



United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission



PTWS PTWC ENHANCED PRODUCTS USER'S GUIDE
UNESCO IOC TS 105, April 2013

PTWC Enhanced Products for the PTWS

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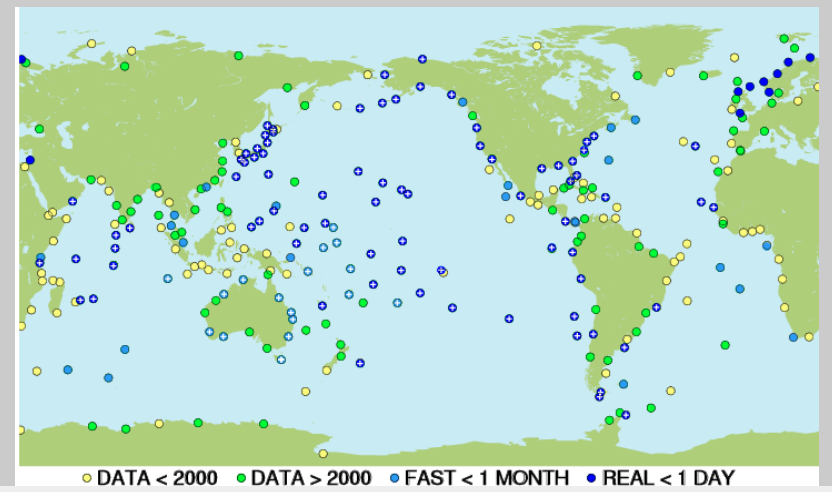
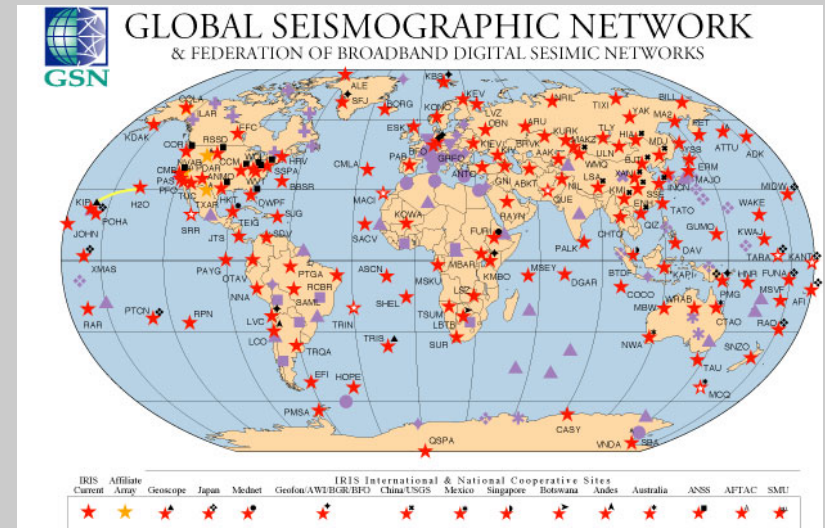


For Tsunami Warning - 3 Basic Needs

- **VERY RAPID EARTHQUAKE EVAL**
- **VERY RAPID TSUNAMI SEA LEVEL EVAL**
- **VERY RELIABLE COMMUNICATIONS**

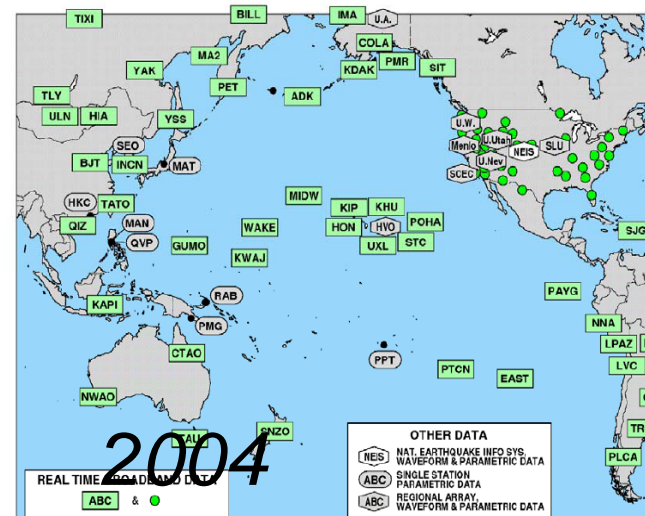
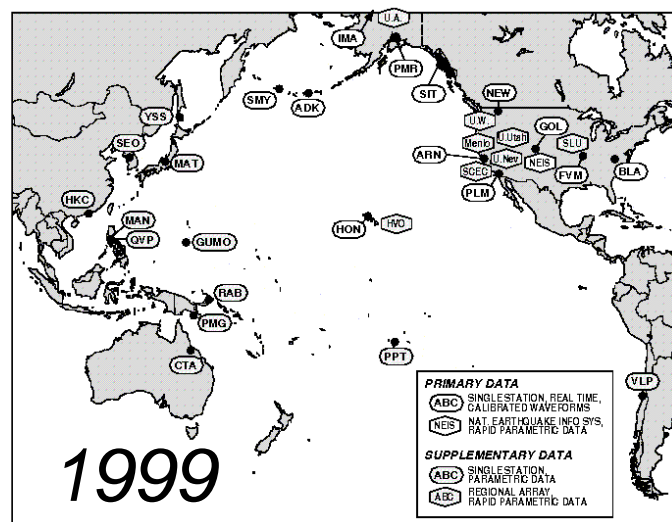
e.g., Multi-national, global data networks with real-time transmission and free/open data sharing

➤ **ALL REQUIRED FOR TIMELY WARNING**

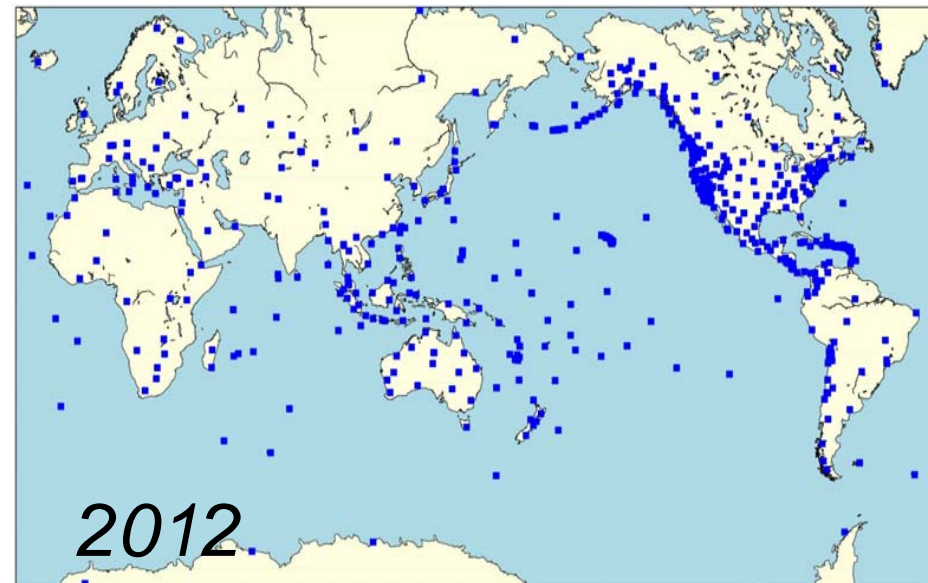


IOC GLOSS Network, incl real-time, non-real time, archive

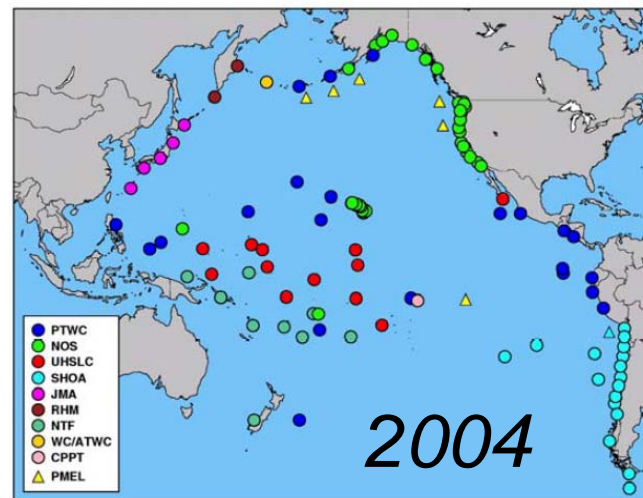
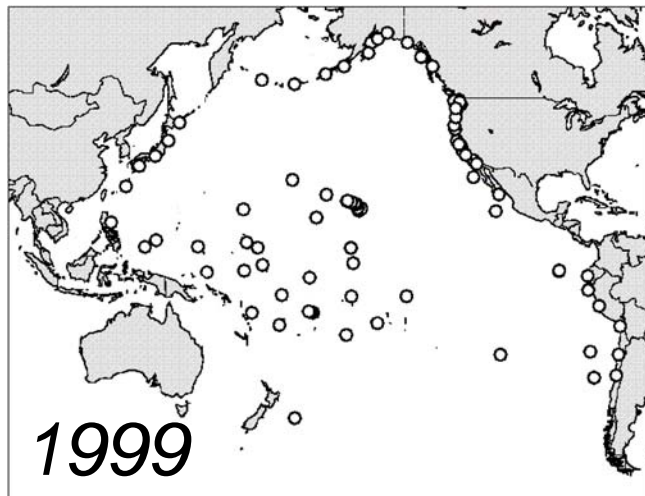
Core Seismic Network - PTWC



