

PROTECTIVE EFFECT OF COASTAL LEVEES AGAINST THE MEGA-TSUNAMI CAUSED BY THE 2011 OFF THE PACIFIC COAST OF TOHOKU EARTHQUAKE

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EARTHQUAKE IN JAPAN

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Catastrophe spares country's major economic zones

But timing could not have been much worse for nation recovering from recession

By Howard Solomon

The earthquake and tsunami in Japan on Friday struck an area that scientists fear only a small fraction of the country's economic activity, but damage could still run into the tens of billions of dollars, according to analysts trying to assess the impact of the disaster.

Bank for International Settlements in the course of only 1.7 percent of Japan's gross domestic product, and damage to infrastructure and commercial facilities in the area appeared to be limited.

Still, the earthquake and subsequent flood, which in a case where damage is struggling to push itself out of recession and bring growth to the Japanese market, said in the world's top economies in economic activity resulting from the disaster at least in the short term, could undercut Japan's economic recovery, analysts said, and could have the country's future efforts to recover in debt and economic deficits while it is badly hit.

"The timing of the disaster could not have been much worse," according to an analysis written by Japanese and other economists' associations at London-based Capital Economics. The Japanese government is already divided over how to assess Japan's debt, so, the economists warned, "the greater the scale and regional damage, the harder the debate is to manage the country's ability and willingness to repay its foreign debt."

The Bank of Japan announced Friday that it would increase a monetary aid and for any area that shows that banks and the financial system have the funds needed to recover from the disaster.

The business toll and the amount of property destruction are in the unknown, and damage at a major power plant triggered a concern. Millions of homes were without power, and public transportation systems to major cities looking like they were shut down.

A host of global corporations — Honda, Toyota, Canon, Panasonic and others — suspended all local sales operations while they assessed damage to plants in the northeastern part of the country. An extended closure could be devastating for Japan's export-oriented economy.

But unlike with the earthquake that

struck heavily industrialized Kobe, in 1995, analysts said they did not expect Friday's quake to drastically reduce Japan's industrial output or cause damage approaching the \$100 billion in destruction Kobe suffered.

Damage to manufacturing facilities and office "business centers" in the quake, while that broke up square with the connecting line 100 miles long, European-based analysts with Japan's National Bank noted in a weekend call that the economic damage caused by the Kobe earthquake, which knocked out an equivalent of 1.3 percent of Japan's gross domestic product, closed major ports and caused manufacturing.

"This has not been commercial in other areas," said Nishiyama's executive vice president.

Chris Nishiyama, deputy head of research for Japan's Tokyo Capital Markets, wrote: "The key parts for Japanese trade are all further south than the most affected area. The overall disruption to Japan's economic trade should be smaller than the Kobe disaster."

The hardest-hit urban area was found to be about 1 billion people. The region hosts as much as agriculture and fishing industries and tourism, images of homes being inundated and industrial plants being washed away suggest that major reconstruction will be needed. But agricultural machines took the worst in the disaster. Prices of many major commodities, including rice, actually fell, indicating that consumers did not think Japanese agricultural production would be significantly damaged.

Tokyo stock prices fell 1.7 percent Friday, but the earthquake struck with only a half-hour left in the trading day and analysts said investors knew the likely extent of trading losses at the start of the week.

An early news network diagram, which noted that the earthquake disrupted a line to be made than others by any investment and investment in people abroad.

Tokyo's economy, Tokyo's Bank and other financial institutions were not in the Kobe region was relatively small. The estimated damage, following the earthquake, is a major economic loss.

Global insurance companies will also contribute to the rebuilding, although the extent of that response is not known. Japanese analysts expected to be shut down all major Japanese companies, which could be an attempt to follow suit in their market, analysts said.



