NOAA/NCEI-WDS Integrated Tsunami Data: Support Research, Forecasts, Warnings, Response, Hazard and Risk Assessments

NOAA National Centers for Environmental Information (NCEI, formerly National Geophysical Data Center (NGDC)) World Data Service for Geophysics (WDS) Boulder, United States

and

Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado, Boulder, United States,





ICSU World Data System

- International Council of Science (ICSU)/World Data System (WDS)
 - Created in 2008--Builds on 50-year legacy of the ICSU World Data Centers
 - 87 Regular Members
- NOAA/NCEI Boulder, Colorado, USA and co-located World Data Service (WDS) for Geophysics provide long-term archive, data management, and access to global tsunami data
 - global tsunami event data, damage photos, raw and processed water Level data from NOAA observational networks, and development of digital elevation models (DEMs)



Historical Tsunami Data Know the past to better understand the future

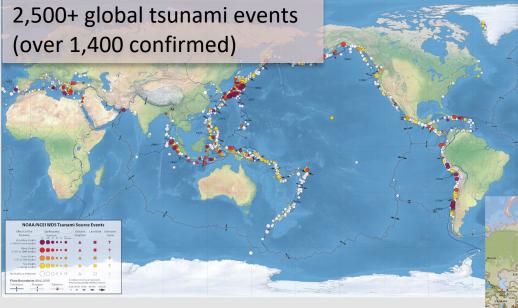
The historical tsunami database is a scientifically curated list of historical tsunami source events and tsunami water height locations throughout the world that range in date from 2000 B.C. to the present. These data support:

- Forecast and Warning, tsunami model validation, coastal hazard assessments and community resiliency
- Authoritative source for historical tsunami event data
- Database is continuously updated based on new sources
- User interface provides a REST API for programmatic access, flexible sorting, and filtering of data through a new graphical user interface that will make tsunami datasets more discoverable. https://www.ngdc.noaa.gov/hazel

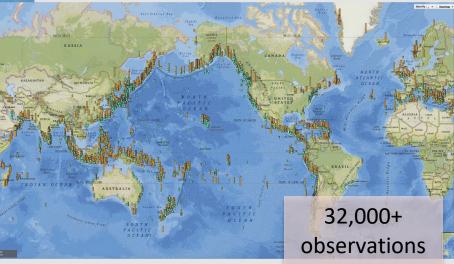
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| Indian Ocean Front | Runups - 25 Results Found T B Mana Deubhal Country Area | Location Name | Latitude Longitude Distance From Initial Wave Initial Wave Initial Wave Dourse (Initial Wave Arrivel Initial Wave Arrivel Initial Wave | Travel Travel Max Ways Max Ways Max Mars Mass Mater | | |
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| | - World Data Ser | vice for G | Seophysics | | | |

Tsunami Source Events and Observations

• Date, location, latitude/longitude, cause (e.g., earthquake, volcanic eruption), maximum water height, socio-economic data (deaths, injuries, damage), source references



- Eyewitness, field survey, tide gauge, DART
 - Location name, latitude/longitude, wave arrival time, water height, socio-economic (deaths, injuries, damage), references





Source Documents

Over 8,500 documents that describe damage and effects from tsunami, earthquake, and volcano events. Types of documents:

- Diaries, ships logs, newspaper reports
- Tsunami, Earthquake, Volcano catalogs
- **National Reports** from ICGs (e.g., PTWS, Caribe-EWS)
- NOAA National Weather Service Tsunami Warning Centers
- NOAA/IOC/UNESCO International Tsunami Information Center (ITIC)
- Web articles, e-mail, journal articles
- International Tsunami Survey Teams



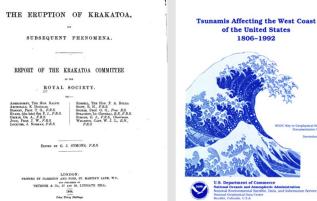


The U.S. Geological Survey said the quake hit the Queen Charlotte Islands just after 8 p.m. local time Saturday at a depth of about 3 miles (5 kilometers) and was centered 96 miles (155 kilometers) south of Masset, British Columbia. It was one of the biggest earthquakes around Canada in decades and was felt across a wide area around British Columbia

The National Weather Service issued a tsunami warning for coastal areas of British Columbia, southern Alaska and Hawaii. The first wave of the small tsunami, about 4 inches (101.6 millimeters), hit the southeast Alaska coastal community of Craig.