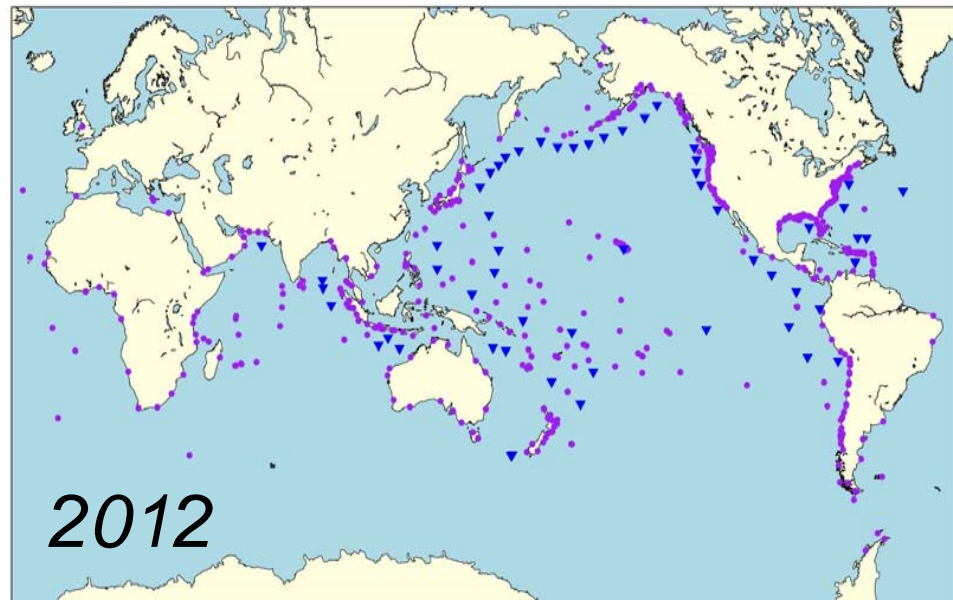
*In 2013, PTWC
receiving data
from > 400 stations
in real time*



Core Sea Level Network - PTWC



*In 2013, PTWC
receiving data
from > 400 stations
(coastal, deep-
ocean) in real time*



PTWC Elapsed Time to Initial Bulletin



**Earthquakes:
Denser Networks, Higher Quality Data, Better and
Faster Methods => Faster Detection & Response**



Current PTWC Products

- ☐ **Text product only**
(by GTS, AFTN, fax, email, EMWIN, website, SMS)
- ☐ **Product Content**
 - **Countries put in Warning / Watch (alert status)**
 - **Forecast tsunami arrival times at designated forecast points**
 - **Measurements of observed tsunami waves**
 - **General response guidance**
- ☐ **Issued hourly, or sooner if new information**

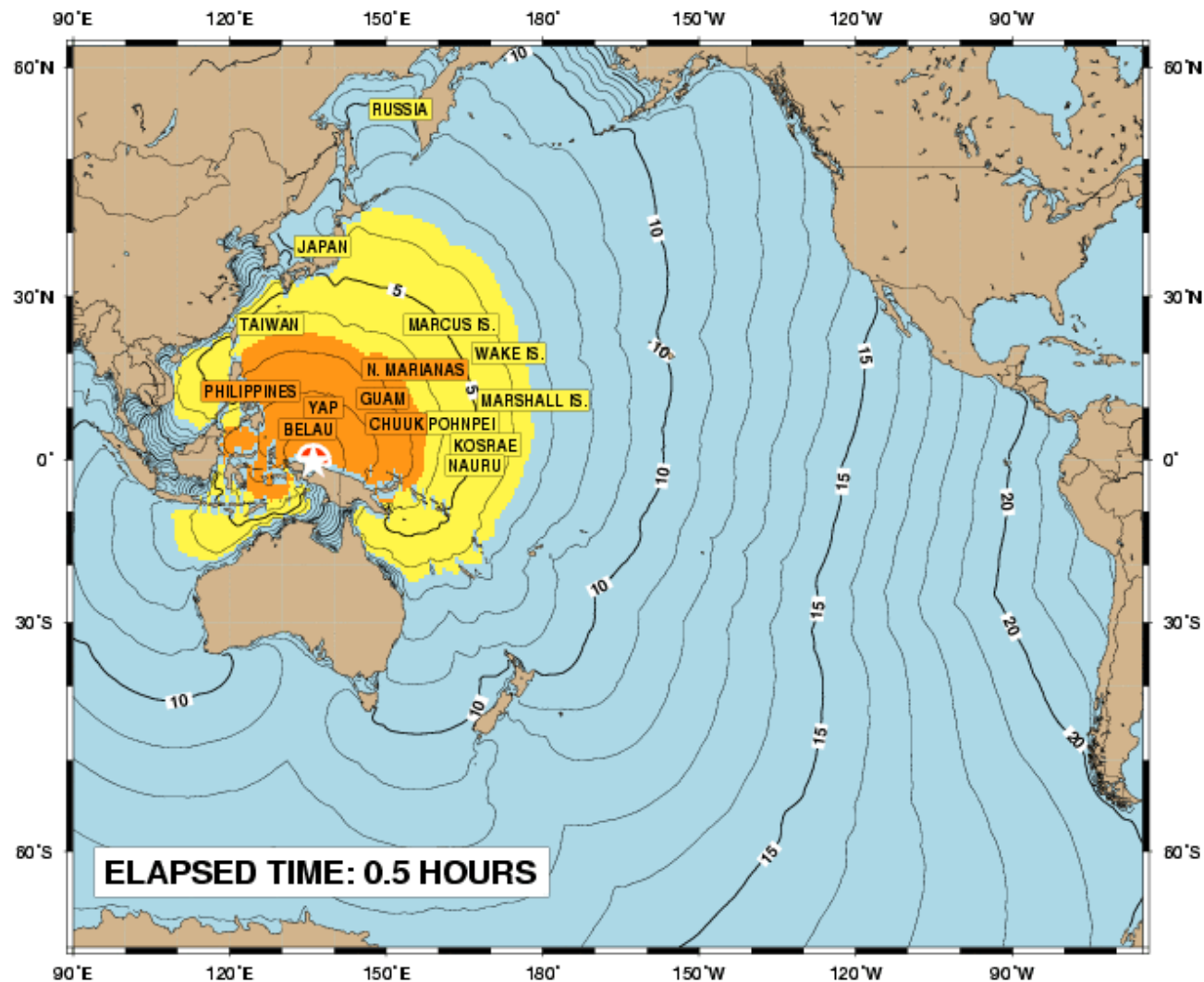


Current PTWC Warning Criteria

Alert Status

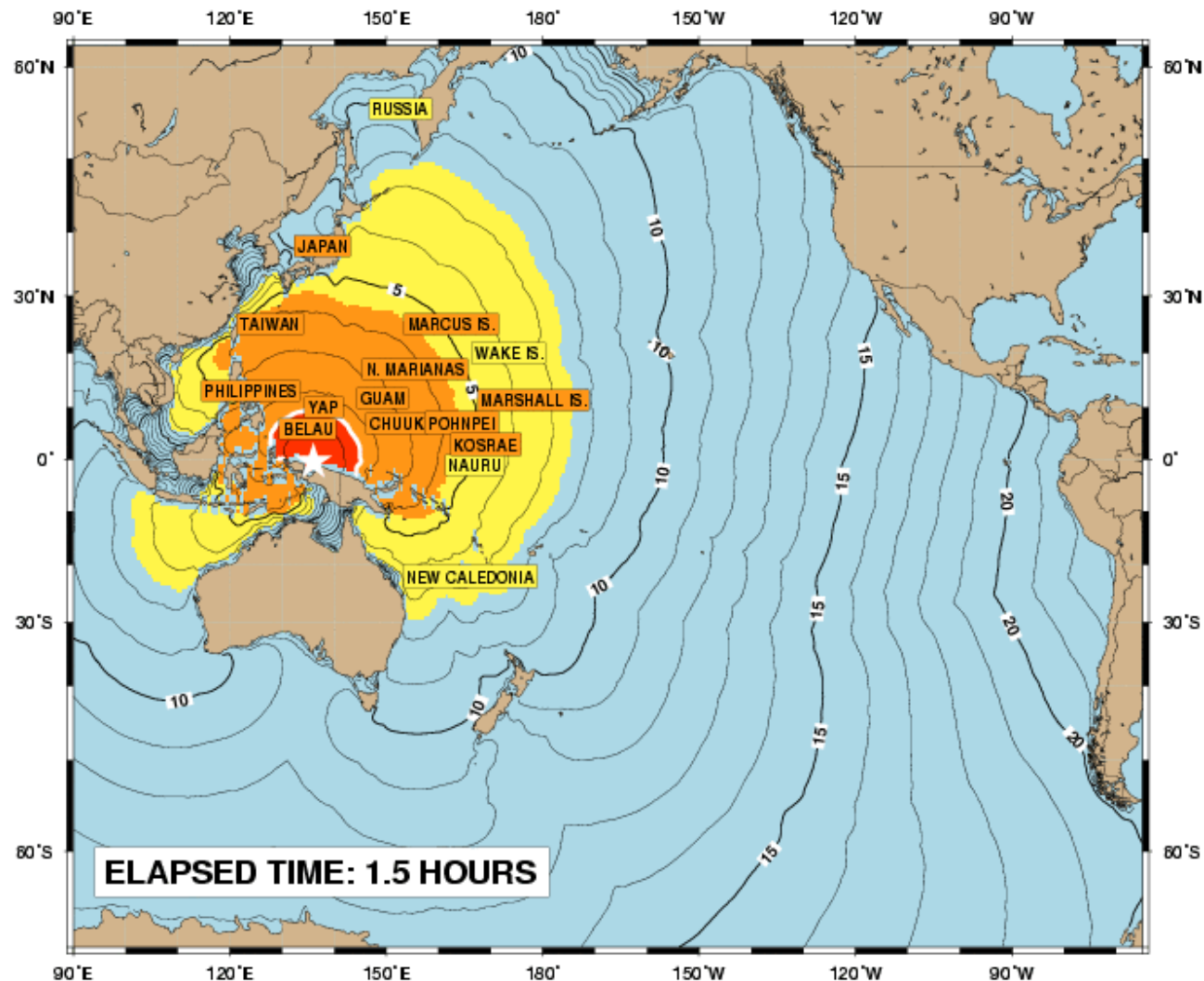
Earthquake	Product Type	Description
Magnitude 6.5-7.5 or >6.5 and >100km depth or far inland	Information Bulletin	No Tsunami Threat or only small Local Tsunami Threat
Magnitude 7.6-7.8 and <100 km depth and under sea or near sea	Regional Warning	Warning to 1000km from epicenter
Magnitude >7.8 and <100km depth and under sea or near sea	Expanding Warning	Warning if < 3 hours to impact, Watch if 3-6 hours to impact
Confirmed major tsunami	Pacific-wide Warning	Confirmed tsunami with widespread destructive threat

