CIRCLE Lunchtime Talk:

Earthquake & Tsunami Trivia
- Cascading and Compounding Effects -

April 2026

Outline

- In October 2025, the CIRCLE team visited Tofino and made a lunchtime presentation. Do you remember what was presented?
- It is a Tsunami Preparedness Week and so let's try to remember key information through trivia quiz questions!
- The large earthquake will cause a sequence of cascading events (shaking -> ground displacement -> liquefaction/landslides -> tsunamis -> fires -> aftershocks) and a sequence of compounding effects on people and infrastructures (building damage, road damage, power failure, water supply disruption, communication malfunctioning, service disruption, lack of supply, etc.).
- It is good to remind ourselves about what could happen and how things could go wrong by reviewing past earthquake-tsunami events.

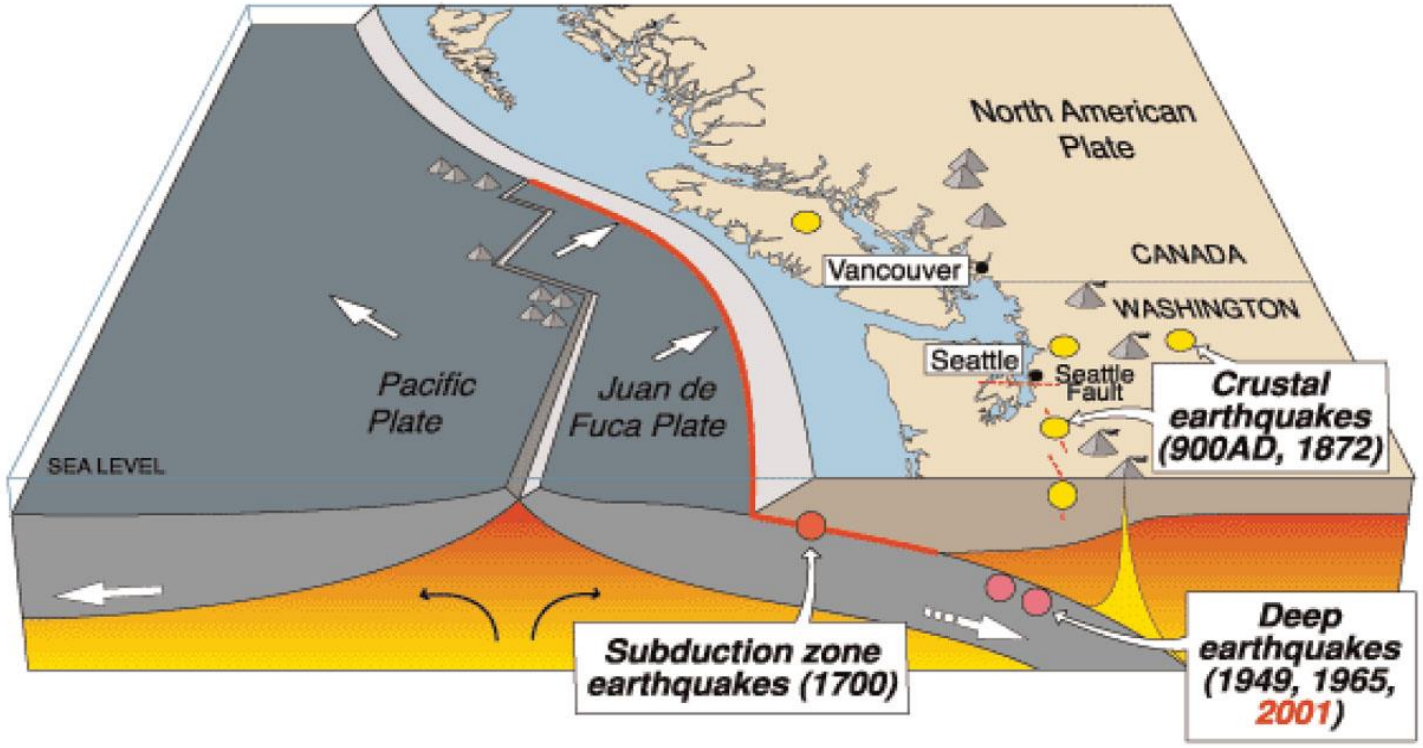
Global Earthquake & Tsunami Risks

Q1: What is the name of a region where 90% of the world's earthquakes occur?

- Ring of Fire (around the Pacific Ocean)
- Subduction zones

Q2: What is the name of a famous subduction zone in the Pacific Northwest, which could host "*the Big One*"?

