



Intergovernmental
Oceanographic
Commission



UNESCO/IOC – NOAA ITIC Training Program in Hawaii (ITP-TEWS Chile)
TSUNAMI EARLY WARNING SYSTEMS
AND THE PACIFIC TSUNAMI WARNING CENTER (PTWC) ENHANCED PRODUCTS
TSUNAMI EVACUATION PLANNING AND UNESCO IOC TSUNAMI READY PROGRAMME
19-30 August 2024, Valparaiso, Chile

5.2 TER Overview:

What do TER agencies provide to the public?
Challenges in Alerting, Evacuation,
Safe-to-Return and Preparedness

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Director, ITIC



Tsunami Emergency Response (TER)

- **TER: Race Against Time!**
- **Goal: Save lives.
Reduce property damage.**
- **Must: Act FAST without confusion.**
- **Notes:**
 - Tsunamis may (or may not) cause damage.
May be “*Destructive*” or “*Non-Destructive*”
 - *Non-destructive tsunamis are small,
but measurable on sea level gauges.*

TER Expectations – Answer this

Key Question:

Has a destructive tsunami been generated?

Yes or No?

Tsunami Decision-Making Environment:

TER want “black & white => Yes or No answer”

YES

NO

TWC operate in “shades of grey color”

Tsunami Warning Center (TWC) - reality

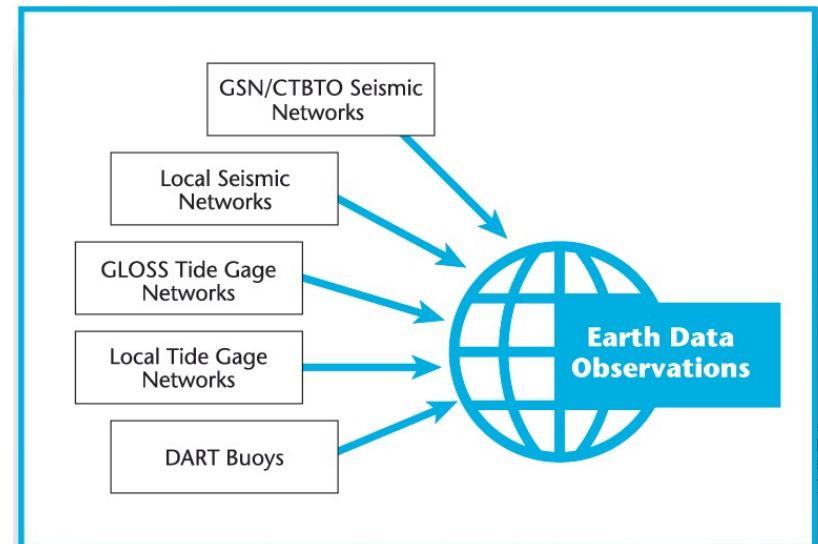
TWC: “eyes and ears” are earthquake and tsunami **detection instruments**.

Limitations include:

