上海交通大學
SHANGHAI JIAO TONG UNIVERSITY

Marine Environmental Data Analysis

Hailong Liu

April 12 2022

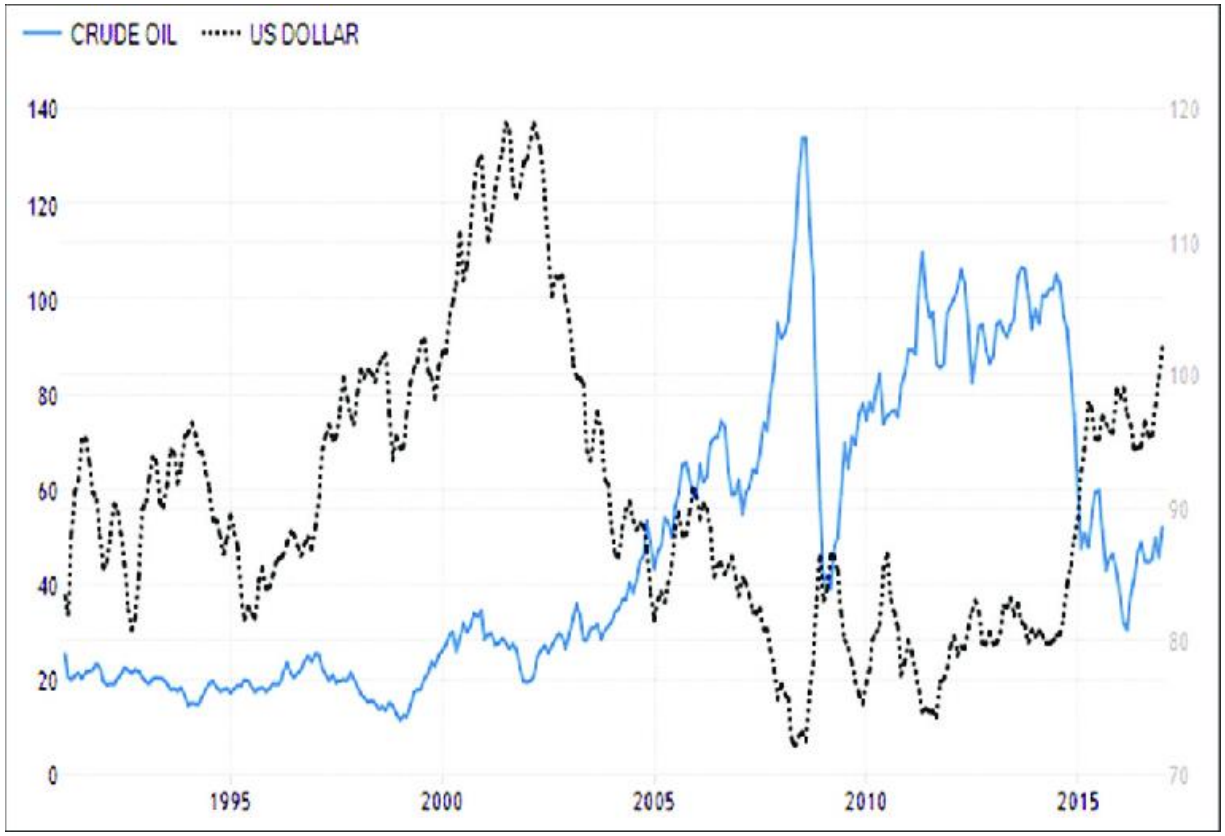
Now you may have two questions already?

1. Why English?

2. What is Marine Environmetnal Data Analysis?

For example: $$\overline{x} = \frac{1}{n}\sum_{i=1}^{n} x_i$$

Correlation $$r = \frac{\sum_{i=1}^{n}\left((x_i - \bar{x})(y_i - \bar{y})\right)}{\sqrt{\sum_{i=1}^{n}(x_i - \bar{x})^2 \sum_{i=1}^{n}(y_i - \bar{y})^2}}$$



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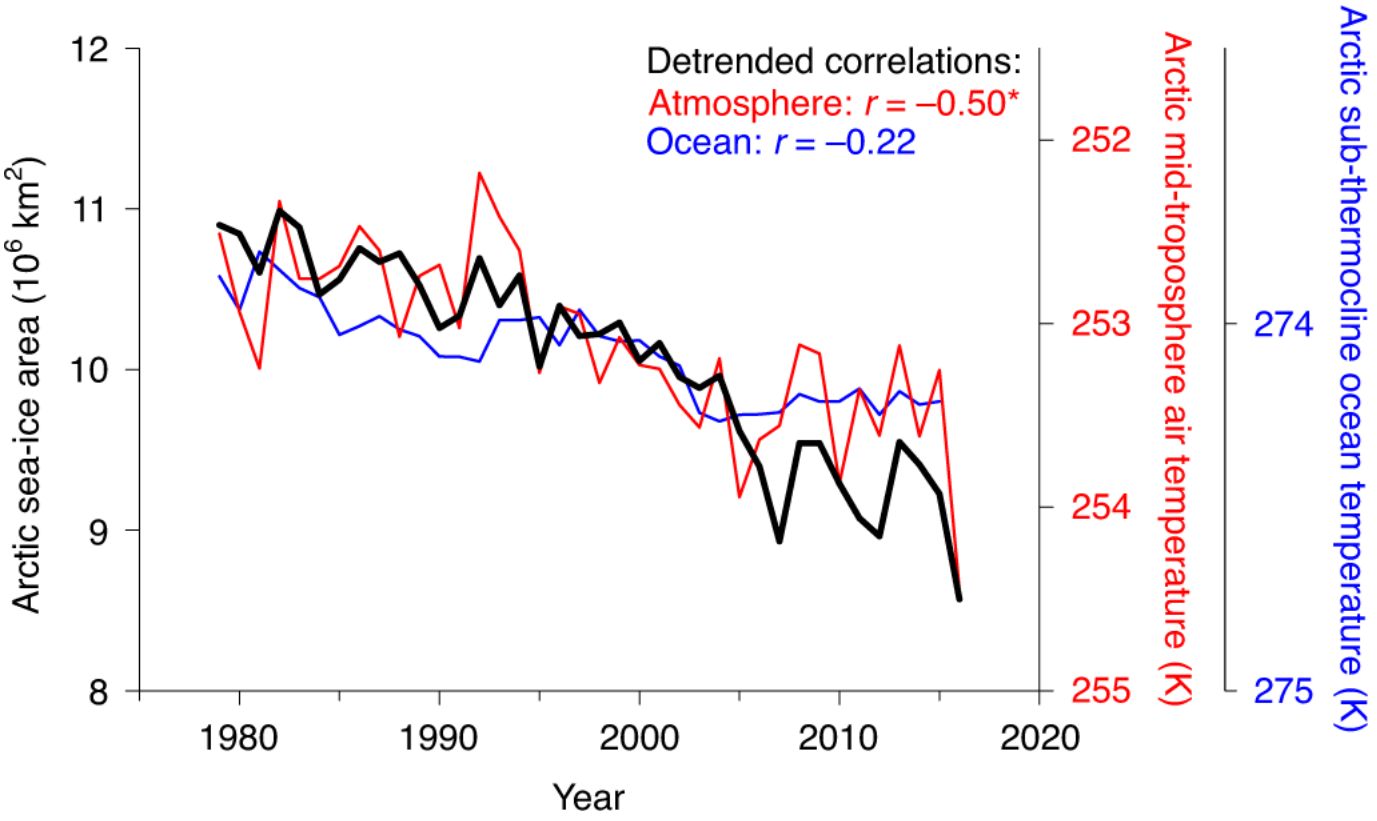

Olonscheck, D., Mauritsen, T. & Notz, D. Arctic sea-ice variability is primarily driven by atmospheric temperature fluctuations. *Nat. Geosci.* **12,** 430–434 (2019).

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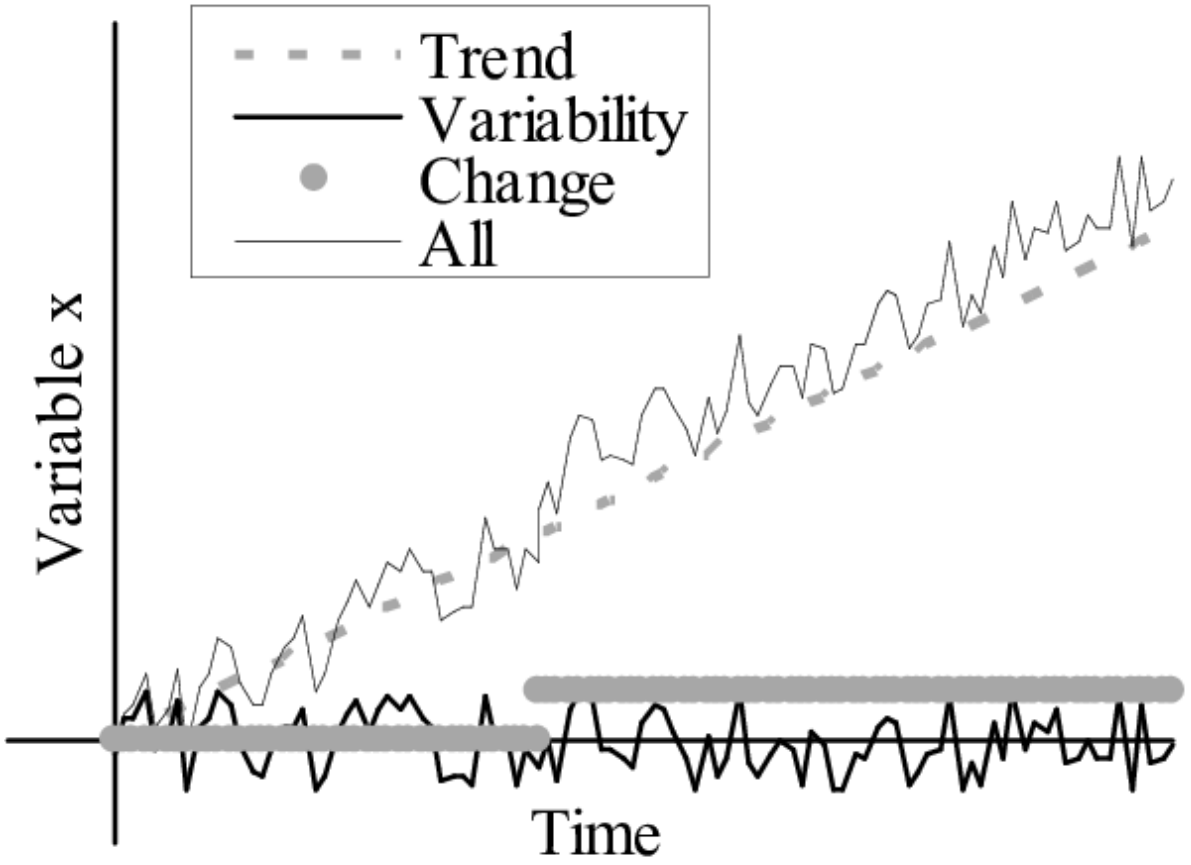

Bruijin et al.

