OCEAN OBSERVATIONS PLATFORMS

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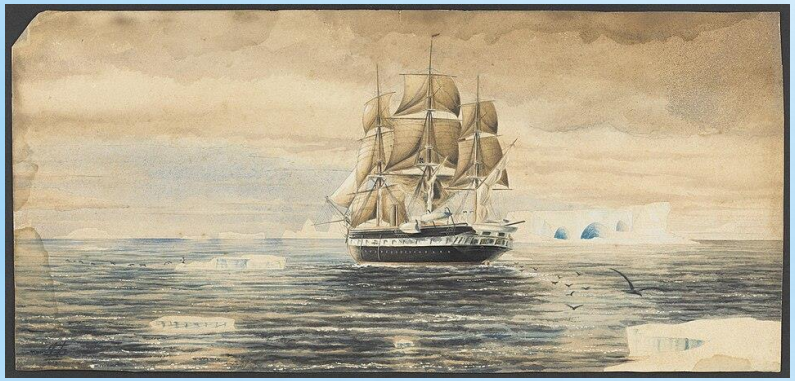
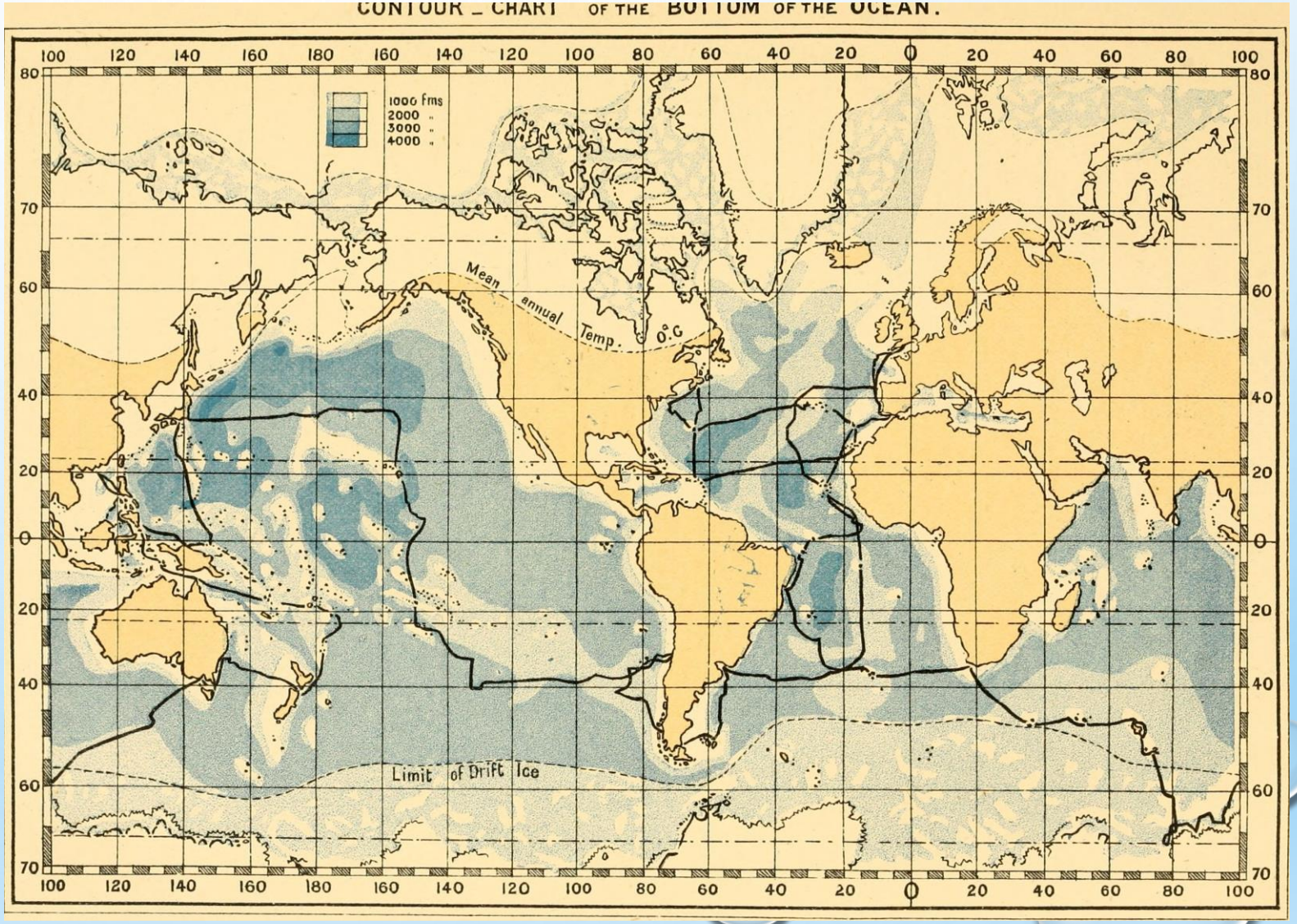
OCEAN VARIABLES AND OBSERVATIONAL TECHNOLOGIES

- WHERE HAVE WE COME FROM
- OCEAN VARIABLES
  - TEMPERATURE, CONDUCTIVITY (SALINITY), PRESSURE (DEPTH) – CTD
  - VELOCITY
- INTERNATIONAL COORDINATION
- COMBINING OCEAN OBSERVING PLATFORMS

A BRIEF HISTORY – CHALLENGER 1872-1876

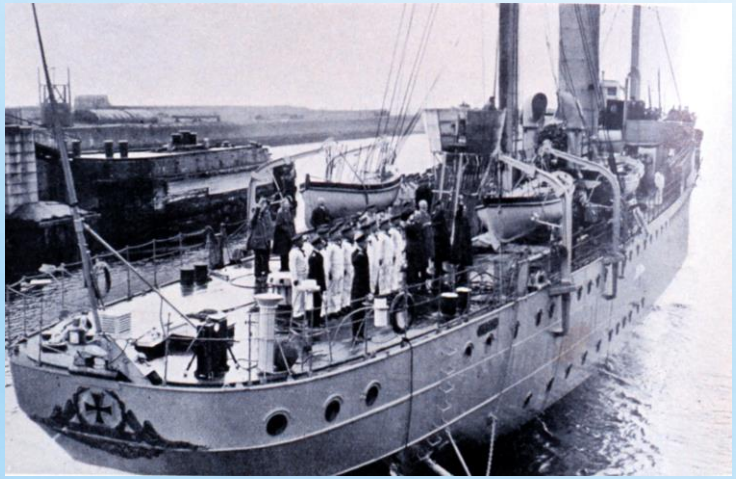
***Challenger* expedition** of 1872–1876 was a scientific programme that made many discoveries to lay the foundation of oceanography.

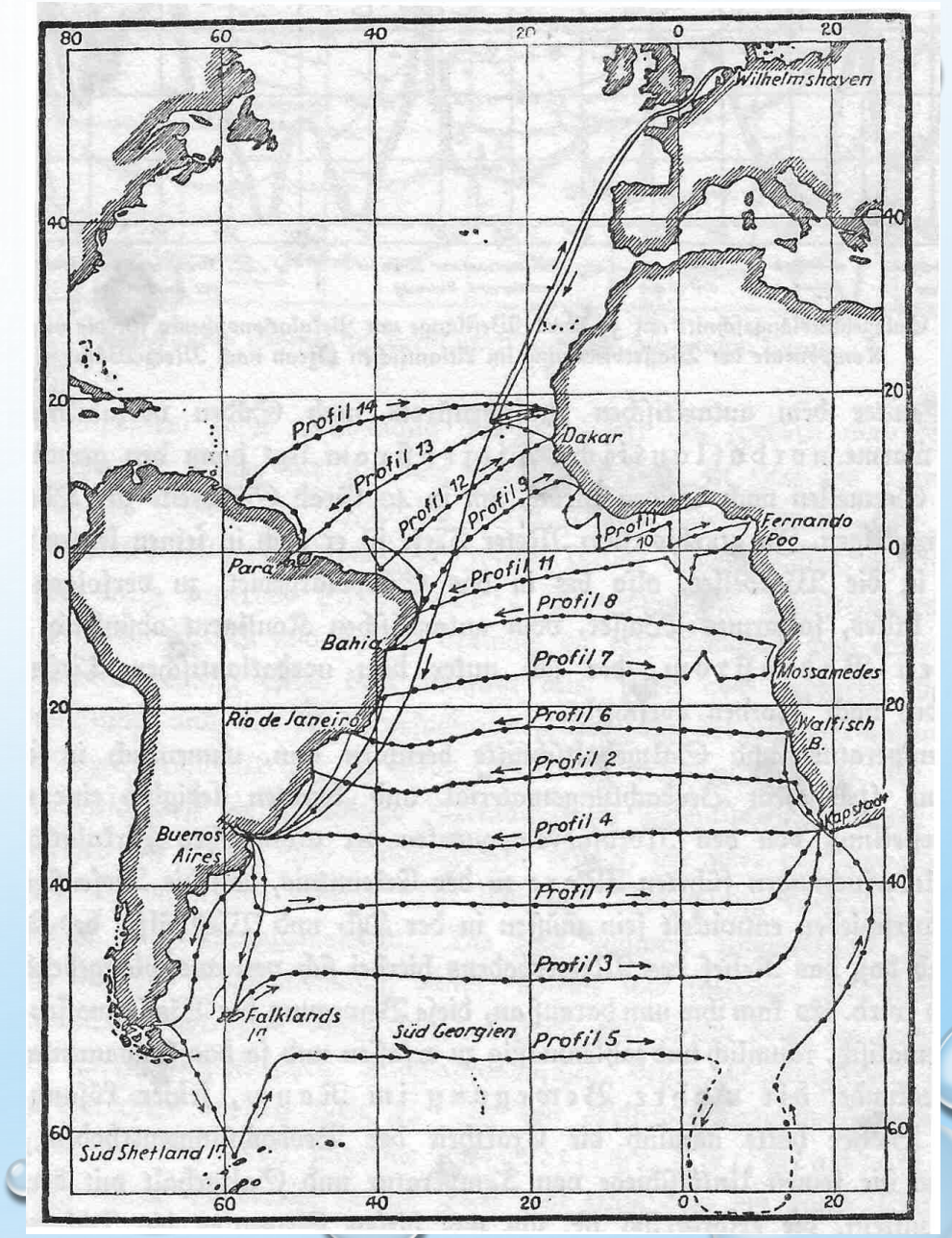




A BRIEF HISTORY – METEOR

The **German Meteor expedition** was an oceanographic expedition that explored the South Atlantic ocean from the equatorial region to Antarctic in 1925–1927. Depth soundings, water temperature studies, water samples, studies of marine life and atmospheric observations were conducted.





