UNESCO/IOC – NOAA ITIC Training Program in Hawaii (ITP-TEWS Hawaii)
TSUNAMI EARLY WARNING SYSTEMS
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME
15-26 September 2025, Honolulu, Hawaii

Lessons Learned from past Tsunamis 1946, 1986, 1994, 2006

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No Common Sense for Tsunamis

- **Tsunamis are Not Common - Often 1st Time**
  - For individuals at risk
  - For government officials that must respond (incl. TWCs)
- **Tsunamis Can Be Learned From**
  - Tsunami wave characteristics from physics / models
  - Human response behavior from social science
- **Each Tsunami is Unique**
- **Warning / Response Planning Needs Imagination.**
  - What situations might occur?
  - How to prepare/respond based on best science?
  - Procedures recorded in SOPs
- **Learn from the Past to Improve Future Response**

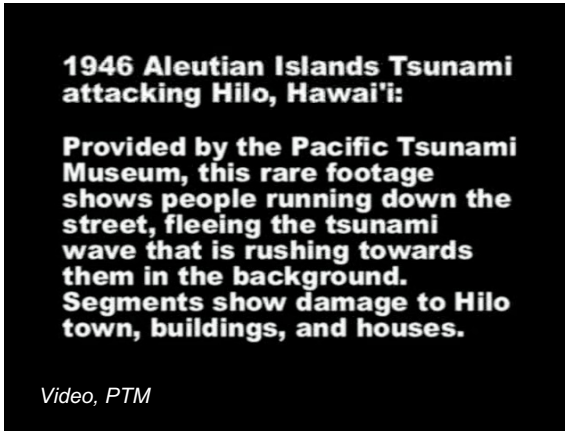
Aleutian Island, M8.0, 1 April 1946

- **Aleutians Island tsunami hit Hawaii**
  - Arrived just before school start
  - No warning system, killed 158 Statewide

Lessons Learned

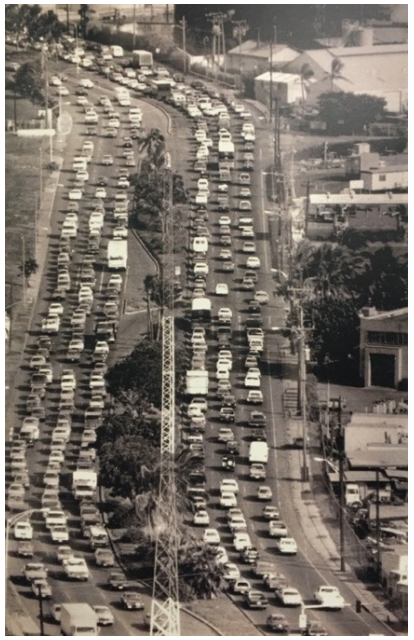
- *US Seismic Sea Wave Warning System established & operational 1949 (now PTWC)*
- *However, 1952, 1957, 1960 tsunamis caused damage and deaths (could have been much worse)*

1 April 1946, Hilo



Aleutian Island, M8.0, 7 May 1986

- **Evacuation Problems**
  - State government sent everyone home
  - Massive traffic jam on coast at time of tsunami arrival
- **False Alarms**
  - 3 of 4 evacuations in Hawaii have been for non-destructive tsunamis



