

# Risk governance deficits in the multiple risk situation: the Great East Japan Earthquake, Tsunami, and Fukushima nuclear accident

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- ✓ Multiple risk situations
- ✓ Personal experience
- ✓ Risk governance deficits
  - Why did damages become so heavy?
- ✓ Hindsight and challenges

# Facts and figures

## Earthquakes and Tsunami

March 11, 2011, at 14:46

Magnitude:9.0

People

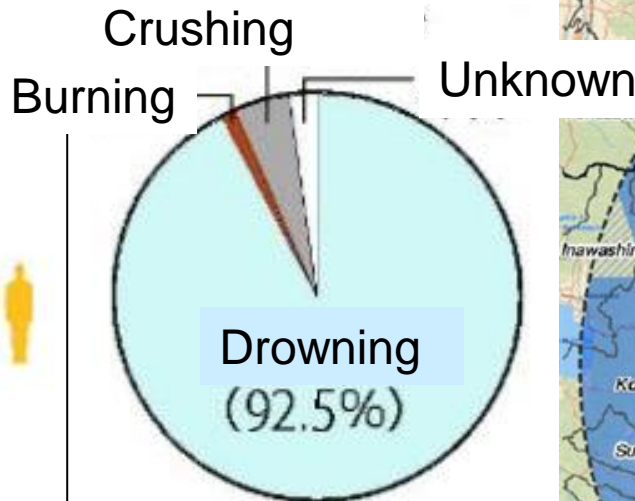
Killed 15,281



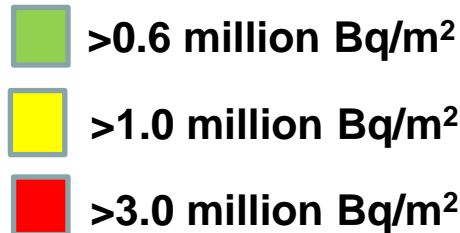
Missing 8,492



(June 1, 2011)

