

Understanding and accessing available Argo floats data

WIO Workshop June 8, 2022

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v4

A world map with a dark blue background and white landmasses. Numerous small, vertical, white and green rectangular markers representing Argo floats are scattered across the map, with a higher density in the Indian Ocean region. A white rectangular box is centered over the map, containing the word "Goals".

Goals

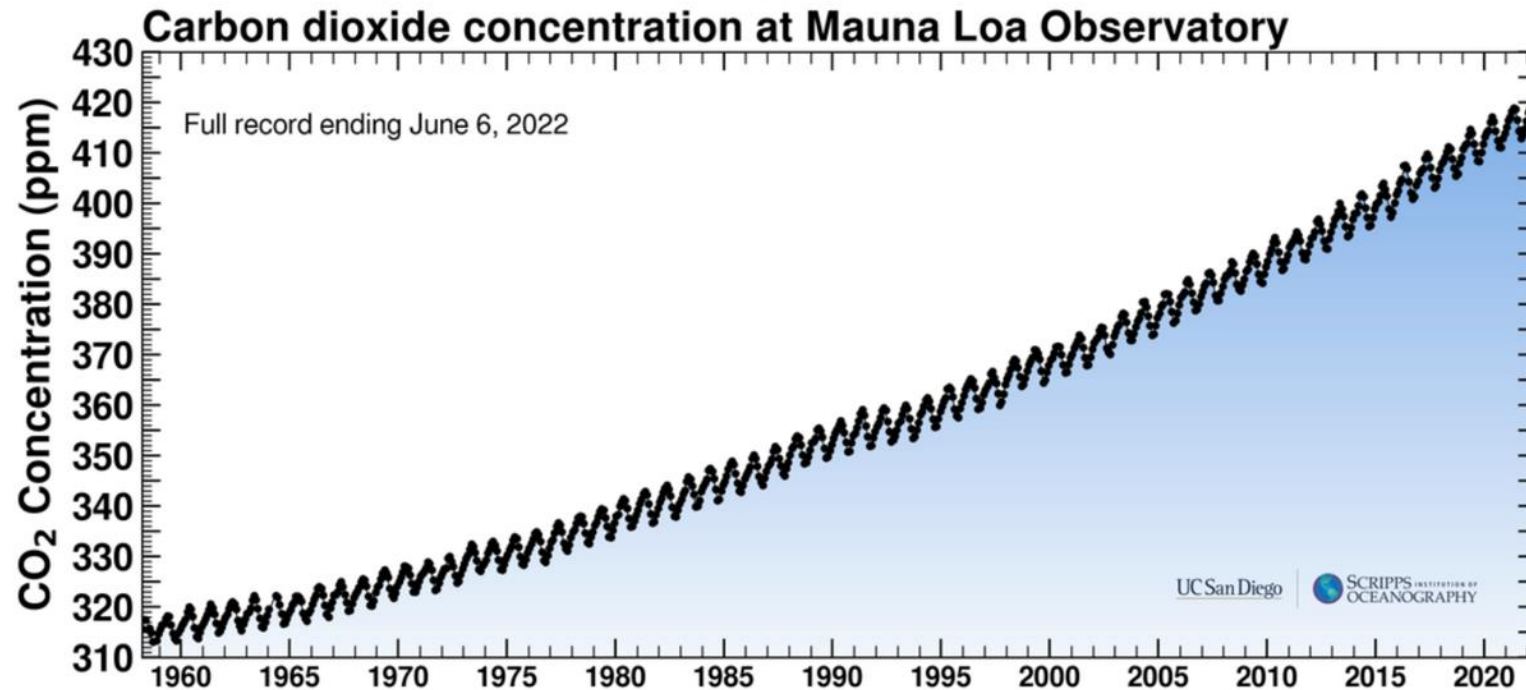
- “to rapidly intensify the IndOOS coverage of the Arabian Sea and western equatorial Indian Ocean, including biogeochemical measurements”
- Introduction to Argo floats.
 - Lecture on what they are, how does it work, what variables can be measured, what data are available, website
- A case study on Data access
 - Argo data application, where one can get the data, data mining and analysis.

The Keeling Curve

[HISTORY](#)[MEASUREMENT NOTES](#)[VIDEOS](#)[OTHER CLIMATE INDICATORS](#)

The Keeling Curve is a daily record of global atmospheric carbon dioxide concentration maintained by Scripps Institution of Oceanography at UC San Diego

*Latest CO₂ reading: **421.18 ppm**

[ONE WEEK](#)[ONE MONTH](#)[SIX MONTHS](#)[ONE YEAR](#)[TWO YEARS](#)[FULL RECORD](#)[1700-PRESENT](#)[2K YEARS](#)[10K YEARS](#)[800K YEARS](#)

<https://keelingcurve.ucsd.edu/>

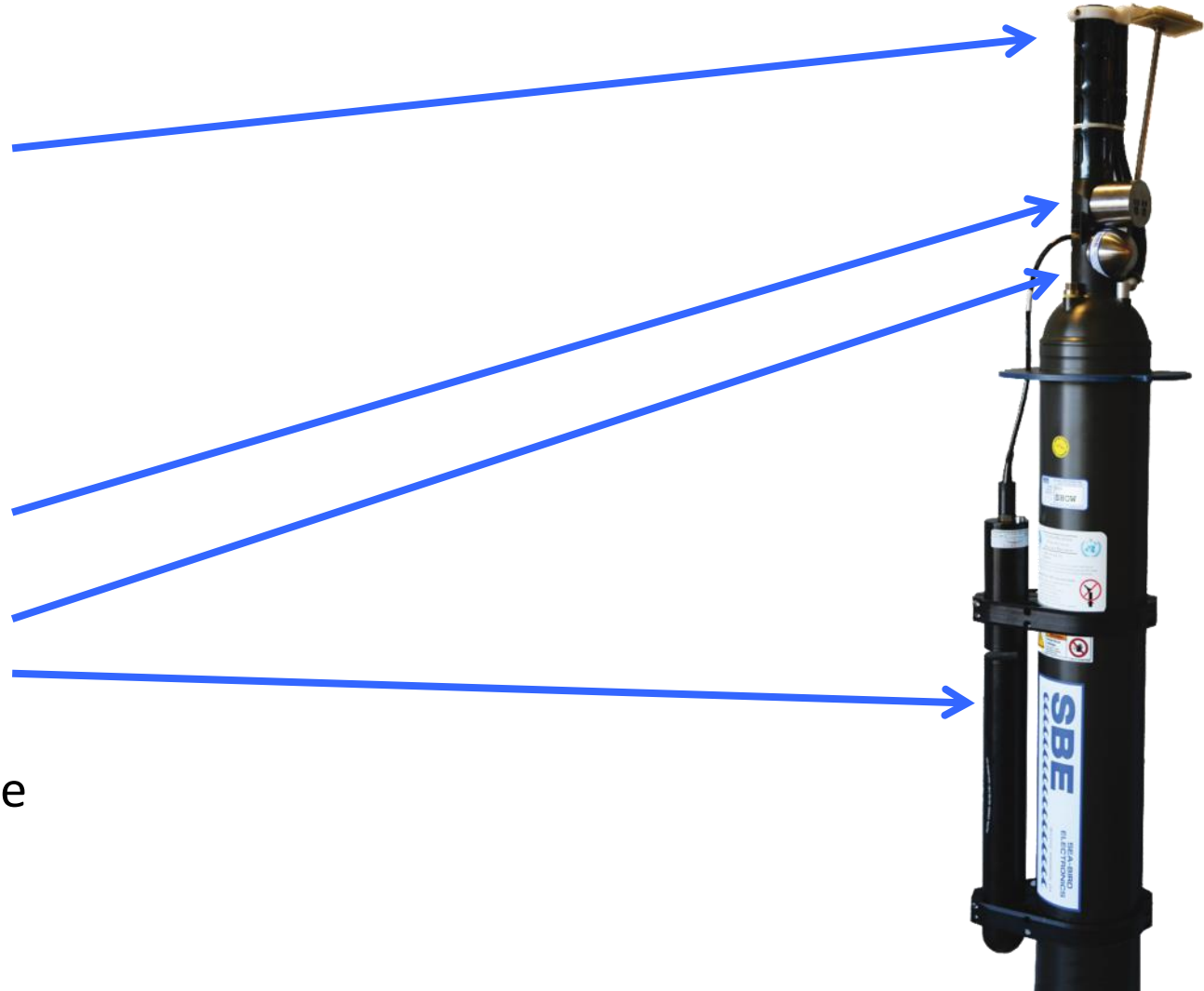
What is a Biogeochemical Float?

- Autonomous Profiling Float
 - Buoyancy Engine
 - Oil Reservoir and Bladder
 - Pump from Reservoir to Bladder:
 - Expands – Float density decreases
- Batteries
- Satellite Antennae
- Control Electronics
- Sensors

