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Richard H. Hagemeyer Pacific Tsunami Warning Center
Director's Report
(Charles S. McCreery, Vice Chairman ICG/ITSU)

Introduction

The Richard H. Hagemeyer Pacific Tsunami Warning Center (PTWC) is the operations centre for the Tsunami Warning System in the Pacific. In this capacity the PTWC provides information on large potentially tsunamigenic earthquakes in the Pacific Basin to Member States of ITSU, as well as to others who may be threatened by tsunamis resulting from these earthquakes. This information usually takes the form of Tsunami Bulletins issued for Warnings, Watches, Advisories, and for Information only. The PTWC is also the national source of Tsunami Warnings, Watches, Advisories, and Information Bulletins for Hawaii, US possessions, and all other US interests in the Pacific located outside of the continental United States. Lastly, the PTWC operates the Regional Tsunami Warning Network for the State of Hawaii (HRTWN). In this capacity, the PTWC provides rapid warnings to the State of Hawaii for tsunamis generated by large local earthquakes associated primarily with Hawaii's active volcanoes. The PTWC is operated by the U.S. National Oceanic and Atmospheric Administration's (NOAA) National Weather Service.

This report describes key activities and accomplishments of PTWC during the intersessional period as well as issues regarding the PTWC for the attention of the Group at ITSU-XX.

Tsunami Warnings, Watches, Information Bulletins, and Other Products

During the intersessional period covering the interval from June 2003 through September 2005, PTWC issued eighty-five bulletins to the Pacific (Table 1). Tsunami Warnings were issued on only one occasion. At 1950Z on 25 September 2003 a magnitude 8.3 (Mw, Harvard) earthquake occurred off of the east coast of Hokkaido, Japan. An initial Tsunami Warning and Watch was issued by PTWC for the region near the epicenter at 2007Z. Supplemental bulletins were issued at 2024Z and 2104Z. Although a tsunami was generated, a cancellation was issued at 2213Z based on only small readings from the nearest gauges. A maximum wave amplitude of 2.54m was recorded at Tokachiko, Japan, (reported by the Japan Meteorological Agency).

Sixty-eight Tsunami Information Bulletins (TIBs) were issued for large Pacific-region earthquakes without a regional or teletsunami potential. Thirteen TIBs were also issued in response to the December 26, 2005 Sumatra event and aftershocks, and the adjacent March 28, 2005 event. Six hundred and sixty-one observatory messages were issued in response to earthquakes that triggered PTWC seismic alarms. These messages, sent primarily to other geophysical observatories, provide PTWC's preliminary earthquake location and magnitude.

Table 1. Bulletins issued by PTWC to the Pacific Region during the intersessional period. Bulletin types are: RWI=Initial Regional Warning, RWS=Regional Warning Supplement, FWC=Final Warning Cancellation, TIB=Tsunami Information Bulletin, and TIS=Tsunami Information Supplement.

