

# On Tsunami Risk Assessment for the West Coast of Thailand

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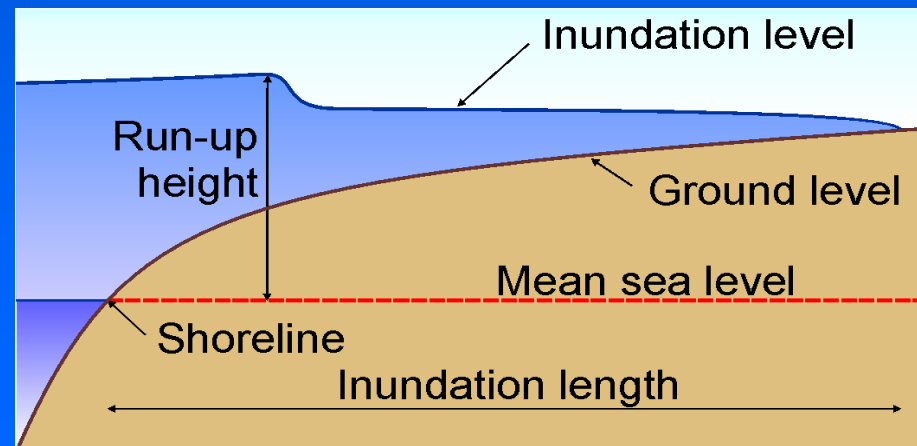
University of Bonn

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Evaluation**

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# Design criteria for tsunami risk mitigation measures

- What is the **'tsunami risk'** today, what will it be in the future, and how much should it be reduced?
- What **inundation level** should the tsunami risk mitigation measures be designed for?



# Risk assessment: tool for decision-making under uncertainty

- What is hazard and what is risk?
- How should we evaluate risk?
- How can we reduce risk?
- How much risk is acceptable or tolerable?

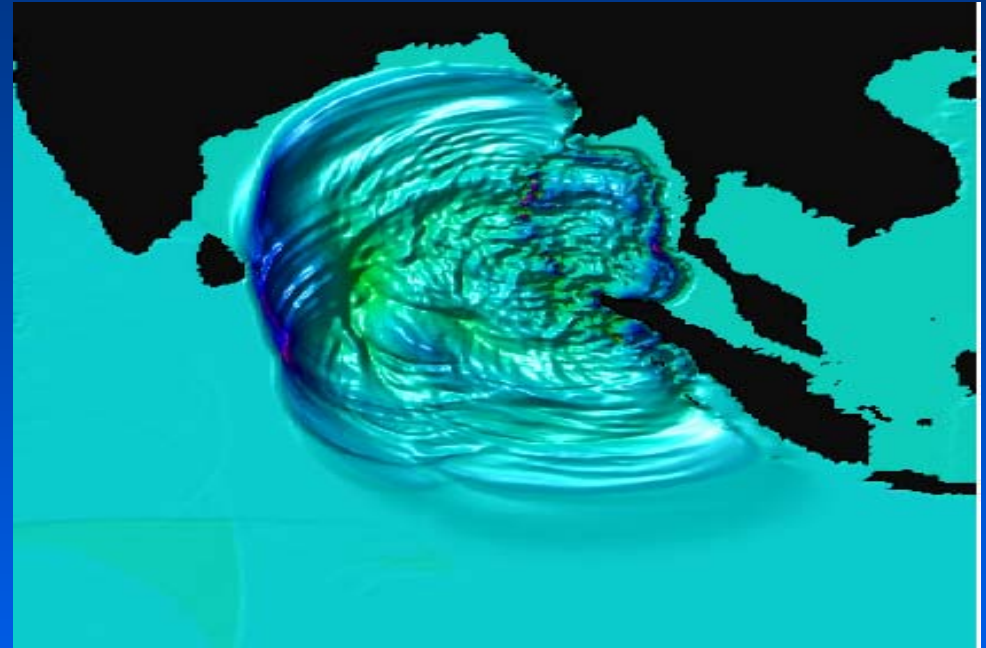


# Terminology: Danger (threat)

***Danger (Threat):*** The natural phenomenon that could lead to damage, described in terms of its geometry, mechanical and other characteristics. The danger can be an existing one (such as a creeping slope) or a potential one (such as a tsunami). *The characterisation of a danger or threat does not include any forecasting.*

