Arvor-Provor Float Technical Workshop Report

28-30 January 2020

Ifremer Laboratory, Brest, France

Summary

The international Argo program is widely recognized as the "gold standard" in global ocean observation systems, especially because of its ability to deliver freely available and accurate data to the science community and end user clients. This does not mean that the Argo program has no challenges to address. As with any sustained Earth observation system there is continuous pressure to increase efficiency, and to find ongoing funding to maintain the global array. Over the last several years, the Argo Steering Team (AST) has been discussing what needs to be done to ensure the long-term sustainability of the Argo program. The move towards integrating new biogeochemical sensors, and deep-profiling floats, into the array makes addressing these needs all the more important as the system becomes more complex. One key element that has been identified by the AST to address sustainability is to improve the level of technical expertise in countries that are deploying Argo floats. The goal is to improve pre-deployment testing and checks to minimize early failures of floats. Also, improved at-sea procedures can help to improve float lifetimes. If we can improve the average lifetime of Argo floats in the ocean, then Argo will have to deploy fewer floats annually to maintain the density goals of the array.

A three-day workshop was held at Ifremer in Brest, France on 28-30 January 2020 with 58 attendees. This workshop was organized by Argo Canada and Argo France for Arvor-Provor Argo float users with the objective of improving the level of technical expertise and to share best practices. In addition to scientists and technicians that deploy floats, the workshop also included representatives of the Argo data management community, and the Arvor/Provor float manufacturer (NKE) and sensor providers (Sea-Bird, RBR, JFE). The format of the workshop combined classroom presentations and discussions with hands-on training at the Ifremer test tank.

Day 1 of the workshop began with an overview of previous float technical workshops held at the University of Washington, with a summary of lessons learned. This was followed by a presentation on the status of the Arvor and Provor floats in the context of the global Argo array and included a discussion of the lifetime and performance of these platforms. The potential to support new scientific research initiatives was highlighted in presentations on the Provor biogeochemical float and the Deep-Arvor platform. In the afternoon, the Arvor/Provor manufacturer (NKE) provided the workshop attendees with an overview of the company and its various products along with information on customer support. This was followed by presentations on float sensors by RBR, NKE and JFE. The day finished with a presentation on new technical developments for the Provor CTS5 at LOV, and an update on Argos and Iridium communications from CLS.

Day 2 began with a presentation from Sea-Bird on the various sensors that the company provides for Argo floats along with information on best practices for handling, storage and preparation of BGC sensors. This was followed with an update on two Ifremer R&D projects, one to incorporate an ADCP on a Deep-Arvor and the second on the 3-head Deep-Arvor with the SBE41, SBE61 and RBR CTDs mounted on a float. The remainder of the morning focussed on best practices for both floats and sensors as well as metadata and data management. In the afternoon, workshop attendees had the

chance to get some hands on experience with floats at the Ifremer test tank facility. This aspect of the workshop was very well received given the interactive nature of the activity, and lots of discussion was generated.

The morning of Day 3 provided an overview of the Argo file structure at the Global Data Assembly Centres (GDAC), naming conventions, file types, etc. An introduction to the R oce package provided attendees with information on how to visualize Argo data from GDAC NetCDF files with minimal effort or training required. A presentation of the Euro-Argo online fleet monitoring tool was demonstrated to show how this can be used to access technical information on all floats in the global array; this tool is an excellent complement to the JCOMMOPS application for the Argo program. In the afternoon of Day 3, two case studies (float recovery, under ice behaviour) were presented as well as an introduction to the Provor CTS5 graphical user interface for mission planning. The workshop concluded with a discussion about key issues and potential recommendations generated over the preceding three days.

All the materials from the workshop are available online at: **https://github.com/euroargodev/techworkshop**

Recommendations

Building on top of positive feedback from the user community on Arvor/Provor floats, the primary recommendations from the workshop are:

1. To improve and facilitate **communication** within the Argo community on all technical issues (eg: floats failure modes, ongoing sensor and float problems to be solved, recommended standard configurations, etc...). The Arvor/Provor float users could potentially build upon the Euro-Argo Collaborative Framework (at github.com/euroargodev) and keep organizing recurrent workshops;
2. To share[1] **pre-deployment** procedures among Arvor-Provor users for:
   a. In house facilities or on dock before departure:
      i. For float configuration (eg: macros defining standard missions, NKE mission design GUI)
      ii. Post-delivery checklist (eg: Iridium tests, battery tests, sensor tests, etc…)
   b. At sea:
      i. Deployment checklist (1 page sheet)
3. The Arvor/Provor user community recommends that sensor manufacturers develop **sensor self-testing capabilities** that would be incorporated into the already existing auto-testing feature of the Arvor/Provor floats.
4. The Arvor/Provor user community recommends **float and sensor manufacturers** to provide central entry points (and machine-to-machine readable) for:
   a. **best practices** checklists for their floats or sensors,
   b. **meta-data** access on floats or sensors with as many technical details as possible (eg: about pre-calibration, sub-component information),

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[1] This will be done online through the Euro-Argo collaborative framework at github.com/euroargodev

    c. technical **vocabulary** definitions in line with those of the Argo data management team
5. To continuously develop and improve online fleet **monitoring** tools like https://fleetmonitoring.euro-argo.eu (eg: to include more information on sensor performance).
6. The user community requests that NKE extend the **mission planning tool** APMT Profiler GUI (dedicated to the Provor CTS5) to the Arvor. This tool allows the user to design a configuration and receive information about the expected lifetime of the float, data telemetry estimates, etc., as a function of sensor payload and cycle configurations.
7. To **improve recovery methods** of floats. This workshop resulted in the creation of a working group on this topic at github.com/euroargodev/recovery