FULL DEPTH OCEAN SAMLPLING

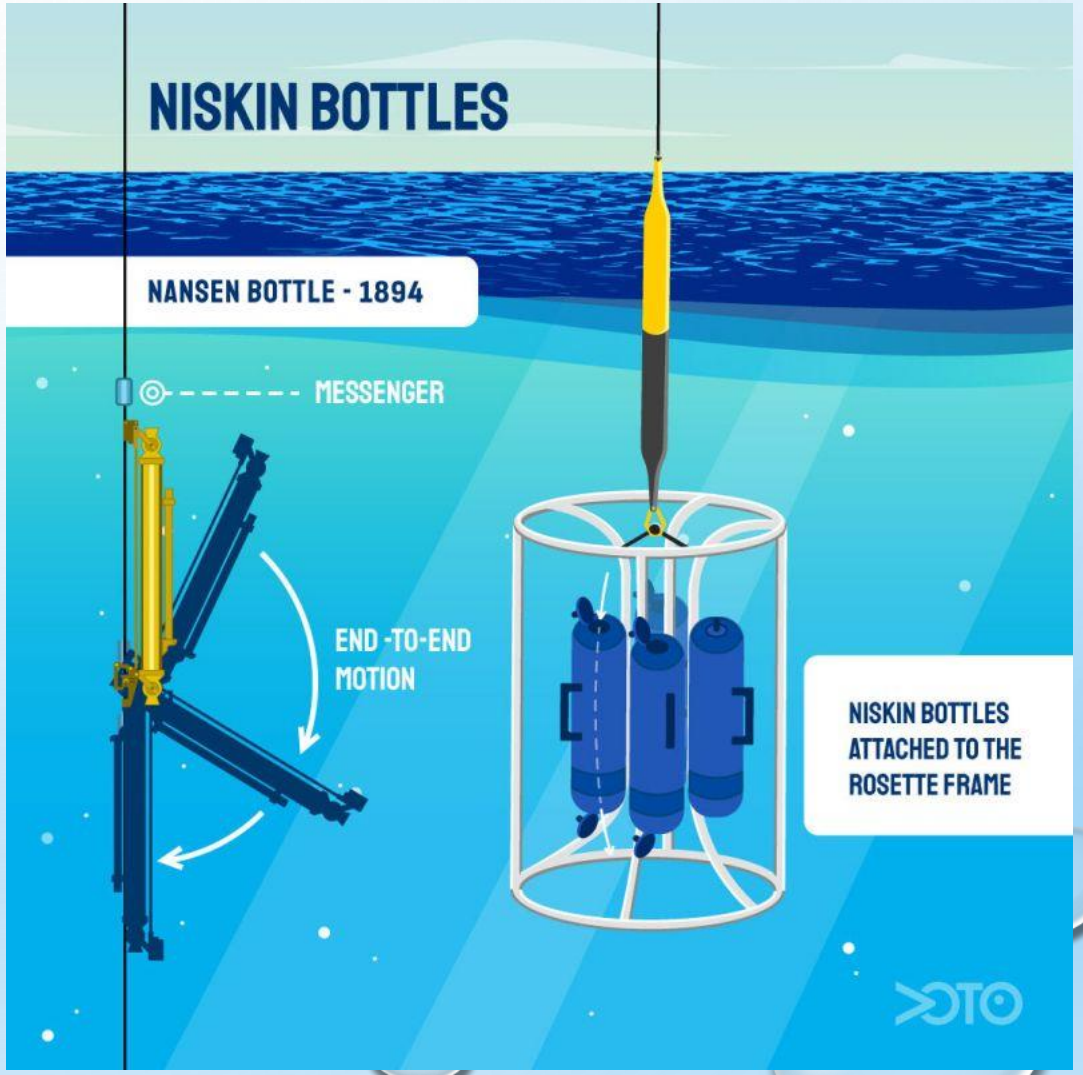
In 1894, the Norwegian oceanographer Fridtjof Nansen designed a device for sampling water at a specific depth. The device was a cylindric metal bottle open in both ends to allow the water to enter and trap it.

To collect the samples, these bottles were lined up and hung from a metal string. They were then triggered and shut by a small weight called a “messenger.”

When the messenger falls, it pushes a button that makes the bottle turn upside down, shutting the openings.

A reversing thermometer was attached to the bottle to record ocean temperature at depth.

The Nansen bottle was later developed and improved by Shale Niskin, who patented the new design in 1966. (After Voice of the Ocean)



UPPER OCEAN TEMPERATURE

In the 1930's the bathythermograph, or BT, also known as a mechanical bathythermograph, or MBT, was a device that holds a temperature sensor and a transducer to detect changes in water temperature versus depth down to a depth of approximately 285 meters.

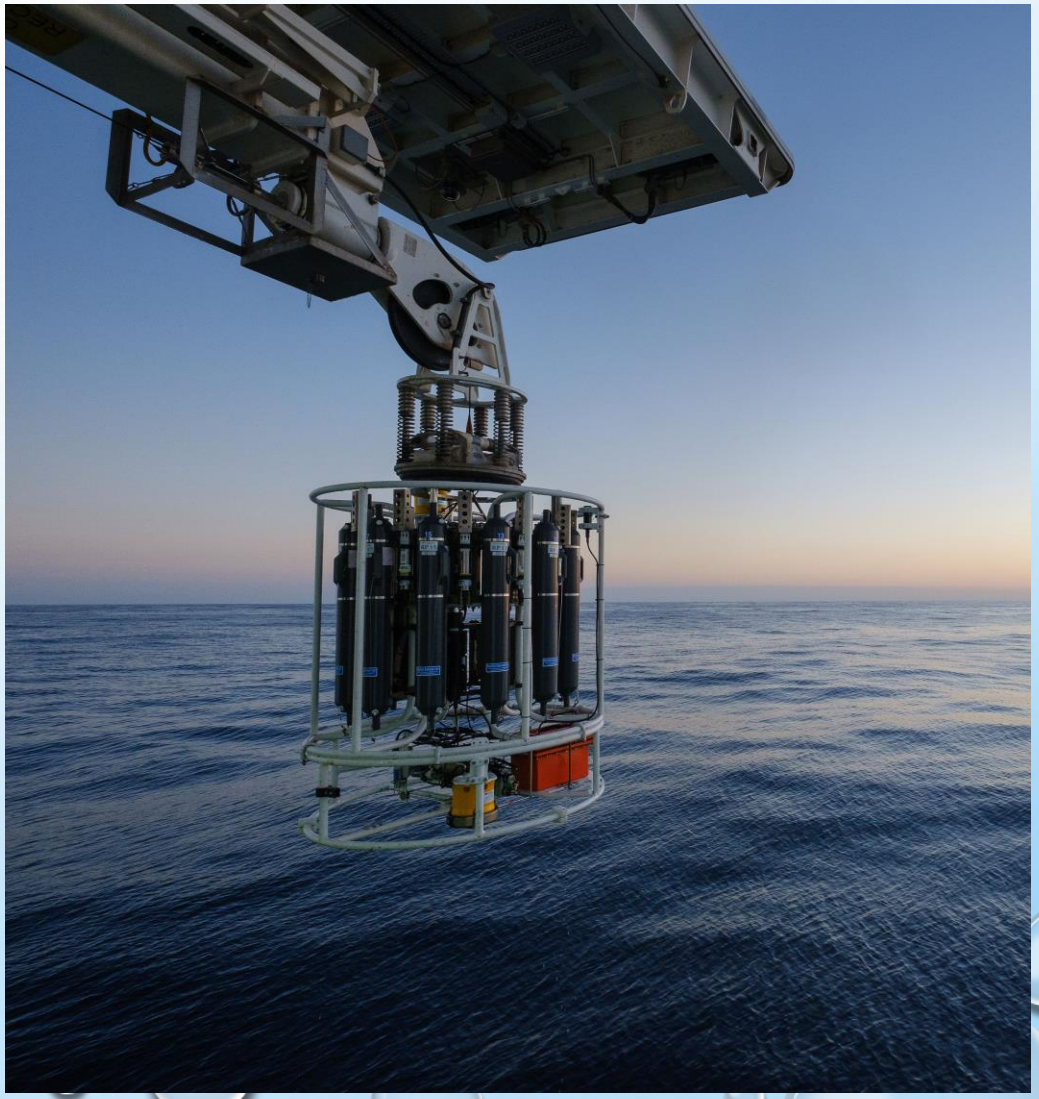
The MBT was phased out of use and replaced by the expendable bathythermograph (XBT) during the 1950s. The unit is composed of a probe; a wire link; and a shipboard canister. Inside of the probe is a thermistor which is connected electronically to a chart recorder. The probe falls freely at a known rate and that determines its depth and provides a temperature-depth trace on the recorder. A pair of fine copper wires which pay out from both a spool retained on the ship and one dropped with the instrument, provide a data transfer line to the ship for shipboard recording.

CONDUCTIVITY, TEMPERATURE, DEPTH (CTD) INSTRUMENT

The CTD system was conceived by Neil Brown and developed at Woods Hole Oceanographic Institution.

In the 1970's Neil Brown's CTD was originally manufactured by Neil Brown Instrument Systems (NBIS), and later by companies like EG&G and Falmouth Scientific, Inc.

Sea-Bird designed and manufactured their own competing CTD instruments. Sea-Bird's entry into the commercial CTD market occurred in 1984 with the introduction of the SBE 9 / SBE 11 CTD system.



CONDUCTIVITY, TEMPERATURE, DEPTH (CTD) INSTRUMENT

Sea-Bird CTD now commonly used on ships, floats, moorings, and gliders.

OCEAN CURRENTS

The history of Aanderaa rotor current meters dates back to the early 1960s when Norwegian inventor Ivar Aanderaa recognized the need for robust, autonomous instruments capable of measuring ocean currents.

With only battery capacity of a few months! Battery life was extended to enable 2-year velocity records during the 1970s.

Fun fact: CSIRO was still using these instruments in the early 2000's.

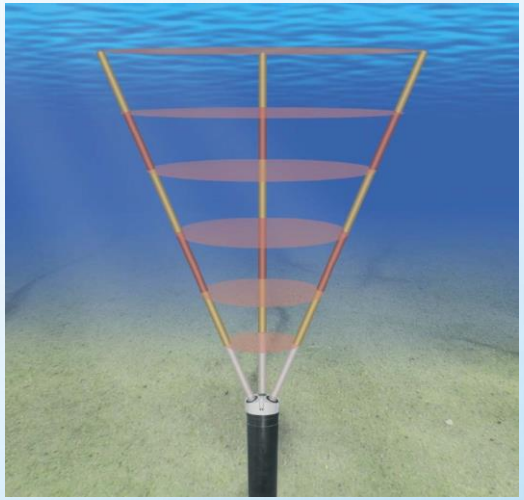
Starting around 1970 and for about 20 years, alternative methods such as electromagnetic current meters and acoustic travel time systems became common. These technologies responded faster to changes in the currents and gave us direct insight into the statistical nature of water flow.

PROFILING OCEAN CURRENT INSTRUMENTS

In water, it is much more common to use sound – or underwater acoustics – to make observations, rather than light. This is because light travels only short distances underwater.

Acoustic Doppler devices use sound waves and the Doppler effect to measure velocity fluctuations underwater, and can do so several times per second. Currents can be measured not only close to the instrument itself, but also some distance away, as well as simultaneously at many points along the way.

This makes acoustic Doppler devices powerful tools for measuring currents not only on a very fine scale in streams and in the laboratory, but also on a large scale in big rivers, coastal seas and deep oceans.

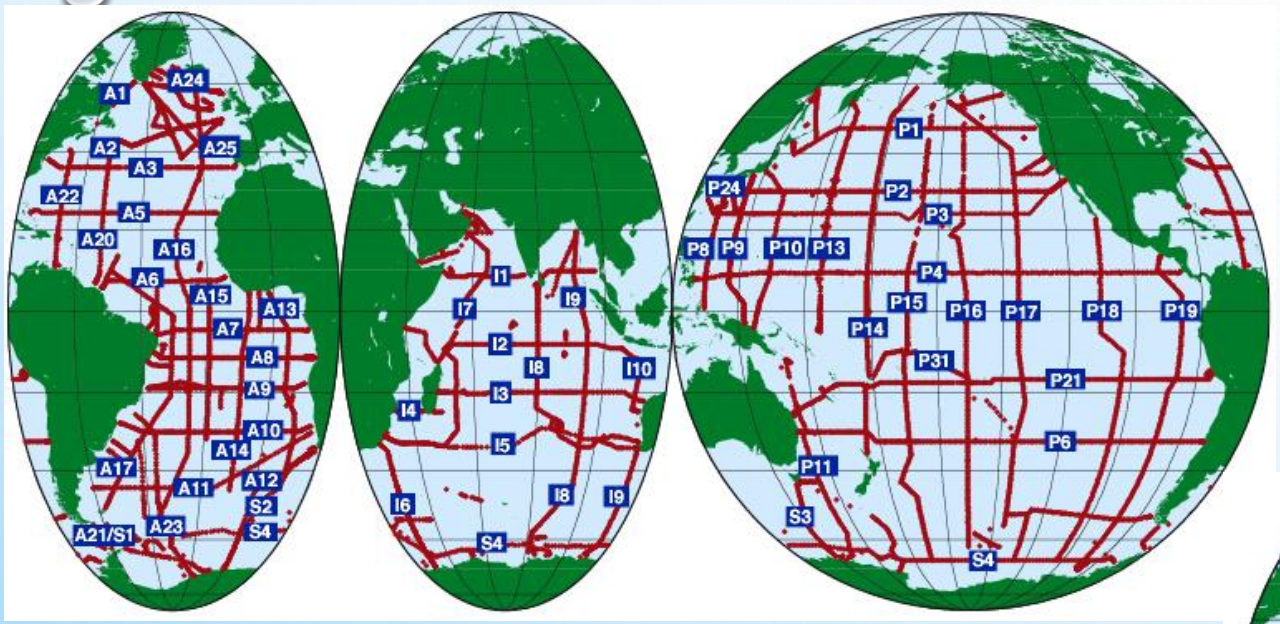


INTERNATIONAL COORDINATED OCEAN OBSERVING

The **World Ocean Circulation Experiment (WOCE)** was the largest internationally coordinated oceanographic program ever conducted. Running its intensive field phase between 1990 and 1998 under the World Climate Research Programme, it utilized research vessels, buoys, mooring array, floats and satellites to map the three-dimensional structure of the global ocean.

