[PRINT]

CIE4305 Coastal Dynamics I (2017-2018),
ZHI LI, 3/15/18 at 4:03:16 PM CET

Question 1: *Score 2/2*

Over the period of years, bars tend to show a net cross-shore movement.

During this movement their amplitude is maximum:

Your response	Correct response
at the outer edge of the surf zone	

Grade: 1/1.0

Total grade: 1.0×1/1 = 100%

Feedback:

Bars generally and on average move offshore under more energetic conditions and may move a little back onshore as a result of less energetic but skewed waves. The initial bar development is in the intertidal zone, after which the bars move offshore and grow in size until a maximum is reached somewhere around the seaward end of the surf zone, after which they gradually decrease in size and amplitude and finally disappear at the end of the active shoreface profile. What is the reason that the offshore movement of a bar stops around the seaward end of the surf zone?

Theory: section 7.3.4 (Bar cycles over years)

Question 2: *Score 0/1*

A linearly sloping beach profile is built in a laboratory flume and subsequently subjected to regular waves with a time-invariant height and period.

At fixed time-intervals the bed profile is measured.

From these profile measurements, sediment transport rates are determined.

The transport magnitudes that are found:

Your response	Correct response
are constant in time	

Grade: 0/1.0

Total grade: 0.0×1/1 = 0%

Feedback:

As the hydrodynamic forcing is constant in time, the profile will reach an equilibrium after some time. If this equilibrium profile differs from the linear initial profile, which is very likely to be the case, the linear profile will change to the equilibrium profile. Over time the differences between the actual profile and the final equilibrium profile will decrease in time. What does that mean for the variation of the sediment transport magnitudes with time?

Theory: section 7.4 (Structural losses or gains)

Question 3: *Score 2/2*

A beach profile is built in a laboratory flume and subsequently subjected to regular waves with a certain height H and period T.

The bed profile is measured at fixed time-intervals.

From these profile measurements, sediment transport rates are determined.

The test is carried on until the transport rates are very small.

Then, the test is continued for a short time with waves with a twice as high wave height viz. 2H.

What can now be concluded about the inferred transport rates in the second half of the test series?

Correct

Your Answer: Offshore directed transport rates are found

Feedback: As the transport rates at the end of the first half of the test are very small, we can assume that the profile reaches an equilibrium after the first part of the test. This profile however is not in equilibrium with the larger waves that are subsequently imposed. Under the forcing of these larger waves the profile strives towards a more dissipative, flatter profile. What does this mean for the transport direction in the second part of the test?

Theory: sections 7.2 (Equilibrium shoreface profile) and 7.3.2 (Beach states)

Question 4: *Score 2/2*

A reflective beach would typically have the following characteristics:

Your response	Correct response
Choice 3: Collapsing or surging breakers Choice 5: Relatively coarse material	

Grade: 1/1.0

Total grade: 1.0×1/1 = 100%

Feedback:

A reflective beach is characterized by a relatively steep and narrow beach face with a berm and a narrow surf zone without bars. Nearshore and beach slopes are between 0.10 and 0.20. The sandy material is relatively coarse and a large Iribarren parameter is to be expected. Collapsing or surging breakers are common on reflective beaches. The corresponding waves have a low steepness, reflective beaches are the result of a period of mild wave conditions that transport sediment onshore. Reflective beaches are often found in swell and monsoon wave climates. Since in these climates the conditions have a low variability, the resulting morphodynamic behaviour is less dynamic than is the case for storm wave climates that are characterized by a higher variability.

How would you answer this question if you would be interested in the characteristics of dissipative beaches?

Theory: section 7.3.2 (Beach states)

Question 5: *Score 0/1*

For which beach states do we find the strongest three-dimensionality in the beach morphology:

Your response	Correct response
Dissipative beach state	

Grade: 0/1.0

Total grade: 0.0×1/1 = 0%

Feedback:

Intermediate beach states are all strongly three-dimensional. Examples of three-dimensional features are rip currents and corresponding rip channels. The three-dimensional structure of the morphology can be wiped out by an episodic event with high energy, such that dissipative beach states are two-dimensional.