1 Tsunami inundation overflowing coastal levee in Minami-soma, Miyagi. (From Washington Post)

押し寄せる津波の第2波…宮城県名取市で3月11日午後4時11分 手塚耕一郎撮影

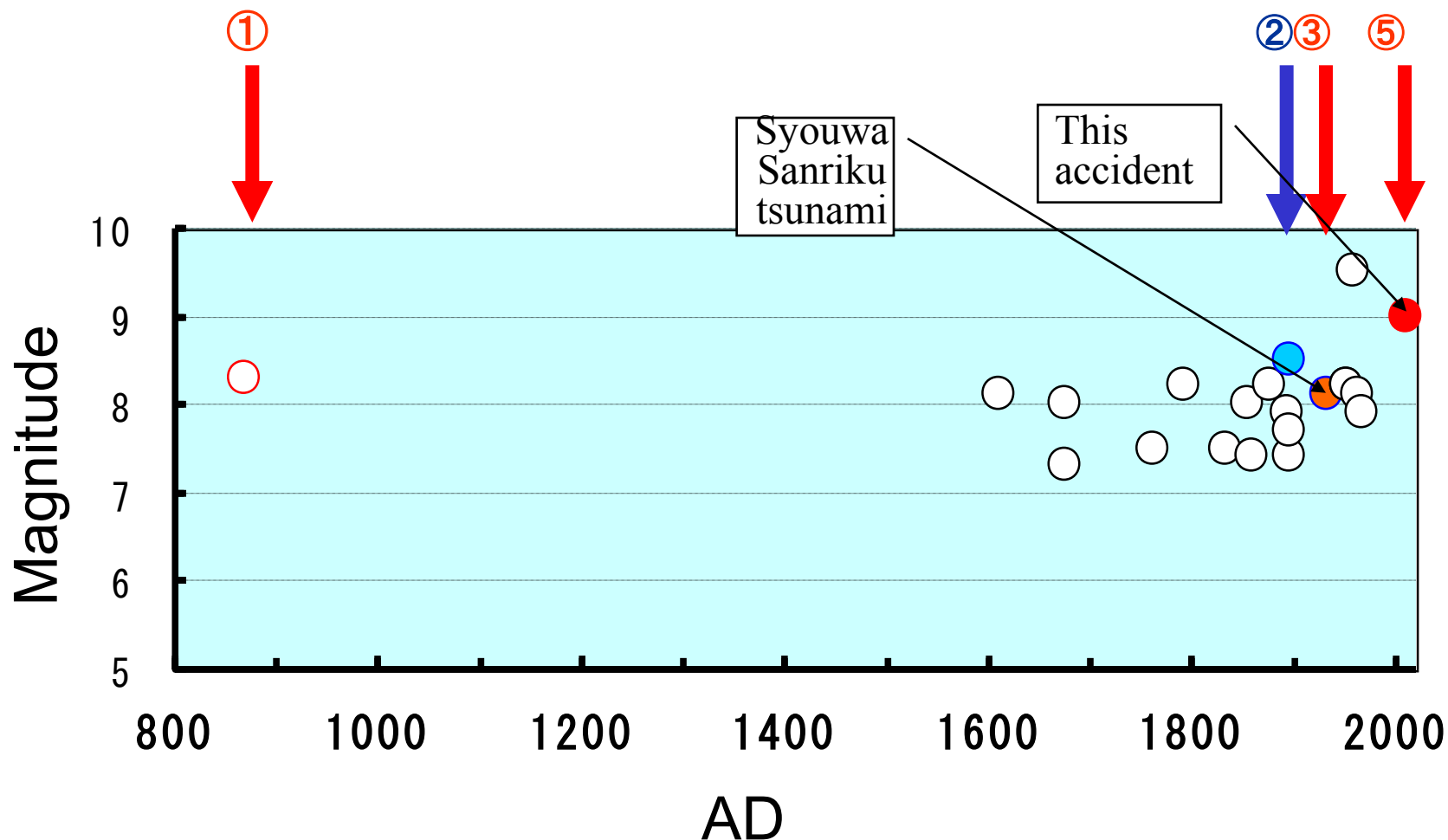


「阪神淡路大震災の1000倍」の巨大地震 生活に、産業に壊滅的大打撃

サンデー毎日増刊 / H23.3.24

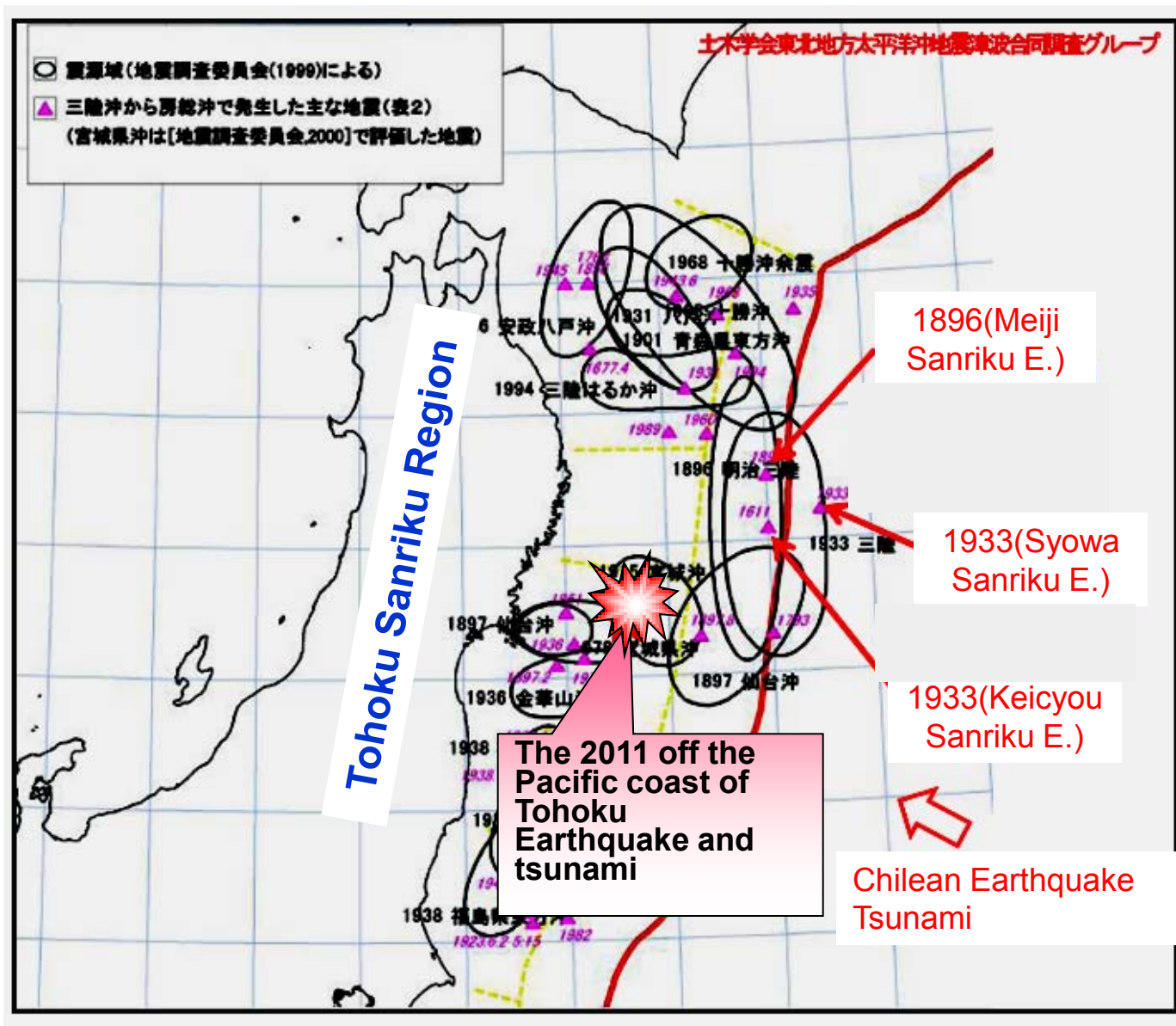
Items of first page about this earthquake reported in Japanese Newspaper;

- **The maximum tsunami height** in Japanese historical tsunami records, The Great Hanshin Earthquake's 180 times energy: The Yomiuri Shimbun (Newspaper), on March 12th, 2011
