Argo National Data Management Report (2018) – India

1. Status

- **Data acquired from floats**
  India has deployed 19 new floats (including 2 Provor-BioArgo, 2 Arovor-Ice Argo floats and 15 Arovor-L floats) between December 2017 and November 2018 in the Indian Ocean taking its tally to 454 floats so far. Out of these 139 floats are active. All the active floats data are processed and sent to GDAC.

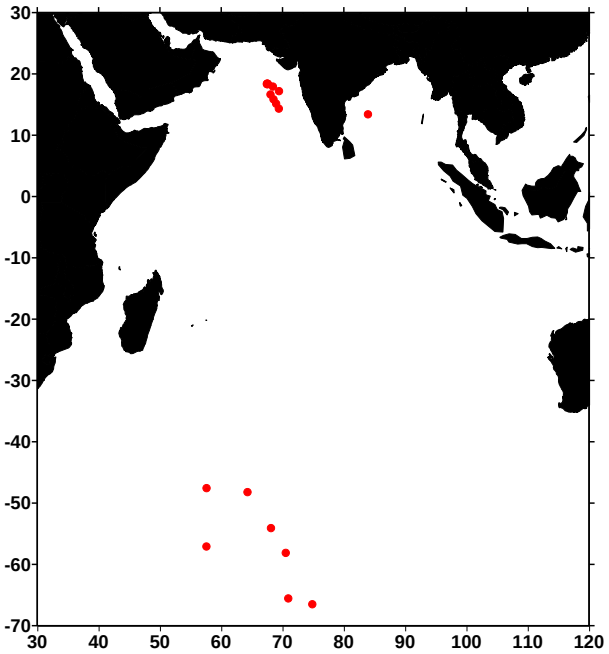


Fig. Location of Argo floats deployed by India

- **Data issued to GTS**
  All the active floats data is being distributed via RTH New Delhi. The problem related to reception of BUFR messages is resolved. This is communicated to Anh Tran and now the count had increased.

- **Data issued to GDACs after real-time QC**
  All the active floats (139) data are subject to real time quality control and are being successfully uploaded to GDAC. Also the some of the old floats whose life had ended are also converted to Ver 3.1 and uploaded to GDAC.

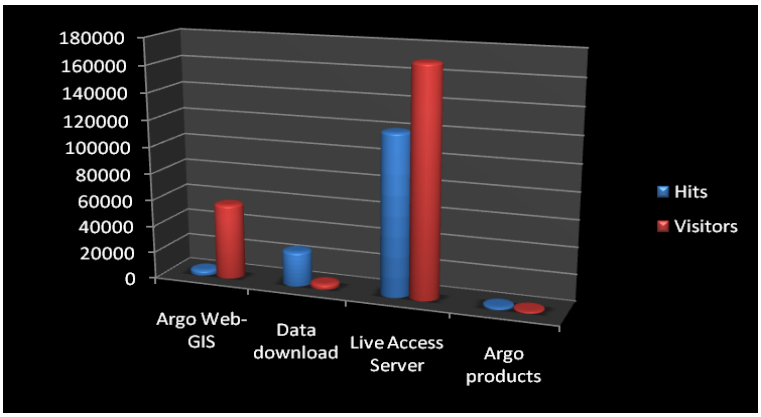
- **Data issued for delayed QC**
  In total ~50% of the eligible profiles for DMQC are generated and uploaded to GDAC. Old DMQCed floats with old version 2.3 are converted to V 3.1 and uploaded to GDAC.

- **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 Argo and Iridium floats and uploading them to GDAC. 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. More and more BioArgo floats are being deployed in the Indian Ocean. Simultaneous cruises are also being planned.
  - This data is continued to be 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	4287	65017
Data download	29692	4001
Live Access Server	121923	172817
Argo products	2078	1619

