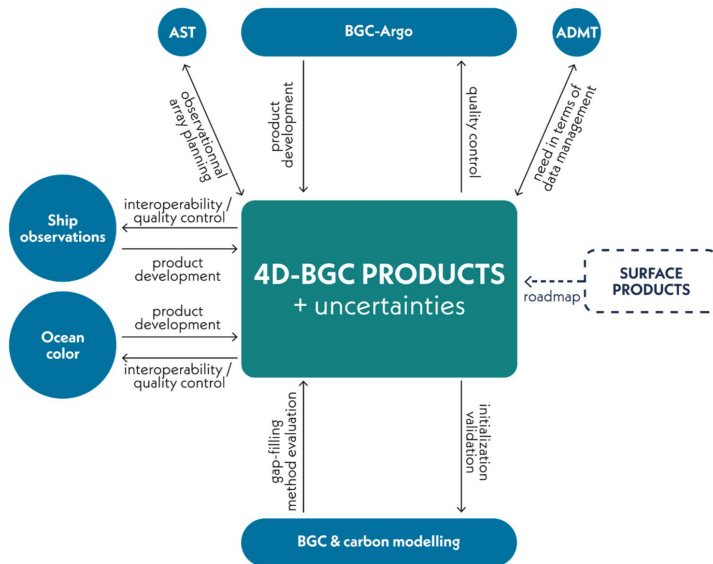


SCOR Working Group 168

Coordinating the Development of Gridded Four-Dimensional Data Products from Biogeochemical-Argo Observations (4D-BGC)

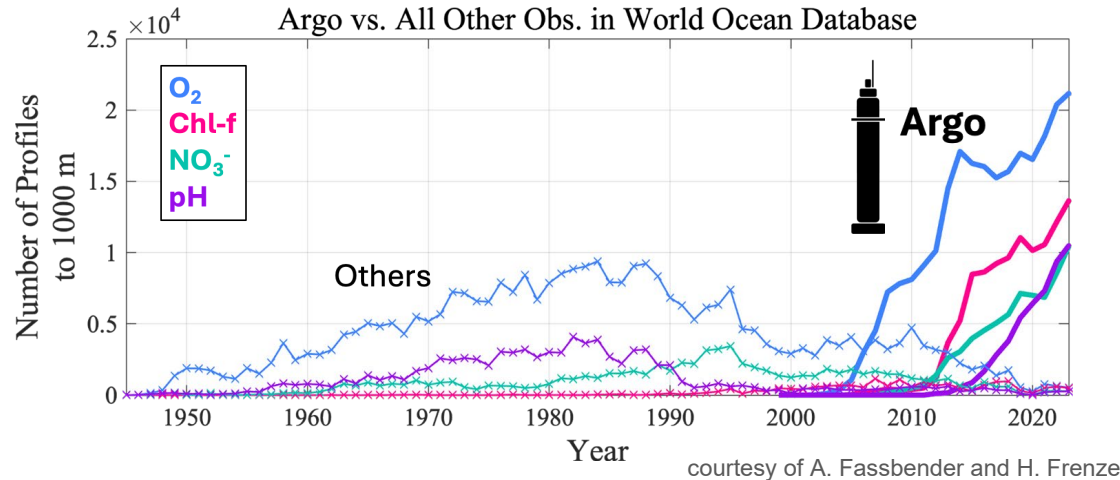
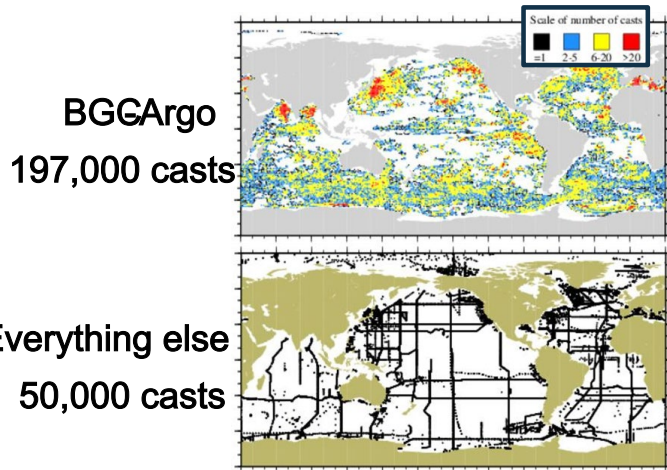


