ABSTRACT: Multibeam sonar data for four submarine canyons from the Washington (US) and Vancouver (Canada) continental margins were used to examine the effect of tsunami propagation. Depths from canyon cross-section profiles were used to calculate wave amplitude and wave celerity for a potential tsunami. The seafloor flanking the canyons shows an increase in tsunami wave amplitude in comparison to amplitude along the canyon axis. Canyon flanks also show a decrease in wave celerity in comparison to celerity at canyon axes. Observations show that tsunami celerity is increased perpendicular to the canyon axis. A wave celerity model with prior studies confirming that the presence of a submarine canyon prevents an increase in wave amplitude along the canyon axis and increases tsunami arrival time to the shore relative to non-canyon areas.

INTRODUCTION: Geoscientists from Oregon State University and the University of Victoria mapped submarine canyons from aboard the University of Washington’s R/V Thomas G. Thompson, along the Washington and Vancouver margins in 2011 and 2012, respectively (Figure 1). Submarine canyons are trough-like depressions on the continental slope and rise to the continental shelf. The canyons along the Washington and Vancouver margins range in depth from 200 m at the shelf to 5500 m at the continental rise. The change in depth occurs from a distance of 15000 m to 23000 m from the continental shelf to the rise. Submarine canyons are studied for sediment transportation, marine habitats, productivity, upwelling and gas hydrates.

METHODS: The R/V Thomas G. Thompson was equipped with a Kongsberg EM122 multibeam sonar. Canyons along the Washington and Vancouver margins were surveyed by the University of Oregon and Virginia Geod. Data from cruises TN 265 (2011) and TN 282 (2012) were imported from the NOAA/NOGDC website. CARIS HIPS and SIPS 8.1 was used to post process the data and create 10 m resolution CUBE BAMS surfaces of the submarine canyons. Measurements of canyon heads and sides of canyon width, depth, and slope were made:

- Wave Celerity (c) or velocity was calculated in Table 2 using the equation: $c = \sqrt{gT}$ where $g = \text{depth} \times \rho = 9.81 \text{m/s}^2$
- Wave Amplitude (A) or height was calculated in Table 2 using the equation: $A = \frac{1}{2} \lambda$ for $\lambda = 5000 \text{m}$ and $A = 1 \text{m}$

RESULTS: The four submarine canyons studied along the Washington and Vancouver margins have deep incisions and wide shoals that decrease wave amplitude and increase wave celerity which manipulates arrival time and surge of a tsunami. Table 2 shows that each mid-canyon depth, taken at each with parallel distance, can have an increase in wave height and a decrease in wave height of 0.40 m in comparison to the canyon floor. In contrast, the flanks of these canyons appear to be areas showing increased amplification of wave amplitude and decrease wave celerity which manipulates surge and arrival time of the tsunami wave. The flats of each canyon have an increased wave height averaging 0.40 m and a decreased wave speed averaging 20 m/s (Table 2). However, this change is just for when the tsunami reaches the canyon, at the canyon foot. When the tsunami reaches the canyon head the wave height is increased by an average of 2.085 m and wave speed decreases by an average of 46.45 m/s on the canyon flanks. This difference of 1.685 m in wave height and 26.45 m/s in celerity between the canyon flank and canyon head will cause major wave retraction and can change where the major damage will occur when the surge of the tsunami finally reaches land. The canyons’ increased distance from land will also have an effect on the impact of the tsunami on land.

DISCUSSION & CONCLUSION: In conclusion, the wave direction and tsunami morphology, including width, depth, and wave height, distance from land and orientation to land. More data on tsunami surge and wave heights in this region is needed to predict how the distance of the canyons will have an effect on tsunami propagation in relation to inland communities. These effects are dependent on the tsunami’s wave direction and canyon morphology, including width, depth, and wave height, distance from land and orientation to land. More data on tsunami surge and wave heights in this region is needed to predict how the distance of the canyons will have an effect on the propagation of a specific tsunami.