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

unesco
Intergovernmental Oceanographic Commission

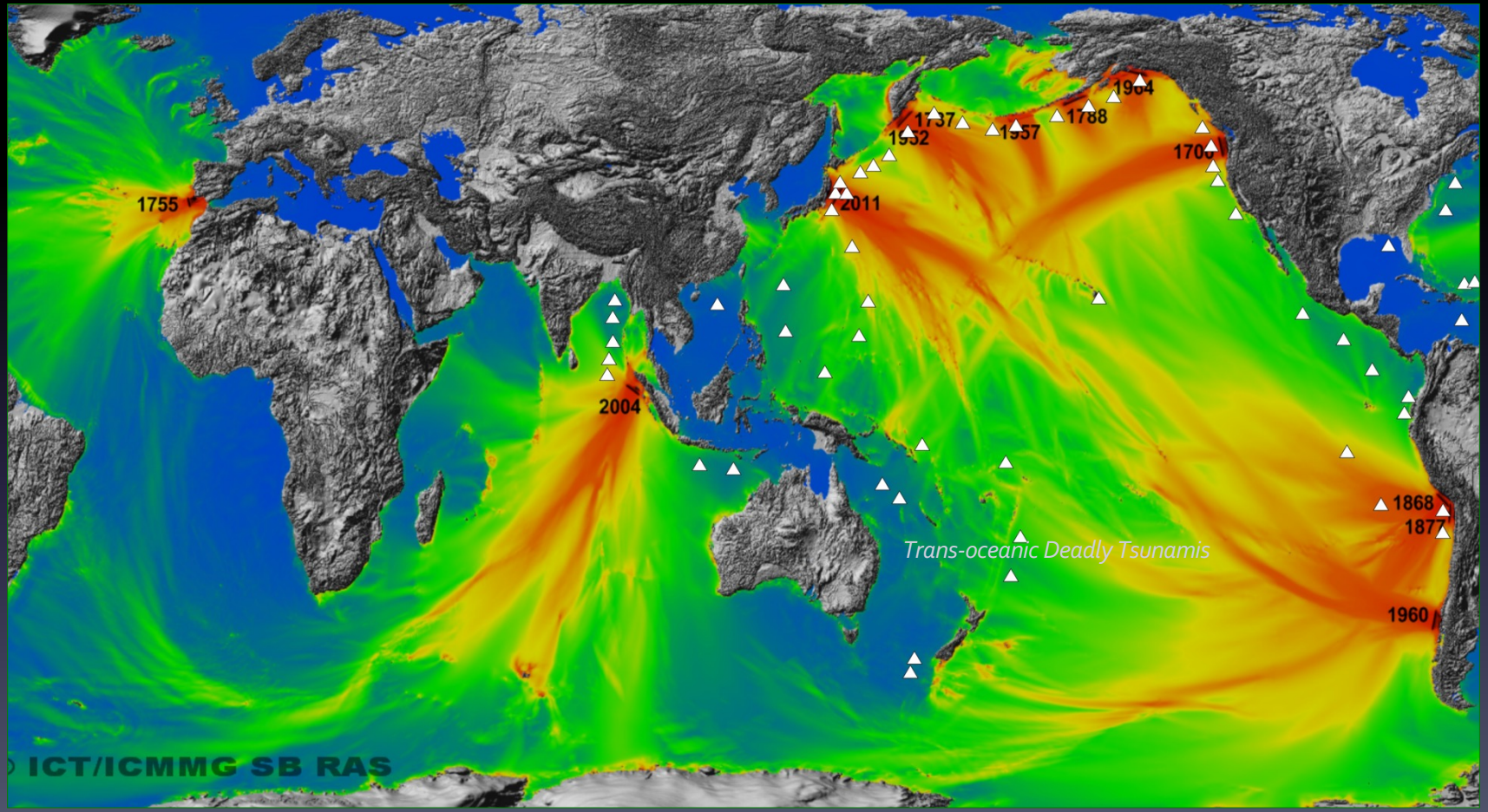
Responding Rapidly and Effectively: Tsunami Warning and Emergency Response Requirements and Timeline-driven SOPs

Dr. Laura Kong
Director, ITIC, USA NOAA

USAID FROM THE AMERICAN PEOPLE

SMART CABLES Earth's Pulse

Historical Teleseismic Tsunamis



TSUNAMI WARNING – 2 THREATS

LOCAL / REGIONAL:

- Generated nearby
- Strikes shore quickly (in minutes)
  => NO TIME for official evacuation
- ➢ Education, Awareness, Preparedness
- ➢ Every person recognizes / acts immediately

February 27,2010, Chile

DISTANT / OCEAN-WIDE:

- Generated far away, instr detection
- Strikes shore later (2+ hours)
  => TIME for official evacuation
- Widespread Damage
- ➢ Tsunami Warning Centre, then
- ➢ People know what to do and where to go - evacuate