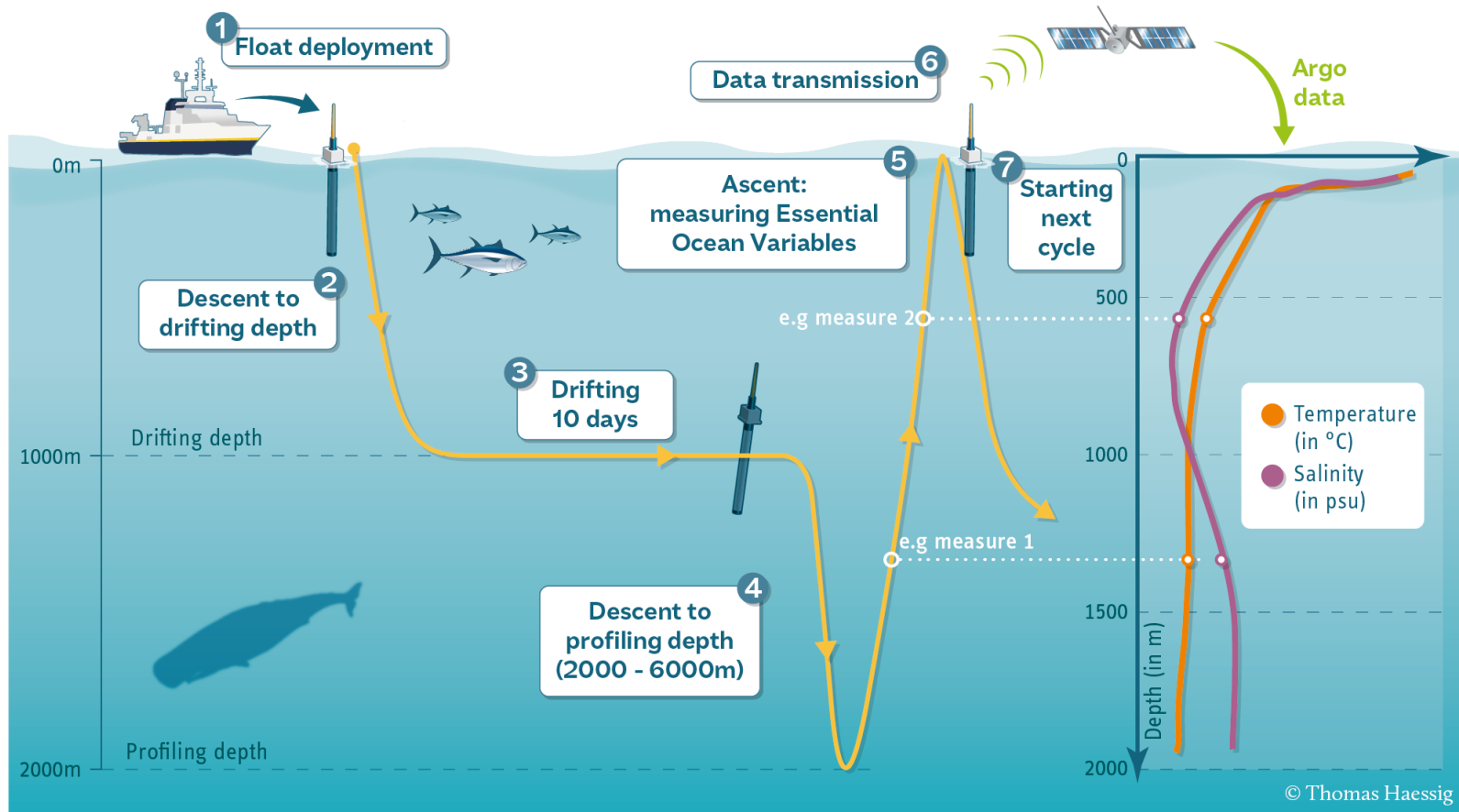


Instruments on a Biogeochemical Float

- Physical:
 - CTD
 - Pressure (Depth)
 - Temperature
 - Salinity
- Biogeochemical:
 - Chlorophyll a
 - Suspended Particles
 - Oxygen
 - Nitrate
 - pH
 - Downwelling irradiance



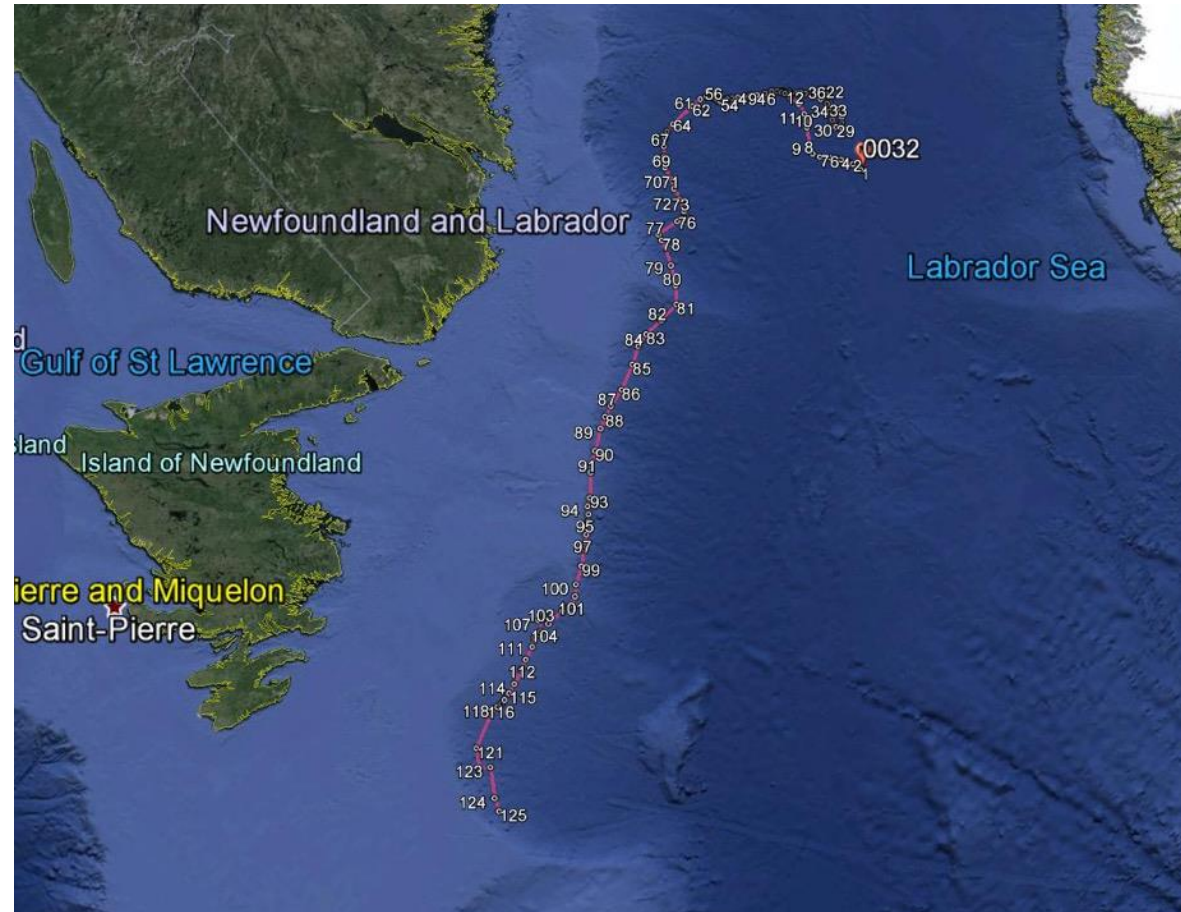
Float Standard Operation



<https://argo.ucsd.edu/how-do-floats-work/>

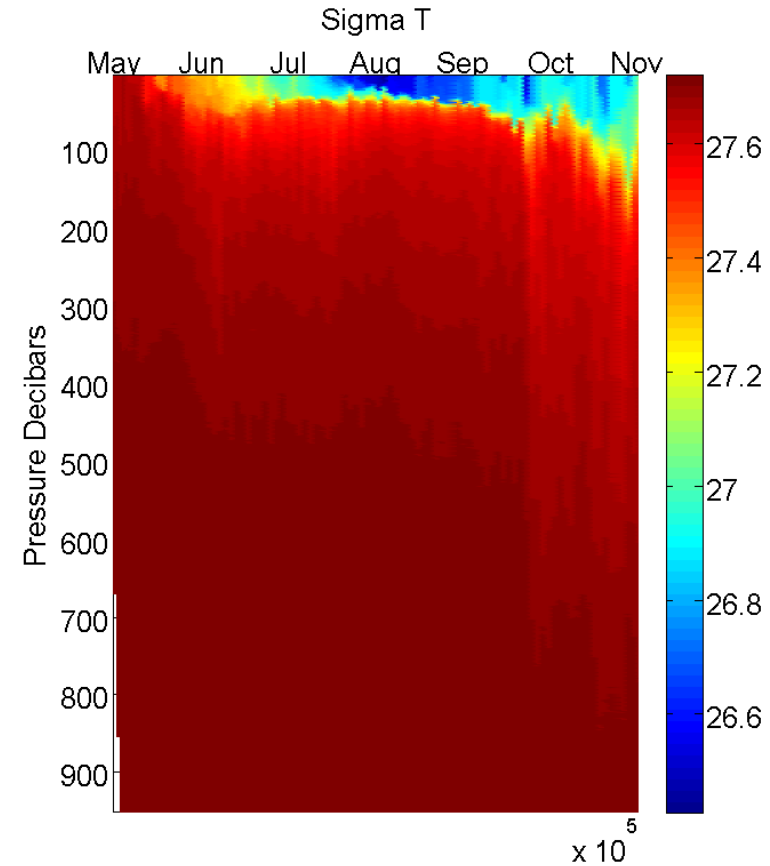
Labrador Sea

Deployed in the spring data from this float shows the biological reaction to stratification

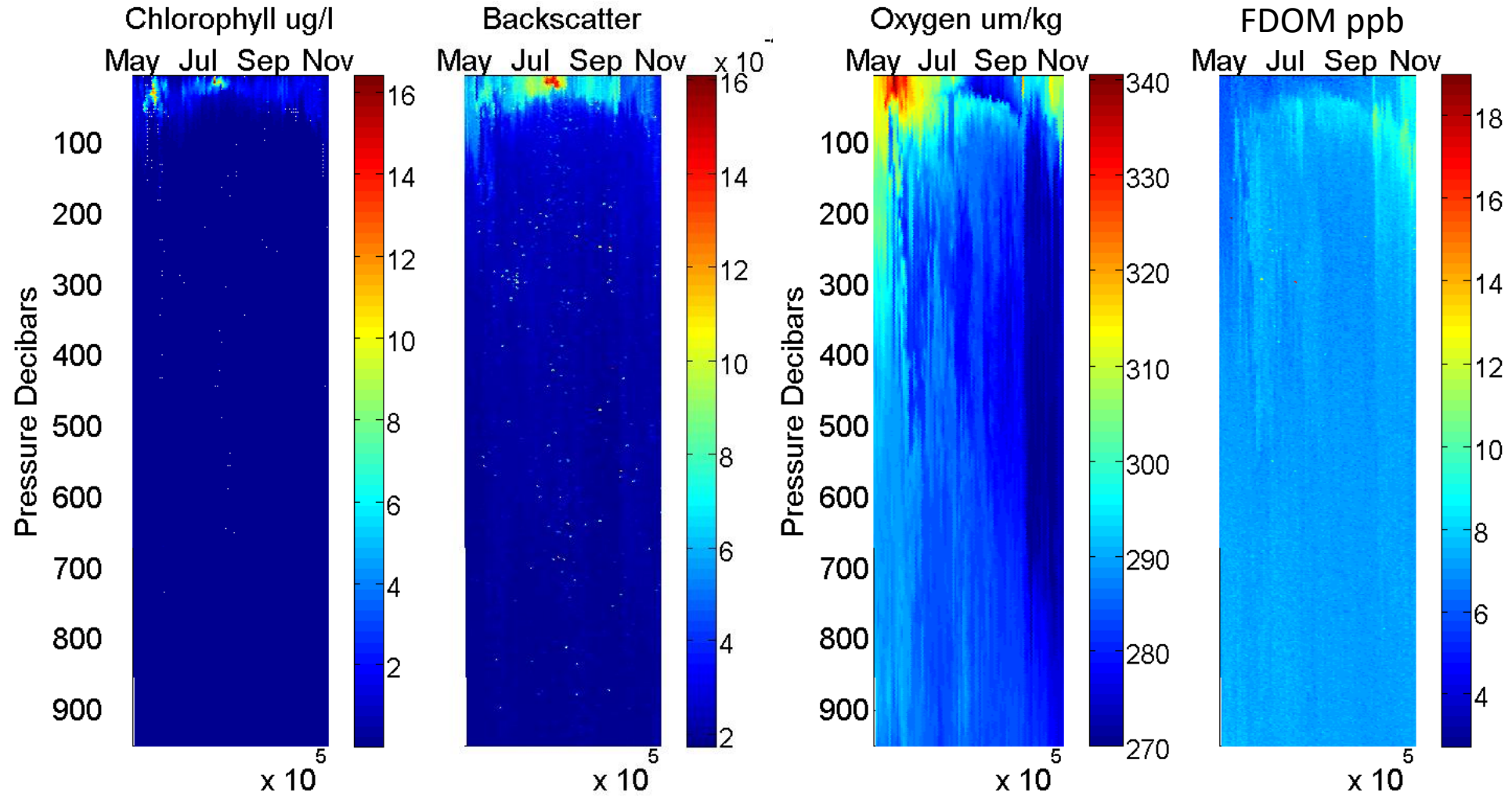


Sigma T

As the float moves south along the coasts of Labrador and Newfoundland stratification develops

