

## **Japan National Report**

(Submitted by Toshio Suga)

### **1. The Status of implementation (major achievements and problems in 2009)**

#### **1.1 Floats deployed and their performance**

Japan Agency for Marine-Earth Science and Technology (JAMSTEC) deployed 57 floats from January 2009 to December 2009: 56 APEXs and 1 POPS (Polar Ocean Profiling System). All the APEXs were deployed with the aid of R/Vs of 10 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 3 days, 3-hourly GPS position, atmospheric temperature and pressure) are transmitted to Iridium Satellites and distributed to GTS via JMA. The Arctic Ocean Climate System Research Team of JAMSTEC deployed a POPS in the Arctic Sea in April 2009. Unfortunately, this POPS was terminated in October 2009. Another POPS is planned to be deployed near the North Pole in April 2010.

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. The region is thus ideal for the evaluation of oxygen sensors. A preliminary comparison of the two types of sensor will be briefly mentioned in Section 1.2. While we hoped that the two floats would stay in the Yamato Basin, they were drifted away from the basin. One of them was drifted into Toyama Bay along the central part of Honshu (the main island of Japan) and recovered on October 6, with the aid of Ishikawa Prefecture Fisheries Research Center. The two sensors on this float have been sent back to the manufacturers for calibration.

Among JAMSTEC's 757 floats (670 APEXs, 76 PROVORs, 11 NINJAs) deployed in the Pacific, Indian and Southern Oceans, from 1999 to the end of January 2010, 254 floats (all of them are APEXs) are now in normal operation. The other 503 floats (415 APEXs, 76 PROVORs, 11 NINJAs) terminated their mission, including 5 floats (all of them are APEXs) transmitting on the beaches after stranding, one APEX drifting at the sea surface and 11 floats (8 APEXs, 2 PROVORs, 1 NINJA) recovered.

The Japan Meteorological Agency (JMA) deployed 17 APEXs as Argo equivalent floats in the seas around Japan from January 2009 to December 2009, whose data have been used for operational ocean analysis and forecast. Among 59 floats (14 PROVORs, 45 APEXs) which JMA deployed from 2005 to 2009, 23 floats (all of them are APEXs) are active at the end of December 2009, while 20 floats (6 PROVOR, 14 APEXs) terminated the transmission in 2009. JMA deployed 10 APEXs in January 2010.

The Fisheries Research Agency (FRA) recovered one float in June 2009 because it was drifted too close to the coast of Hokkaido, Japan. The float was one of the 4 isopycnal-APEXs with AANDERAA Oxygen sensor, which were deployed in the Kuroshio-Oyashio region of the Northwestern Pacific as Argo equivalent floats aiming to trace source waters of the North Pacific Intermediate Water in 2008. The recovered float was redeployed in the same region in September 2009. Three floats out of the four are still active. FRA is developing lithium battery of a Slocum glider (manufactured by Webb Research) to extend the observational life time until 3 months. They conducted several field observation tests during 2009. However, it is still under a developing stage.

Among Tohoku University's 8 floats deployed during 2008 as Argo equivalent floats (3

NINJAs having a WET Labs chlorophyll sensor 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 a WET Labs chlorophyll sensor with 3-day cycle, and an APEX with an AANDERAA oxygen sensor with 3-day cycle), 4 floats (2 NINJA and 2 APEX) are active at the end of December 2009. While one NINJA float is in normal operation, the WET Labs sensor of the other has not functioned since its 7th profile. While one APEX with an AANDERAA oxygen sensor is in normal operation, the WET Labs sensor of the other has not functioned since its 25th profile. One NINJA terminated the transmission in 2009. Two APEXs recovered in 2008 have been in the process of repair and will be ready for redeployment in 2010.

### **1.2 Technical problems encountered and solved**

Because of the micro-leak problem in the Druck sensor, JAMSTEC cancelled most of the APEXs' deployment from May to September 2010 and sent 38 sensors to the manufacturer for repairs. All of them have been sent back to JAMSTEC by the end of January 2010. The twenty four of the repaired sensors were the products of the Kistler and the others were those of the Druck.

For the same reason, JMA cancelled four APEXs' deployment and sent them to the manufacturer for repairs in May 2009. They were sent back to Tokyo in November 2009 and immediately deployed by JMA's research vessels in the sea south of Japan. The three of the repaired sensors were the products of the Kistler and the other was a screening tested Druck. Besides, JMA ordered 14 APEXs in April 2009. The delivery of the floats was delayed about two months for the same reason and made in December 2009. The sensors of them were all the Kistlers.

Among the APEX floats with APF9 controller in Japan, 5 floats have the negative surface pressure drift larger than -2.4 dbar. Among these floats, 2 floats have the extreme negative surface pressure drift, exceeding -10 dbar.

Most of the six WET Labs chlorophyll sensors (ECO-FLNTU) on APEXs deployed by Tohoku University and JAMSTEC during 2008 went wrong after 3-26 profiles. It has been unofficially reported that the manufacturer identified and fixed the causes of this short life after inspection of two sensors on the Tohoku University's APEXs that had been recovered from the sea. The manufacturer is trying to send two floats with repaired sensors back to Tohoku University by the end of March 2010.

The two sets of a pair of different oxygen sensors (Optode3830 and SBE43) experimentally deployed in the Japan Sea showed that the oxygen profiles from the two sensors were systematically different. A comparison with Winkler Oxygen made by JMA R/V Seifu-Maru at the float deployment clarified that there were negative biases of 5-10% of oxygen values for SBE43 and 10-15% for Optode. Causes of the difference between the two types have not been identified. One set of the two was recovered from the sea and sent back to the manufacturers as mentioned above.

Tsurumi Seiki Co., in corporation with JAMSTEC, began to develop a new profiling float for a depth greater than 2000 dbar, which adopts a new buoyancy engine working at up to 3500 dbar. The prototype is capable of descending down to 3000 dbar and we hope to improve it to be capable of descending down to 4000 dbar.

### **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 292 active floats as of February 10, 2010. 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 92,761 profiles to GDACs as of January 2010. Among these data, some 16,000 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 21,000 profiles will be cleared by this operation.

## **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 has started in April 2009, JAMSTEC has been trying to continue the operation nearly in the same scale. JMA plans to increase deploying floats to 27 around Japan every year for operational ocean analysis and forecast.

## **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 FY2010, it has been proposed that JAMSTEC will deploy about 80 floats in total in the Pacific, Indian, and Southern Oceans. JMA will deploy 27 floats around Japan every year from FY2010 for operational ocean analysis and forecast.

JMA continues serving as the Japan DAC for the upcoming year. 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 production 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 analyses and forecasts by JMA. Daily and monthly products of subsurface temperatures and currents for the seas around Japan and northwestern Pacific Ocean, 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 (<http://goos.kishou.go.jp/>) 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 web site (<http://ds.data.jma.go.jp/tcc/tcc/products/elnino/>). JMA has expanded the ocean monitoring and prediction area for climate to the tropical Indian Ocean since July 2009.

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) and objectively mapped velocity field data based on YoMaHa'07. 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 of the SOARC.

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 provides 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 provides 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 1321 CTD casts conducted by JMA in the western North Pacific from autumn 2008 to summer 2009 were uploaded to the CCHDO website.

## **6. Argo bibliography**

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