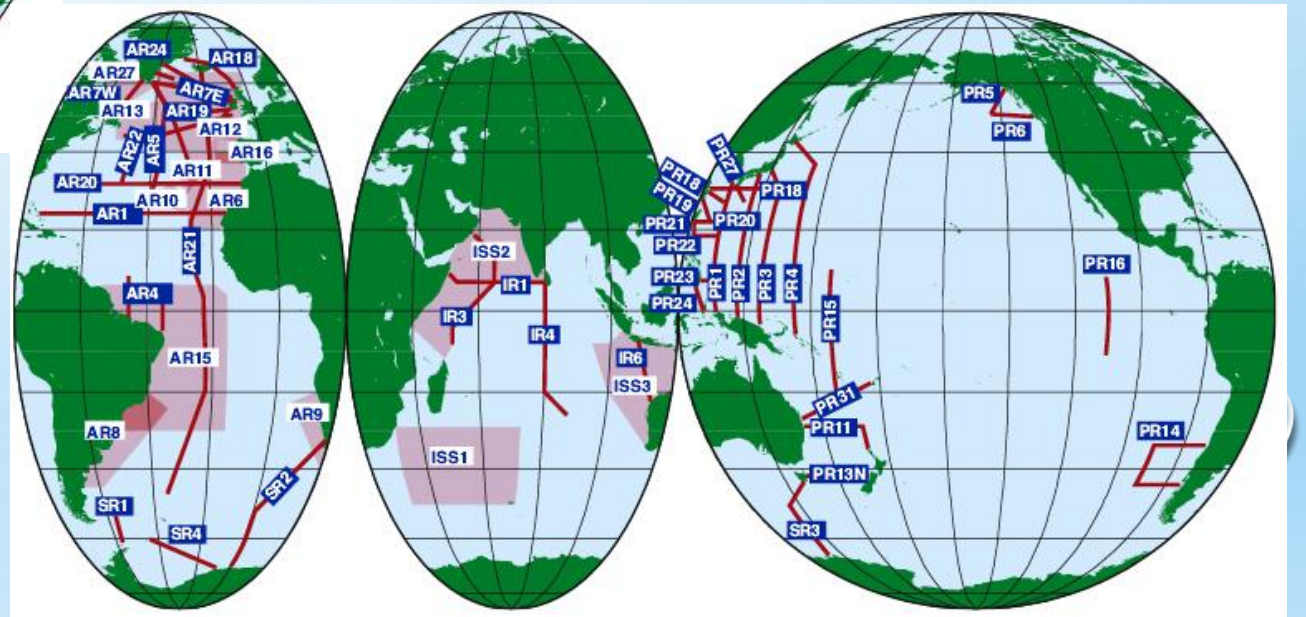
WOCE was the foundation for todays Global Ocean Observing System, from instruments, international collaboration, meta data, data servers and analysis

WOCE HYDROGRAPHIC PROGRAM

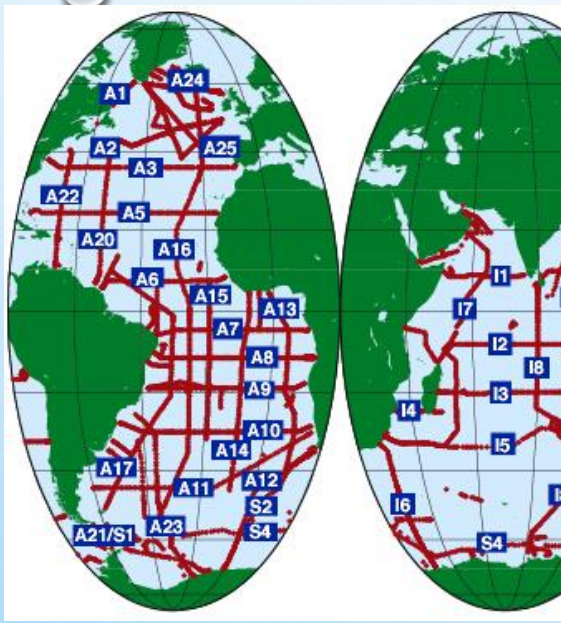


WOCE one-time repeat section

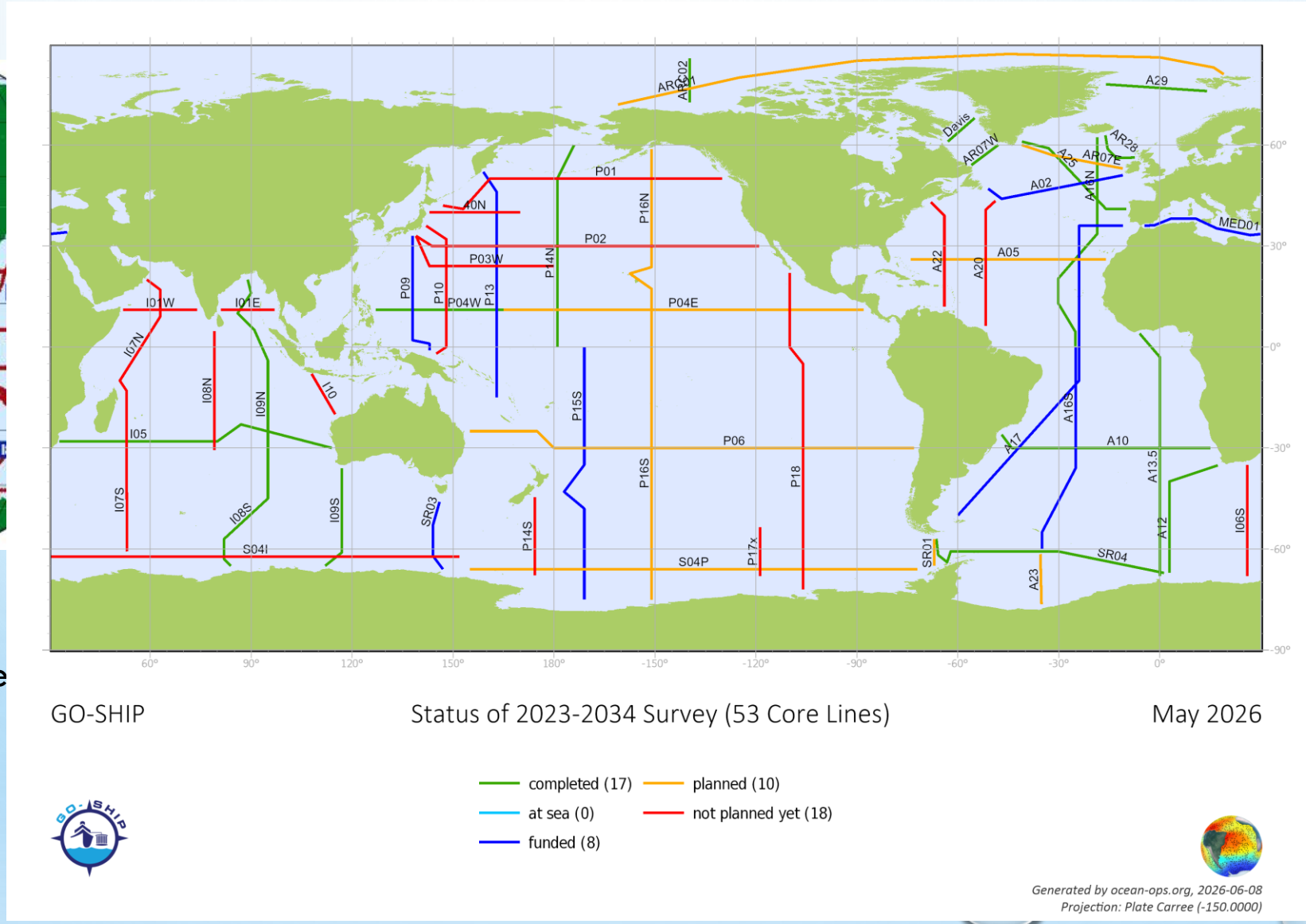
WOCE repeat (3-4 years) repeat sections



GO-SHIP



WOCE repe



WOCE FLOAT PROGRAM

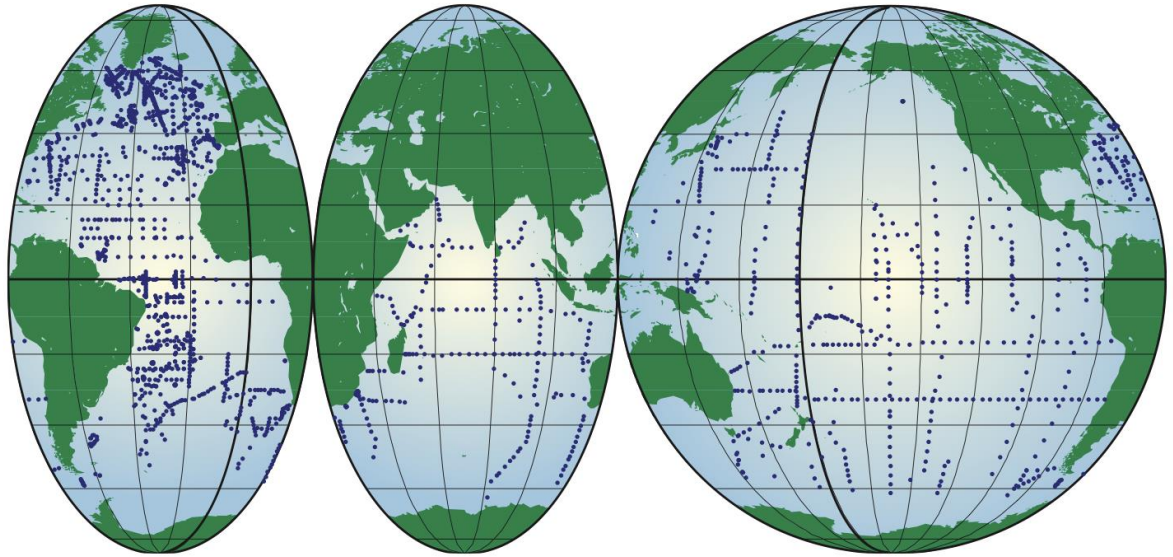


Figure 14. WOCE Subsurface Floats: deployment locations.

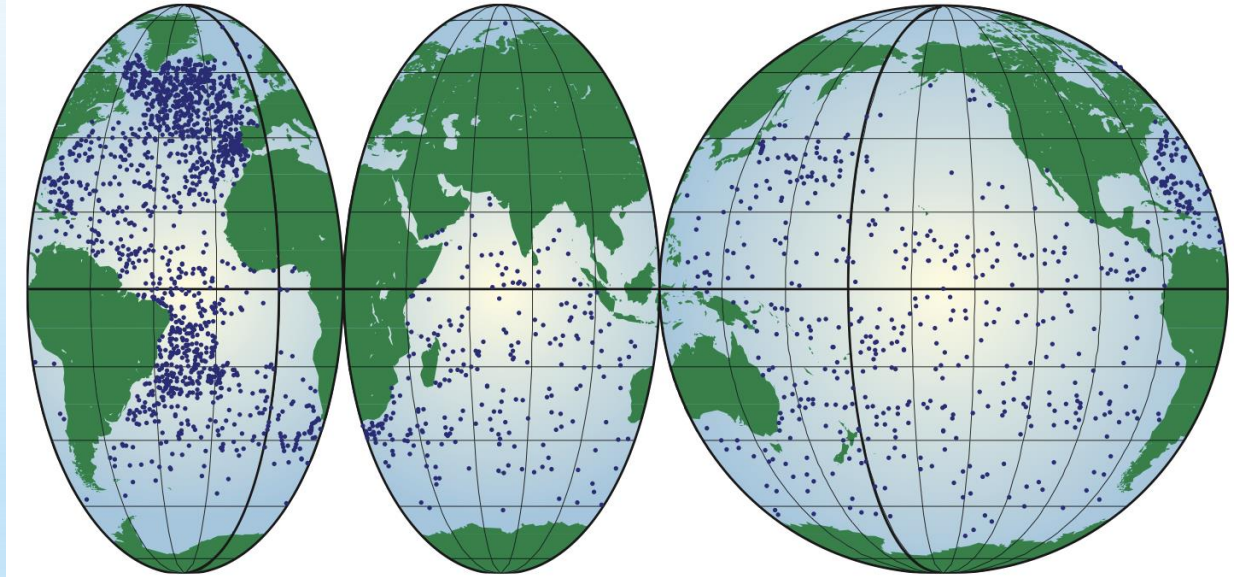


Figure 15. WOCE Subsurface Floats: latest locations in mid-2002.

