Partnership for Observation of the Global Ocean

Understanding and accessing available Argo floats data

WIO Workshop June 8, 2022

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v4

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.

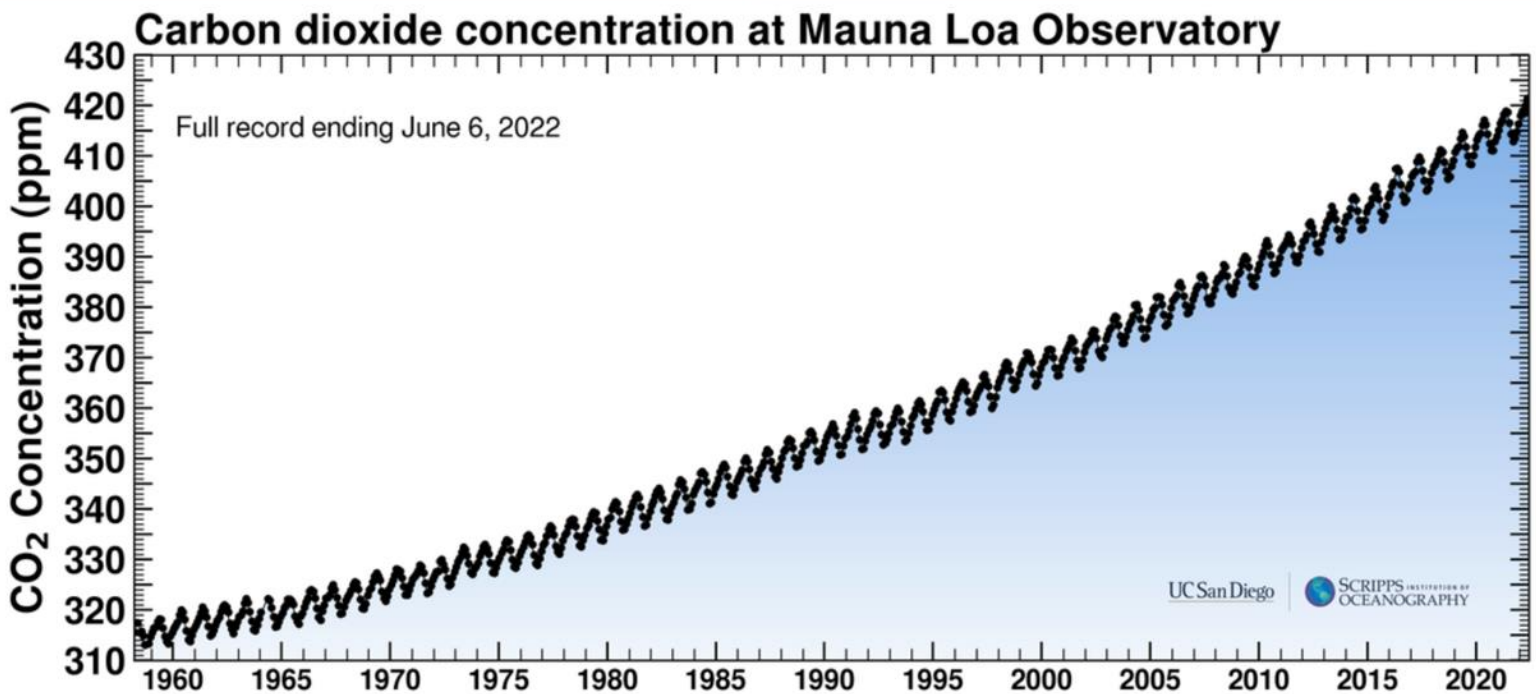
The Keeling Curve

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 CO_2 reading: 421.18 ppm

ONE WEEK | ONE MONTH | SIX MONTHS | ONE YEAR | TWO YEARS | FULL RECORD | 1700-PRESENT | 2K YEARS | 10K YEARS | 800K YEARS



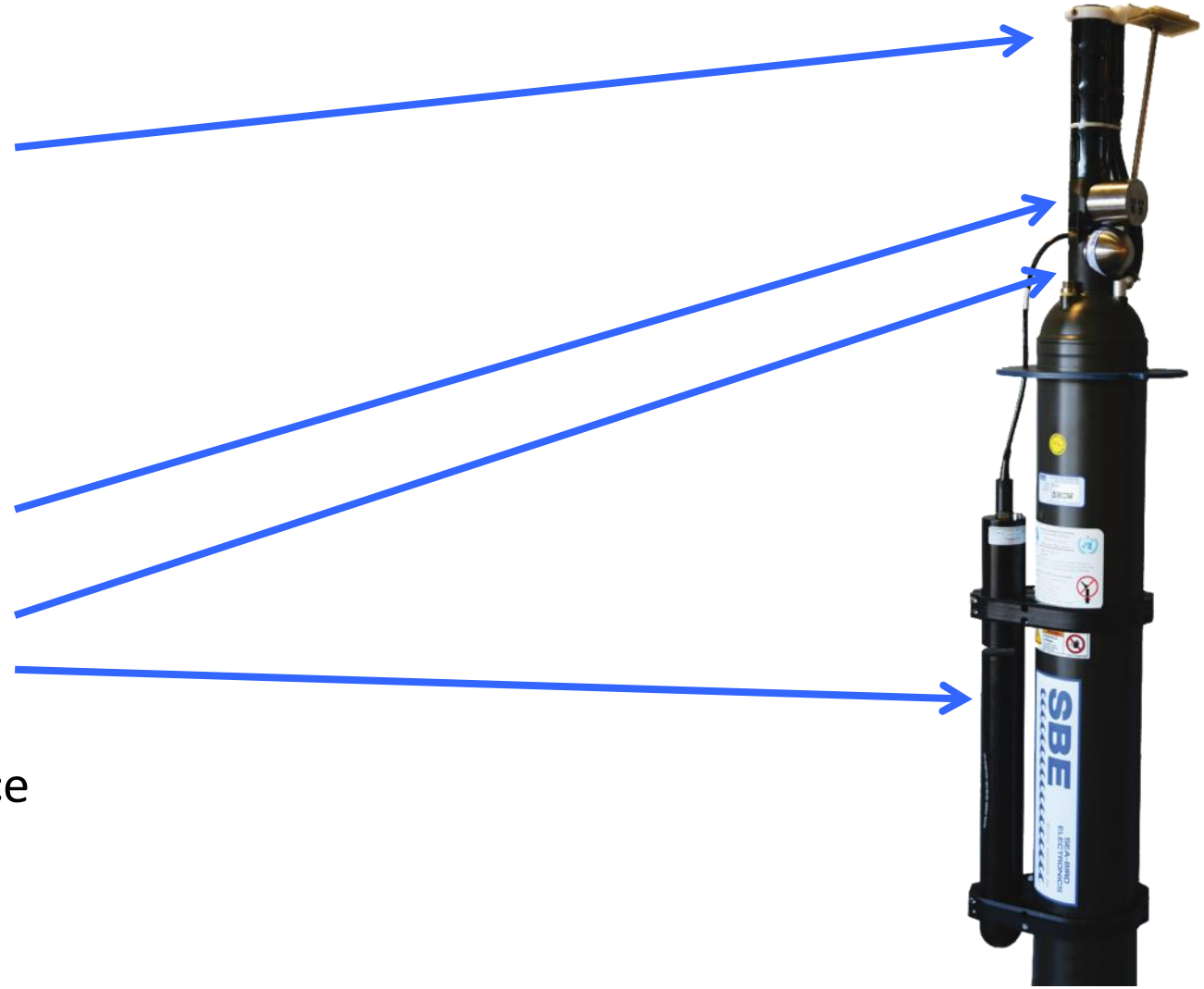
https://keelingcurve.ucsd.edu/

What is a Biogeochemical Float?

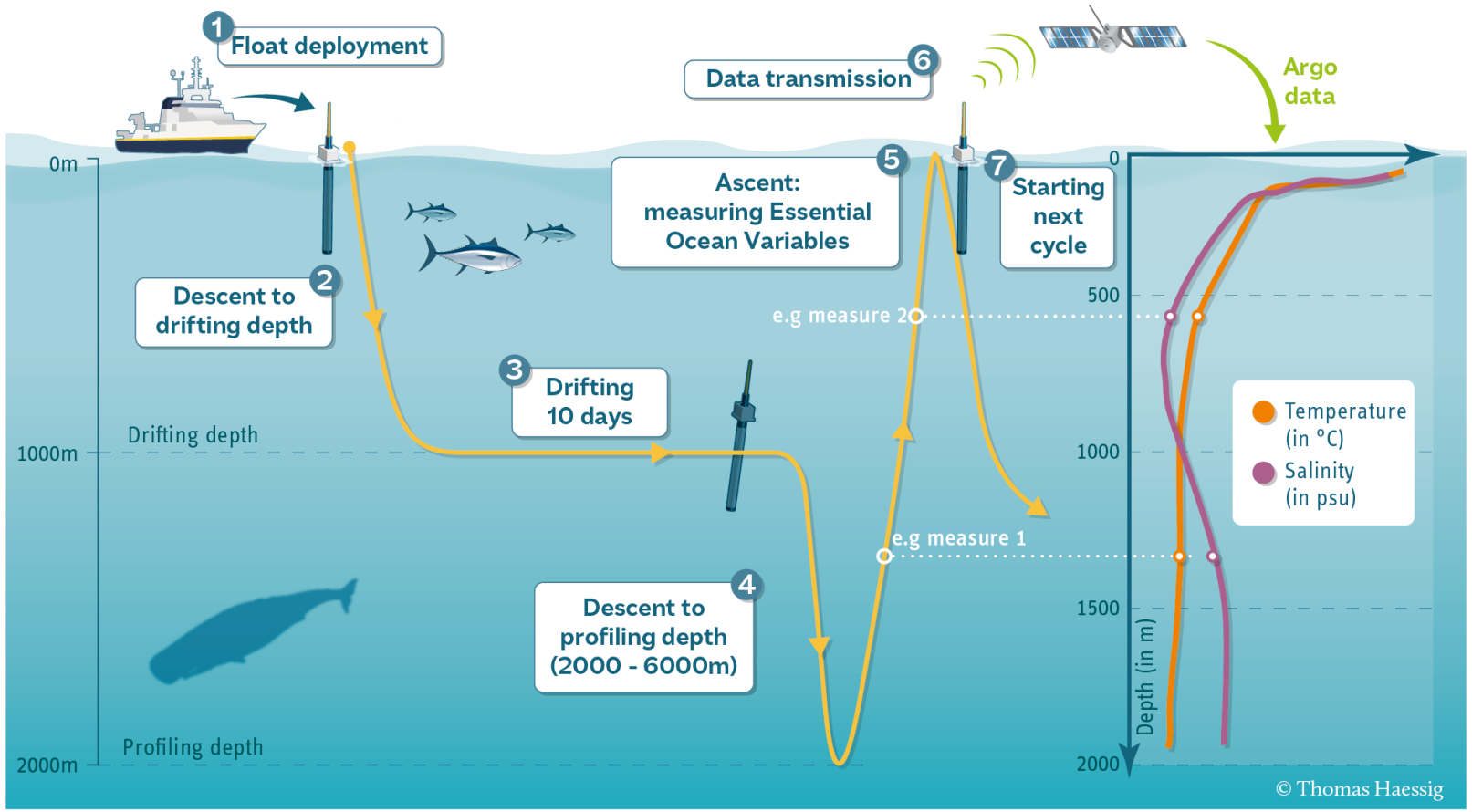
- Autonomous Profiling Float
  - Buoyancy Engine
    - Oil Reservoir and Bladder
      - Pump from Reservoir to Bladder:
      - Expands – Float density decreases
- Batteries
- Satellite Antennae
- Control Electronics
- Sensors