Bulletin		Issue Time						EQ Origin Time						Coordinates			Dep	Mag	Location
Type	#	Yr	Mo	Da	Hr	Mn	Sc	Yr	Mo	Da	Hr	Mn	Sc	Lat	Lon	km	Mw		
TIB	1	2003	06	23	12	25	33	2003	06	23	12	13	07	51.5	176.6	033	7.1	RAT ISLANDS ALEUTIAN ISLANDS	
TIB	1	2003	08	04	05	22	43	2003	08	04	04	37	57	-60.0	-43.1	033	7.7	SCOTIA SEA	
TIB	1	2003	08	21	12	31	04	2003	08	21	12	13	24	-45.3	166.5	033	7.3	OFF W. COAST OF S. ISLAND N.Z.	
RWI	1	2003	09	25	20	07	52	2003	09	25	19	50	44	42.6	143.9	033	8.1	HOKKAIDO JAPAN REGION	
RWS	2	2003	09	25	20	04	13	2003	09	25	19	50	21	42.1	143.6	033	8.1	EASTERN HONSHU JAPAN	
RWS	3	2003	09	25	21	04	43	2003	09	25	19	50	21	42.1	143.6	033	8.1	EASTERN HONSHU JAPAN	
FWC	4	2003	09	25	22	13	24	2003	09	25	19	50	21	42.1	143.6	033	8.1	EASTERN HONSHU JAPAN	
TIB	1	2003	10	08	09	18	10	2003	10	08	09	07	26	42.6	144.8	034	6.6	HOKKAIDO JAPAN REGION	
TIB	1	2003	10	31	01	21	42	2003	10	31	01	07	04	37.9	142.6	035	6.6	OFF EAST COAST OF HONSHU JAPAN	
TIB	1	2003	11	17	06	54	41	2003	11	17	06	43	40	50.8	178.5	040	6.9	RAT ISLANDS ALEUTIAN ISLANDS	
TIB	2	2003	11	17	07	09	45	2003	11	17	06	43	39	50.8	178.4	040	7.5	RAT ISLANDS ALEUTIAN ISLANDS	
TIB	1	2003	11	18	17	35	39	2003	11	18	17	14	58	12.2	125.2	060	6.1	SAMAR PHILIPPINE ISLANDS	
TIB	1	2003	11	25	20	43	54	2003	11	25	20	20	29	-5.6	150.9	130	6.7	NEW BRITAIN REGION P.N.G.	
TIB	1	2003	12	05	21	40	27	2003	12	05	21	26	45	55.6	165.7	033	7.0	KOMANDORSKY ISLANDS REGION	
TIB	1	2003	12	10	04	54	06	2003	12	10	04	38	53	23.0	121.4	083	7.1	TAIWAN	
TIB	1	2003	12	22	19	23	55	2003	12	22	19	16	22	35.4	-121.2	005	6.8	CENTRAL CALIFORNIA	
TIB	1	2003	12	25	21	07	34	2003	12	25	20	43	10	-22.1	169.7	044	6.7	LOYALTY ISLANDS REGION	
TIB	1	2003	12	26	21	48	48	2003	12	26	21	26	39	-22.4	169.7	033	6.8	LOYALTY ISLANDS REGION	
TIB	1	2003	12	27	16	19	12	2003	12	27	16	01	40	-22.0	169.5	046	7.3	LOYALTY ISLANDS REGION	
TIS	2	2003	12	27	19	49	19	2003	12	27	16	01	38	-22.0	169.5	040	7.3	LOYALTY ISLANDS REGION	
TIB	1	2003	12	27	22	55	37	2003	12	27	22	38	38	-21.7	169.8	033	6.8	LOYALTY ISLANDS REGION	
TIB	1	2004	01	03	16	41	13	2004	01	03	16	23	53	-22.3	169.7	033	7.0	LOYALTY ISLANDS REGION	
TIB	1	2004	01	25	12	01	44	2004	01	25	11	43	47	-16.7	-174.2	179	6.7	TONGA ISLANDS	
TIB	1	2004	01	28	22	35	18	2004	01	28	22	16	01	-3.8	126.6	033	6.6	BURU INDONESIA	
TIB	1	2004	02	05	21	22	14	2004	02	05	21	05	35	-3.6	135.6	033	6.9	IRIAN JAYA REGION INDONESIA	
TIB	1	2004	02	07	02	59	22	2004	02	07	02	43	08	-4.0	135.1	033	7.4	IRIAN JAYA REGION INDONESIA	
TIB	1	2004	02	08	09	15	40	2004	02	08	08	59	23	-3.8	135.4	033	6.7	IRIAN JAYA REGION INDONESIA	
TIB	1	2004	05	03	04	54	35	2004	05	03	04	37	22	-37.7	-73.2	033	6.8	NEAR COAST OF CENTRAL CHILE	
TIB	1	2004	06	10	15	35	59	2004	06	10	15	20	30	55.7	160.2	231	6.8	KAMCHATKA	
TIB	1	2004	06	28	10	00	35	2004	06	28	09	50	19	55.0	-134.3	033	7.0	SOUTHEASTERN ALASKA	
TIB	1	2004	07	15	04	43	09	2004	07	15	04	27	46	-17.7	-179.0	645	7.0	FIJI ISLANDS REGION	
TIB	1	2004	07	25	14	52	14	2004	07	25	14	35	48	-2.5	104.0	583	7.1	SOUTHERN SUMATERA INDONESIA	
TIB	1	2004	07	28	04	12	07	2004	07	28	03	57	03	-0.7	133.0	033	6.6	IRIAN JAYA REGION INDONESIA	
TIB	1	2004	09	05	10	19	05	2004	09	05	10	07	41	33.3	136.8	033	7.4	NEAR S. COAST OF WESTERN HONSHU	
TIB	1	2004	09	05	15	16	36	2004	09	05	14	57	52	33.4	137.2	033	7.2	NEAR S. COAST OF HONSHU JAPAN	
TIB	1	2004	09	06	23	44	21	2004	09	06	23	30	09	33.3	137.3	033	6.6	NEAR S. COAST OF HONSHU JAPAN	
TIB	1	2004	10	08	08	45	22	2004	10	08	08	28	24	-10.9	162.3	033	7.1	SOLOMON ISLANDS	
TIB	1	2004	10	08	14	57	35	2004	10	08	14	36	36	13.9	120.6	105	6.6	MINDORO PHILIPPINE ISLANDS	
TIB	1	2004	10	09	21	38	42	2004	10	09	21	27	25	11.5	-86.7	033	7.3	NEAR COAST OF NICARAGUA	
TIB	1	2004	10	15	04	23	35	2004	10	15	04	09	19	24.6	122.6	082	6.7	TAIWAN REGION	
TIB	1	2004	11	02	10	11	04	2004	11	02	10	02	45	49.3	-128.8	033	6.7	VANCOUVER ISLAND REGION	
TIB	1	2004	11	10	00	11	39	2004	11	09	23	59	00	-11.1	163.6	040	7.0	SOLOMON ISLANDS	
TIB	1	2004	11	11	18	17	27	2004	11	11	17	34	43	-11.1	162.2	033	6.7	SOLOMON ISLANDS	
TIB	1	2004	11	11	21	41	44	2004	11	11	21	27	16	-8.2	124.5	033	7.4	TIMOR REGION INDONESIA	
TIB	1	2004	11	15	09	20	02	2004	11	15	09	07	29	4.8	-77.4	033	7.2	NEAR WEST COAST OF COLOMBIA	
TIB	1	2004	11	22	20	40	52	2004	11	22	20	26	29	-46.6	164.9	002	7.2	OFF W. COAST OF S. ISLAND N.Z.	
TIB	1	2004	11	26	02	39	35	2004	11	26	02	25	46	-3.5	135.2	109	7.1	IRIAN JAYA REGION INDONESIA	
TIB	1	2004	11	28	18	44	33	2004	11	28	18	32	44	43.1	145.0	033	7.0	HOKKAIDO JAPAN REGION	
TIB	1	2004	12	06	14	27	23	2004	12	06	14	15	44	43.0	144.9	056	6.8	HOKKAIDO JAPAN REGION	
TIB	1	2004	12	23	15	19	35	2004	12	23	14	59	35	-50.1	161.1	033	7.9	NORTH OF MACQUARIE ISLAND	
TIB	1	2004	12	26	01	14	19	2004	12	26	00	59	24	3.4	95.7	033	8.0	OFF W COAST OF NORTHERN SUMATERA	
TIB	2	2004	12	26	02	04	28	2004	12	26	00	59	24	3.4	95.7	033	8.5	OFF W COAST OF NORTHERN SUMATERA	
TIB	3	2004	12	27	15	28	24	2004	12	26	00	59	30	3.4	95.7	103	9.0	OFF W COAST OF NORTHERN SUMATERA	
TIB	1	2005	01	01	06	40	57	2005	01	01	06	26	19	5.0	92.2	050	6.6	OFF W COAST OF NORTHERN SUMATERA	
TIB	1	2005	01	16	20	30	07	2005	01	16	20	18	24	10.9	141.0	033	6.9	WESTERN CAROLINE ISLANDS	
TIB	1	2005	01	22	20	46	13	2005	01	22	20	30	48	-7.6	159.6	033	6.6	SOLOMON ISLANDS	