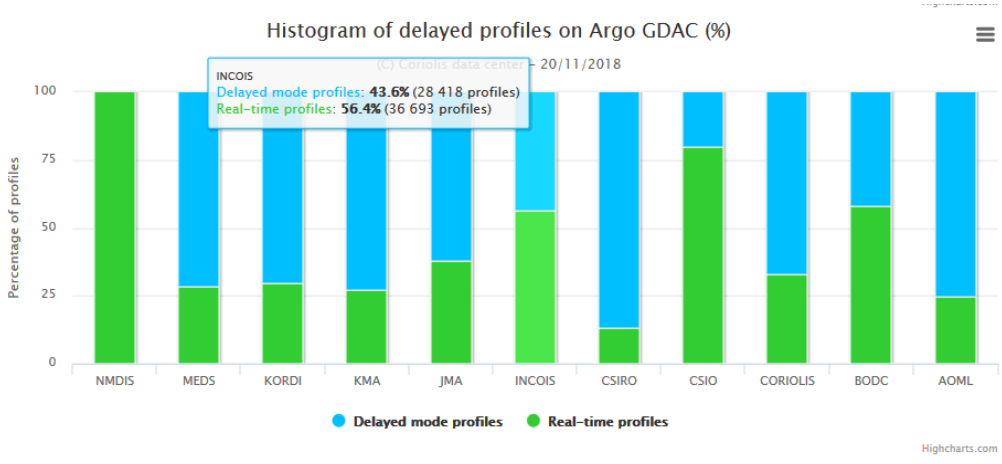
- **Products generated from Argo data**
  1. Value added products obtained from Argo data are continued. Continued to variational analysis method while generating value added

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 2.2 of DVD on "Argo data and products for the Indian Ocean" is released to public for use with data corresponding to April 2018 updated. This DVD consists of ~ 3,30,000 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 51% 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.



3. GDAC Functions

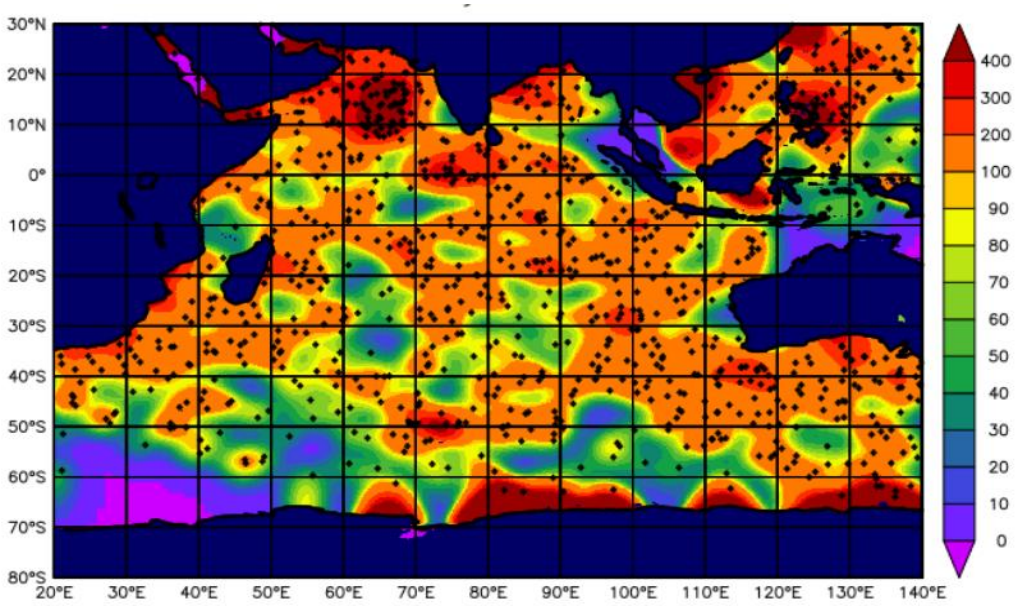
INCOIS is not operating as a GDAC.

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.
- ERDDAP site was set up for the data and data products derived 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 21 Nov, 2018 is shown below.