ARGO

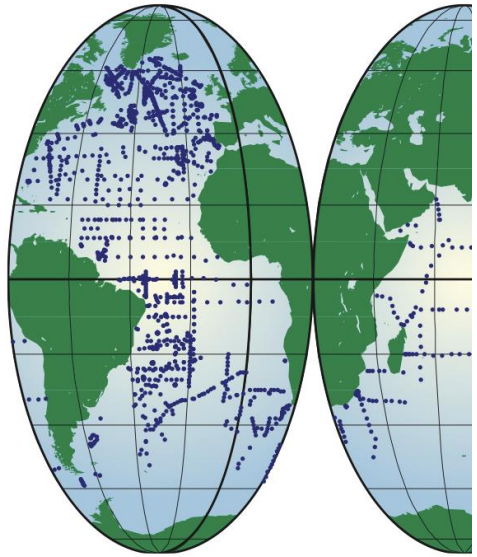
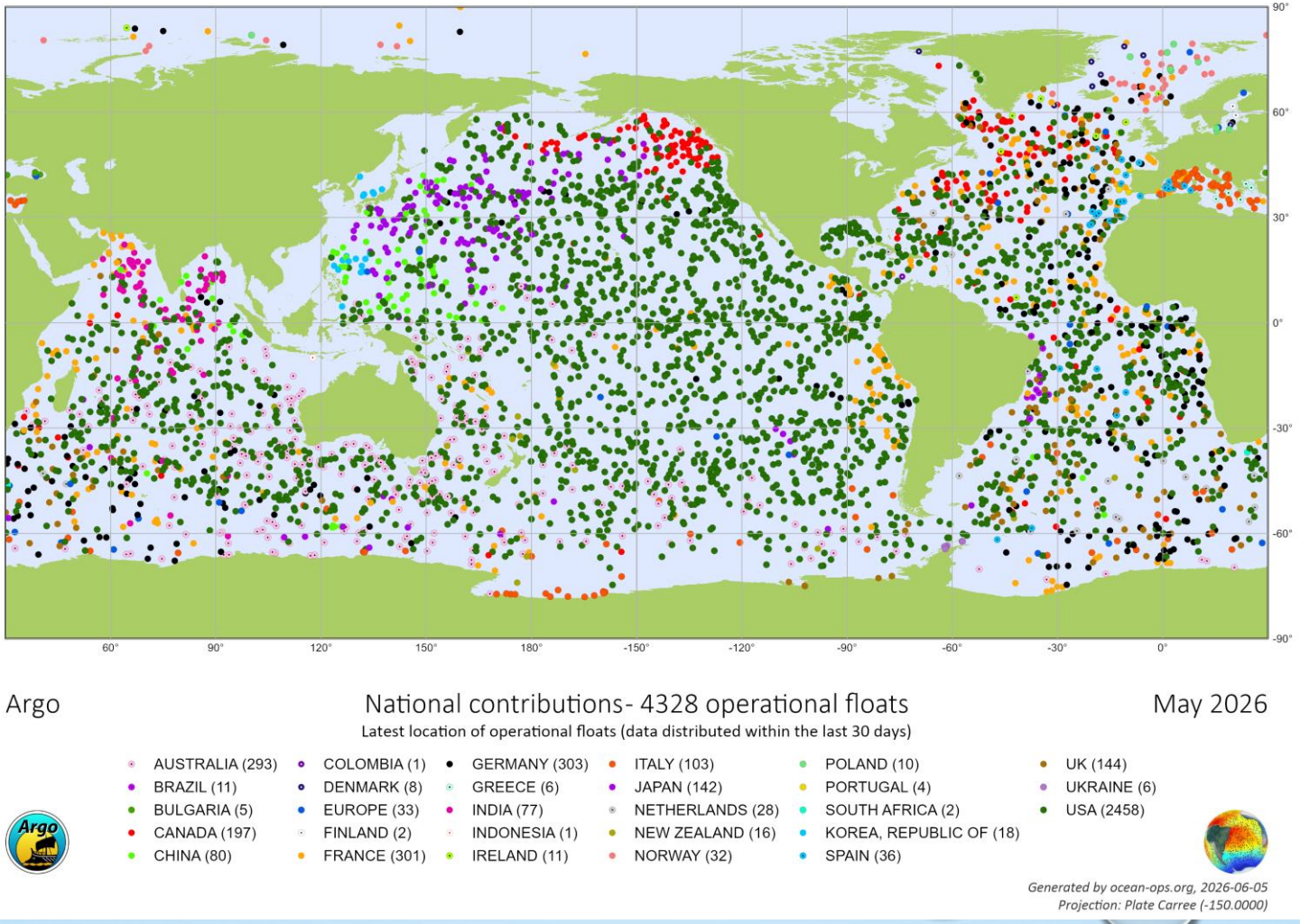
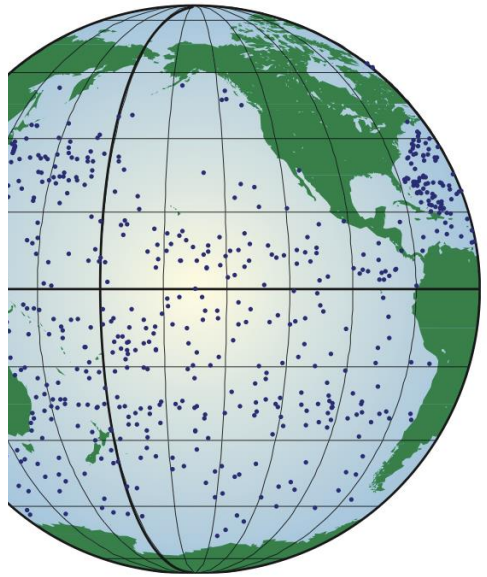


Figure 14. WOCE





cations in mid-2002.

WOCE MOORING ARRAYS AND PACIFIC TROPICAL ARRAY

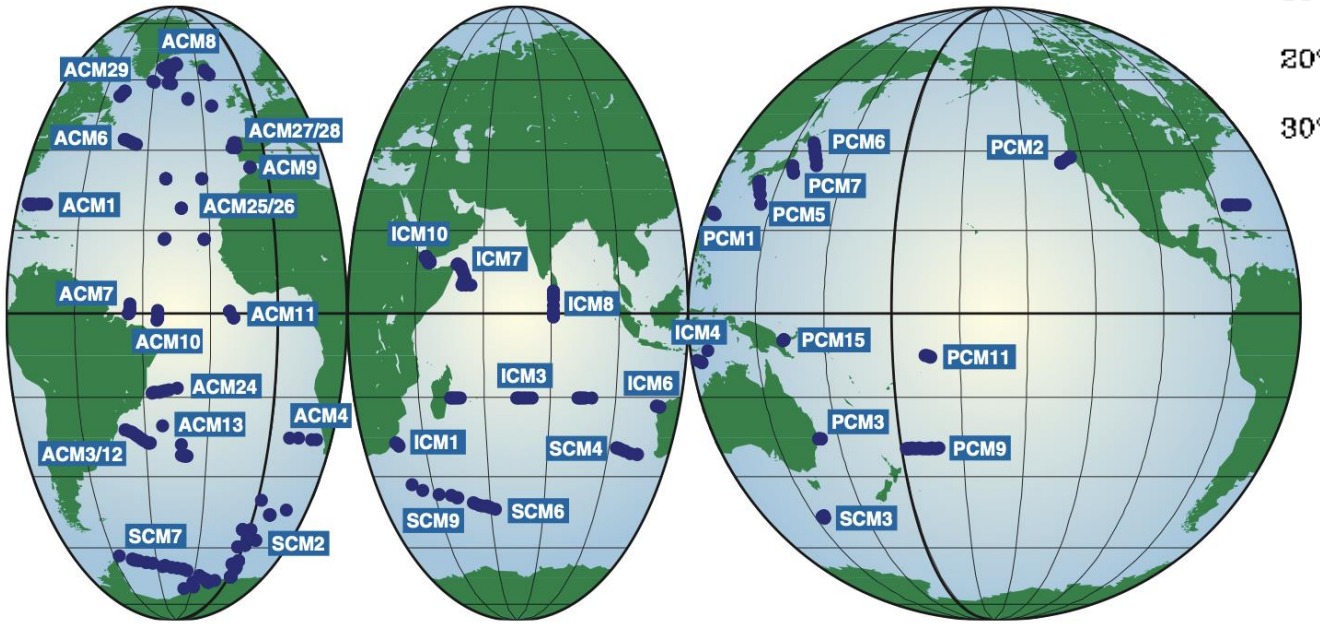
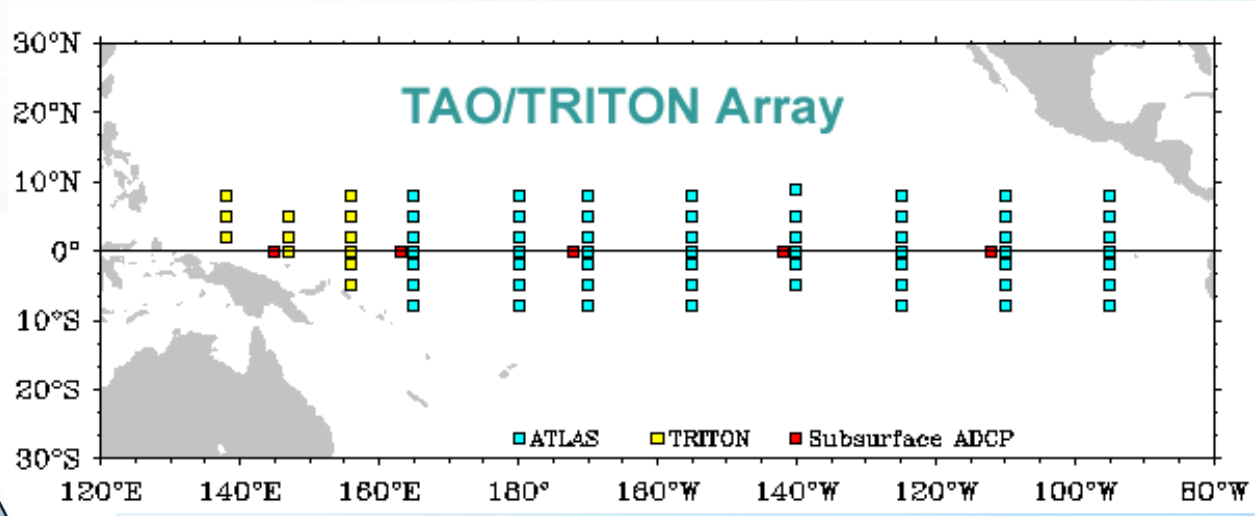


Figure 16. WOCE Moored Current Meter Arrays.



