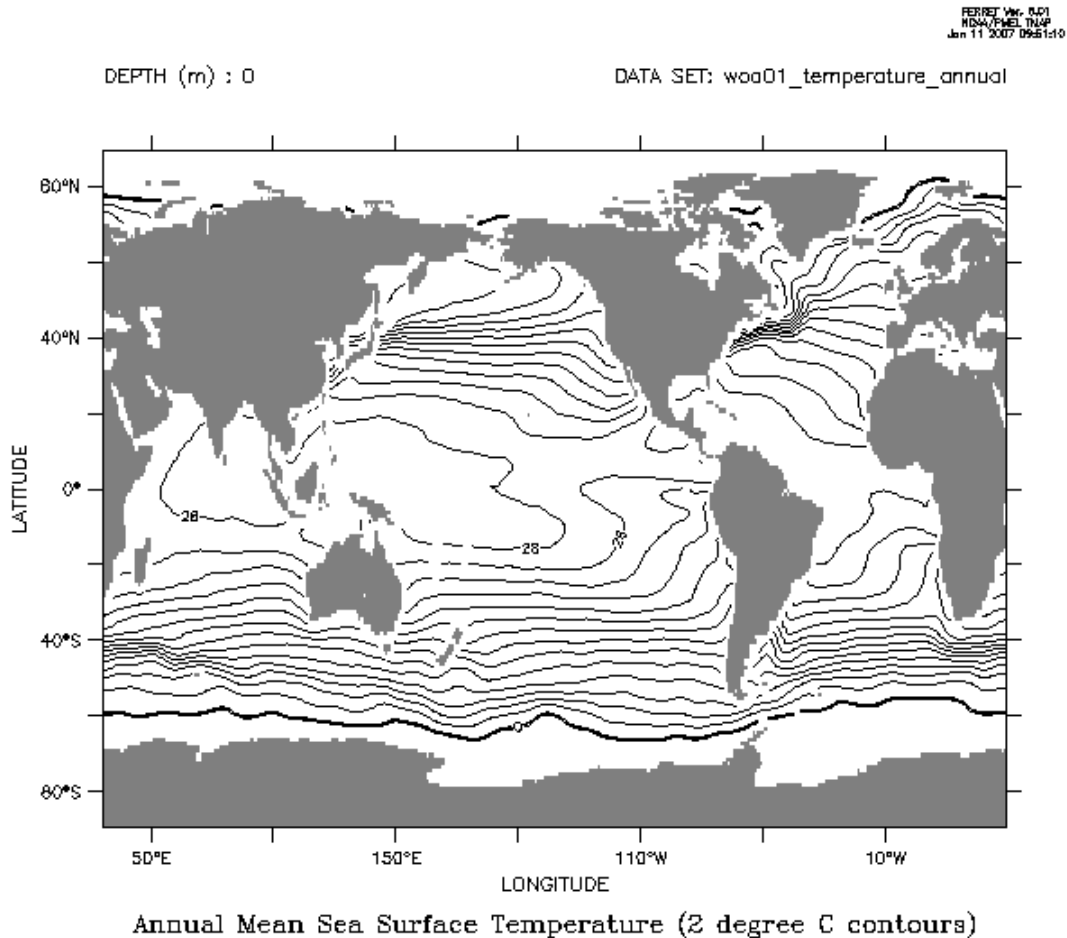


A. Ocean geography and surface currents



Place the following features on the map above (1 point each)

- |                        |                      |
|------------------------|----------------------|
| A: Drake Passage       | B: North Sea         |
| C: Sea of Okhotsk      | D. Black Sea         |
| E. Persian Gulf        | F. Bering Sea        |
| G. Baffin Bay          | H. Weddell Sea       |
| I. Bay of Bengal       | J. Strait of Hormuz  |
| K. Pacific Cold tongue | L. Pacific Warm pool |

Label and show the course of the following currents (with arrows, showing the direction of flow) on the map above (2 points each)

- |                     |                                |
|---------------------|--------------------------------|
| M. Oyashio Current  | N. Somali Current              |
| O. Benguela Current | P.. Falklands/Malvinas Current |

B. Counterfactuals (5 points each)

1. If water were not a polar molecule, would the difference between summer and winter temperatures be larger or smaller? What property of water would explain this change?  
(*Tiebreaker 1*)

2. If the earth's gravity were stronger, would a wave with a 100m wavelength have a longer period or a shorter period? Why?

3. If the earth's rotation were slower but the wind stress at the ocean surface were the same, would the Ekman transport be larger or smaller? Why?