Theory: section 7.3.2 (Beach states)

Question 6: *Score 0/2*

Consider a coastal profile with the onshore direction taken as positive.

Assume that the horizontal velocity $u(t)$ close to the bed is the sum of a time-averaged component $\bar{u}$, an oscillatory component $u_{lo}(t)$ at the wave group scale and a short-wave oscillatory component $u_{hi}(t)$, hence $u(t) = \bar{u} + u_{lo} + u_{hi}$.

Herewith, the third odd velocity moment can be decomposed as (time-averaging indicated by brackets):

$$\underbrace{\left\langle u\,|u|^2\right\rangle}_{A} = \underbrace{3\left\langle \bar{u}\,|u_{hi}|^2\right\rangle}_{B} + \underbrace{3\left\langle u_{lo}\,|u_{hi}|^2\right\rangle}_{C} + \underbrace{\left\langle u_{hi}\,|u_{hi}|^2\right\rangle}_{D} + \ldots$$

The magnitude and sign of each of these four terms depends on the location on the shoreface.

Select the term(s) in the above equation that can have a positive as well as a negative sign on the shoreface.

Your response	Correct response
Choice 4: D Feedback: Choice 4:	

Grade: 0/1.0

Total grade: 0.0×1/1 = 0%

Feedback:

First, notice that the equation is the same as in the book (eq. 7.15) but that the terms are in a different order. Also notice that the question is about the shoreface, so this includes both the upper and lower shoreface.

The first term (B) in the RHS is related to the transport by the mean current. The mean current could be the onshore directed wave-induced near bed streaming in non-breaking waves or the offshore directed undertow in the surf zone.

The second term (C) in the RHS is non-zero as long as there is a correlation between the slowly varying short wave velocity variance (short wave envelope) and the long wave forced by the wave group. Outside the surf zone this correlation is negative, the through of the bound long wave is found under the larger amplitude waves in the group. In this case, most sediment is stirred up (highest waves) while the long wave velocities are offshore directed (through of the bound long wave). In the surf zone the phase relationship between the short wave envelope and the long waves changes (postive correlation) and the transport can be onshore.

The third term (D) in the RHS is zero for a completely symmetrical oscillating velocity signal. In shoaling waves, the velocity signal becomes asymmetric around the horizontal axis (positively skewed). As a result this term is non-zero and onshore directed. And do you know what the magnitude and sign is of D for saw-tooth waves (breaker zone)?

So this leaves us with term A, the summation of the other terms. Could this term have a positive as well as a negative sign on the shoreface?

Theory: section 5.8.2. (Bound long waves and surf beat) and section 7.5.2 (Decomposition of the transport rate)

Question 7: *Score 1/2*

Consider a coastal profile with the onshore direction taken as positive.

Assume that the horizontal velocity $u(t)$ close to the bed consists of a short-wave oscillatory component $u_{hi}(t)$, hence $u(t) = u_{hi}$.

Herewith, the third odd velocity moment can be written as (time-averaging indicated by brackets):

$$\left\langle u_{hi} \left| u_{hi} \right|^2 \right\rangle$$

For which of the below velocity signals is this term equal to zero?

Your response	Correct response
Choice 2:$u_{hi}=\hat{u}_1\cos(\omega t)$ Feedback: Choice 2:	

Grade: 0.5/1.0

Total grade: 0.5×1/1 = 50%

Feedback:

This term is zero for a oscillating velocity signal that is symmetrical **around the x-axis**. So this is the case for for a sinusoidal wave. And what about a sawtooth wave shape in the breaker zone? Or a skewed profile of a shoaling wave?

Theory: section 7.5.2 (Decomposition of the transport rate)

Question 8: *Score 3/3*

Consider a coastal profile with the onshore direction taken as positive.