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

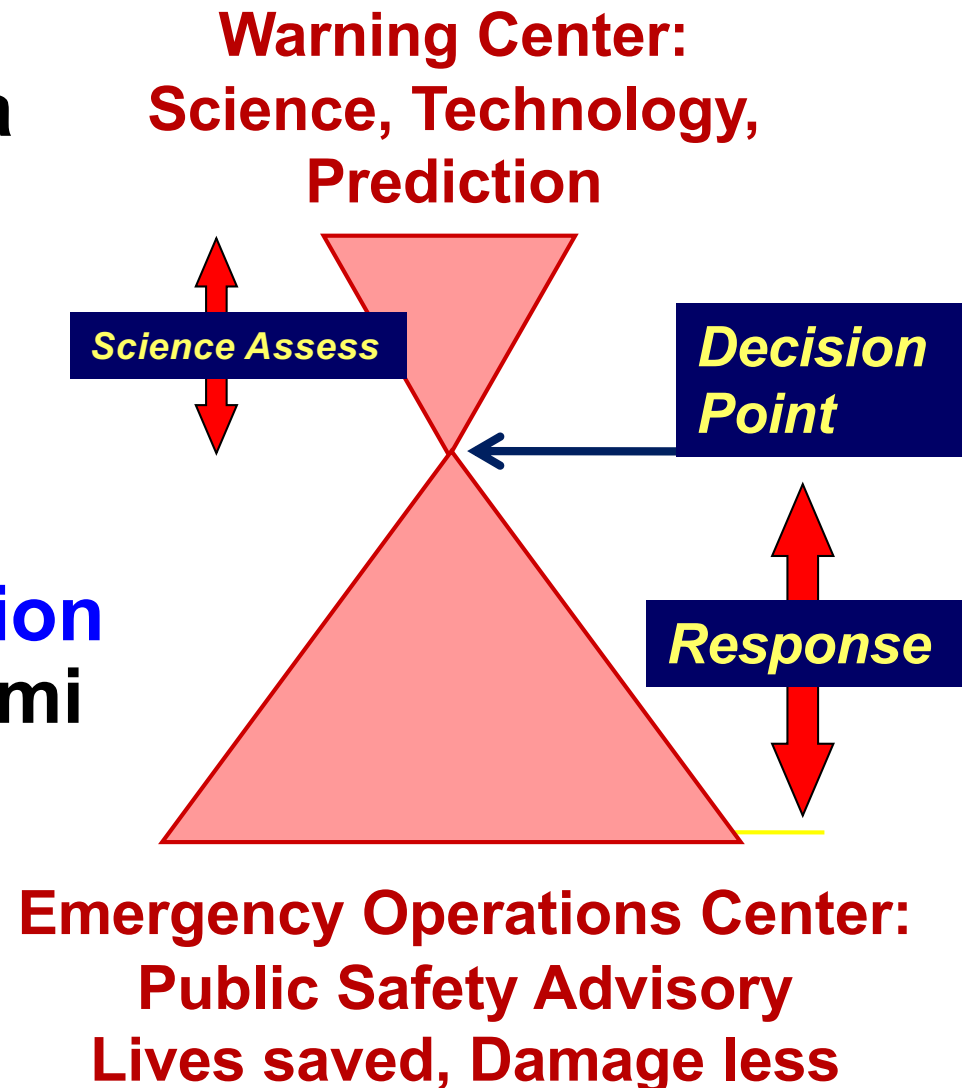
Result =>

TWC may not be able to confirm existence of local destructive tsunami prior to official TER evacuation decision making.



TWC provides – esp Local Tsunami

- Preliminary analysis:
There is “**potential**” of a destructive tsunami.
- At time of official evacuation decision making:
 - Likely **NO confirmation** of intensity of tsunami waves.
 - Local Warning issued **based only on seismic data.**



TER Saving Lives - Tsunami Evacuation

Modeling → Inundation map → Evacuation map



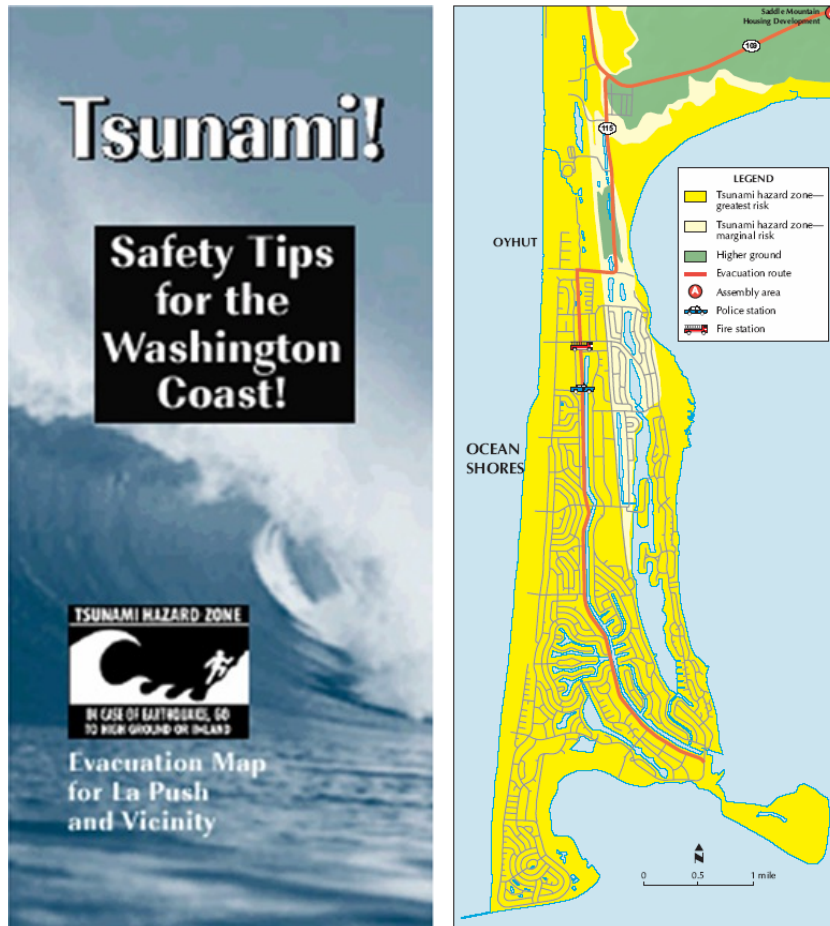
Tsunami evacuation maps are community-owned

Evacuation - Challenges

Distant & Local tsunami responses:

- ❑ Day time or night time
- ❑ People awake or asleep
- ❑ Regular business / school hrs vs. non-duty hrs
- ❑ 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
- No time to go inland
- Special needs populations

Solution:

- Vertical evacuation
- How high, strong?

