Earthquakes, Risks, and Earthquake Early Warning in Canada

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2025.11 Building Resilient Communities

Seconds save lives!

Natural Resources Canada | Ressources naturelles Canada

Canada

Earthquake Hazard & Risk

Damage & Other Impacts

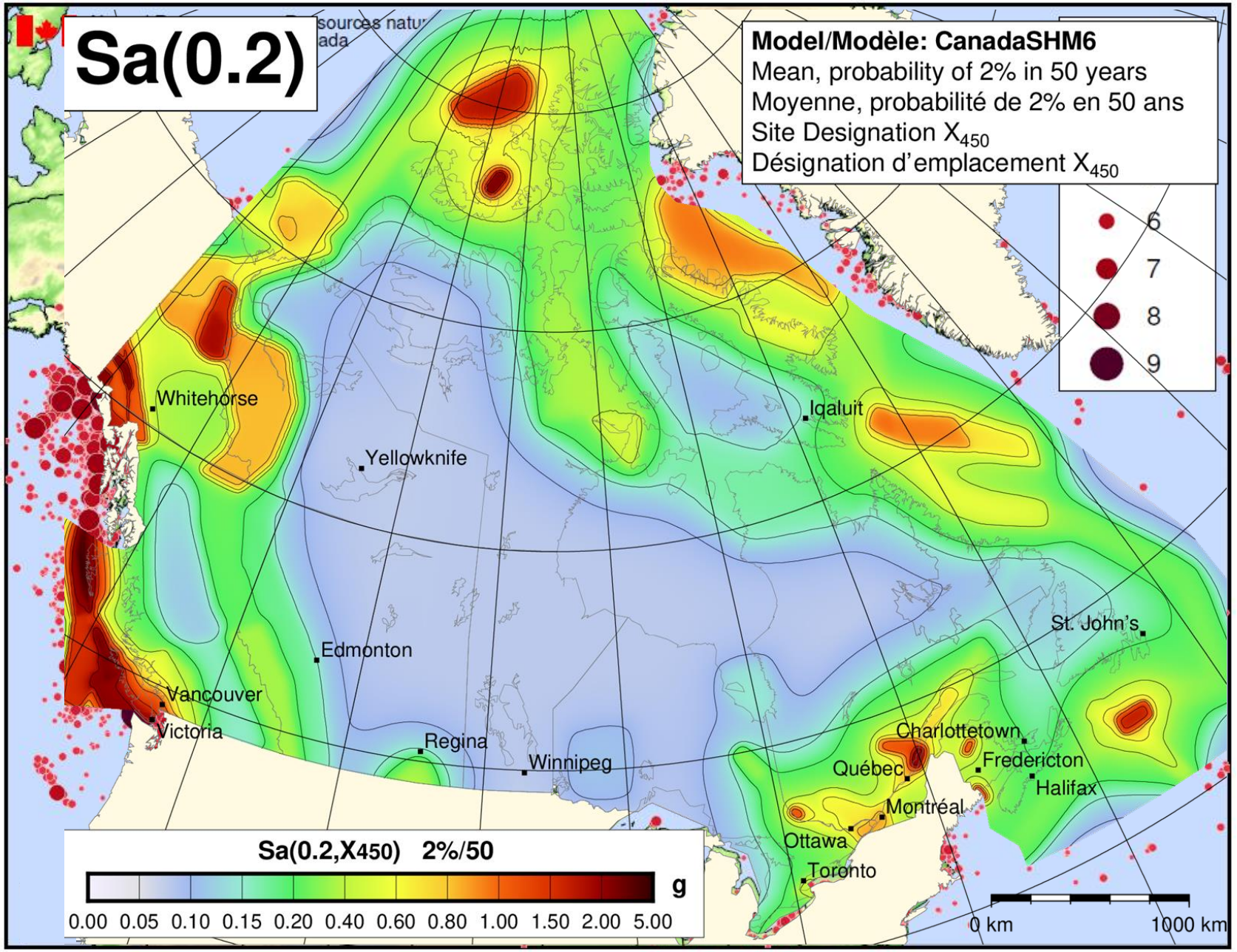
Preparedness

Earthquake Early Warning

Canada is at risk of earthquakes

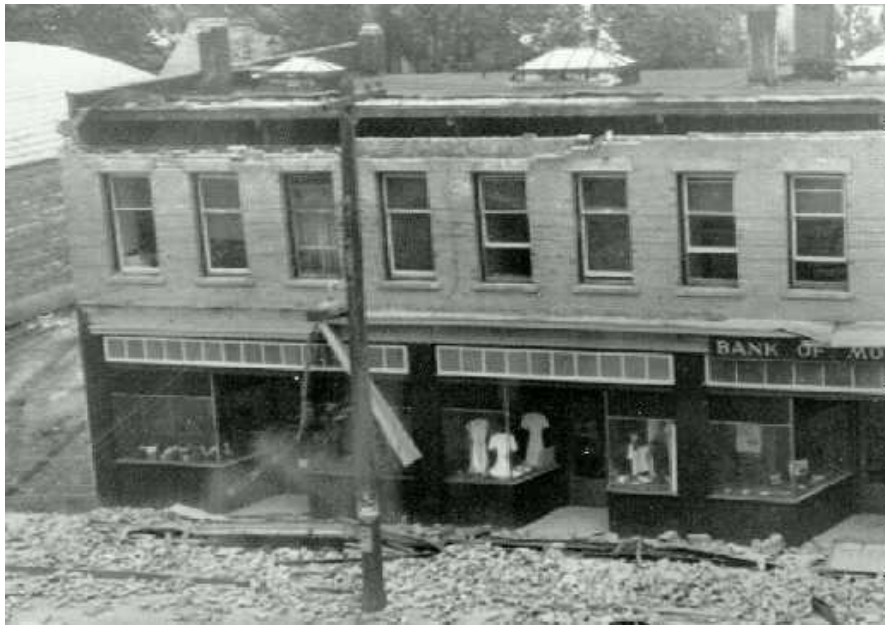
- Indigenous histories
- Geophysical evidence
- Monitoring since 1898
- Numerous damaging earthquakes
- Data inform National Building Code

