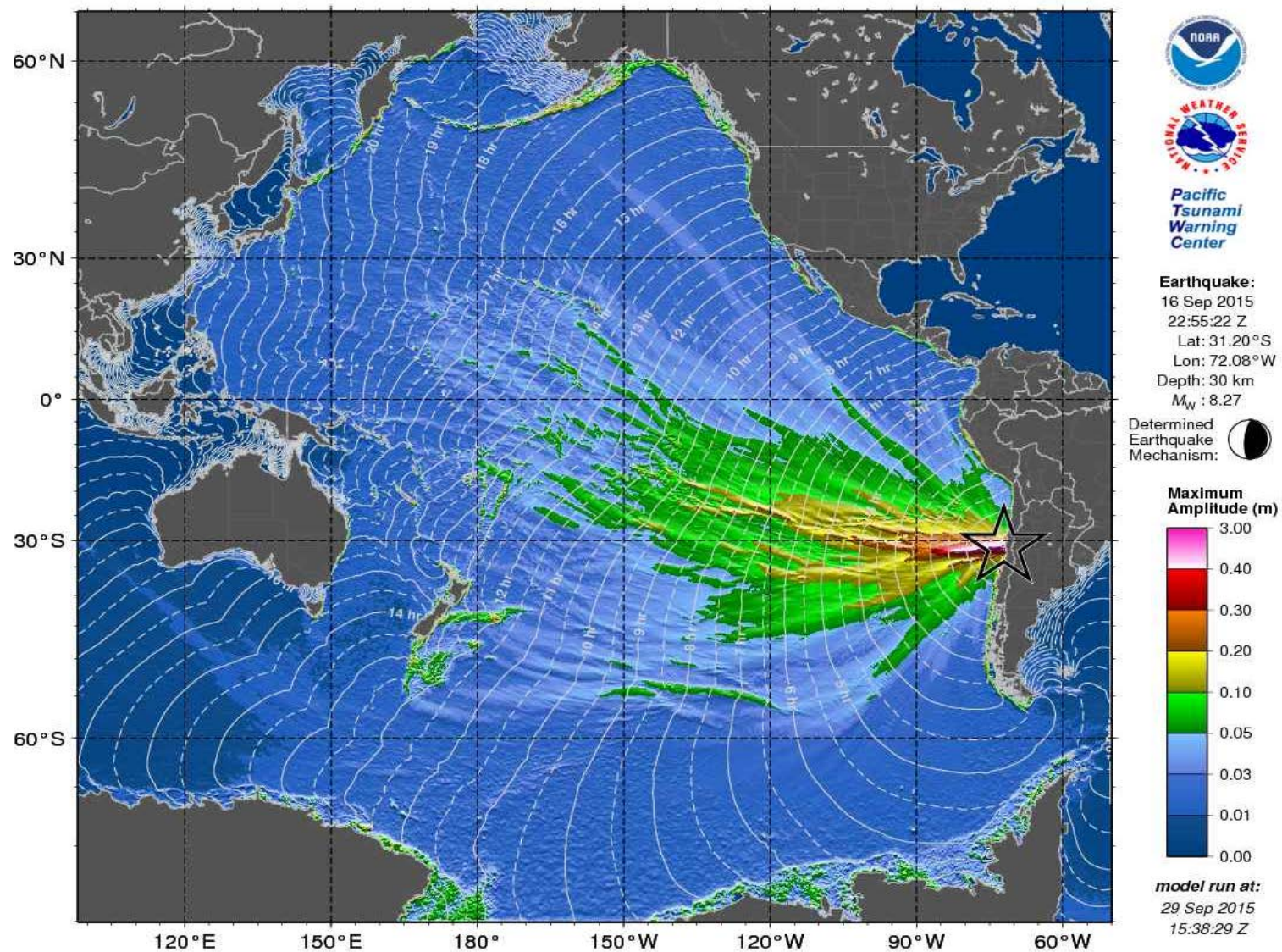


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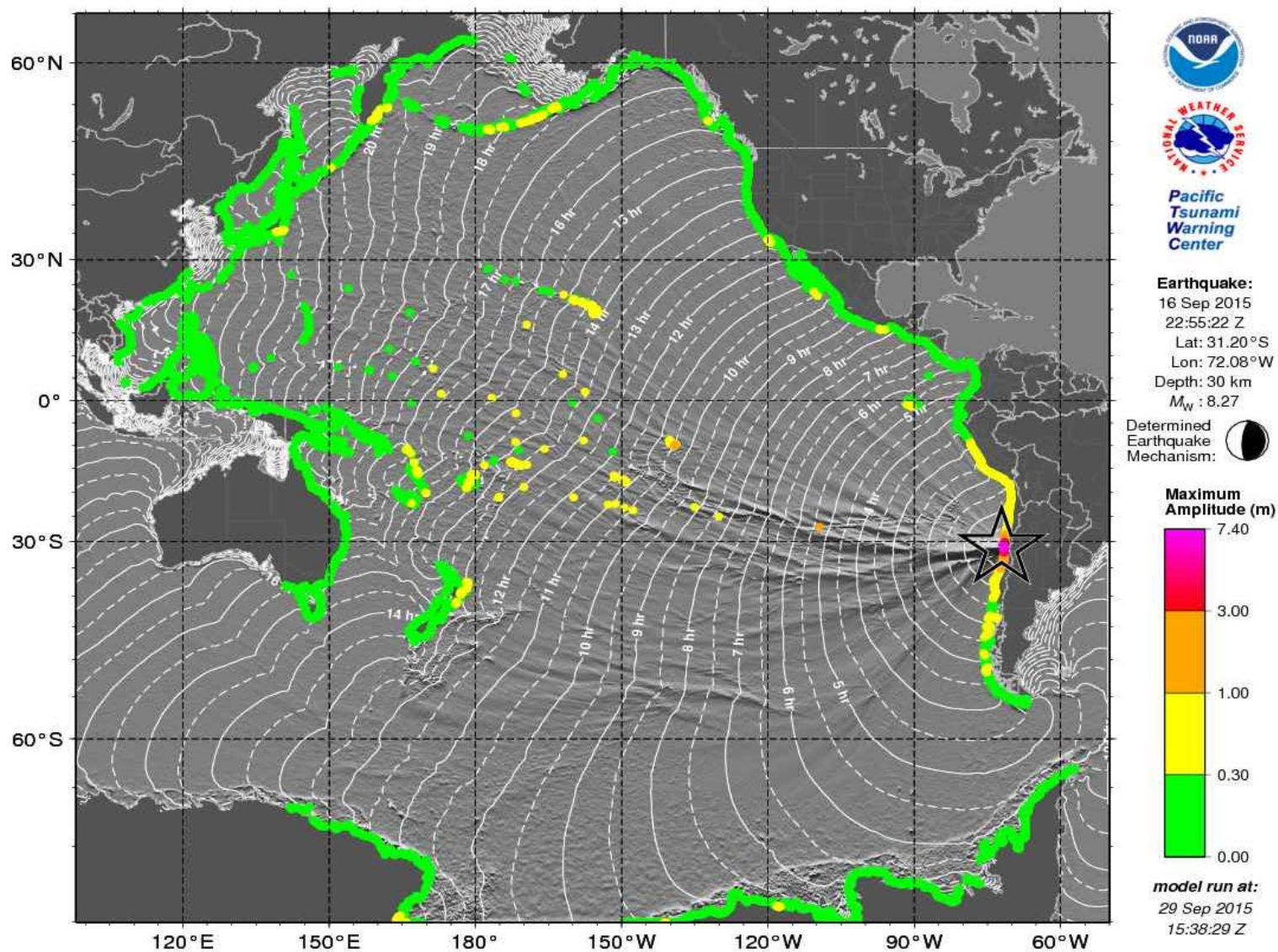
Regional Forecast based on EQ Mechanism



