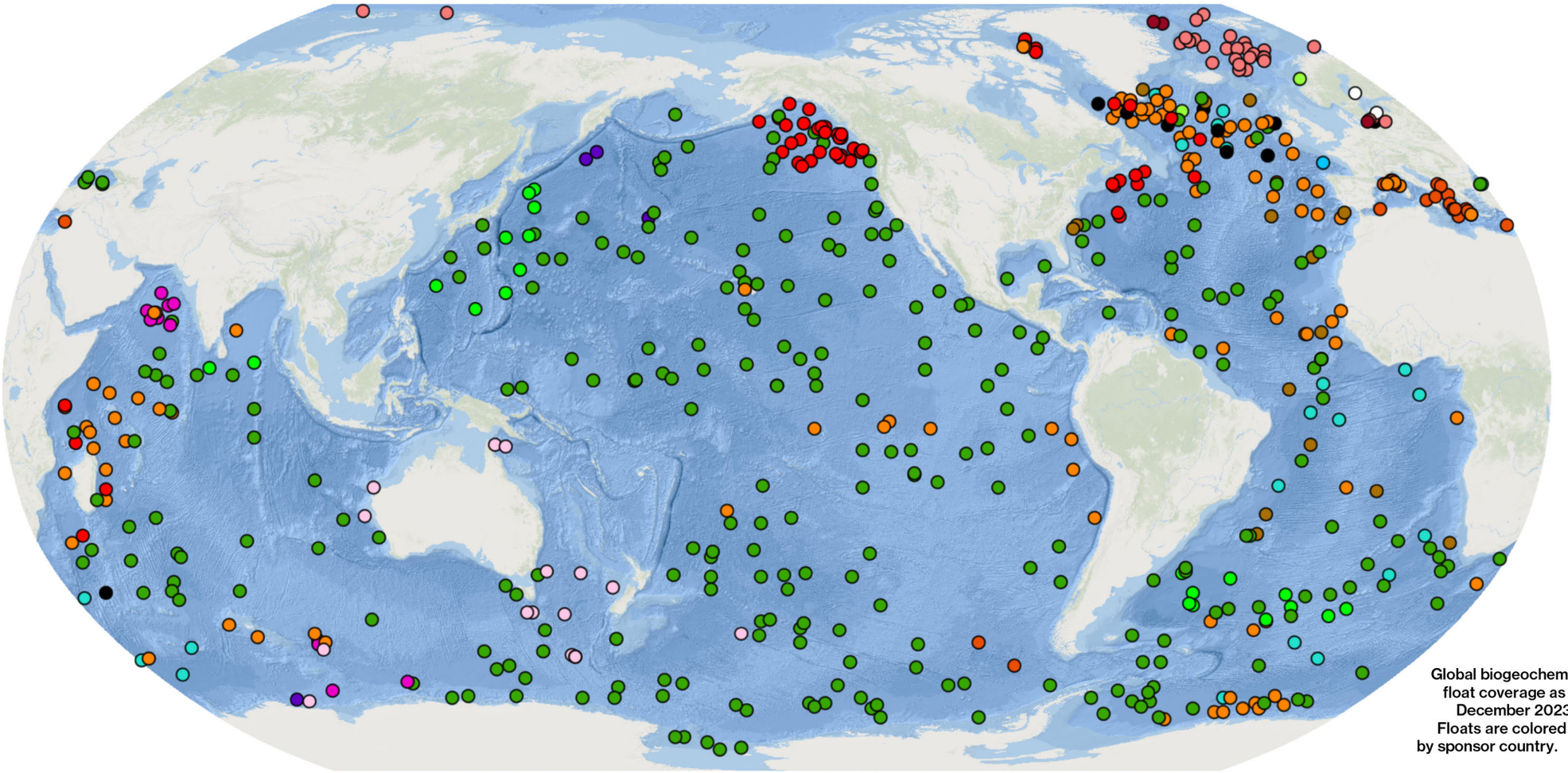
BGC-Floats Observe Global Ocean Health & Carbon in Real Time

SOCCOM
Southern Ocean Carbon and Climate Observations and Modeling

Global Ocean Biogeochemistry Array



Global biogeochemical float coverage as of December 2023. Floats are colored by sponsor country.