Co-chairs: Jon Sharp (University of Washington CICOES)
Raphaëlle Sauzède (Institut de la Mer de Villefranche)

Motivation for SCOR WG #168

- Autonomous platforms are delivering high-quality biogeochemical observations with impressive spatial distribution and seasonal resolution.

2005-2025 (T/S/O₂ to 1000m)



Motivation for SCOR WG #168

- Groups around the world are using these new observations to create observationally constrained estimates of ocean properties.

Estimating Oxygen in the Southern Ocean Using Argo Temperature and Salinity

D. Giglio¹, V. Lyubchich², and M. R. Mazloff¹

¹Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, USA, ²Chesapeake Biological Laboratory, University of Maryland Center for Environmental and Estuarine Science

GOBAI-O₂: temporally and spatially resolved fields of ocean interior dissolved oxygen over nearly 2 decades

Jonathan D. Sharp^{1,2}, Andrea J. Fassbender², Brendan R. Carter^{1,2}, Gregory C. Johnson², Cristina Schultz^{3,4}, and John P. Dunne³

A neural network-based method for merging ocean color and Argo data to extend surface bio-optical properties to depth: Retrieval of the particulate backscattering coefficient

R. Sauzède¹, H. Claustre¹, J. Uitz¹, C. Jamet², G. Dall'Olmo^{3,4}, F. D'Ortenzio¹, B. Gentili¹, A. Poteau¹, and C. Schmechtig¹

Recent Trends and Variability in the Oceanic Storage of Dissolved Inorganic Carbon

L. Keppler^{1,2,3}, P. Landschützer^{2,4}, S. K. Lauvset⁵, and N. Gruber⁶

¹Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, USA, ²Max Planck Institute for Meteorology, Hamburg, Germany, ³International Max Planck Research School on Earth System Modelling, Hamburg, Germany, ⁴Flanders Marine Institute (VLIZ), Ostend, Belgium, ⁵NORCE Norwegian Research Centre, Bjerknes Centre for Climate Research, Bergen, Norway, ⁶Environmental Physics, Institute of Biogeochemistry and Pollutant Dynamics, ETH Zurich, Zurich, Switzerland

A data assimilating model for estimating Southern Ocean biogeochemistry

A. Verdy¹ and M. R. Mazloff¹

¹Scripps Institution of Oceanography, La Jolla, CA, USA



Vertically Resolved Global Ocean Light Models Using Machine Learning

Pannipullath Raman Renosh¹, Jie Zhang, Raphaëlle Sauzède, and Hervé Claustre



A Reconstructing Model Based on Time-Space-Depth Partitioning for Global Ocean Dissolved Oxygen Concentration

Zhenguo Wang^{1,2,3}, Cunjin Xue^{1,2,3} and Bo Ping⁴

A global monthly climatology of oceanic total dissolved inorganic carbon: a neural network approach

Daniel Broullón¹, Fiz F. Pérez¹, Antón Velo¹, Mario Hoppema², Are Olsen³, Taro Takahashi⁴, Robert M. Key⁵, Toste Tanhua⁶, J. Magdalena Santana-Casiano⁷, and Alex Kozyr⁸

ESTIMATION OF OCEANIC PARTICULATE ORGANIC CARBON WITH MACHINE LEARNING

R. Sauzède¹, J. Emmanuel Johnson², H. Claustre¹, G. Camps-Valls², A.B Ruescas²

¹CNRS-INSU, Sorbonne Université, Institut de la Mer de Villefranche, Villefranche-Sur-Mer, France
²University of Valencia, Image Processing Laboratory, 46980 Paterna (Valencia), Spain

