NAME:

December 14, 2005

EAS-4300 Oceanography FINAL Exam

There are 6 questions and you have up to 2 hours and 50 minutes. However you should be done earlier!

Remember: this exam is not to test your ability to memorize things. Use the concepts you learned in the class to give answers and reasonable explanations to the questions. The questions may have more than one answer so it is important that you explain when asked to do so. However try to be brief and synthetic.

If you have questions during the exam, ask me.

You have about 30 minutes for each question.

Figure 1 shows vertical sections of dissolved oxygen in the Atlantic and Pacific Ocean.

a) Based on your knowledge of the thermohaline circulation, what can you say about the relationship between the age of the water masses and their dissolved oxygen content? (Hint: define what we mean by age of a water mass first)

b) Mark the Atlantic and Pacific section.
Mark one location at the surface where deep waters are formed with a 'D'.
Mark one location at the surface where intermediate waters are formed with an 'I'.

c) If you wanted to solve the global warming problem by removing Carbon Dioxide from the atmosphere and you could put it into the ocean in any point of sections A or B, what would be the best location? Explain your answer.

d) Mark (if you can) the approximate location of the formation region for the Antarctic Bottom Waters (AABW) and the North Atlantic Deep Water. Briefly explain how each of these deep water are formed and discuss their temperature and salinity characteristic (e.g. which one is colder/warmer and fresher/saltier and why).

Figure 2 shows a map of precipitation and water vapor.

a) Label the Trade winds and Westerlies.

b) Label the ascend and descent locations of the Hadley Cell and Polar Cell (AH = Ascending Hadley, DH = Descending Hadley, AP=Ascending Polar, DP=Descending Polar). Also indicate if these location correspond to low surface pressure of high surface pressure.

c) Where are the winds expected to be stronger and why?

d) Where do you expect convection to be the strongest at the time of the maps in Figure 2? Explain. Would this be a region of low level convergence or divergence?

e) Isolate a mid-latitude cyclone and it correspondent cold front with the blue pen and the label MLC.

f) Identify the location of a tropical cyclone with the red pen and the label TLC. What are the conditions needed for formation of a tropical cyclone?

c) Why do most mid-latitude areas only rarely experience a hurricane?

d) Why are there no hurricanes at the Equator?

e) Draw the ocean circulation on panel C of figure 2 for the Pacific, Atlantic and Southern ocean. Make sure to include the gyres, the currents at the equator and label the major upwelling systems with UPW and a circle.

Figure 3 shows a map of Sea Surface Temperature Anomalies (SSTa).

a) What is the North Atlantic Oscillation and how is it defined?

b) Label in figure 3, which of the two patterns corresponds to the positive phase of the NAO (hint: during the NAO the Gulf Stream is stronger and the storm track intensifies and shift northward bringing wet climate over northern Europe).

c) Briefly explain which physical processes force the SST anomalies at location A and B (in the figure) during the NAO positive and negative phase.

d) The ecosystem response to the NAO is classified into direct, indirect or integrated. For each type of response state briefly what it means and give at least one example.

a) On Figure 4a, draw a schematic of nutrient cycling in the biological system and sediment in the ocean. In the arrows you will draw indicate if the transfer of mass is associated with organic or inorganic matter.

b) With a different color insert in the diagram where nitrogen fixation and denitrification occur.

c) Discuss briefly the role of bacteria in nutrient cycling.

d) Also what special property makes bacteria vital in hydrothermal vents?

e) Briefly sketch/describe how changes in availability of nutrients and sunlight in the regions listed in Figure 4b affect the primary productivity. **Please write your answer on the figure in the appropriate space.**

a) It has been argued during the GW debate that burning fossil fuel and emitting more CO2 is beneficial to the planet because it increases plant growth as estimated in figure 5a. More plant growth equals more photosynthesis and therefore more storage of carbon in the vegetation. How would you argue against this theory?

b) Figure 5b shows the globally averaged temperature over the last 140 years. The anti-global warming group have argued that although CO2 has increased throughout the century the global temperature has had a negative trend between 1940-1980. During this period there is not positive correlation between temperature and CO2. How would you argue against this statement?

c) You are the president of the United States and you are concern about increase in sea level over the next century. What decision would you make about emissions of Carbon Dioxide in the atmosphere? Justify your choice (to the voters) by indicating the advantages/disadvantages of your choice.