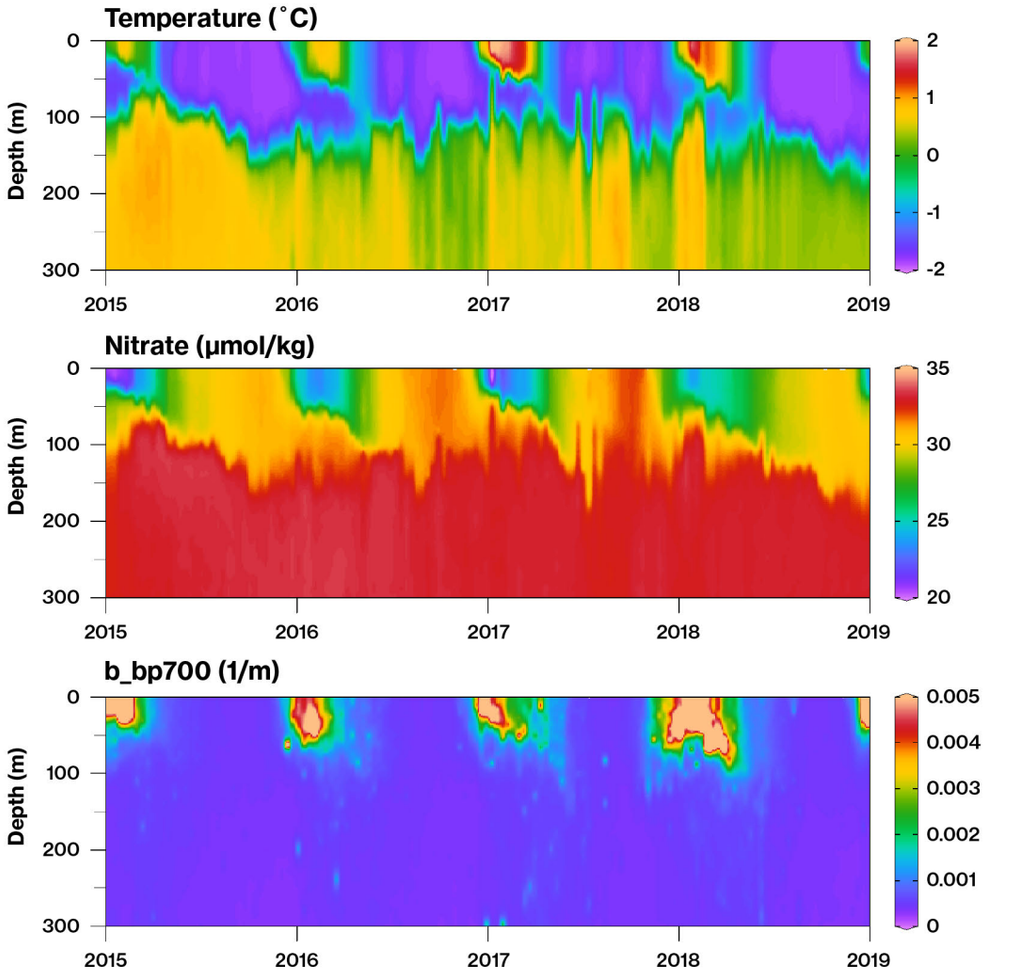
Robotic floats enable real-time observations of global ocean biogeochemistry

A global ocean observing system is essential if we want to understand, model, and sustainably manage the largest living space on our planet. Autonomous biogeochemical (BGC) floats provided through the **Global Ocean-Biogeochemical (GO-BGC) Array** and the **Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM)** projects assist in this effort by measuring ocean health parameters such as temperature, salinity, oxygen, pH, chlorophyll fluorescence, backscatter, nitrate, and irradiance of the water column.