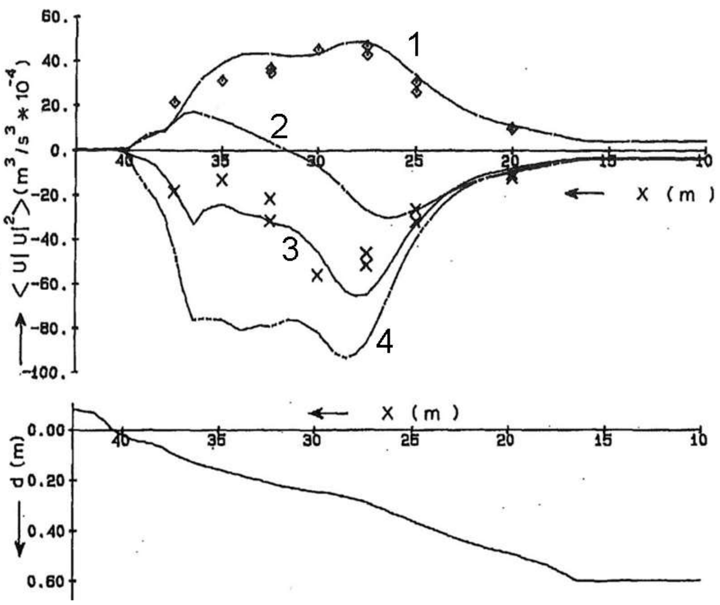
Assume that the horizontal velocity $u(t)$ close to the bed is the sum of a time-averaged component $\bar{u}$, an oscillatory component $u_{lo}(t)$ at the wave group scale and a short-wave oscillatory component $u_{hi}(t)$, hence $u(t) = \bar{u} + u_{lo} + u_{hi}$.

Herewith, the third odd velocity moment can be decomposed as (time-averaging indicated by brackets):

$$\underbrace{\left\langle u\,|u|^2\right\rangle}_{A} = \underbrace{3\left\langle \bar{u}\,|u_{hi}|^2\right\rangle}_{B} + \underbrace{3\left\langle u_{lo}\,|u_{hi}|^2\right\rangle}_{C} + \underbrace{\left\langle u_{hi}\,|u_{hi}|^2\right\rangle}_{D} + \dots$$

The below figure shows model predictions (lines in upper panel) and wave flume data (symbols in upper panel) of the third odd velocity moment and its constituent components.

The total third odd velocity moment is indicated with 3. The constituent components are indicated with line 1,2 and 4.



Each of the four lines corresponds with one of the four terms in the above equation.

Complete the correspondence:

Term A corresponds to line 3

Term B corresponds to line

Your response	Correct response
4	

Grade: 1/1.0

Term C corresponds to line	
Your response	**Correct response**
2	

Grade: 1/1.0

Term D corresponds to line	
Your response	**Correct response**
1	

Grade: 1/1.0

Total grade: 1.0×1/3 + 1.0×1/3 + 1.0×1/3 = 33% + 33% + 33%
Feedback:

First, notice that the equation is the same as in the book (eq. 7.15) but that the terms are in a different order.

The first term in the RHS is related to the subsequent transport by the mean current. The mean current could be the onshore directed wave-induced near bed streaming in non-breaking waves or the offshore directed undertow in the surf zone. As the waves approach the shore, they will break and this term should be offshore directed at least in the surf zone. The only line that satisfies this condition is line 4.

The second term in the RHS is non-zero as long as there is a correlation between the slowly varying short wave velocity variance (short wave envelope) and the long wave forced by the wave group. Outside the surf zone this correlation is negative, the trough of the bound long wave is found under the larger amplitude waves in the group. In this case, most sediment is stirred up (highest waves) while the long wave velocities are offshore directed (trough of the bound long wave). If the phase relationship between the short wave envelope and the long waves changes (as it does in the surf zone), this situation may change and the transport could be onshore (line 2).

The third term in the RHS is zero for a completely symmetrical oscillating velocity signal. In shoaling waves, the velocity signal becomes asymmetric around the horizontal axis (positively skewed). As a result this term is non-zero and onshore directed (line 1).

