

Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System



TSUNAMI NEWSLETTER



International Tsunami Information Center

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ITIC and PTWC Move to New NOAA Inouye Regional Center at Pearl Harbor, Oahu, Hawaii

ITIC and PTWC moved their offices to a US federally-owned 30-acre property at Ford Island in the Pearl Harbor Naval Complex on 3 and 10 March 2014, respectively, as part of a consolidation of NOAA programs and operations on the island of Oahu. ITIC and PTWC offices, previously separated by over 25 miles distance between downtown Honolulu and Ewa Beach, Oahu, are now co-located on the 3rd floor of the central building in the new NOAA Inouye Regional Center (IRC). PTWC will transition its 24/7 operations from its Ewa Beach facility to the NOAA IRC over the summer 2014.



The NOAA Inouye Regional Center. Photo courtesy of NOAA.

The NOAA Inouye Regional Center was named after US Senator Daniel K. Inouye of Hawaii, who was instrumental in its creation and securing of federal construction funds. The NOAA IRC is the hub for over 700 NOAA employees and contractors. NOAA in Hawaii manages an extensive portfolio of programs addressing fisheries, ocean, coastal, climate, and atmospheric issues in the entire Pacific. The Ford Island area is protected by cultural landscape guidelines that seek to preserve both built and natural resources associated with events of historic significance.

SUMMARY OF EARTHQUAKES

1 JANUARY - 30 APRIL 2014

Reported by: International Tsunami Warning Centres

Compiled by: International Tsunami Information Center, ITIC

Advisories issued by international tsunami warning centers. The Pacific Tsunami Warning Center (P) issues: Tsunami Information Bulletins (TIB), Fixed and Expanding Regional Warnings (FRW, ERW), and Ocean-wide or Widespread Watch/Warnings (TWW) for the Pacific; Tsunami Information Bulletins (TIB), Local, Regional, and Ocean-wide Tsunami Watches (LTW, RTW, TW) for the Indian Ocean (IO) until 31 March 2013; Tsunami Information Statements (TIS), Local, Regional, and Ocean-wide Watches (LTW, RTW, TW) for the wider Caribbean (C). The Japan Meteorological Agency (J), issues: Tsunami Advisories (NWPTA) for the Northwestern Pacific; Tsunami Watch Information (TWI) for the Indian Ocean until 31 March 2013. The US National Tsunami Warning Center (N - formerly A, renamed on 1 October 2013, formerly known as West Coast/Alaska Tsunami Warning Center), issues: Tsunami Information Statements (TIS), Tsunami Advisories (TA), Tsunami Watch/Warnings (TWW) for Canada, the US (including Puerto Rico, excluding Hawaii and US-affiliated Pacific Island countries), and the US/British Virgin Islands. Depth (from GCMT solution), epicenter and Mw from the USGS (G), and Mw from PTWC, NTWC, and JMA at action time. Other earthquakes with Mw greater than or equal to 6.5 and a depth no greater than 100 km, as recorded by USGS, have also been included. Wave height and period measurements from sea level gauges (g) reported as amplitude (amp), peak to trough, or greatest value for either flow depth (fd) or runup (r) as indicated. Event location (e.g. name) is derived from PTWC message(s).

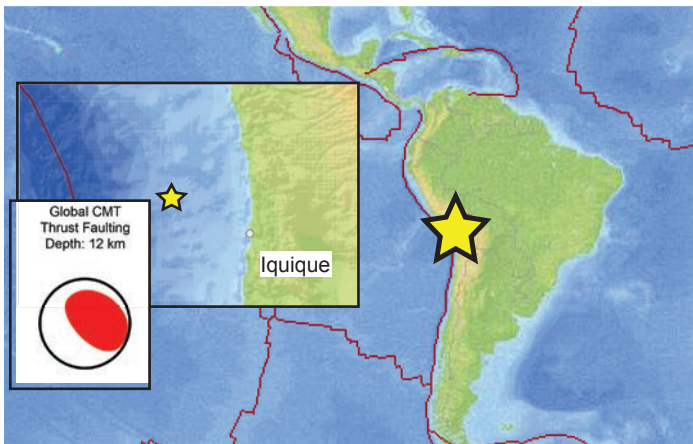
DATE	TIME (UTC)	LOCATION	EPICENTRE	DEPTH (km)	M _w	PTWC (P), JMA (J) or NTWC (N) ACTION	ACTION TIME (UTC)	TSUNAMI? DAMAGING?	MAXIMUM MEASUREMENT and LOCATION
1-Jan	16:04	Vanuatu	13.878° S	197	6.6 (N-formerly A,P)	(P) 01 TIB	16:10	NO	
			167.243° E		6.5 (G)	(N - formerly A) 01 TIS	16:12	NO	
13-Jan	04:01	Puerto Rico Region	18.997° N	22	6.4 (N, P)	(N) 01 TIS	04:04	NO	
			66.829° W		6.5 (G)	(P) 01 TIS	04:07	NO	
21-Jan	01:29	Tonga	40.650° S	12	6.5 (N, P)	(P) 01 TIB	01:36	NO	
			175.864° E		6.3 (G)	(N) 01 TIS	01:39	NO	
2-Feb	09:27	South of the Kermadec Islands	32.904° S	51	6.5 (N, P)	(P) 01 TIB	09:33	NO	
			177.817° W		6.6 (G)	(N) 01 TIS	09:35	NO	
7-Feb	08:40	Vanuatu	15.060° S	128	6.5 (G, N, P)	(P) 01 TIB	08:50	NO	
			167.339° E			(N) 01 TIS	08:51	NO	
18-Feb	09:27	North Atlantic Ocean	14.651° N	13	6.7 (N, P)	(P) 01 TIS	09:36	NO	
			58.948° W		6.5 (G)	(N) 01 TIS	09:39	NO	
2-Mar	20:11	Ryukyu Islands	27.405° N	128	6.6 (J, N, P)	(J) 01 NWPTA	20:18	NO	
			127.335° E		6.5 (G)	(P) 01 TIB	20:20	NO	
						(N) 01 TIS	20:22		
10-Mar	05:18	Off the Coast of Northern Cali- fornia	40.829° N	14	7.0 (N, P)	(N) 01 TIS	05:22	NO	
			125.134° W		6.8 (G)	(P) 01 TIB	05:26	NO	
11-Mar	02:44	East of the South Sandwich Islands	60.839° S	17	6.8 (N, P)	(P) 01 TIB	02:55	NO	
			19.957° W		6.4 (G)	(N) 01 TIS	03:01	NO	
16-Mar	21:17	Near the Coast of Northern Chile	19.925° S	12	7.0 (N)	(P) 01 TIB	21:23	YES	28 cm amp (g), Patache, Chile
			70.628° W		6.7 (G, P)	(N) 01 TIS	21:26	NO	
						(P) 02 TIB	21:26		
26-Mar	03:30	South of the Fiji Islands	26.092° S	513	6.5 (G, N, P)	(P) 01 TIB	03:36	NO	
			179.279° E			(N) 01 TIS	03:41	NO	
1-Apr	23:47	Near the coast of Northern Chile	19.642° S	22	8.2 (N, G, P)	(P) 01 ERW	23:55	YES	2.59 m amp (g), Iquique, Chile
			70.817° W			(N) 01 TIS	23:56	YES	

Earthquakes, *continued*

DATE	TIME (UTC)	LOCATION	EPICENTRE	DEPTH (km)	M _w	PTWC (P), JMA (J) or NTWC (N) ACTION	ACTION TIME (UTC)	TSUNAMI? DAMAGING?	MAXIMUM MEASUREMENT and LOCATION
2-Apr						(P) 02 ERW (P) 03 ERW (N) 02 TIS (P) 04 ERW (N) 03 TIS (P) 05 ERW (N) 04 TIS (P) 06 ERW (P) 06 ERW * Note: Total of 7 PTWC bulletins were issued for this event.	00:14 00:34 00:38 01:31 01:36 02:35 02:35 03:44 04:43		
3-Apr	02:43	Near the coast of Northern Chile	20.400° S 70.135° W	31	7.8 (N, P) 7.6 (G)	(P) 01 TIB (N) 01 TIS (P) 02 FRW (N) 02 TIS (P) 03 FRW	02:51 02:52 03:13 03:20 03:59	YES NO	74 cm amp (g), Iquique, Chile
11-Apr	07:07	Solomon Islands	6.625° S 155.064° E	44	7.3 (J, N, P) 7.1 (G)	(P) 01 TIB (N) 01 TIS (J) 01 NWPTA	07:15 07:17 07:33	NO NO	
11-Apr	08:17	Solomon Islands	6.855° S 155.017° E	28	6.8 (J, N, P) 6.5 (G)	(P) 01 TIB (N) 01 TIS (J) 01 NWPTA	08:26 08:27 08:37	NO NO	
11-Apr	20:29	Near the coast of Nicaragua	11.710° N 85.963° W	143	6.6 (N, G, P)	(P) 01 TIB (N) 01 TIS	20:36 20:38	NO NO	
12-Apr	20:15	Solomon Islands	11.315° S 162.211° E	28	7.6 (N, G, J, P)	(P) 01 FRW (N) 01 TIS (P) 02 FRW (J) 01 NWPTA (N) 02 TIS (P) 03 FRW (J) 02 NWPTA (P) 04 FRW	20:20 20:25 20:35 20:40 20:52 20:53 21:20 21:36	YES NO	3 cm amp (g), Lata Wharf, Solo-
13-Apr	12:36	Solomon Islands	11.451° S 162.069° E	38	7.7 (N) 7.4 (G, J, P)	(P) 01 FRW (N) 01 TIS (J) 01 NWPTA (P) 02 FRW (P) 03 FRW (J) 02 NWPTA	12:46 12:47 12:56 13:18 13:55 14:28	YES NO	16 cm amp (g), Lifou, New Cale- donia
15-Apr	03:57	Southwest Africa	53.527° S 8.704° E	16	6.8 (N, P) 6.9 (G)	(P) 01 TIB (N) 01 TIS	04:10 04:14	NO NO	