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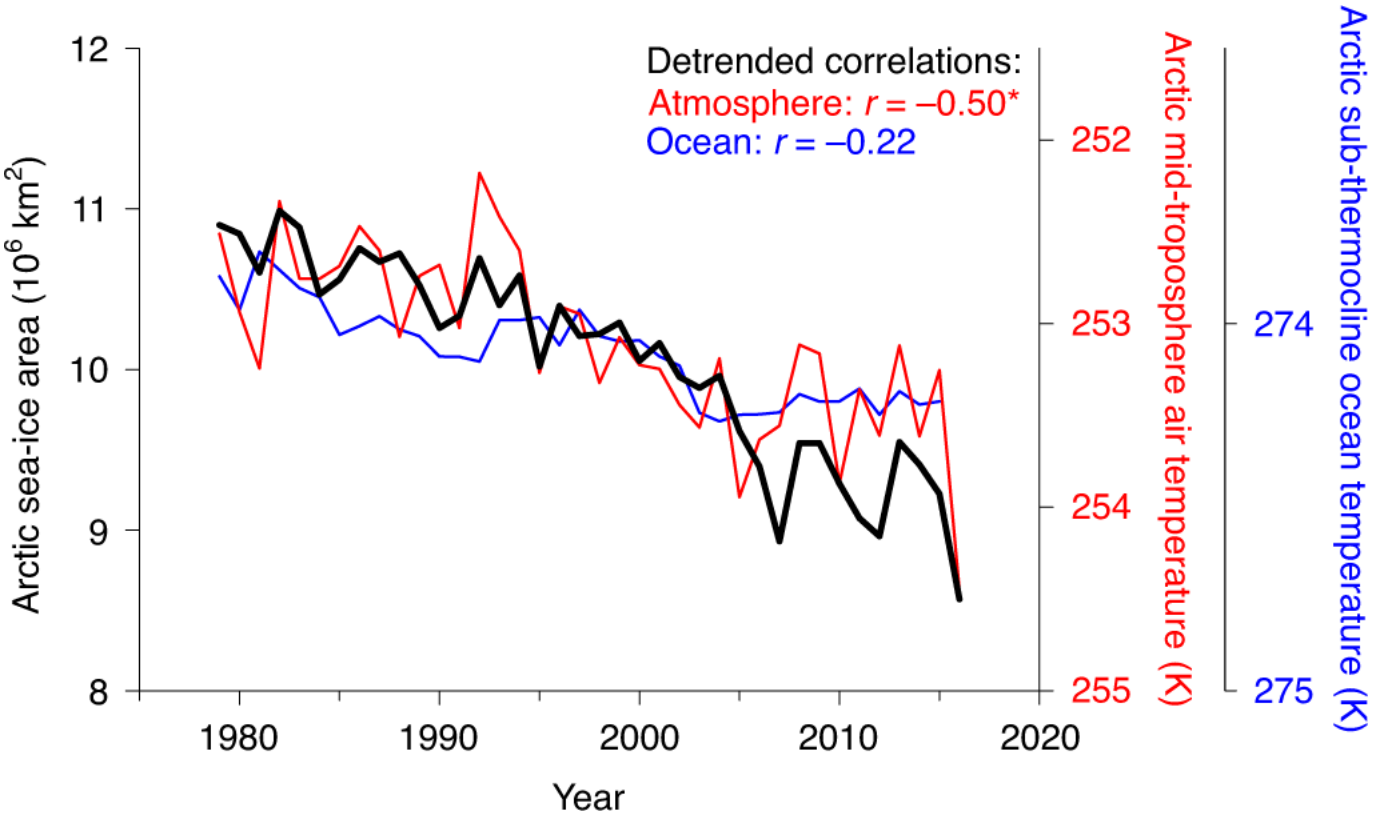

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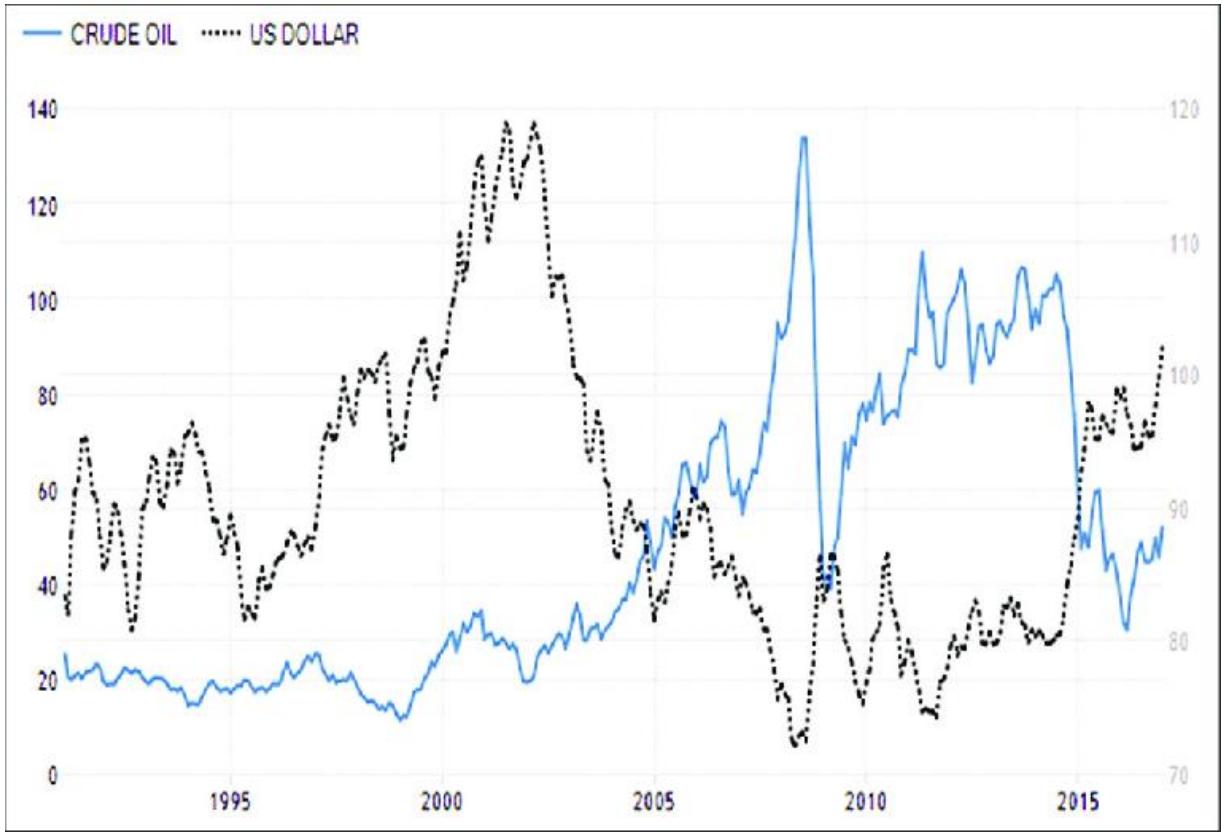

r=-0.23

Data analysis has a broad application in different fields

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Telephone: 15901724935 e-mail: hailong.liu@sjtu.edu.cn

Follow the textbook:

Data Analysis Methods in Physical Oceanography

Wunsch, C., 1996: The Ocean Circulation Inverse Problem. Cambridge University Press

Hans von Storch and Francis W. Zwiers., Statistical Analysis in Climate Research.

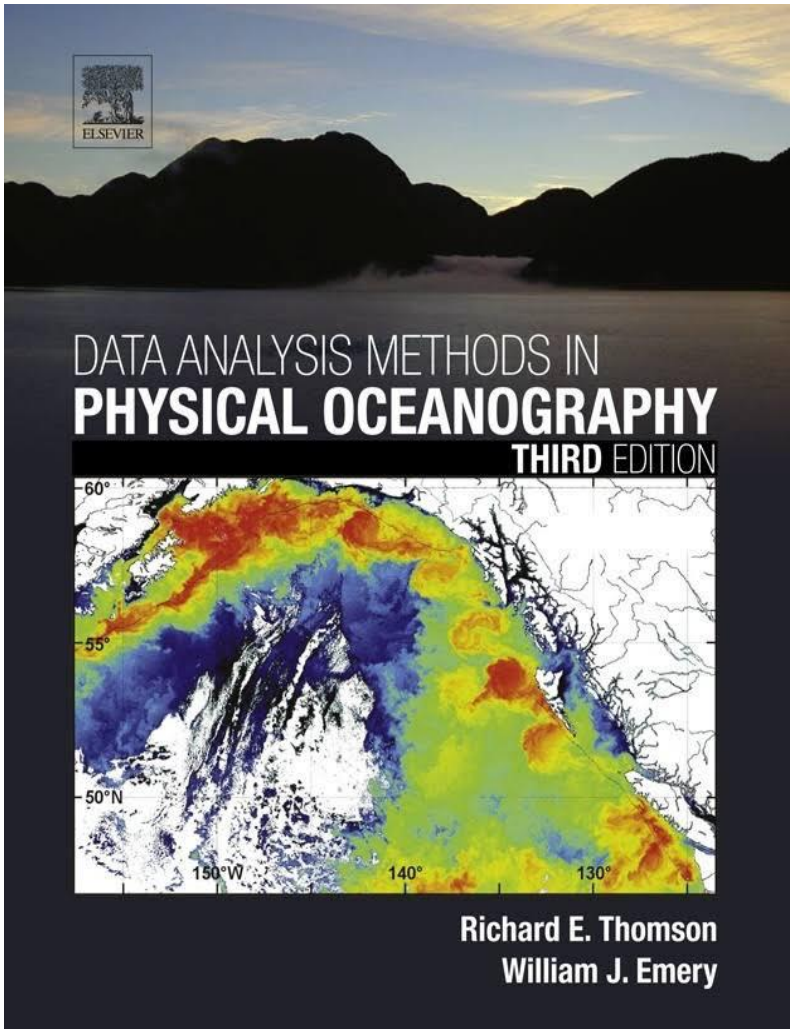
Grading:

20% attendance rate

30% homework

50% final exam (project)

Textbook 6 chapters



My expectation

1. Interactive (different students have different background)

2. Practical (linked with your research)

   Data

   Matlab

In the end this semester if all of you can play with data and benefit from this course , I feel acomplished.