Kobe, 1995



History of Damaging Earthquakes

Vancouver Island 1946 M7.3



Saguenay
1988 M5.9

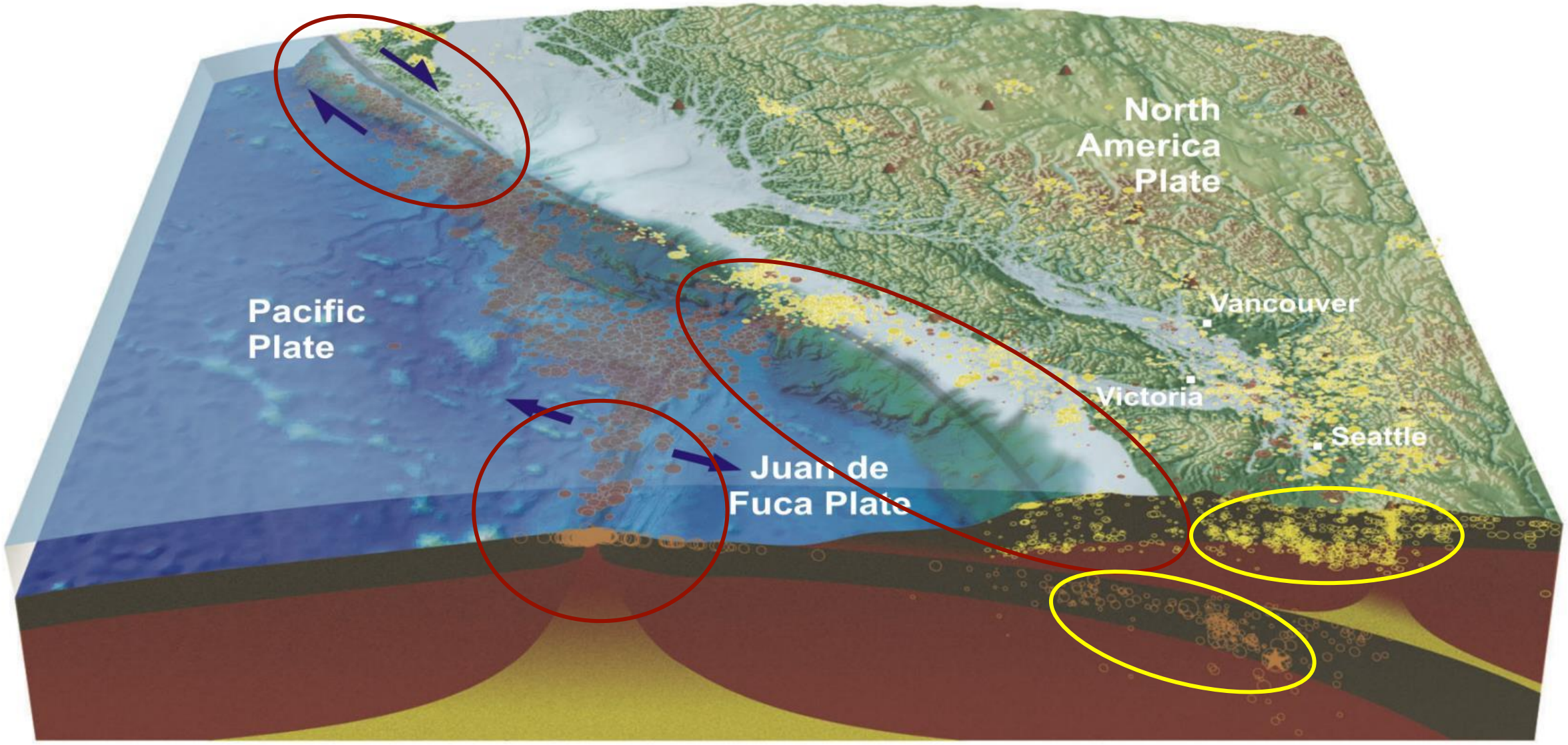
Val des Bois 2010 M5.0

Haida Gwaii 2012 M7.8

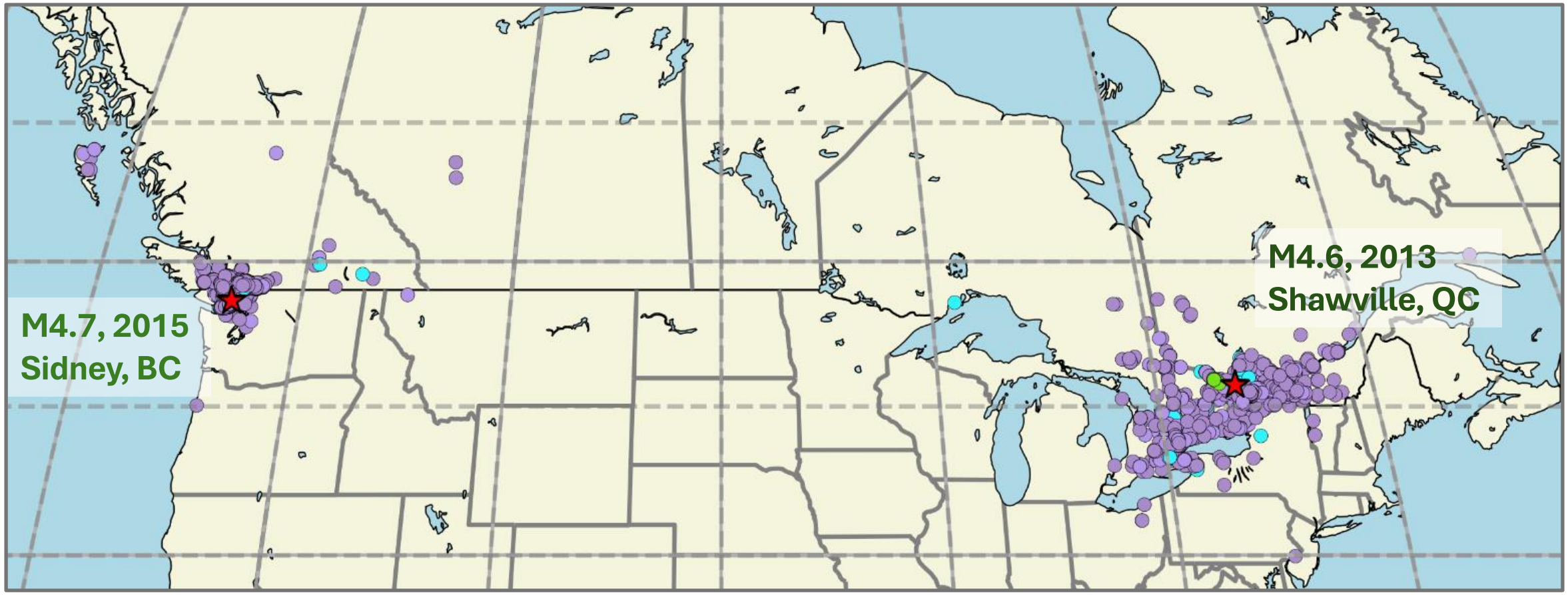
Charlevoix
1925 M6.2

Jean Levac, Ottawa Citizen

Earthquakes in BC



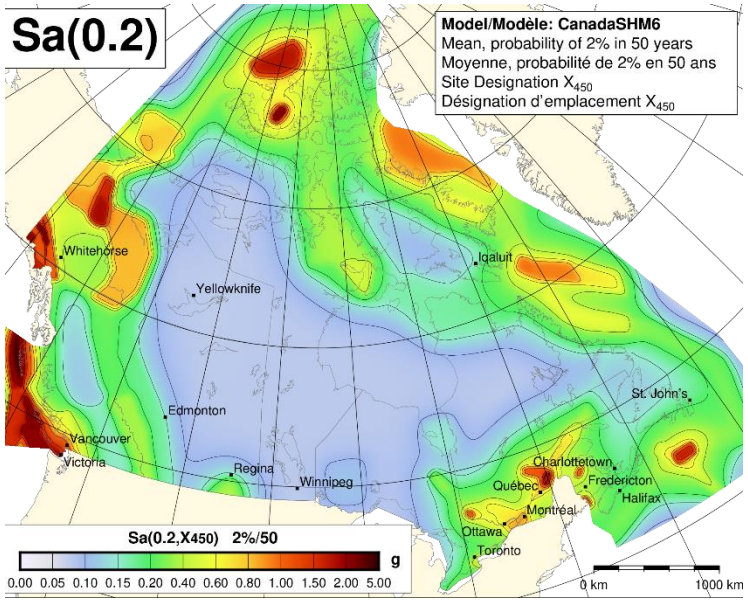
Eastern Canada has lower hazard but similar risk



Earthquakes impact more strongly and broadly in east than in west

Greater concentrations of infrastructure and people in east than west

Earthquake Risk Assessment



Hazard (estimated potential strength of shaking)

x Exposure x Vulnerability (infrastructure, assets, & people)

= Risk (damage, injuries, & fatalities)

Earthquake risk information for emergency management and planning in Canada.

Tools to help Canadians build resiliency to seismic risk through planning and emergency management.

