NTHMP Partner Brief
November 17, 2020, 1900-2000 UTC

# Pacific Tsunami Warning Center Current Operations Overview

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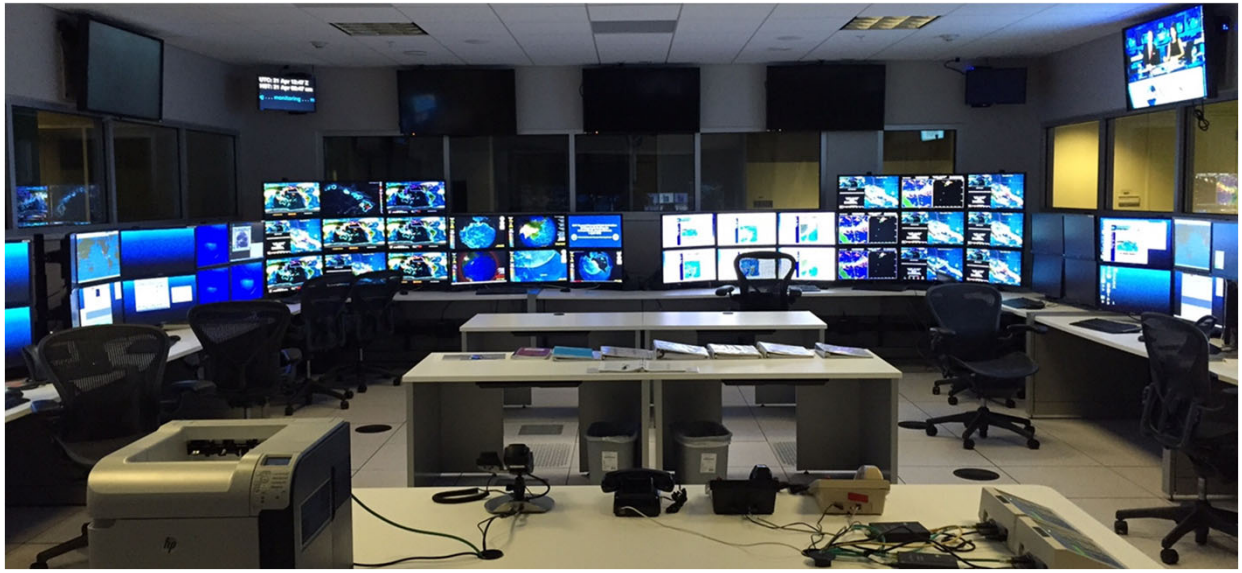
# PTWC – Pacific Tsunami Warning Center

- 1949 - Formed for Hawaii after 1946 tsunami hit Hawaii
- 1965 - Center for Pacific after 1960 Chile tsunami
- 2005+ - Center for Indian Ocean, Caribbean, Am. Samoa, Guam/CNMI & Puerto Rico after 2004 Sumatra Tsunami
- 2015 - Moved to the NOAA IRC Building in Pearl Harbor



# PTWC Location in Hawaii


Just west of Honolulu on Ford Island in Pearl Harbor at the NOAA Inouye Regional Center Building

# Current Staff

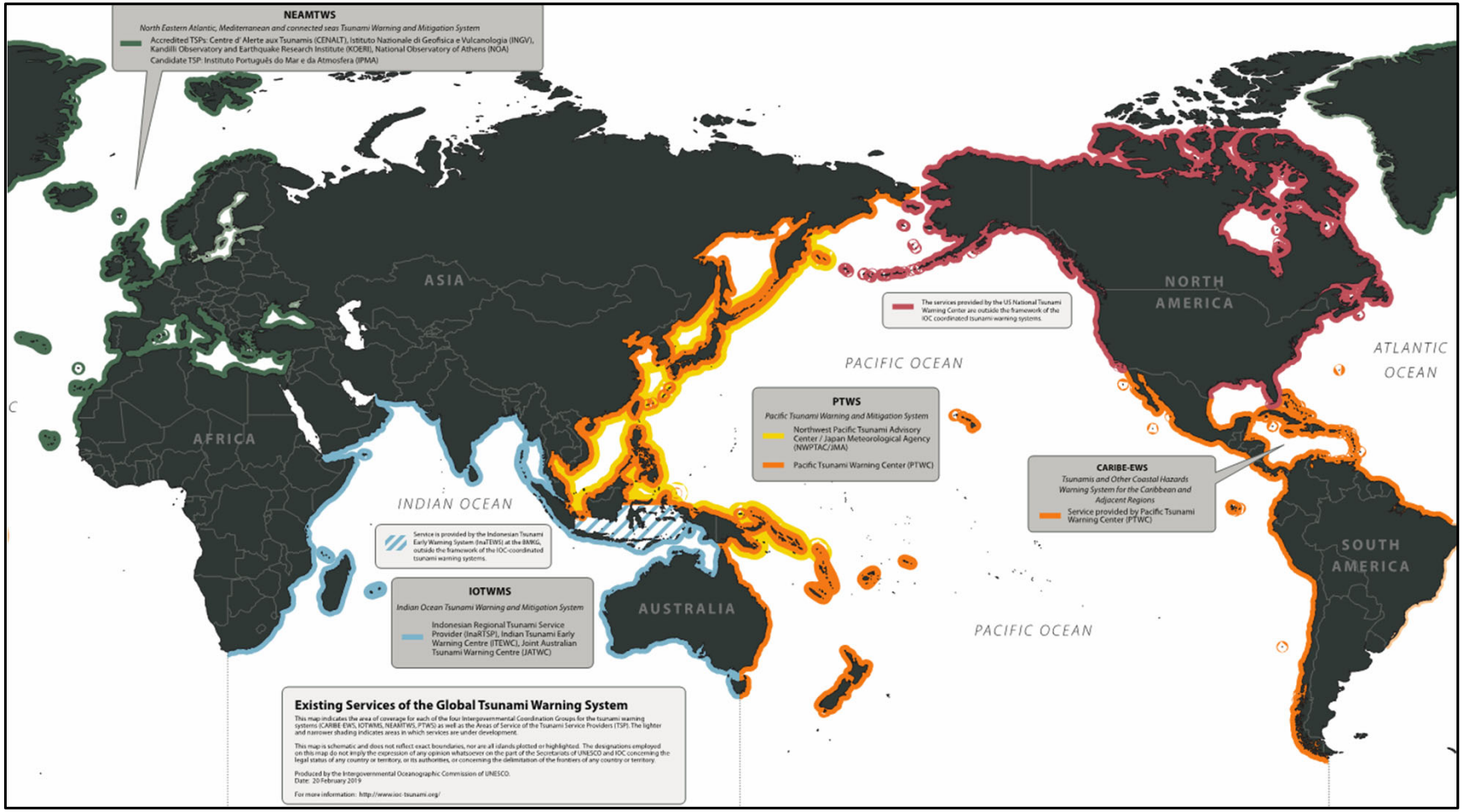
- Director: Charles McCreery
- Science Officer: Stuart Weinstein
- Duty Scientists: Victor Sardina, Dailin Wang, David Walsh, Nathan Becker, Kanoa Koyanagi, Cindi Preller, Stan Goosby, Erica Emry
- Electronics Technician: Lynn Kaisan
- Administrative Assistant: Brenda Acosta
- IT Contractor: Sean Gleason

**COVID19 Status: All staff have so far remained healthy and none with any direct known exposure.**

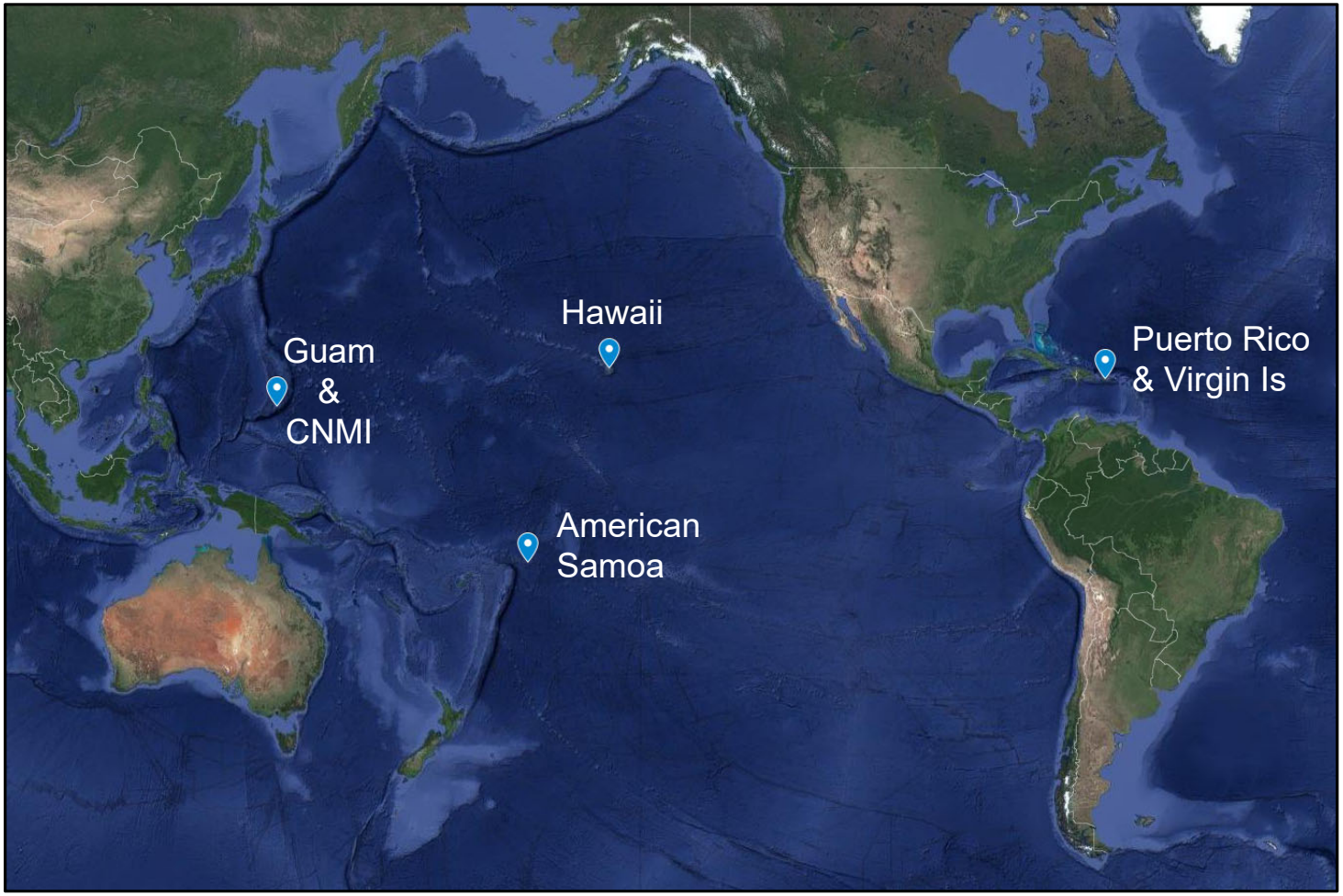
# PTWC International Areas of Service

- **PTWC is a Tsunami Service Provider under the UNESCO/IOC Global Tsunami Warning System**
  - **Pacific**: for the Pacific Tsunami Warning and Mitigation System (PTWS)
  - **Caribbean**: for the Tsunami and Other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS)