Observation Platforms

- Ships
- Moorings
- Autonomous Platform
- Satellite

Ships

Chinese Icebreakers Xuelong1 and Xuelong2

Stations: Poking Holes in the Ocean

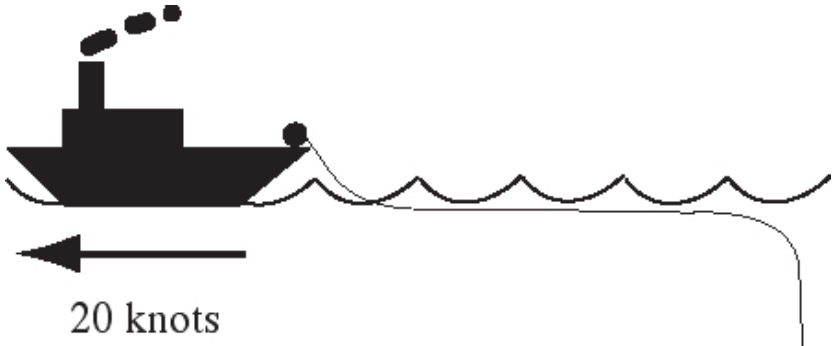
CTD Rosette

CTD

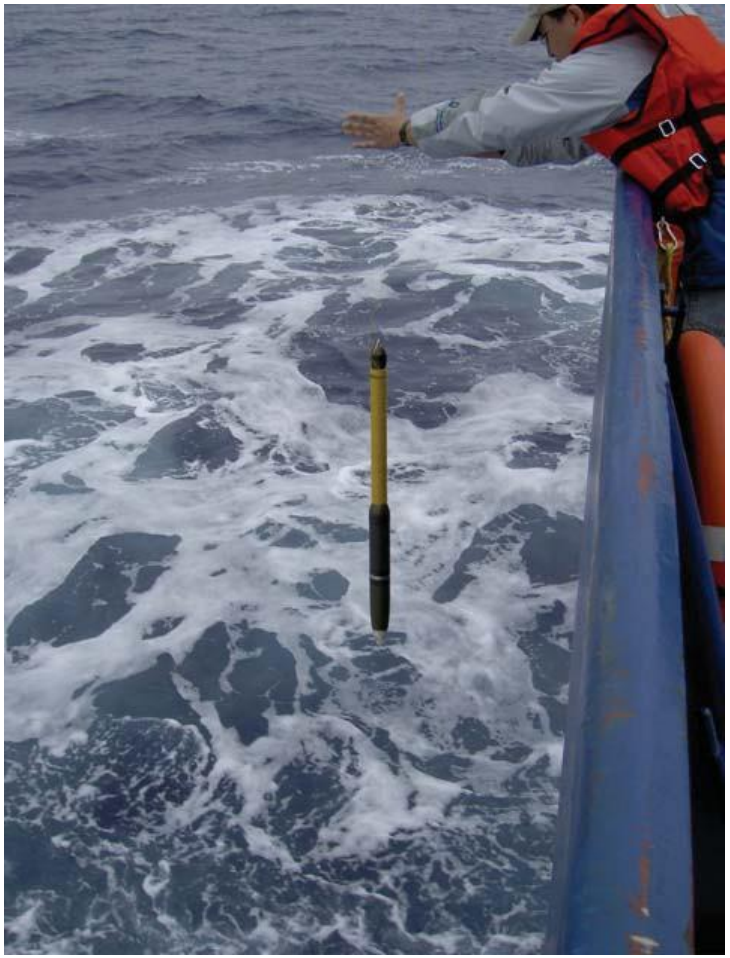
Samples

CTD: conductivity, temperature, and depth

Underway Profilers

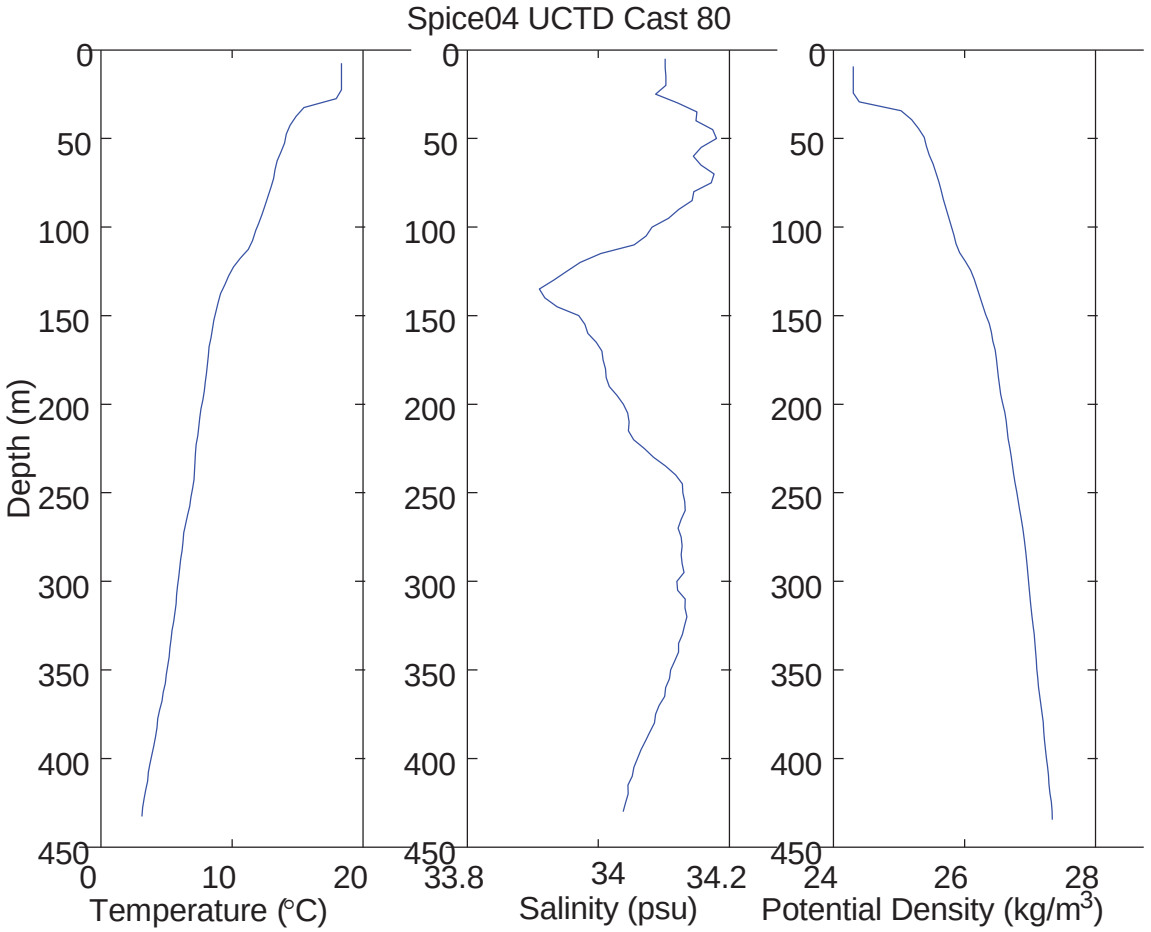


XBT

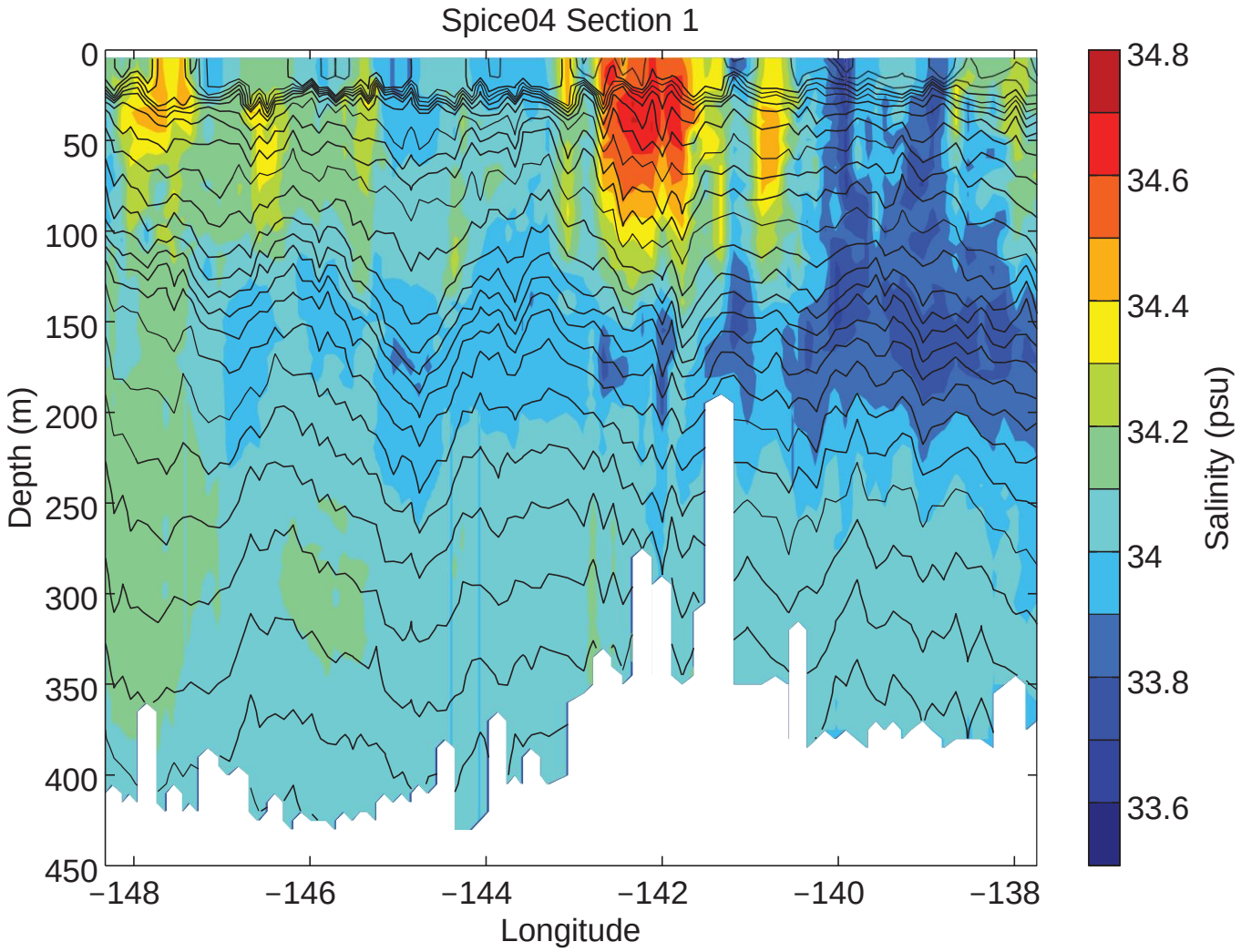


uCTD

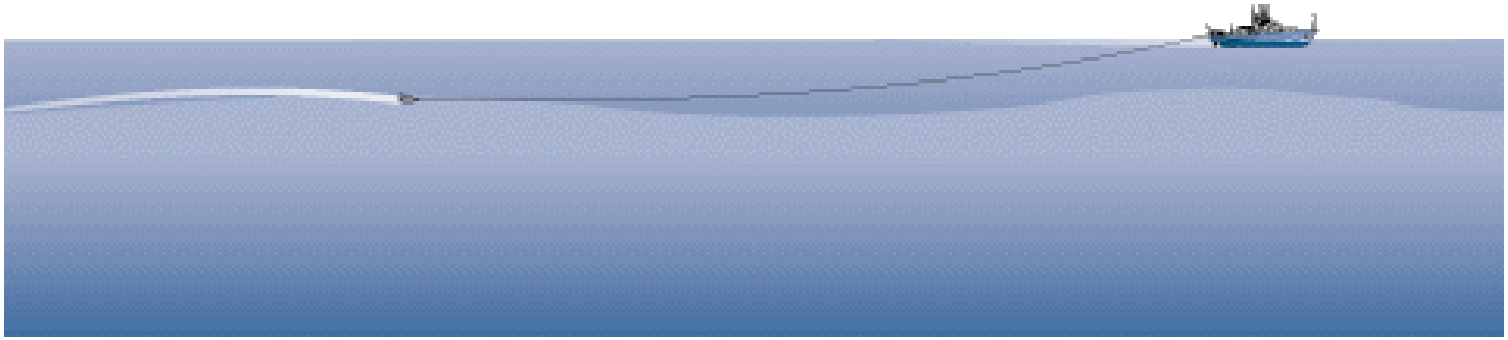
Vertical Profiles

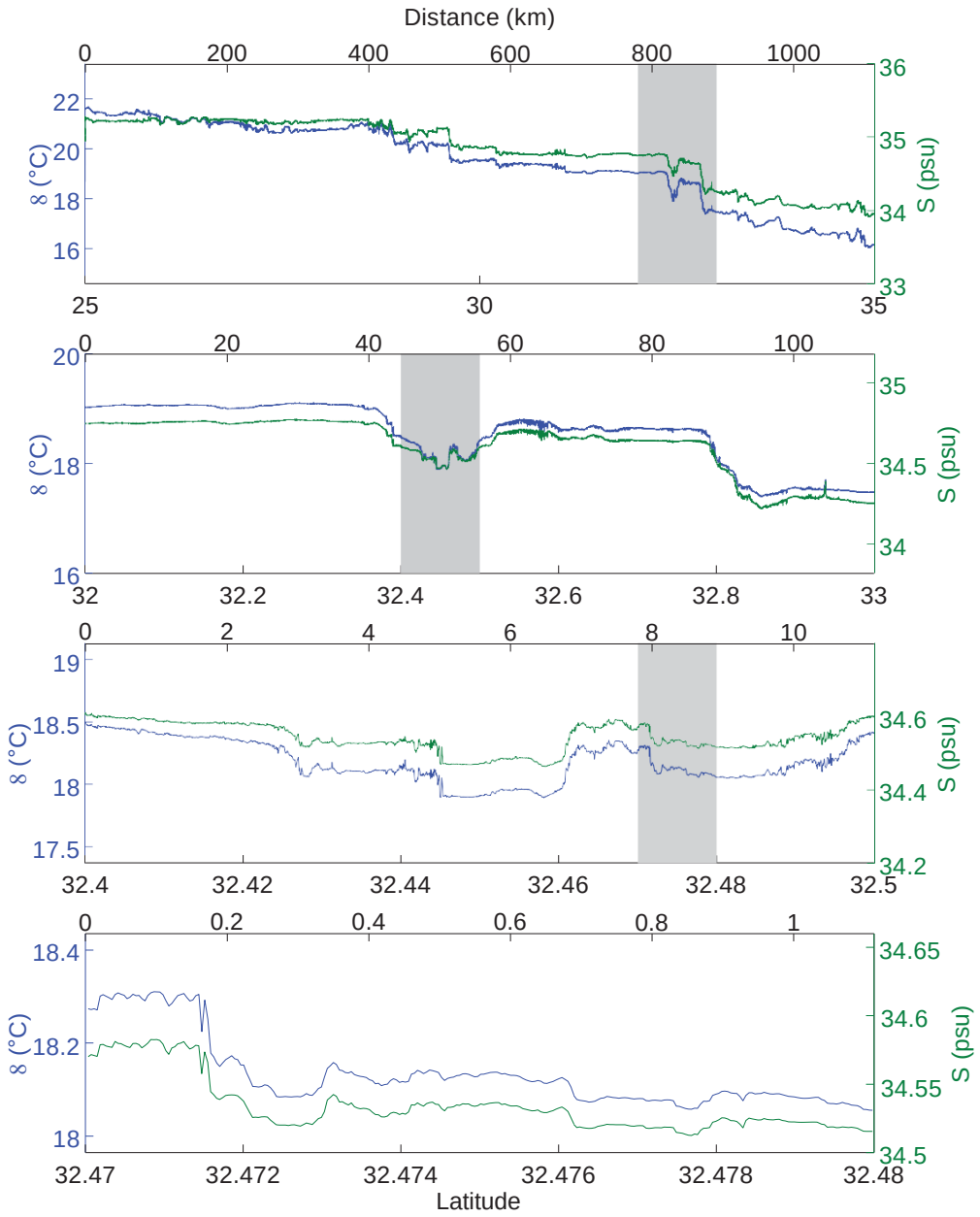


Sections (Spatial Pattern)