Earthquakes, *continued*

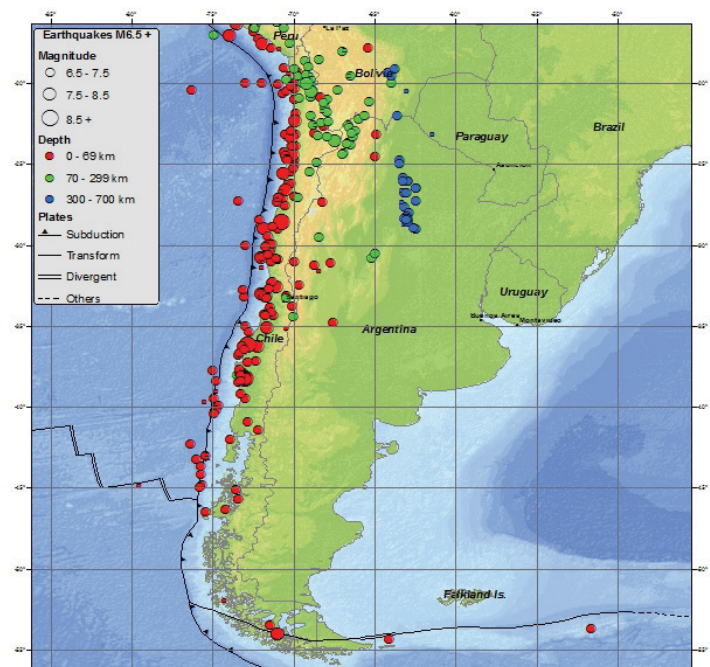
DATE	TIME (UTC)	LOCATION	EPICENTRE	DEPTH (km)	M _W	PTWC (P), JMA (J) or NTWC (N) ACTION	ACTION TIME (UTC)	TSUNAMI? DAMAGING?	MAXIMUM MEASUREMENT and LOCATION
18-Apr	14:27	Guerrero, Mexico	17.552° N 100.816° W	21	7.4 (N, P) 7.2 (G)	(P) 01 TIB (N) 01 TIS	14:39 14:41	YES NO	43 cm amp (g), Acapulco, Mexico
19-Apr	01:04	Solomon Islands	6.679° S 155.085° E	35	6.9 (J, N, P) 6.6 (G)	(P) 01 TIB (N) 01 TIS (J) 01 NWPTA	01:12 01:13 01:30	NO NO	
19-Apr	13:28	Solomon Islands	6.720°S 154.931°E	36	7.8 (J, N) 7.5 (G, P)	(P) 01 FRW (N) 01 TIS (J) 01 NWPTA (P) 02 FRW (P) 03 FRW	13:37 13:38 13:53 14:18 14:39	YES NO	11 cm amp (g), Tarekukure Wharf, Solomon Islands
24-Apr	03:10	Vancouver Island Canada Region	49.846° N 127.444° W	76	6.7 (N, P) 6.6 (G)	(N) 01 TIS (P) 01 TIB (N) 02 TIS	03:13 03:16 03:20	NO NO	

Near the Coast of Northern Chile, 16 March 2014, UTC 21:17 M_w=6.7

16 March 2014 Northern Chile foreshock earthquake location marked by star. Map courtesy of USGS National Earthquake Information Center (NEIC).

On 16 March 2014, a M6.7 earthquake occurred at 21:17 UTC off the coast of northern Chile at a depth of 12 km, due to shallow thrust faulting slip on the primary plate boundary interface between the Nazca and South American plates. *The 16 March earthquake appears to have been a foreshock to the 1 April 2014 M8.2 northern Chile earthquake that generated a tsunami observed throughout the Pacific and caused damage locally.* Both earthquakes occurred in the same locality where the Nazca plate subducts eastward beneath the

South American plate at a rate of 65 mm per year. For the 16 March earthquake, a small tsunami of 28 cm amplitude was recorded at Patache in northern Chile, with no reports of tsunami damage.

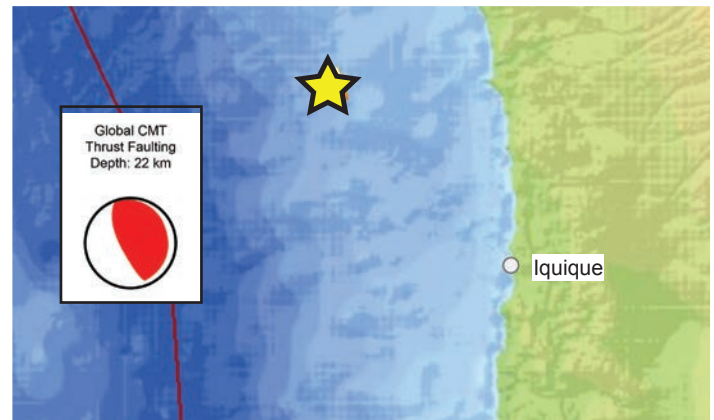


Historic Seismicity Map of Chile (1900 - March 2012). Map courtesy of USGS National Earthquake Information Center (NEIC).

Near the Coast of Northern Chile, 1 April 2014, UTC 23:47 $M_w=8.2$

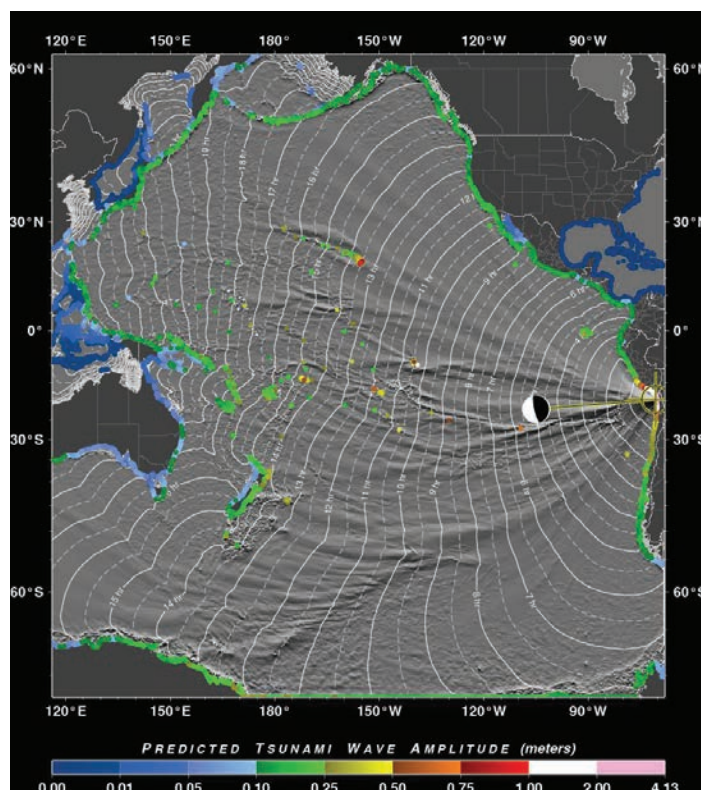
On 1 April 2014, a magnitude 8.2 earthquake occurred at 23:47 UTC off the coast of northern Chile, 95 km northwest of Iquique, at a depth of 22 km, and generated a tsunami that was observed throughout the Pacific and caused damage locally. The earthquake resulted from shallow thrust faulting on the primary plate boundary interface between the Nazca and South American plates. *The 1 April earthquake was the main shock following a foreshock earthquake of magnitude 6.7 on 16 March in the same northern Chile region.* Both earthquakes occurred in the same location where the Nazca plate subducts eastward beneath the South American plate at a rate of 65 mm per year. There were six fatalities due to the earthquake ground shaking. The events occurred in a region of historic seismic quiescence called the northern Chile or Iquique seismic gap. In the Iquique gap, the last event was a M8.8 earthquake in 1877.

For the 1 April 2014 earthquake, a maximum observed tsunami wave of (-) 2.59 m amplitude was recorded at the nearest city of Iquique. There was also tsunami

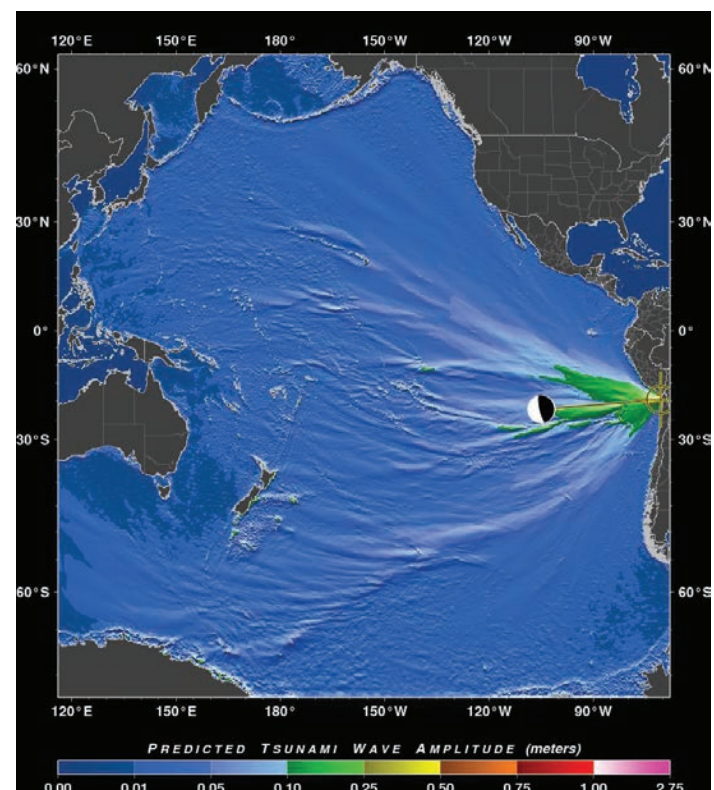


The 1 April 2014 northern Chile earthquake, location marked by star, was the main shock following a 16 March foreshock earthquake in the same region. Map courtesy of USGS National Earthquake Information Center (NEIC).

port damage in Iquique and inundation along the coasts of Pisagua and Arica, Chile. In February 2010, a magnitude 8.8 earthquake located near the central coast of Chile generated a local tsunami that caused 156 fatalities.



Tsunami travel time map and coastal amplitude forecast of the 1 April 2014 northern Chile tsunami. Courtesy of PTWC.

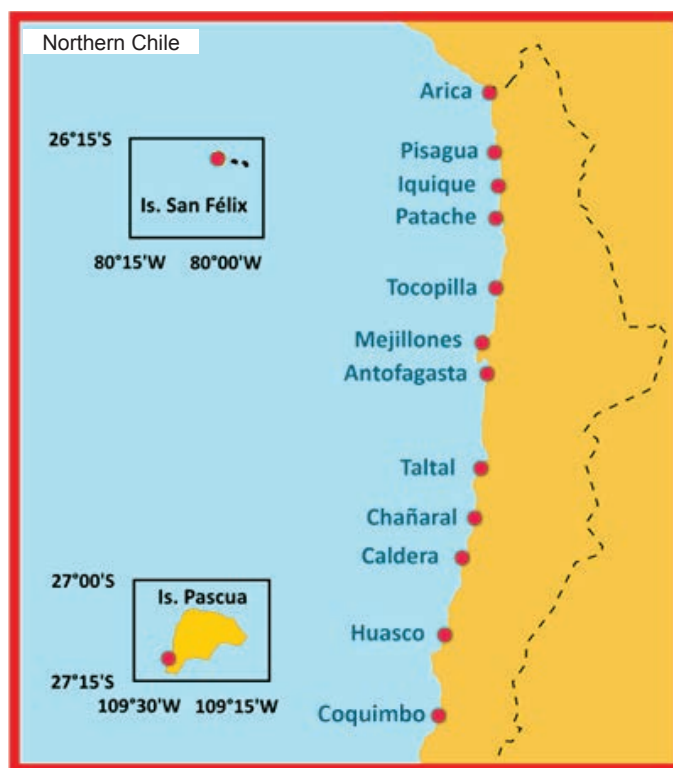


Tsunami Maximum Wave and Energy Propagation Forecast in the Pacific Basin of the 1 April northern Chile earthquake. Courtesy of PTWC.

