


Peru-Chile-Japan Joint Symposium on Earthquake and Tsunami Disaster Mitigation  
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**Lessons learned from the 2011 Great East  
Japan Earthquake/Tsunami  
towards tsunami-resilient communities**

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# ***The 2011 Tohoku Tsunami***

15:59:24;28

An aerial photograph showing a coastal town and surrounding fields. The town is densely packed with buildings, and the surrounding area consists of large, flat fields. The image is slightly hazy, and the timestamp '15:59:24;28' is overlaid in the upper center.

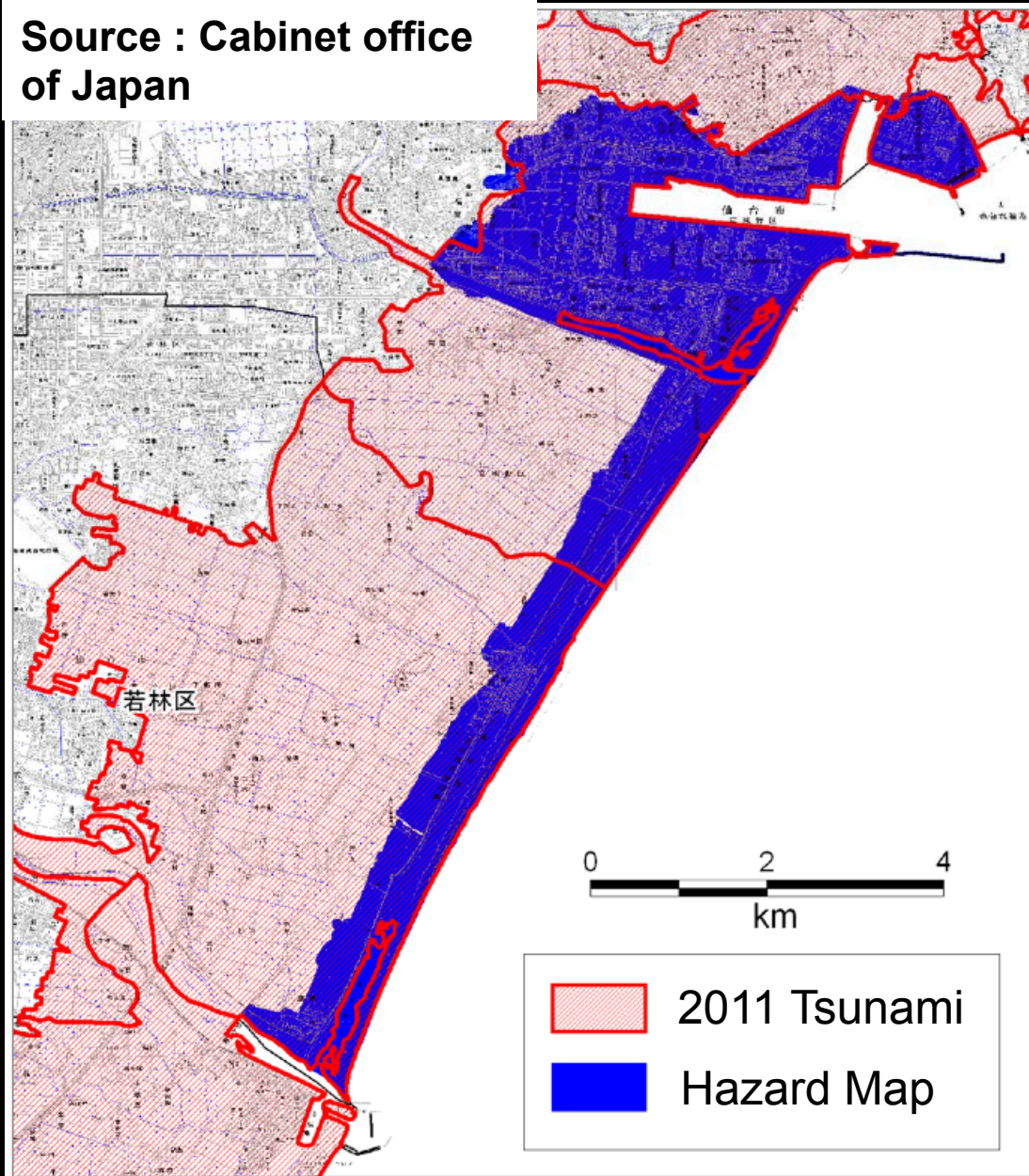
NHK

# *Topics*

- Hazard map
- Coastal defense structure
- Structural vulnerability
- Reconstruction and Land use management