- Cascadia subduction zone



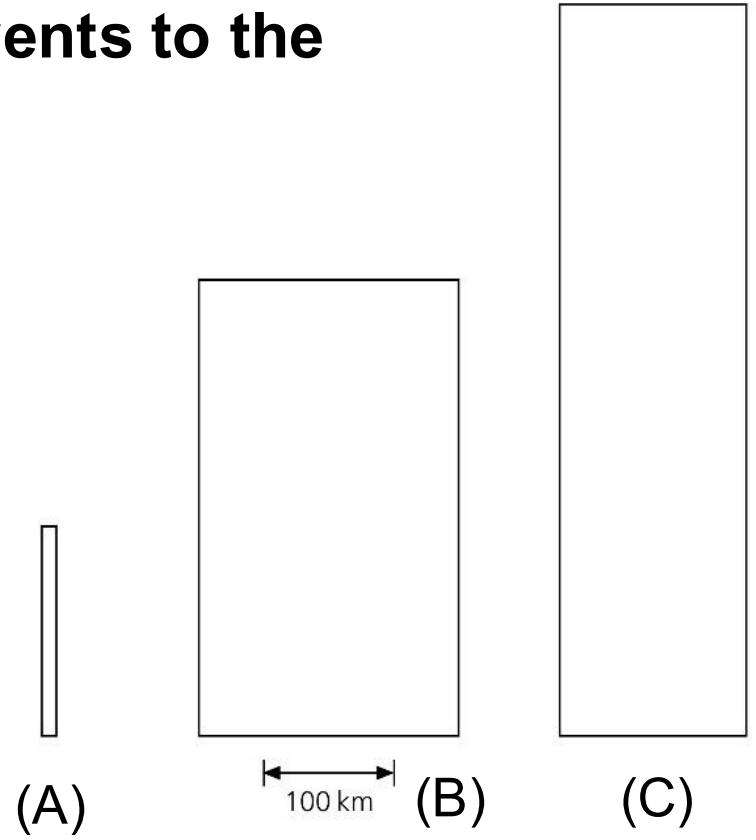
Source	Affected area	Max. Size	Recurrence
Subduction Zone	W.WA, OR, CA	M 9	500-600 yr
Deep Juan de Fuca plate	W.WA, OR,	M 7+	30-50 yr
Crustal faults	WA, OR, CA	M 7+	Hundreds of yr?

Scale of Earthquakes

Q3: *M*8 and *M*9 earthquakes, how much difference in released energy for these two classes? (Multiple choice)

- A factor of 2
- A factor of 3
- A factor of 10
- A factor of 30

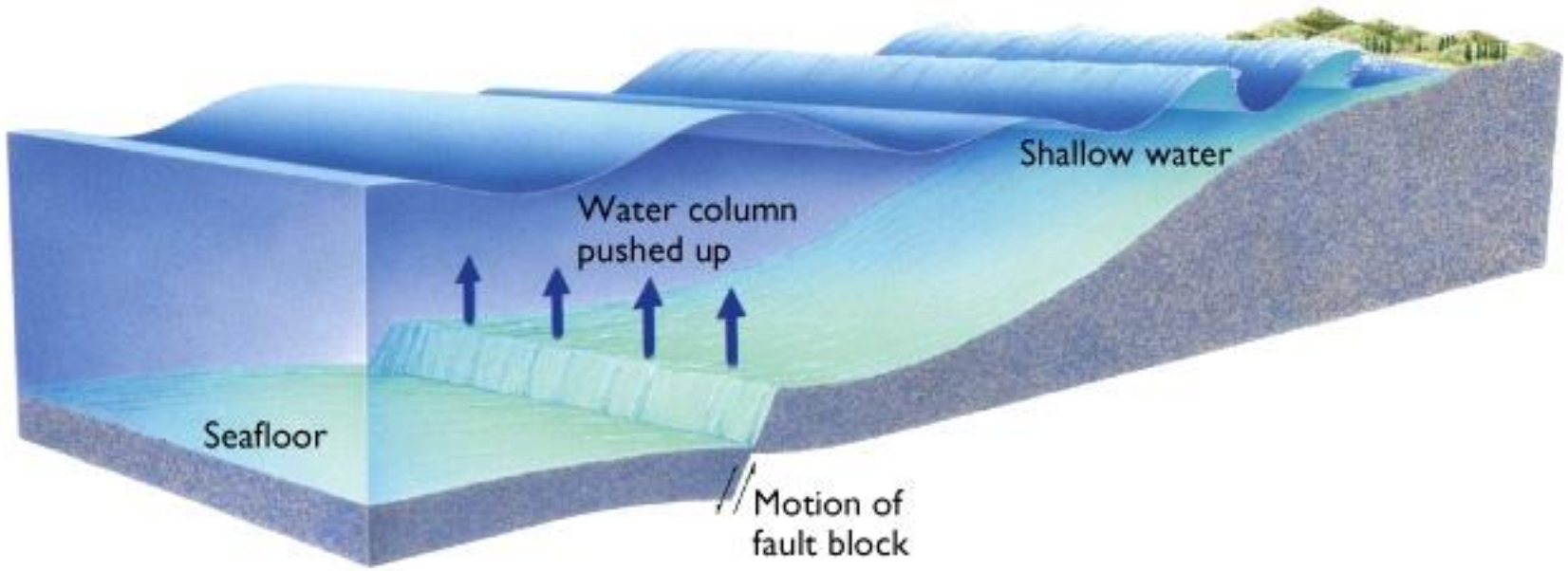
Q4: Schematic diagrams shown below illustrate a spatial scale/dimension of three historical events: 1906 San Francisco event, 1960 Chile event, and 1964 Alaska event. Match these events to the diagrams (A) to (C).



Tsunami Generation

Q5: How do large subduction earthquakes generate tsunamis?

- Earthquakes occur in ocean (e.g., 1000 to 3000 m deep).
- A large volume of water is uplifted by the seafloor displacement over a large area.
- Due to gravity, uplifted waters return to the original position.
- Tsunamis have long wavelengths (less tendency to decay over space).



Imagine a massive water volume is suddenly uplifted by 5 m over 500 km * 100 km * 1 km?

