The 22th Argo Steering Team Meeting, Virtual meeting, March 22-26, 2021

Argo Chinese National Report 2020

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1. The status of implementation of the new global, full-depth, multidisciplinary Argo array (major achievements and problems in 2020)

a. floats deployed and their performance

From last February, China deployed 34 floats (6 HM2000, 21 PROVOR, 2 AROVR_D, 4 BGC PROVOR and 1 BGC NAVIS) in the northwestern Pacific Ocean, Bay of Bengal and the South China Sea. All these floats transmit data with Iridium satellite system, and were deployed by 4 PIs from the Second Institute of Oceanography (SIO), Ministry of Natural Resources and Zhejiang University. It is worth noting that 21 PROVOR floats were deployed in the tropical western Pacific as part of China TPOS2020 project. In total, China has deployed 495 floats, and approximately 87 floats are operational as of 28 February 2021.

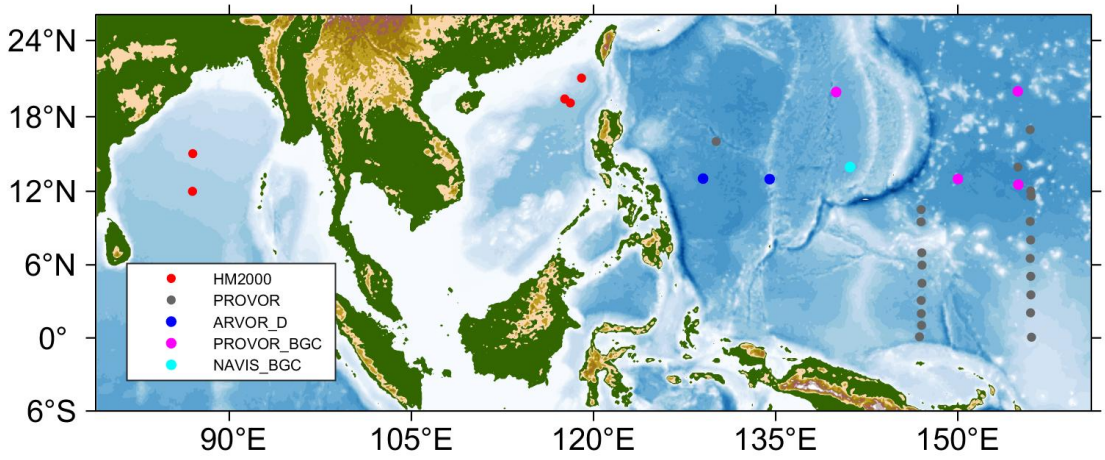

Fig.1 Launch positions of the floats from March 2020 to February 2021.

b. technical problems encountered and solved

4 out of 6 HM2000 floats which we deployed in 2020 have been found message packet loss problem even if HM2000 has the capacity to re-transmit lost messages in the previous cycle. The problem has been

submitted to HSOE. Their analysis indicated that these floats were manufactured in 2017, due to a long period of storage before deployment, the performance of the communication model has degraded.

The ECO sensor failure problem was found in a PROVOR float (WMO: 2902751) that we deployed in the northwest Pacific (20.36 ℃N, 127.73 ℃E) on 9th July, 2020. The float profiled normally and CTD worked well, but there was no ECO sensor data received since its first profile. The failure was unable to be fixed through remote commands. CSIO contacted a nearby fishing boat to recover this float on 11th October. Now it is going to be sent to NKE for a full test and battery replacement.

c. status of contributions to Argo data management (including status of high salinity drift floats, decoding difficulties, ramping up to include BGC or Deep floats, etc)

CSIO: CSIO is maintaining a Matlab-based data system for data decoding. The MEDD test has been added into this system. From the last February, CSIO received data from 127 active floats (including 5 Deep Argo and 13 BGC floats) and submitted 4,629 TS profiles (plus 487 DOXY, 465 CHLA, 465 BBP, 392 CDOM, 894 DOWN_IRRIDIANCE, 363 NITRATE and 115 pH) to GDACs. All the profile data are converted into BUFR bulletin and sent to the GTS via Chinese Meteorological Agency (CMA, Beijing).