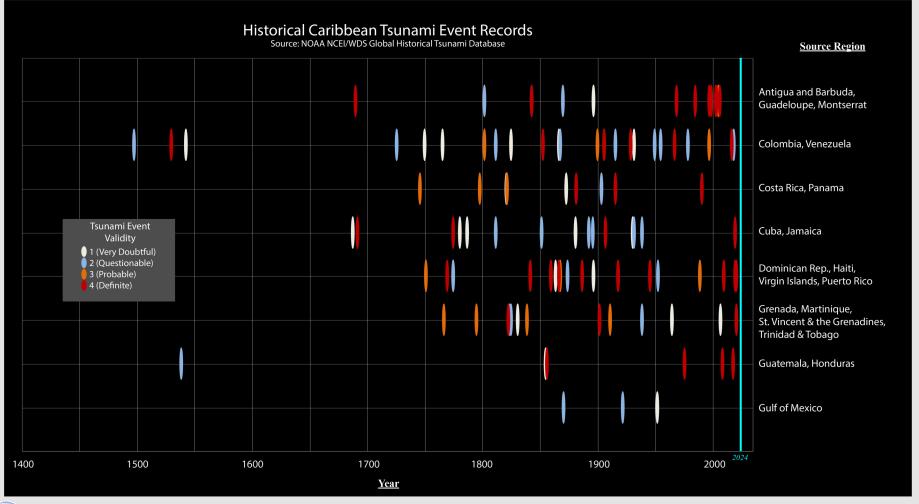
Dennis Sinnott of the Canadian Institute of Ocean Science said a 69 centimeter (27 inch) wave was recorded off Langara Island on the northeast tip of Haida Gwaii, formerly called the Queen Charlotte Islands, Another 55 centimeter (21 inch) wave hit Winter Harbour on the northeast coast of Vancouver Island.





