Argo National Data Management Report (2016) – India

1. Status

- **Data acquired from floats**
  India has deployed 27 new floats (including 8 Apex-Bio Argo floats and 2 with EM software) between October 2015 and September 2016 in the Indian Ocean taking its tally to 397 floats so far. Out of these 131 floats are active. All the active floats data are processed and sent to GDAC.
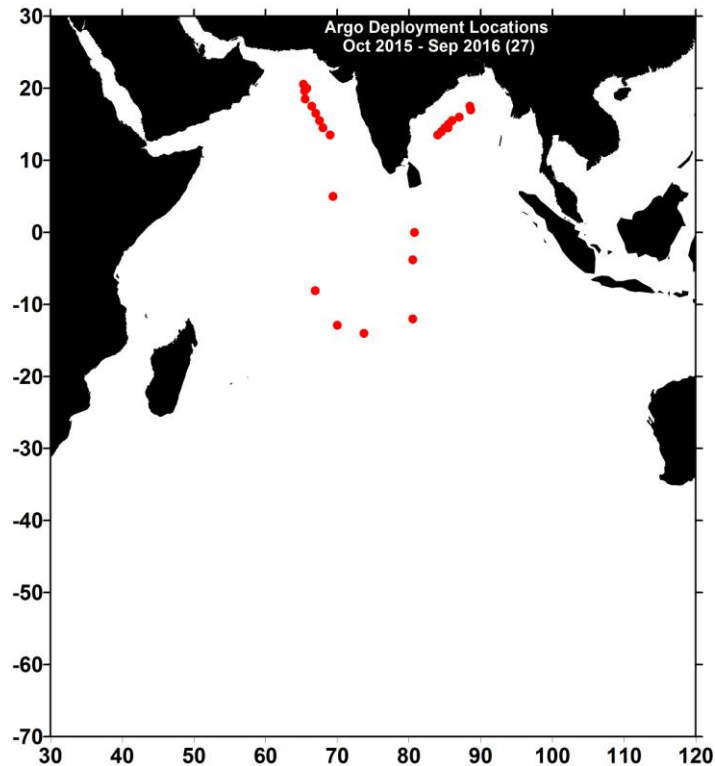

Fig. Location of Argo floats deployed by India

- **Data issued to GTS**
  All the active floats data is being distributed via RTH New Delhi. However there seems to be a problem in these messages being received by some centres. Started transmission of BUFR messages from June 2015. Even the BUFR count is found to be less then TESAC messages. Working on resolving the issue.

- **Data issued to GDACs after real-time QC**
  All the active floats (131) data are subject to real time quality control and are being successfully uploaded to GDAC. Also the old floats whose life had ended are also converted to Ver 3.1 and uploaded to GDAC.

- **Data issued for delayed QC**
  In total 54% of the eligible profiles for DMQC are generated and uploaded to GDAC. Old DMQCed floats with old version 2.3 are converted to V 3.1 and uploaded 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. Apart from the floats deployed by India, data from floats deployed by other nations in the Indian Ocean are received from the Argo Mirror and made available in the INCOIS website. User can download the data based on his requirement.
    - Statistics of Indian and Indian Ocean floats are generated and maintained in INCOIS web site. The density maps for aiding people for new deployments are made available on a monthly basis. For full details visit http://www.incois.gov.in/Incois/argo/argostats_index.jsp.

- **Trajectory**

  INCOIS started generating Ver 3.1 trajectory files for all APEX float and uploading them to GDAC. Iridium and Provor, Arvor floats data will be uploaded shortly.

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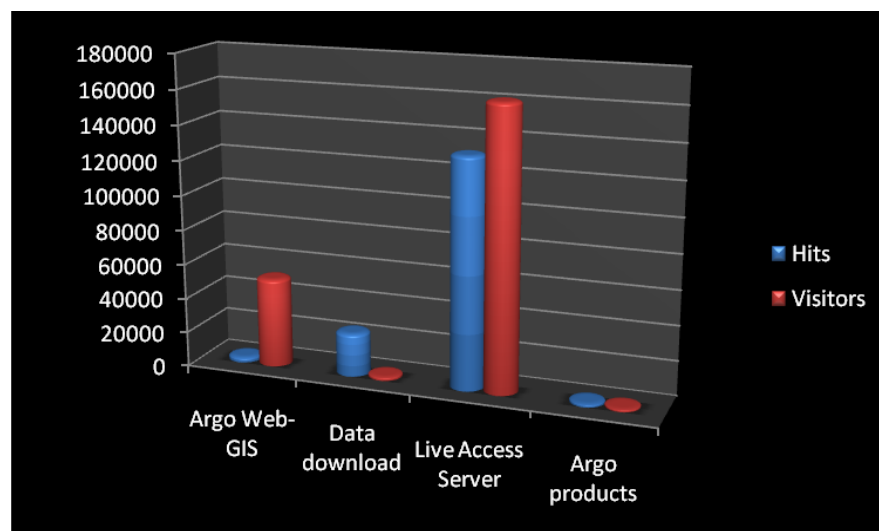
INCOIS Argo web page statistics (for the past one year) are as shown below

Page	Hits	Visitors
Argo Web-GIS	3024	51728

Data download	25106	2001
Live Access Server	131801	161502
Argo products	1881	1474

- **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 see 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.

