Historical Tsunami Effects in Papua New Guinea and the Solomon Islands (1768-2018)

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Introduction

Papua New Guinea and the Solomon Islands are vulnerable to local, regional, and distant tsunamis generated around the Pacific. NOAA's National Centers for Environmental Information (NCEI) and co-located World Data Service (WDS) for Geophysics, and the International Tsunami Information Center (ITIC), a UNESCO/IOC-NOAA partnership, have collaborated to produce a poster showing historical tsunami effects to Papua New Guinea and the Solomon Islands. NCEI/WDS provides long-term archive, data management, and access to global tsunami data. ITIC works to mitigate the effect of tsunamis throughout the Pacific, and has collected post-tsunami event information to support hazard assessment since its inception in 1965.

Papua New Guinea and the Solomon Islands lie in one of the most seismically active and tectonically complex regions of the world. The dominant earthquake mechanisms are thrust and strike slip faulting associated with arc-continent collisions and the relative motion between the numerous local microplates. Tsunami sources include shallow subduction and crustal earthquakes, volcanic eruptions, and landslides.

The islands sit at the eastern section of the Australian and Pacific plate boundary, which in total stretches over 4000 km on its northern margin and extends from the Sunda (Java) trench in the west to the South Solomon trench in the east. Along the New Britain and South Solomon trenches, general north to east-northeast subduction of the Australian plate dominates, and large and great earthquakes are common. On the island of New Guinea, arc-continent collision leads to convergence resulting in shortening and the 2-8 mm/yr uplift of the New Guinea Highlands, as well as slow southward subduction of the Pacific Plate at the New Guinea Trench.

Tsunamis in Papua New Guinea and the Solomon Islands

Examination of the NCEI/WDS Global Historical Tsunami Database reveals that the earliest confirmed historical account of a tsunami impacting either Papua New Guinea or the Solomon Islands was in 1768. The tsunami was generated by an earthquake off of New Ireland and was observed locally. A wave generated by an earthquake off of New Ireland in 1899 was the first tsunami observed in both Papua New Guinea and the Solomon Islands, causing damage in both countries.

From 1768 to 2018, there were over 70 confirmed tsunamis observed in Papua New Guinea. The 1998 Aitape, Papua New Guinea tsunami was the deadliest tsunami in either Papua New Guinea or Solomon Islands with 1,636 deaths. Following the 1998 tsunami, marine investigations concluded that a submarine landslide triggered by a Mw 7.0 earthquake off of New Guinea was the tsunami source. The event generated interest in tsunami hazards in parts of the world not previously considered at high risk of earthquake-generated landslide tsunamis, and highlighted the importance of knowing and acting on a tsunami's natural tsunami warning signs as the key for saving lives. The largest historical tsunami runup height in Papua New Guinea was 15 meters (m), from the 1888 and 1998 local tsunamis. The 1888 tsunami was generated by the collapse of Ritter Island volcano. More recently in 2002, an earthquake off of Wewak, Papua New Guinea, generated a tsunami resulting in a 5.5 m runup.

From 1897 to 2018, a total of over 50 confirmed tsunamis were observed in the Solomon Islands. The 2007 Solomon Islands earthquake-generated tsunami generated tsunami runups up to 12.1 m in Choiseul, Ghizo, and Simbo, Solomon Islands and caused 50 deaths. Prior to 2007, the deadly 1939 Solomon Islands tsunami was the largest historical tsunami to impact the Solomon Islands, with a 10.5 m runup on Guadalcanal. Since 2007, two earthquakes have generated tsunamis with runups greater than 5 m. In 2010, a tsunami hit Rendova (runup of 7.5 m) causing damage; in 2013, a tsunami hit Malo, Nendo, and Noi (runups up to 11 m) causing 10 deaths and the destruction of almost 600 houses.