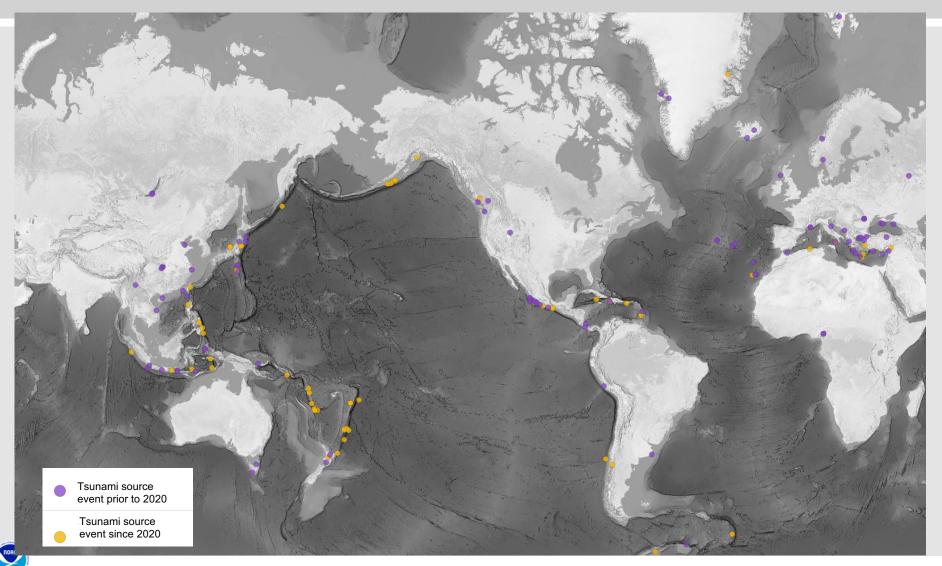


Gaps in records

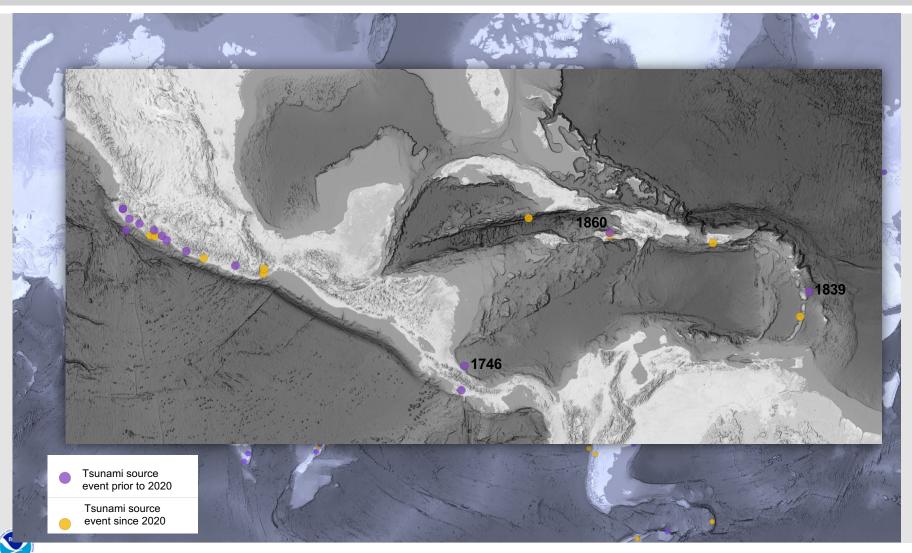




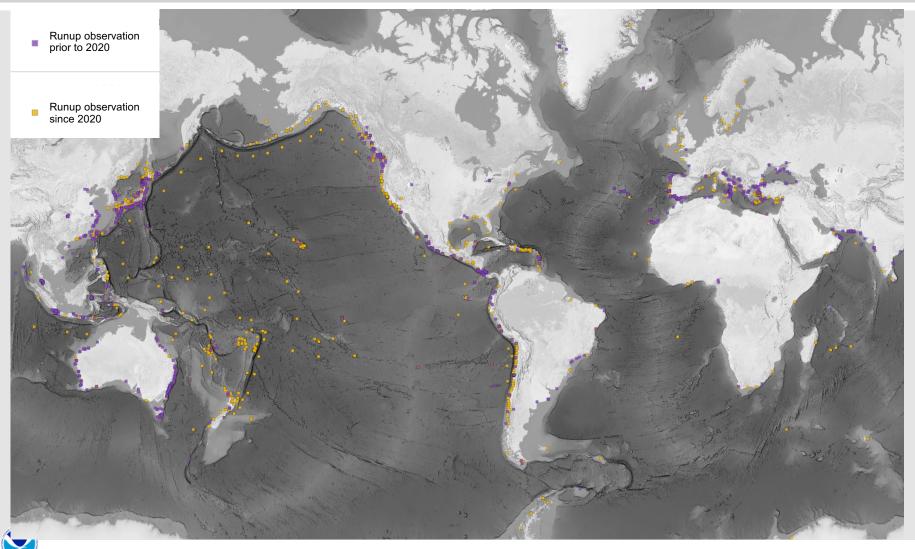
Tsunami Source Event data since 2020



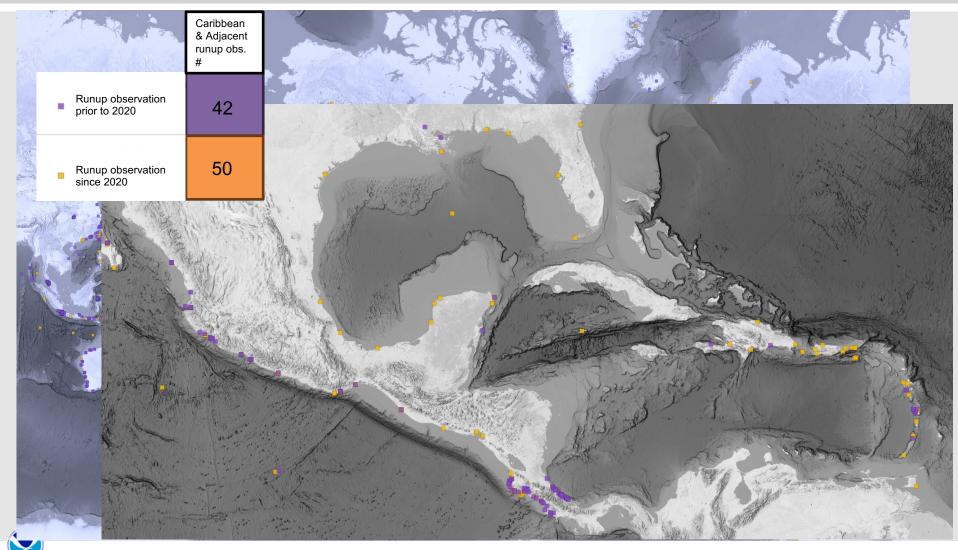
Tsunami Source Event data since 2020



Tsunami Runup data since 2020



Tsunami Runup data since 2020



NCEI and ITIC Collaborative Projects

Tsunami Sources 1610 B.C. to A.D. 2022 From Earthquakes, Volcanic Eruptions, Landslides, and Other Causes