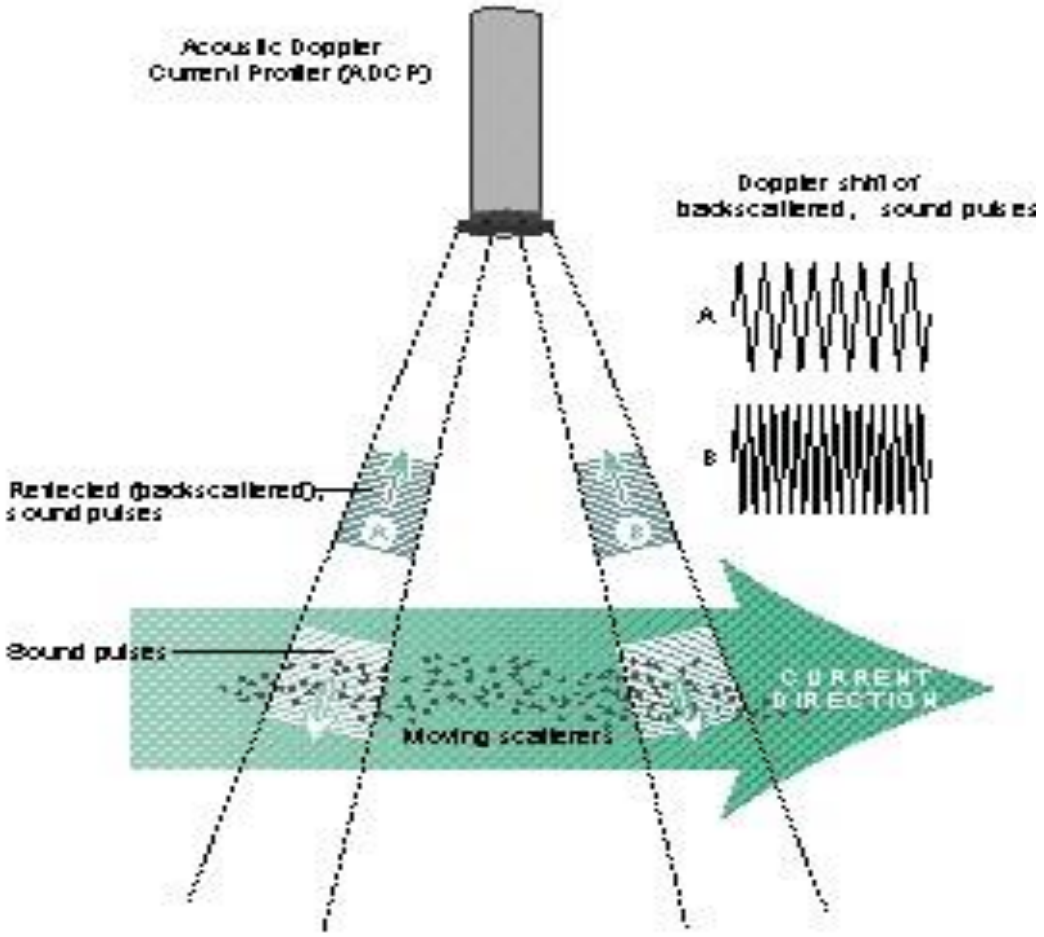
Towed Instrument: SeaSoar



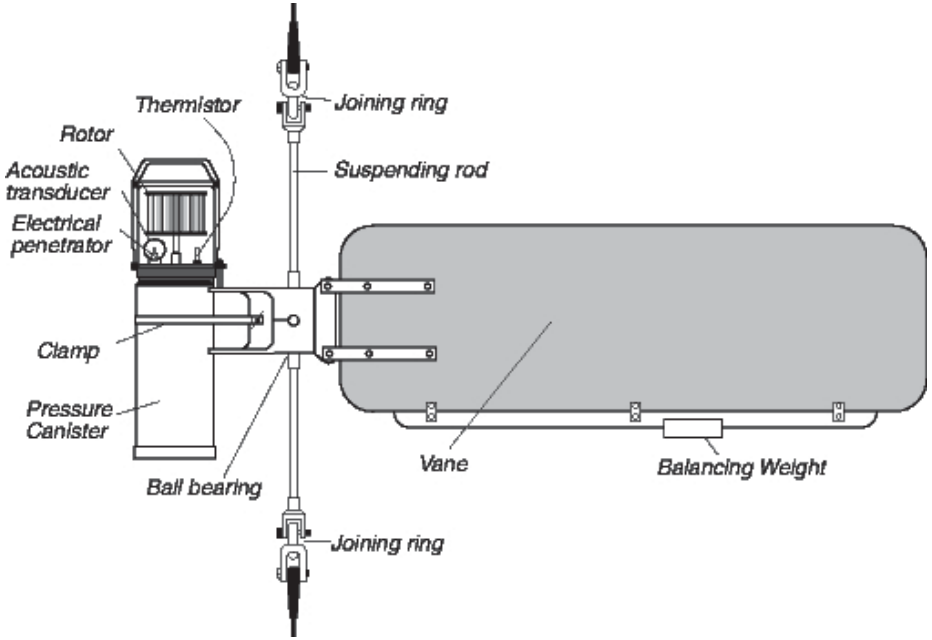


Horizontal Profiles

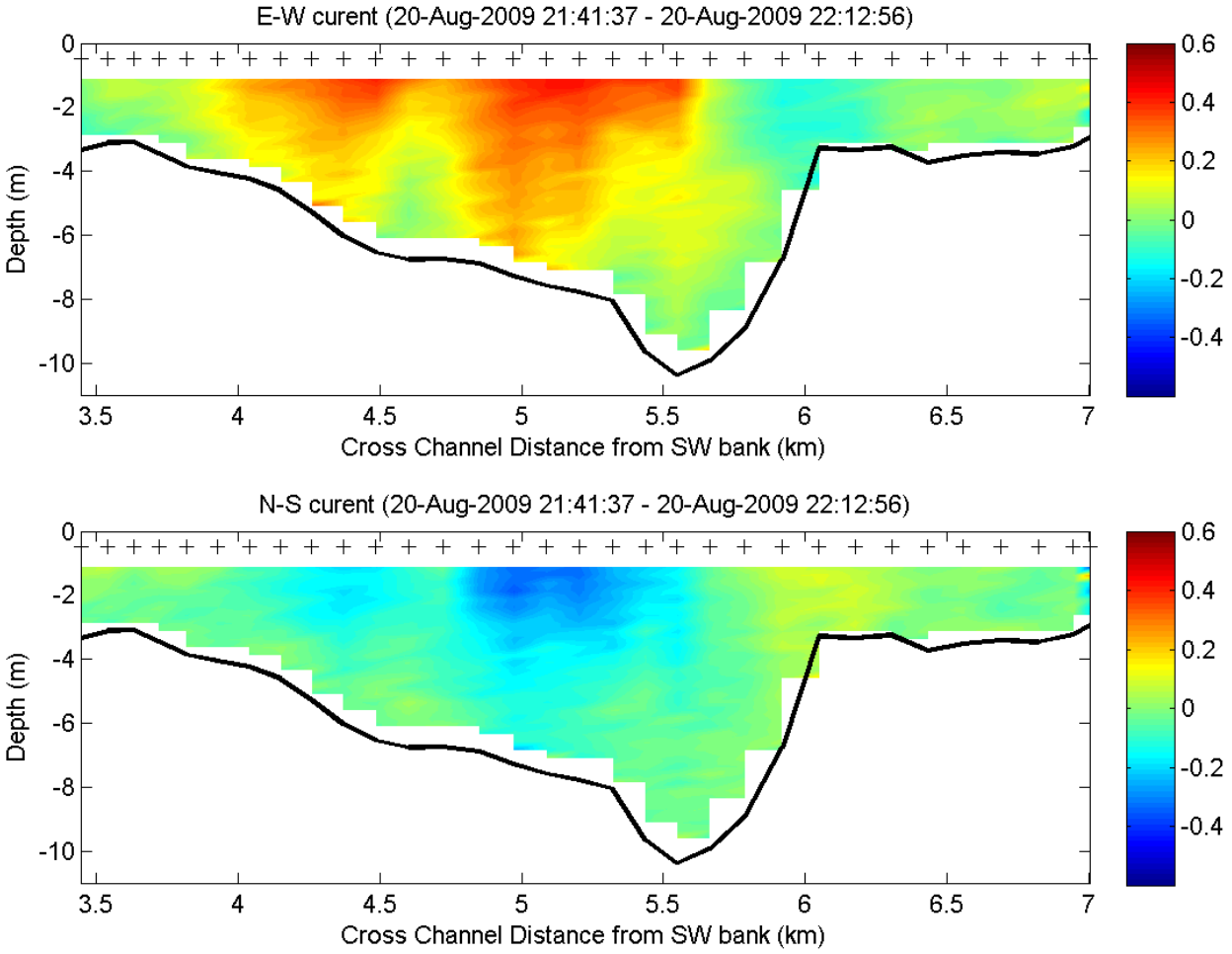
Acoustic Doppler Current Profiler (Station or Underway Observation)