# UNESCO/IOC Area of Service Map

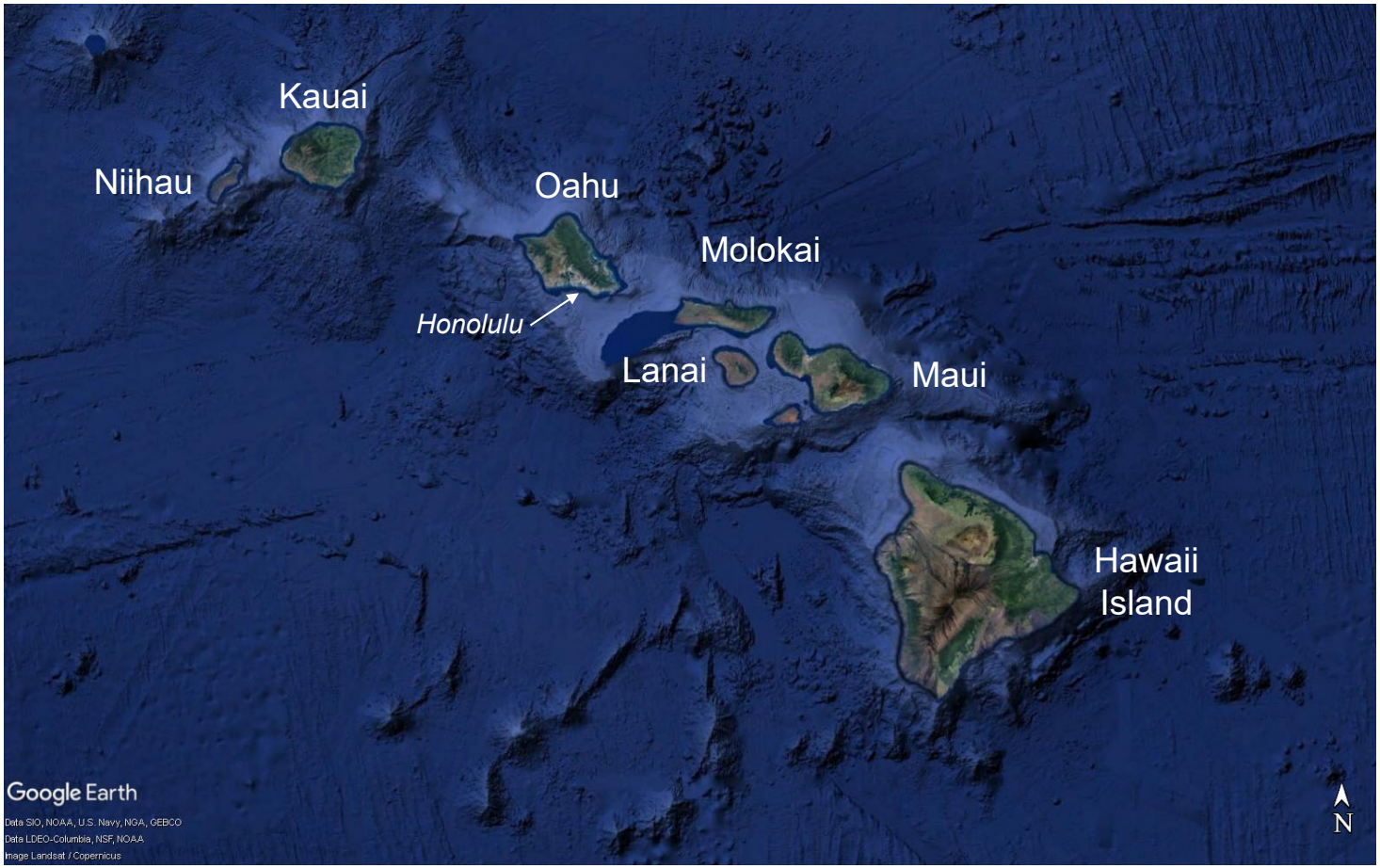


# PTWC Domestic Areas of Service

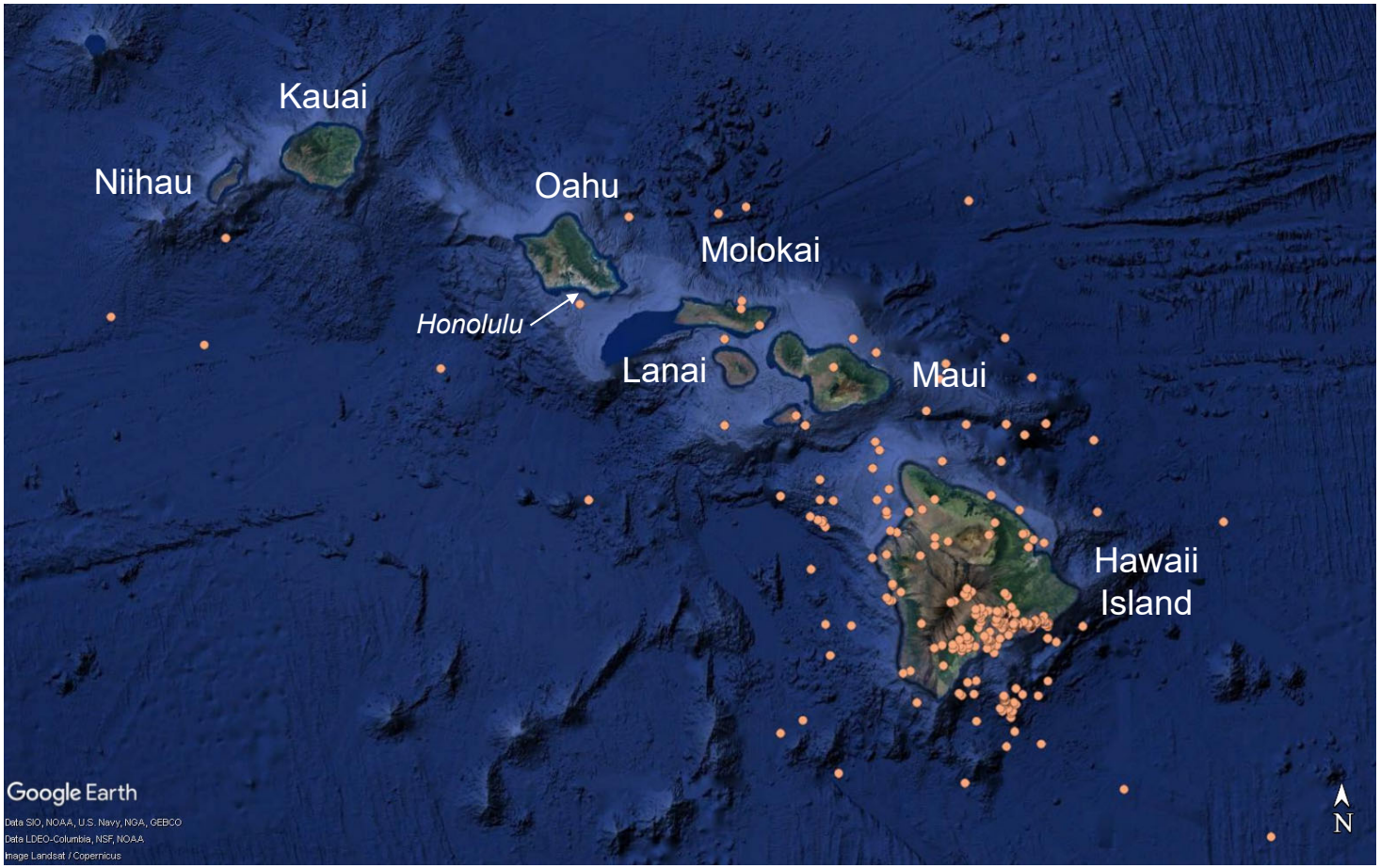



The Pacific Ocean as well as the Atlantic Ocean and Caribbean Sea have many seismic zones capable of creating tsunami waves that can propagate across those bodies of water and strike these places within minutes to hours.

# Hawaii's Populated Islands



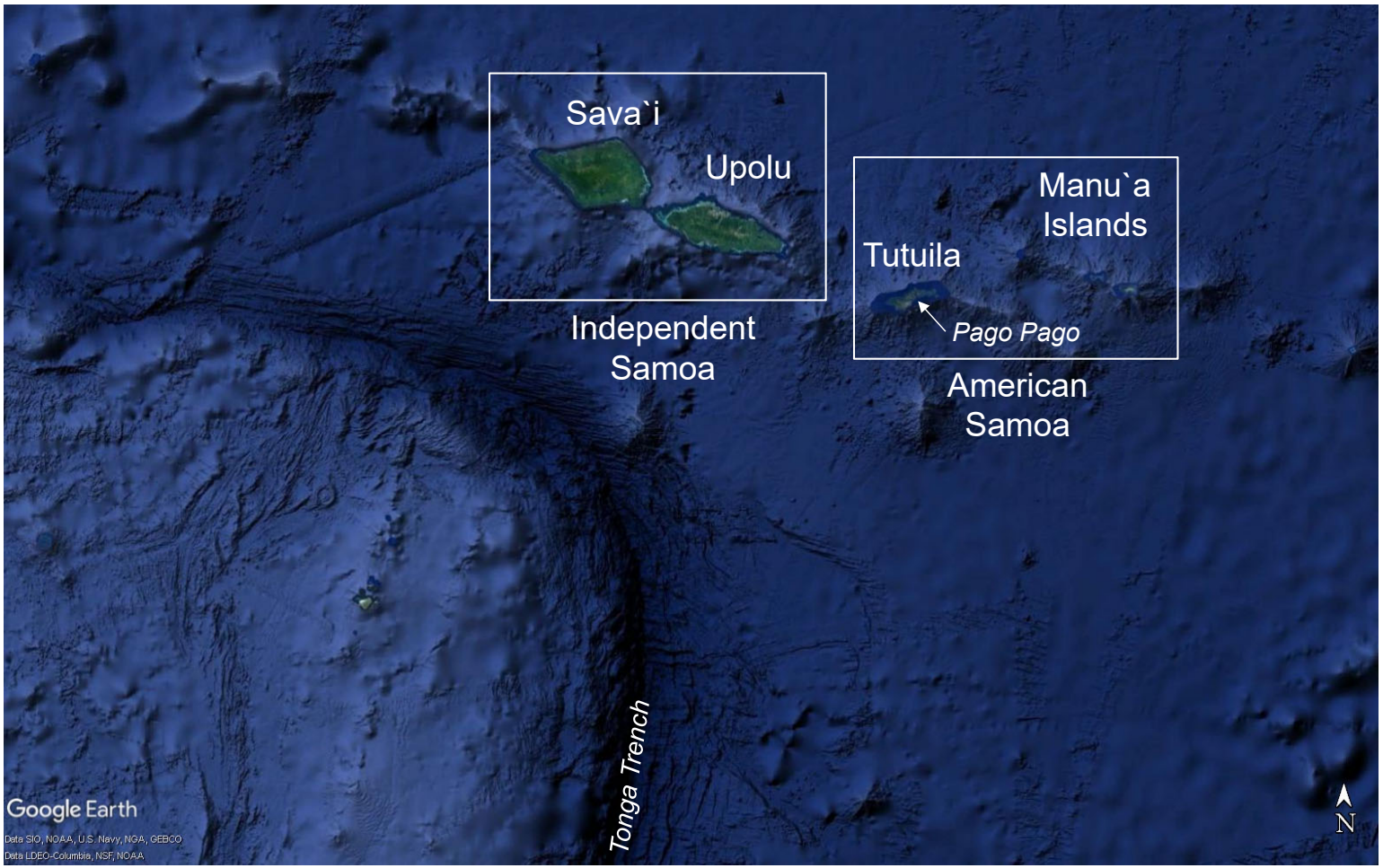
# Seismicity: 1800-Present, M > 4.5, H ≤ 100 km