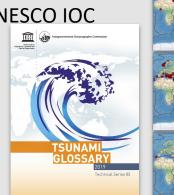
Global posters:

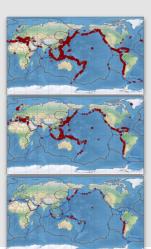
- Tsunamis (2022 & 2023)
- Significant earthquake (2023)
- Significant volcanic eruptions (2023)

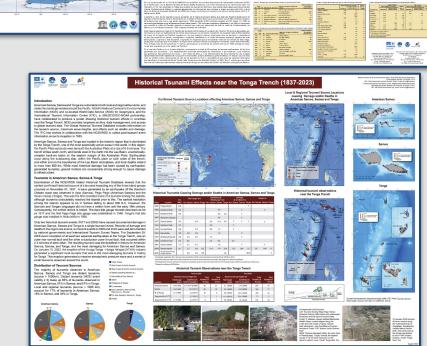
Regional:

- Caribbean and adjacent regions (English & Spanish)
- Tonga Trench

Assisted in updating UNESCO IOC Tsunami Glossary







NCEI and ITIC Collaborative Projects

Tsunamis Históricos (desde 1610 hasta el año 2023) Caribe, Centroamérica, México y Regiones Adyacentes

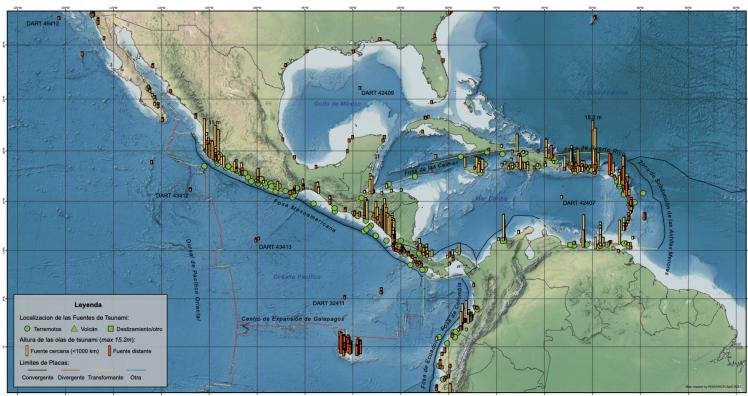
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Regional:

- Caribbe (English
- Tonga⁻

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En una colaboración de la COI de la UNESCO con la NOAA, los Centros Nacionales de Información Ambiental (NCE)) de la NOAA, lunto con el Sistema Mundial de Datos (NOS) Geoficios y el Centro Internacional de Información Aprelos Tsunamis (ITIC), han diseñado un mapa que muestra los tsunamis históricos y sus alturas observadas para las zonas del Carabo, Centroamérica, Máxico y regiones adyacentes. La Información que contiene el mapa, provine el NICEI y de la base de datos de tsunamis históricos del WDS que incluye las fuentes de tsunamis de todo el mundo desde 1610 a.C. hasta marzo 2023.

Cuarenta y cinco de los taunamis que se muestran en el mapa provocaron daños que abarcan dede la destrucción de algunas embarcaciones hasta la devastación de ciudedes enteras. Diecinueve provocaron unas 6.500 víclimas mortales. El taunami más tetal fue el que azotó Jamaica en 1692 causando 2.000 víclimas mortales en Port Royal. En 1984, el terremoto tsumamigienico de la República Dominicana causó 1.760 víclimas mortales en Matanzas y en 1960, un terremoto que sacutó la costa de Ecuador generó un tsumami que pudo ser observado en toda la costa de Centroamérica, en Máxico y en California causado 1.000 víclimas mortales en Aldombia.

