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Japan National Report

(Submitted by Toshio Suga)

1. The Status of implementation (major achievements and problems in 2010)

1.1 Floats deployed and their performance

The current positions of all the active Japanese floats are shown in Fig.1.

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed 63 floats from January 2010 to December 2010: 46 APEXs, 5 PROVORs, 11 NEMOs and 1 POPS (Polar Ocean Profiling System). All the floats except POPS were deployed with the aid of R/Vs of 7 domestic organizations.

POPS is an ice-based drifting buoy with a PROVOR float moving up and down along a 1000m cable. The observed data (temperature-salinity profiles of every day, hourly GPS position, atmospheric temperature and pressure) are transmitted to Iridium Satellites and distributed to GTS via JMA. One POPS was deployed in the Arctic Sea in April 2010. Unfortunately, this POPS terminated the mission in October 2010. Another POPS is planned to be deployed near the North Pole in April 2011.

Eight NEMO floats were deployed in the western tropical Pacific in April and May 2010 in order to investigate oceanic mixed layer structure and tropical air-sea interaction. The floats use the Iridium transmitter, measuring temperature and salinity from 500 dbar depth to the sea surface every day. Six floats among these floats operated for 8 months. Another NEMO float is planned to deployed in the tropical Indian Ocean in 2011 as part of Cooperative Indian Ocean Experiment on intraseasonal variability in the year 2011 (CINDY2011).



Figure 1: The distribution of active Argo floats. The red dots represent active Japanese floats.

Five floats (2 APEXs and 3 NEMOs) equipped with dissolved-oxygen sensors (Aanderaa Optode3830) were deployed in September and October 2010 around a biogeochemical observing

mooring site S1 (30N, 145E) maintained by JAMSTEC (Fig. 2). The purposes of the deployments are to investigate changes in biogeochemical parameters associated with mesoscale physical variability as a preliminary experiment for developing an integrated physical and biogeochemical ocean observation system, in collaboration with other observation systems such as moorings and research vessels. The floats measure temperature, salinity and dissolved oxygen from surface to 2000 dbar every 3 days, transmitting a large amount of data using the Iridium interactive telecommunication system. The time series data from these floats already detected biogeochemical responses to mesoscale disturbances. To enhance the measurement of biogeochemical variability associated with mesoscale and sub-mesoscale physical variability, another 25 oxygen floats are planned to be deployed around the S1 site in July 2011.



Figure 2. NEMO and APEX floats with dissolved oxygen sensor (left), Optode3830 oxygen sensor (middle) and the positions (circles) of the 5 floats around S1 (diamond) plotted on the of sea surface height anomaly map from a merged altimeter satellite product distributed by AVISO (http://www.aviso.oceanobs.com) (right).

Two APEXs equipped with two different oxygen sensors (Optode3830 and SBE43) were deployed in the Yamato Basin, Japan Sea late January 2009. The main purpose of this deployment was to evaluate sensor biases, drifts, etc. The layer below 300-500 m in this basin is occupied by Japan Sea Proper Water, which is vertically and horizontally homogeneous deep water with small temporal variability. One of them was recovered after drifted close to the Japanese coast in 2009 as reported last year. The other float was also recovered on October 11, 2010 with the aid of Akita branch of Japan Coast Guard after drifted close to the northern coast of Honshu (the main island of Japan). The two types of sensors on these floats have been sent back to the manufacturers for calibration. We expect the calibration results for the recovered floats will provide useful information about performance of the sensors.

Among JAMSTEC's 812 floats (708 APEXs, 77 PROVORs, 11 NEMOs, 11 NINJAs, and 5 POPSs) deployed in the Pacific, Indian and Southern Oceans, from 1999 to the end of January 2011, 249 floats (240 APEXs and 9 NEMOs) are now in normal operation. The other 563 floats (468 APEXs, 77 PROVORs, 2 NEMO, 11 NINJAs, and 5 POPSs) terminated their mission, including 6 floats (all of them are APEXs) transmitting on the beaches after stranding, two floats drifting at the sea surface (1 APEX and 1 NEMO) and 11 floats (8 APEXs, 2 PROVORs, 1 NINJA) recovered. The Japan Meteorological Agency (JMA) deployed 30 Argo equivalent floats (14 APEXs and 16 ARVORs) in the seas around Japan from January 2010 to December 2010. The floats get 2,000m T/S profiles every 5-day for operational ocean analysis and forecast. Among 89 floats (14 PROVORs, 59 APEXs and 16 ARVORs) which JMA deployed from 2005 to 2010, 38 floats (22 APEXs and 16 ARVORs) are active as of the end of December 2010, while 15 floats (all of them are APEXs) terminated the transmission in 2010. JMA deployed 3 ARVORs in January 2011.

