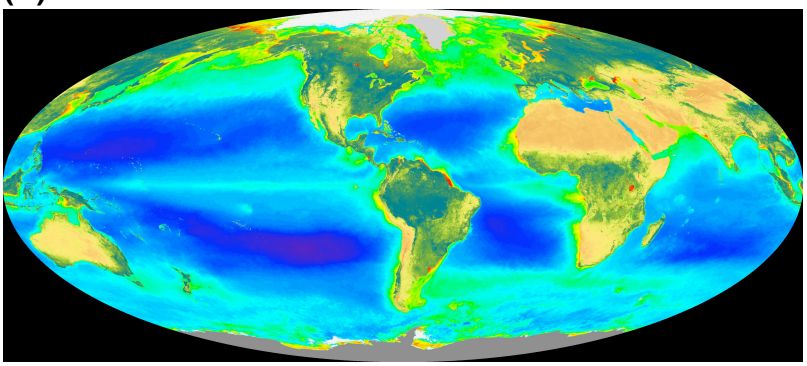
# Introduction to Oceanography
# EAS 4300

**Homework #10:** The Marine Ecosystem and Food Web

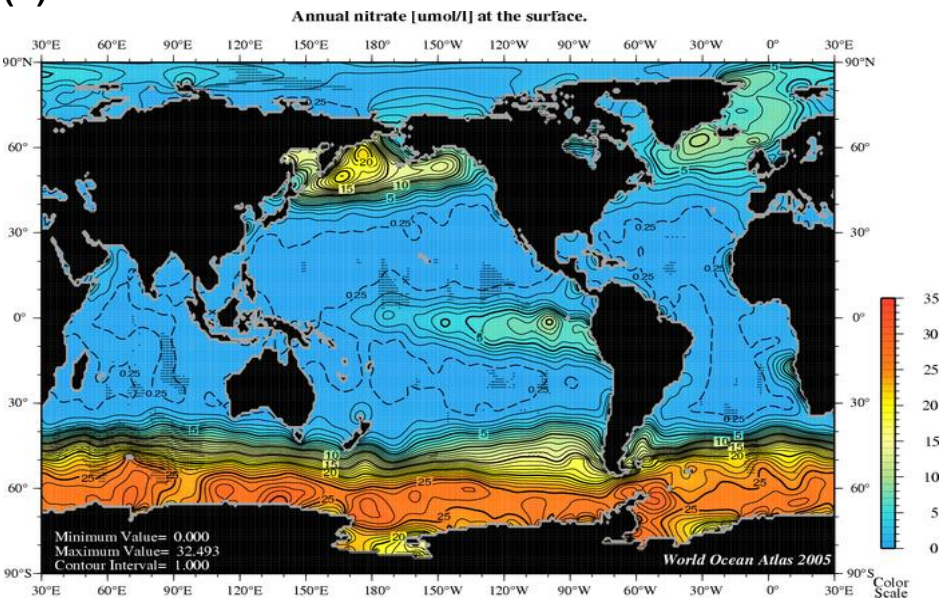
**Question 1: Marine Primary Productivity**

The figure below shows the average surface Chl-a concentration derived from satellite (panel A) and the mean surface distribution of Nitrate (panel B).

**(A)**



**(B)**




(a) Briefly explain the physical and biological processes that control primary productivity in the surface ocean. In your description explain the processes that contribute to maintaining a low Chl-a conentration in the sub-tropical gyres of the ocean.

(b) What are the Redfield ratios and why is dissolved nitrogen considered a limiting nutrient in todays ocean? Where is dissolved nitrogen mostly consumed by the marine ecosystem and where/how is it regenerated?

(c) Is nitrogen always the limiting nutrient? Panel B shows regions of very high nitrogen concentration at the ocean surface. Can you explain why?

(d) Photosynthesis is considered a very important process to capture the sun energy and use if to fuel the marine ecosystem. However, recent discovery at the ocean floor have shown that ecosystem can get their primary energy source by alternative pathways that do not require the sun. Explain.

**Question 2: Marine Ecosystem Response to Climate Change**

(a) What is the metabolic index? How is this useful to understand the effect of climate change on marine ecosystems? According to future projections that use the metabolic index what will happen to most fish habitats?

*Polar Ecosystems*

(b) Briefly summarize the seasonal cycle of ice and primary productivity in the Arctic ecosystem (e.g. make sure to distinguish between ice-algae and open ocean primary productivity). Discuss how the changes in sea-ice coverage forced by climate change impact the seasonal cycle of (1) primary producers, and (2) health of benthic and pelagic communities.

(c) In the Antarctic the krill is an efficient and important energy pathway from the primary producers to the higher trophic levels. Briefly describe how climate change is affecting krill abundance. Are there new or alternative energy pathways from the primary producers to the higher trophic levels that are emerging in the Antarctic?

*Tropical Ecosystems*

(d) The decline of tropical coral reefs have been reported worldwide. List a set of potential causes for their decline. Now discuss the role of seaweeds and diversity in fish grazers on coral health.