You can use Safari again to access the course website.

Dynamics of Marine Ecosystems
Recitation 4. November 9, 2011
Jeana Drake

1. Definitions
   a. Estuary

   Semi-enclosed coastal body of water; connection to ocean

   b. Estuarine dynamic balance

   Between pressure & friction/mixing
   Both from density differences

   c. Role of Coriolis

In most estuaries, the area is too small & things happen too quickly for Coriolis to have an effect.
If river flow is weak enough & the estuary is wide enough, Coriolis can play a role.

   d. Ebb & Flood versus High & Low Tides

Ebb & flood = water moving. Ebb is when river wins, flood is when ocean wins.
High & low tide = water not moving; between high & low tides.

   e. Exogenous Cues

From the environment: temp, salinity, depth/pressure, light.

   f. + versus – taxis

+ means organism moves towards the cue; - means it moves away. NOT up versus down
For +: light=up; pressure=down; temp=usually up; salinity=usually down or horizontal

   g. Flocc, Flocculation, Flocculate

Flocculate = verb; Flocculation = adjective/noun; Flocc = noun
When small particulates w/ charge or dissolved uncharged substances such as humics meet a solution of higher ionic strength, the molecules get closer together & flocc.
This is typically done by salinity of 15.

   h. Non-conservative Mixing

Happens when chemical processes in the water column result in addition or removal of the dissolved phase.
Addition: desorption from particulates; breakdown of organics

Removal: flocculation, adsorption, precipitation, biology

i. Turbidity Maximum

In a salt-wedge estuary, there is a region in the z direction where the chemistry & flow rates/directions change rapidly. Get particles suspended in this region.

j. Bioaccumulation & Biomagnification

Bioaccumulation: stays in the organisms up the food chain; may not affect lower trophic levels.
Biomagnification: result of bioaccumulation. Affects highest trophic levels.

2. Practice Problems
   a. Draw three vertical profiles for each type of mixing (salt-wedge, partially mixed, well-mixed) in an estuary. One profile should isohalines and water movement, one should be a salinity profile with depth in the idealized middle of the estuary, and the final a velocity profile also in the idealized middle. How does each of these mixing regimes get set up?

See the figure at the bottom of the 2nd to last page of Dr. Wilkin's handout.

   b. You are a benthic estuary crustacean who reproduces by planktonic larvae. You can handle a medium amount of salinity but your larvae do best in water of oceanic salinity. What differences do you see in the behavior of you versus your offspring?

You: go to your maximum salinity tolerance & wait for a strong ebb tide before you release your offspring. The strong ebb tide will quickly carry the larvae out to the ocean where the salinity is high enough for their tolerance.
Offspring: Once they have metamorphosed and are ready to re-enter the estuary, they ride a flood tide in & stay on the bottom. Since they're still metamorphosing & therefore still slowly lowering their salinity tolerance, they use low water slack tides at night to slowly move up the estuary. By only moving at night, they limit predation by critters that want to eat them.

c. Both iron (Fe) and phosphorus (as PO_4^{2-}) show non-conservative mixing. Draw their profiles (concentration) as a function of salinity and explain why, even though the profile shapes are very similar, they are actually caused by different things.

Both Fe^{2+} and PO_4^{2-} are sourced from rock weathering, which means they are highest upriver in the estuary. The both show non-conservative curves for concentration versus salinity, but are due to different reasons. Iron gets desorbed from DOC and quickly attaches to suspended solids. This happens mostly by a salinity of 5. Therefore it is mostly chemistry-driven. Phosphate has low uptake by phytoplankton at the low salinity end of the estuary, mostly because the water is so turbid that not enough light is available for many phytoplankton to bloom. By a salinity of ~15, enough of the turbidity has settled out that there is sufficient light for phytoplankton to bloom & they can start taking up phosphate.

d. Why does slope of the shoreline matter when sea level rises?

Shallower slope = more ground lost when sea level rises. (Think of the slope of the coast as they hypotenuse and prove to your self (by $a^2+b^2=c^2$).)
But with steeper slope, slope balances energy, so waves more energetic & can get more erosion rather than migration of shallow-slope barrier island

e. Sketch the direction of (1) wave energy and (2) where sediment (a) gets deposited and (b) gets scoured from on the beach drawn below.

Wave energy moves from left to right up the beach and then washes back down. By being blocked by the jetties, sand gets piled up "up-stream" of each jetty & washed away "down-stream" of each jetty.