

Tsunami Warning Systems



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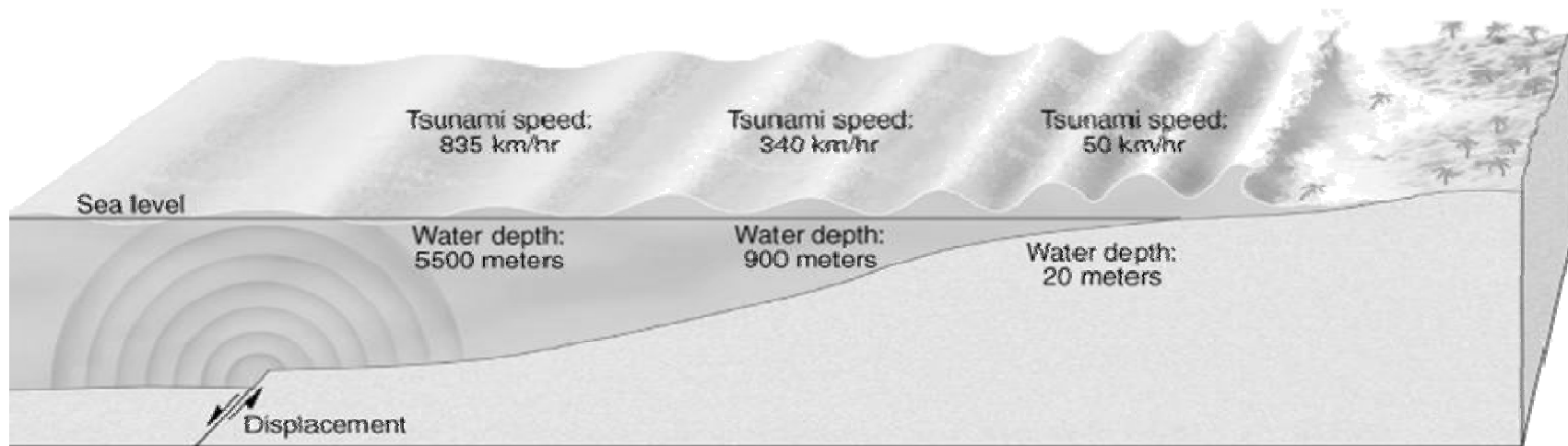
Feel, See, or Hear



Tsunami Sources

- ❖ **Earthquakes (local and distant)**
- ❖ **Landslides and Slumps**
- ❖ **Combination Earthquake and Slumps**
- ❖ **Volcanoes**
- ❖ **Meteors**
- ❖ **Other (explosions, icebergs, glaciers, etc.)**

What is a Tsunami?



**A tsunami is not a single wave, but a series of waves.
Stay out of danger until an “ALL CLEAR” is issued
by a competent authority.**

Natural Warning Signs

A strong earthquake felt in a low-lying coastal area is a natural warning of immediate danger. Keep calm and quickly move to higher ground away from the coast.



Approaching tsunamis are sometimes heralded by noticeable rise or fall of coastal waters. This is nature's tsunami warning and should be heeded.

Tsunami Tips



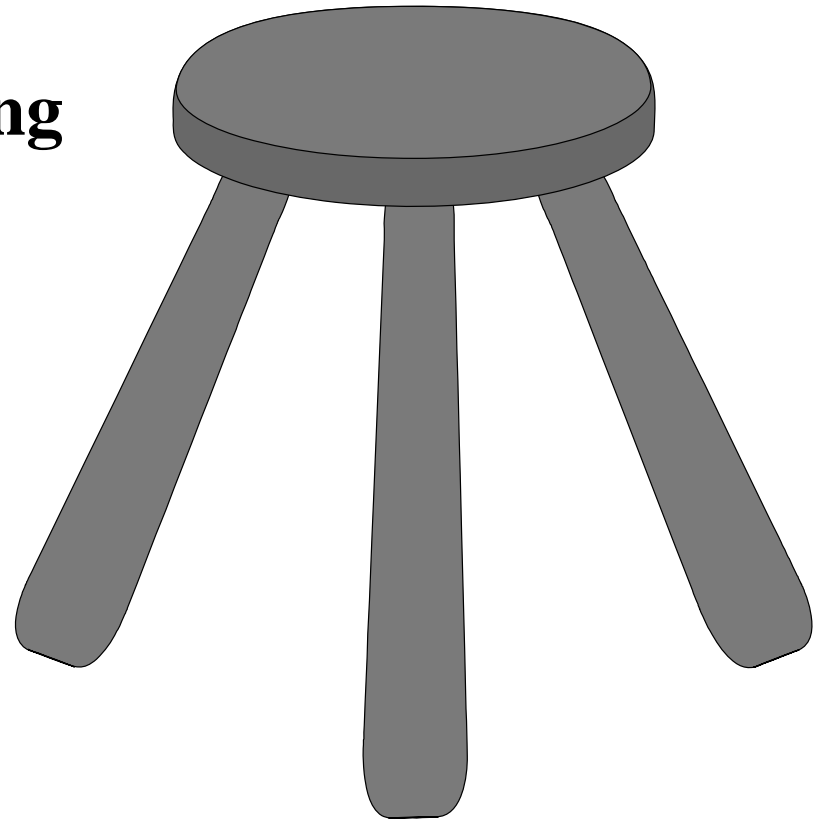
Never go down to the beach to watch for a tsunami! WHEN YOU CAN SEE THE WAVE, YOU ARE TOO CLOSE TO ESCAPE! Tsunamis can move faster than a person can run.