Este mapa presenta un total de 72 fuentes de tsunamis confirmados en la región del Pacífico: 69 de ellos generados por intermolos y 3 por un desilizamiento de lierars provendos por un teremolico. Asimismo, es el So registrion de nung en la región del Pacífico (lugares en los que testigos oculares observaron olas de tsunami; o ublicaciones en las que estudios de campo, menegrafora o sensores instatados en el fondo del costen publicario registrar las olas del tsumani). Cuarenta y tres tsunamis, originados en regiones que se encuentran fuera de los límites de este mapa produjeron los runos que se meseran, la mayor parte de estos eventos se produjeron en Alsaka, Chile, Nueva Zelanda, Perú y Rusia. Una ola de tsunami de 11 metros, generada por el teremoto de Jalismo-Colima en 1995, produje ol mayor runu que se puede ver en la región del Pacífico.

En el mar del Cambe y en el océano Atlántico, se muestran un total de 58 eventos de tsunami confirmados: 42 de ellos generados por terremotos, 7 por desilizamientos de tiernas provocados por terremotos, 5, por volcanes, 20 por volcanes, es que generador por terremotos, 7 por desilizamientos de tiernas, topor volcanes, es por volcanes, es apoximadamento 40 registros de numo para el mar Cambio, océano Atlántico y pol de México. El mayor runu de esta zona se pródujo como consecuencia de uma sia de tsunami de 152 m, generada por una serie de voltentos terremotos furar de los filmeis sue abarca este mana por consecuencia de Cambo, de des Atlántico y del do Búrdo. El mayor una de esta furar de los filmeis sue abarca este mana porvocarion runuas en la accosta de Carbio. Ad Múntico y Atlántico y del do de do Máxico.

| | Fecha Mes | Dia | Ubicación del terremoto | Lugares en los que se registraron victimas | Número estimado de muertos o desaparecidos |
|---|--|-----|---|--|--|
| 1530 | 9 | 1 | Venezuela | Golfo de Cariaco (Venezuela) | 4 |
| 1092 | 6 | 7 | Jameica | Port Royal (Jamaica) | 2000 |
| 1842 | 5 | 7 | Halti | Port de Paix (Haiti) | 300 |
| 1867 | 11 | 18 | Islas Virgenes (EE.UU.) | Islas Virgenes (EE.UU.) | 24 |
| 1918 | 10 | 11 | Puerto Rico (EE.UU.) | Puerto Rico (EE.UU.) | 140 |
| 1946 | 8 | 4 | República Dominicana | Matanzas (República Dominicana) | 1790 |
| 1946 | | 8 | República Dominicana | Santo Domingo (República Dominicana) | 75 |
| 2010 | 1 | 12 | Halti | Petit Paradis (Haiti) | 7 |
| uadr | o 2. Ts Fech | _ | mis que causaron víctim | as mortales en Centroamérica, Colomb | Número estimado |
| Año | _ | • | mis que causaron víctim Xe Ubicación de la fuent | Lugares en los que se registraron | Número estimado |
| Año | Fech | | | Lugares en los que se registraron | Número estimado de muertos o |
| Año | Fech Mes | | Xa Ubicación de la fuent | Lugares en los que se registraron le víctimas | Número estimado de muertos o desaparecidos |
| Año 1787 | Fech Mes 3 9 | | Xa Ubicación de la fuent 28 México | Lugares en los que se registraron a víctimas Oaxaca (México) | Número estimado de muertos o desaparecidos 11 |
| Año 1787 1882 | Fech Mes 9 2 | | Xa Ubicación de la fuent 28 Mixico 7 Panamá* | Lugares en los que se registraron e víctimas Oaxaca (México) San Blas, Panamá | Número estimado de muertos o desaparecidos 11 100 |
| Año 1787 1882 1902 | Fech Mes 3 9 2 1 | | Xa Ubicación de la fuent 28 Milxico 7 Panamá* 26 El Salvador | Lagares en los que se registraron e victimas Gaxaca (Mixico) San Bias, Panamà El Salvador | Número estimado de muertos o desaparecidos 11 100 185 |
| Año 1787 1882 1902 | Fech Mes 3 9 2 1 6 | | Xia Ubicación de la fuent 28 Mixico 7 Panamid 26 El Salvador 31 Ecuador | Lugares en los que se registraron e victimas Oaxaca (Minico) Sen Bias, Panamà El Salvador Colombia | Número estimado de muertos o desaparecidos 11 100 185 *1000 |
| Año 1787 1882 1902 1906 1932 | Fech Mes 3 9 2 1 6 6 | | Xia Ubicación de la fuent 28 Mixico 7 Panamá* 26 El Salvador 31 Ecuador 3 Mixico | Lugares en los que se registraron a victimas Oaxaca (Micrico) Sen Bias, Panamà El Salvador Colombia Jalisco, Micrico | Número estimado de martos o desaparecidos 111 100 185 *1000 4 |
| Año 1787 1882 1902 1906 1932 1932 | Fech Mes 3 9 2 1 6 6 6 | | Xa Ubicación de la fuent 28 Micico 7 Panamá* 28 El Salvador 21 Ecuador 3 Micico 22 Micico | Lugares en los que se registraron • victimas Oaxea (Marcio) San Bias, Panamà El Balvador Colombia Jafísco, Minico Cayulán, Minico | Número estimado de muertos o desaparecidos 111 100 185 *1000 4 75 |
| Año 1787 1882 1902 1906 1932 | Fech Mes 3 9 2 1 6 6 6 | | Xa Ubicación de la fuent 28 México 7 Panamá* 28 El Salvador 11 Ecuador 3 México 29 México 19 Ecuador | Lugares en los que se registraron • victimas Oaraca (Nárcio) Sea Bias, Panamá El Baivador Colontais Jafísco, Nárcio Coyutín, Márcio Esmenaisa, Ecuador | Número estimado de muertos o deseparecidos 11 1000 185 *1000 4 75 6 |
| Año 1787 1882 1902 1905 1932 1932 1938 1975 | Fech Mes 3 9 2 1 6 6 1 12 4 9 | | Ka Ubicación de la fuent Mixico Paramit El Salvador In Ecuador Mixico Mixico Mixico Di Scuador Colombia | Lugares en los que se registraron • vicilimas Conrara (Mixino) dan Bias, Panarná El Salvador Colombia Jálico, Nikico Coyutile, Nikico Elsmenidas, Ecuador Turraco, Colombia | Nomero estimado de muertos o desaparecidos 110 185 *1000 4 75 4 4 *600 |