May 22, 1960, Chile tsunami in Hilo

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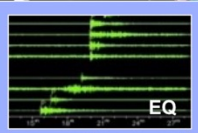
SAVING LIVES BY EARLY WARNING

EQ
Tsunami



Country
Alert System

Emergency Alert System
& Mass Media

Public

TWC - Science | DMO / EMA – Safety

Intl / Natl | Natl / Prov / Local Govt | Community

EQ
T=0

Race against Time

LIVES
SAVED

WAVE
T=20 min

Effective Tsunami Warning

- **2 Key Stakeholders – work closely together**
  Warning, Response, Awareness, Preparedness
- **NATIONAL TSUNAMI WARNING CENTER**
  - Assess and confirm dangerous tsunami
- **NATIONAL / LOCAL DISASTER MANAGEMENT**
  - Assess threat to coastal community
  - Inform community/public what to do
    (Evacuate, All-Clear safe-to-return)
- **COMMUNITIES ACT**
  - Aware and prepared
  - How to receive warning, what to do, where to go

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Taking Action – Timely Warnings

- **Goal**:
  Act fast
  w/o confusion

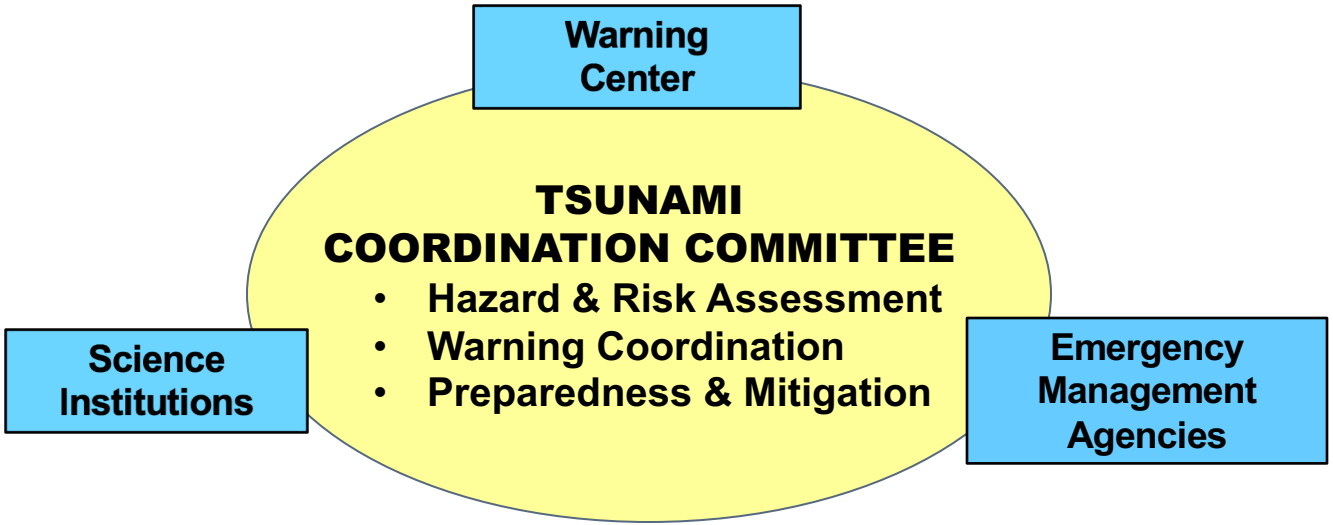
- **Requirements**:
  - Know what to do
    - Develop TWC and TER / DMO SOPs
  - Practice
    - Test Communications end-to-end
    - Conduct Drills since tsunamis are infrequent

SOP Definition

"A description and procedure on agreed steps by institutions used in coordinating who, what, when, where and how for tsunami early warning and response"

From Indonesia Local SOP Workshops: Capacity Building for Development of Local SOPs for Tsunami Early Warning and Response. 2006-2007

Stakeholder Coordination is Essential



Civil Society & NGOs

- **Community organizations** (social, gender, cultural, age, language, religious …)
- Trade, business organizations
- Disaster response & relief

Government Agencies:

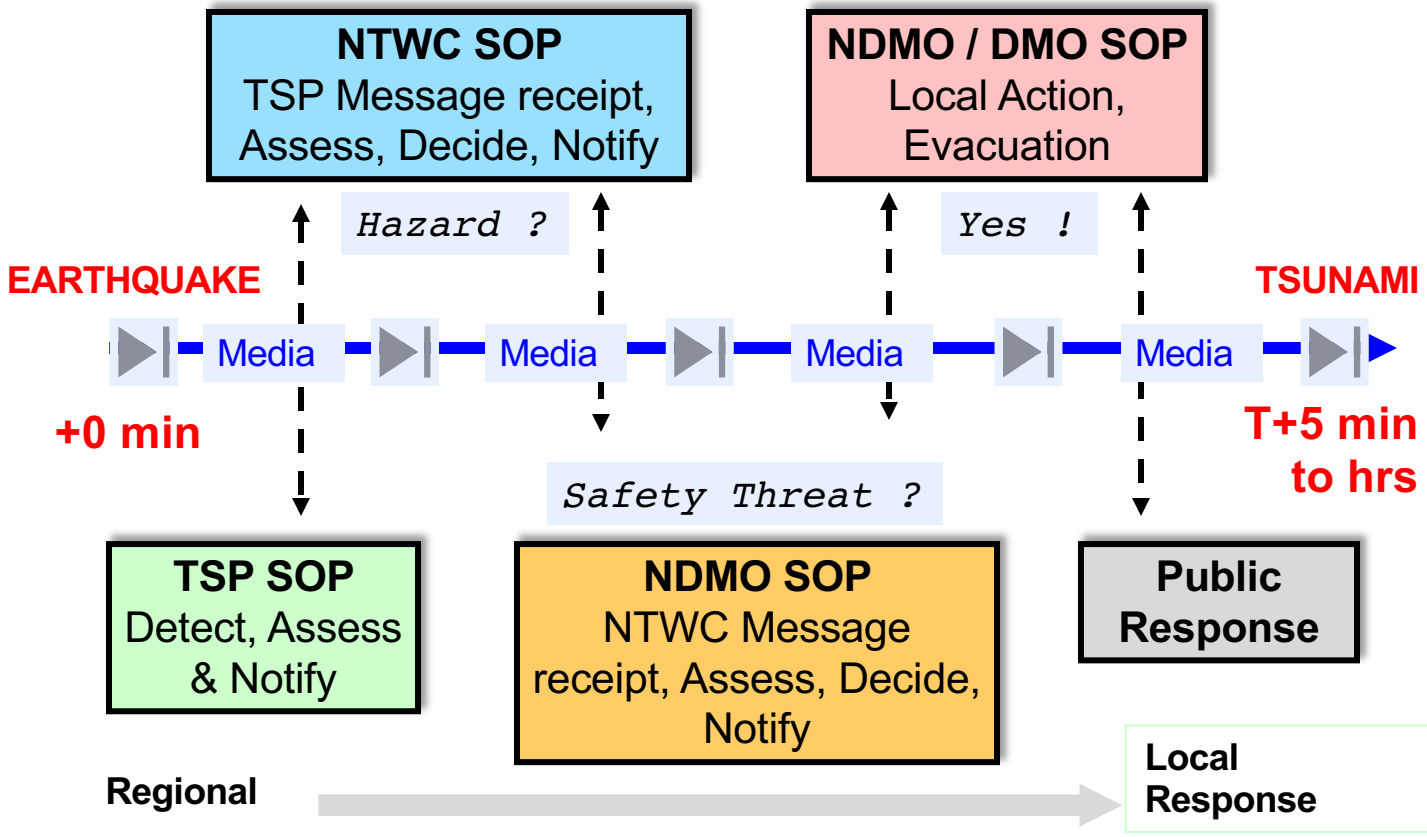
- Planning & Development
- Transportation
- Health & Education
- Coastal Management
- Social Services

Other:

- Media
- Utilities
- Tourism
- International Agencies

ITIC, NZ, IOC, SeismicReady Consulting, 2009-2015

End-to-End Warning and Response



Build Strong, Reliable Systems
Science & Technology

- Earthquake Monitoring and Analysis
- Tsunami Monitoring and Detection
- Forecast Modeling
- Warning Communications
- Hazard Risk Assess – Paleotsunami history
- Hazard Risk Assess – Engineer Strong Structures
- Hazard Risk Assess – Ports and Harbors Policy