To help you with your decision world wide scientist have presented you the following diagram.

Look at figure 6. As a coastal engineer, you have been hired to prepare a plan for the area shown on the coastal chart. The main goals are to protect the town on Mitchell Point and the harbor facilities in Herman Bay. The land area consists of easily eroded sediment, mainly sand and silt. A study of wave and wind records for the past ten years indicates that from October through May the wind and waves are primarily from the southwest. From June through September they are from the Southeast.

a) Draw in red the longshore currents during the summer. Draw in blue (or dashed line) the longshore currents during winter. Remember to allow the refraction around headlands.

b) In figure 6, locate where you expect the formation of rip currents with the label RP and a circle. Do rip currents occupy the same location year round or do they change location with season?

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FIGURES

Dissolved Oxygen ml/l Figure 1

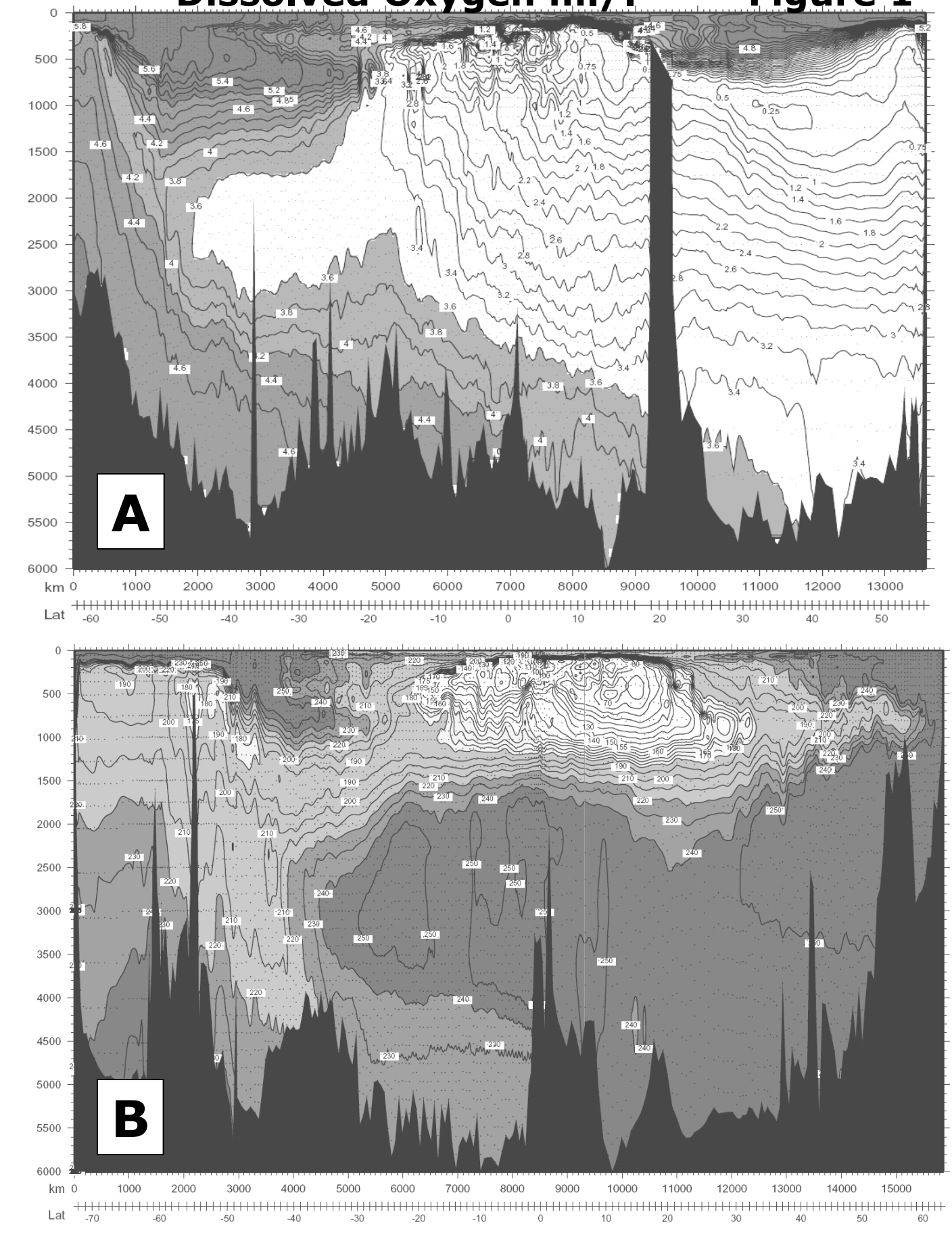
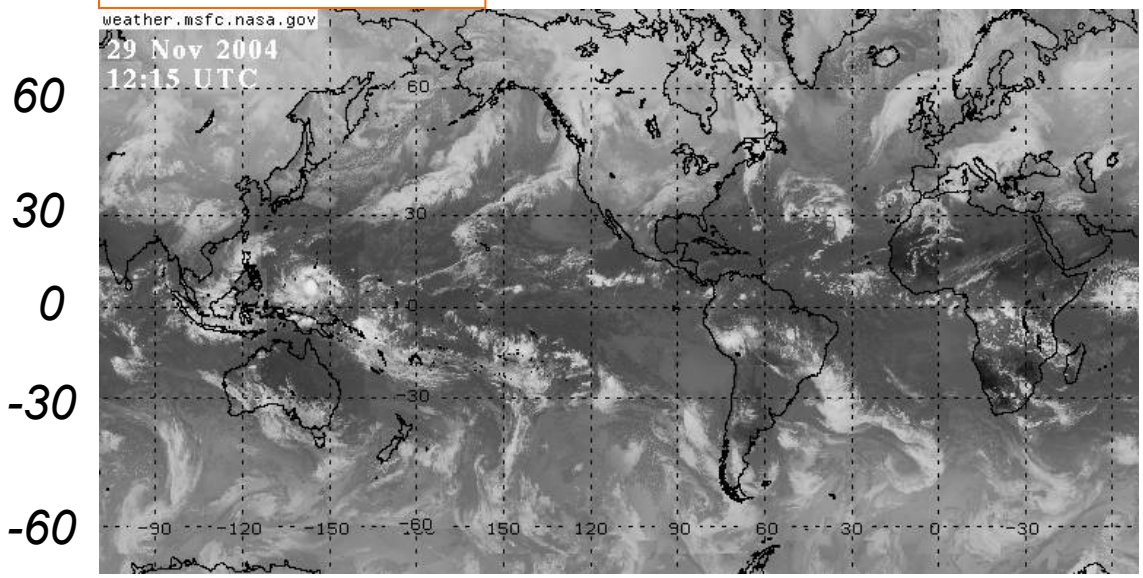