Bulletin		Issue Time							EQ Origin Time							Coordinates			Dep	Mag	Location
Type	#	Yr	Mo	Da	Hr	Mn	Sc	Yr	Mo	Da	Hr	Mn	Sc	Lat	Lon	Km	Mw				
TIB	1	2005	02	05	03	53	47	2005	02	05	03	34	58	16.0	146.1	150	6.5	MARIANA ISLANDS			
TIB	1	2005	02	05	12	38	42	2005	02	05	12	23	46	5.5	123.4	491	6.9	MINDANAO PHILIPPINE ISLANDS			
TIB	1	2005	02	08	15	04	01	2005	02	08	14	48	55	-14.4	167.1	231	6.8	VANUATU ISLANDS			
TIB	1	2005	02	08	15	12	41	2005	02	08	14	48	55	-14.4	167.1	231	6.8	VANUATU ISLANDS			
TIB	1	2005	02	09	19	00	03	2005	02	09	18	46	42	26.1	144.1	033	6.5	BONIN ISLANDS REGION			
TIB	1	2005	02	19	00	19	18	2005	02	19	00	05	16	-5.7	122.2	033	6.5	SULAWESI INDONESIA			
TIB	1	2005	02	26	13	13	47	2005	02	26	12	57	22	3.1	95.6	033	6.7	OFF W COAST OF NORTHERN SUMATERA			
TIB	1	2005	03	02	10	56	02	2005	03	02	10	42	10	-6.6	129.8	190	7.2	BANDA SEA			
TIB	1	2005	03	20	02	19	19	2005	03	20	01	53	47	34.0	130.1	033	6.7	WESTERN HONSHU JAPAN			
TIB	1	2005	03	28	16	29	33	2005	03	28	16	09	38	2.3	97.1	033	8.5	NORTHERN SUMATERA INDONESIA			
TIB	2	2005	03	28	18	41	28	2005	03	28	16	09	38	2.3	97.1	033	8.4	NORTHERN SUMATERA INDONESIA			
TIS	3	2005	03	28	22	10	15	2005	03	28	19	02	25	1.1	97.9	074	5.9	NORTHERN SUMATERA INDONESIA			
TIS	4	2005	03	28	22	26	56	2005	03	28	16	09	35	2.3	97.1	033	8.5	NORTHERN SUMATERA INDONESIA			
TIB	1	2005	04	10	10	47	35	2005	04	10	10	29	15	-1.1	99.4	033	6.7	SOUTHERN SUMATERA INDONESIA			
TIB	1	2005	04	11	17	26	06	2005	04	11	17	08	57	-22.0	170.6	095	6.7	LOYALTY ISLANDS REGION			
TIB	1	2005	05	05	19	24	14	2005	05	05	19	12	27	5.5	-82.2	033	6.9	SOUTH OF PANAMA			
TIB	1	2005	05	14	05	23	47	2005	05	14	05	05	25	0.6	98.4	084	6.9	NORTHERN SUMATERA INDONESIA			
TIB	1	2005	05	16	04	11	36	2005	05	16	03	54	16	-32.4	-179.1	033	6.7	SOUTH OF KERMADEC ISLANDS			
TIB	1	2005	05	19	02	13	15	2005	05	19	01	54	53	2.0	96.9	033	6.8	NORTHERN SUMATERA INDONESIA			
TIB	1	2005	06	13	22	59	26	2005	06	13	22	44	32	-20.1	-69.1	104	7.8	NORTHERN CHILE			
TIB	1	2005	06	14	17	19	51	2005	06	14	17	10	13	51.1	179.4	033	6.9	RAT ISLANDS ALEUTIAN ISLANDS			
TIB	1	2005	06	15	02	59	14	2005	06	15	02	50	54	41.3	-125.7	040	7.4	OFF COAST OF NORTHERN CALIFORNIA			
TIB	1	2005	06	17	06	28	06	2005	06	17	06	21	43	40.6	-126.3	033	6.9	OFF COAST OF NORTHERN CALIFORNIA			
TIB	1	2005	07	02	02	27	28	2005	07	02	02	16	47	11.2	-86.5	033	6.7	NEAR COAST OF NICARAGUA			
TIB	1	2005	07	05	02	10	49	2005	07	05	01	52	07	2.3	97.1	033	6.8	NORTHERN SUMATERA INDONESIA			
TIB	1	2005	07	24	15	56	59	2005	07	24	15	42	08	7.9	92.1	033	7.2	NICOBAR ISLANDS INDIA			
TIB	1	2005	08	16	02	57	31	2005	08	16	02	46	31	38.4	141.8	055	7.0	NEAR EAST COAST OF HONSHU JAPAN			
TIB	1	2005	09	09	07	44	43	2005	09	09	07	27	02	-4.6	153.3	264	7.3	NEW IRELAND REGION P.N.G.			
TIB	1	2005	09	26	02	10	27	2005	09	26	01	55	37	-5.7	-76.2	110	7.5	NORTHERN PERU			

Thirty-one Local Tsunami Information Bulletins were issued to the State of Hawaii as a result of local earthquakes (Table 2). No Local Tsunami Warning Bulletins for Hawaii were issued.

Table 2. Bulletins issued by PTWC to Hawaii during the intersessional period for local Hawaii earthquakes. Bulletin types are all EQI=Earthquake Information.

Bulletin		Issue Time						EQ Origin Time						Coordinates				Dep	Mag	Location
Type	#	Yr	Mo	Da	Hr	Mn	Sc	Yr	Mo	Da	Hr	Mn	Sc	Lat	Lon	Km	Mw			
EQI	1	2003	09	05	10	41	39	2003	09	05	10	37	55	18.8	156.1	007	4.1	32 MILES SSW OF PAPA HAWAII		
EQI	1	2003	09	18	06	37	33	2003	09	18	06	33	59	19.9	156.3	040	3.2	19 MILES NW OF KEAHOE POINT HAWAII		
EQI	1	2003	11	08	03	13	18	2003	11	08	03	10	06	19.0	155.0	046	3.0	HAWAII		
EQI	1	2003	11	08	03	17	24	2003	11	08	03	10	06	19.0	155.0	046	3.4	HAWAII		
EQI	1	2004	01	05	02	03	08	2004	01	05	02	00	34	19.8	155.9	013	3.5	HAWAII		
EQI	1	2004	01	22	02	52	29	2004	01	22	02	49	14	18.9	155.3	013	4.0	HAWAII		
EQI	1	2004	02	02	03	42	37	2004	02	02	03	38	52	19.3	155.2	009	4.1	HAWAII		
EQI	1	2004	02	05	10	24	53	2004	02	05	10	19	28	19.3	155.0	041	4.3	HAWAII		
EQI	1	2004	02	08	17	45	25	2004	02	08	17	38	42	19.3	155.2	004	2.6	HAWAII		
EQI	1	2004	02	08	18	32	19	2004	02	08	17	39	35	19.6	156.2	015	4.0	HAWAII		
EQI	1	2004	02	23	06	20	16	2004	02	23	06	16	52	19.3	156.4	008	3.6	32 MILES WSW OF HONAUNAU HAWAII		
EQI	1	2004	03	18	22	16	17	2004	03	18	22	13	25	19.2	155.2	045	3.5	HAWAII		
EQI	1	2004	03	21	19	21	57	2004	03	21	19	16	51	20.0	155.5	016	3.5	2 MILES NORTH OF MAKAHALAU HAWAII		
EQI	1	2004	06	02	00	57	16	2004	06	02	00	53	07	19.2	155.3	047	3.7	4 MILES ESE OF NALIKAHAKANI POINT HAWAII		
EQI	1	2004	06	05	00	09	14	2004	06	05	00	05	34	19.1	155.4	040	3.7	8 MILES SSW OF NALIKAHAKANI POINT HAWAII		
EQI	1	2004	08	05	03	12	15	2004	08	05	03	09	02	18.8	155.5	039	3.4	19 MILES SSE OF HONUPO HAWAII		
EQI	1	2004	08	14	19	51	06	2004	08	14	19	46	07	19.9	155.6	033	3.2	5 MILES ENE OF WAIKII HAWAII		
EQI	1	2004	09	09	05	23	19	2004	09	09	05	20	21	19.7	155.0	044	3.5	6 MILES NE OF KALOLI POINT HAWAII		
EQI	1	2004	09	06	17	16	05	2004	09	06	17	11	34	19.4	155.5	013	2.6	9 MILES SE OF MAUNA LOA SUMMIT HAWAII		
EQI	1	2004	10	11	20	32	11	2004	10	11	20	29	49	19.3	155.3	037	3.9	7 MILES NNE OF NALIKAHAKANI POINT HAWAII		
EQI	2	2004	10	11	20	35	27	2004	10	11	20	29	49	19.3	155.3	037	4.4	7 MILES NNE OF NALIKAHAKANI POINT HAWAII		
EQI	1	2004	10	12	23	21	18	2004	10	12	23	17	58	19.3	155.1	009	4.7	9 MILES WSW OF KALAPANA HAWAII		
EQI	1	2004	11	08	21	07	53	2004	11	08	21	04	22	19.3	155.8	013	3.7	8 MILES NE OF PAPA HAWAII		
EQI	1	2004	12	13	01	03	18	2004	12	13	00	58	50	19.4	155.2	036	4.9	3 MILES SE OF VOLCANO HAWAII		
EQI	1	2005	01	13	06	20	16	2005	01	13	06	16	24	20.0	155.5	024	3.9	2 MILES NORTH OF MAKAHALAU HAWAII		
EQI	1	2005	03	08	17	30	16	2005	03	08	17	26	16	19.0	155.3	016	4.5	15 MILES SSE OF NALIKAHAKANI POINT HAWAII		
EQI	1	2005	04	23	13	05	44	2005	04	23	13	01	28	18.7	-155.2	048	4.3	35 MILES SE OF HONUPO HAWAII		
EQI	1	2005	04	26	18	18	00	2005	04	26	18	13	24	20.1	-156.7	030	3.0	33 MILES SSW OF LUA MAKIKA KAHOLAWE		
EQI	1	2005	05	13	10	12	04	2005	05	13	10	06	41	18.8	-155.2	045	4.7	30 MILES SE OF HONUPO HAWAII		
EQI	1	2005	07	15	15	54	01	2005	07	15	15	48	53	20.4	-155.1	006	5.5	30 MILES NNE OF LAUPAHOE HAWAII		
EQI	1	2005	07	17	19	18	21	2005	07	17	19	15	02	18.8	-155.4	030	5.6	22 MILES SSE OF HONUPO HAWAII		

