

10th IWSMRR meeting at GRIPS, September 25, 2013

Heights Distribution and Damage of the Tsunami of the 2011 off the Pacific Coast of Tohoku Earthquake on the north part of the Sanriku Coast

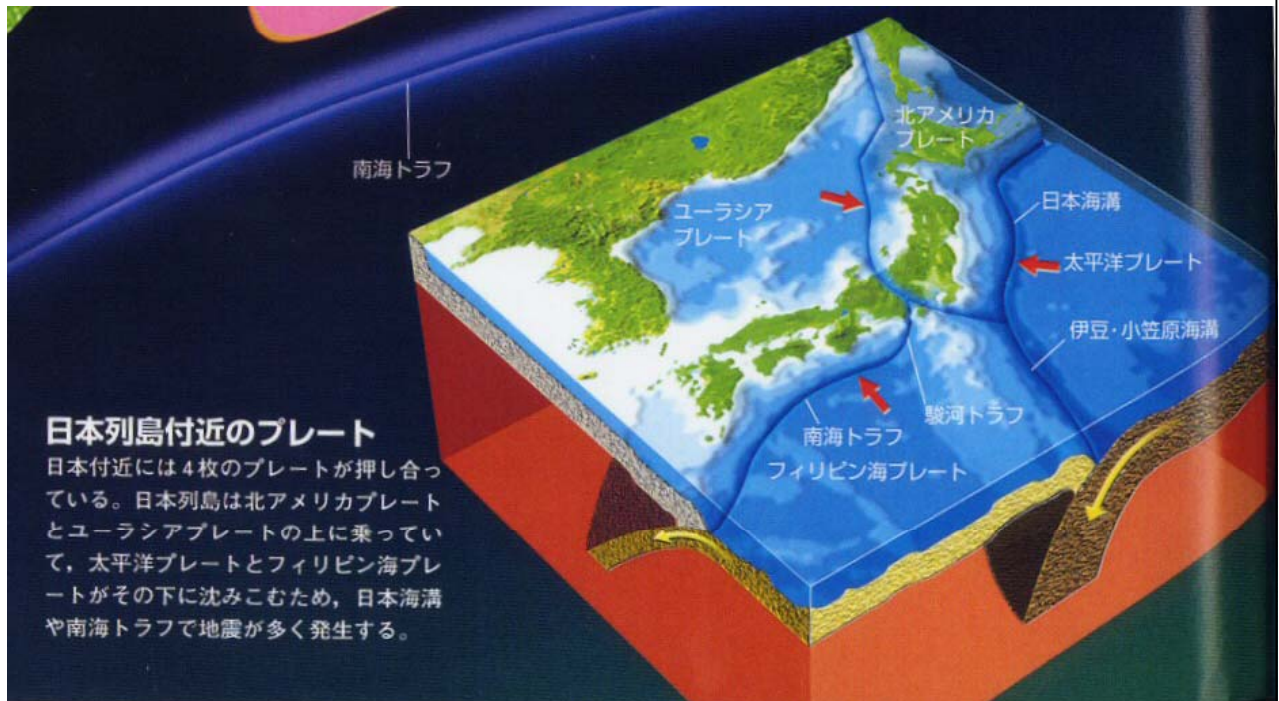
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**Lessons given by the Tsunami of the Great
East
Japan Earthquake of March 11th,
2011**

**—Disaster Prevention for Millennium Earthquakes-
Tsunamis**

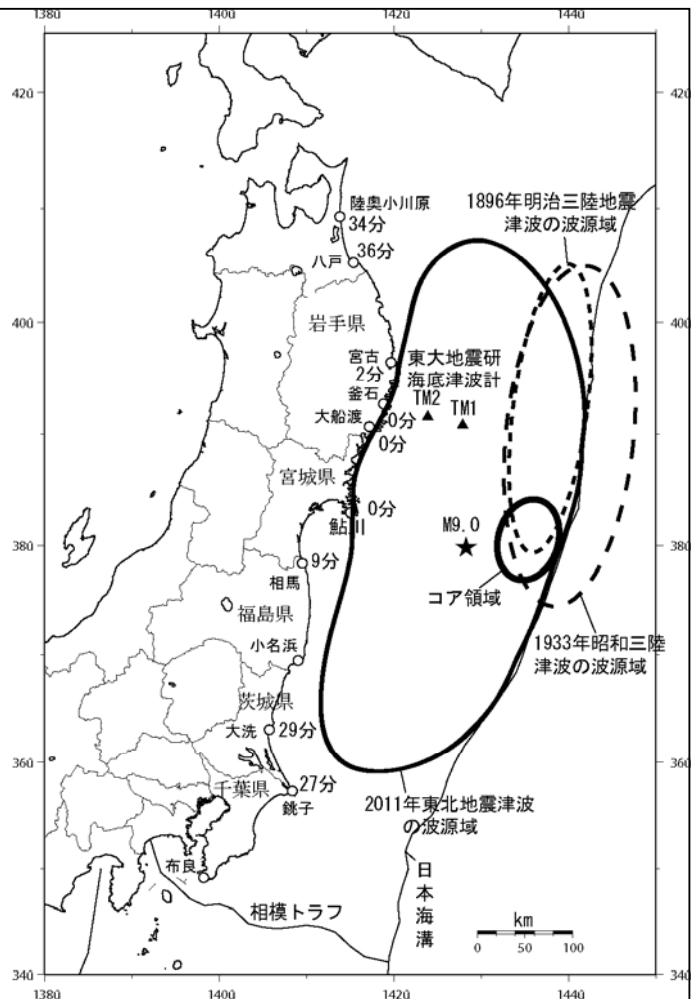
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Plate Configuration around the Japanese Islands