Tsunami Early Warning: What needs to be in place to save lives - warn, respond

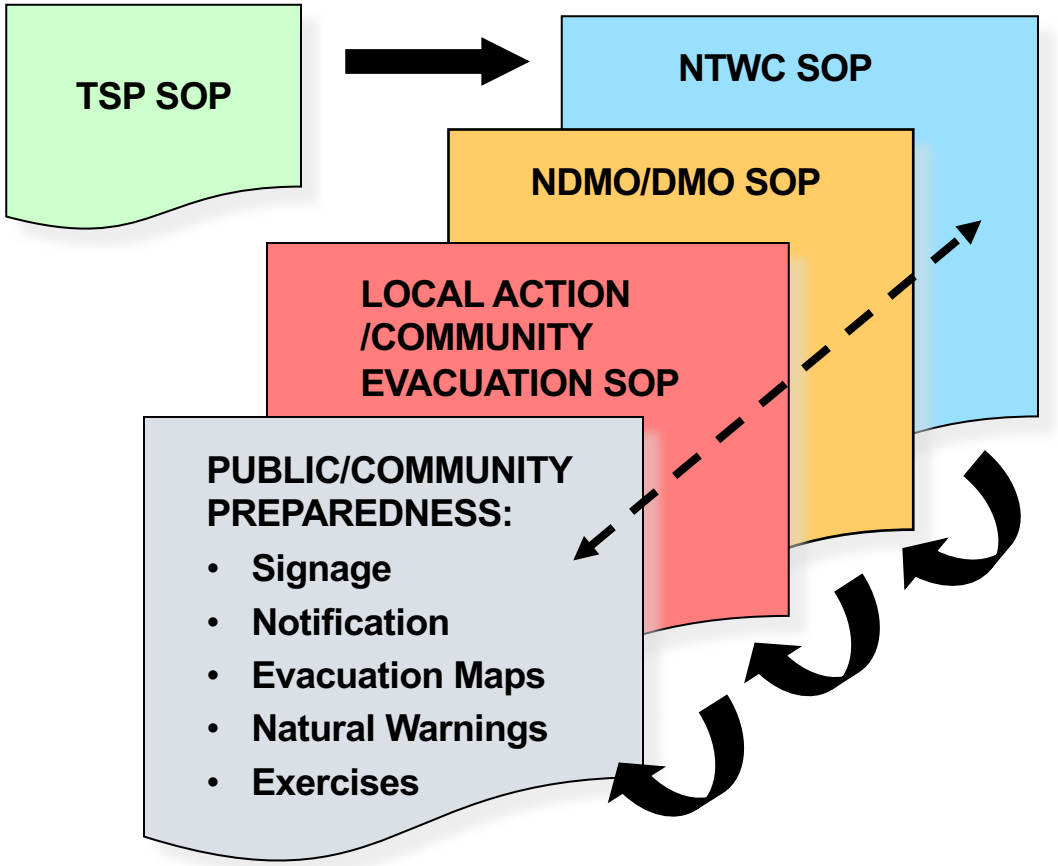
- **Warn.** Early Detection, Assess, Rapid Alerting
  Earthquake triggers. Forecast gives threat.
  Sea Level Monitoring confirms tsunami

- **Respond.** Community at risk, Evacuate, Safe Return
  Pre-event planning, maps, and practice exercises
  Hazard Risk assessment – vulnerable communities

➢ ***Ready, Rapid, Reliable***

Credibility requires same-quality response (SOPs)

Warning Chain – set of linked SOPs

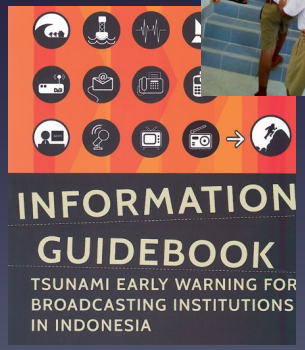


Plans & Procedures (SOPs): Practice

A perfect warning will be useless if people do not know what to do in case of an emergency

Build Strong & Reliable Systems
Preparedness

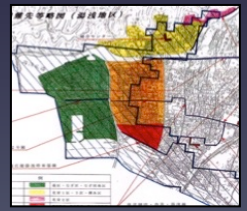
- Education and Awareness
- Indigenous Knowledge
- Evacuation
- Exercises
- Training



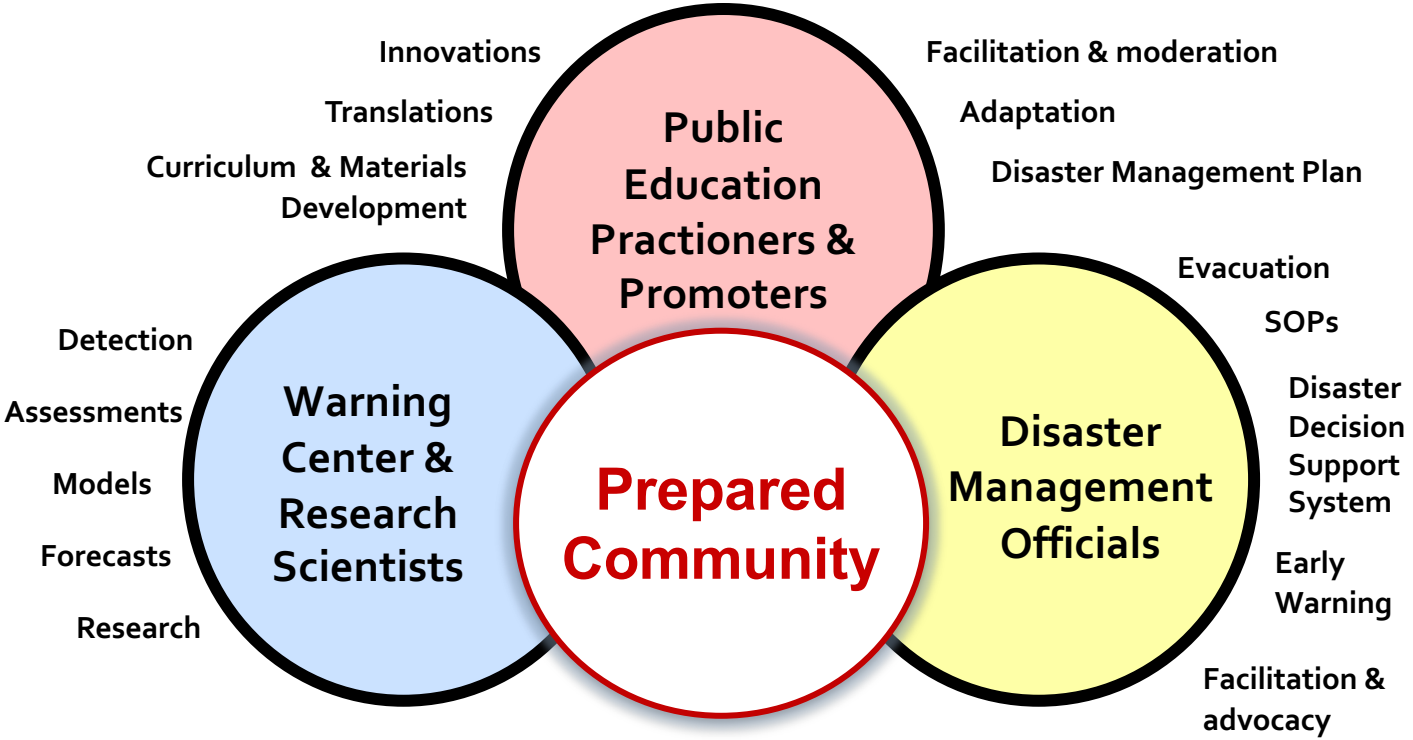
Tsunami Emergency Response:

Alerting a Prepared Public to Evacuate Beaches

- Early and Sustained Education and Awareness
- How will Alerts be quickly disseminated?
- What to expect? Which communities?
- Evacuation - What to do? Where to go?
  - 1st choice: Inland to higher ground
  - Last choice: vertical evacuation

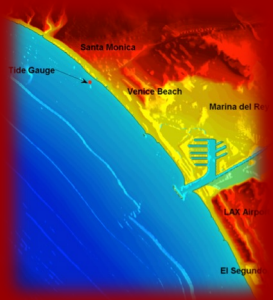


Community Preparedness is collaborative



GOAL: Disaster-resilient community "TSUNAMI READY"

Indonesia, I. Rafliana, 2008
ITIC, L. Kong 2013



Tsunami Evacuation Maps, Plans, and Procedures (TEMPPs)

… communities knowing what to do and where to go

ITIC Essential Community Preparedness
Capacity Building, Honduras, Central America, 2015-16

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Great East Japan Tsunami
Warning decision point, Evacuation, and Human Response

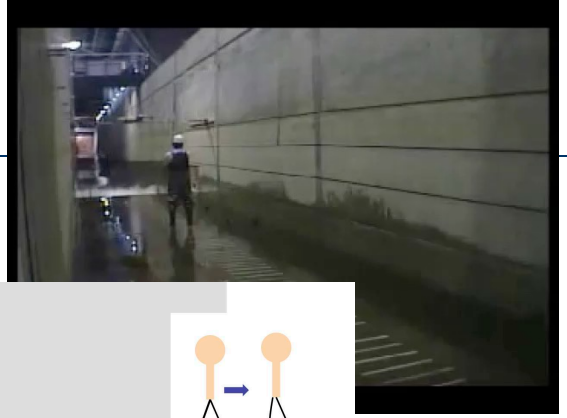
Deciding to issue warnings – Facts

- **JMA Warning timely,** incl wave forecast 3+ m
  (but was underestimate)
- **Small waves can be dangerous**
  Laboratory expts show waves 30 cm flow depth cause people to lose balance / cars to float
- **Swift-moving waves are dangerous**
  especially later waves as debris-laden rivers and/or walls of water.
- **Most people evacuated. Some did not.**
  Only 5% died, nonetheless, it was ~18,000

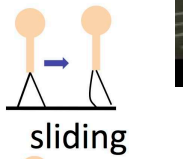
⇒ **NTWC DECISIONS MUST BE CONSERVATIVE (ENSURE SAFETY)**

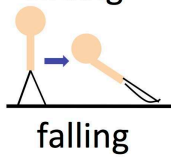
⇒ **FOR LOCAL, PUBLIC SELF-EVACUATES - DO NOT WAIT FOR NTWC**