Seismic Program

The PTWC seismic program continues to derive significant benefits as a result of the Consolidated Reporting of Earthquakes and Tsunamis (CREST) co-operative program with the US Geological Survey (USGS). This program provides dedicated digital communication links between PTWC and the USGS National Earthquake Information Center (NEIC) in Golden, Colorado, as well as to the USGS Hawaiian Volcano Observatory (HVO) on the island of Hawaii for the exchange of seismic waveform and parametric data. It also continues to support USGS-developed 'Earthworm' hardware and software to facilitate the exchange and processing of these data.

For the local tsunami problem, PTWC receives continuous digital waveform data from approximately thirty HVO seismic stations using the Earthworm system and CREST data link. It also continues to operate an array of ten seismic stations in Hawaii that provide telemetered waveform data from four islands in the Hawaiian chain. In addition, PTWC receives continuous waveform data from eight stations of the Hawaiian Volcano Observatory over a radio/microwave link, and first arrival parametric data from more than 50 HVO stations over both the Internet and a dedicated circuit. These data enable PTWC to automatically determine earthquake hypocenters in less than a minute, and to produce a reviewed/revised hypocenter and magnitude in less than five minutes.

PTWC is now in the process of upgrading its local seismic network in Hawaii to replace instruments and communications links that are analog, based on decades-old technology, and are now inadequate. The plan is to install 9 STS-2 broadband seismometers, and up to 22 accelerometers across the Hawaiian Islands. Data will be field digitized and sent to PTWC, WC/ATWC, and the USGS by standard TCP/IP transmission methods. These new data will enhance reliability, and provide more accurate earthquake hypocenters and magnitudes.

For teleseismic earthquakes, PTWC receives continuous digital broadband seismic waveform data from more than eighty stations worldwide using the Earthworm system and CREST data link to NEIC. For redundancy, PTWC receives much of the same broadband data directly from a variety of other sources including some of the US regional seismic networks. The PTWC also receives parametric hypocenter and first arrival data from other USGS observatories over the Internet. In addition, first arrival data is received following each significant earthquake from many co-operating international observatories in the Pacific region. The PTWC also operates three-component short and long period seismometers and an STS-2 three-component broadband seismometer in a seismic vault just a few hundred meters from its operations center. These combined data enable PTWC to determine preliminary earthquake locations and magnitudes for any Pacific earthquake in less than ten minutes, and to utilize the most modern seismic analysis techniques for determining earthquake parameters useful for tsunami warning decision-making.

PTWC is also currently working to incorporate data from the Comprehensive Nuclear Test Ban Treaty's International Monitoring System to supplement and provide new capabilities for teleseismic detection and evaluation.

Sea-Level Programme

For tsunamis generated within the State of Hawaii, the PTWC operates an array of eight continuous real-time telemetered sea-level gauges. The PTWC also operates an array of seven dial-up gauges that can be accessed as needed. To supplement these data, PTWC and the State of Hawaii have added an array of eight run-up gauges along coasts where historical local tsunamis have struck. Based on home security alarm technology, these inexpensive gauges will alert PTWC within about 40 seconds of being flooded and provide the most rapid confirmation that a potentially destructive local tsunami is underway.

For tsunamis generated elsewhere in the Pacific, PTWC receives data from more than 100 coastal sea-level gauges, most of which transmit their data back to the center through either the GOES or GMS satellites (Figure 1). About twenty of these gauges are operated and maintained by PTWC, while the rest belong to other organizations, including WC/ATWC, the US National Ocean Survey (NOS), the University of Hawaii Sea-Level Center (UHSLC), the Hydrographic and Oceanographic Service of the Chilean Navy (SHOA), the Japan Meteorological Agency (JMA), and Australia's National Tidal Facility (NTF). PTWC also receives real time data from eight Alaska sea level stations operated by WC/ATWC.