Theory: section 5.8.2. (Bound long waves and surf beat) and section 7.5.2 (Decomposition of the transport rate)

Question 9: *Score 0/2*

According to Bruun, relative sea-level rise leads to a coastline retreat equal to:

Retreat = RSLR(L/d)

where RSLR is the rise of relative sea level above MSL.

What is the order of magnitude of L/d?

Your response	**Correct response**
1000	

Grade: 0/1.0

Total grade: 0.0×1/1 = 0%
Feedback:

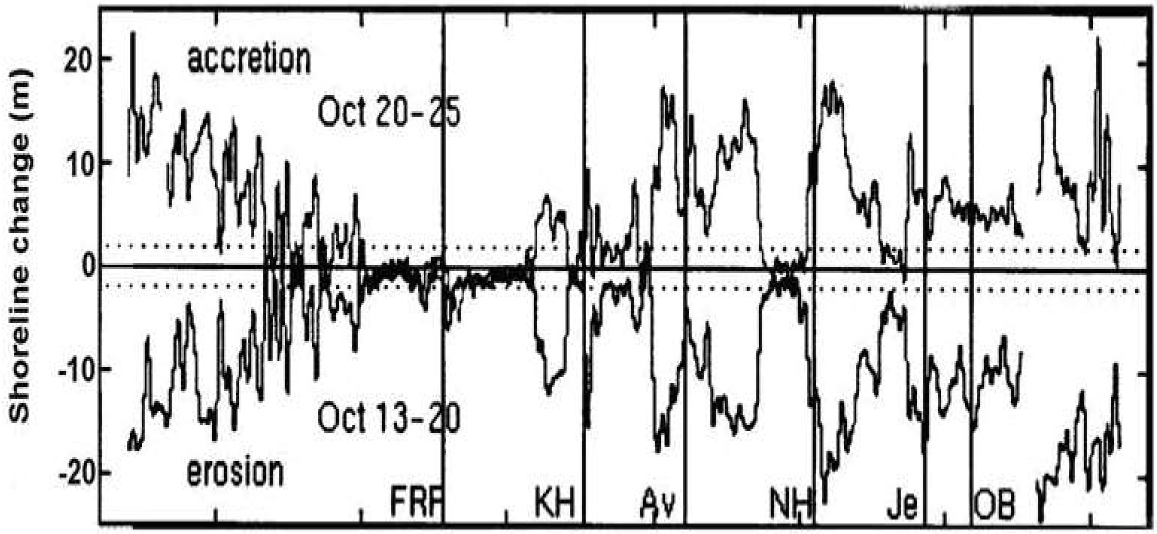
In this equation, L is the length over which the erosion and sedimentation takes place and d represents the corresponding height. In practice the ratio L/d is of the order 50 to 150.

Theory: section 7.4 (Structural losses or gains)

Question 10: *Score 1/1*

In the below figure the shoreline change between October 13 and 20 and between October 20 and 25 is given along an 80 km long stretch of US East coast.

FRF denotes the location of the Field Research Facility of the Army Corps of Engineers.



Correct

The FRF location is a so-called hot-spot.

Your Answer: False

Feedback: A hot spot refers to a location with a strong erosion, much more than in its environment.

Theory: section 7.3.3 (Storm and seasonal changes)

Question 11: *Score 2/2*

A ridge is:	
Your response	**Correct response**
An elongated low mound that runs (almost) parallel to the shore	

Grade: 1/1.0

Total grade: 1.0×1/1 = 100%

Feedback:

(Other) definitions you should know:

- Berm: a nearly horizontal portion of the beach formed by the deposit of sediment by wave action
- Cusp: an arc-shaped accumulation of sediment just above the waterline
- Runnel: an elongated trough that runs (almost) parallel to the shore
- Ridge: an elongated low mound that runs (almost) parallel to the shore
- Scarp: a vertical slope along the beach due to erosion

- Low-tide terrace: a nearly horizontal shallow portion of the beach exposed during low-tide

Theory: section 7.1 (Introduction)

Question 12: *Score 1/1*

Hallermeier's closure depth corresponds to the surf zone width for extreme conditions exceeded 12 hours per year.

