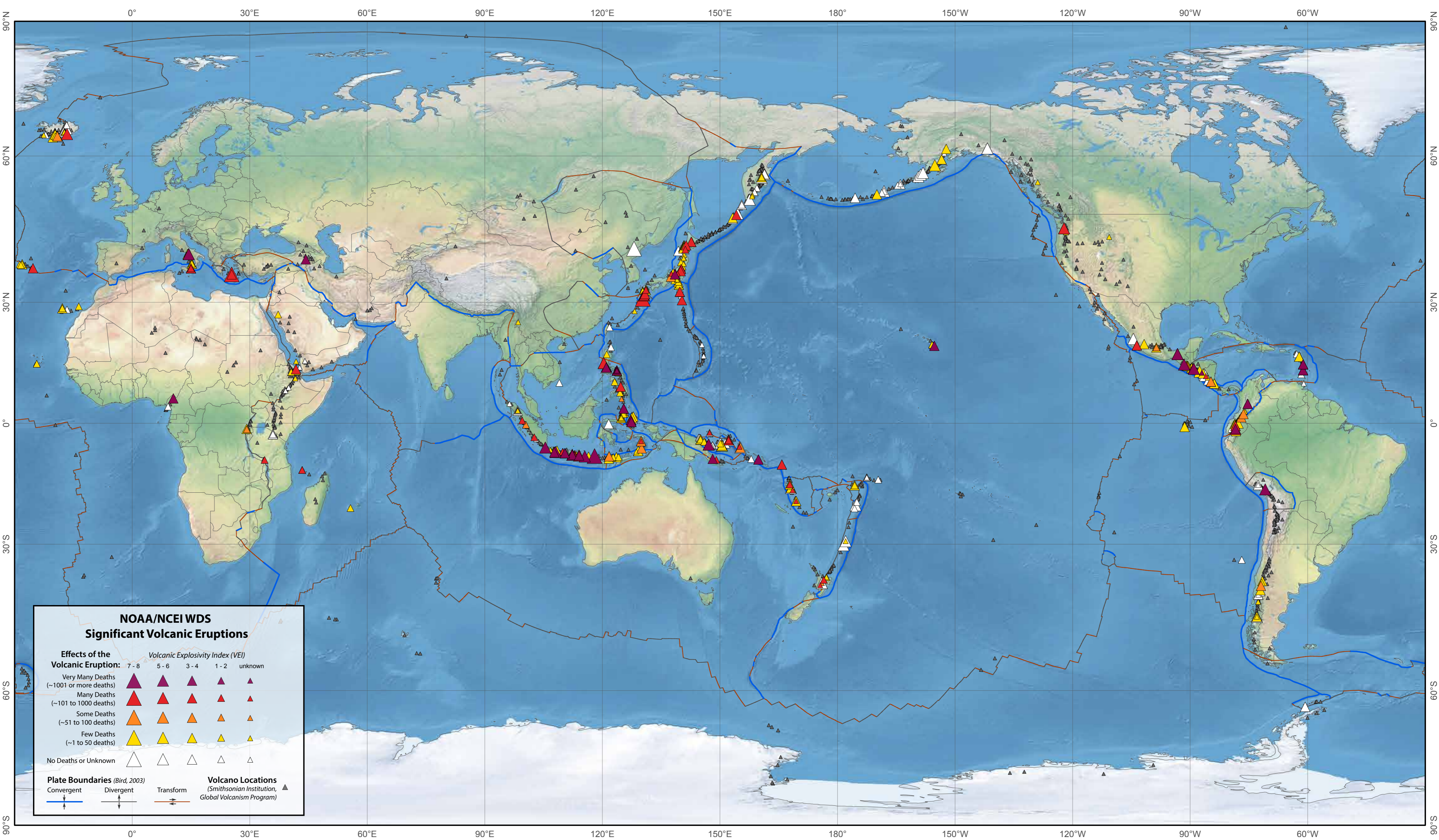


Significant Volcanic Eruptions 4360 B.C. to A.D. 2023



**NOAA/NCEI WDS
Significant Volcanic Eruptions**

Effects of the Volcanic Eruption:	Volcanic Explosivity Index (VEI)				
	7 - 8	5 - 6	3 - 4	1 - 2	unknown
Very Many Deaths (~1001 or more deaths)	Large Purple Triangle	Medium Purple Triangle	Small Purple Triangle	Very Small Purple Triangle	White Triangle
Many Deaths (~101 to 1000 deaths)	Large Red Triangle	Medium Red Triangle	Small Red Triangle	Very Small Red Triangle	White Triangle
Some Deaths (~51 to 100 deaths)	Large Orange Triangle	Medium Orange Triangle	Small Orange Triangle	Very Small Orange Triangle	White Triangle
Few Deaths (~1 to 50 deaths)	Large Yellow Triangle	Medium Yellow Triangle	Small Yellow Triangle	Very Small Yellow Triangle	White Triangle
No Deaths or Unknown	White Triangle	White Triangle	White Triangle	White Triangle	White Triangle

Plate Boundaries (Bird, 2003)
 Convergent: Blue line with arrows pointing towards each other
 Divergent: Blue line with arrows pointing away from each other
 Transform: Blue line with arrows pointing in opposite directions

Volcano Locations (Smithsonian Institution, Global Volcanism Program)
 Represented by small black triangles

Patterson Cylindrical Projection

Symbol drawing order: more deaths on top of fewer deaths; smaller VEI eruptions on top of larger VEI eruptions.

