GLY 4734/6932 - Coastal Morphology and Processes
Alongshore Sediment Transport

Group 1

March 14, 2019

Help sheet for alongshore sediment transport graphics

Legend

- Panel 1
  - solid red line: a breaking wave crest
  - dotted red lines: two arbitrarily spaced wave rays.
  - blue lines: the distance between the two wave rays along the breaking crest (W_break) and the distance between the positions the two rays meet the shoreline (W_shore).
  - white arrows: alongshore and cross-shore components of energy density (E) projected along n, the unit vector normal to the wave crest.
- Panel 2
  - blue asterisks: the magnitude of the alongshore component of energy density (see "Energy Density")
  - orange asterisks: the ratio of the distance between two wave rays at the break point (W_break) to the distance between the same two wave rays when they reach the shore (see "Energy Spread")
- Panel 3
  - black asterisks: the instantaneous rate of volumetric alongshore sediment transport with the current wave conditions (see "Sediment Flux").

Energy Density

- Energy density (E) refers to the mean energy per unit horizontal area ($J/m\hat{2}$).
- Because E is a scalar, it is projected along the unit vector normal to to the wave crest (parallel to wave propagation), n.
- The alongshore directed energy density (E_y) is given by E times the alongshore component of n.
- The cross-shore directed energy density (E_x) is given by E times the cross-shore component of n.

Energy Spread

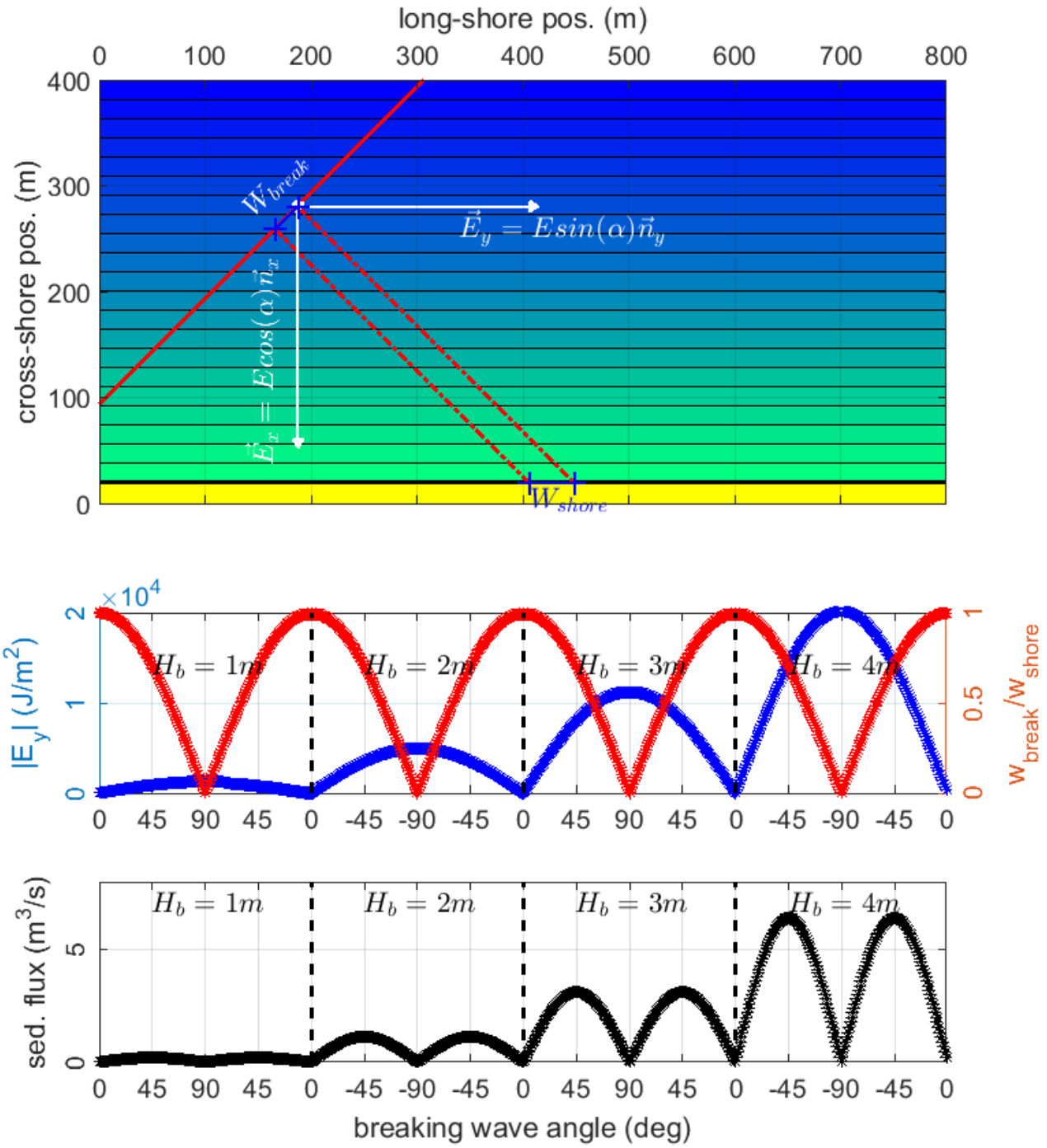
- The ratio of the distance between any two wave rays at the break point (W_break) to the distance between the same two wave rays when they reach the shore (W_shore) represents the wave energy inverse spreading factor (ISF).
- Low ISF values indicate high spreading of wave energy density along stretches of shoreline.
- The ISF ratio is maximized by an orthogonally approaching wave, where W_break = W_shore such that the ISF = 1, indicating no spreading of wave energy density.
- As the wave angle becomes more oblique, W_shore increases to infinity and the ISF approaches zero.

Sediment Flux

- Volumetric alongshore sediment transport is shown by a black plot in the application and determined by Komar's equation (Komar, 1971).
- It represents an instantaneous transport rate at a given alongshore position.

References

1. Ashton, A., Murray, A. B., & Arnoult,. O. (2001). Formation of coastline features by large-scale instabilities induced by high-angle waves. Nature, 414(6861), 296.
2. Komar, P. D. (1971), The mechanics of sand transport on beaches,J. Geophys. Res.,76, 713721.


long-shore pos. (m)
0
100
200
300
400
500
600
700
800
cross-shore pos. (m)
400
300
200
100
0
W_{break}
W_{shore}
$\vec{E}_y = Esin(\alpha)\vec{n}_y$
$\vec{E}_x = Ecos(\alpha)\vec{n}_x$
$\times 10^4$
$|E_y|$ (J/m^2)
2
1
0
$H_b = 1m$
$H_b = 2m$
$H_b = 3m$
$H_b = 4m$
W_{break}/W_{shore}
1
0.5
0
0 45 90 45 0 -45 -90 -45 0 45 90 45 0 -45 -90 -45 0
sed. flux (m^3/s)
5
0
breaking wave angle (deg)