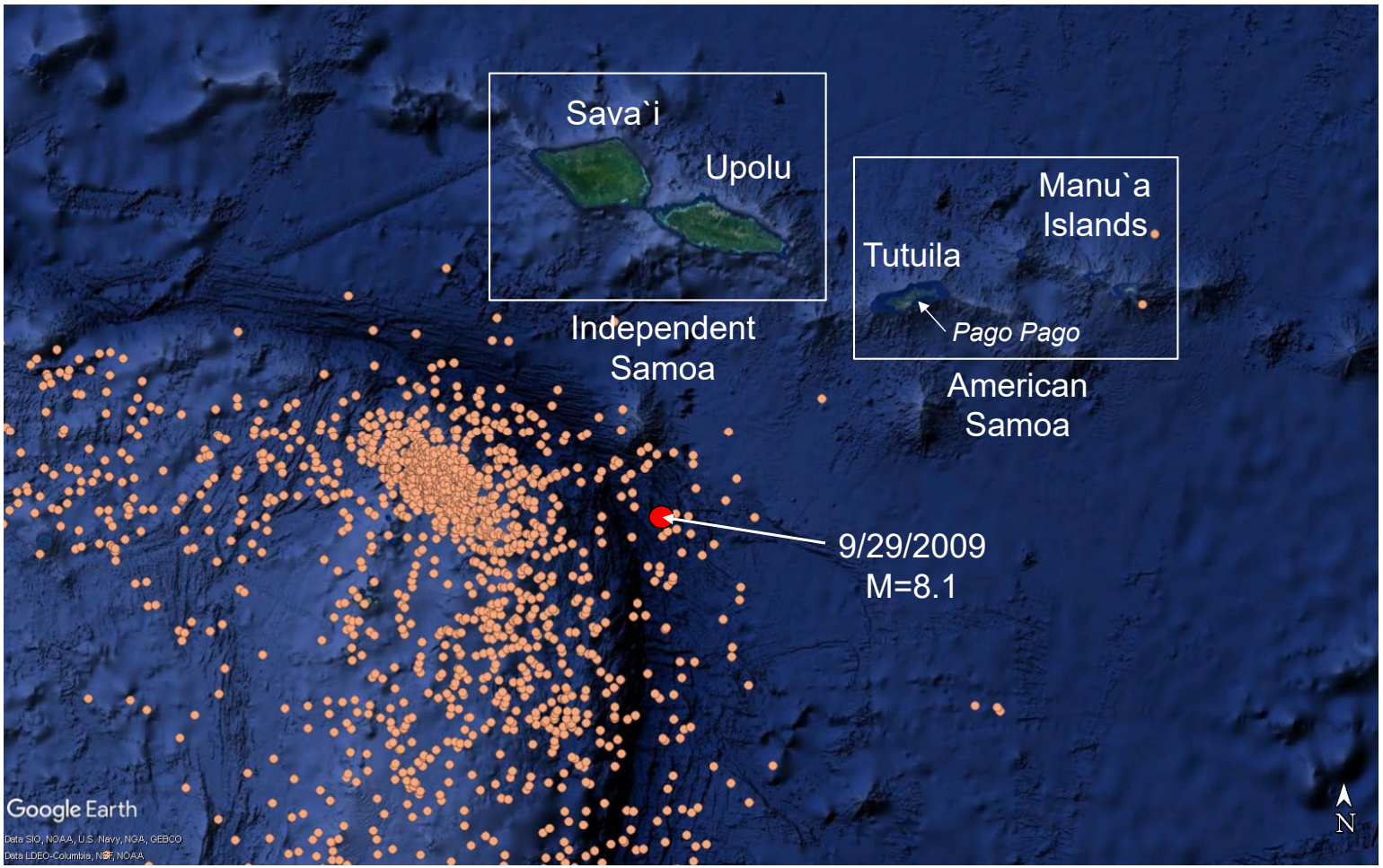

Two significant local tsunamis in 1868 and 1975.