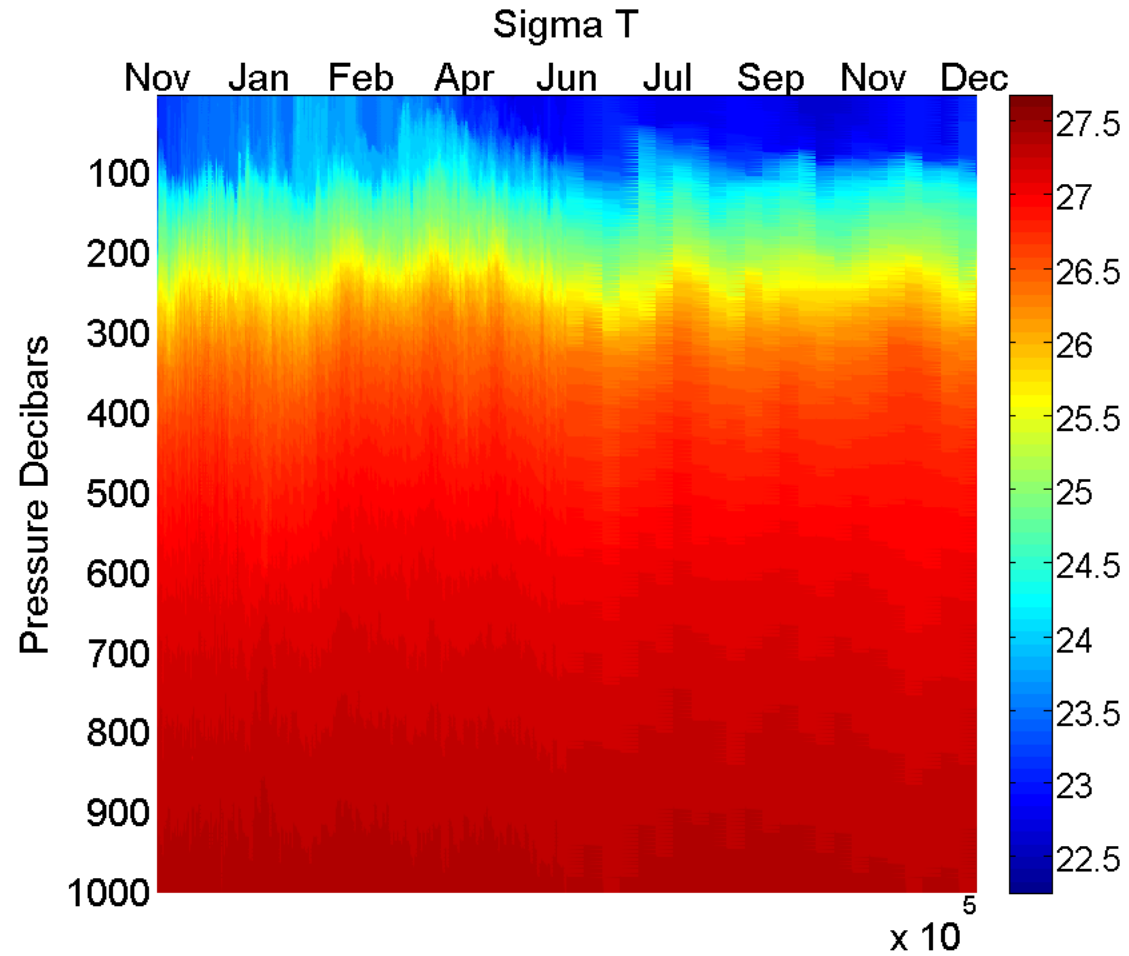


Chlorophyll, Backscattering, Oxygen, FDOM

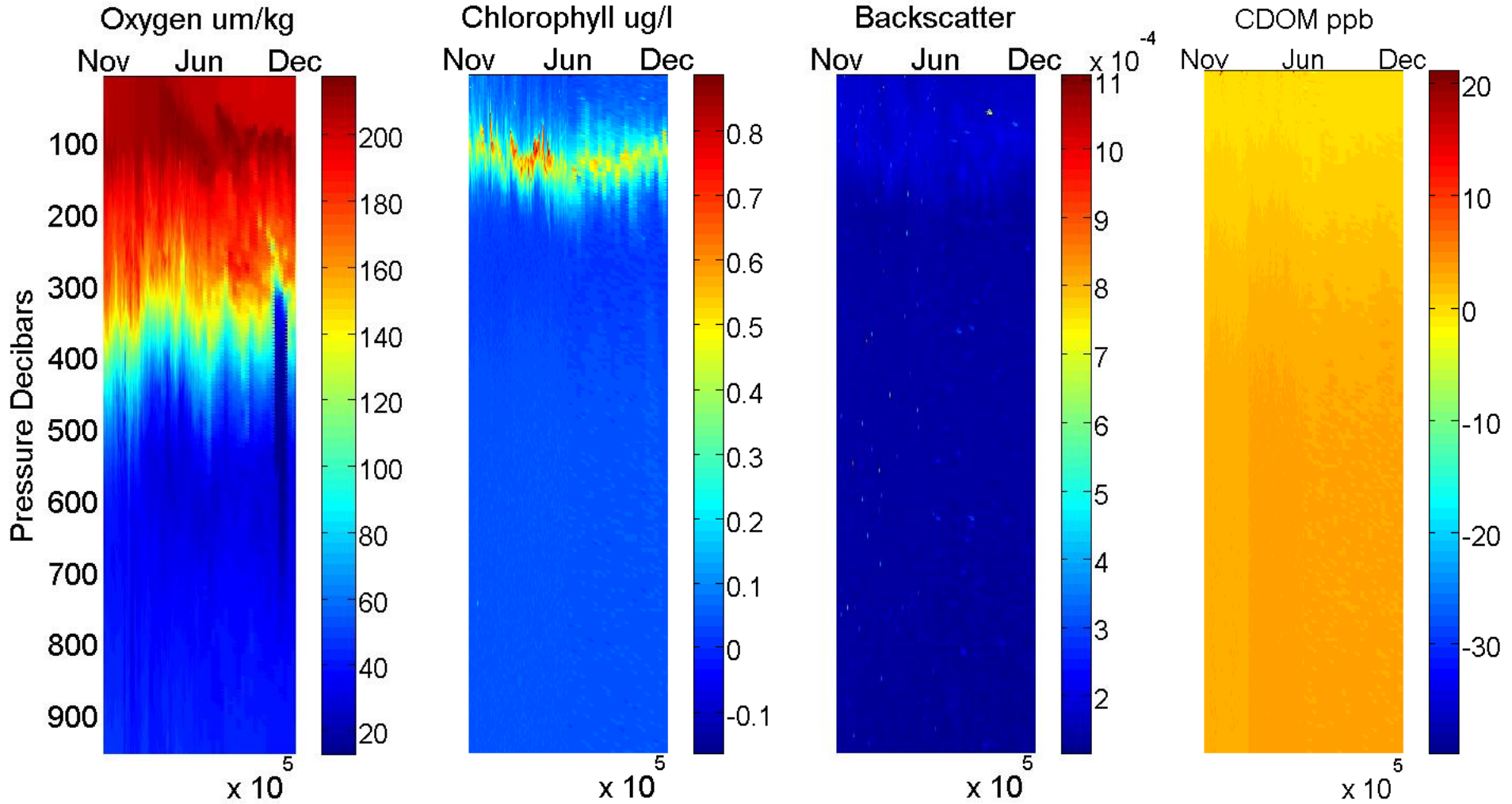


Hawaii

- Deployment near the HOT site provides an oligotrophic example



Oxygen, Chlorophyll, Backscattering and CDOM



Downloading Bio-Argo Data

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v1

<https://biogeochemical-argo.org/index.php>

Format: header has an active link to the webpage pictured



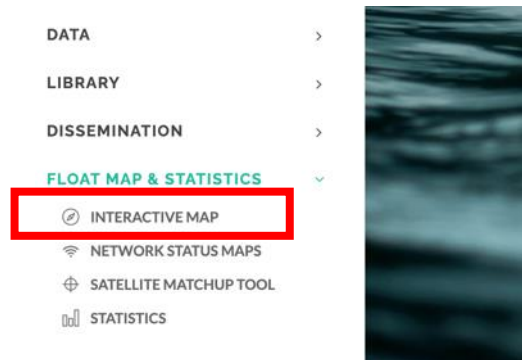
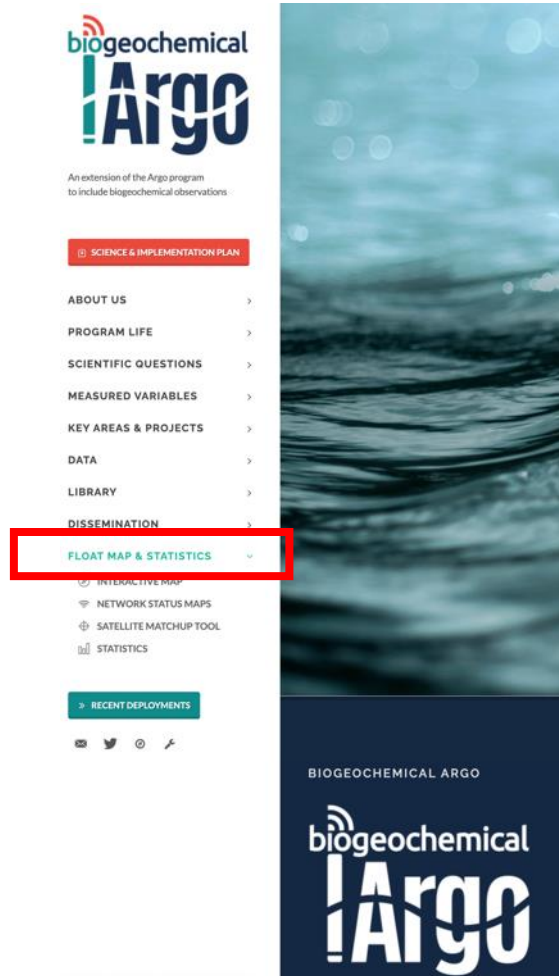
Red outlines indicate active areas on the webpage to modify and/or activate.