Status based time until wave arrival



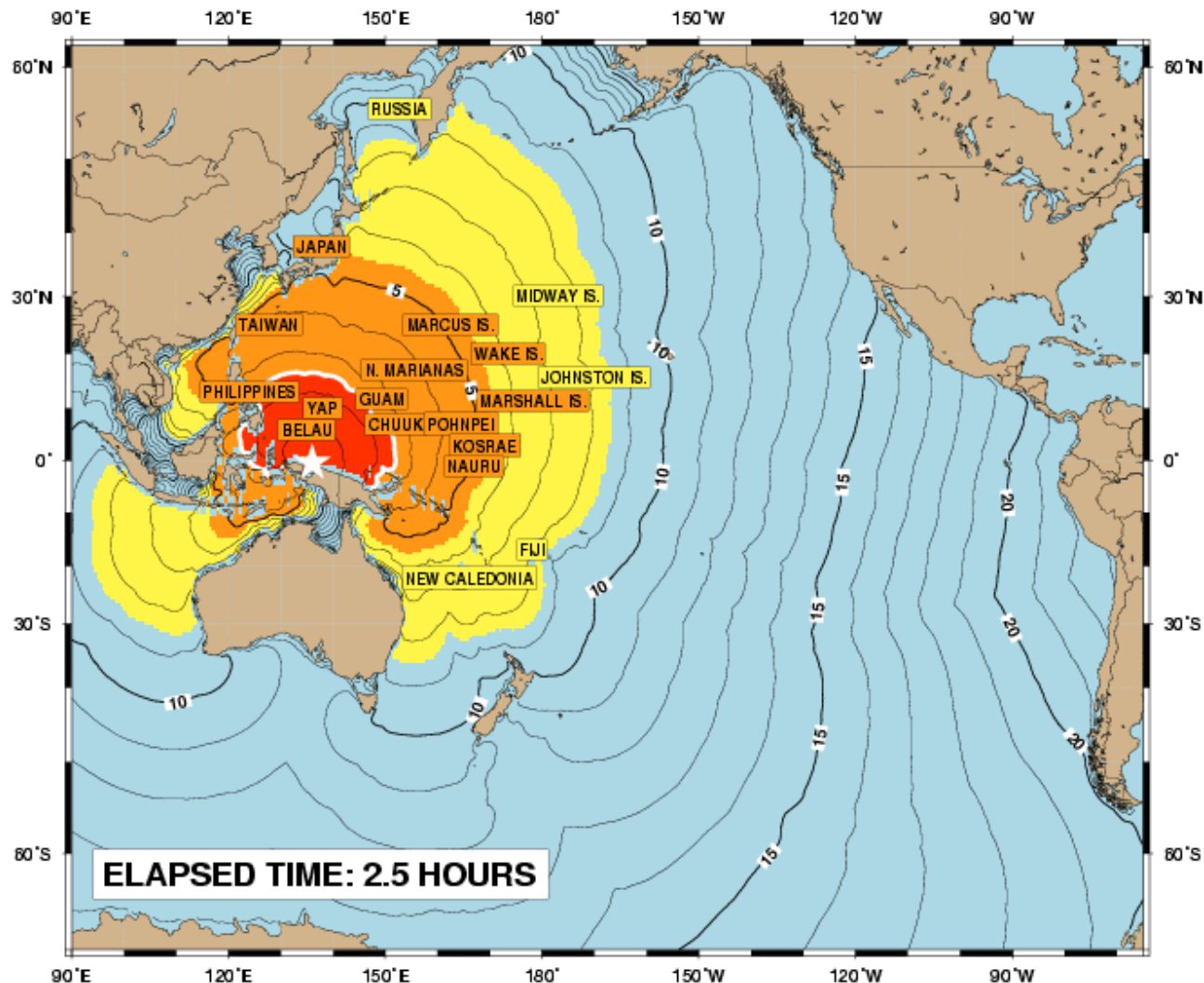
Tsunami Warning < 3 hrs, Watch 3 – 6 hrs from arrival

Status based time until wave arrival



Tsunami Warning < 3 hrs, Watch 3 – 6 hrs from arrival

Status based time until wave arrival



Tsunami Warning < 3 hrs, Watch 3 – 6 hrs from arrival

Limitations of Current Procedures

- **Last major revision in 2001 (change Ms to Mw)**
- **Very conservative for safety.**
Based primarily on limited historical data.
Has resulted in significant over-warning
- **Initially puts areas in Warning or Watch based on:**
 - **Earthquake magnitude,**
 - **Estimated time left to tsunami impact or**
 - **Distance from earthquake epicenter**
- **Timely Alert for regional and basin-wide tsunamis.**
No timely Alert or guidance for local tsunamis
- **No information about expected levels of wave impact**
- **PTWC warning advice can cause confusion with Country's authoritative warning**
- **Text product only**



Changes – Enhanced Procedures, Products

- **Base threat on forecast models, not on pre-determined magnitude threshold (can also apply to local tsunamis)**
- **Initial Products:**
 - Forecast based on preliminary earthquake parameters (hypocenter, magnitude)
 - Issued in < 10 min, so helpful for local threat
- **Later improved forecasts constrained by earthquake mechanism (W-CMT) and sea level readings**
- **No Alert levels. Instead, 3 THREAT LEVELS based on maximum forecast wave amplitudes:**
 - 0.3 to less than 1 m
 - 1 to less than 3 m
 - 3 m or more
 - Other: Forecast not yet computed

No Threat - 0 to less than 0.3 m



Benefits

- **Reduce conflict with Country NTWC Alert levels**
- **Still conservative but should greatly reduce over-warning**
- **Provides estimated level of impact**
- **Includes graphical as well as text products**
- **Includes “kmz” file of forecast points to facilitate drilling-down to finer spatial resolution**
- **Real-time model can handle earthquake locations and mechanisms anywhere, not just than shallow-thrust events in subduction zones (limitation of SIFT / ATFM models).**



Limitations – Forecast Models

Greatest unknown in real-time is tsunami source.

e.g., How did seafloor deform? How much was seafloor displaced up or down, over what areas, over what time?

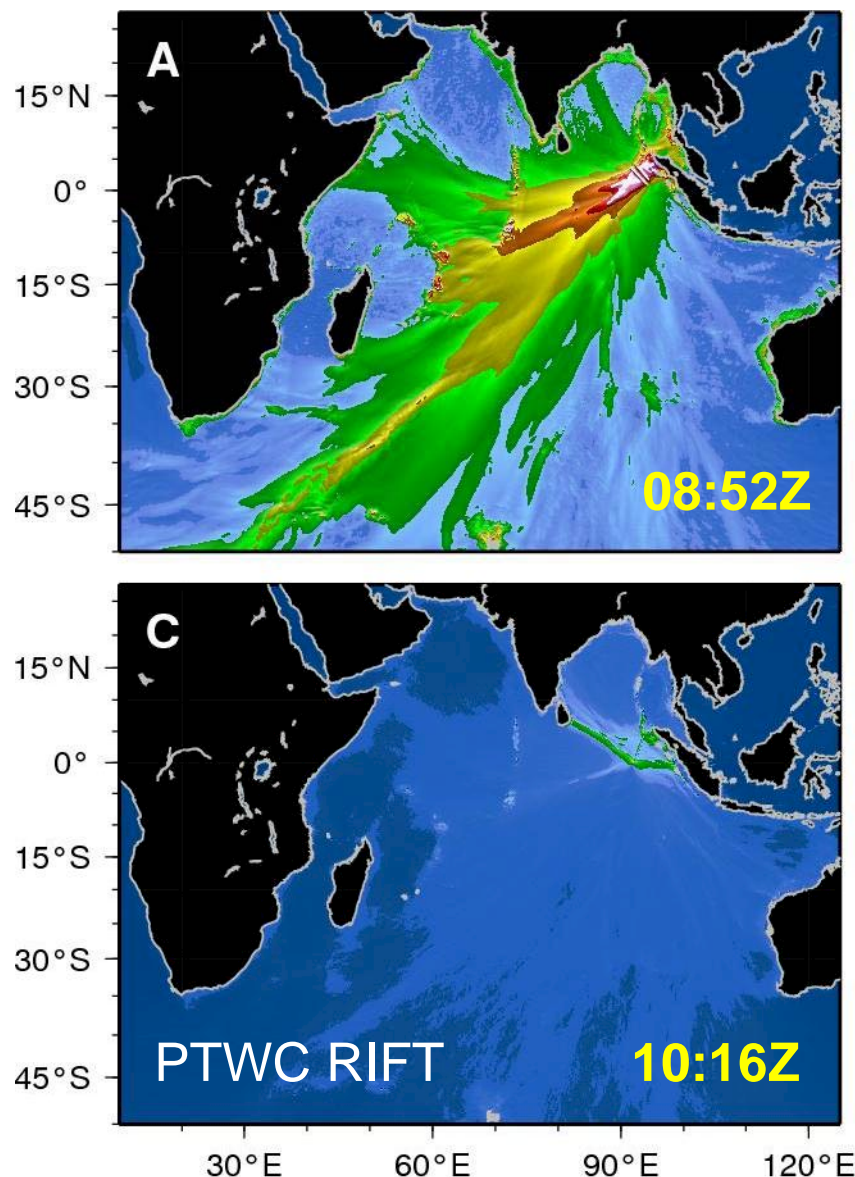
Forecast models make assumptions based on best available seismic or sea level gauge readings. But this is only an approximation of the real source – which can evolve from the 1st few minutes to hrs after earthquake with more data.

