Semi-Structured Language Usage for Tsunami Alerts

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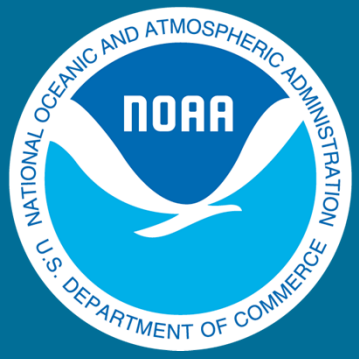


6th CAP Workshop, Negombo Sri Lanka, 19 June 2014

Agenda

- *Tsunamis*
- *Tsunami Warning System*
- *PTWC Operations*
- *The Problem*
- *The Solution: TEX & CAP*
- *Challenges & Next Steps*
- *Links*
- *Questions*

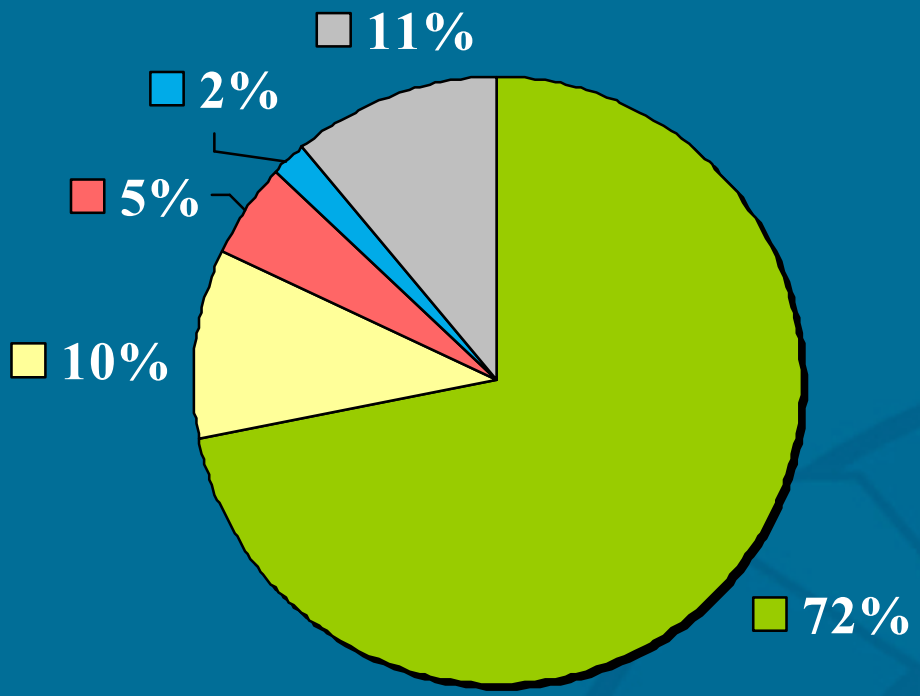
Tsunamis

What is a tsunami?

A tsunami is a series of long-period waves created by an abrupt disturbance that displaces a large amount of water.

Causes:

- Earthquakes
- Landslides
- Volcanoes
- Atmosphere
- Other/Unknown

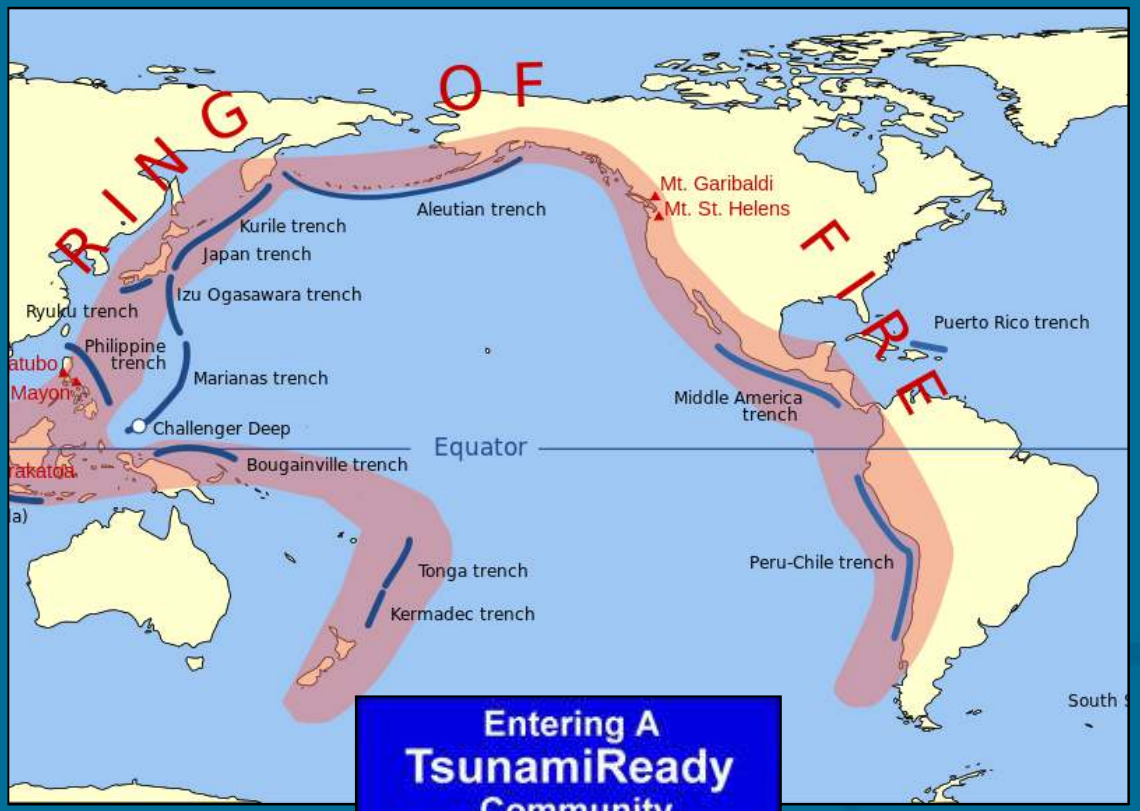


Tsunami Warning Premise

Subduction zones produce earthquakes that could generate tsunamis.

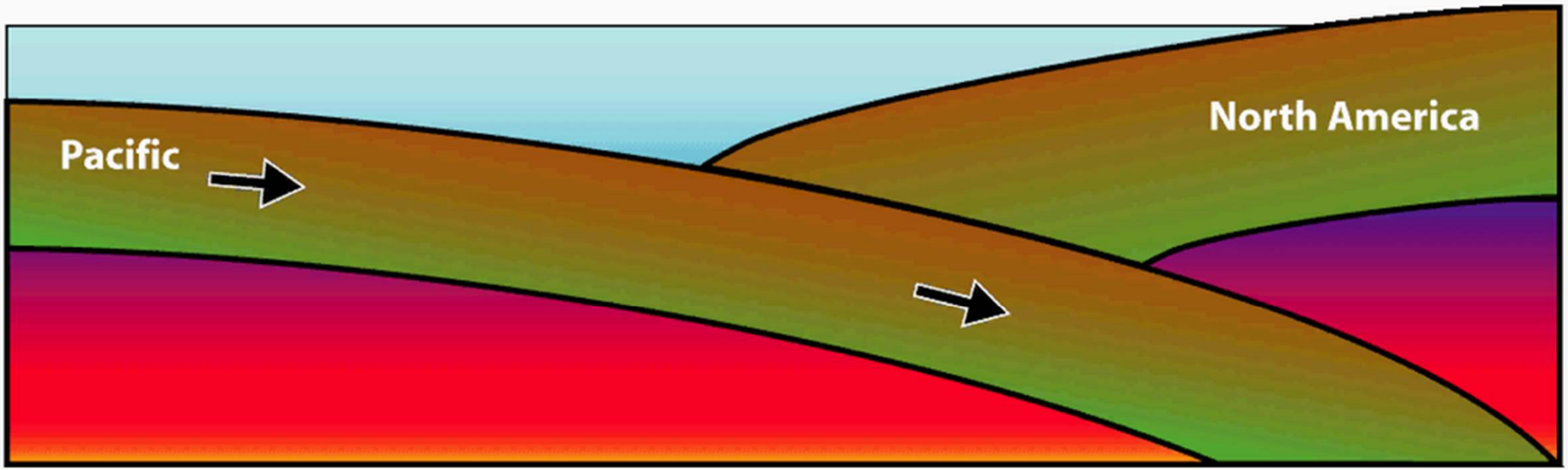
Seismic waves travel about 30 times faster than tsunami waves.

- **Possible to warn for a tsunami ahead of its arrival!**

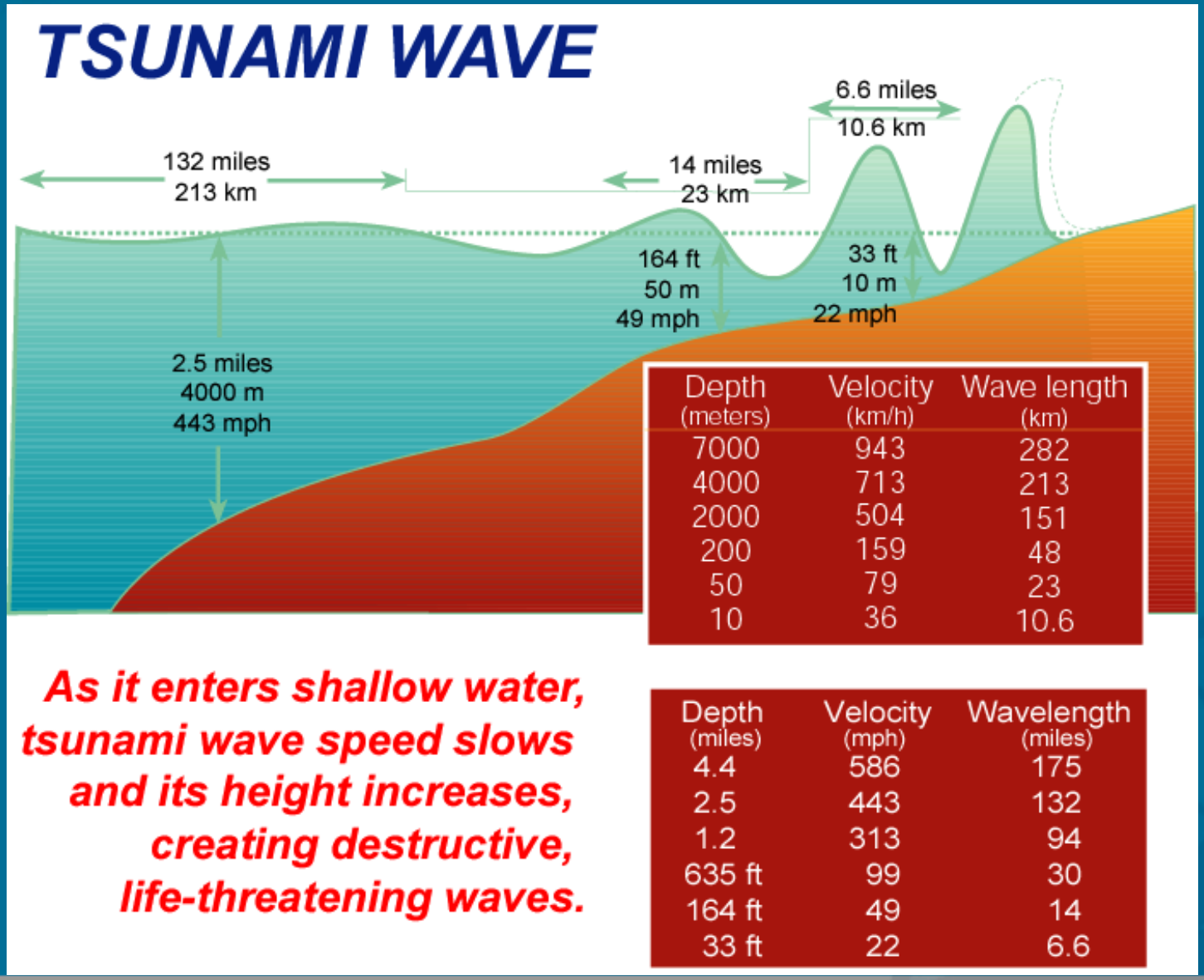


How subduction earthquakes make tsunamis

When the plate snaps up during the earthquake,
it displaces a large volume of water.