Ocean Forecast

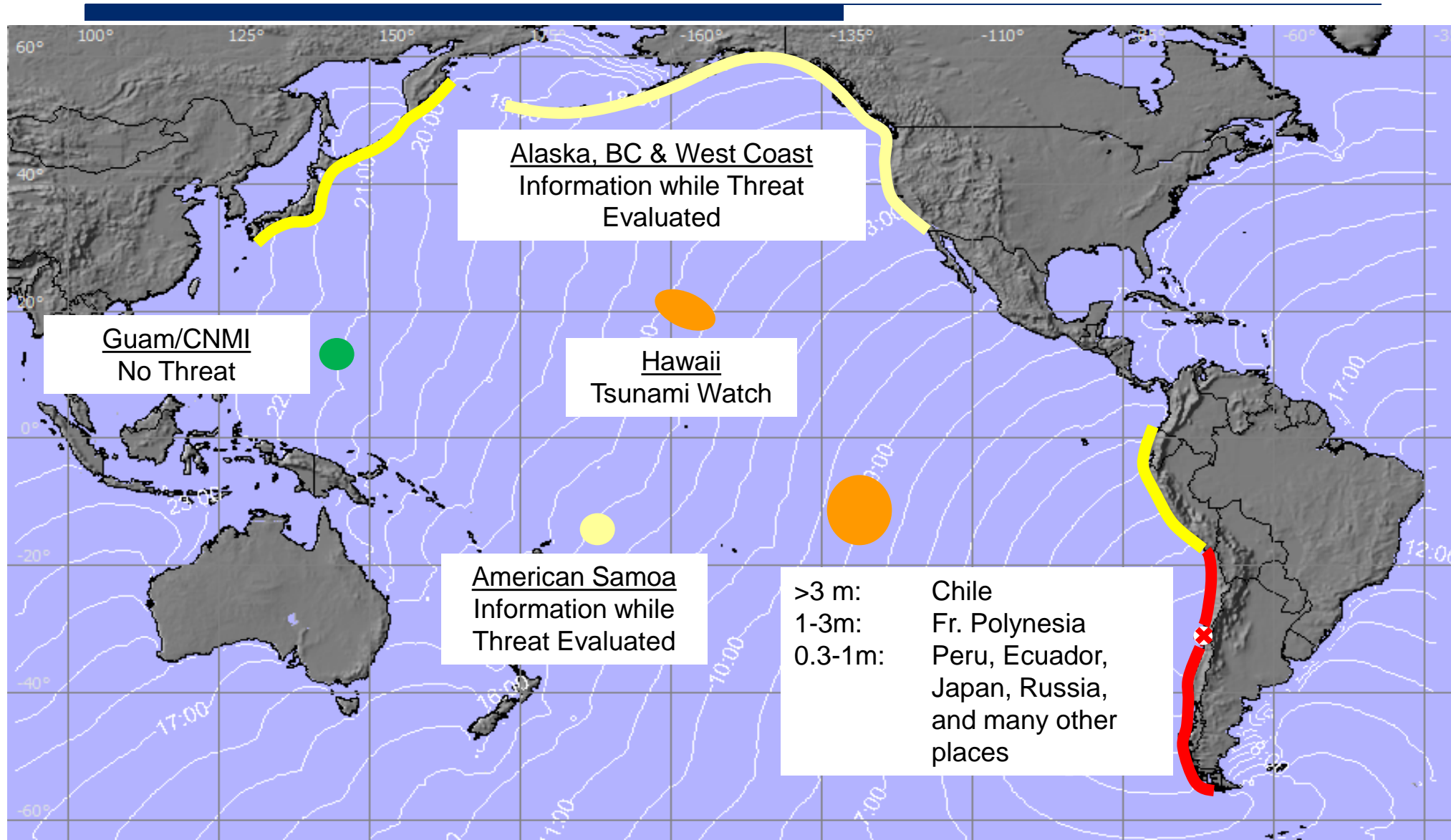


Coastal Forecast



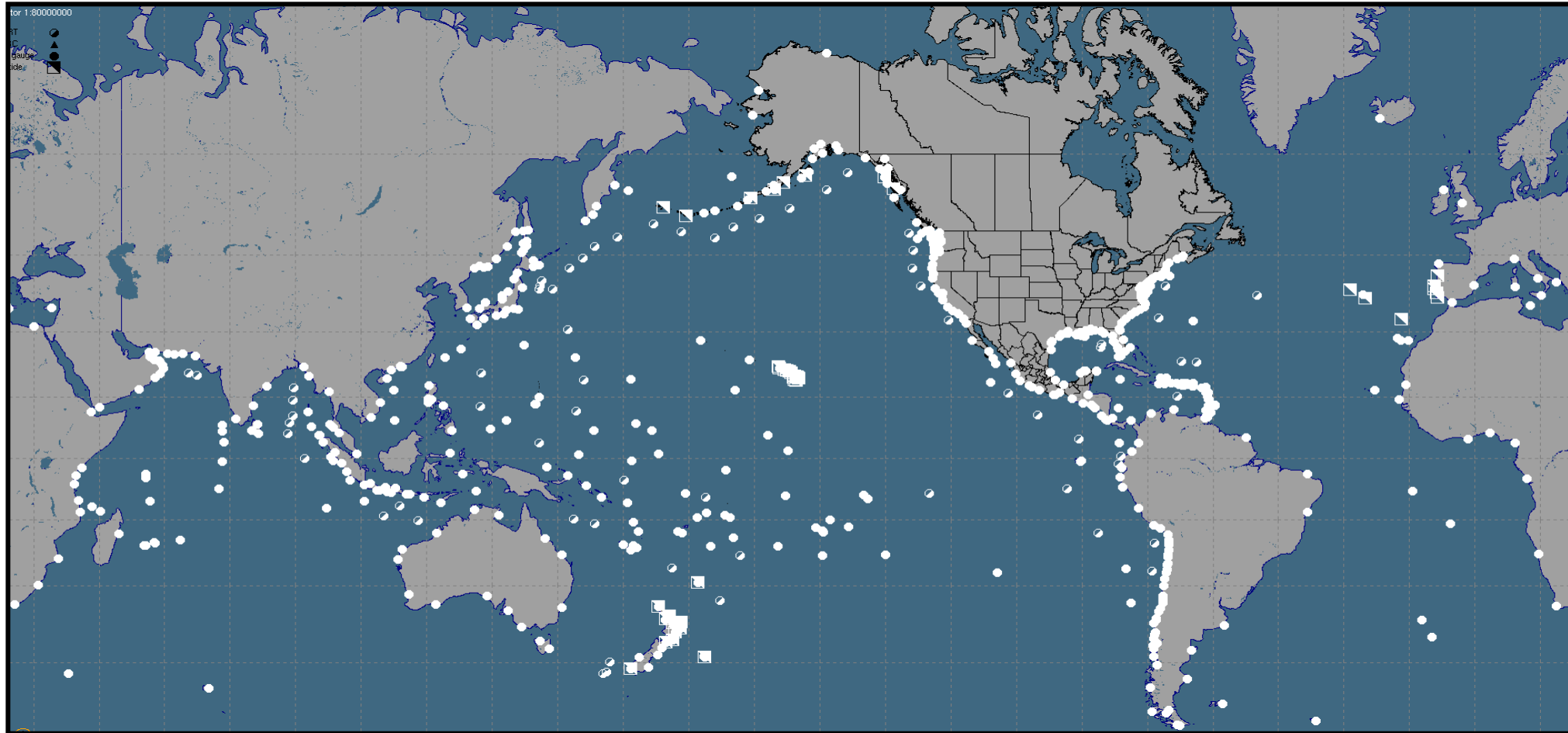
Elapsed Time: 52 Minutes

Forecast based on EQ Mechanism

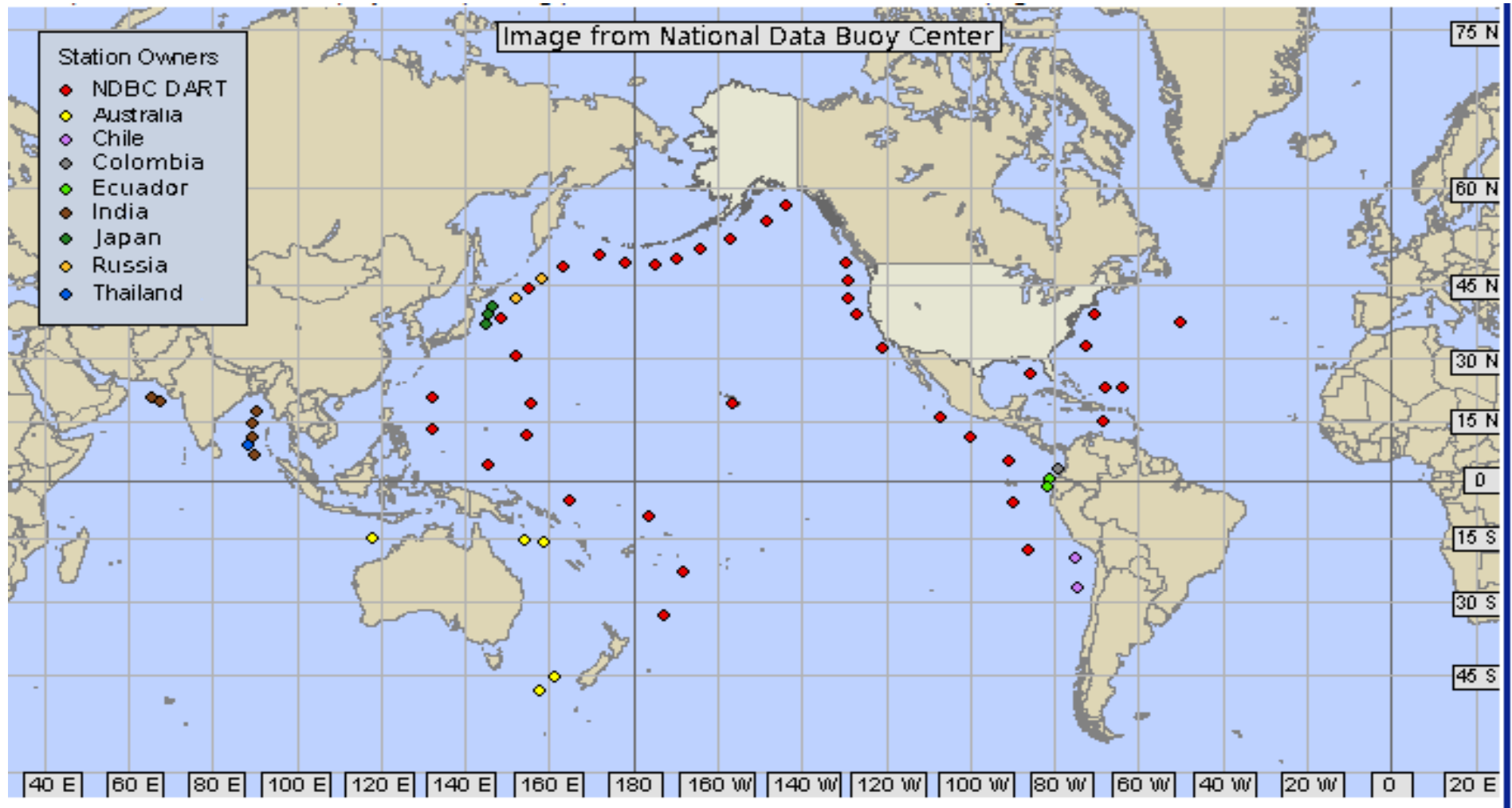




Real-Time Reporting Sea Level Gauges



Real-Time Reporting Deep-Ocean Gauges (DARTs)



Confirmation of Tsunami, Evaluation of Threat, and US Alerts



Elapsed	Place	Event	Max Value
00:10-01:29	Quintero, Chile	Gauge Reading	1.77 m
00:21-00:29	Coquimbo, Chile	Gauge Reading	4.72 m
00:51-01:03	Chanaral, Chile	Gauge Reading	1.14 m
00:25-00:39	DART 32402	Gauge Reading	0.10 m
	TWCs	Models Constrained with DART Data	
01:31-01:46	DART 32401	Gauge Reading	0.05 m
	TWCs	Confidence in All Model Results	
02:29	Hawaii	Advisory	0.3-1 m
02:29	Guam/CNMI	No Threat	<0.3 m
02:48	S. California	Advisory	0.3-1 m
03:14	Am. Samoa	Advisory	0.3-1 m

