

OFF HONSHU JAPAN, 5 SEPTEMBER 2004

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Two major earthquakes occurred on September 5, 2004 southeast off Kii Peninsula, Honshu Island, Japan (Figures 1-3). An earthquake of magnitude $M_w 7.2$ (HRV, JMA 6.9) occurred at 1007 UTC 450 km southwest of Tokyo, and was followed about five hours later at 1457 UTC by the magnitude $M_w 7.4$ (HRV, JMA 7.4) mainshock about 30 km ENE from foreshock. About four people and 40 people were injured in the Kyoto area in the 1007 UTC and 1457 UTC earthquakes,

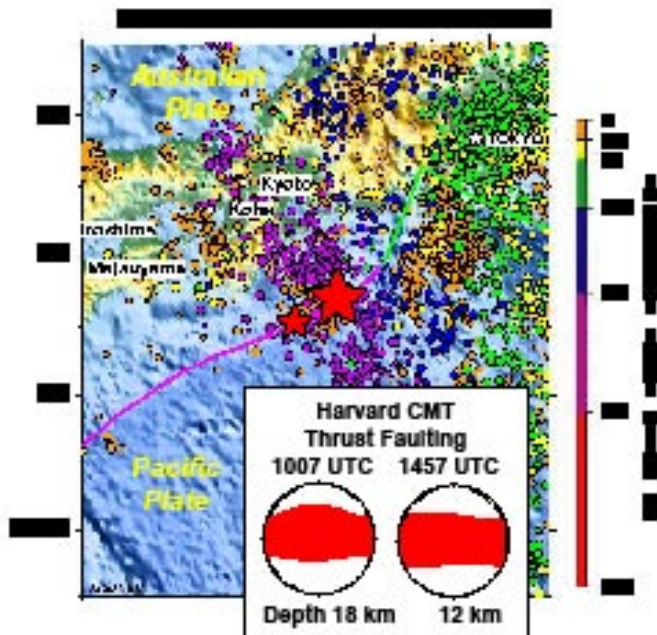


Figure 1. Historical seismicity (1900-present, NEIC) and tsunamis (ITDB, 2004) observed in the region. The events are represented by red stars, with the larger star representing the larger 1457 UTC earthquake. Harvard Centroid Moment Tensor solutions indicate thrust faulting at shallow depths associated with the subduction of the Philippine Sea Plate beneath Japan.

respectively, which were felt in much of southwestern Japan and as far north as Tokyo. A Tsunami Advisory was issued by the Japan Meteorological Agency (JMA) to the coasts along the Pacific within seven minutes for each earthquake. Small local tsunamis were recorded at several tidal stations (Table 1 and Figures 4 and 5). Maximum tsunami heights (above mean sea level) of 63 cm and 93 cm were recorded by each tsunami respectively at Kozushima island located in the Pacific Ocean to the west, with heights of 34 cm and 86 cm, respectively, observed to the east-northeast at Kushimoto in Wakayama Prefecture, south-central Honshu island.

Some reports of overturned fishing boats were made, but no major tsunami damage was reported. Aftershocks were located over an 80-km length along

the Nankai trough and also perpendicular to the trend of the trough (Figure 3). The largest aftershocks were recorded on 6 September with a magnitude $M_w 6.7$ (HRV), and another on 8 September measuring $M_w 6.2$ (HRV). The CMT solutions for the foreshock, mainshock, and largest aftershocks all indicated reverse or thrust faulting.

The epicenter of the 1944 magnitude 7.9 Tonankai Earthquake was located near the September earthquakes. The JMA reports the expected probability of occurrence for at least a magnitude 8.1

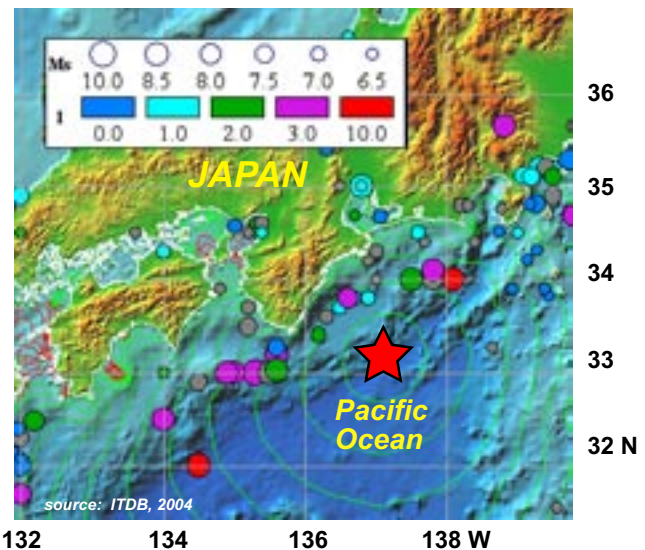


Figure 2. Tsunami times (green lines) are contoured in 5-minute intervals assuming a point source for the 1457 UTC earthquake. Circles show the locations of historical tsunamis with the colors corresponding to tsunami intensity on the Soloviev-Imamura scale.

