



-Scoping Paper, June 2021-

Continued support for the implementation of a Global Biogeochemical Argo Array by 2030.

In cooperation with the International Biogeochemical Argo Programme, GOOS, and the WMO-IOC Joint Centre for Oceanography and Marine Meteorology in situ Observations Programmes Support (OceanOPS), the G7 FSOI will establish a standing activity with a goal of encouraging and facilitating G7 commitment for the implementation of the full-1000 float Array by 2030. This activity will monitor G7 implementation support and commitments, highlight scientific, technical, and governance issues requiring coordinated G7 action, and provide an informal consultative forum for dialogue between BGC Argo scientists and G7 funding agencies and ministries.

Action Areas 1, 3 and 4

1. BACKGROUND

In 2016, the Biogeochemical Argo Implementation Plan was established with a goal to develop a global array of 1000 BGC profiling floats, each carrying 6 new biogeochemical sensors, building on the success of the International Argo Programme. During the preparatory phase (2008-2015), regional pilots demonstrated the operational feasibility of the network and the scientific utility of such biogeochemical data. In 2017, G7 FSOI Working Group agreed that BGC Argo was a priority for coordinated investment.

As a result, G7 members and international partners have announced new commitments beginning in 2021 to implement approximately 60%¹ of the global array.

In May 2021, the G7 FSOI co-sponsored a US-led international workshop, [The Global Biogeochemical-Argo Fleet: Knowledge to Action Workshop](#). This multi-day virtual workshop convened the global community, including scientists, representatives from G7 ministries and government agencies, and stakeholders from industry and the private sector, to showcase new G7 commitments to the BGC Argo array and to engage in high-level discussions exploring the applications of the Array to address critical societal needs such as fisheries management, carbon budget verification, and environmental forecasting.

Completion of the global array will require establishing collaborations with international partners, including those beyond the G7 nations. The workshop experts and participants discussed how to ensure that the joint coordinated investment of multiple countries meets the scientific and societal goals for international funders and stakeholders. The workshop also

¹ Not all floats labelled as contributions to the BGC Argo array include all 6 sensors. The 60% estimate shown here includes all floats that include at least one bgc sensor (e.g., o2).

prioritized next steps for the BGC Argo Programme with partners to ensure full implementation of the array and the international collaboration required to sustain the array into the future.

Achieving global goals for the BGC Argo Array will require continued G7 support for coordinated actions and targeted investment. This G7 FSOI Task Team will establish a standing activity on BGC Argo with a goal of ensuring the implementation of the full-1000 float Array by 2030. This activity will work directly with the new BGC Argo coordinator of the WMO-IOC Joint Centre for Oceanography and Marine Meteorology in situ Observations Programmes Support (OceanOPS) project office to be established in last quarter 2021. The G7 FSOI activity will (*inter alia*) monitor G7 implementation commitments and support, highlight scientific, technical, and governance issues requiring coordinated G7 action, and provide an informal consultative forum for dialogue between BGC Argo scientists and G7 funding agencies and ministries.

2. DESCRIPTION OF THE ACTIVITY AND NEXT STEPS

The role of the G7 FSOI BGC Argo Task Team would be to work with the International BGC Argo programme to:

1. Foster agreements with G7 Members and global partners beyond the G7 to complete and sustain the array and to support the necessary coordination and data infrastructures required to create a global system from multiple contributions.
2. Raise awareness of the utility and benefit of the Biogeochemical Argo Array with implementing agencies and ministries to highlight both the successes and the continued development and funding needs for the global array.
3. Ensure that BGC Argo provides data that are Findable, Accessible, Interoperable, and Reusable (FAIR) to meet needs of a broad range of applications and users.

The Knowledge to Action workshop highlighted several priority issues for the development of the observing system relevant to the BGC Argo Programme and its integration with and importance for other elements of the observing system to meet stakeholder needs. These issues will be addressed by Decade programmes, GOOS panels, and the BGC Argo Programme as the system matures. The G7 FSOI will provide regular information to national focal points about these developments throughout the Decade to highlight how BGC Argo data are being used by multiple stakeholders:

Multi-platform synergy: It was noted in all sessions that there is a strong synergy between BGC Argo observations, satellite observing systems, and ship-based observations. Each of these areas has unique capabilities, but a unified system provides dramatically-improved benefits with capabilities that would not be achievable with any one system. A future focus for the observing system should be on multi-platform observing strategies including data assimilation, and modelling and forecasting.