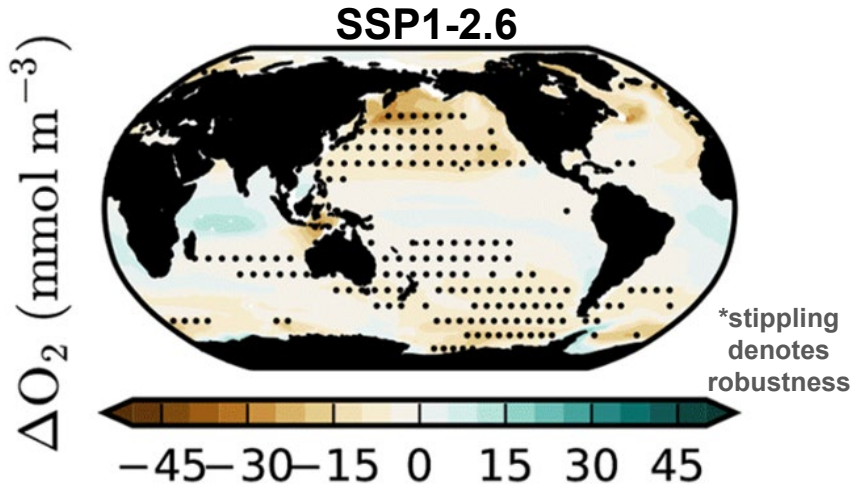
Southern Ocean Acidification Revealed by Biogeochemical-Argo Floats

Matthew R. Mazloff¹, Ariane Verdy¹, Sarah T. Gille¹, Kenneth S. Johnson², Bruce D. Cornuelle¹, and Jorge Sarmiento³

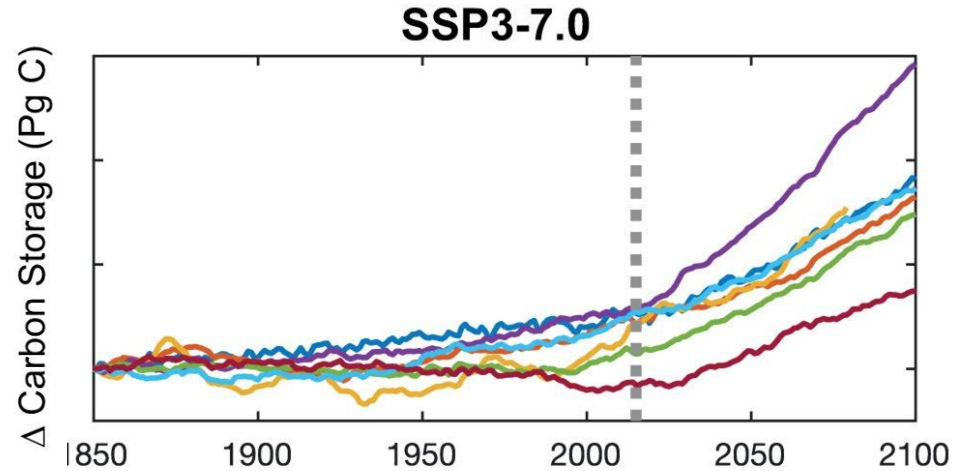
¹Scripps Institution of Oceanography, University of California San Diego, La Jolla, CA, USA, ²Monterey Bay Aquarium Research Institute, Moss Landing, CA, USA, ³Princeton University, Princeton, NJ, USA

Motivation for SCOR WG #168

- Coordination of these efforts will be beneficial for addressing critical questions about the response of ocean processes to ongoing and projected climate changes.