Chile, 1 April 2014, *continued*



PTWC Realtime Forecast of Tsunamis (RIFT) Model of Chilean coastal tsunami amplitudes. Circle shows earthquake's epicenter. Courtesy of PTWC.



Tsunami waves were recorded at the sea level stations located along the northern (top) and central (bottom) coasts of Chile. Images courtesy of the Chilean Navy Hydrographic and Oceanographic Service (SHOA).

Chile, 1 April 2014, continued**Chile tsunami measurements from the 1 April 2014 Northern Chile earthquake and tsunami.**

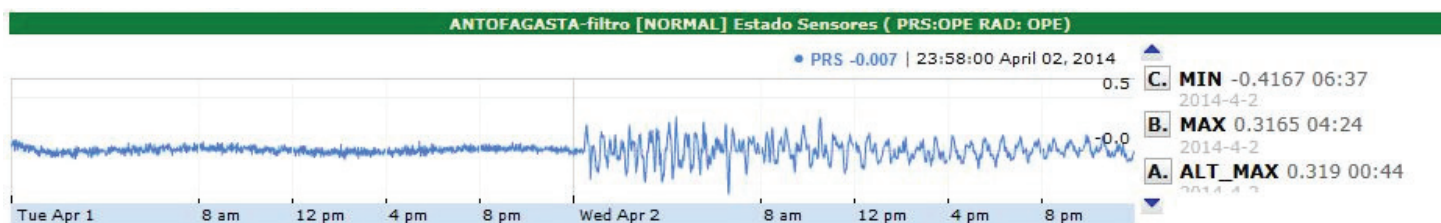
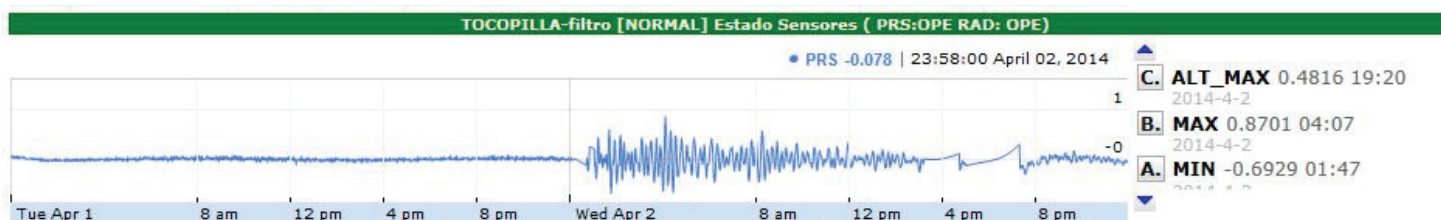
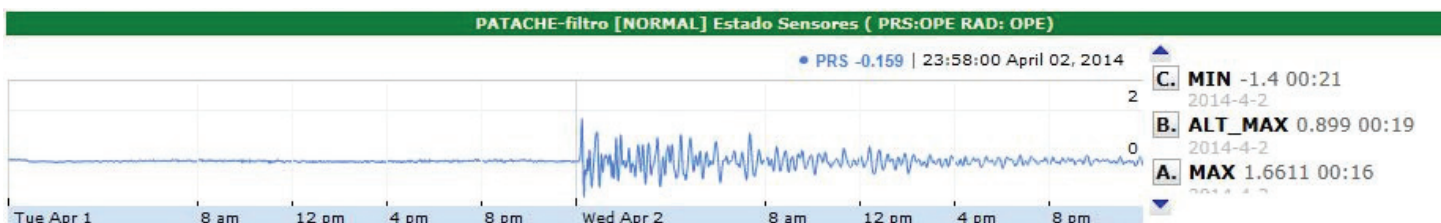
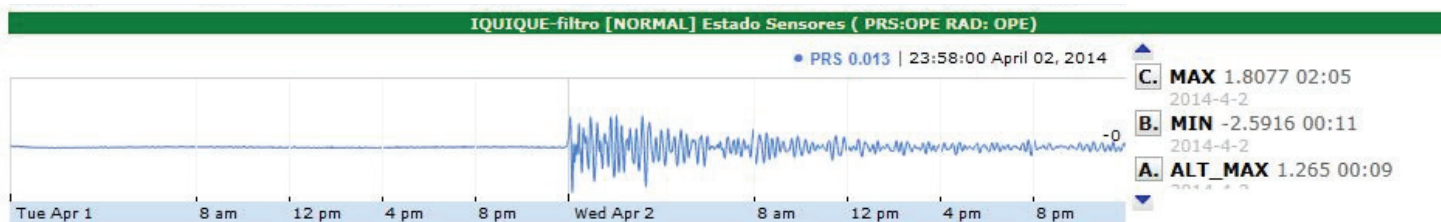
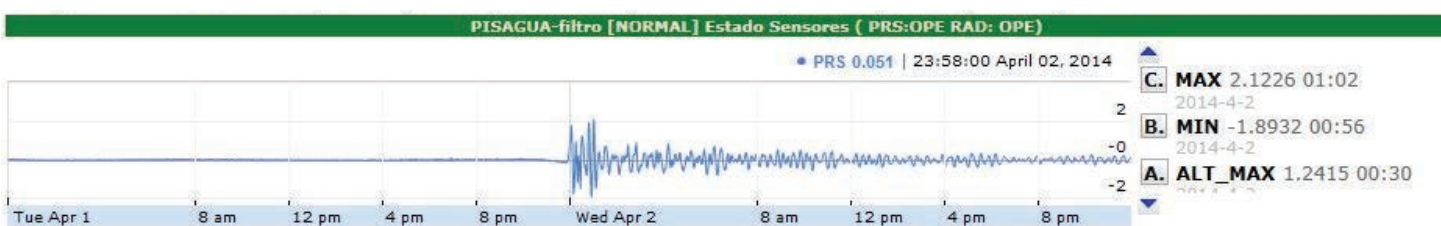
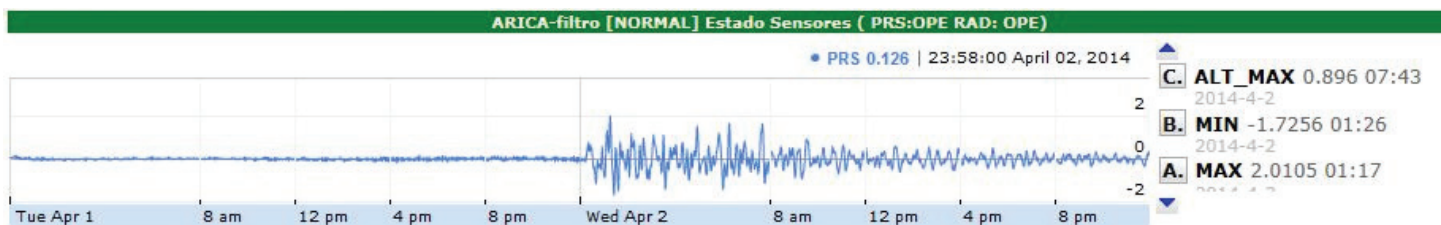
Observed maximum amplitude: Maximum distance observed from normal sea-level to the crest or trough. (+) / (-): The prefixed signs of the observed values indicate that the measurement is referred to above Mean Sea level (Positive) or below Mean Sea Level (Negative). Courtesy of Chile SHOA.

Tide Gauge Location	Observed maximum amplitude	
	Time (UTC)	Amplitude (m)
Arica	0:26	(-)1.72
	1:17	(+)2.01
Pisagua	0:56	(-)1.89
	1:02	(+)2.12
Iquique	0:11	(-)2.59
	2:05	(+)1.8
Patache	0:16	(+)1.66
	0:21	(-)1.4
Tocopilla	1:47	(-)0.69
	4:07	(+)0.87
Mejillones	1:21	(-)1.03
	7:13	(+)0.82
Antofagasta	4:24	(+)0.31
	6:37	(-)0.41
Paposo	1:37	(-)0.33
	3:32	(+)0.31
Taltal	1:18	(+)0.3
	1:30	(-)0.31
Chañaral	8:07	(-)0.35
	8:26	(+)0.45
Caldera	5:16	(-)0.25
	17:18	(+)0.26
Huasco	6:08	(+)0.2
	6:15	(-)0.18
Coquimbo	9:51	(+)0.33
	10:12	(-)0.28
Pichirangui	5:25	(-)0.23
	8:21	(+)0.19
Quintero	5:13	(-)0.19
	5:45	(+)0.19
Valparaíso	8:28	(+)0.24
	9:37	(-)0.21
San Antonio	4:41	(-)0.22
	5:07	(+)0.27
San Félix	1:38	(-)0.67
	1:41	(+)0.7
Juan Fernandez	2:25	(+)0.18
	2:43	(-)0.24
Constitución	5:22	(-)0.34
	6:42	(+)0.32
Quiriquina	5:28	(-)0.29
	6:18	(+)0.23
Talcahuano	5:34	(-)0.36
	6:17	(+)0.36
Coronel	9:36	(-)0.28
	10:16	(+)0.26
Lebu	13:15	(+)0.12
	13:22	(-)0.1
Corral	7:10	(-)0.1
	7:35	(+)0.11
Bahía Mansa	4:54	(-)0.18
	9:22	(+)0.12

Chile, 1 April 2014, *continued*

Tsunami marigrams (tide removed) at sea level stations along the coast of Chile.

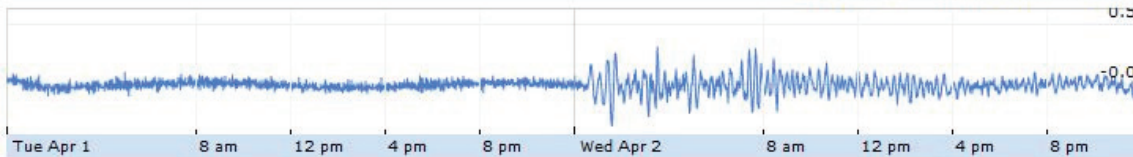
Vertical scale in meters, Horizontal scale in UTC time. MAX and ALT_MAX (+) are primary and secondary maximum tsunami amplitude above mean sea level in UTC, respectively. MIN (-) = largest tsunami amplitude below mean sea level. Courtesy of Chile SHOA.