# Hawaii's Vulnerability

# American Samoa

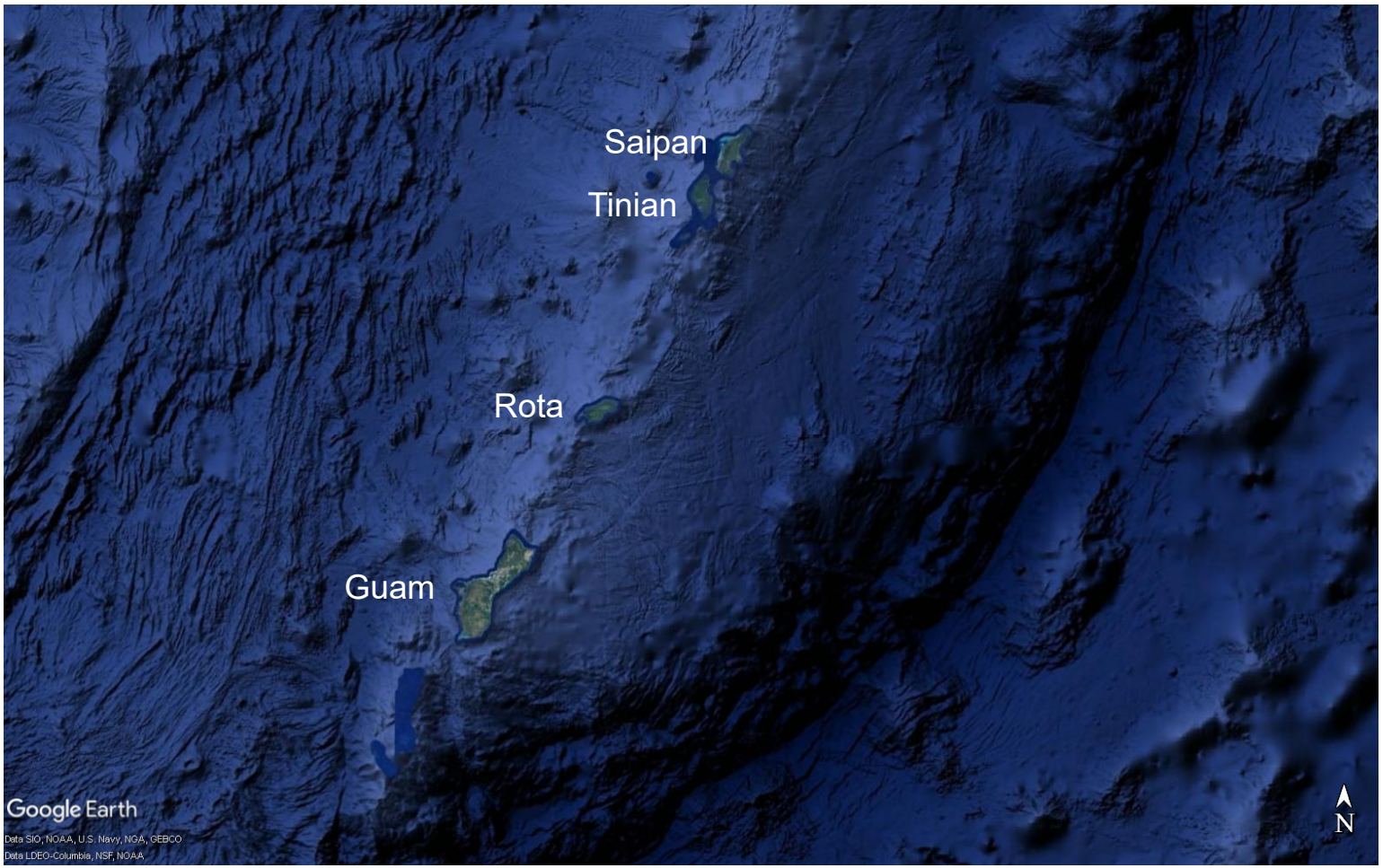


# Seismicity: 1800-Present, M ≥ 5.0, H ≤ 100 km



# American Samoa - Vulnerability

# Guam and CNMI - Populated Islands



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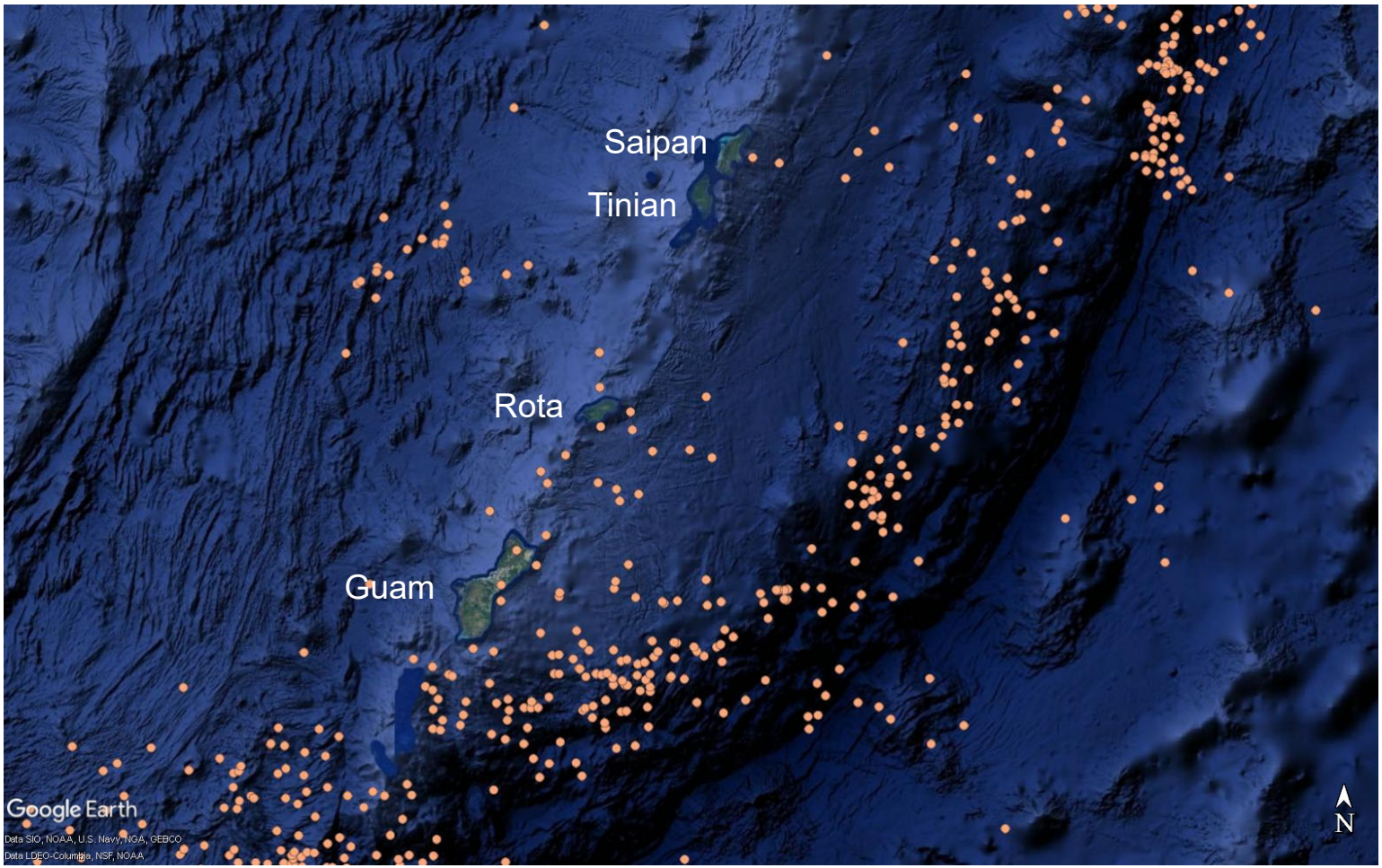
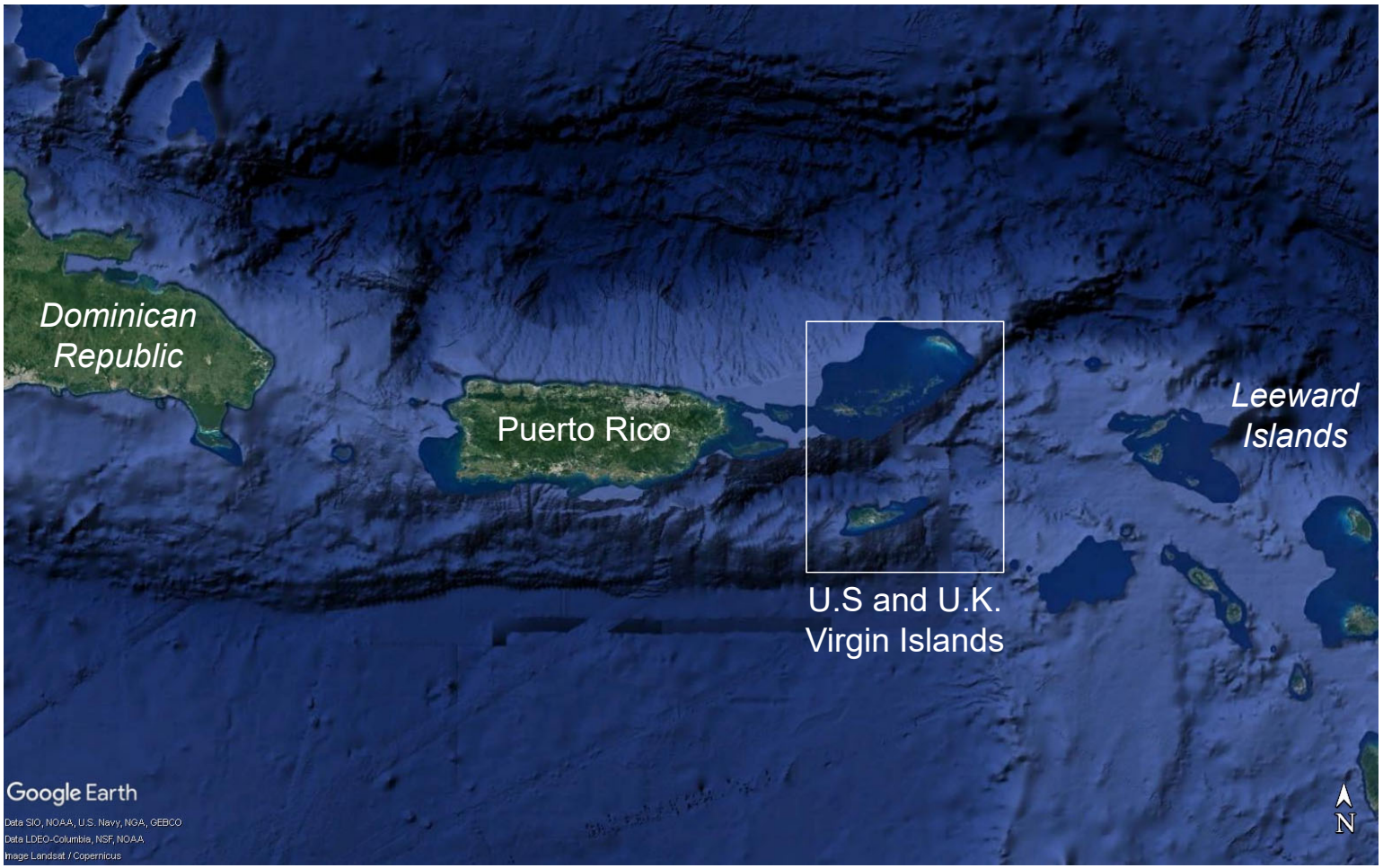


# Guam and CNMI - Vulnerability

# Puerto Rico and the Virgin Islands



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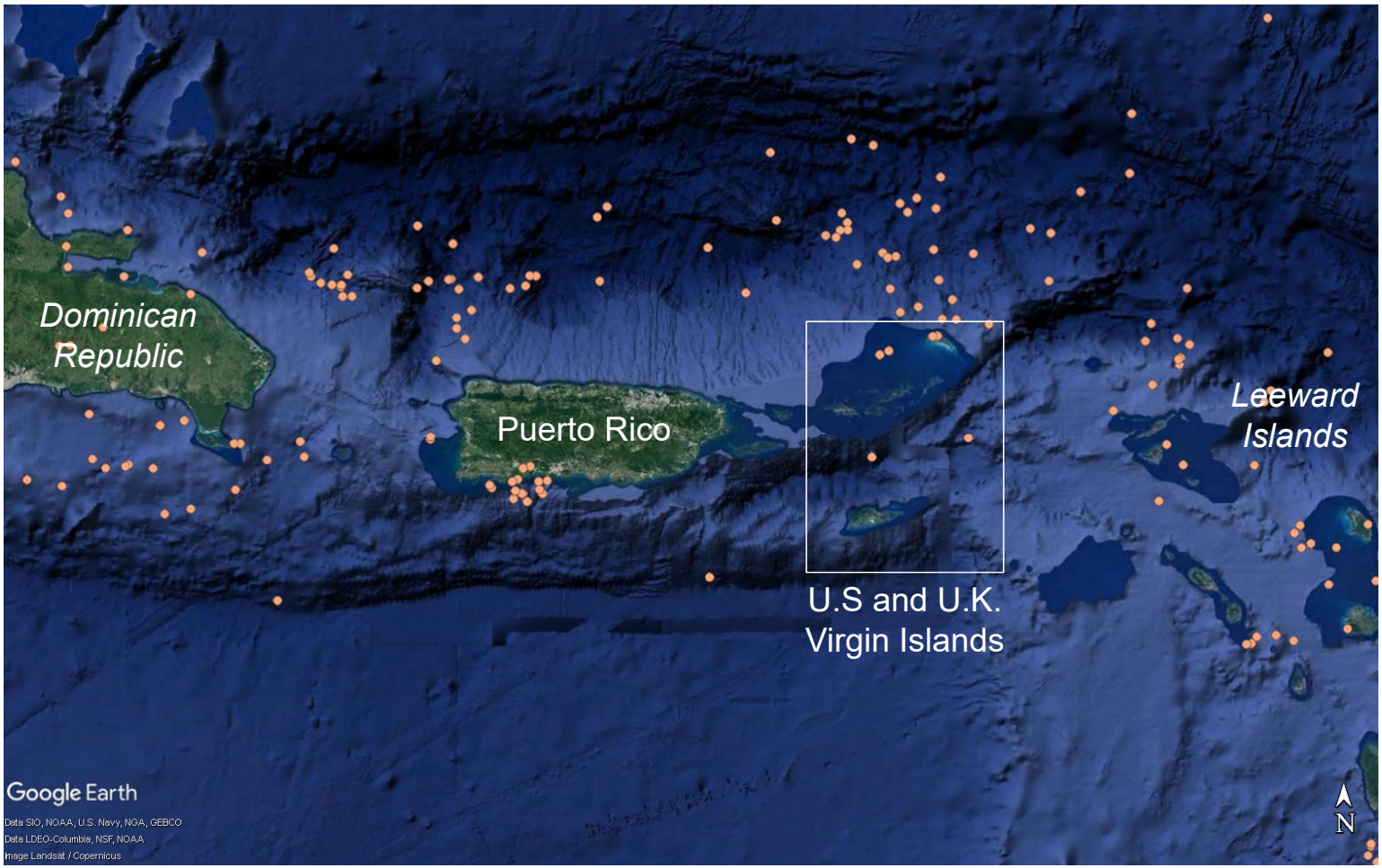


# Puerto Rico & Virgin Islands - Vulnerability

St. Thomas Harbor, U.S. Virgin Islands

# Overview of Presentation

- **Tsunami Warning – The Basic Steps**
- **Products**
  - Text Products
  - Graphical and Other Products
- **Staging - The Timeline**