“Although global mean subsurface (100–600 m) O_2 concentration is projected to decline under all SSPs, there is a high degree of variability in projections at regional scales” (*Kwiatkowski et al., 2021*)



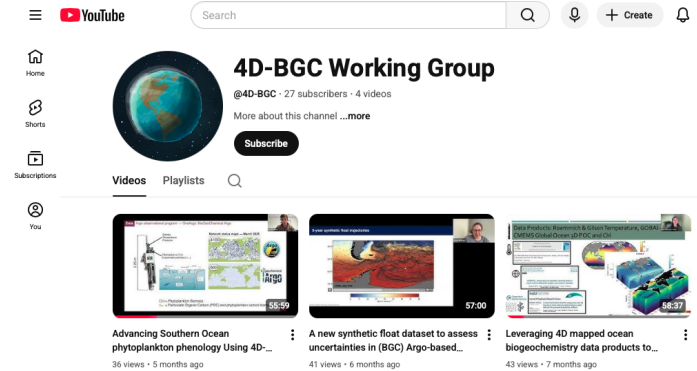
“the magnitude and direction of future changes in carbon sequestration by the BCP are uncertain”
(Wilson et al., 2022)

SCOR Working Group 168: 4D-BGC



4D-BGC Webinar Series

- Launched in November 2024
- Goal is to introduce 4D-BGC products and use cases to the oceanographic community
- All webinars are recorded and posted to 4D-BGC YouTube channel (27 subscribers 😊)
- Next Webinar: **Nov. 12 (Louise Delaigue)**



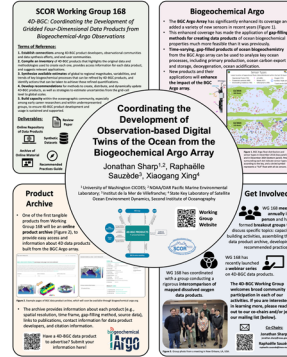
Working Group Meeting (April 2025)

- Heard science talks from five group members about recent updates related to 4D-BGC product development and science
- Checked in about progress on synthesis paper
- Discussed plans for organizing 4D-BGC product mapping intercomparison experiments focused on synthetic datasets extracted from ocean models



Presentations at International Meetings

- Xiamen Symposium on Marine Environmental Sciences
 - Xiamen, China (January 2025)
- Argo Steering Team Meeting
 - Virtual (April 2025)
- One Ocean Science Congress
 - Nice, France (May 2025)
- Presentations have been focused on working group progress and advancements in 4D-BGC products

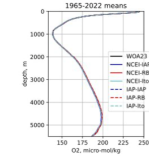


XMAS



OOSC

Some Early Results from the Dissolved Oxygen Mapping Intercomparison Project Phase 1 (DOMIP-1)



AST

Effort led by: Takamitsu Ito (Georgia Tech)
 Collaborators: Hernan Garcia, Lijing Cheng, Zhankun Wang, Chris Roach, **Jon Sharp**, Jun Du, Shoshiro Minobe, Sivan Lauvset, Seth Bushinsky, Zachary Nachod