# Terminology: Hazard & Risk

**Hazard:** Probability that a particular danger (threat) occurs within a given period of time



**Risk:** Measure of the probability and severity of an adverse effect to life, health, property, or the environment

(risk could be real or perceived)

# Terminology: Hazard & Risk

Quantitatively:

$Risk = Hazard \times \textit{Consequence}$ , or

$Risk = Hazard \times \textit{Potential Worth of Loss}$

Loss could be:

- ***Loss of human life***
- ***Economic loss***
- ***Loss of reputation***



The project focused mainly on **loss of human life**, and to a lesser extent on loss of reputation. Risk in terms of economic loss was not assessed.

# Tsunami Risk Mitigation

- Is the existing tsunami risk acceptable or tolerable?
  - **Yes**  $\Rightarrow$  Nothing needs to be done
  - **No**  $\Rightarrow$  Risk should be reduced
- Risk is product of **hazard** and **consequence**
- Tsunami hazard **cannot** be changed
- To reduce the risk, **we should mitigate the consequences**

# Challenges in application of risk management theory to tsunamis

**Tsunami risk estimates are uncertain:**

- Very low hazard
  - Extremely high consequence
- ⇒ **risk estimates are highly uncertain**



# Challenges in application of risk management theory to tsunamis

## “Tsunami hazard” changes with time:

- Tsunami hazard in Thailand is mostly due to movements along the northern section of the subduction zone.
- Lower seismic activity expected in coming decades because of the major earthquakes that occurred in Dec. 2004 and March 2005.

# Challenges in application of risk management theory to tsunamis

## Real risk vs. perceived risk:

The **real risk\*** and the **perceived risk** for the tsunami are likely to be quite different.

\* **'Real risk'** in this context refers to the scientifically derived risk.



# Challenges in application of risk management theory to tsunamis

## Real vs. perceived risk:

Since the perceived risk is very high, the potentially affected **population expect that tsunami risk mitigation measures are done**, even if one cannot document the immediate need for such measures or justify them through a cost-benefit analysis.

# Challenges in application of risk management theory to tsunamis

**Different groups of potentially affected population have different exposure to tsunami danger:**

- 1) people who live in the exposed areas permanently,
- 2) tourists who only live in the exposed areas one or two weeks each year, and
- 3) locals who do not live in the exposed areas, but work there during the tourist season.

**The risk considerations for the 3 groups are not the same.**

# More challenges in tsunami risk mitigation

- Risk mitigation measures should be for potential **future tsunamis**, not the tsunami that happened on 26 December 2004.
- It is vital to have a **long-term** view of the problem. **What is done now affects the exposure of future generations to tsunami risk.**

# Scenario-based approach adopted in the project

1. Define **scenarios** for tsunami-generating earthquakes.
2. Compute the **tsunami inundation levels** for the scenario earthquake events.
3. Estimate the **tsunami risk** for the different scenarios.
4. Compare the estimated risk with tolerable or **acceptable risk levels**.