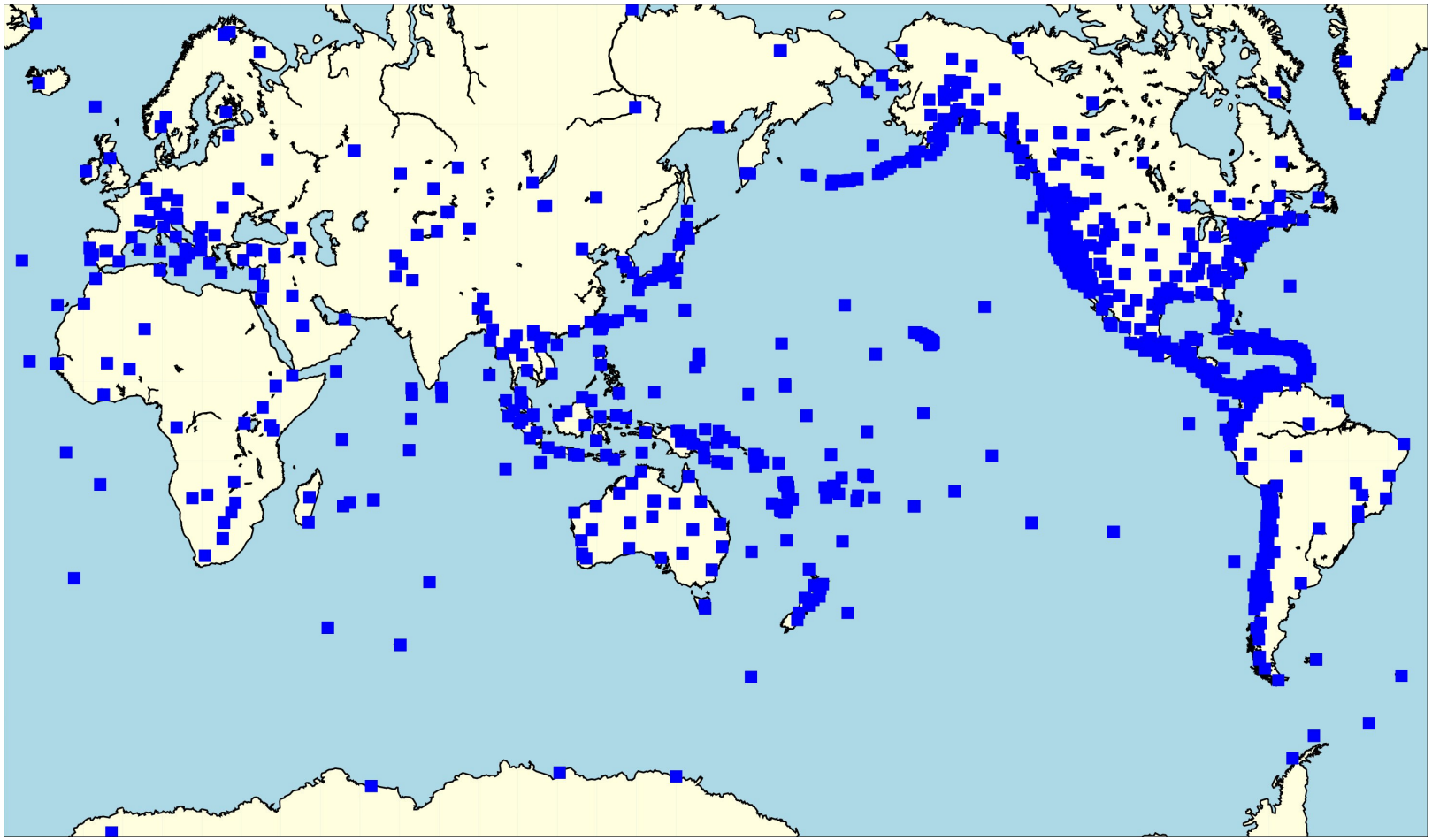
**REFERENCE:** User's Guide for the Pacific Tsunami Warning Center Enhanced Products for the Tsunami and other Coastal Hazards Warning System for the Caribbean and Adjacent Regions (CARIBE-EWS). IOC Technical Series No 135. UNESCO/IOC 2017

# Tsunami Warning - The Basic Steps

*All steps need to be rapid, accurate, and reliable*

1. **Earthquake Detection and Evaluation (within a few minutes)**
   - Alarms ring based on computer detection of seismic signals
   - Automatic - Interactive determination of the earthquake's location, depth, and magnitude (2-10 minutes)
   - WCMT provides the earthquake mechanism (15-25 minutes) and a more accurate magnitude

# Seismic Network Monitored by TWCs



# Tsunami Warning - The Basic Steps

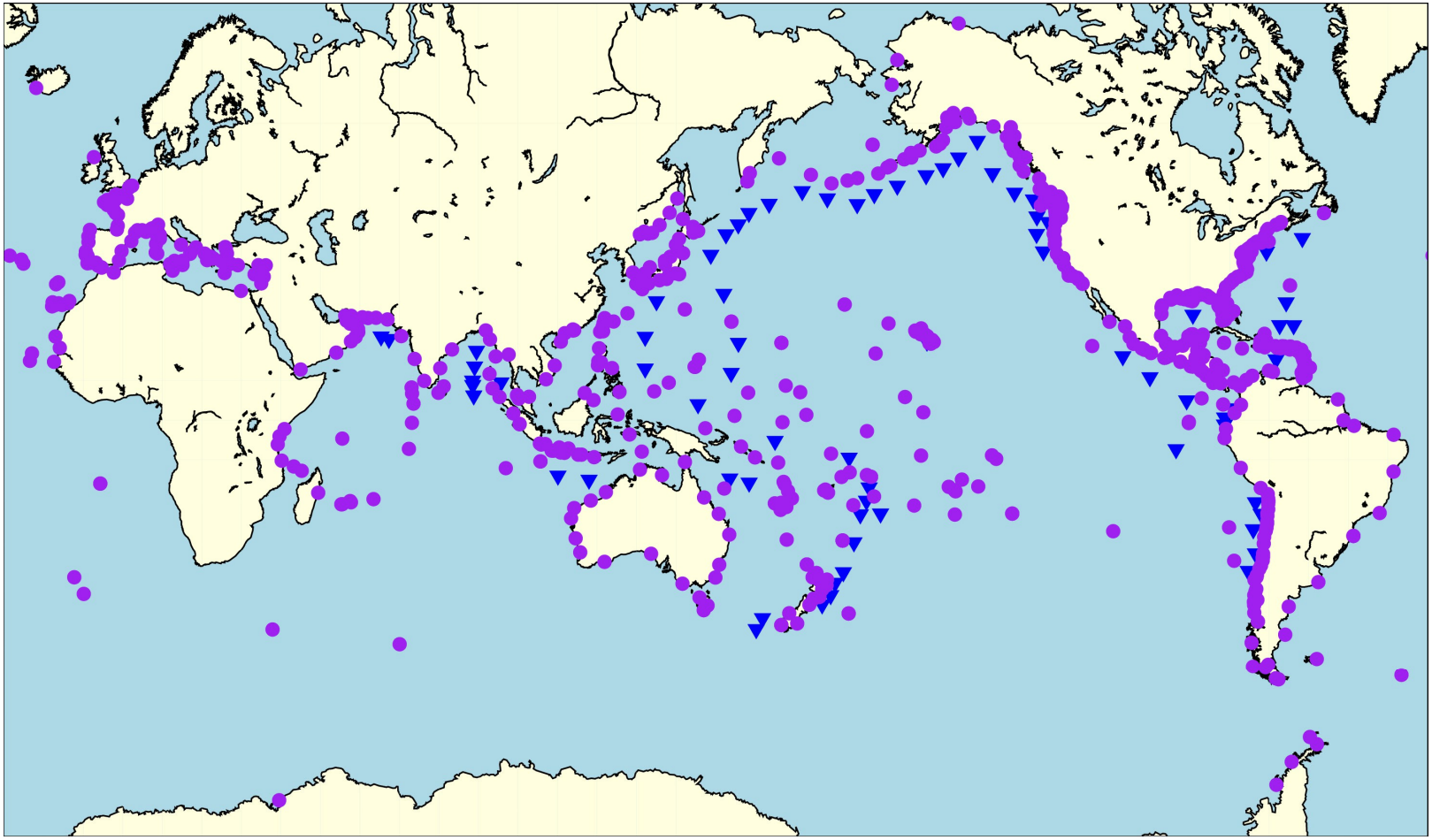
*All steps need to be rapid, accurate, and reliable*

1. **Earthquake Detection and Evaluation (within a few minutes)**
2. **Tsunami Wave Detection and Measurement (within the first hour or two)**
   - Was a tsunami generated or not?
   - Compare waveforms to RIFT, SIFT, ATFM forecasts
   - DART waveform observations constrain SIFT forecast

# Sea Level Network Monitored by TWCs

Purple Dots Are Coastal Stations

Blue Triangles Are Deep-Ocean Stations



# Tsunami Warning - The Basic Steps

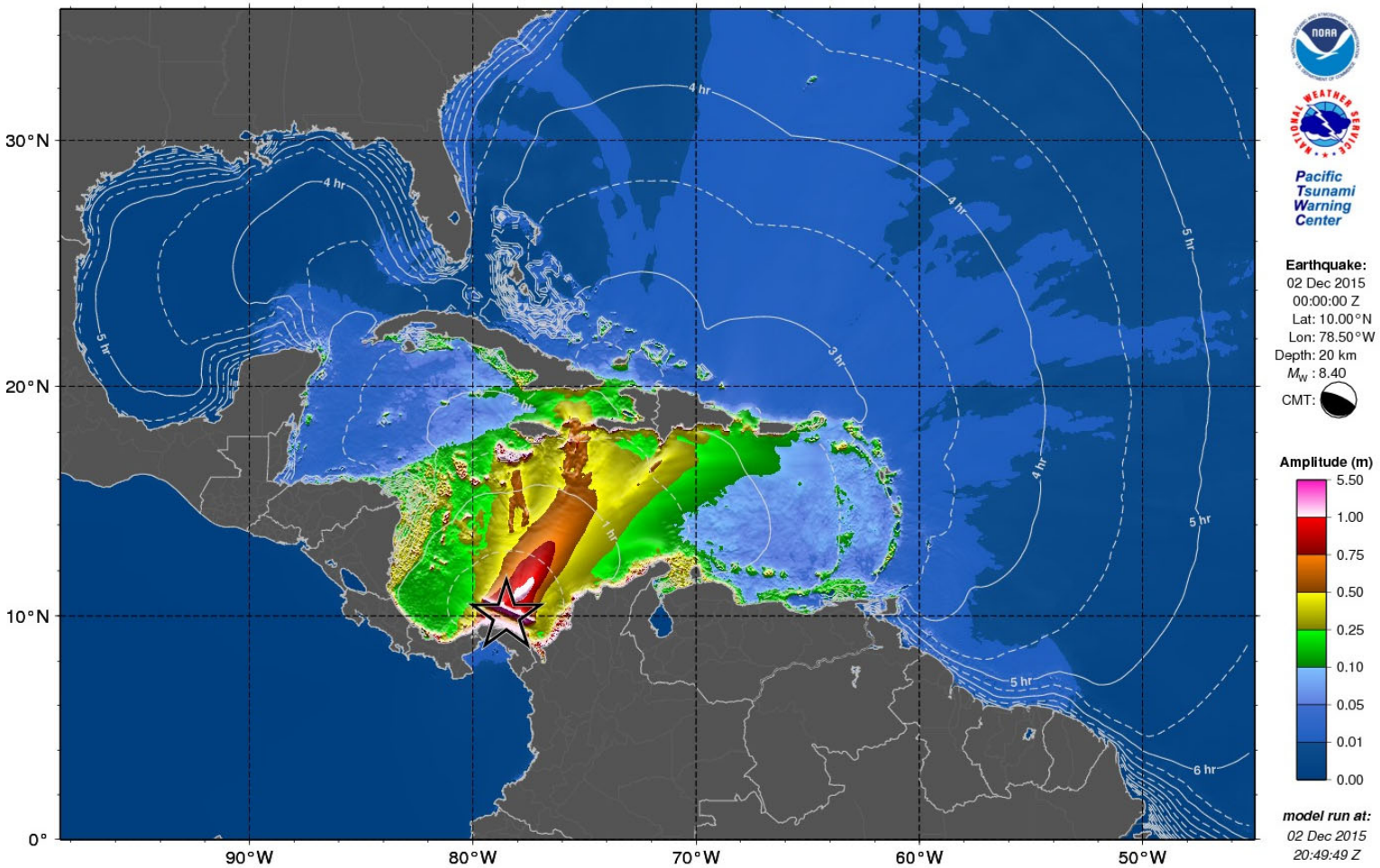
*All steps need to be rapid, accurate, and reliable*

