What do TERs do with TWC information?
Challenges in Alerting, Evacuation, and Safe to Return

Nicolas Arcos
UNESCO/IOC – NOAA
International Tsunami Information Center
TER goals

- Tsunami Emergency Response: A Race Against Time!
- Goal is to save lives and reduce property damage.
- Act FAST without confusion.

Tsunamis may or may not cause destruction.

Classified as “Destructive” or “Non-Destructive.” Non-destructive tsunamis are small, but measurable on sea level gauges.
TER Expectations

Key Question:
Has there been a destructive tsunami generated??
Yes or No??

Tsunami Decision Making Environment:
TER want “black & white, yes or no answers.”

TWC are operating in “shades of grey color.”
TWC “eyes and ears” sensors are earthquake and sea level detection instruments.

Limitations include:
- Lack of timely data.
- Lack of time to analyze data before wave impact.

Result => TWC may not be able to confirm the existence of a local destructive tsunami prior to official TER evacuation decision making.
TWC will provide

- Local tsunami scenario: preliminary analysis may be that there is “potential” of a destructive tsunami.

- At time of official evacuation decision making, there will likely be NO confirmation of the intensity of the tsunami waves. Local Tsunami Warning issued **based only on seismic data.**
TER - Alerting

- Wide Accessibility
- Speed
- Accurate and reliable
- Live updates
- 24/7
- Skilled Human Resources
- Established Infrastructure
- Established Broadcasting SOP
- Experience in Breaking News
- Provide Guidance
Alerting Example – Hawaii EAS Radio/TV
TER – Alerting Challenges

- Utility and communications systems disrupted or destroyed due to earthquake
- Areas where electricity is scarce
- Time of day (night people are sleeping TV/radio off)
- Communication system overloaded
“Local tsunami evacuation maps developed from inundation modeling, mapping, and community input”
Tsunami Evacuation - Challenges

Considerations - Distant & Local tsunami:

- Day time or night time
- People awake or asleep
- Regular business / school hours vs. non-duty hours.
- Weekday vs. weekends
- Tourist Peak vs. Off-season
- Traffic jams and rush-hour periods
- Television and radio stations off-air
- Little to no response personnel available to support evacuation (during local tsunami)
Evacuation Problems?

Issues:
- No high ground exists
- No time to go inland to high ground
- Special needs populations

Solutions:
- Vertical evacuation
# Siting, Spacing, and Sizing Considerations

After calculating percentage of the population needs a vertical evacuation structure

<table>
<thead>
<tr>
<th>Warning time</th>
<th>Ambulatory Speed*</th>
<th>Travel Distance**</th>
<th>Required Spacing</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt; 2 hrs</td>
<td>2 mph</td>
<td>4 miles</td>
<td>8 miles</td>
</tr>
<tr>
<td>30 min</td>
<td>2 mph</td>
<td>1 mile</td>
<td>2 miles</td>
</tr>
<tr>
<td>15 min</td>
<td>2 mph</td>
<td>1/2 mile</td>
<td>1 mile</td>
</tr>
</tbody>
</table>

* Assumed average speed of mobility-impaired population
** Must allow time for vertical circulation within refuge

ATC-64 Design and Construction Guidance for Vertical Evacuation from Tsunami
Vertical Evacuation - Considerations

- Structural costs will be higher
- Structural is only a portion of total building costs (5% to 40%)
- Tsunami-resistant structures would experience about 10% to 20% increase in total constructions costs
Evacuation Simulation – Owase City

Immediate Evacuate

20-min delay to Evacuate

Delay in Alert or Evacuation => more deaths
TER – Safe to Return (All-clear)

- Tsunami means series of waves striking the coastline for hours
- Resonance
- Debris (floating)
- HAZMAT spills
- Additional damage adding to earthquake impacts

Who declares “All-clear”? National/Provincial/Local TER…?
TER official evacuation decision impacts TEWS credibility

1. Action: Order timely, official evacuation...Result destructive tsunami. **Performance: Successful TEWS**

2. Action: Don’t officially evacuate ...Result non-destructive tsunami. **Performance: Successful TEWS**

3. Action: Officially Evacuate ...but result non-destructive tsunami. **Performance: TEWS Limitations – Credibility Degraded**

4. Action: Don’t officially evacuate ... result destructive tsunami. **Performance: Failed TEWS**

Note: There will be public criticism if alert notifications took too long to reach people on the coastline, or people not notified at all.
Pacific-wide Tsunami Warnings Issued
Sirens sounded, Statewide evacuations
BUT small, non-destructive tsunamis

1986 - mid-afternoon to pm rush hour
1994 - early morning to am rush hour

Losses
1994 (DBEDT Study) => $50M
(extrapolated) => $30M
(extrapolated) => $68M

Media reports shape public opinion
Successful Outcomes – Recommendations

• Disclose “End-to-End” TEWS limitations to stakeholder agencies and key decision makers at national/provincial/local levels.

• Convene joint press conference shortly after cancellation of tsunami warning event to explain what happened and how official evacuation decisions determined.
How to Improve Tsunami Response

Community-level

- Know tsunami natural warning signs
- Have evacuation maps
- Know evacuation routes/evacuation assembly areas
- Know community support network
- Have family plan and preparedness kit
- Know response for local and distant tsunamis
- Know community warning system
How to Improve Tsunami Response

Exercises Drills

• Drill evacuation of schools and communities
• Exercise communications protocols
• Exercise all levels of government
Thank You

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