2. Delayed Mode QC

- INCOIS started generating and uploading D files to GDAC form 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 archeology 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.


Histogram of delayed profiles on Argo GDAC (%)
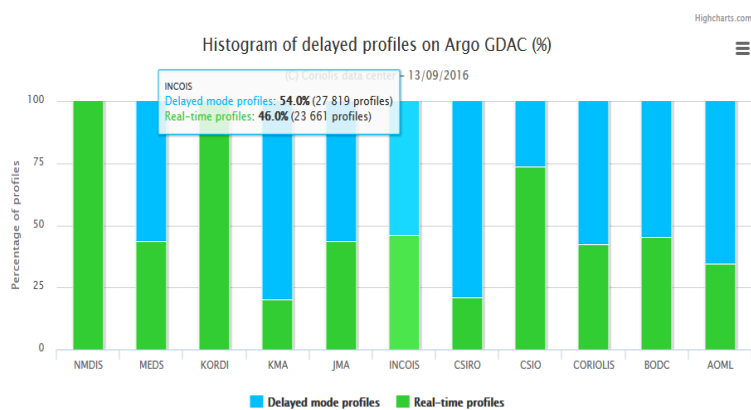
3. GDAC Functions

INCOIS is not operating as a GDAC.

4. Regional Centre Functions

- 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

- Regional Co-ordination for Argo floats deployment plan for Indian Ocean. The float density in Indian Ocean as on 15 Sep, 2016 is shown below.

Active Float Density as on 15−Sep−2016
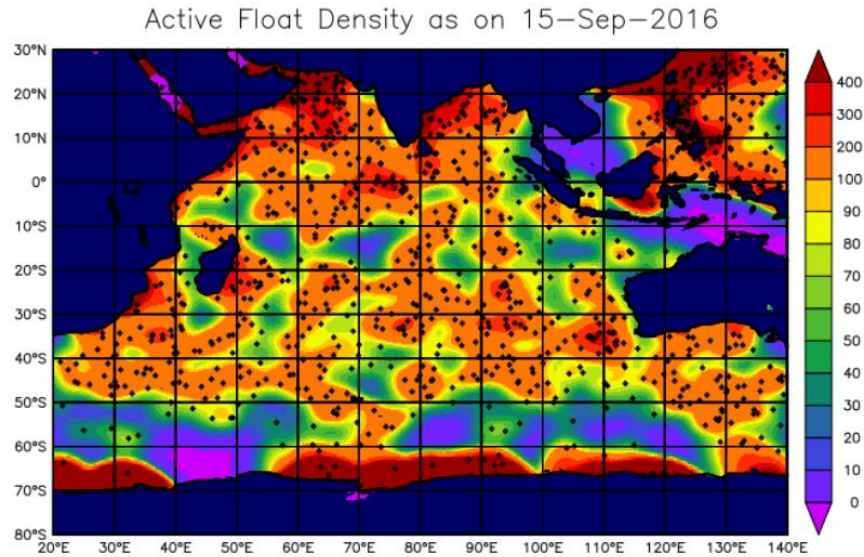
Publications:

INCOIS is actively involved in utilization of Argo data in various studies pertaining to Indian Ocean. Also INCOIS is encouraging utilization of Argo data by various universities by funding them. Some of the publications resulted from Argo data which includes scientists from INCOIS are given below:

1. Akhil, V. P., M. Lengaigne, F. Durand, J. Vialard, A. V. S. Chaitanya, M. G. Keerthi, V. V. Gopalakrishna, J. Boutin, and C. de Boyer Montégut, 2016: Assessment of seasonal and year-to-year surface salinity signals retrieved from SMOS and Aquarius missions in the Bay of Bengal, *Int. J. Remote Sens.*, **37**(5), 1089-1114.
2. Keerthi, M. G., M. Lengaigne, K. Drushka, J. Vialard, C. Boyer Montegut, S. Pous, M. Levy, and P. M. Muraleedharan, 2016: Intraseasonal variability of mixed layer depth in the tropical Indian Ocean, *Climate Dynamics*, **46**(7), 2633-265.
3. Muni Krishna, K., 2016: Observational study of upper ocean cooling due to Phet super cyclone in the Arabian Sea, *Advances in Space Research*, **57**(10), 2115-2120.
4. Riser, S. C., et al., 2016: Fifteen years of ocean observations with the global Argo array, *Nature Clim. Change*, **6**(2), 145-153.
5. Roxy, M. K., A. Modi, R. Murtugudde, V. Valsala, S. Panickal, S. Prasanna Kumar, M. Ravichandran, M. Vichi, and M. Lévy, 2016: A reduction in marine primary productivity driven by rapid warming over the tropical Indian Ocean, *Geophys. Res. Lett.*, **43**(2), 826-833.
6. Udaya Bhaskar, T. V. S., C. Jayaram, P. R. R. E, and K. H. Rao (2016), Spatio-temporal evolution of chlorophyll-a in the Bay of Bengal: a remote sensing and bio-argo perspective, SPIE conference.