***The tsunami was far more extensive than expected***

Source : Cabinet office  
of Japan



***Sendai city  
Fatality : 755***



# ***Lesson***

**Tsunami hazard map helps for understanding risks. However, sometimes the tsunami will be higher and more extensive.**

**We should change our perception, attitude and norms to risks.**



# Devastated Seawalls

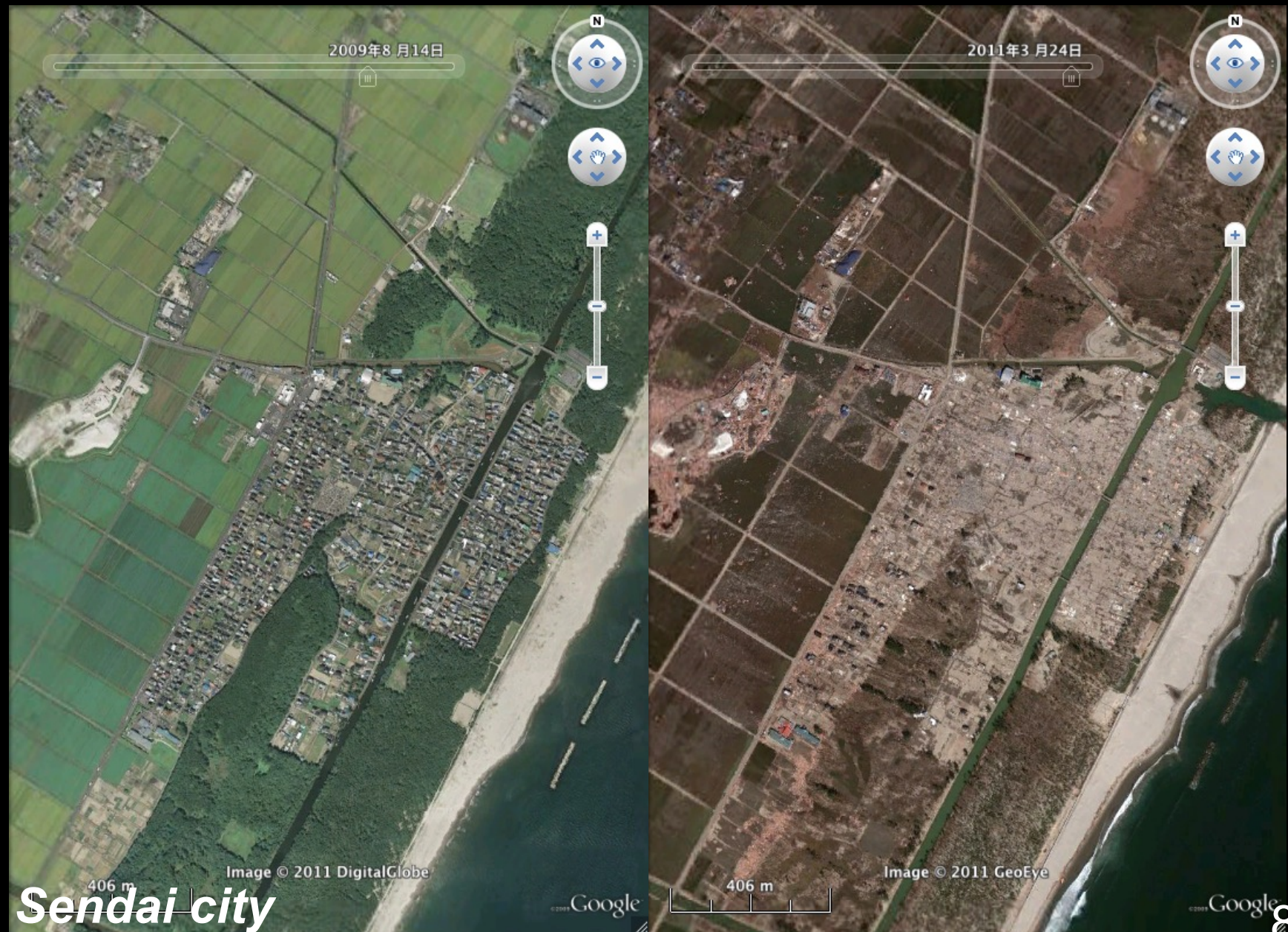


## *Lesson*

**Breakwaters and seawalls can NOT always protect our lives and properties. It's design should assume overtopping and resiliency.**