Instruments on a Biogeochemical Float

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



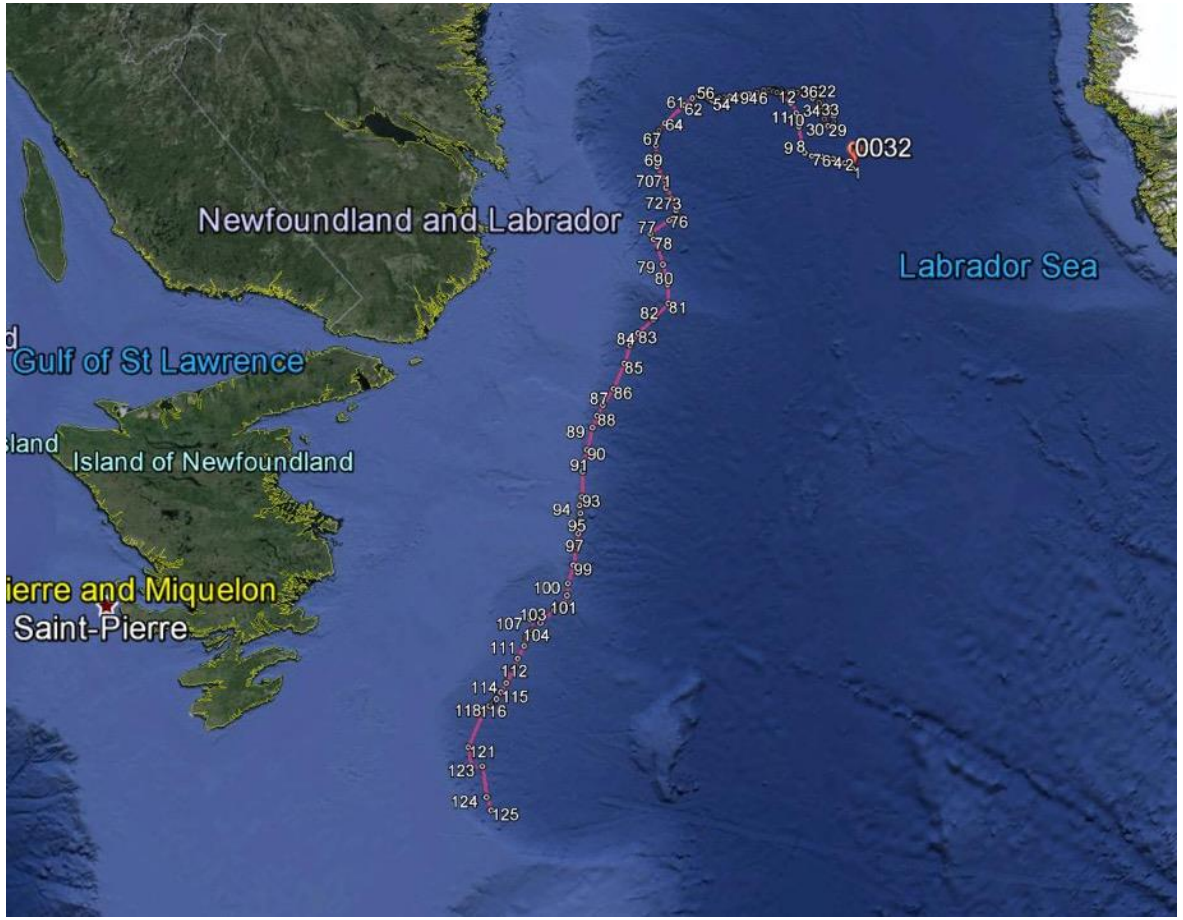
Float Standard Operation



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

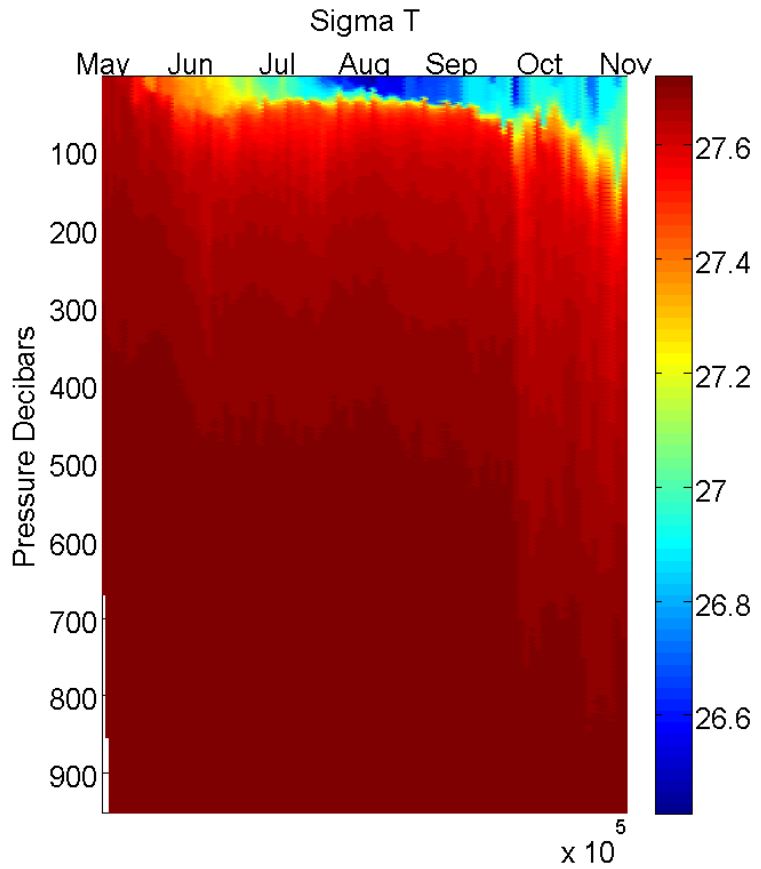
Labrador Sea

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

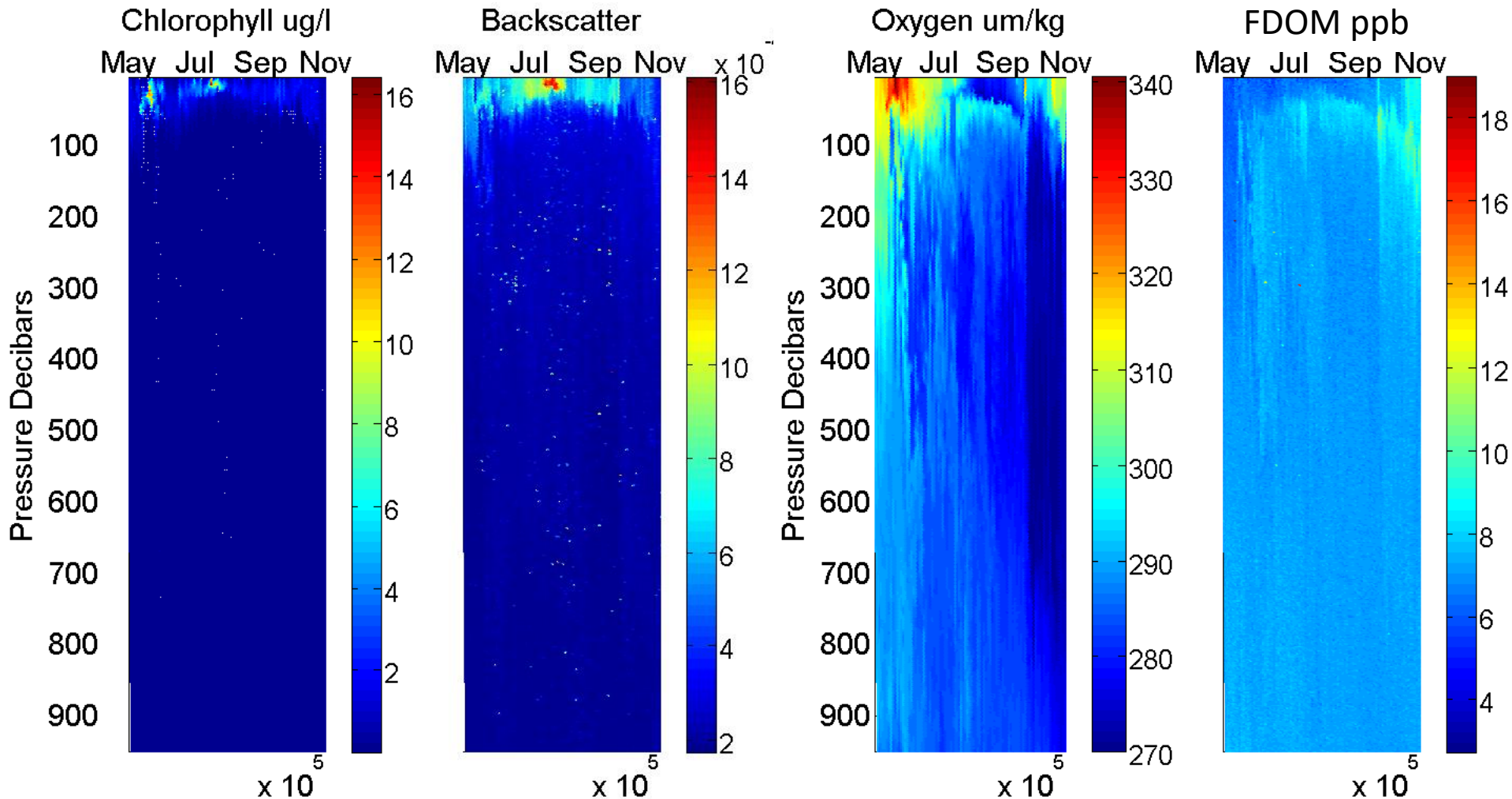


Sigma T

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

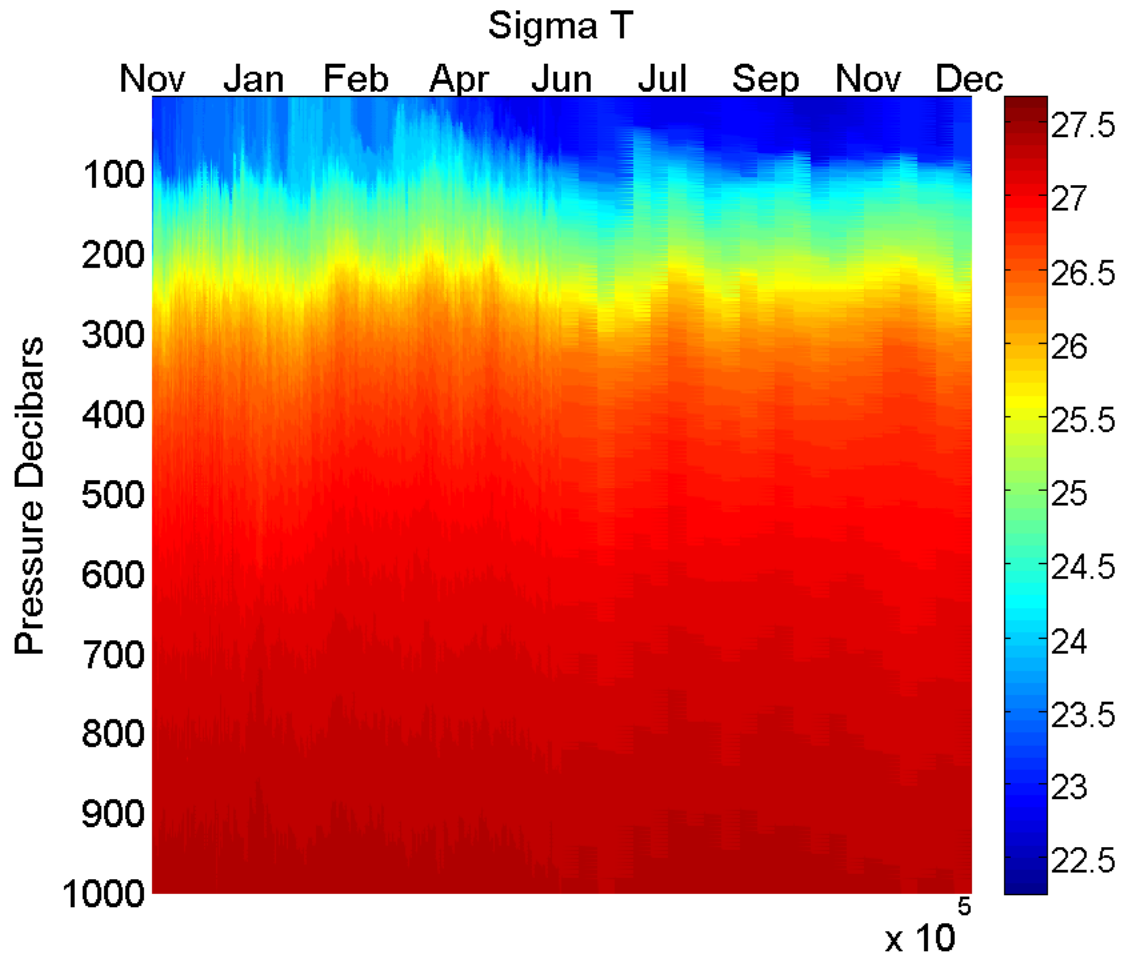


Chlorophyll, Backscattering, Oxygen, FDOM

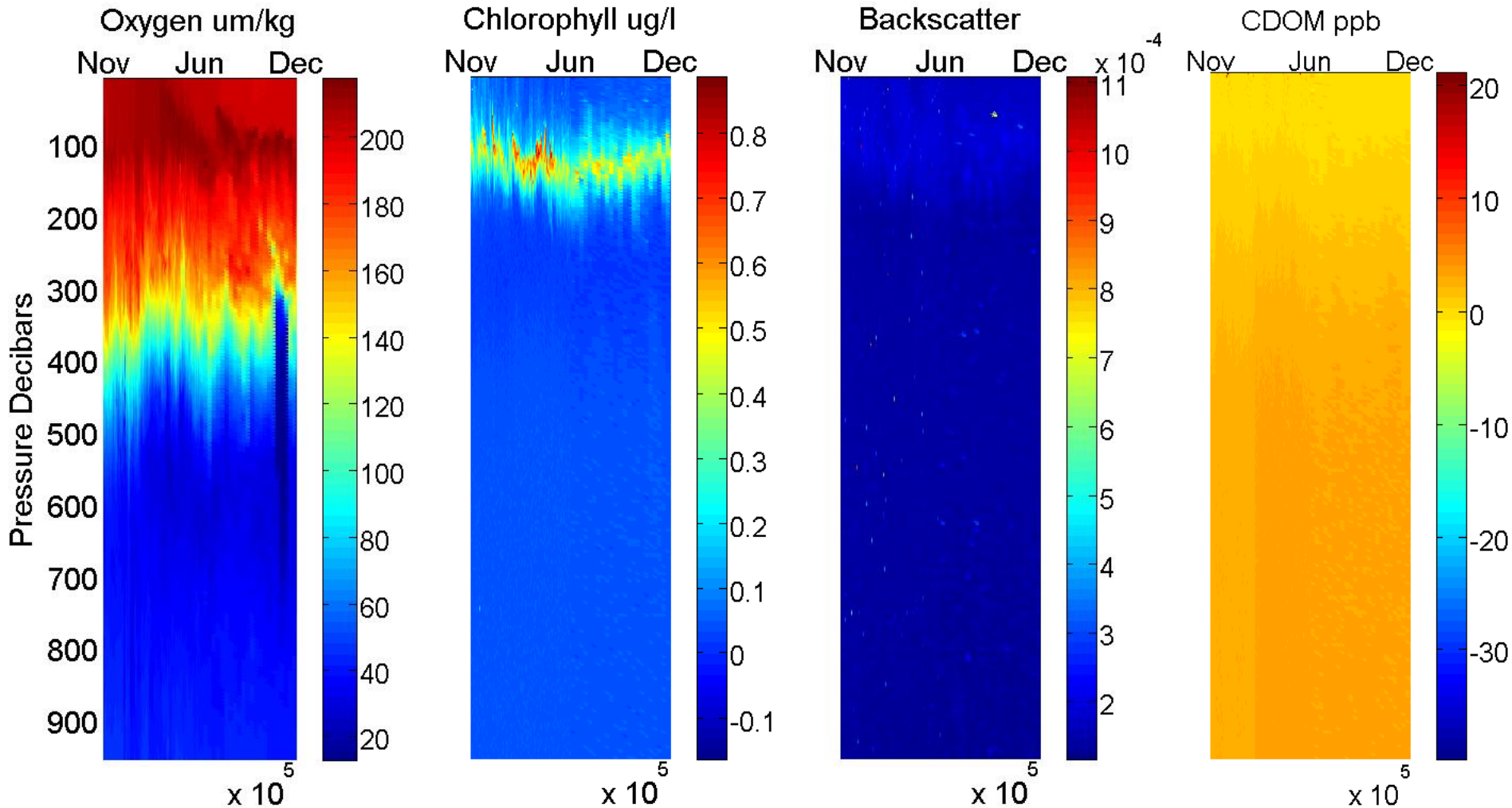


Hawaii