- **The earthquake in the once thousand**. The Mainiti Newspapers, on March 13th.
- By linking **4 regions, the submarine geologic formation changed**. The Mainiti Newspapers, on March 12.
- Simultaneously, whole area in Japan Trench was almost broken.. The Sankei Shimbun (Newspapers) , on March 11th.



4

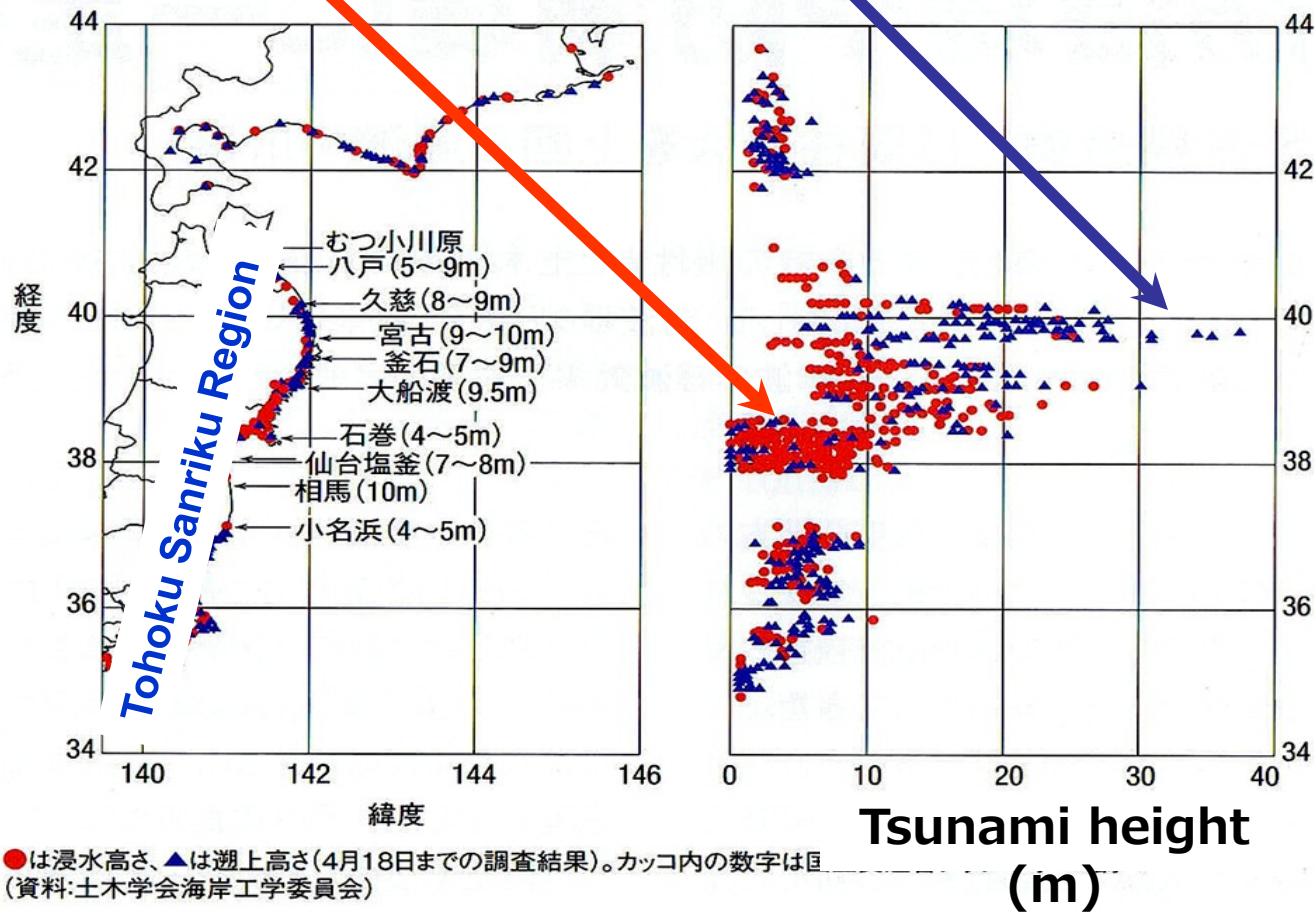
Typical earthquakes and subsequent tsunamis that gave large effect to the Tohoku area up to now