Chile, 1 April 2014, *continued*

CALETA PAPOSO-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

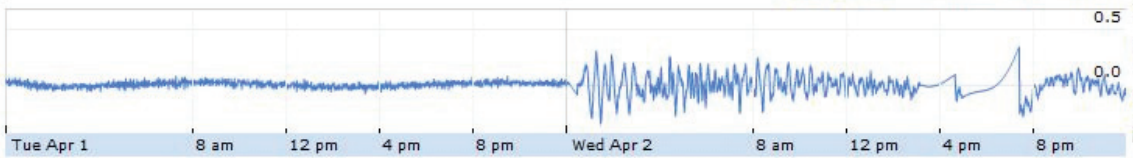
• PRS -0.115 | 23:58:00 April 02, 2014



C. ALT_MAX 0.194 07:45
2014-4-2
B. MAX 0.3156 03:32
2014-4-2
A. MIN -0.3345 01:37
2014-4-2

TALTAL-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

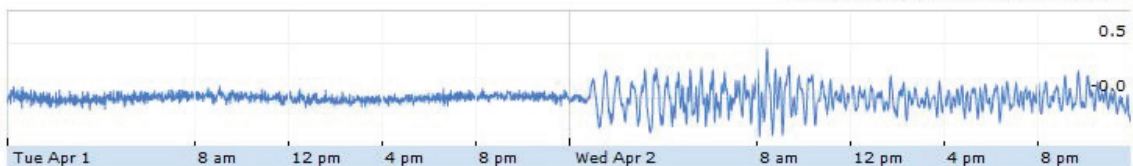
• PRS -0.114 | 23:58:00 April 02, 2014



C. ALT_MAX 0.5986 19:25
2014-4-2
B. MAX 0.3407 19:24
2014-4-2
A. MIN -0.3552 01:29
2014-4-2

CHANARAL-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

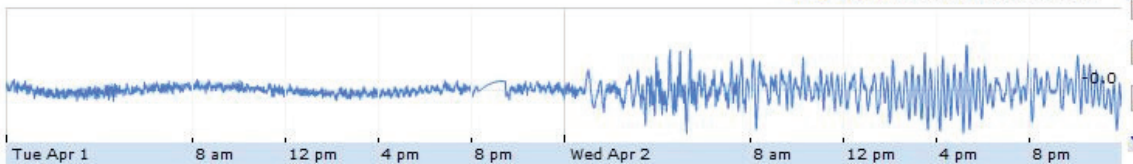
• PRS -0.198 | 23:58:00 April 02, 2014



C. MAX 0.4545 08:26
2014-4-2
B. ALT_MAX 0.2368 08:23
2014-4-2
A. MIN -0.3566 08:07
2014-4-2

CALDERA-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

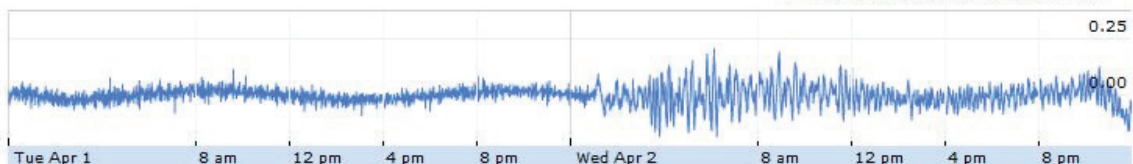
• PRS -0.112 | 23:58:00 April 02, 2014



C. MAX 0.2617 17:18
2014-4-2
B. MIN -0.2569 05:16
2014-4-2
A. ALT_MAX 0.1619 04:35
2014-4-2

HUASCO-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

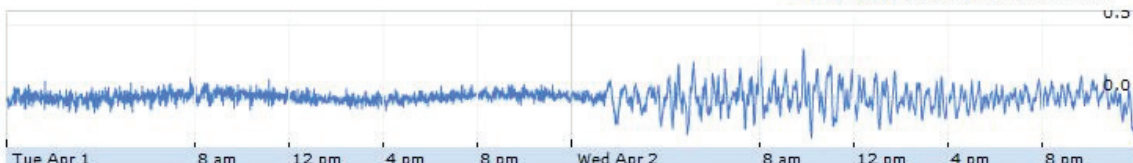
• PRS -0.097 | 23:58:00 April 02, 2014



C. MIN -0.187 06:15
2014-4-2
B. MAX 0.2088 06:08
2014-4-2
A. ALT_MAX 0.1642 04:11
2014-4-2

COQUIMBO-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

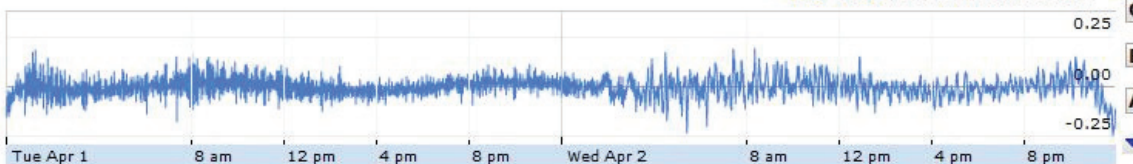
• PRS -0.247 | 23:58:00 April 02, 2014



C. MIN -0.2853 10:12
2014-4-2
B. MAX 0.3323 09:51
2014-4-2
A. ALT_MAX 0.1996 01:39
2014-4-1

PICHIDANGUI-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

• PRS -0.115 | 23:58:00 April 02, 2014

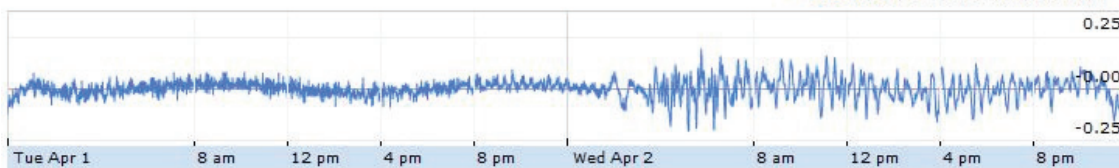


C. MIN -0.2469 23:50
2014-4-2
B. MAX 0.1916 08:21
2014-4-2
A. ALT_MAX 0.3294 07:23
2014-4-1

Chile, 1 April 2014, *continued*

QUINTERO-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

• PRS 0.017 | 05:47:00 April 01, 2014



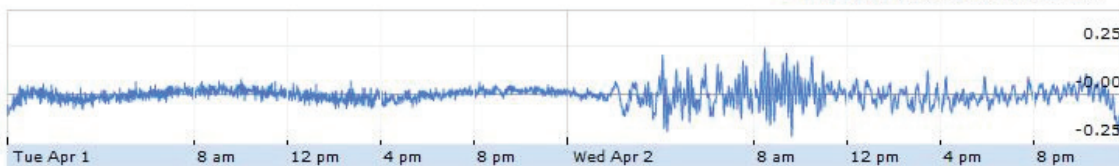
C. MIN -0.2377 23:50
2014-4-2

B. MAX 0.1932 05:45
2014-4-2

A. ALT_MAX 0.1367 05:14
2014-4-2

VALPARAISO-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

• PRS -0.168 | 23:58:00 April 02, 2014



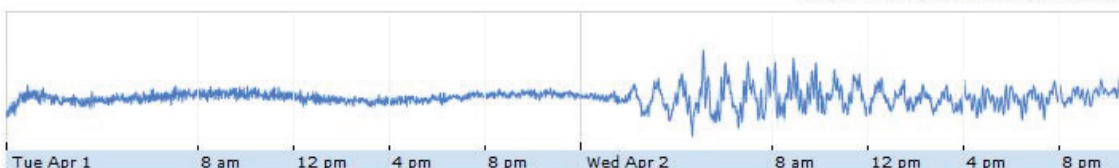
C. MIN -0.2142 09:37
2014-4-2

B. MAX 0.2405 08:28
2014-4-2

A. ALT_MAX 0.1559 04:09
2014-4-2

SAN ANTONIO-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

• PRS -0.184 | 23:58:00 April 02, 2014



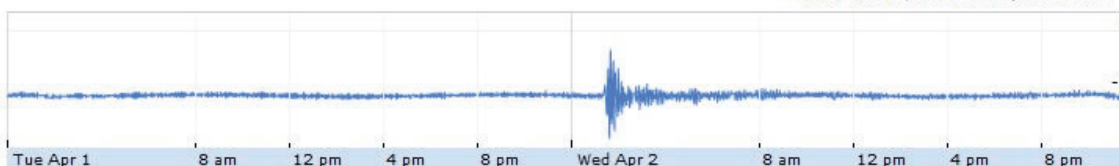
C. MIN -0.2562 23:49
2014-4-2

B. ALT_MAX 0.132 09:53
2014-4-2

A. MAX 0.2735 05:07
2014-4-2

SAN FELIX-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

• PRS -0.093 | 23:58:00 April 02, 2014



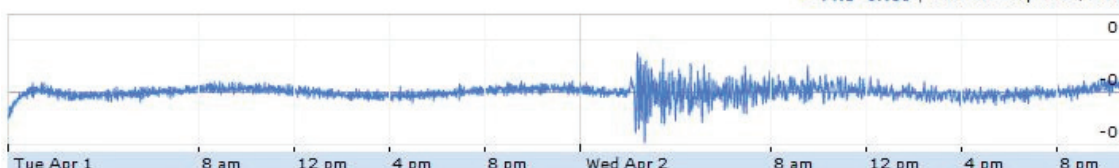
C. MAX 0.7073 01:41
2014-4-2

B. ALT_MAX 0.7267 01:40
2014-4-2

A. MIN -0.6718 01:38
2014-4-2

JUAN FERNANDEZ-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

• PRS -0.186 | 23:58:00 April 02, 2014



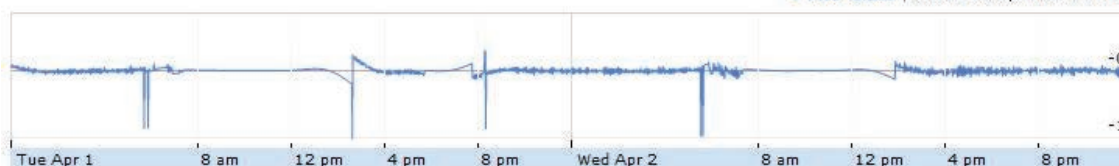
C. ALT_MAX 0.1895 02:46
2014-4-2

B. MIN -0.242 02:43
2014-4-2

A. MAX 0.1865 02:25
2014-4-2

ISLA DE PASCUA-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

• PRS -0.068 | 23:58:00 April 02, 2014



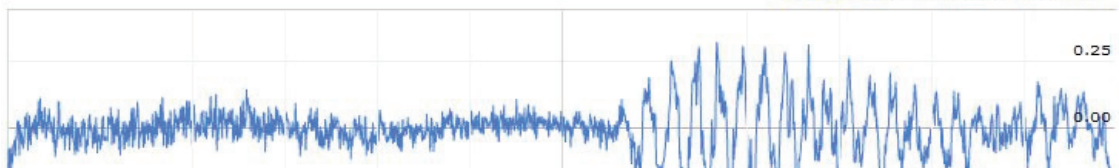
C. MAX 0.3095 20:19
2014-4-1

B. ALT_MAX 1.2717 14:39
2014-4-1

A. MIN -1.035 14:38
2014-4-1

CONSTITUCION-filtro [NORMAL] Estado Sensores (PRS:OPE RAD: OPE)

• PRS -0.258 | 23:58:00 April 02, 2014



C. ALT_MAX 0.1885 11:40
2014-4-2

B. MAX 0.3206 06:42
2014-4-2

A. MIN -0.3425 05:22
2014-4-2

Chile, 1 April 2014, *continued*Pacific Basin tsunami measurements from the 1 April 2014 Northern Chile earthquake and tsunami.
Courtesy of PTWC.