- Deployment near the HOT site provides an oligotrophic example



Oxygen, Chlorophyll, Backscattering and CDOM



Downloading Bio-Argo Data

WIO Workshop June 8, 2022
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ianwalsh@comcast.net
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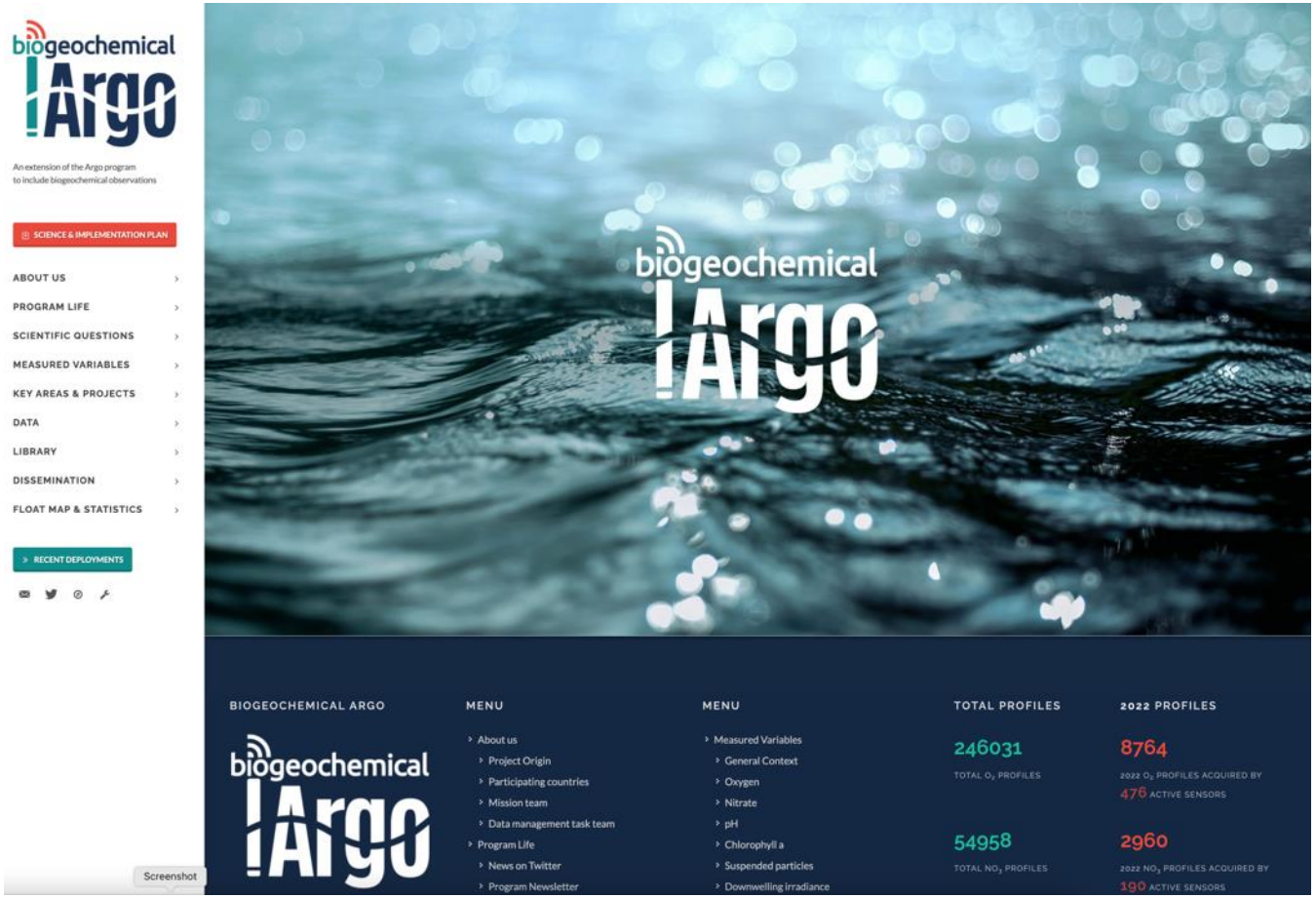
v1

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

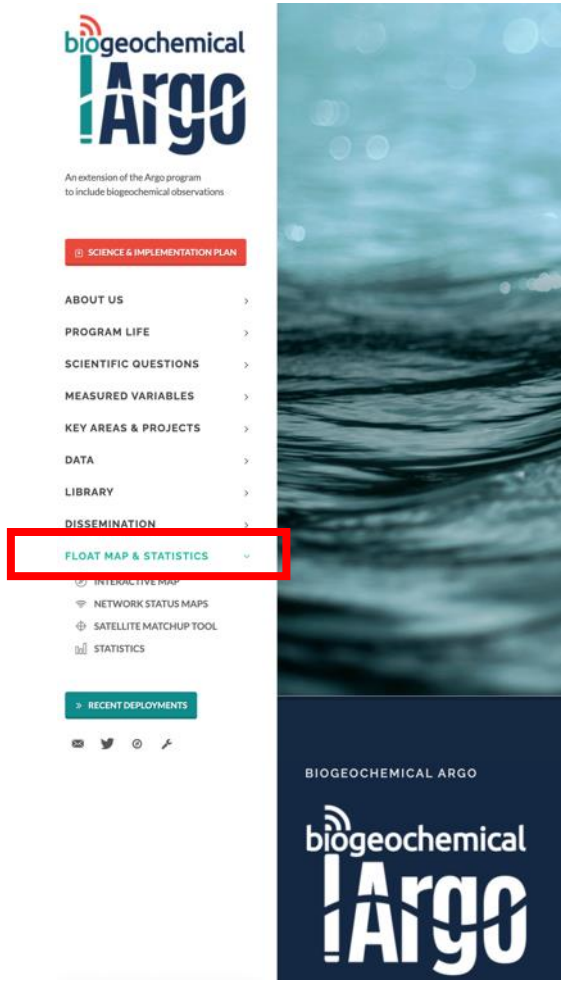
Format: header has an active link to the webpage pictured

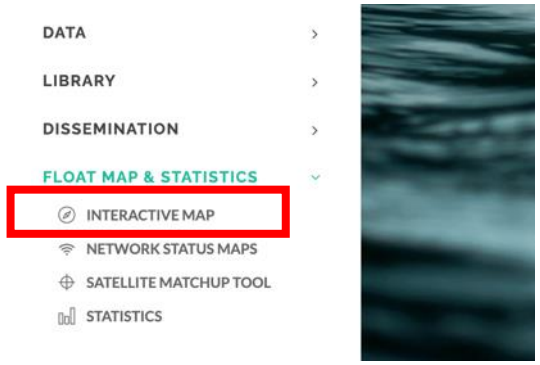
Red outlines indicate active areas on the webpage to modify and/or activate.