5 Distribution of the epicenter of earthquake which generated large tsunami in Tohoku Sanriku Region.

Inundation height and Runup Height in Tsunami

■ 津波の浸水高さの実測値





Just overflowing
tsunami in
Miyako, Iwate at
3.21pm, March
11th, 2011.

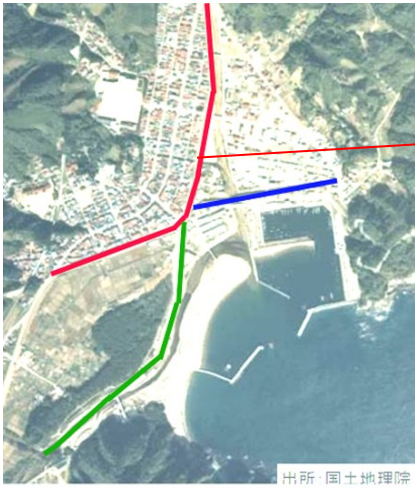


〔図 2-26〕 破壊されなかった宮古市の堤防。宮古市役所のそばにある鉄筋コンクリート造の堤防。鉄筋で補強されているため、破壊されなかった

伊藤 滋, 三船康道: 東日本大震災からの復興覚書, 万来舎



After the
tsunami



Total coastal levee length: 2,433m

Construction completed: 1966

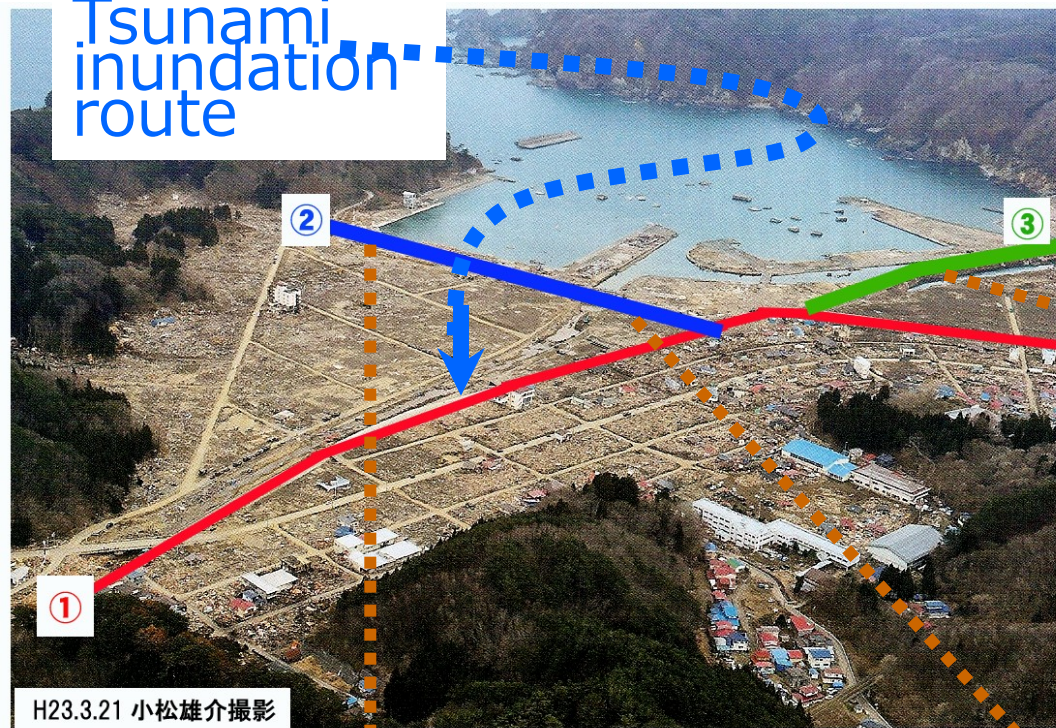
Total construction cost: estimation 0.5trillion-yen(about 5,000million-euro).