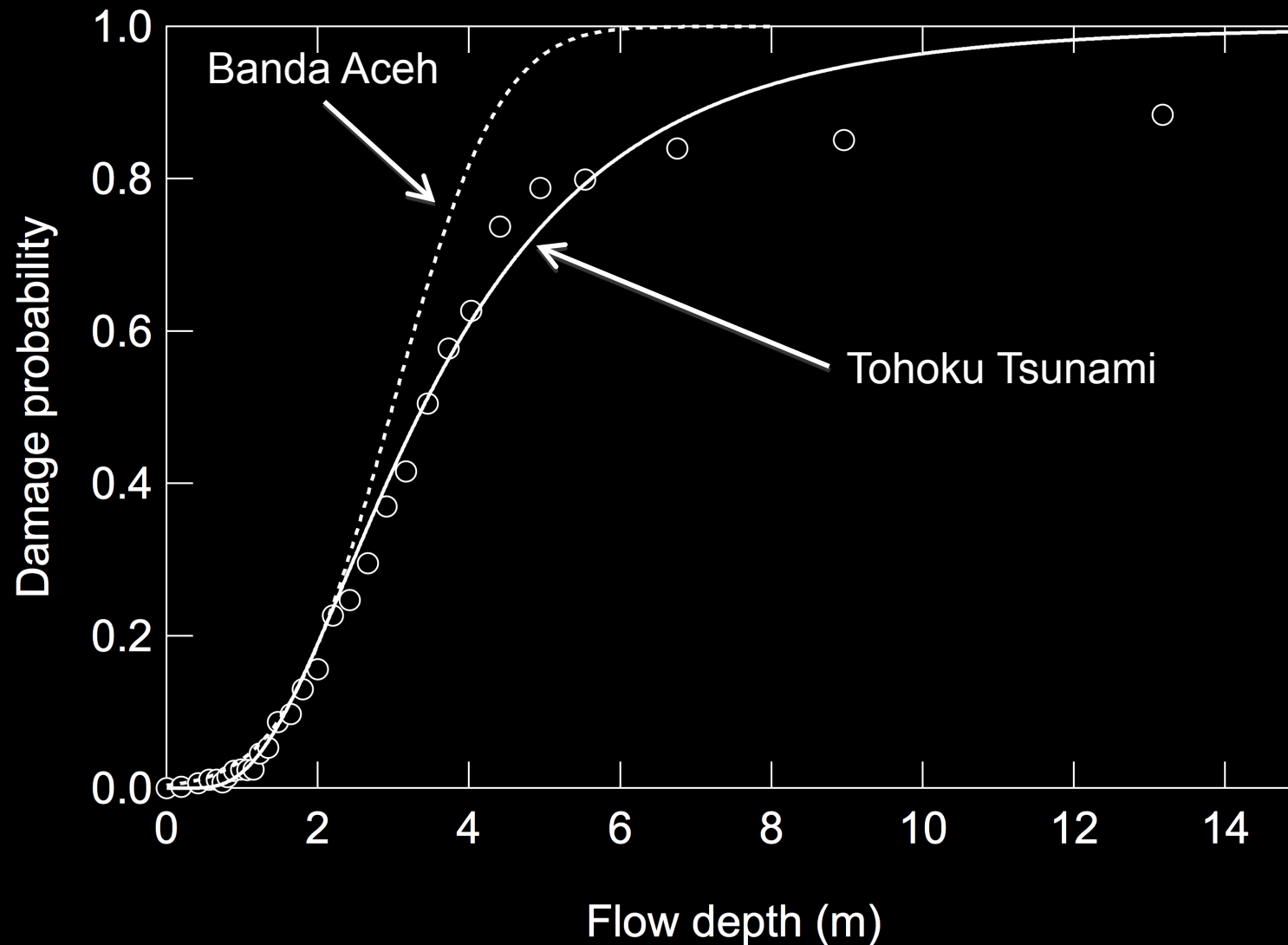


# *Devastated coastal communities*





# ***Structural vulnerability Tohoku & Banda Aceh***



# ***Lesson***

**2 m tsunami flow