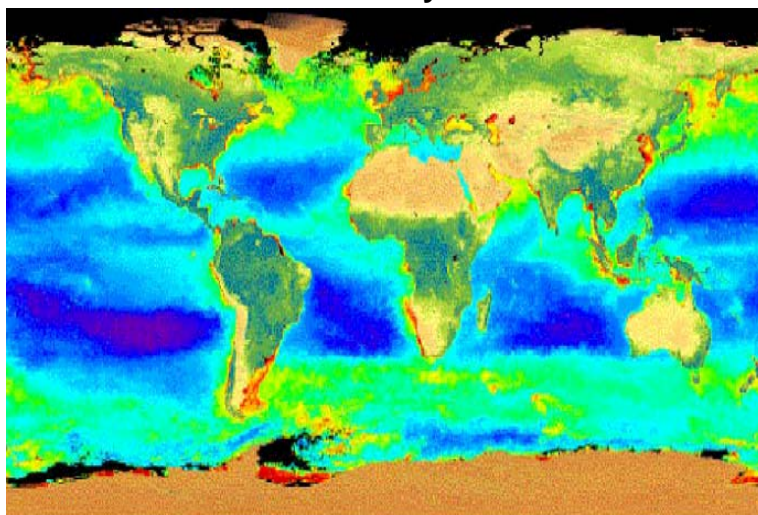


7.014

Lecture 19
Regulation of Productivity

March 28, 2005

Terrestrial Primary Production



Productivity ranges (g/m²/yr):

NASA satellite image



< 100



100 - 600

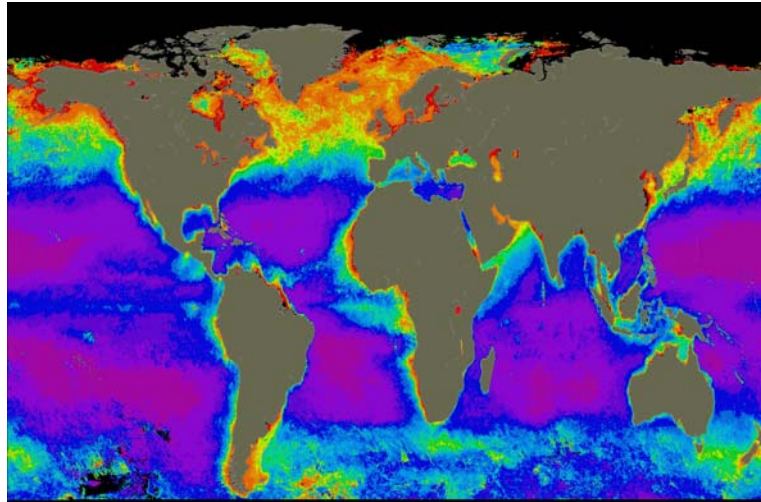


> 600

Image is taken from NASA's Web site: <http://www.nasa.gov>.

Marine Primary Production

Higher in Zones of Upwelling



Productivity ranges (g/m²/yr):

NASA satellite image



< 40



40 - 90



> 90

Image is taken from NASA's Web site: <http://www.nasa.gov>.

Phytoplankton: A tour

- Over 20,000 species
- Occur wherever there is water
- Range from 0.5 to 1000 μm in diameter
- There is as much genetic information in a liter of seawater as in the entire human genome

Photos removed due to copyright restrictions.

Please see:

Round, F. E., R. M. Crawford, and D. G. Mann. *Diatoms: Biology and Morphology of the Genera*. Cambridge, England; New York, NY: Cambridge University Press, 1990. ISBN: 0521363187.

Contents removed due to copyright restrictions.

Please see:

Hamm, C. E., R. Merkel, O. Springer, P. Jurkojc, C. Maier, K. Prechtel, and V. Smetacek.

"Architecture and material properties of diatom shells provide effective mechanical protection."

Nature 421, no. 6925 (February 20, 2003): 841-3.

Bio-Mineralization slide removed due to copyright considerations.

Coccolithophores

Photos removed due to copyright restrictions.

Please see:

Winter, Amos, and William G. Siesser. *Coccolithophores*.

London, UK: Cambridge University Press, June 2, 1994. ISBN:
0521380502.

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Please see:

Winter, Amos, and William G. Siesser. *Coccolithophores*.

London, UK: Cambridge University Press, June 2, 1994. ISBN:
0521380502.