This depth is important for engineering purposes since:

Your response	Correct response
Choice 2: It is the deepest point for which profile equilibrium exists: FALSE Choice 3: It is the deepest point showing significant morphodynamic activity on yearly to decadal time-scales: TRUE	

Grade: 1/1.0

Total grade: 1.0×1/1 = 100%

Feedback:

For engineers it is important to know which part of the profile is morphologically active on yearly to decadal time scales. The concept of closure depth can assist in that.

Theory: sections 1.5.1 (Coastal morphodynamics) and 7.2.3 (Engineering applications)

Question 13: *Score 0/1*

In the past, it has been hypothesised that spacings of rip-channels are correlated to length scales of edge waves.

Underlying such a hypothesis is the concept of:

Incorrect

Your Answer: self-organization

Feedback: In a self-organization approach, it is assumed that rhythmic features are initiated by positive feedbacks between hydrodynamics and morphology (leading to divergent behaviour) and are stabilized by negative feedbacks (leading to convergent behaviour). This implies that observed length scales in the coastal morphology do not necessarily correspond to the length scales of the initial forcing processes. We then speak about free behaviour.

In this case, the length scales do correspond to the scales in the forcing. Therefore it was hypothesized that the behaviour was forced rather than free.

Theory: intermezzo 7-1 (Spatial scales: governed by external forcing or internal dynamics?)

Question 14: *Score 0.66/2*

Which of the following mechanisms are likely to result in an offshore transport on either the lower or upper shoreface:

Your response	Correct response
Choice 2: Undertow Choice 5: Free long waves Choice 6: Gravity under the influence of the average bed slope	

Grade: 0.33/1.0

Total grade: 0.3333333333333333×1/1 = 33%
Feedback:

For this question, you could look to the decomposition of the transport rates. For positive wave skewness (as is the case especially in shoaling waves), the transport is onshore directed.

For the long waves, you should consider the correlation between the slowly varying short wave velocity variance (short wave envelope) and the long wave forced by the wave group. Outside the surf zone this correlation is negative, the trough of the bound long wave is found under the larger amplitude waves in the group. In this case, most sediment is stirred up (highest waves) while the long wave velocities are offshore directed (trough of the bound long wave). If the phase relationship between the short wave envelope and the long waves changes (as it does in the surf zone), this situation may change and the transport could be onshore (free long waves, look this up in section 5.8.2).

Further, the undertow and gravity under the influence of the averaged bed slope (downhill movement of sediment) are both offshore directed. Finally, wave boundary layer streaming is directed onshore.

Theory: sections 5.4.3 (Wave boundary layer), section 5.8.2. (Bound long waves and surf beat), section 5.5 (Wave induced set-up and currents) and 7.5 (Cross-shore sediment transport)

Question 15: *Score 0/2*

Typical characteristics of the shoreface are:

Your response	Correct response
Choice 2: Wind waves are non-dispersive: FALSE Choice 4: The depth-contours are parallel or nearly parallel: FALSE Choice 6: Waves are either shoaling or breaking: FALSE	

Grade: 0/1.0

Total grade: 0.0×1/1 = 0%
Feedback:

If you have difficulties with this question, you could take a look at chapter 3 again.

Theory: chapter 3 (Ocean waves) and section 7.1 (Introduction)

Question 16: *Score 0/2*

On the shelf region seaward of the shoreface we may find:

Your response	Correct response
both tide- and wave-induced features	

Grade: 0/1.0

Total grade: 0.0×1/1 = 0%

Feedback:

On the shelf we may observe three-dimensional morphologies that are commonly a result of tidal action. Outside the shoreface, waves are of no morphological importance.

Theory: section 7.1 (Introduction)