depth potentially causes severe damage on houses or may devastate.**

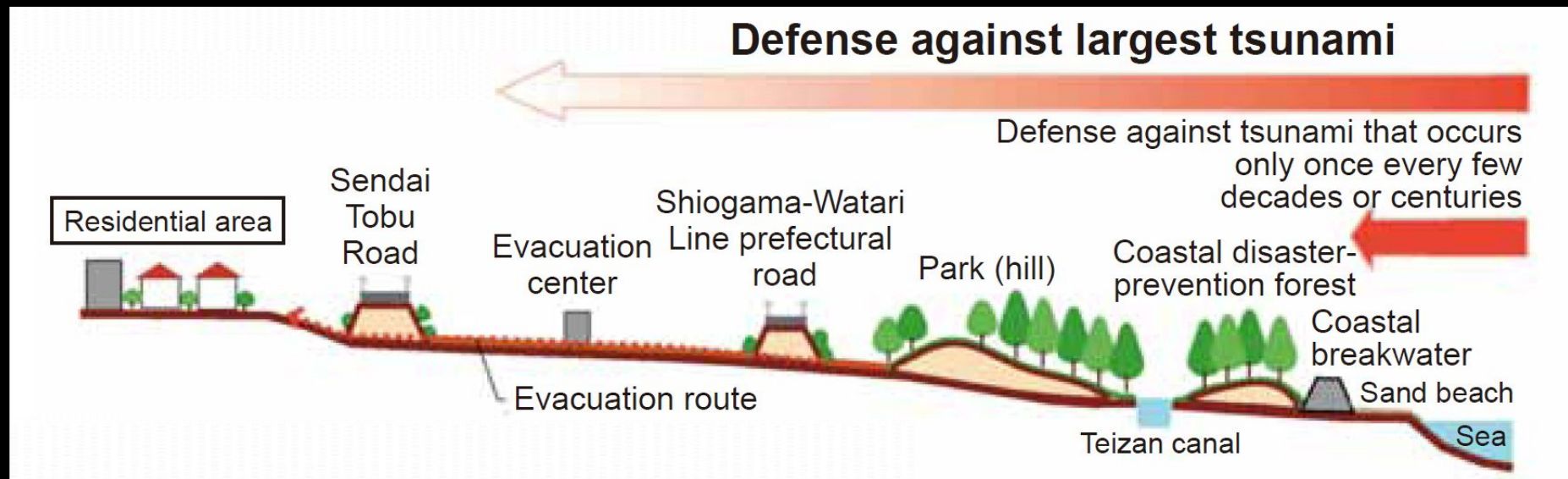
**Over 6 m tsunami flow depth will cause total devastation.**