Workshop Conveners:
Noé Poffa (Ifremer, France)
Blair Greenan (DFO, Canada)
Guillaume Maze (Ifremer, France)
Antoine Poteau (LOV, France)

Workshop Agenda

Tuesday 28 January 2020		
08:30	Registration in the Hall of the Salon de l'Océan (upstairs)	
OPENING SESSION		
09:00	Welcome and overview of workshop objectives	Noé Poffa *(Ifremer)* and Blair Greenan *(DFO)*
09:15	Overview of previous float workshops with lessons learned	Stephen Riser *(UW)*
10:00	ARVOR & PROVOR Argo network status	Mathieu Belbéoch *(Jcommops)*
10:30	**Coffee Break - Poster session**	**30 min**
Session 1: Argo Platforms SCIENCE aspects		
11:00	1. Provor BGC floats and sensors	Hervé Claustre *(LOV)*
11:30	2. Deep-Arvor profiling floats	Virginie Thierry *(Ifremer)*
12:00	3. Discussion with workshop attendees	All
13:00	4. Lunch break	**60 min**
Session 2: R&D and Manufacturers		
14:00	1. NKE company, products and customer support	Jérôme SAGOT *(NKE)*
14:30	2. RBR CTD sensors	Greg Johnson *(RBR)*
15:00	3. NOSS sensor	Yves Degres *(NKE)*
15:30	4. RINKO 02 sensor	Herminio Foloni Neto *(JFE)*
16:00	**Coffee Break - Poster session**	**30 min**
16:30	5. R&D on CTS5 at LOV	Edouard Leymarie *(LOV)*
17:00	6. Iridium communication and new developments at CLS	Solène Routaboul *(CLS)*
17:15	7. SBE 41CP CTD technical aspects and best practices before deployment – SBE BGC sensors	Joshen Klinke *(SEABIRD)*

Wednesday 29 January 2020

	Session 2: R&D and Manufacturers	
09:00	R&D at Ifremer - The "WAPITI ADCP deep-Arvor" and the "3-heads (SBE41, SBE61, RBR) deep-Arvor" projects	Xavier André & Martin Amice *(Ifremer)*
	Session 3: Best practices	
09:30	1. Paper good practice[1] - Sensors	Henry Bittig *(IOW)*
10:00	2. Float metadata on DAC – GDAC good practice Float metadata on JCOMMOPS Feedback from everyone	Catherine Schmechtig *(OSU Ecce Terra)* / Anthonin Lize *(Jcommops)* All
10:30	Coffee Break - Poster session - Discussion	60 min
11:30	3. CTD/O2 2000m and Deep floats configuration habits	Andrea Garcia Juan *(Euro-Argo)*
12:00	4. BGC float navigation and parameters (CTS4 et CTS5-USEA)	Antoine Poteau (LOV) / Edouard Leymarie (LOV)
12:30	5. Float tests, handling and deployment good practices	Noé Poffa *(Ifremer)* / Romain Cancouët *(Euro-Argo)* / Antoine Poteau *(LOV)*
13:00	**Lunch break**	60 min
	Session 4: Hands-on floats: hardware **IFREMER test-tank**	
14:00	1. Ifremer test-tank facility overview	Noé Poffa *(Ifremer)*
14:15	2. Sensor handling, float configuration, deployment, etc...	Noé Poffa *(Ifremer)* / Romain Cancouët *(Euro-Argo)* / Antoine Poteau *(LOV)*
15:00	3. Hands on floats Group should split into two working groups : one with people interested in Arvor/Deep floats and one dedicated to PROVOR BGC USEA for UVP6 sensor Arvor and Deep Arvor Floats PROVOR USEA for UVP6 sensor Note: *The test area dedicated to the workshop can get really cold and wet, make sure to wear appropriate clothing. We will also have a (warmer) meeting room next to the pool but with limited access to about 15.*	 Noé Poffa *(Ifremer)* / Romain Cancouët *(Euro-Argo)* / NKE Antoine Poteau (LOV) / Edouard Leymarie (LOV) / NKE

Thursday 30 January 2020

Session 4: Hands-on floats: hardware		
IFREMER test-tank		
09:00	1. Float recovery from Ifremer test tank	Noé Poffa *(Ifremer)* / Romain Cancouët *(Euro-Argo)* / Antoine Poteau *(LOV)*
09:30	2. Raw data recovery, float re-conditioning, etc...	All
10:30	Coffee Break - Poster session - Discussion	60 min
Session 5: Data handling and tools		
11:30	1. Data handling : raw and .nc files	Henry Bittig *(IOW)* / Antoine Poteau *(LOV)* / Catherine Schmechtig *(OSU Ecce Terra)*
12:00	2. Data handling: The R oce package	Blair Greenan *(DFO)*
12:30	3. At sea monitoring tools	Romain Cancouët *(Euro-Argo)*
13:00	Lunch break	60 min
Session 6: Open session : Case studies		
14:00	1. Case study n°1: Hydraulics / groundings	Romain Cancouët *(Euro-Argo)*
14:20	2. Case study n°2: Arvor float under Ice behaviour	Noé Poffa *(Ifremer)*
14:40	3. Case study n°4: CTS5-USEA new interface graphic	Edouard Leymarie *(LOV)*
15:00	4. Case study n°5: Float recovery at sea	Noé Poffa *(Ifremer)*
15:20	5. Open discussion: Improving float lifetime	All
15:40	6. Open discussion: Requirements in future developments	All
16:00	WORKSHOP CONCLUSION	Guillaume Maze *(Ifremer)* /(Noé Poffa *(Ifremer)* and Blair Greenan *(DFO)*

List of Attendees

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