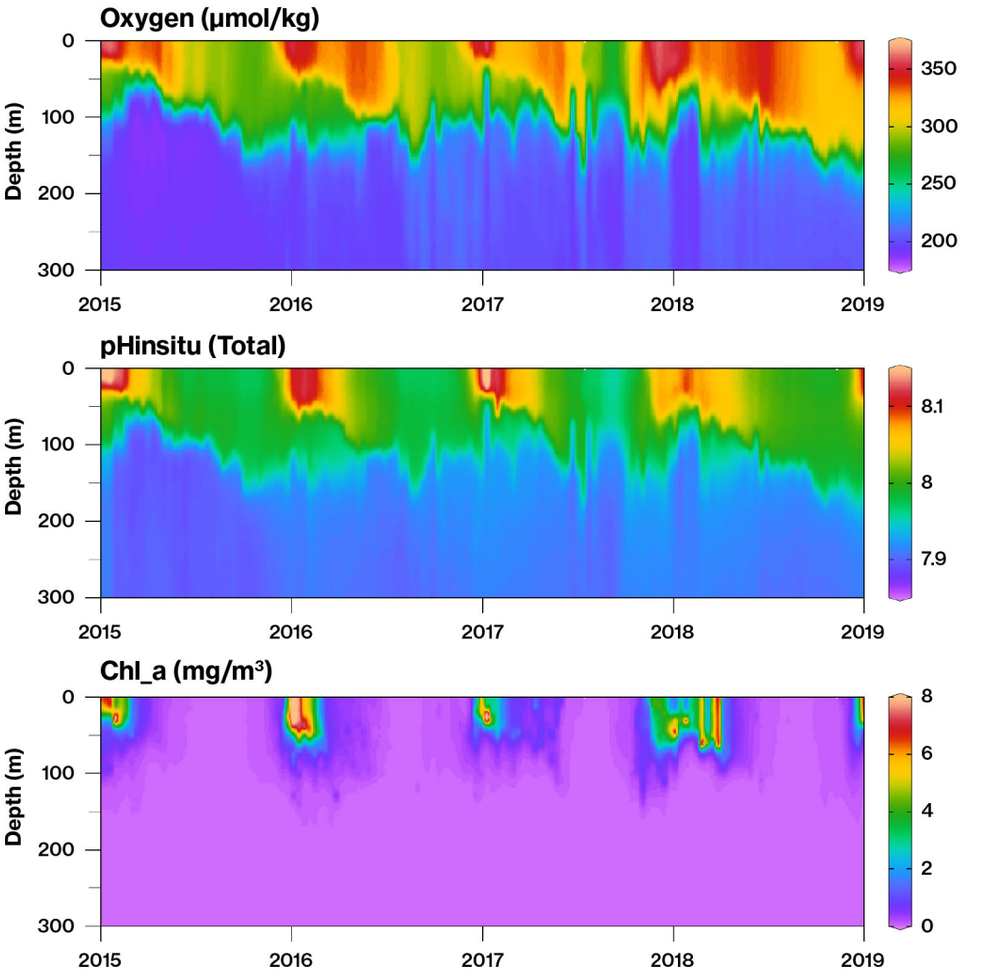
Together with floats provided by international partners in **One-Argo**, they provide the information needed to understand and manage the ocean.

Several hundred of these floats are now in operation and provide freely available, high-resolution, quality-controlled data in real-time to:

- Observe ecosystem changes over time and space every few days
- Quantify the carbon flow at climate-relevant time scales
- Accelerate understanding and prediction of ocean biogeochemical cycles
- Serve as a baseline dataset for comparisons against future changes
- Incorporate quality-controlled data into Earth system models
- Provide the foundation for an ocean carbon observatory



Data for six different variables collected by one float, downloaded straight from the Biogeochemical-Argo database, and plotted using Ocean Data View (ODV®). The float also measures salinity (not shown here).



Establishing a biogeochemical baseline, one float at a time

Float ID# 5904468 (indicated by the star on the globe to the right) profiled the Southern Ocean around 65˚S every 10 days, providing biogeochemical data with high spatio-temporal resolution.

The plots above are time series for six variables collected by this autonomous robot. The float provides critical information about ocean health and carbon and records the region's strong seasonal cycle.

- During the summer, sunlight increases. This warms the waters and enhances primary productivity in the upper 100 meters of the ocean, as evidenced by high levels of chlorophyll fluorescence and backscatter (bbp, a proxy for plankton carbon).
- Annual phytoplankton blooms take up nutrients (nitrate) during photosynthesis while releasing oxygen and raising pH.
- These blooms end as nutrients are depleted or deep mixing in the fall resets the system.
- Float data also reveals interannual variability. This float shows that the summer of 2018 experienced the strongest and longest bloom between 2015 and 2019.

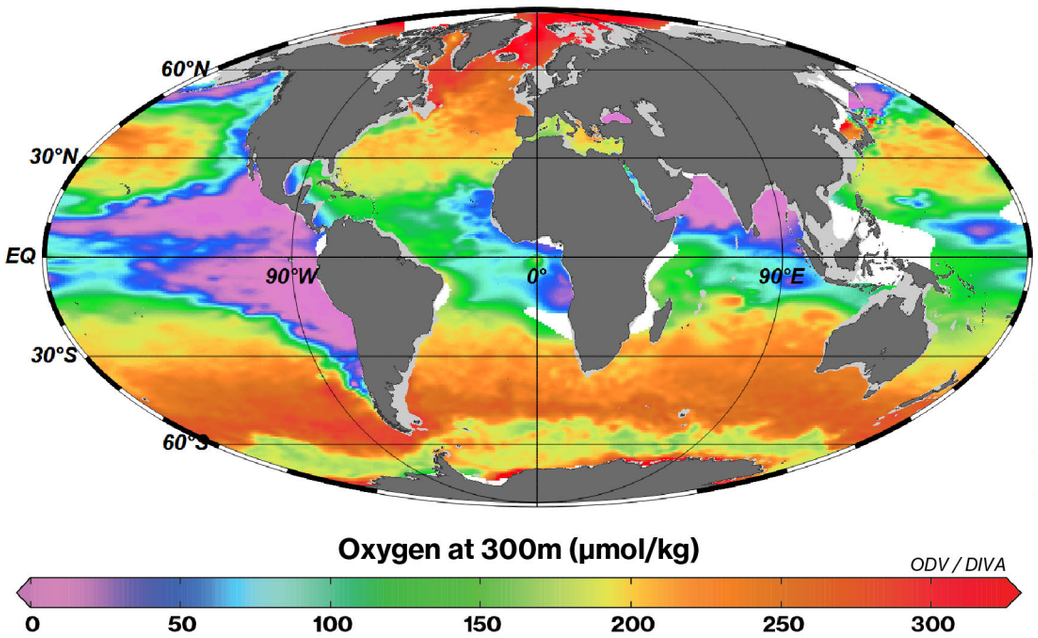
Going global: the power of an international fleet