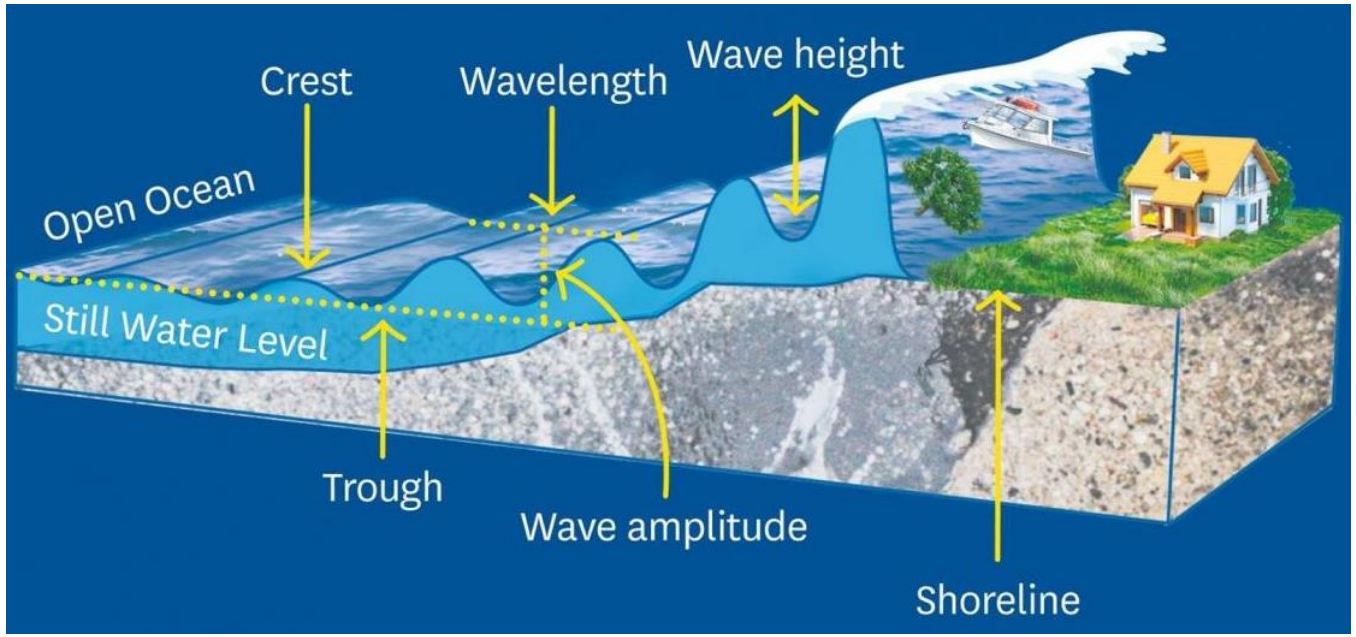
Tsunami Characteristics

Q6: Do tsunamis travel faster in shallow ocean? (Multiple choice)

- Yes
- No
- No change

Q7: Do tsunamis become higher in shallow ocean? (Multiple choice)

- Yes
- No
- No change



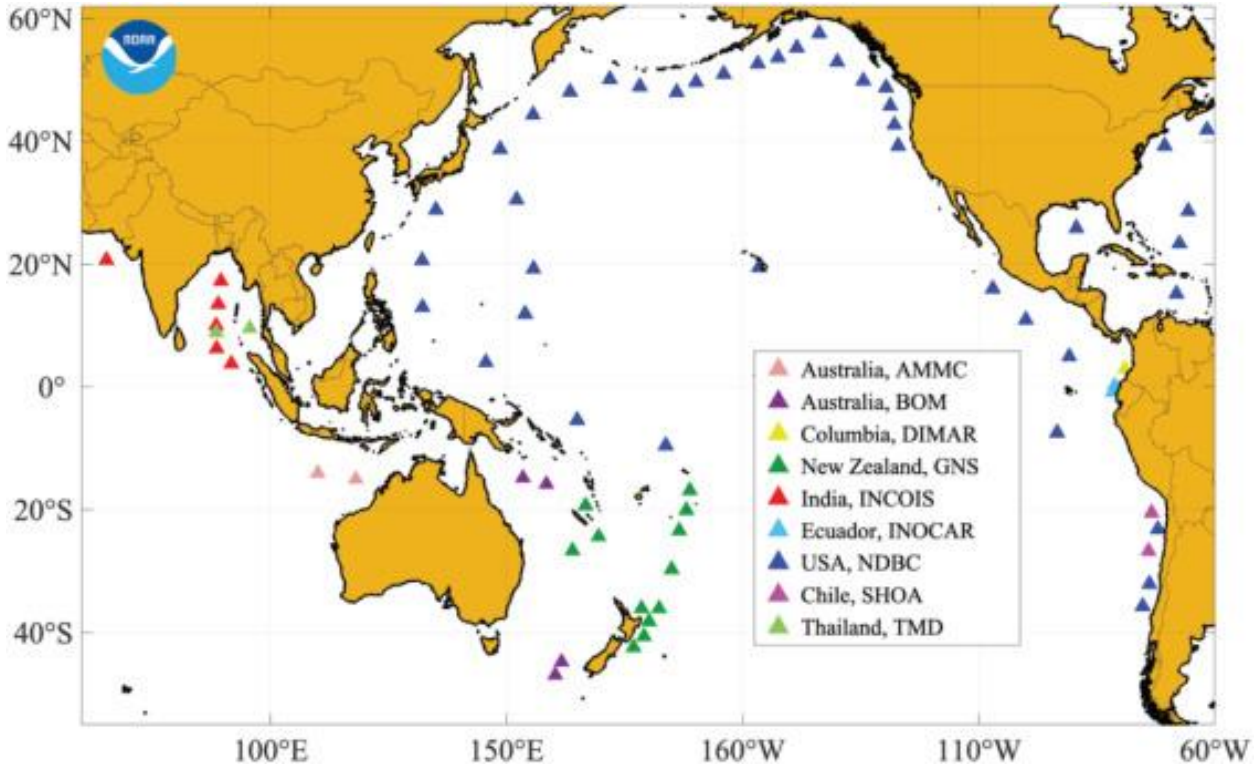
Tsunami Warning & Evacuation

Q8: If a massive tsunami happens in Japan, how long would it take to see tsunamis in BC?