# Results of from seismic hazard evaluation and tsunami modelling

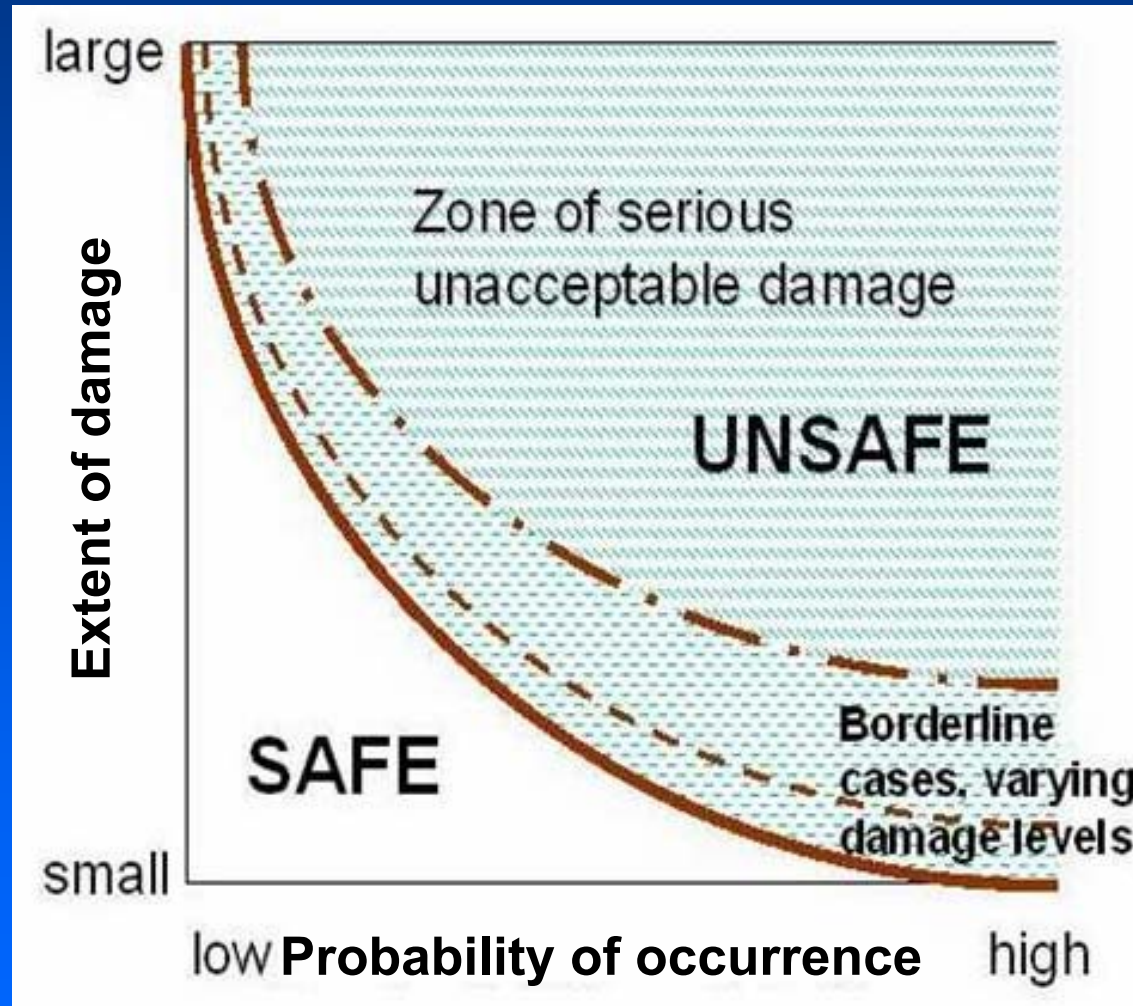
## Short to medium term (next 10 – 100 years)

In the short- to medium term, the maximum credible earthquake that could generate a tsunami affecting Thailand is a magnitude 8.5 event.

An M 8.5 earthquake, located at the most critical location, could cause at most **inundation levels of +2.5 to +3.0 m** at high tide.