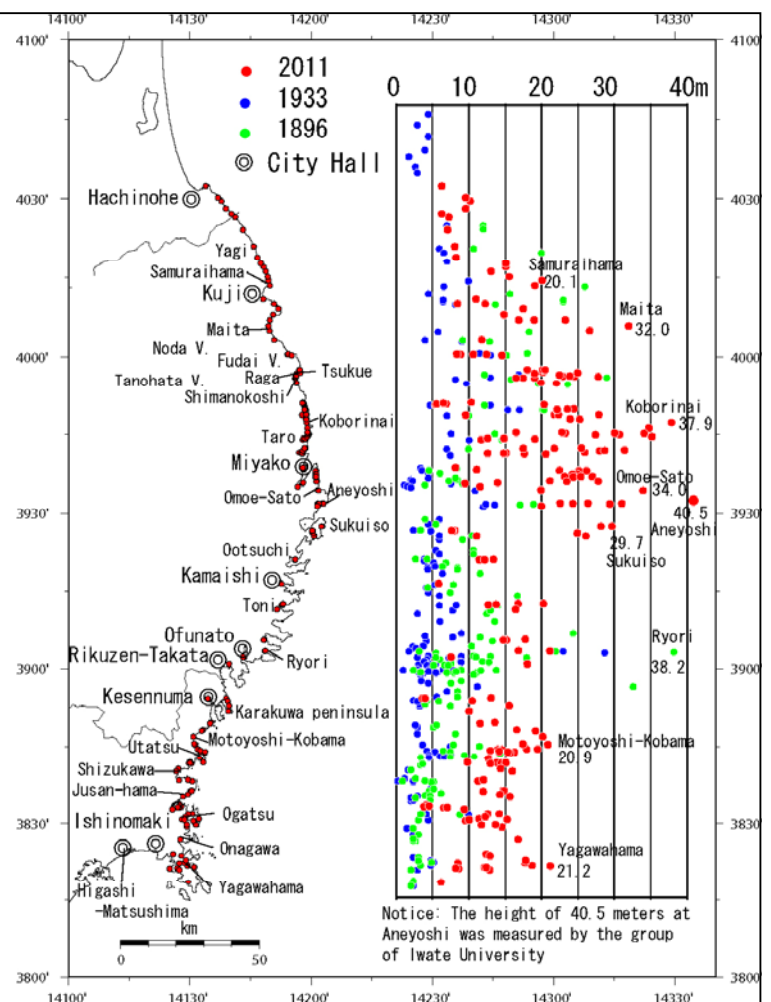
Characteristics of the 2011 East Japan Earthquake

- (A) Large size epicenter area 500km X 200km
- sea bed upheaval
- 2~4 meters
- (B) Existence of small sized core area
- 100km X 70km
- where sea bed upheaved
- 15m or more