Speed, Wavelength & Runup



Depth (meters)	Velocity (km/h)	Wave length (km)
7000	943	282
4000	713	213
2000	504	151
200	159	48
50	79	23
10	36	10.6

As it enters shallow water, tsunami wave speed slows and its height increases, creating destructive, life-threatening waves.

Depth (miles)	Velocity (mph)	Wavelength (miles)
4.4	586	175
2.5	443	132
1.2	313	94
635 ft	99	30
164 ft	49	14
33 ft	22	6.6

Tsunami Warning System

The tsunami that started it all

1 April 1946

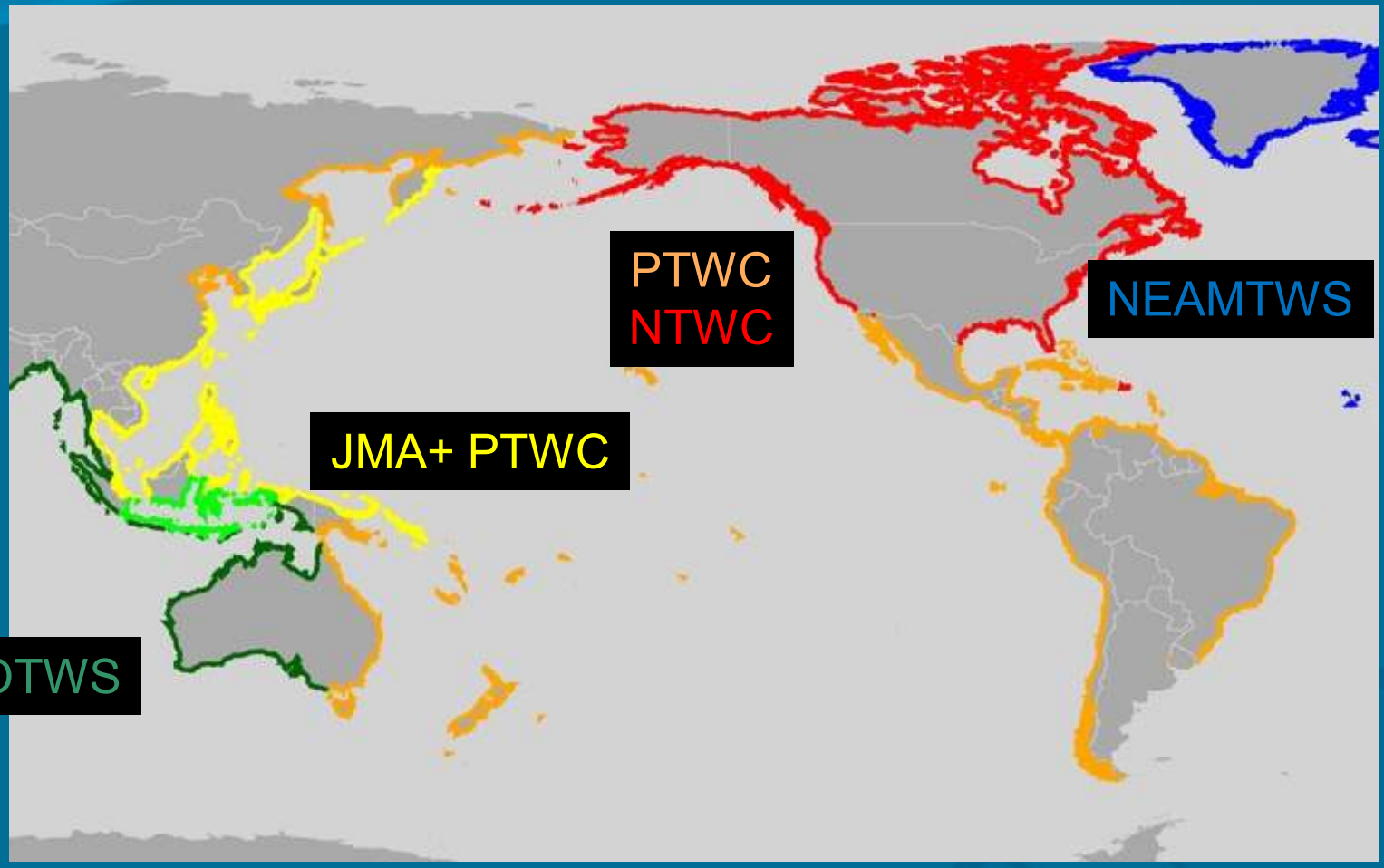
M8.1 earthquake in Aleutian Islands

Pacific-wide tsunami devastated parts of Hawaii

Kahuku, O`ahu

PTWC Areas of Responsibility

- Established in 1949 (*following 1946 tsunami*)
- International center for Pacific Ocean since 1965 (*following 1960 tsunami*)
- Interim center for Indian Ocean from 2005-2013
- Interim center for Caribbean Sea since 2006



PTWC staff grew from 4 to 12 scientists in 2005, allowing us to maintain 24x7 shift operations since March 2006.

Tsunami Warning System

International Warning Systems coordinated by the United Nations through UNESCO/IOC.

Sous le patronage de

UNESCO

Organisation des Nations Unies pour l'éducation, la science et la culture

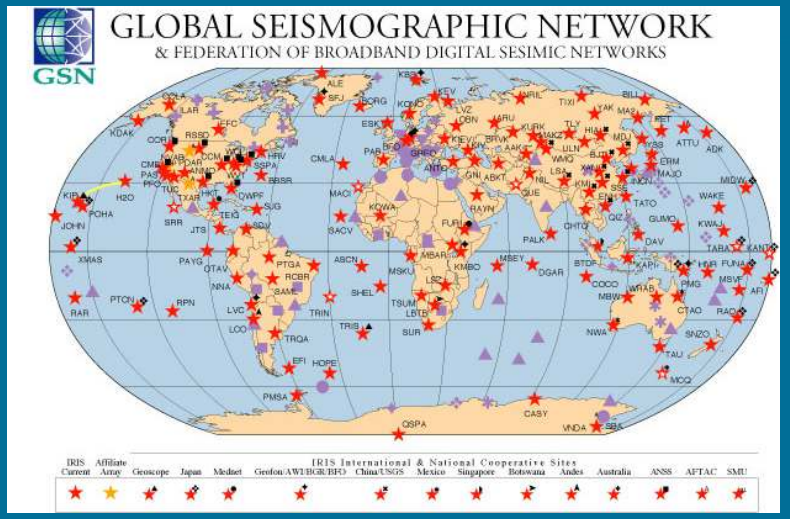
Commission océanographique intergouvernementale

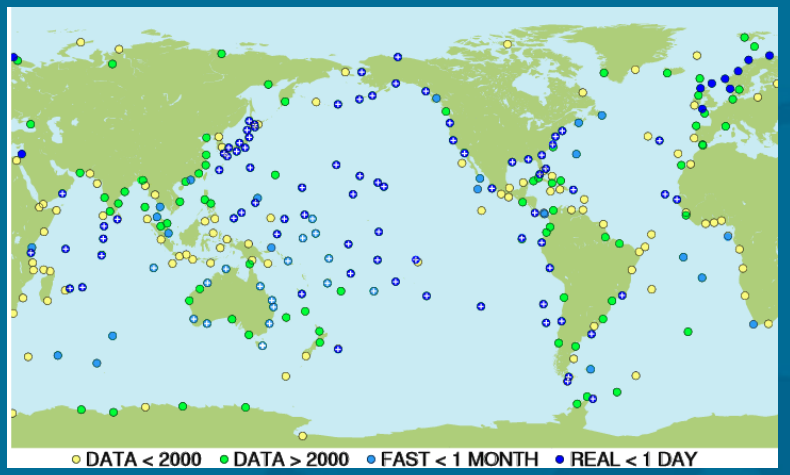
Wide variety of politics, cultures, and techncial capabilities in the member countries makes warning integration a challenge.

3 Basic Needs of Tsunami Warning Systems

1. ***Very rapid earthquake evaluation***
2. ***Very rapid sea level evaluation***
3. ***Very reliable communications***

Multi-national, global data networks with real time transmission and free/open data sharing