Yellow highlights actions to take

The screenshot shows the homepage of the biogeochemical-argo.org website. The header features the logo and a navigation menu with red outlines around the 'SCIENCE & IMPLEMENTATION PLAN' and 'RECENT DEPLOYMENTS' items. The main content area has a large blue background with the logo and a 'Screenshot' label. The footer contains a 'MENU' section with two columns of links and a statistics table.

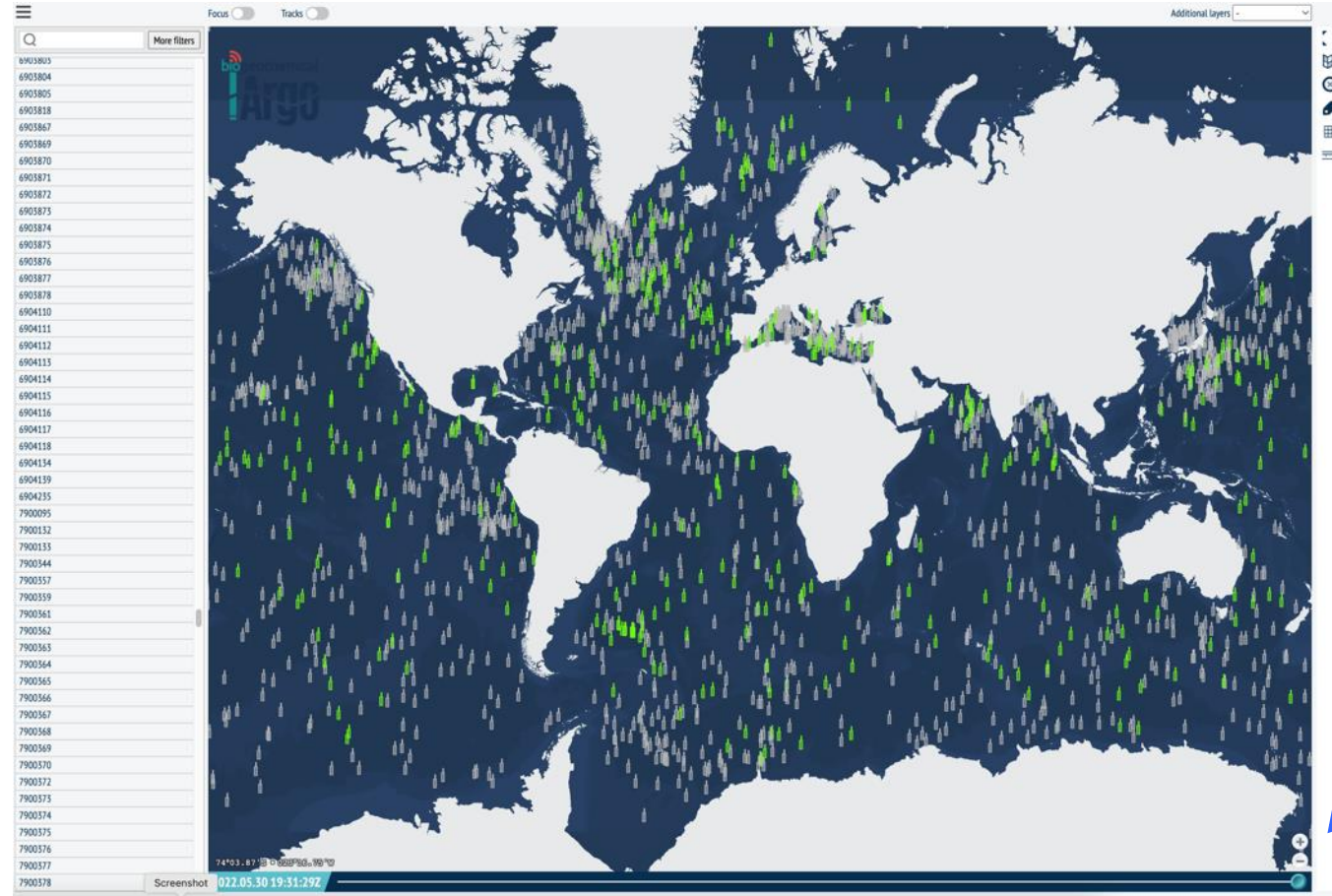
BIOGEOCHEMICAL ARGO		MENU		MENU		TOTAL PROFILES		2022 PROFILES	
biogeochemical !Argo		> About us	> Measured Variables	> General Context	246031	8764			
> Project Origin	> Oxygen	> Participating countries	> Nitrate	> pH	TOTAL O ₂ PROFILES	2022 O ₂ PROFILES ACQUIRED BY			
> Mission team	> Chlorophyll a	> Data management task team	> Suspended particles	> Downwelling Irradiance	54958	476 ACTIVE SENSORS			
> Program Life	TOTAL NO ₃ PROFILES	> News on Twitter	109 ACTIVE SENSORS						
> Program Newsletter									

<https://biogeochemical-argo.org/index.php>



Select (Click): **Interactive Map**

<https://maps.biogeochemical-argo.com/bgcargo/>



Map Zoom Controls



<https://maps.biogeochemical-argo.com/bgcargo/>



Inactive Float

Active Float

<https://maps.biogeochemical-argo.com/bgcargo/>

Path of Active Float
5906204

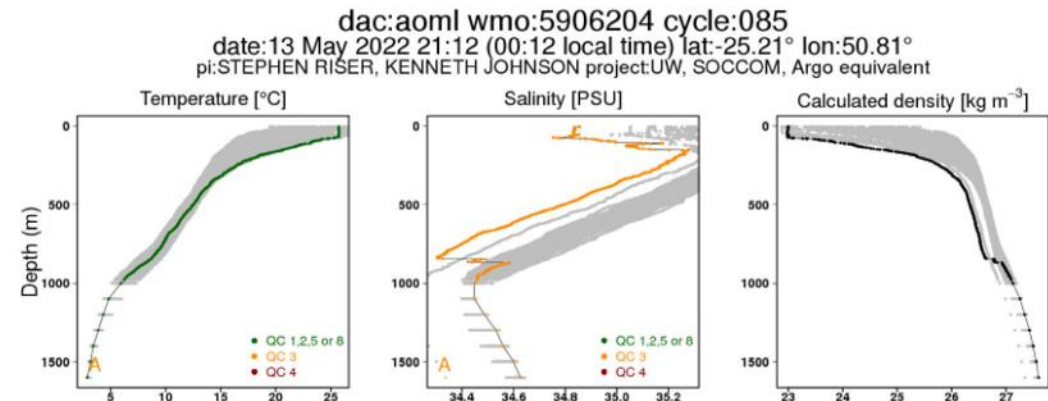
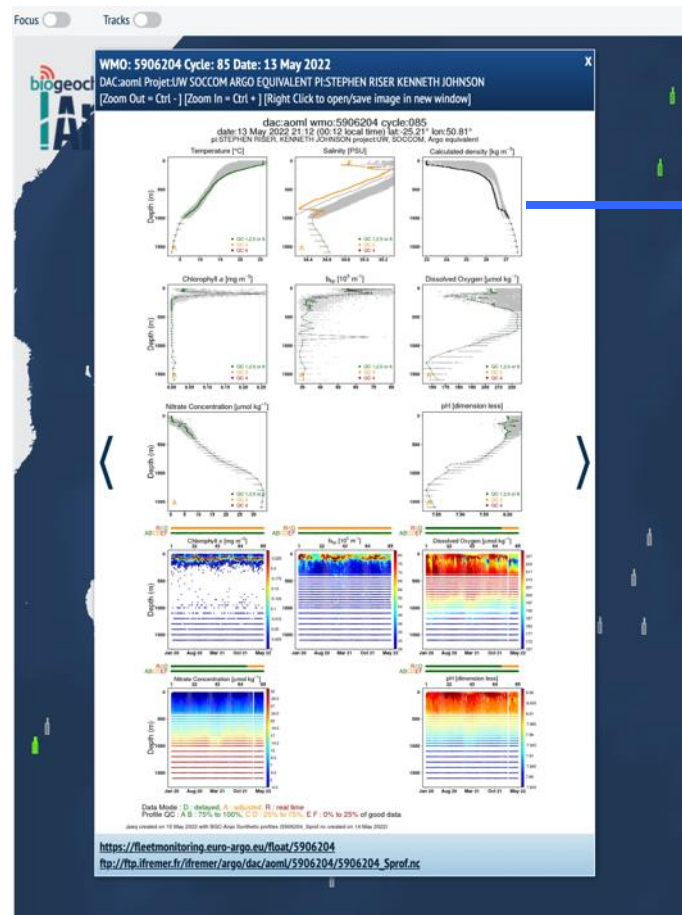


<https://maps.biogeochemical-argo.com/bgcargo/>

Hover over the dots
on the map and the
date and time of the
profile will pop up



<https://maps.biogeochemical-argo.com/bgcargo/>



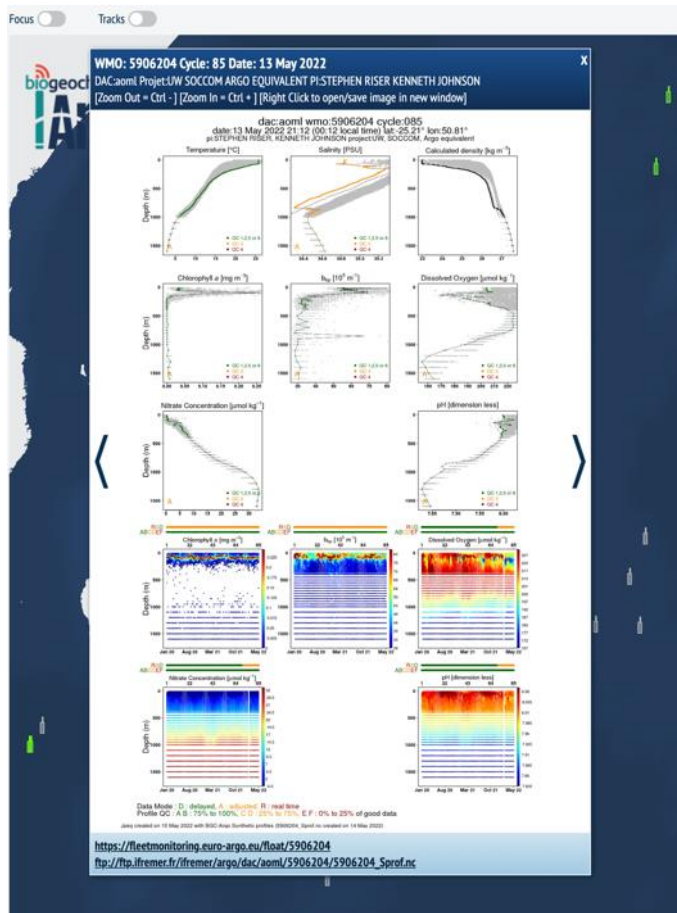
Double click on a profile dot and data from the float is displayed.