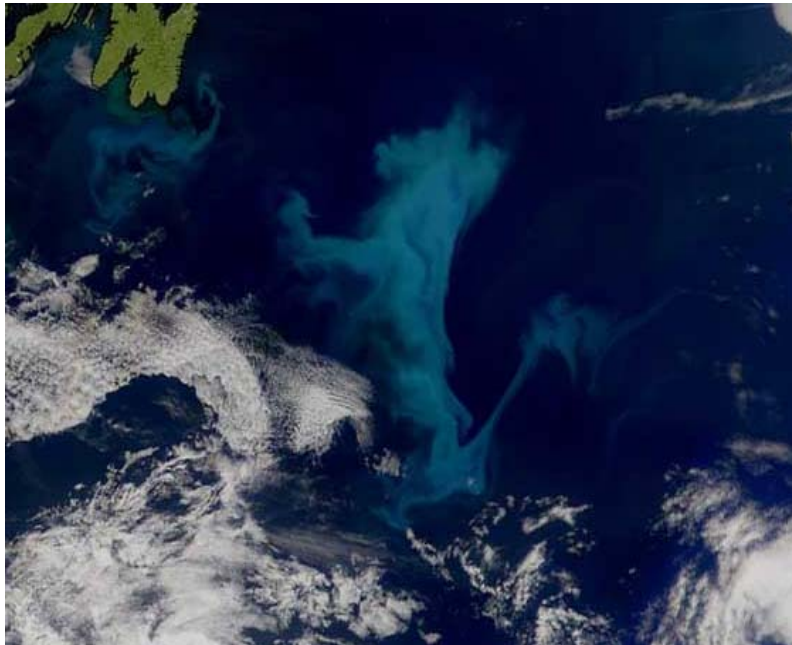


Image is taken from NASA's Web site: <http://www.nasa.gov>.

Cyanobacteria

Photo removed due to copyright considerations.

 0.5 mm

Courtesy D. Karl

Cyanobacteria import
nitrogen into the
oceans from the
atmosphere

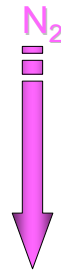
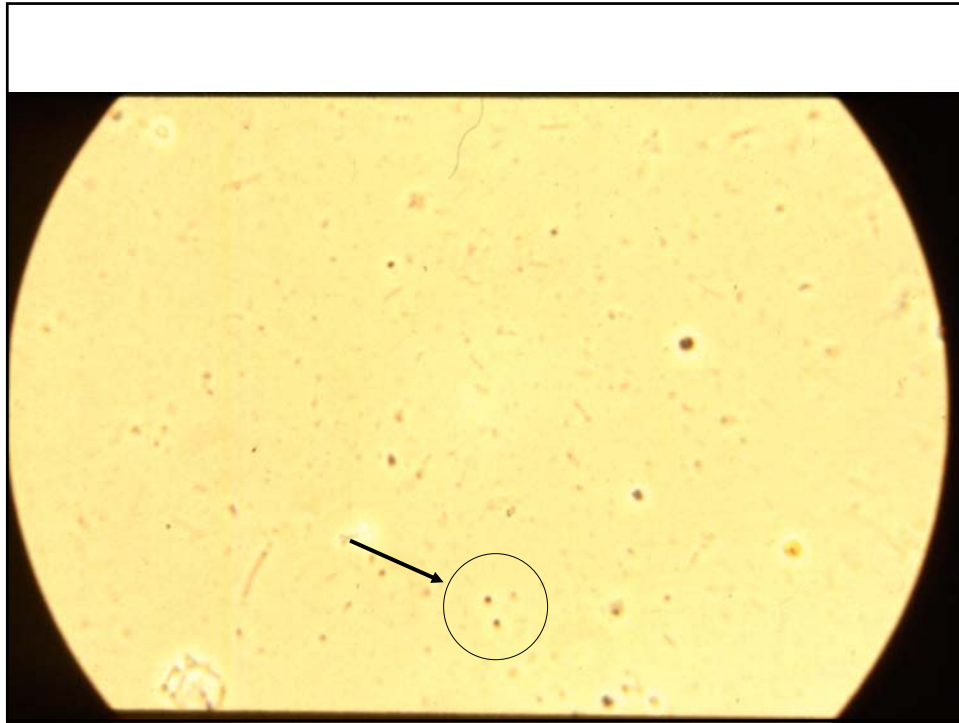


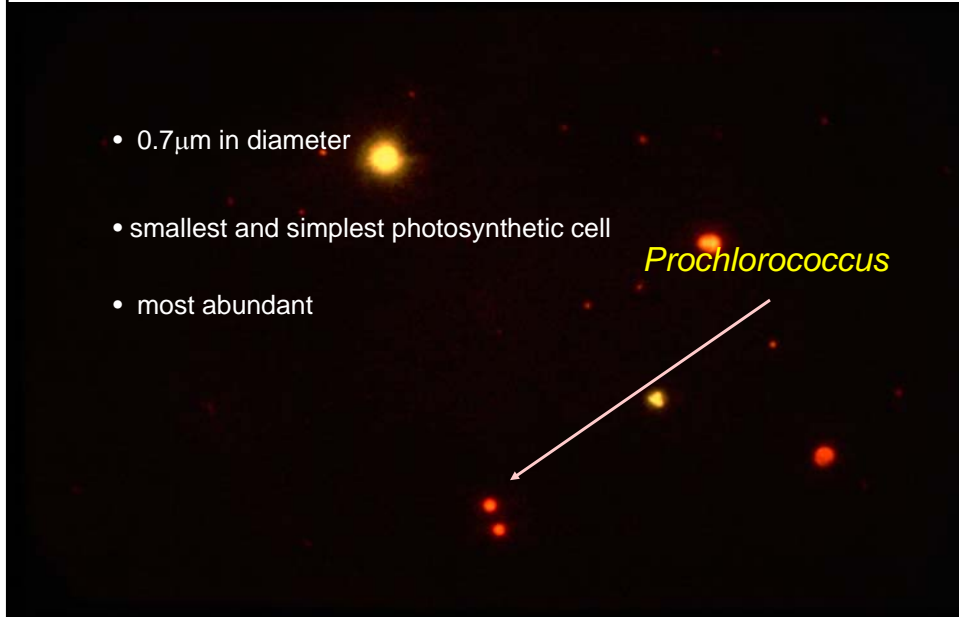
Photo removed due to copyright considerations.