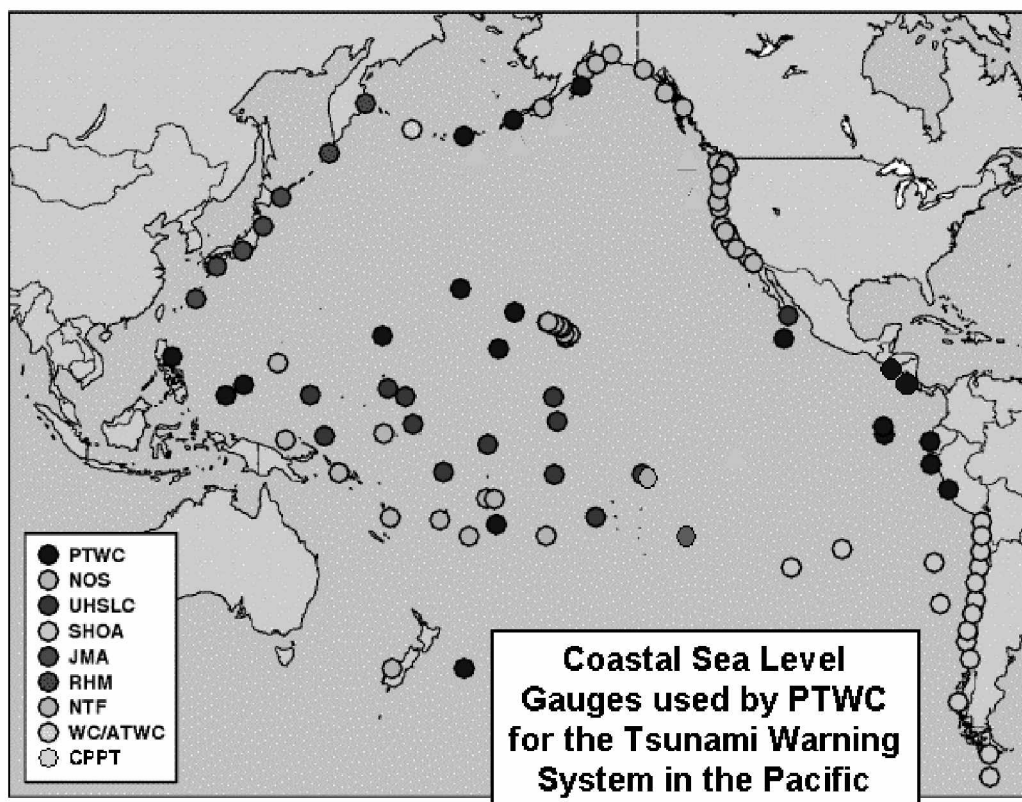


Figure 1. Coastal Sea Level Gauges in the Pacific Ocean basin accessed by PTWC for tsunami detection and evaluation. Gauges are operated by the agencies of many countries and for many purposes other than tsunamis.

During the intersessional period a number of improvements to the coastal network took place. The U.S. National Ocean Service installed the following new Pacific Basin stations in FY-2005: Santa Barbara, CA, Garibaldi, OR, LaPush, WA, Elfin Cove, AK, and King Cove,

AK. New Pacific Basin station installations planned for FY-2006 include one new station in Washington and four new stations in Alaska. In addition, the following stations were upgraded in FY-2005 to 1-minute sampling and 6-minute transmissions (from 6-minute sampling and 1-hour transmissions): Nawiliwili, Kauai, HI, Honolulu, Oahu, HI, Mokuoloe, Oahu, HI, Kahului, Maui, HI, Hilo, Hawaii, HI, Kawaihae, Hawaii, HI, Crescent City, CA, Astoria, OR, Longview, WA, Ketchikan, AK, Sitka, AK, Juneau, AK, Skagway, AK, Yakutat, AK, Cordova, AK, Valdez, AK, Seward, AK, Seldovia, AK, Anchorage, AK, Kodiak, AK, Sand Point, AK, Unalaska, AK, Adak Island, AK, Nome, AK, Red Dog Mine, AK, and Prudhoe Bay, AK. It is anticipated that the following Pacific Basin / West Coast NOS stations will be upgraded in FY-2006 to 1-minute sampling and 6-minute transmissions: LaJolla, CA, San Diego, CA, Los Angeles, CA, Santa Monica, CA, Port San Luis, CA, Monterey, CA, San Francisco, CA, Alameda, CA, Port Chicago, CA, Point Reyes, CA, Arena Cove, CA, North Spit (Eureka), CA, Port Orford, OR, Charleston, OR, South Beach (Newport), OR, Toke Point, WA, Neah Bay, WA, Port Angeles, WA, Port Townsend, WA, Friday Harbor, WA, Cherry Point, WA, Seattle, WA, Tacoma, WA, and Nikiski, AK. In addition, PTWC, the University of Hawaii Sea Level Center, the National Tidal Center of Australia, and the Japan Meteorological Agency are upgrading stations or making other modifications to increase sampling rates and reduce transmission delays.

In addition, PTWC is now receiving data from ten deep ocean pressure sensors operated by the U.S. that are capable of detecting tsunami waves only 1 cm in height (Figure 2). Four are south of Alaska and the Aleutian Islands, four are off the US West Coast, one is in the southeast Pacific, just south of the equator, and one is located near the Hawaiian Islands for local tsunami detection and evaluation. Developed by the NOAA Pacific Marine Environmental Laboratory and operated jointly with the US National Weather Service's National Data Buoy Center, these "Deep-ocean Assessment and Reporting of Tsunamis" (DART) instruments provide the only accurate measure of a tsunami as it propagates in deep water, and will provide a key input for future tsunami forecasting using numerical models. A total of 32 DART buoys are now scheduled for deployment in the Pacific over the next two years (Figure 3). In additions, PTWC receives data from a single DART buoy operated by the Hydrographic Service of the Chilean Navy (SHOA).

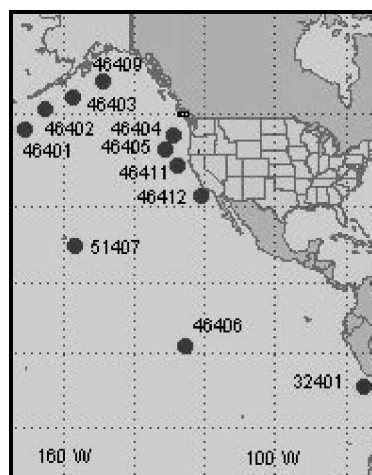


Figure 2. Location of DART gauges currently in operation with data being received by PTWC. The 10 northernmost gauges are operated by the U.S. The southernmost gauge (#32401) is operated by Chile.

Procedures

PTWC procedures for the Pacific did not change during the intersessional period.