- Less than 2 hours
- 2 to 5 hours
- 6 to 10 hours

Q9: If a massive earthquake occurs in Cascadia, how long would it take to observe tsunamis in BC?

- Less than 2 hours
- 2 to 5 hours
- 6 to 10 hours



Q10: If a massive earthquake occurs in Cascadia, what should you do?

- Drop, cover, and hold on
- Go to shoreline
- Go to high ground

SURVIVAL AGAINST THE WAVE:
KEY DRIVERS OF TSUNAMI MORTALITY

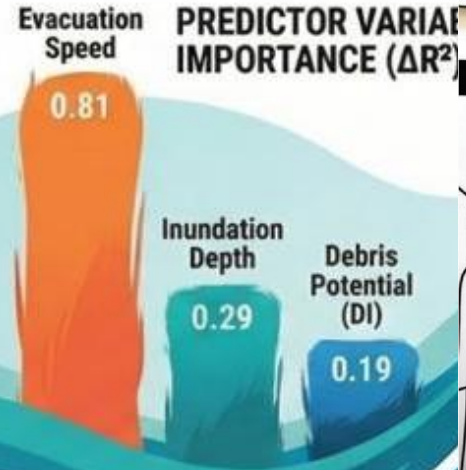
CONTEXT SUMMARY

Analysis of the 2011 Töboku tsunami shows mortality is a complex interplay of wave intensity, evacuation logistics, and demographics, not just a single factor.

PRIMARY DRIVERS OF SURVIVAL

EVACUATION SPEED IS THE #1 PREDICTOR

Velocity to reach safety is more decisive than wave hydraulic force.



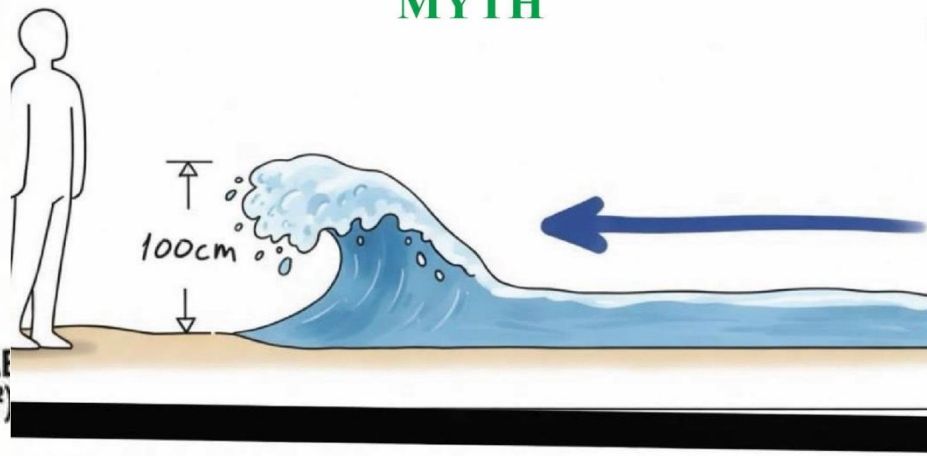
INUNDATION DEPTH VS. MOBILITY

While water depth matters, survival is primarily determined by the capacity to evacuate early.

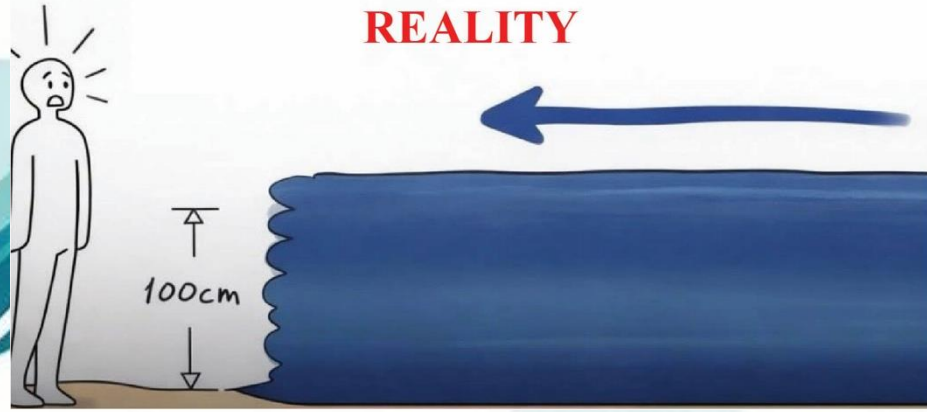
DEMOGRAPHIC TIPPING POINTS

Fatalities rise sharply in communities where the elderly population exceeds 25–30%.