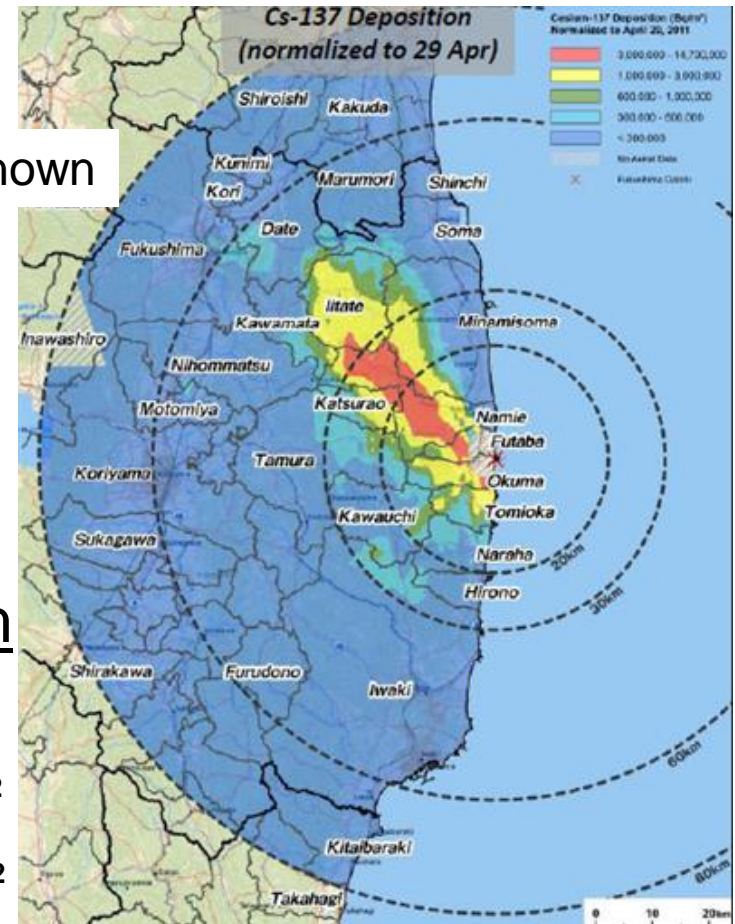


Causes of death



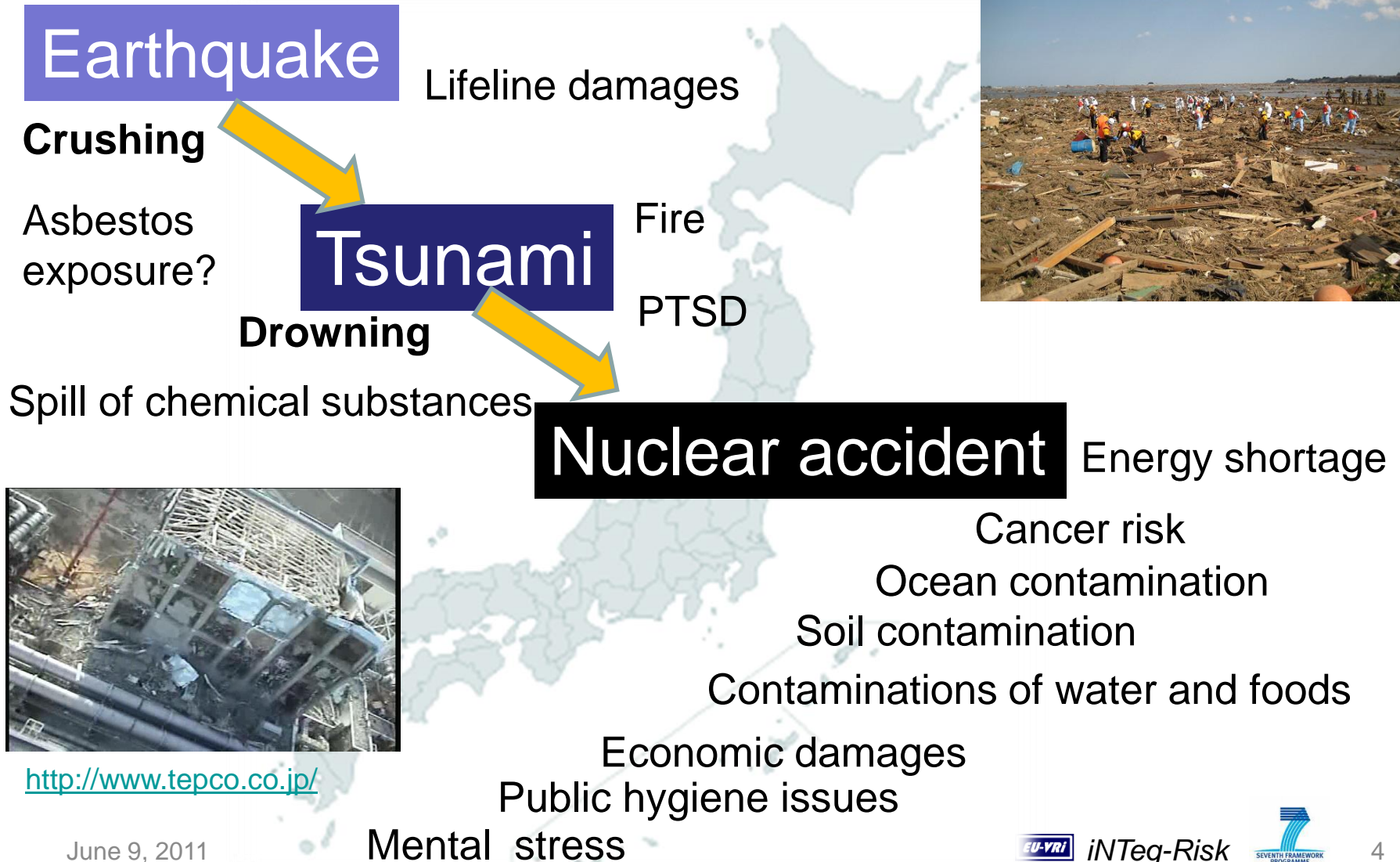
## Nuclear accident

### Cs-137 Deposition



Result of aircraft monitoring by MEXT and U.S.DOE (as of April)