Approaching large tsunamis are usually accompanied by a loud roar that sounds like a train or aircraft. If a tsunami arrives at night when you cannot see the ocean, this is also nature's tsunami warning and should be heeded.

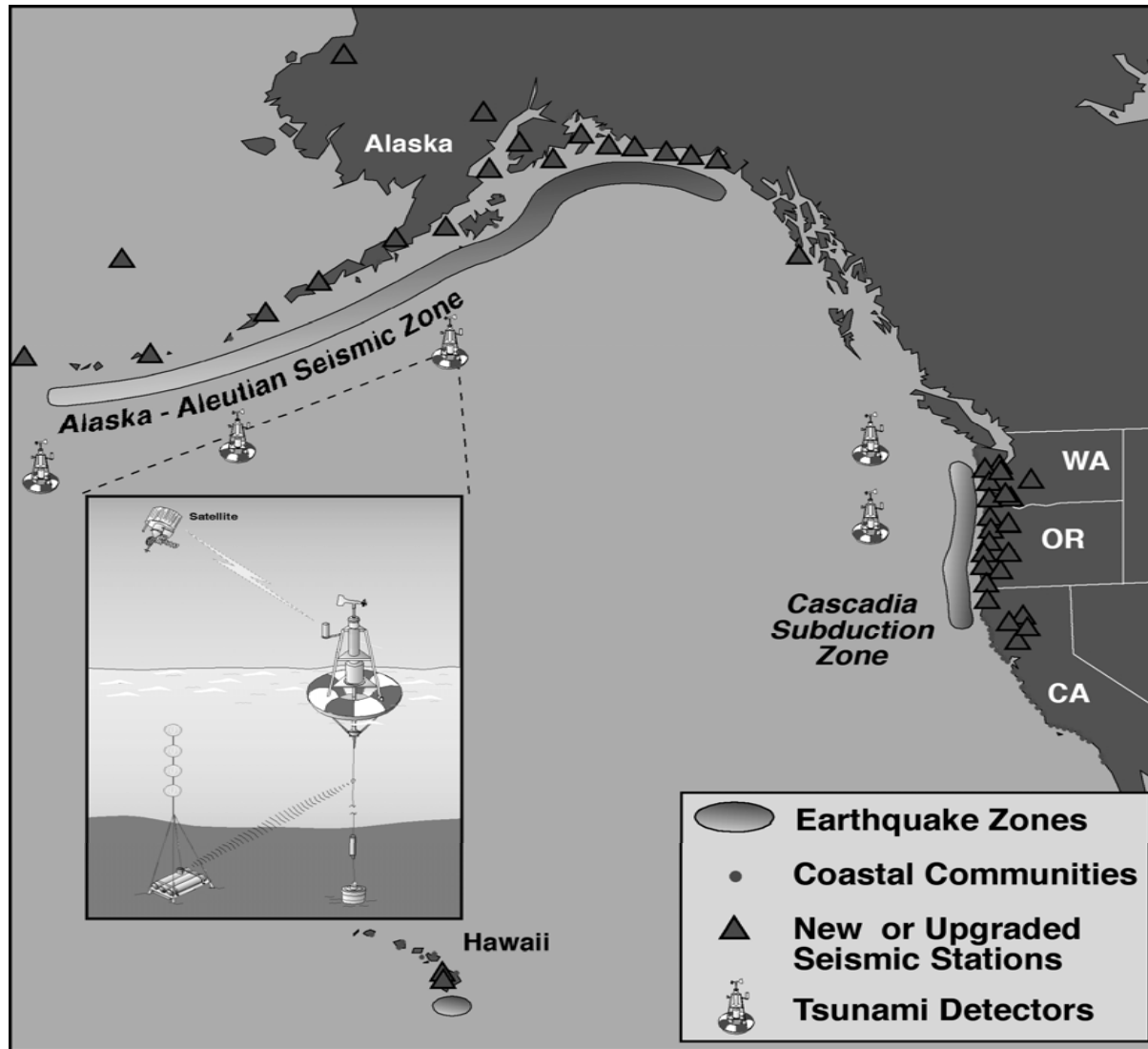


The Warning System

- ❖ - Detection / Warning
- ❖ - Dissemination
- ❖ - Response



Detection



Tsunami
Established real-time, deep ocean, tsunami detection array of 6 buoys