CONTRIBUTION OF 4D-BGC PRODUCTS TO ARGO DATA

R. SAUZÈDE, C. SCHMECHTIG, J. UITZ & H. CLAUSTRÉ

26TH AST
 15TH OF APRIL 2025



Progress on 4D-BGC Review Paper

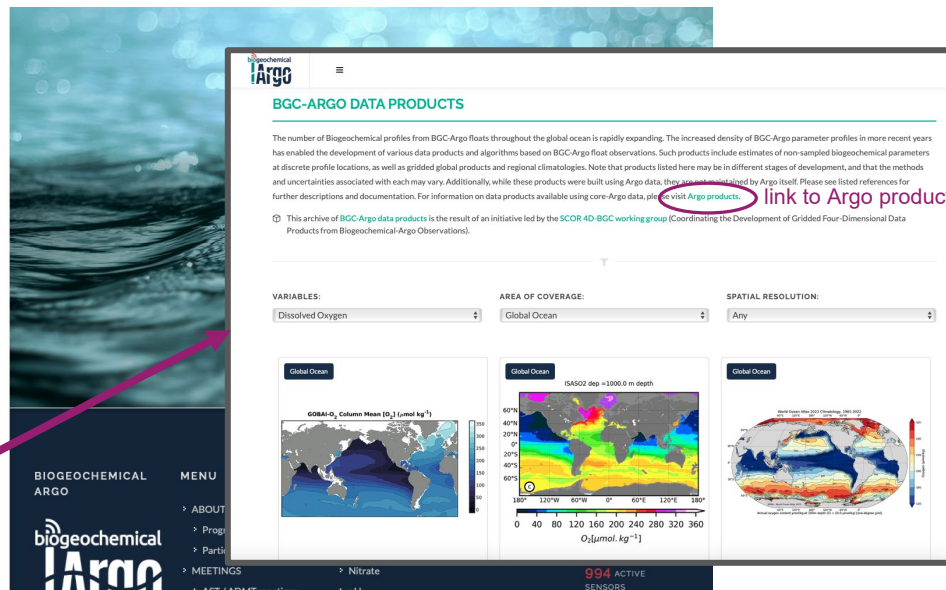
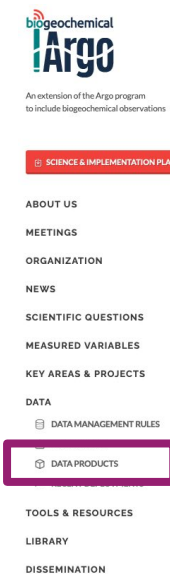
- We are currently writing a manuscript reviewing available 4D data products
- Focused on types of products available, data sources, and future outlook
- We are just about ready for community input on this paper, so please let us know if you'd like to be involved in this effort (jonathan.sharp@noaa.gov / raphaelle.sauzede@imev-mer.fr)

4D-BGC Data Product Repository

- Launched in April 2025 in collaboration with BGC-Argo
- Provides information and access links for 4D-BGC data products
- Will be updated in the future with new published products
- Has been presented to the Argo community a number of times, raising awareness about the existence of the repository as a community resource



Many thanks to Thomas Jessin, the BGC-Argo webmaster for his work!



New Product Submissions

4D-BGC Data Product Information Collection

This survey is intended to collect information about available four-dimensional data products of ocean biogeochemistry constructed using observations from biogeochemical Argo floats, for inclusion on a public-facing archive of data products on the BGC Argo website.

jdsharp215@gmail.com [Switch account](#)

The name, email, and photo associated with your Google account will be recorded when you upload files and submit this form

*** Indicates required question**

Email *

Your email

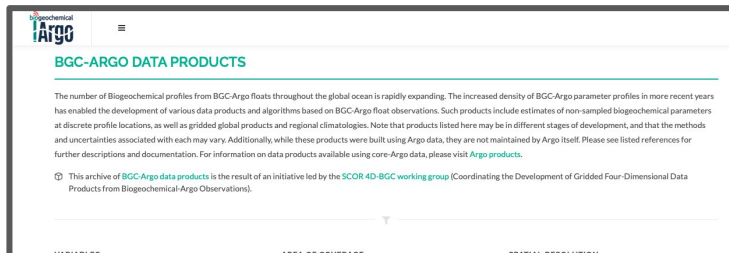
Name and Surname of Primary Contact of the Product *