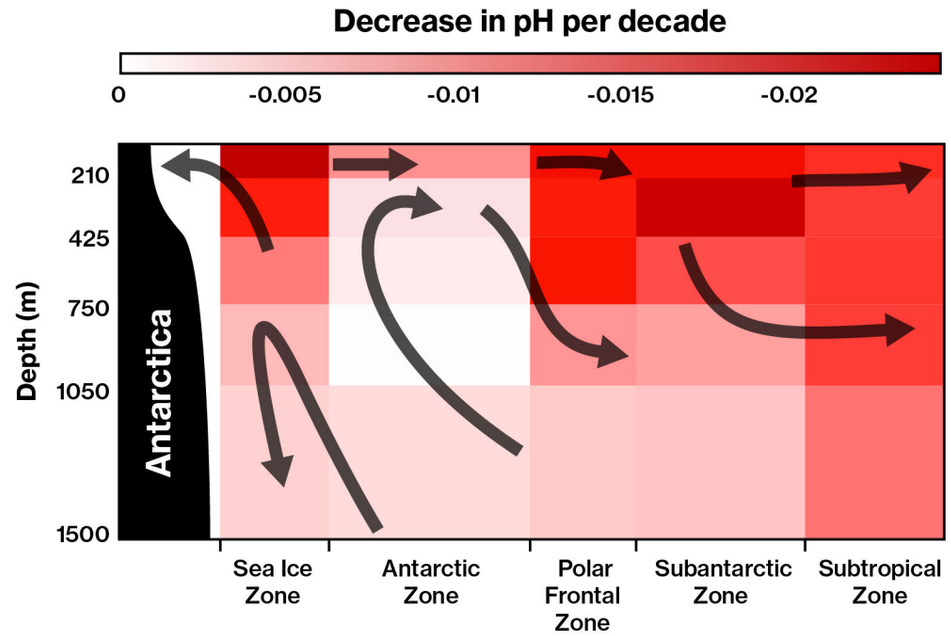
When used as a fleet, float datasets allow for biogeochemical observations on a global scale from the surface down to 2000 meters and with high vertical resolution.

The gridded map below is an example of this, showing the ocean's oxygen concentrations at 300 meters of depth.

Purple areas denote oxygen-deficient zones (ODZs), which are predicted to expand due to global warming. Since many organisms cannot tolerate the low oxygen levels found in these zones, measuring changes in ODZ size is crucial for monitoring ocean health.

Floats can also track the expansion of ODZs over time: monthly, seasonally, and annually. However, the success of the program in monitoring long-term changes in the global ocean requires that we maintain the fleet's size and coverage.





Decadal trends in Southern Ocean acidification, partitioned by spatial zones of the Southern Ocean and depth. Arrows indicate the pattern of overturning circulation. Adapted from: Mazloff et al., 2023. Southern Ocean Acidification Revealed by Biogeochemical-Argo Floats. *JGR: Oceans.*

Modeling the ocean with quality-controlled data

BGC-floats improve climate models that analyze and predict long-term ocean trends by providing data to test model accuracy.

The figure above is an output of a model that incorporates older ship pH data and newer float pH data. The model shows decadal trends in ocean acidification across the Southern Ocean, revealing a significant decrease in pH overall in the region. It also reveals a spatial acidification pattern that mirrors the overturning circulation of water within the Southern Ocean's different zones.

Decreases in ocean pH may harm marine life and reduce the ocean's capability to absorb more atmospheric CO_2. Thus, observing changes in pH, deoxygenation rates, and productivity is critical. BGC-floats are a valuable asset in the mission to obtain high-quality observations and long-term analyses of our changing ocean.

Access BGC-float data today: it's online and free!

Complete with tutorials for getting started.

Explore our outreach efforts

- Adopt-a-Float Program: adopt a float, track its progress, and work with data.
- MATE Floats! Competition: engages students in building their own profiling float.
- Scripps Makerspace: offers hands-on courses on building sensors.

Image: © SOCCOM

Learn more at:

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Brochure created by Mariana Bif, Heidi Cullen, Madeline Go, and Ken Johnson.

go-bgc.org/brochure