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 map showing significant volcanic eruptions. The information comes from the NCEI Significant Volcanic Eruptions Database which includes volcanic eruptions from 4360 B.C. to A.D. 2023 meeting at least one of the following criteria: resulted in moderate damage (approximately USD \$1 million or more), caused fatalities, produced a large eruption with a volcanic explosivity index (VEI) of 6 or larger, generated a tsunami, or was associated with a major earthquake. VEI is a simple 0-8 index of increasing explosivity that combines quantitative data with descriptions from observers (Newhall and Self, 1982).

There are over 850 eruptions in the database. The global distribution of these eruptions is 25% Central and South Pacific, 17% East Asia, 16% Europe, 15% Southern Asia (including western Indonesia), 7% Central America and the Caribbean, 7% North America and Hawaii, 7% South America, 3% Africa, 2% Kamchatka and the Kuril Islands, and 1% Middle East. The majority of the volcanic eruption information comes from eyewitness observations that are now enhanced with satellite data. Dating methods (e.g., radiocarbon and tephrochronology) are used when there is an absence of human observations.

The total number of deaths due to volcanic eruptions is over 300,000 and the total damage is over USD \$10.8 billion (2023 dollars). These numbers are probably underestimates, however, since the actual numbers are unknown for many events. Tables 1 and 2 list the deadliest and largest (VEI ≥ 6) eruptions in the last 4,000 years. Eruptions can also generate deadly tsunamis (Table 3). For example, most of the 36,000 deaths from the 1883 Krakatau explosion resulted from the tsunami.