Assembly Area - Siting, Spacing, and Sizing

Warning time	Ambulatory Speed*	Travel Distance**	Required Spacing
> 2 hrs	3.2 km/hr (1 m/s) 2 mph	6.4 km 4 miles	12.8 km 8 miles
30 min	3.2 km/hr (1 m/s) 2 mph	1.6 km 1 mile	3.2 km 2 miles
15 min	3.2 km/hr (1 m/s) 2 mph	0.8 km 0.5 mile	1.6 km 1 mile

* Assumed average speed of mobility-impaired population

** Must allow time for vertical circulation within refuge

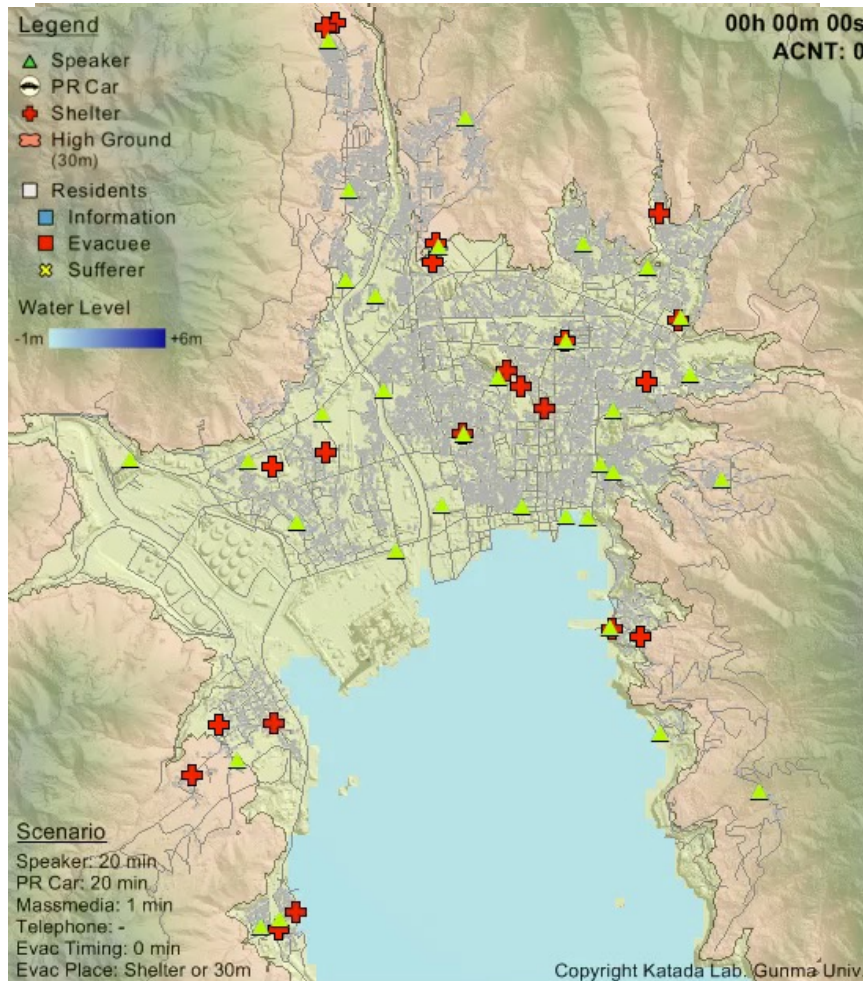
Evacuation Simulation – Owase, Japan



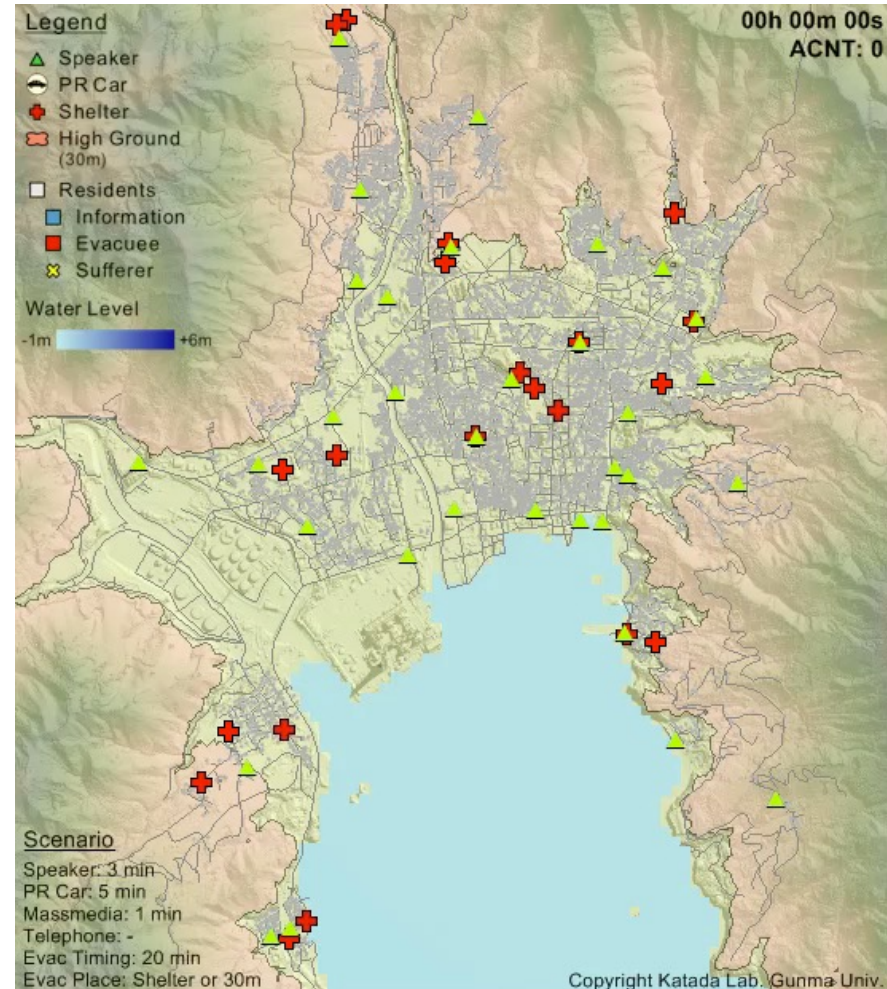
Map of Owase City (Kii Peninsula, Japan)

Evacuation Simulation – Owase, Japan

Delay in Alert or Evacuation => more deaths



Immediate Evacuate



20-min delay to Evacuate

Evacuation Simulation – Owase, Japan

Examples of casualties resulting from simulation runs

		Timing (min) of Official Tsunami Warning												
		1	2	3	4	5	6	7	8	9	10	20	30	60
Evacuation Start Timing (min)	0	0	0	0	0	0	0	0	0	0	0	1	1	7
	1	0	0	0	0	0	0	0	0	0	0	1	1	10
	2	0	0	0	0	0	0	0	0	0	0	2	2	17
	3	0	0	0	0	0	0	0	1	1	1	4	6	32
	4	0	0	0	0	0	1	2	2	4	3	7	14	50
	5	0	0	0	1	2	4	6	7	8	7	12	20	75
	6	0	1	2	5	8	9	9	9	11	10	17	44	120
	7	1	2	7	9	9	13	14	13	12	12	36	94	190
	8	1	8	10	10	12	15	17	19	16	19	81	148	302
	9	9	11	13	12	12	24	26	51	53	56	189	273	440
	10	11	14	14	17	41	72	91	124	148	165	373	463	566

TWC Cancellation versus “All-Clear”

- ❑ **Cancellation Message issued by TWCs**
 - Officially cancels warning, watch, and advisory messages
 - Means that destructive waves have stopped in areas that can be monitored by the TWCs
 - Does not mean it is safe to return to Tsunami Hazard Zone