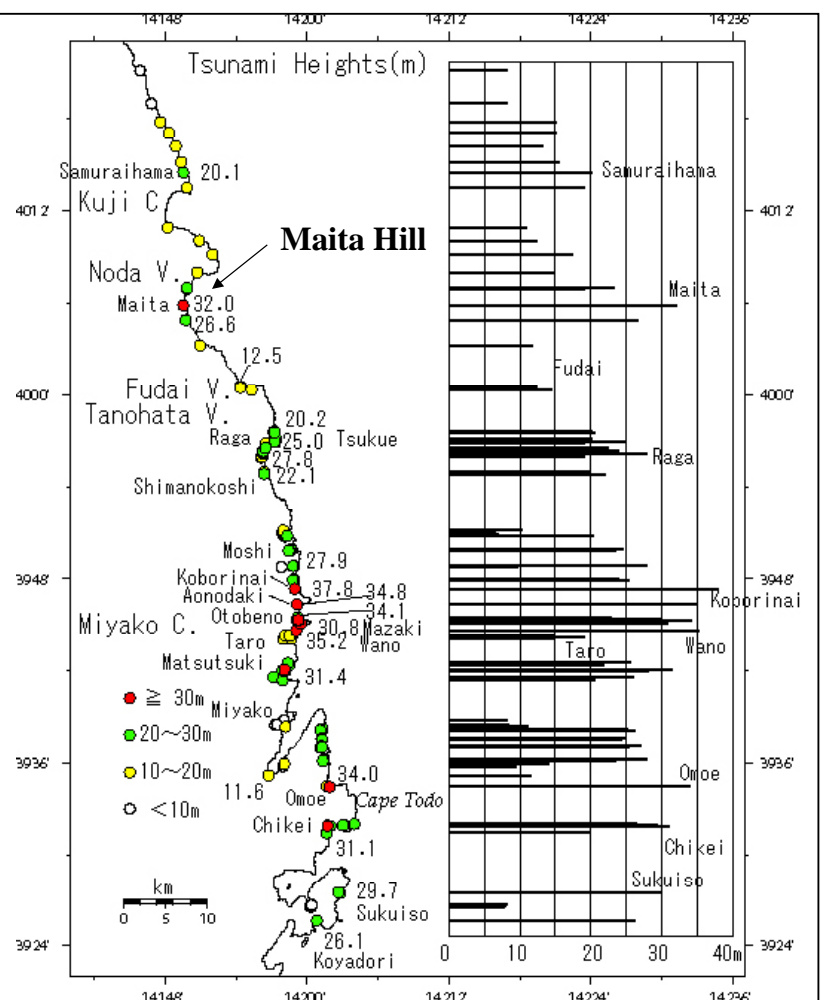


Comparison of the distributions of the tsunami heights of the 2011 East Japan, the 1896 Meiji Sanriku, and the 1933 Showa Sanriku Earthquakes

Human loss
killed and
missing
18,879
people
that of the 1896
Meiji
22,000
people
of the 1933 Sanriku



Tsunami height distribution on the north part of Sanriku Coast



Map of Maita Hill

The coastline is not an innermost point of a V-shaped bay.