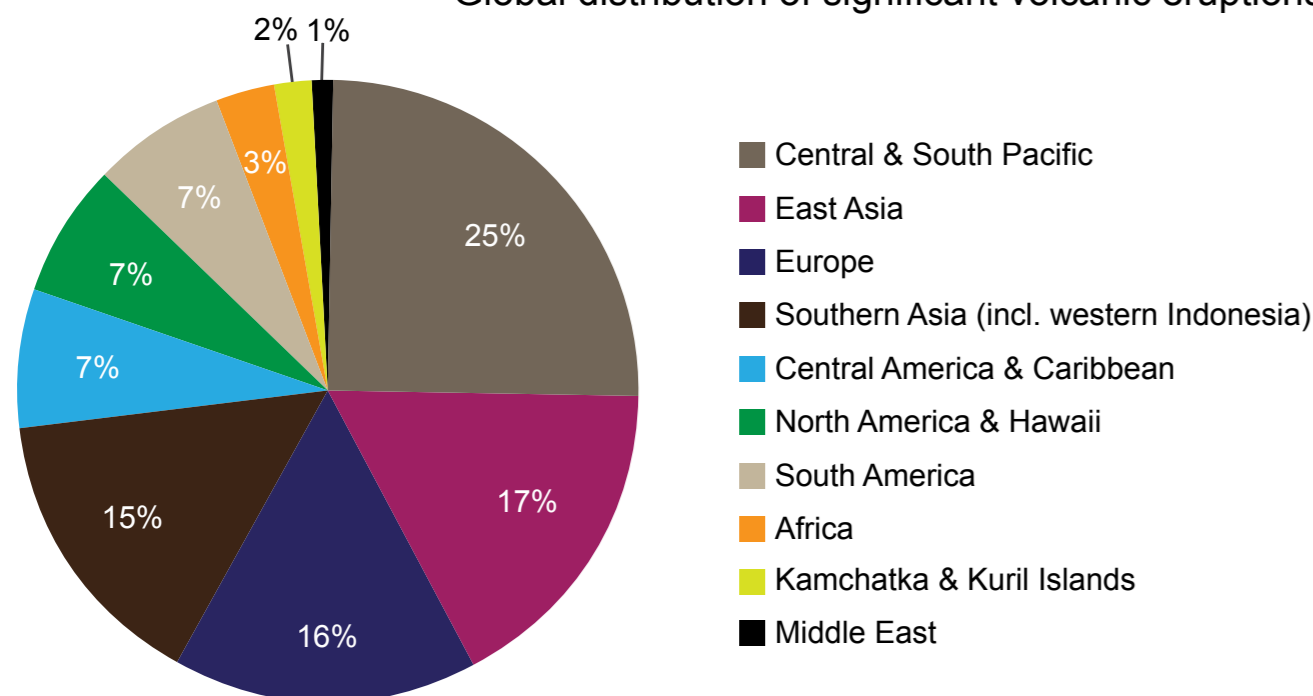
The events in the NCEI Significant Volcanic Eruptions Database were gathered from the Smithsonian Institution's Global Volcanism Program (GVP), the U.S. Geological Survey, volcano catalogs, national and government databases and reports, post-event reconnaissance reports, journal articles, newspapers, internet sources, email, and other documents. For a complete listing of references used to compile the database, please visit: <http://www.ngdc.noaa.gov/hazard/>

Triangles on the map represent the location, VEI, and number of deaths for significant volcanic eruptions. Gray triangles represent all volcanoes that did not cause death or damage based on the GVP catalog.

References:
Newhall C. G., and S. Self. 1982. The volcanic explosivity index (VEI): an estimate of explosive magnitude for historical volcanism. *J Geophys Res (Oceans & Atmospheres)*, 87: 1231-38.

Venzke E, R. W. Wunderman, L. McClelland, T. Simkin, J. F. Luhr, L. Siebert, G. Mayberry and S. Sennert (eds.). *Global Volcanism, 1968 to the Present*. Smithsonian Institution. (http://volcano.si.edu/reports_bgvn.cfm).