Mechanical Current Meters



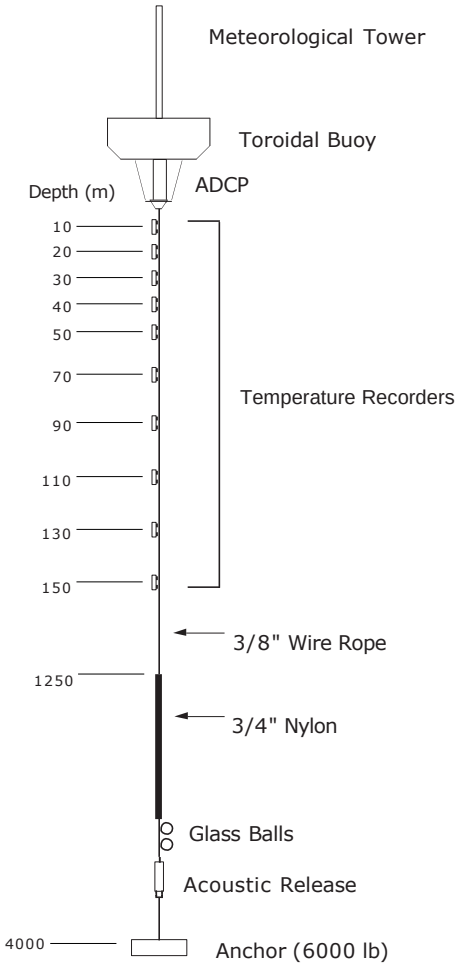
Velocity Profiles

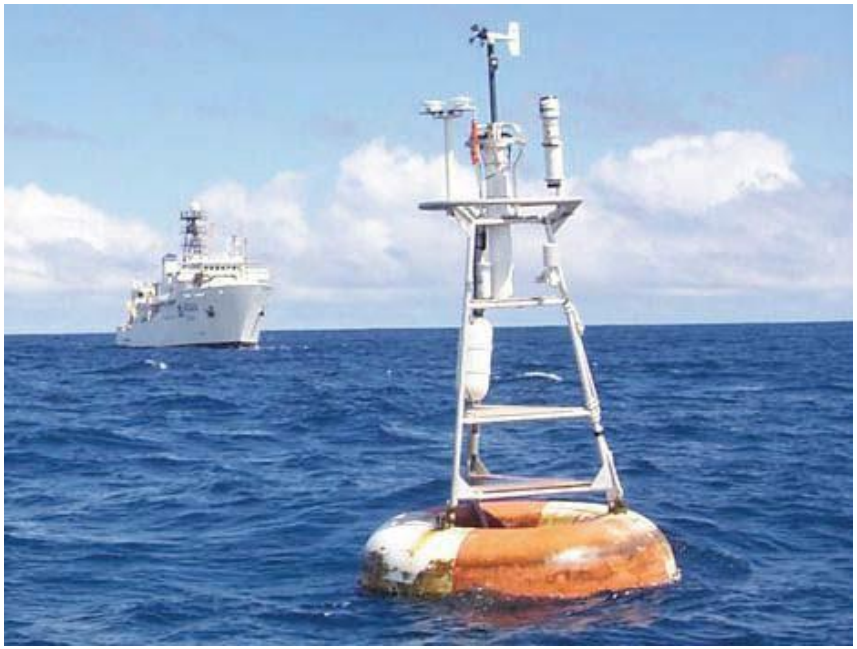


Platforms

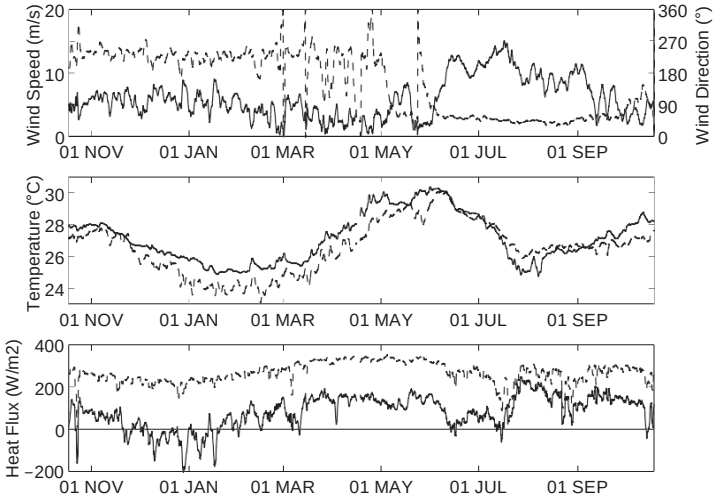
- Ships
- Moorings
- Autonomous Platform
- Satellite

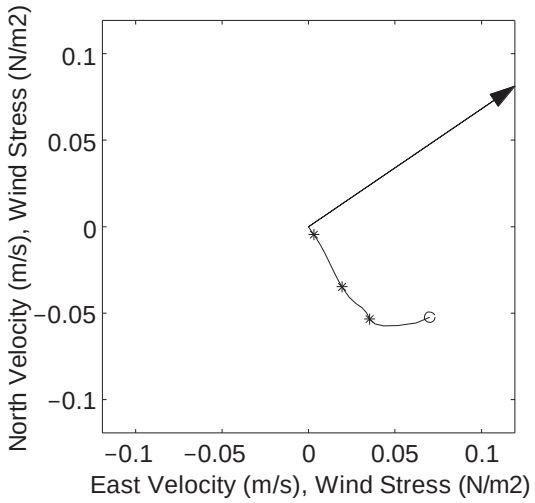
Moorings

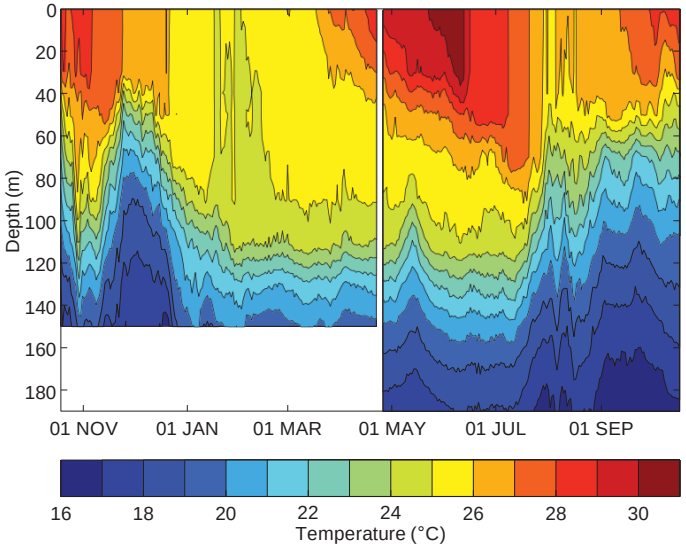

Meteorological Tower
Toroidal Buoy
Depth (m)
ADCP
10
20
30
40
50
70
90
110
130
150
Temperature Recorders
3/8" Wire Rope
1250
3/4" Nylon
Glass Balls
Acoustic Release
4000
Anchor (6000 lb)

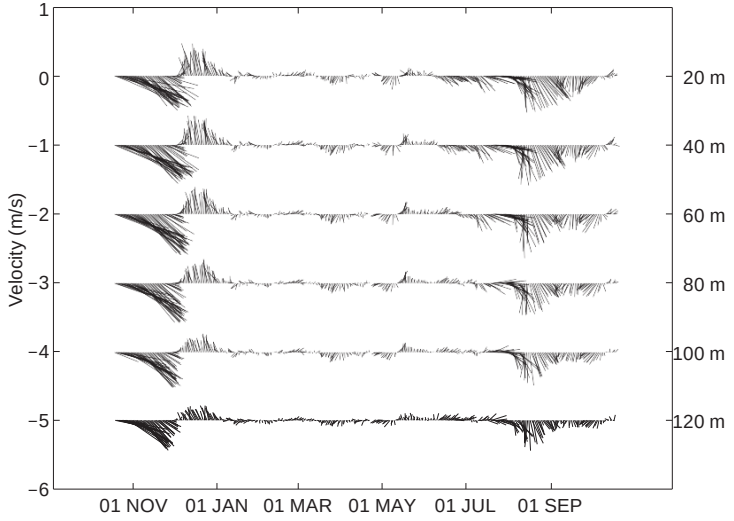


Mooring Data (Temporal Pattern)









Platforms

- Ships
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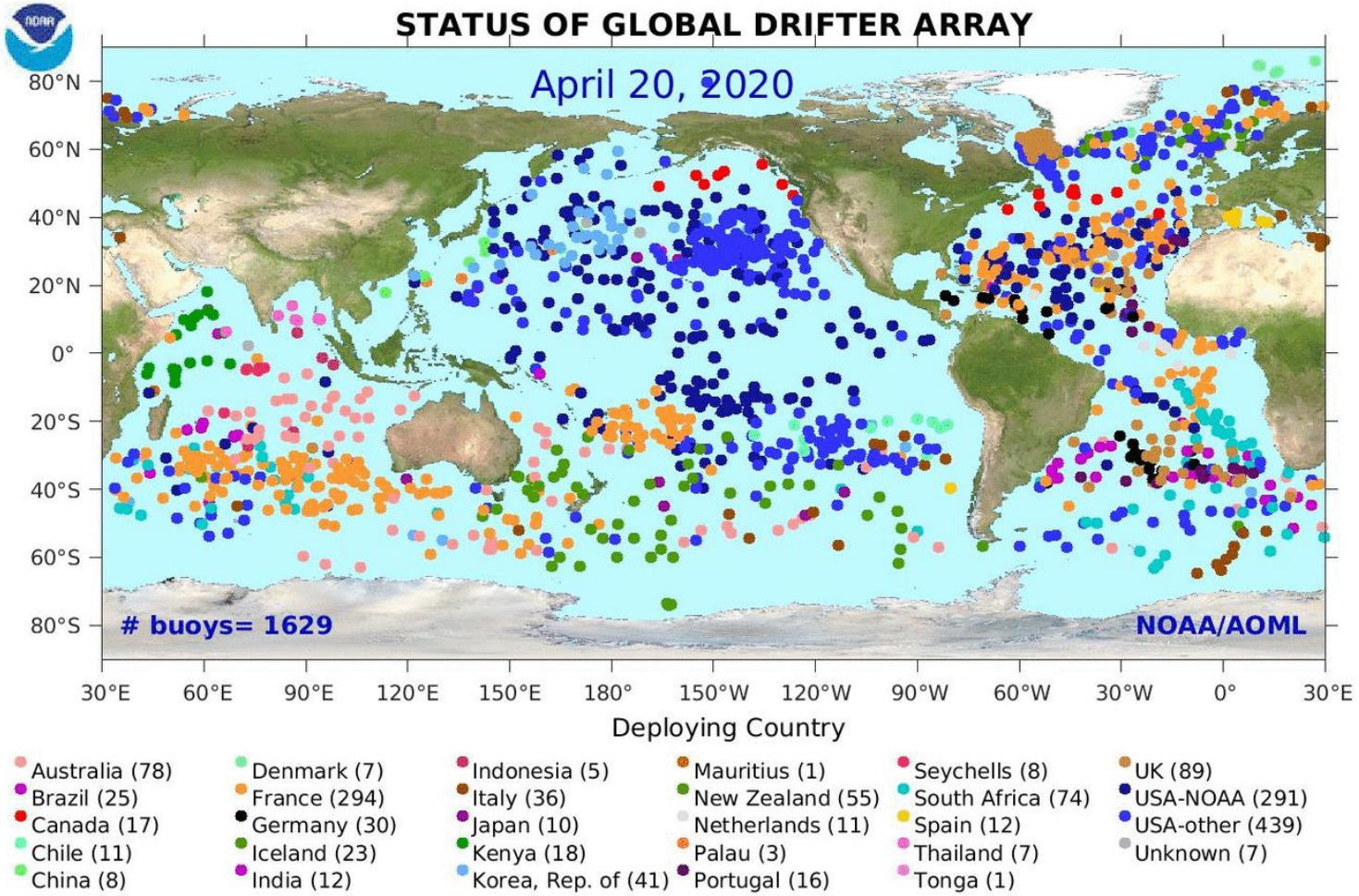
- Autonomous Platform
- Satellite

Autonomous Platform

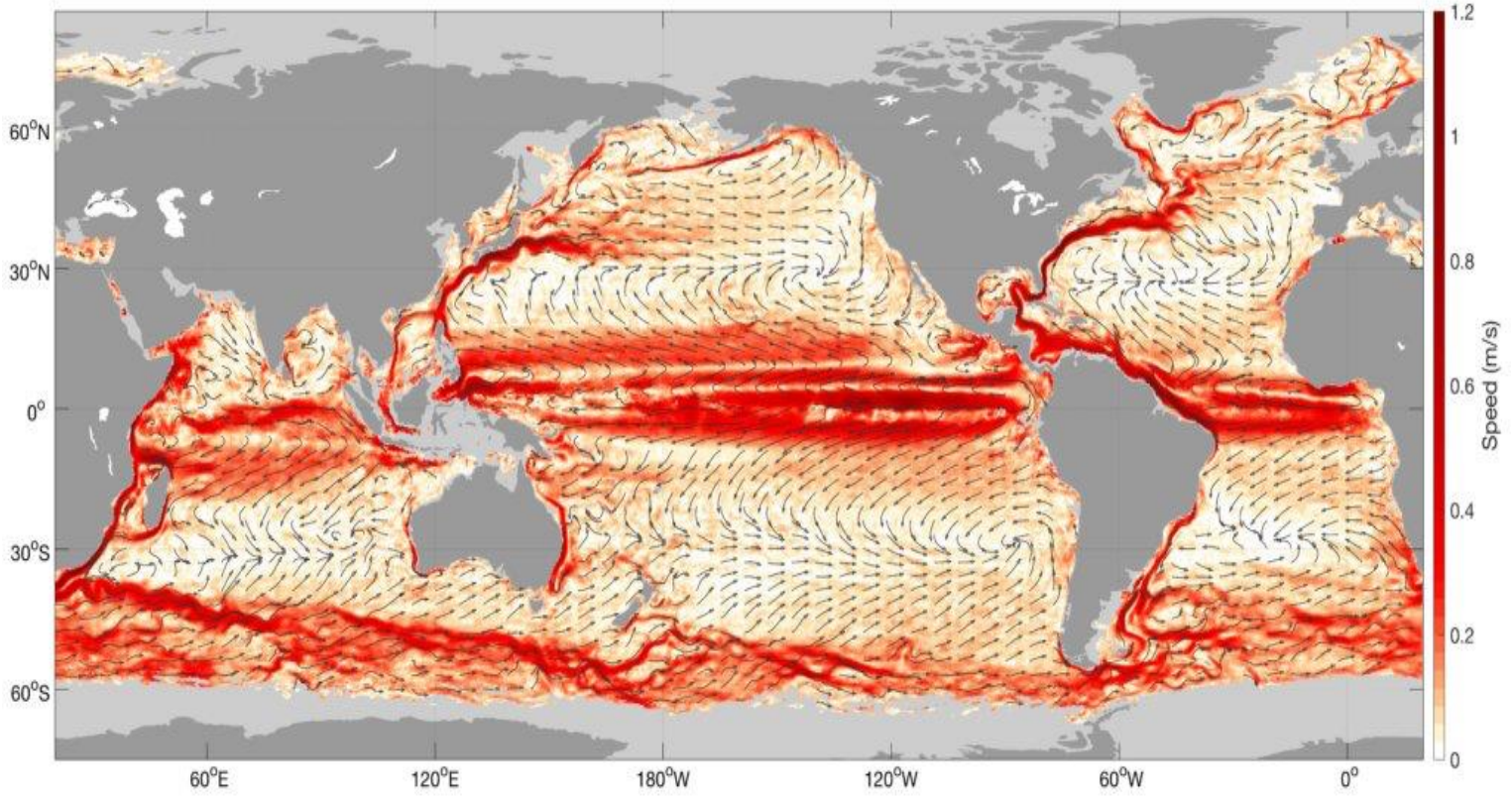
Table 1.
Platforms and their characteristics