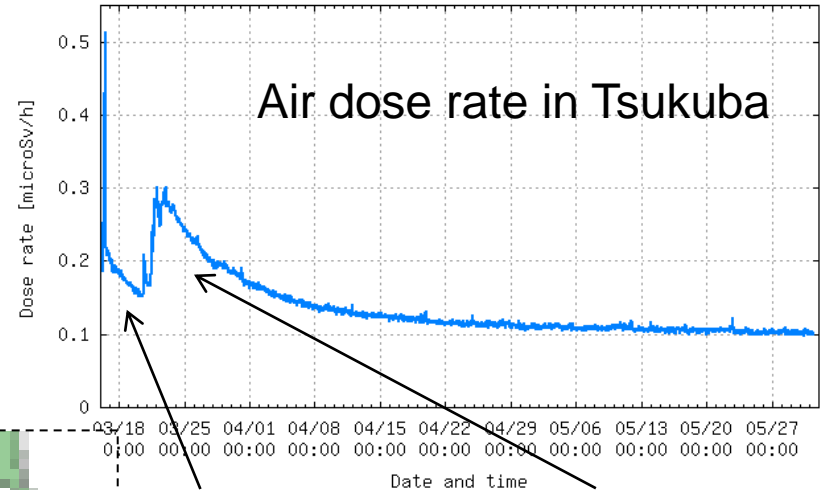
# The multiple risk situations



# Personal experience in March 2011

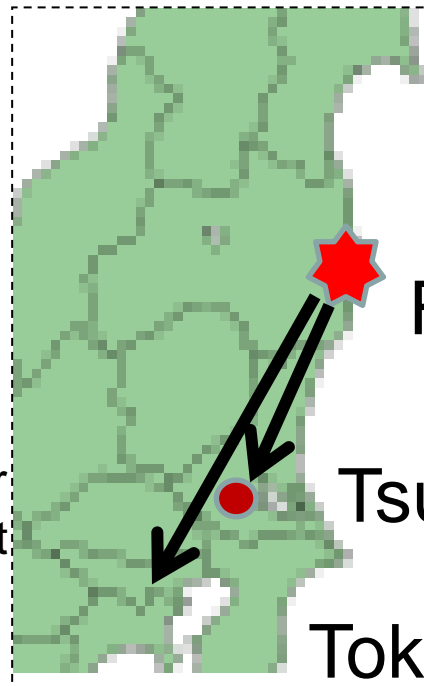


Earthquake  
Epicenter



Hydrogen  
explosions  
(12-15 March)

Rainfall  
(21 March)



Fukushima nuclear plant

Tsukuba 170km

Tokyo 230km

- Strong and long-continued quakes
- three days without tap water
- Real-time risk management

# Why did damages become so heavy?

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- ◆ The earthquake did not damage many buildings, because buildings in Japan are reinforced against earthquakes.
- ◆ It was said that there were 30 to 60 minutes between the earthquake and the tsunami.
- ◆ Knowing that tsunamis hit the coastal line periodically, the evacuation buildings / places have been designated and annual evacuation drills have been carried out.
- ◆ Hazard maps have been made and community wireless systems have been provided.
- ◆ We witnessed Tsunami disaster in Southeast Asia on TV seven years ago.

## Then why?



# Classification of risk governance deficits

	Earthquake	Tsunami	Nuclear accident
Before 3.11	★	★ ★	★ ★
On 3.11		★ ★ ★	★
After 3.11			★

# Before 3.11 Earthquake

Too much emphasis has been placed on Tokai area

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## National seismic hazard map

*Probability distribution of big earthquakes within 30 years  
(1 Jan. 2010)*

Kobe earthquake on Jan. 1995 counted 6,437 deaths

Tokai area

11 March 2011

× Tohoku earthquake Epicenter

Recent big earthquakes have occurred in places of “low probability”.