<http://image.search.yahoo.co.jp/search?rkf=2&ei=UTF-8&p=%E7%94%B0%E8%80%81+%E9%98%B2%E6%BD%AE%E5%A0%A4#mode%3Dsearch>

Before, just and after Taro's coastal levee by attacking the tsunami

Tsunami
inundation
route



Tsunami inundation and destroyed coastal levees in Taro, Miyako, Iwate P.

Characteristics: the 2011 off the Pacific coast of Tohoku earthquake and tsunami

1. **Mw 9** earthquake, which occurred in the Pacific Ocean off the northeastern coast of the Japanese mainland on 11 March 2011 (Tohoku Sanriku Region).
2. The mega tsunami had a **maximum run-up height of 37.9 m** at Iwate-Miyako,
3. The mega tsunami destroyed or severely damaged **numerous breakwaters, tidal embankments, coastal levees, and coastal towns.**
4. **15,854** people died, **3,155** went missing, **26,992** were injured, approximately **470,000** were displaced, and at least **383,246** buildings were either destroyed or damaged.

Huann Damage	Number of people	Cause
Dead person.	15,854	Tsunami
Mssing P.	3,155	
Injyured P.	26,992	
Displaced P.	470,000	Radiqactivity by atomic energy pla nt accident

Planning levee height

Before coastal levee height



The newspaper that reports the signboard which shows the coastal levee height, and delay of construction.

Buck ground/ Some problems on the restorations of coastal levees

At present, the mutual agreement of local area inhabitant is not obtained on the restoration of coastal levees. Therefore, coastal levees construction has been retarded. Some reasons of inhabitants are as follows.

1. The sea is not seen, when the coastal levee is heightened from the convention and then tourists do not visit.
2. By the higher coastal levee, the refuge is retarded, because the inundation of tsunami can not be seen.
3. The fishery is not possible, when town and village are surrounded in the coastal levees, and our life becomes difficult.
4. Is it possible to prevent the tsunami, if coastal levees are really heightened, ?

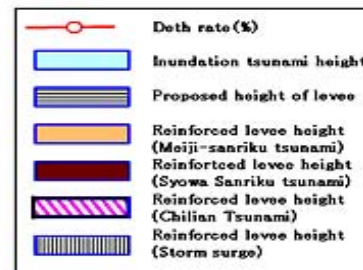
Aim of study

1. Alogshore distributions of death rate, Tsunami inundation height, raising height of levee, and destroyed levee, from Iwate-kuji to Miyagi-south coast.
2. We examine that how much was the life-saving effect for human life due to the coastal levees against mega tsunami.

Methods

1. Alogshore distributions are arranged and discussed by using the surveying reports by Iwate and Miyagi Prefectures.
2. We examine by comparing on-site observation data of the Showa Sanriku Tsunami (1933), using the dearth rate of each coastal town.
The relationships between death rates, tsunami inundation heights, and the existence of coastal levees is discussed.