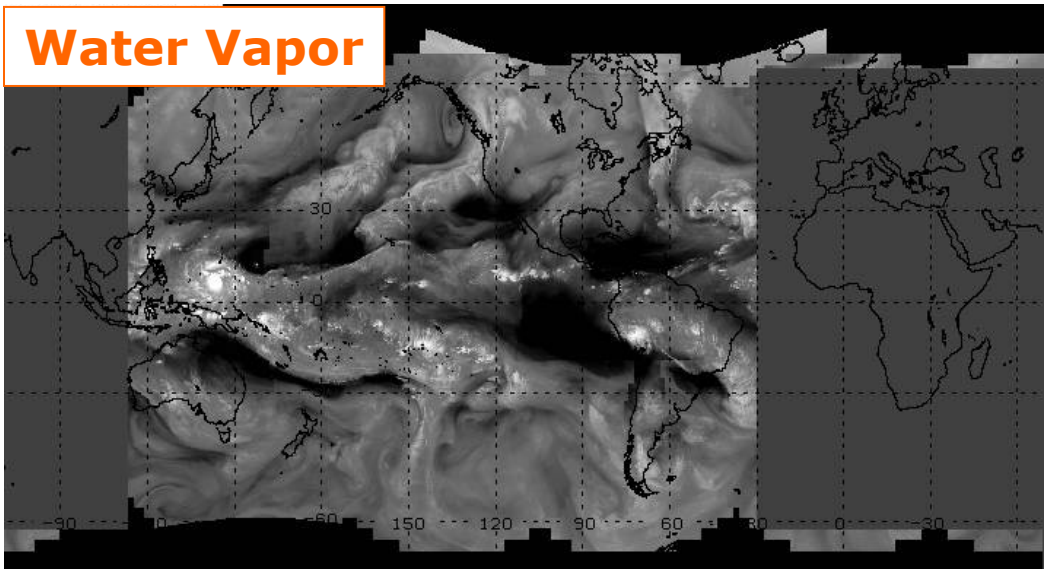
Figure 2

Precipitation

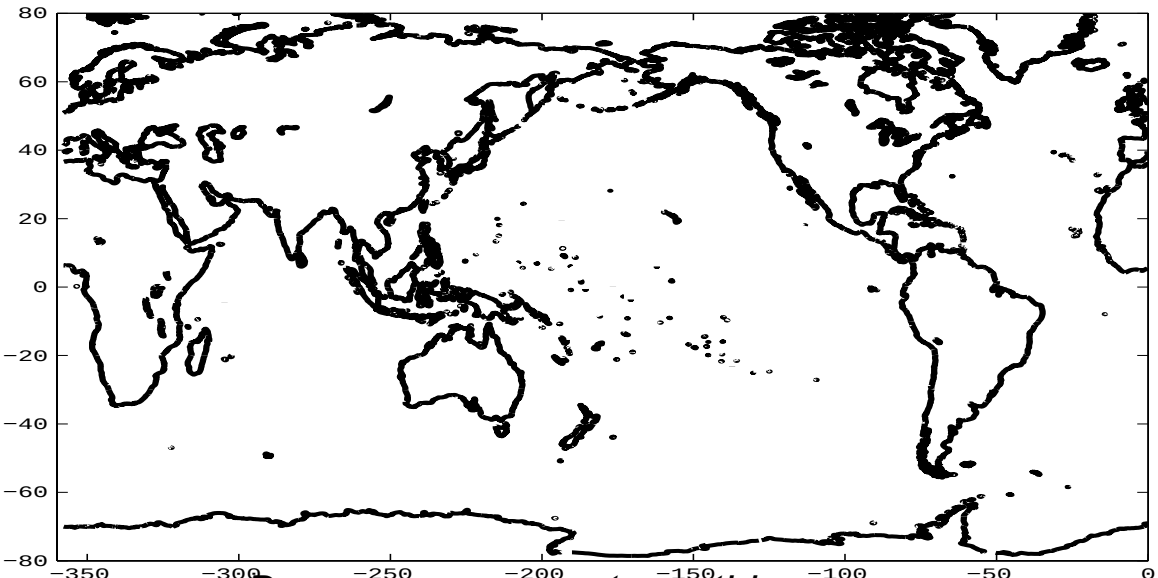


A

Water Vapor



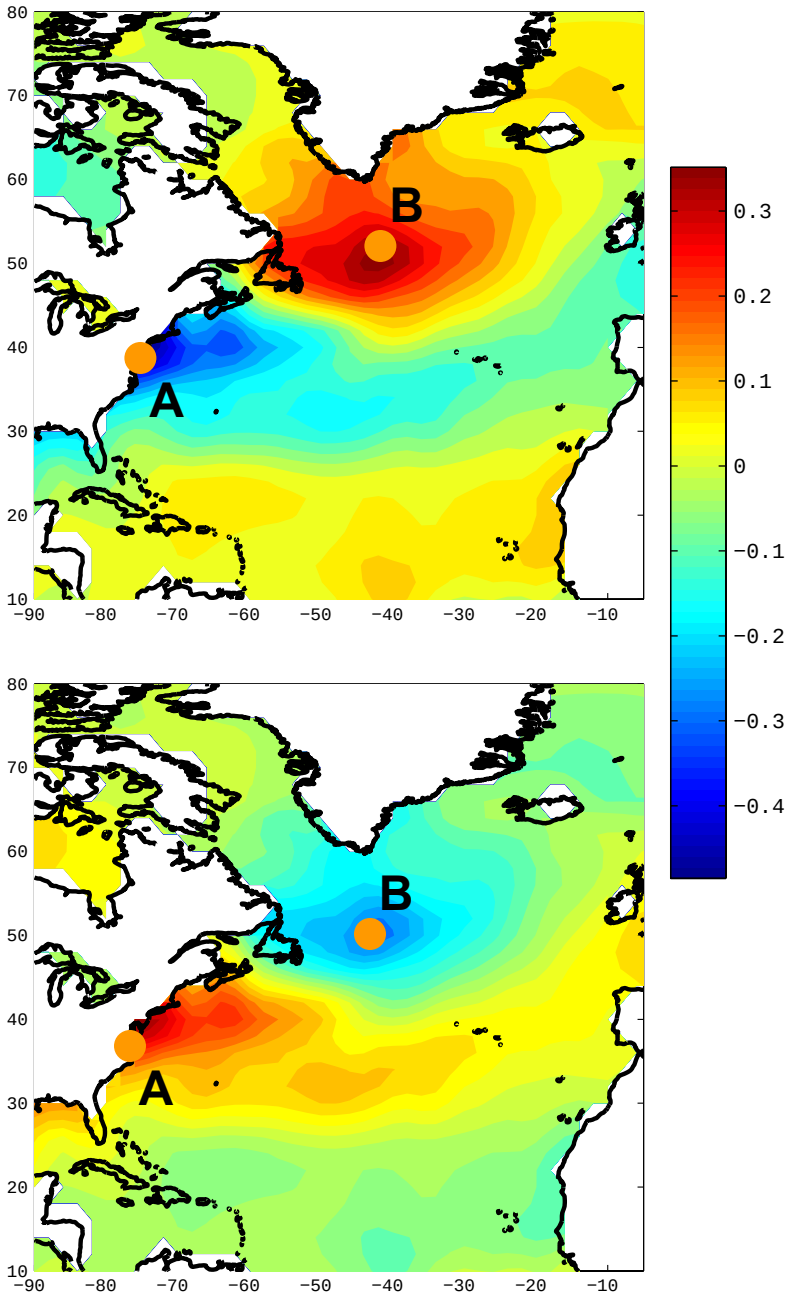
B



C