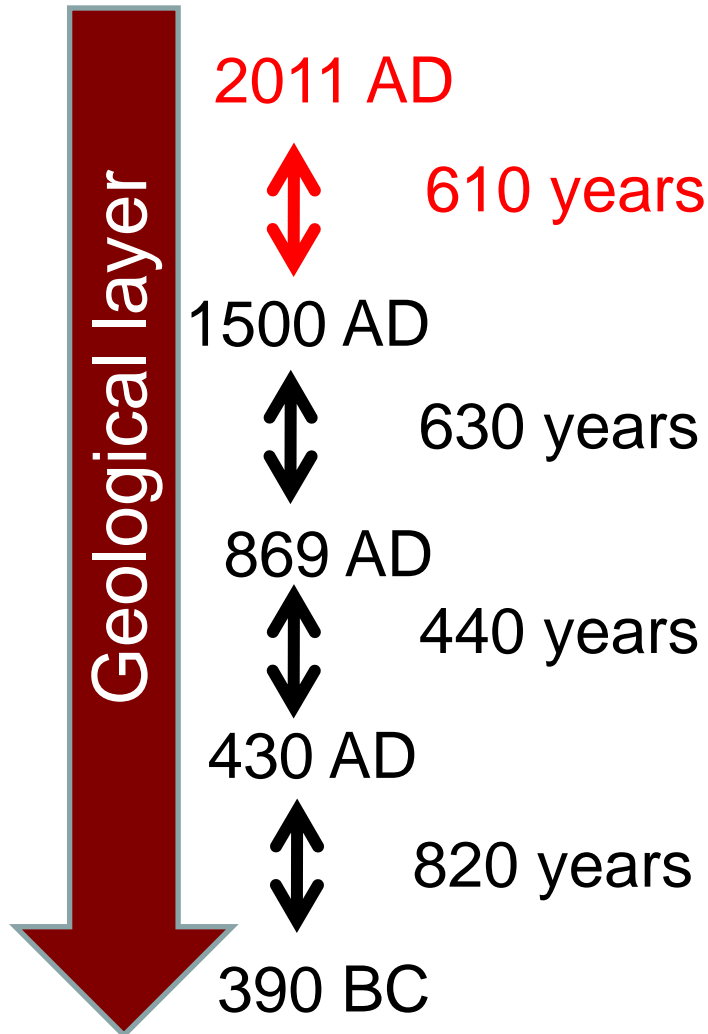
→ This map did not work as an *early warning system*



# Before 3.11 Earthquake and Tsunami

## Tohoku earthquake was not unprecedented

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A historical survey on tsunami deposits tells us that similar events had repeated with a period of 450 - 800 years.

Some experts had correctly predicted that a large scale of Tsunami could happen in the near future.

# Before 3.11 Tsunami

## Stone monuments as early warning system

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*"Remember the calamity of the great tsunamis. Do not build any homes below this point."*

*"When you notice the tsunamis, evacuate to the higher places."*



In Tohoku region, there are more than 200 stone monuments alarming Tsunami. They really saved some communities.

**However, as time passed and population grows, people began to live *below* these monuments or these monuments themselves were *moved to other places* when roads or buildings were built.**

# Before 3.11 Nuclear accident (1)

## Lack of preparation for emergencies

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A deep conflict between proponents and opponents of nuclear energy have prevented from reasonable preparations.

Opponents

Nuclear power cannot be accepted unless the probability of severe accidents is zero.



Proponents

Severe accidents will never happen at the nuclear power plants in Japan.