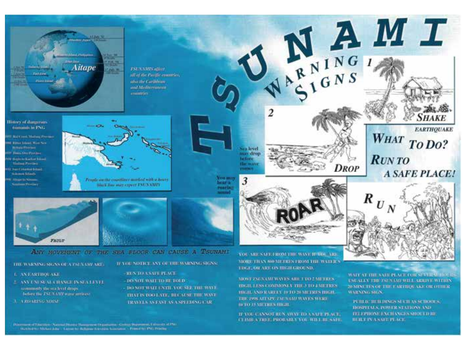
Distribution and Types of Tsunami Sources

The majority of tsunamis observed in Papua New Guinea and the Solomon Islands are local and regional tsunamis (source <1000 km from the earthquake epicenter). Distant tsunamis make up only 25% and 22% of tsunamis observed in Papua New Guinea and the Solomon Islands, respectively.

Approximately 90% of tsunami sources for Papua New Guinea are from earthquake (including earthquake-generated landslide) sources. The remaining tsunami sources are volcanic eruptions (8%) and landslides (1%). The distribution of tsunami sources for the Solomon Islands is similarly dominated by earthquakes (93%), with the remaining (7%) coming from volcanic eruptions.

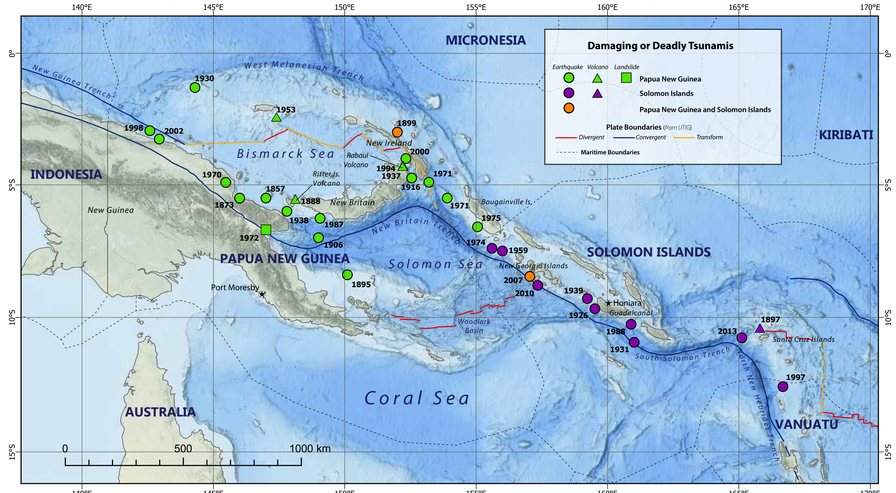
Lower floor of 2-story Sissano Mission school building collapsed after being carried 65 m by the wave in the 1998 Aitape, Papua New Guinea tsunami. Credit: Hugh Davies

Fifty-two people were killed and several villages were destroyed by the 2007 Solomon Islands earthquake and tsunami. Credit: Hermann Fritz

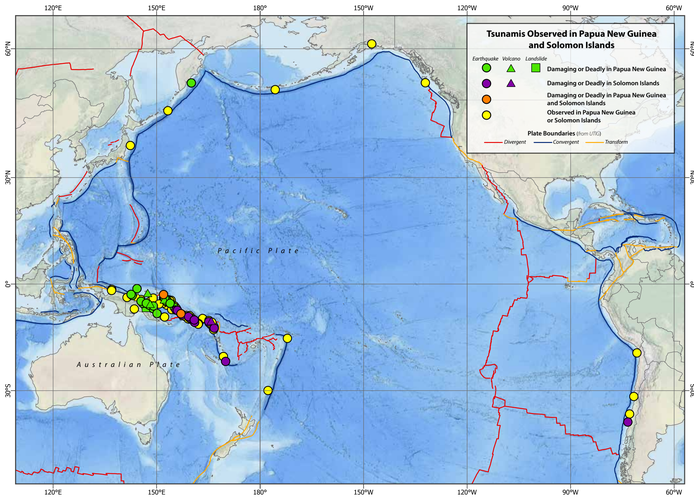


Awareness poster of tsunami natural warning signs created after the 1998 Aitape, Papua New Guinea tsunami (PNG National Disaster Management Office, Asian Disaster Reduction Center, PNG Dept of Education).