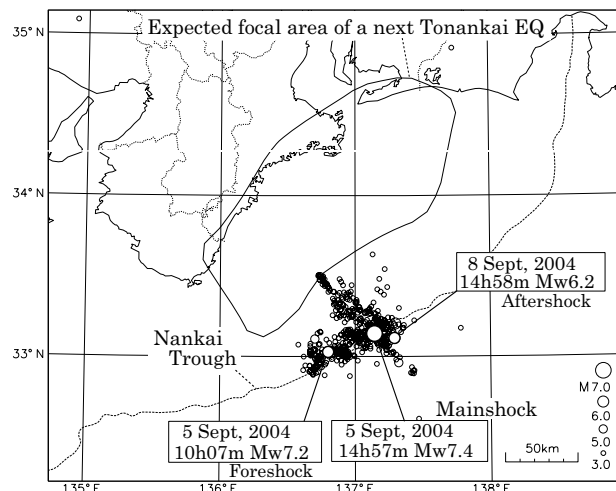


Figure 3. Seismicity associated with the 5 September 2004 earthquakes and aftershocks determined by the JMA.

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Tonankai earthquake within the next 30 years to be 60% presently. A repeat of the Tonankai earthquake could cause the generation of a teletsunami capable of propagating across the Pacific and seriously damaging distant coastal regions.

TABLE 1. TSUNAMI ARRIVAL TIMES AND HEIGHTS (JAPAN METEOROLOGICAL AGENCY)

Tide station name	Latitude	Longitude	1007 UTC Earthquake			1457 UTC Earthquake		
			Arrival time (JST)	Initial wave height (cm)	Max wave height (cm)	Arrival time (JST)	Initial wave height (cm)	Max wave height (cm)
AYUKAWA	38°18'	141°30'				1:55	-3	7
CHOSHIGYOKO	35°45'	140°51'				1:35	7	15
MERA	34°55'	139°49'	20:27	-16	36	0:53	-18	43
OKADA	34°47'	139°23'				0:47	-12	26
KOZUSHIMA	34°13'	139°08'	19:53	21	63	0:24	11	93
AKO	34°04'	139°29'	19:30	-8	27	0:26	17	49
TSUBOTA	34°03'	139°33'	19:29	-12	21	0:28	-27	37
CHICHIJIMA	27°06'	142°11'	20:34	10	19	1:23	11	39
IROZAKI	34°37'	138°51'	19:57	11	30	0:23	19	58
UCHIURA	35°01'	138°53'				0:32	9	33
OMAEZAKI	34°37'	138°13'				0:29	17	40
MAISAKA	34°41'	137°37'				0:33	23	23
TAKETOYO	34°53'	136°57'				1:17	4	5
YOKKAICHIKOU	34°57'	136°38'				1:40	-5	6
TOBA	34°29'	136°49'				1:16	-24	33
OWASE	34°05'	136°12'	19:27	-4	29	0:22	54	58
KUSHIMOTO	33°29'	135°46'	19:27	27	34	0:20	86	86
URAGAMI	33°33'	135°54'	19:26	-3	28	0:17	61	61
SHIRAHAMA	33°41'	135°23'	20:05	-12	14	0:28	-9	19
WAKAYAMA	34°13'	135°09'				1:09	8	8
TANNOWA	34°20'	135°11'				1:28	-9	5
KOMATSUSHIMA	34°01'	134°35'				1:04	9	13
MUROTOMISAKI	33°16'	134°10'	19:48	-29	29	0:37	32	35
TOSASHIMIZU	32°47'	132°58'	19:33	-6	17	0:54	21	31