Seismic
Installed 53 Broadband Seismometers

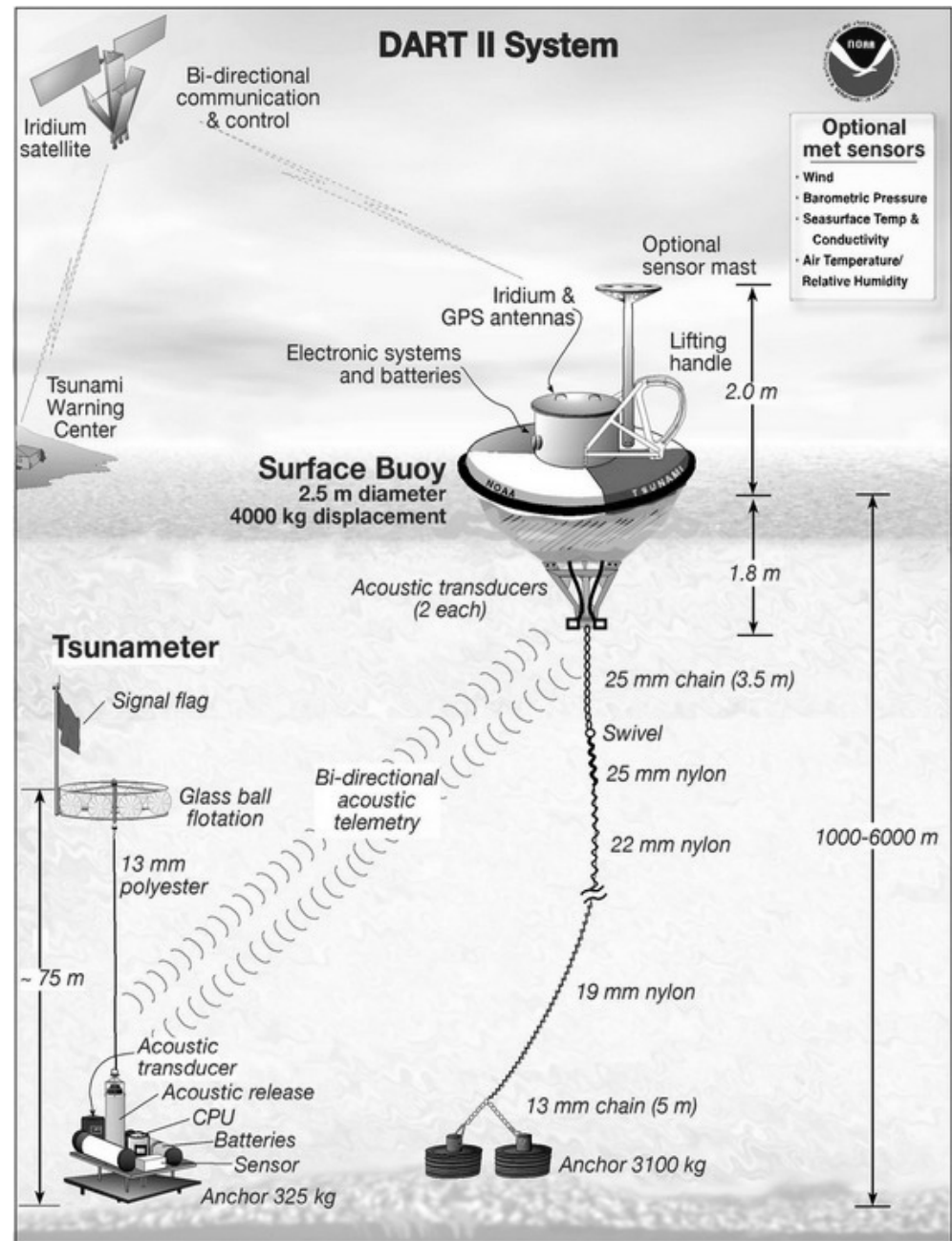
DART Concept

BPR measures small changes in pressure at the seafloor. Data sent acoustically to surface buoy, then via satellite to the Warning Centers.

❖ Normal transmissions: Hourly reporting of 15 minute data to confirm system readiness.

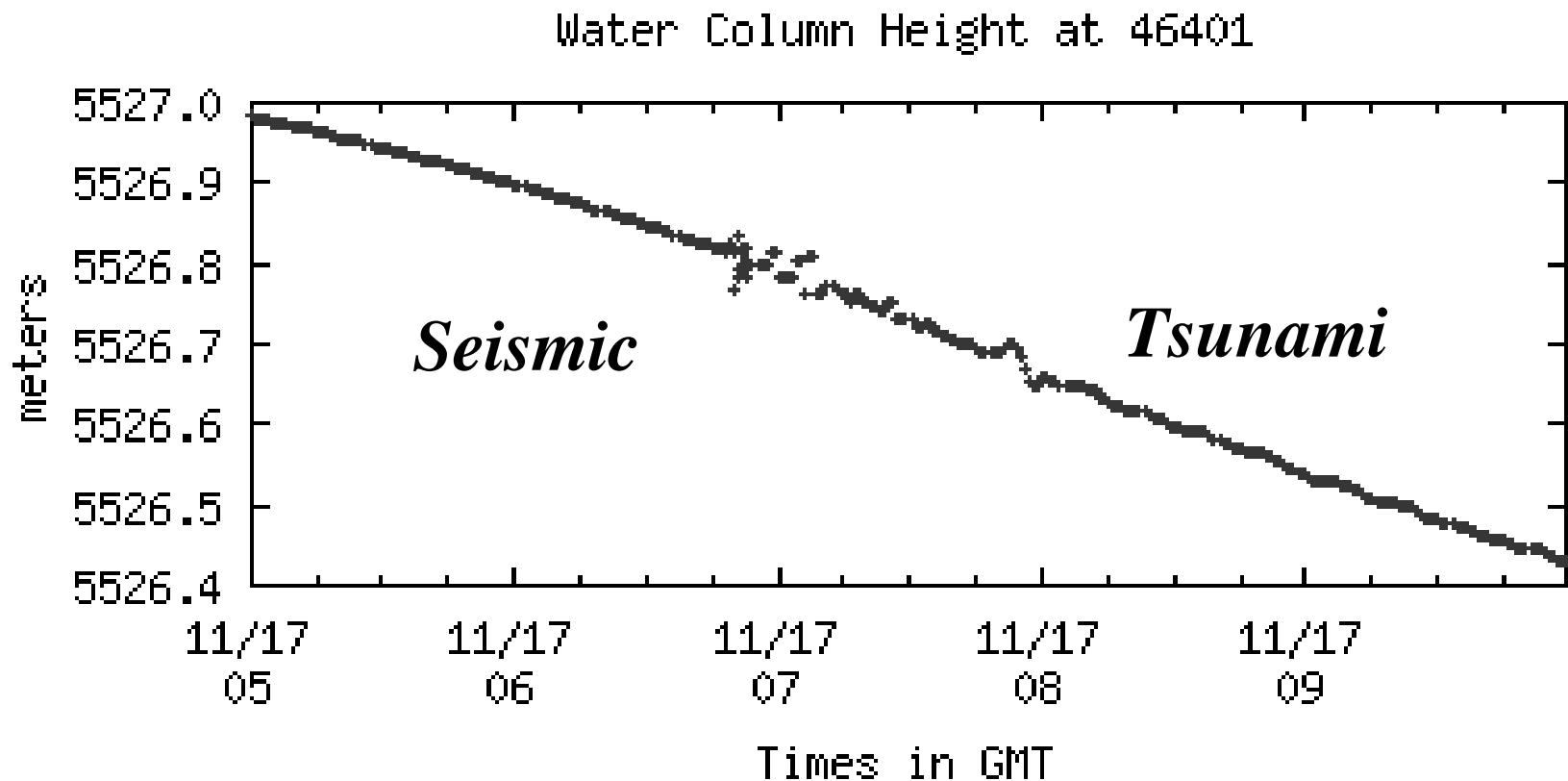
❖ Two Event Modes:

- Automatic: Triggered by seismic or tsunami wave
- Request: Warning Center triggers data stream

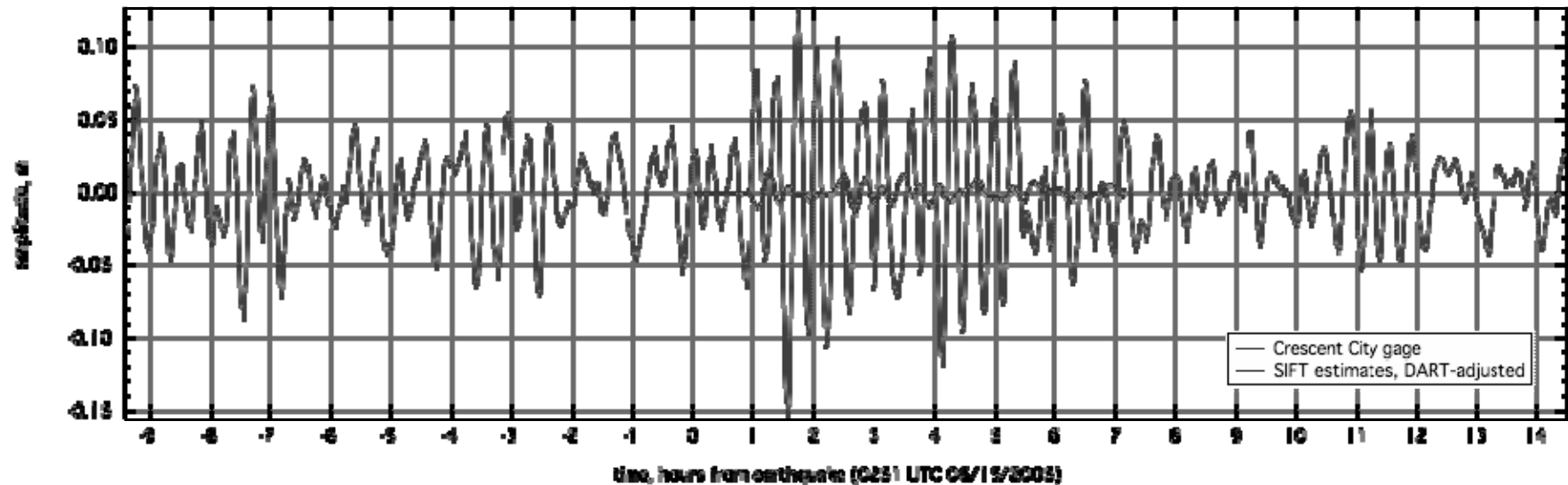


Animation

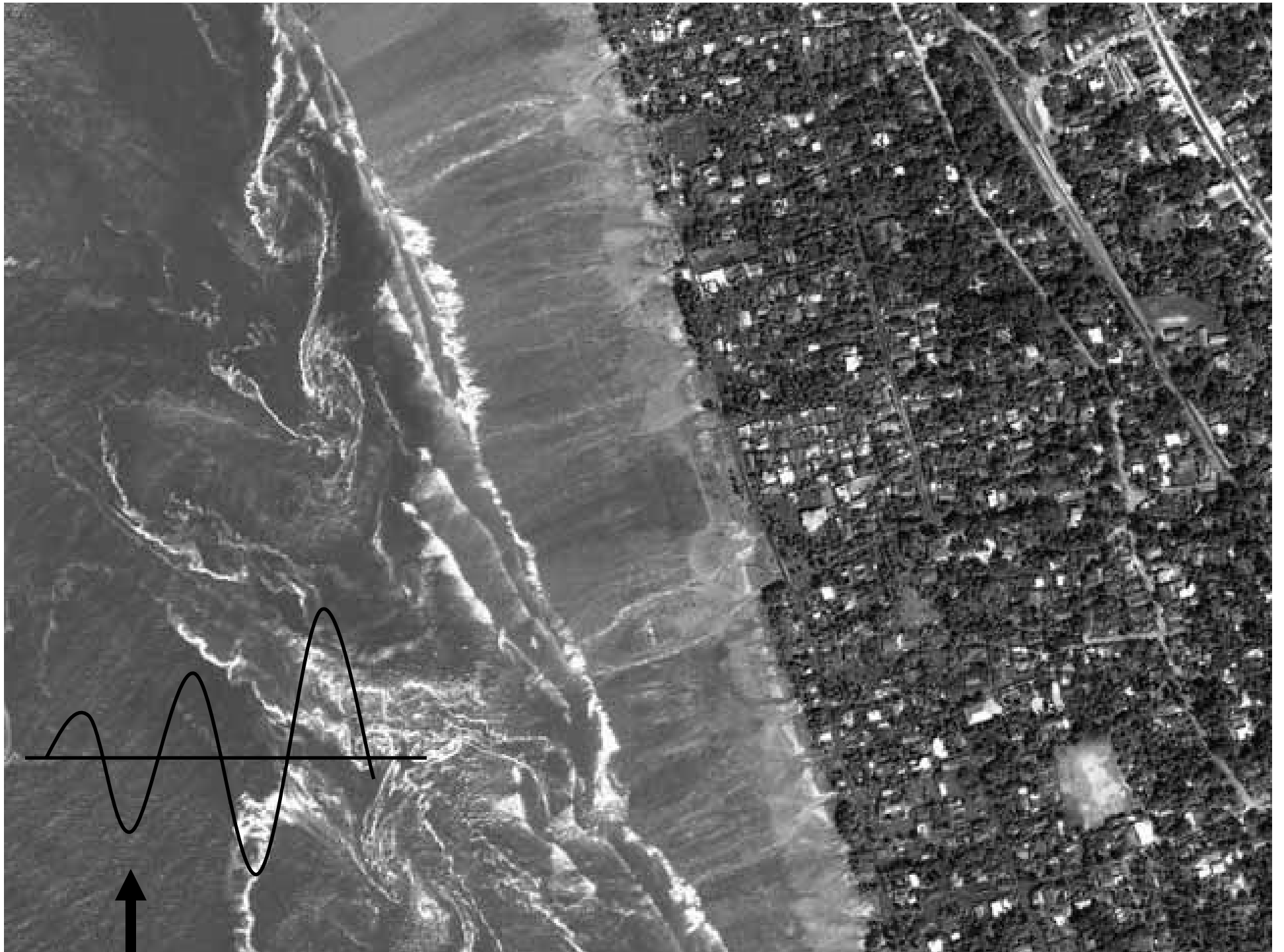