**Implication to land use management and tsunami risk evaluation.**

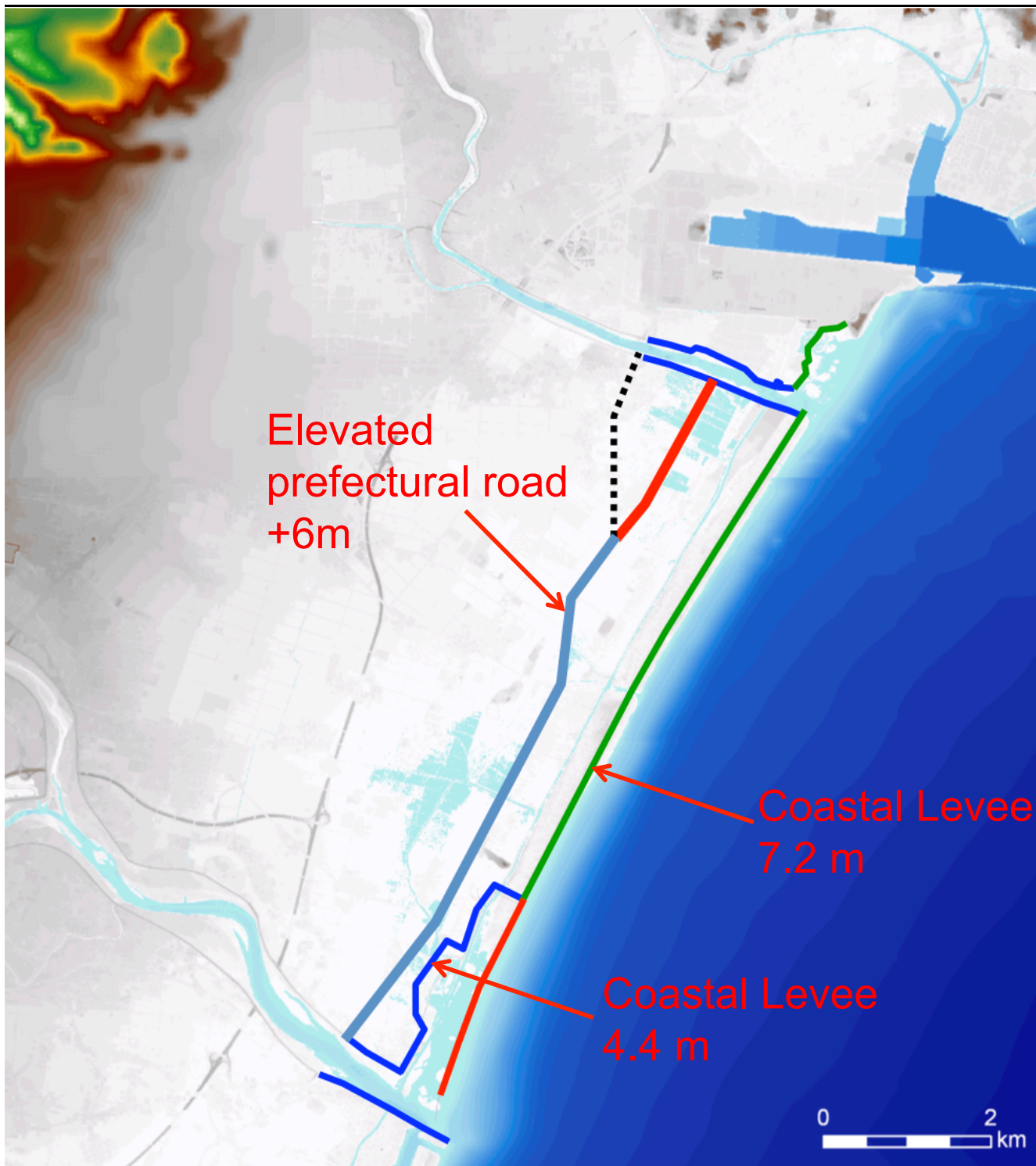


# ***Sendai city's reconstruction plan***

## ***Multiple protection to minimize losses***

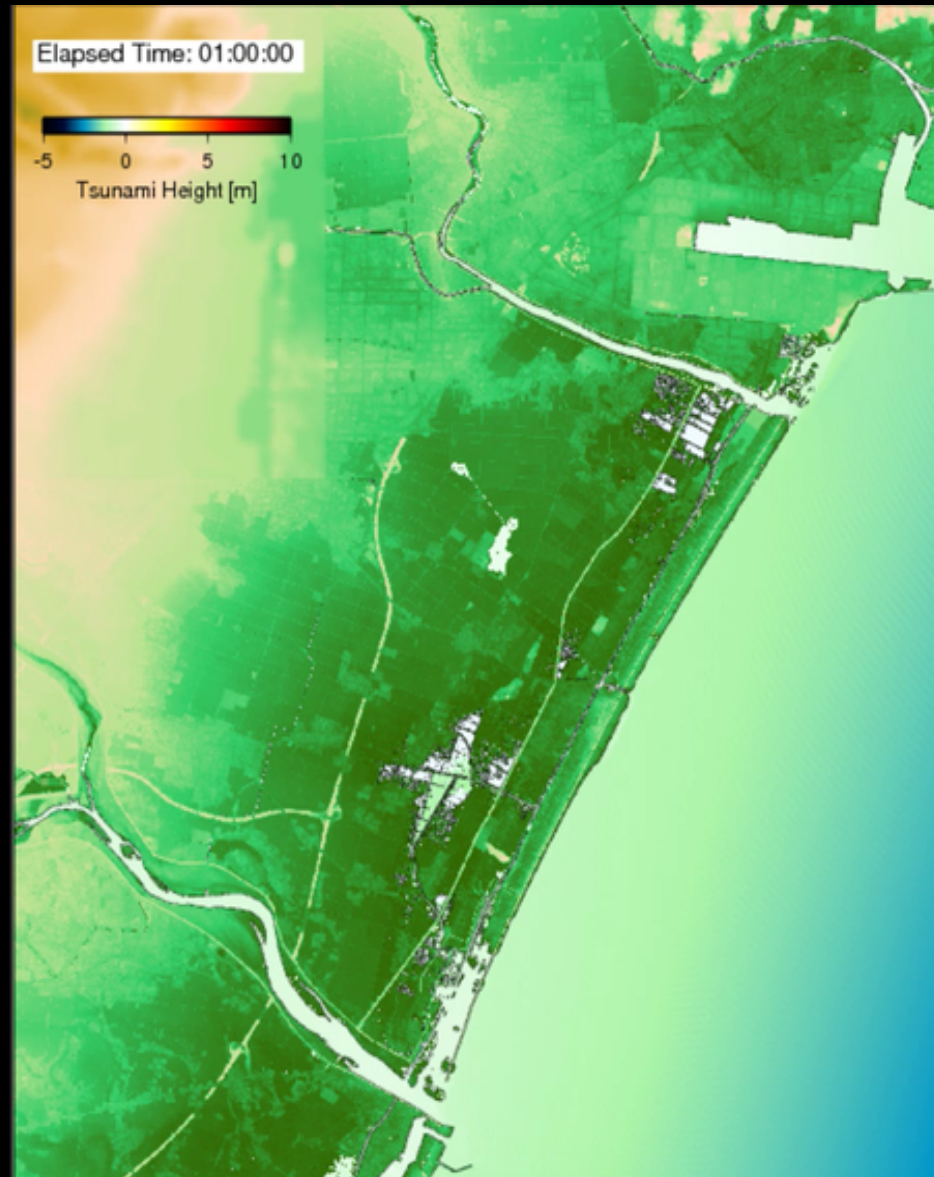


# Final plan in Sendai city



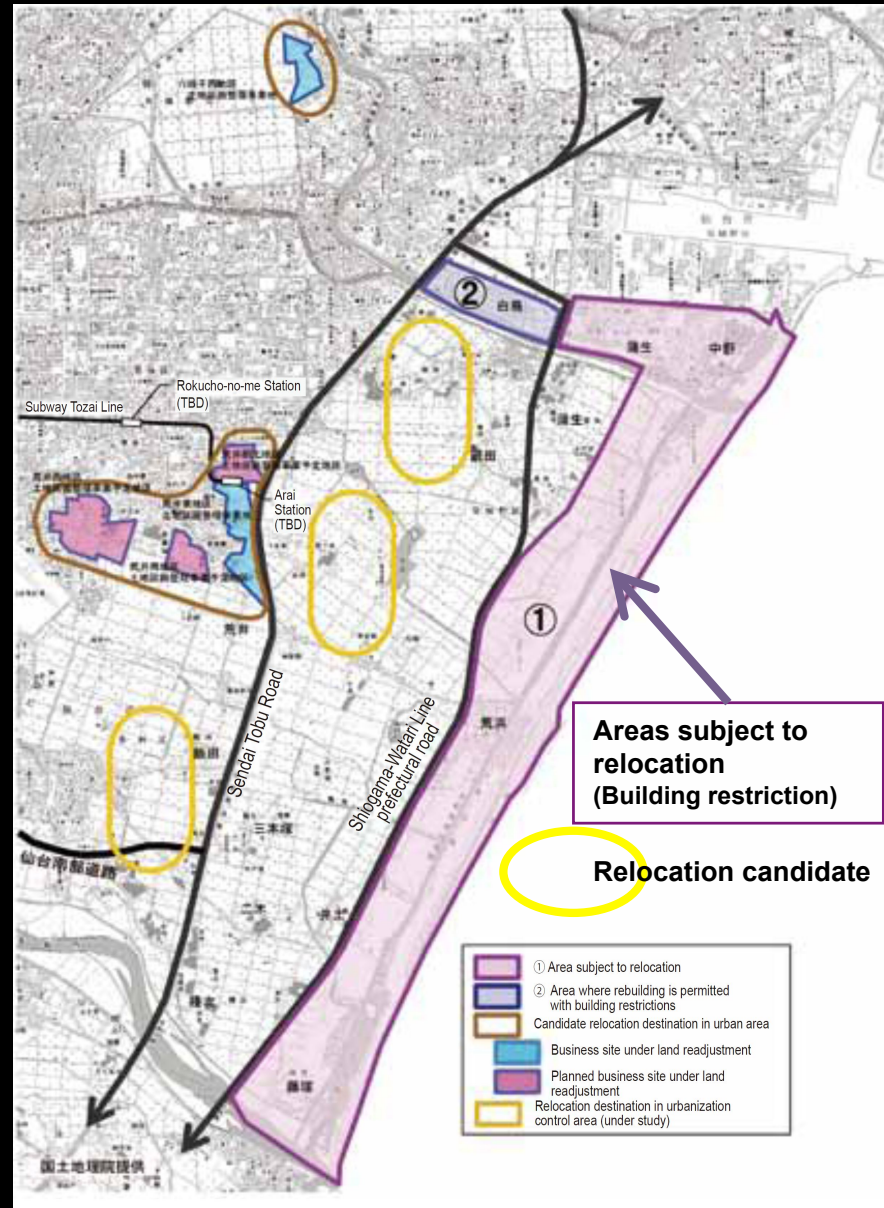


# *How the multiple protection works ...*



# *Implication to land use management and relocation plan in the tsunami affected areas*

Sendai city



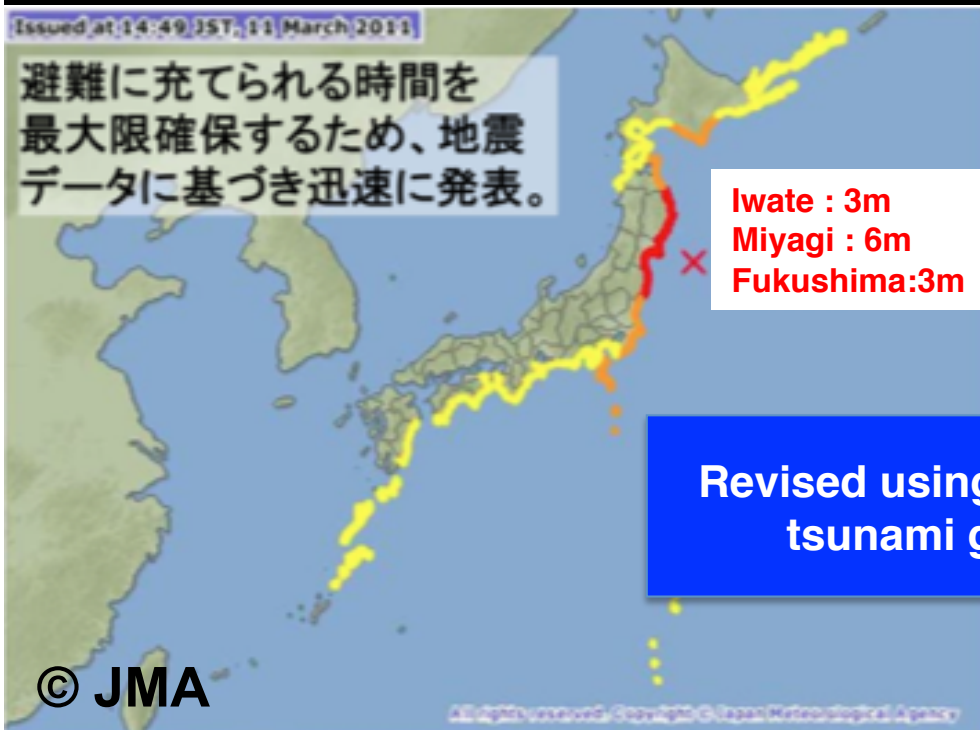


## *Lesson*

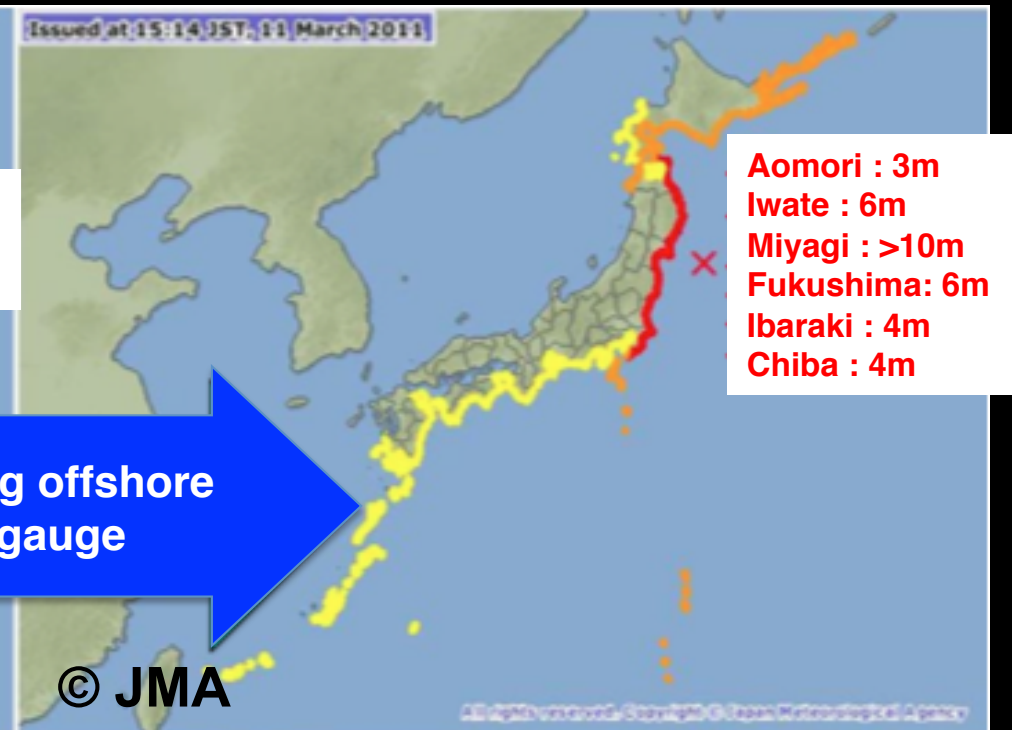