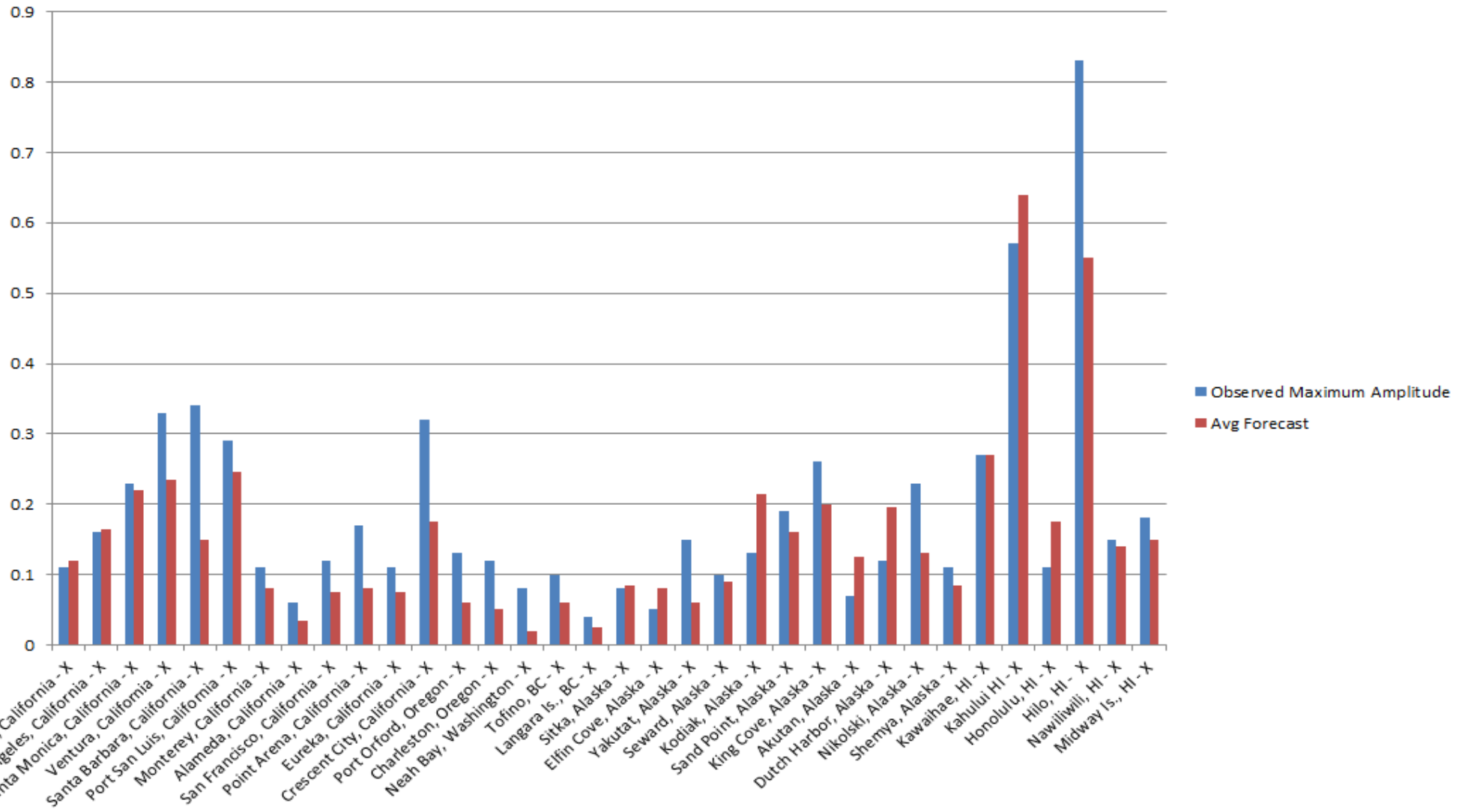


Summary of Forecast and Observations

PLACE	FORECAST	ALERT	MAXIMUM ON GAUGE
Chile	>3 m	N/A	4.72 m (Coquimbo)
Fr. Polynesia	1-3 m	N/A	1.40 m (Nuku Hiva)
Peru	0.3-1 m	N/A	0.52 m (Callao)
Ecuador	0.3-1 m	N/A	0.18 m (Baltra)
Japan	0.3-1 m	N/A	0.80 (Kuji)
Russia	0.3-1 m	N/A	0.44 m (Shikotan Is.)
Hawaii	0.3-1 m	Advisory	0.85 m (Hilo)
West Coast	0.3-1 m	Advisory	0.33 m (Ventura)
Am. Samoa	0.3-1 m	Advisory	0.63 m (Pago Pago)
Guam/CNMI	<0.3 m	None	<0.03 m (Apra Harbor)



Comparison of Ntwc Domestic Forecasts





Cancellation of Threat and US Alerts

Elapsed	Place	Event
18:39	Hawaii	Advisory Cancelled
18:39	American Samoa	Advisory Cancelled
20:24	Southern California	Advisory Cancelled
24:10	Countries of the Pacific System (PTWS)	Final Threat Message for the Pacific

Summary of Casualties and Damages (Earthquake and Tsunami)



- ❑ All major effects happened in Chile
- ❑ Over 1 million were evacuated from the coast
- ❑ 13 deaths and 14 injuries (most or all from earthquake)
- ❑ 6 persons missing as of 24 September
- ❑ 55 persons in shelters
- ❑ 13427 without housing
- ❑ 816 homes destroyed
- ❑ 1011 homes uninhabitable
- ❑ Most tsunami damage around Coquimbo and Tongoy
- ❑ Most earthquake damage around Salamanch and Illapel

Particulars Courtesy of
ONEMI and SHOA



Coquimbo Sea Level Gauge (+4.72 m)



Photo Courtesy of SHOA



Multiple Ships Aground at Coquimbo



Photo Courtesy of SHOA



Summary of Event Response

- ❑ TWCs Responded Quickly
- ❑ Preliminary and Later Seismic Analysis was Accurate
- ❑ Judgment of Potential Tsunami Threat was Accurate
- ❑ Three Tsunami Forecast Models Used
 - Seismic and Sea Level Model Constraints were Sufficient
 - All Models Gave Consistent and Accurate Forecasts
 - Appropriate Alert and Threat Levels Issued
- ❑ Domestic and International Systems Worked Well



THANK YOU

2015 Tsunami Alerts

- Chile – September, 2015
 - Tweb used experimentally; viewer; ViewOnly
 - Lessons
 - Should Watch have been issued by NTWC?
 - Should NTWC provide impact estimates without validation by observation?
 - Others?
 - California Survey results
 - NTHMP Survey? Action!

Products – New Format

- New NTWC Format Live November, 2015
 - Major changes
 - Headlines
 - Organization
 - Impacts
 - Recs.
 - Need to better include forecast information in headline

Products – PTWC Update

PTWC is a new product line that will be available in the near future.

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Products

- WEA Polygon Status – Action!
- EAS for Advisory Status
- Auto EAS at WFO Status
- BC Notification Project
- Brainstorming on graphical/mobile products

Improving End-To-End Tsunami Warning for Risk Reduction on Canada's West Coast

Supported by the Canadian Safety and Security Program, in partnership with
Emergency Management British Columbia

Project Update

Peter Anderson
Simon Fraser University
anderson@sfu.ca

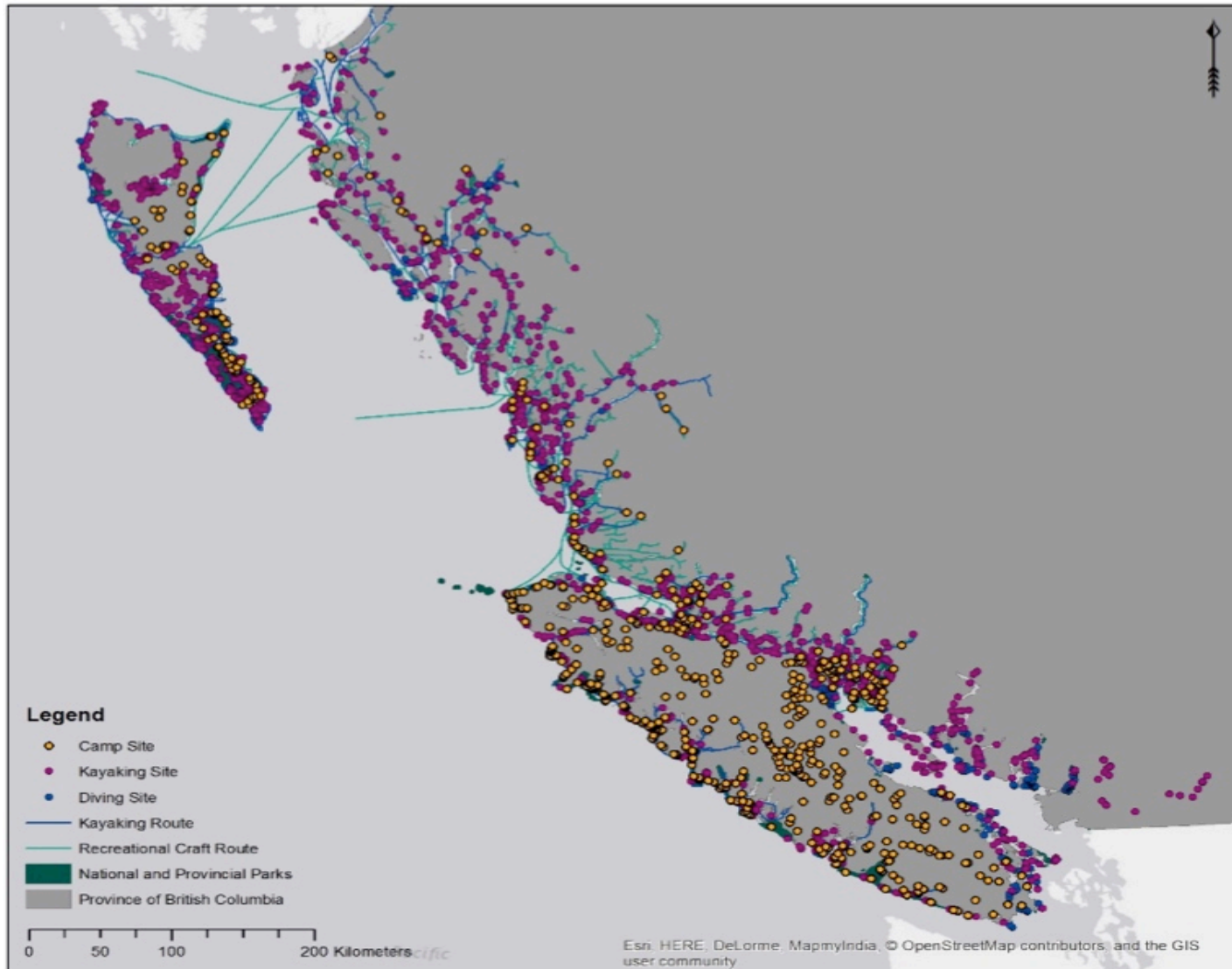
Objective

Pilot and evaluate new notification techniques and technologies along the British Columbia coastline

B.C. Notification Challenges

- 26,000+ kms of varying coastline, much of which is rugged and remote
- Biggest challenges:
 - notifying populations in remote permanent communities with limited and/or poor communications coverage
 - identifying and notifying populations on the move or in temporary fixed locations (transient populations) who now inhabit areas all year round

Examples of Recreational Activities



Coastal National and Provincial Park Attendance

	Total Visits			
Year	Gwaii Haanas	Pacific Rim	Gulf Islands	Provincial Parks
2010	1,721	844,217	NA	4,166,604
2011	1,717	904,929	14,064	3,845,861
2012	1,760	880,813	14,502	4,321,870
2013	1,703	887,611	15,177	4,760,111
2014	1,785	926,453	16,307	4,625,044

Annual total visitation numbers for coastal Provincial and National Parks from 2010 to 2014

Note: Many parks are used during off-season but attendance is not recorded.