Four isopycnal-APEX floats among 9 floats deployed by the Fisheries Research Agency

(FRA) in 2005 and 2008 are active at the end of January 2011. One of them has been operating for longer than 2000 days. FRA developed lithium buttery for a Slocum glider (1-km model; manufactured by Webb Research) to extend its life time to 3 months. They conducted observation using this glider in the Kuroshio-Oyashio mixed water region in the North Pacific for 5days in July and 8 days in September 2010.

Among Tohoku University's 8 floats deployed during 2008 as Argo equivalent floats (3 NINJAs having a ECO FLNTU (Fluorometer and Turbidity Sensor) manufactured by WET Labs and an anti-biofouling shutter with the parking depth of 40 dbar and 5-day cycle, 4 APEXs having a Sea-Bird oxygen sensor and an ECO FLNTU with 3-day cycle, and an APEX with an AANDERAA oxygen sensor with 3-day cycle), one APEX float is active at the end of January 2011. All the FLNTUs except one on the NINJA failed after 3-26 profiles as reported last year. Two APEXs recovered in 2008 have been repaired, equipped with a new sensor, ECO FLbb-AP (Combination Fluorometer-Scattering Sensor) and ready for redeployment in 2011.

1.2 Technical problems encountered and solved

Last year JAMSTEC purchased 73 PROVOR floats, which was planned to be deployed in 2010. However, several problems were found in almost all the floats, namely, unsatisfied accuracy of conductivity sensor, deep scratch on a float body, oil bladder trouble, and data acquisition trouble. In June, all the floats except for 5 already deployed were recalled by the manufacturer. Because of a lack of deployable JAMSTEC floats until the end of summer in 2010, when the floats purchased this year were delivered, the number of active Japanese float has been decreased. Regarding the recalled floats, the causes of most of the problems were identified by late 2010 and all the floats will be fixed and sent back to JAMSTEC by the end of March 2011, after large effort in discussion among and investigation by NKE, SBE and JAMSTEC.

Among the 73 APEX floats with APF9 controllers deployed by Japan before the SBE41 and 41cp recall due to micro-leak problem, 8 floats have the negative surface pressure drift larger than -2.4 dbar. Among these floats, 3 floats have the extreme negative surface pressure drift, exceeding -10 dbar. The floats repaired and sent back or those purchased after the problem was fixed have either a Kistler pressure or a Druck pressure sensor. The Kistler sensors show slight positive drift smaller than 1dbar; the Druck sensors show no drift.

Tsurumi Seiki Co. and JAMSTEC are developing a new profiling float for deep ocean, Deep NINJA, which has an ability to measure PTS profiles at the depth of up to 4000 dbar. We are planning the first field test in the southeast of Japan this year.

1.3 Status of contributions to Argo data management

The Japan DAC, JMA has operationally processed data from all the Japanese Argo and Argo-equivalent floats including 275 active floats as of January 17, 2011. Nine Japanese PIs agree to provide data to the international Argo. All profiles from those floats are transmitted to GDACs in netCDF format and issued to GTS using TESAC and BUFR code after real-time QC on an operational basis. Argo BUFR messages have been put on GTS since May 2007.

1.4 Status of delayed mode quality control process

JAMSTEC has submitted the delayed-mode QCed data of 71,089 profiles to GDACs as of January 2011. Among these data, 20,277 profiles were provided within a year. JAMSTEC has continued the operation of delayed-mode QC for the floats of Japanese PIs other than JAMSTEC. The remaining backlog of about 24,000 profiles will be cleared by this operation.

At the 11th Argo Data Management Meeting, the definition of APEX Truncated Negative Pressure Drift (TNPD) was decided. In according to the new definition of APEX TNPD, JAMSTEC

updated processing program and is now re-creating D files of target floats.

2. Present level of and future prospects for national funding for Argo including a summary of the level of human resources devoted to Argo.

Japan Argo had been conducted in a 5-year program from FY1999 to FY2004, as a part of Millennium Project implemented under cooperation among the Ministry of Education, Culture, Sports, Science and Technology (operation: by JAMSTEC), the Ministry of Land, Infrastructure and Transport, JMA and Japan Coast Guard. After the Millennium Project terminated in March 2005, JAMSTEC continued the operation until FY2008 nearly in the same scale (about 80 floats to be deployed every year) under its mid-term program. While new mid-term program for FY2009-2013 started in April 2009, JAMSTEC has been trying to continue the operation nearly in the same scale as part of its research activity. JMA allocates operational budget for 27 floats every fiscal year.

