

Argo Steering Team Meeting (AST-10)

National Report – India (Submitted by M. Ravichandran)

Organization of Indian Argo Project

- a) The Indian Argo Project, fully funded by the Ministry of Earth Sciences (MoES), Government of India is implemented by the Indian National Center for Ocean Information Services (INCOIS) of MoES at Hyderabad.
- b) The Indian Argo Project for the year 2007-2012 envisages (a) Deployment of 200 Argo floats in the Indian Ocean, (b) Argo Data Management Activities, (c) Development of Ocean Data Assimilation System, (d) Analysis and utilization of Argo data and (e) Capacity Building at National level.
- c) Several R&D Institutions including the National Institute of Oceanography at Goa, NCAOR, Goa, Space Applications Centre, Ahmedabad, National Remote Sensing Centre, Hyderabad, Indian Institute of Tropical Meteorology, Pune, National Centre for Medium range Weather Forecasting (NCMRWF), New Delhi, Centre for Mathematical Modelling and Computer Simulation (C-MMACS), Bangalore participate in the utilization of Argo data. Efforts are underway to encourage and enable academic institutions in this endeavour. National level Argo utilization meeting was conducted during July 21-23, 2008.

1. Status of Implementation

a. Float deployed and their performance

During the year 2008-09, 15 floats were deployed in the northern Indian Ocean taking the total to 168. In addition, 30 floats are being planned to be deployed in the northern Indian Ocean during April-June 2009.

Out of 168 floats deployed so far, 83 floats are active. Out of these 83, active floats 65 floats are less than 2 years old.

b. Technical problems encountered and solved

Eight of Indian floats have completed the normal cycle of 255 and still providing data. This has resulted in the cycle rollover. With the help of CSIRO this problem was successfully eliminated and now the profiles cycles are adjusted accordingly.

c. Status of contributions to Argo data management

- ***Data acquired from floats***

All active floats data are acquired, processed and sent it to GDAC.

- **Data issued to GTS**
Presently we do not have GTS access and hence we are not able to send Indian floats data to GTS. Up on our request CLS ARGOS is still continuing to send Indian floats data in TESAC format to GTS.
- **Data issued to GDACs after real-time QC**
All the active floats data are subject to real time quality control and are being sent to GDAC. Software for Real Time processing of Argo data is acquired from CSIRO and implemented at INCOIS. We take this opportunity to thank the CSIRO team for sharing the software with INCOIS.
- **Web pages**
INCOIS is maintaining Web-GIS based site for Indian Argo Program. It contains entire Indian Ocean floats data along with trajectories. Further details can be obtained by following the link:
http://www.incois.gov.in/incois/argo/argo_home.jsp.
- **Statistics of Argo data usage**
Argo data is widely put to use by various Organisations/ Universities/Departments. INCOIS Argo web page statistics (for the past one year) are as shown below

Pages	Hits	Visitor
Argo Web-Gis	3340	1318
Data downloads	6427	351
Live Access Server	273	62
Argo products	691	263

d. Status of Delayed Mode Quality Control process

- INCOIS started generating and uploading D files to GDAC from July 2006, and as of today, profiles belonging to all eligible floats have been subjected to DMQC. John Gilson's GUI is extensively used at different stages of DMQC. It is appreciated that he extended whole hearted support in setting up the GUI and slight modifications required due to platform change.
- Number of Real time profiles from INCOIS DAC : 20,008.
- 66.41 % of FLOATS are DMQCied for INCOIS DAC.

Major hurdles for DMQC are

- Lack of sufficient CTD profiles from North Indian Ocean is still a critical problem, when decision is to be taken for the complicated cases.
- The second major issue is the Manpower.

e. Trajectory files status:

A total of **140 trajectory** netcdf files were processed and uploaded to the GDAC. The process of generation of trajectory netcdf files undergoes quality checks like position, time, cycle number, etc., and corresponding quality status is assigned to each parameter. Finally a visual check is performed to verify that there are no missing cycles without cycle numbers and to check the surface time intervals.

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

Indian Argo Project is a 5 year Program from April 2007 to March 2012 fully funded by MoES, Govt. of India. Funding is secured upto 2012 for deployment of 200 Argo floats (40 floats per year), Data management activities, Data analysis, etc.