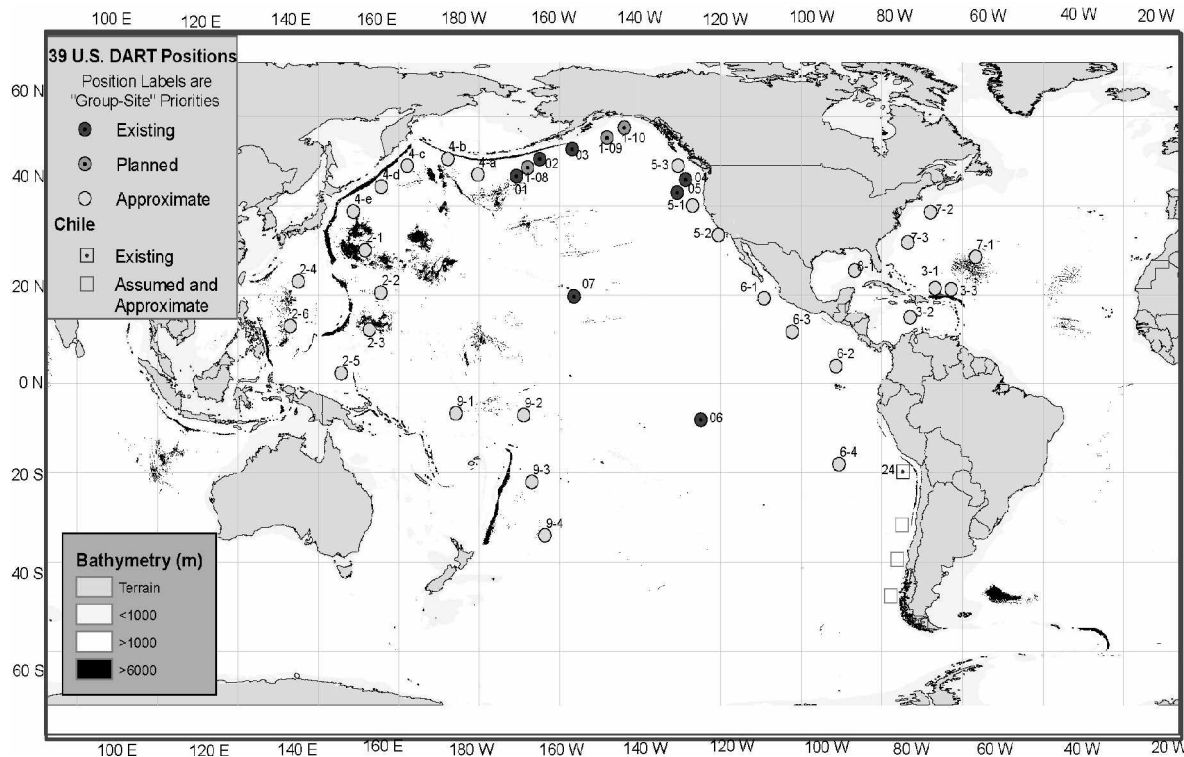


Figure 3. Proposed locations for 39 U.S. DART gauges in the Pacific (32 total) and Atlantic-Caribbean (7 total). Since this figure was made, DARTs 5-1, 5-2, and 1-09 have been deployed.

Message Dissemination

PTWC bulletins continue to be disseminated through a wide variety of communication methods. Bulletins in text form are transmitted over the Global Telecommunications System (GTS), the NOAA Weather Wire (NWW), the Aeronautical Fixed Telecommunications Network (AFTN), the Emergency Managers Weather Information Network (EMWIN), the US Defense Communications System (DCS), soon to be replaced by the Defense Messaging System or (DMS), the Hawaii Inter-island Data Network (IDN), and TELEX. Bulletins are also transmitted by voice over a dedicated Hawaii Warning System (HAWAS) telephone, and by e-mail and fax.

Forecast Tool Development

Immediately following the 26 December 2004 Indian Ocean disaster, the U.S. President called for an improved U.S. Tsunami Warning System. As part of the NOAA response, an accelerated and expanded effort was initiated to complete the Tsunami Forecasting System for U.S. coastal communities in the Pacific, Caribbean and Atlantic. This collaborative effort by NOAA's Pacific Marine Environmental Laboratory and the Tsunami Warning Centers integrates DART network data and state-of-the-art tsunami numerical models to provide real-time forecasts for potential affected coasts. During the

FY2004-FY2005 period, a prototype, web-based forecast system was implemented, known as SIFT, for Short-term Inundation Forecasting for Tsunamis. This prototype SIFT system is undergoing testing by the Tsunami Warning Centers. Operational SIFT systems, physically resident at each Tsunami Warning Center, will be implemented within the next year. Forecast models for a total of 74 specific U.S. sites are planned for the end of FY2009. This methodology could be expanded to cover coastal communities of the Member States.

Input from the Group is requested regarding the type and form of forecast products that would be most useful and should be developed using this methodology.

Additional Warning Points

Warning bulletins issued by PTWC name certain countries or locations as being in a warning or watch based on the epicentral distance or estimated tsunami arrival time at specific "warning points" in those areas, and estimated arrival times to those points are provided in the bulletins. Based on discussions made during ITSU-XIX, during the intersessional period PTWC added warning points for countries that were without warning points at that time. They included Guatemala, Honduras, Costa Rica, Australia, the Solomon Islands, Papua New Guinea, Indonesia, Tokelau, Vanuatu, Tonga, Kermadec Islands, Tuvalu, Wallis and Futuna, Pitcairn, Niue, and Antarctica. They also added warning points where there were gaps. A complete list of Pacific warning points currently in use are given in Table 3. PTWC welcomes suggestions for any changes to this list.

Table 3. PTWC Pacific Warning Points

COUNTRY OR OTHER ENTITY	NAME OF THE WARNING POINT	LATITUDE (+N,-S)	LONGITUDE (+E,-W)
AMERICAN_SAMOA	PAGO_PAGO	-14.300	-170.700
ANTARCTICA	THURSTON_IS.	-72.000	-100.000
	CAPE_ADARE	-71.000	170.000
AUSTRALIA	HOBART	-43.270	147.650
	SYDNEY	-33.860	151.450
	BRISBANE	-27.220	153.300
	GLADSTONE	-23.820	151.440
	MACKAY	-21.060	149.270
	CAIRNS	-16.740	145.790
BELAU	MALAKAL	7.300	134.500
CHILE	ARICA	-18.500	-70.300
	IQUIQUE	-20.200	-70.100
	ANTOFAGASTA	-23.320	-70.430
	CALDERA	-27.100	-70.800
	COQUIMBO	-29.930	-71.350
	VALPARAISO	-33.000	-71.600
	TALCAHUANO	-36.700	-73.100
	PUERTO_MONTT	-41.500	-73.000
	PUNTA_ARENAS	-53.200	-70.900
	PUERTO_WILLIAMS	-54.800	-68.200
	EASTER_IS.	-27.150	-109.450
	CORRAL	-39.770	-73.540
	GOLFO_DE_PENAS	-47.100	-74.890
CHUUK	CHUUK_IS.	7.445	151.845
COLOMBIA	BAHIA_SOLANO	6.300	-77.400
	BUENAVENTURA	3.800	-77.200
	TUMACO	1.820	-78.860
COOK_ISLANDS	RAROTONGA	-21.200	-159.800