QUICK LINKS

Explore Earthquake Scenarios

Consider Probabilistic Earthquake Risks

Learn More

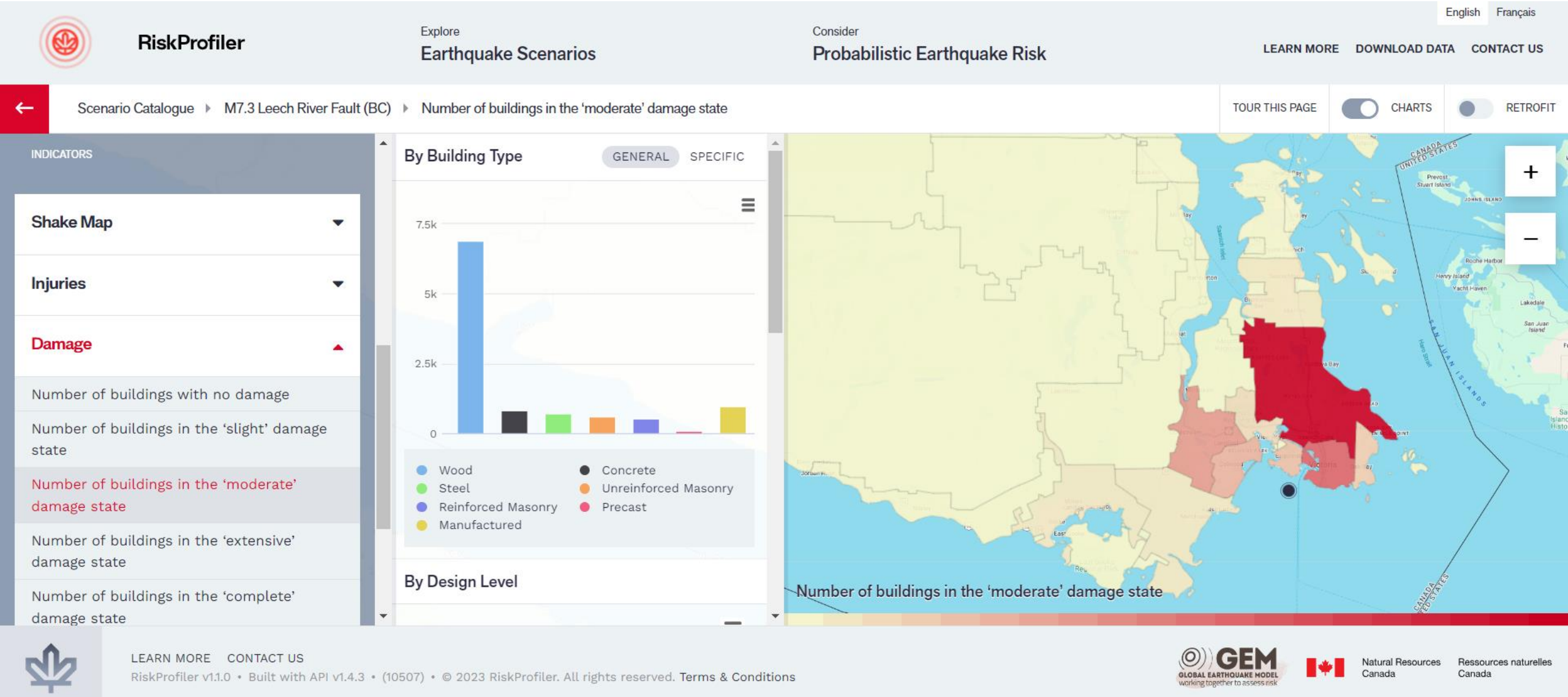
Download Data

GEM
GLOBAL EARTHQUAKE MODEL
working together to assess risk

Natural Resources Canada | Ressources naturelles Canada

Earthquake Risk Portal

www.RiskProfiler.ca



Earthquake Hazard & Risk

Damage & Other Impacts

Preparedness

Earthquake Early Warning

Typical Structure Damage

Unreinforced masonry

table provides protective shelter

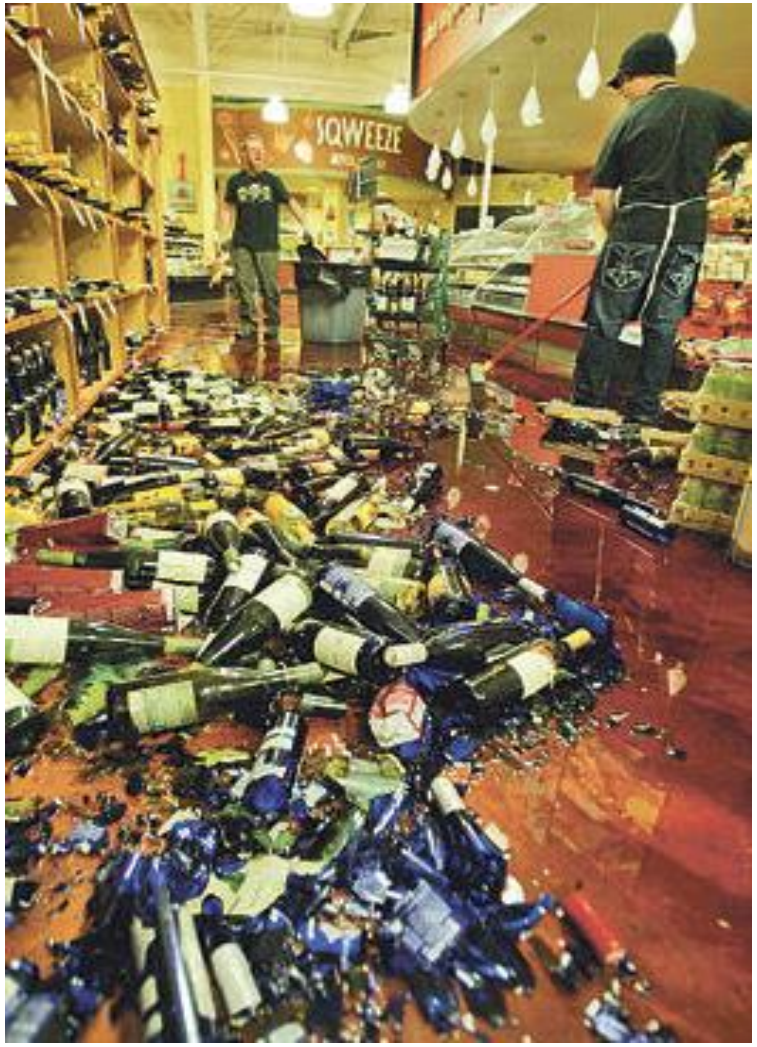
Poorly reinforced concrete

Chimneys

Porches & weak additions

Garages

Typical Non-structural Damage

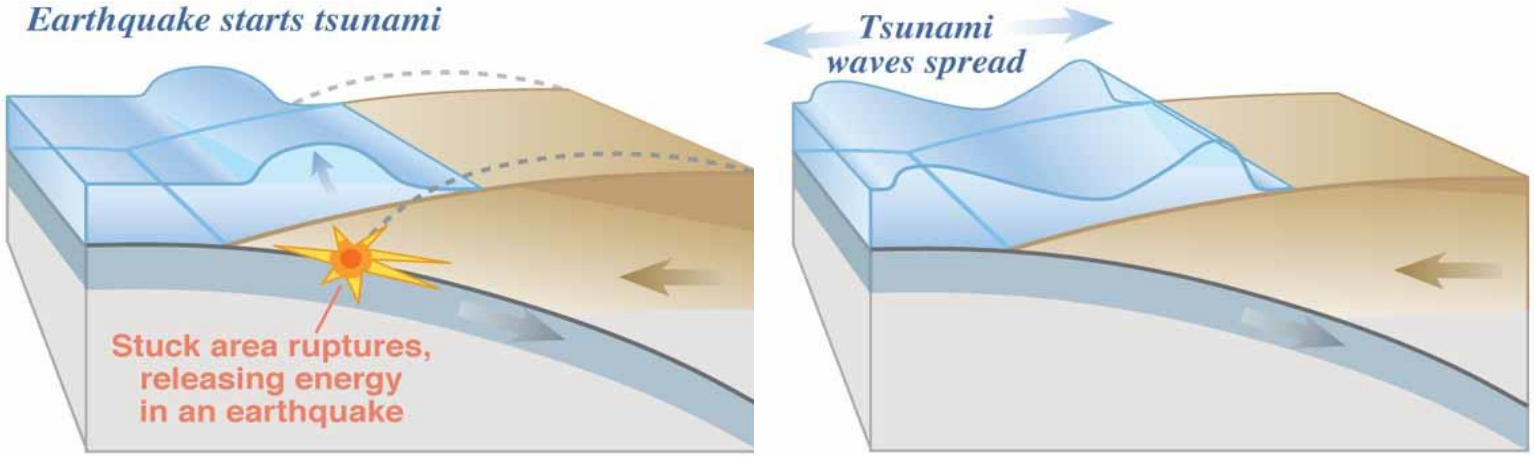


Landslides and Liquefaction

Tsunami

a **series** of ocean waves generated by:

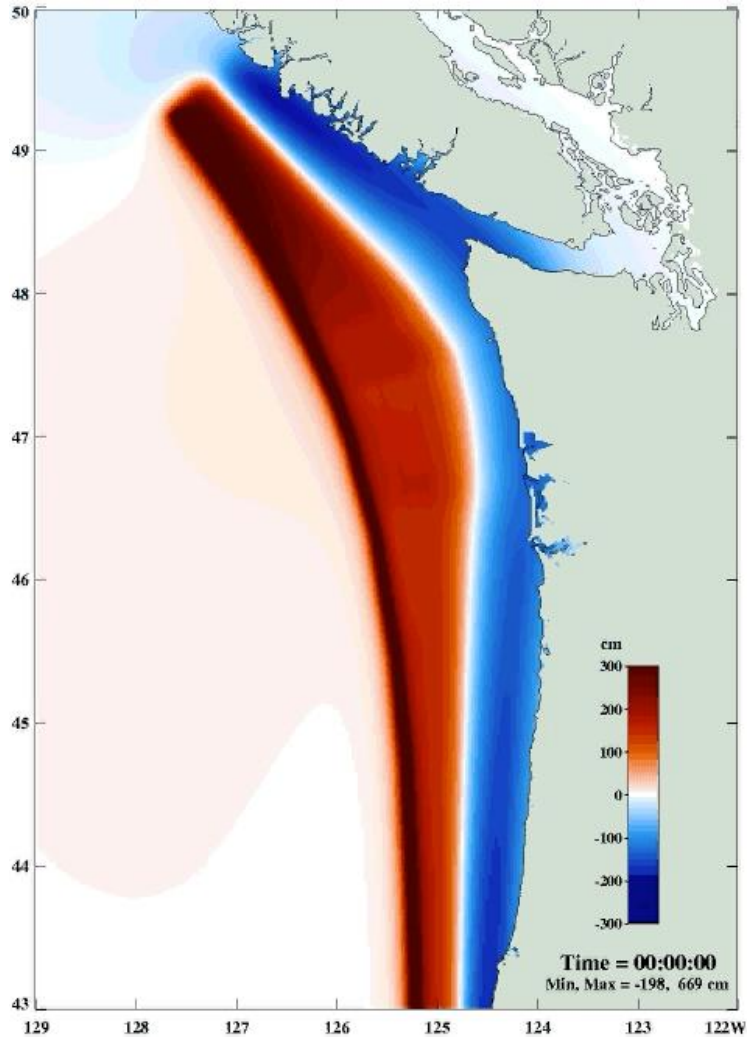
- subduction style earthquake (~90%),



- landslide (coastal or submarine – occasionally triggered by an earthquake),
- other phenomena

CSZ model does not show how far inland waves travel

the first wave is usually not the highest

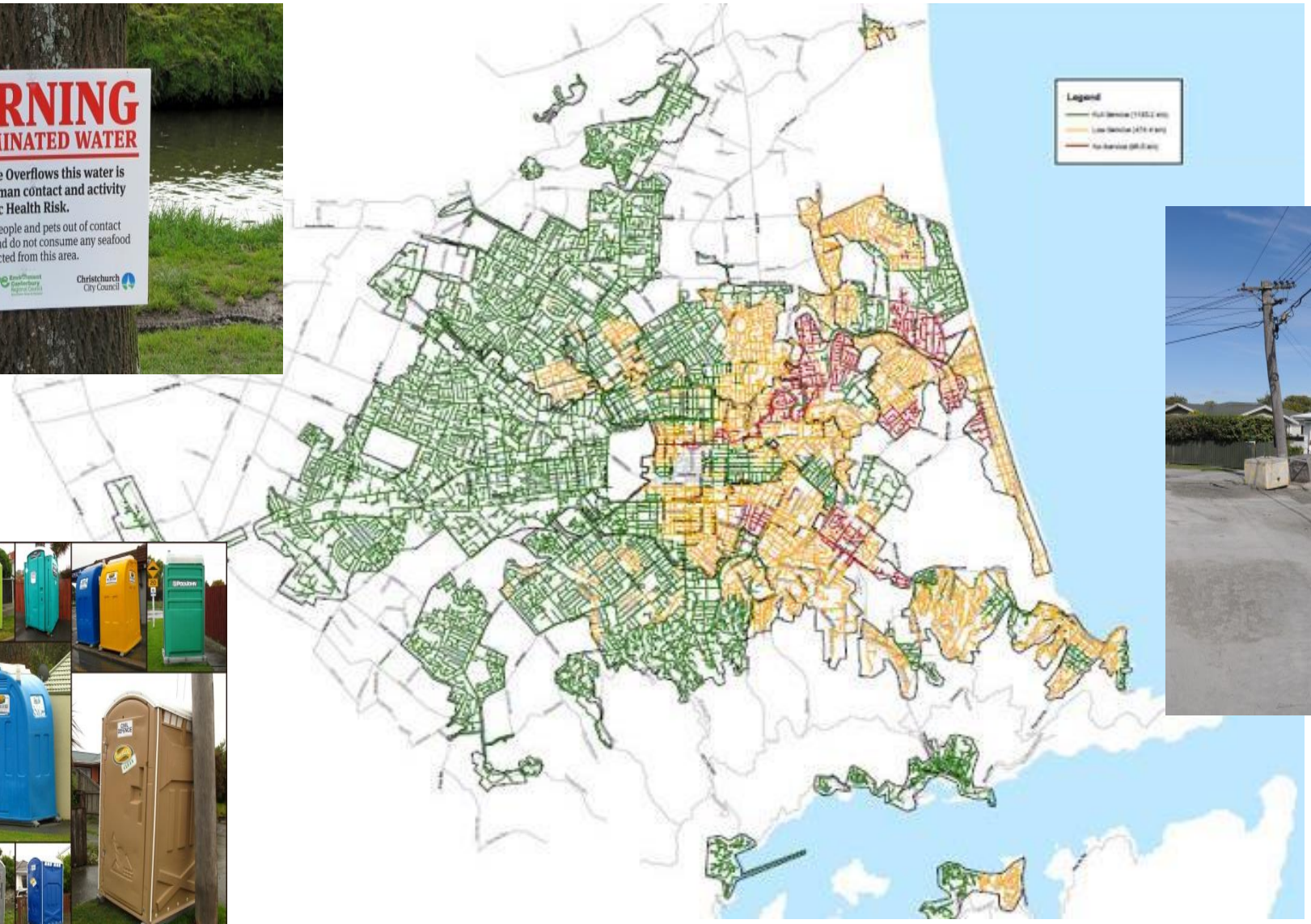


Tsunami are Forceful and Carry Debris

vertical evacuation

…even with a 2.4m wave

Outages: Water, Sewage, Electricity, Internet



OperationalConcerns

- Facility may be damaged
- Utilities will likely be compromised
- Communications may be down or intermittent
- Some transportation routes will be impassable
- Staff may be injured, unable to access site, and/or concerned about their families
- Capacities may be reduced at a time when demand is heightened