OCEANSITES

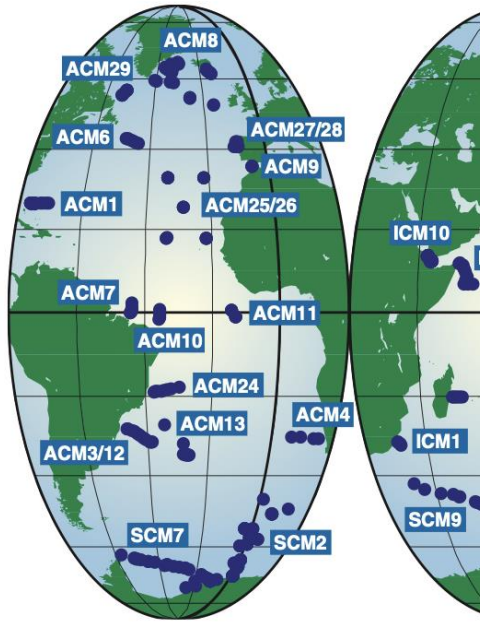
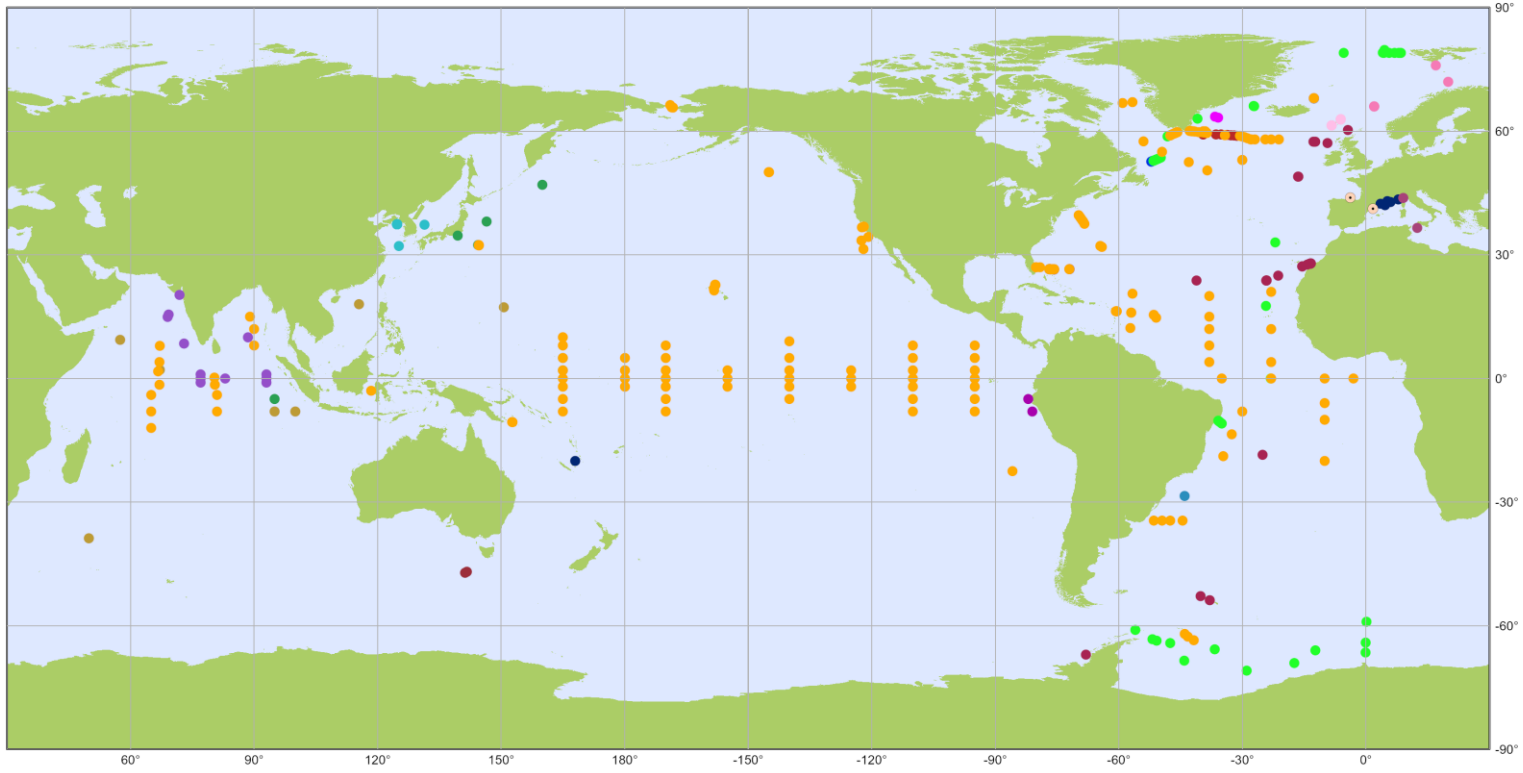


Figure 1



OceanSITES

Platforms by country

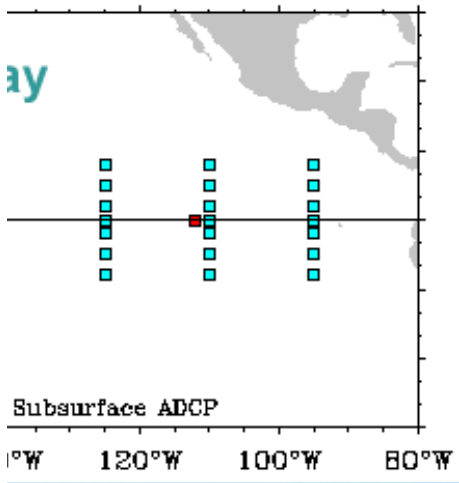
Information received from the platform operators

May 2026

- AUSTRALIA (2)
- BRAZIL (1)
- CANADA (5)
- CHINA (7)
- DENMARK (4)
- EUROPE (2)
- FRANCE (6)
- GERMANY (42)
- ICELAND (1)
- INDIA (12)
- ITALY (2)
- JAPAN (5)
- KOREA, REPUBLIC OF (27)
- NETHERLANDS (8)
- NORWAY (5)
- PERU (2)
- SPAIN (2)
- UK (41)
- USA (181)

OceanSITES

Generated by ocean-ops.org, 2026-06-08
Projection: Plate Carree (-150.0000)



WOCE SURFACE DRIFTER PROGRAM

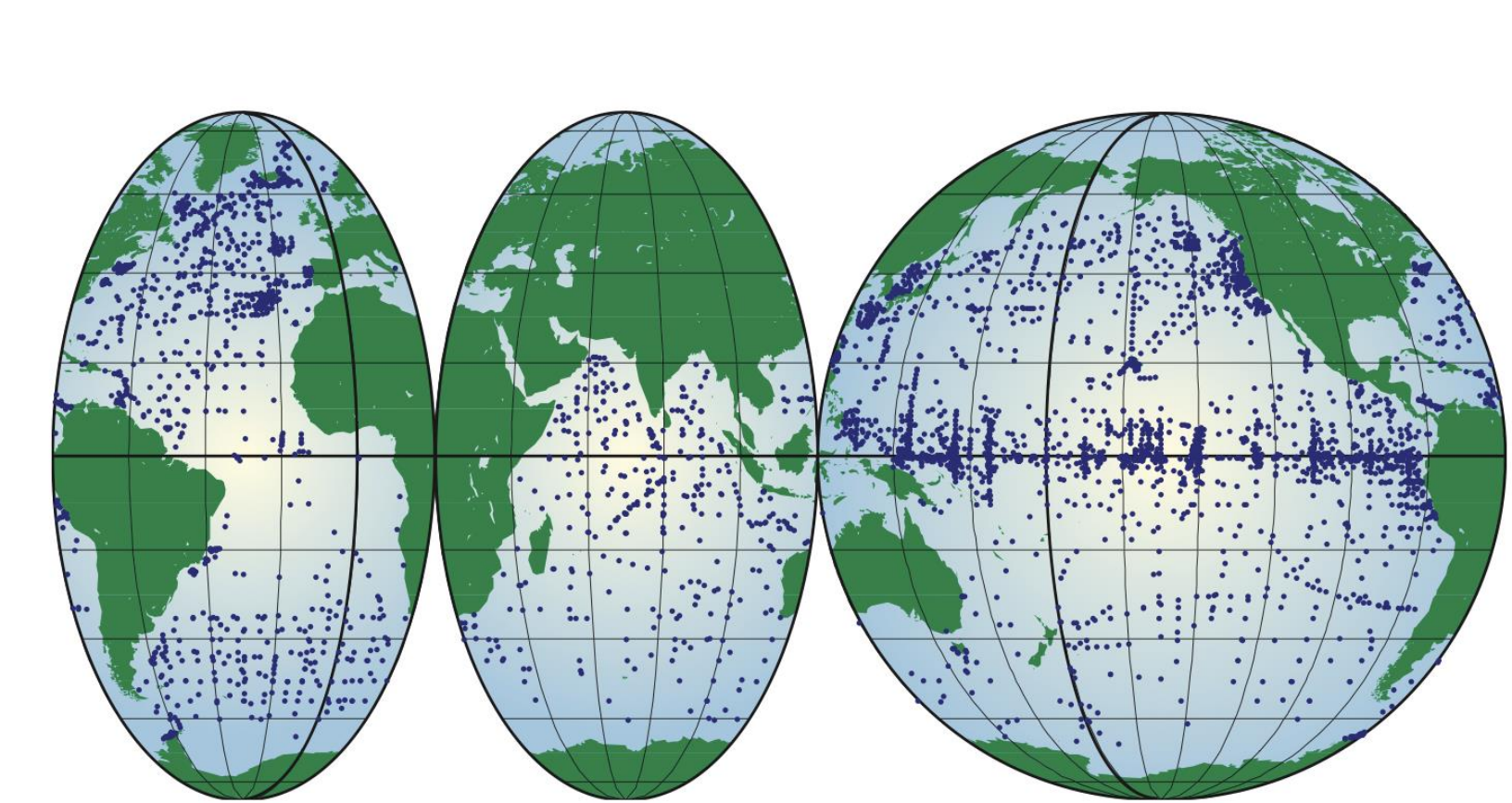


Figure 13. The Surface Velocity Programme: surface drifter deployment locations.