Yellow highlights actions to take



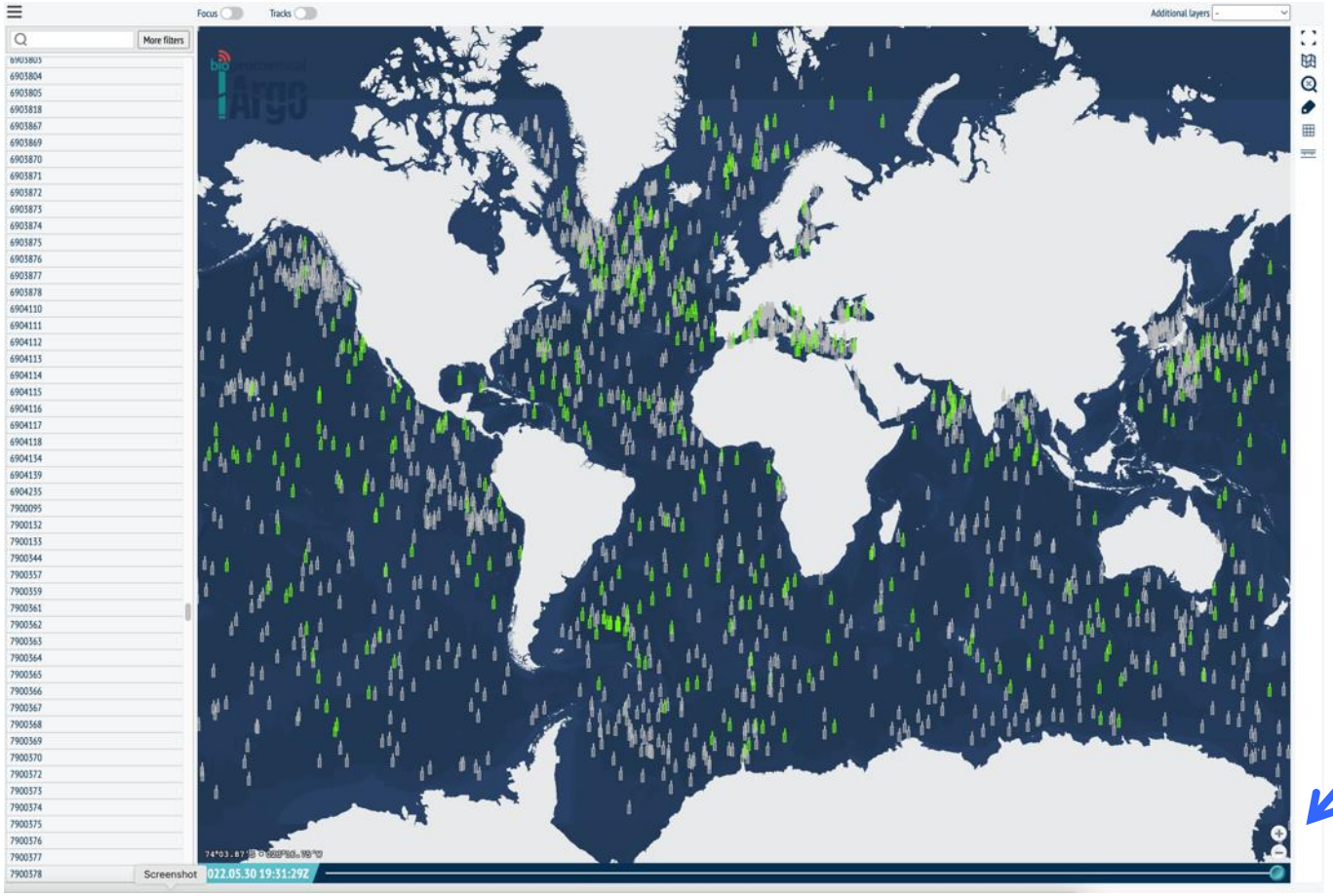
https://biogeochemical-argo.org/index.php





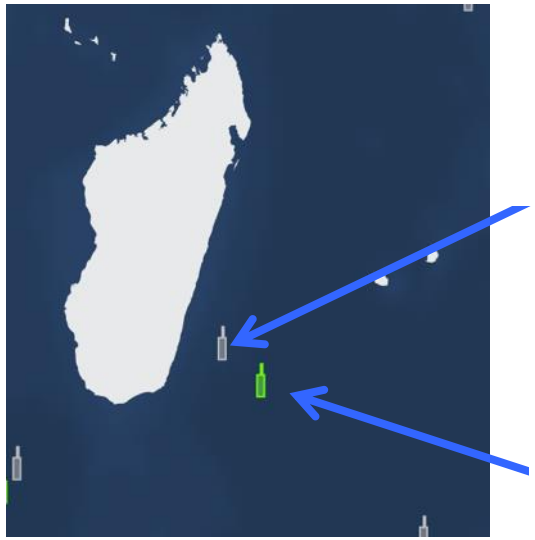
Select (Click): Interactive Map

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



Map Zoom Controls

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



Inactive Float

Active Float

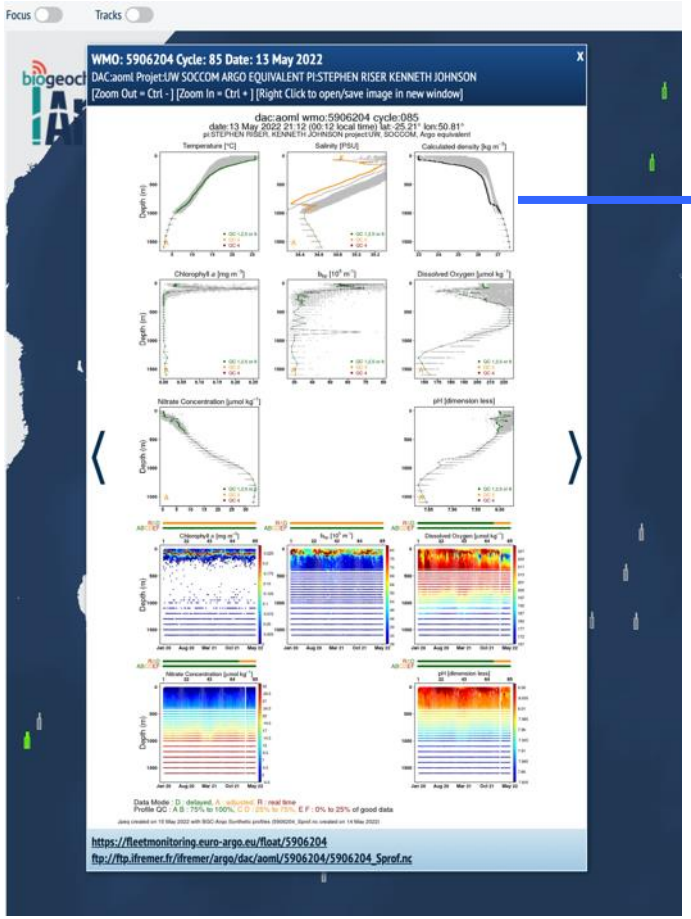
https://maps.biogeochemical-argo.com/bgcargo/

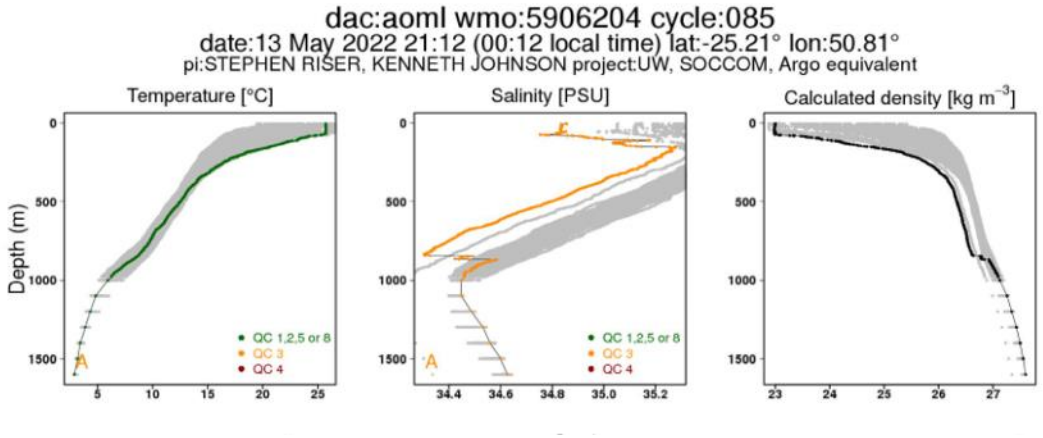
Path of Active Float
5906204

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/





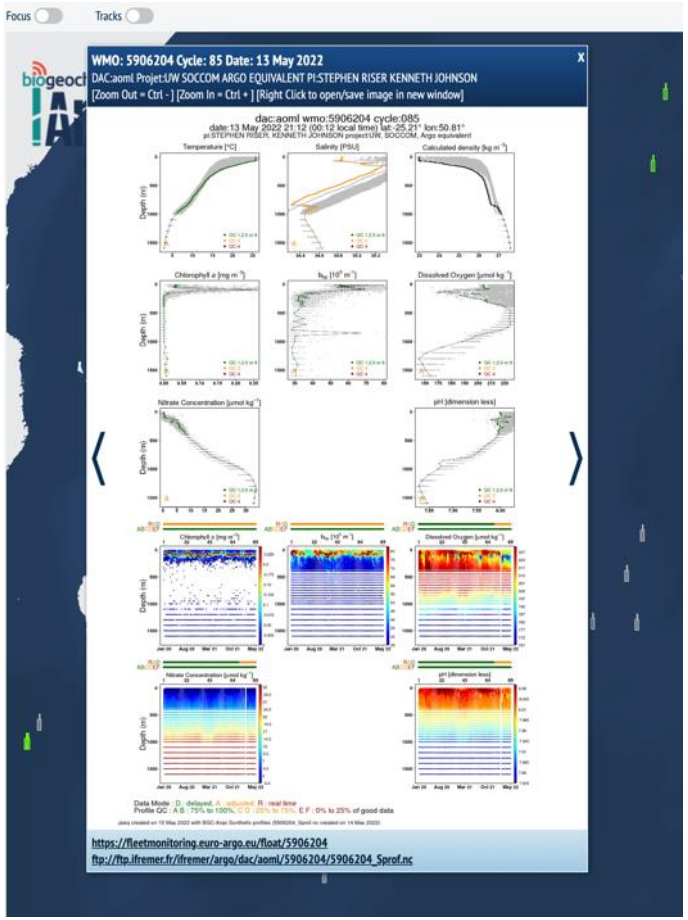
Double click on a profile dot and data from the float is displayed.