Earthquake Hazard & Risk

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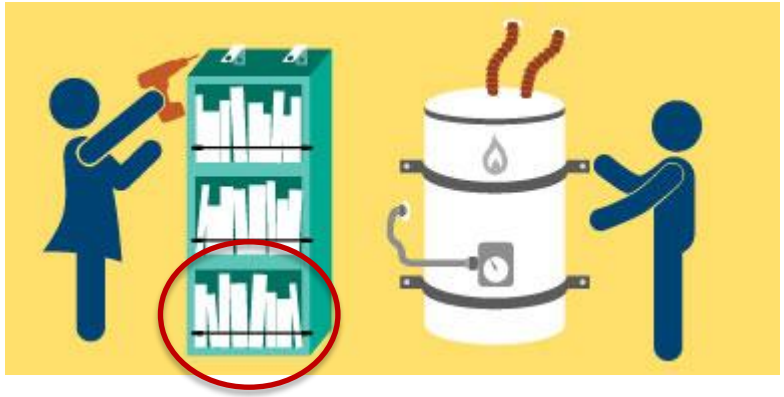
Earthquake Early Warning

What to do - Before

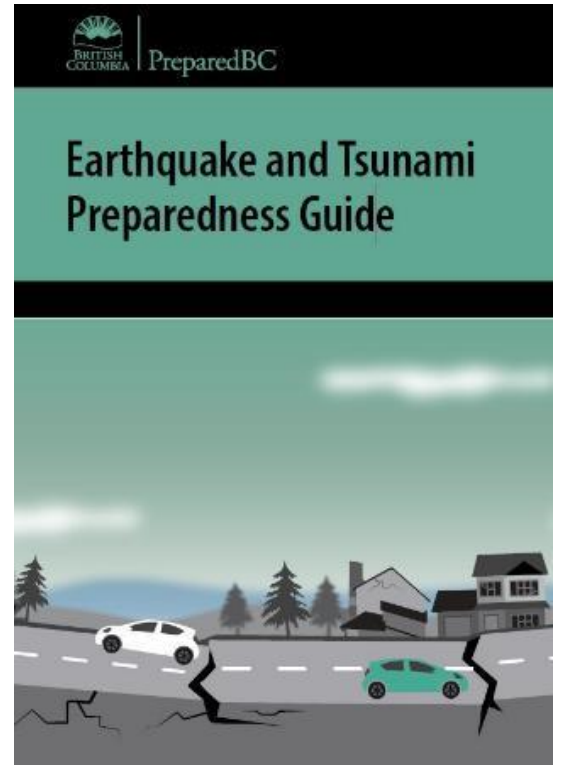
kit + **plan** - for **two weeks**

GetPrepared

PreparedBC; EM Ontario; Sécurité publique Québec



heavy items stored low



Include dust masks

under bed

What to do - During

Do **NOT**:

run outside

get into a doorway

or believe the “triangle of life”

if inside, **under** sturdy tables or desks, in corners of rooms **practice** what to do in each room of your home…and at work!

What to do - After

- use your plan
- do NOT use 'phone (only text)
- expect aftershocks

- get away from the coast,
  - if shaking strong (difficult to stand)
  - & long (more than a minute)

Earthquake Hazard & Risk

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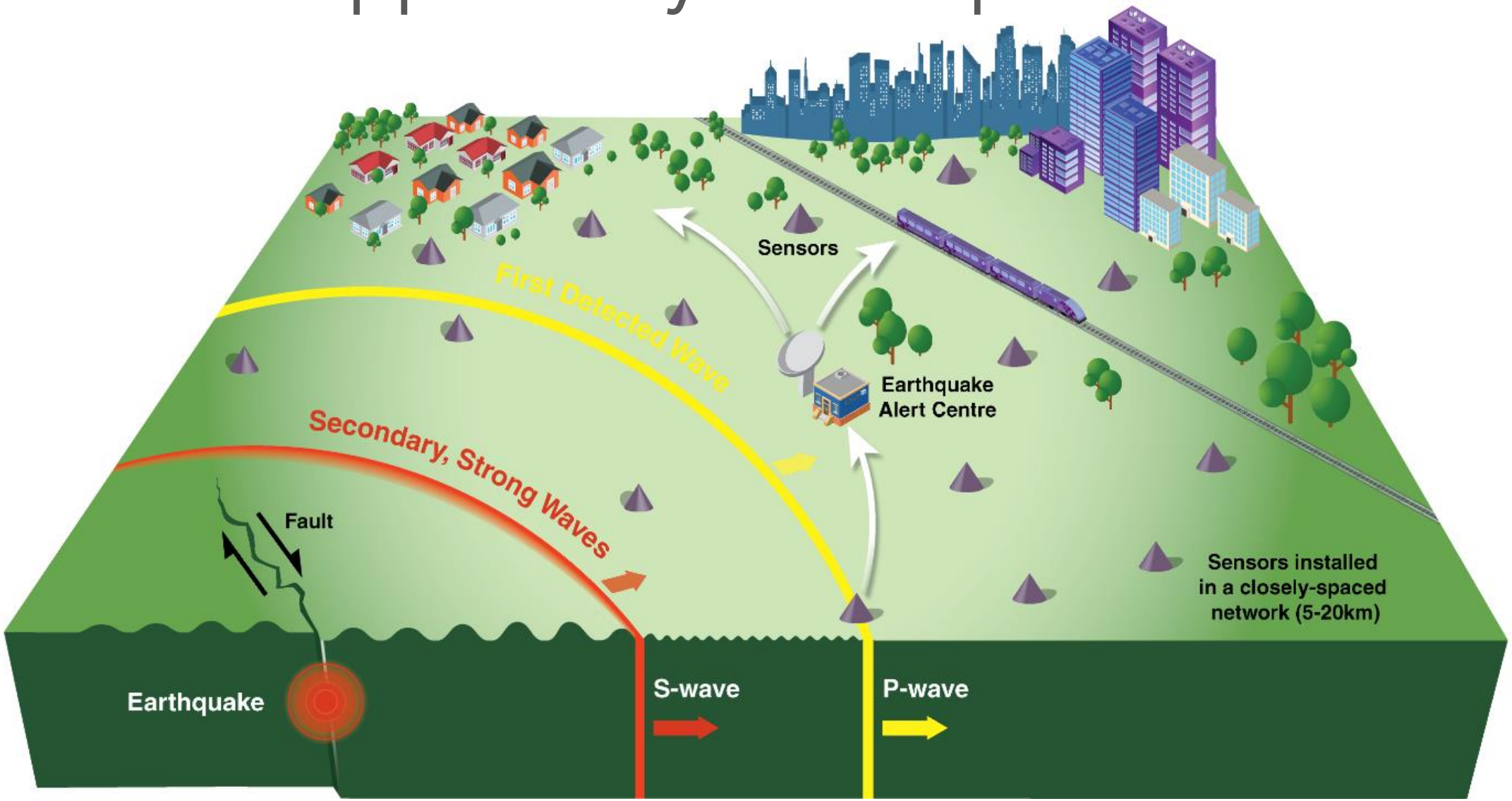
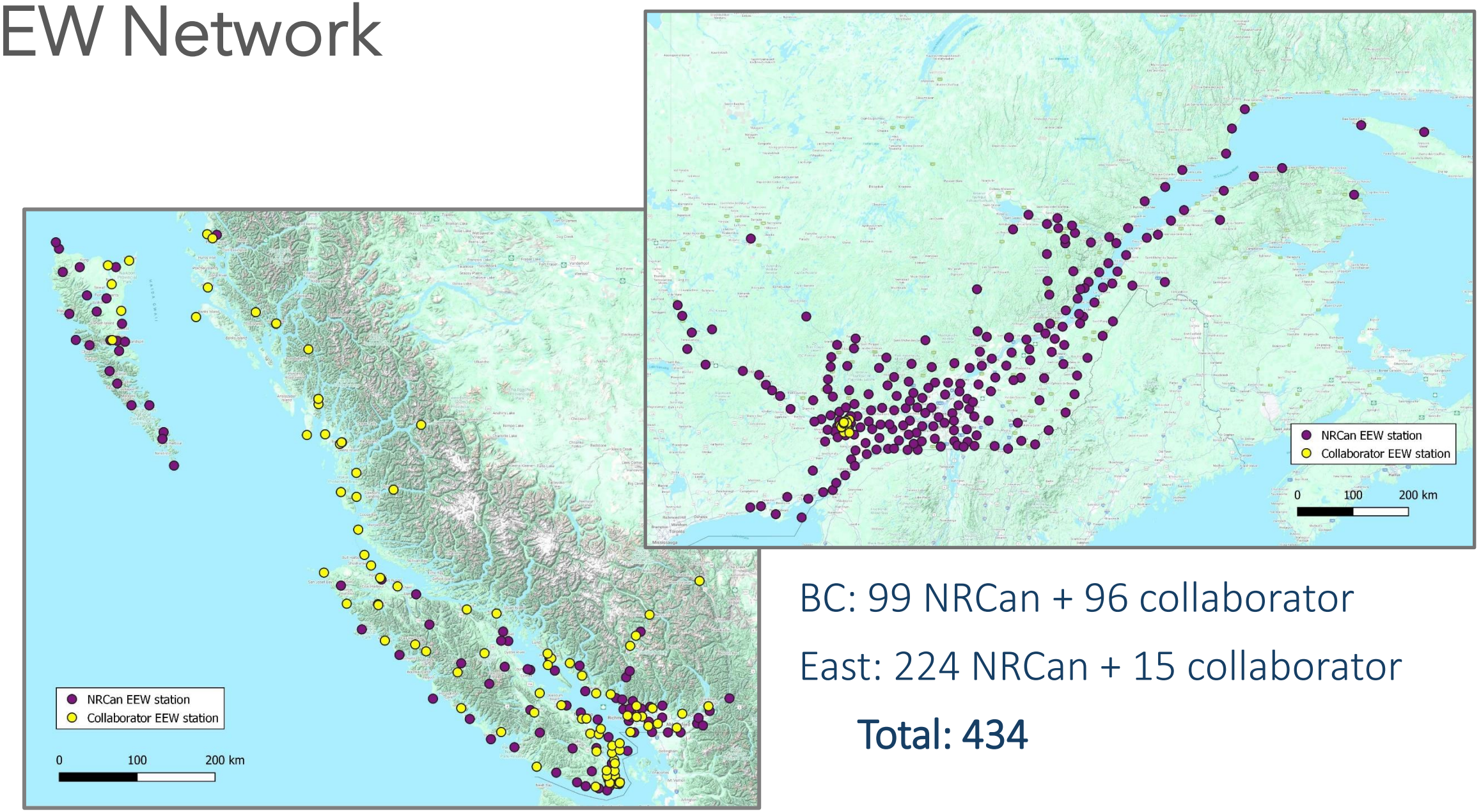
Earthquake Early Warning