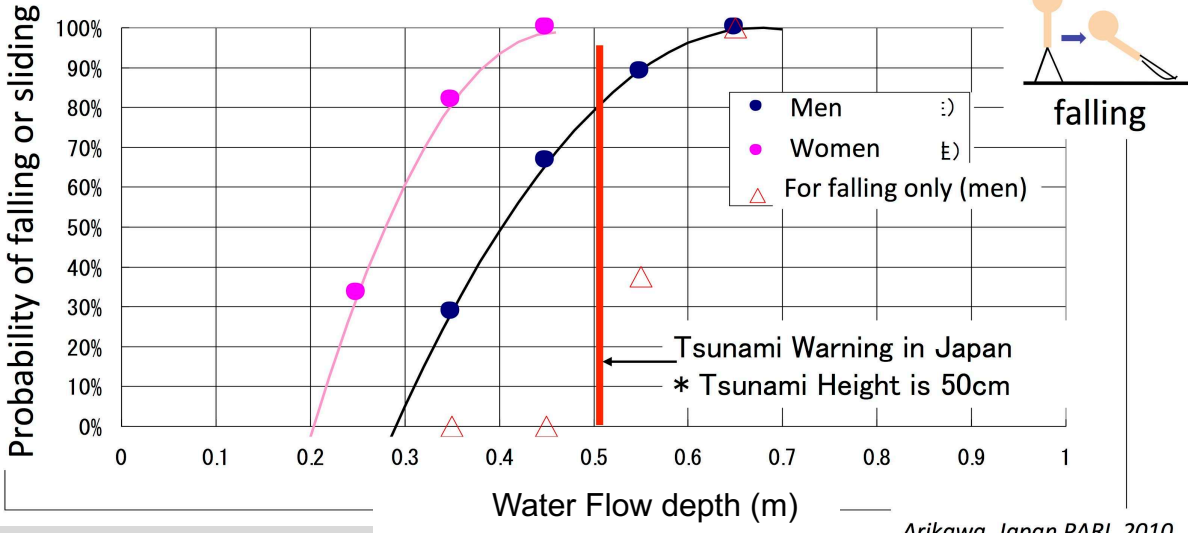
Flow Depth – Humans



Preliminary Results:
Probability of falling or sliding
=> lose balance at 0.3 m (1 ft) depth







Arikawa, Japan PARI, 2010

Velocity > 2-3 m/s (7-11 km/hr, 4-7 mph, 4-6 kts)

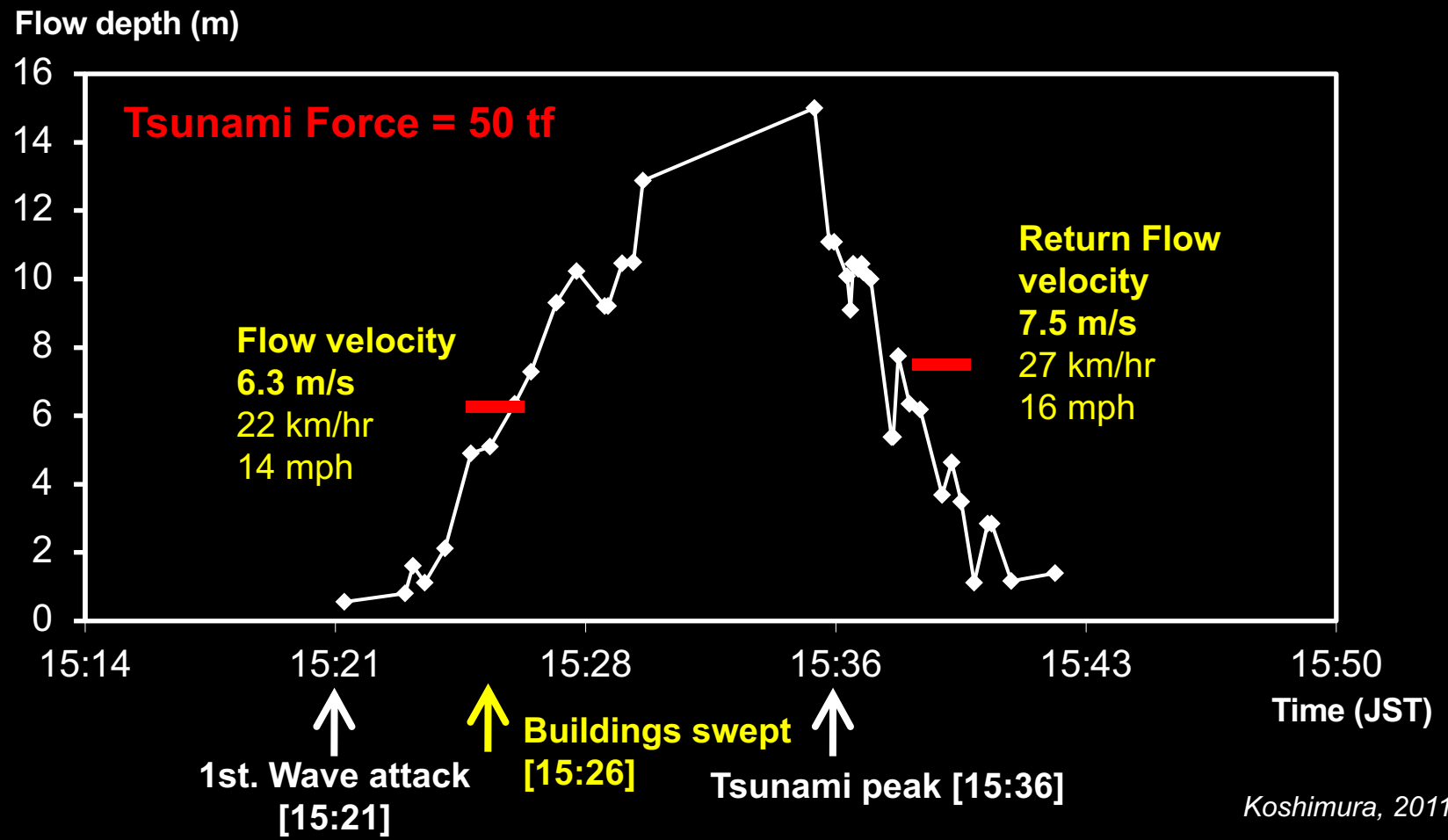
Onagawa, Miyagi Pref.