2nd greatest unknown is how tsunami will hit coast.

General approximation used (Green's Law). Needed are detailed bathymetry, and coastal inundation models that can properly and accurately capture coastal resonances, trapped wave energy, multiple wave interactions after a few wave cycles, and in real-time as tsunami is approaching..



TWC Forecasts - Source Uncertainty



08:38 UTC, 11 April 2012
Sumatra, Indonesia, M8.6:

- OT + 5 to 20 min:
Thrust fault assumed 1st
=> *Dangerous tsunami*
 - OT + 25 min or more:
W-CMT-constrained
source shows strike-slip
fault => *Not Dangerous*
- *For great earthquakes,
fault rupture details
uncertain for 20-30+ min
so early forecasts may
over- / under-estimate*



Limitations – RIFT Forecast Model

- **Initial forecasts can vary easily by 2X**, because of uncertainties in preliminary magnitude, depth assumed fault mechanism. Later results, constrained by earthquake centroid moment tensor as well as by deep-ocean observations should be more reliable.
- **For small islands (e.g., islands <30 km diameter), Green's Law can overestimate the coastal amplitude.** In those cases, a forecast amplitude between offshore and Green's Law amplitude may be more appropriate.
- **For resonant harbors, Green's Law amplitude can underestimate the actual wave amplitude.** Should interpret as avg wave amplitude at open coast, not necessarily max amplitude inside harbor or at sea-level gauge.
- **The RIFT forecast coastal amplitude is not necessarily indicative of inundation depth**, which is function of local topography. A 30-m coastal amplitude from Green's Law does not mean inundation depth will reach 30 m. But it does indicate a major tsunami impact.
- **In near field, Green's law amplitude does not necessarily takes into account wave propagation and dissipation.** Thus, coastal amplitude of 20-30 m can be misleading, it should simply be interpreted as major tsunami.

New PTWC Products – Text Product

- ❑ Text product continues, but also graphical
- ❑ Product Content
 - (new) Gives locations where maximum tsunami amplitudes forecast. Levels are: $< 0.3\text{m}$, $0.3\text{-}1\text{m}$, $1\text{-}3\text{m}$, $\geq 3\text{m}$
 - Predicted tsunami arrival times (ETAs) at designated forecast points
 - Measurements of observed tsunami waves
 - General response guidance
- ❑ Issued hourly, or sooner if new information



New PTWC Products – Text, Graphical

- Other Text Products**
 - Polygon Forecast Table (Offshore and Coastal forecasts at designated points)**
 - Pending Country feedback, more extensive table of ETAs and/or observations**
- Graphical products**
 - Coastal Polygon Threat Map**
 - Energy and Offshore Forecast Map**
 - Coastal Forecast and Travel-Time map**
 - Coastal Forecast points in kmz file**



Example Procedures and Products



00h00m	A Large Earthquake occurs in the Pacific region.
00h02m	Vibrations from the earthquake reach seismic stations near the earthquake epicenter, triggering Event Alarms at PTWC . PTWC duty analysts respond to operations center and begin to analyze event.
00h08m	Using a combination of automatic and interactive analyses, duty analysts complete preliminary determination of the earthquake epicenter, depth, and magnitude . These parameters, adjusted conservatively if necessary to account for error, are used to initiate RIFT numerical tsunami forecast model run for a limited region near the epicenter . [<i>RIFT is one of three numerical forecast models in use at PTWC, each of which has its own strengths and weaknesses. RIFT is the model upon which the new products are primarily based. Forecasts from the other two models, SIFT and ATFM, are compared for consistency. For this initial RIFT run, the earthquake fault mechanism is based upon the mechanism of historical nearby earthquakes.</i>]

Example Procedures and Products



00h09m	RIFT run completes within 5-20 seconds, providing a preliminary forecast of tsunami amplitudes for coasts generally within about 3 hours tsunami travel time of the earthquake.
00h10m	<p>Based on RIFT forecast, initial products issued.</p> <ul style="list-style-type: none">• If forecast coastal tsunami amplitudes are less than 0.3m everywhere, then only text Tsunami Information Statement issued, indicating no tsunami threat. This is the only statement issued unless further analysis indicates a greater threat or to report observed tsunami waves.• If forecast coastal amplitudes above 0.3m in some places, then text Tsunami Threat Message issued along with accompanying maps of forecast tsunami travel times, energy distribution and coastal amplitudes, table summarizing forecast coastal amplitudes, and kmz file of individual coastal forecast points. Products followed by later product sets, at least one/hour, which may refine forecast and report observations until threat has largely passed.

Initial Text Product

TSUNAMI MESSAGE NUMBER 1
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI
1118 UCT FRI FEB 8 2013

...TSUNAMI THREAT MESSAGE...

THIS MESSAGE IS FOR ALL COASTAL AREAS OF THE PACIFIC AND ITS
ADJACENT SEAS EXCEPT THOSE OF U.S. STATES AND BRITISH COLUMBIA.
IT IS ISSUED AS ADVICE IN SUPPORT OF THE UNESCO/IOC PACIFIC
TSUNAMI WARNING SYSTEM.

TSUNAMI THREAT FORECAST

* TSUNAMI WAVES REACHING 3 METERS OR MORE ABOVE THE NORMAL TIDE
ARE FORECAST FOR COASTS IN

CHILE.

* TSUNAMI WAVES REACHING 1 TO 3 METERS ABOVE THE NORMAL TIDE
ARE FORECAST FOR COASTS IN

PERU.



Initial Text Product

PRELIMINARY EARTHQUAKE PARAMETERS

* MAGNITUDE 1.0
* ORIGIN TIME 1112 UTC FEB 8 2013
* COORDINATES 33.7 SOUTH 72.3 WEST
* DEPTH 20 KM / 12 MILES
* LOCATION OFF THE COAST OF CENTRAL CHILE

EVALUATION

- * AN EARTHQUAKE WITH A PRELIMINARY MAGNITUDE OF 1.0 OCCURRED OFF THE COAST OF CENTRAL CHILE AT 1112 UTC ON FRIDAY FEBRUARY 8 2013.
- * BASED ON THE PRELIMINARY SEISMIC PARAMETERS... HAZARDOUS TSUNAMI WAVES ARE FORECAST FOR SOME COASTS.

RECOMMENDED ACTIONS

- * GOVERNMENT AGENCIES RESPONSIBLE FOR THREATENED COASTAL AREAS SHOULD TAKE ACTION TO INFORM AND INSTRUCT ANY COASTAL POPULATIONS AT RISK IN ACCORDANCE WITH THEIR OWN EVALUATION... PROCEDURES AND THE LEVEL OF THREAT.
- * PERSONS LOCATED IN THREATENED COASTAL AREAS SHOULD STAY ALERT FOR INFORMATION AND FOLLOW INSTRUCTIONS FROM LOCAL AUTHORITIES.



Initial Text Product

ESTIMATED TIMES OF ARRIVAL

* ESTIMATED TIMES OF ARRIVAL -ETA- OF THE INITIAL TSUNAMI WAVE ARE GIVEN BELOW. ACTUAL ARRIVAL TIMES MAY DIFFER AND THE INITIAL WAVE MAY NOT BE THE LARGEST. A TSUNAMI IS A SERIES OF WAVES AND THE TIME BETWEEN WAVES CAN BE FIVE MINUTES TO ONE HOUR.

LOCATION	REGION	COORDINATES		ETA (UTC)	
VALPARAISO	CHILE	33.0S	71.6W	1130	02/08
COQUIMBO	CHILE	29.9S	71.4W	1153	02/08
TALCAHUANO	CHILE	36.7S	73.1W	1204	02/08
CALDERA	CHILE	27.1S	70.8W	1213	02/08
ANTOFAGASTA	CHILE	23.3S	70.4W	1235	02/08
CORRAL	CHILE	39.8S	73.5W	1235	02/08
IQUIQUE	CHILE	20.2S	70.1W	1307	02/08
ARICA	CHILE	18.5S	70.3W	1319	02/08
MOLLEND	PERU	17.1S	72.0W	1326	02/08
SAN JUAN	PERU	15.3S	75.2W	1344	02/08
GOLFO DE PENAS	CHILE	47.1S	74.9W	1348	02/08
LA PUNTA	PERU	12.1S	77.2W	1436	02/08
PUERTO MONTT	CHILE	41.5S	73.0W	1531	02/08



Initial Text Product

POTENTIAL IMPACTS

- * TSUNAMI WAVES OF MORE THAN 3 METERS ARE CAPABLE OF CAUSING ALMOST COMPLETE DESTRUCTION OF COASTAL STRUCTURES AND INFRASTRUCTURE IN LOW-LYING COASTAL AREAS.
- * TSUNAMI WAVES OF 1 TO 3 METERS ARE CAPABLE OF FLOODING AND DAMAGING STRUCTURES AND INFRASTRUCTURE IN LOW-LYING COASTAL AREAS.
- * PERSONS CAUGHT IN THE WATER OF A TSUNAMI MAY DROWN... BE CRUSHED BY DEBRIS IN THE WATER... OR BE SWEEPED OUT TO SEA.
- * A TSUNAMI IS A SERIES OF WAVES. THE TIME BETWEEN WAVE CRESTS CAN VARY FROM 5 MINUTES TO AN HOUR. THE HAZARD MAY PERSIST FOR MANY HOURS OR LONGER AFTER THE INITIAL WAVE.
- * IMPACTS CAN VARY SIGNIFICANTLY FROM ONE SECTION OF COAST TO THE NEXT DUE TO LOCAL BATHYMETRY AND THE SHAPE AND ELEVATION OF THE SHORELINE.
- * IMPACTS CAN ALSO VARY DEPENDING UPON THE STATE OF THE TIDE AT THE TIME OF THE MAXIMUM TSUNAMI WAVES.