Platform	Mode of operation	Typical deployment duration	Spatial scales	Sensor payload
Surface drifter	Floats on surface, sometimes drogued at depth	Weeks to years	Regional to global	Moderate, power-limited
Float	Neutrally buoyant, sometimes profiling	Weeks to years	Regional to global	Moderate, power-limited
Glider	Profiles, controls horizontal position by gliding	Weeks to months	Regional	Light, power and size-limited
Autonomous Underwater Vehicle	Powered with propeller	Hours to days	Small	Heavy

Surface Drifters

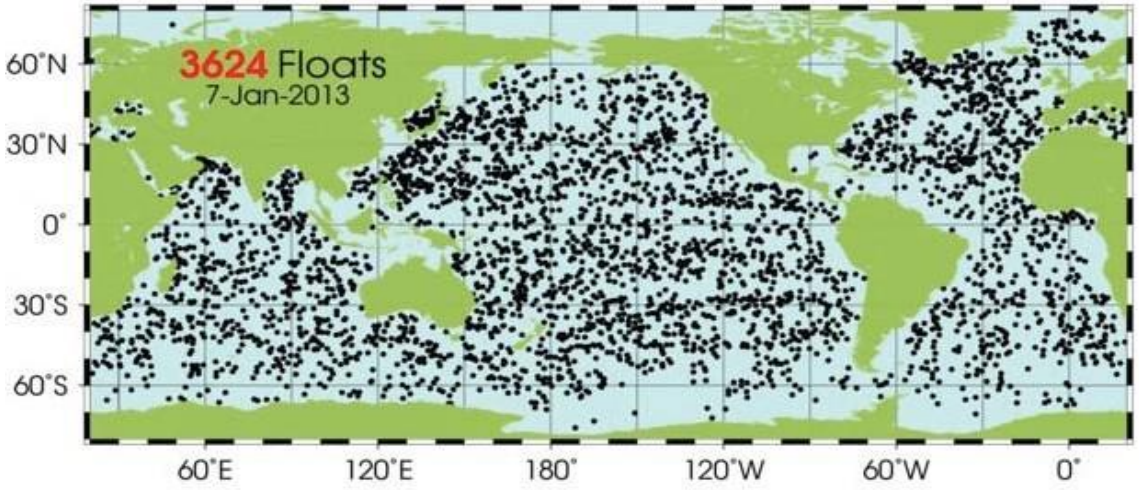


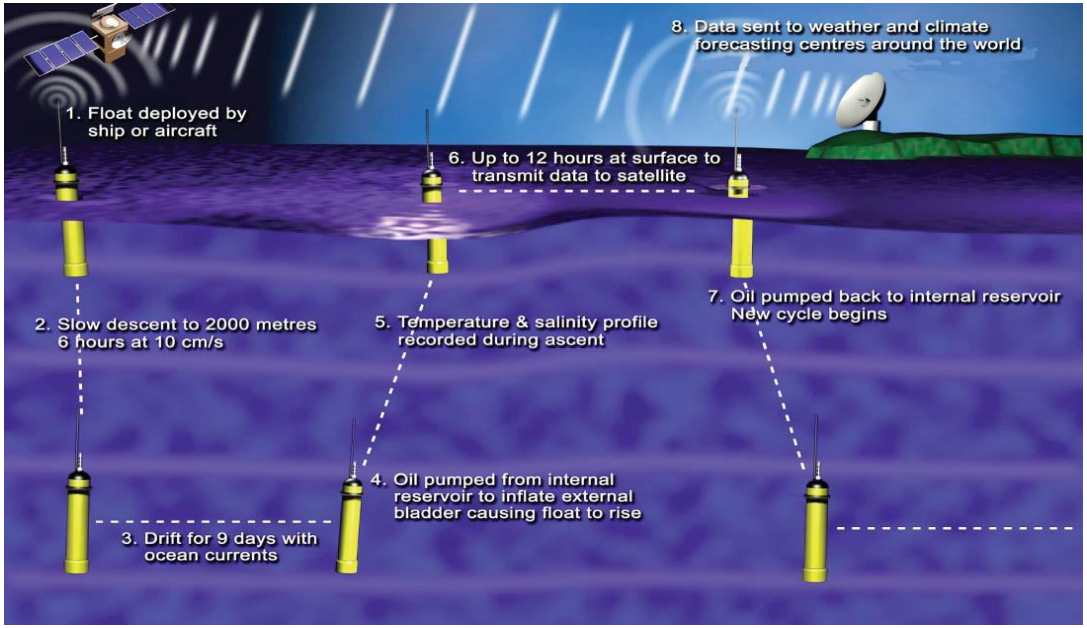
Ocean Currents at 15m Depth



By L Laurindo

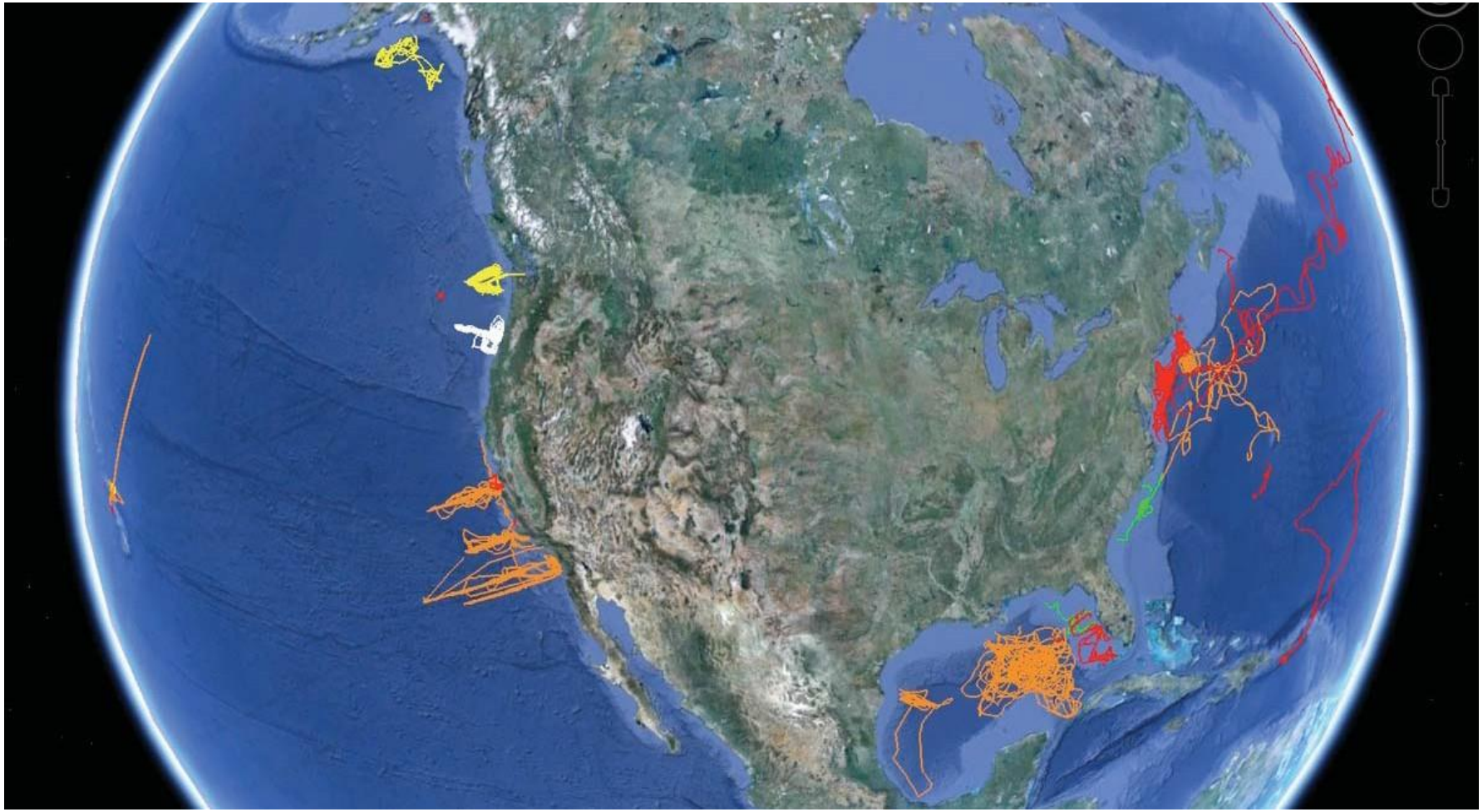
Neutrally Buoyant Floats (Argo floats)

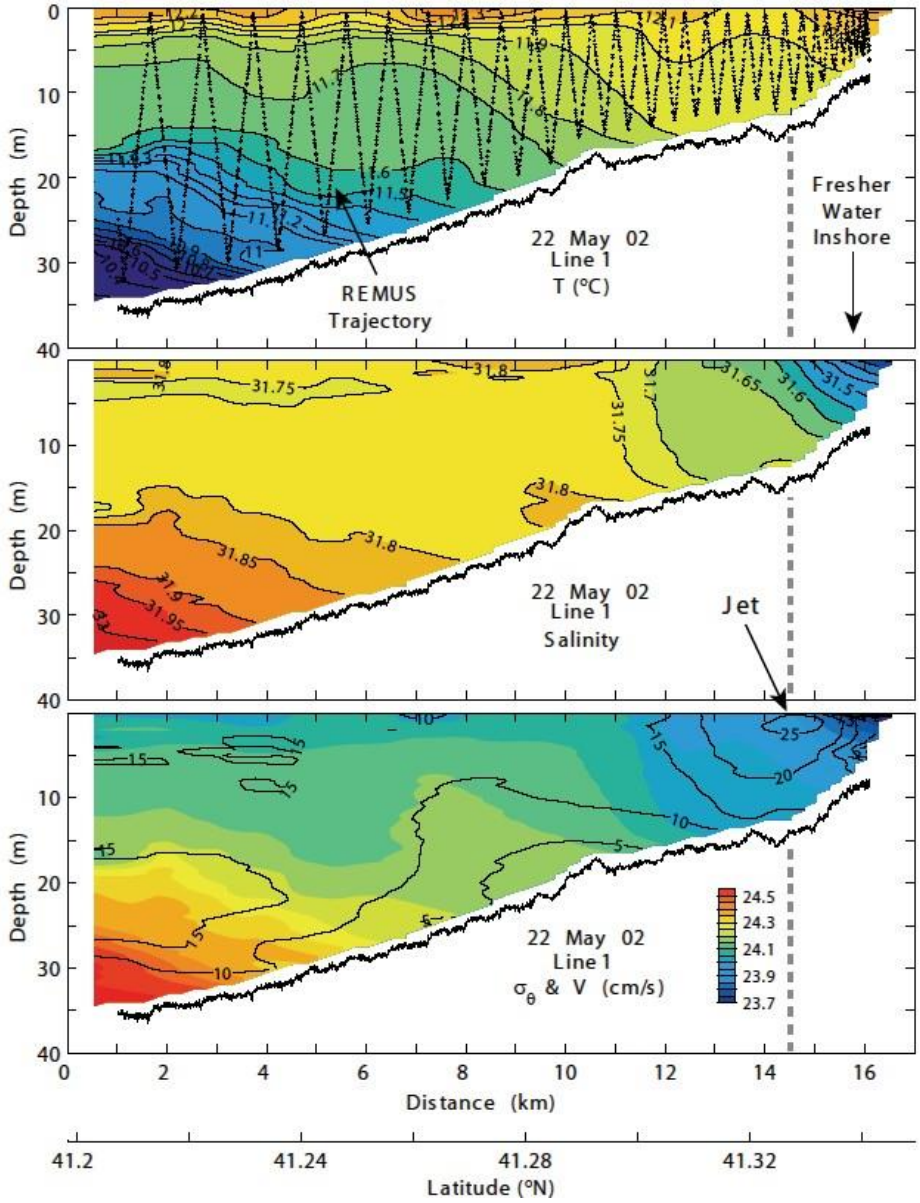




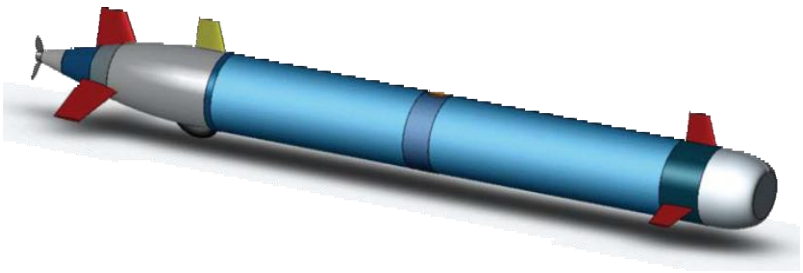
Underwater Gliders

Gliders along the US Coast





Autonomous Underwater Vehicles (AUVs)