MYTH



REALITY



COASTAL MORPHOLOGY IMPACT

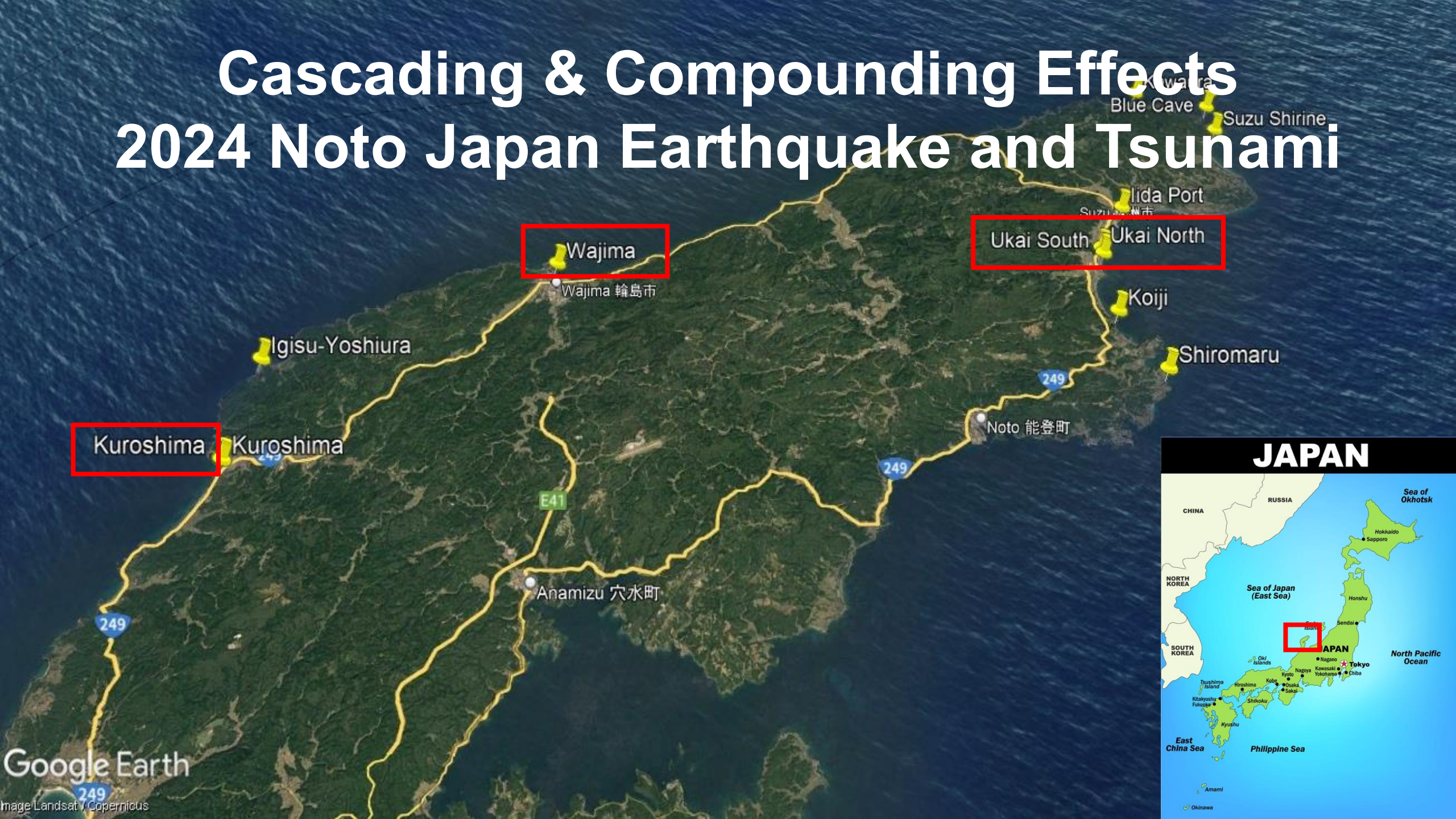
Ria (fjord-like) Coasts

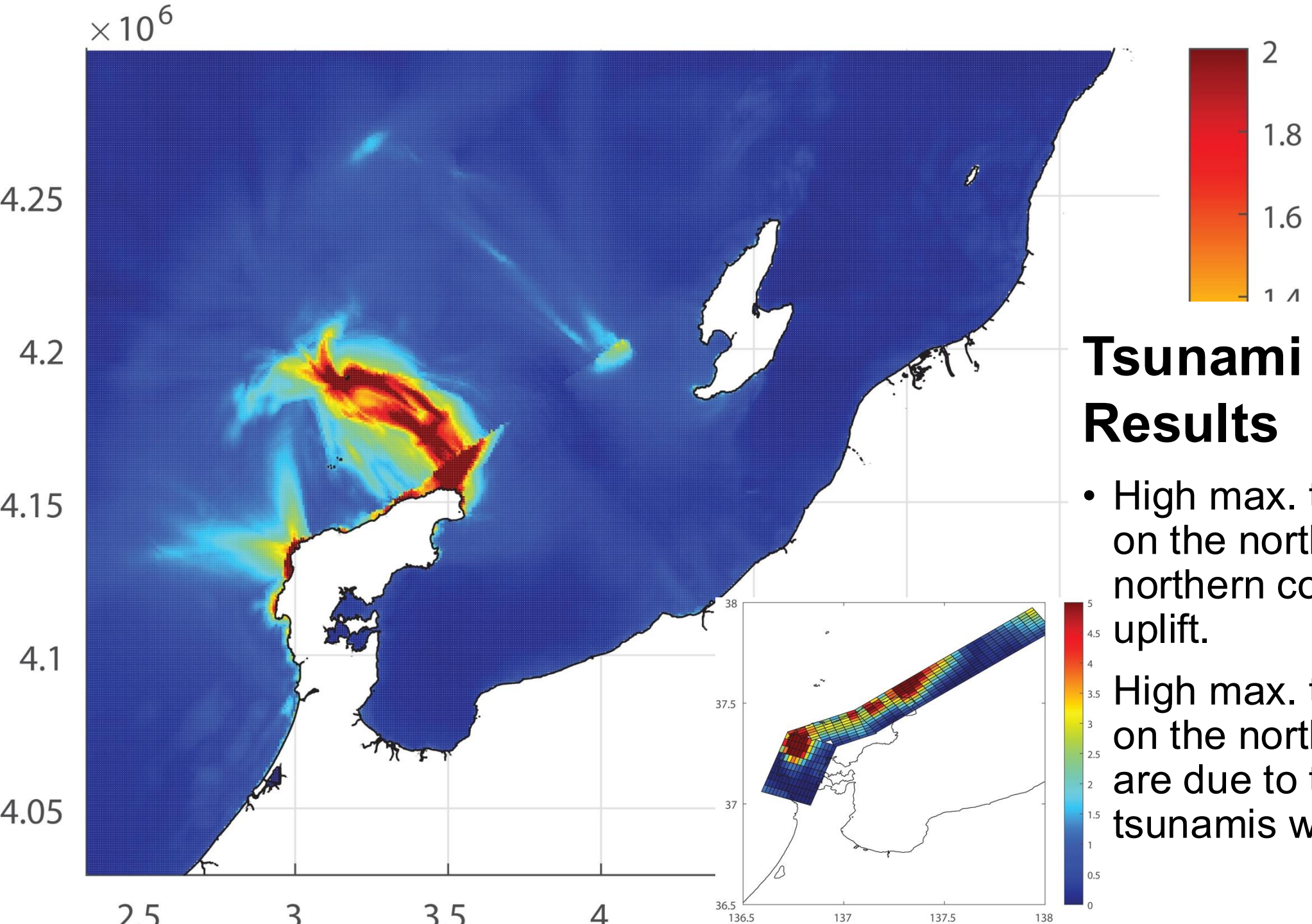
Ria coasts amplify risk more due to concentrated wave energy.