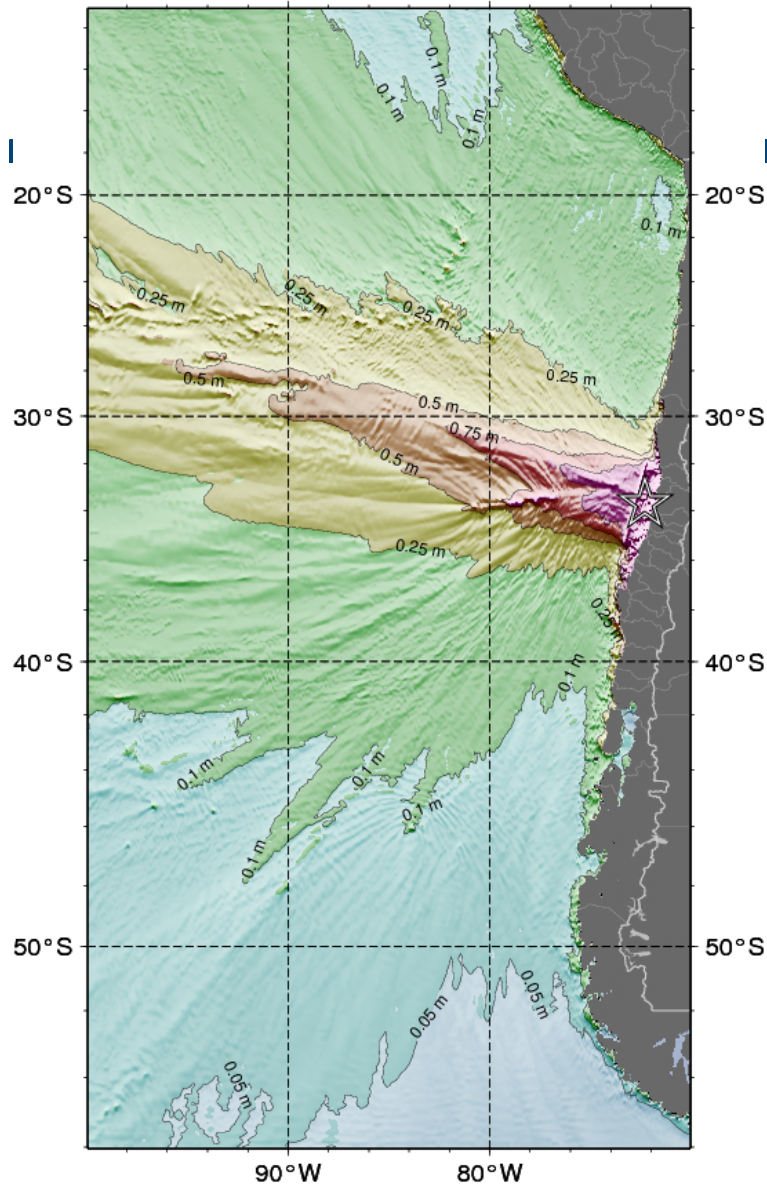
Initial Text Product

NEXT UPDATE AND ADDITIONAL INFORMATION

- * THE NEXT MESSAGE WILL BE ISSUED IN ONE HOUR... OR SOONER IF THE SITUATION WARRANTS.
- * COASTAL REGIONS OF HAWAII SHOULD REFER TO PACIFIC TSUNAMI WARNING CENTER MESSAGES FOR HAWAII THAT CAN BE FOUND AT PTWC.WEATHER.GOV.
- * COASTAL REGIONS OF CALIFORNIA... OREGON... WASHINGTON... BRITISH COLUMBIA AND ALASKA SHOULD REFER TO WEST COAST AND ALASKA TSUNAMI WARNING CENTER MESSAGES THAT CAN BE FOUND AT WCATWC.ARH.NOAA.GOV.
- * AUTHORITATIVE INFORMATION ABOUT THE EARTHQUAKE FROM THE U.S. GEOLOGICAL SURVEY CAN BE FOUND ON THE INTERNET AT EARTHQUAKE.USGS.GOV/EARTHQUAKES/MAP.
- * FURTHER INFORMATION ABOUT THIS EVENT MAY BE FOUND AT PTWC.WEATHER.GOV AND AT WWW.TSUNAMI.GOV.

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PREDICTED TSUNAMI WAVE AMPLITUDE (meters)

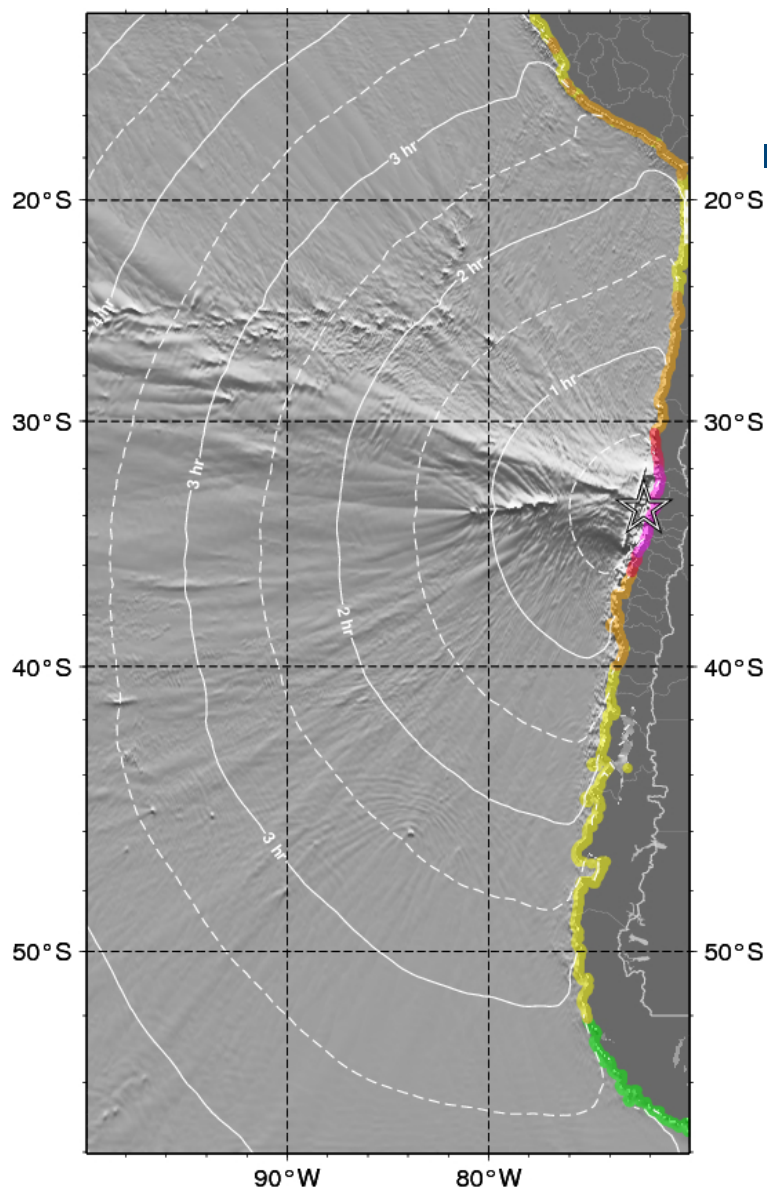


Earthquake: 02/08/2013 11:12 UTC 33.7S 72.3W 20km Mw=8.7

Graphical Product: Energy Forecast Map

- Deep-ocean forecast
- Tsunami Wave Amplitudes
- Color ranges scaled so that red / white show maxima
- Gray-shade textures shows energy distribution
- For Initial Forecasts, only nearby region is simulated.

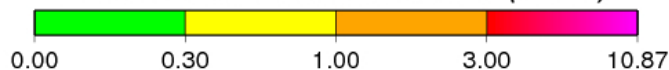
PTWC RIFT Tsunami Forecast #20130208124826



Graphical Product: Coastal Forecast Map

- Coastal forecast. Green's Law used to propagate off-shore, deep-ocean to coast
- Tsunami Travel Time contours (assumes point source)
- Tsunami Wave Amplitudes at designated coastal forecast points (using Green's Law)
- Gray-shade textures shows energy distribution