www.town.onagawa.miyagi.jp：
Fatality：455, Missing：739 (Pop.10,010). 12% of population were killed or missing.
Destroyed houses/buildings： 4432. 70% of houses in town was severely damaged.

Koshimura, 2011

Koshimura, 2011

Time series of tsunami inundation interpreted from video



Koshimura, 2011

Onagawa, Japan

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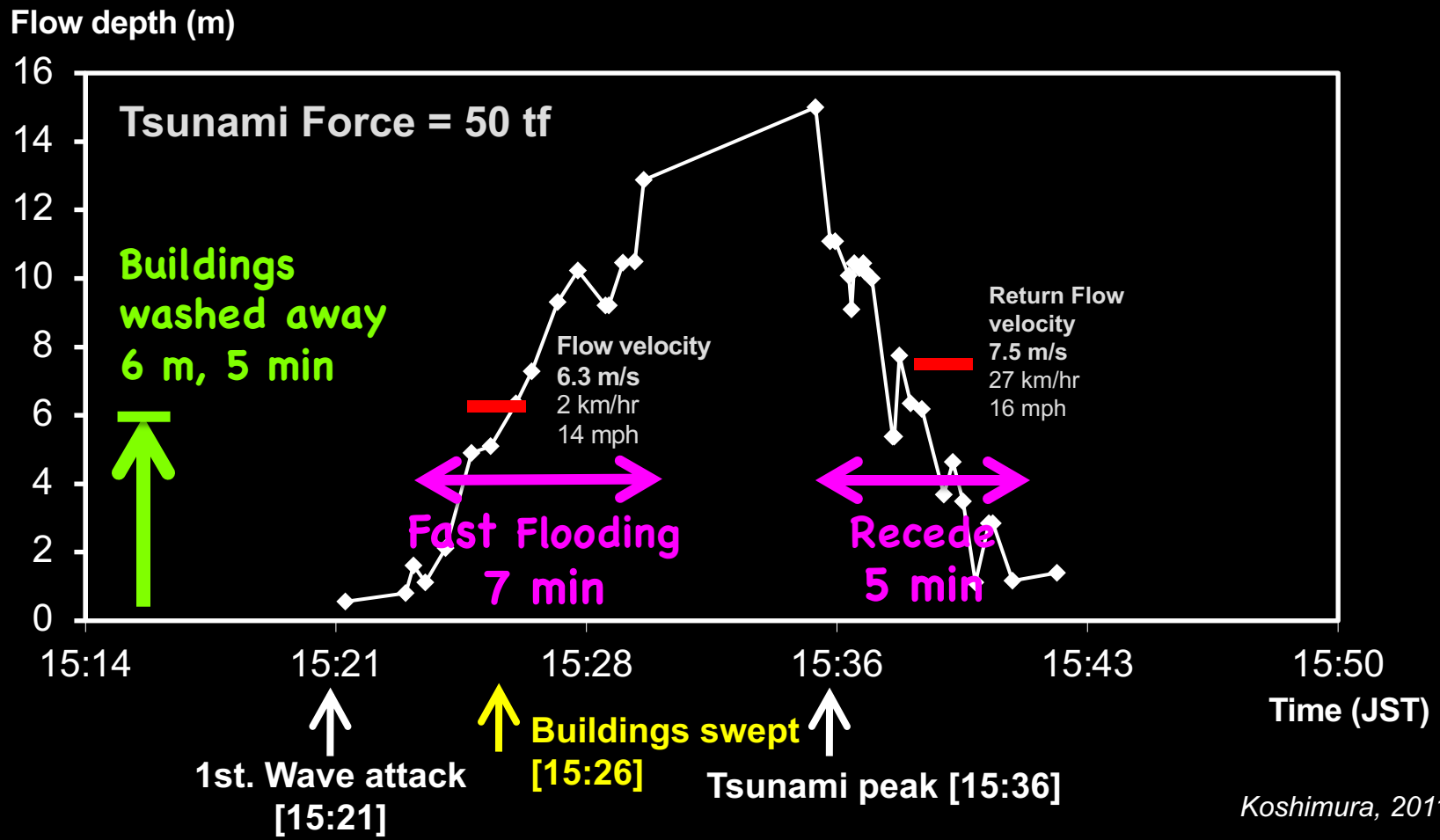
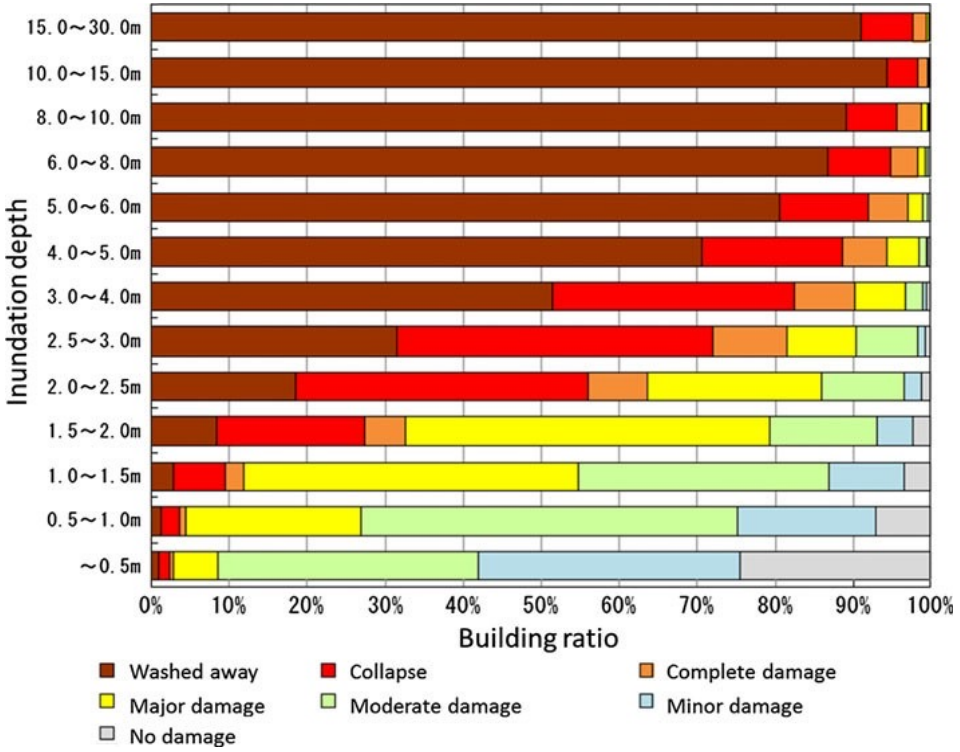