Global distribution of significant volcanic eruptions



Date	Year		Name, Location	Deaths		
	Mon	Day		*VEI	Eruption	Tsunami
	79	8 25	Vesuvius, Italy	5	2,100	
	450		Ilopango, El Salvador	6	30,000	
	1568		Savo, Solomon Islands	3	^L 1,000	
	1586		Kelut, Java, Indonesia	5	10,000	
	1600	2 19	Huaynaputina, Southern Peru	6	1,500	
	1631	12 16	Vesuvius, Italy ^T	5	4,000	
	1638		Raung, Java, Indonesia	4	1,000	
	1640		Tungurahua, Ecuador	3	5,000	
	1660		Long Island, PNG ^T	6	^L 2,000	
	1672	8 4	Merapi, Java, Indonesia	3	3,000	
	1711	12 11	Awu, Sangihe Is, Indonesia	3	3,000	
	1760		Makian, Halmahera Is, Indonesia	4	2,000	
	1772	8 12	Papandayan, Java, Indonesia	3	2,957	
	1775		Gamalama, Halmahera, Indonesia	3	1,300	
	1783	8 5	Asama, Honshu, Japan	4	1,491	
	1784	4	Grimsvotn, Iceland	4	**9,350	
	1790	11	Kilauea, Hawaii, USA	4	5,405	
	1814	2 1	Mayon, Luzon, Philippines	4	1,200	
	1815	4 10	Tambora, Lesser Sunda Is, Indonesia ^T	7	**60,000	***
	1822	10 8	Galunggung, Java, Indonesia	5	4,011	
	1840	7 2	Ararat, Turkey	3	1,900	
	1845	2 19	Ruiz, Colombia	3	1,000	
	1856	3 2	Awu, Sangihe Is, Indonesia ^T	3	2,806	***
	1875		Mayon, Luzon, Philippines	^R 1,500		
	1883	8 27	Krakatau, Indonesia ^T	6	2,000	34,417
	1892	6 7	Awu, Sangihe Is, Indonesia ^T	3	1,532	
	1902	5 7	Soufriere St. Vincent, West Indies ^T	4	1,680	
	1902	5 8	Pelee, Martinique ^T	4	28,000	
	1902	8 30	Pelee, Martinique ^T	4	1,500	
	1902	10 25	Santa Maria, Guatemala	6	**10,000	
	1911	1 30	Taal, Luzon, Philippines ^T	3	1,335	50?
	1919	5 19	Kelut, Java, Indonesia	4	5,110	
	1930	12 18	Merapi, Java, Indonesia	3	1,369	
	1951	1 21	Lamington, New Guinea, PNG	4	2,942	
	1963	3 18	Agung, Lesser Sunda Is, Indonesia ^T	5	1,028	
	1982	3 29	El Chichon, Southern Mexico	5	1,879	
	1985	11 13	Ruiz, Colombia	3	23,080	
	1986	8 21	Oku Volcanic Field, Cameroon, Africa		1,700	
	1998	10 30	San Cristobal, Nicaragua	^R 1,620		
	2006	11 30	Mayon, Luzon, Philippines	1	^R 1,266	

^T The eruption generated a tsunami
^{*}Volcanic Explosivity Index: 2 = small, 3 = moderate-large, 4 = large, ≥ 5 = very large
^{**}Total deaths includes eruption and subsequent indirect causes (e.g. famine and disease)
^{***}Deaths, but the actual number is not known
^LBased on legends
^RRain triggered lahars, no eruption

Date	Year		Name, Location	Deaths		
	Mon	Day		*VEI	Eruption	Tsunami
	-1610		Santorini, Greece ^T	7		***
	-1460		Taupo, New Zealand	6		
	-1370		Pago, New Britain, PNG	6		
	-1050		Pinatubo, Luzon, Philippines	6		
	-250		Raoul Island, Kermadec Is, New Zealand	6		
	-100		Okmok, Aleutian Is, Alaska, USA	6		
	-50		Apoyeque, Nicaragua	6		
	50		Ambrym, Vanuatu	6		
	60		Bona-Churchill, Eastern Alaska, USA	6		
	233		Taupo, New Zealand	6		
	240		Ksudach, Kamchatka	6		
	450		Ilopango, El Salvador	6	30,000	
	653		Dakataua, New Britain, PNG	6		
	683		Rabaul, New Britain, PNG	6		
	710		Pago, New Britain, PNG	6		
	847		Bona-Churchill, Eastern Alaska, USA	6		
	930		Ceboruco, Mexico	6		
	946		Changbaishan, Eastern China	7		
	1280		Quilotoa, Ecuador	6		
	1477	2	Bardarbunga, Iceland	6		
	1580		Billy Mitchell, Bougainville, PNG	6		
	1600	2 19	Huaynaputina, Peru	6	1,500	
	1660		Long Island, PNG ^T	6	^L 2,000	
	1815	4 10	Tambora, Lesser Sunda Is, Indonesia ^T	7	**60,000	***
	1883	8 27	Krakatau, Indonesia ^T	6	2,000	34,417
	1902	10 25	Santa Maria, Guatemala	6	**10,000	
	1912	9 6	Novarupta, Alaska Peninsula, USA	6		2
	1991	6 15	Pinatubo, Luzon, Philippines	6	**800	

