

Tsunami Safety: Engineering Formulae vs Land-Use Planning

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Around the world...

- Tsunami hazards are dealt with via land-use planning, education, and evacuation plans.
- Japan, by far the most experienced nation, uses a national law governing what uses can be made of areas expected to be inundated.
- Prefectures and municipalities can have different approaches locally.

Japanese National Law (2012)

- ...stipulates that areas expected to flood at a depth of 2 m or less (which was the case for many locations in the recent tsunami) are suitable for residential use, but areas expected to flood at a depth of more than 2 m are designated as **non-habitable areas** in the application of disaster hazard zone regulations. Land use in these areas is **limited to industrial uses or parks**; residential use is not permitted ("Tsunami Disaster Reduction Levels"). In such cases, the residential functions of villages and towns have to be moved to higher ground or to more inland locations.
- Summarized from "The Great East Japan Earthquake 2011, Recovery Status Report 06", Cabinet Office of Japan, Asia Disaster Reduction Center, UNISDR.

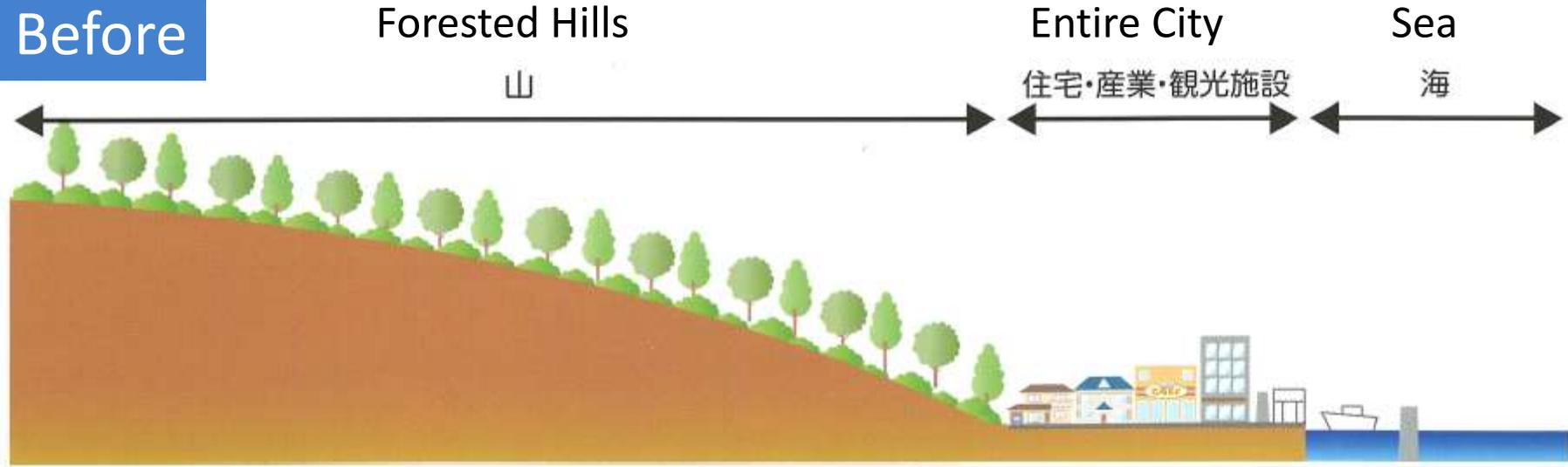
Japanese strategy

- Coastal zone and land-use planning
- Sea walls and water discharge tunnel
- Hazard maps
- Safety guidelines
- Evacuation procedures
- Emergency kits, food supplies and shelters
- Warning and prediction systems

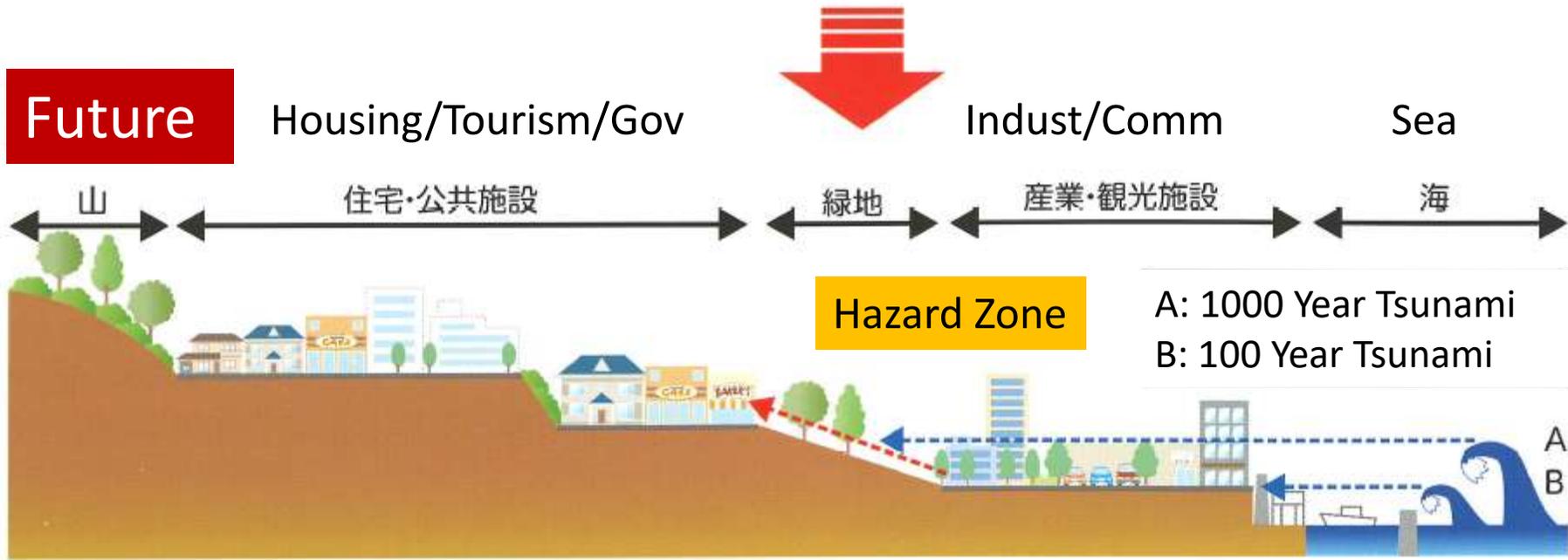
Minamisanriku - Relocation to Higher Ground