| | Altura más | Número | |
|-------------------------------------|------------|--|----------|
| Localización | Managarate | Testigos oculares y estudios de campo | total de |
| Antiqua y Bartsuda | 0.15 | 3.7 | 9 |
| Barbados | 0.23 | 1.5 | |
| Bermuda (Raino Unido) | 0.12 | *08S | |
| Cuba | | *08S | 7 |
| Dominica | 0.06 | 3.7 | 6 |
| Oraneda | | 3.1 | |
| Guadalupe (Francia) | 0.31 | 10.0 | 26 |
| Haiti | 0.02 | 5.0 | 37 |
| Islas Caimin (Raino Unido) | 0.26 | | 2 |
| Islas Virgenes (EE.UU.) | 0.09 | 15.2 | 31 |
| latas Virgenes Británicas | | 3.6 | 4 |
| Jamaica | | 2.5 | 15 |
| Aartinica (France) | 0.3 | 4.0 | 16 |
| Montsiemat | | 4.0 | 4 |
| Puerto Rico (EE.UU.) | 0.66 | 6.1 | 44 |
| República Dominicana | 0.09 | 5.0 | 17 |
| Saba (Paises Bajos) | | 6.4 | 2 |
| Saint Kitts y Navis | | ^OBS | 3 |
| San Bartolomé (Francia) | | 2.1 | 2 |
| San Eustaquio (Países Bajos) | | ^OBS | 1 |
| San Martin (Francia y Países Bajos) | | 4.5 | 2 |
| San Vicente y las Granadinas | 0.05 | 1.8 | 7 |
| Santa Lucía | | 1.2 | 5 |
| Trividad y Tobago | 0.06 | ^OBS | |
| Venezuela | 0.08 | 10.0 | 26 |



at ?