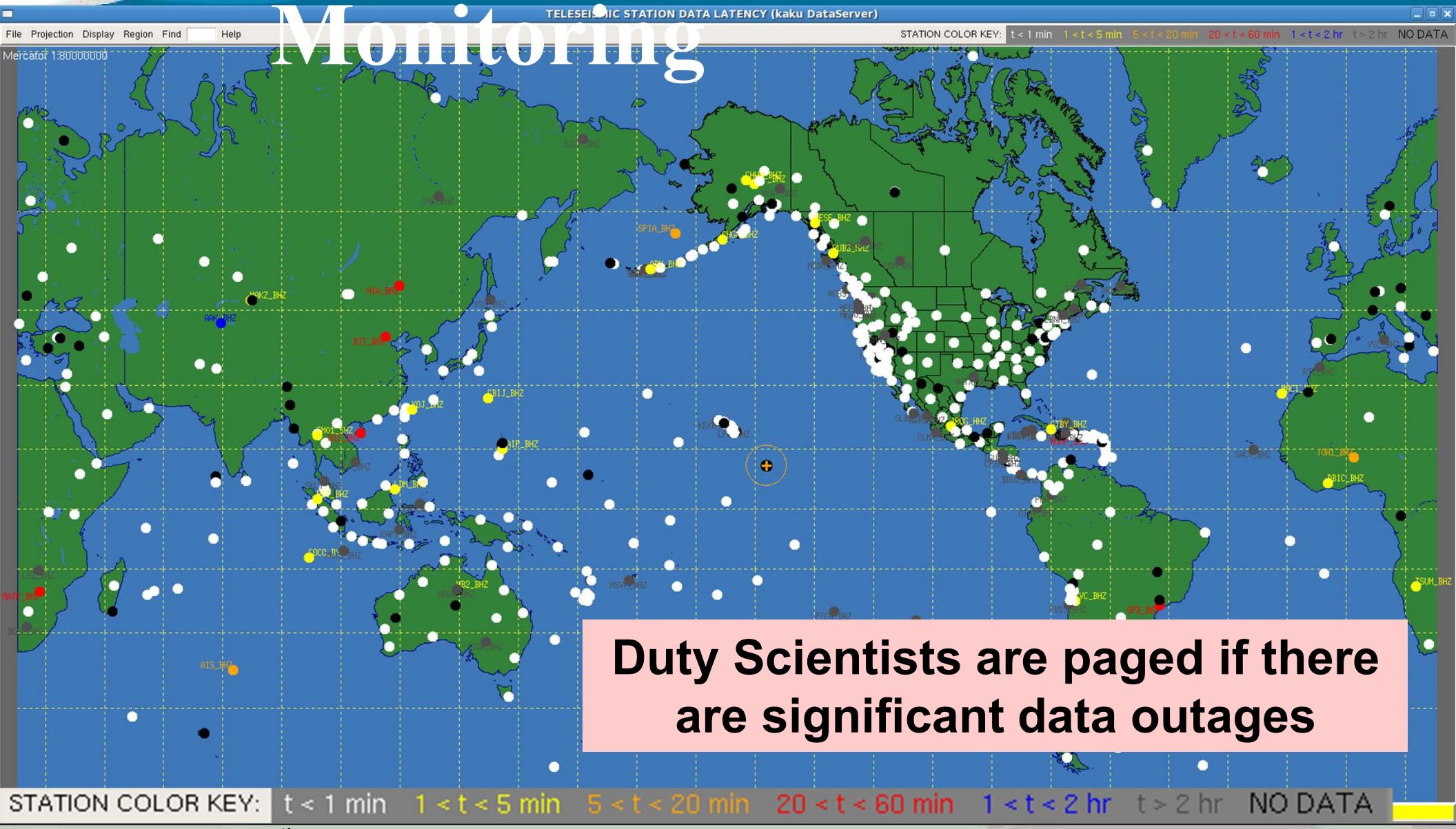




➢ **ALL REQUIRED FOR TIMELY WARNING**

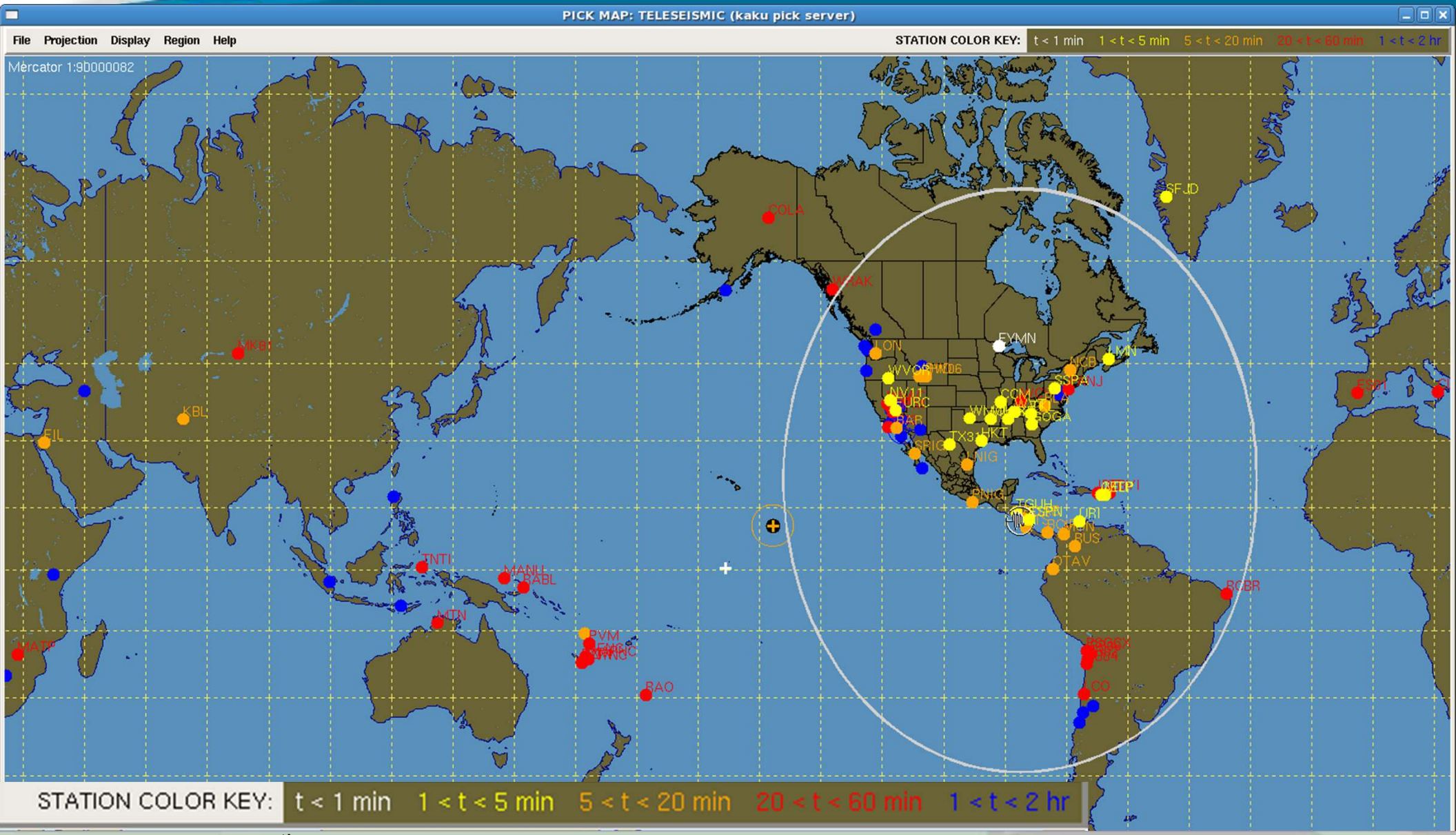
PTWC Operations

PTWC: Data Availability/Latency Monitoring

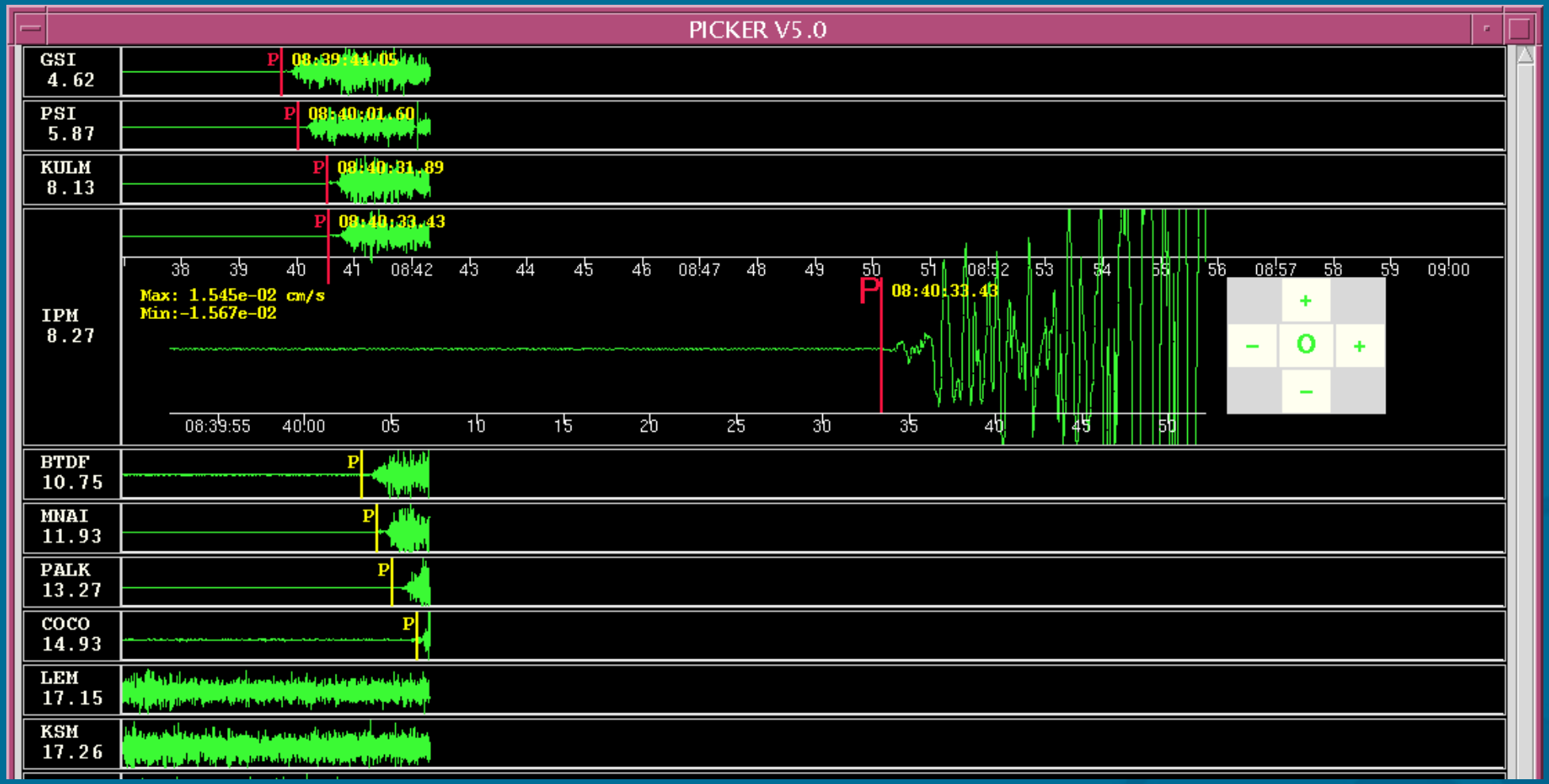


Duty Scientists are paged if there are significant data outages

PTWC: Seismic Detection Monitor