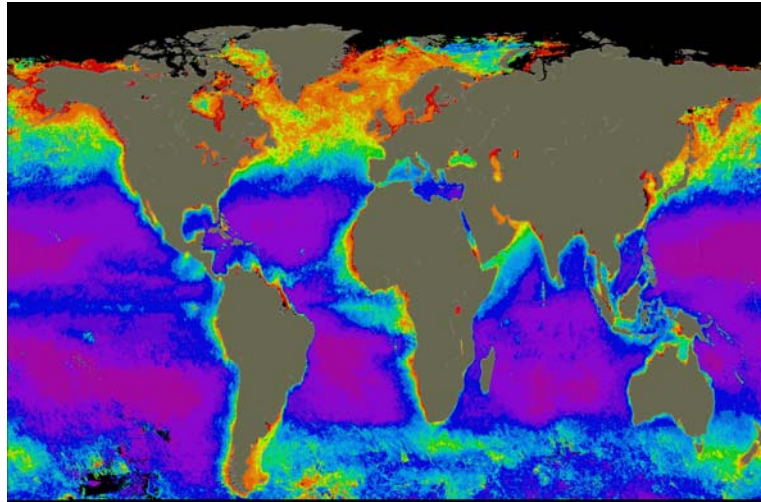
Prochlorococcus

- 0.7 μm in diameter
- smallest and simplest photosynthetic cell
- most abundant

Prochlorococcus



What regulates Marine Primary Production ?



Productivity ranges (g/m²/yr):

NASA satellite image



< 40



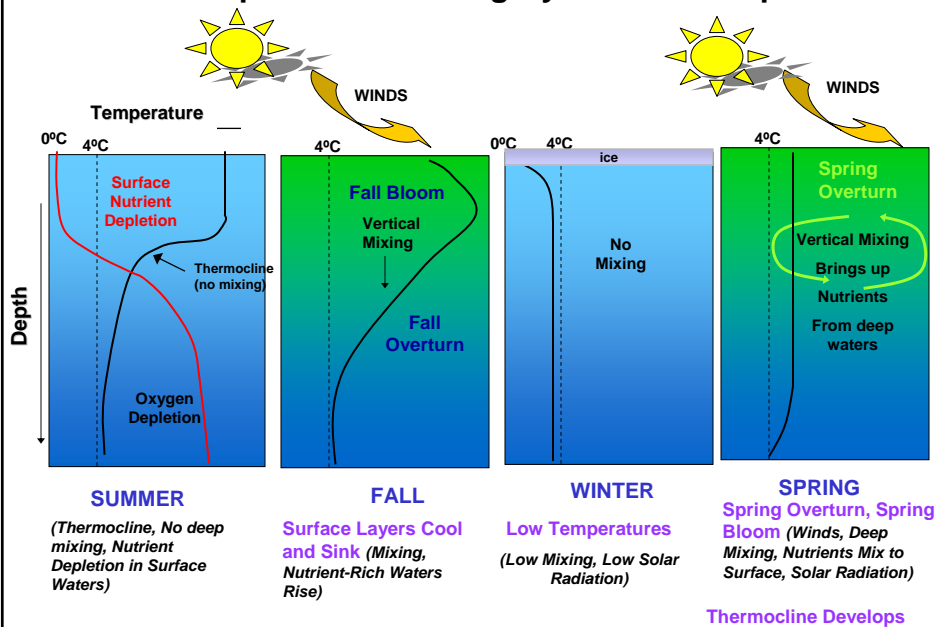
40 - 90



> 90

Image is taken from NASA's Web site: <http://www.nasa.gov>.