Platforms

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- Moorings
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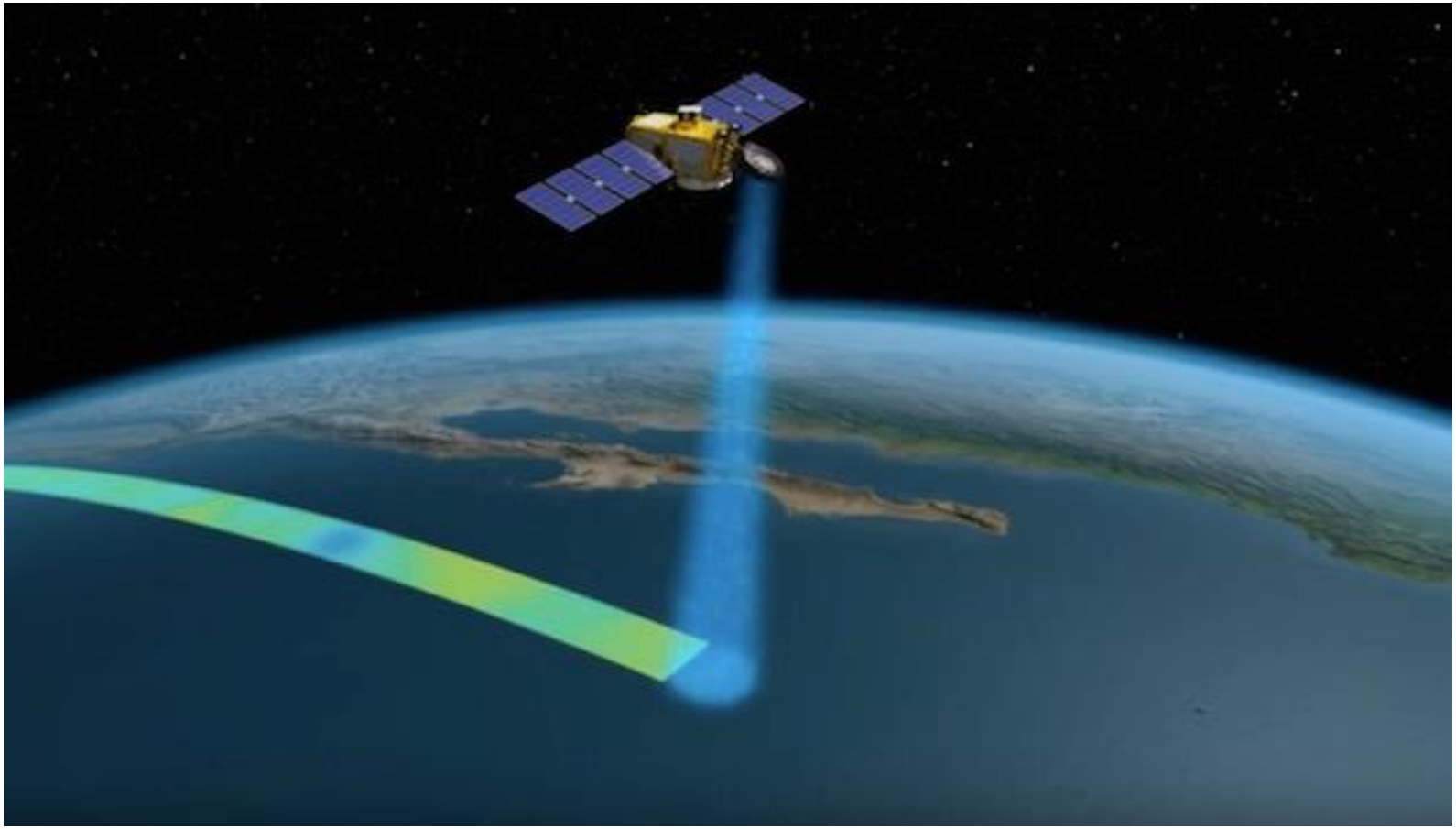
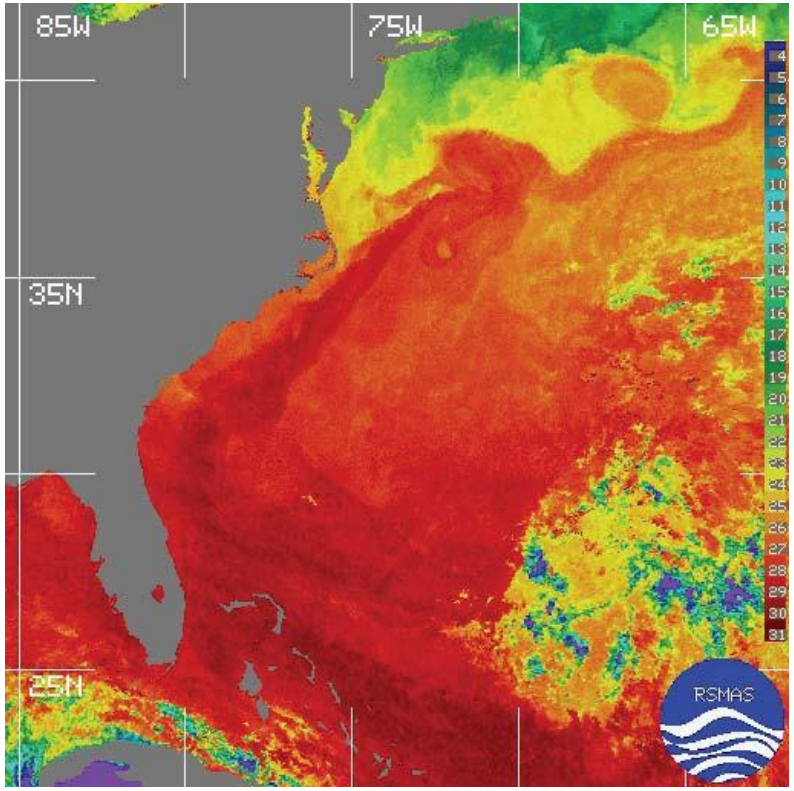
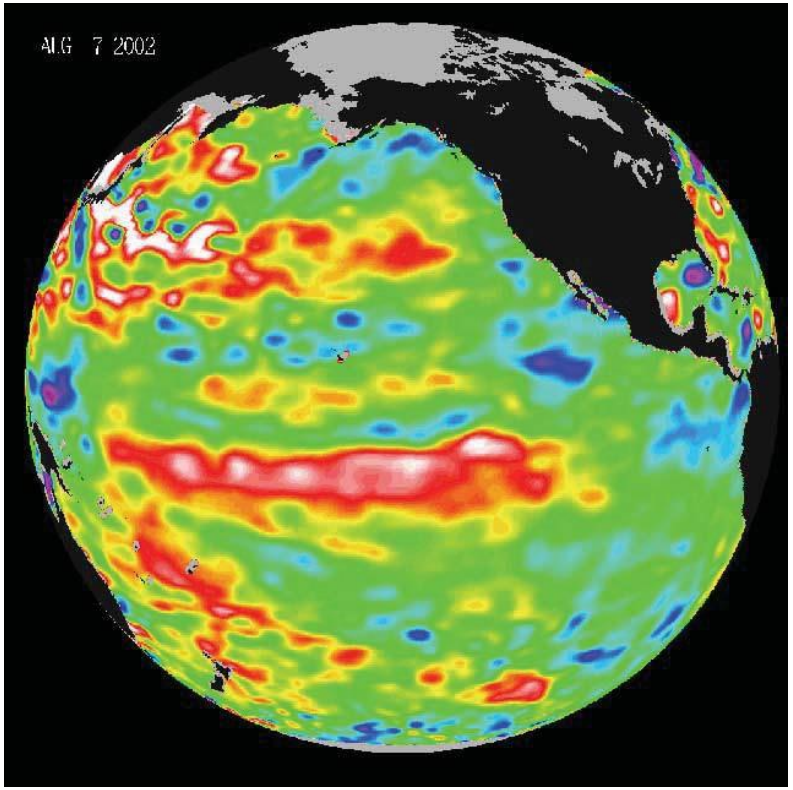
Satellite