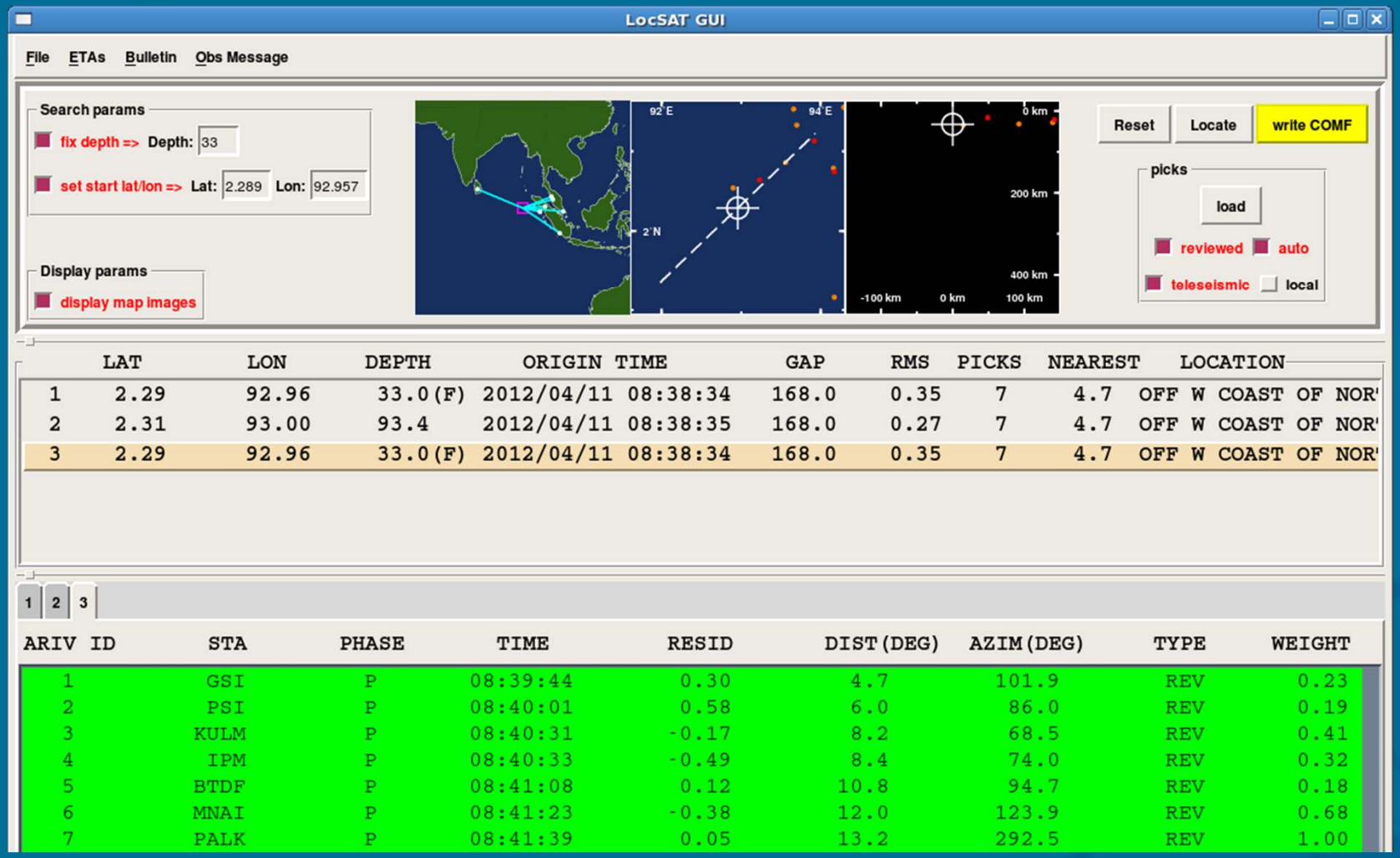


PTWC: Seismic Analysis



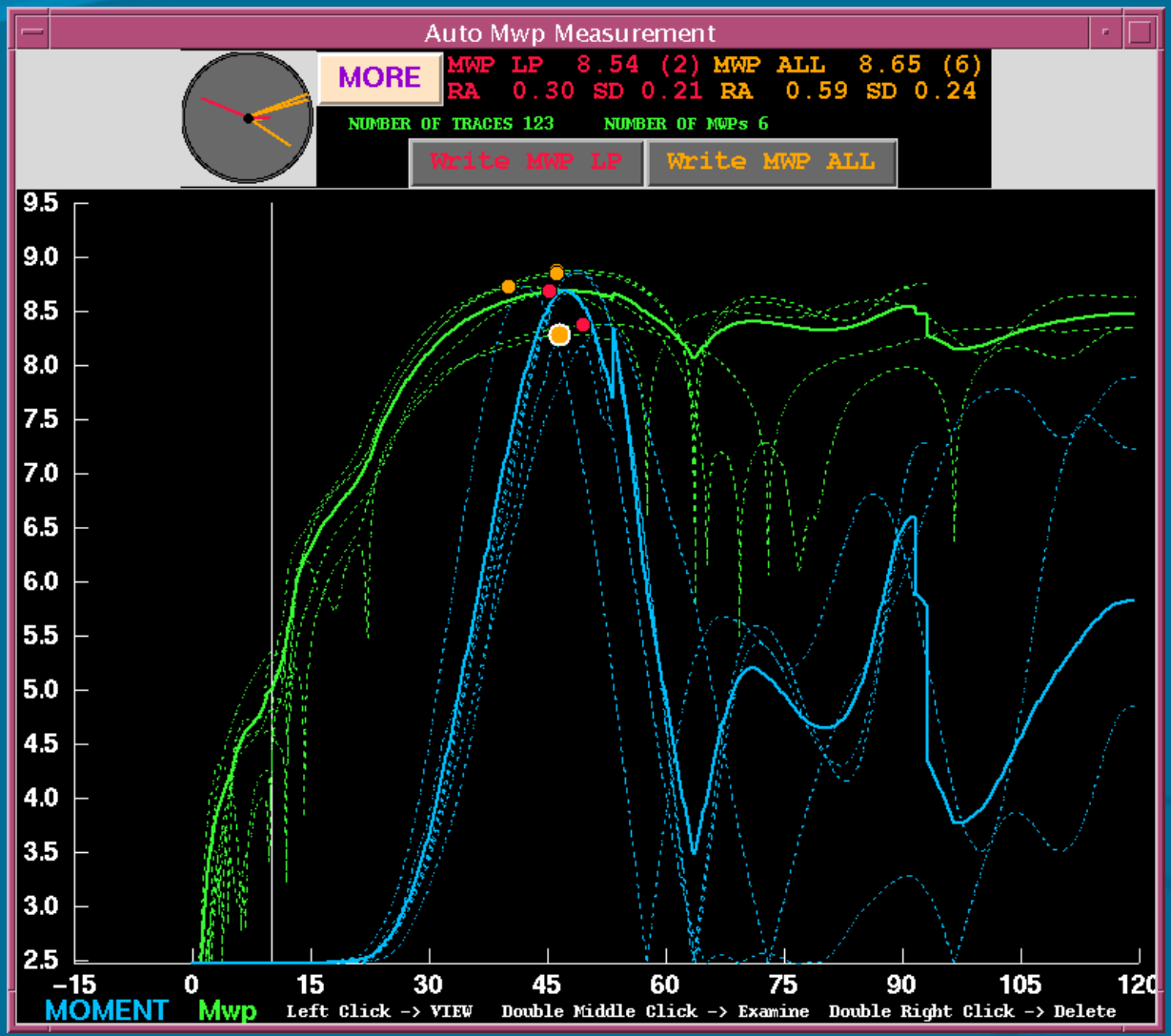
Sumatra earthquake 11 April 2012 (origin time + 270 seconds)

PTWC: Seismic Analysis



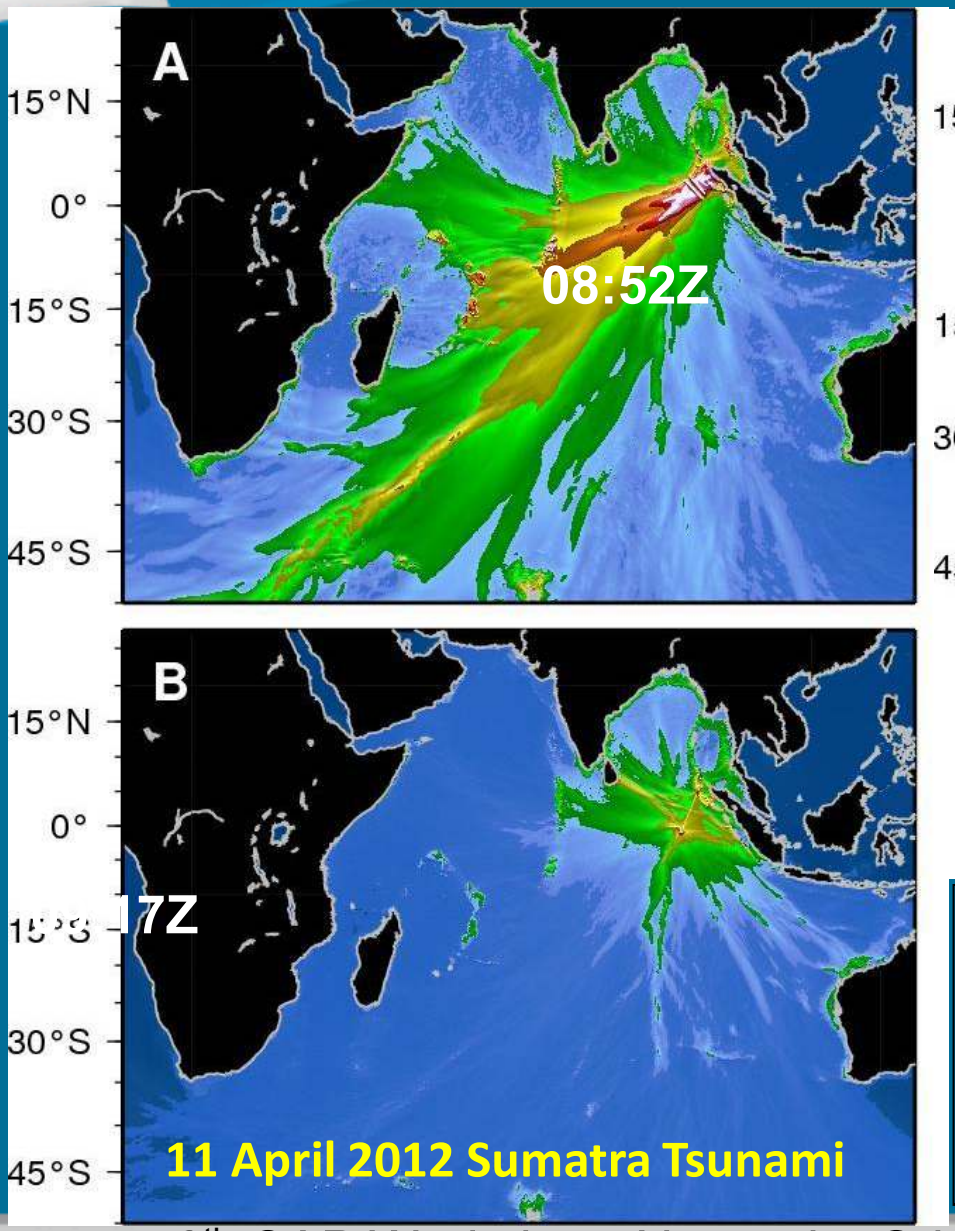
Interactive tool to refine earthquake solution, including depth.

