

# National report of India - March 2017

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## 1. The status of implementation

### 1.1a Floats deployment

During the year 2016–17, 22 floats were deployed in the Indian Ocean, taking the total to 418. The new deployment includes 7 Bio-Argo floats with additional sensors like Doxy, FLBB, Chl-a.

### 1.1b performance Analysis of Floats deployed

Out of 418 floats deployed so far 140 floats are active. Out of these 140 active floats, 96 (63) floats are less than 3 (2) years old.

## 1.2 Technical problems encountered and solved

None

## 1.3 Status of contributions to Argo data management

- **Data acquired from floats**

India had deployed 418 floats so far. Out of these 140 floats are active. All the active floats data are processed and sent to GDAC.

- **Data issued to GTS**

TESAC and BUFR format messages from these floats are being sent to GTS via New Delhi RTH.

- **Data issued to GDACs after real-time QC**

All the active floats (140) data are subject to real time quality control and are being sent to GDAC.

- **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](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. Indian Meteorological Department (IMD) is using Argo data for their operational purpose. Scientists, Students and Researchers from INCOIS, NIO, SAC, C-MMACS, NRSA, IITM, NCMRWF, IISc etc are using Argo data in various analysis. Many paper based on Argo data were also published in reputed journals. See the references below. → The demand for Bio-Argo data is increasing and the same is being supplied for research interest by various research institutes and universities. → This data is also used for validation of Biogeochemical model outputs like ROMS with Fennel module.

INCOIS Argo web page statistics (for the past one year) are as shown below:

Page	Hits and Visitors
Argo Web pages	3333
Argo Data Bank	6916

Products generated from Argo data

1. Value added products obtained from Argo data are continued. Continued to variational analysis method while generating value added products. Many products are generated using Argo temperature and salinity data. The Argo T/S data are first objectively analysed and this gridded output is used in deriving value added products. More on this can be seen in the RDAC functions.
2. Version 2.1 of DVD on “Argo data and products for the Indian Ocean” is released to public for use with data corresponding to 2016 being updated. This DVD consists of ~ 2,85,000 profiles and products based on the Argo T/S. A GUI is provided for user to have easy access to the data. DVD product is discontinued and it is being made available via INCOIS and UCSD web sites.
3. To cater to many users of INCOIS LAS, it is enhanced in term of capacity. New Server is procured and new products viz., model outputs, new wind products (OSCAT), fluxes are made available. New products as per the request received from the users in future are being made available. For further details visit <http://las.incois.gov.in>.

#### **1.4 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.
- Advanced Delayed Mode Quality Control s/w developed by CSIRO is being put to use successfully. Using this s/w all the eligible floats are reprocessed to tackle pressure sensor offset problems, salinity hooks, thermal lag corrections, salinity drifts.
- Under the data search and archive initiative, data from our own sister concerns is being obtained and put to use in the delayed mode processing.
- About 54% of the eligible profiles are subjected to DMQC and the delayed mode profiles are uploaded on to GDAC. Majority of the old dead float which are passed through DMQC are converted to Ver 3.1 and uploaded to GDAC.

#### **1.5 Trajectory files status:**

A total of 408 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. Trajectory files in Ver 3.1 format for all APEX floats is being uploaded to GDAC and trajectories wrt to PROVOR floats need to generated.

#### **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 (April 2012 to March 2017) fully funded by Ministry of Earth Sciences, (MoES), Govt. of India. Funding is secured for the deployment of 200 Argo floats (40 floats per year including 10 Bio-argo floats), Data management activities,

Data analysis, etc. until 2017. During the next plan period 2017-2020, India plans to deploy 50 floats/per (40 tropical Indian Ocean and 10 in the Southern ocean).

Three Permanent and one temporary scientific/technical personnel are working under Indian Argo project, which include personal for deployment of Argo floats, Data system, Analysis of Data, etc.

### **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.**

India is committed to deploy floats in the Indian Ocean wherever gap exists. India has committed 40 floats per year until 2017 (10 floats each in the Southern Ocean, Bay of Bengal, equatorial Indian Ocean and Arabian Sea). Out of 40 floats, 10 floats will be bio-argo floats. After ascertaining the gap region and cruise plan of MoES research vessels, these floats will be deployed. The existing data management resources will continue until 2017. During the next plan period 2017-2020, India plans to deploy 50 floats/per (40 in the Tropical Indian Ocean and 10 in the Southern ocean)

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

**Operational:** All Argo data are being routinely assimilated in Ocean Model for providing Global ocean analysis. This analysis is being used by Indian MET department for initialization of coupled ocean-atmosphere forecast of the Monsoon. From the year 2011, India is providing seasonal forecast of monsoon using dynamical model wherein Ocean analysis (with assimilation of Argo) is an important contribution. The analysis products are being made available through INCOIS live access server (las.incois.gov.in).