Koshimura, 2011

Flow Depth - Building Damage



11 March 2011 Data: Fig. 2 Distribution of the total 251,301 building data surveyed by MLIT (2012) Ministry of Land, Infrastructure and transportation (MLIT): Survey of tsunami damage condition: http://www.mlit.go.jp/toshi/toshi-hukkou-arkaibu.html. Accessed 4 July 2012

Suppasri et al., 2013

Tsunami Impact - summary

Criteria to estimate damage by tsunamis

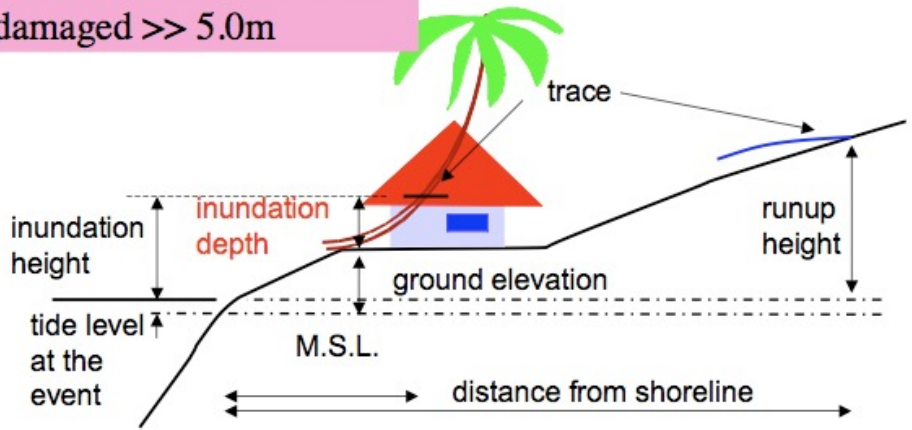
Inundation depth

Human: killed >> 50cm

House: partially damaged >> 1.0m

totally damaged >> 2-3.0m

Building: damaged >> 5.0m



Expect Fast Flooding - Have a Personal Plan

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Thank You
Muchas Gracias

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Earth's Pulse