2015 Pilot Projects

Mobile Satellite Emergency Notification Devices (SEND) Tests

- Enable GPS tracking and two-way short email and SMS text messaging
- Tested two types:
 1. inReach
 2. Iridium Go
- Both use the Iridium Low Earth Orbit Satellite network
- Mobile phones and tablets running special apps can be paired to the devices
- Messages sent from devices can be pre-composed or composed free-form
- Can be used to receive @NWS_NTWC, @NWS_PTWC, @EmergencyInfoBC Twitter to SMS messages

2015 B.C. Community/Regional SEND Pilot locations

- Gitga'at Nation (Hartley Bay)
- Wuikiunxv Nation (Rivers Inlet)
- Port Alice
- Ehattesaht/Chinehkint First Nation
- Zeballos
- Ucluelet
- Tseshaht First Nation (Port Alberni)
- Kwikwikwasut'inuxwHaxwa'mis First Nation (Gilford Island)
- Regional District of Mount Waddington
- Strathcona Regional District
- Prince Rupert to Victoria coastline
- Pacific Rim National Park – Westcoast Trail

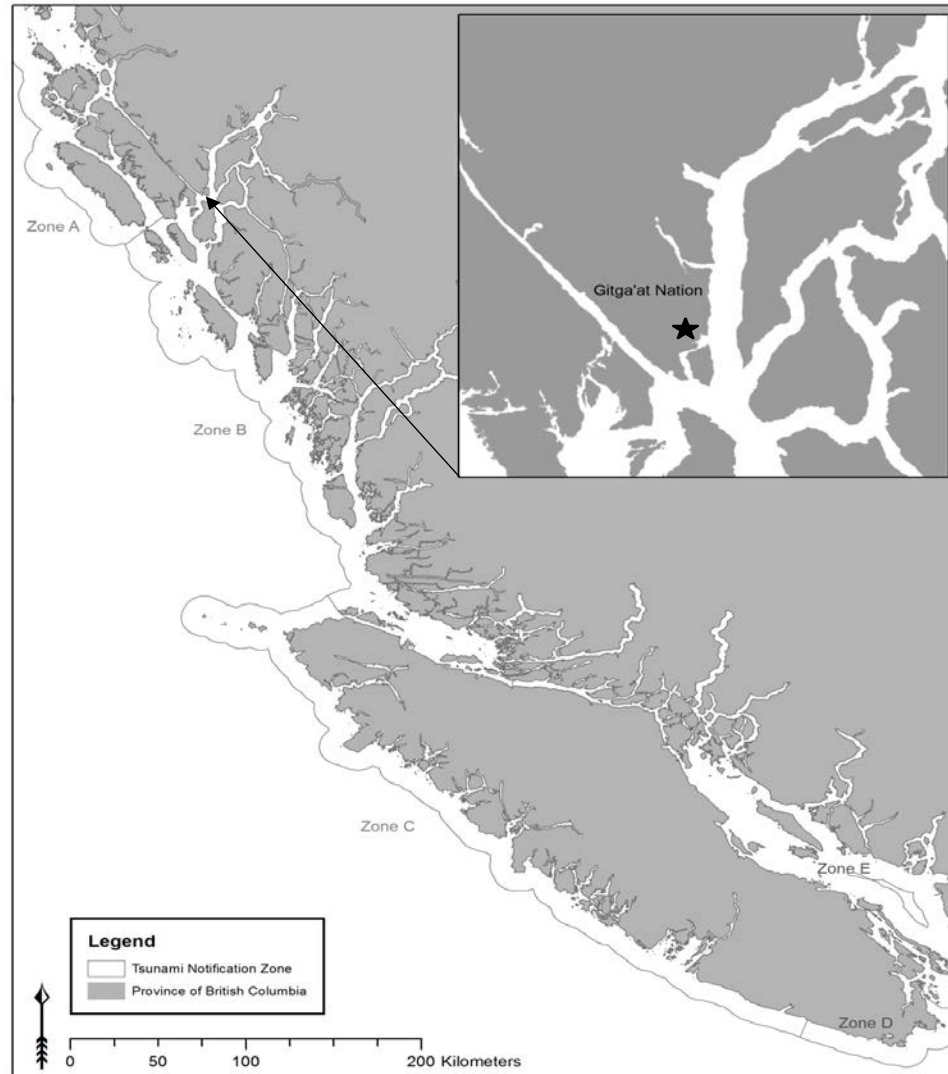


inReach

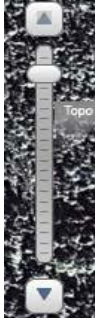
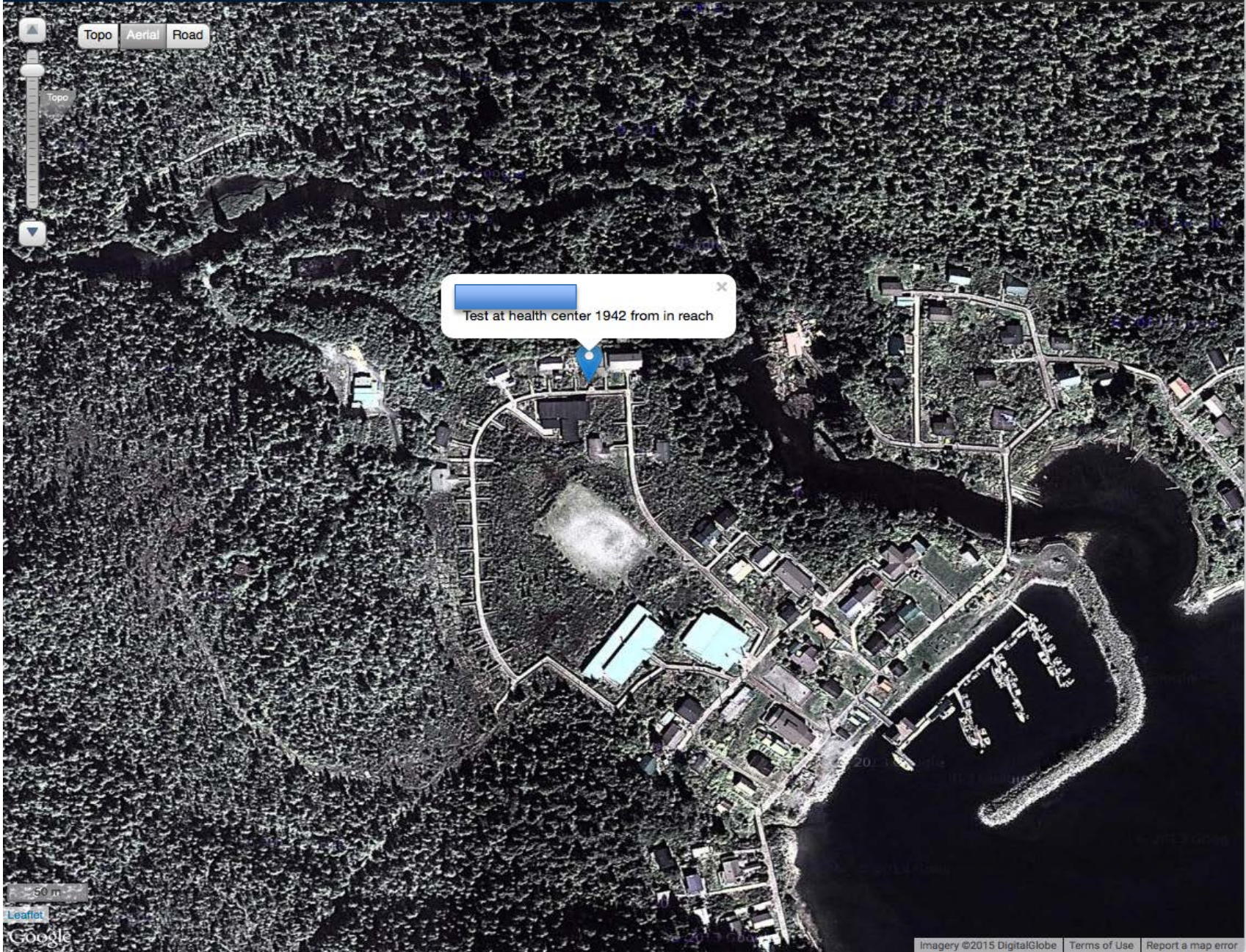


Iridium Go





Gitga'at Nation



Topo Aerial Road

Test at health center 1942 from in reach

50 m

Leaflet Google

https://explore.delorme.com/Map

DELOME

Home Map Groups & Users Devices My Info Settings Sync Log Out | Site Help | Support | Legal

Map Filters (Off)

[Select a bookmark] + -

Message Types

Date & Time Range:

All Time

Clear Filters

Users (2) Waypoints Routes

Track Locate Message Send Center

ID Name

Last: May 26th 2015 8:06 pm

Track Summary

May 26th 8:06 PM

Dist Traveled	Trip Time
0.85 km	01:00:45
Average Speed	Max. Speed
0.69 km/h	4.83 km/h
	Max. Elevation
	38 m