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.

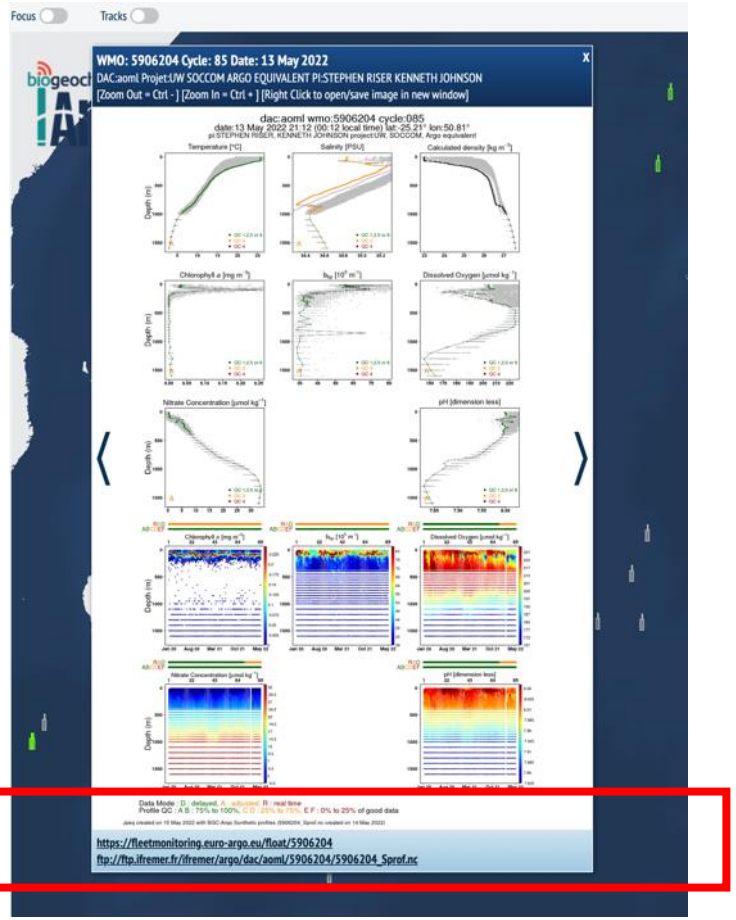
https://maps.biogeochemical-argo.com/bgcargo/



Data is available from two sources here.

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

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



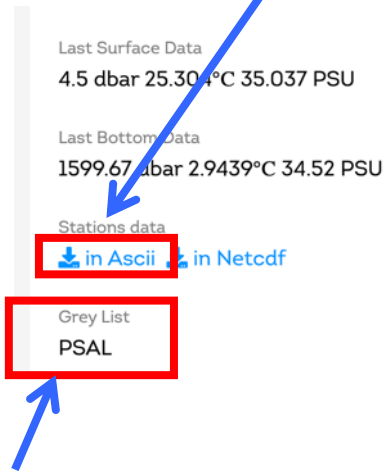
Select (Click): https://fleetmonitoring.euro-argo.eu/float/5906204