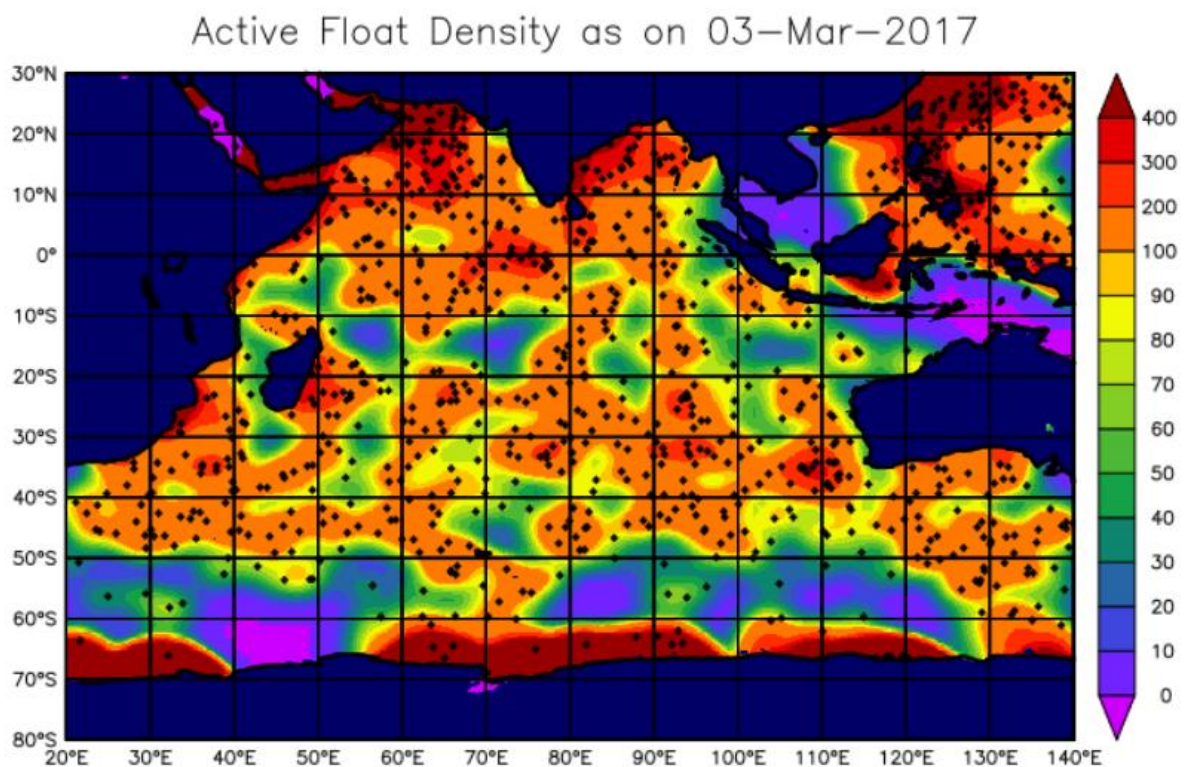
**Research:** Argo data are being widely used for many applications to understand the Indian Ocean dynamics, cyclone and monsoon system in relation to heat content, thermosteric component of sea level and validation of OGCM by various Indian institutions and university students.

#### **Argo Regional Centre (ARC) - Indian Ocean**

(<http://www.incois.gov.in/argo/ARDCenter.jsp>)

- Acquisition of Argo data from GDAC corresponding to floats other than deployed by India and made them available on INCOIS web site.
- All these data sets are made available to the user through a s/w developed with all GUI facilities. This s/w is made available through FTP at INCOIS and UCSC web sites.
- Delayed Mode Quality Control (Refer 2.0 above)
- Data from the Indian Ocean regions are gridded into 1x1 box for monthly and 10 days and monthly intervals. These gridded data sets are made available through INCOIS Live Access Server (ILAS). Users can view and download data/images in their desired format.
- Efforts are underway to setup ERDDAP for the data and data products from Argo floats.
- Additionally SST from TMI, AMSRE and Wind from ASCAT, Chla from MODIS and OCM-2 are also made available on daily and monthly basis.
- Global wind products from OSCAT is also generated and made available on LAS along with TROP flux data sets.

- Data Sets (CTD, XBT, Subsurface Moorings) are being acquired from many principle investigators. These data are being utilized for quality control of Argo profiles.
- Value added products: Two types of products are currently being made available to various user from INCOIS web site. They are:
  - (i) Time series plots corresponding to each float (only for Indian floats).
  - (ii) Spatial plots using the objectively analysed from all the Argo floats data deployed in the Indian Ocean. These valued added products can be obtained from the following link  
[http://www.incois.gov.in/Incois/argo/products/argo\\_frames.html](http://www.incois.gov.in/Incois/argo/products/argo_frames.html)
- Regional Co-ordination for Argo floats deployment plan for Indian Ocean. The float density in Indian Ocean as on 03 Mar 2017 is shown below.



Further, as part of the ARC activities of Indian ocean, INCOIS has undertaken the following activities:

1. Conducted several user awareness and data utilization workshops to bring about awareness of Argo among the students of various universities. This is also our mandate as a part of our International Training Center for Operational Oceanography (ITCOO) centre.
2. Developed Graph theoretical based algorithms for performing QC of Argo data. This has been tested with some typical floats deployed by Indian and found to yield good results. A manuscript is prepared and will be submitted for peer review. Once published it can be expanded to other ocean basins.
3. Continued data search and archaeology of high quality CTD for updating the Argo reference data base and also for use in DMQC of Argo data from various sister concerns.
4. Continued archiving of temperature and salinity profile data from floats deployed by Indian and other countries in the Indian Ocean and making them available through Web-GIS.

5. Sustaining generation of value added products based on gridded products obtained from Objective and Variational Analysis methods. These value added products are made available on the web and also on the Live Access Server. Also monitoring the publications that are arising out of the Argo and derived products.

6. Continued to synchronize the "Argo data and product for Indian Ocean" products being made available on INCOIS and UCSD website. These products have GUI features catering to students and other researchers with low bandwidth capabilities.

**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.**

None

**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.**

All the CTD data outside EEZ was identified which will be submitted to CCHDO for adding to the reference database.

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