

SMS-204: Integrative marine sciences. Assignment #4

You have a choice of **one of three(!)** sub-questions (A, B or C). Do one (you can get 10pts of *extra credit* for each additional one). It is valued at (60/100).

A. Annual cycle of temperature in the Gulf of Maine as observed from a buoy (60/100): Look at <http://gyre.umeoce.maine.edu/buoyhome.php> and choose a data buoy for which there are temperature measurements at least at two depths (or surface and air temperature). Go to http://neracoos.org/datatools/climatologies_display, select that buoy on the top left of the graph, select the temperature depth you want (or air) and select the “averaging time period” to be daily (you will have to plot the water data below the surface closest to the surface). Click on “2019” below the graph and on “view climatology data table”. Copy the data into a spreadsheet program for plotting by yourself (you may have to use the command ‘paste special’ and choose ‘text’).

Plot the annual cycle that is the change in temperature as function of day-of-the-year near the surface. (10pt)

1. Note the maximal and minimal temperatures and when they occur. (10pt)
2. Explain the observation with regards to the annual cycle of the sun radiation in the Gulf of Maine (10pt).
3. Is the coldest day also the shortest? Is the warmest day the longest? If the answer is no, why do you think it is not? (10pt)
4. Compare the result obtain in your graph with another graph you generate of:
 - a. the annual cycle of the temperature in the air at the same location **OR**
 - b. the annual cycle of temperature at 20m depth or deeper at the same location.(10pt)

Plot **both** on the **same** graph.

5. Based on what ***you have learned*** regarding heat and temperature explain why there are (or are not) differences between the two temperature time series? (10pt)

B. Annual cycle of temperature at the two opposite ends of the Gulf of Maine as observed by satellite (60/100). Go to NASA’s remote sensing portal, Giovanni at:

<https://giovanni.gsfc.nasa.gov/giovanni/>

You will have to register to this site to get the data you need (done via the login tab). Select ‘Oceanography’, and ‘Sea Surface Temperature at 11 microns (day)’ by clicking the square near it. At the top of the page, click on ‘Time-series’ within which select ‘Area-averaged’. Select ‘Date Range’ from 1/1/2019->12/31/2019. Then ‘Select Region’: one within the Bay of Fundy / NE Gulf of Maine and one in the SW Gulf of Maine in front of MA/NH/Southern Maine. Do it by using the map tool, moving to and focusing in on the region and drawing a bounding box within it. Plot data by pushing the ‘Plot Data’ button at the bottom of the page. Once the figure plotted, use the ‘download’ button on the left to download the data (ASCII CSV) for *your own* plotting (the graph should be done by you). To change click on ‘user input’ on the left-hand side.

1. Plot the annual cycle that is the change in temperature as function of time of the year at both locations on the same graph, with a label for each. (20pt)

2. Note the maximal and minimal temperatures and when they occur. (10pt)
3. Explain the observation with regards to the annual cycle of the sun radiation in the Gulf of Maine. (10pt).
4. Is the coldest day also the shortest? Is the warmest day the longest? If the answer is no, why do you think it is not? (10pt)
5. Based on what ***you have learned*** regarding heat and temperature explain why there are (or are not) differences between the two temperature time series? (10pt)

C. Annual cycle of temperature at the top 1000m of the ocean as measured with a profiling float. Go to <http://www3.mbari.org/chemsensor/floatviz.htm>. Choose a float that has at least profiled for the full 2019 year (you will need to plot temperature as function of date to see that).

1. (10pts) Use the tool to plot:
 - a. The float trajectory (x-axis longitude, y-axis: latitude).
 - b. Temperature (y-axis) as a function of date (x-axis).
 - c. Temperature (x-axis) as a function of depth (y-axis). You can download the figure by right clicking on it and saving the image. Include the plots in your homework.
2. How does the amplitude of the temperature seasonal change varies with depth? Why (10pts)?
3. Note the maximal and minimal temperatures and when they occur. (10pt)
4. Explain the observation with regards to the annual cycle of the sun radiation in the location where the float was (10pt).
5. Is the coldest day also the shortest? Is the warmest day the longest? If the answer is no, why do you think it is not? (10pt)
6. Based on what ***you have learned*** regarding heat and temperature explain why there are (or are not) differences between surface and depth? (10pt)

2. Unit conversion (MKS stands for meter, kilogram, seconds) (30/100):

- How many ml's are there in 0.01m^3 ? How many liters? How many cm^3 ?
- A river is flowing at 10km/day . How much is it in cm/s ?
- An organism weighing 2kg has a velocity of 40cm/s as it sinks through water. What is its kinetic energy in MKS (= SI) units?
- What are the mass and volume fluxes in MKS (= SI) units of a stream (density 1g cm^{-3}) flowing at an average speed 0.3 m/s with a 250 cm width and 300mm depth?
- What distance (in kilometers) does a tuna swimming at 110 cm s^{-1} swim in a day?
- What is, approximately, the density of water in g/ml , g/cm^3 and kg/m^3 ?

3. Watch the NASA's short movie on the greenhouse effect

(<https://www.youtube.com/watch?v=ZzCA60WnoMk>) and other materials you can find to answer the following (10/100):

- What is the difference between the incoming/outgoing radiation into/from the Earth surface?

- How different would the Earth temperature be w/o the greenhouse effect? Would it be more or less suitable to life?

4. Extra credit (10pts): Scientists have found that a Hershey kiss has 26 Calories (= 26,000 calories) and claim that if we can convert this energy to mechanical energy, without loss, it could lift an SUV 2m up in the air (see: <http://www.npr.org/templates/story/story.php?storyId=6700905&sc=emaf>). Evaluate this claim and calculate how high you could lift a 6,000lb heavy SUV.

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