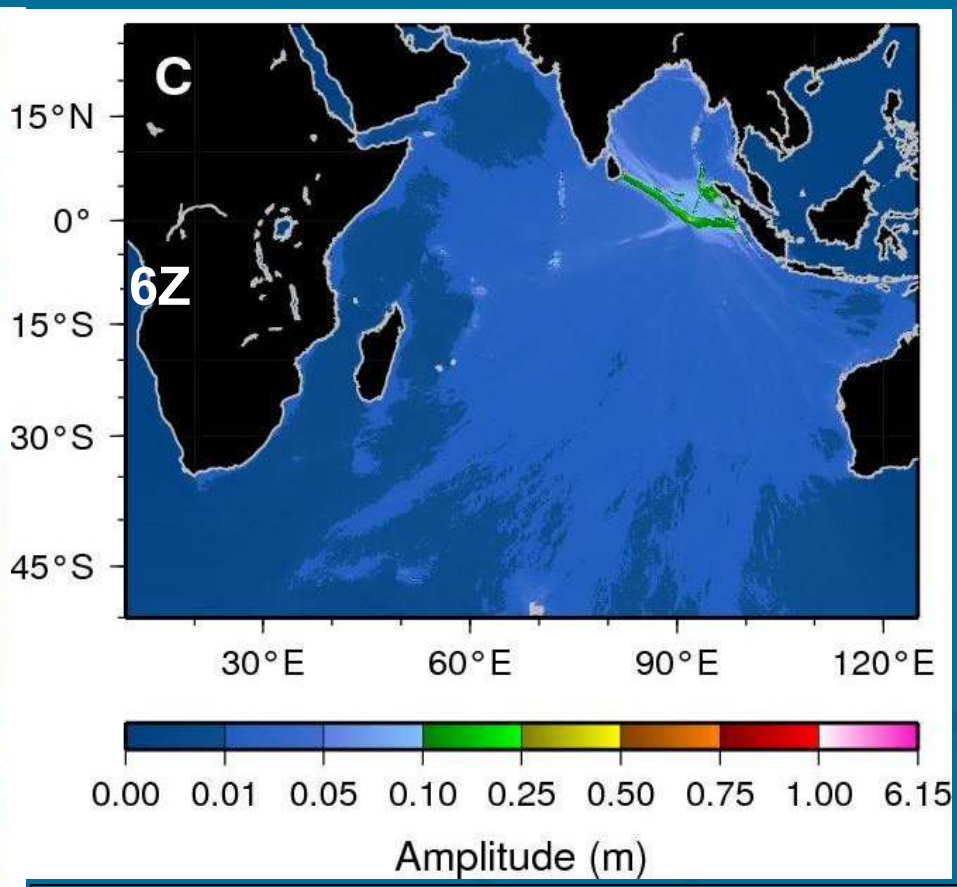
PTWC: Seismic Analysis



Sumatra earthquake 11 April 2012 (Mwp method,Tsuboi et al 1995)

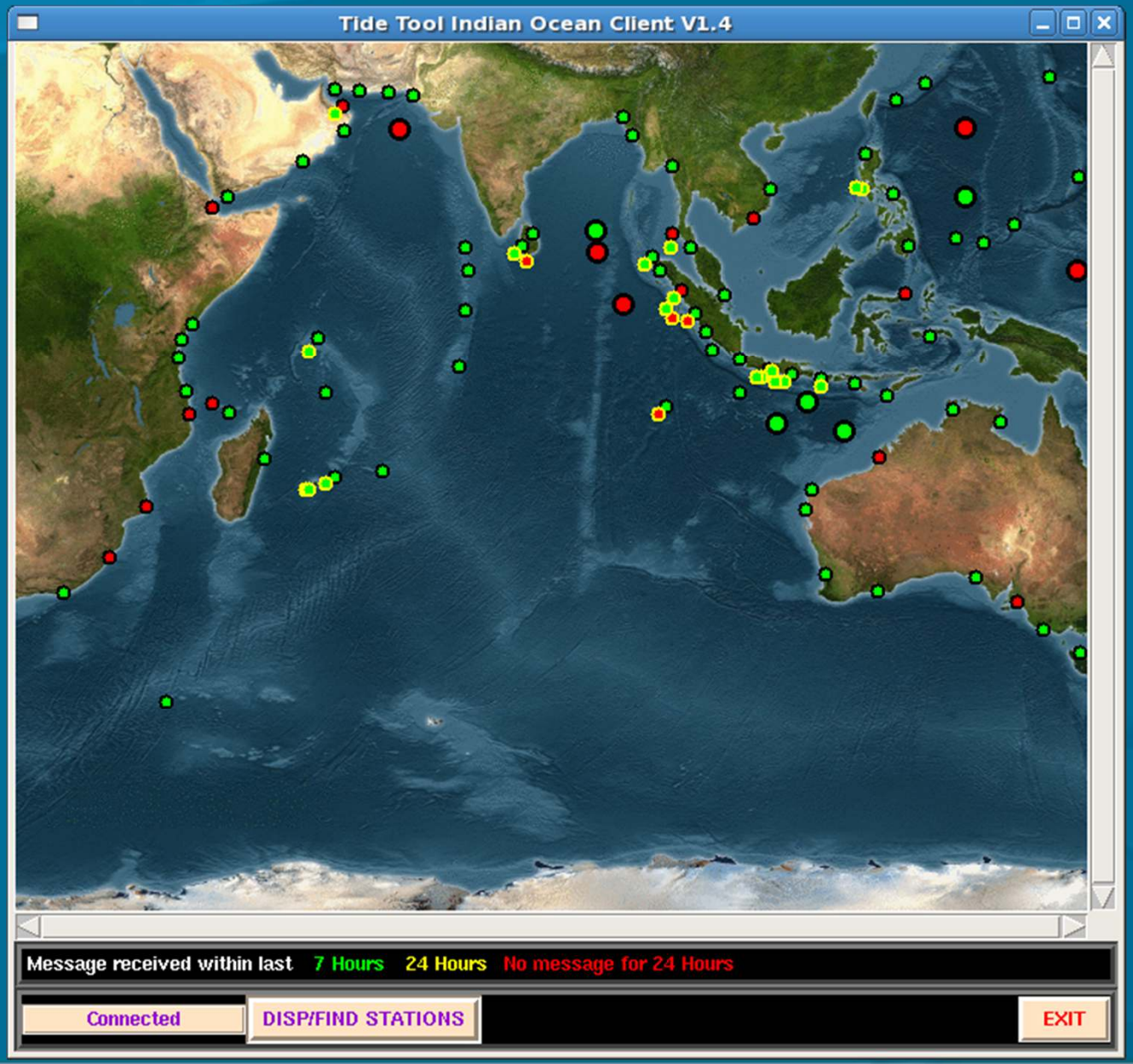
PTWC: Tsunami Forecasting



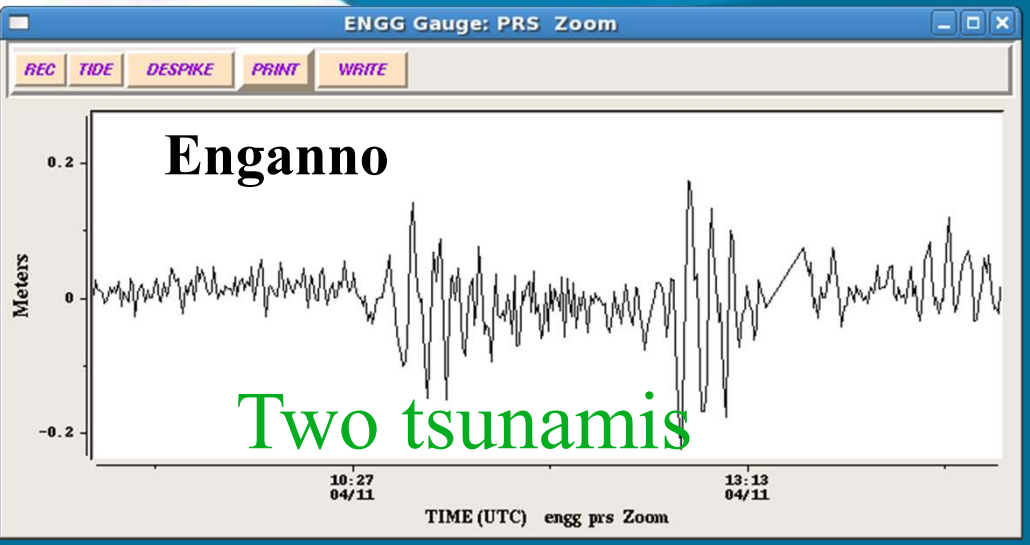


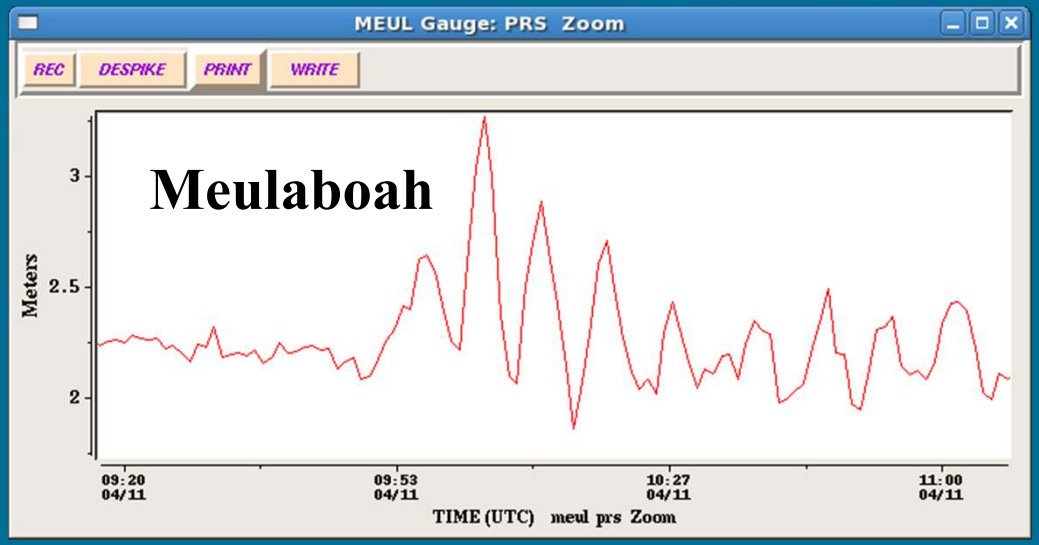
A. Pure Vertical Thrust
B. Oblique-Slip (Mw=8.8)
C. Strike-Slip (Mw=8.6)