3 Permanent and 2 temporary scientific/technical personal are working under Indian Argo project, which include personal for deployment of Argo floats, Data system, Analysis of Data, etc. Efforts are underway to get more manpower.

3. Summary of deployment plans and other commitments to Argo for the upcoming year and beyond where possible.

India committed to deploy floats in North Indian Ocean wherever gap exists. Also plans to deploy few tens of floats in the Southern Indian Ocean. 10 floats with ARGOS and 20 floats with iridium will be received during April 2009. After ascertaining the gap region and cruise plan of MoES research vessels, these floats will be deployed.

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

The first Indian Argo User's workshop was organised during July 20-22, 2008 in INCOIS, Hyderabad. The prime objective of the workshop was to take stock of utilization of Argo floats by Indian Scientists. The workshop will also provide opportunity to understand the requirement of modification in temporal and spatial distribution of floats and need of deploying additional sensors. Sixty three

Scientists from 17 Institutions participated in this workshop. The major outcome of this workshop is as follows:

- Argo data has been widely utilized to understand the Indian Ocean dynamics, especially Dipole event, understanding the monsoon system in relation to heat content, buoyancy flux of the Indian Ocean and for validation of OGCM.
- Studies need to be initiated to assimilate Argo floats in OGCM for better forecast of various ocean variables at different time scales.
- In the Bay of Bengal, Argo floats with 5 days cycling period need to be deployed. These observations are to be sustained over a long period by deploying new floats as and when required. These observations are required for studying the intra-seasonal variations of thermo-haline structure.
- New Iridium floats with an additional high-resolution CTD are to be deployed in the Bay of Bengal. This additional CTD sensors measures P, T, S at very fine resolution (2 m) from 200 m upto the surface.
- Quality control methods followed by various institutions need to be pooled. All such Institutes to provide feedback on quality of data to INCOIS.

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.

- Nil

6. As part of an action item from AST-9 aimed to improve CTD cruise data being added to the reference database by Argo PIs, it is requested that you include the number and location of CTD cruise data uploaded by PIs within your country to the CCHDO website in the past year. These cruises could be used for Argo calibration purposes only or could be cruises that are open to the public as well.

326 CTD profiles acquired during research cruise for the North Indian Ocean region have been supplied to CCHDO.

Publications

Rao, A.D. , Joshi, M., M. Ravichandran, Oceanic upwelling and downwelling processes in waters off the west coast of India, *Ocean dynamics*, Volume 58, Issue 3-4, November 2008, Pages 213-226.

Gopalakrishna, V. V., R. R. Rao, K. Nisha, M. S. Girishkumar, T. Pankajakshan, M. Ravichandran, Z. Johnson, K. Girish, N. Aneeshkumar, M. Srinath, S. Rajesh, and C. K. Rajan (2008), Observed anomalous upwelling in the Lakshadweep Sea during the summer monsoon season of 2005, *J. Geophys. Res.*, 113, C05001, doi:10.1029/2007JC004240.

M. J. McPhaden, G. R. Foltz, T. Lee, V. S. N. Murty, M. Ravichandran, G.A. Vecchi, J. Vialard, J. D Wiggert, and L.Yu, Ocean- Atmosphere Interactions During Cyclone Nargis, *EOS*, Vol. 90, No. 7, 17 February 2009.

Rao, A. D., M. Joshi, and M. Ravichandran (2009), Observed low-salinity plume off Gulf of Khambhat, India, during post-monsoon period, *Geophys. Res. Lett.*, 36, L03605, doi:10.1029/2008GL036091.

K. Nisha, Suryachandra A. Rao, V. V. Gopalakrishna, R. R. Rao, M. S., Girishkumar, T. Pankajakshan, M. Ravichandran, S. Rajesh, K. Girish, M., Anuradha, S. S. M. Gavaskar, V. Suneel and S. M. Krishna, Reduced near-surface thermal inversions in 2005-2006 in the Southeastern Arabian Sea (Lakshadweep Sea), *Journal of Physical Oceanography*, 2009 (in Press).