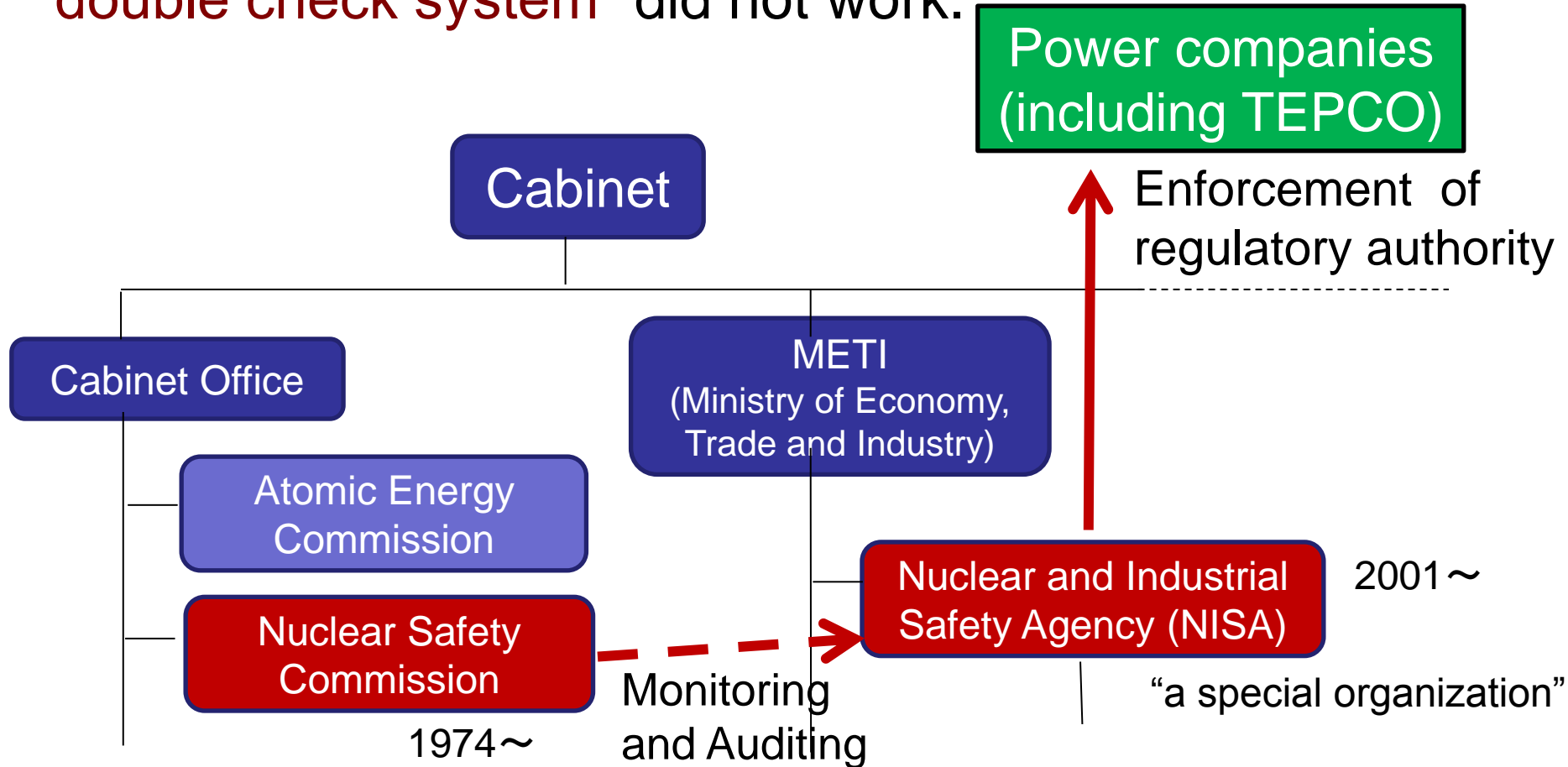
Preparation for emergency was difficult for the proponents, for it semantically contradicts their presupposition.

# Before 3.11 Nuclear accident (2)

## Lack of independence in safety regulatory bodies

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“double check system” did not work.



# On 3.11 Tsunami (1)

## Recent memories prevented precautionary behavior

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Why did many people not evacuate after the earthquake?