1 April 2014

Location	LONG	LAT	Predicted Arrival		Actual Arrival		Z2P	P2P	Per.		
			Time (UTC)		Time (UTC)						
Pisagua_CL	-70.2138	-19.5969	Apr	1	23:58	Apr	1	23:52	2.12	3.99	12:45
Iquique_CL	-70.1478	-20.2044	Apr	1	23:59	Apr	1	23:55	1.761	4.25	10:15
Patache_CL	-70.1942	-20.8003	Apr	2	0:09	Apr	2	0:05	1.662	3.025	7:00
Arica_CL	-70.335	-18.4758	Apr	2	0:12	Apr	2	0:14	2.01	3.666	14:00
DART_Arica_32401	-74.7311	-19.2872	Apr	2	0:20	Apr	2	0:06	0.249	0.341	13:00
Matarani_PE	-72.1088	-17.0009	Apr	2	0:21	Apr	2	0:22	0.586	1.167	7:30
Antofagasta_CL	-70.4044	-23.6531	Apr	2	0:23	Apr	2	0:26	0.282	0.654	18:00
Paposo_CL	-70.4687	-25.009	Apr	2	0:32	Apr	2	0:35	0.291	0.592	19:30
Taltal_CL	-70.4917	-25.4081	Apr	2	0:36	Apr	2	0:41	0.291	0.649	21:45
Chanaral_CL	-70.6461	-26.3567	Apr	2	0:42	Apr	2	0:50	0.424	0.776	21:30
Caldera_CL	-70.8247	-27.0644	Apr	2	0:46	Apr	2	0:52	0.24	0.513	14:30
DART_Caldera_Chile_32402	-73.9831	-26.7433	Apr	2	0:50	Apr	2	0:44	0.047	0.068	18:30
Coquimbo_CL	-71.3353	-29.95	Apr	2	1:11	Apr	2	1:24	0.303	0.483	18:00
San_Felix_CL	-80.1086	-26.2922	Apr	2	1:23	Apr	2	1:21	0.72	1.381	6:30
Callao_La-Punta_PE	-77.1668	-12.069	Apr	2	1:38	Apr	2	1:44	0.25	0.515	20:00
DART_Lima_32412	-86.392	-17.975	Apr	2	2:00	Apr	2	1:52	0.066	0.108	17:00
Juan_Fernandez	-78.8297	-33.6358	Apr	2	2:11	Apr	2	2:15	0.164	0.386	8:00
DART_Galapagos_32413	-93.499	-7.4003	Apr	2	3:26	Apr	2	3:26	0.033	0.05	13:00
Salina_Cruz_MX	-95.1968	16.1684	Apr	2	6:58	Apr	2	8:31	0.16	0.32	17:30
Hiva_Oa_Marquesas	-139.0347	-9.8049	Apr	2	10:17	Apr	2	10:23	0.59	1.092	14:00
Nuku_Hiva_Marquesas	-140.0958	-8.9148	Apr	2	10:25	Apr	2	10:48	0.444	0.998	13:00
Ensenada_MX	-116.6181	31.8484	Apr	2	11:12	Apr	2	12:30	0.049	0.116	11:30
Papeete_Tahiti	-149.5726	-17.5331	Apr	2	11:27	Apr	2	12:02	0.09	0.171	17:30
Huahine_PF	-151.0324	-16.7216	Apr	2	11:40	Apr	2	11:33	0.093	0.137	18:00
Santa_Monica_CA	-118.5	34.0083	Apr	2	11:41	Apr	2	12:35	0.193	0.247	21:15
Crescent_City_CA	-124.184	41.7456	Apr	2	13:07	Apr	2	12:37	0.142	0.325	12:45
Kapoho_HI	-154.8197	19.4992	Apr	2	13:18	Apr	2	13:38	0.139	0.232	12:30
Honuaopo_HI	-155.5509	19.0845	Apr	2	13:21	Apr	2	13:40	0.032	0.07	7:00
Hilo_HI	-155.0553	19.7303	Apr	2	13:24	Apr	2	13:42	0.528	1.13	17:15
Honokohau_HI	-156.0235	19.6689	Apr	2	13:33	Apr	2	13:44	0.101	0.183	10:15
Waitangi_Chatham_NZ	-176.5608	-43.9458	Apr	2	13:33	Apr	2	14:35	0.339	0.609	15:00
Kawaihae_Hawaii	-155.829	20.0366	Apr	2	13:38	Apr	2	13:47	0.25	0.43	12:00
Makapu'u_HI	-157.6688	21.3199	Apr	2	13:50	Apr	2	14:13	0.078	0.15	14:30
Kahului	-156.477	20.895	Apr	2	13:51	Apr	2	13:57	0.485	1.052	17:00
Boat_Cove_Raoul_Is_NZ	-177.8944	-29.28	Apr	2	13:52	Apr	2	14:44	0.049	0.106	6:00
Barber's_PT_HI	-158.1193	21.3218	Apr	2	13:55	Apr	2	14:11	0.083	0.157	5:00
Waianae_HI	-158.197	21.4498	Apr	2	13:56	Apr	2	14:13	0.081	0.188	9:00
Honolulu_HI	-157.867	21.3067	Apr	2	13:56	Apr	2	14:11	0.055	0.115	22:30
Haleiwa_HI	-158.1055	21.593	Apr	2	13:57	Apr	2	14:18	0.182	0.383	14:45
Nawiliwili_HI	-159.3561	21.9544	Apr	2	13:58	Apr	2	14:16	0.036	0.07	12:00
Palmyra_Island_US	-162.09	5.89	Apr	2	13:58	Apr	2	14:18	0.027	0.049	12:00
Hanalei_HI	-159.4982	22.2125	Apr	2	14:01	Apr	2	14:29	0.158	0.29	14:45
Nukualofa_TO	-175.1815	-21.138	Apr	2	14:16	Apr	2	14:49	0.073	0.12	21:30
Pago_Pago_AS	-170.689	-14.2766	Apr	2	14:17	Apr	2	14:45	0.343	0.705	18:00
Castle_Point_NZ	176.2317	-40.8993	Apr	2	14:20	Apr	2	15:08	0.166	0.272	23:00
Apia_Upolu_WS	-171.7613	-13.8268	Apr	2	14:28	Apr	2	15:01	0.098	0.203	14:00
Wellington_NZ	174.7791	-41.2846	Apr	2	14:31	Apr	2	17:30	0.148	0.286	16:45
Great_Barrier_Is_NZ	175.4889	-36.189	Apr	2	14:48	Apr	2	15:01	0.103	0.179	15:15
Kaikoura_NZ	173.7028	-42.4129	Apr	2	14:58	Apr	2	15:47	0.117	0.154	10:00
Port_Napier_NZ	176.9201	-39.4757	Apr	2	15:03	Apr	2	15:35	0.194	0.33	21:45
Dunedin_NZ	170.6294	-45.8143	Apr	2	15:06	Apr	2	15:47	0.05	0.094	22:00
Midway	-177.36	28.2117	Apr	2	16:24	Apr	2	16:42	0.093	0.168	12:00
Ouinne_New_Caledonia_FR	166.6833	-21.9829	Apr	2	16:34	Apr	2	17:53	0.119	0.236	17:15
Vanuatu	168.3077	-17.7553	Apr	2	16:37	Apr	2	17:57	0.204	0.391	11:00
Nikolski_AK	-168.871	52.9406	Apr	2	17:06	Apr	2	17:35	0.101	0.188	15:30
Port_Kembla_AU	150.9119	-34.4738	Apr	2	17:11	Apr	2	19:56	0.069	0.146	11:15
Lata_Wharf_SB	165.8019	-10.7208	Apr	2	17:49	Apr	2	18:38	0.061	0.115	18:00
Tarekukure_Wharf_SB	156.4086	-6.6928	Apr	2	19:26	Apr	2	20:58	0.48	0.096	11:15
Chichijima_JP	142.1947	27.0939	Apr	2	21:02	Apr	2	22:21	0.178	0.335	17:30

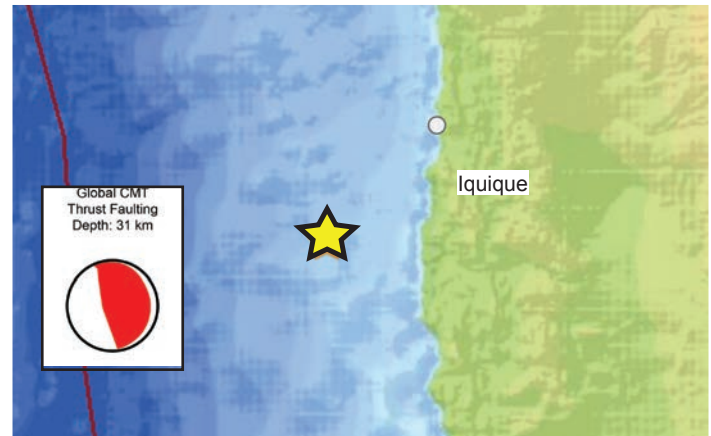
P2P: Peak to Peak measurement (m)

Z2P: Zero to Peak measurement (m)

Per: Wave period (min)

Near the Coast of Northern Chile, 3 April 2014, UTC 02:47 $M_w=7.6$

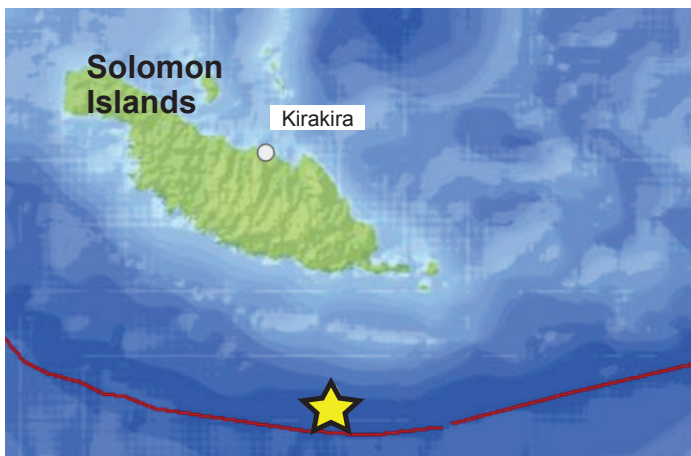
On 3 April 2014, a magnitude 7.6 earthquake occurred at 02:47 UTC off the coast of northern Chile, at a depth of 31 km due to slip on the plate boundary between the Nazca and South American plates. *The 3 April earthquake was an aftershock to the 1 April 2014 magnitude 8.2 northern Chile earthquake that generated a tsunami observed throughout the Pacific and caused damage locally.* Both earthquakes occurred in the same location where the Nazca plate subducts eastward beneath the South American plate at a rate of 73 mm per year at this latitude. Since the 1 April earthquake, over 45 aftershocks greater than magnitude 4.2 have occurred. For the 3 April earthquake, a small tsunami of 74 cm amplitude was recorded at Iquique in northern Chile, with no reports of tsunami damage.



3 April 2014 Northern Chile aftershock earthquake location marked by star. Map courtesy of USGS National Earthquake Information Center (NEIC).