Flat Plains

Flat plains disperse wave energy.

Cascading & Compounding Effects
2024 Noto Japan Earthquake and Tsunami



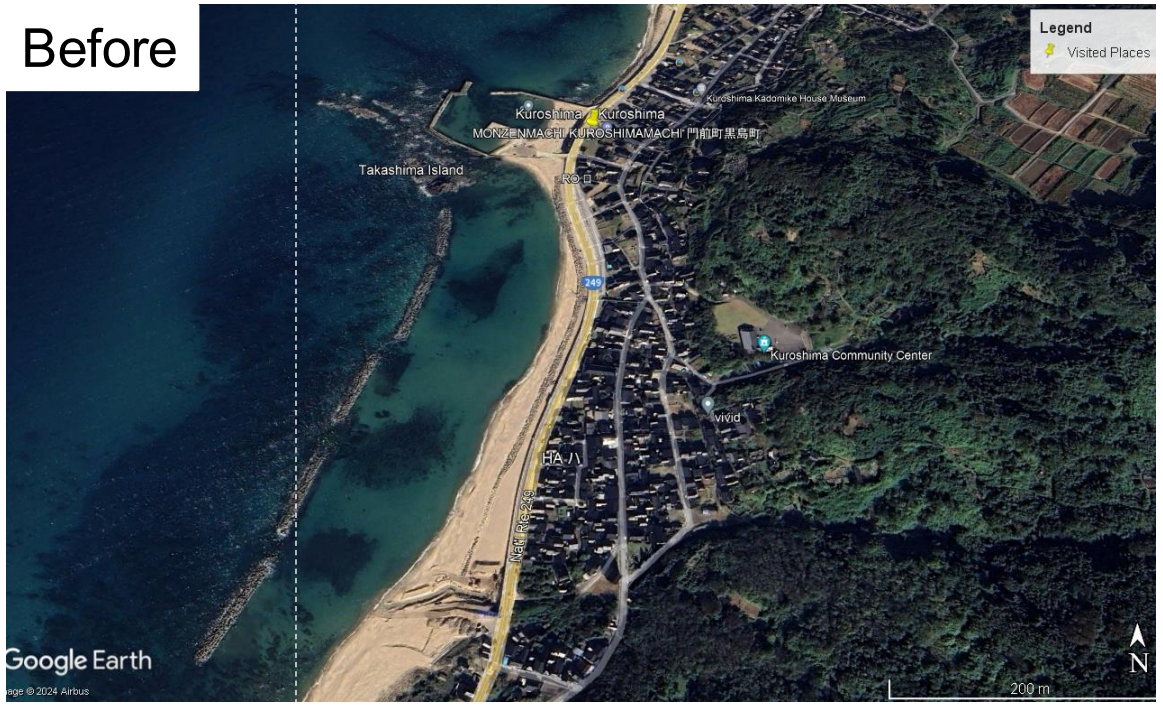


Tsunami Simulation Results

- High max. tsunami heights on the northwestern and northern coasts are due to uplift.
- High max. tsunami heights on the northeastern coast are due to tsunamis. 2+m tsunamis were observed.