Satellite Data

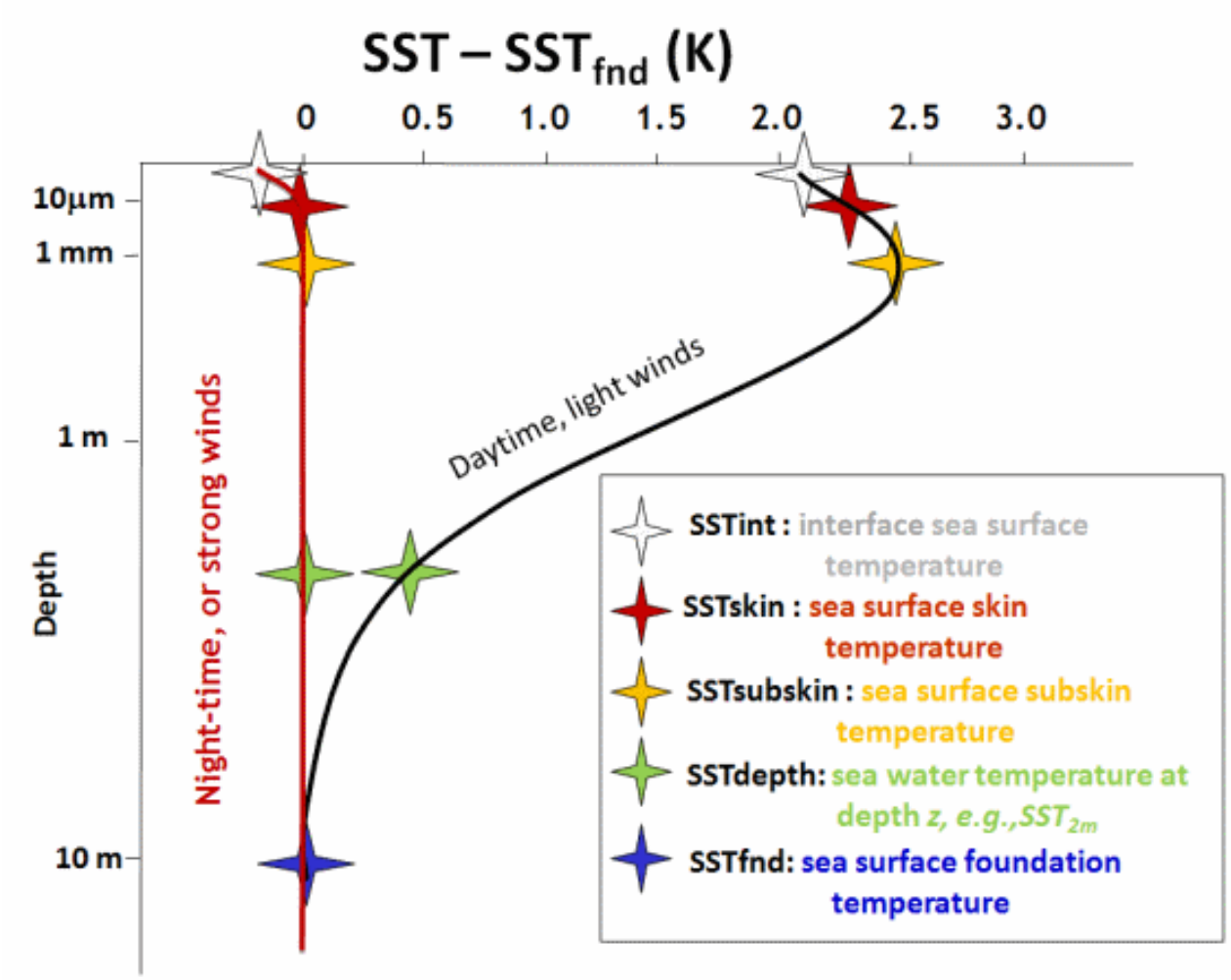


Sea Surface Temperature

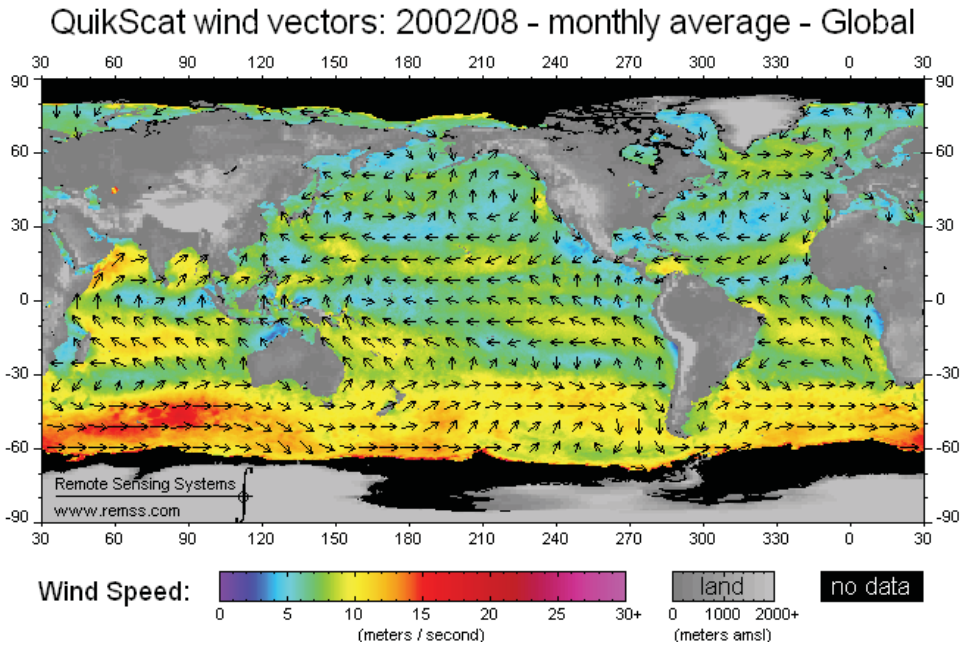


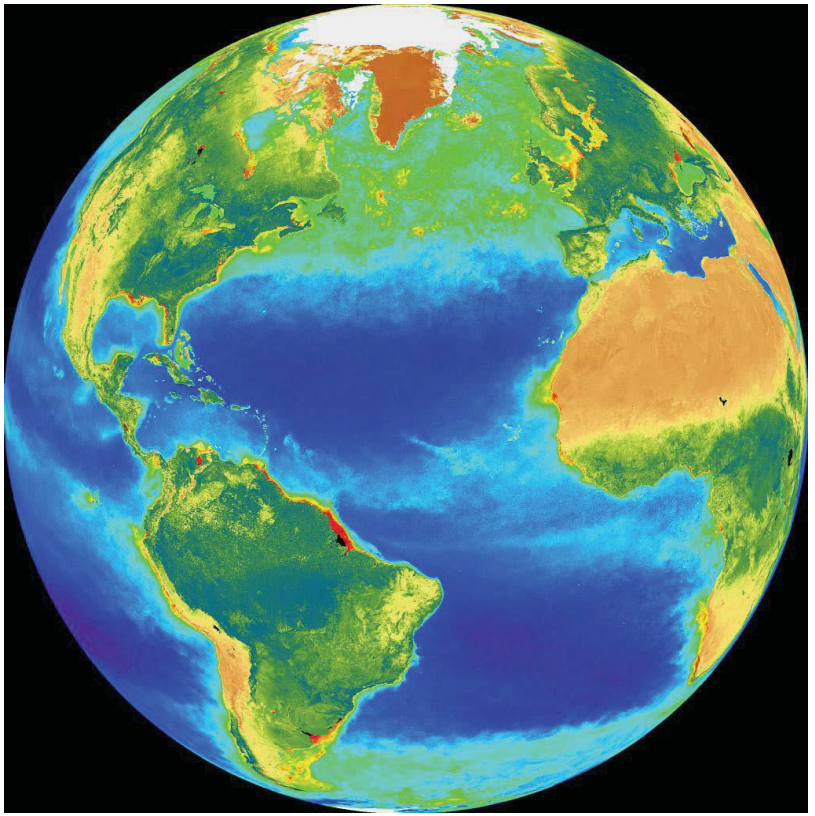
Sea Surface Height Anomaly

Sea Surface Temperature



More Satellite Data

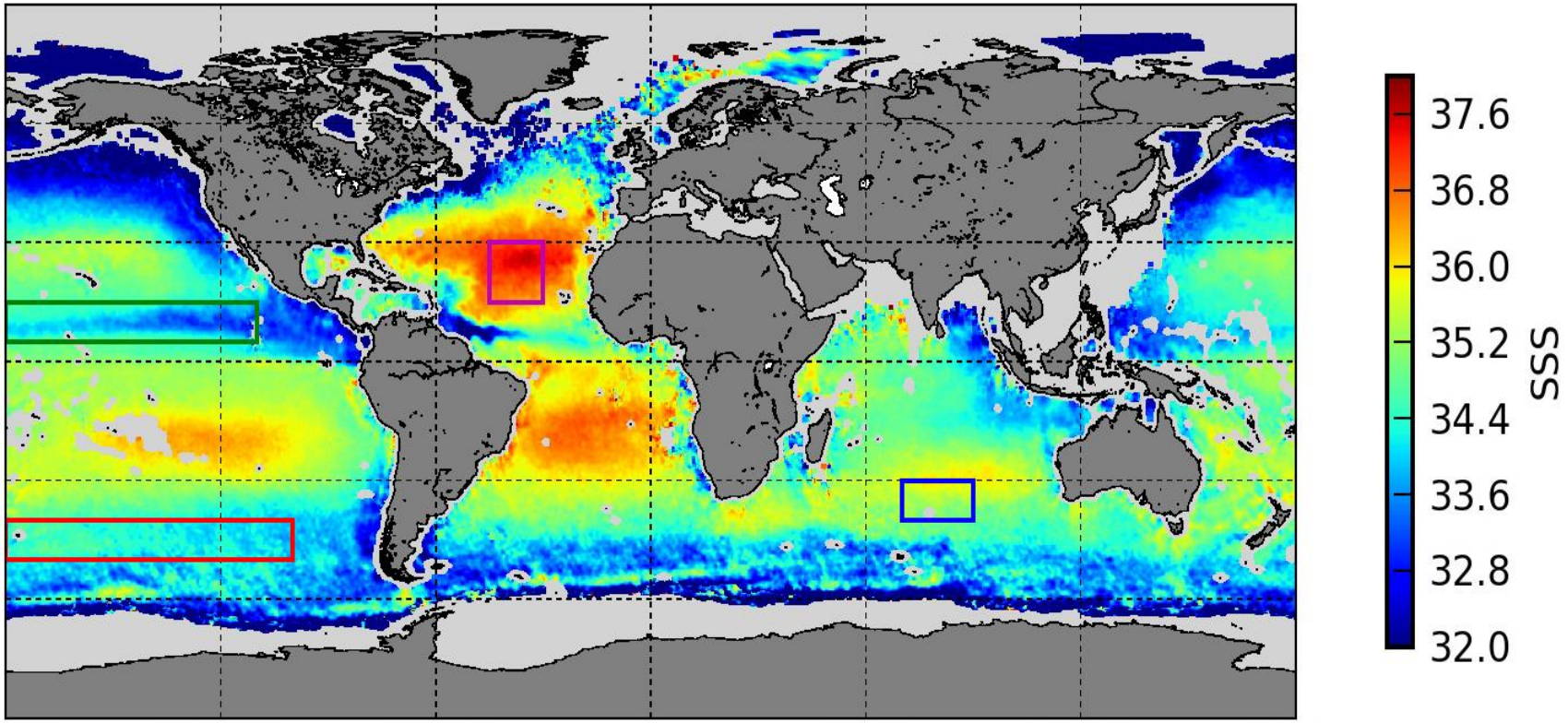




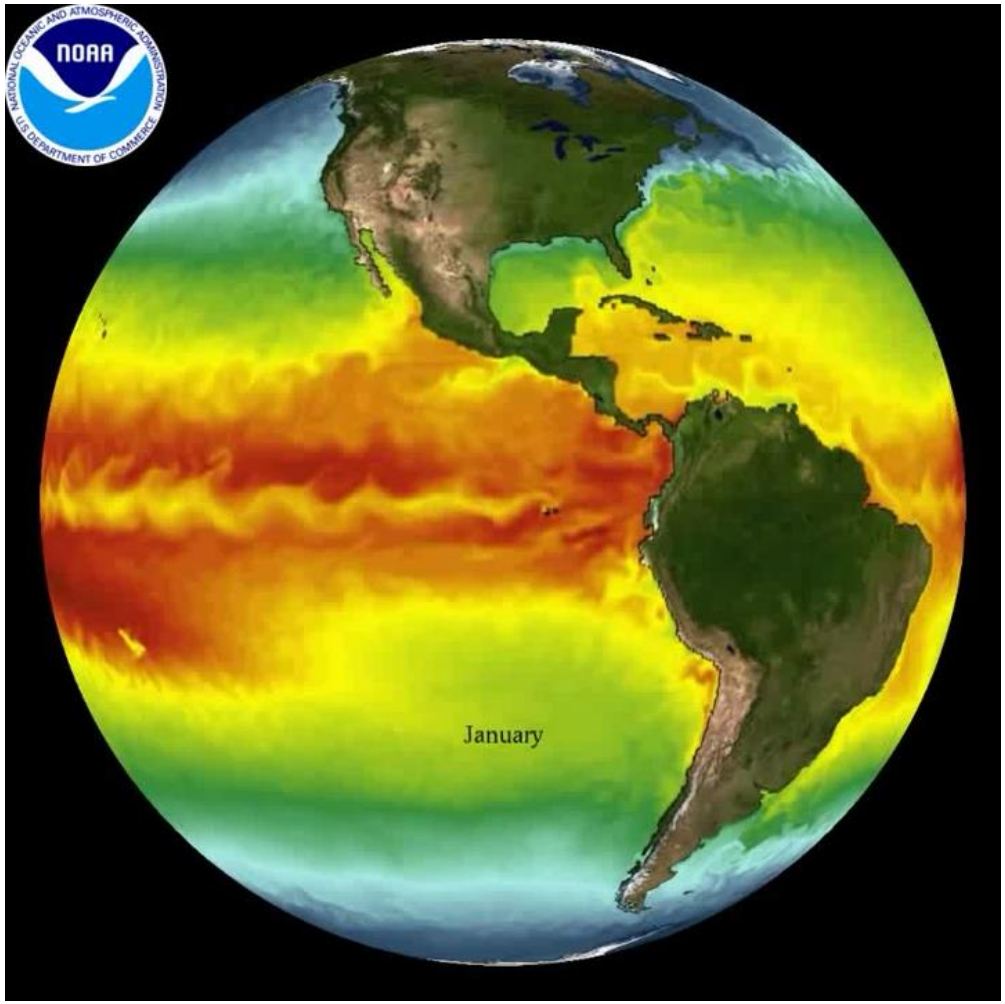
Wind

Color

Sea Surface Salinity (SMOS, Aquarius, SMAP)



Numercal Models (Regional, Global)




CMIP
The World Climate Research Programme's
Coupled Model Intercomparison Project

Today class is over