

# Introduction to Oceanography

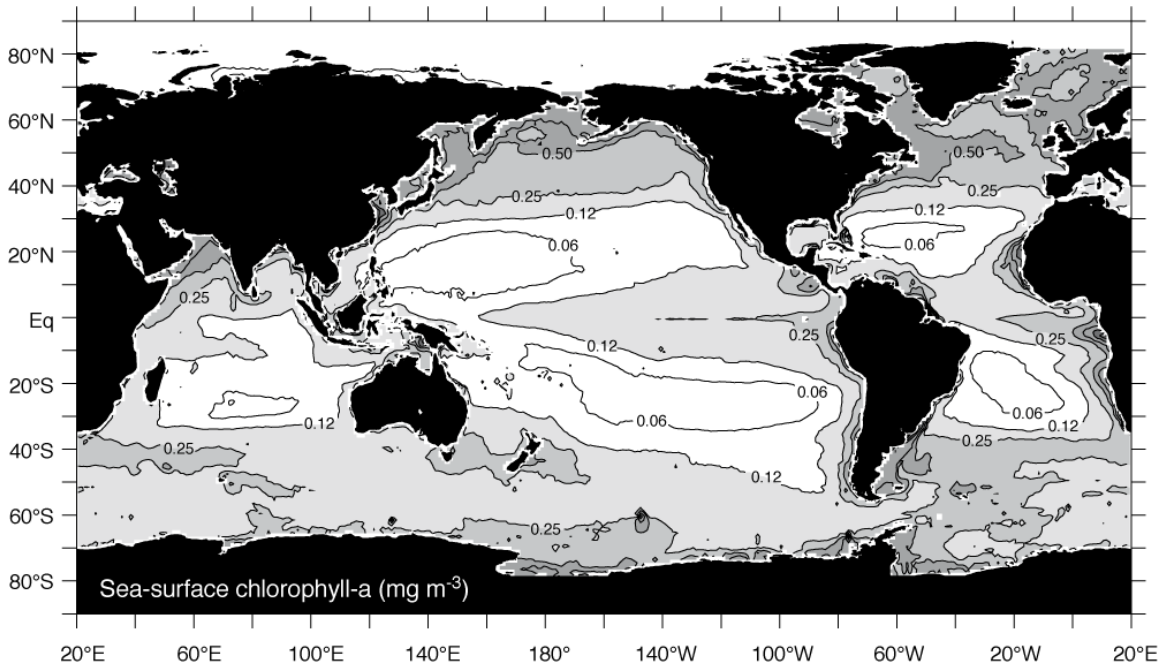
## EAS 4300

### Homework #9:

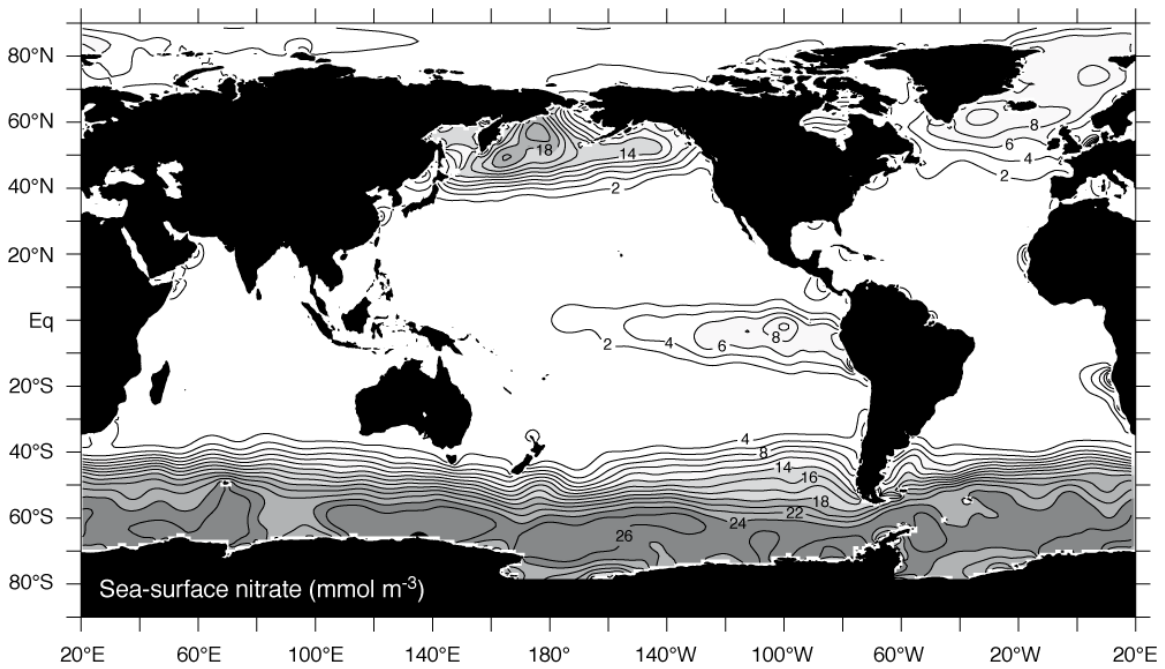
#### *Ocean circulation, nutrient cycling and biological productivity*