Message Tuesday 8:06 PM

Test from Heli pad at 2007

Message Tuesday 7:57 PM

From school 1958

Message Tuesday 7:56 PM

From school

Message Tuesday 7:55 PM

Test from Inreach at 1957

Message Tuesday 7:49 PM

Test from Gitga'at gym at 1950 on in reach

Message Tuesday 7:43 PM

Test at health center 1942 from in reach

Message Tuesday 7:24 PM

Topo Aerial Road New Waypoint New Route Import Export

Topo

Test at health center 1942 from in reach 7:43 pm

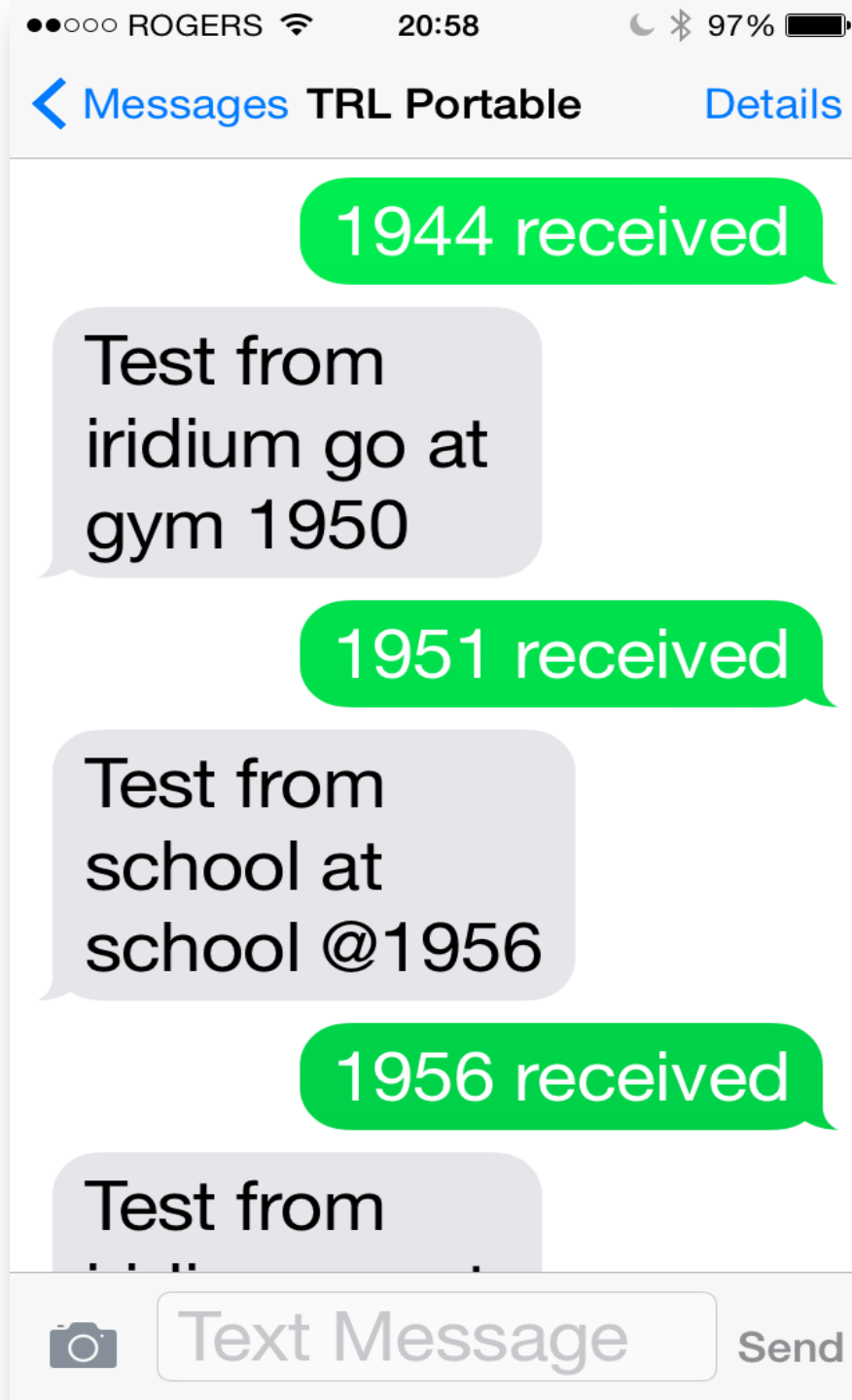
Marc D'Aquino

100 m

Leaflet

Google

Imagery ©2015 Cnes/Spot Image, DigitalGlobe Terms of Use Report a map error



Paired Smartphone App
Testing message delivery times

CCGS Bartlett

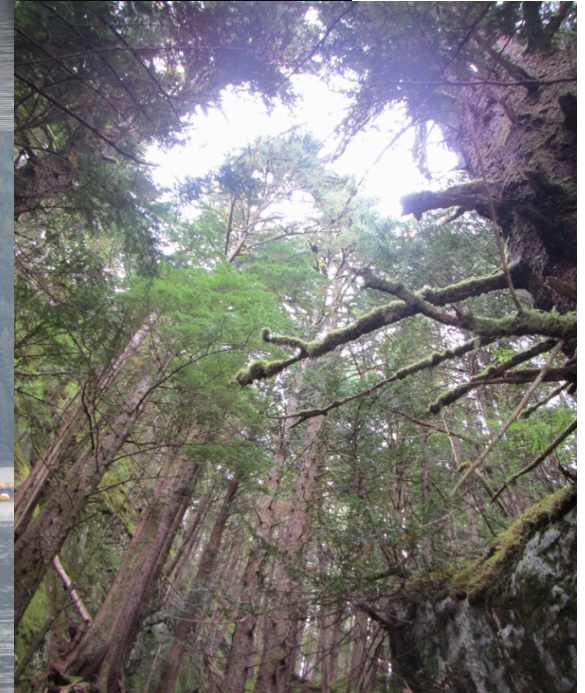
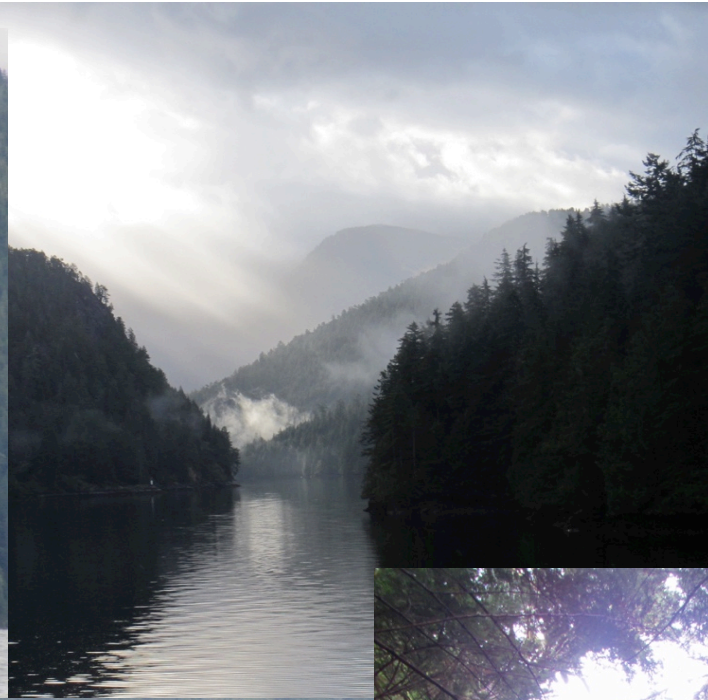
25 August - 3 September, 2015

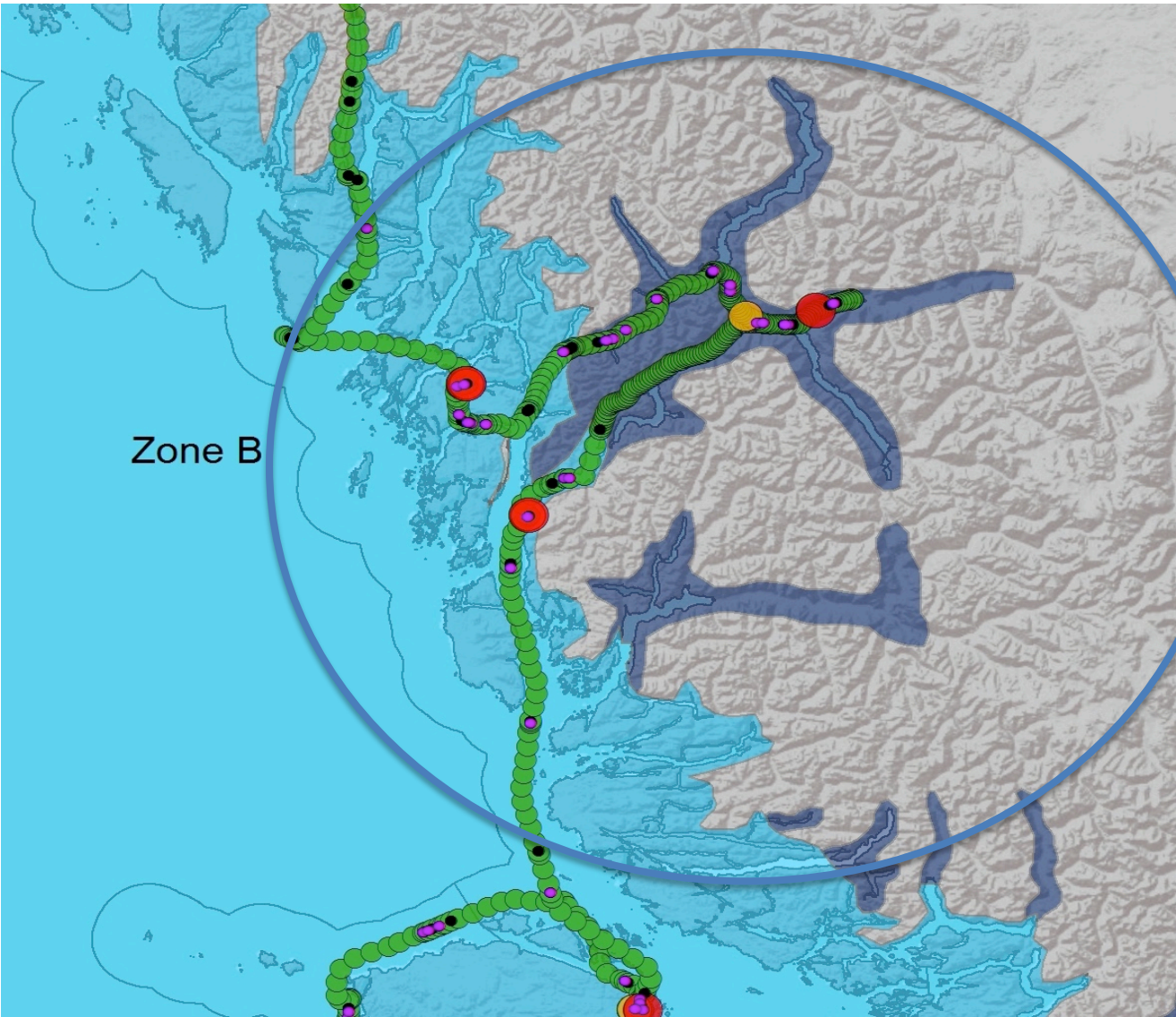








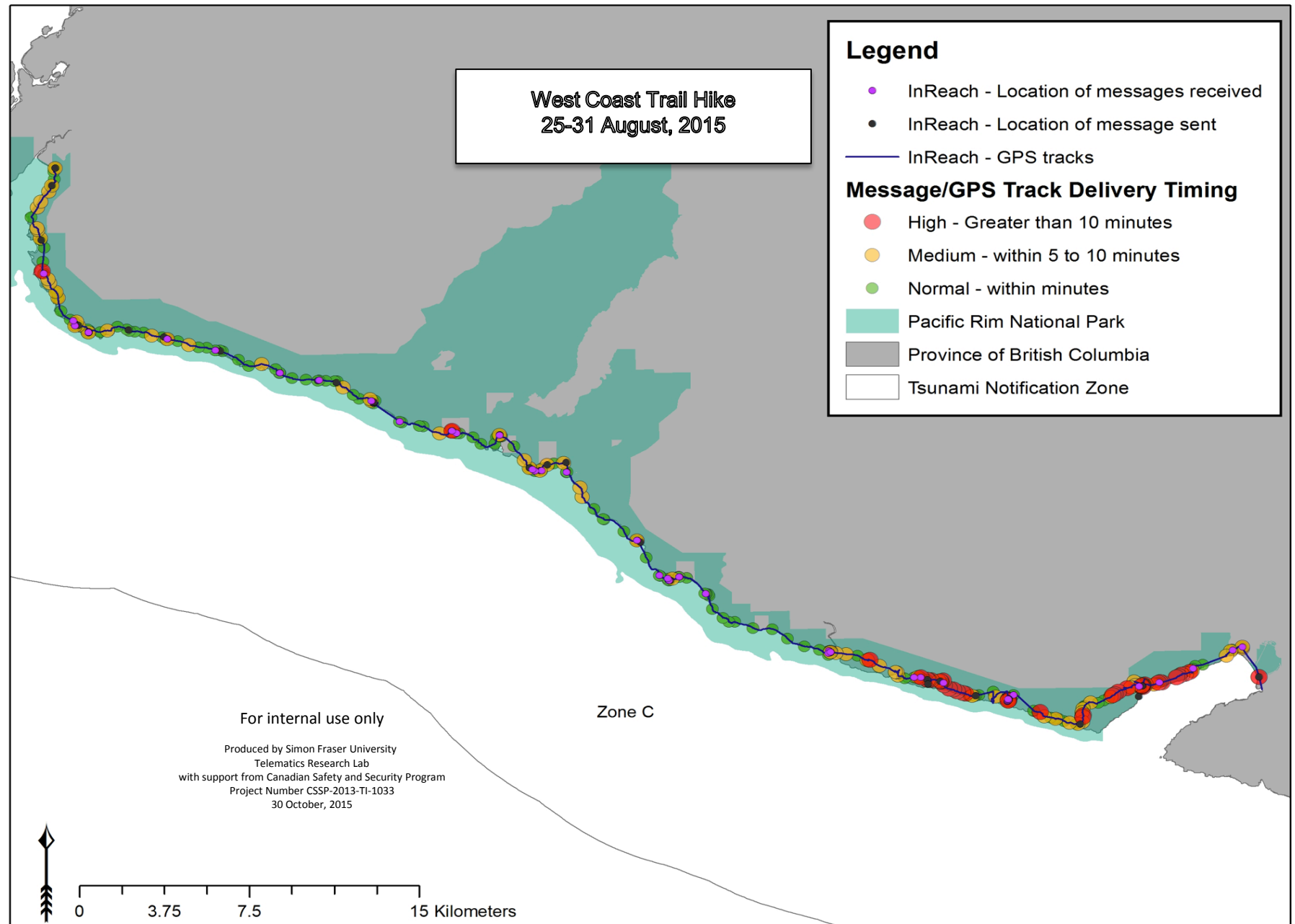




West Coast Trail Trek
Pacific Rim National Park
West Coast of Vancouver Island
25-31 August, 2015



75 km Backpacking Trail



Observations

- Timeliness of messages sent and received
 - Subject to line-of-sight and satellite connectivity conditions
 - Since messages are stored and forwarded, they will eventually arrive, but could be delayed for considerable time in forested or mountainous terrain, especially narrow inlets
 - Consequently, not suitable for local/near-shore tsunami event notification
- GPS reporting is useful for reporting last known locations
- Generally useful where there is no other form of external communication
- Affordable and accessible technology

Follow up – Next Steps

- Analysis of message input procedures
 - Manual versus automated
 - Timeliness of tsunami messaging
- Knowledge and technology transfer
- Interest in collaboration with other Pacific regions

For Further Information

Please Contact:

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Exercises

- Monthly Comms. Tests
 - False Alarms – recent
 - Continue using live code?
- CaribeWave16 – 14/1500UTC March 17, 2016
 - Venezuela
 - Hispaniola
- Lantex16 – 1300UTC March 16, 2016
 - Offshore New England quake and landslide
- Cascadia Rising – 1500UTC June 7, 2016
 - [Link to Plans](#)
- PacWave Plans

Exercises

- EAS/NWR Test Plans
- 2017 Exercises
 - Pacific
 - Suggestions?
 - Atlantic
 - Wednesday March 29, 2017?
 - Source? Action!
 - Caribbean
 - Define Action!