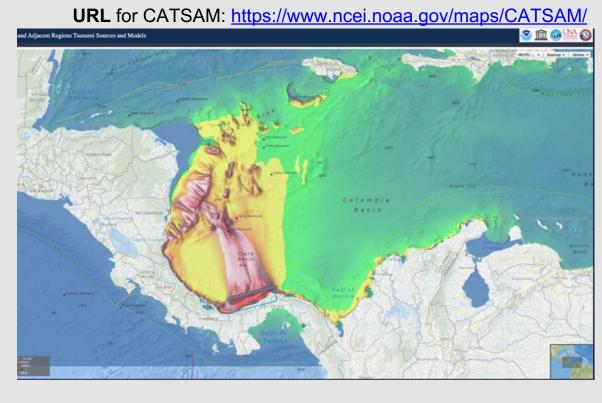
Nationa



CATSAM (Caribbean and Adjacent Regions Tsunami Sources and Models) webmap

In Collaboration with CARIBE-EWS Working Group 1 (*formerly WG2*)

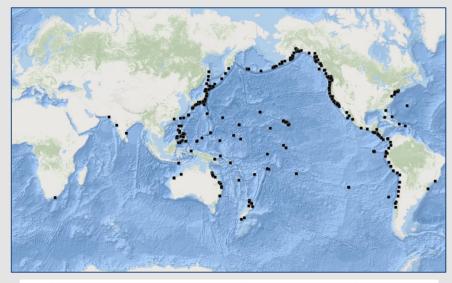
- 35+ scenarios and their associated fault planes and sources from IOC Experts Meetings and Caribe Wave Exercises have been added.
- Historical Tsunami Data
- IOC Sea Level Stations displayed/linked

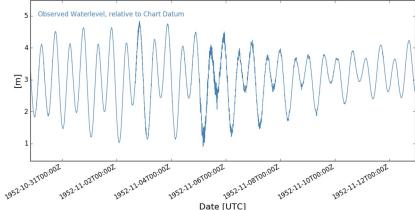


Analog Data Records (Marigrams)

https://www.ngdc.noaa.gov/hazel/view/hazards/tsunami/marigram-search

- Over 3,400 historic paper records (between 1854 and 1994)
 - ~2650 images online
 - More scans expected in 2024
 - Recent request on smaller tsunami events
- Collected from U.S. and international stations
 - ~2500 U.S. and U.S. territories
 - ~980 international stations
- Digitized 47 marigram records over 9 significant historical tsunami events.

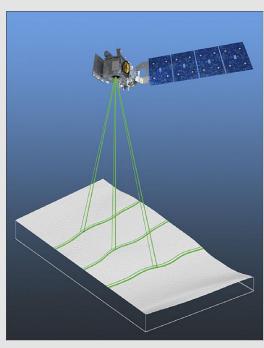




IVERT

The ICESat-2 Validation of Elevations Reporting Tool (IVERT) is a global high-accuracy statistical validation tool for Digital Elevation Models (DEMs).

- Originally built during ETOPO 2022 development to compare source datasets
- Now a primary validation tool for the NCEI/CIRES Coastal DEM team
 - Results included in archived metadata reports with each DEM product release





IVERT

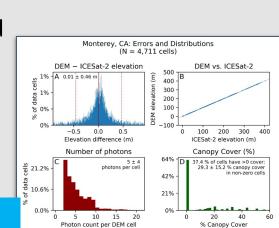
- Provides error statistics for "how good" a DEM is for flood, tsunami, and storm-surge modeling. The better the DEM, the better the hazard forecast results.
- Helps identify artifacts that should be fixed before a DEM is released

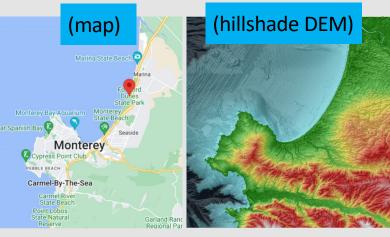
(statistical plots)

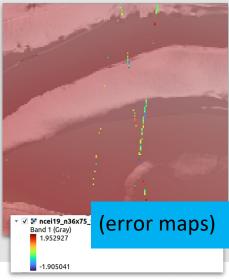
- Future plans:
 - Currently migrating to the cloud
 - Shallow-water bathymetry
 - Publicly-accessible interface

https://github.com/ciresdem/IVERT

National Centers for Environmental Info







Summary

NCEI and the co-located World Data Service for Geophysics continues to:

- Maintain and update a global historical tsunami event database
- Steward water level data for tsunami research
- Develop high-resolution DEMs to support a variety of programs
- Look for partners to work with on detailed information in their region to support these products

Encourage ICG/CARIBE-EWS Member States to submit tsunami data for archiving



Thank you!

National Centers for Environmental Information (NCEI) World Data Service for Geophysics

> http://ngdc.noaa.gov haz.info@noaa.gov dem.info@noaa.gov