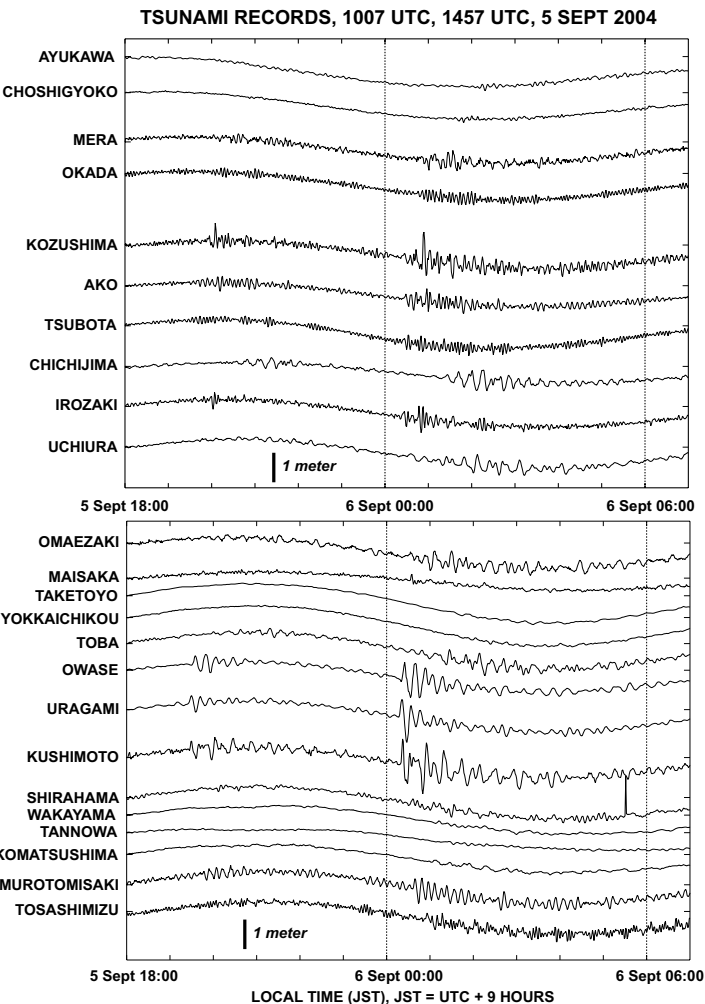


Figure 4. Sea level records showing the tsunamis from the 1007 UTC and 1457 UTC events. Data courtesy JMA.

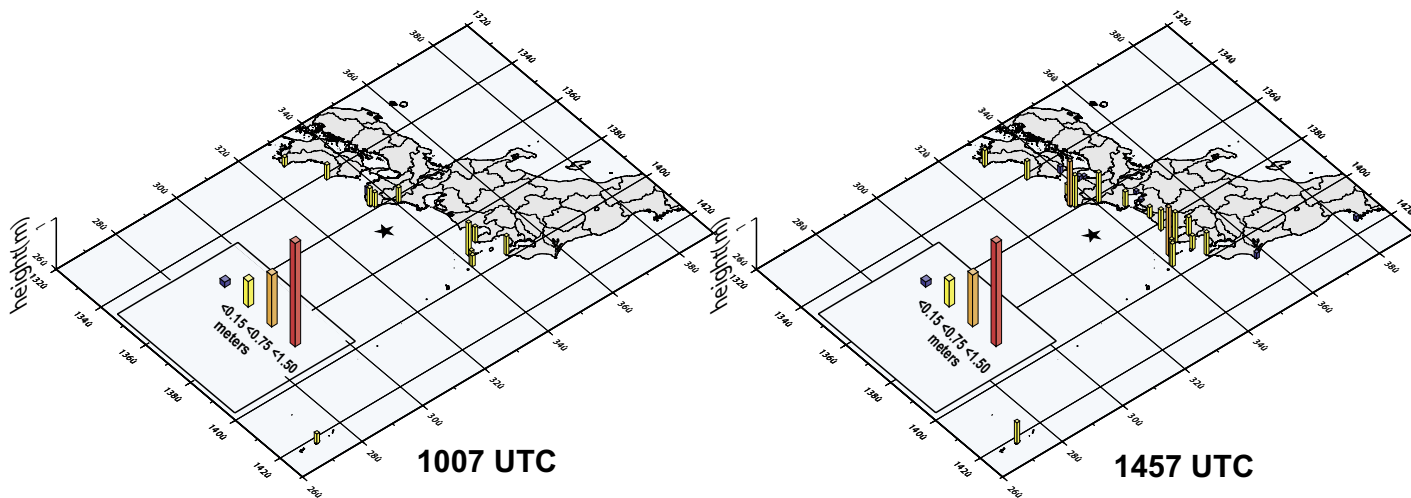


Figure 5. Observed tsunami heights from the two earthquakes as reported by the JMA. Heights are values above mean sea level. Star indicates earthquake epicenter.