### 80 years ago (March 3, 1933)

Showa Sanrikuoki Tsunami killed 3,000 people.

### 50 years ago (May 24, 1960)

Chili Tsunami killed 142 people.

### 1 year ago (February 28, 2010)

“**Major Tsunami**” **warning** was issued, but the actual height of the waves was less than 2 m. People might think that even “Major Tsunami” was not so serious.

### Two days ago (March 9 2011)

A strong earthquake happened and “**Tsunami**” **advisory** was issued, but the actual height was less than 1m.



Few people remember the disaster



“Major Tsunami” warning 1 year ago

## On 3.11 Tsunami (2)

### Failure in transmitting tsunami information

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As the first estimation of magnitude of the earthquake was 7.9, the height of the Tsunami was forecasted to be **6m** in Miyagi, **3m** in Iwate and Fukushima prefectures.

But, the actual magnitude was 9.0 and the height of the tsunami was **more than 20 m** (revision of the forecast comes *after* Tsunami hit the coast).

Tsunami warning system consists of only three categories. There is no category above “Major tsunami” warning.

	Warning	Major Tsunami	3m or more
		Tsunami	about 2m
	Advisory		about 0.5m



# On 3.11 Tsunami (3)

## Overconfidence in sea walls

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A sea wall of 10m high, 2.4 km length, was built in Miyako city along the coast, taking more than 30 years. Some people were too confident in the seawall, and did not evacuate. But, in reality, 25 m high Tsunami easily overrode the wall.



“The largest seawall in Japan”

<http://sankei.jp.msn.com/affairs/news/110406/dst11040622210068-n1.htm>

# On 3.11 Nuclear accident

## Losing all power was beyond the assumption

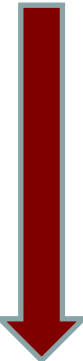
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### Earthquake



Reactors were automatically shut-down at 14.46.  
But, external power supply was lost.

### Tsunami (estimated more than 14m)



Emergency diesel generators and pumps supplying seawater to the cooling system were halted at 15.41.

The case of losing all power for cooling system was **beyond the assumption** in a guide for safety design review.

### Resulting tradeoff

Ongoing nuclear crisis requires huge efforts and resources, which might cause the delay of the relief of victims by earthquakes and tsunamis.

# After 3.11 Nuclear accident

## Lack of accountability for radiation risk

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Radiation risk was *a new risk* to the general public.

- Lack of dose limits in case of emergency (foods, drinking water, total dose to the public, school field....)
- Poor risk communications ( “No problem”, “It’s safe. Do not panic”)
- No integrated risk management (external exposure and internal exposure were addressed separately)
- No consensus of the risk from low-dose exposure among experts(thresholds model, LNT model)
- Delay of release of the results of emergency dose prediction model called “SPEEDI”. (The first results were published on 23 March, two weeks after the accident.)

These deficits cause confusion among the public.

# Some hindsights (1): Tsunami

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## To transmit disaster experience

- Oral lessons (“Tsunami Tendenko”)
- Folk stories (“Michibiki Jizo”)
- Shrines (“Namiwake Shrine”)
- Statue and stone monuments



# Some hindsights (2): Tsunami

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## To investigate historic records

- Historical documents
- tsunami deposits



## To doubt the idea that public bodies protect us

- Do not depend on disaster prevention maps too much.

Act on our own judgment !

## To recognize the danger of “risk homeostasis”

- Feeling safe through technologies such as sea walls may prevent us from preparing emergencies.



# Challenges for risk researchers

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- ❑ We must turn back to the classical questions, “**what is safety?**” “**how safe is safe enough?**”.
- ❑ The concept of “risk governance deficit” (proposed by IRGC) is effective for drawing useful lessons for the future.
- ❑ Challenges we must tackle over the next decades

- ◆ Energy shortage

- Every alternative energy has some risks and increases in cost.

- ◆ Soil contamination

- Physical half-life of Cesium 137 is about 30 years



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# Thank you very much