Seasonal Temperature & Mixing Cycles in a Temperate Lake



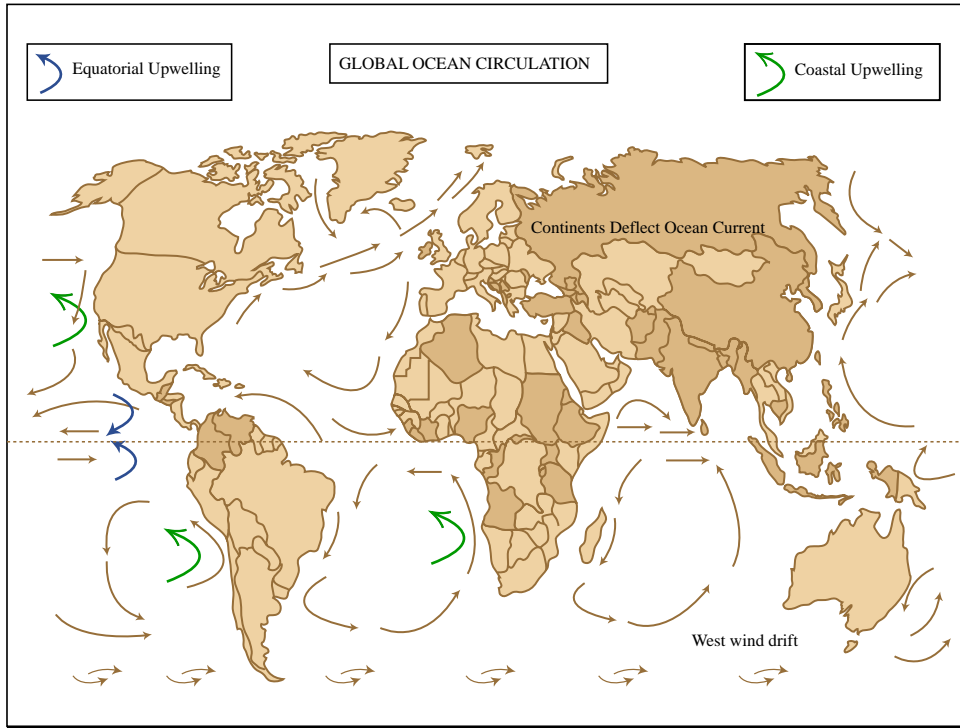


Figure by MIT OCW.

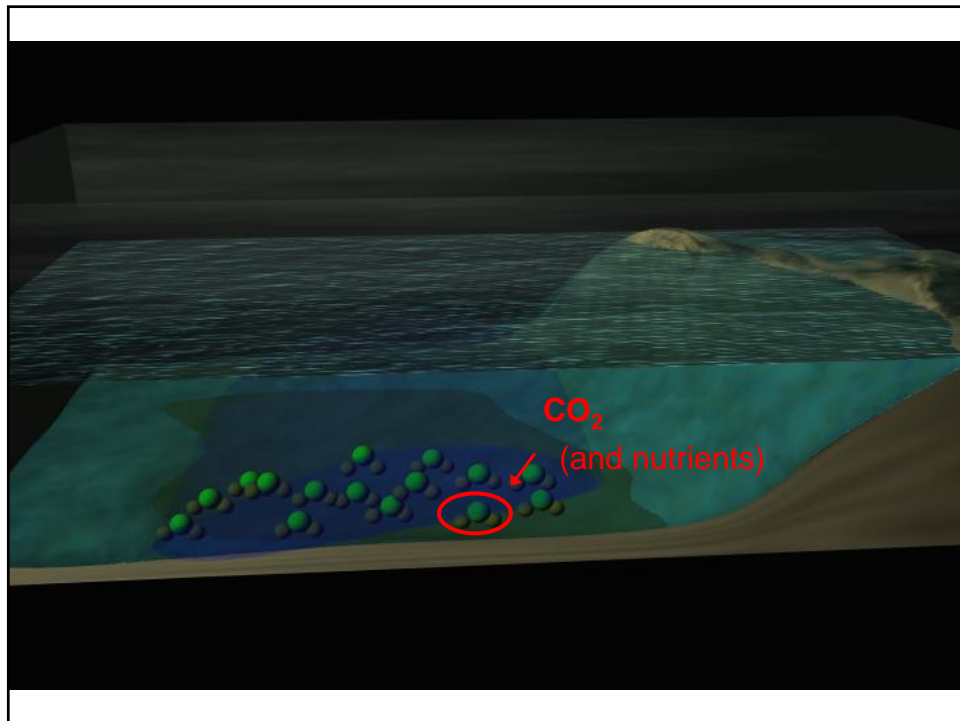


Image is taken from NASA's Web site: <http://www.nasa.gov>.