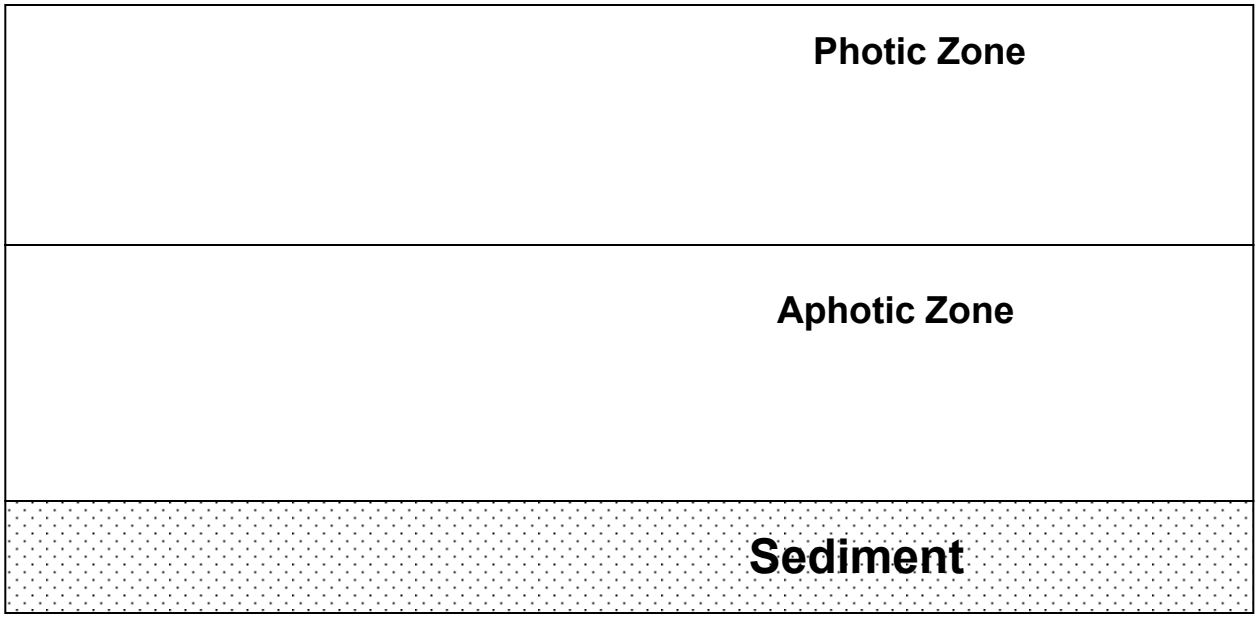
Draw ocean currents on this map

Figure 3


SST Anomalies [C]
80
70
60
50
40
30
20
10
−90
−80
−70
−60
−50
−40
−30
−20
−10
B
A
0.3
0.2
0.1
0
−0.1
−0.2
−0.3
−0.4