COUNTRY OR OTHER ENTITY	NAME OF THE WARNING POINT	LATITUDE (+N,-S)	LONGITUDE (+E,-W)
COSTA_RICA	PENRYN_IS.	-8.880	-157.840
	PUKAPUKA_IS.	-10.800	-165.860
	CABO_SAN_ELENA	10.850	-86.040
	PUERTO_QUEPOS	9.400	-84.200
ECUADOR	CABO_MATAPALO	8.350	-83.290
	BALTRA_IS.	-0.500	-90.300
	ESMERELDAS	1.170	-79.790
	LA_LIBERTAD	-2.190	-81.230
EL_SALVADOR	ACAJUTLA	13.600	-89.800
FIJI	SUVA	-18.137	178.425
FR._POLYNESIA	PAPEETE	-17.533	-149.567
	RIKITEA	-23.100	-135.000
	HIVA_OA	-10.000	-139.000
	GUAM	13.436	144.652
GUATEMALA	SIPIRATE	13.900	-91.230
HAWAII	NAWILIWILI	21.957	-159.360
	HONOLULU	21.300	-157.900
	HILO	19.700	-155.100
	AMAPALA	13.230	-87.640
HONG_KONG	HONG_KONG	22.300	114.200
HOWLAND-BAKER	HOWLAND_IS.	0.550	-176.620
INDONESIA	JAYAPURA	-2.410	140.760
	WARSA	-0.620	135.790
	MANOKWARI	-0.810	134.210
	SORONG	-0.810	131.130
	PATANI	0.430	128.760
	BEREBERE	2.460	128.690
	GEME	4.590	126.800
	HACHINOHE	40.500	141.500
JAPAN	OKINAWA	26.200	127.800
	SHIMIZU	32.800	133.000
	KATSUURA	35.110	140.330
	KUSHIRO	42.900	144.330
	JARVIS_IS.	-0.370	-160.050
JOHNSTON_IS.	JOHNSTON_IS.	16.738	-169.525
KERMADEC_IS	RAOUL_IS.	-29.210	-177.940
KIRIBATI	CHRISTMAS_IS.	1.980	-157.480
	MALDEN_IS.	-3.940	-154.900
	FLINT_IS.	-11.400	-151.820
	KANTON_IS.	-2.820	-171.670
	TARAWA_IS.	1.500	173.000
	KOSRAE_IS.	5.500	163.000
MARCUS_IS.	MARCUS_IS.	24.300	154.000
MARSHALL_IS.	ENIWETOK	11.400	162.300
	KWAJALEIN	8.700	167.700
	MAJURO	7.117	171.370
MEXICO	ENSENADA	31.830	-116.780
	CABO_SAN_LUCAS	22.840	-109.980
	PUNTA_ABREOJOS	26.680	-113.620
	MAZATLAN	23.170	-106.440
	PUERTO_MADERO	14.790	-92.530
	MANZANILLO	19.100	-104.300
	SOCORRO	18.800	-111.000
	ACAPULCO	16.900	-99.900
MIDWAY_IS.	MIDWAY_IS.	28.200	-177.400
N._MARIANAS	SAIPAN	15.300	145.800

COUNTRY OR OTHER ENTITY	NAME OF THE WARNING POINT	LATITUDE (+N,-S)	LONGITUDE (+E,-W)
NAURU	NAURU	-0.518	166.900
NEW_CALEDONIA	NOUMEA	-22.300	166.500
NEW_ZEALAND	NEW_PLYMOUTH	-39.053	174.069
	NORTH_CAPE	-34.400	173.300
	AUCKLAND(E)	-36.700	175.000
	AUCKLAND(W)	-37.100	174.200
	EAST_CAPE	-36.231	175.105
	GISBORNE	-38.052	176.446
	NAPIER	-39.474	176.910
	WELLINGTON	-41.270	174.837
	LYTTELTON	-43.617	172.717
	DUNEDIN	-45.883	170.514
	BLUFF	-46.566	168.333
	MILFORD_SOUND	-44.626	167.877
	WESTPORT	-41.752	171.583
	NELSON	-41.260	173.266
NICARAGUA	CORINTO	12.500	-87.200
	PUERTO_SANDINO	12.200	-86.800
	SAN_JUAN_DL_SUR	11.200	-85.900
NIUE	NIUE_IS.	-19.000	-170.000
PALMYRA_IS.	PALMYRA_IS.	6.340	-162.450
PANAMA	BALBOA HTS.	9.000	-79.600
	PUNTA_BURICA	8.020	-82.850
	PUNTA_MALA	7.480	-79.950
	PUERTO_PINA	7.390	-78.050
PAPUA_NEW_GUINEA	VANIMO	-2.580	141.340
	WEWAK	-3.520	143.650
	MADANG	-5.170	145.840
	LAE	-6.760	147.030
	RABAU	-4.180	152.270
	PORT MORESBY	-9.340	146.940
	KAVIENG	-2.530	150.690
	MANUS_IS.	-2.030	147.490
	KIETA	-6.070	155.630
	AMUN	-5.960	154.690
PERU	LA_PUNTA	-12.100	-77.200
	TALARA	-4.630	-81.470
	PIMENTAL	-6.900	-80.020
	CHIMBOTE	-9.000	-78.830
	MOLLENDO	-17.080	-72.000
	SAN_JUAN	-15.330	-75.240
PHILIPPINES	LEGASPI	13.200	123.800
	PALANAN	17.150	122.610
	DAVAO	6.850	125.650
PITCAIRN	PITCAIRN_IS.	-25.080	-130.080
POHNPEI	POHNPEI_IS.	7.000	158.218
RUSSIA	MEDNNY_IS	54.720	167.430
	UST_KAMCHATSK	56.120	162.580
	PETROPAVLOVSK_K	53.230	159.580
	SEVERO_KURILSK	50.830	156.070
	URUP_IS	46.120	150.540
SAMOA	APIA	-13.800	-171.800
SOLOMON_IS.	FALAMAE	-7.360	155.560
	MUNDA	-8.380	157.210
	HONIARA	-9.290	159.960
	KIRAKIRA	-10.360	161.940

COUNTRY OR OTHER ENTITY	NAME OF THE WARNING POINT	LATITUDE (+N,-S)	LONGITUDE (+E,-W)
	PANGGOE	-6.870	157.160
	GHATERE	-7.770	159.170
	AUKI	-8.750	160.620
TAIWAN	HUALIEN	24.000	121.600
TOKELAU	NUKUNONU_IS.	-9.160	-171.830
TONGA	NUKUALOFA	-21.020	-175.230
TUVALU	FUNAFUTI_IS.	-7.880	178.500
VANUATU	ESPERITU_SANTO	-15.110	167.290
	ANATOM_IS.	-20.160	169.850
WAKE_IS.	WAKE_IS.	19.300	166.600
WALLIS-FUTUNA	WALLIS_IS.	-13.250	-176.250
YAP	YAP_IS.	9.500	138.100

Graphical Products

PTWC continues to consider the development of graphical products for distribution on its web site and via dissemination methods such as EMWIN and email. However, no graphical products were implemented during the intersessional period other than the map on the PTWC web site showing the location of the earthquake

Communications Tests

Communications tests continue to be conducted by PTWC to key international warning system participants, and dissemination times logged. No significant problems occurred with dissemination methods during the intersessional period, and dissemination times are typically less than 10 minutes. Response to the tests continues to be sporadic.