This is a convenient view to check what sensors are on the float.

The grey area is the area of all previous measurements from the float.

The left and right arrows will change the display to previous and subsequent profiles.

<https://maps.biogeochemical-argo.com/bgcargo/>



Data Mode : D : delayed, A : adjusted, R : real time
Profile QC : A B : 75% to 100%, C D : 25% to 75%, E F : 0% to 25% of good data

Jpeg created on 15 May 2022 with BGC-Argo Synthetic profiles (5906204_Sprof.nc created on 14 May 2022)

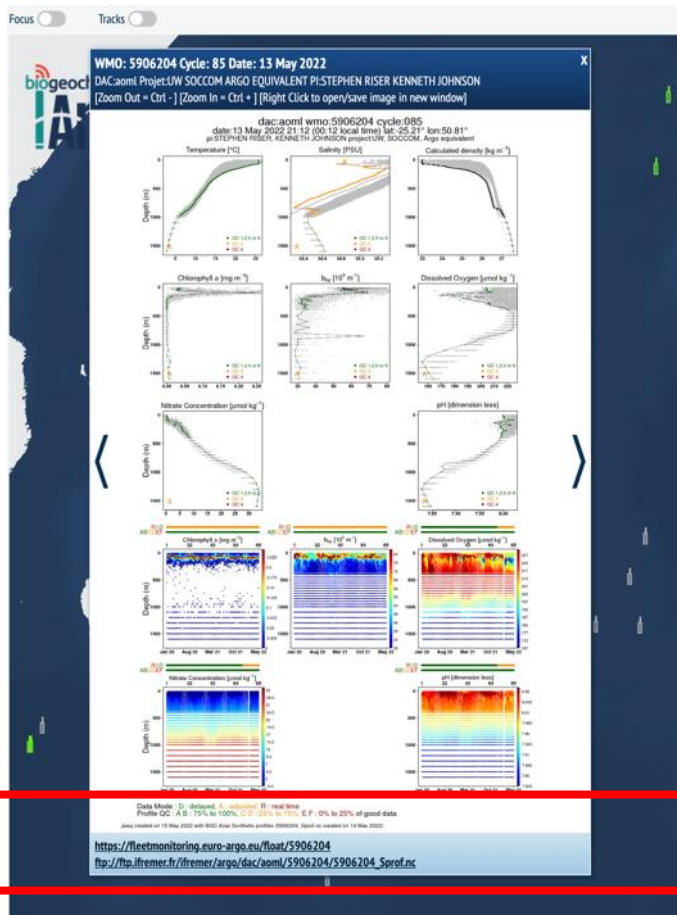
<https://fleetmonitoring.euro-argo.eu/float/5906204>

ftp://ftp.ifremer.fr/ifremer/argo/dac/aoml/5906204/5906204_Sprof.nc

Data is available from two sources here.

Fleetmonitoring page has more float information as well as data access links

<https://maps.biogeochemical-argo.com/bgcargo/>



Data Mode : D : delayed, A : adjusted, R : real time
Profile QC : A B : 75% to 100%, C D : 25% to 75%, E F : 0% to 25% of good data

Jpeg created on 15 May 2022 with BGC-Argo Synthetic profiles (5906204_Sprof.nc created on 14 May 2022)

<https://fleetmonitoring.euro-argo.eu/float/5906204>

ftp://ftp.ifremer.fr/ifremer/argo/dac/aoml/5906204/5906204_Sprof.nc

Select (Click): <https://fleetmonitoring.euro-argo.eu/float/5906204>

<https://fleetmonitoring.euro-argo.eu/float/5906204>

Float information webpage

Download Ascii file link is in the Cycle activity section

Select (Click):

 in Ascii

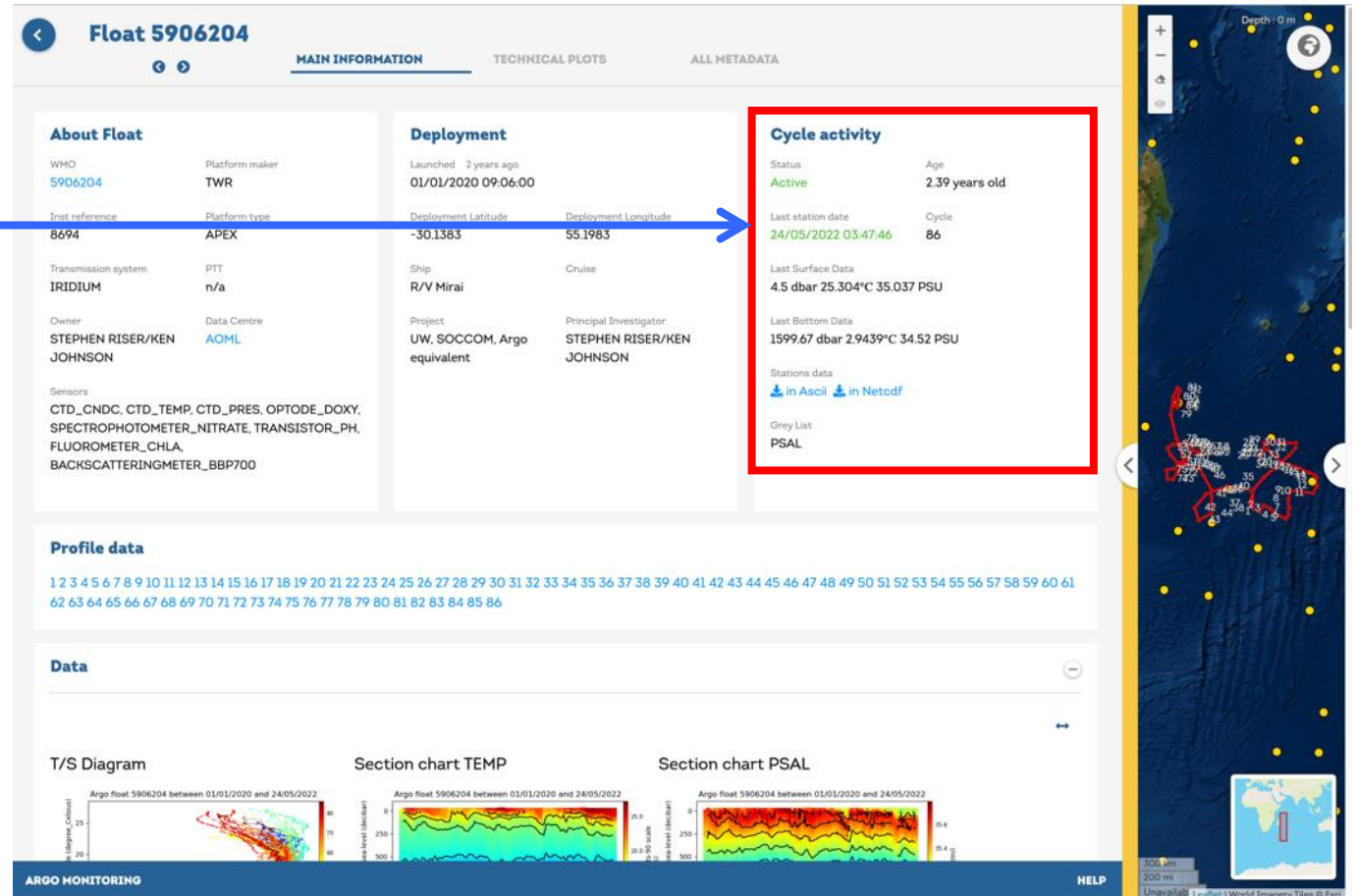
Last Surface Data
4.5 dbar 25.304°C 35.037 PSU

Last Bottom Data
1599.67 dbar 2.9439°C 34.52 PSU

Stations data
 in Ascii  in Netcdf

Grey List
PSAL

Grey List – Suspect data sets



The screenshot displays the 'Float 5906204' webpage with several sections:

- About Float:** WMO 5906204, Platform maker TWR, Inst reference 8694, Platform type APEX, Transmission system IRIDIUM, PTT n/a, Owner STEPHEN RISER/KEN JOHNSON, Data Centre AQML.
- Deployment:** Launched 2 years ago (01/01/2020 09:06:00), Deployment Latitude -30.1383, Deployment Longitude 55.1983, Ship R/V Mirai, Cruise, Project UW, SOCCOM, Argo equivalent, Principal Investigator STEPHEN RISER/KEN JOHNSON.
- Cycle activity:** Status Active, Age 2.39 years old, Last station date 24/05/2022 03:47:46, Cycle 86, Last Surface Data 4.5 dbar 25.304°C 35.037 PSU, Last Bottom Data 1599.67 dbar 2.9439°C 34.52 PSU. Includes links for 'in Ascii' and 'in Netcdf'.
- Profile data:** A list of station numbers from 1 to 86.
- Data:** A section for data visualization.
- Charts:** T/S Diagram, Section chart TEMP, and Section chart PSAL, all showing data for Argo float 5906204 between 01/01/2020 and 24/05/2022.
- Map:** A satellite map on the right side showing the float's location in the Indian Ocean, with a red outline around the data points.

<https://fleetmonitoring.euro-argo.eu/float/5906204>

The screenshot displays the 'Float 5906204' page with a modal dialog open. The dialog has a title 'Export selected Argo profiles' and a subtitle 'The download process is performed off-line. It will take around 1h30.' Below this, a blue section titled 'Provide your email' contains the text 'The download off-line process will be able to provide you the data exported URL.' A text input field labeled 'Your email' is highlighted with a red border. A yellow button labeled 'Download CSV data' is also highlighted with a red border. A blue arrow points from the 'Download CSV data' button to the 'Download CSV data' text in the yellow callout box on the left. Another blue arrow points from the 'Your email' input field to the 'Enter your email' text in the yellow callout box on the left.