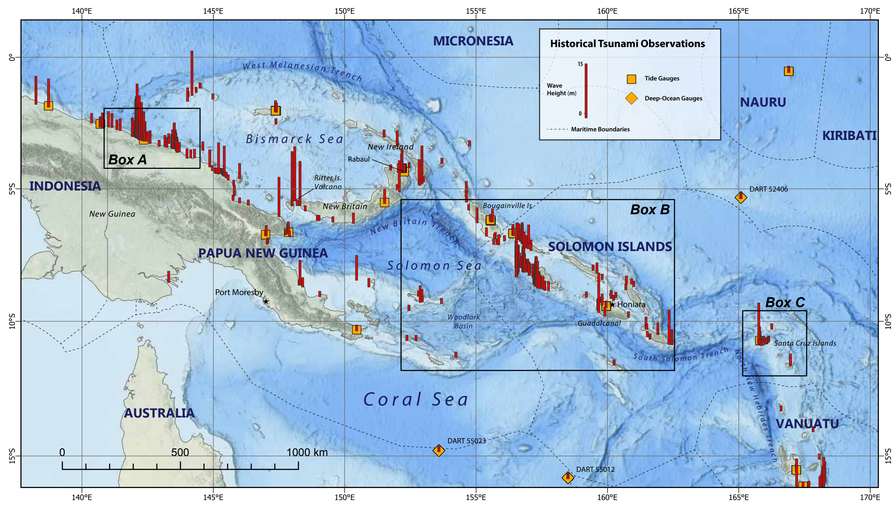
Local & Regional Confirmed Tsunami Source Locations Causing Damage or Deaths