Communications Plan

A draft of the 13th Edition of the Communications Plan for the Tsunami Warning System in the Pacific is now complete and will be distributed to the Member States at ITSU-XX. Member States are requested to review the Plan and provide comments and changes to the body of the document and updates to the contact points. Following incorporation of the comments and other needed changes, the document will be distributed by mail and electronic means by the end of 2005.

Increased Staffing

Following the December tsunami tragedy in the Indian Ocean, the U.S. government approved an increase in the staffs of both PTWC and WC/ATWC to a level of 15 persons at each Center (Figures 4 & 5). The increased staff will facilitate there being at least one person in the Center on a 24x7 basis. It will also facilitate improvements to all aspects of service that the Centers provide.

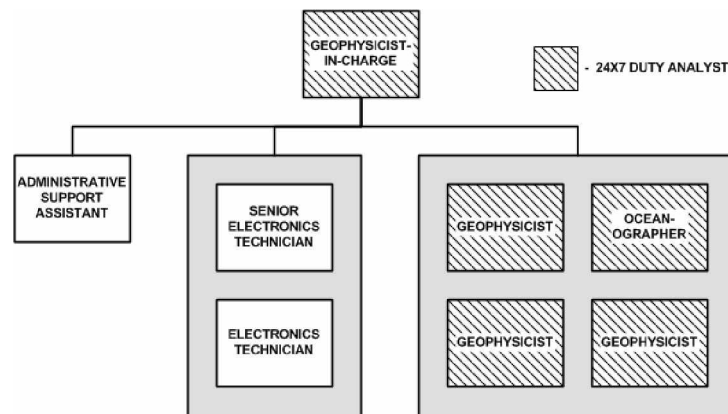


Figure 4. PTWC staffing level at the beginning of 2005.

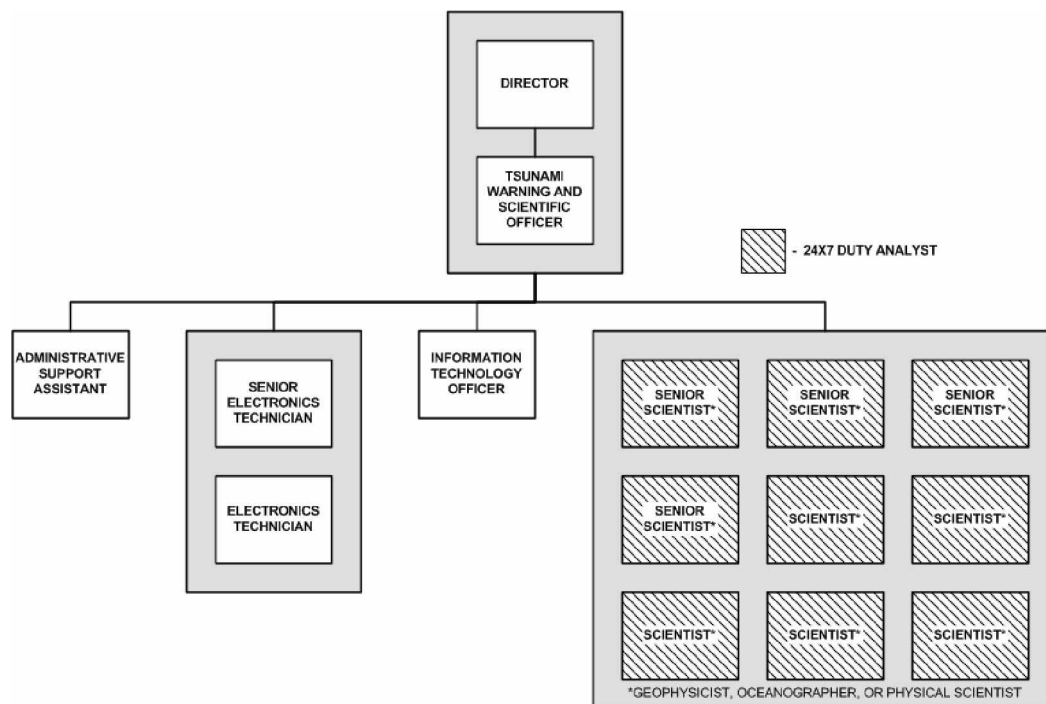


Figure 5. Projected PTWC staffing by the end of 2005.

Facility

To accommodate its expanded staff, the NWS has purchased, installed, and outfitted a new portable building (Figure 6). The new building includes 4 offices, 2 workstations, and a conference room.

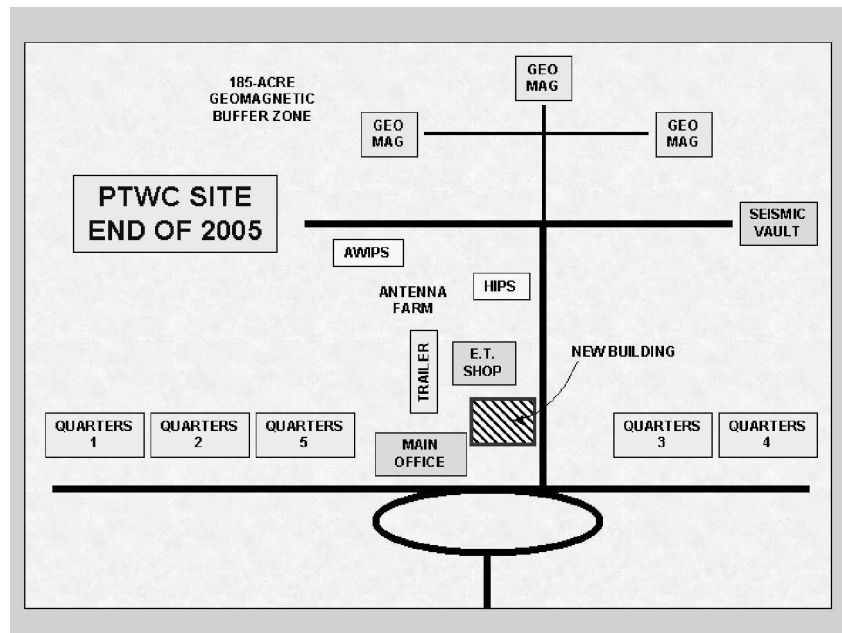


Figure 6. A new building was constructed in late 2005 next to PTWC's Main Office to accommodate nearly a doubling of PTWC's staff.