Real Time Detection of November 17, 2003 Tsunami



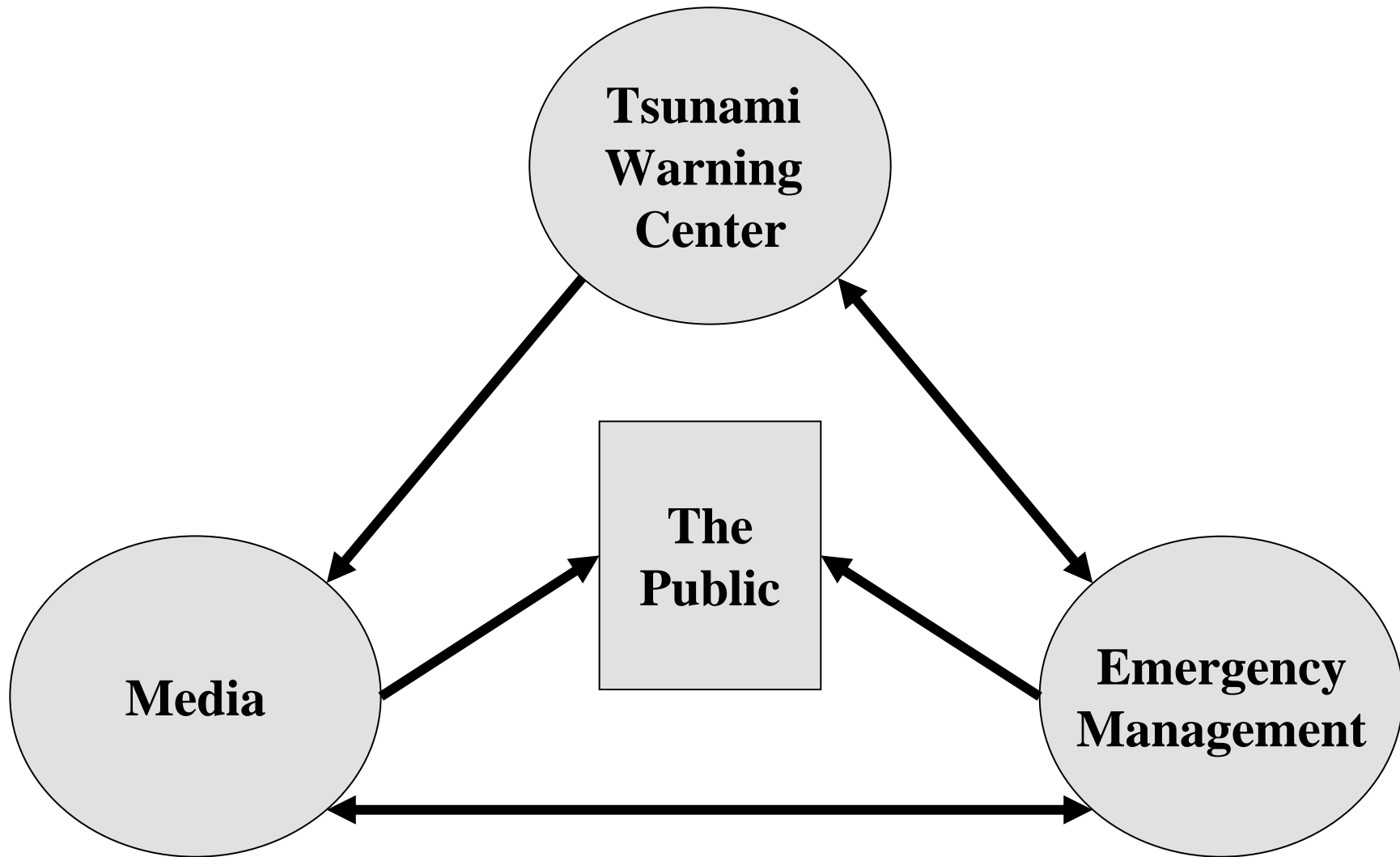
June 14, 2005 California Earthquake: Tsunami Forecast using DART data







