What is the best way to observe the ocean?

What are the independent variables of the ocean state?

How was the ocean observed so far…

What processes to observe

What technologies are available

Who is driving who?

How does our understanding of the ocean change our future observation strategies?

Oceanography is an observationally driven field!

What are the independent variables for the ocean?

What do they measure and what is there use?

Geological: coastlines, bathymetry, (recently movement of plates)

Physics: T, U, V, S, SSH

Biology: Chl-a, Productivity, Zooplankton, Phytoplankton, Fish and Egg counts, too many!

Chemistry: Carbon, Nitrogen, Iron, Oxygen…

How was the ocean observed so far?

Lots of historical account of early explorations – (see book).

HMS *Challenger*

Good link!

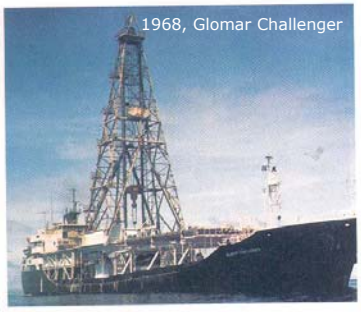
http://duedall.fit.edu/ocn1010eng/week1-1pptslide/ocnhistory1%5B1%5D_files/frame.htm

Curiosity:
Guns, Germ and Steel by Diamond

http://www.amazon.com/gp/reader/0393317552/ref=sib_dp_pt/103-3317661-1512644#reader-page

International Observational Programs

Deep Sea Drilling Project - DSDP



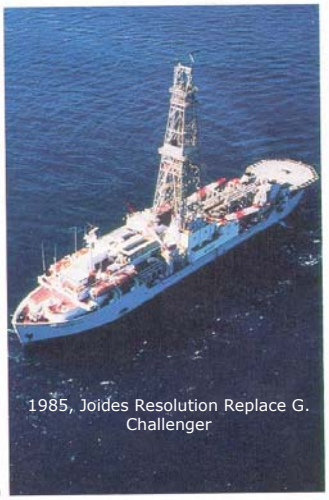


Figure 1-18 Deep-Sea Drilling Ships

(a) The *Glomar Challenger* could produce 8800 continuous or 10,000 intermittent hp for propulsion and for operating drilling equipment. To remain over the drill site, the ship used dynamic positioning that could move the vessel in any direction. *(Photo courtesy of Victor S. Soleto, Deep Sea Drilling Project)*
(b) *JOIDES Resolution*, replaced the *Glomar Challenger* as the new drilling ship for the Ocean Drilling Program. *(Photo courtesy of the Ocean Drilling Program)*

Theory of Plate Tectonics and much more…

International Observational Programs

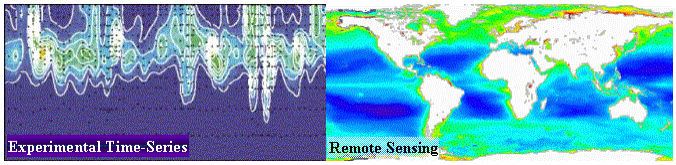
JGOFS

The Joint Global Ocean Flux Study (JGOFS)
was launched in 1987 at a planning meeting in Paris

The Operational Goal of JGOFS :

Spatial Scale: regional to global
Temporal Scale: seasonal to interannual

1) Fluxes of carbon between the atmosphere-surface ocean-ocean interior.
2) Sensitivity to climate changes



International Observational Programs

The World Ocean Circulation Experiment
1990-1998

http://woce.nodc.noaa.gov/wdiu/

International Programme on Climate Variability and Predictability, 1995-present

http://www.clivar.org/index.htm

http://www.clivar.org/publications/other_pubs/clivar_transp/index.htm

World Climate Research Programme

WCRP http://www.wmo.ch/web/wcrp/wcrp-home.html

US Programs sponsors
Incredible amount of resources!

National Science Foundation
WHERE DISCOVERIES BEGIN
http://www.nsf.gov/

e.g. GLOBEC http://www.pml.ac.uk/globec/

National Oceanic & Atmospheric Administration
U.S. Department of Commerce
http://www.noaa.gov/

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
EXPLORE. DISCOVER. UNDERSTAND.
http://science.hq.nasa.gov/oceans/

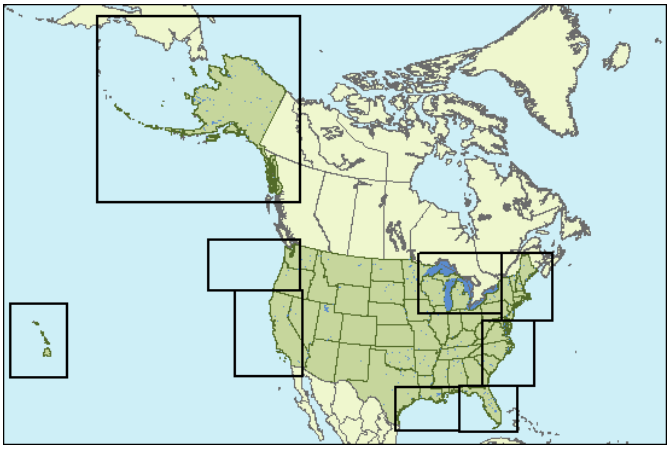
Office of Naval Research
http://www.onr.navy.mil/focus/ocean/habitats/default.htm

U.S. Coastal Observing Systems

NOAA Coastal Services Center
LINKING PEOPLE, INFORMATION, AND TECHNOLOGY

National Science Foundation
WHERE DISCOVERIES BEGIN

http://www.csc.noaa.gov/coos/



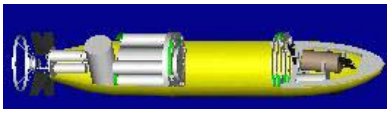
Technologies for ocean observing

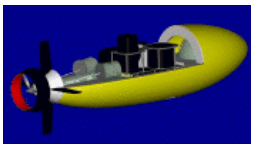
Remote Sensing/Satellite Imagery:
Geostationary Server -http://www.goes.noaa.gov/
Satellite significant events: http://www.osei.noaa.gov/
National Geophysical Data Center: http://www.ngdc.noaa.gov/ngdc.html

Floating devices in the ocean:
Argo FLoats - http://www.argo.ucsd.edu/
Drifter Programs: http://www.aoml.noaa.gov/phod/graphics/pacifictraj.gif

Remotely Operated Vehicles (ROVs) :
Amazing discoveries…
http://oceanexplorer.noaa.gov/technology/subs/rov/rov.html

Automated Underwater Vehicles (AUVs) :





SO MUCH DATA!!!

How to synthetize it?

HomeWork:

1) Choose one of the international or national programs.

(a) Identify two more specific objectives, (b) identify the types of observations required, (c) identify the technology involved, (d) list some of the major advances made towards the objective (selected), (e) list the interdsicplinary implications and aspects of the findings, (f) List at least 2 relevant publications.

2) Describe two amazing discoveries obtained with ROVs or AUVs. Describe the unique role of the ROVs, Describe the impact of the finding.

3) Isolate a phenomena of interest to you, either in the ocean or atmoshpere. (a) Design a feasible observational strategy you think would be useful to study such phenomena. Indicate what type of observational instrumentation you need, what spatial and temporal scales you are looking at. (b) Try to find out or Guess how much it would cost!