GLY 4734/6932 - Coastal Morphology and Processes
Wave Refraction

November 11, 2020

Solution key

Part 1

Answer the following questions before you open the Wave Refraction application.

1. What equation describes wave refraction? What is it called?
   Snell's Law: $\frac{\sin \alpha_1}{C_1} = \frac{\sin \alpha_2}{C_2}$

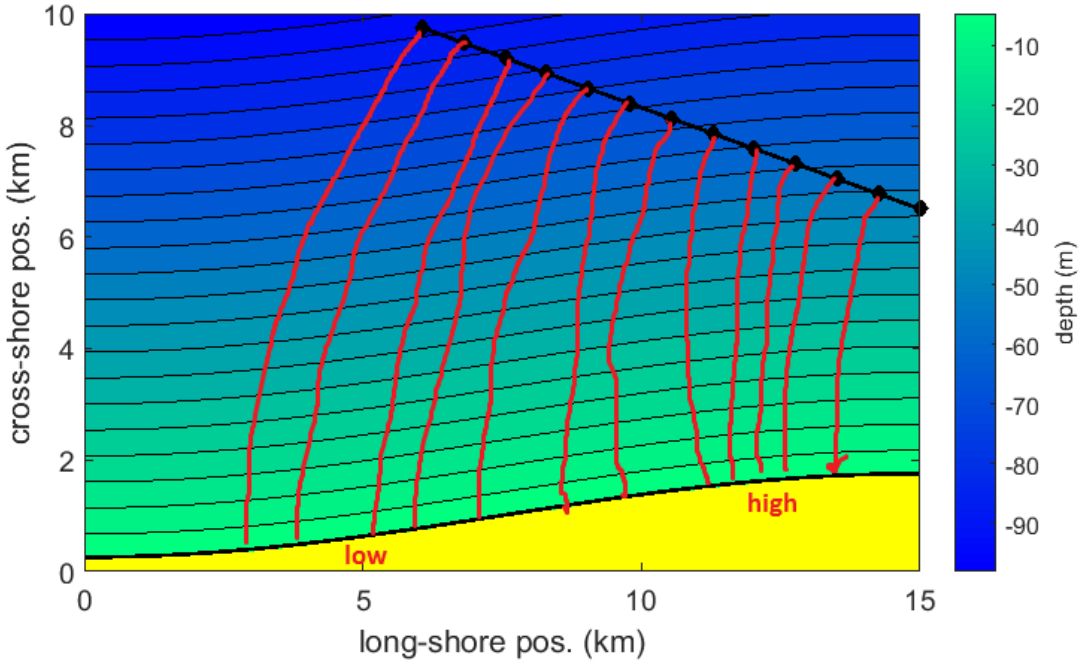
2. What parameters influence wave refraction? Be specific. Are those parameters influenced by other factors?
   water depth, wave angle relative to shoreline, wave period

3. Describe the effects of wave refraction. What are the visible effects? Are there effects which are not visible?
   Refraction causes waves to bend to shore-parallel. This causes variable wave energy distribution which concentrates in some areas and diffuses in others.

Part 2

Open the Wave Refraction app and use it to answer the following questions.

1. On the diagram below, draw the propagation of wave rays, starting from the points indicated by black dots and ending at the shoreline. Identify the regions of shoreline with the **highest** and **lowest** energy flux per shoreline length.



2. What causes wave refraction? Explain the wave ray pattern you drew on the diagram above.
Depth/bathymetry controls refraction. Since the left side of the diagram is deeper than the right, the left side of the wave travels faster, causing the wave rays to bend toward the right.

3. As a wave propagates into shallower water,

   (a) How does the orientation of wave rays change as a wave propagates into shallower water?
   Wave rays become more perpendicular to the shoreline.

   (b) How does the orientation of wave crests change as a wave propagates into shallower water?
   Wave rays become more parallel to the shoreline.

   (c) Considering these patterns, describe the relationship between wave energy flux distribution and shoreline concavity.
   Because wave rays bend to shore-perpendicular, convex features focus energy flux and concave features diffuse energy flux.

4. Describe the effects of each of the following on spatial patterns of wave energy flux:

   (a) Coastline shape
   Energy flux is concentrated on protruding features and spread across recessed features.

   (b) Wave angle of approach
   Higher wave angles cause more refraction, leading to more diffuse wave energy flux.

   (c) Wave period
   Longer period waves refract in deeper water, therefore longer period waves refract more.

5. Describe the impact of bathymetric features, such as shoals or borrow pits, on the distribution of wave energy flux in the coastal zone.
   Energy flux is concentrated behind shoals or raised features. Energy flux is shadowed behind pits or recessed features.

Part 3

Now that you have completed the activity, revisit part 1. Have any of your answers changed? Explain.