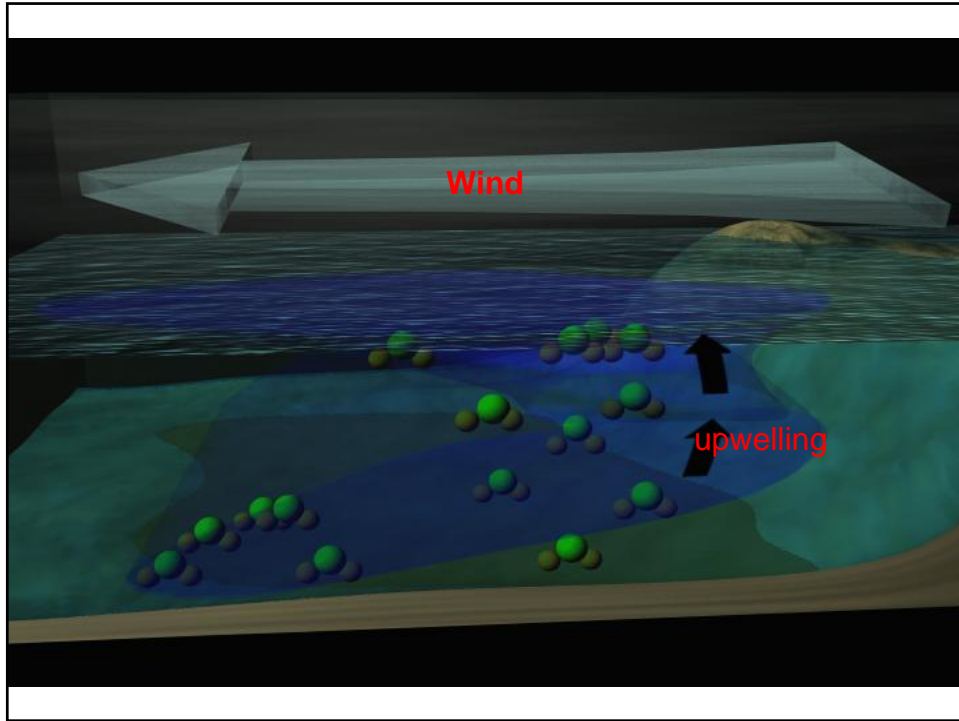


Image is taken from NASA's Web site: <http://www.nasa.gov>.

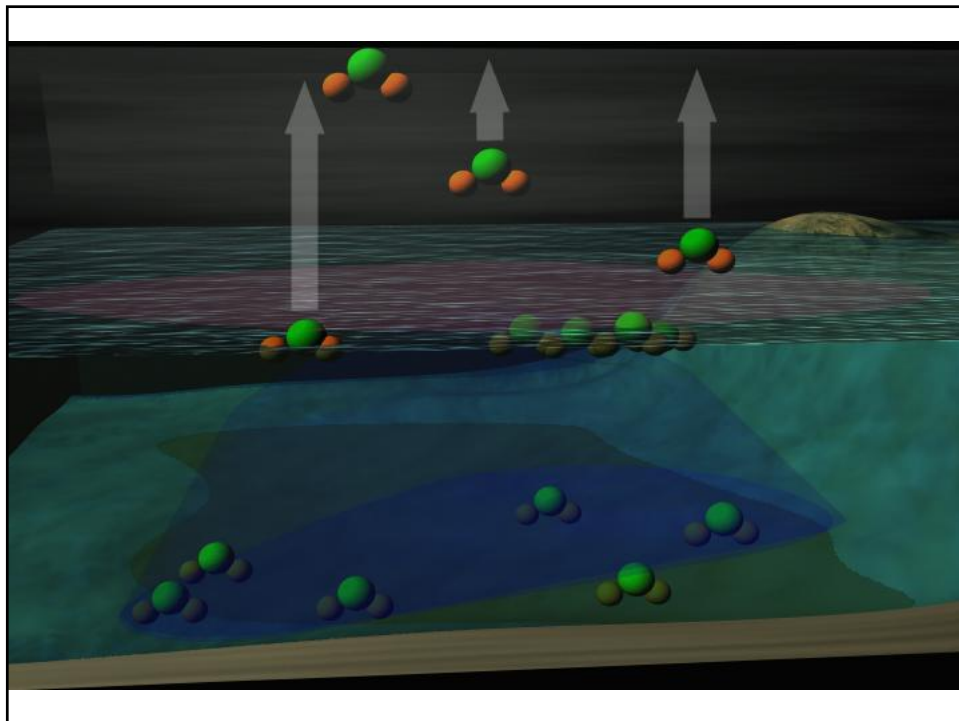


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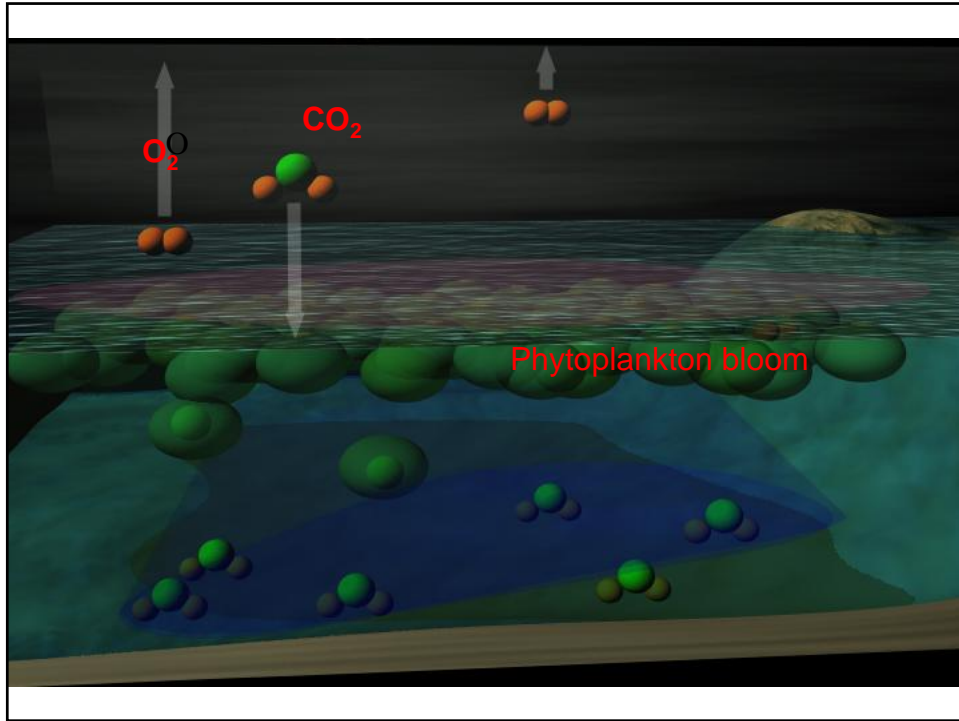


Image is taken from NASA's Web site: <http://www.nasa.gov>.