# So, how much is the risk and is it acceptable?

Consequence →



Hazard →



# How much risk are we willing to accept?

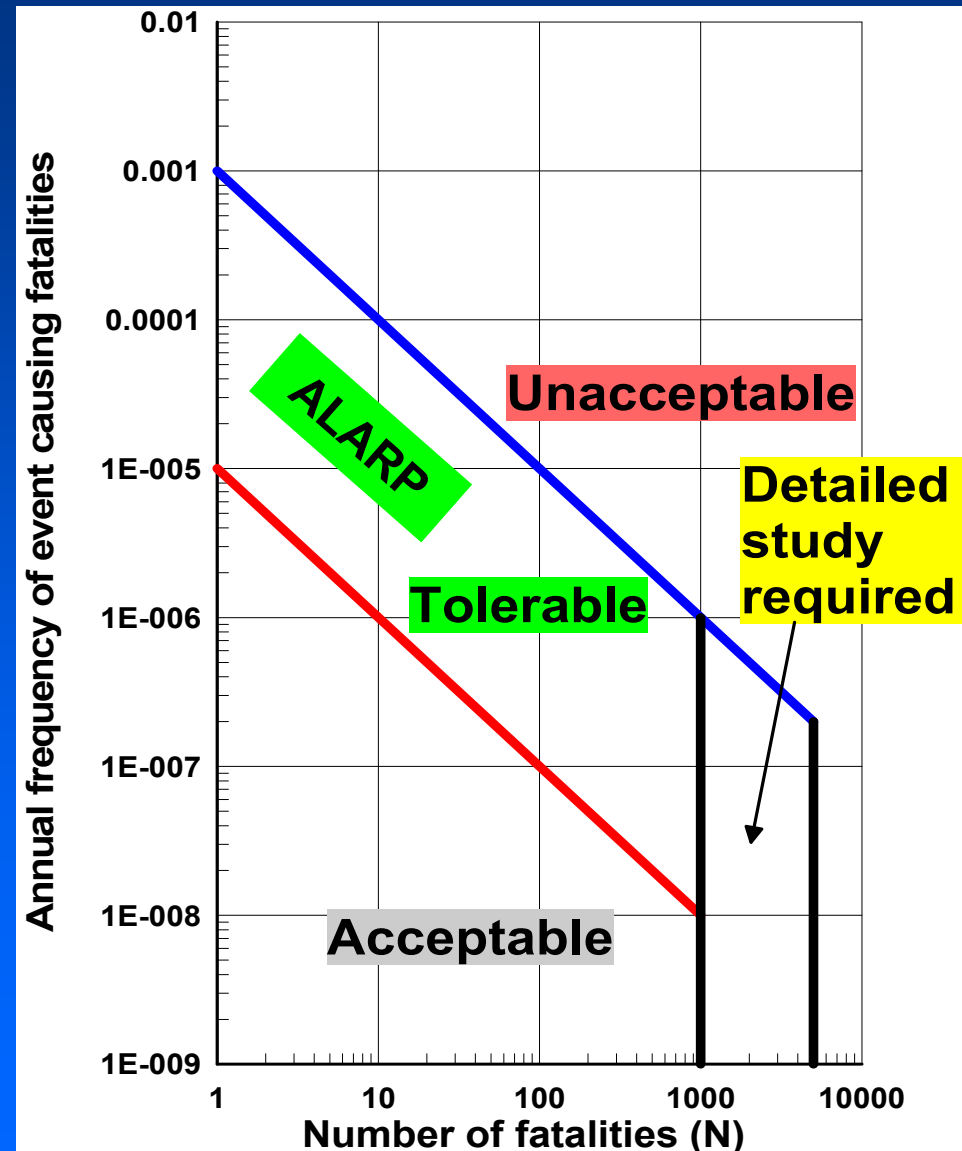
Depends on whether the situation is voluntary or imposed.