About Float		Deployment	
WMO 5906204	Platform maker TWR	Launched 01/01/2020 09	Age 2.39 years old
Inst reference 8694	Platform type APEX	Deployment Latitude -30.1383	Cycle 86
Transmission system IRIDIUM	PTT n/a	Ship R/V Mirai	Temperature 35.037 PSU
Owner STEPHEN RISER/KEN JOHNSON	Data Centre AOML	Project UW, SOCCOM, equivalent	Depth 9439°C 34.52 PSU
Sensors CTD_CNDC, CTD_TEMP, CTD_PRES, OPTODE_DOXY, SPECTROPHOTOMETER_NITRATE, TRANSISTOR_PH, FLUOROMETER_CHLA, BACKSCATTERINGMETER_BBP700		Download options in Ascii in Netcdf	

Enter your email

Select (Click):
Download CSV data

File processing progress E-mail messages

The file you requested has been enqueued.

Best regards,
Coriolis data management team.

The file you requested is being processed (step 0 of 2 completed) on DATARMOR

Best regards,
Coriolis data management team.

The file you requested is being processed (step 1 of 2 completed) on DATARMOR

Best regards,
Coriolis data management team.

Your data file is available at
https://data-subsetting.ifremer.fr/DataSelection_b729a92b-f609-41f0-8568-3c671b7c24b0.tar.gz

Keep in mind that the link to your file will expire after 7 days

Best regards,
Coriolis data management team.

Elapsed Time: 5 minutes

Download Data

Your data file is available at

https://data-subsetting.ifremer.fr/DataSelection_b729a92b-f609-41f0-8568-3c671b7c24b0.tar.gz

Keep in mind that the link to your file will expire after 7 days

Best regards,
Coriolis data management team.

gzip compressed archive: DataSelection_b729a92b-f609-41f0-8568-3c671b7c24b0.tar.gz

1.1 MB

Expands to: PR_PF_5906204.csv

7.6 MB

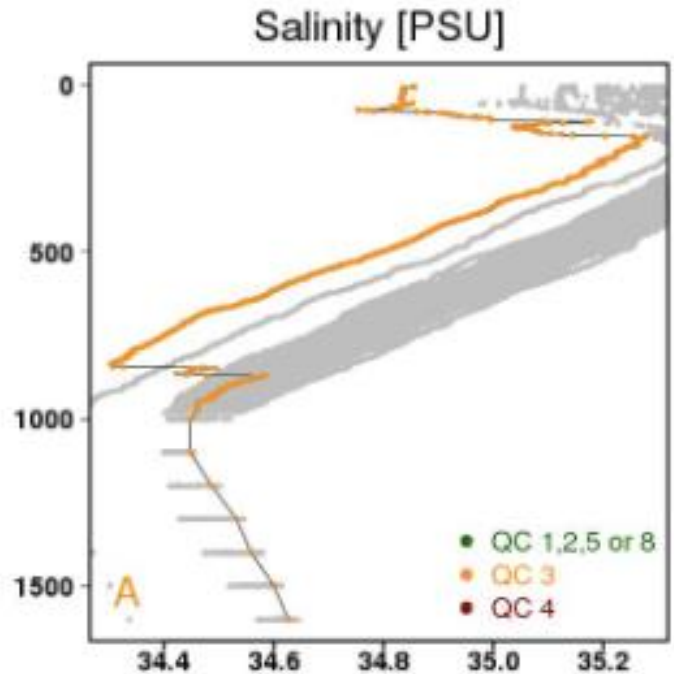
Data File Includes Quality Control Flags

	1	2	3	4	5	6	7	8	9	10
1	PLATFORM_CODE	DATE (YYYY-MM-DDTHH:MI:SSZ)	DATE_QC	LATITUDE (degree_north)	LONGITUDE (degree_east)	POSITION_QC	PRES (decibar)	PRES_QC	PSAL (psu)	PSAL_QC
2	5906204	2020-01-01T22:44:55Z	1	-30.138	55.198	1	24.4	1	35.628	1
3	5906204	2020-01-01T22:44:55Z	1	-30.138	55.198	1	26	1	35.628	1

7	8	9	10
PRES (decibar)	PRES_QC	PSAL (psu)	PSAL_QC
24.4	1	35.628	1
26	1	35.628	1

Data File Includes Quality Control Flags

1	PLATFORM_CODE	DATE (YYYY-MM-DDTHH:MI:SSZ)	DATE_QC	LATITUDE (degree_north)	LONGITUDE (degree_east)	POSITION_QC	PRES (decibar)	PRES_QC	PSAL (psu)	PSAL_QC	TEMP (degree)	TEMP_QC
47175	5906204	2022-05-13T21:12:53Z	1	-25.209	50.809	1	4.4	1	34.848	4	25.72	1
47176	5906204	2022-05-13T21:12:53Z	1	-25.209	50.809	1	6	1	34.85	4	25.715	1
47177	5906204	2022-05-13T21:12:53Z	1	-25.209	50.809	1	8	1	34.829	4	25.713	1
47178	5906204	2022-05-13T21:12:53Z	1	-25.209	50.809	1	10.1	1	34.83	4	25.715	1
47179	5906204	2022-05-13T21:12:53Z	1	-25.209	50.809	1	11.8	1	34.831	4	25.718	1



PRES (decibar)	PRES_QC	PSAL (psu)	PSAL_QC	TEMP (degree)	TEMP_QC
4.4	1	34.848	4	25.72	1
6	1	34.85	4	25.715	1
8	1	34.829	4	25.713	1
10.1	1	34.83	4	25.715	1
11.8	1	34.831	4	25.718	1

Highly recommend reading:



A BGC-Argo Guide: Planning, Deployment, Data Handling and Usage

 Henry C. Bittig^{1,2*},  Tanya L. Maurer³,  Joshua N. Plant³,  Catherine Schmechtig⁴,  Annie P. S. Wong⁵,  Hervé Claustre²,  Thomas W. Trull⁶,  T. V. S. Udaya Bhaskar⁷,  Emmanuel Boss⁸,  Giorgio Dall'Olmo⁹,  Emanuele Organelli²,  Antoine Poteau²,  Kenneth S. Johnson³,  Craig Hanstein⁶,  Edouard Leymarie²,  Serge Le Reste¹⁰,  Stephen C. Riser⁵,  A. Rick Rupan⁵,  Vincent Taillandier²,  Virginie Thierry¹⁰ and  Xiaogang Xing¹¹

<https://doi.org/10.3389/fmars.2019.00502>

Data File Includes Quality Control Flags

REAL-TIME (R-mode)

- Data has been decoded and converted to meaningful values
- Real-time quality control tests applied
- Data is received at the GDACs within 24 h of float surfacing
- Data is assumed acceptable for operational use
- Processing is automatic and does not require human intervention
- Data is not acceptable for direct usage in scientific applications

REAL-TIME ADJUSTED (A-mode)

- Data has been decoded and converted to meaningful values
- Real-time quality control tests applied
- Data is received at the GDACs within 24 h of float surfacing
- Data is assumed acceptable for operational use
- Processing is automatic and does not require human intervention
- Data adjustments (gain, offset, and/or drift) are applied in real-time

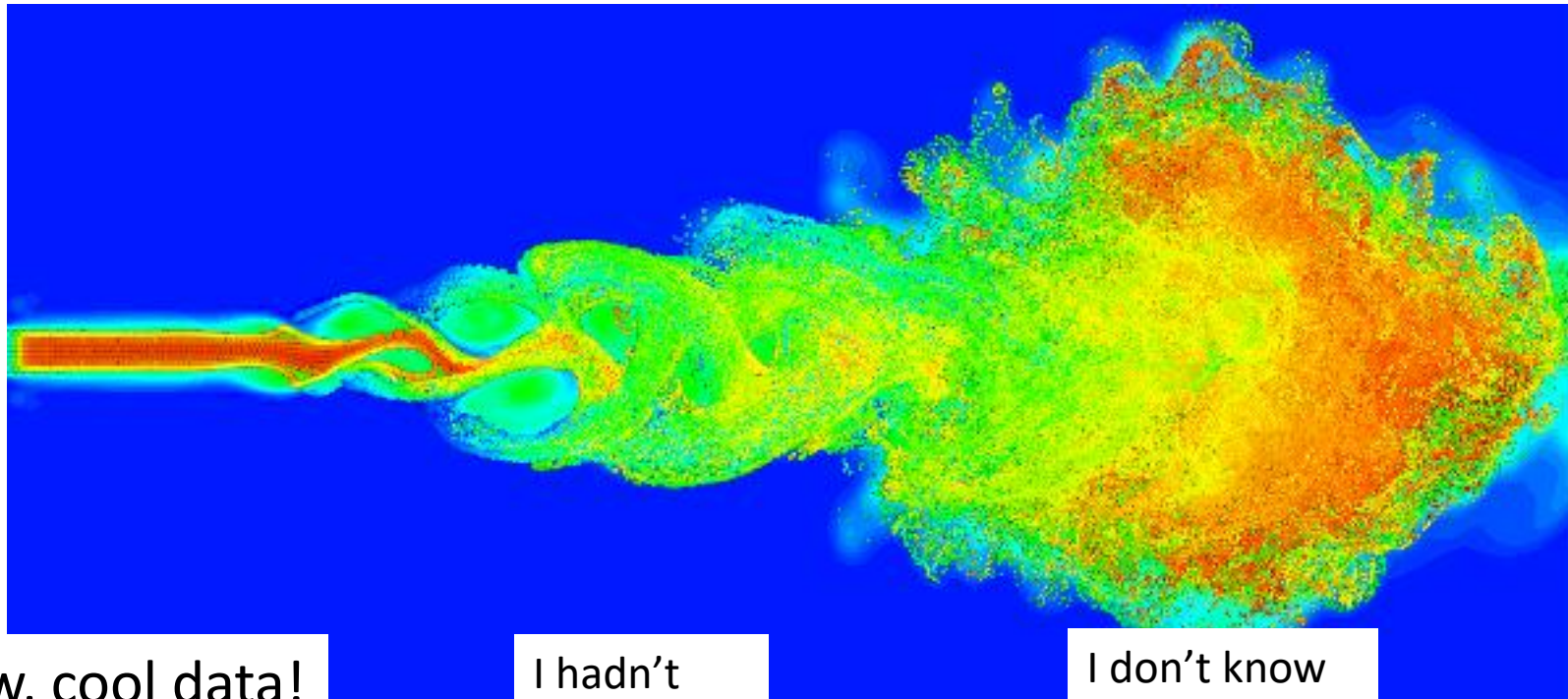
DELAYED-MODE (D-mode)