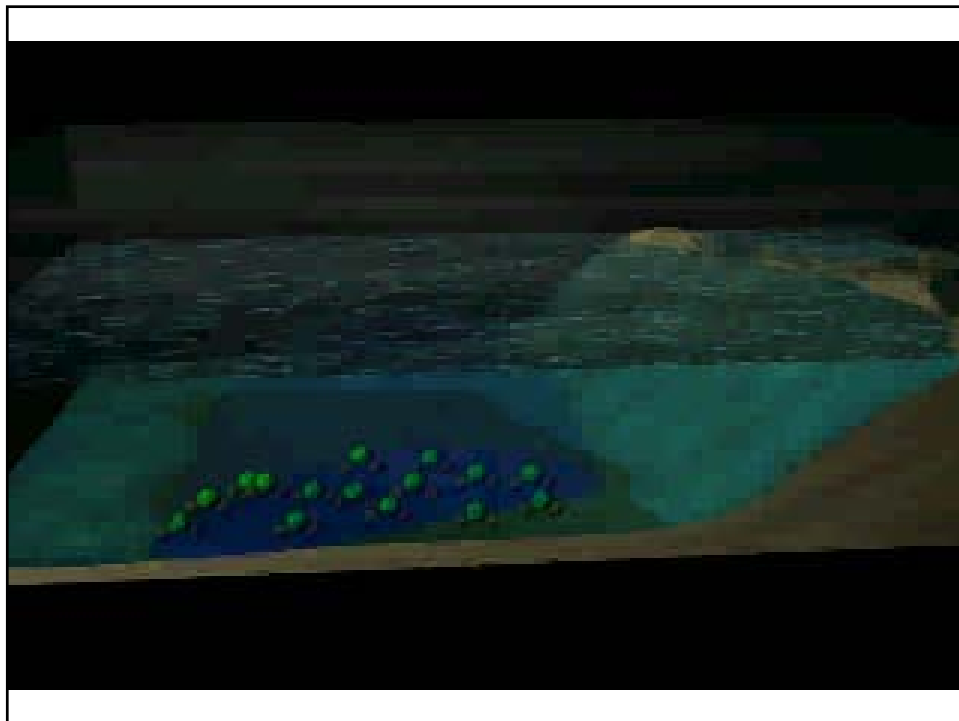


Image is taken from NASA's Web site: <http://www.nasa.gov>.

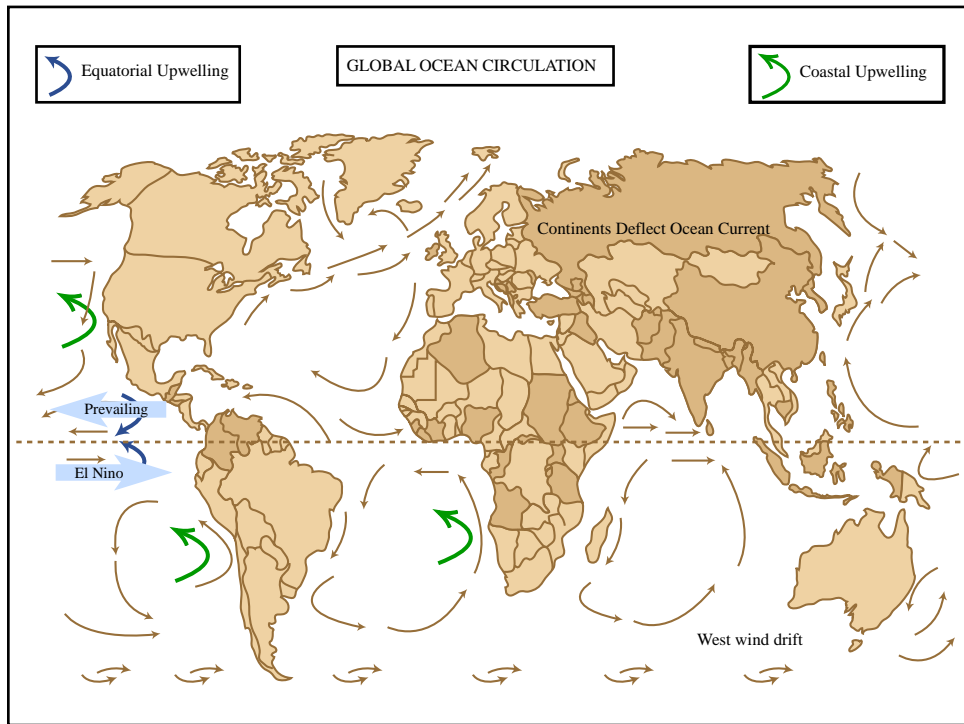


Figure by MIT OCW.