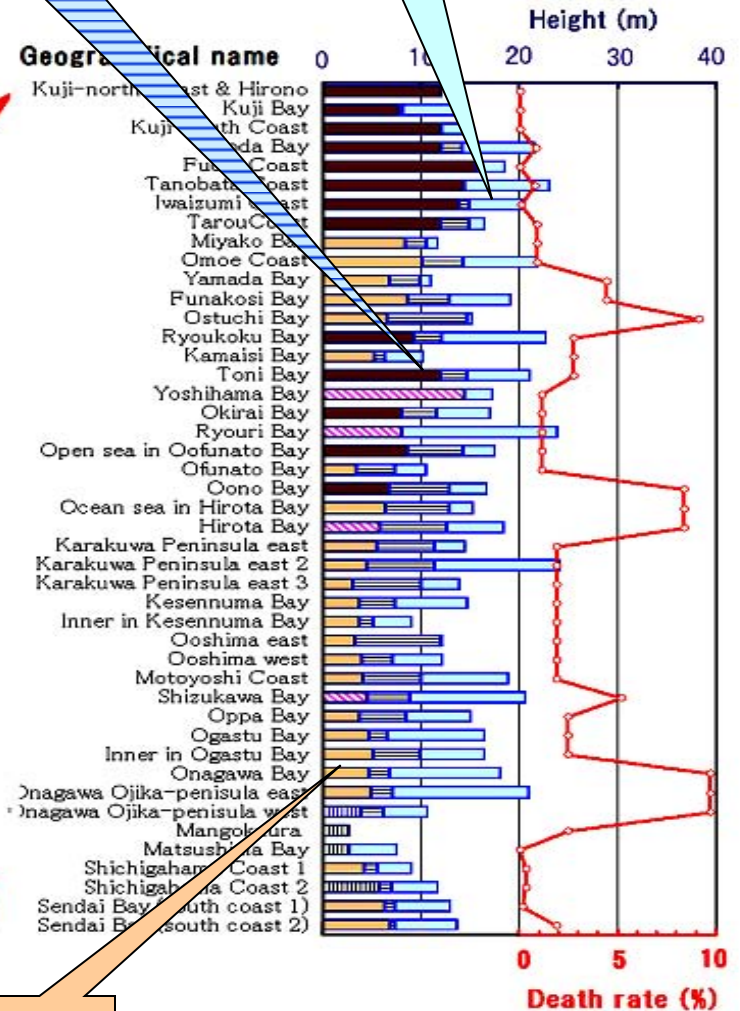
Alongshore distribution of previous coastal levee height, proposed levee height, tsunami inundation height, and death rate due to the 2011 off the Pacific coast of Tohoku Earthquake Tsunami between Aomori-Kuji and Sendai.