Training

- COMET Updates
 - Tsunamis! – Dec. 23, 2014
 - Community Tsunami Preparedness – Oct. 28, 2015
 - Tsunami Warning Systems – Jan. 7, 2016
- NTWC TWS training
- Others

Training

- COMET Usage
 - Tsunamis!
 - About 1500 per year
 - Tsunami Warning Systems
 - About 400 per year
 - Community Tsunami Preparedness
 - Variable – 400 to 2000 per year
 - Tsunami Strike!
 - Two versions; 500 to 1200 per year

TWC TOPS Update

Tsunami Research Adv. Comm.

- 2016 Projects
 - Ongoing
 - GPS Ships – last year
 - COMMIT
 - GPS Source/NASA
 - Tweb
 - DART4g
 - SIFT – Ongoing and upgrades

Tsunami Research Adv. Comm.

- 2016 Projects
 - New
 - HF Radar
 - Real-time SIFT models
 - SIFT source units - smaller
 - Time dependent rupture
 - Proposed
 - [Webcams](#)



UNITED STATES DEPARTMENT OF COMMERCE
NATIONAL OCEANIC AND
ATMOSPHERIC ADMINISTRATION

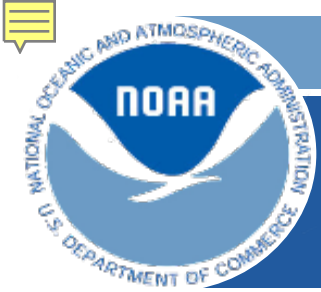


Meteotsunamis: Working Toward an Operational Forecasting Capability

Michael Angove, NOAA/NWS
Paul Whitmore, NOAA/NTWC

January 12, 2016

Fourth Symposium on Building a Weather-Ready Nation: Enhancing Our Nation's
Readiness, Responsiveness, and Resilience to High Impact Weather Events



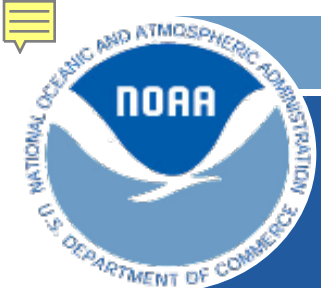
Meteotsunamis

- Tsunami-like waves of meteorological vs. seismic origin
- Depend on intensity, direction, and speed of **disturbance over water** body with a depth that enhances wave magnification
- NOT same as storm surge



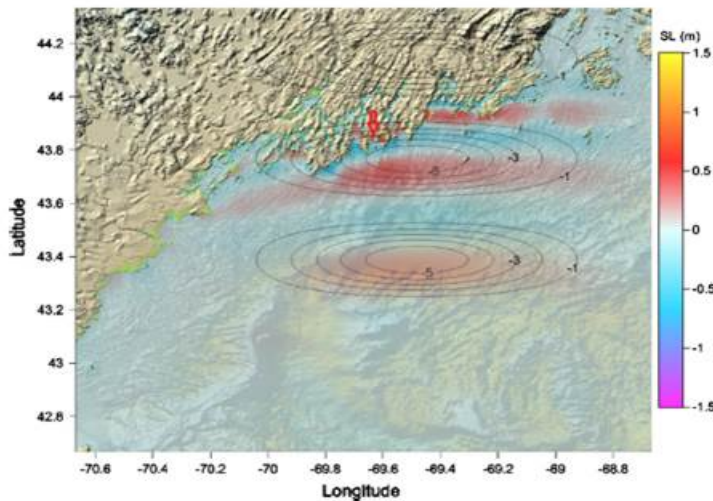
Source: Monserrat, Vilibić, Rabinovich; Nat. Hazards Earth Syst. Sci., 6, 2006





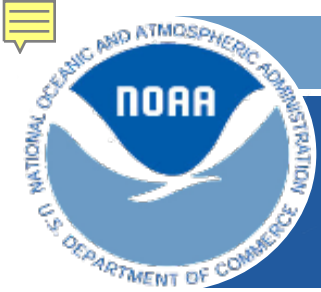
October 28, 2008

- Boothbay Harbor, Maine (Gulf of Maine shelf)
- Waves up to 12' high emptied and flooded the harbor at least 3 times over 15 minutes, damaging boats and shoreline infrastructure
- Wave heights were reproduced by tsunami forecast model and atmospheric gravity wave source
- Tsunami models work, but case highlights challenge of forecasting met parameters prior to detection



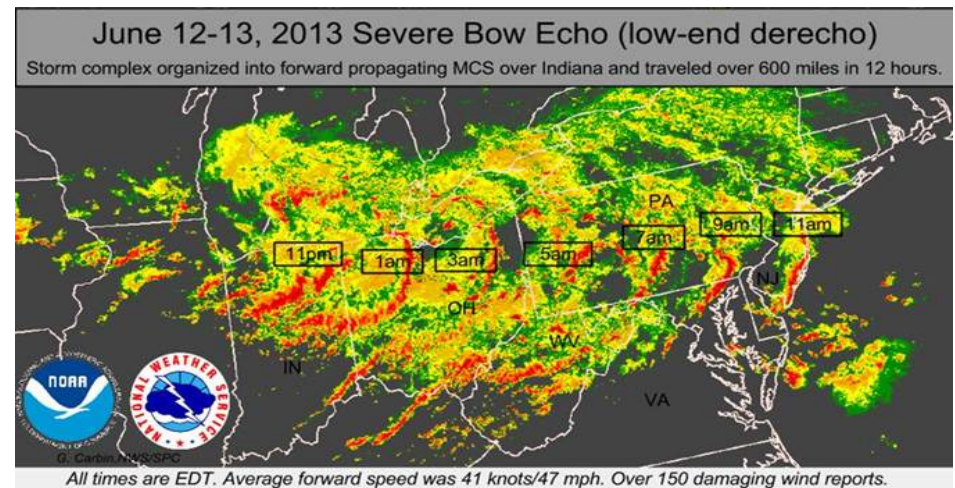
NJ News Clip – **We will insert the video clip before uploading it to AMS. With the video, the file is too large and cannot be sent over e-mail for purposes of working on it remotely. Once inserted. All you'll have to do is click on it and it will play. It will not take you to YouTube.**

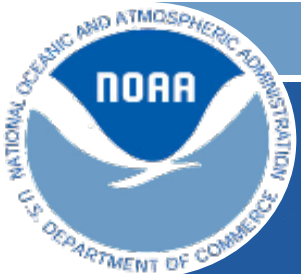
<https://www.youtube.com/watch?v=QHw2KIC3a2o>



June 13, 2013

- New Jersey and southern Massachusetts coasts
- Barnegat Inlet, New Jersey: 3 people injured by 6-foot wave that swept them off jetty into water
- Waves recorded on water-level stations from Puerto Rico to New England and tsunami buoy
- Caused by weakening, low-end derecho
- Alerts possible based on shelf effect





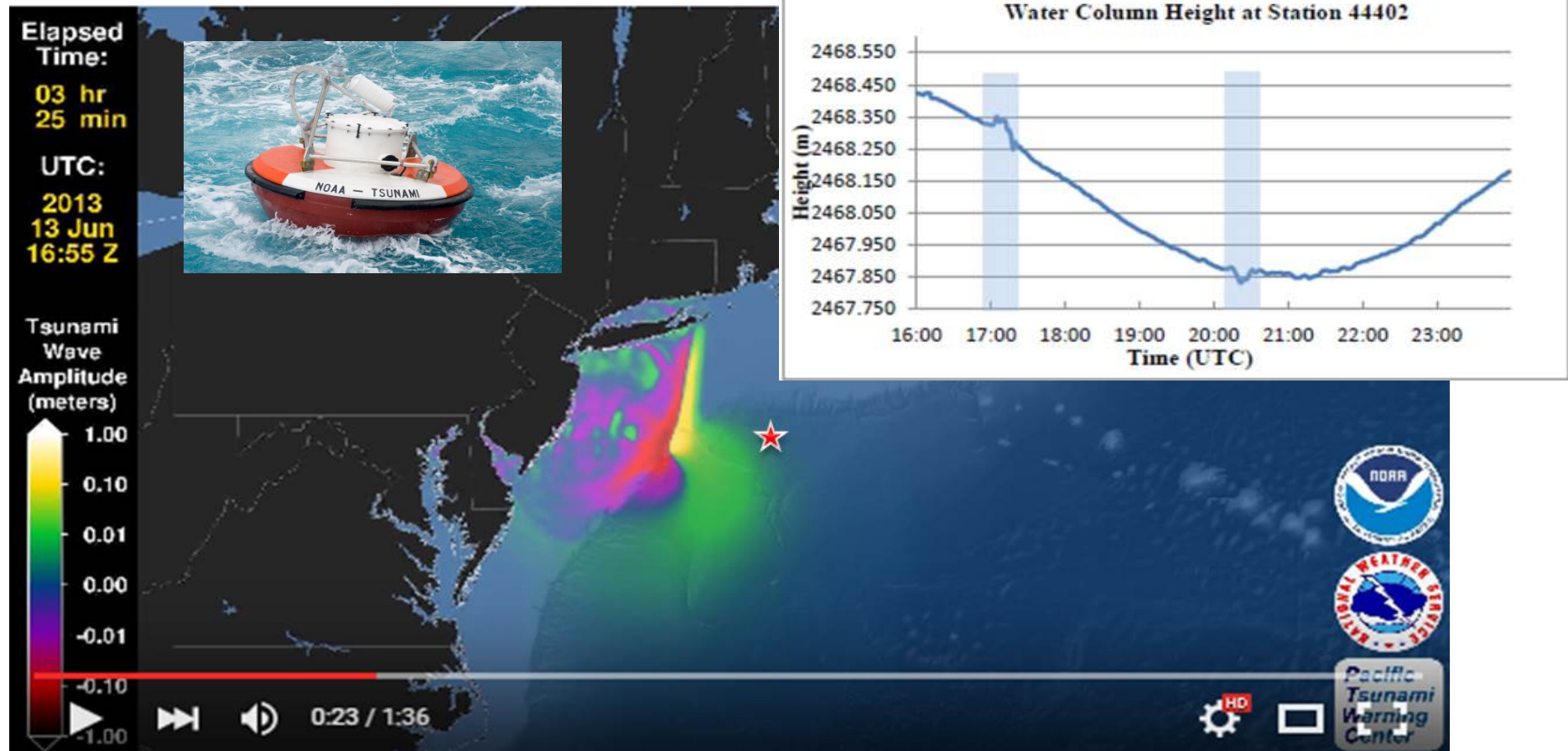
2013 Animation

Insert video before uploading to AMS. **We will insert the video clip before uploading it to AMS. With the video, the file is too large and cannot be sent over e-mail for purposes of working on it remotely. Once inserted. All you'll have to do is click on it and it will play. It will not take you to YouTube.**