**Maita Hill, sea water rose up to near the top of
the hill. run-up height: 32.0m**



Measurement work at the inundation limit on Maita Hill

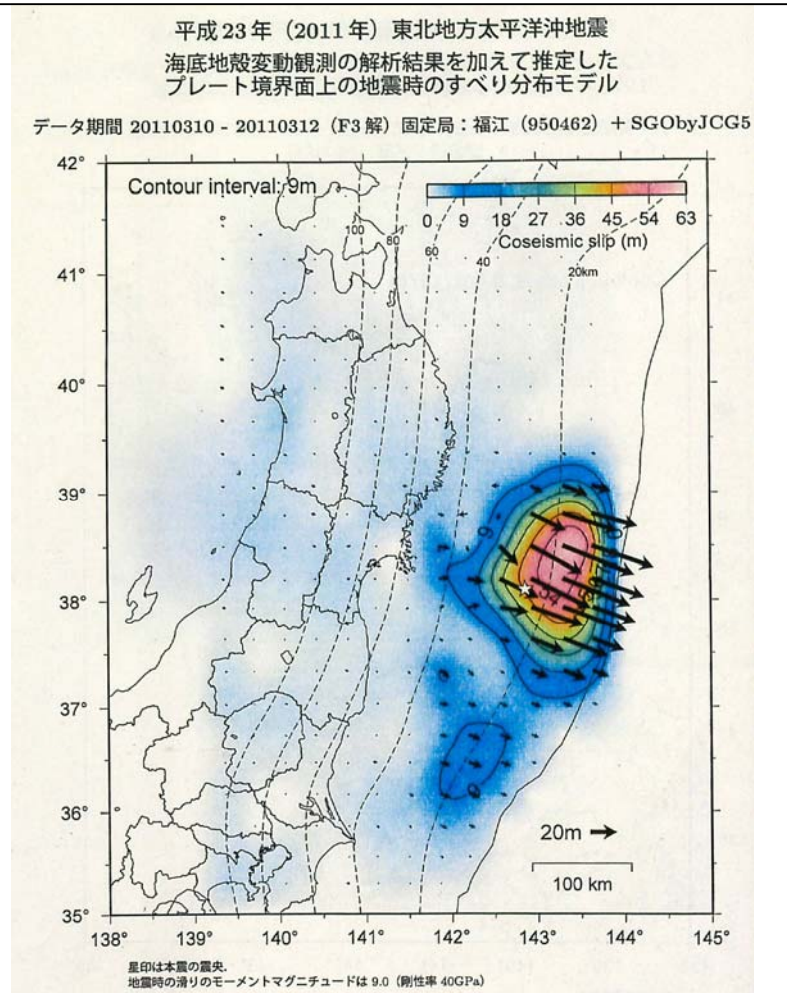


Down view from the inundation limit on Maita Hill

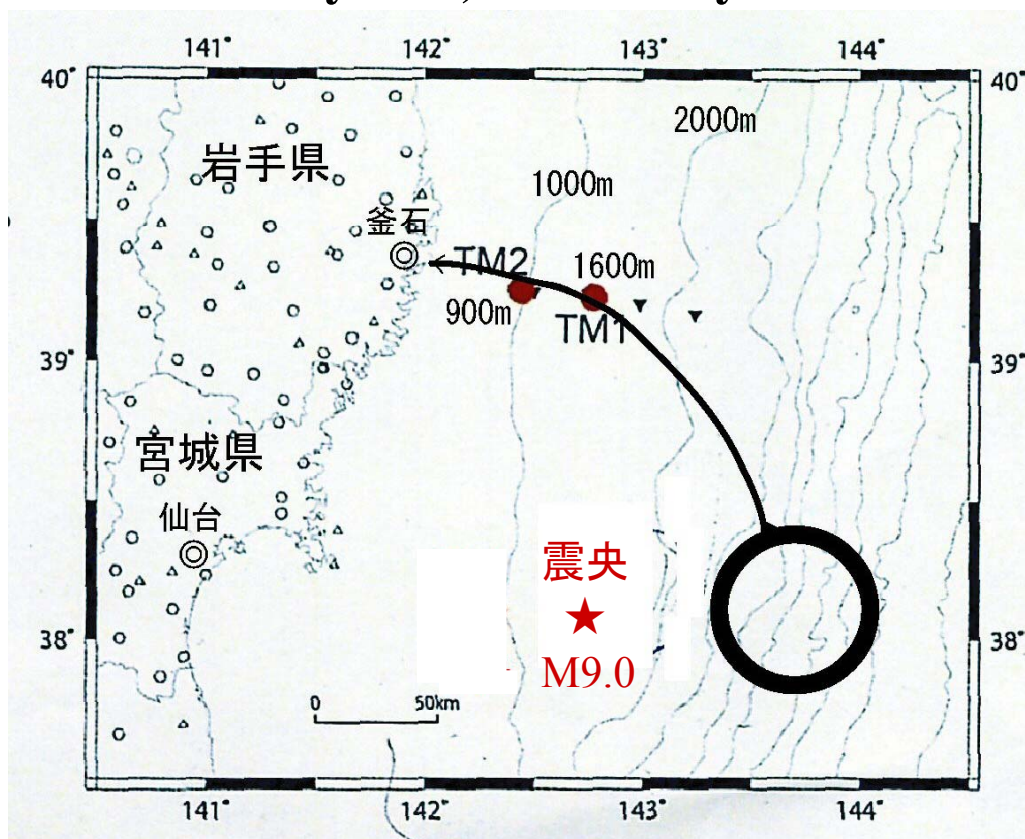


Horizontal motion of Seabed at the core area measured by GPS

Geophysical Research Institute,
Tsukuba Science City



Locations of two ocean bottom pressure gauges set by ERI, Univ. Tokyo



Sea level records obtained at the ocean bottom sensors

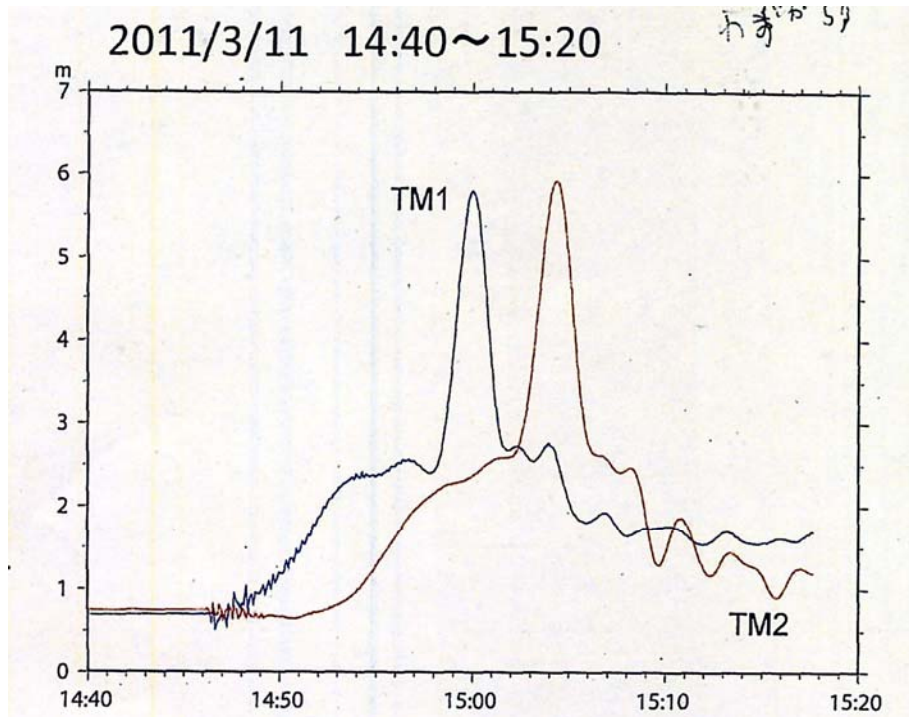


Photo taken on the 4th floor of the City Hall of Miyako



Tsunami suddenly came at 30 minutes after the main shock (Hiyako City Hall)



Railway station was lost at Shimanokoshi



Railway station “Shimanokoshi” was washed away



- Unsuitable Tsunami Shelters

Failure Example 1.