Tsunami Dissemination Partners



Tsunami Warning Dissemination

Integrated on-shore communications infrastructure must be in place to get the message to the public


- ❖ **Communication infrastructures to support alert and notification system need to be in place to make these system effective and reliable**
- ❖ **An indoor alert and notification system for public facilities, homes and businesses will facilitate warning and evacuation**
- ❖ **An outdoor alert and notification system for tsunami communities to warn the public on beaches or high traffic areas**

NOAA Weather Radio

- ❖ All-Hazards Warning System
- ❖ Cheaper than a pair of shoes
- ❖ Part of Emergency Alert System
- ❖ Works in concert with All-Hazard Alert Broadcasting (AHAB) Radio
- ❖ Operational in event of local power outages
- ❖ Automatically relays warnings directly to you if you have a NOAA Weather Radio

NOAA WEATHER RADIOS

save lives
for the cost of a pair of shoes




NOAA Weather Radio is Washington's All-Hazards Warning System

NOAA Weather Radio is a warning system used not only for flood and weather-related events, but also for hazards like tsunamis, volcanic activity, hazardous releases, and Amber Alerts.

NOAA Weather Radio automatically relays lahar and volcano warnings direct from volcano monitors to you.




- NOAA Weather Radio is a major part of the Emergency Alert System (EAS).
- Now "EAS-type" weather radio models permit you to alarm only the warning messages you want for your area.



- Weather Radios have a warning alarm feature that instantly alerts you to fast breaking events around the clock.
- Weather Radios are battery-operated in the event of power outages.
- Weather Radios are available at most radio electronic retailers and Internet outlets.

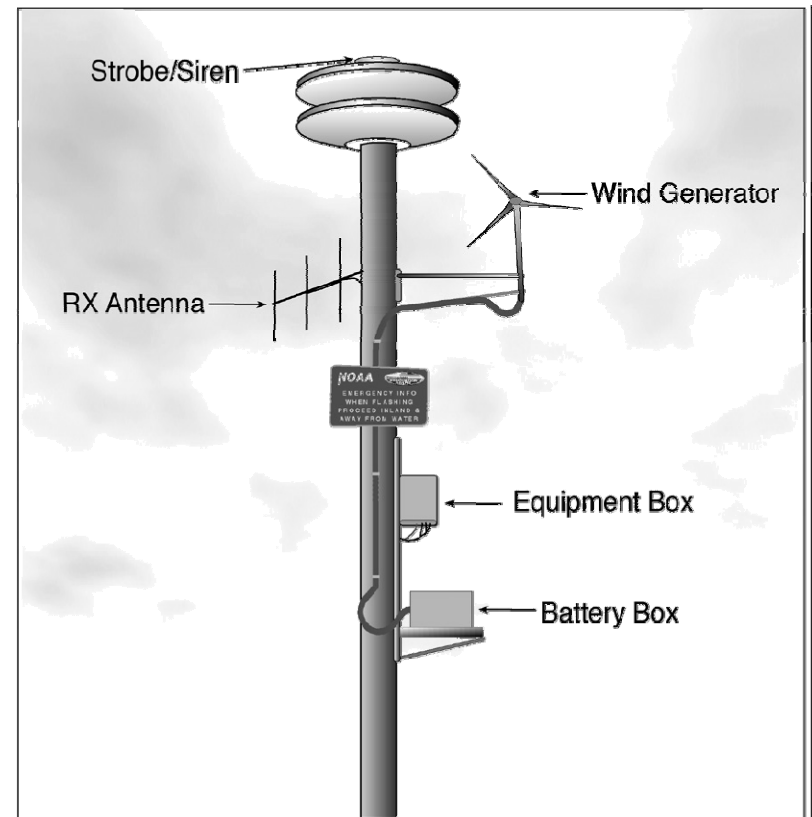
NOAA
Weather Radio
enables you to monitor weather-related
Forecasts, Watches and
Warnings — 24 hours
a day direct from the
National Weather Service.