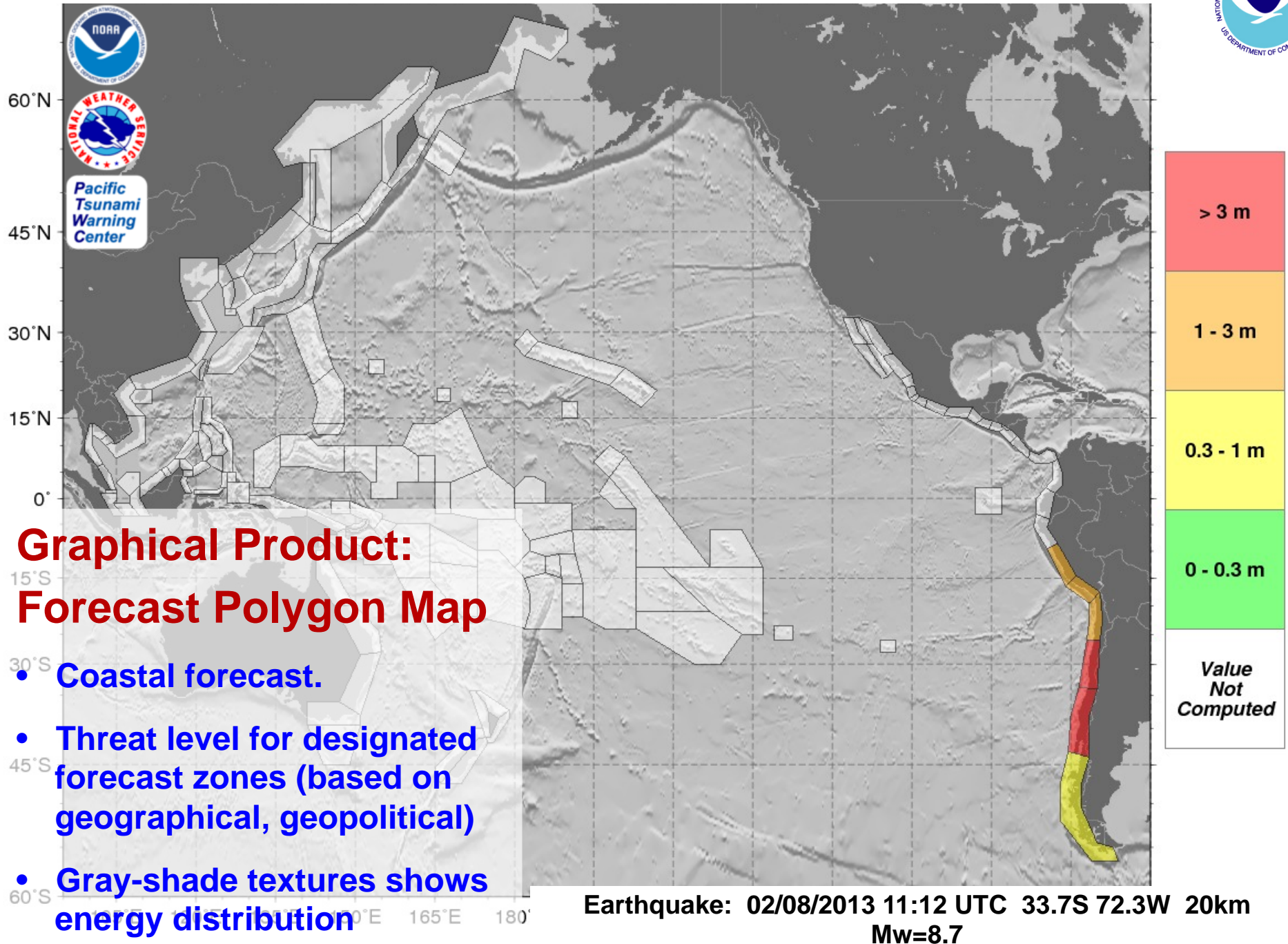
PREDICTED TSUNAMI WAVE AMPLITUDE (meters)



Earthquake: 02/08/2013 11:12 UTC 33.7S 72.3W 20km Mw=8.7



PTWC RIFT Tsunami Forecast #20130208124826



Forecast Polygon Table – Text file

- Coastal and Offshore forecasts for polygons
- Includes statistics giving uncertainty / quality estimate.
- E.g., for each polygon (comprised of # forecast points), max / mean / median / standard deviation of coastal and offshore (deep-ocean) wave amplitude for that polygon
- Complements GoogleEarth .kmz tool - can show value variation from point-to-point.

PTWC RIFT Tsunami Forecast Model - Run ID: 2013020812511

Earthquake - Origin: 02/08/2013 11:12:13 UTC Coordinates: 33.7S 72.3W Depth: 020km Magnitude: 8.9

Coastal Forecast (meters)				Offshore Forecast (meters)				Total	Points	Region Name
Maximum	Mean	Median	STD	Maximum	Mean	Median	STD	STD		
14.48	6.05	3.29	4.53	6.60	2.12	1.40	1.69		120	North Central Chile
13.81	4.39	1.78	4.52	7.65	1.83	1.21	1.41		160	South Central Chile
6.28	3.66	3.44	1.24	2.47	0.89	0.72	0.57		27	Marquesas Islands
2.47	2.47	2.47	0.00	0.41	0.41	0.41	0.00		1	Palmyra Island
2.23	1.18	1.08	0.35	0.98	0.36	0.31	0.15		145	Hawaii
2.20	1.75	1.77	0.43	1.09	0.82	0.86	0.24		4	Tuamotu Archipelago
2.09	1.39	1.37	0.23	1.01	0.71	0.71	0.14		101	Central Peru
1.95	1.69	1.65	0.09	1.00	0.53	0.51	0.12		73	Southern Peru
1.92	1.37	1.20	0.39	0.40	0.25	0.18	0.10		3	Line Islands
1.89	1.89	1.89	0.00	0.42	0.42	0.42	0.00		1	Easter Island
1.74	1.41	1.40	0.15	1.17	0.45	0.38	0.18		119	Northern Chile



Example Procedures and Products



00h20m	Seismic analyses continue as data from additional seismic stations arrive and are processed. If earthquake parameters change significantly then RIFT re-run. If there is significant change in forecast then appropriate supplemental products, similar to those described above, are issued.
00h25m	For earthquakes > ~M7.0, preliminary W-phase Centroid Moment Tensor (W-CMT) analysis based upon broadband seismic data completes. The W-CMT analysis not only gives a more accurate estimate of earthquake location, depth and magnitude , but also estimate of earthquake's mechanism – strike angle of fault, dip angle of fault, and direction of slip along fault. These parameters help constrain estimate of seafloor deformation that is tsunami source, and they are used to drive subsequent run of RIFT for entire Pacific.
00h35m	For events with forecast coastal amplitudes above 0.3m, then based on updated RIFT result, supplemental Tsunami Threat Message issued along with accompanying maps, table, kmz file that cover entire Pacific region and PTWS marginal seas.

Supplemental Text Product

TSUNAMI MESSAGE NUMBER 1
NWS PACIFIC TSUNAMI WARNING CENTER EWA BEACH HI
1340 UCT FRI FEB 8 2013

...TSUNAMI THREAT MESSAGE...

THIS MESSAGE IS FOR ALL COASTAL AREAS OF THE PACIFIC AND ITS
ADJACENT SEAS EXCEPT THOSE OF U.S. STATES AND BRITISH COLUMBIA.
IT IS ISSUED AS ADVICE IN SUPPORT OF THE UNESCO/IOC PACIFIC
TSUNAMI WARNING SYSTEM.

TSUNAMI THREAT FORECAST...UPDATED

* TSUNAMI WAVES REACHING 3 METERS OR MORE ABOVE THE NORMAL TIDE
ARE FORECAST FOR COASTS IN

CHILE... AND FRENCH POLYNESIA.



Supplemental Text Product

- * TSUNAMI WAVES REACHING 1 TO 3 METERS ABOVE THE NORMAL TIDE ARE FORECAST FOR COASTS IN

MEXICO... ECUADOR... PERU... ANTARCTICA... JAPAN...
PHILIPPINES... NEW ZEALAND... MARSHALL ISLANDS... FIJI...
SAMOA... COOK ISLANDS... VANUATU... KIRIBATI... MIDWAY
ISLAND... JARVIS ISLAND... PALMYRA ISLAND... TONGA...
PITCAIRN... SOLOMON ISLANDS... PAPUA NEW GUINEA... AND
RUSSIA.

- * TSUNAMI WAVES REACHING 0.3 TO 1 METERS ABOVE THE NORMAL TIDE ARE FORECAST FOR COASTS IN

EL SALVADOR... GUATEMALA... COSTA RICA... NICARAGUA...
PANAMA... COLOMBIA... AUSTRALIA... NEW CALEDONIA... TAIWAN...
CHINA... NORTHERN MARIANAS... GUAM... YAP... AMERICAN SAMOA...
TOKELAU... NAURU... WAKE ISLAND... HOWLAND AND BAKER...
TUVALU... WALLIS AND FUTUNA... NIUE... AND INDONESIA.