Earthquake Early Warning provides opportunity to take protective action



EEW Network



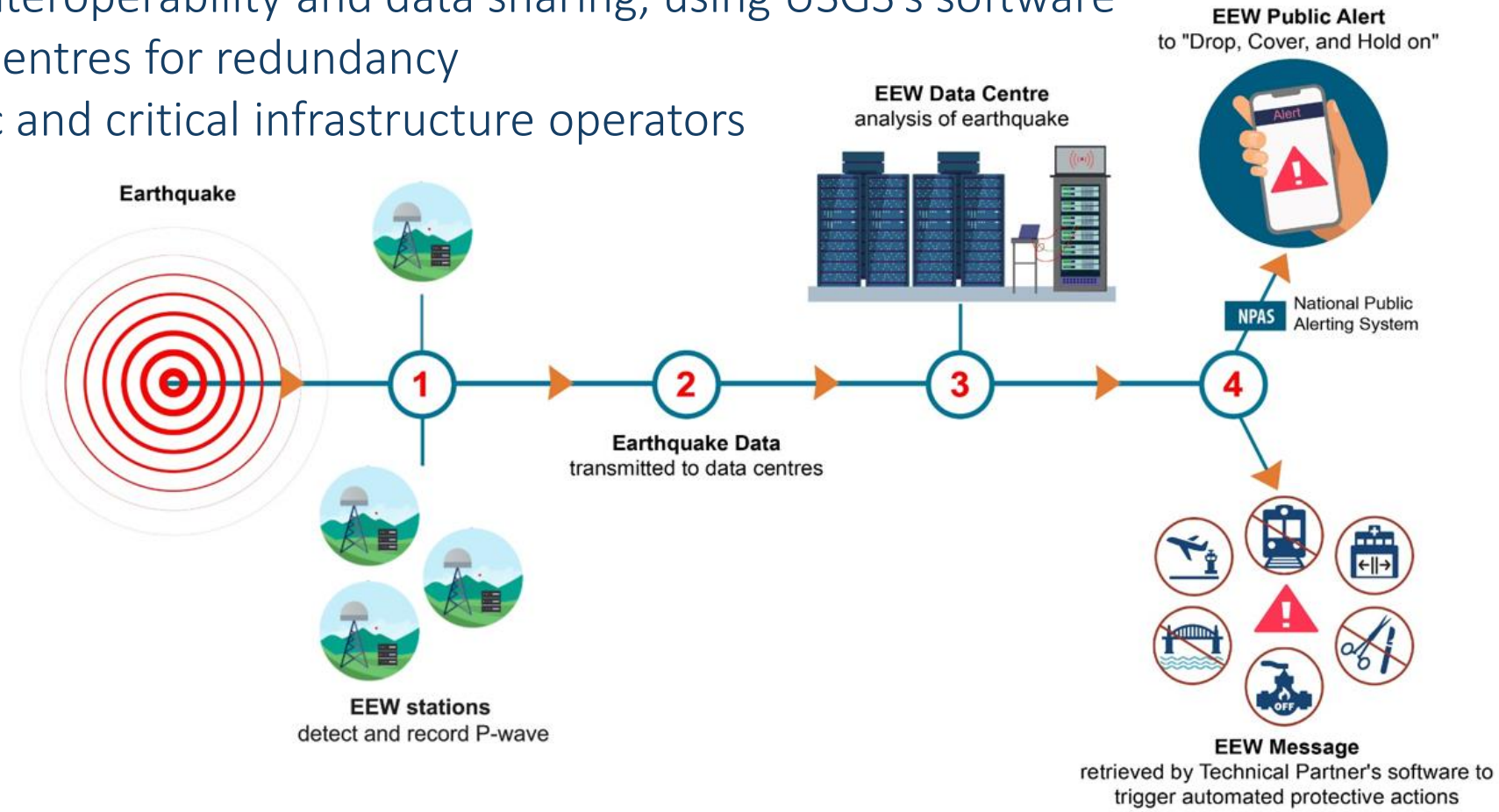
BC: 99 NRCan + 96 collaborator

East: 224 NRCan + 15 collaborator

Total: 434

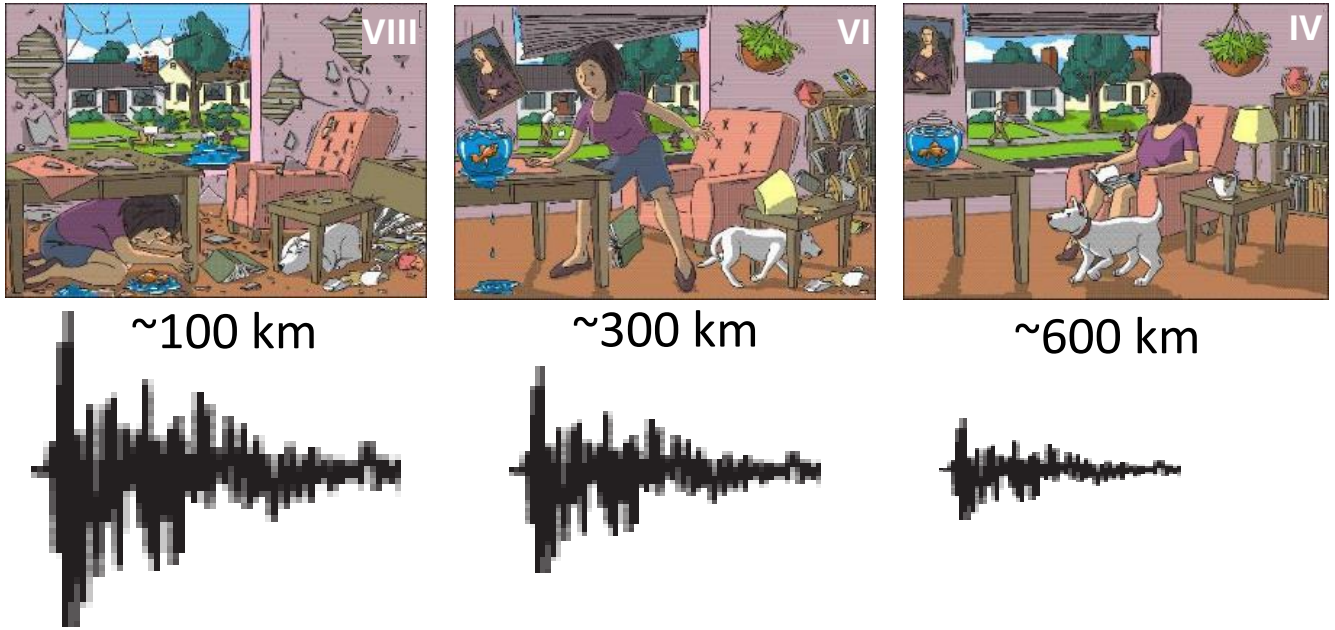
EEW System

- Operational in BC since May 2024; slated for initiation in eastern Canada late 2025
- Sensor stations in areas of significant earthquake risk
- High speed communications (Internet, cellular, and satellite)
- Cross border interoperability and data sharing, using USGS's software
- Multiple data centres for redundancy
- Alerts to public and critical infrastructure operators



EEW Alerting Thresholds

- **Magnitude** (M; size of earthquake)
- **Intensity** (MMI; strength of shaking)
- Alerts only for potentially harmful shaking