<https://www.youtube.com/watch?v=ykABRe5Yt3c>

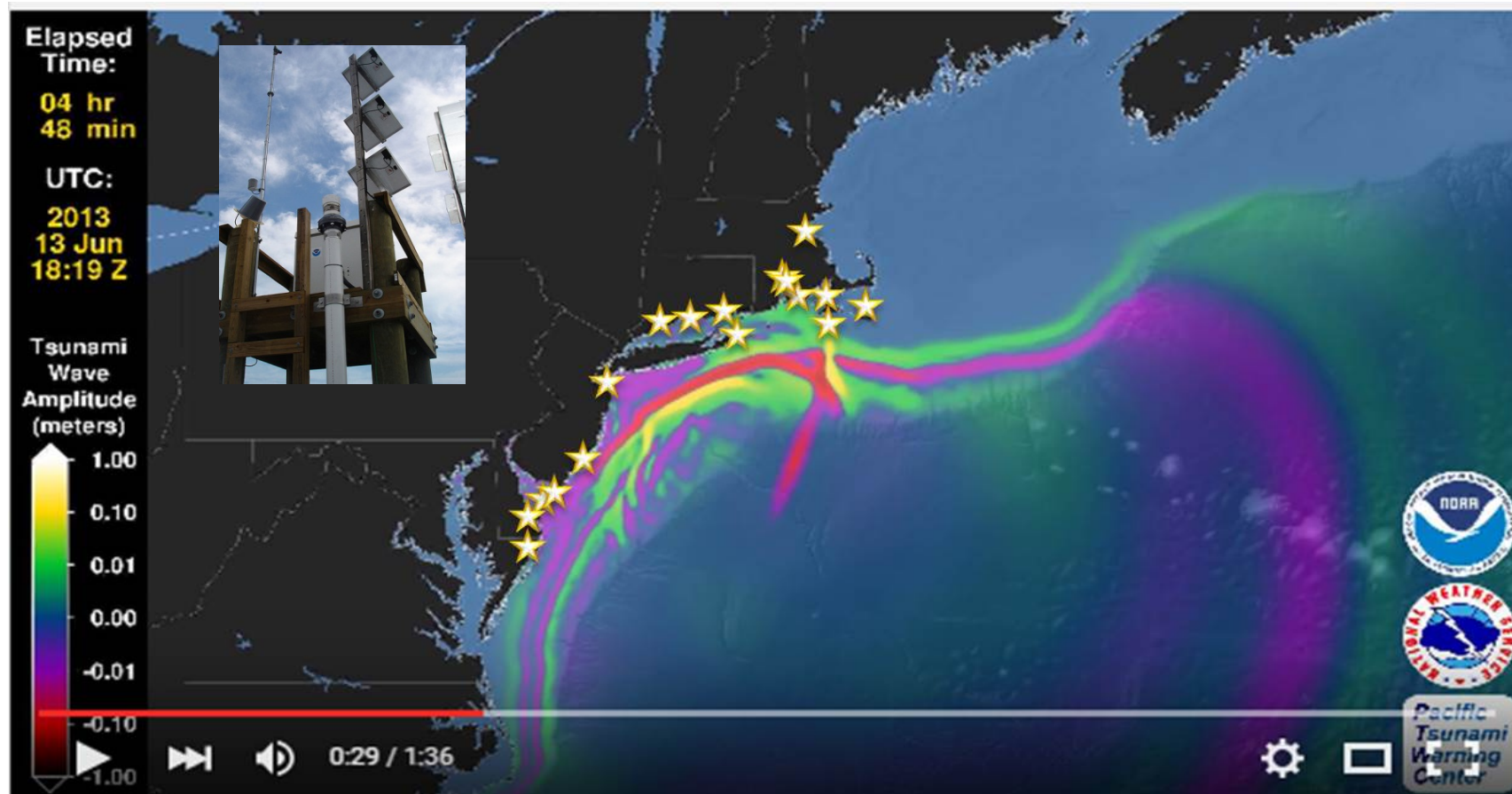


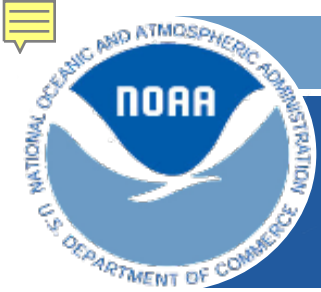
DART Systems





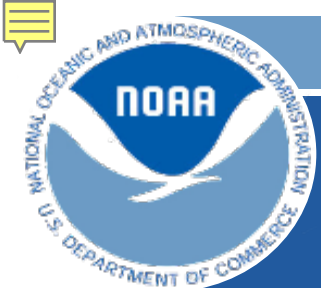
Coastal Water-Level Gauges





Challenges

- Forecasting—Meteotsunami (MT) formation tightly constrained by depth, translational speed of disturbance, and direction; requires extremely accurate mesoscale forecast
- Detection—Even if MT forms, network of observation systems not dense enough to detect MT disturbance
- Messaging—Potential for confusion with wind-driven storm surge and normal seiche activity



Proposed Protocol

- Not for all MTs; emphasis on eastward propagating disturbances
- May, June, July—National Tsunami Warning Center (NTWC) will follow medium-range numerical weather prediction (NWP) models to ID candidate disturbances
- If disturbance is in models at TAU 24 or less, NTWC will contact responsible WFOs to discuss
- WFOs may include potential for MT in forecast discussions or special weather statements
- Inside TAU 12, NTWC will monitor tsunami detection networks—DART buoys placed in event mode, coastal gauges, HF coastal radar (potentially)—for MT signals
- If detection made, NTWC will alert WFOs and provide *estimates* of amplitude and travel time to coastal locations
- WFOs may issue alerts (e.g., coastal flood warning)





Future Development

1. More accurate and timely alert on detection capability
 - MT source inversion techniques
 - MT historical libraries/simulations
 - Denser detection network
2. Work toward alert on forecast capability
 - High-resolution mesoscale maritime NWP
 - Sophisticated MT detection algorithms
 - High-density sea level pressure detection network over coastal margin



Q&A

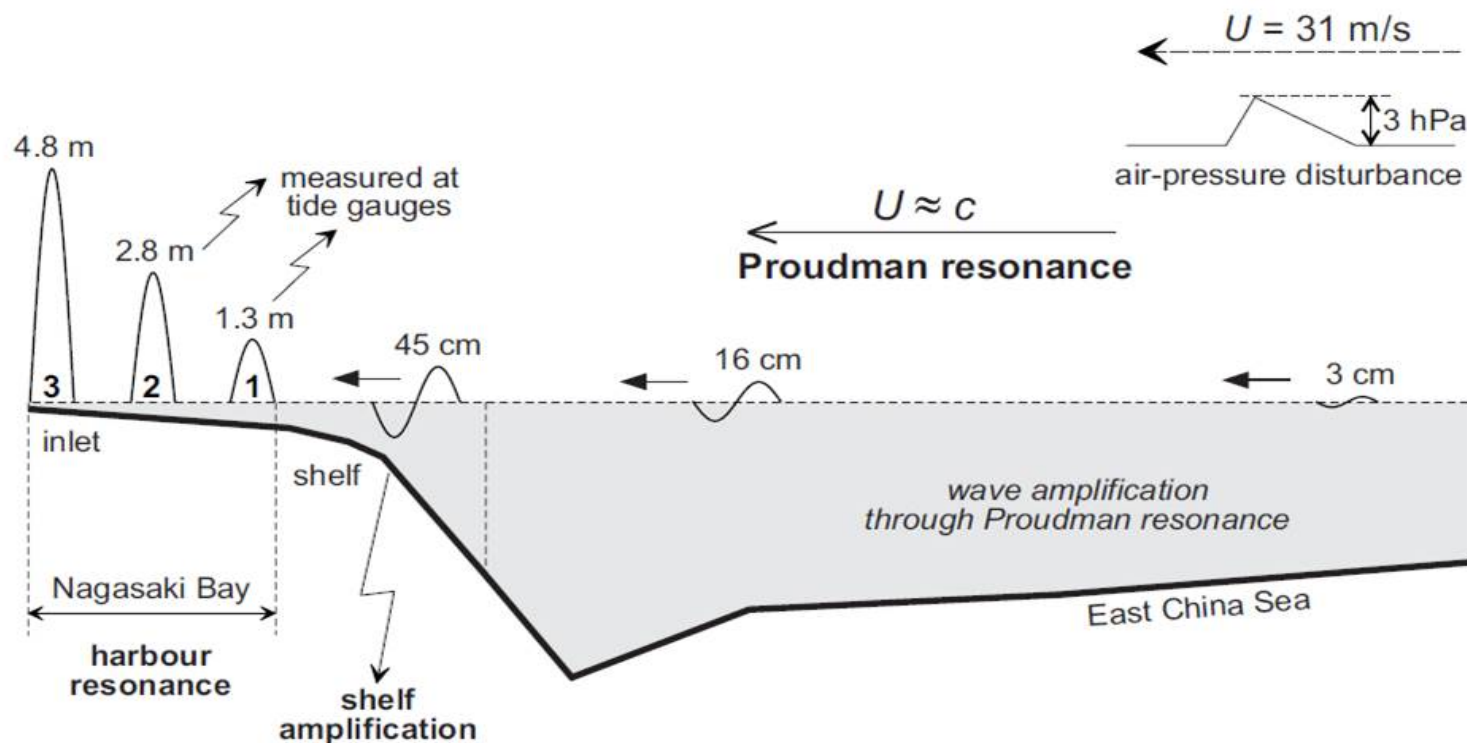
Michael Angove
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Paul Whitmore
NOAA/NWS National Tsunami Warning Center
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<http://ntwc.arh.noaa.gov>