Societal relevance: The information provided by a multi-platform system including BGC Argo has the capability to transform a suite of societally-relevant topics. These include improved ocean ecosystem and fishery management, improved validation of ocean / atmosphere carbon budgets at the regional to global level, and improved skill in forecasting a variety of processes

from weather to climate. The activity should liaise with international partners such as Geo Blue Planet to develop data and information tools, use cases, and demonstrators.

Coastal connections: A BGC Argo observing system will provide essential benefits to our understanding of coastal processes, but fully realizing these benefits will require extending open-ocean observations into coastal systems with additional, autonomous systems such as gliders, coastal profiling floats, and autonomous surface platforms. This activity should encourage and facilitate these open-to-coastal connections through G7 national and regional programmes, and in partnership with (*inter alia*) the GOOS Regional Alliances, the GOOS Boundary Systems Task Team and the GOOS OceanGliders programme.

Cross-platform data: Synthesis of observations from multiple platforms will require transparent data systems that provide quality-controlled data in real time. Observations must be unbiased across the various platforms. Significant strides have been made, but full realization of a multi-platform data system remains a challenge. This activity, in close cooperation with Action Area 3 on Data Sharing Infrastructure should ensure that BGC Argo provides data that is Findable, Accessible, Interoperable, and Reusable (FAIR) to meet needs of a broad range of applications and users.

Observing higher trophic levels: Extending observations from basic biological properties such as chlorophyll to higher trophic levels required for ecosystem monitoring is highly desirable. This capability would make transformational breakthroughs in our ability to understand and forecast fisheries, carbon budgets, and coastal ocean health issues. This activity should provide a forum for the BGC Argo community and sensor and technology development activities to identify priority needs and encourage and support pilot activities.

Training users: There is a significant and unmet need to train potential users of these data. While efforts are underway to increase scientific users, there is not yet a comparable effort to train end users at various management levels. This problem is particularly acute for less-resourced nations. The workshop noted the significant efforts made by Indian National Centre for Ocean Information Services (INCOIS) in India to transfer multi-platform observing to end users. This G7 FSOI activity should evaluate needs and opportunities for this type of training and outreach, and work with INCOIS and other international programmes such as the Partnership for Observations of the Global Ocean (POGO) and GEO Blue Planet to understand how this model could be applied to training programmes across the G7.

Connecting observations to models: Extensive efforts are being made to incorporate BGC Argo data into ocean models through assimilation and validation. Further work is needed, and this is dependent on provision of data from a geographically-expanded array, as well as the development of gridded products. The activity should facilitate synergies between the BGC Argo array, Action Area 3 on Data Sharing Infrastructures, modelling and forecasting programmes of the G7 Members and Decade programmes to strengthen the uptake and use of BGC Argo data.

Task Team Development

The G7 FSOI BGC Argo Task Team should be established to include G7 BGC Argo experts and representatives from relevant funding agencies and ministries, and should work directly with the International BGC Argo Mission Team and the BGC Argo Coordinator at OceanOPS.

The Task Team should initiate the activity through a meeting with the International BGC Argo Mission Team and Data Management Task Team to:

- define the scope and content of regular reporting on implementation progress and identification of priorities for coordinated investment to the G7 Members,
- identify opportunities / events for publication of joint high-level messaging and communiques to mobilize enhanced support,
- review the links between the BGC Argo programme and relevant GOOS and Decade programmes to identify and highlight how BGC Argo contributes to multiple observing-system and research goals and to raise awareness at the international / intergovernmental level of the utility and benefit of BGC Argo data,
- review and highlight data sharing infrastructure issues to ensure that data are FAIR and identify data management / sharing issues requiring specific G7 support, and
- support the development of applications using BGC Argo data, in particular, for carbon budget verification, fishery management and ocean modelling and prediction.

Deliverables:

Task Team meeting report outlining the scope of the activity based on the above issues.

Report outlining initial priority areas requiring coordinated support for the G7 Members.

3. RESOURCING FOR THE G7 FSOI TASK TEAM

Estimate 15% FTE support by G7 FSOI Coordination Centre to establish the Task Team, guide and facilitate its work, and communicate regularly with G7 members and stakeholders.

Estimate < 2% FTE in-kind support from each G7 member to ensure engagement and communications with respective national experts and programmes.

Estimate <2% FTE in-kind support from the secretariat of the OceanOPS BGC Argo Coordinator.

Task Team meeting (likely virtual or mixed) – estimate \$30k USD for members if the meeting is not virtual; G7 members to provide participation support for their experts and representatives. Other financial support is required for participation of international (non G7) experts and representatives of partner programmes.