GLOBAL DRIFTER PROGRAM

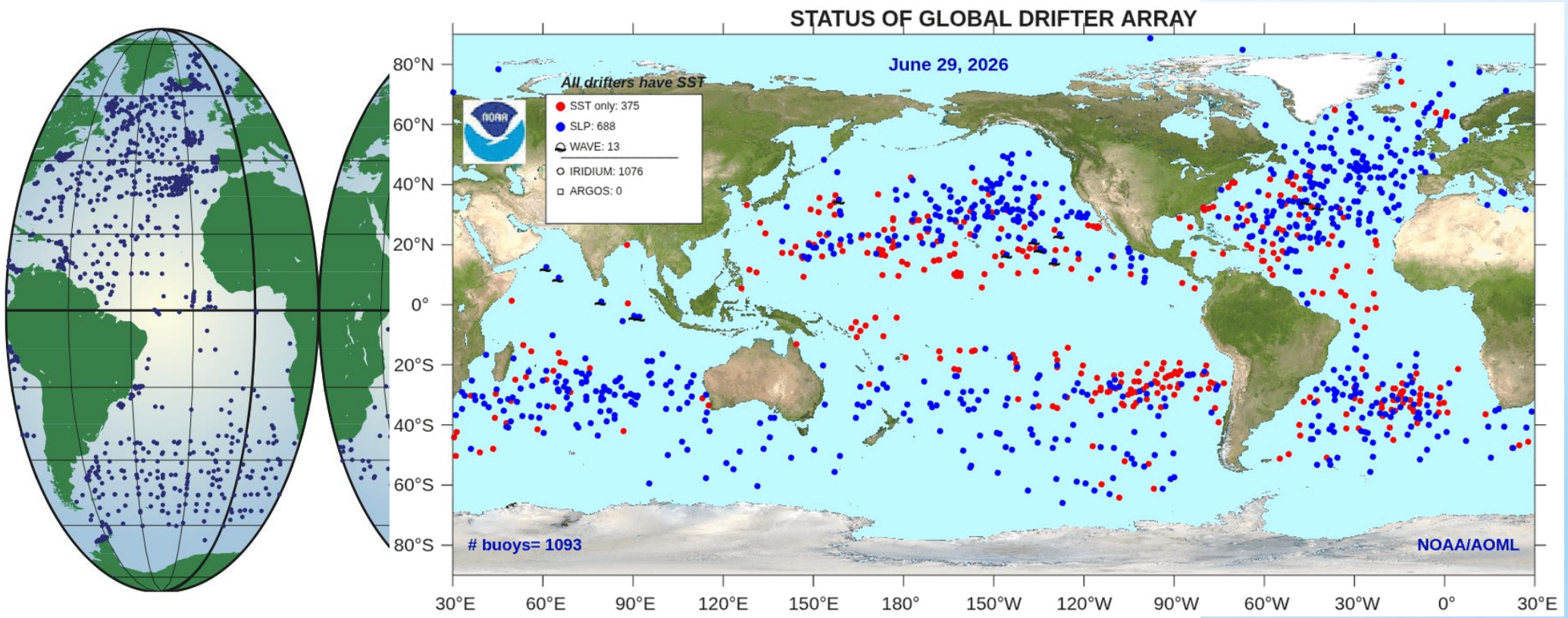
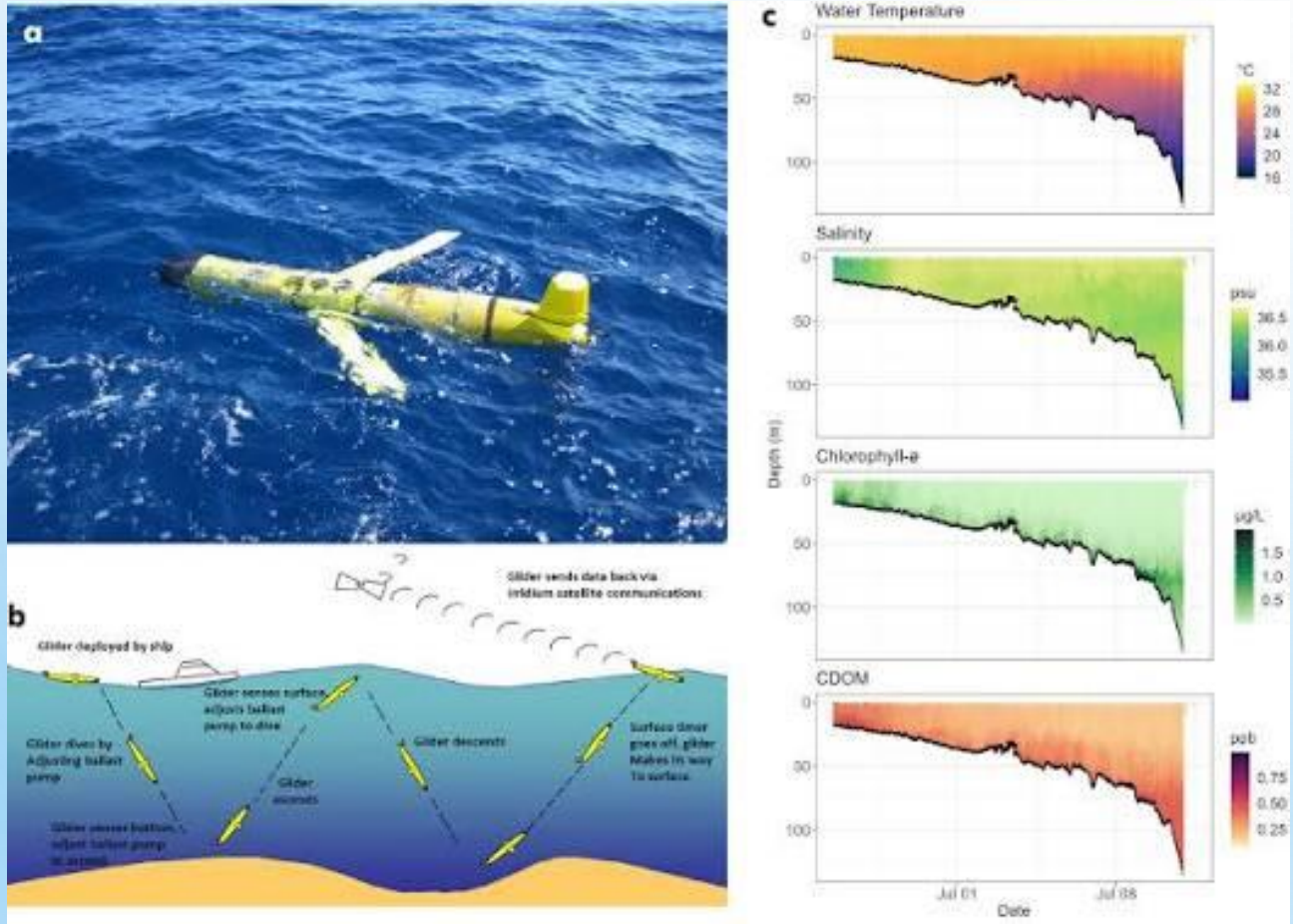
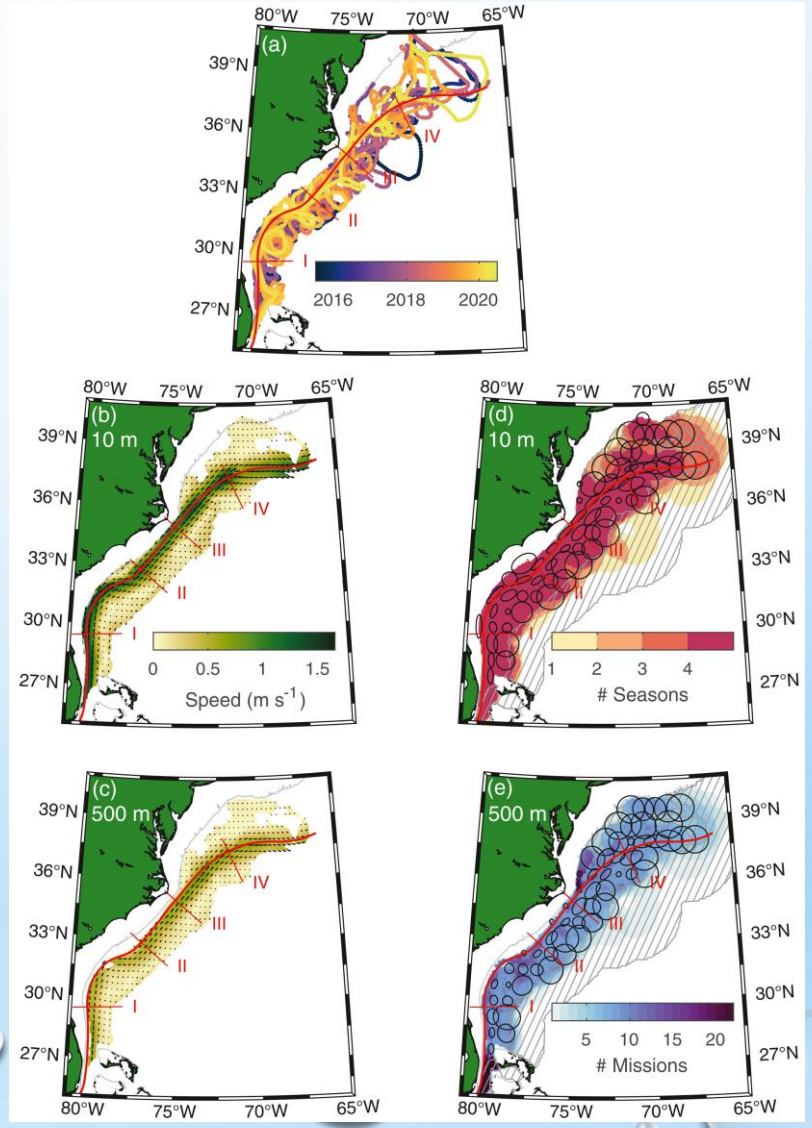


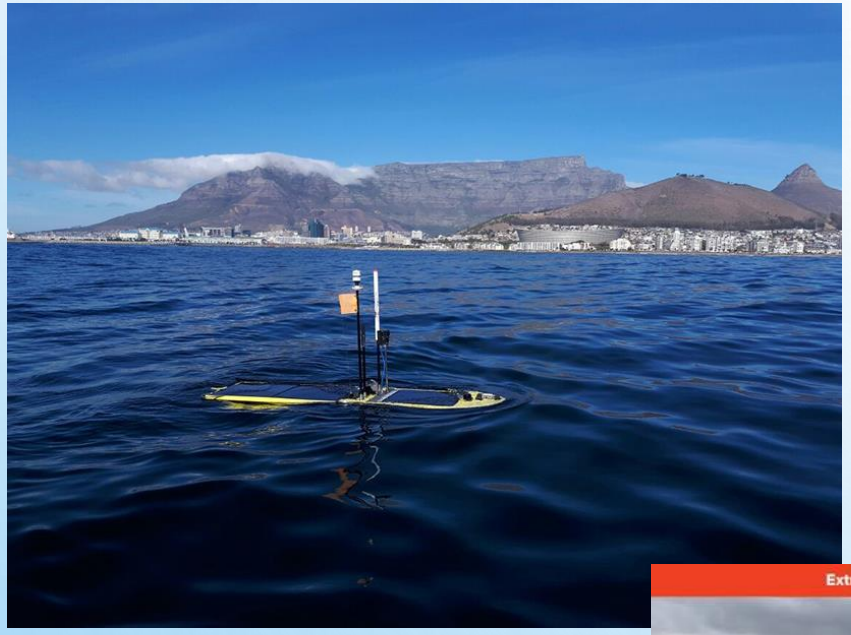
Figure 13. The Surface Velocity Programme: surface drifter deployment locations.