NMDIS: The data processing system of NMDIS is developed with C # language. The quality control methods are updated in time according to Argo quality control manual. The system is upgraded in 2020 in order to further refine the data processing. The quality control methods and parameters released by other plans and organizations are sorted out and combined, and the detailed qc results are recorded so as to improve the parameters, methods and processes during QC.

d. status of delayed mode quality control process

Based on the CSIRO DMQC system and the OWC tools, about 37,275 D-files have been submitted to GDACs from CSIO. Except those floats deployed in late 2020, almost all of the core Argo data have been DMQC'ed. In addition, the DMQC for HM2000 floats has been carried out smoothly with the help from CSIRO. Here, we still want to express our sincere gratitude to Australian Argo group, especially their DMQC team, and professor Annie Wong. Thanks for your help in this task.

e. status of post-processing of the global Argo data set

CSIO: CSIO maintains a global Argo data set which is derived from the profiles provided by GDAC. A fast receiving and post-quality-control system has been established which enable us to synchronize with the GDAC server four times per day. 15 QC tests including a climatological test and MEDD test are being applied prior to generating new QC flags. The global BGC-Argo data set with originally allocated QC flags is also updated at CSIO. Both the data sets are accessible from ftp://ftp.argo.org.cn/pub/ARGO/global/.

NMDIS: Relying on the automatic processing system, NMDIS synchronizes the data from the GDAC every day. NMDIS carries out format conversion, quality control and duplication removing during post-

processing of the profile data. Both the original NC data files and post-processing data files are delivered through the website of China Argo data center for public use. The quality control methods are specified in Argo quality management manual. The duplication is determined mainly based on platform number, data center, position, time and observation data, etc. The results of the duplication were feedback to the GDAC in France. China Argo data center website: https://www.argo-cndc.org.

f. update of Chinese COPEX float

In May 2020, CSIO helped NOTC deploy 3 COPEX floats in the South China Sea for a field test. Each float had operated for about 3 months (daily cycle) and observed about 110 TS profiles in depths of 0-2000 dbar. The main technical problems are the platform does not tend to park stably at 1000 dbar and the lifetime is too short to meet the goal of long-term observation. CSIO has provided a technical report to NOTC, in which some suggestions are proposed to improve the performance of COPEX. During August-September 2020, NOTC deployed 4 COPEX floats installed with NOTC Argo CTD sensor in the northwestern Pacific Ocean. The results from TS observations show that 3 out of 4 sensors have the salinity bias within 0.02 psu from the historical CTD dataset, while the one remaining float's salinity bias is as large as 0.04 psu. The Argo community is very careful to permit the usage of new sensor on a float, therefore we ought to inspect the performance of this CTD sensor in a long term.

g. update of Chinese HM2000 & HM4000 floats

An internal meeting was held between CSIO and HSOE in last December. The discussion referred to the performance of HM2000 float according to observations from those floats that have been deployed by China Argo. Some technical problems were raised from the summary accomplished by CSIO. Suggestions have been proposed for improvement of HM2000 float. HSOE also agreed to install Tadiran battery packs into several HM2000 floats for a comparison of energy consumption between Tadiran and battery currently used.

With respect to HM4000 float, the deep float R&D team of HSOE have upgraded the HM4000 prototype in terms of improving the production and testing processes after 2019-test in the western Pacific. In addition, the power supply module and main control system have been improved, and the power consumption test has been conducted. Currently, the measurement module can be compatible with both SBE61 and RBRArgo^3 CTD|deep 6k sensors.

The team has also carried out the development of deep floats for 6000 m in terms of some key techniques like design and test of pressure casing, buoyancy-driven module, and buoyancy compensation module. They have finished the design of pressure casing structure and buoyancy-driven scheme, while manufacturing of pressure casing and buoyancy-driven system is under way.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo, and funding for sustaining the core mission and the enhancements: BGC, Deep, Spatial (Polar, equator, WBCs)

The new China Argo program has been named China Argo Infrastucture construction, with the goal of maintaining 400 floats in the northwestern Pacific Ocean, Indian Ocean and the South China Sea. HM2000 float (with Beidou satellite system for data transmission) has been selected as the main instrument to build the array.

The pilot project of China Deep Argo sponsored by Pilot National Laboratory for Marine Science and Technology (Qingdao, QNLM) was also impacted by COVID-19 in 2020. The manufacturer, HSOE is still waiting for the deliveries of CTD sensors (both from RBR and SBE). QNLM plans to organize a cruise in the mid of 2021 to deploy 10 HM4000 floats in the Kuroshio extension.

CSIO: About 9 staffs at CSIO contribute to the logistics and data management for China Argo and BGC-Argo.

NMDIS: 6 staffs, of which two are IT professionals, responsible for system development and website maintaining, one is working for RT data processing, and one for DM processing, and two for product making.

3. Summary of deployment plans (level of commitment, areas of float deployment, Argo missions and extensions) and other commitments to Argo (data management) for the upcoming year and beyond where possible.

In the upcoming cruise in the northwestern Pacific Ocean, 10 HM4000 floats will be deployed in the Kuroshio Extension during May-June 2021. 9 of these floats are equipped with RBRargo^3 CTD|deep 6k and the one remaining is equipped with SEB61. To verify observations from these deep floats, a Guidline salinometer will be taken to the vessel. All data derived from the deployed HM4000 floats will be transmitted to CSIO and HSOE.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers. Please also include any links to national program Argo web pages to update links on the AST and AIC websites.