Solomon Islands, 12 April 2014, UTC 20:15 $M_w=7.6$

Solomon Islands, 13 April 2014, UTC 12:36 $M_w=7.4$



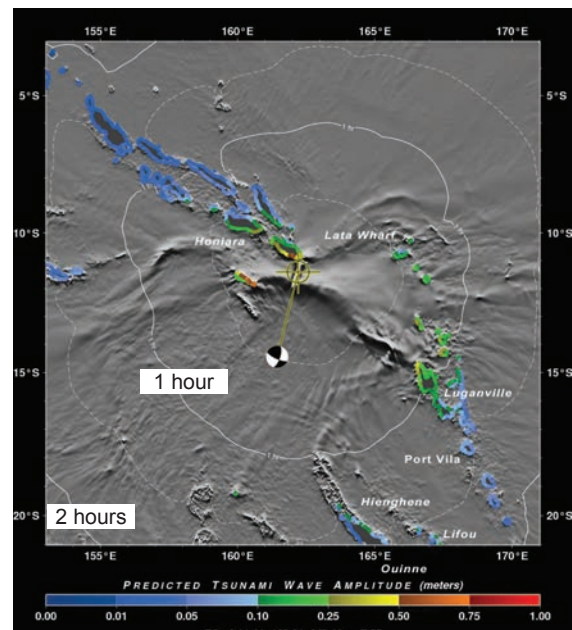
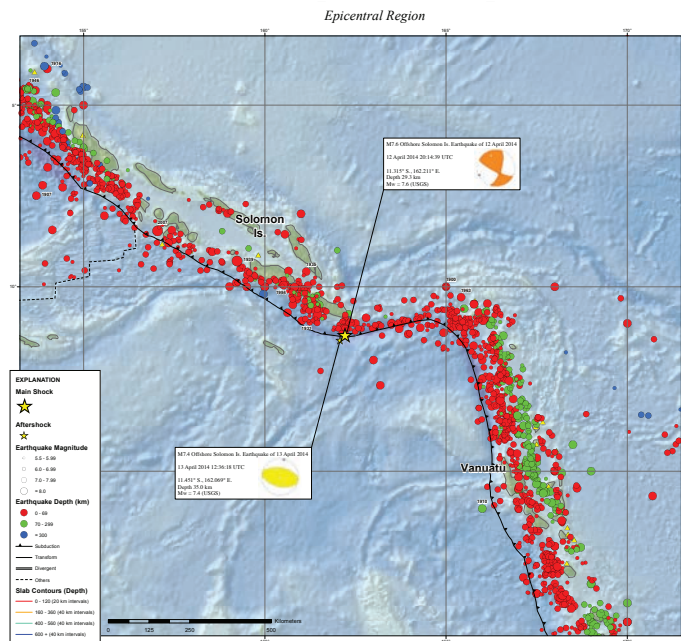
12 April 2014 Solomon Islands earthquake location marked by star. Map courtesy of USGS National Earthquake Information Center (NEIC).

On 12 April 2014, over 43,000 residents of the Solomon Islands were exposed to the very strong shaking from a magnitude 7.6 earthquake that struck 100 km southeast of Kirakira. The rupture resulted from a strike-slip fault located at a depth of 28 km at 11.315°S and 162.211°E. Initially, the earthquake was listed as 8.3 in magnitude before it was downgraded. The PTWC issued alerts stating “an earthquake of this size has the potential to generate a destructive tsunami that can strike coastlines in the region near the epicentre

within minutes to hours”. Tsunami warnings were in effect for the islands of Solomon, Vanuatu, and Papua New Guinea. The PTWC later cancelled their alerts 1 to 2 hours later when only 20-30 cm waves were observed at the Honiara sea level gauge.

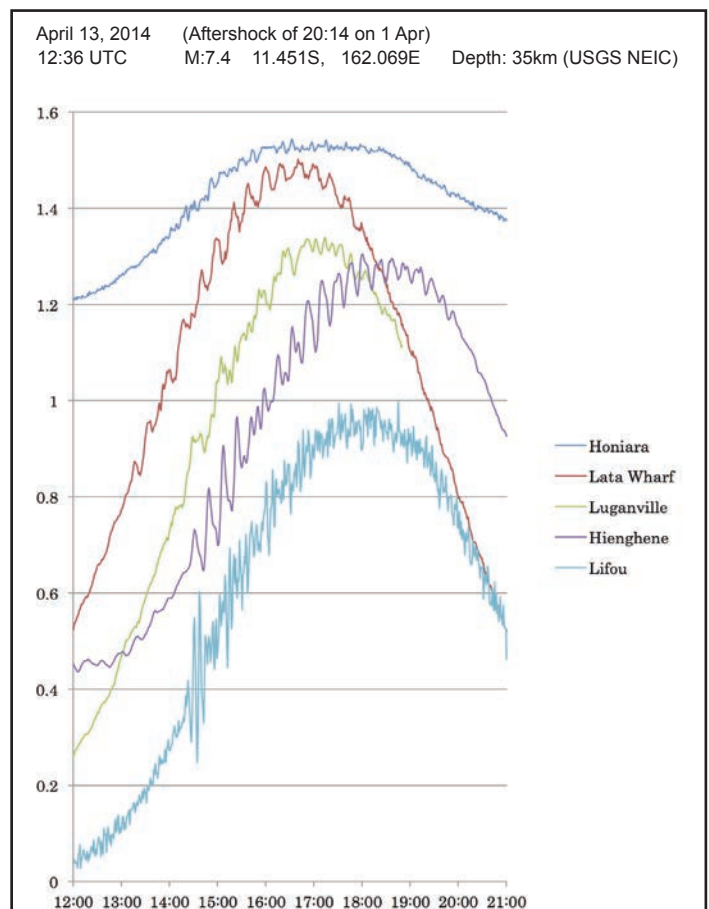
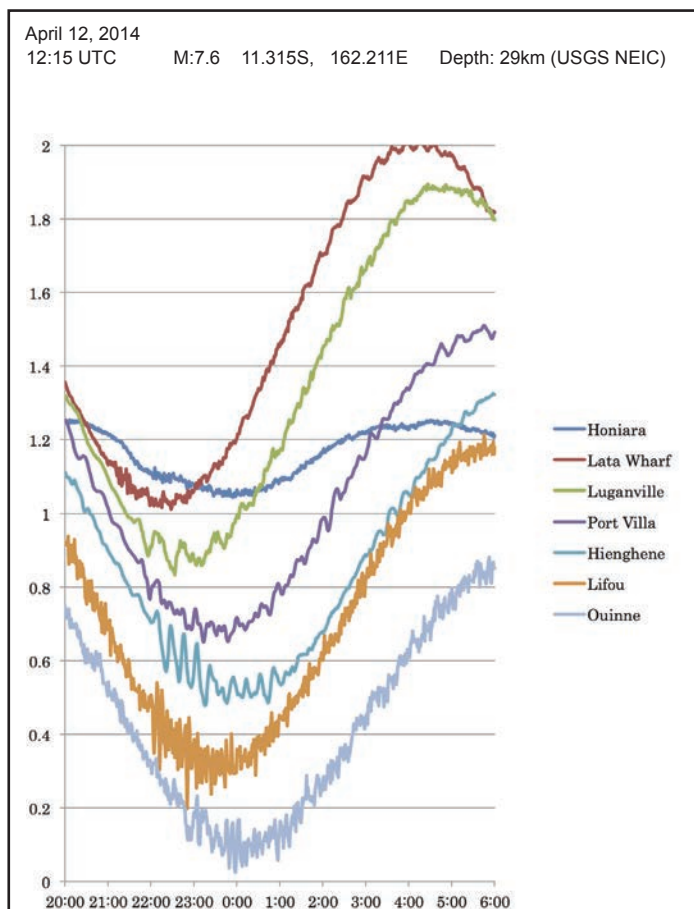
The following day, 13 April, 2014, another large earthquake occurred 323 km (200 miles) southeast of the capital, Honiara. The epicentre was located 38 km in depth and approximately 20 km from the previous day's earthquake in the Solomon Islands. This magnitude 7.4 earthquake (11.451°S, 162.069°E) was followed by a 5.9 magnitude aftershock. Several homes were pulled into the waterways where 20-30 cm waves were observed by the Honiara sea gauge.

The Solomon Island region is highly active seismically. Since 1900, this region has experience 27 earthquakes with M_6+ and another 62 events of M_7+ within 500 km of this event's epicenter. Seismic activity occurred on a NW-SE oriented left-lateral fault between the Australia and Pacific Plates. The USGS suggests plate convergence in this region occurs at a rate of 95 mm/yr. The 12 April 2014 earthquake occurred as thrust faulting along the New Britain Trench to the northwest to thrust faulting along the New Hebrides Trench farther east.

Solomon Islands 12 & 13 April 2014, *continued*

Historic Seismicity Map of Eastern Margin of Australian Plate (1900-2012). Map courtesy of USGS National Earthquake Information Center (NEIC).

PTWC Realtime Forecast of Tsunamis (RIFT) Model of coastal amplitude and travel contours (hours) disseminated 38 minutes after the Solomon Islands earthquake. Courtesy of PTWC.



Tsunamis recorded on nearby coastal sea level gauges in the Solomon Islands (Honiara, Lata Wharf), Vanuatu (Luganville, Port Vila), and New Caledonia (Hienghene, Lifou, Ouinne). Courtesy of M. Yamamoto.