Lessons Learned

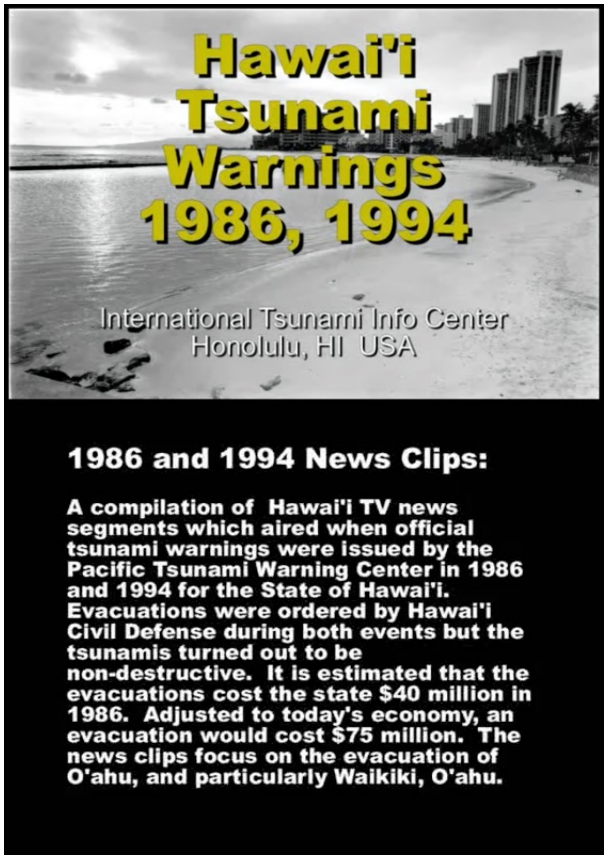
- *New instructions*
  - *Stay put unless in hazard area (evac zone)*
  - *Walk to safety*
- *Avoid term "false alarm" – tsunami did arrive*
  - *Call it a "non-destructive tsunami"*
  - *Educate media and public about limitations*

Kuril Islands, M8.3 4 October 1994

- **Hawaii Evacuation Problems**
  - Schools closed due to tsunami warning
  - Sunny day and surf was coming up
  - Several hundred surfers in the water at time of tsunami arrival

Lessons Learned

- *Increase awareness – target surfers*
- *Ocean / Beach Safety officials trained (lifeguards)*



https://www.youtube.com/watch?v=TB44LMX6xgk

Hawaii, M6.7, 15 October 2006

- **Shaking felt in Honolulu, but tsunami warning threshold not reached.**
- **Triggered Power shutoff (black-out for hours-days, including Waikiki**

Lessons Learned

- ***Public notification that no tsunami generated*** for earthquakes below triggering thresholds for warning. PTWC special product
- **Family preparedness plan important to have** - *public communications (phone), electricity, and other utilities may be disabled for hours/days even for non-destructive events.*

Kamchatka, M8.8, 29 July 2025 - Highlights

- **6th largest earthquake in History.**
  Near to 1952 M9.0 earthquake that generated a destructive Pacific-wide tsunami.
- **1st Pacific-wide tsunami since 2011 M9.1 Great East Japan earthquake and tsunami**
- **PTWS TSP (PTWC) issued 1st Threat Message 10 min after Earthquake (24 bulletins for 26 hrs until waves hit Chile). NWPTAC issued 15 bulletins for 20 hrs.**
- **National Tsunami Warning Centres issued alerts prompting localized evacuations**
  - **Warnings: Russia, Japan, USA (Hawaii, California, Alaska), Pacific Island Countries (French Polyn, Cook Isl, Tonga, PNG), S America (Ecuador, Chile)**
- **Tsunami monitoring by DART, coastal sea level stations (IOC SLMF, PTWC Tide Tool)**
  - **5 DART systems NW Pacific triggered => calibrate forecasts – largest 0.9 m ampl**
  - **> 100 measurements on coastal gauges – largest 1.74 m, Kahalui, Maui, Hawaii**
- **Earthquake: thrust/reverse faulting, but rupture was complex.**
  Initial earthquake M8.0 upgraded to M8.8, updating tsunami forecast.
  Later processing (finite fault solution) showed 2 bursts of rupture.
- Post Post-Event Brief, 13 August 2025 (https://oceanexpert.org/event/4835)

Hawaii's event

- Pacific Tsunami Warning Center
- Hawaii State Emergency Management
- Honolulu Dept of Emergency Management

State Tsunami Advisor Laura Kong

Discussion – Yes, No, Why, Next time?

1. **Information from TWC:** Adequate, Timely, Reliable?
2. **Alerting:** Timely, Received, Ubiquitous? Understood, Actionable?
3. **Evacuation**
   a. **Tsunami Hazard Area** - 2 zones, as depicted online tools and signage in Honolulu, caused some confusion (normal / historical vs GAR / extreme) – solutions?
   b. **Execution**
      i. Land Evacuation (urban centers, islands) - traffic jams after siren sounding, after State / County let workers go (stores closed?). But at wave arrival, streets clear - how to improve?
      ii. Marine - commercial, state, county – procedures, compliance?
      iii. Air - commercial, other – procedures, airline compliance?

Thank You
Mahalo

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