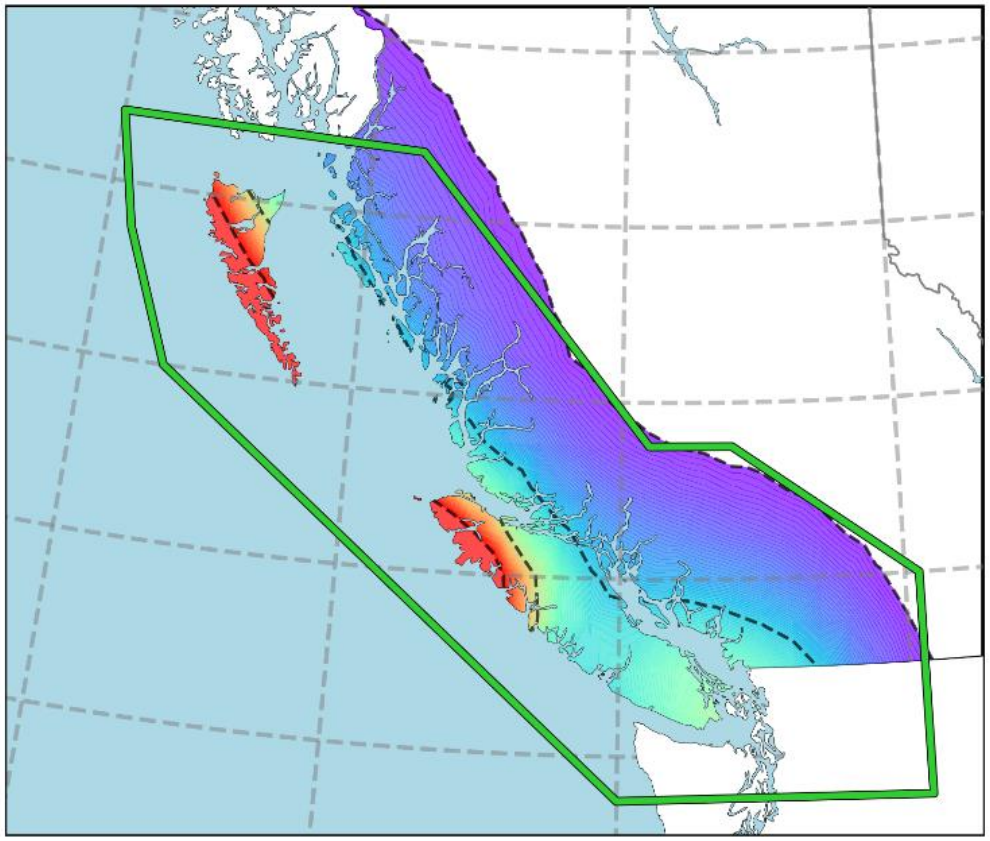


EEW Alerting to the Public

Alerts to public via National Public Alerting System (NPAS), through Pelmorex

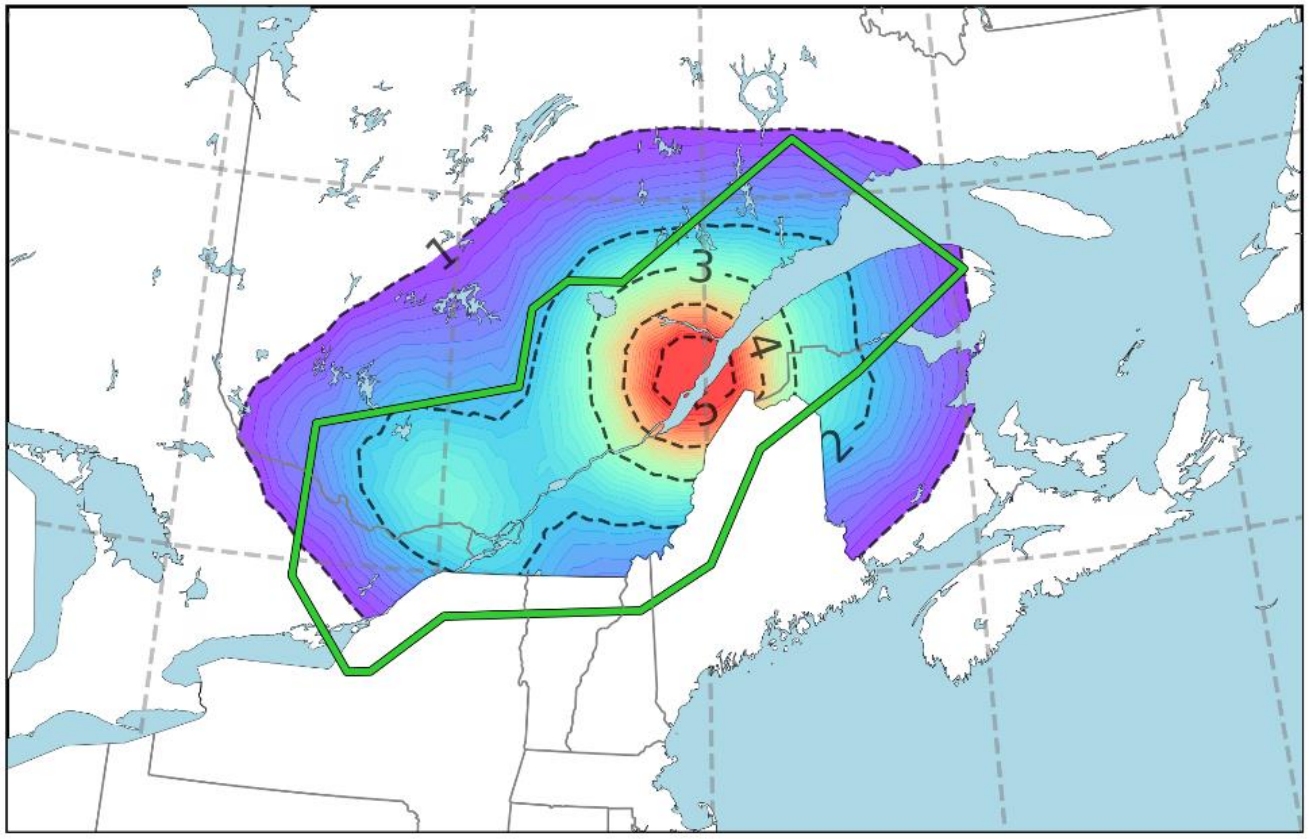
- For M ≥5
- In regions with MMI ≥IV
- Via cell, radio, and television
- **Drop, Cover, and Hold on**

Public EEW Frequency & Regions



EEW Coverage Area

1 5 10 15



EEW Coverage Area

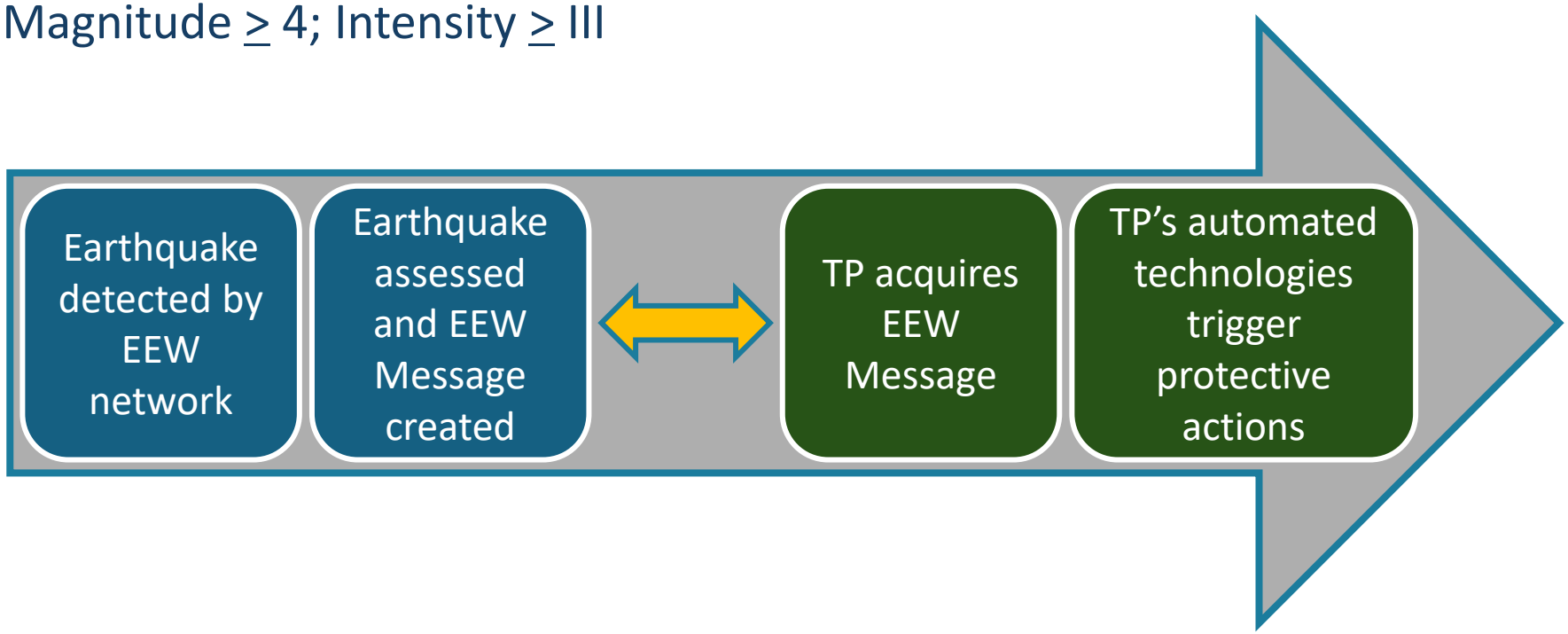
1 2 3 4 5

Annual chance (%) of a public EEW

EEW Messages for Technical Partners

Alerts available to **Technical Partners** (TP): **critical infrastructure** operators (transportation, utilities, health, etc.) and other **technical users**

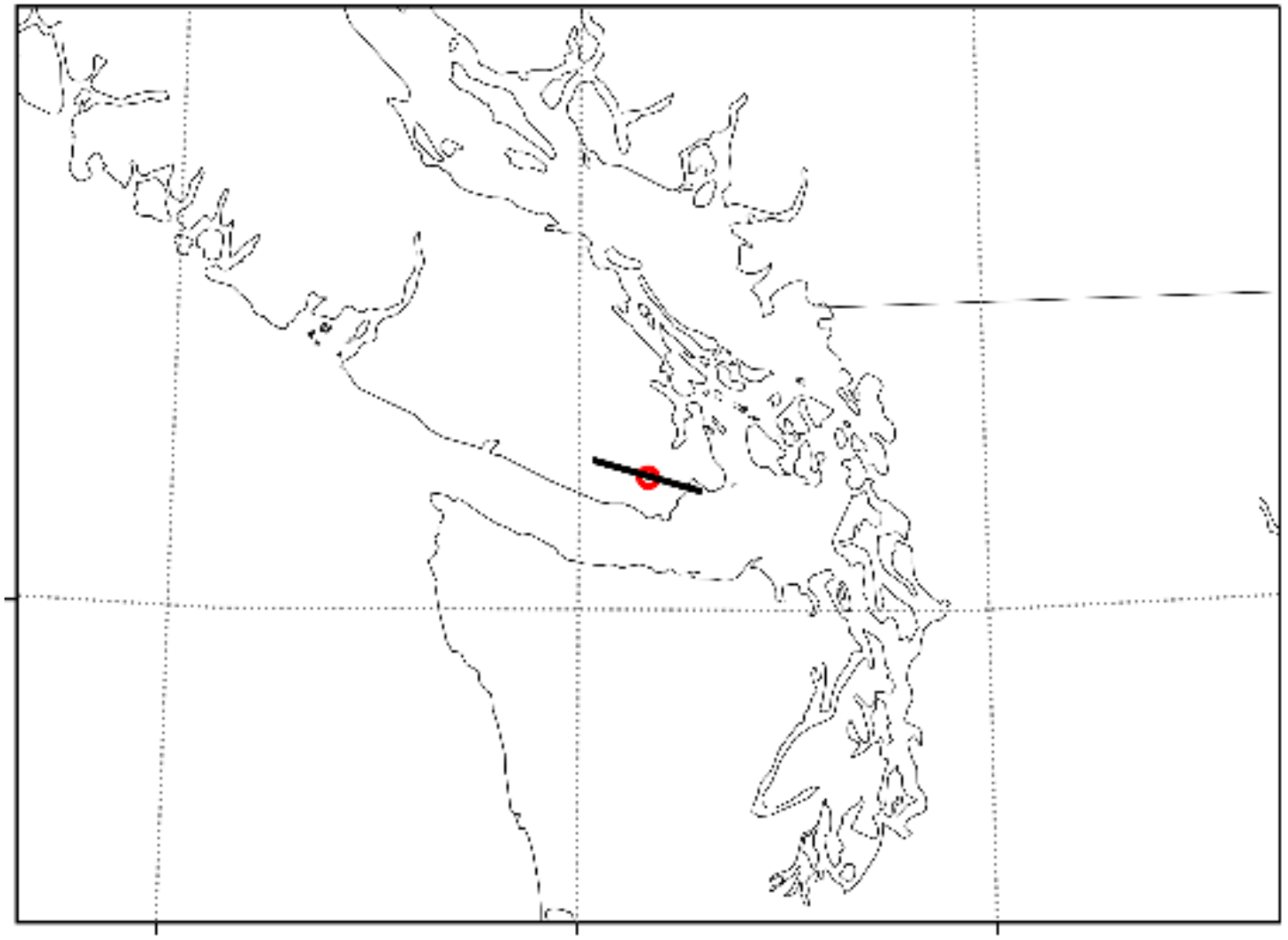
- Accessed by TPs through message broker at NRCan data-centre
- EEW messages provide location, magnitude, MMI, Peak Ground Velocity (PGV), and Peak Ground Acceleration (PGA)
- Magnitude $\geq$ 4; Intensity $\geq$ III