Two Levels of Tsunami Protection: 100 yr (seawalls) and 1000 yr (elevation)

Before



Future



A: 1000 Year Tsunami
B: 100 Year Tsunami

Elsewhere in the world, including Oregon, the same approach is in use.



OFFICE FOR COASTAL MANAGEMENT
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

Counties and municipalities on the Oregon coast have adopted the DOGAMI TIMS maps and their own land use planning in the absence of State leadership. This has been underway for many years led by DLCD in collaboration with NOAA.



Prepared by
The Department of
Land Conservation
and Development

April 2015

**Preparing for a
Cascadia Subduction
Zone Tsunami:
A Land Use Guide
for Oregon Coastal
Communities**

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- In no case that I have found, has land use planning as the primary tool been rejected in favor of either:
 - 1) nothing, or
 - 2) an engineering formula approach, or
 - 3) anything else.

Analysis of proposed ASCE 7-16 Tsunami modeling.

DOGAMI Open-File Report O-19-04 Released August, 2019. The report compares AECOM modeling by Hong Kie Theo (ASCE 7-16) to DOGAMI models developed by Tsunami modeling team 2008-2013.

CG comments:

- DOGAMI approach used a team of experts to assess earthquake sources, geodetics, ground deformation, paleoseismology, hydrodynamics and topographic models over five years
- Models are consistent with best available scientific evidence on recurrence, source zones, tsunami runup, past event subsidence etc.
- All of the data, results and conclusions are published in peer reviewed international journals. (Priest et al., 2009, Priest et al. 2013, Priest et al., 2014, Witter et al., 2011, Witter et al., 2012, Witter et al., 2013, Priest et al., 2017, Goldfinger et al., 2012, 2013, 2017)).

Analysis of proposed ASCE 7-16 Tsunami modeling.

CG comments continued:

- AECOM models did not use geologic, geophysical, or geodetic data from Cascadia to define locking patterns.
- Global averages were used instead.
- AECOM models done by a single investigator without a track record in the field, are not published or reviewed, have not been accepted by the community of Cascadia researchers.

Analysis of proposed ASCE 7-16 Tsunami modeling.

DOGAMI report results:

- Source zones not obvious, and not provided by AECOM even on direct request.
- Slip on the fault not balanced or consistent with plate motion. Some extreme slips (> 150 m) are included, but not reported anywhere on Earth.
- Estuaries poorly simulated (poor DEM's used, no Lidar data)
- Lower tide levels used (less conservative)
- Doesn't provide time histories of current forces and magnitudes.
- AECOM sources are random, and do not make use of the well developed Cascadia paleoseismic record. Many simulations included for which there is no evidence.

Analysis of proposed ASCE 7-16 Tsunami modeling.

DOGAMI report results continued:

- Source slip magnitudes taken from global averages of other subduction zones, a poor fit for Cascadia.
- AECOM included more of the partial ruptures in Southern Cascadia (good). But did not include a splay fault rupture, and important feature in Oregon and Washington that generates large tsunami (bad).
- The overall result is that AECOM/ASCE tsunamis are quite a bit **larger** than produced by DOGAMI for any time range of interest for central and northern Cascadia. 42% of the events have larger slip than considered possible by DOGAMI due to lack of physical constraints on the AECOM models.

Analysis of proposed ASCE 7-16 Tsunami modeling.

DOGAMI report results continued:

- Southern Cascadia tsunami from AECOM are just the opposite, very **small**, likely due to underestimation of slip based on global averages. This difference is less obvious in terms of causes and whether or not it makes physical sense.

The bottom line is the AECOM tsunami models are not defensible scientifically, produce an erratic and unusable set of inundation lines, and most importantly, are no substitute for sensible land-use planning.

This is an important topic for open public discussion that has received almost no attention at all, and should.



Mayor Jin Sato, Minami sanriku

Buildings constructed to the ASCE code will look like this after the tsunami. A structural success, but still destroyed functionally. Everyone in this building died except for Mayor Sato and a few others who climbed the cell tower





Questions?

Thanks for your attention!