**To build tsunami-resilient community, NEVER forget the memories of disasters and keep it around us.**

# ***JMA Tsunami warning issued based on 100,000 cases of database of tsunami simulation, but ...***

**1<sup>st</sup>. issue**  
**3 minutes after the quake**



**2<sup>nd</sup>. (revised) issue**  
**28 minutes after the quake**



**Revised using offshore  
tsunami gauge**

# ***Lesson***

**Tsunami warning information is to know you are in danger, but it does NOT guarantee your safety.  
Do NOT wait for official information.**



## ***Lessons towards tsunami-resilient community***

- **Knowing risks**
  - Very important to know risks but sometimes the nature is beyond our science and technology.
- **Structural vulnerability**
  - Breakwaters and seawalls can NOT always protect our lives. It should be designed with assumption of overtopping and destruction.
  - Do NOT rely on coastal protection.
  - Over 2 m tsunami flow depth potentially causes destruction on houses.
- **Reliability of information**
  - Increase the reliability of tsunami warning towards quick, accurate and robust dissemination. Attitude NOT to rely on official information.

# ***Cause of death***

- **Underestimated seismic evaluation.**
- **Hazard map – underestimation of tsunami risks.**
- **Delay of tsunami warning and evacuation information.**
- **Blackout and failure of information dissemination.**
- **Relying on coastal protection.**
- **Using a car to pickup children and elderly.**
- **Difficulty in access to evacuation place.**

# ***The 2011 Tohoku tsunami disaster***

## **❖ Inundation zone**

- **561 km<sup>2</sup> along the Pacific coast of Japan.**

## **❖ Fatality**

- **15,850 people were killed, and 3,281 people are still missing. More than 90% of deaths were caused by drowning and 65% of the dead were over 60 years old.**

## **❖ Structural damage**

- **128,581 buildings/houses were washed-away or collapsed.**

## **❖ Tsunami debris**

- **23 mil. ton**

## **❖ Economic losses**

- **16 to 25 trillion JPY, ¼ of annual budget of Japan.** 20