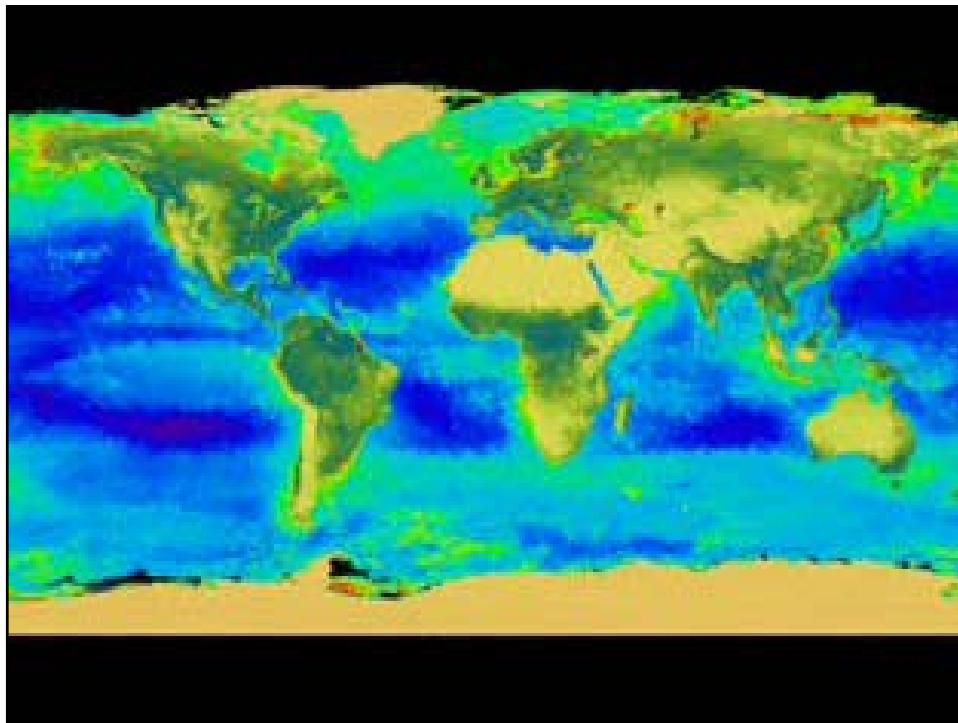


Image is taken from NASA's Web site: <http://www.nasa.gov>.

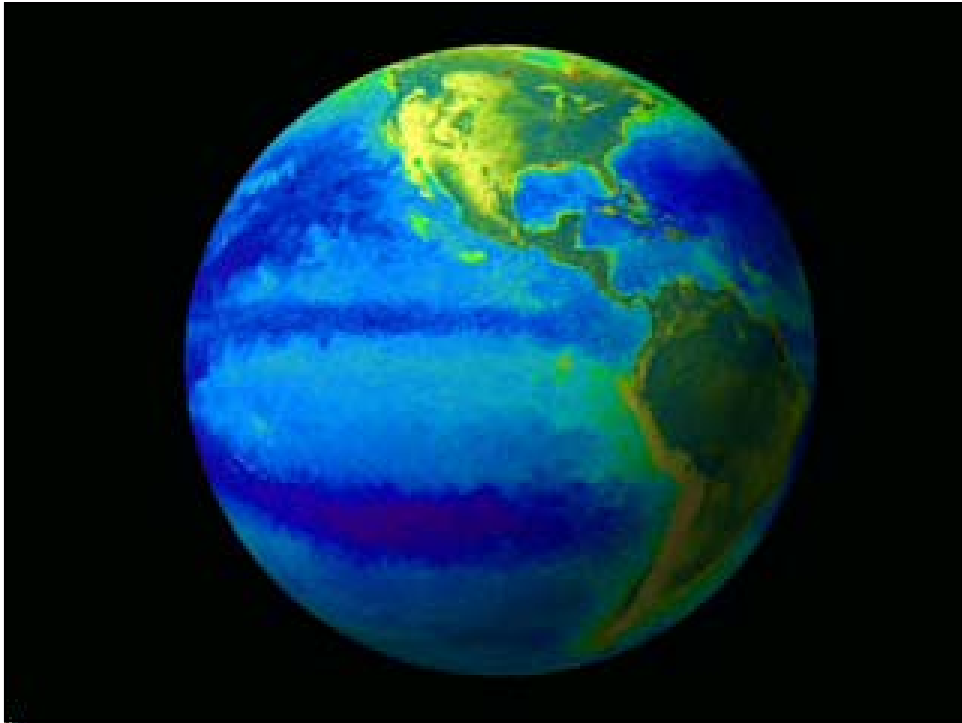
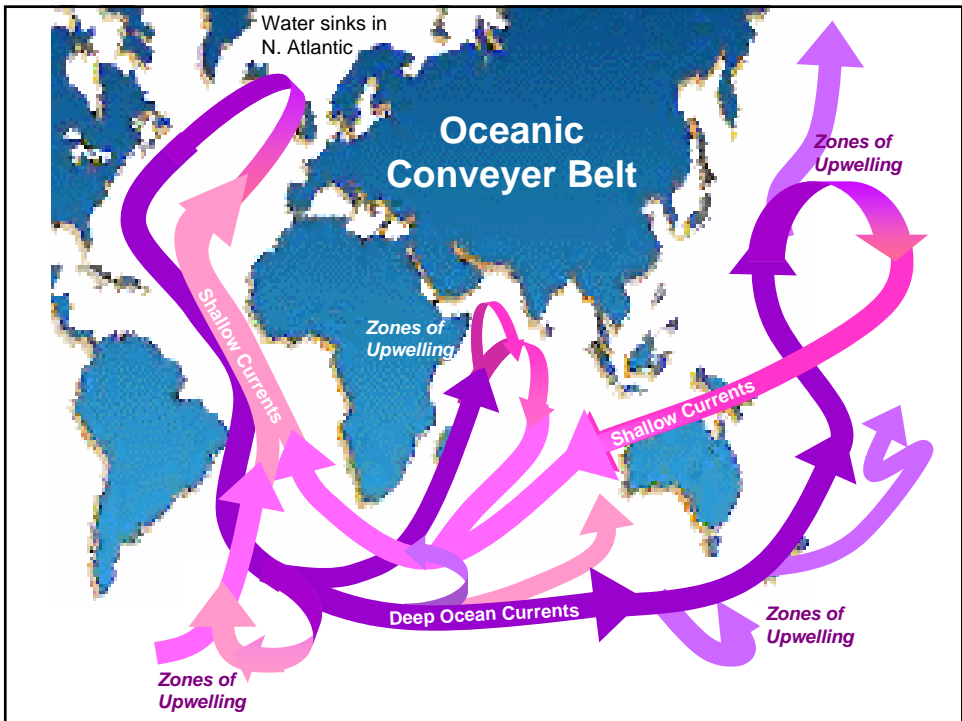