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

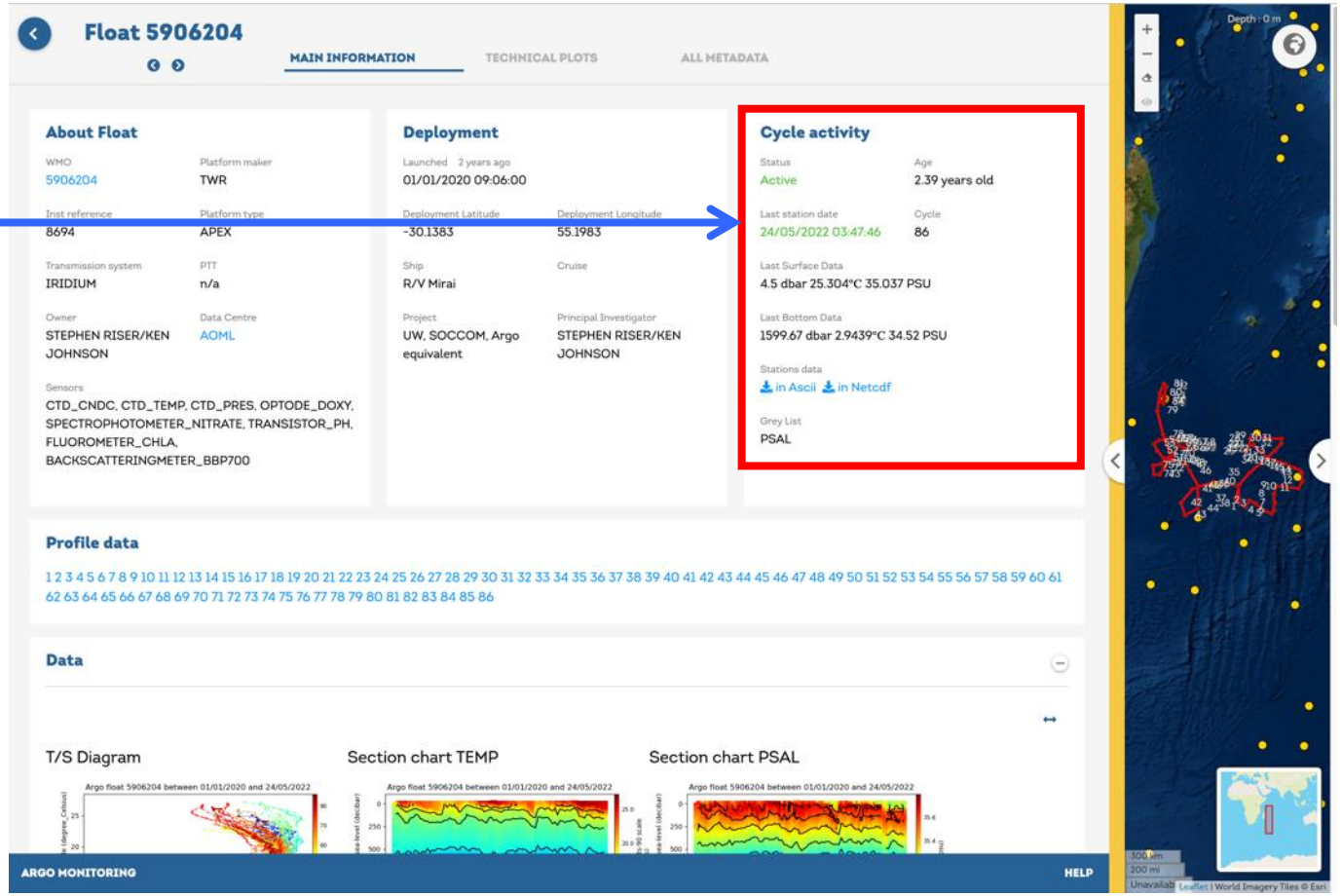
Float information webpage

Download Ascii file link is in the Cycle activity section

Select (Click): in Ascii



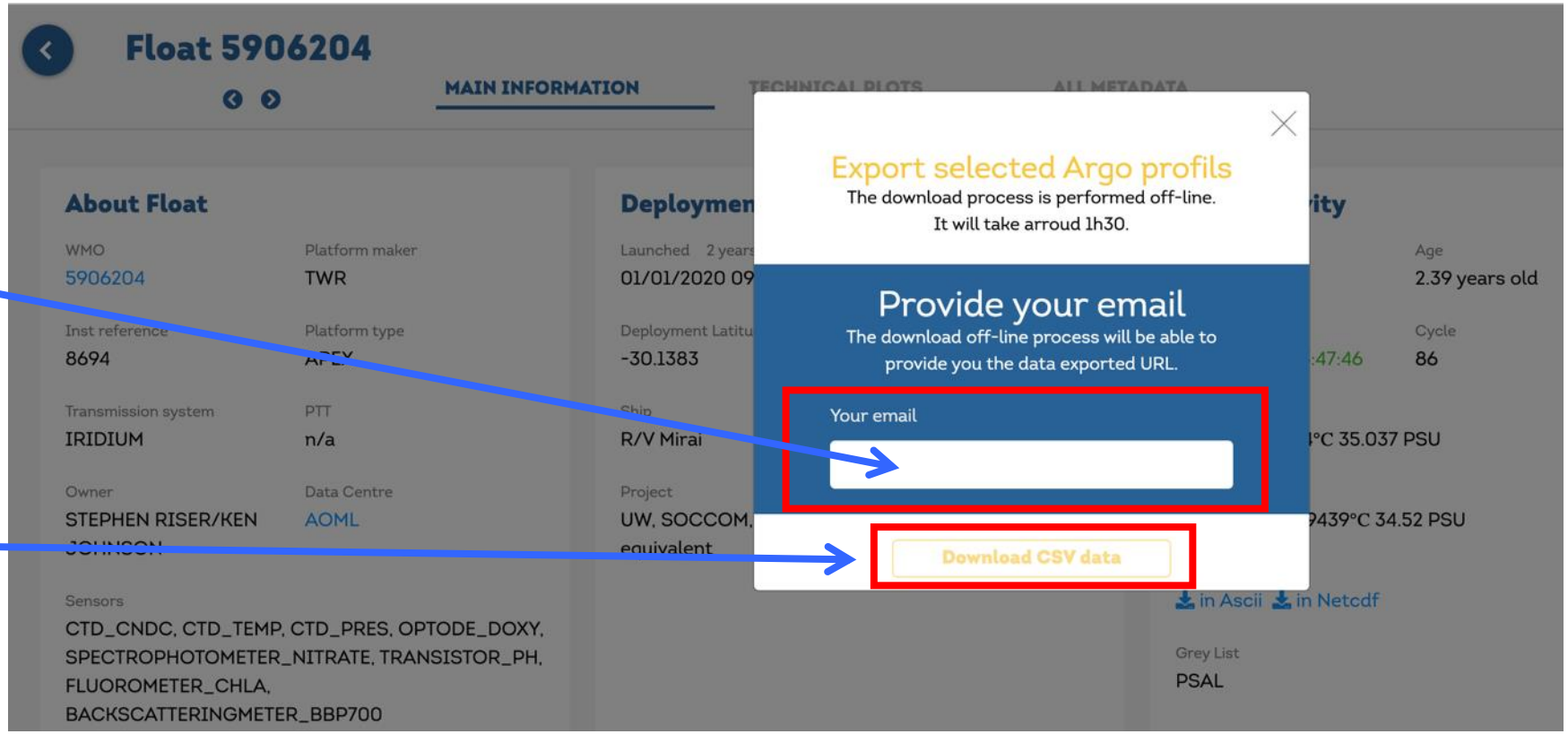
Grey List – Suspect data sets



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

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

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	PLATFORM_	DATE (YYYY-	DATE_QC	LATITUDE (d	LONGITUDE	POSITION_Q	PRES (decibe	PRES_QC	PSAL (psu)	PSAL_QC	TEMP (degre	TEMP_QC	DOX2 (micro	DOX2_QC	CPHL (milligr	CPHL_QC	PRES_ADJUS	PRES_ADJUS	PRES_ADJUS	PRES_ADJUS	TEMP_ADJU	TEMP_ADJU	TEMP_ADJU	TEMP_ADJU	PSAL_ADJUS	PSAL_ADJUS
2	5906204	2020-01-01T	1	-30.138	55.198	1	24.4	1	35.628	1	19.702	1					24.46	1	2.4	0	19.702	1	0.002	0	35.65014	1
3	5906204	2020-01-01T	1	-30.138	55.198	1	26	1	35.628	1	19.603	1					26.06	1	2.4	0	19.603	1	0.002	0	35.65013	1
4	5906204	2020-01-01T	1	-30.138	55.198	1	28.1	1	35.627	1	19.471	1					28.16	1	2.4	0	19.471	1	0.002	0	35.64914	1
5	5906204	2020-01-01T	1	-30.138	55.198	1	29.9	1	35.629	1	19.384	1					29.96	1	2.4	0	19.384	1	0.002	0	35.65112	1
6	5906204	2020-01-01T	1	-30.138	55.198	1	32	1	35.63	1	19.323	1					32.06	1	2.4	0	19.323	1	0.002	0	35.65211	1
7	5906204	2020-01-01T	1	-30.138	55.198	1	34	1	35.63	1	19.302	1					34.06	1	2.4	0	19.302	1	0.002	0	35.65214	1
8	5906204	2020-01-01T	1	-30.138	55.198	1	36	1	35.63	1	19.277	1					36.06	1	2.4	0	19.277	1	0.002	0	35.65213	1
9	5906204	2020-01-01T	1	-30.138	55.198	1	38	1	35.627	1	19.232	1					38.06	1	2.4	0	19.232	1	0.002	0	35.64912	1
10	5906204	2020-01-01T	1	-30.138	55.198	1	40	1	35.63	1	19.192	1					40.06	1	2.4	0	19.192	1	0.002	0	35.65212	1
11	5906204	2020-01-01T	1	-30.138	55.198	1	42	1	35.625	1	19.087	1					42.06	1	2.4	0	19.087	1	0.002	0	35.64714	1
12	5906204	2020-01-01T	1	-30.138	55.198	1	44	1	35.621	1	19.049	1					44.06	1	2.4	0	19.049	1	0.002	0	35.64312	1
13	5906204	2020-01-01T	1	-30.138	55.198	1	46	1	35.616	1	18.979	1					46.06	1	2.4	0	18.979	1	0.002	0	35.6381	1
14	5906204	2020-01-01T	1	-30.138	55.198	1	48	1	35.61	1	18.897	1					48.06	1	2.4	0	18.897	1	0.002	0	35.63212	1
15	5906204	2020-01-01T	1	-30.138	55.198	1	50.3	1	35.607	1	18.826	1					50.36	1	2.4	0	18.826	1	0.002	0	35.62911	1
16	5906204	2020-01-01T	1	-30.138	55.198	1	51.6	1	35.596	1	18.655	1					51.66	1	2.4	0	18.655	1	0.002	0	35.61811	1
17	5906204	2020-01-01T	1	-30.138	55.198	1	54	1	35.563	1	17.974	1					54.06	1	2.4	0	17.974	1	0.002	0	35.58507	1
18	5906204	2020-01-01T	1	-30.138	55.198	1	55.9	1	35.559	1	17.83	1					55.96	1	2.4	0	17.83	1	0.002	0	35.58106	1
19	5906204	2020-01-01T	1	-30.138	55.198	1	58	1	35.551	1	17.649	1					58.06	1	2.4	0	17.649	1	0.002	0	35.57305	1
20	5906204	2020-01-01T	1	-30.138	55.198	1	60	1	35.546	1	17.547	1					60.06	1	2.4	0	17.547	1	0.002	0	35.56805	1
21	5906204	2020-01-01T	1	-30.138	55.198	1	62	1	35.542	1	17.438	1					62.06	1	2.4	0	17.438	1	0.002	0	35.56405	1
22	5906204	2020-01-01T	1	-30.138	55.198	1	64	1	35.54	1	17.342	1					64.06	1	2.4	0	17.342	1	0.002	0	35.56205	1
23	5906204	2020-01-01T	1	-30.138	55.198	1	66	1	35.539	1	17.283	1					66.06	1	2.4	0	17.283	1	0.002	0	35.56104	1
24	5906204	2020-01-01T	1	-30.138	55.198	1	68	1	35.541	1	17.266	1					68.06	1	2.4	0	17.266	1	0.002	0	35.56305	1
25	5906204	2020-01-01T	1	-30.138	55.198	1	70	1	35.542	1	17.271	1					70.06	1	2.4	0	17.271	1	0.002	0	35.56403	1
26	5906204	2020-01-01T	1	-30.138	55.198	1	72	1	35.544	1	17.272	1					72.06	1	2.4	0	17.272	1	0.002	0	35.56605	1
27	5906204	2020-01-01T	1	-30.138	55.198	1	74	1	35.545	1	17.266	1					74.06	1	2.4	0	17.266	1	0.002	0	35.56703	1
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31	5906204	2020-01-01T	1	-30.138	55.198	1	82	1	35.529	1	16.976	1					82.06	1	2.4	0	16.976	1	0.002	0	35.55102	1
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33	5906204	2020-01-01T	1	-30.138	55.198	1	86	1	35.524	1	16.882	1					86.06	1	2.4	0	16.882	1	0.002	0	35.54604	1
34	5906204	2020-01-01T	1	-30.138	55.198	1	88.1	1	35.524	1	16.844	1					88.16	1	2.4	0	16.844	1	0.002	0	35.54601	1
35	5906204	2020-01-01T	1	-30.138	55.198	1	90	1	35.528	1	16.79	1					90.06	1	2.4	0	16.79	1	0.002	0	35.55005	1
36	5906204	2020-01-01T	1	-30.138	55.198	1	92	1	35.527	1	16.73	1					92.06	1	2.4	0	16.73	1	0.002	0	35.54905	1
37	5906204	2020-01-01T	1	-30.138	55.198	1	94	1	35.523	1	16.658	1					94.06	1	2.4	0	16.658	1	0.002	0	35.54503	1

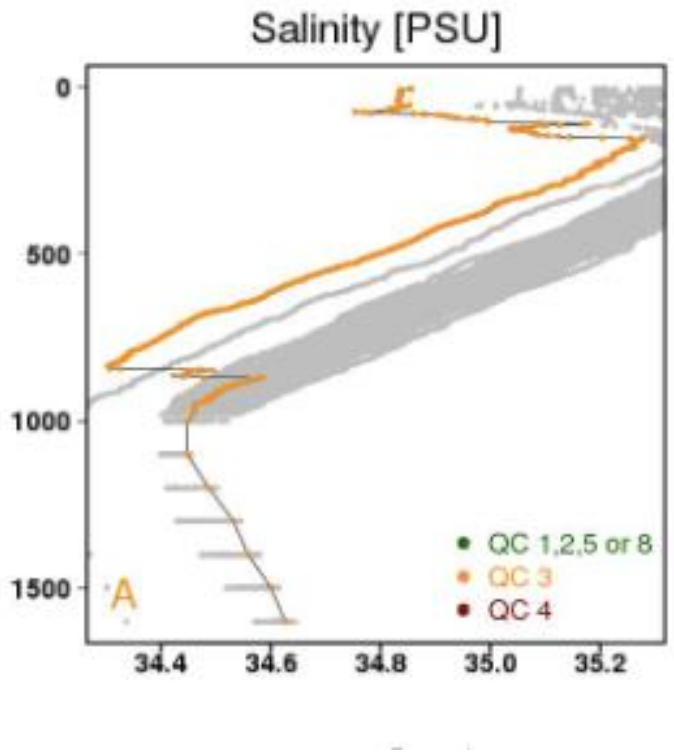
Data File Includes Quality Control Flags

	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 (degre	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. Maurer[3], Joshua N. Plant[3], Catherine Schmechtig[4], Annie P. S. Wong[5], Hervé Claustre[2], Thomas W. Trull[6], T. V. S. Udaya Bhaskar[7], Emmanuel Boss[8], Giorgio Dall'Olmo[9], Emanuele Organelli[2], Antoine Poteau[2], Kenneth S. Johnson[3], Craig Hanstein[6], Edouard Leymarie[2], Serge Le Reste[10], Stephen C. Riser[5], A. Rick Rupan[5], Vincent Taillandier[2], Virginie Thierry[10] and Xiaogang Xing[11]

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

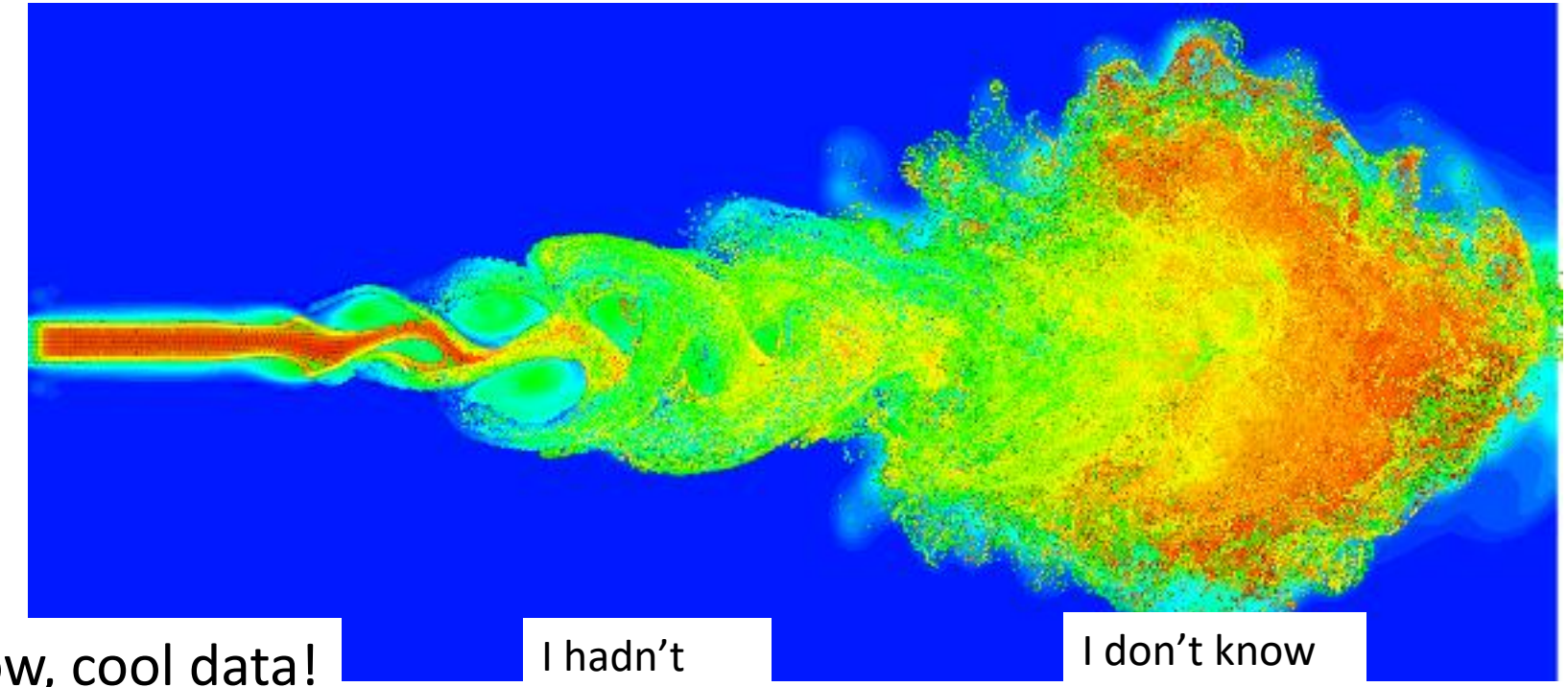
DELAYED-MODE
(D-mode)