4. Granite is about 5-10% lighter than basalt. If basalt were lighter would Princeton be more or less likely to be a coastal city? Why?

5. If the earth's atmosphere were to contain more carbon dioxide, would this be good for corals or bad for corals? Why?

6. If the earth rotated much slower would there be more or fewer amphidromic points? Why? (*Tiebreaker 2*)

C. Identifications: (2 points each)

1. \_\_\_\_\_ The American oceanographer who headed the Naval Hydrographic Office and used ship logs to map surface currents:

2. \_\_\_\_\_ The process by which wind causes sand grains to jump and bump along the ground on a dune.

3. \_\_\_\_\_ The expedition that inaugurated the modern era of oceanography by surveying all the ocean basins in the late 19<sup>th</sup> century.

4. \_\_\_\_\_ The apparent force arising because of the Earth's spin about its axis.

5. \_\_\_\_\_ Depression found along the axis of oceanic spreading centers.

D. Short answers (5 points each, 30 points total)

1. What is a tracer that provides evidence that the “oldest” water (longest time since the water was at the surface) is found in the North Pacific? (Tiebreaker 3)

2. Compare and contrast the processes that resulted in the formation of Iceland with those that resulted in the formation of Hawaii.

3. Do the following increase or decrease or stay the same as a shallow-water surface gravity wave shoals as it moves onto the shore?

a) Speed

b.) Period

c) Wavelength

d.) Height

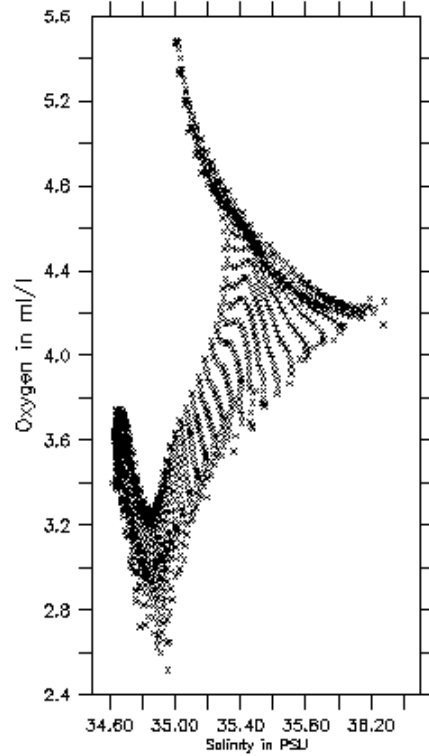
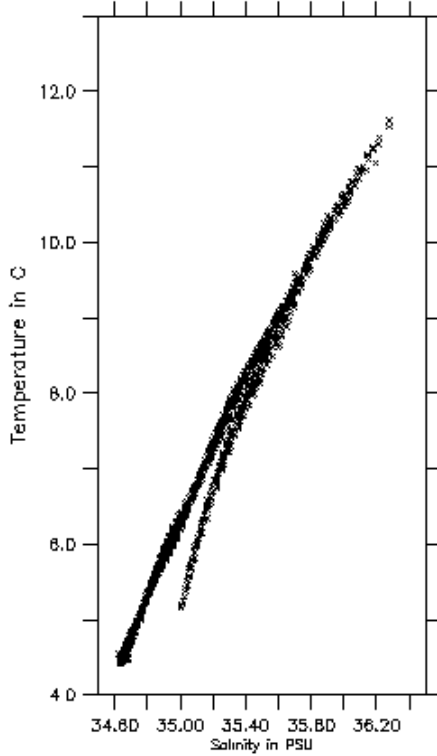
e.) Slope

4. On which quadrant of a northward moving hurricane in the northern hemisphere are the highest waves found? Why?

5. If the wind blows to the north along the eastern boundary of an ocean basin in the northern hemisphere, what kind of flow pattern will result?

6. If a drifter in the Southern Hemisphere is moving from the southeast to the northwest at a depth just below the Ekman layer, towards which direction (point of the compass) is the sea surface height sloping downhill?

Hydrographic/water mass analysis



The two plots above show data from the North Atlantic Ocean from 0-45N at a depth of 1000m. Use what you know about the water masses at this depth to answer the following questions

1. The plot on the left plots temperature vs. salinity. This plot can be described in terms of 3 water masses. Identify them by name on the T-S plot. (6 points)
  
2. Why does the plot on the right, which shows oxygen vs. salinity look so different from the plot on the left? (4 points)