**Procedure**

In groups of two, explore data collected in the Irminger Sea (North Atlantic Ocean) as part of the Ocean Observatories Initiative (OOI). Go to <https://datalab.marine.rutgers.edu/explorations/2019/seasonal.php?level=exploration>

**Learning Objectives**

By the end of this exercise, you should be able to

* Convert between different plot types to visualize ocean mixed layer variability over time
* Synthesize atmosphere and ocean data to describe how and why mixed layer depth varies seasonally

**Concept Invention**

With your partner, make observations of the data. Don’t try to interpret anything yet. Discuss what variables are shown, how the data was collected (check out the background at the bottom), what time period is shown, and the range in values for each variable. Then complete the following tasks.

1. **Draw a temperature depth profile.** Examine the temperature data. This data is collected continuously from 12 different depths as shown in panel 3. Translate this temperature time series into a temperature profile. Do this by selecting two time points (one summer and one winter) and plotting temperature with depth. Templates are provided below. Add numbers to your axes. Along the Y-axis, start with 0 m depth at the top and go to 1000 m at the bottom.

Late Summer: Late Winter/ Early Spring:

Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_ Date \_\_\_\_\_\_\_\_\_\_\_\_\_\_

 

1. One definition commonly used for mixed layer depth is the depth at which the temperature has decreased by 0.5°C relative to the sea surface temperature. On each profile, draw an X on the plot that indicates the approximate mixed layer depth (if one is present).
2. **Mixed Layer Depth (MLD).** Using your ability to translate the temperature time series data into a profile format, estimate the depth of the mixed layer over time. Create a plot of the MLD over the course of one average year using the template below. You are not expected to calculate MLD at each time, rather capture the seasonal trend.



Describe the seasonal cycle in mixed layer depth/stratification in words. Include information on the approximate range in values, the season in which it is the shallowest, and the season in which it is the deepest.

Now consider the temperature and MLD time series along with the wind and irradiance data.

What relationship do you observe between solar irradiance (the amount of incoming solar radiation at the sea surface) and the depth of the mixed layer? Consider seasonality. Is the relationship direct or is there a lag time?

What relationship do you observe between winds and the depth of the mixed layer? Consider seasonality. Is the relationship direct or is there a lag time?

From your observations, summarize what drives the seasonal cycle in MLD in the Irminger Sea.

**Application**

Now go to <https://datalab.marine.rutgers.edu/explorations/2019/seasonal.php?level=invention>

and answer the following questions as they relate to the data shown, now for the Irminger Sea and Station Papa in the Pacific Ocean.

How does the stratification of the water column compare between the two stations in March each year?

How does the difference in stratification relate to differences in solar heating and winds throughout a year?

Explain how the water column dynamics you observed relate to the formation of North Atlantic Deep Water as part of the meridional overturning circulation.