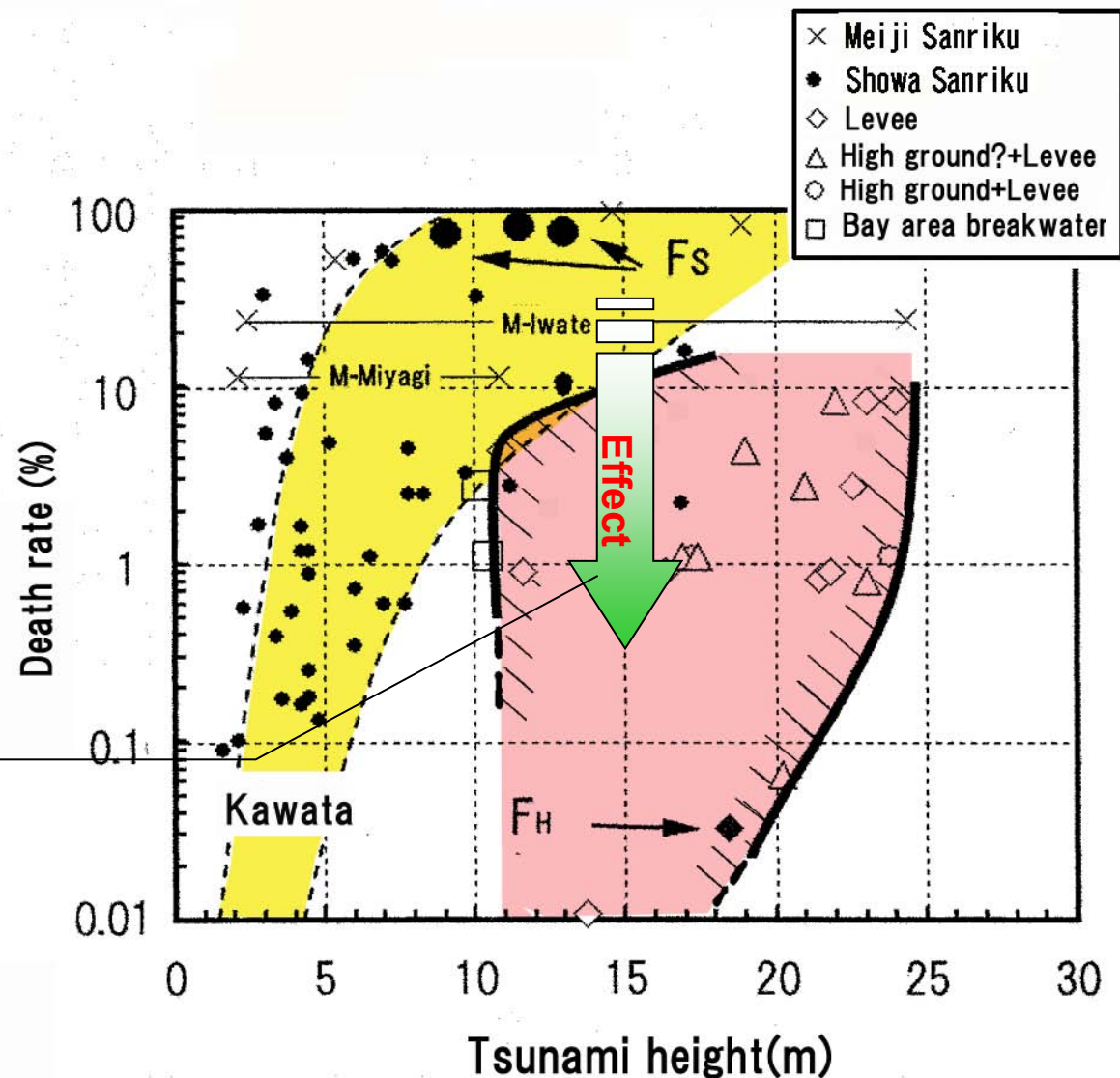


Raising height of levee

Tsunami height

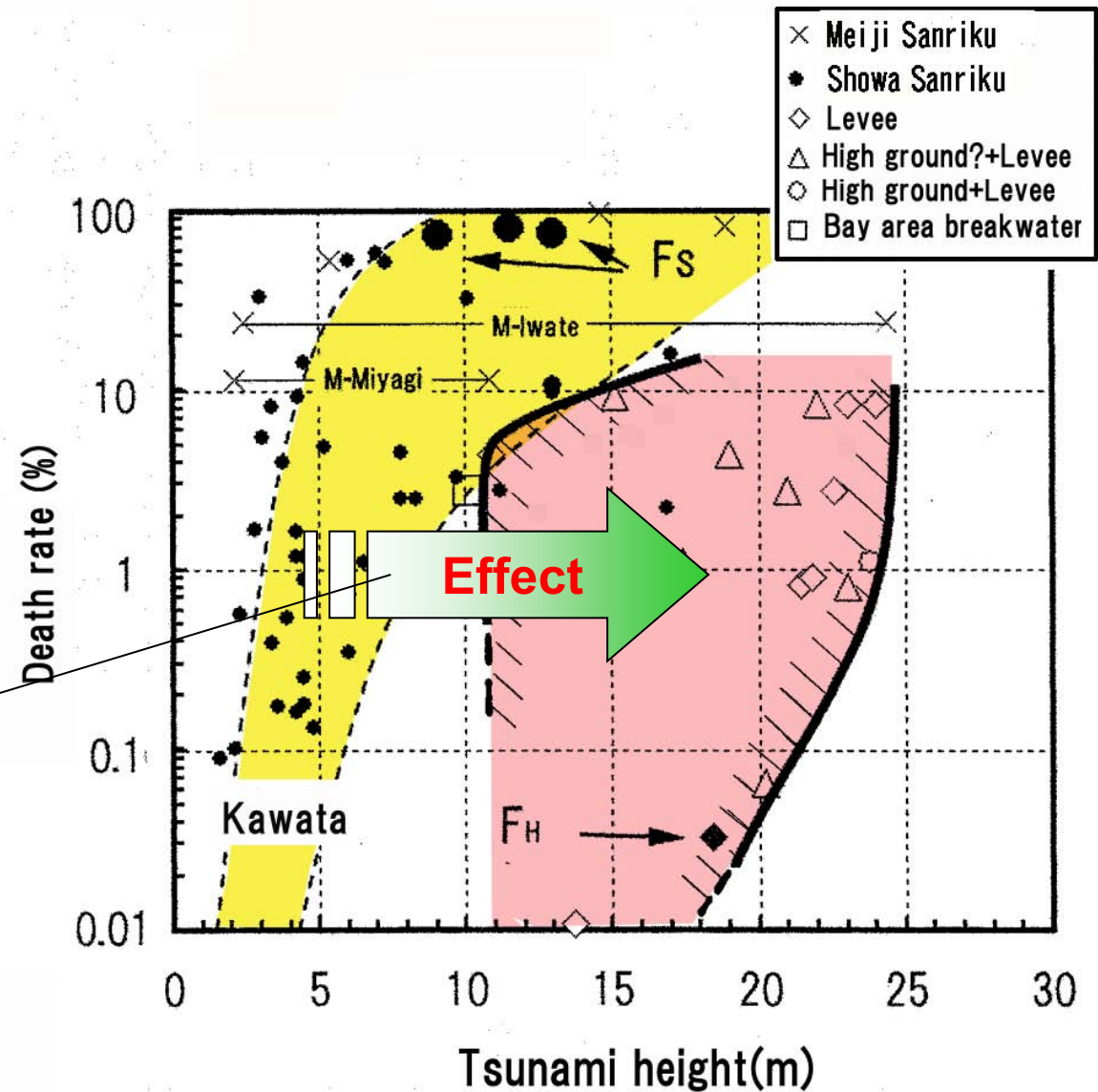
Broken levee





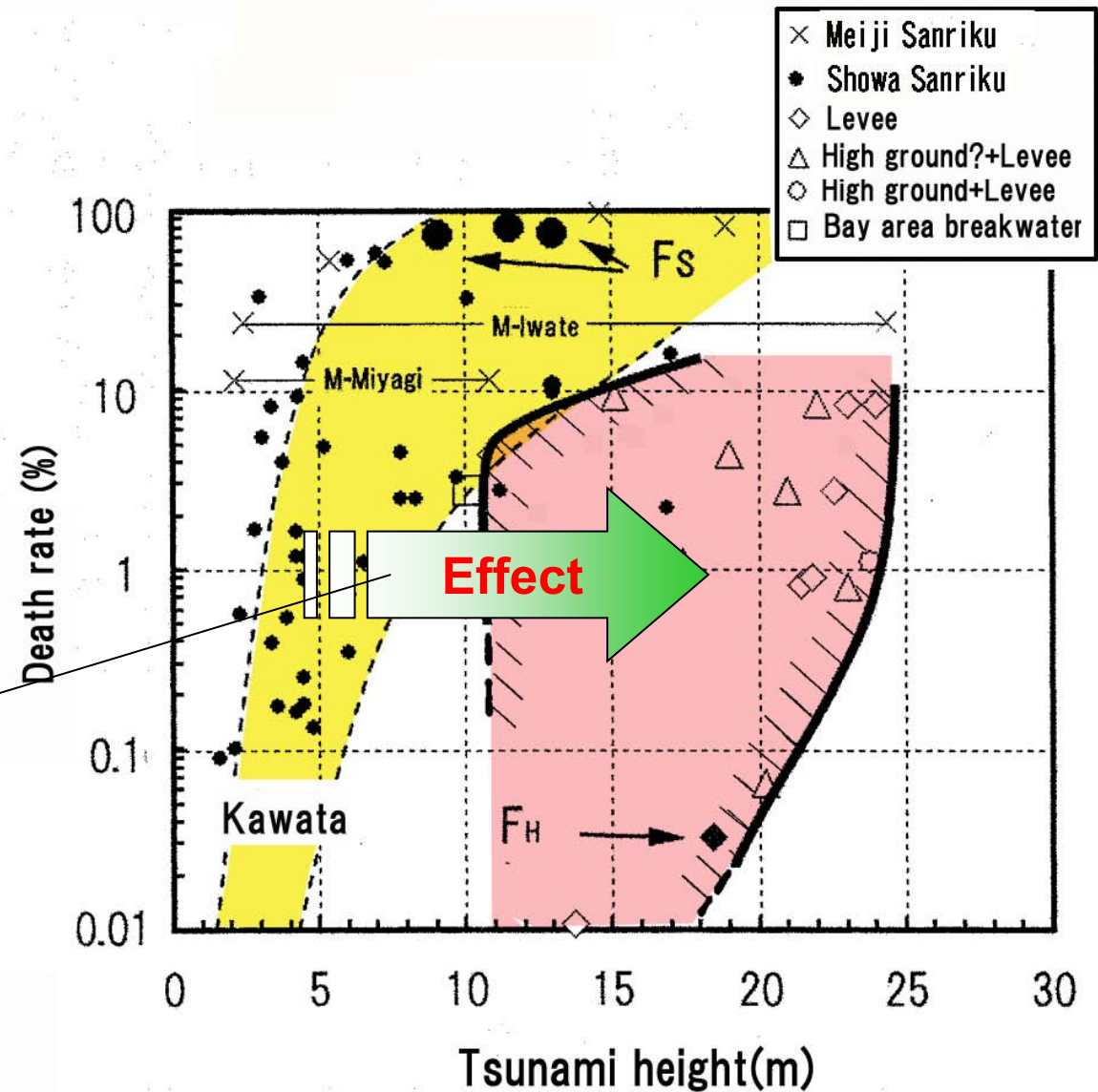
When tsunami height is 15m, a death rate decreases considerably.

Comparison of the Showa Sanriku Tsunami and the 2011 Great Tohoku earthquake Tsunami, and the life-saving effect due to the coastal levee



In a 1% death rate, Syouwa Sanriku is 5m-tsunami height, while this tsunami increases 11-24m.

Life-saving effect due to the coastal levee.



In a 1% death rate, Syouwa Sanriku is 5m-tsunami height, while this tsunami increases 11-24m.

Conclusions

1. Alongshore distributions of tsunami height, death rate, levee height, and height to which levees need to be raised, **differ markedly depending on area.**
2. If we take notice of 1-percent death rate, in the 2011 off the Pacific coast of Tohoku Earthquake Tsunami, the life-saving effects due to the existence of coastal levees, provides the inundation tsunami height **from 5 m** (in Showa Sanriku Tsunami) **to 15 m.**
3. From the relationship between death rates, tsunami height, and the existence of coastal levees, the **10-90%** of death rates were recorded when the tsunami inundation height during the Showa Sanriku Tsunami was **15 m.**
4. However, for this time earthquake tsunami, the death rate recorded for the same tsunami inundation height decreased to **10-1%.**
5. The death rate is not only related to the **effect of coastal levee** height, but a **variety of another factors.**
6. The **life-saving effects** are likely due to both **hard-** and **soft-countermeasures.** This study can not be discussed separating the effect of soft-countermeasures.

Thank you very much
for your attention