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

In FY2011, it has been proposed that JAMSTEC will deploy about 70 floats in total in the Pacific, Indian, and Southern Oceans for the Argo core mission. Twenty five Argo equivalent floats with dissolved oxygen sensor Optode3830 will be deployed near 30N 145E in June 2011 as part of Western North Pacific Integrated Physical-Biogeochemical Ocean Observation Experiment (INBOX). One POPS is planned to be deployed as an Argo equivalent float near the North Pole in April 2011. One NEMO float is planned to be deployed also as an Argo Equivalent float in the tropical Indian Ocean in 2011 as part of CINDY2011. JMA will deploy 27 Argo equivalent floats around Japan in FY2011 and in the coming years. All the JMA floats are same with Core Argo floats but in 5day cycle, which is identical with real time model cycle. Tohoku University will deploy 3 Argo equivalent floats equipped in or near the Kuroshio Extension region.

JMA continues serving as the Japan DAC. JAMSTEC continues running the Pacific Argo Regional Center for the upcoming year.

4. Summary of national research and operational uses of Argo data as well as contributions to Argo Regional Centers.

Many groups in JAMSTEC, JMA, FRA and Japanese universities are using Argo data for oceanographic researches on water mass formation and transport in the Pacific Ocean, the mid-depth circulation, the mixed layer variation, the barrier layer variation, and tropical atmosphere-ocean interaction in the Pacific and Indian Ocean and so on. Japanese fisheries research community is conducting their biogeochemical studies using Argo floats equipped with chlorophyll and/or oxygen sensors.

The global Argo TESAC messages are used for operational ocean analysis and forecasts by JMA. Daily and monthly products of subsurface temperatures and currents for the seas around Japan and western North Pacific, based on the output of the real-time ocean data assimilation system (MOVE/MRI.COM-WNP), are distributed through the JMA web site (in Japanese). Numerical outputs of the system are available from the NEAR-GOOS Regional Real Time Data Base (<u>http://goos.kishou.go.jp/</u>) operated by JMA. Monthly Diagnosis and Outlook of El Nino-Southern Oscillation based on the outputs of the Ocean Data Assimilation System and the El Nino Prediction System (an ocean-atmosphere coupled model) are also operationally distributed through the JMA web site (in Japanese) and the Tokyo Climate Center (TCC) web site (<u>http://ds.data.jma.go.jp/tcc/tcc/products/elnino/</u>). JMA has introduced the ocean-atmosphere coupled model, which is the same as that for El Nino prediction, into seasonal forecast of climate in Japan since February 2010. The model products for seasonal forecast are available from the TCC

web site (http://ds.data.jma.go.jp/tcc/tcc/products/model/).

JAMSTEC is providing a variety of products including objectively mapped temperature and salinity field data (Grid Point Value of the Monthly Objective Analysis using Argo float data: MOAA-GPV: http://www.jamstec.go.jp/ARGO/argo_web/MapQ/Mapdataset_e.html) and objectively mapped velocity field data based on YoMaHa'07 (version September 2010) (http://www.jamstec.go.jp/ARGO/argo_web/G-YoMaHa/index_e.html). JAMSTEC is also providing information about consistency check of float data related to delayed-mode QC for the Pacific Argo Regional Center (PARC) web site as a main contributor. JAMSTEC will support the activities of the Southern Ocean ARC (SOARC) in the Pacific sector. JAMSTEC is now upgrading the site which provides the float monitoring information and the upgraded site will be open soon. New Google Earth application has been created by Argo Information Center (AIC) and JAMSTEC. The application can show the recent location of Argo floats and various information of each float. JAMSTEC has created contents which show profile plot for not only Japanese floats but also all the Argo floats (Fig. 3).





Based upon the accomplishment of the JAMSTEC research project "Japan Coastal Ocean Predictability Experiment (JCOPE)", Forecast Ocean Plus, INC (FOP) was established as a JAMSTEC venture in March 2009. FOP has been providing the ocean current forecast information over the global ocean based on the state of the art ocean models, including real time forecasts for the shipping companies, offshore industries, coastal engineering works, and the weather information company. Argo is one of important sources of in-situ data for the FOP data assimilation system.

Following the accomplishment of the FRA-JAMSTEC joint research project "A new operational ocean prediction system with hydrographic data of coastal repeated observation lines and its linkage for ecosystem problems", FRA has been operating the ocean prediction system FRA-JCOPE since 2007. FRA-JCOPE has been providing the hydrographic forecast information around Japan both to the fisheries research/management community and the general public. Argo is one of important sources of in-situ data for the FRA-JCOPE data assimilation system.

5. Summary of the number and location of CTD cruise data to the CCHDO website.

Data of 631 CTD casts conducted by JMA in the western North Pacific from autumn 2009 to winter 2010 were uploaded to the CCHDO website.

6. Argo bibliography

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