Supplemental Text Product

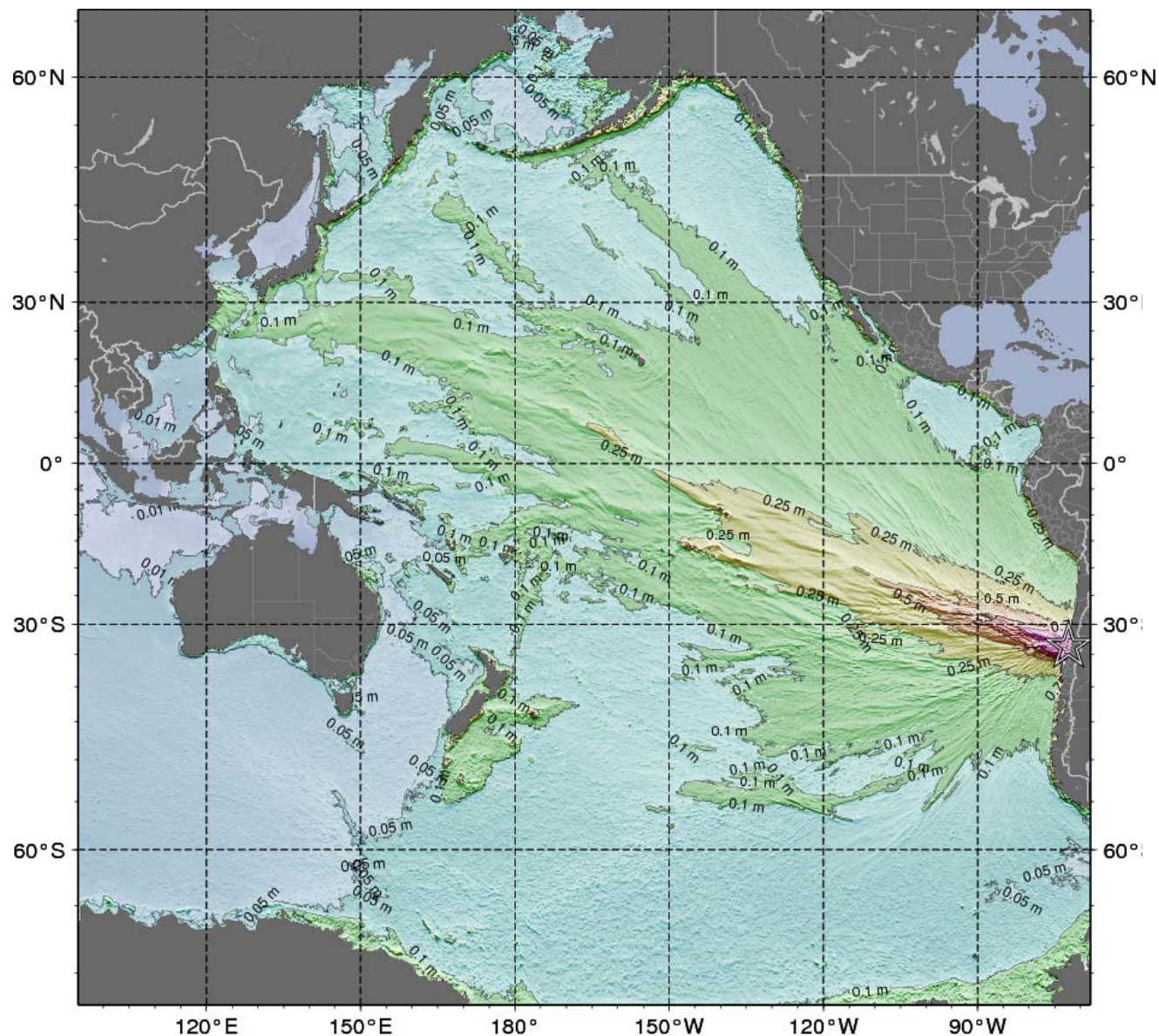
TSUNAMI OBSERVATIONS

* THE FOLLOWING ARE TSUNAMI WAVE OBSERVATIONS FROM COASTAL AND/OR DEEP-OCEAN SEA LEVEL GAUGES AT THE INDICATED LOCATIONS. THE MAXIMUM TSUNAMI HEIGHT IS MEASURED WITH RESPECT TO THE NORMAL TIDE LEVEL.

GAUGE LOCATION	GAUGE COORDINATES		TIME OF MEASURE (UTC)	MAXIMUM TSUNAMI HEIGHT	WAVE PERIOD (MIN)
	LAT	LON			
LEBU CL	37.6S	73.7W	1246	0.3M/ 1.0FT	36
DART	19.3S	74.7W	1150	0.1M/ 0.3FT	12
EASTER CL	27.2S	109.5W	1153	0.2M/ 0.8FT	98
VALPARAISO CL	33.0S	71.6W	1113	0.6M/ 2.1FT	30



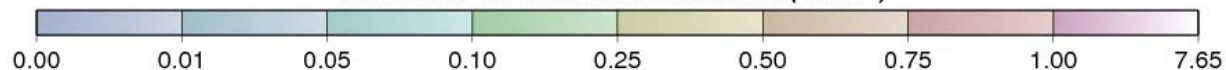
PTWC RIFT Tsunami Forecast #20130208125110



Graphical Product: Energy Forecast Map

- Deep-ocean forecast
- Tsunami Wave Amplitudes
- Color ranges scaled so that red / white show maxima
- Gray-shade textures shows energy distribution
- For Initial Forecast, only nearby region is simulated.

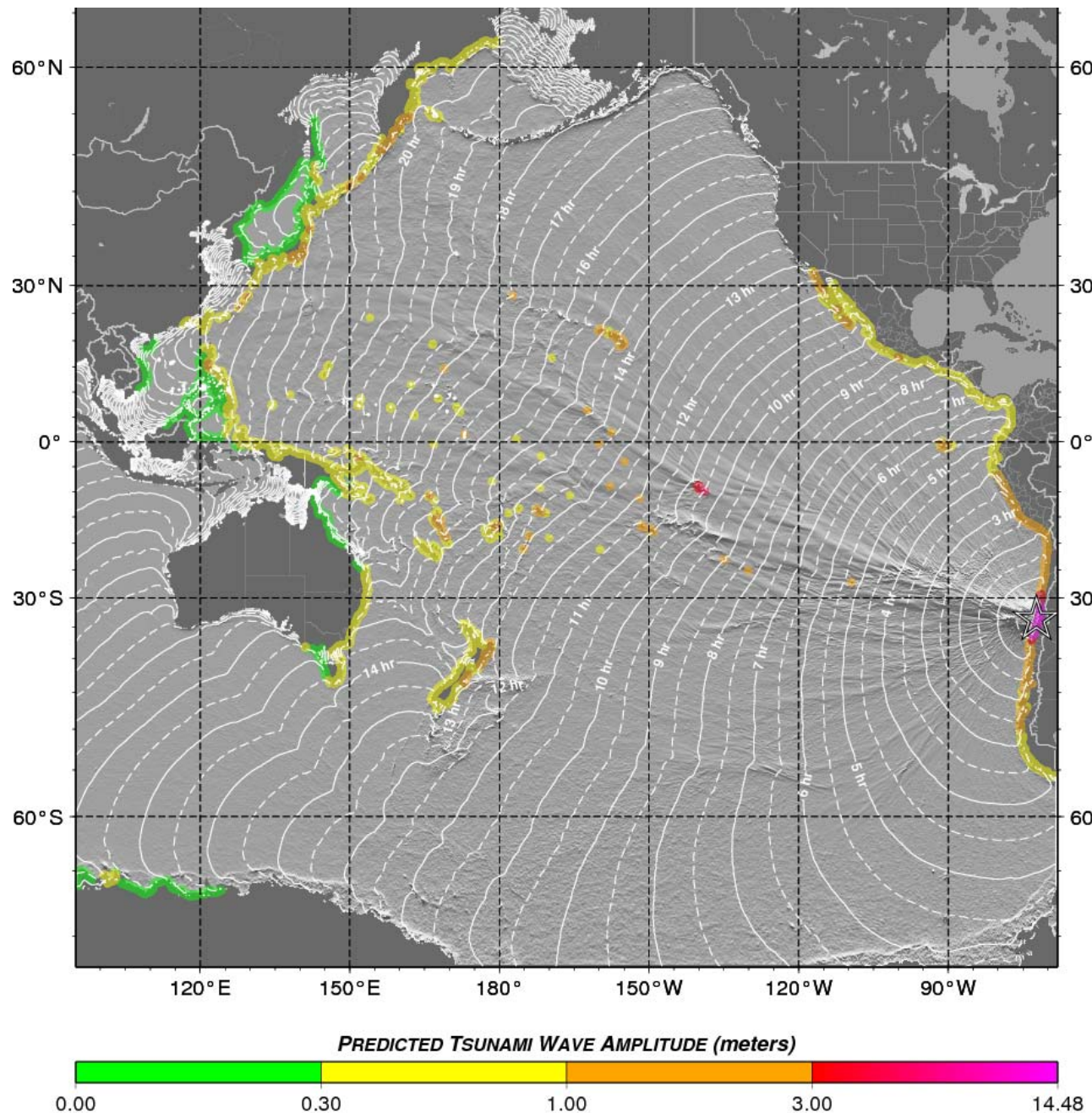
PREDICTED TSUNAMI WAVE AMPLITUDE (meters)