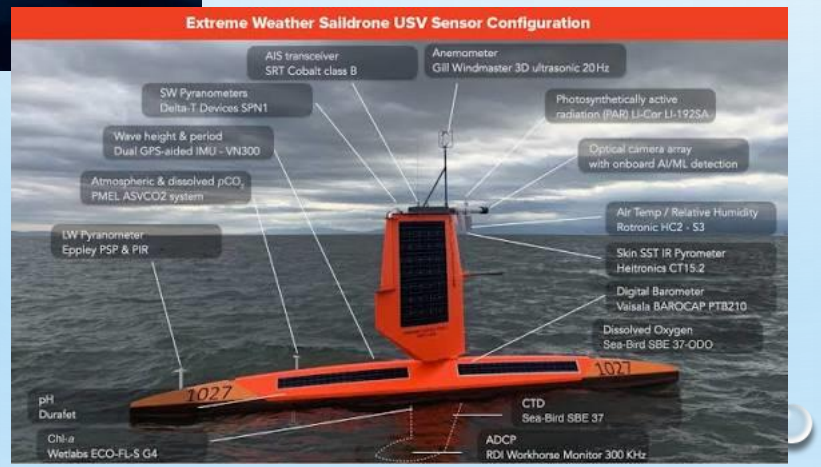
CONTINUING INSTRUMENT EVOLUTION

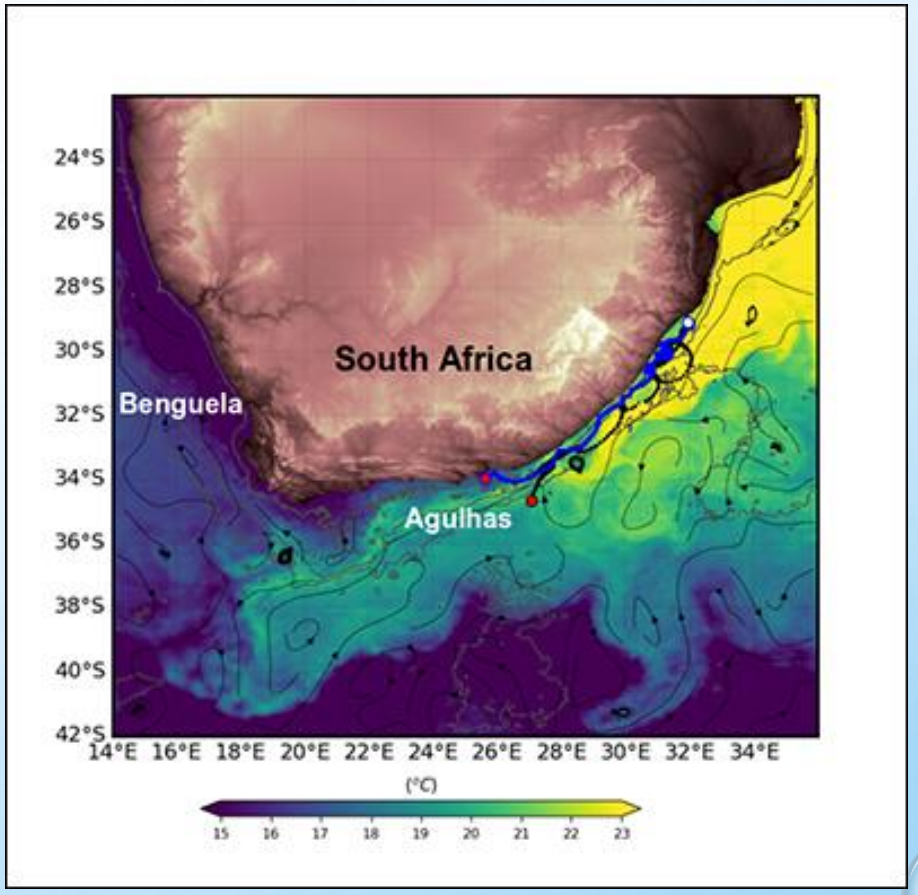




CONTINUING INSTRUMENT EVOLUTION







ADVANCING OCEAN SCIENCE: COMBINING INSTRUMENTS

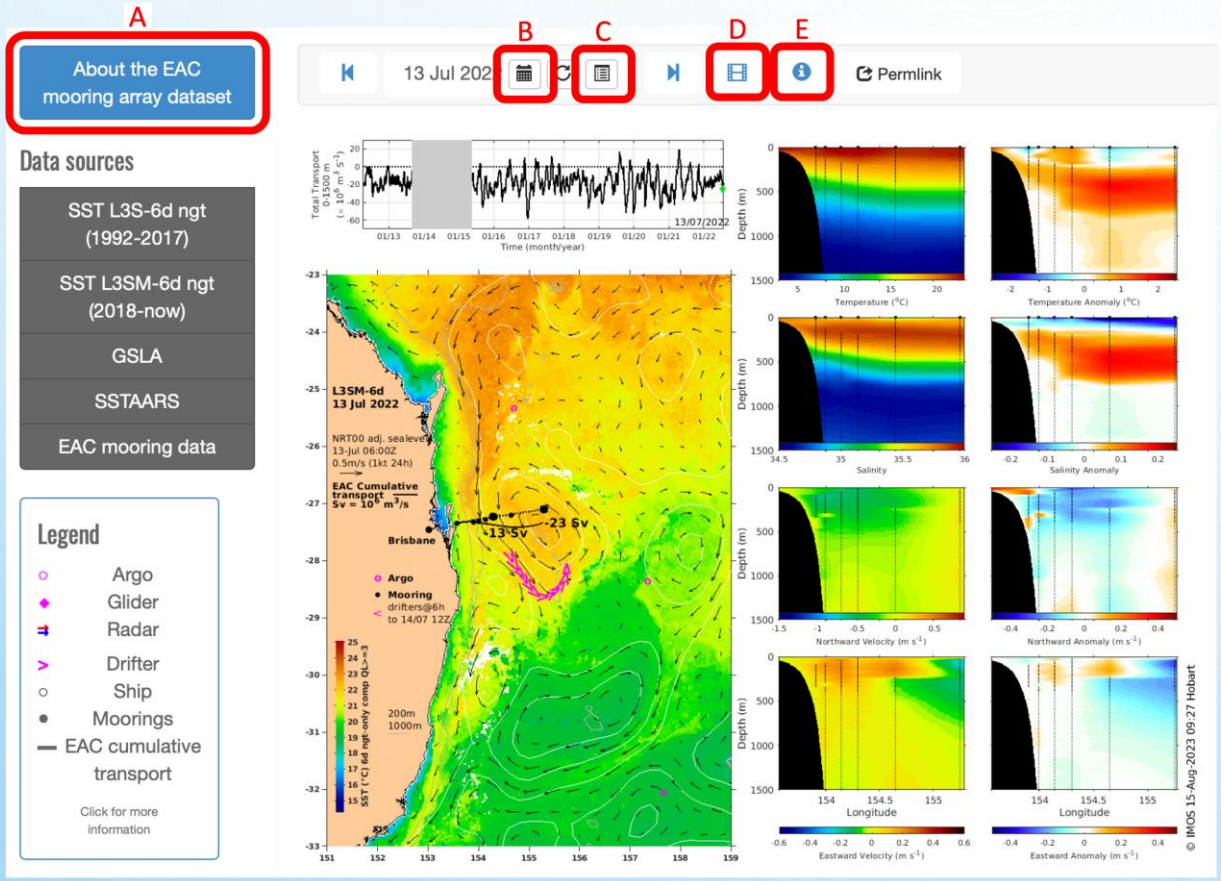
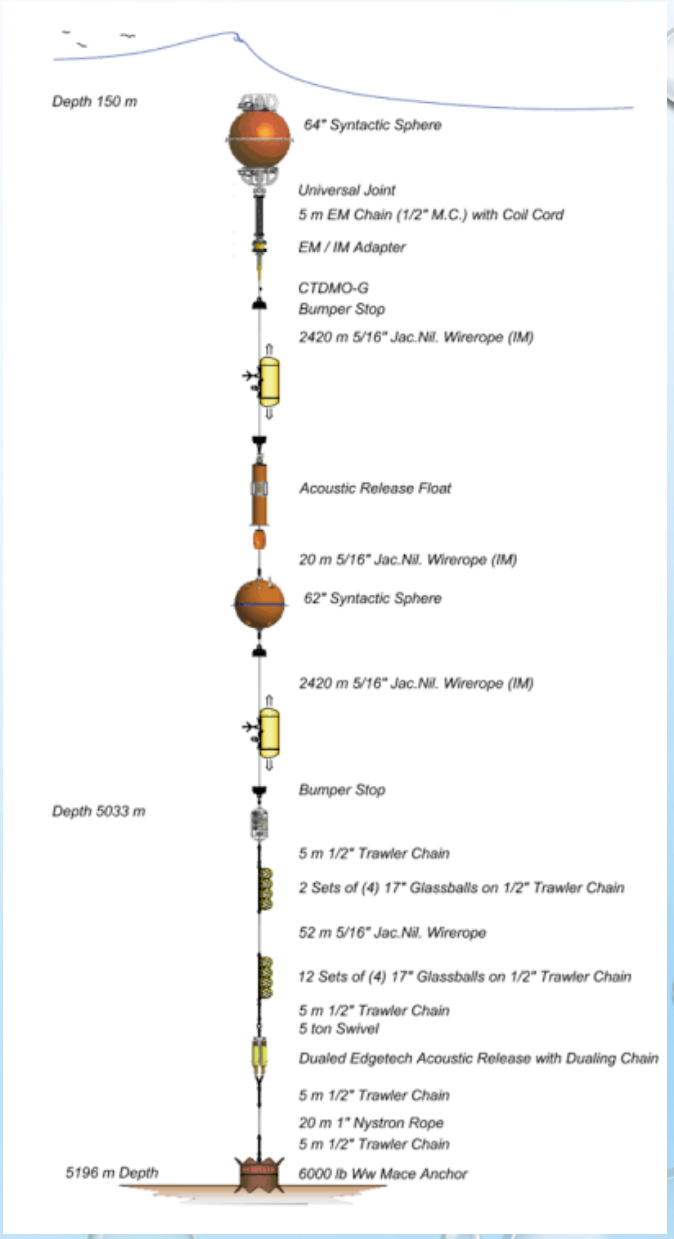
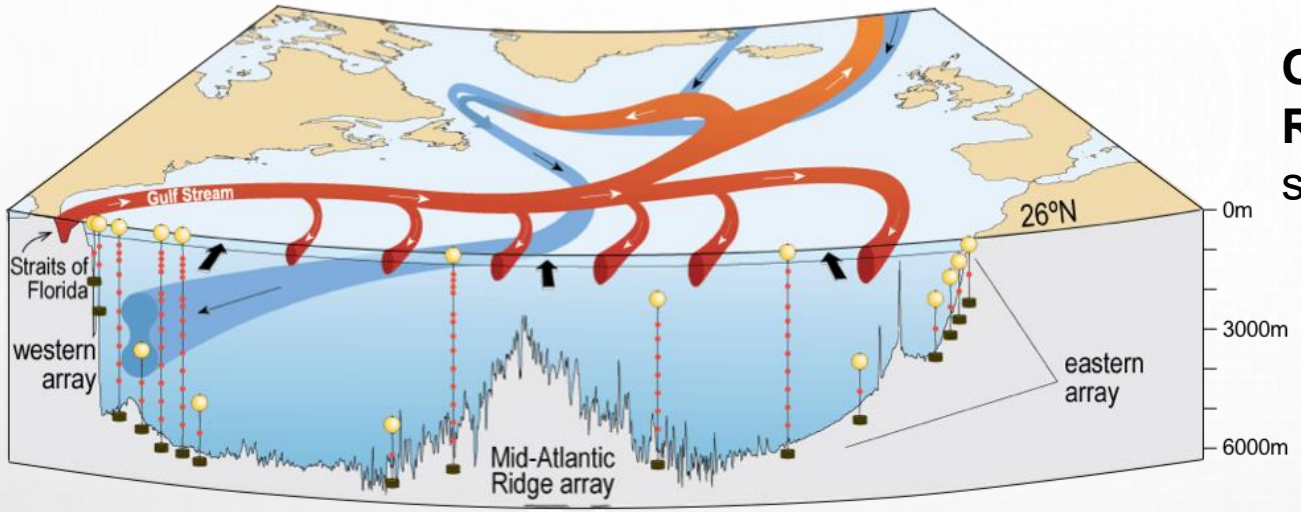


Figure 1: Overview of the EAC mooring array product. The upper left plot is the time-series of the EAC total transport (surface to 1500 m depth. The map below is a 6-day SST composite with daily cumulative EAC transport from west to east (solid black line). The plots on the right show the EAC mooring array temperature, salinity, and northward and eastward velocity interpolated onto a 1-2 km grid along the mooring line segment (black dashed line on SST map). The first column are the daily property sections, and the second column are the anomalies from the 2012-2022 seasonal climatology. For a complete description click on the 'info' button at the menu above the figures.