Presented jointly by:

- 
National Oceanic and
Atmospheric
Administration (NOAA)
National Weather Service
- 
Washington Military
Department
Emergency Management Division
- 
Pierce County
Emergency Management Division

All Hazard Alert Broadcasting (AHAB) Radio

- ❖ Washington Emergency Management and Federal Signal Partnership
- ❖ Withstands gale-force winds and salt corrosion with little to no maintenance
- ❖ Battery operated. Charged by:
 - Electrical
 - Wind
 - Solar



Concept drawing of AHAB Radio

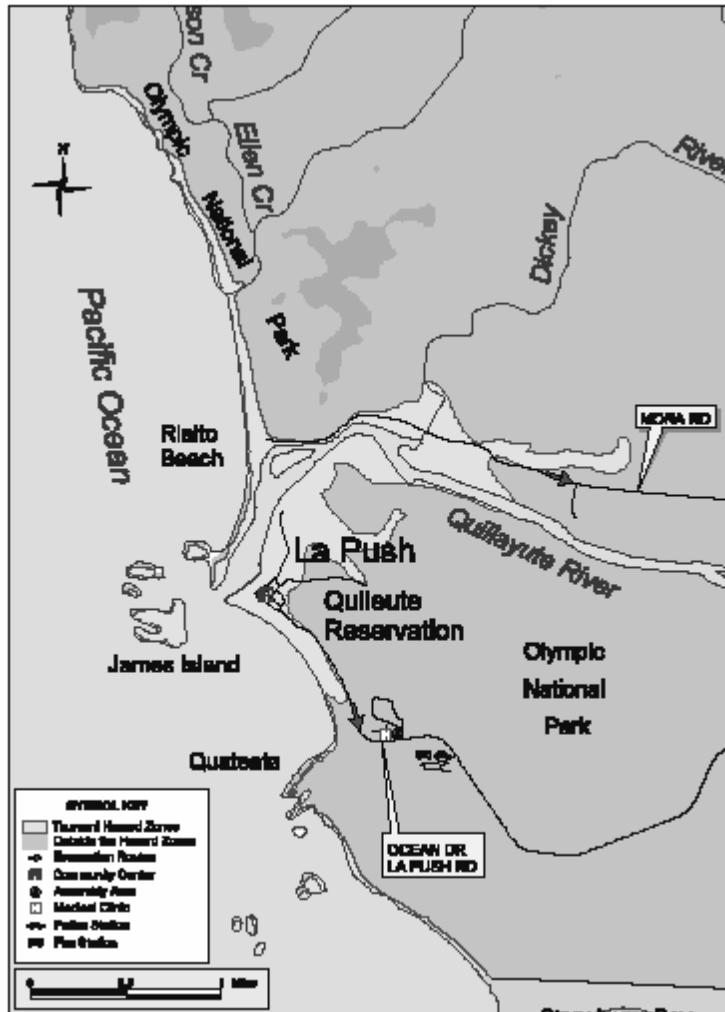
AHAB Radio

- ❖ **Modulator siren – 360 Degree**
- ❖ **An intense blue light activated to further indicate that the area is under a hazardous situation**
- ❖ **Can be activated via:**
 - **National authorities**
 - **State/local emergency management**
 - **Other communication protocols**

