

Tsunami activity 10: **Tsunami warning system**

Description: An introduction to tsunami warnings, followed by a hands-on activity to calculate velocity, amplitude and travel time of an earthquake-induced tsunami and preparation of a tsunami warning notice.

Note. The lab is written for Prince Rupert. It can be changed to any coastal community in British Columbia, although tsunami run-up hazard is much lower for communities protected by Vancouver Island. If you select another town, enter the correct distance to the continental slope in the table.

Materials: student worksheet (1. Tsunami warning)
Overhead (1. Wave velocity and amplitude)

Duration: 1 class

Teacher instructions and notes:

1. In advance, look over the British Columbia Tsunami Fact Sheets (General Information) to understand how a Tsunami Warning is developed and how it is used to warn citizens of an approaching tsunami.

http://www.pep.bc.ca/hazard_preparedness/Tsunami_Fact_Sheets.html

See also:

Recommended Tsunami Planning Levels

http://www.pep.gov.bc.ca/hazard_preparedness/Tsunami_Plan_Levels_Recomm.pdf

Description of Tsunami Notification Zones in BC

http://www.pep.gov.bc.ca/hazard_preparedness/Description_Tsunami_Notification_Zones_BC.pdf

Map of Tsunami Notification Zones in BC

http://www.pep.gov.bc.ca/hazard_preparedness/TSU_BC_Zones_2005-2.pdf

2. Discuss the people and organizations that would need to be informed of an approaching tsunami and perhaps warned to prepare for an evacuation.

Local authorities, local emergency program coordinators, radio and TV stations, police, traffic services, marine communications, ferries, possibly airports, etc.

3. Explain the tsunami warning, watch and advisory bulletins that would be issued if a tsunami was approaching or has the potential to be approaching:

Tsunami Warning Message: *This is the highest and most serious level of tsunami notification.*

- There is imminent threat of a tsunami or confirmation of a tsunami wave
- Communities should activate local emergency plans (likely to include the immediate evacuation of at-risk coastal areas and restricting access to emergency response routes and coastal beaches)
- Warnings are updated as conditions change.

Tsunami Advisory: *The second highest level of tsunami alert.*

- There is the threat of a tsunami that has the potential to produce strong currents dangerous to those in or near the water
- Significant inundation is not expected for areas under Advisory but coastal regions prone to damage due to strong currents may be at risk.

- Appropriate actions by emergency management personnel may include closing beaches and evacuating harbours and marinas. Additionally, local officials may opt to move boats out of harbours to deep waters, if there is time to safely do so.

Tsunami *Watch* Message:

- Notification is based on early seismic information
 - It provides advanced alerting to areas that could be impacted if a tsunami has been generated.
 - Local emergency plans should be activated, and local authorities should prepare for possible evacuation in the event that their area is upgraded to a Warning.
4. Distribute the student handouts. Review the formulas in Part A of the worksheet with the students.
 5. Discuss results.
 6. Optional: Hold a class discussion regarding possible tsunami damages.

Worksheet answers/comments:

Part A (Show overhead of the graph to focus the discussion.)

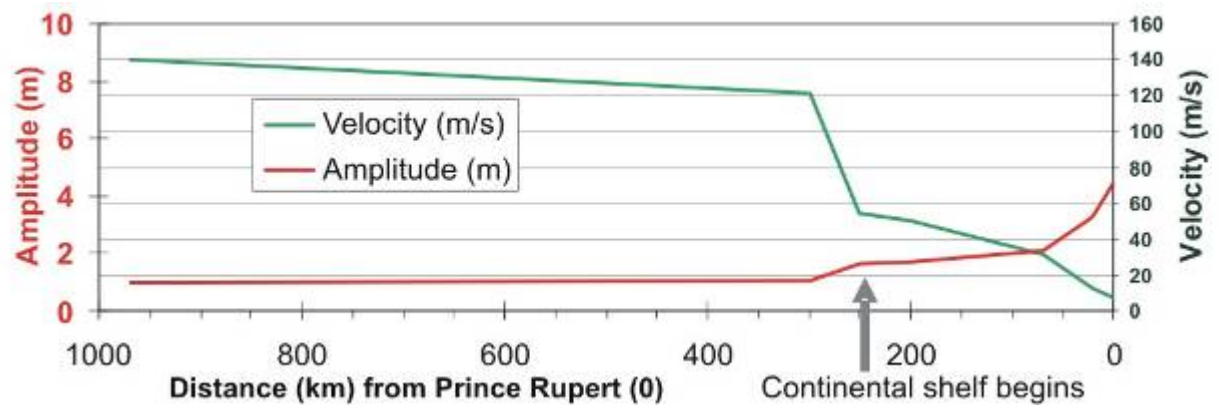
- Expected time of arrival in Prince Rupert = 1:30 pm + 3.3 hours
- Estimated wave amplitude at Prince Rupert = 4.4 m. Note: value of A_d and V_d is not a constant, but continually changes to that of the preceding location.
- Notice: Watch (>3 hrs) quickly followed by Warning notice. Considering the closeness, and estimated amplitude, you may decide to go immediately to Warning.