- Data has been visually inspected by the delayed mode operator
- Data has been compared against relevant reference datasets and necessary adjustments have been applied
- QC flag assignments have been thoroughly checked
- Data suitable for direct usage in scientific applications

Data File Includes Quality Control Flags

Flag	Meaning	Real-time comment	Delayed-mode comment
0	No QC was performed	No QC was performed	No QC was performed
1	Good data	All Argo real-time QC tests passed	The adjusted value is statistically consistent and a statistical error estimate is supplied
2	Probably good data	Probably good data	Probably good data
3	Probably bad data that are potentially correctable	A flag "3" may be assigned by an operator during additional visual QC for bad data that may be corrected in delayed-mode	An adjustment has been applied, but the value may still be bad
4	Bad data	Data have failed one or more of the real-time QC tests. A flag "4" may be assigned by an operator during additional visual QC for bad data that are uncorrectable	Bad data. Not adjustable. Data replaced by FillValue

The timeline of adaptation to new data

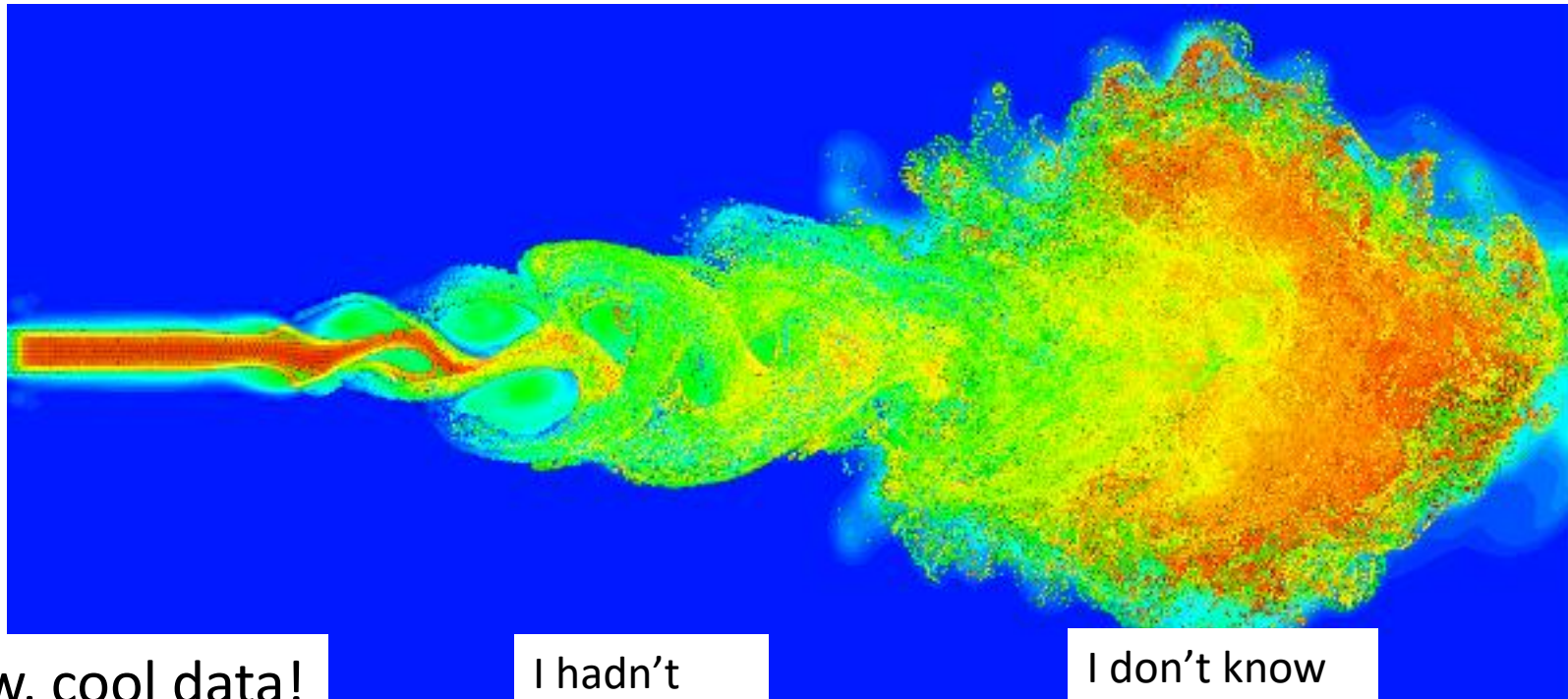


Wow, cool data!

I hadn't
thought
about that

I don't know
anything!

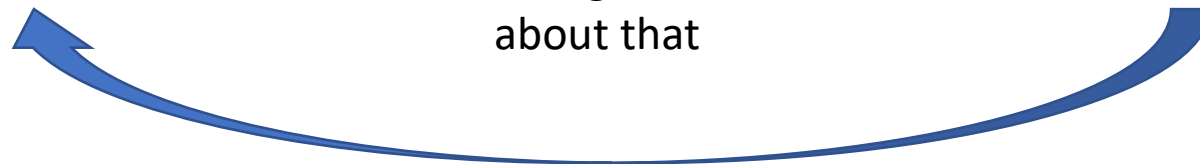
The timeline of adaptation to new data



Wow, cool data!

I hadn't
thought
about that

I don't know
anything!



Alternative Data Access: GO-BGC Global Ocean Biogeochemistry Array

GO-BGC
Global Ocean Biogeochemistry Array

DATA ▾ MAP ROOM ▾ RESOURCES ▾ OUTREACH ▾ NEWS & EVENTS ▾ ABOUT US ▾ 🔍

Pressure (dbar)

Data Access and Visualization

Float data are made publicly available in near-real time, typically within 24 hours from when a float surfaces.






GO-BGC data can be used freely, with no restrictions. However, we ask that GO-BGC is properly acknowledged when used in a publication or a product.

Float data can be accessed in various formats through multiple data portals

FLOAT DATA ACCESS

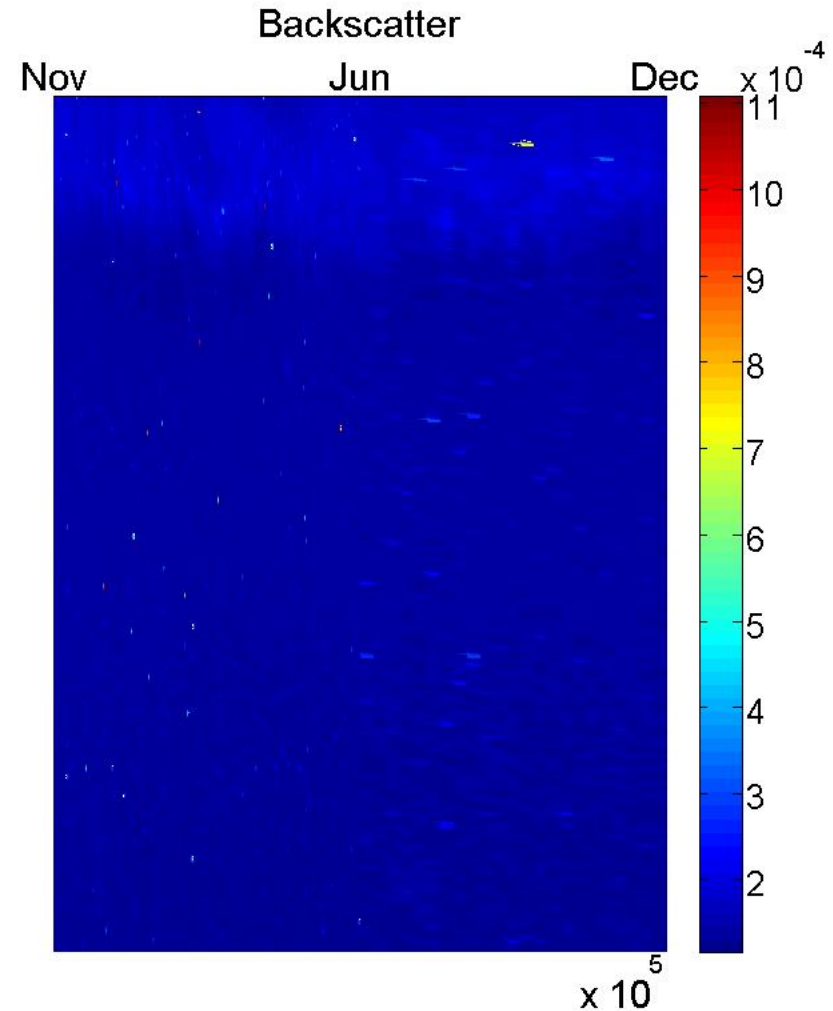
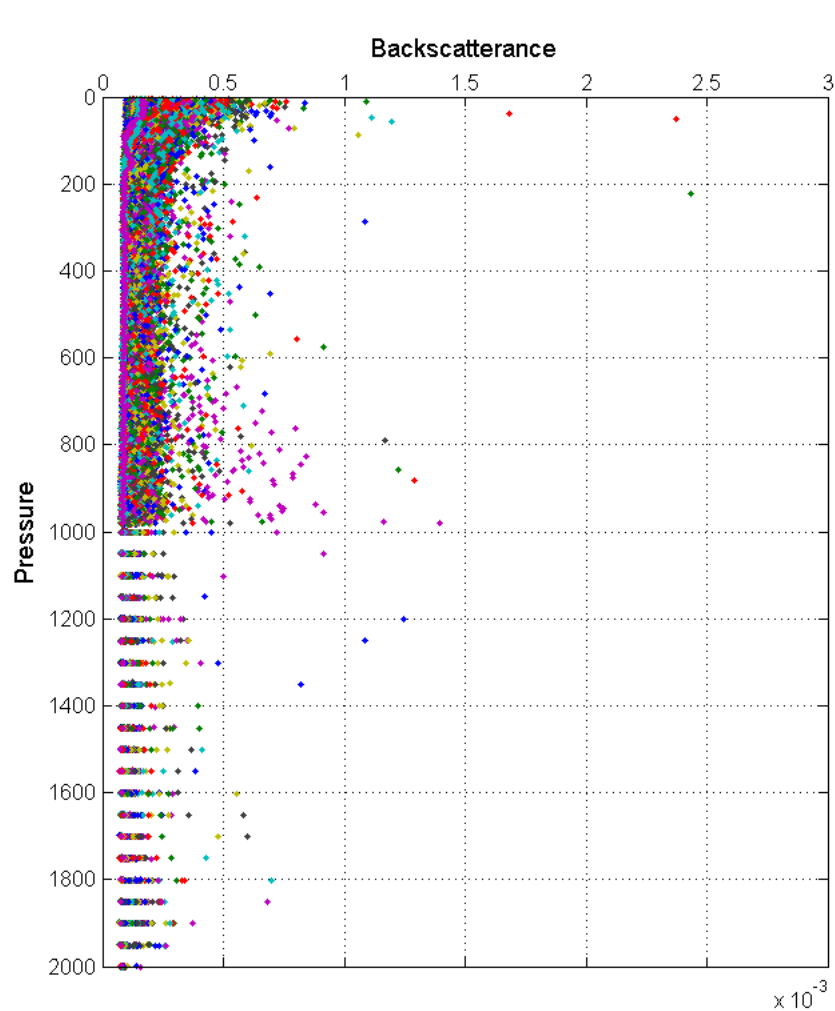
<https://www.go-bgc.org/data/access-and-visualization>