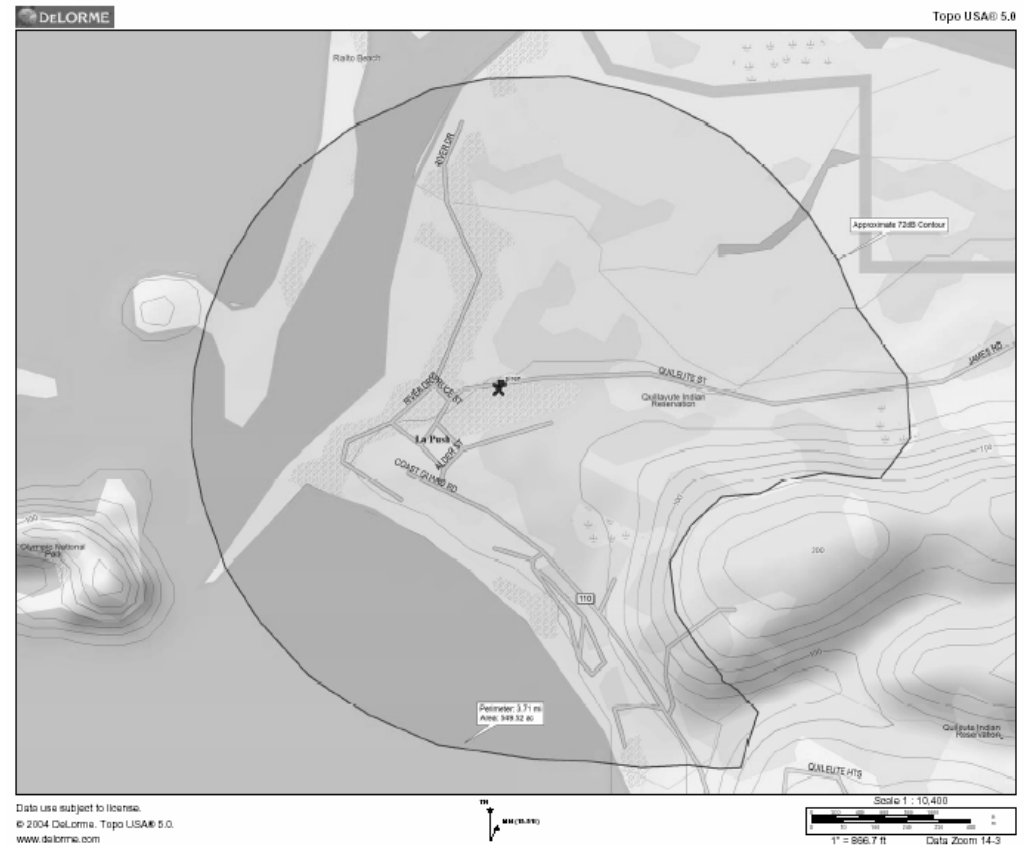


*Installed Oct 30, 2003
Port of Port Townsend*

Process for Developing Coverage Area

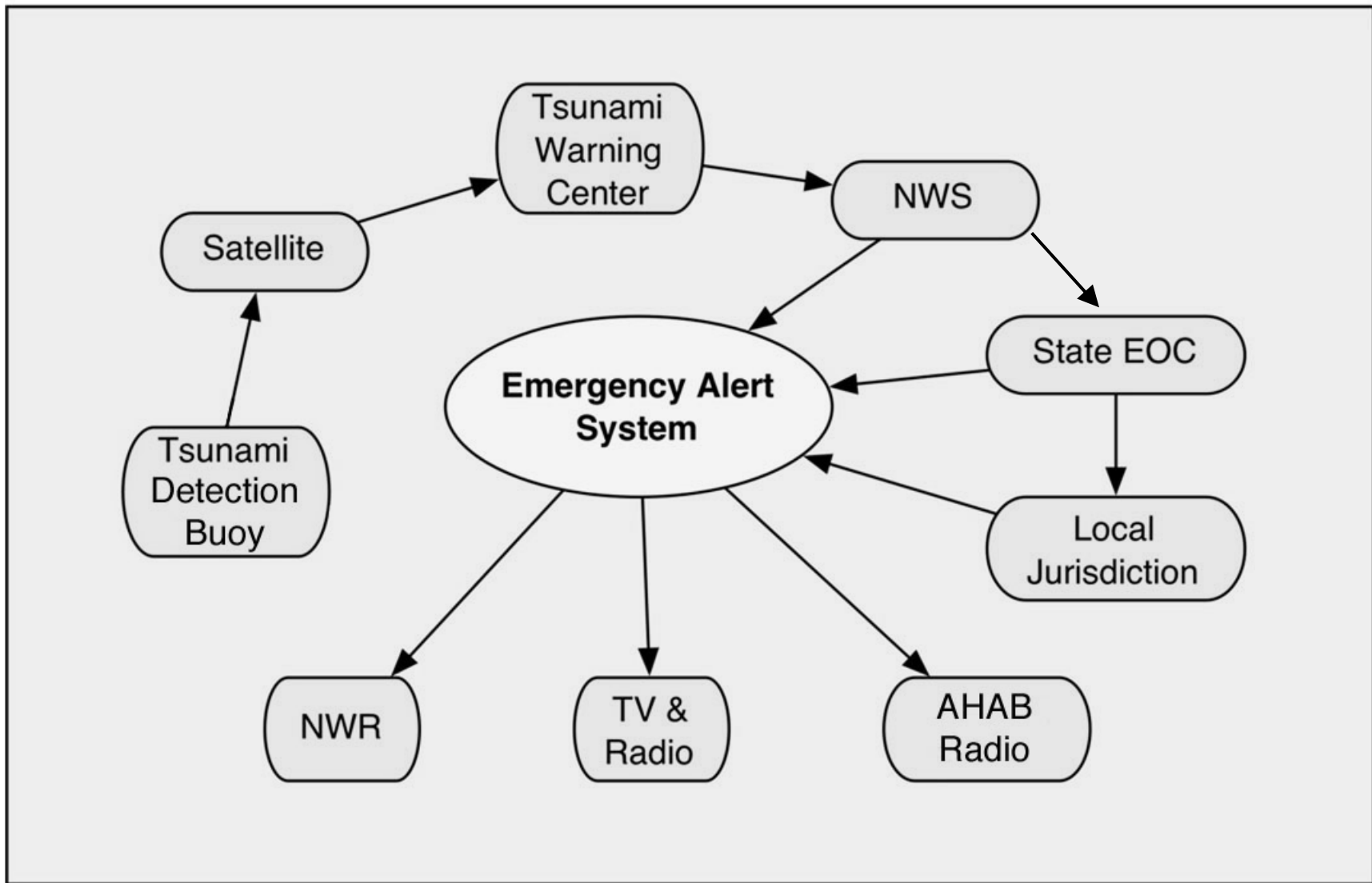


Evacuation Map



Coverage Area Map

Tsunami Warning / Evacuation Communications Cycle



Lessons Learned

Tsunami Warning - Jun 14, 2005

- ❖ **Consistent Warning Message**
- ❖ **Decisions on tsunami warning/cancellation must be based on tsunami data and not seismic models**
- ❖ **Do not second guess the generation of a tsunami**
- ❖ **Multiple communication paths must be available**
- ❖ **Media must be part of the tsunami warning process**
- ❖ **Educate public on watch and warning**

“Tsunami programs are constantly evolving as we learn more of the hazard and new tools are developed to support hazard assessment, warning, and mitigation in tsunami communities”

Thank You