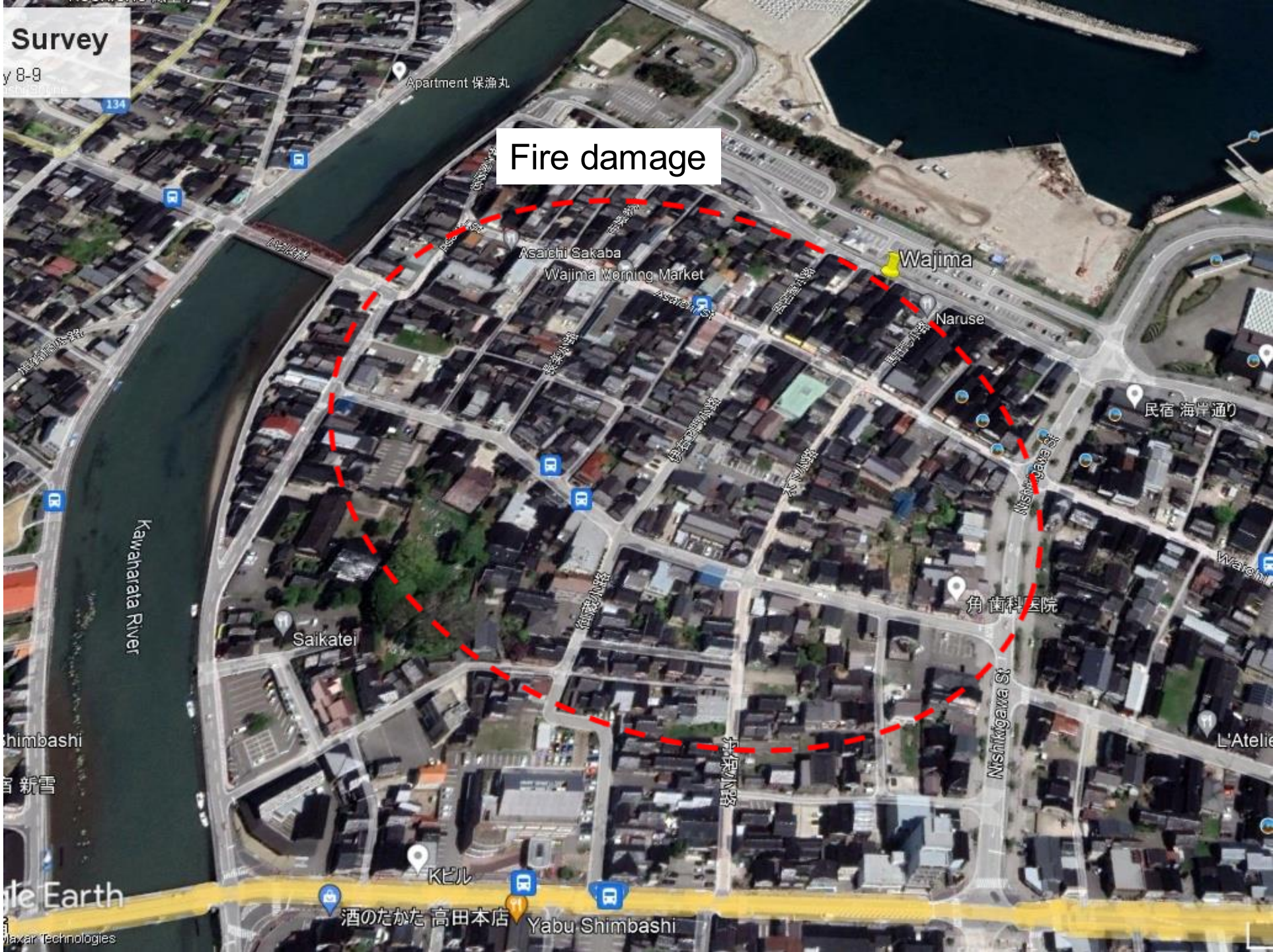
Kuroshima

- Northwestern coast of Noto Peninsula
- 2 to 3-m uplift (Google images confirm this)
- Historical buildings – shaking damage and ground failures, but no tsunamis.
- Loss of traditional port due to uplifting -> loss of livelihood and loss of community's identify.



Wajima

- A regional hub in northern Noto.
- Shaking (soft-story) and fire damage
- Ground failures (liquefaction and lateral spreading)

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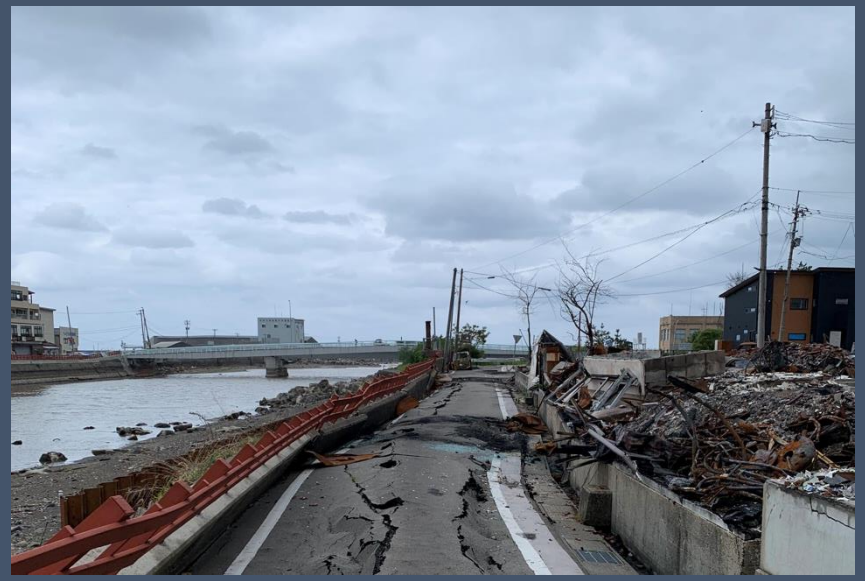