Draw Nutrient Cycling Diagram

Figure 4a



Tropics and Subtropics

Temperate regions

Polar regions

Figure 4b

CO_2 & Plant Growth

Figure 5a

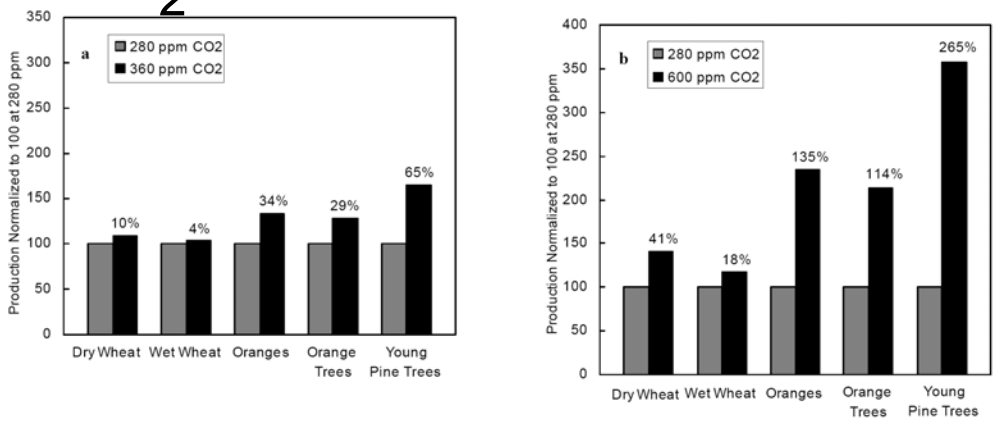


Figure 5b