- ❑ **Official All-Clear issued by local authority when it is safe to re-enter the Tsunami Hazard Zone**

TER – Safe to Return (All-Clear)

- ❑ Tsunami is a series of waves striking coastline for hours
- ❑ Resonance in bays / harbors
- ❑ Debris (floating)
- ❑ HAZMAT spills
- ❑ Additional earthquake damage
- **Who declares “All-Clear”?**
National/Provincial/Local TER...?

Evacuation Decision affects Credibility

<i>ACTION</i>	<i>RESULT</i>	<i>PERFORMANCE</i>
Official Evacuation	Destructive Tsunami	Successful TWS
No Official Evacuation	Non-destructive Tsunami	Successful TWS
Official Evacuation	Non-destructive Tsunami	TWS limitation - Credibility Downgraded
No Official Evacuation	Destructive Tsunami	Failed TWS

Note: There will be public criticism if alert notifications took too long to reach people on the coastline, or people not notified at all.

Achieving Successful Outcomes

- **Disclose “End-to-End” TWS limitations *beforehand* to Stakeholders (agencies, key decision-makers at National / Provincial / Local levels)**
- **Convene Press Conference shortly after Warning cancellation to explain what happened and how official evacuation decisions determined.**



Improving Tsunami Response

Community-level focus / customize outreach:

- ❑ Know tsunami natural warning signs
- ❑ Have evacuation maps
- ❑ Know evacuation routes/assembly areas
- ❑ Have 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 - schools easiest)
- Exercise communications protocols - critical
- Exercise all levels of government – want seamless action w/o confusion





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Thank You
Muchas Gracias

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