Image is taken from NASA's Web site: <http://www.nasa.gov>.



The Experimental Lakes Area - Ontario



Photo courtesy of Karen Scott, Fisheries and Oceans Canada / Canada Pêches et Océans Canada.

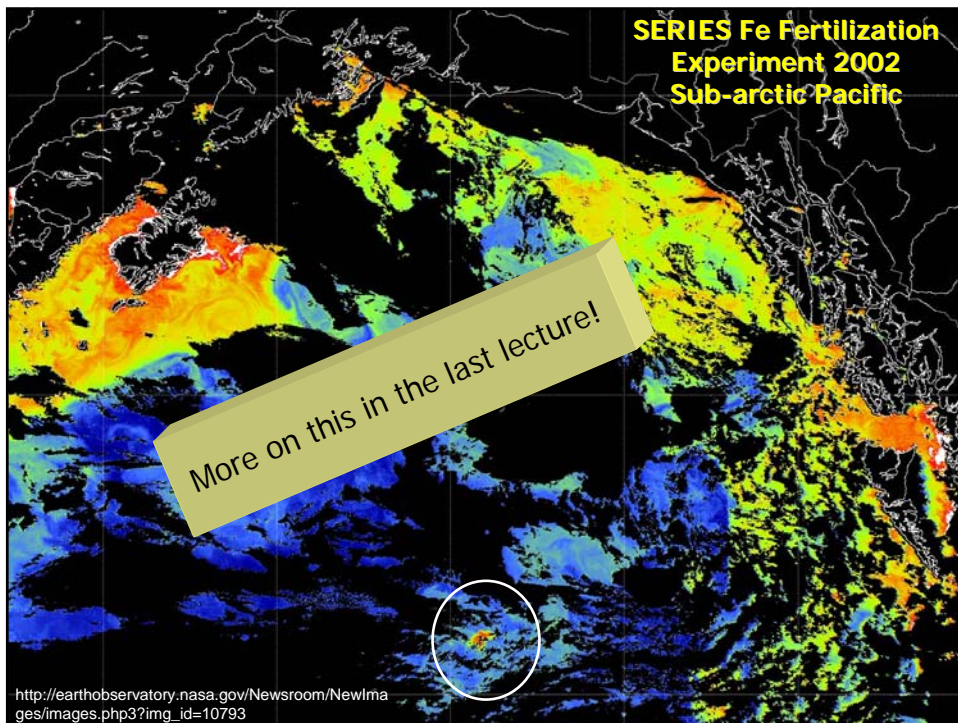


Image is taken from NASA's Web site: <http://www.nasa.gov>.

Take Home Messages

- ❑ Land – water, sunlight, nutrients
- ❑ Ocean – sunlight and nutrients
- ❑ Biosynthesis and nutrient regeneration along gradients
- ❑ Upwelling in oceans critical
- ❑ Limiting factors/Law of the minimum – Redfield Ratio