

Homework #4, due October 22

(All questions can be answered with the material from the class ppt slides.)

1) Let the vertical sound speed distribution consist of 3 homogeneous layers: 1490m/s for 0-500m, 1500m/s for 500-1500m, 1510m/s for 1500-3000m.

Your echosounder works internally with a sound speed of 1490m/s (i.e. it assumes that is the sound speed in the water) and shows a depth of 3000m. It is mounted 7m below the surface in the ship's hull. What is the actual total water depth ?

2) It was shown in the class that horizontal sound propagation over long distance occurs in a wave guide (the sound channel) with up and down loops/undulations. Assuming the downward loops occur over a completely linear sound speed profile (resulting only from the pressure effect), estimate the typical length (horizontal distance covered) of a steep downward loop in the deep ocean.

3) Calculate the signal level, the noise level, and the SNR (in decibels) at the receiver in the following configuration: source level $SL = 192$ db re $1\mu\text{Pa}$ @ 1m, propagation range 1000km, frequency 250Hz, bandwidth 85Hz, sea state 4, negligible shipping noise.

4) Slide 23 of the light&optics class presentation shows diffuse attenuation coefficients K for the downwelling irradiance, for different chlorophyll concentrations. What can you say about the color of the water for the 0.03 and $9.3\text{mg}/\text{m}^3$ case (and what is the explanation) ? Estimate the percentage of surface irradiance found at 450nm and 570nm at 10m and 100m depth in the two cases (assume a simple exponential decay with the constant attenuation coefficient K) ?

5) Assume the figure with downwelling (and upwelling) spectral irradiance at different depths for the Sargasso Sea and the Baltic Sea gives an average over a day. Make a rough estimate of the PAR at 10m depth at each location, and estimate how many grams of organic carbon can be formed by photosynthesis per day and per square meter, if all this downwelling radiation energy at 10m depth was used completely for photosynthesis.