**Okawa Elementary School, Ishinomaki city,
Miyagi Prefecture**

**74 students were killed (total 108 students)
10 teachers were killed (total 13 teachers)**

Location of Okawa Elementary school



Teachers guided students in red arrow

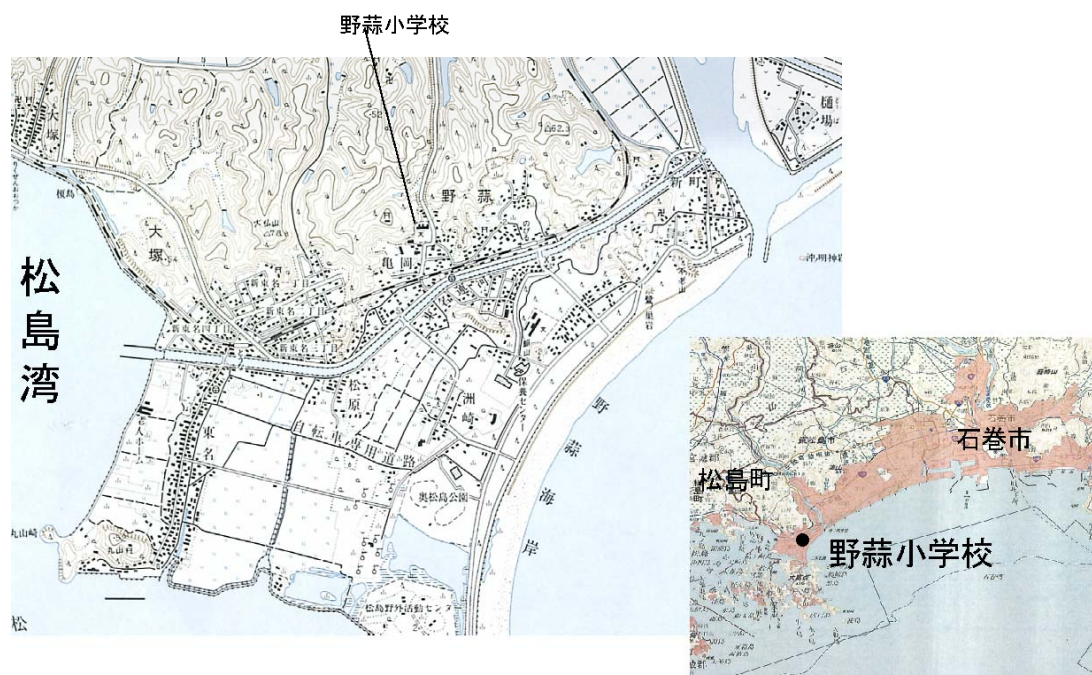


**The hind slope
Children could not
climb up on this slope
No hiking route!**

→ A zigzag climbing route
should existed



Failure Example 2. Gymnasium of Nobiru Elementary School



Gymnasium of Nobiru Elementary School



Sea water rose up to the level 3 meters above the floor. 20 people were killed here.