Your answer

E-mail of Primary Contact of the Product *

Your answer

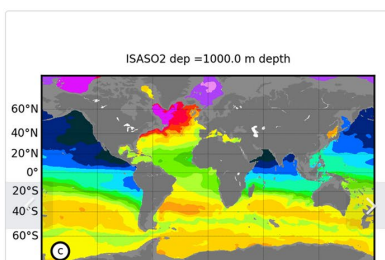
4D-BGC Data Product Repository



BGC-ARGO DATA PRODUCTS

The number of Biogeochemical profiles from BGC-Argo floats throughout the global ocean is rapidly expanding. The increased density of BGC-Argo parameter profiles in more recent years has enabled the development of various data products and algorithms based on BGC-Argo float observations. Such products include estimates of non-sampled biogeochemical parameters at discrete profile locations, as well as gridded global products and regional climatologies. Note that products listed here may be in different stages of development, and that the methods and uncertainties associated with each may vary. Additionally, while these products were built using Argo data, they are not maintained by Argo itself. Please see listed references for further descriptions and documentation. For information on data products available using core-Argo data, please visit [Argo products](#).

🕒 This archive of BGC-Argo data products is the result of an initiative led by the [SCOR 4D-BGC working group](#) (Coordinating the Development of Gridded Four-Dimensional Data Products from Biogeochemical-Argo Observations).



ISASO2 dep = 1000.0 m depth

60°N
40°N
20°N
0°
20°S
40°S
60°S

ISASO2

- 🔑 **Acronym:** ISASO2
- 📄 **Product Name:** Argo DO Optimal Interpolation
- 🗺️ **Feature Type:** Grid
- 🌟 **Gap-Filling Method:** Optimal interpolation
- 🌐 **Spatial Resolution:** 1/2° × 1/2°
- 📏 **Depth Range:** 0 - 5500 m (187 levels)
- 🕒 **Temp. resolution:** Multi-year mean map

📘 Description

👤 Authors

📄 Product Citation

★ Funding Sources

How to cite BGC-Argo Product

We kindly ask users to cite this product as indicated on the product webpage and DOIs provided in the link below. Proper citation ensures that the use of the dataset is correctly tracked and credited. Please also note that OneArgo data products are freely available without restriction. However, to help us track usage and assess the impact of these products, we request that users include an appropriate acknowledgement in any resulting publications or derived products.

In addition to citing the product DOI, please include the following acknowledgement:

"The OneArgo data were collected and made freely available by the International Argo Program and the national programs that contribute to it (<https://argo.ucsd.edu>, <https://www.ocean-ops.org>). The OneArgo Program is part of the Global Ocean Observing System."

We greatly appreciate your cooperation in supporting open science and the continued development of these data products.



4D-BGC

Coordinating the
Development of Gridded
Four-Dimensional Data
Products from
Biogeochemical-Argo
Observations

Webinar Series

Group Information

Group Activities

Resources

Proposal



Join the Mailing List!

4D-BGC Mailing List

[SCOR Working Group 168 \(4D-BGC\)](#) facilitates discussion and coordination among different scientific communities around developing, validating, and distributing 4D-BGC products from observational datasets, with a focus on the BGC-Argo array. Activities and accomplishments of the working group can be found at [4d-bgc.github.io](#).

To receive information by email about upcoming virtual webinars and other 4D-BGC working group events, please fill out the short form below.

jonathan.sharp@noaa.gov [Switch account](#)

Not shared

First Name

Your answer

Last Name

Your answer

Email Address

AST

BGC-Argo

ADMT

Group
Survey

Product
Development

Argo
Quality

Terms of
Service

4d-bgc.github.io

SCOR Annual Meeting
October 30, 2025



Webinar Series

The goal of this webinar series is to introduce new and in-development BGC data products, review techniques used to develop data products from in situ observations, and to explore ways in which 4D-BGC products are leveraged to answer scientific questions.