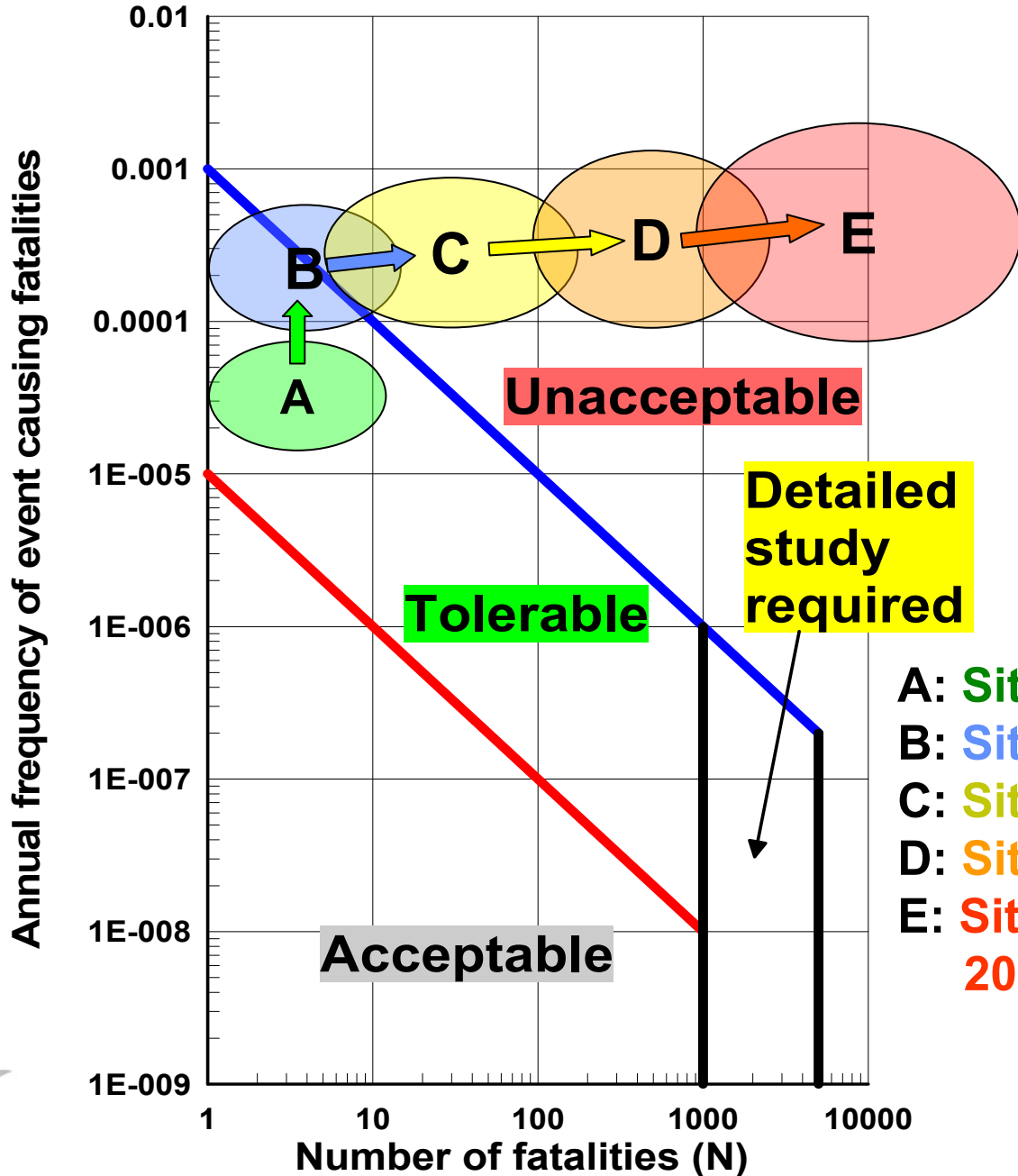
# Acceptable / Tolerable Risk

## Criteria of Hong Kong Geotechnical Engineering Office:

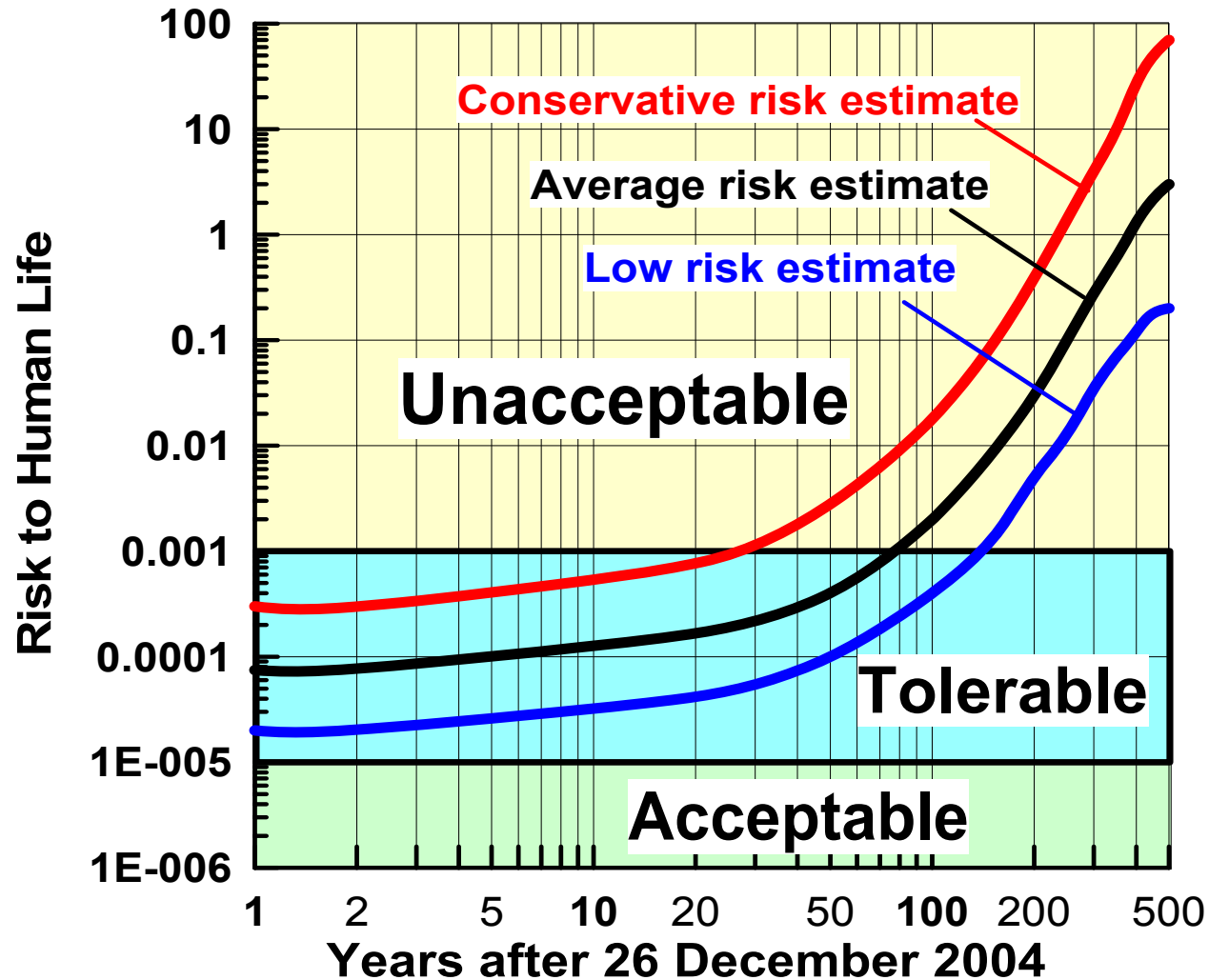
Acceptable, tolerable, and unacceptable societal risk from natural hazards



# Evolution of tsunami risk with time



# Estimated future tsunami risk to human life in Thailand



# Conclusions from risk evaluation

## Short to medium term (next 10 – 100 yrs)

**No immediate mitigation measures are strictly necessary, but increased public awareness is desirable.**

## Long term (100 – 400 years)

**The probability of occurrence of a major tsunami will increase gradually with time.**

**If no risk mitigation measures are taken, the societal risk due to a major tsunami will be unacceptably high after about 50 – 100 years, approaching catastrophic levels in 200 – 400 years.**