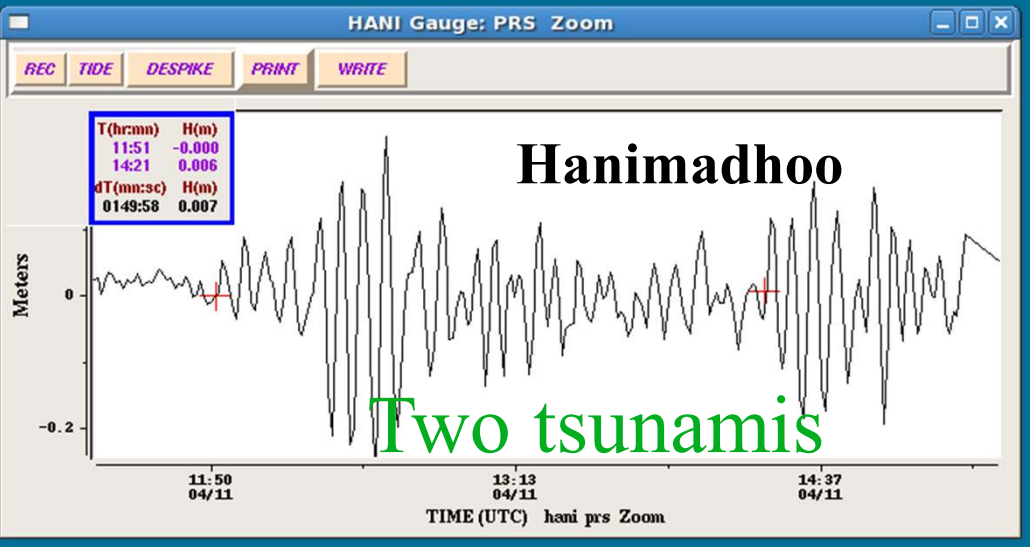
PTWC: Sea Level Monitoring

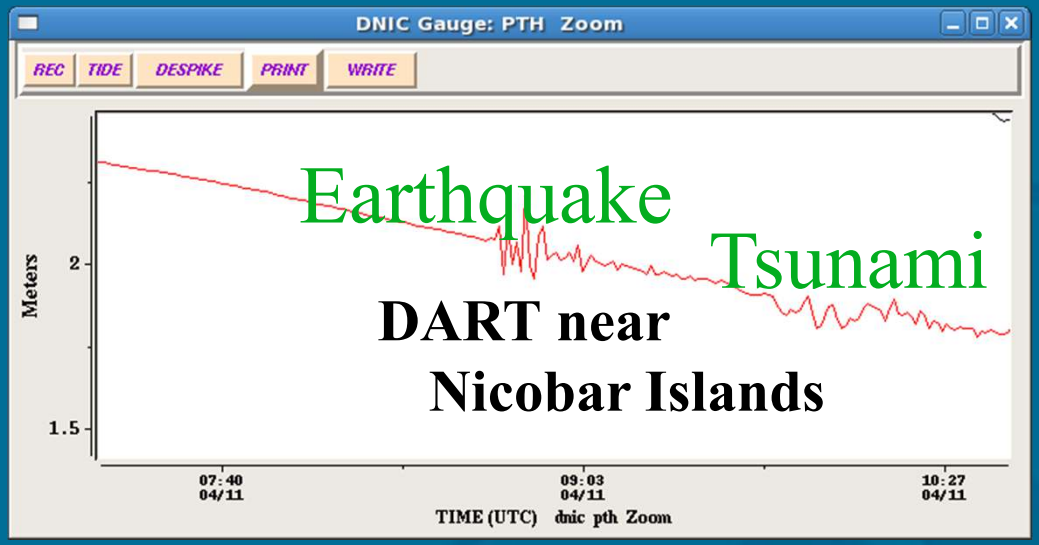


PTWC: Sea Level Monitoring







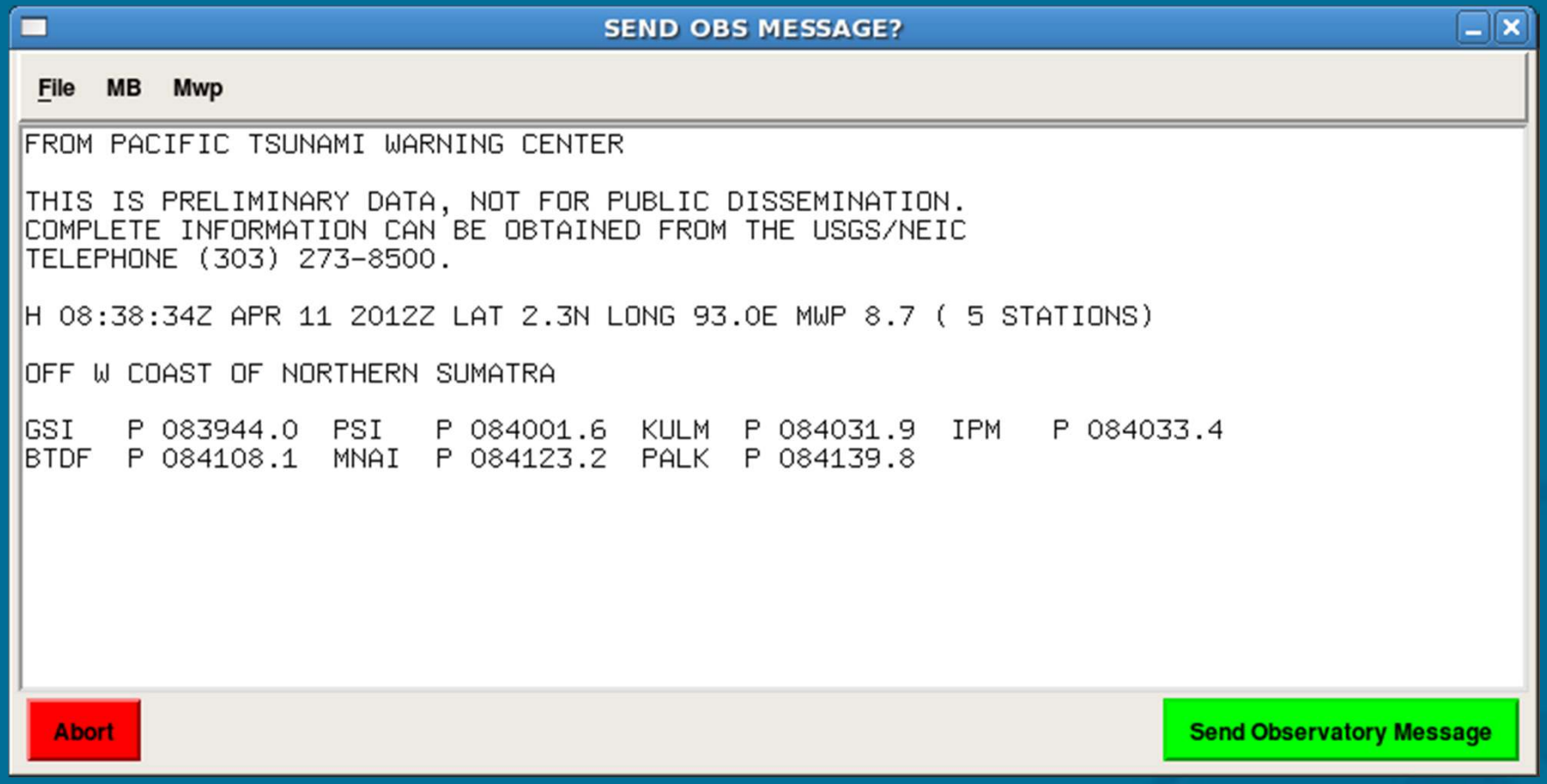


Sumatra earthquake 11 April 2012 (Mw 8.6, aftershock Mw 8.2)

PTWC: Sea Level Monitoring

PTWC: Observatory Message

Observatory Message (AFTN, Email, QuakeWatch)



Sumatra earthquake 11 April 2012 (origin time + 329 seconds)