December 4, 2025	Gian Giacomo Navarra (Upcoming) Title TBD
November 12, 2025	Louise Delaigüe (Upcoming) Secret shifts in the ocean's biological carbon pump
April 22, 2025	Nicolas Mayot (Recording) Advancing Southern Ocean phytoplankton phenology Using 4D-BGC data products
March 26, 2025	Cara Nissen (Recording) A new synthetic float dataset to assess uncertainties in (BGC) Argo-based analyses
February 20, 2025	Mary Margaret Stoll (Recording) Leveraging 4-dimensionally mapped ocean biogeochemistry data products to inform species distribution modeling
November 26, 2024	Bruno Buongiorno Nardelli (Recording) Advancements in Biogeophysical 4D reconstructions: New methods development and exploitation of existing products for scientific investigations

Webinar Recordings: [4D-BGC YouTube Page](#)

Group Information

Substantial advances in oceanographic observation have been made in recent decades, allowing scientists to address questions relating to ocean physics and biogeochemistry on previously unattainable spatial and temporal scales. Remote sensing technology (1970s-pres.) has enabled highly resolved views of surface ocean properties and the Argo array (2000s-pres.) has generated unprecedented ocean interior temperature and salinity observations. The Biogeochemical (BGC) Argo array has grown over the early 21st century, and its planned expansion will soon generate ocean interior carbon, oxygen, nutrient, and optical data with near-global coverage. Four-dimensional (4D; latitude × longitude × depth × time), gridded, and gap-filled data products of these ocean interior properties are being developed. These products will enhance data accessibility and ease data interpretation, transforming our understanding of ocean biogeochemical processes such as carbon fixation, export and remineralization, ocean acidification, deoxygenation, and nutrient cycling. Regular updates to these 4D-BGC products will allow scientists and decision-makers to monitor changes to important biogeochemical processes in near-real-time. This group will facilitate discussion and coordination among different scientific communities around developing, validating, and distributing 4D-BGC products from observational datasets, with a focus on the BGC-Argo array. The ultimate goal of this initiative is to significantly enhance access and utility of BGC observations through 4D-BGC products, and thus refine our understanding of ocean biogeochemistry, improve models and reanalysis products, and inform policy decisions.

Chairs

Raphaëlle Sauzède (France), Jonathan Sharp (USA)

Full Members

Haimanti Biswas (India), Henry Bittig (Germany), Laique Djeutchouang (South Africa), Tobias Ehmen (UK), Tetsuichi Fujiki (Japan), Rodrigo Kerr (Brazil), Jens Daniel Müller (Switzerland), Andrea Rochner (UK)



Resources

4D-BGC Data Products



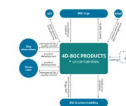
This archive of 4D-BGC data products is maintained by SCOR WG #168 on the Biogeochemical Argo website. The goal is to increase visibility and promote the use of 4D-BGC products. To submit a published data product for consideration for the 4D-BGC archive, complete [this form](#).

SCOR Webpage








A link to the Working Group's webpage on the Scientific Committee on Oceanic Research (SCOR) website.

WG 168 Proposal



A pdf copy of the proposal submitted to SCOR in 2023 that formed the 4D-BGC Working Group.

Terms of Reference for SCOR WG #168

1. **Establish connections** among 4D-BGC product developers, observational communities and data synthesis efforts, and user communities. 
1. **Compile an inventory** of 4D-BGC products that highlights the original data and methodology used to create each one, provides data access information, and suggests relevant applications. 
1. **Synthesize available estimates** of global to regional magnitudes, variabilities, and trends of key biogeochemical processes that can be refined BGC4D products, and identify actions that can be taken to achieve those refined quantifications. 
1. **Develop recommendations** for methods to create, distribute, and dynamically update BGC4D products, as well as strategies to estimate uncertainties from global scales. 
1. **Build capacity** within the oceanographic community, especially among early career researchers and within underrepresented groups, to ensure BGC4D product development and usage is sustained and supported. 

Deliverables for SCOR WG #168

1. **Online repository of gridded BGCArgo data products (T2):**

A catalog will be developed and integrated with the ~~ARGO~~ website featuring descriptions, statistics, and accessibility information for ~~4DBGC~~ products. This will include a process for researchers to submit and update ~~BGC~~ their 4D products.