1. **Earthquake Detection and Evaluation (within a few minutes)**
2. **Tsunami Wave Detection and Measurement (within the first hour or two)**
3. **Tsunami Forecast and Alert Level decisions based on the earthquake parameters, tsunami wave measurements, historical data, and numerical models**
   - Pre-determined criteria for initial message
   - Constrained model guidance for later messages

# Initial Product Criteria – Pre-Determined

| PRODUCT TYPE | LOCAL EARTHQUAKE | DISTANT EARTHQUAKE |
|---|---|---|
| Information Statement | Mw: 6.0 – 9.9 Deep or Inland | |
| Information Statement | Mw: 6.0 – 7.0 Shallow, Undersea | |
| Information Statement | | |
| Tsunami Watch | Mw: 7.1 – 7.5 Shallow, Undersea | |
| Tsunami Advisory | Mw: 7.6 – 7.8 Shallow, Undersea | |

# RIFT Tsunami Model – Based on WCMT



# Tsunami Warning - The Basic Steps

*All steps need to be rapid, accurate, and reliable*

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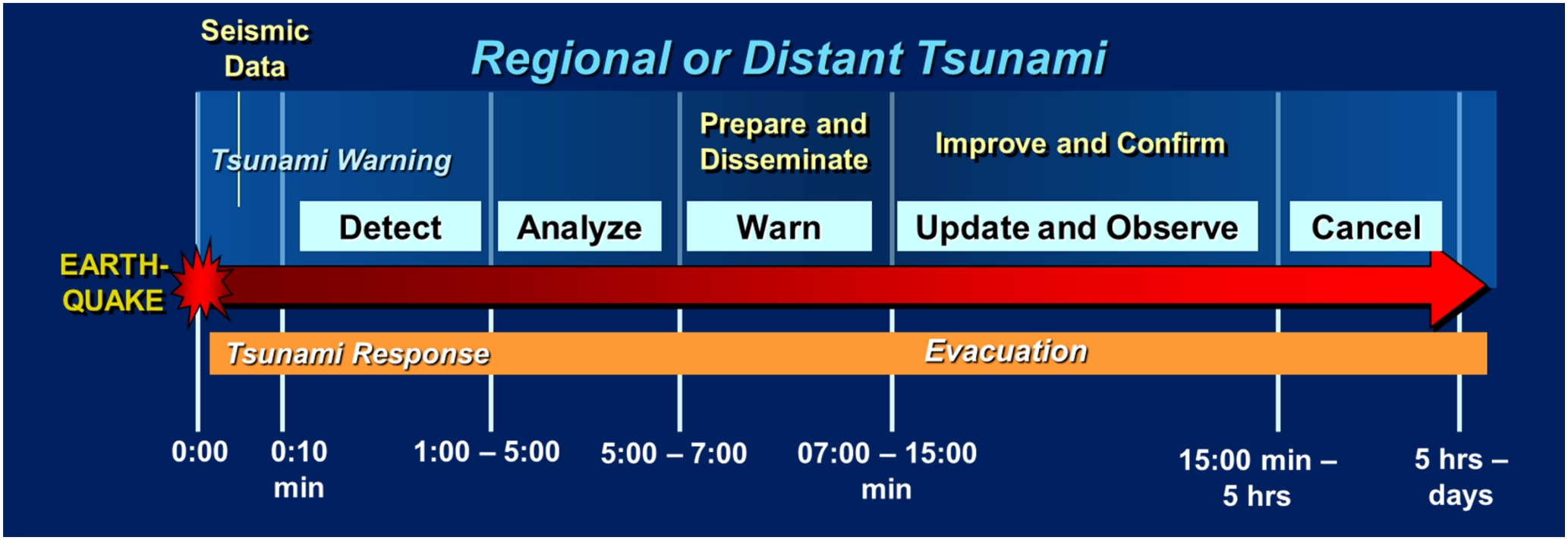
3. **Tsunami Forecast and Alert Level Decisions based on the earthquake parameters, tsunami wave measurements, historical data, and numerical models**
   - Pre-determined criteria for initial message
   - Constrained model guidance for later messages
4. **Product Generation and Dissemination**

# Product Types and Meaning

- **Tsunami Information Statements**
  - A large earthquake occurred and there is no tsunami threat, or there is a possible tsunami threat but premature to declare an alert level
- **Tsunami Alerting Messages (Initial, Supplements, Cancel)**
  - **Tsunami Watch** - there is a credible tsunami threat still being evaluated
  - **Tsunami Advisory** - forecast tsunami amplitudes between 0.3 to 1 meters that is mostly a marine hazard
  - **Tsunami Warning** - forecast tsunami amplitudes exceeding 1 meter that will flood coastlines
  - **Extreme Tsunami Warning** (Hawaii Only) – forecast tsunami inundation that exceeds the normal tsunami evacuation zone

# Typical Timeline

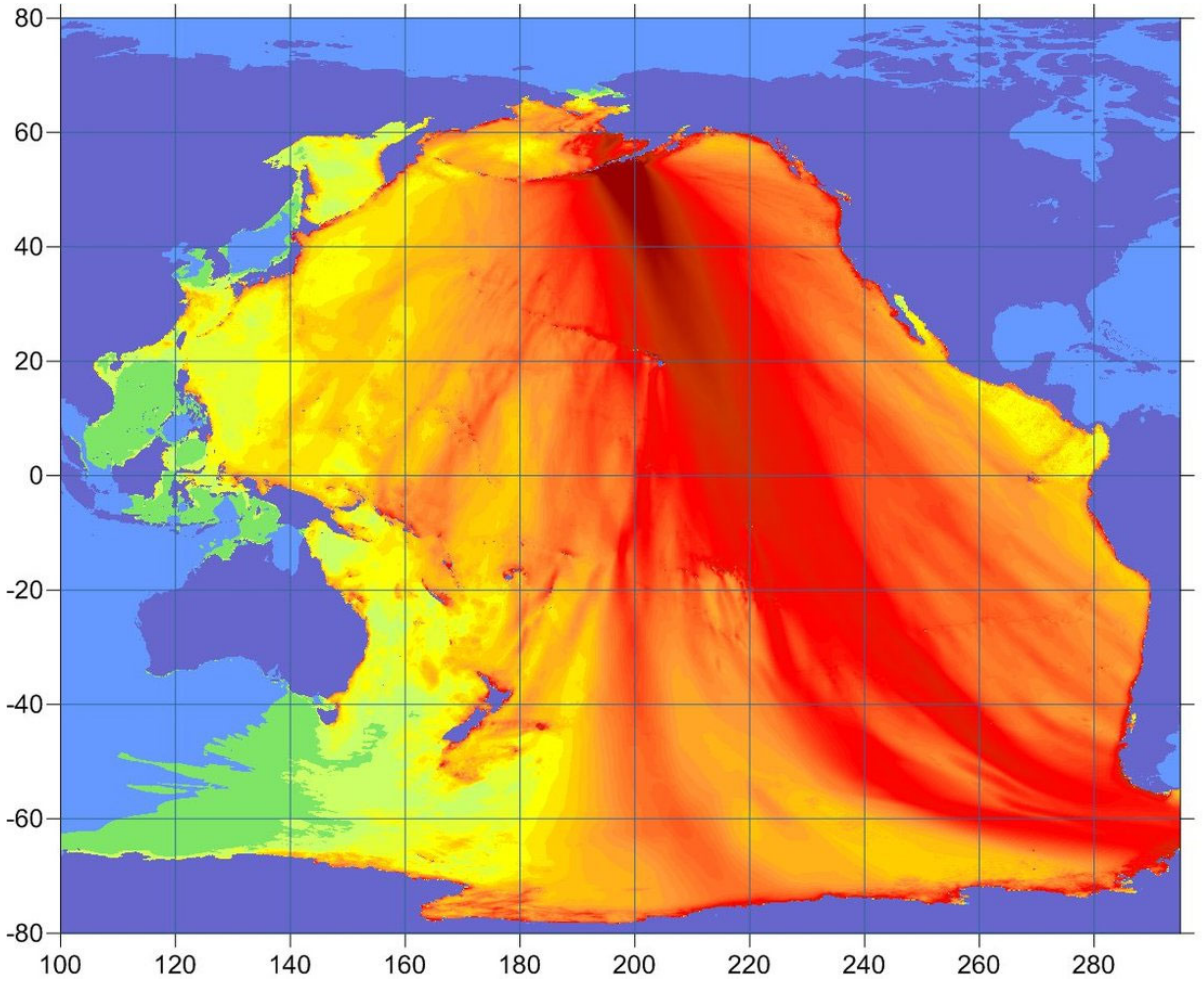


# Tools for Forecasting and Alerts

- Historical Data (but very limited and poorly characterized)
- Supporting Real-Time Data
  - Preliminary earthquake location, depth and magnitude (2-10 min)
  - Earthquake mechanism (15-30 min)
  - Deep-ocean (DART) sea level gauge readings of tsunami waves
  - Coastal gauge readings of tsunami waves
- SIFT, RIFT, and ATFM Numerical Tsunami Models
  - Three different ways to estimate the source
  - Three different ways to estimate the propagation
  - Three different ways to estimate coastal impacts
- Sometimes all methods give similar results (easy call)
- Sometimes the methods give different results (judgement required)