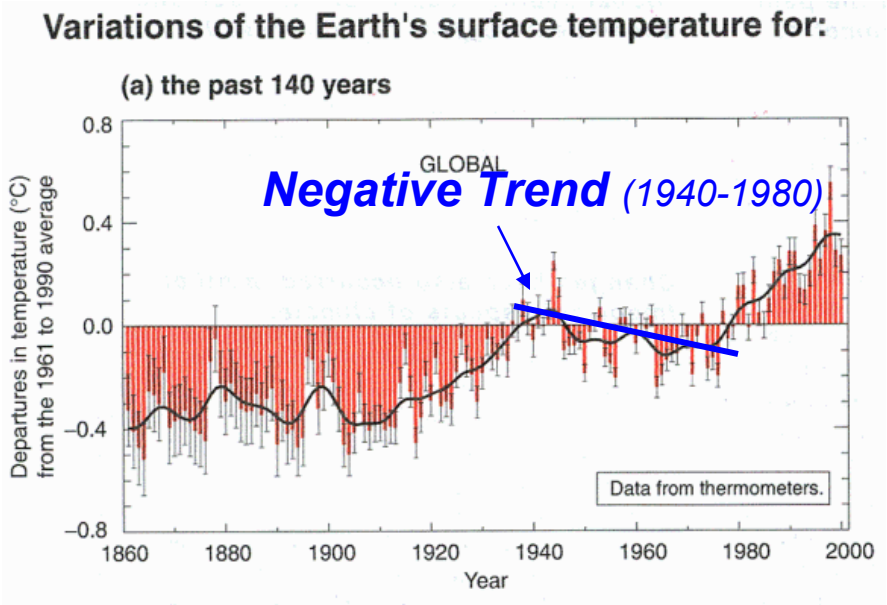


Figure 5c

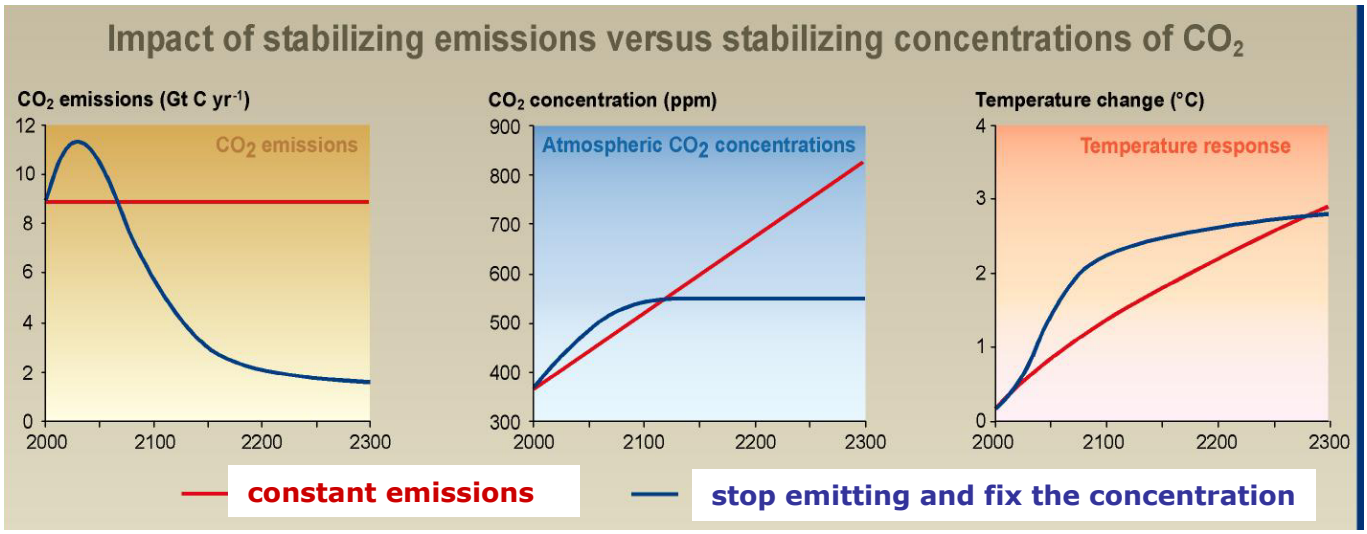
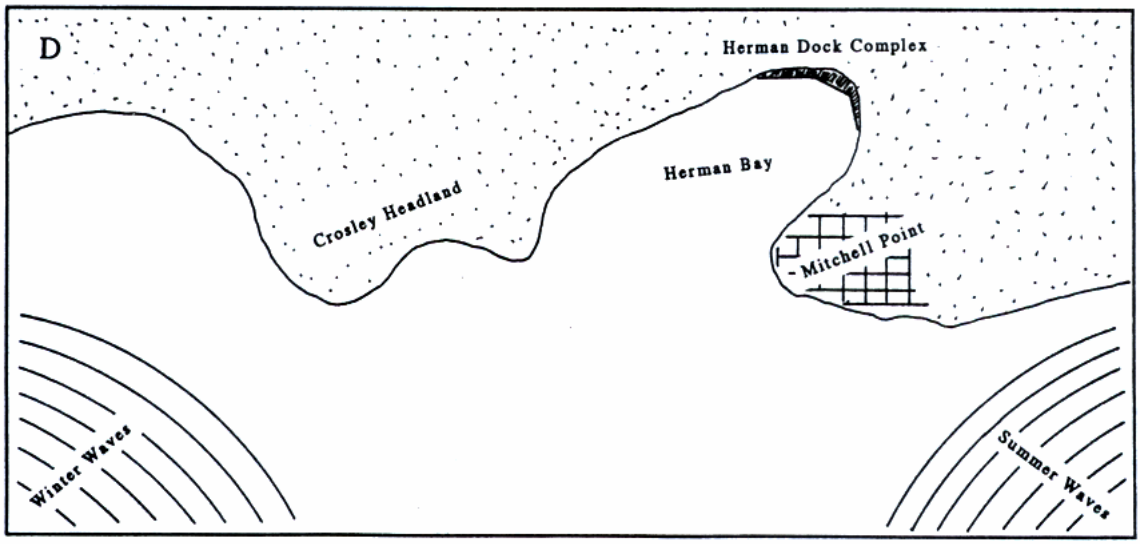


Figure 6


D
Herman Dock Complex
Herman Bay
Crosley Headland
Mitchell Point
Winter Waves
Summer Waves