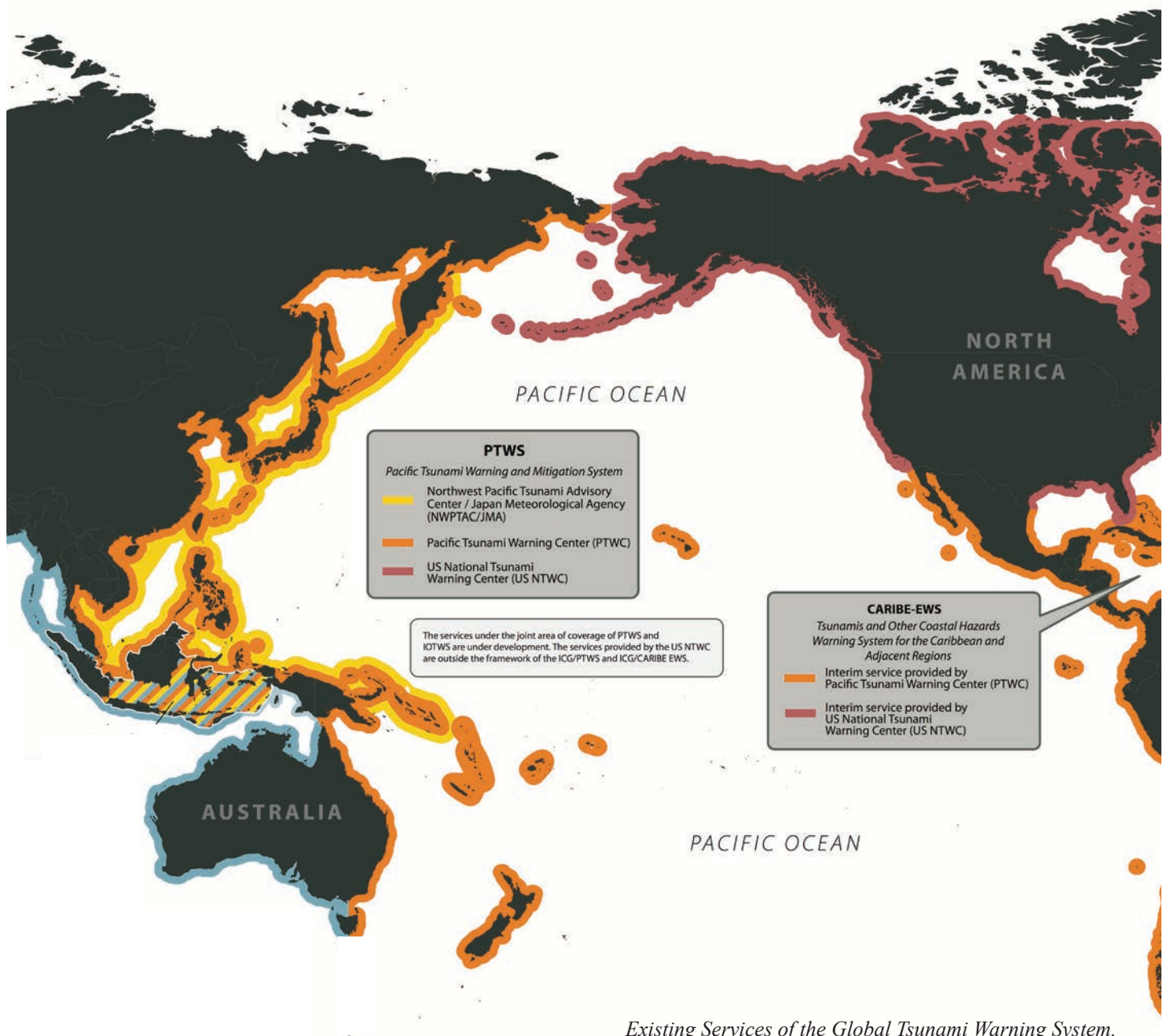
IOC News

IOC Tsunami Meetings, Paris, France 10-14 February 2014

http://ioc-unesco.org/index.php?option=com_oe&task=viewEventRecord&eventID=1417

ICG/PTWS representatives, Ken Gledhill (New Zealand, Chair PTWS), Takeshi Koizumi (JMA, Vice-Chair PTWS), David Coetzee (New Zealand, Working Group 3 Disaster Management and Preparedness), Laura

Kong (ITIC, Task Team PacWave 15), and Charles McCreery (PTWC, Task Team Enhanced Products), were among 22 participants that attended the Seventh Meeting of the IOC Working Group on Tsunamis and Other Hazards Related to Sea-Level Warning and Mitigation Systems Working Group (TOWS-WG-VII) with Task Team meetings on Tsunami Warning Operations and Disaster Management and Preparedness in Paris, France from 10 -13 February 2014. Michida of the



Existing Services of the Global Tsunami Warning System.

Paris, continued

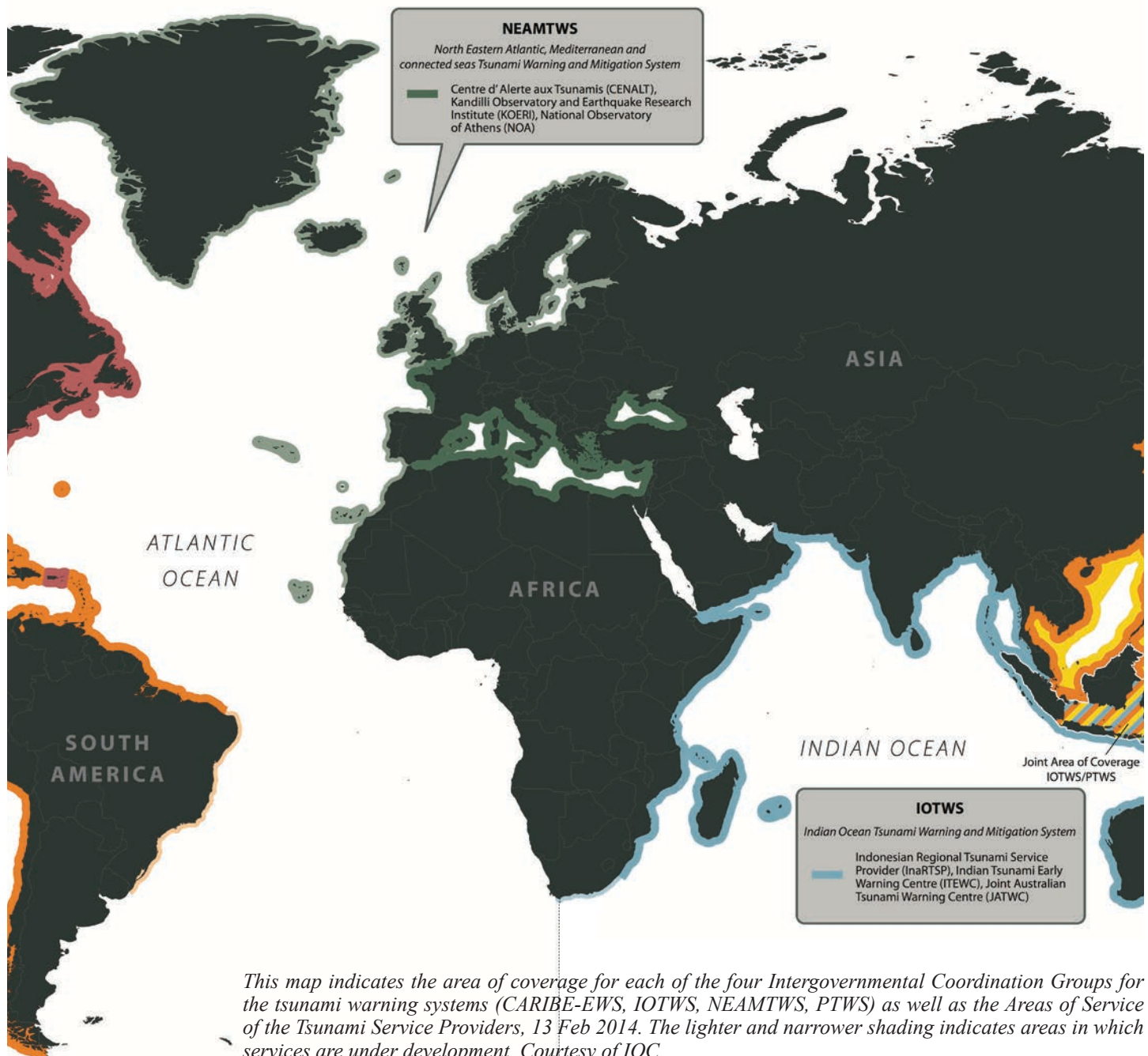
University of Tokyo, and Vice Chair of IOC in charge of TOWS-WG chaired the TOWS-WG-VII meeting. On 14 February 2014, Dr. Kong attended the Tsunami Information Center (TIC) coordination meeting. Yutaka

The IOC established the TOWS-WG to advise the IOC Governing Bodies on coordinated development and implementation activities on warning and mitigation systems for tsunamis and other hazards related to sea level as a common priority to all Global Inter-governmental Coordination Groups (ICG) for Tsunami

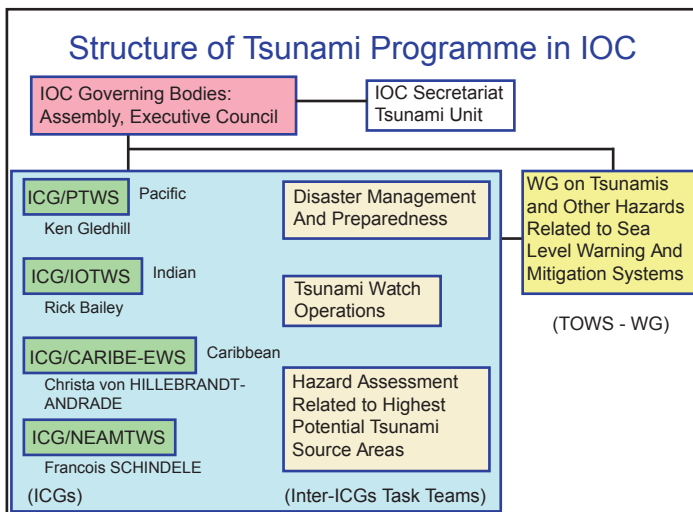
Warning and Mitigation Systems.

The Group acknowledged the need for harmonization of terminology across the ICGs. The definitions of National Tsunami Warning Center (NTWC) and Tsunami Warning Focal Point (TWFP) to read as follows:

- National Tsunami Warning Center (NTWC): A center officially designated by the government to monitor and issue tsunami warnings and other related statements within their country according to estab-



Paris, *continued*



Structure of IOC Tsunami Programme. Courtesy of Y. Michida.

lished National Standard Operation Procedures.

- Tsunami Warning Focal Point (TWFP). A 24 x 7 point of contact (office, operational unit or position, not a person) officially designated by the NTWC or the government to receive and disseminate tsunami information from an ICG Tsunami Service Provider to established National Standard Operation Procedures. The TWFP may or not be the NTWC.

For Tsunami Watch Operations, Dr. McCreery (PTWS) and Mr. Takeshi Koizumi (JMA) represented the PTWS. Key issues that required discussion and coordination included areas of responsibility services, common terminology for alert levels, seismic magnitude and sea level parameters, format and content of products and dissemination methods. Dr. Kong (ITIC) and Mr. David Coetzee (MCDEM) represented the Task Team on Disaster Management and Preparedness. Topics of discussion included exchange of information on preparedness actions, education/awareness campaigns and other matters related to disaster management



Delegates attending the Twenty-fifth session of the IOC ICG/PTWS in Vladivostok, Russian Federation in September 2013. The ICG/PTWS is one of four global ICGs in the IOC Tsunami Programme. Photo courtesy of ITIC.

and preparedness, facilitate Standard Operating Procedures across ICGs to strengthen emergency response capabilities, and facilitate the coordination of Tsunami Information Centers of the ICGs.

The TOWS WG accepted the following recommendations:

- Publish a Standard Operating Manual
 - Initiate development of a document containing (i) reference list of tsunami evacuation mapping material, and (ii) a template for comprehensive mapping guidelines
 - Promote education and awareness strategies as well as accredited community preparedness programmes as exemplified in the CARIBE-EWS.
 - Finalize and publish the Post Event Performance Survey
 - Underline the role of Tsunami Information Centres (TICs) have in the management of post event performance surveys.
 - Approval of procedures and guidelines for ICG-TSPs issuing and disseminating tsunami bulletins for earthquakes outside their respective ICG coverage
 - Chair of TOWS-WG will communicate with and request the Executive Secretary of IOC (i) to contact UN-OCHA and WMO to express concern of the Group about the confusion that the Global Disaster Alert and Coordination System (GDACS) tsunami alert products creates viz-a-viz with the products issued by the ICG-TSPs, and (ii) to seek clarification about the scope, methodology, purpose and intended users of the GDACS service
 - ICG-TSPs adapt their bulletins to clearly define water levels, tsunami arrival times and the method/terminology in order to avoid confusion and achieve more harmonized products.
- Outcomes:
- Inter-ICG Task Team improvement in the Areas of Responsibility (AoR) and geographical coverage mapping since 2011, a recommendation for the naming convention of tsunami events, and procedures for RTSPs to disseminate bulle-

Paris, continued

tins for AoR between the Indian Ocean Tsunami Warning and Mitigation System and the PTWC

- The main outcomes from the Twenty- fifth Session of the ICG/PTWS are the endorsement of the PTWC enhanced products for PTWS and the establishment of an Advisory System for the South China Sea, and the continuation of wave exercises.