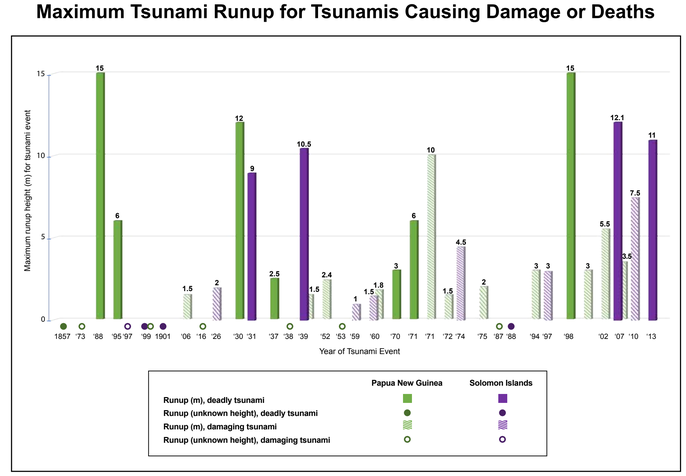
Confirmed Tsunami Source Locations

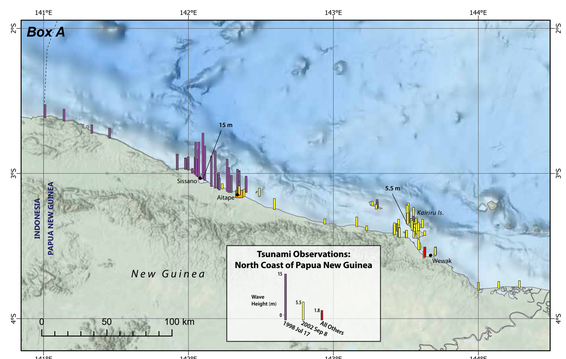


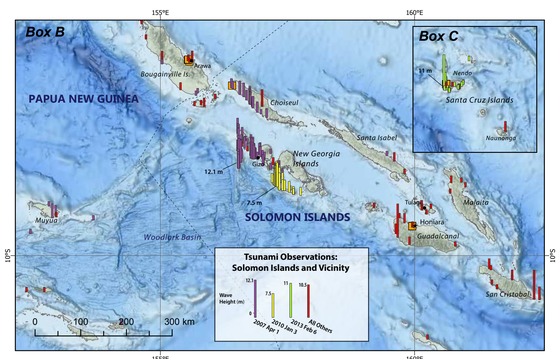
Historical Tsunami Observations



Maximum Tsunami Runup for Tsunamis Causing Damage or Deaths



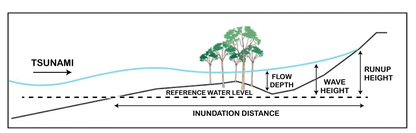




Historical Tsunami Observations

Location	Total Number of Runups Observed		Total Number of Events Observed		Maximum Runup Height (m) Tide Gauge		Maximum Runup Height (m) Eyewitness & Field Survey	
	All	Distant*	All	Distant*	All (year)	Distant* (year)	All (year)	Distant* (year)
Papua New Guinea	297	24 (8%)	73	18 (25%)	1.2 (1985 & 1994)	1.1 (2011)	15.0 (1888 & 1998)	2.4 (1952)
Solomon Islands	364	28 (8%)	55	12 (22%)	1.0 (2013)	0.2 (2015)	12.1 (2007)	1.5 (1960)

*Observation >1000 km from the source epicenter



Tsunami hydrodynamic data terminology (after ITST Post-Tsunami Survey Field Guide, 2nd ed, IOC MG 37, UNESCO, 2014).

Tsunamis in Papua New Guinea (≥ 2 m Runup or Deaths)

Date	Source Location	Eq Mag	Max Runup Height (m)	Deaths	Damage	Location of Effects
1857	Bismarck Sea, PNG	8.0		Some		Aralu, PNG
1888	Ritter Is Volcano, PNG		15	Many	X	Umboi Is, New Britain Island
1895	Solomon Sea, PNG	7.3	6	Some	X	Oro, PNG
1900	Rabaul Harbor, PNG	7.1	3		X	Rabaul, New Britian Island
1930	Bismarck Sea, PNG	6.5	12	27	X	Madang and Manus, PNG
1937	Rabaul Volcano, PNG		2.5	Few		New Britain Island
1952	Kamchatka, Russia	9.0	2.4		X	New Britain and Bougainville Is
1970	PNG	7.3	3	3		Biliau Island
1971	Solomon Sea, PNG	7.9	6	1	X	Bougainville Island
1971	Solomon Sea, PNG	7.9	10		X	New Britain and New Ireland Is
1975	Solomon Sea, PNG	7.9	2		X	Bougainville Island
1994	Rabaul Volcano, PNG		3			New Britain Island
1998	Bismarck Sea, PNG	7.0	15	1,636	X	Northwest PNG
2000	Bismarck Sea, PNG	8.0	3		X	New Britain and New Ireland Is
2002	Bismarck Sea, PNG	7.6	5.5		X	Northwest PNG
2007	Solomon Islands	8.1	3.5		X	Bougainville Island, Milne Bay

From 1768 to 2018 over 70 tsunamis were observed in Papua New Guinea.
The majority were caused by earthquakes in or near Papua New Guinea.

Tsunamis in the Solomon Islands (≥ 2 m Runup or Deaths)

Date	Source Location	Eq Mag	Max Runup Height (m)	Deaths	Damage	Location of Effects
1901	New Caledonia	7.9		?		Santa Cruz
1926	Solomon Islands	6.9	2		X	Guadalcanal
1931	Solomon Islands	7.8	9	50	X	San Cristobal
1939	Solomon Islands	7.9	10.5	12	X	Guadalcanal
1966	Solomon Islands	7.8	2			Santa Cruz
1971	Papua New Guinea	7.9	3			N. Solomon Islands?
1974	Solomon Islands	7.1	4.5			Choiseul
1988	Solomon Islands	7.6		1		San Cristobal
1997	Solomon Islands	7.7	3		X	Solomon Islands
2003	Solomon Islands	7.3	2			Makira
2007	Solomon Islands	8.1	12.1	50	X	Choiseul, Ghizo, Simbo
2010	Solomon Islands	7.1	7.5		X	Rendova
2013	Solomon Islands	7.9	11	10	X	Malo, Nendo, Noi

From 1897 to 2018 over 50 tsunamis were observed in the Solomon Islands.
The majority were caused by earthquakes in or near the Solomon Islands.

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