- 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

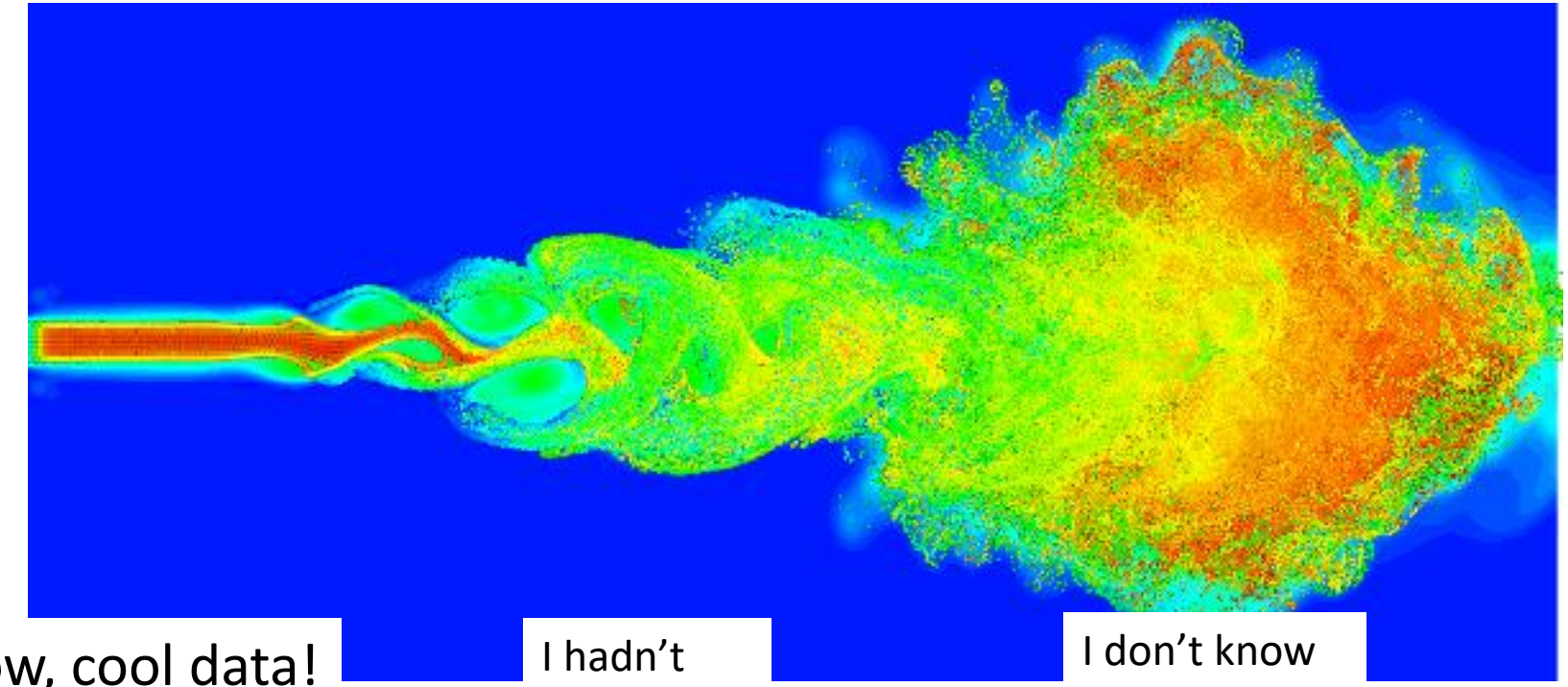


Wow, cool data!

I hadn’t thought about that

I don’t know anything!

The timeline of adaptation to new data



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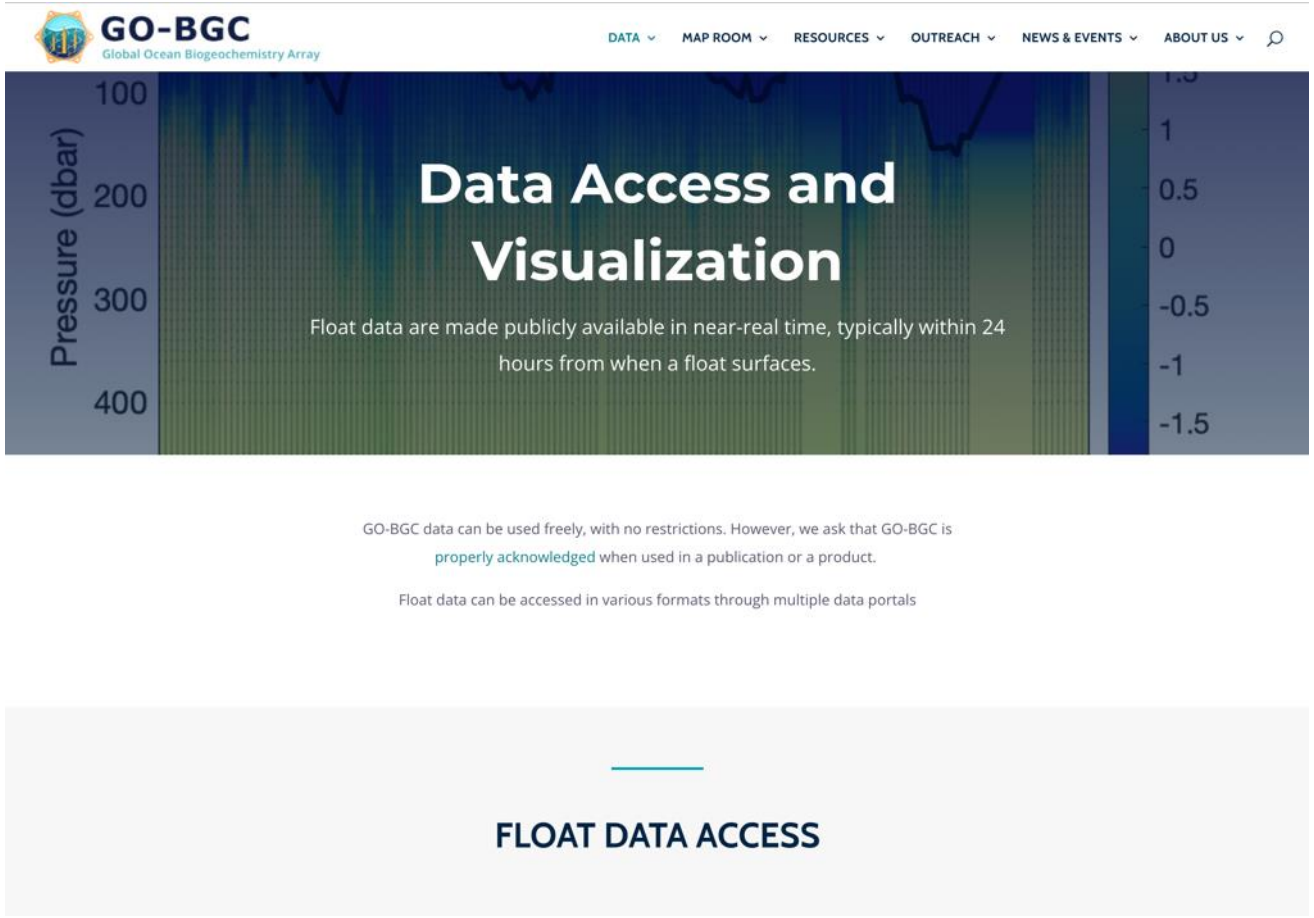
Alternative Data Access: GO-BGC Global Ocean Biogeochemistry Array



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

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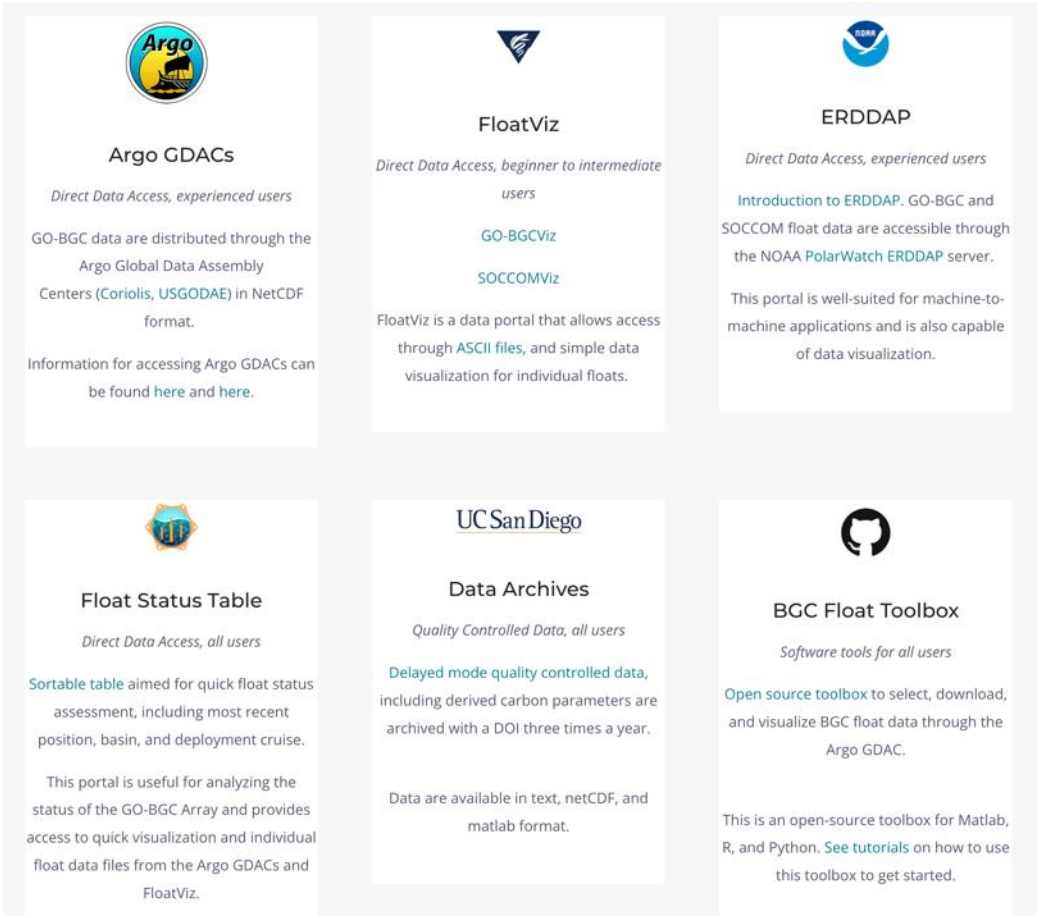