Part B

1. Warnings to: Local emergency program coordinators, radio and TV stations, airports, ferries, police, traffic services, marine communications, local shipping etc.
2. Warning message: Answers will vary. Ensure that all the required information is contained in the warning message and that it is unambiguous.

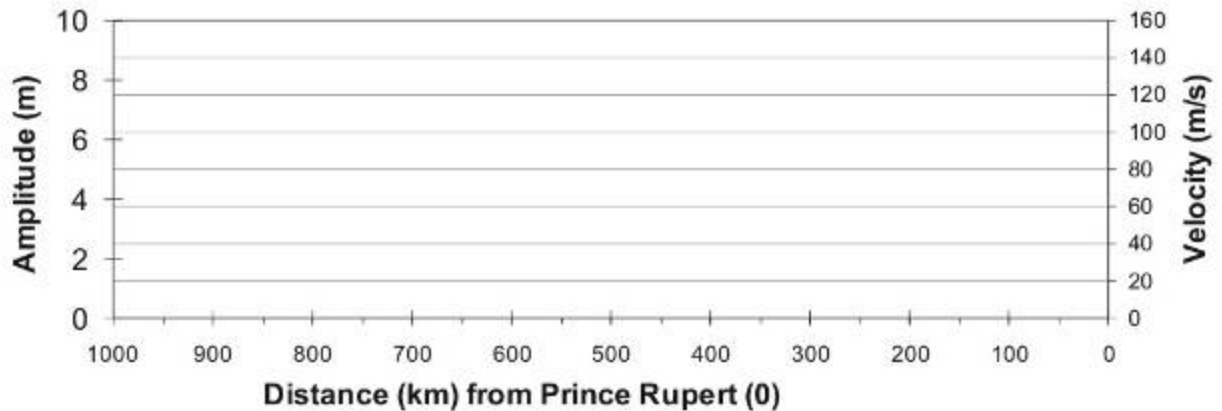
Overhead diagram 1

Wave velocity and amplitude



	Distance from PR* km	Water depth m	Velocity m/s	Velocity km/h	Amplitude m	Distance from preceding location km	Travel time from preceding location
A	970	2000			1.0		
B	300	1500					
C	250	300					
D	200	250					
E	70	100					
F	20	18					
PR	0	5					
Total travel time to Prince Rupert =							

2. Expected real time of arrival in Prince Rupert _____
3. Graph the velocities and amplitudes against distance from Prince Rupert. Use two y-axes. Identify the location where the wave encounters the continental shelf on your graph.



4. Therefore, according to your calculations, wave velocity _____ as the wave approaches the shore. Because velocity changes in shallow water, to preserve wave energy (which remains approximately the same), amplitude of the waves must _____.
5. Considering travel distance, would you issue an advisory, watch or warning notice? Why?

Part B: Issue Warnings

1. The appropriate agencies to prepare for an emergency, including evacuations, must be issued a warning. List the organizations that you would need to warn.
2. Using your calculations in Part A and the information provided by the Geological Survey of Canada, write a warning message to be sent out to warn emergency program coordinators. It should be short, but contain all relevant information on the earthquake, and tsunami including expected arrival time and estimated amplitude.