Alternative Data Access: GO-BGC Global Ocean Biogeochemistry Array

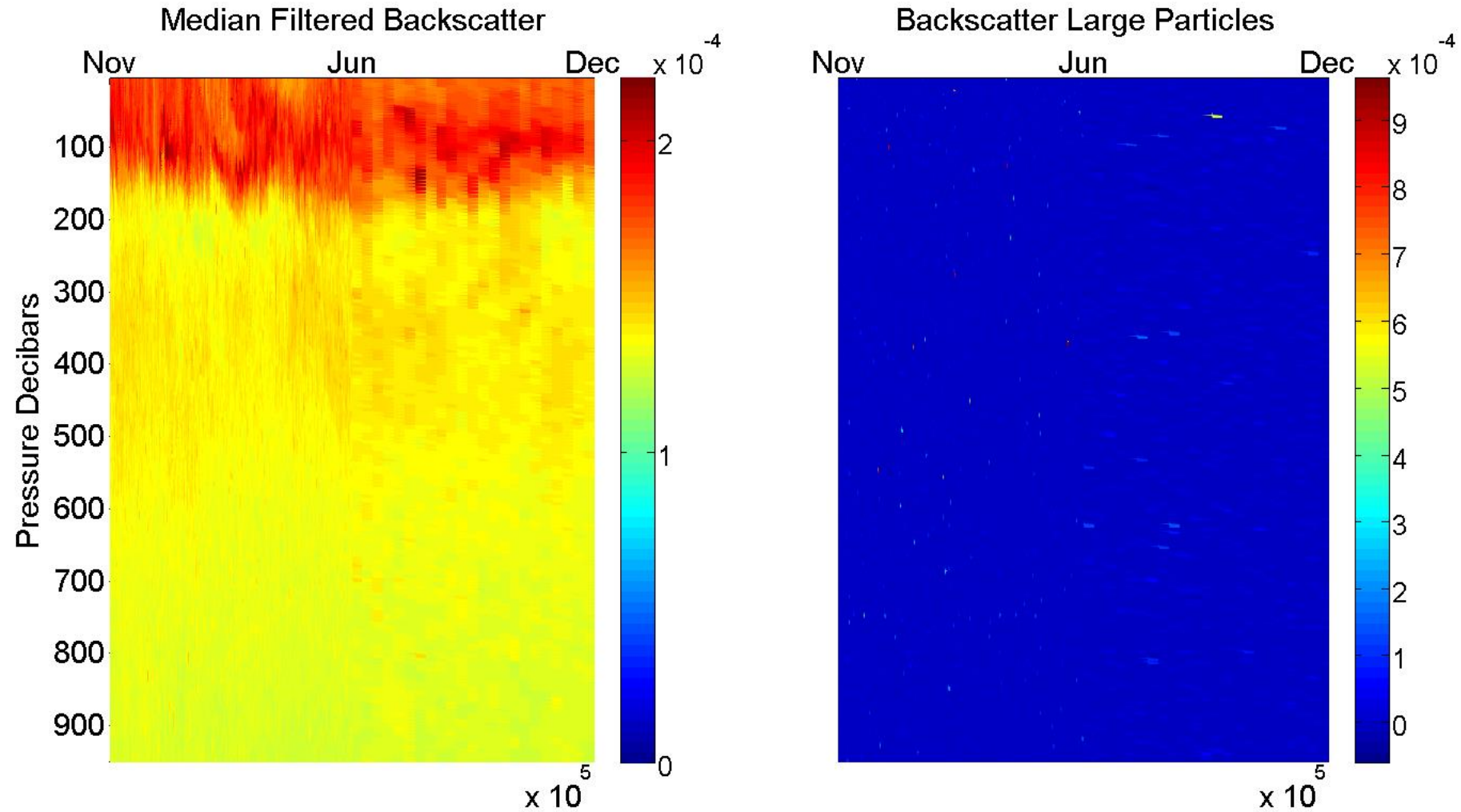
 <h3>Argo GDACs</h3> <p><i>Direct Data Access, experienced users</i></p> <p>GO-BGC data are distributed through the Argo Global Data Assembly Centers (Coriolis, USGODAE) in NetCDF format.</p> <p>Information for accessing Argo GDACs can be found here and here.</p>	 <h3>FloatViz</h3> <p><i>Direct Data Access, beginner to intermediate users</i></p> <p>GO-BGCviz</p> <p>SOCCOMviz</p> <p>FloatViz is a data portal that allows access through ASCII files, and simple data visualization for individual floats.</p>	 <h3>ERDDAP</h3> <p><i>Direct Data Access, experienced users</i></p> <p>Introduction to ERDDAP. GO-BGC and SOCCOM float data are accessible through the NOAA PolarWatch ERDDAP server.</p> <p>This portal is well-suited for machine-to-machine applications and is also capable of data visualization.</p>
 <h3>Float Status Table</h3> <p><i>Direct Data Access, all users</i></p> <p>Sortable table aimed for quick float status assessment, including most recent position, basin, and deployment cruise.</p> <p>This portal is useful for analyzing the status of the GO-BGC Array and provides access to quick visualization and individual float data files from the Argo GDACs and FloatViz.</p>	<h3>UC San Diego</h3> <h4>Data Archives</h4> <p><i>Quality Controlled Data, all users</i></p> <p>Delayed mode quality controlled data, including derived carbon parameters are archived with a DOI three times a year.</p> <p>Data are available in text, netCDF, and matlab format.</p>	 <h3>BGC Float Toolbox</h3> <p><i>Software tools for all users</i></p> <p>Open source toolbox to select, download, and visualize BGC float data through the Argo GDAC.</p> <p>This is an open-source toolbox for Matlab, R, and Python. See tutorials on how to use this toolbox to get started.</p>

<https://www.go-bgc.org/data/access-and-visualization>

Backscattering: Small vs. Large Particles

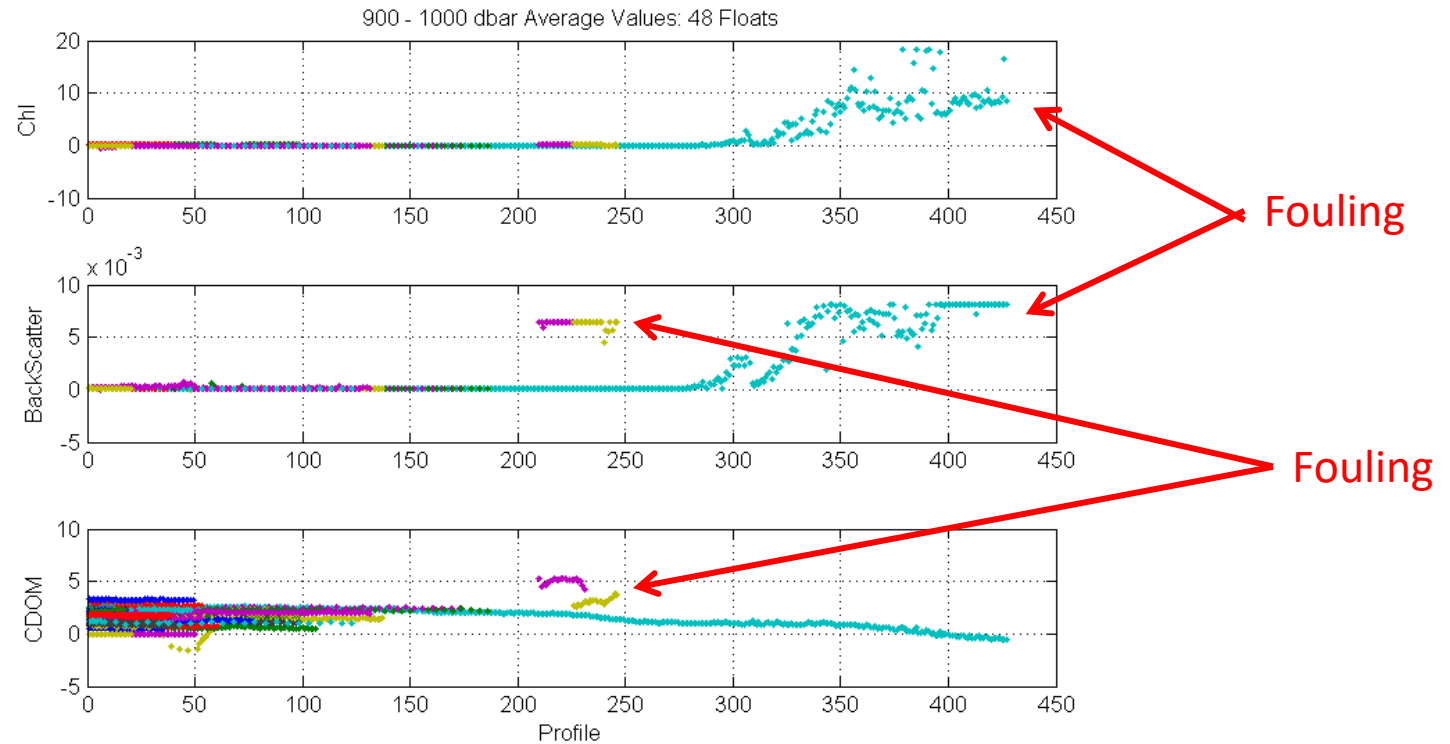


Small vs. Large Particles



Assessing Sensor Performance

Time series at depth is an effective way to judge performance



New Era of Open Oceanography

- Bio-Geochemical sensors on profiling floats are a new tool for investigating upper ocean biological processes
- Data is useful with minimal quality control by the user (but check!)
- Lots of data, many applications – Use your imagination!
 - Particle / Carbon flux
 - From the surface
 - Off the shelf
 - Carbon reservoirs
 - Productivity
 - Add satellite imagery estimate bloom extent
 - Deploy in an eddy, watch the biology change