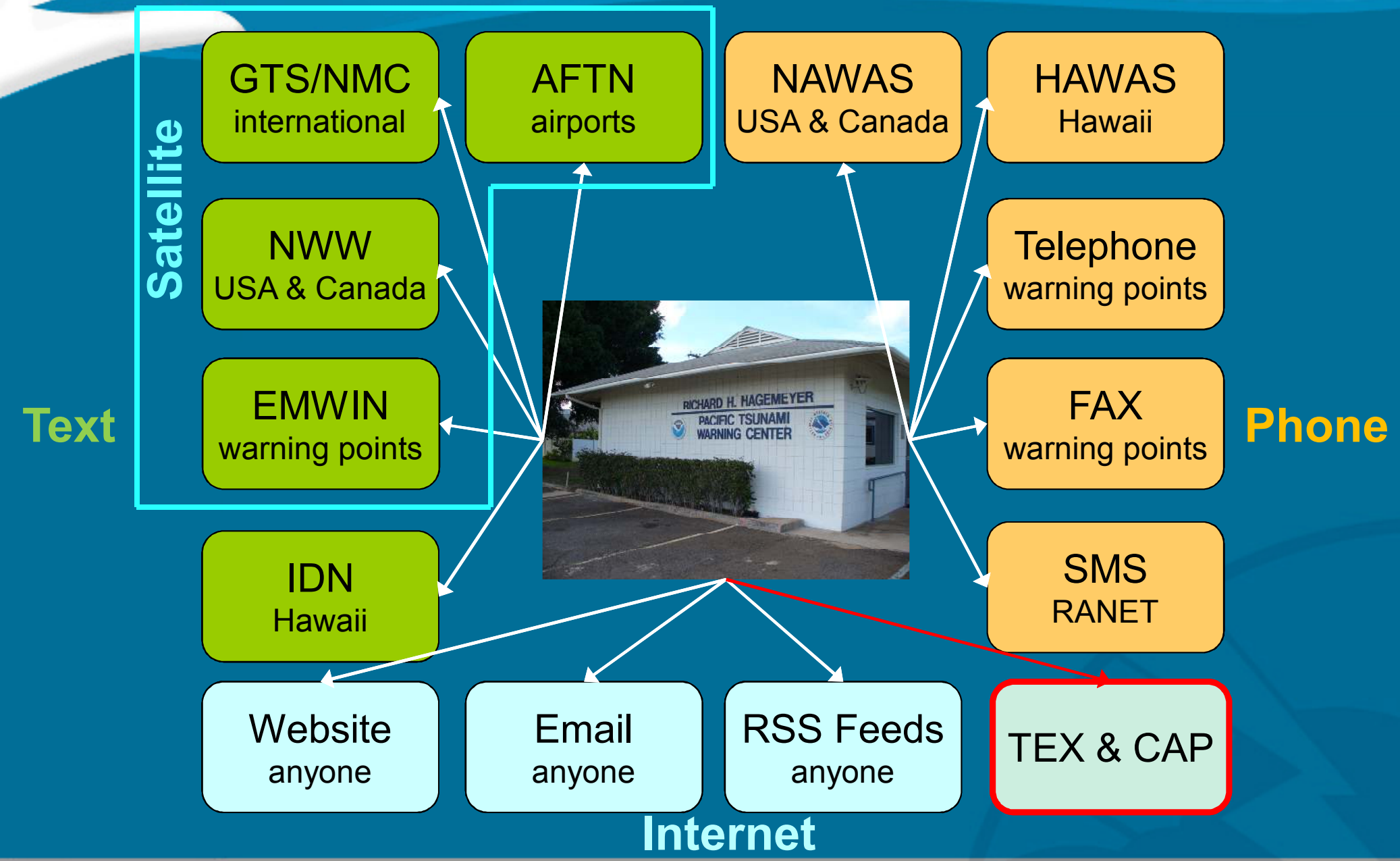
PTWC: Bulletin Message

First bulletin

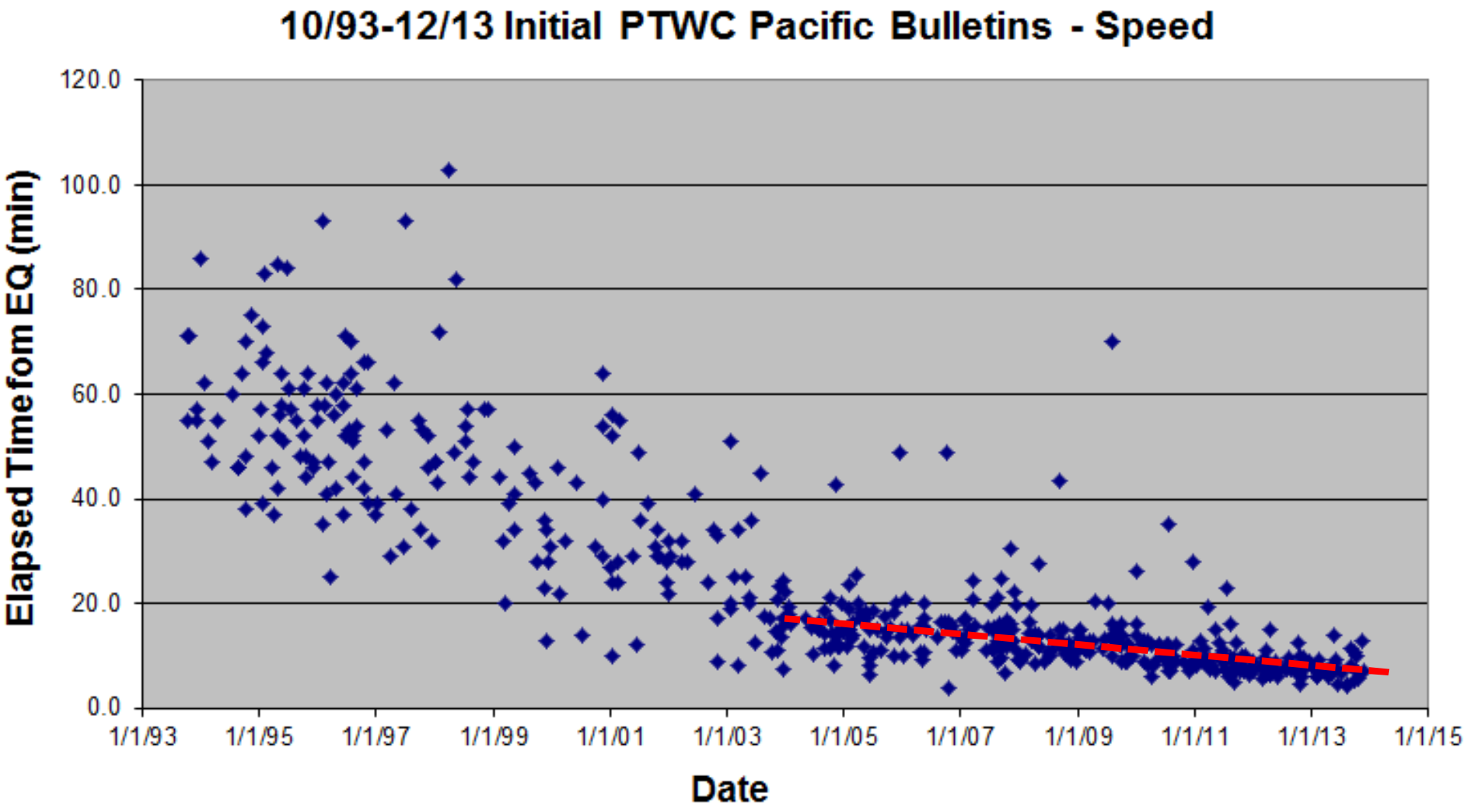
```
TSUNAMI BULLETIN NUMBER 001
PACIFIC TSUNAMI WARNING CENTER/NOAA/NWS
ISSUED AT 0845Z 11 APR 2012

THIS BULLETIN IS FOR ALL AREAS OF THE INDIAN OCEAN.

... AN INDIAN-OCEAN-WIDE TSUNAMI WATCH IS IN EFFECT ...

A TSUNAMI WATCH IS IN EFFECT FOR

 INDONESIA / INDIA / SRI LANKA / AUSTRALIA / MYANMAR / THAILAND /
 MALDIVES / UNITED KINGDOM / MALAYSIA / MAURITIUS / REUNION /
 SEYCHELLES / PAKISTAN / SOMALIA / OMAN / MADAGASCAR / IRAN /
 UAE / YEMEN / COMORES / BANGLADESH / TANZANIA / MOZAMBIQUE /
 KENYA / CROZET ISLANDS / KERGUELEN ISLANDS / SOUTH AFRICA /
 SINGAPORE

THIS BULLETIN IS ISSUED AS ADVICE TO GOVERNMENT AGENCIES.  ONLY
NATIONL AND LOCAL GOVERNMENT AGENCIES HAVE THE AUTHORITY TO MAKE
DECISIONS REGARDING THE OFFICIAL STATE OF ALERT IN THEIR AREA AND
ANY ACTIONS TO BE TAKEN IN RESPONSE.

AN EARTHQUAKE HAS OCCURRED WITH THESE PRELIMINARY PARAMETERS

 ORIGIN TIME -  0839Z 11 APR 2012
 COORDINATES -   2.0 NORTH   92.5 EAST
 LOCATION    -  OFF W COAST OF NORTHERN SUMATRA
 MAGNITUDE   -  8.7
```

Sumatra earthquake 11 April 2012 (origin time + 422 seconds)

PTWC: Message Pathways



PTWC: Message Speed



The Problem

Text is not a robust information-sharing medium

Sharing data between disparate information systems has always been a thorny problem.

Often Tsunami Bulletin Text is used to communicate between systems…

```
000
SEHW70 PHEB 070245
EQIHWX
HIZ001>003-005>009-012>014-016>021-023>026-070445-
TSUNAMI SEISMIC INFORMATION STATEMENT NUMBER 1 NWS PACIFIC TSUNAMI
WARNING CENTER EWA BEACH HI 445 PM HST FRI JUN 06 2014
. . .           . . .           . . .           . . .           . . .
. . .           . . .           . . .           . . .           . . .
$$
```

Problems with parsing legacy text bulletins

Brittle – easy to break

Not extensible

Bulletin can be difficult to understand …

- **e.g.,** `HIZ001>003-005>009-012>014-016>021-023>026-070445-`

Requires custom coding – no third party tools

Tightly-coupled

Parsing Example

Hand Edited

Any application parsing our bulletin could break as a result of the hand-edited line, which the parser won't expect.

```
THIS BULLETIN IS FOR ALL AREAS OF THE INDIAN OCEAN.

... AN INDIAN-OCEAN-WIDE TSUNAMI WATCH IS IN EFFECT ...

... A MAJOR AFTERSHOCK OCCURRED AT 11:43Z WITH MAGNITUDE 8.3 ...

A TSUNAMI WATCH IS STILL IN EFFECT FOR

 INDONESIA / INDIA / AUSTRALIA / SRI LANKA / MYANMAR / THAILAND /
 MALDIVES / UNITED KINGDOM / MALAYSIA / MAURITIUS / REUNION /
 SEYCHELLES / OMAN / PAKISTAN / SOMALIA / MADAGASCAR / IRAN /
 UAE / YEMEN / COMORES / MOZAMBIQUE / KENYA / TANZANIA /
 CROZET ISLANDS / BANGLADESH / KERGUELEN ISLANDS / SOUTH AFRICA /
 SINGAPORE

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ANY ACTIONS TO BE TAKEN IN RESPONSE.

 ORIGIN TIME -  0839Z 11 APR 2012
 COORDINATES -   2.3 NORTH   93.1 EAST
 LOCATION    -  OFF W COAST OF NORTHERN SUMATRA
 MAGNITUDE   -  8.7
```

The Solution

Semi-structured Data

The Solution is to use Semi-Structured Data.

- *Extensible Markup Language (XML).*

History:

- **Common Alerting Protocol (CAP)**
  - *CAP 1.0. Approved by OASIS: April 2004*
  - *CAP 1.1. Approved by OASIS: October 2005*
  - *CAP 1.2 (Current). Approved by OASIS: July 2010*
- **TWML - National ICT Australia (NICTA) - 2006**
  - *Tsunami Warning Markup Language (TWML): "first attempt to define structured semantic data models for tsunami bulletins"*

Tsunami Event XML (TEX)

XML dialect, used to solve integration problem between TWCs and other systems.

- **'Back-end'**
- **Internal (i.e., not subject to OASIS, etc.)**

Used to generate:

- **Web based products, primarily via Transformations (XSL/XSLT)**
  - *Generates: Atom, HTML, PHP, etc. using Java code (via JAXB)*

Third Party Open Source Libraries (Google CAP)

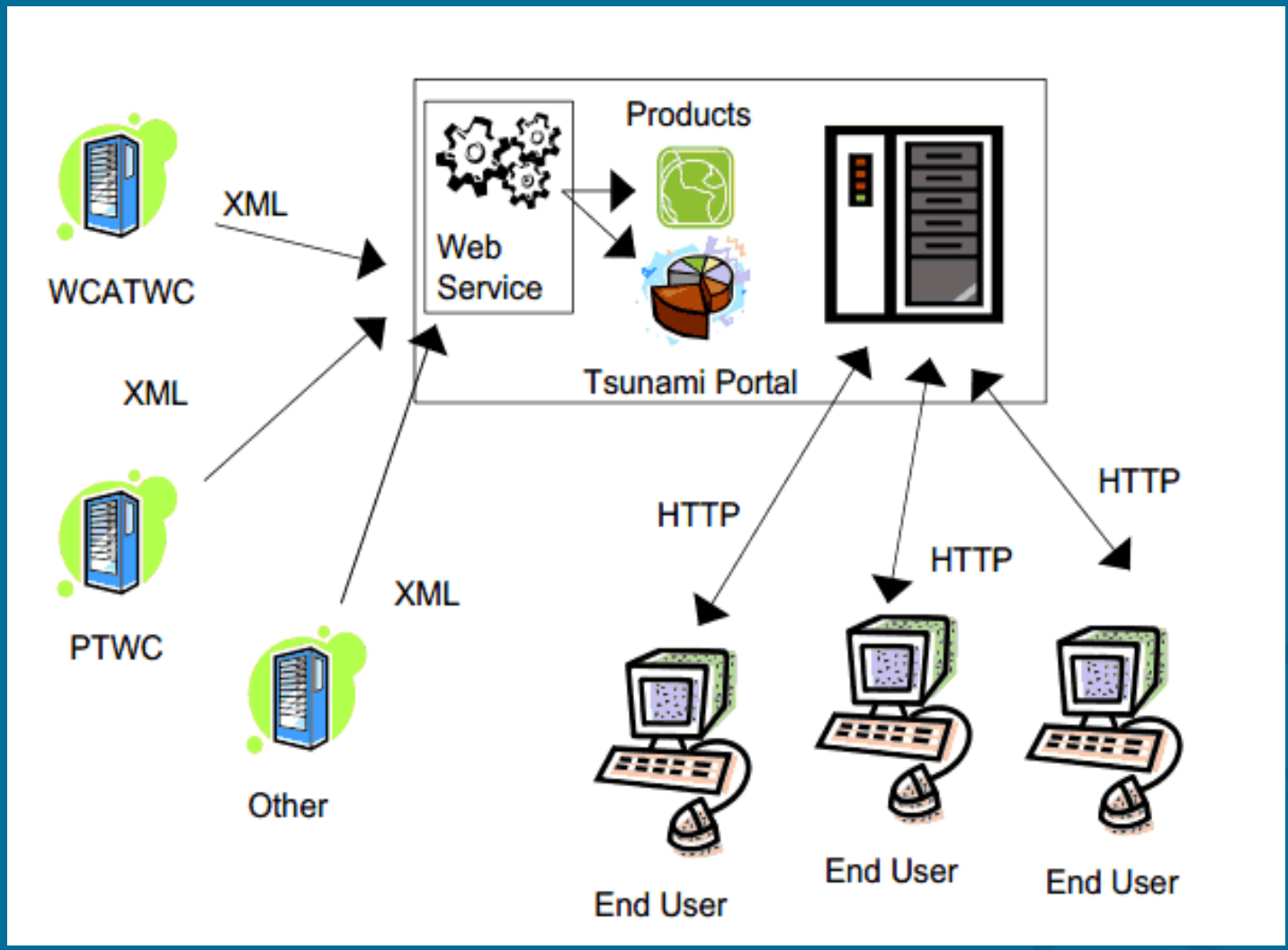
Schema is much more comprehensive than CAP

In development since mid-2010. Current version 1.8.