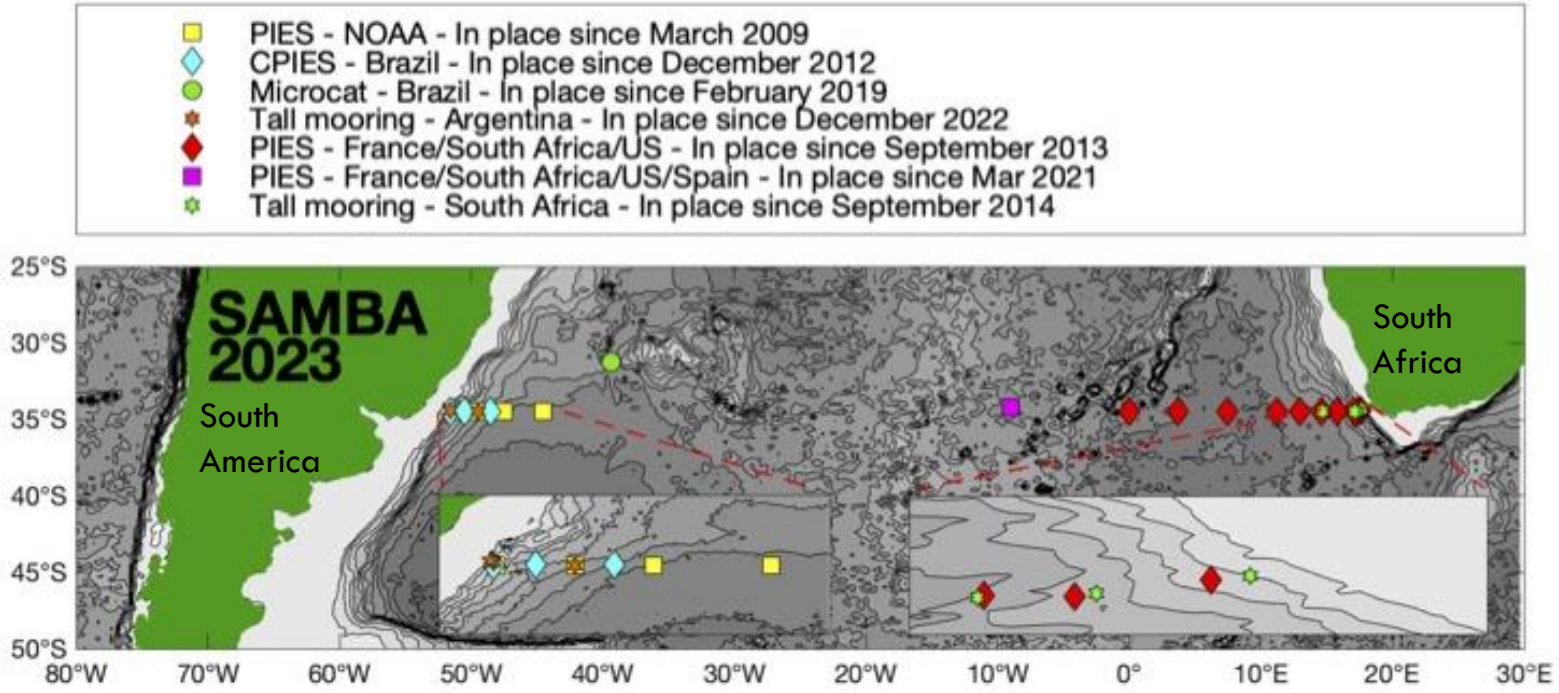
Combining Ocean Observing Platforms



Observing the overturning circulation
RAPID 26°N
since 2004

NERC, NSF & NOAA funded

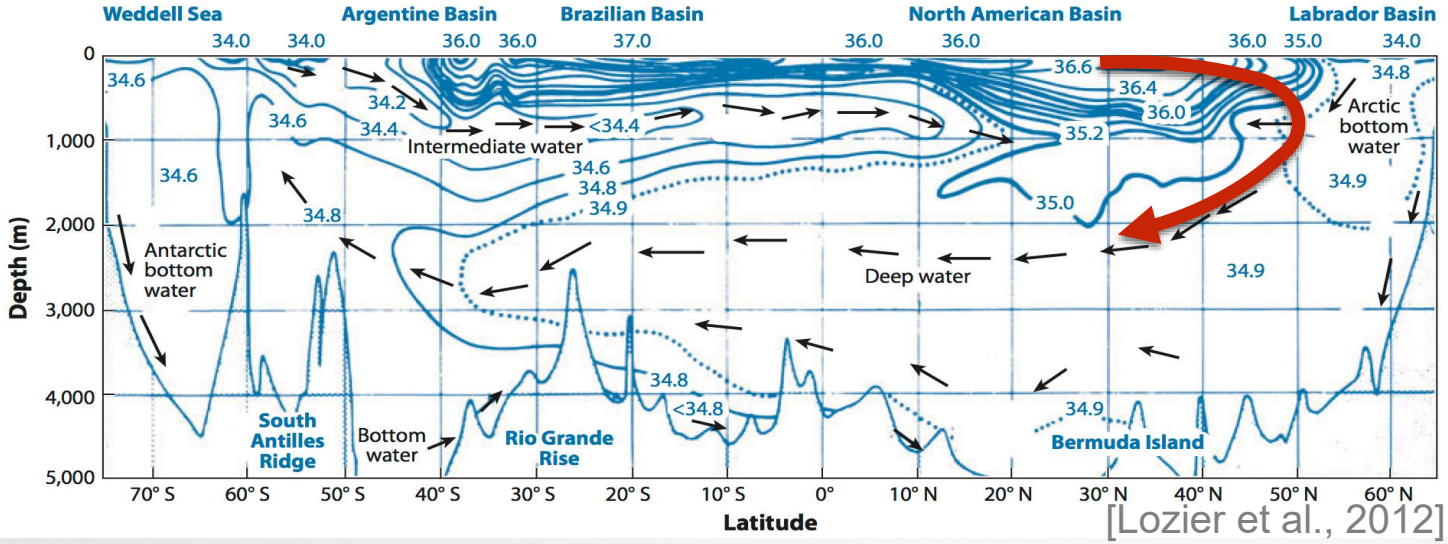
Courtesy Eleanor Frajka-Williams



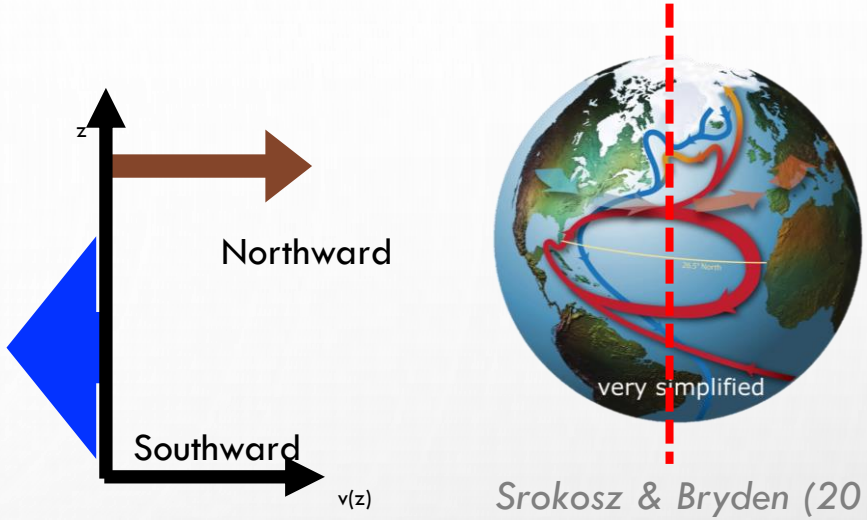
SAMBA, South Atlantic MOC Basin-Wide Array (**34.5°S**)
since 2009

Courtesy Renellys C. Perez

Measuring and computing the MOC



[Lozier et al., 2012]



Srokosz & Bryden (2015)

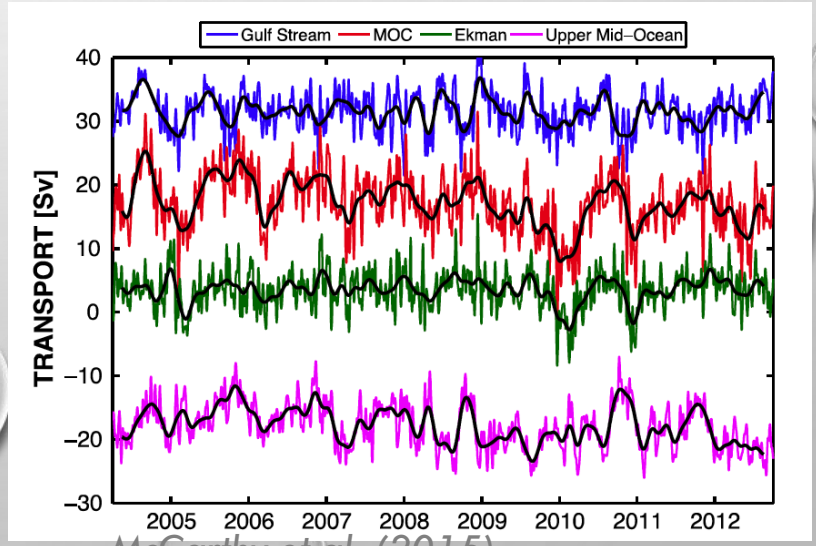
MOC strength is the maximum northward volume transport of the water across a given latitude.

We describe transport as how many "millions of cubic metres per second" are moving
1,000,000 m^3/s = 1 Sverdrup

Trans-basin observations → **T, S, dynamic height, pressure** across the Atlantic (moorings concentrated on the boundaries)
Geostrophy (or current meters/ADCPs/cables) → **velocity**
Satellite (or model) winds → **Ekman volume transport**
Models or zero-net-mass-flow assumption used → **reference velocity**
No systematic method across observing platforms

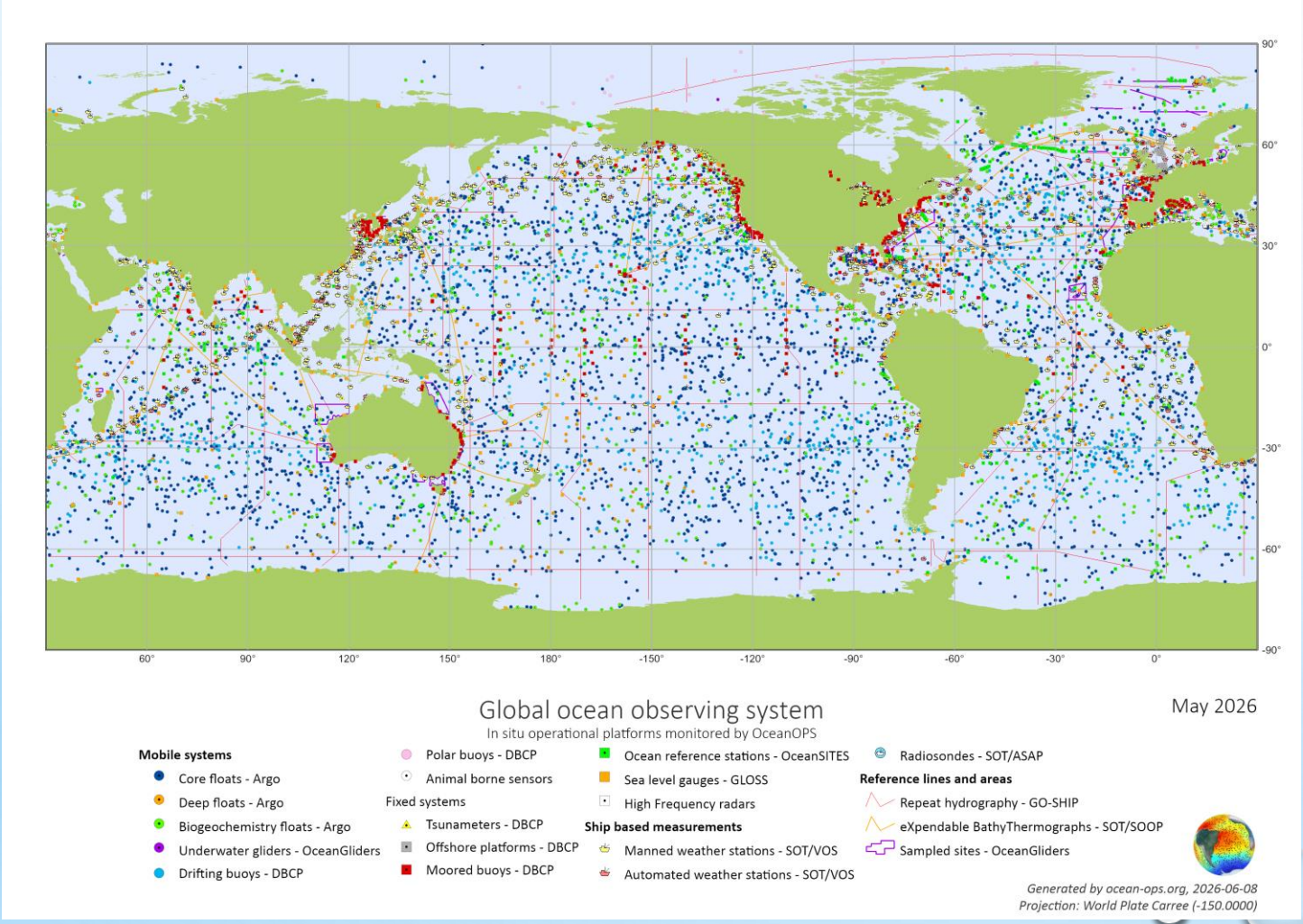
Courtesy Eleanor Frajka-Williams

MOC transport = Ekman (wind-driven) + geostrophic (density-driven) + (reference + boundary current +) …



McCarthy et al. (2015)

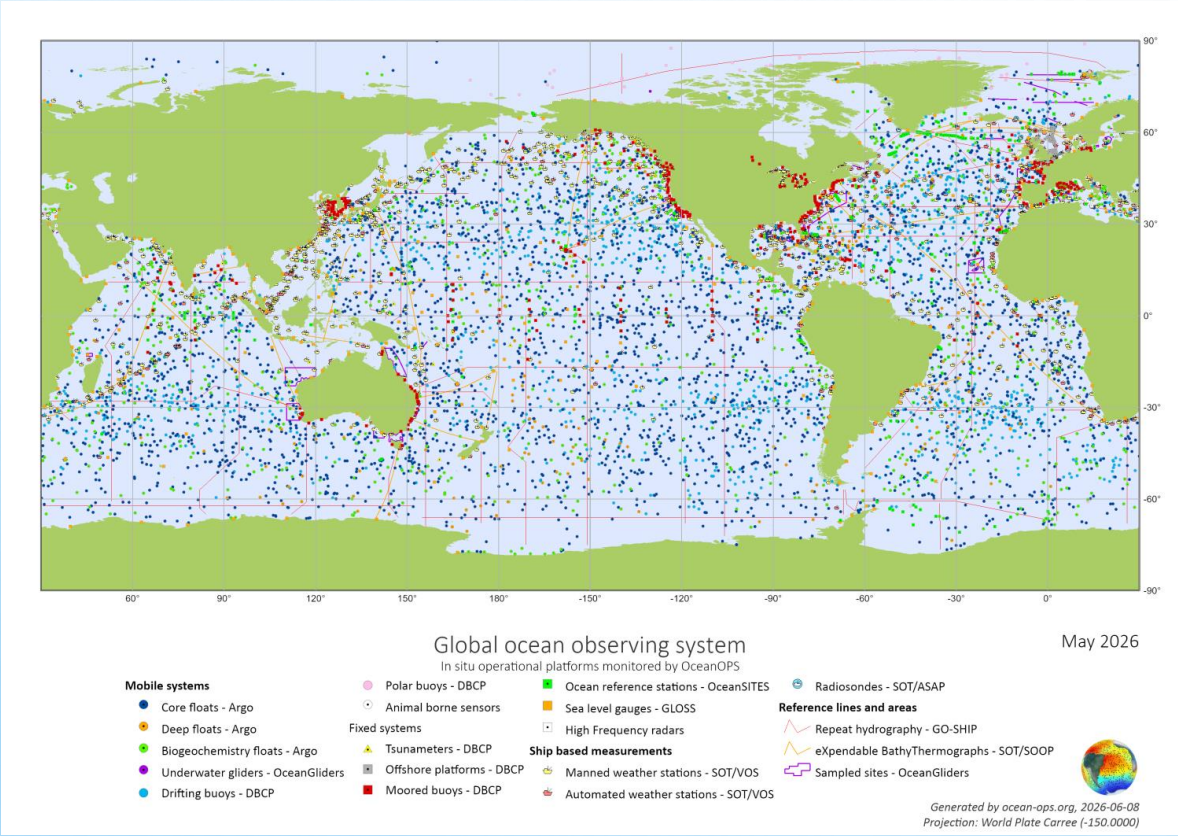
GLOBAL OCEAN OBSERVING SYSTEM



Measuring essential ocean/climate variables:

Temperature
Salinity
Velocity
Nutrients
Carbon

GLOBAL OCEAN OBSERVING SYSTEM



Questions / Discussion