Technical Partners access EEW Messages

EEW Event Message:

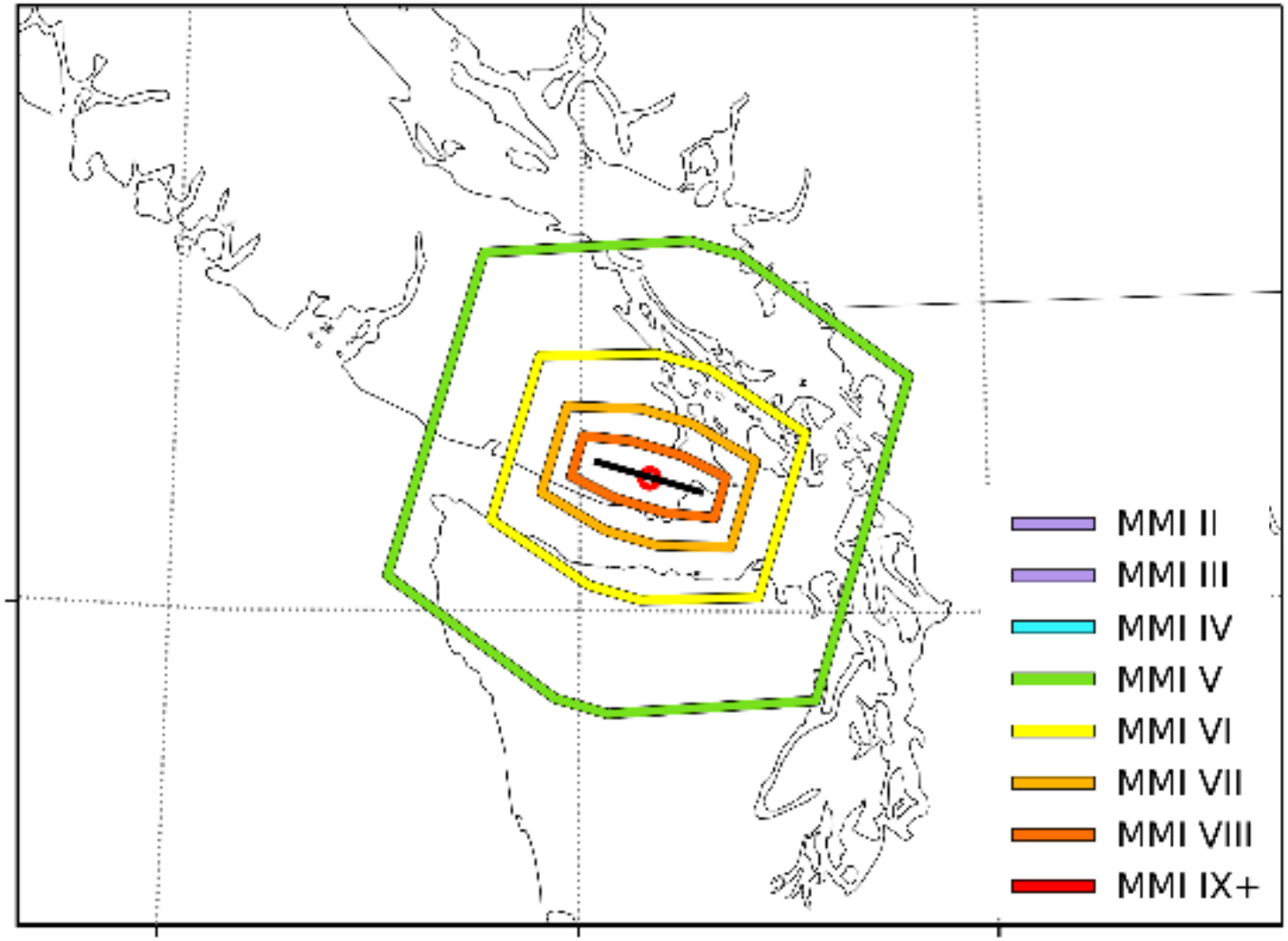
- Origin time, location, and magnitude
- Fast, but not very helpful



Technical Partners access EEW Messages

EEW Polygon Message:

- Time, location, and magnitude
- Ground motion (velocity and acceleration) plus intensity

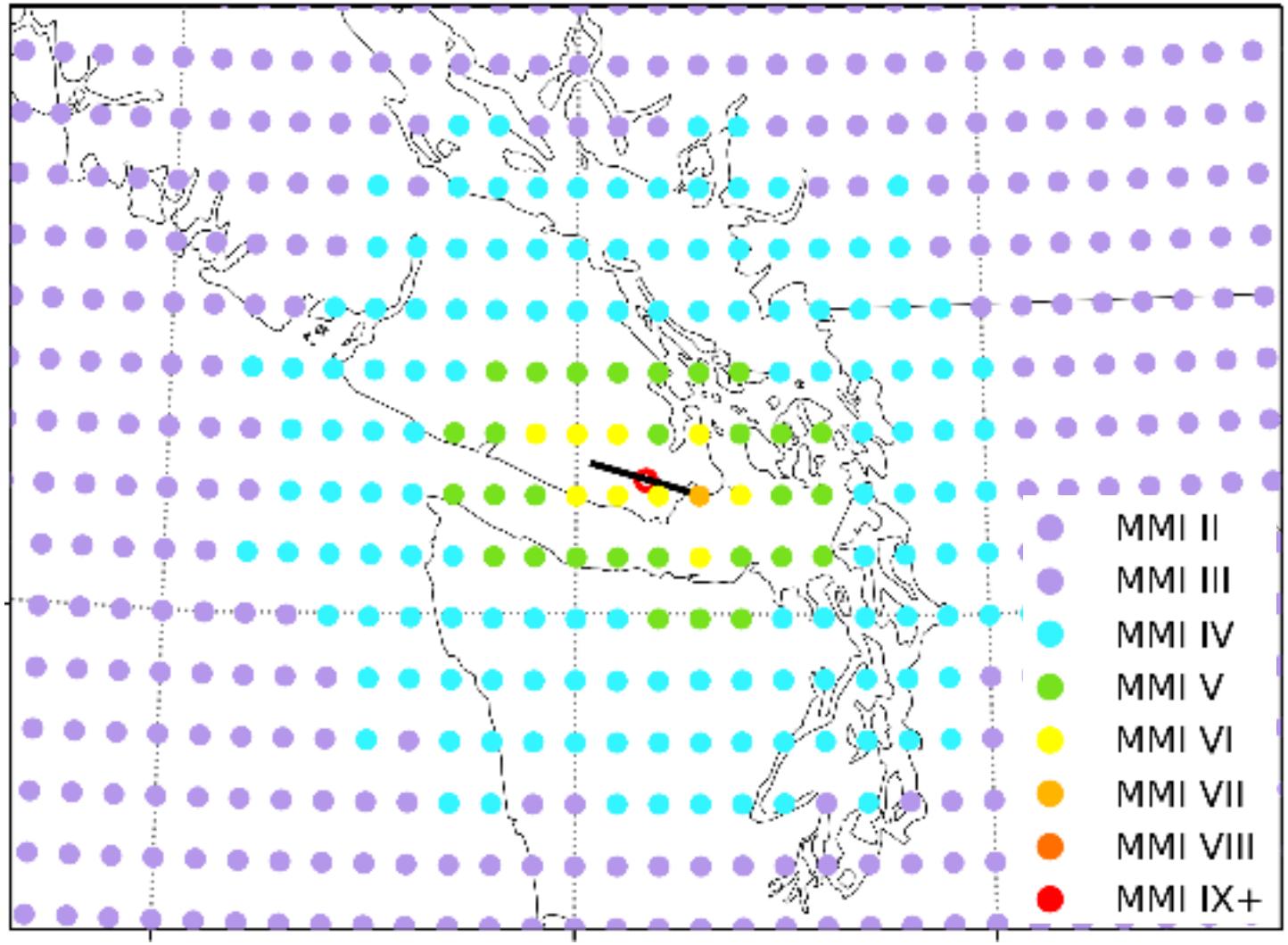


Technical Partners access EEW Messages

EEW Grid Message:

- Time, location, and magnitude
- Ground motion and intensity
- Based on distance and site conditions
- Slower, but more accurate & higher resolution