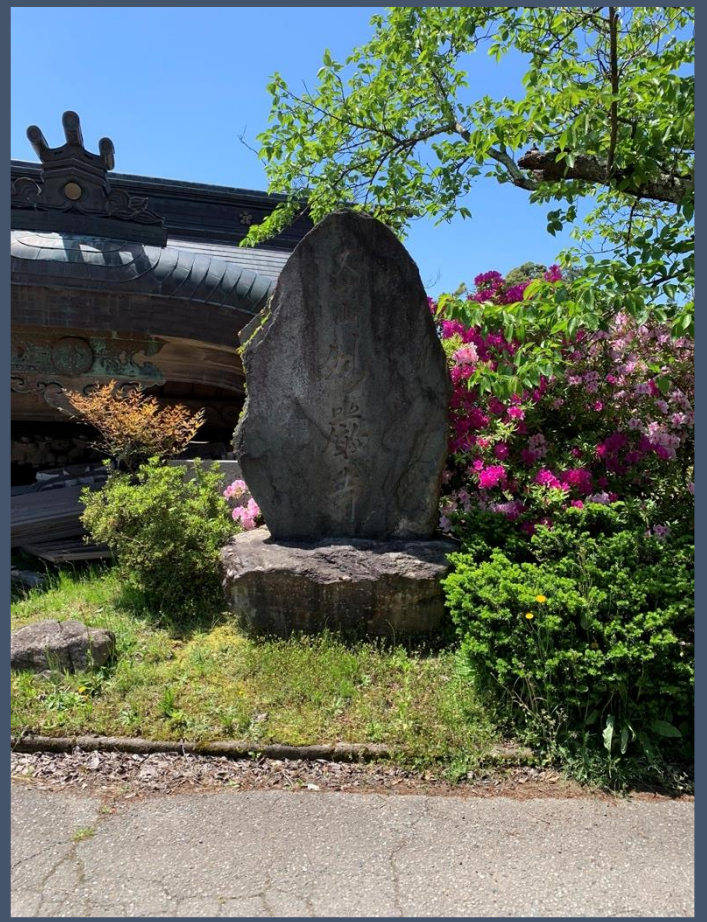

金沢
Kanazawa
珠洲
Suzu
門前
Monzen

Ukai

- Sandy site conditions (liquefaction)
- Building damage and tsunami damage
- Fire damage
- High (overall) building damage occurrences
- Loss of cultural heritages

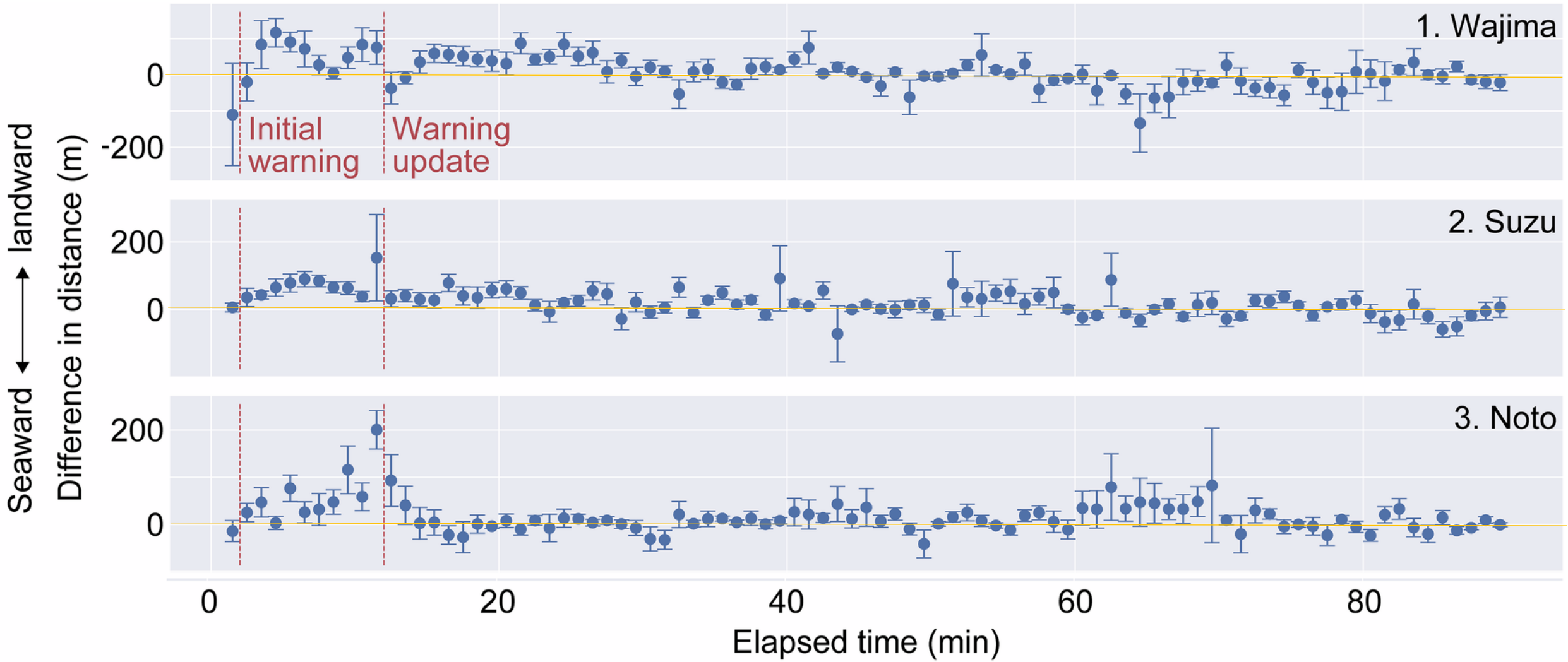

KYOTO U

Myogen Temple



Insight for Future Scenarios

- Three focused locations had different characteristics of cascading and compounding impacts.
- Many people evacuated immediately.
- Liquefaction damaged water supply system.
- The uplift reduced tsunamis but made existing port facilities unusable.
- The compounding effects of sever winter (snow) and ageing community.
- Some villages were abandoned after the earthquake and tsunami.
- Landslides and rock falls made many roads unpassable.



Makinoshima, F., Yotsui, S., Sato, S. *et al.* Large-scale geolocation data reveal evacuation behaviour during the 2024 Noto Peninsula earthquake and tsunami. *Commun Earth Environ* **6**, 891 (2025). https://doi.org/10.1038/s43247-025-02819-8

Questions?

New Frontiers in Research Fund
Fonds Nouvelles frontières en recherche
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