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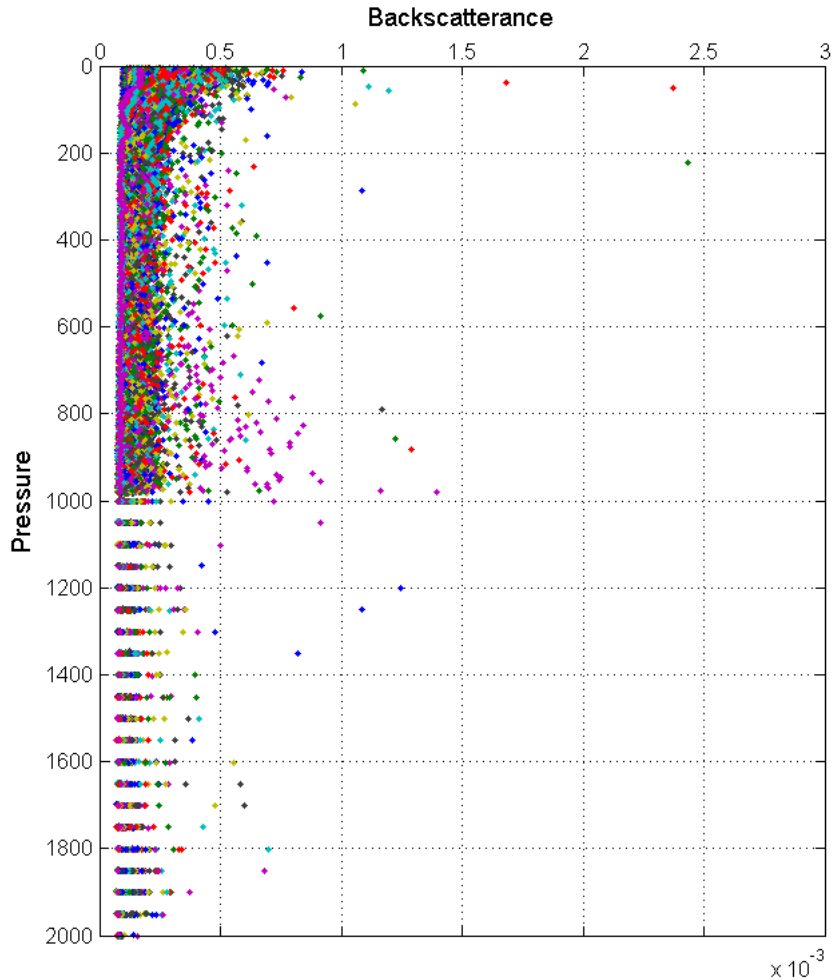
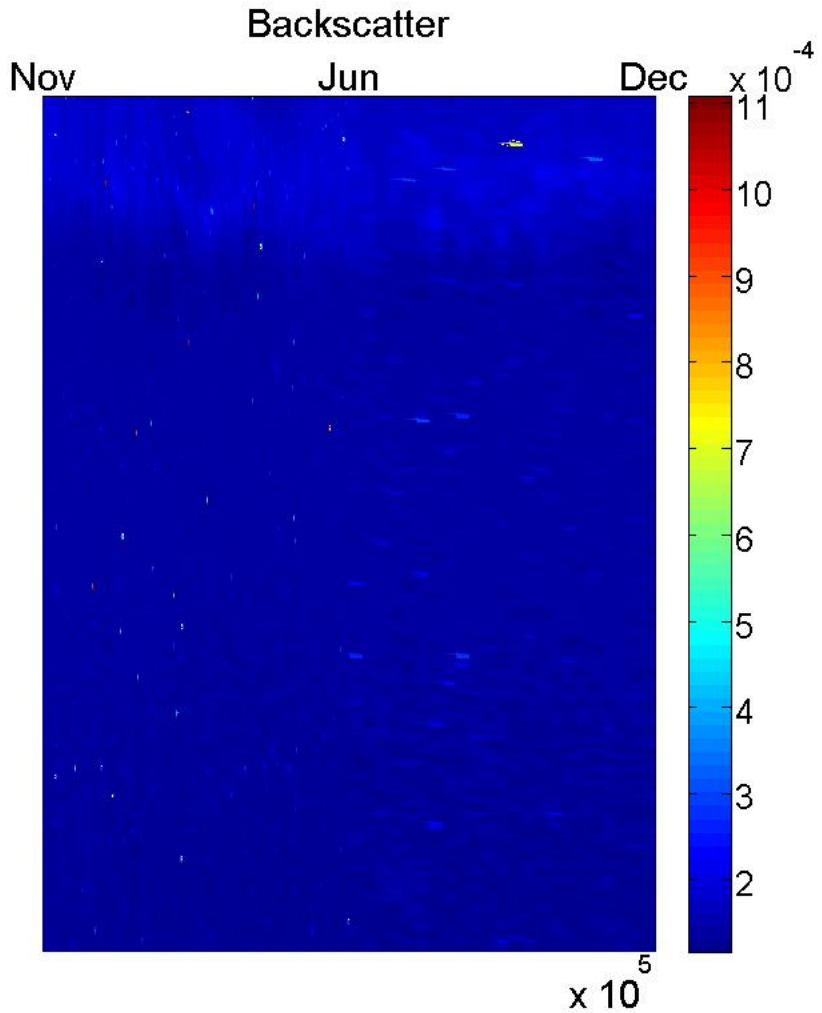
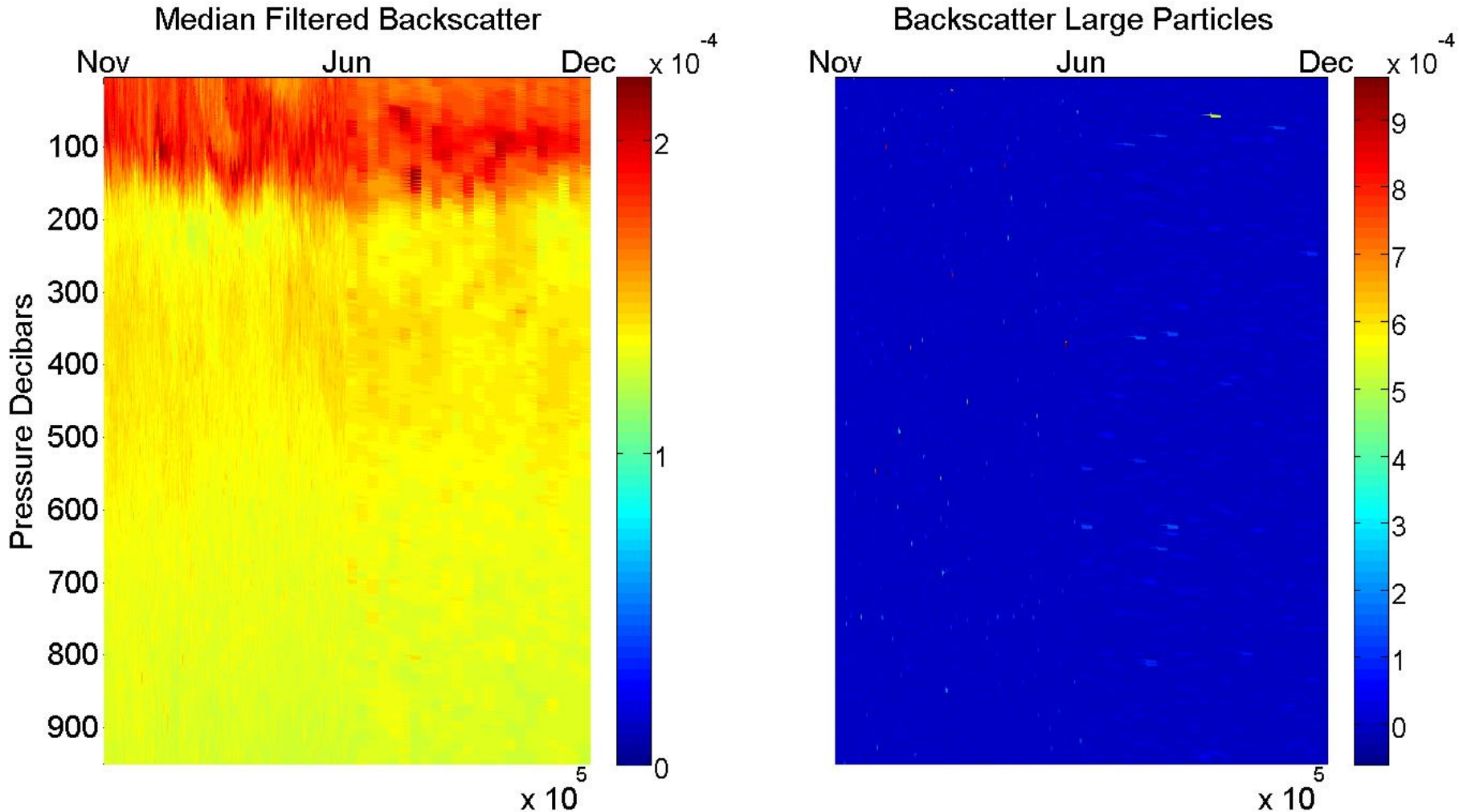
Backscattering: Small *vs.* Large Particles



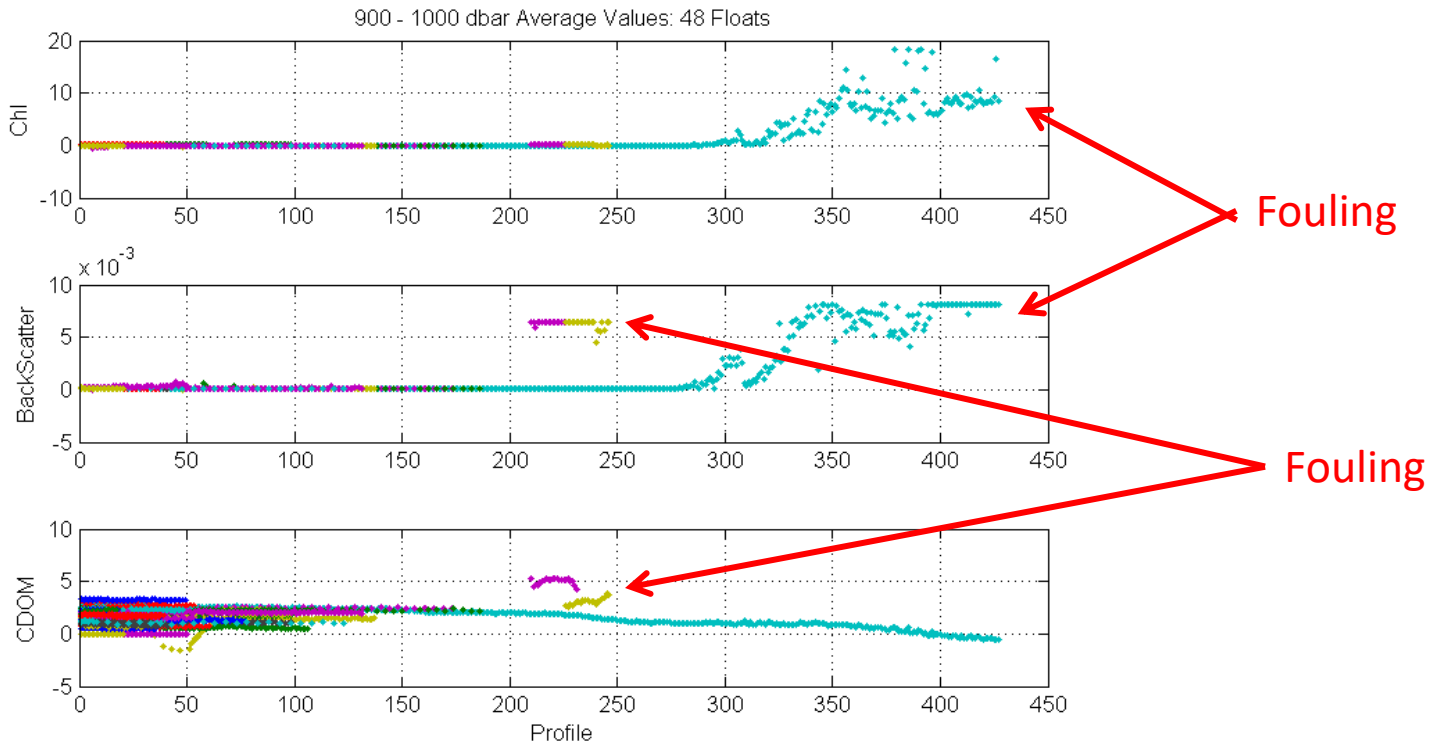


Small *vs.* Large Particles



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