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. V. V. S. S. Sarma, T. V. S. Udaya Bhaskar, Ventilation of Oxygen to Oxygen Minimum Zone Due to Anticyclonic Eddies in the Bay of Bengal, Journal of Geophysical Research, https://doi.org/10.1029/2018JG004447.
2. Kakatkar, R., C. Gnanaseelan, J. S. Chowdary, A. Parekh, and J. S. Deepa, 2018: Indian summer monsoon rainfall variability during 2014 and 2015 and associated Indo-Pacific upper ocean temperature patterns. Theoretical and Applied Climatology, 131, 1235-1247, https://doi.org/10.1007/s00704-017-2046-4.
3. Karmakar, A., A. Parekh, J. S. Chowdary, and C. Gnanaseelan, 2018: Inter comparison of Tropical Indian Ocean features in different ocean reanalysis products. Climate Dynamics, 51, 119-141, https://doi.org/10.1007/s00382-017-3910-8.
4. Lotliker, A. A., S. K. Baliarsingh, V. L. Trainer, M. L. Wells, C. Wilson, T. V. S. Udaya Bhaskar, A. Samanta, and S. R. Shahimol, 2018: Characterization of oceanic Noctiluca blooms not associated with hypoxia in the Northeastern Arabian Sea. Harmful Algae, 74, 46-57, https://doi.org/10.1016/j.hal.2018.03.008.
5. Misra, T., R. Sharma, R. Kumar, and P. K. Pal, 2018: Ocean Remote Sensing: Concept to Realization for Physical Oceanographic Studies. Observing the Oceans in Real Time, R. Venkatesan, A. Tandon, E. D'Asaro, and M. A. Atmanand, Eds., Springer International Publishing, 165-202, https://doi.org/10.1007/978-3-319-66493-4_9.
6. Pattabhi Rama Rao, E., T. V. S. Bhaskar, R. V. Seshu, N. S. Rao, K. Suprit, and G. Geetha, 2018: Marine Data Services at National Oceanographic Data Centre-India. Data Science Journal, 17, 11, http://doi.org/10.5334/dsj-2018-011.
7. Ravichandran, M. and M. S. Girishkumar, 2018: Applications of Ocean In-situ Observations and Its Societal Relevance. Observing the Oceans in Real Time, R. Venkatesan, A. Tandon, E. D'Asaro, and M. A. Atmanand, Eds., Springer International Publishing, 303-313, https://doi.org/10.1007/978-3-319-66493-4_15.
8. Santhanam, H. and T. Natarajan, 2018: Short-term desalination of Pulicat lagoon (Southeast India) due to the 2015 extreme flood event: insights from Land-Ocean Interactions in Coastal Zone (LOICZ) models. Ecological Processes, 7, 10, https://doi.org/10.1186/s13717-018-0119-7.
9. Sarangi, R. K., S. K. Shrinidhi, P. Chauhan, and B. R. Raghavan, 2018: Remote sensing and in situ platform based study on impact of Bay of Bengal cyclones (Phailin, Helen, Lehar, and Madi) on ocean chlorophyll and associated physical parameters. Natural Hazards, 93, 413-451, https://doi.org/10.1007/s11069-018-3307-y
10. Seelanki, V., P. Sreenivas, and K. V. S. R. Prasad, 2018: Impact of Aquarius Sea-Surface Salinity Assimilation in Improving the Ocean Analysis Over Indian Ocean. Marine Geodesy, 41, 144-158, https://doi.org/10.1080/01490419.2017.1422817.
11. Sherin, V. R., F. Durand, V. V. Gopalkrishna, S. Anuvinda, A. V. S. Chaitanya, R. Bourdallé-Badie, and F. Papa, 2018: Signature of Indian Ocean Dipole on the western boundary current of the Bay of Bengal. Deep Sea Research Part I: Oceanographic Research Papers, 136, 91-106, https://doi.org/10.1016/j.dsr.2018.04.002.
12. Tyagi, G., K. N. Babu, A. K. Mathur, and H. A. Solanki, 2018: INSAT-3D and MODIS retrieved sea surface temperature validation and assessment over waters

surrounding the Indian subcontinent. International Journal of Remote Sensing, 39, 1575-1592, https://doi.org/10.1080/01431161.2017.1407051.
13. Valsala, V., S. Singh, and S. Balasubramanian, 2018: A Modeling Study of Interannual Variability of Bay of Bengal Mixing and Barrier Layer Formation. Journal of Geophysical Research: Oceans, 123, 3962-3981, https://doi.org/10.1029/2017JC013637.
14. Venkatesan, R., A. Tandon, D. Sengupta, and K. N. Navaneeth, 2018: Recent Trends in Ocean Observations. Observing the Oceans in Real Time, R. Venkatesan, A. Tandon, E. D'Asaro, and M. A. Atmanand, Eds., Springer International Publishing, 3-13, https://doi.org/10.1007/978-3-319-66493-4_1.
15. Vidya, P. J. and S. Kurian, 2018: Impact of 2015–2016 ENSO on the winter bloom and associated phytoplankton community shift in the northeastern Arabian Sea. Journal of Marine Systems, 186, 96-104, https://doi.org/10.1016/j.jmarsys.2018.06.005.