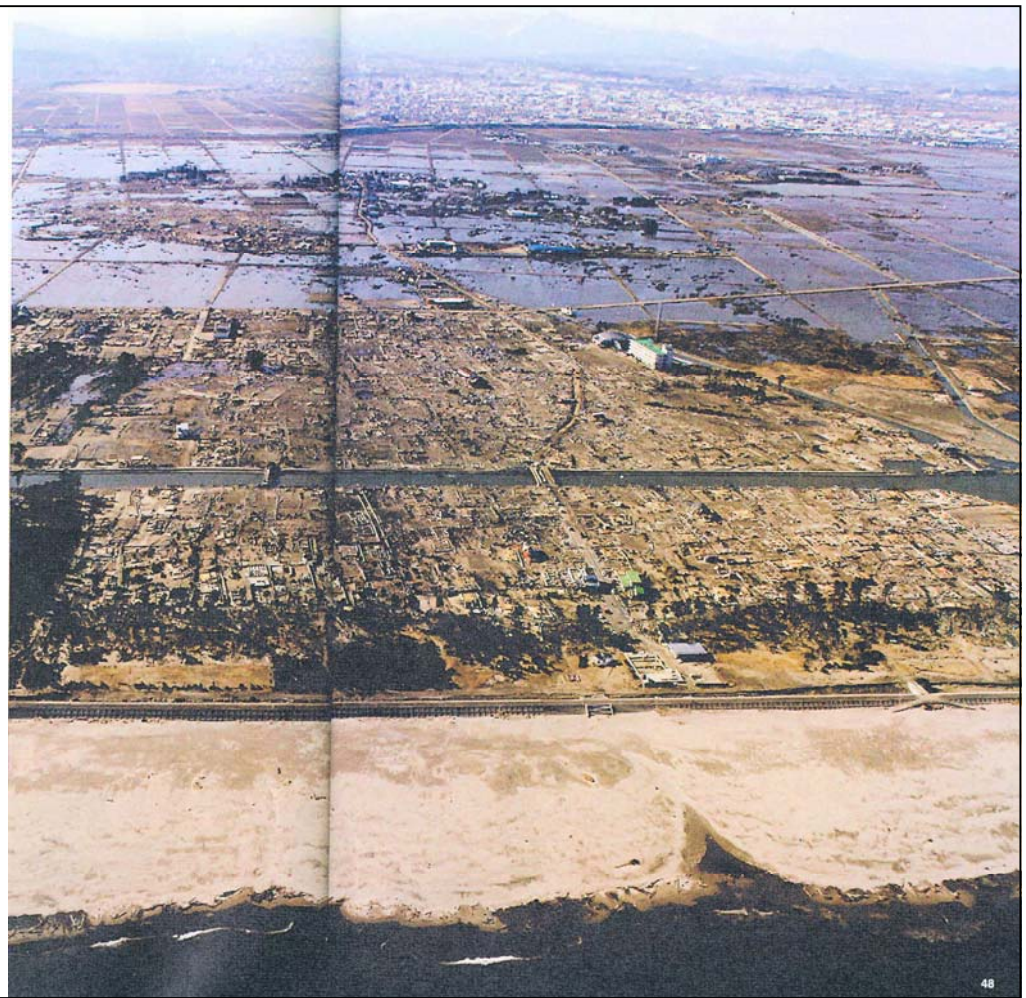


About 100 people sheltered here after the issuance of tsunami warning.

We once entered here, we can not see outside.

Failure
Example 3.
Arahama
area in
Sendai City.

Only the 4th
floor of the
elementary
school
building was
not
submerged.



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Tsunami hit
the coast!

Notice the channel
called “Teizan-Bori”
which prevent
evacuation of people.
これが避難を妨げた。



津波にのみ込まれる名取・岩沼市の沿岸
=11日午後3時56分

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Failure Example 4: Tragedy on Suginoshita Hill in Kasen-numa City, Miyagi Prefecture

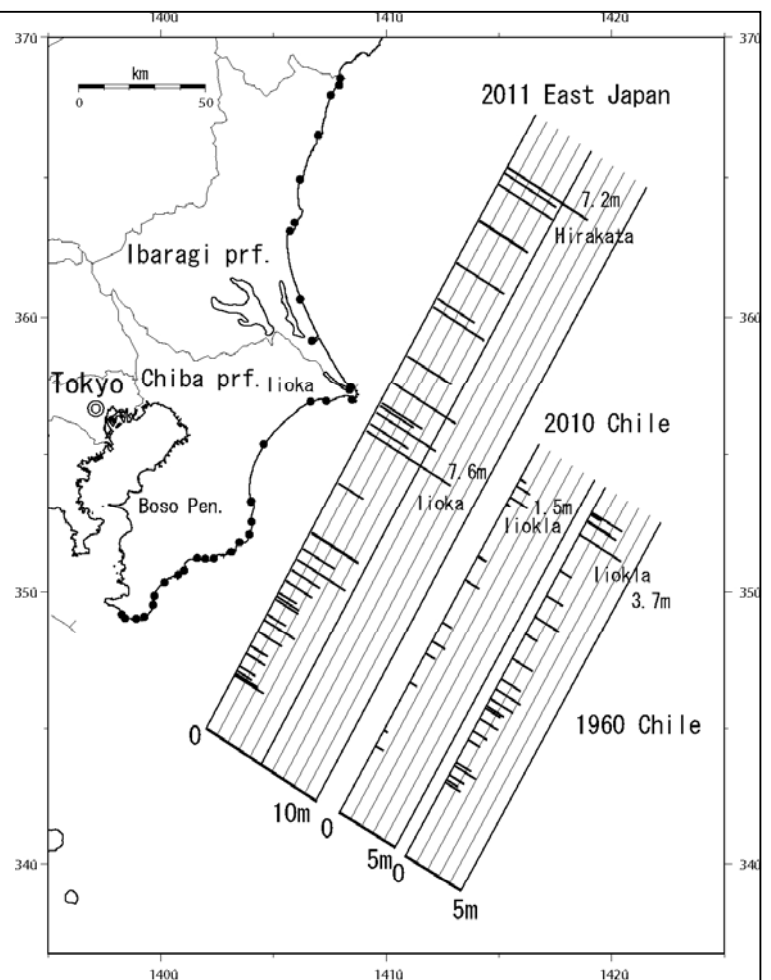


Suginoshita Hill (height: 12m) had been appointed as a shelter place from tsunamis, and about 100 people were evacuated. Sea water passed over the top of this hill with making water layer thickness of two meters, and 93 people were killed.