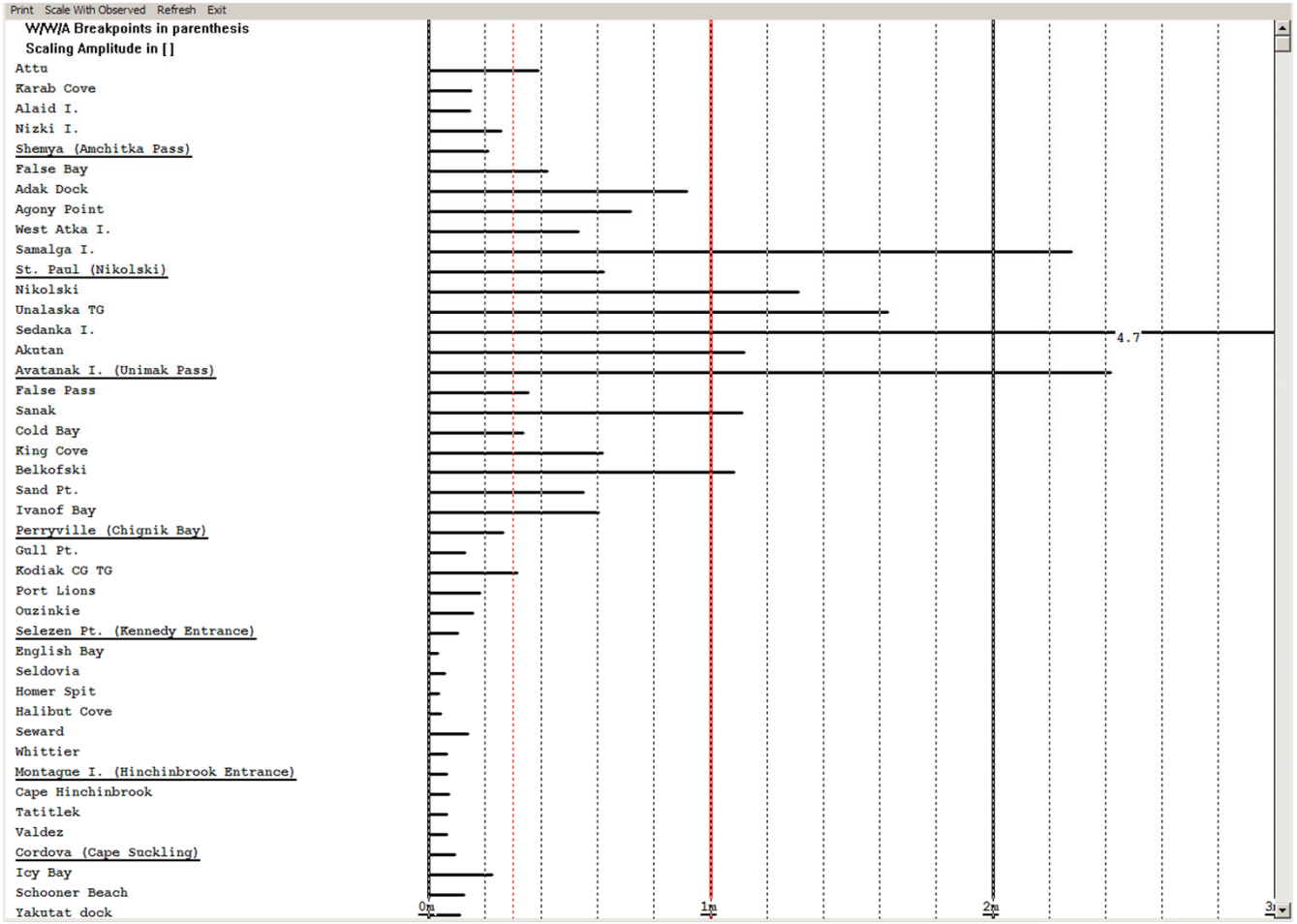
# ATFM Propagation Forecast

Pre-computed scenarios similar to the actual event, scaled with observations.



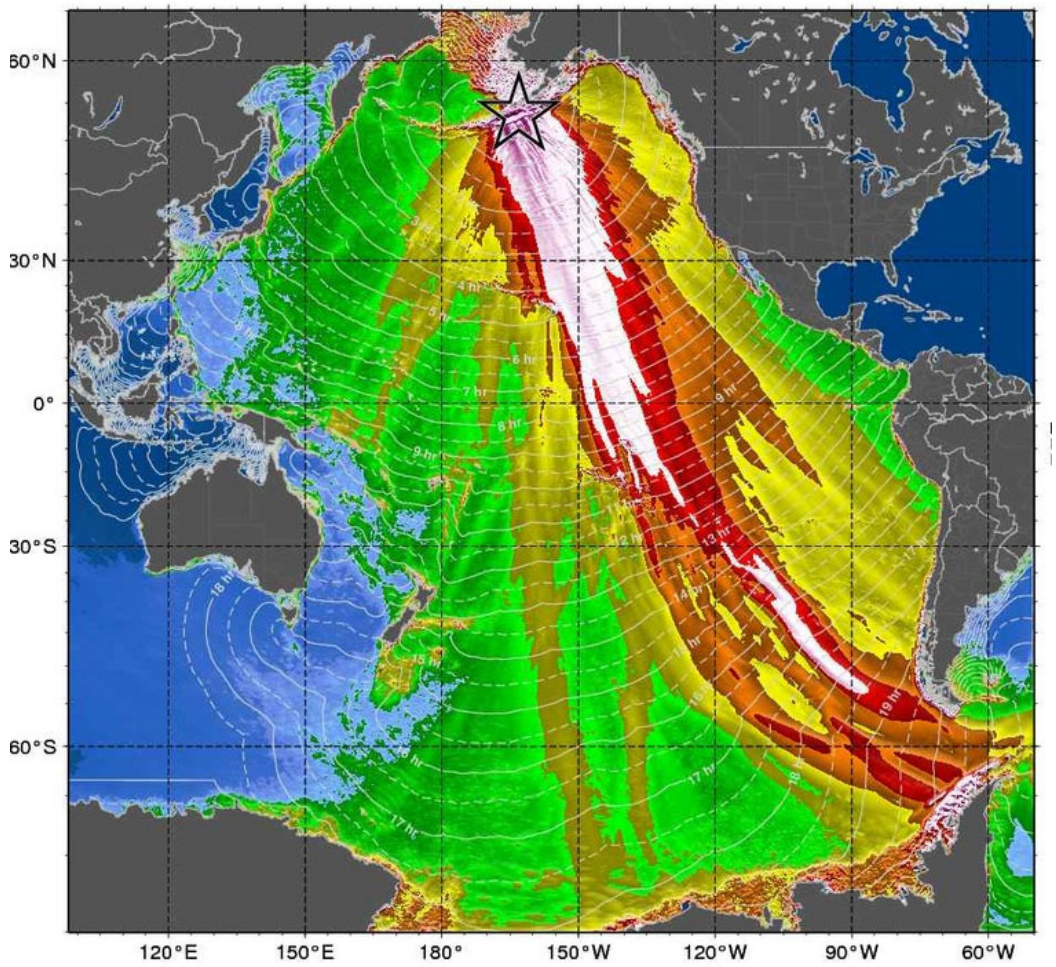
# ATFM Coastal Forecast

Maximum forecast amplitudes given at select locations based on pre-run scenarios scaled with observations. The pre-run scenarios include nested grids to take the tsunami waves from the deep-ocean to the coast at those locations.



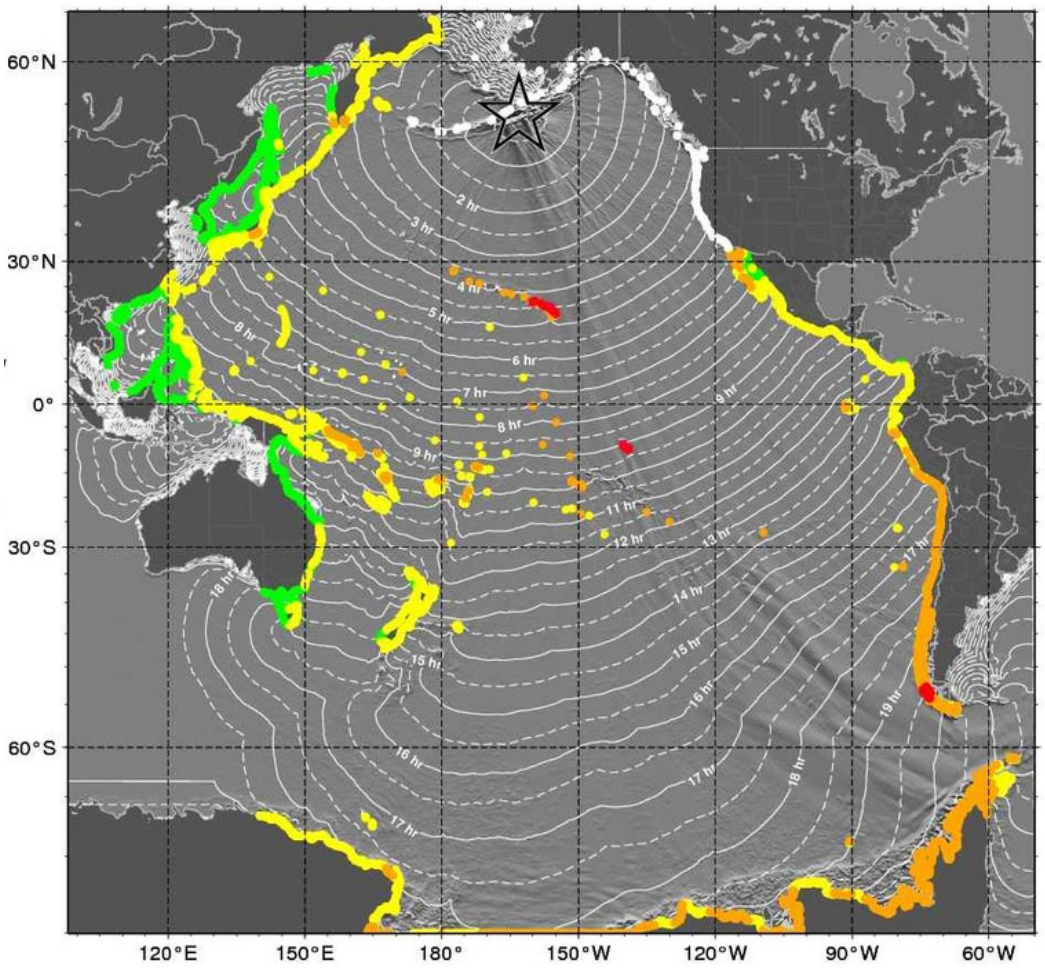
# RIFT Propagation Forecast

Forecast is computed in real time based upon the earthquake mechanism (the direction and dip of the fault and the direction and amount of slip across the fault).