TPs can then initiate automated response technologies at their facilities



Technical Partners - Potential Automated Responses

Halt trains

Sound alarms to pause surgery

Open doors

Divert aircraft from landing

Stop traffic onto bridges or into tunnels

Stop elevators at nearest floor & open doors

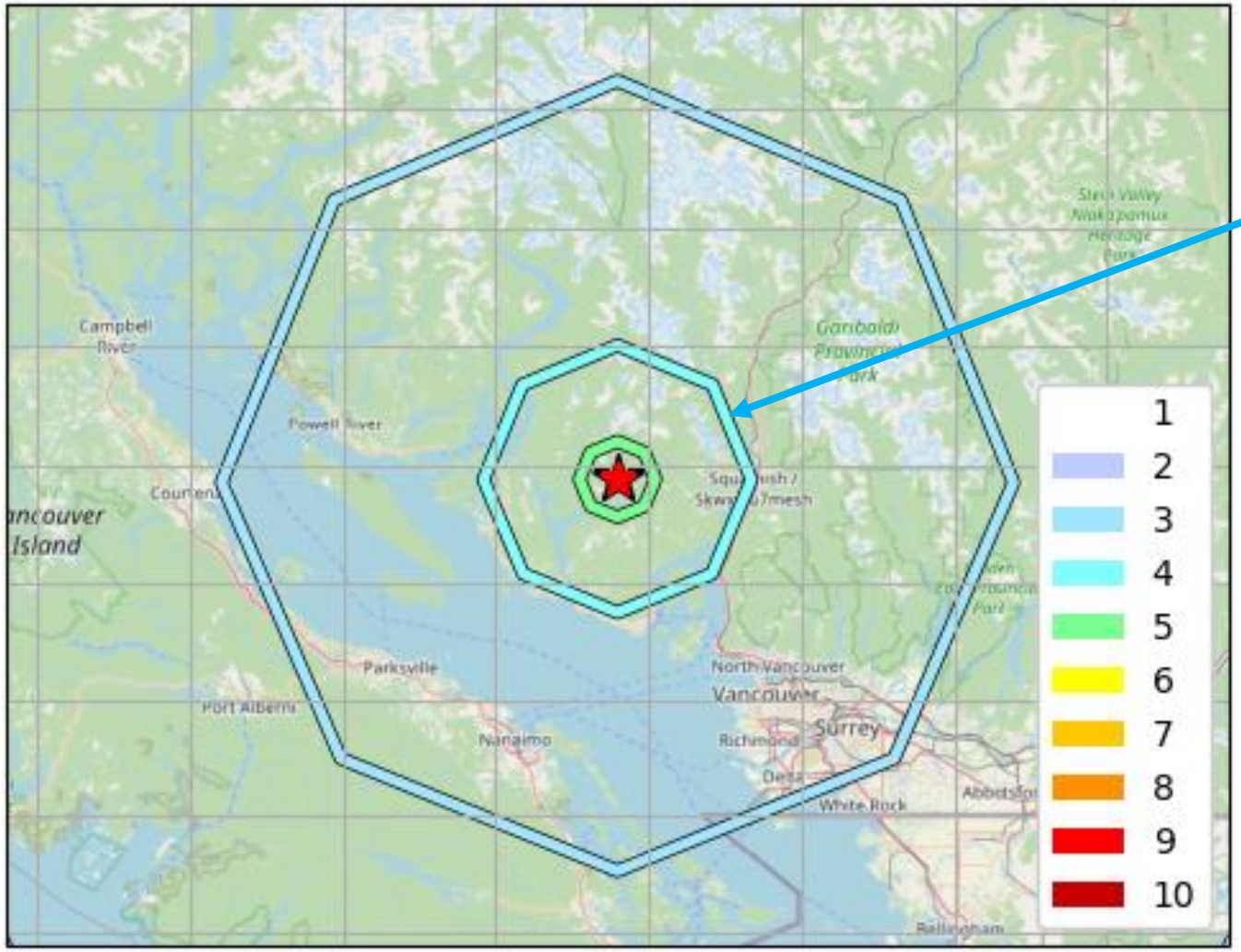
Secure cranes & dock equipment

Close valves

Secure hard-drives

Ready generators

South-western BC's first EEW



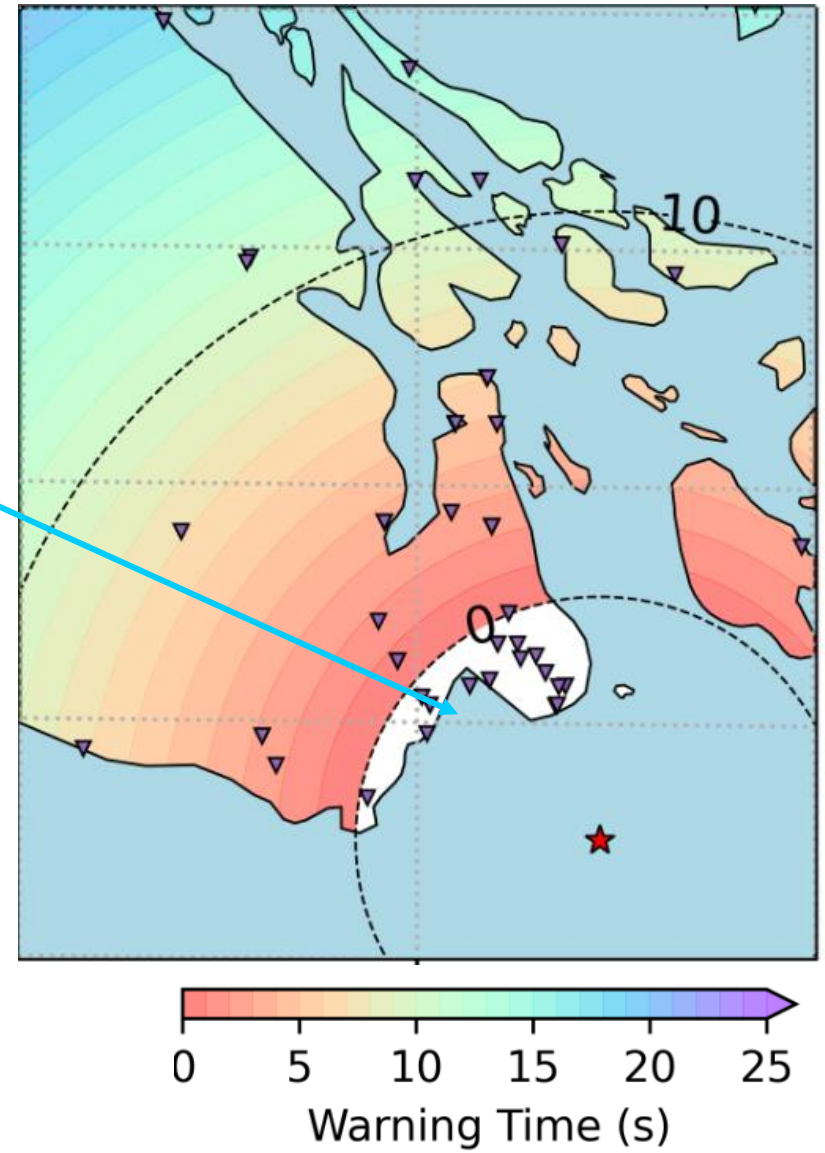
- 21st February: M=5.1 northeast of Sechelt
- Strong shaking estimated for immediate vicinity
- EEW Message delivered to NPAS within 10s
- Public alert then delivered by NPAS, via cell, tv, and radio to region of strong shaking
- Opportunity to cultivate culture of awareness around earthquakes and EEW

Eastern EEW is operating in test mode

- 19th March: M=3.7 near L'Annonciation, QC
- Shaking felt in southwestern Quebec and Ottawa area, but below thresholds for alerting
- EEW system, operating in test mode, processed event effectively
- Opportunity to build awareness of soon-to-be-launched EEW in the region

EEW Considerations

- Most EEWs provide seconds to tens-of-seconds of warning
- Late-Alert-Zone: close to epicentre, alert may be received after strong shaking
- False & missed alerts are possible
- EEW is only effective if people & systems take protective actions



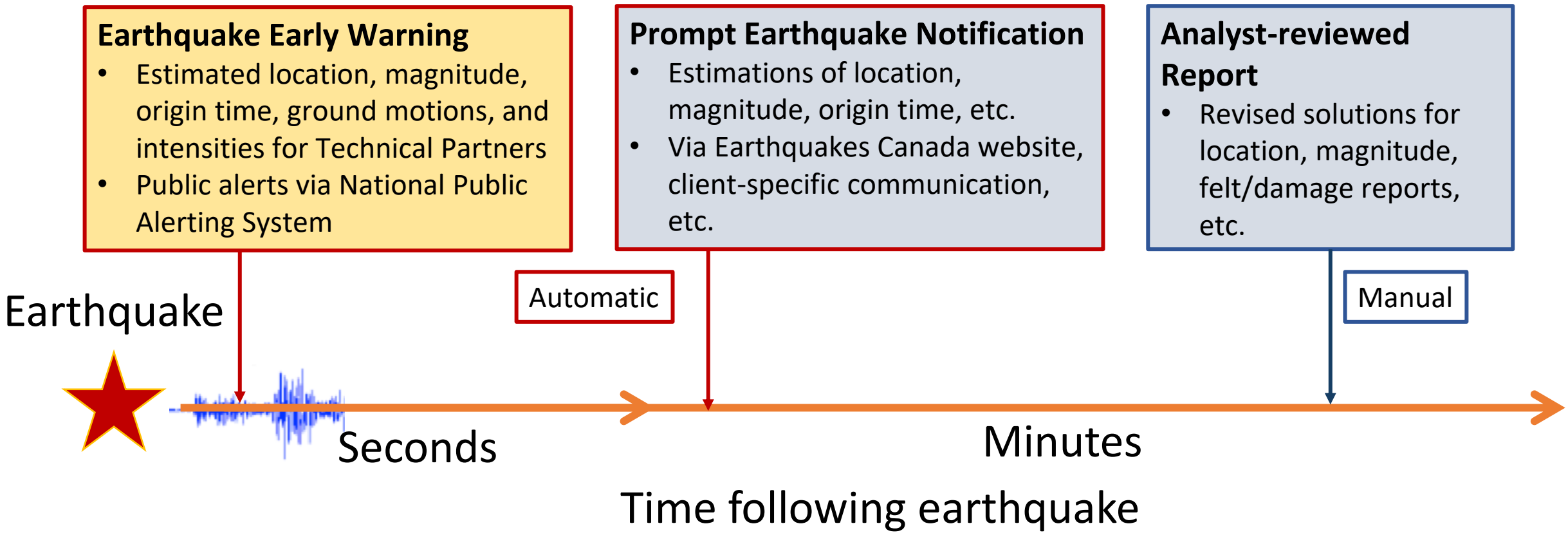
Earthquake Products

New

Earthquake Early Warning
- Estimated location, magnitude, origin time, ground motions, and intensities for Technical Partners
- Public alerts via National Public Alerting System

Prompt Earthquake Notification
- Estimations of location, magnitude, origin time, etc.
- Via Earthquakes Canada website, client-specific communication, etc.

Analyst-reviewed Report
- Revised solutions for location, magnitude, felt/damage reports, etc.



Summary

- Many populated centre in Canada are at risk of damaging earthquakes
- Several measures can be taken to reduce damages and injuries
- Earthquake Early Warning provides up to tens-of-seconds of warning of strong shaking to communities in Canadian EEW coverage areas, for most earthquakes in the region
- EEW will reduce the impact of major earthquakes, when people and systems take protective action
- Canadian EEW system operational in BC since May 2024; EEW will become operational in eastern Canada this autumn
- Next:
  - Continued public education
  - Gradual on-boarding of Technical Partners