Meteotsunami Fact Sheet: <http://nws.weather.gov/nthmp/meteotsunamis.html>



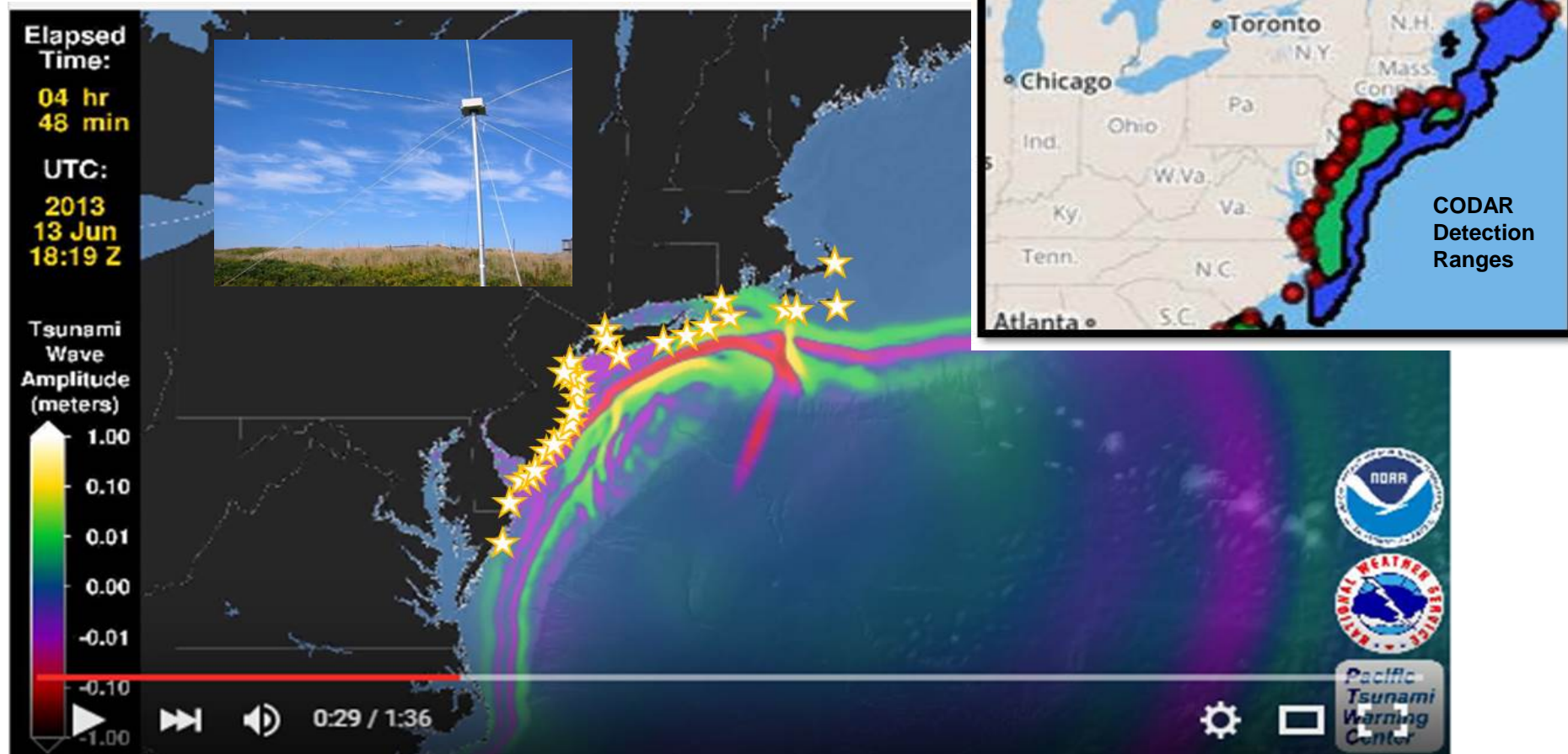
Proudman Resonance



Source: Monserrat, Vilibić, Rabinovich; Nat. Hazards Earth Syst. Sci., 6, 2006



HF Coastal Radar





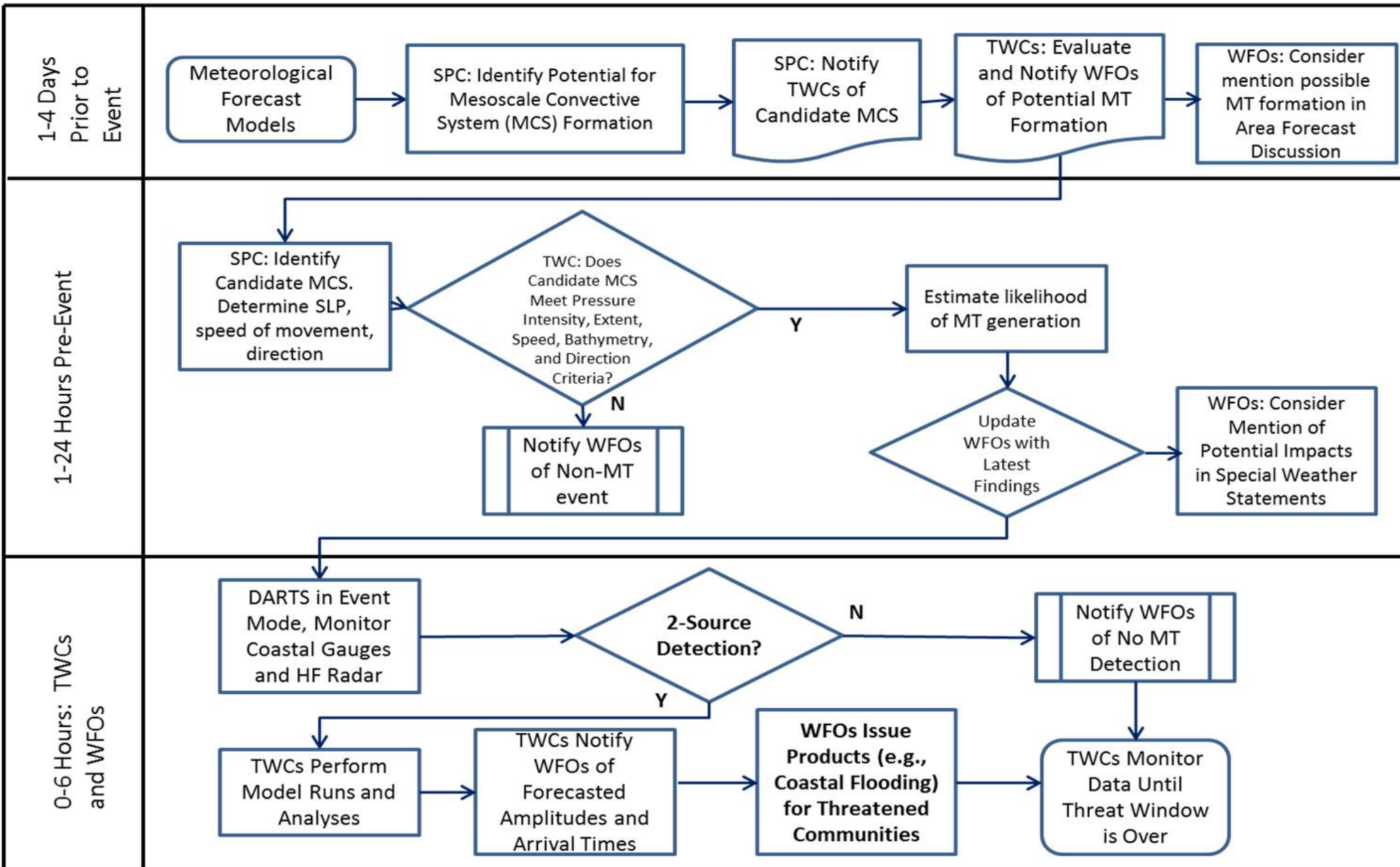
DART Systems (cont'd)

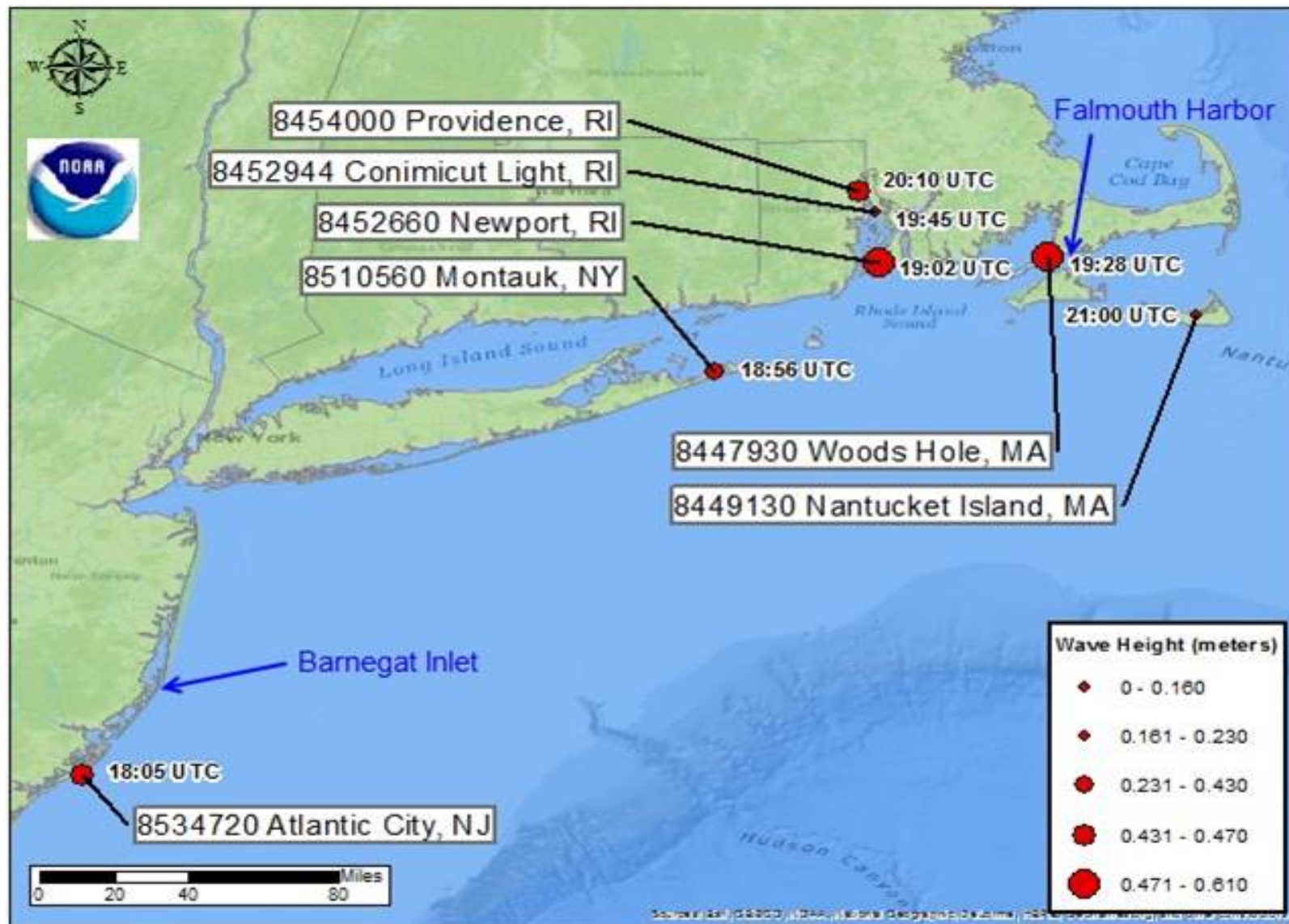




Meteotsunami Protocol Process Flow

Primary Season: May-July





Maximum recorded at NOAA gauges

New Actions

- Products
 - WEA Polygons?
 - EAS Activation for Advisories?
- Establish date and scenario for 2017 Exercises
- Training?
- TWeb
- Meteotsunami alerts?
- New Tide gage sites?
- Update TOR?