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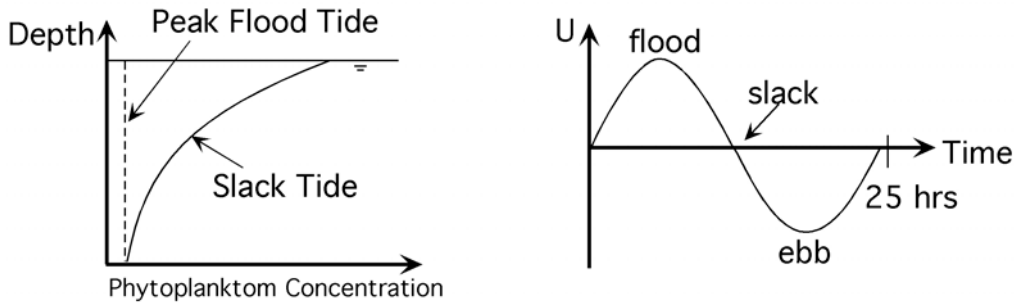
1.061 / 1.61 Transport Processes in the Environment
Fall 2008

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1.061/1.61: Homework # 2 [10 pt total]

Problem 1 [4 pts]

The bottom of a bay is completely covered by continuous colony of mussels that graze on plankton from the water column. All plankton is removed from water siphoned through the mussels. Each square meter of mussel colony can siphon 1 m^3 of water per hour. During peak tidal flows (flood and ebb) the concentration of plankton in the water is uniform over depth. During slack tide, however, the vertical profile of plankton concentration is not uniform. It is high at the surface and decreases toward the bed. Two representative profiles of plankton concentration are shown below. The bay is 1 m deep.

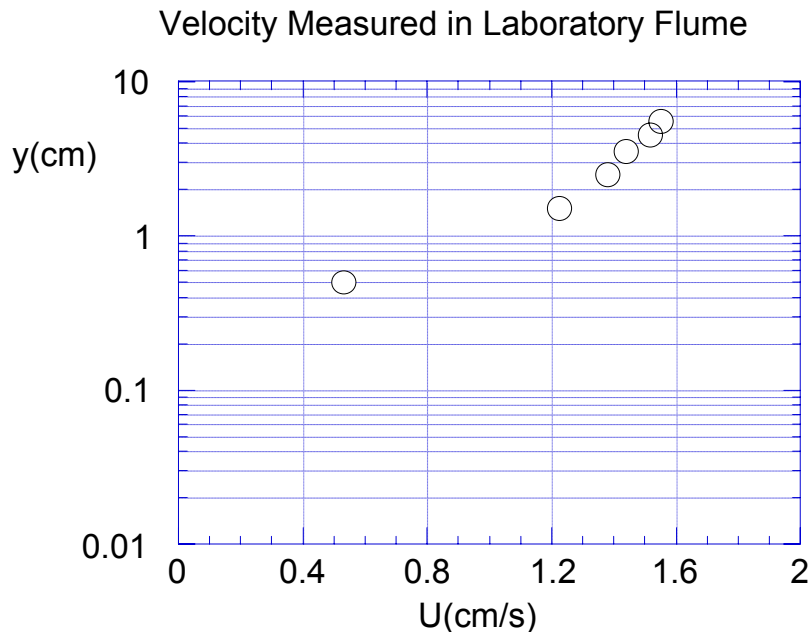


- a. Compare the time scale for vertical mixing during peak flood and slack tide. Why do they differ?
- b. Assume plankton growth is first order. Describe an upper and lower limit for the plankton growth rate, K_p .

Problem 2. [3 pts]

You have been asked to conduct flume experiments to examine the dissolution of chemical from the bed under conditions of smooth turbulent flow. You begin by measuring the velocity profile shown below.

- a. Assuming that the flume cannot be truly smooth, but has some roughness of scale, d . What does it mean to have smooth turbulent flow.
- b. Determine whether the flow is smooth or rough turbulent.
- c. Estimate the laminar sub-layer thickness, δ_s .
- d. Sketch the pattern made by a streak of dye released at $y < \delta_s$ and $y > \delta_s$.



Problem 3. [3 pts] - Detach this page and submit with homework.

The velocity profile measured some distance downstream of a bluff is shown below. **On the same graph,**

- a. Sketch the shape for the profile of turbulence intensity, u_{rms}/U ;
- b. Sketch the largest eddy scale that forms in the wake of the body and indicate the direction of eddy rotation.