The TIC Coordination meeting was attended by ITIC, JTIC, CTIC, NEAMTIC, and the IOC Tsunami Unit. Discussion topics included TIC governance, staffing, and work plans, commonalities, collaboration in awareness materials and training, and tsunami event data collection.

Micronesia Regional Tsunami Training, Honolulu, Hawaii, 14 March 2014

As a follow up to the IOC Pacific Island Countries Regional Tsunami Training held in August 2013 in Wellington, New Zealand, ITIC and PTWC conducted a PTWC International New Products Implementation Training for Micronesia Weather Service Offices (WSO) on 14 March 2014 at the NOAA Inouye Regional Center at Pearl Harbor, Hawaii. ITIC Director, Dr. Laura Kong, and PTWC Director, Dr. Charles McCreery, organized the training for Micronesia WSO Managers from Chuuk, Yap, Palau, Pohnpei, and

Micronesia, continued

(Top) Map of Micronesia region. (Bottom) Aerial view of typical island atolls in Micronesia with fringing reef system, 2013. Photo courtesy of ITIC.

Marshall Islands. Also in attendance was NWS Guam Weather Forecast Office (WFO).

The PTWC International New Products are scheduled for official implementation on 1 October 2014 throughout the Pacific Basin. The current PTWC international messages containing Warning / Watch / Cancellation threat levels would be eliminated. The Micronesia WSO staff would receive the new products on a 24/7 basis, interpret forecast wave amplitudes for their countries, and make recommendations on course of actions to enable. The training encompassed an ITIC analysis of the Micronesia Tsunami Hazard, including historic earthquake and tsunami sources, tsunami travel times, and vulnerability. PTWC provided a detailed description of the content and various types of new PTWC international text and graphical products, as well as tsunami forecast limitations.



Participants of the Micronesia Regional Tsunami Training. Left to Right: Chip McCreery (PTWC), Laura Kong (ITIC), Maria Ngemaes (WSO Koror, Palau), Joe Berdon (WSO Chuuk, FSM), Reggie White (WSO Majuro, Marshall Islands), Chip Guard (WFO Guam), Eden Skilling (WSO Pohnpei, FSM), Joe Lukangaw (WSO Yap, FSM). Photo courtesy of ITIC.

Micronesia, *continued*

Guidance was provided on country actions to be taken for the various levels of forecast wave amplitudes based on Micronesia regional and local tsunami hazard scenarios.

During discussion periods, there were reservations expressed by the Marshall Islands about the transition to the new products and the elimination of Warning / Watch / Cancellation threat levels, which small island countries have relied upon for decades to guide their response actions. Another area of detailed discussion was that since the new products have a Final Tsunami Threat Message, without a Cancellation subject line, countries would have to develop standard operating procedures on how to enable declaring an end to a tsunami event.

At the end of the training, the Micronesia WSO Managers understood the content of the PTWC new international products. The Micronesia WSO Managers further discussed their country implementation strategies. They requested additional training be made available within their countries for their staff and emergency response stakeholder agencies to become familiar with the new products. ITIC and NWS Guam WFO agreed to partner together to travel and deliver further tsunami trainings on the PTWC new international products to individual Micronesia countries. A schedule of training deliveries to the Micronesia countries was planned for the spring and summer of 2014.



Sea level station at Pohnpei, FSM with (top) Chip Guard (Weather Forecast Office - Guam) and (bottom) Eden Skilling (Weather Service Office - Pohnpei), 2013. Photo courtesy of ITIC.



Each WSO will be equipped with CISN to monitor earthquakes and TideTool to monitor tsunamis. Shown is the configuration installed by ITIC at the WSO Majuro, Marshall Islands, in late April 2014. Photo courtesy of ITIC.

ITIC - PTWC NEWS**American Samoa New US Domestic Tsunami Products Training, Honolulu, Hawaii, 12 March 2014**

Dr. Charles McCreery, Director of PTWC, and Dr. Laura Kong, Director of ITIC, conducted PTWC - American Samoa US Domestic Tsunami Product training on 12 March 2014 at the Hawaii Convention Center in Honolulu. American Samoa is a territory of the United States located in the southern Pacific Ocean north of Tonga, and east of Independent Samoa. It consists of five volcanic islands and two atolls with a population of about 55,000, most of who spend most of their time very near the coast. American Samoa is vulnerable to impacts from tsunamis generated by earthquakes from the nearby Tonga subduction zone, as well as those generated far away by earthquakes around the Pacific Rim.

American Samoa has for the past several decades, been included in PTWC international products issued for the UNESCO/IOC Pacific Tsunami Warning and Mitigation System. However, as of 30 March 2014, PTWC started the implementation of the American Samoa US Domestic Tsunami Products in which PTWC provides authoritative Tsunami Warning, Advisory, Watch, and Information levels from large, potentially-tsunamigenic Pacific earthquakes.

This separate set of American Samoa US Domestic Tsunami Products give more customized information

American Samoa, *continued*

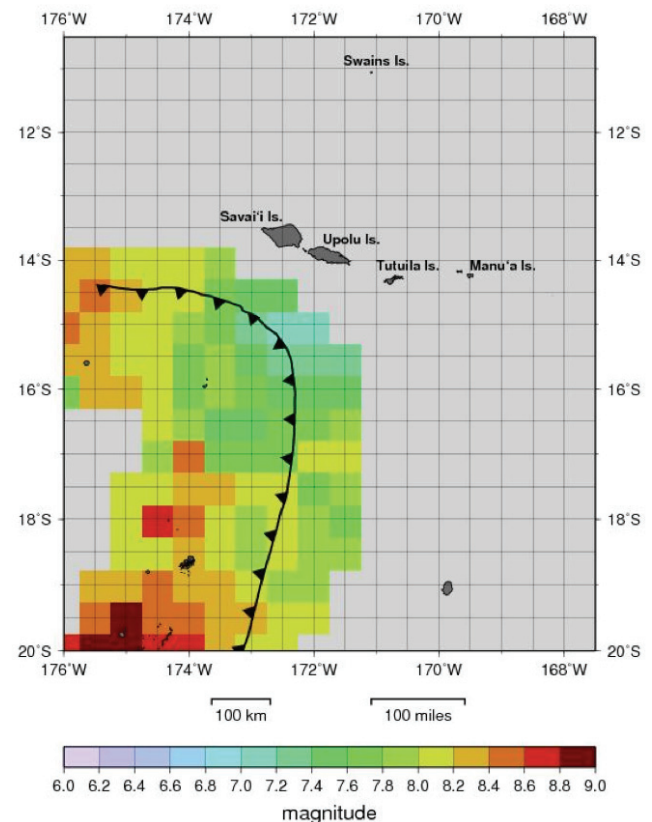
Pago Pago Plaza flooded by the 2009 South Pacific tsunami. Photo courtesy of G. Yamasaki.



In the severely damaged village of Leone, a traditional Samoan fale is destroyed. Photo courtesy of J. Latham.



Sailboat grounded in Pago Pago Park by a series of tsunami waves from the 2009 South Pacific tsunami. Photo courtesy of G. Yamasaki.



This figure shows the minimum magnitudes of shallow earthquakes in the Tonga Trench seismic zone that produce simulated tsunamis having coastal amplitudes anywhere in American Samoa that exceed the Tsunami Warning threshold ($>3.3\text{ft}$ or $>1\text{m}$ above the tide level). Simulated epicenters are centered on a half-degree grid across the area of seismicity. The black line shows the axis of the Tonga Trench where the Pacific Plate is subducting beneath the Australian Plate (NOAA/NWS PTWC, User's Guide: PTWC Tsunami Warning Products for American Samoa, 2014).

than is possible with the current international products. Moreover, these new products were prompted by the 29 September 2009 tsunami that struck American Samoa from a magnitude-8.0 earthquake located just 200 km to the southwest of the main island of Tutuila. It caused 34 American Samoa casualties and significant damage. The new domestic products have also been prompted by an upcoming change to the international products that will eliminate the use of alerting terms such as watch and warning, but instead provide only a general forecast of expected tsunami impacts.

Similarly, the US Territory of Guam and the Commonwealth of the Northern Mariana Islands (CNMI) currently subscribe to PTWC international bulletins. New Guam/CNMI US Domestic Tsunami Products are being developed and planned for implementation in August 2014.

ITIC - PTWC NEWS, *continued***ASEAN Defense Ministers Meet with PTWC and ITIC at NOAA Inouye Regional Center, Honolulu, Hawaii, USA, 2 April 2014**

PTWC Director, Dr. Charles McCreery and ITIC Director, Dr. Laura Kong provided tsunami organizational briefings to Defense Ministers of the Association of Southeast Asian Nations (ASEAN) meeting, hosted at the new NOAA Inouye Regional Center on 2 April 2014. The theme of the ASEAN

conference was international military assistance during natural hazards. Participants included US secretary of Defense Chuck Hagel, NOAA administrator Kathleen Sullivan, ASEAN Defense Ministers, and the US Pacific Command. This included tours of PTWC and ITIC spaces and a recap of the previous day, 1 April 2014 Northern Chile tsunami event, including the use of PTWC enhanced forecast products. Tsunami Awareness packets were also distributed to ASEAN participants.



PTWC Director, Chip McCreery (center left), provides an orientation briefing about PTWC operations to ASEAN Defense Ministers at the NOAA Inouye Regional Center. Photo courtesy ITIC.



NOAA Administrator Kathleen Sullivan briefs US Secretary of Defense Chuck Hagel (center) and ASEAN Defense Ministers on the 1 April 2014 Chile tsunami using PTWC enhanced forecast energy and wave model products projected on the Science on a Sphere globe at the NOAA Inouye Regional Center. Photo courtesy ITIC.

Located in Honolulu, Hawaii, USA, the International Tsunami Information Center (ITIC) was established on 12 November 1965 by the Intergovernmental Oceanographic Commission (IOC) of the United Nations Educational, Scientific, and Cultural Organization (UNESCO) and is hosted by the US National Oceanic & Atmospheric Administration (NOAA). In 1968, the IOC first convened the International Coordination Group for the Tsunami Warning System in the Pacific (ITSU). In 2005, ITSU became the Intergovernmental Coordination Group for the Pacific Tsunami Warning and Mitigation System (ICG/PTWS) so as to better convey the comprehensive approach required to reduce tsunami risks. The ICG/PTWS encompasses 46 countries within the Pacific Ocean and its marginal seas and basins.

**After an earthquake,
a tsunami may follow.**
Move quickly to higher ground.