TEX Sample

```
<?xml version="1.0" encoding="UTF-8" ?>
<tsunamiEvent xmlns:geo="http://www.w3.org/2003/01/geo/wgs84_pos#">
<TWCBulletin>
 <TWCEventID>803322</TWCEventID>
 <WMOID source="PAAQ">WEPA40</WMOID>
 <WMOCenterID>PHEB</WMOCenterID>
 <WMODateTimeGroup>251907</WMODateTimeGroup>
 <AWIPSID>TSUPAC</AWIPSID>
 <bulletinNumber>1</bulletinNumber>
 <bulletinName>Tsunami Bulletin Number 1</bulletinName>
 <issuingCenter>Pacific Tsunami Warning Center/NOAA/NWS</issuingCenter>
 <bulletinIssueTime>2010-10-25-T19:07:36Z</bulletinIssueTime>
 <bulletinIssueTimeString>Issued at 1907Z 25 OCT 2010</bulletinIssueTimeString>
 <messageUpdates></messageUpdates>
 <preHeadline><![CDATA[This bulletin applies to areas within and bordering the
    Pacific Ocean and adjacent seas, except Alaska, British Columbia, Washington,
    Oregon, and California. ]]></preHeadline>
 <bulletinAreas>
  <segment id="1”>
   <headline><![CDATA[A Tsunami Warning is in effect for: RUSSIA, and JAPAN.
    ]]></headline>
```

How TEX will help TWCs integrate



CAP and CAP-TSU

Common Alerting Protocol (CAP)

- **Used to solve 'alerting' problems (whereas TEX solved integration problems)**

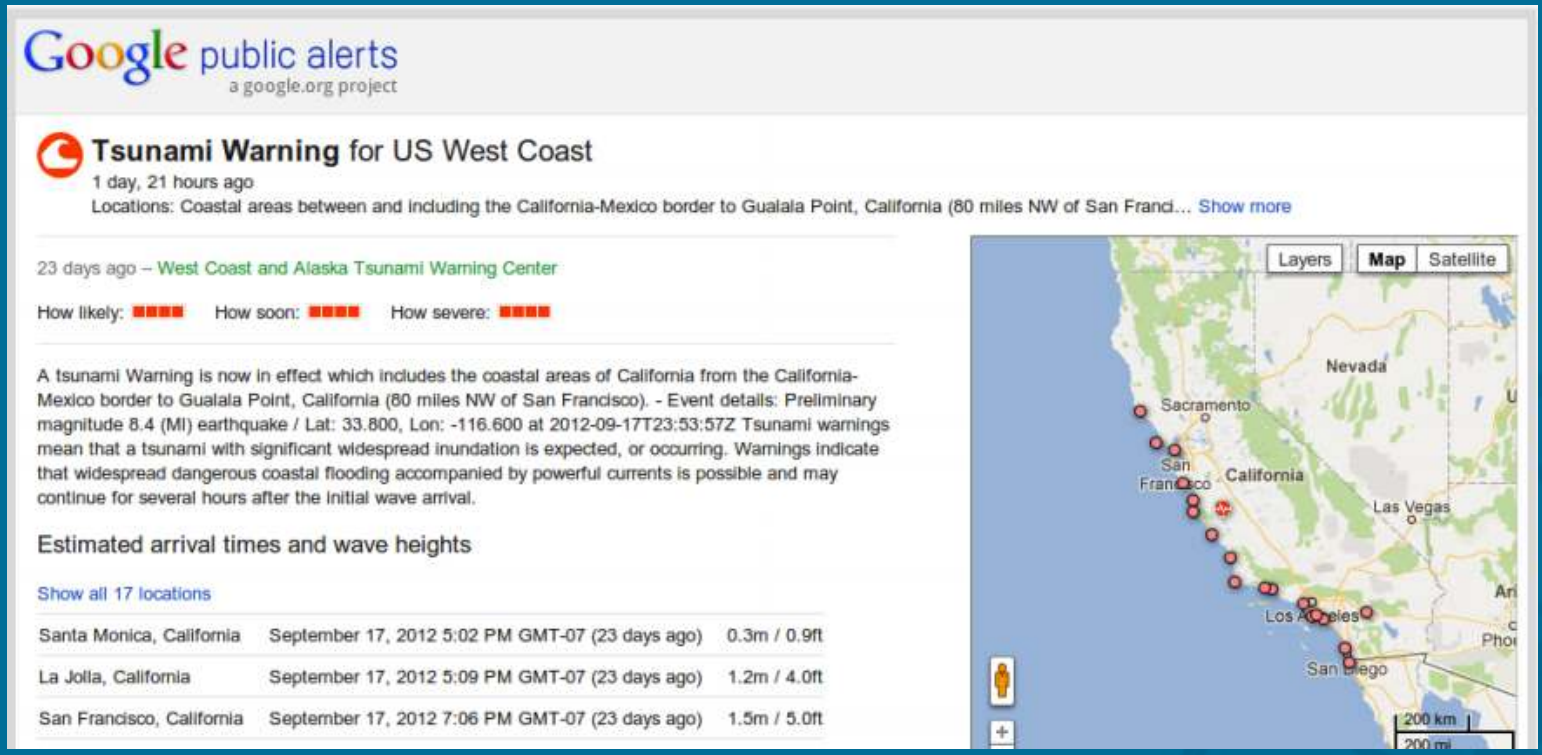
CAP-TSU Profile

- **Allows us to use the CAP/IPAWS specifications to address needs specific to the tsunami community.**
- **The tsunami CAP profile provides a tsunami hazards context with regards to the alerting community**
- **In development since late 2012. Current version 1.1.**

CAP-TSU Example

Currently used by:

- **Google Alerts**
  - *http://www.google.com/alerts*



CAP-TSU Example

Currently used by:

- **Government of Canada – Multi-Agency Situational Awareness System (MASAS)**
  - *http://www.masas-x.ca/en/*

Challenges and Next Steps

CAP Extensibility Challenges

Currently, CAP has limited extensibility:

- **parameter, tag - list of (key, value) pairs**

<Parameter> is not ideal:

- **Custom parsing code**
- **Field definitions not clear**
- **Difficult to include data, such as sea level observations:**

```
Neah Bay, Washington";2013-01-05T03:32:00-08:00;48.4;-
  124.6;PZZ130;"CAP-TSU:1.0
```

Why ';' ? What does 1.0 mean?

Meeting CAP Challenges

Google and others have proposed added extensibility options for CAP, but this still needs further discussion.

Do the CAP guiding principles need revisiting?

- **e.g., should they include sensor data or exclude sensor data?**

Security also needs to be considered. (e.g., FEMA does not support foreign name-spaces.)

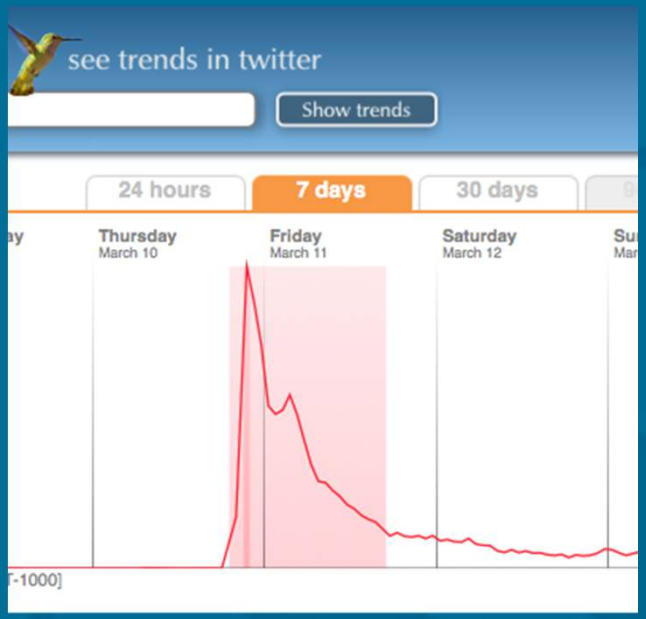
CAP Spinoffs & Benefits

CAP can easily drive geographically aware alerting systems:

- **IPAWS/WEA from FEMA**
- **Google Public Alerts**

And other systems that are fast, robust, and viral:

- **SMS text messaging**
- **Social media (twitter, facebook)**
- **Citizen-led initiatives such as #hitsunami**



Next Steps

Continue to promote and expand machine-to-machine exchange of event data within the tsunami community:

- **U.S., India, Indonesia, Australia etc. can exchange data during tsunami events**

Form a tsunami Community-of-Interest for anyone interested in the real time exchange of tsunami event data.

Grow TEX and CAP-TSU to address international needs.

Links

CAP-TSU

- http://ntwc.arh.noaa.gov/?page=cap

Tsunami Event XML

- http://ntwc.arh.noaa.gov/TEXDoc/

Tsunami Warning Markup Language (TWML)

- http://nicta.com.au/__data/assets/pdf_file/0007/7567/TsunamiWarningML-V10.pdf

CAP Extensibility Options

- https://www.oasis-open.org/committees/download.php/50028/CAPExtensibilityOptions_v2.pdf

Google Public Alerts

- https://www.wmo.int/pages/prog/amp/pwsp/documents/CAP-IW-2013-p03-10-US-Google.pdf

IPAWS

- http://www.fema.gov/integrated-public-alert-warning-system

Questions ?

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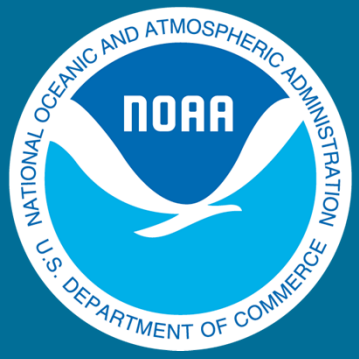

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