CSIO currently provides a mirror access to the global Argo data set (synchronize with the GDAC server four times per day), and also provides a free download of the BOA_Argo (the Argo product developed by CSIO) as well as the post-quality-controlled global Argo data set (quarterly updated). Argo data and data product have been widely used in scientific research and operational forecasts.

CSIO maintains the website of the China Argo Real-time Data Center (http://www.argo.org.cn) where the implementation status of China Argo, real-time data display including observed profiles, float trajectory, profile data, the derived products and status of global Argo are accessible. A new global Argo data visualization application is being developed by a company.

5. Issues that your country wishes to be considered and resolved by the Argo Steering Team regarding the international operation of Argo. These might include tasks performed by the AIC, the

coordination of activities at an international level and the performance of the Argo data system. If you have specific comments, please include them in your national report.

Nothing to report.

6. To continue improving the quality and quantity of CTD cruise data being added to the reference database by Argo PIs, it is requested that you include any CTD station data that was taken at the time of float deployments this year. Additionally, please list CTD data (calibrated with bottle data) taken by your country in the past year that may be added to the reference database. These cruises could be ones designated for Argo calibration purposes only or could be cruises that are open to the public. To help CCHDO track down this data, please list the dates of the cruise and the PI to contact about the data.

CSIO: One CTD cast was submitted.

NMDIS: Under the European Union-China Marine Data Network Partnership, NMDIS shared 27 cruises and 521 in total CTD TS casts from July 1992 to September 2017. Over 65% of profiles are deeper than 2000m and 33% are deeper than 4000m. All these data have been uploaded to the Argo reference database. The data could be download on the website: http://www.cmoc-china.cn/pages/dataService.html

7. Keeping the Argo bibliography (Bibliography | Argo (ucsd.edu)) up to date and accurate is an important part of the Argo website. This document helps demonstrate the value of Argo and can possibly help countries when applying for continued Argo funding. To help me with this effort, please include a list of all papers published by scientists within your country in the past year using Argo data, including non-English publications.

The following articles are not listed in Argo Bibliography:

Wang D L and Zhang S W. 2020. Design and application of a real-time temperature and salinity profile observation system under ice for polar regions. Chinese Journal of Polar Research (in Chinese). 32(4):523-532.

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Mao K, Liu C X, Li Z Q, et al., 2020, Response of the upper salinity to the super typhoon Sarika in the South China Sea, Transactions of Oceanology and Limnology (in Chinese),4:7-13.

Su H, Zhang H J, Geng X P, et al., 2020. A New Estimation of Global Ocean Heat Content for Upper 2000 Meters from Remote Sensing Data. Remote Sensing. 12(14), DOI: 10.3390/rs12142294.

Liu Y P, Tang D L, Liang W Z. 2020. Chlorophyll a concentration response to the typhoon "wind pump" and the Kuroshio in the northeastern South China Sea. Haiyang Xuebao (in Chinese).42(7):16-31.

Liu Y, Yan Y F, Ling Z. 2020. Preliminary analysis on climatological and seasonal variation of barrier layer thickness in the northern Indian Ocean and it' s mechanism. Journal of Tropical Oceanography, 39(5):98-108.

Shi H Y, Du L, Xu D H,2020. The robust salinity anomaly event during 2015–2017in the tropical Pacific Ocean. Haiyang Xuebao (in Chinese).42(3):47-58.

8. How has COVID-19 impacted your National Program's ability to implement Argo in the past year? This can include impacts on deployments, procurements, data processing, budgets, etc.

The COVID-19 pandemic has little impact on our float deployment and DAC's operation, however, the deliveries of CTD sensors may significantly influence the implementation of our program. CSIO DAC work-force was not impacted by the COVID-19, and staffs worked normally since March 2020. A cruise to Argentine basin, where 10 HM4000 deep floats were planned to be deployed was cancelled due to unavailability of the ocean fishing vessel.

9. Argo is still interested in piloting the RBR CTD. Does your National Program have any deployment plans for RBR floats in the next couple years? If so, please indicate how many floats will you be buying in 2021 and 2022 (if known) and where they might be deployed.

We plan to purchase 18 RBRargo CTDs to be installed on HM2000 floats for a field test which could be the contribution we have known.

The Deep Argo Mission Team in China has fixed a short-term plan that floats manufactured by HSOE are suggested to involve the pilot testing of RBR CTDs. This year 9 HM4000 floats equipped RBRargo^3 CTD|deep 6k will be deployed in the northwestern Pacific, which will be a part of China Argo's contribution to RBR CTD. At present it's difficult to confirm how many RBR CTDs to be installed on our floats in the next couple years before RBR CTD receives an approval from Argo Steering Team.