Tsunami height distribution in Kanto District



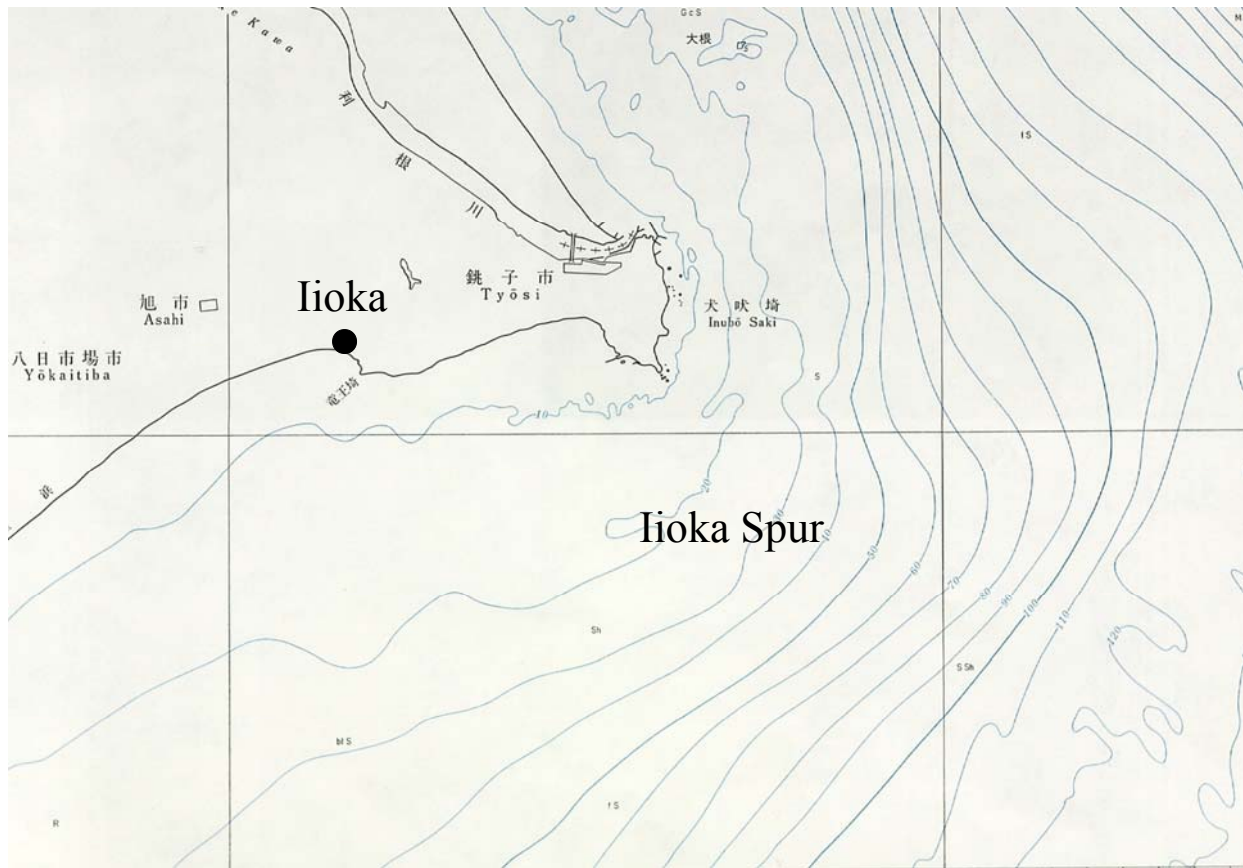
Damage of Iioka Town, Chiba Prefecture

- 13 people were killed, 2 missings
- at Iioka Town

- → Tsunami Heights 7.6meters
-

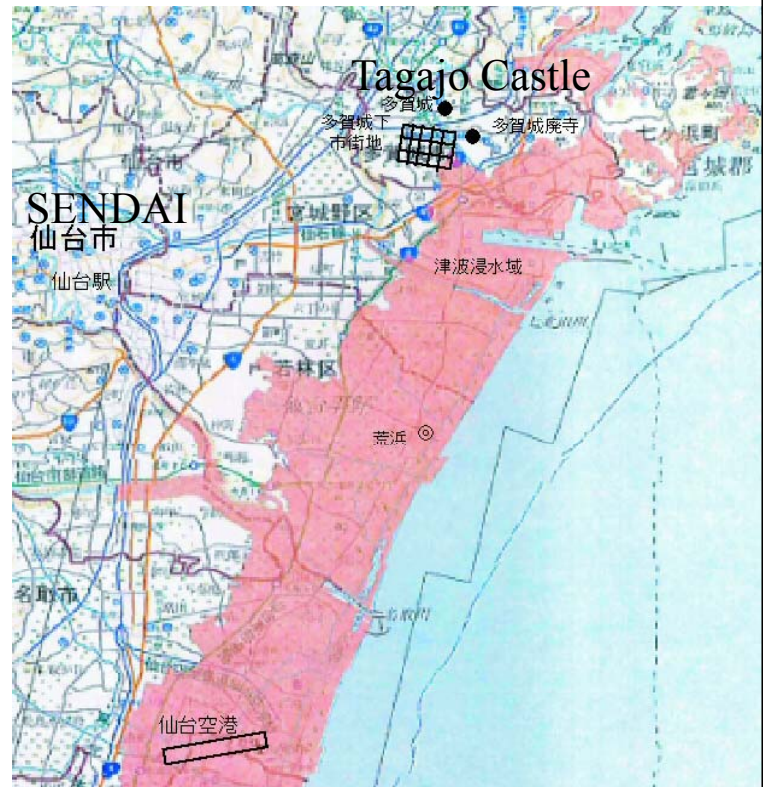
Damaged houses at Iioka



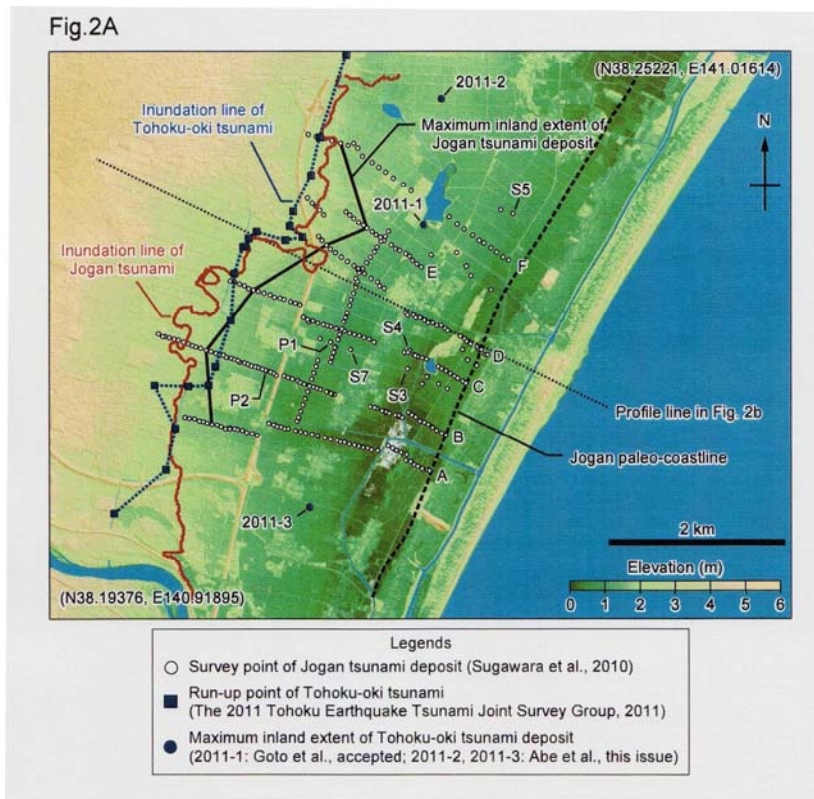


**The tsunami of Jogan 11
(AD 869)
had the same magnitude as
that of the 2011**

Sea water reached at the
city area of Tagajo
Castle town
In the times of the 869
Jogan
and the 2011 East Japan
Tsunamis.



Submerged area in Sendai Coastal Area
2011 event (blue) and Jogan(869) event(red)
Sugawara et al.(2012)



2. Disaster prevention for Future Tsunamis We should consider

Level A: Tsunamis for once in one hundred years

The 1946 Showa Nankai and the 1854 Ansei Nankai Tsunamis for West Japan. Tsunami Height 9 meters at maximum

Level B: Tsunamis for once in one thousand years

“Millennium Tsunami” Tsunami Height 20-40m

the 869 Jogan and the 2011 East Japan tsunamis (EJ)

the 1707 Hoen and the 1498 Meio Tsunamis (WJ)

Tsunami Escape Facilities Construction of Escape Route for a Millennium Tsunami.

Plan of Shimanto City, Kochi Prefecture Shikoku



Tsunami Escape Stairs (20m)



They set each step on the surface of a concrete wall by anchor bolts



Tsunami Escape Tower in Shimanto City

Height 18 meters. The top floor area has 500 square meters in order to accept 1,000 people.



Life Jackets are kept in the Box
The door of the box will be broken by
a young refugee



Pull up box equipped at a shelter place.
Leg weak people will be pull up by human
power. (Shimanto City)



Tsunami Escape Station for a Millennium Tsunami at Yoshida Town, Shizuoka Prefecture.

The construction was completed on 23rd September, 2013.
Deck Height is 10.5 meters above mean sea level. This
place of refuge can accommodate 1,000 people.