Figure 1, 2 and 3 show the pattern of surface chlorophyll-a, surface nitrate and vertical velocity at the base of the mixed layer from Sarmiento and Gruber (2006).

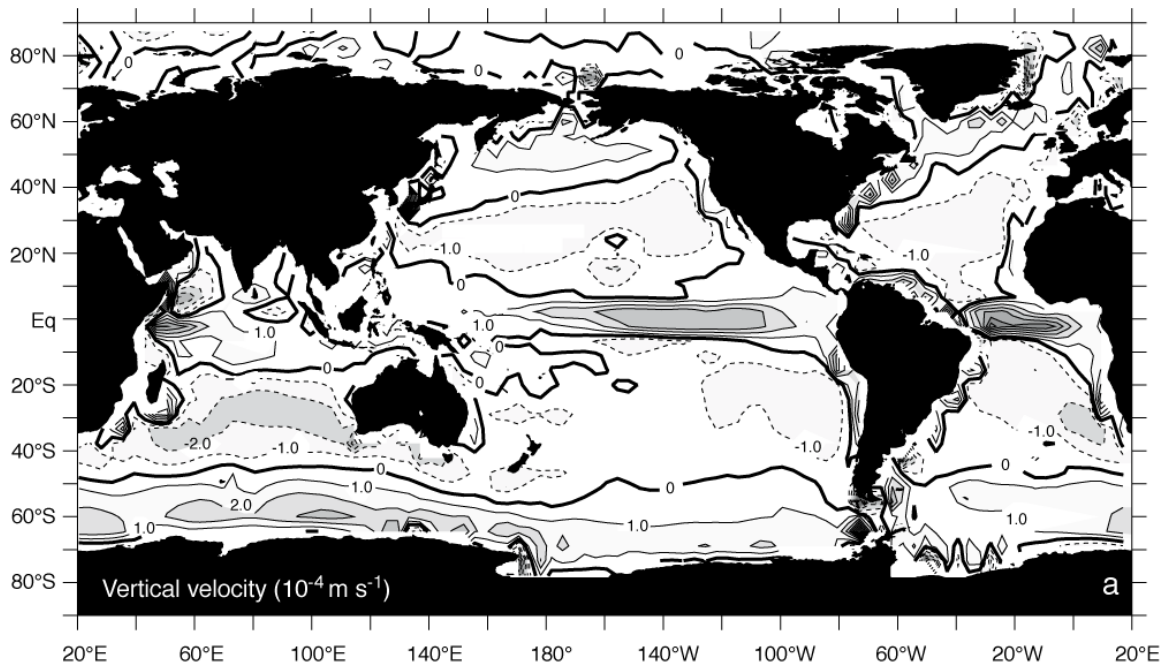
1. (25pts) Chlorophyll partly reflects the biomass in the surface ocean. Identify the geographic regions of particularly high and low chlorophyll concentration from the Figure 1.
2. (25pts) What are the common features of the low chlorophyll regions. Explain the mechanism limiting the accumulation of biomass in such regions. Use the information from both Figure 2 and 3 in your explanation.
3. (25pts) Compare the high chlorophyll regions between northern North Atlantic and the South Atlantic. Even though the nitrate concentration is higher in the South Atlantic, chlorophyll is relatively lower there. Explain the reason behind the decoupling between surface chlorophyll and nitrate concentrations.
4. (25pts) Both idealized and complex climate models predict that increasing global mean temperature will expand the latitudinal extent of the Hadley cell of the atmospheric circulation. What will be the response of vertical velocity in the oceans? Speculate the response of the surface chlorophyll distribution to the warming climate.



**Figure 1. Surface chlorophyll concentration.**



**Figure 2. Surface nitrate concentration**



**Figure 3. Vertical velocity at the base of the surface mixed layer.**