1. **Synthesis paper on ~~4DBGC~~ product development (T3):**

This ~~open~~ access paper will summarize progress in creating 3D and 4D gridded products of physical and biogeochemical ocean properties, review new insights from emerging ~~BGC4D~~ products, provide an outlook on this area of research over the next decade, and set goals for critical questions about Earth system processes ~~BGC~~ that it should address.



1. **Synthetic datasets for methodological comparisons (T1):**

Model-derived, synthetic datasets (e.g. profiles extracted from ESM output to match Argo float profiles) will be made available to support validation and intercomparison exercises ~~BGC 4D~~ product creation methods.



1. **Recommended practices guide (T4):**

This document will outline recommended practices for the production, validation, evaluation, and distribution of 4D BGC products from the ~~BGC~~ Argo array, integrating perspectives from various communities.



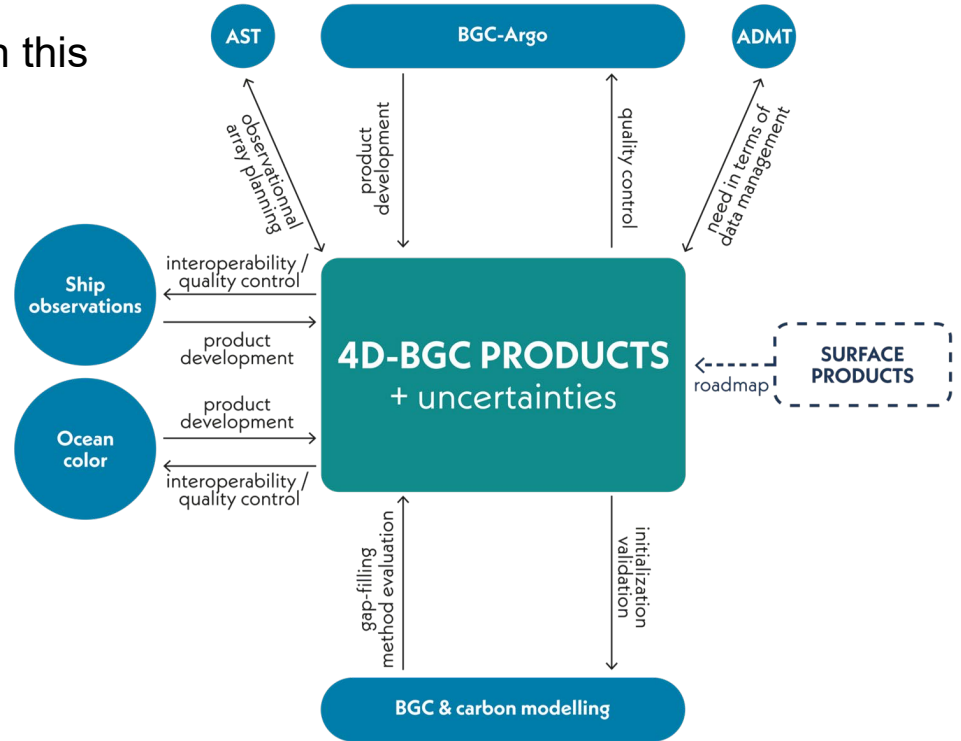
1. **An archive of material (code, presentations, reports) on ~~BGC~~ products (T5):**

Material developed for virtual webinars and workshops will be retained in an accessible archive. In particular, a programming-based “hackathon” will support the development of ~~open~~ source code to produce products and compare them with model output.



Philosophy of SCOR WG #168

- A variety of communities have interest in this topic: data providers and quality controllers, ocean and Earth system modellers, data scientists, marine resource managers, etc.
- We want to do everything we can to work together with these communities at the organizational (e.g., Global Carbon Project, Argo, Coupled Model Intercomparison Project) and grassroots level
- For that reason, the work of SCOR WG #168 should extend beyond its 21 members



THANK YOU!