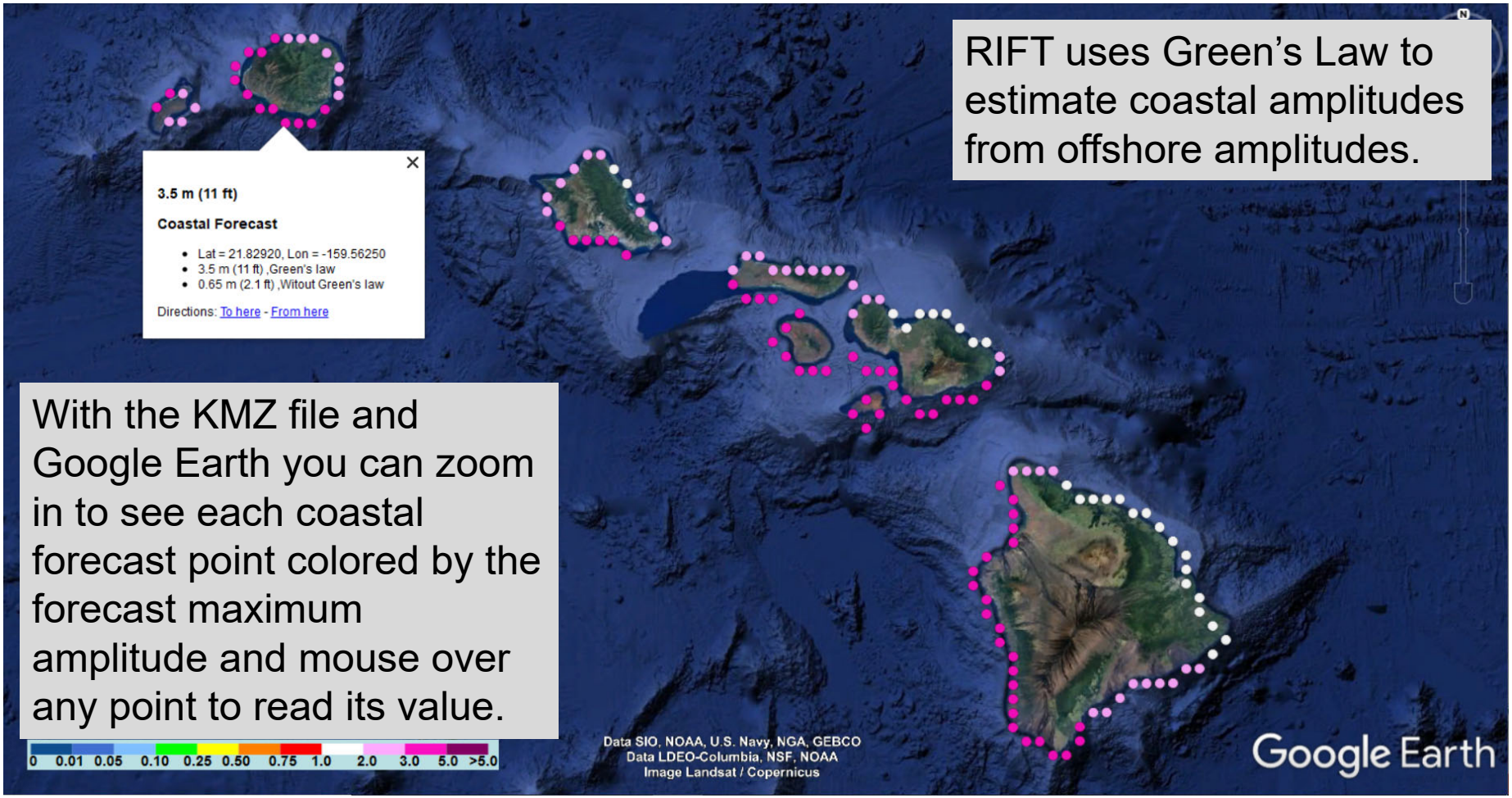


# RIFT Coastal Forecast

Coastal forecast amplitudes are estimated from the deep-ocean amplitudes of the propagation model using Green's Law. This method facilitates a comprehensive forecast for all coasts in the Pacific and Caribbean.

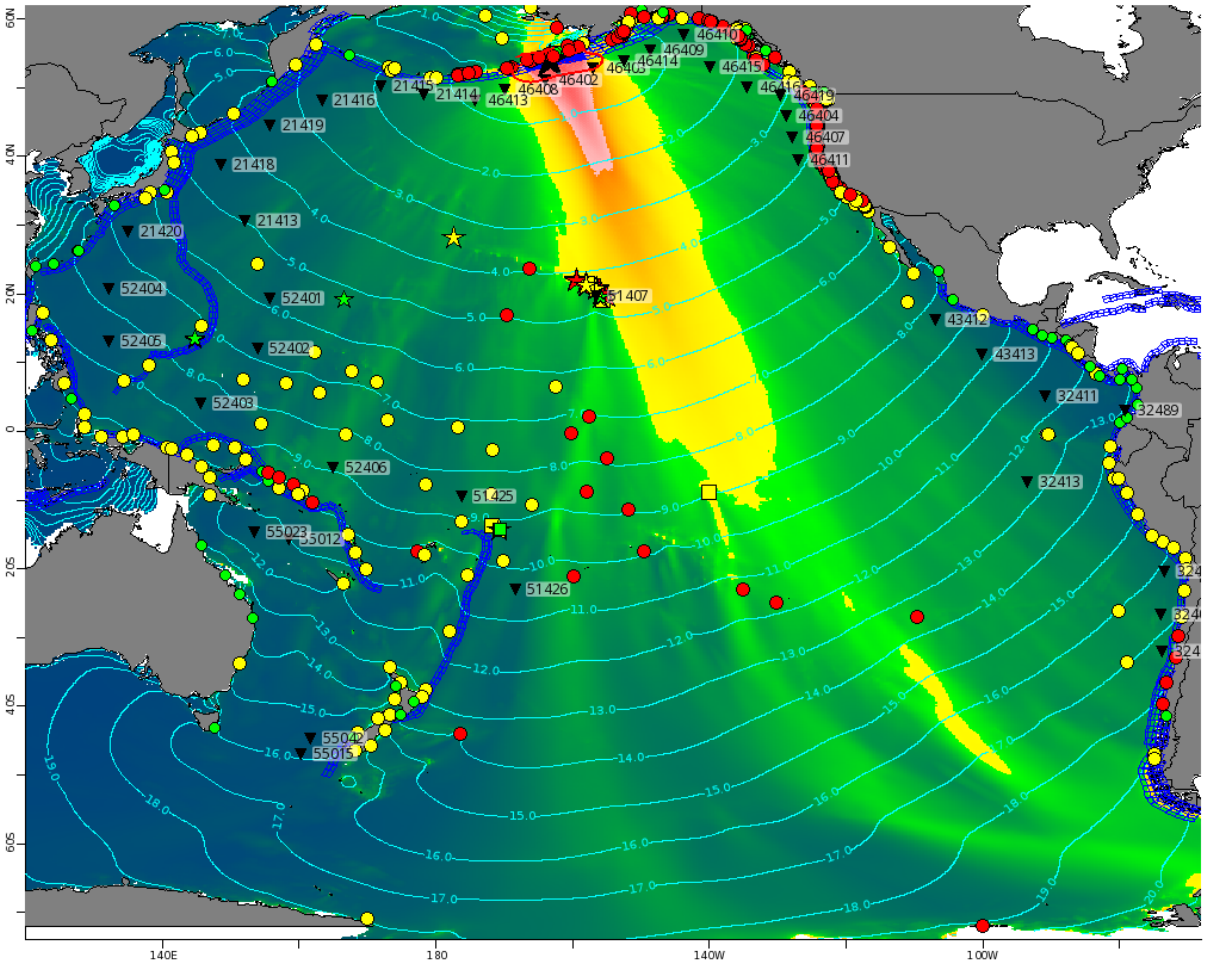


# RIFT Coastal Forecast – KMZ File



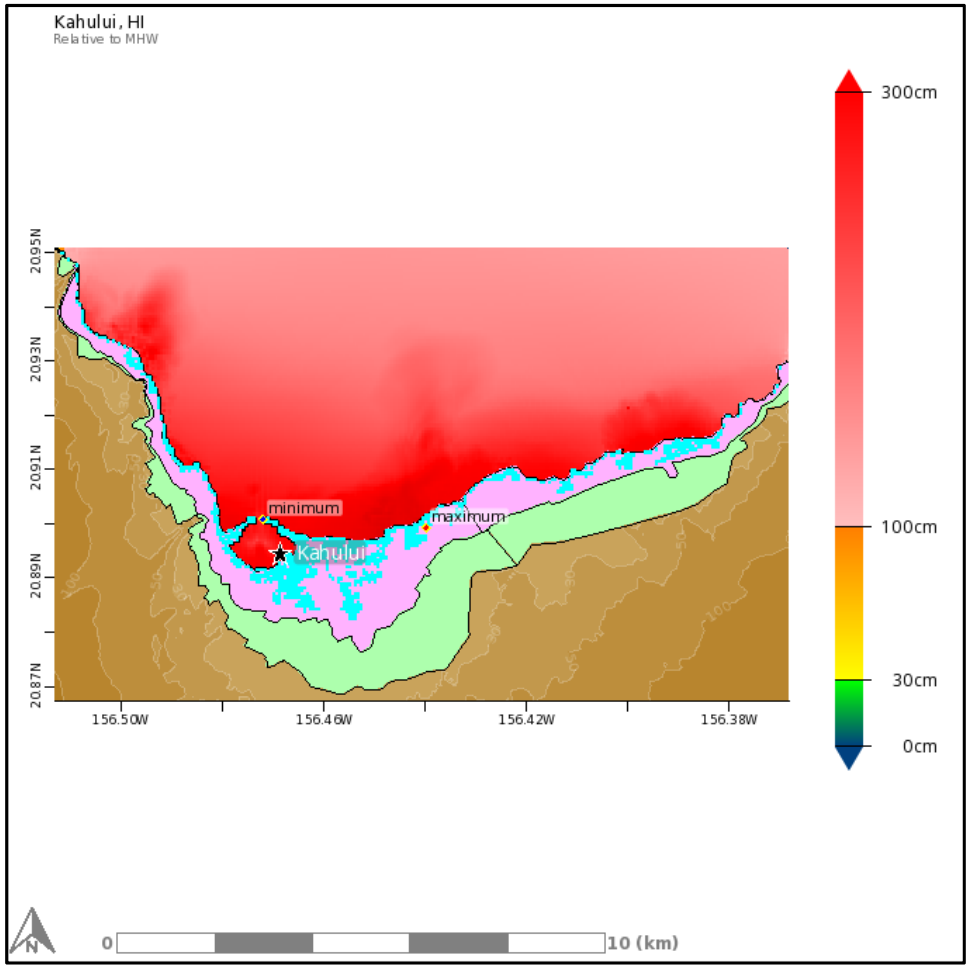
# SIFT Propagation Forecast

The SIFT propagation forecast is based on pre-run unit sources near the epicenter combined and scaled to match the signals observed on waveforms from the nearest DART gauges.



# SIFT Inundation Model - Kahului

SIFT inundation models are run in real time to estimate tsunami amplitudes and flooding along the coast.



# SIFT Inundation Models

| State or Territory | # | Where |
|---|---|---|
| Hawaii | 12 | Haliewa, Hanalei, Hilo, Honolulu, Kahului, Kawaihae, Keauhou, Kihei, Kailua-Kona, Lahaina, Nawiliwili, Pearl Harbor |
| American Samoa | 1 | Pago Pago |
| Guam / CNMI | 1 | Apra Harbor |
| Puerto Rico and Virgin Islands | 6 | Arecibo, Charlotte Amalie, Christiansted, Fajardo, Mayaguez, Ponce, San Juan |

# Ongoing Activities

- Exercises
  - CaribeWave21 – March 11, 2021
- Increase Collaboration, Coordination, Commonality and Consistency between 2 TWCs
  - Procedures
  - Products
  - For Backup
  - For Efficiency
- With the NOAA Pacific Marine Environmental Laboratory (PMEL)
  - Using GNSS (GPS) data to help characterize seafloor deformation
  - Upgrades to SIFT model (smaller unit sources computed in real time)
- Convert “Advisory” to something else (HazSimp Project)
- Subdivide Island Coasts for Alerts (open a dialogue) Group
- Staying COVID-free and Staying Operational

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# Thank You