^T The eruption generated a tsunami
^{*}Volcanic Explosivity Index: 2 = small, 3 = moderate-large, 4 = large, ≥ 5 = very large
^{**}Total deaths includes eruption and subsequent indirect causes (e.g. famine and disease)
^{***}Deaths, but the actual number is not known
^LBased on legends

Date	Year		Name, Location	*VEI	Deaths		
	Mon	Day			Eruption	Tsunami	Total
	-1610		Santorini, Greece	7		***	***
	766	7 20	Sakura-jima, Kyushu, Japan	3	***	***	***
	1640	7 31	Komaga-take, Hokkaido, Japan	5		700	700
	1741	8 23	Oshima-Oshima, Hokkaido, Japan	4		2,000	2,000
	1781	4 11	Sakura-jima, Kyushu, Japan	4	23	15	38
	1792	5 21	Unzen, Kyushu, Japan	2	***	15,000	15,000
	1815	4 10	Tambora, Lesser Sunda Is, Indonesia	7	**11,000	***	^L 60,000
	1856	3 2	Awu, Sangihe Is, Indonesia	3	2,806	***	2,806
	1871	3 3	Ruang, Sangihe Is, Indonesia	2		400	400
	1883	8 27	Krakatau, Indonesia	6	2,000	34,417	36,417
	1888	3 13	Ritter Island, PNG	2		***	***
	1911	1 30	Taal, Luzon, Philippines	3	1,335	50?	1,335
	1928	8 4	Paluweh, Lesser Sunda Is, Indonesia	3	98	128	226
	1930	9 11	Stromboli, Italy	3	5	1	6
	1933	1 8	Kharimkotan, Kuril Islands	5		2	2
	1937	5 29	Rabaul, New Britain, PNG	4	507	***	507
	1965	9 28	Taal, Luzon, Philippines	4	355	355	**355
	2018	2 22	Krakatau, Indonesia	3		437	437
	2022	1 15	Tonga Islands, Tonga	5		6	6

^{*}Volcanic Explosivity Index: 2 = small, 3 = moderate-large, 4 = large, ≥ 5 = very large
^{**}Tsunami and eruption deaths could not be separated
^{***}Deaths, but the actual number is not known
^LTotal of 60,000 deaths from the eruption and subsequent famine and disease, which includes 11,000 from the bomb impacts, tephra falls and tsunami



International Tsunami Information Center
 A UNESCO/IOC - NOAA Partnership
 1845 Wasp Boulevard, Building 176
 Honolulu, Hawaii 96818, USA
 Tel: 1-808-725-6050, Fax: 1-808-725-6055
 Email: laura.kong@noaa.gov
 URL: <http://www.tsunamiwave.org>



National Oceanic and Atmospheric Administration (NOAA)
 National Centers for Environmental Information
 World Data Service for Geophysics
 325 Broadway
 Boulder, CO 80305-3328, USA
 Tel: 1-720-446-9821, Fax: 1-303-497-6513
 Email: nicolas.arcos@noaa.gov
 URL: <http://www.ngdc.noaa.gov/hazard/>