Earthquake: 02/08/2013 11:12 UTC 33.7S 72.3W 20km Mw=8.9



PTWC RIFT Tsunami Forecast #20130208125110



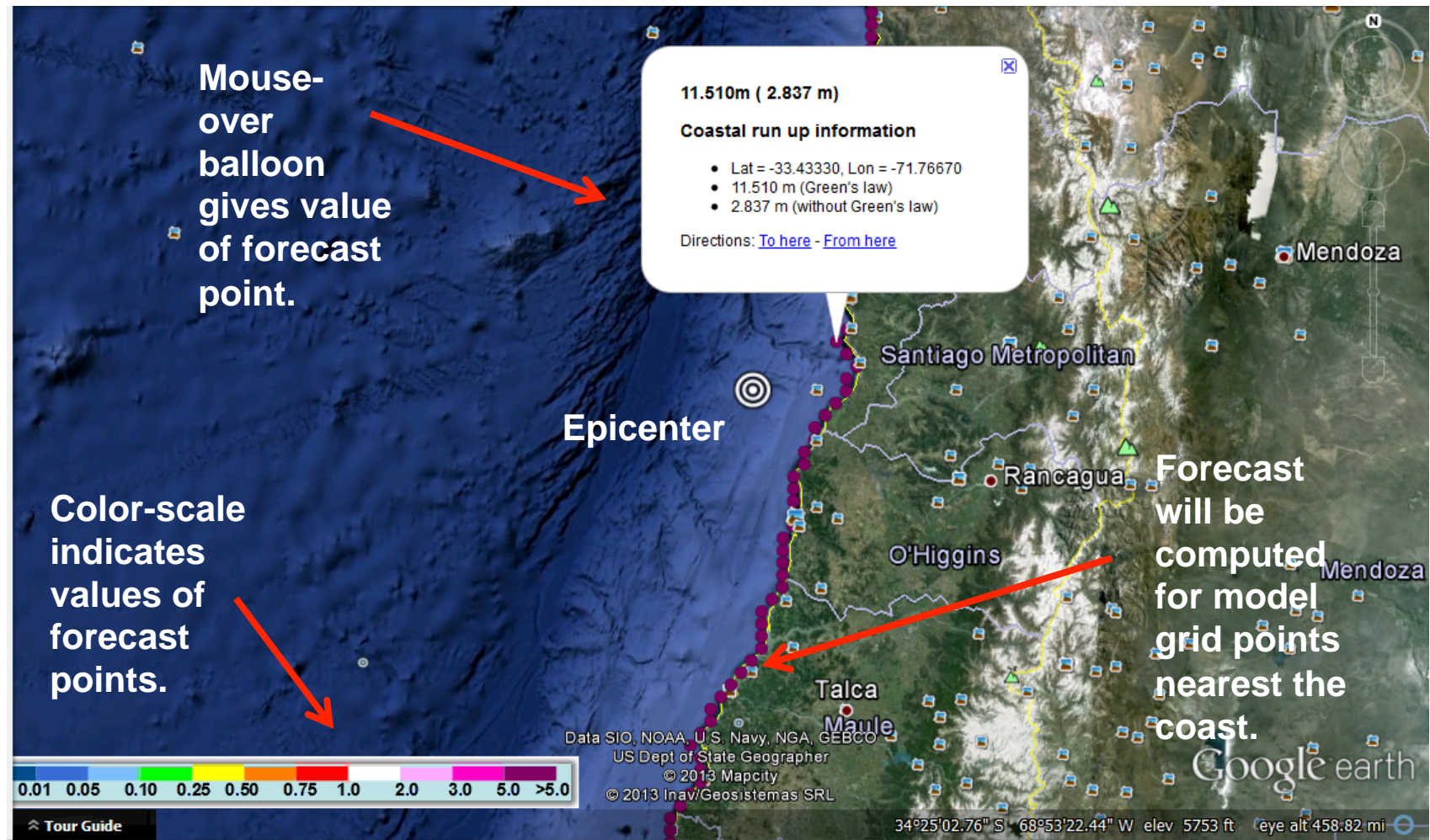
Earthquake: 02/09/2012 11:42 UTC 22.7S 72.2W 20km Mw=8.0

Graphical Product: Coastal Forecast Map

- Coastal forecast.
- Tsunami Travel Time contours (assumes point source) (22-23 hrs to Japan)
- Tsunami Wave Amplitudes at designated coastal forecast points (using Green's Law)
- Gray-shade textures shows energy distribution
- For later products, includes entire Pacific Ocean and marginal seas



Sample of kmz file in GoogleEarth



Earthquake: 02/08/2013 11:12 UTC 33.7S 72.3W 20km Mw=8.9

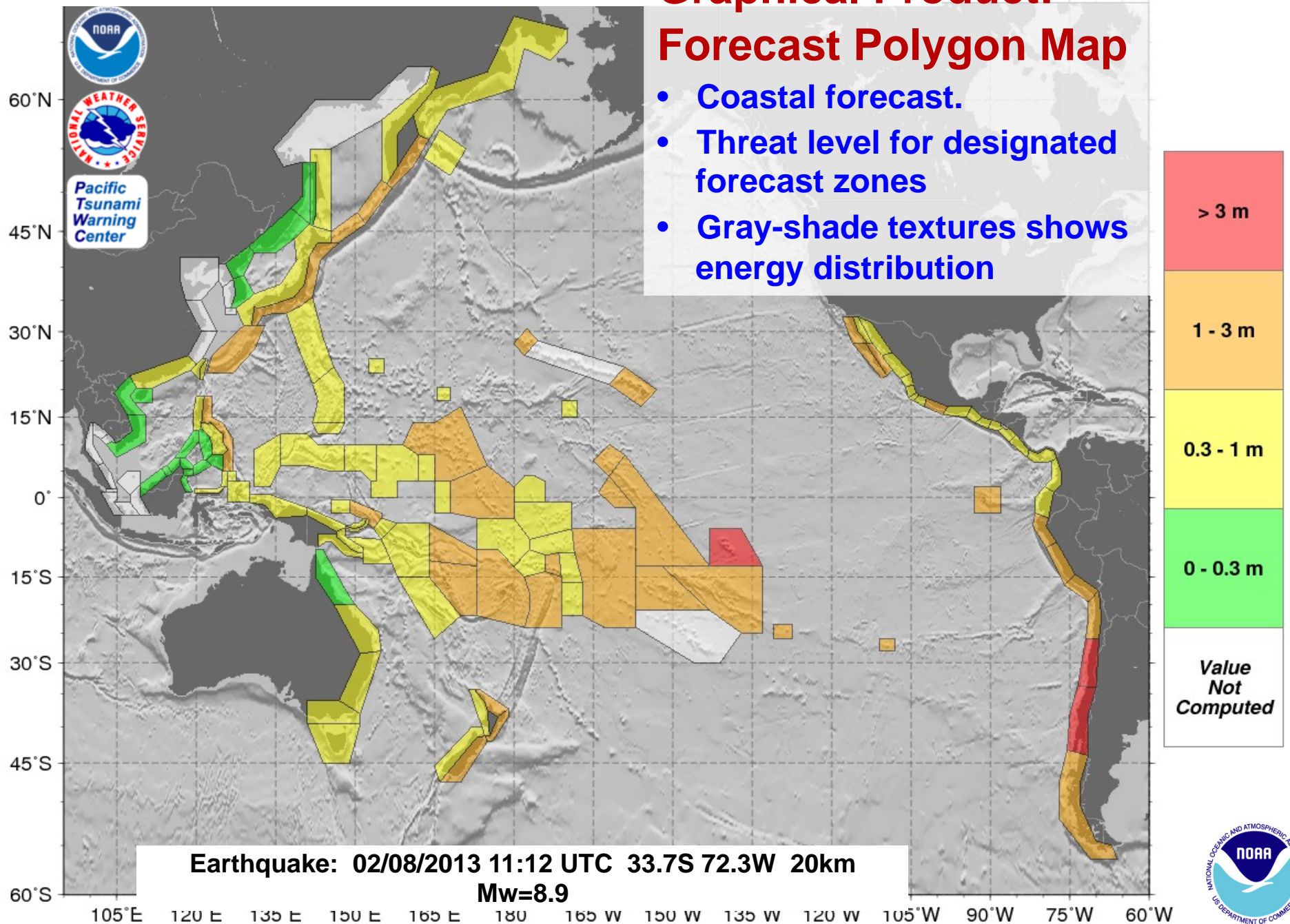
Zoom in to area of interest.



PTWC RIFT Tsunami Forecast #20130208125110 (P157) Results

Graphical Product: Forecast Polygon Map

- Coastal forecast.
- Threat level for designated forecast zones
- Gray-shade textures shows energy distribution



FORECAST => EMERGENCY RESPONSE

- **Amplitude ≥ 3 m**
=> Major Land Threat:
Evacuate Tsunami Coastal Evacuation Zones
- **1 m < Amplitude < 3 m**
=> Land Threat:
Evacuate Tsunami Coastal Evacuation Zones
- **0.3 m < Amplitude < 1 m**
=> Marine Threat:
Clear beaches, harbors, low lying coastal areas
- **Amplitude < 0.3 m => No Threat, No Evacuation**
- **Value not computed => Monitor Event**



Example Procedures and Products



00h30m to 02h00m	Sea level gauges monitored for tsunami signals. Within the first 30 minutes to an hour the tsunami may arrive on the nearest one or two coastal gauges and one or two deep-ocean gauges. Tsunami amplitudes measured and compared, when possible, with forecast amplitudes. Model forecasts may be adjusted to be more consistent with observations.
Beyond 2h	The process of refining earthquake parameters and collecting additional sea level observations continues, with that information used to constrain forecast. The tsunami is monitored as it advances. When it is likely that there is no longer a significant tsunami threat then a final product is issued.

Feedback Requested (PacWave13) – Products

**Enhanced Products will be:
Text Message, Forecast Polygon Map and Table,
Energy / Deep-Ocean Forecast Map,
Coastal Forecast Map, Coastal KMZ)**

- ☐ **Format and Content OK?**
- ☐ **Content understood, including use and limitations?**
- ☐ **Forecast Polygons, Polygon Names, and Forecast Points correct, appropriate, and adequate?**
- ☐ **Other Information to include?**
- ☐ **Which products could be made public by PTWC and/or redistributed by NTWCs?**



Feedback Requested (PacWave13) - Readiness

PTWC Alert products (Watch/Warning) will be discontinued (in 2014) and NTWCs will need to be responsible for issuing Warnings

- ☐ **Are Key Stakeholders (NTWC, NDMO, other) ready?**
- ☐ **Are SOPs modified to take the change into account?**
- ☐ **Do Stakeholders and response agencies need training? By whom (international, national, other)?**
- ☐ **Are country outreach and awareness materials needed to inform customers about this change (Stakeholders, Media, Public)?**



PTWC New Products - Training

IOC / ITIC will work together to organize training

- **Based on PacWave13 Post-Exercise Evaluation and Country / Regional requests to ITIC / IOC**
- **Conducted:**
 - **ITP-Hawaii Training (PTWS: Chile, China, Colombia, FSM, Malaysia, Mexico, Peru, Solomon Islands, USA Amer Samoa), 20-31 Aug 2012**
 - **Regional Training:**
 - **Central America SOP Workshop, 11-15 Feb 2013**
 - **South America SOP Workshop, 4-8 Mar 2013**
- **Possible Planned:**
 - **Southwest Pacific**
 - **South China Sea**
 - **Others - on request**

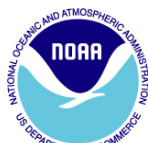




United Nations
Educational, Scientific and
Cultural Organization



Intergovernmental
Oceanographic
Commission



PTWS PTWC ENHANCED PRODUCTS USER'S GUIDE
UNESCO IOC TS 105, April 2013

Questions ?

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