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TECHNICAL REPORT ON ARGO DATA PROCESSING

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11. Abstract (Maximum 100 words):

In this document, details of Argo program, data acquisition system and data processing are documented to serve as a reference for Argo data. Several plots are included to serve as quick reference. The data will be useful to describe major thermo-haline features in the Indian Ocean. In conjunction with other sources of data from various platforms, the data can be used for studying meso-scale structure and dynamics of upper ocean process. At smaller scales, the float temperature and salinity data will be useful to document the seasonal to intra seasonal variability of temperature, salinity and various other derived parameters. This temperature and salinity data can be useful for updating the climatology and for assimilation into ocean model for better forecasts.

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Abstract

During the period October 2002 to March 2007, 132 ARGOS tracked autonomous drifting floats with temperature, conductivity and dissolved oxygen sensors were deployed to make continuous measurements of temperature and salinity and dissolved oxygen in the Indian Ocean. This report describes the data obtained from 132 floats deployed during the period October 2002 to March 2007.

In this document, details of Argo program, data acquisition system and data processing are documented to serve as a reference for Argo data. Several plots are included to serve as quick reference. The data will be useful to describe major thermo-haline features in the Indian Ocean. In conjunction with other sources of data from various platforms, the data can be used for studying meso-scale structure and dynamics of upper ocean process. At smaller scales, the float temperature and salinity data will be useful to document the seasonal to intra seasonal variability of temperature, salinity and various other derived parameters. This temperature and salinity data can be useful for updating the climatology and for assimilation into ocean model for better forecasts.

1. Introduction

1.1 ARGO Introduction

A broad-scale global array of temperature/salinity profiling floats, known as ARGO, is planned as a major component of the ocean observing system, with deployment scheduled to begin in 2000. Conceptually, ARGO builds on the existing upper-ocean thermal networks, extending their spatial and temporal coverage, depth range and accuracy, and enhancing them through addition of salinity and velocity measurements. The name ARGO is chosen to emphasize the strong complementary relationship of the global float array with the Jason altimeter mission. For the first time, the physical state of the upper ocean will be systematically measured and assimilated in near real-time.

Objectives of ARGO fall into several categories. ARGO will provide a quantitative description of the evolving state of the upper ocean and the patterns of ocean climate variability, including heat and freshwater storage and transport. The data will enhance the value of the Jason altimeter through measurement of subsurface vertical structure (T(z), S(z)) and reference velocity, with sufficient coverage and resolution for interpretation of altimetric sea surface height variability. ARGO data will be used for initialization of ocean and coupled forecast models, data assimilation and dynamical model testing. A primary focus of ARGO is seasonal to decadal climate variability and predictability, but a wide range of applications for high-quality global ocean analyses is anticipated.

The initial design of the ARGO network is based on experience from the present observing system, on newly gained knowledge of variability from the TOPEX/Poseidon altimeter, and on estimated requirements for climate and high-resolution ocean models. ARGO will provide 100,000 T/S profiles and reference velocity measurements per year from about 3000 floats distributed over the global oceans at 3-degree spacing. Floats will cycle to 2000 m depth every 10 days, with a 4-5 year lifetime for individual instruments. All ARGO data will be publicly available in near real-time via the GTS, and in scientifically quality-controlled form with a few months delay. Global coverage should be achieved during the Global Ocean Data Assimilation Experiment, which together with CLIVAR and GCOS/GOOS, provide the major scientific and operational impetus for ARGO. The design emphasizes the need to integrate ARGO within the overall framework of the global ocean observing system. International planning for ARGO, including sampling and technical issues, is coordinated by the ARGO Science Team. Nations presently having ARGO plans that include float procurement or production include Australia, Canada, France, Germany, Japan, the U.K., and the U.S.A., plus a European Union proposal. Combined deployments from these nations may exceed 700 floats per year as early as 2001. Broad participation in ARGO by many nations is anticipated and encouraged either through float procurement, logistical support for float deployment, or through analysis and assimilation of ARGO data [ARGO Science Team].

INCOIS made a modest beginning in October 2002 by deploying and monitoring 10 Argo floats in the Indian Ocean. This program is supported by the Department of Ocean Development (DOD), New Delhi.

1.2 GLOBAL DATA FLOW

The assembly of data in the ARGO program is a distributed responsibility. In many cases, individual countries have established data centres to handle the data collected by floats that their countries have contributed. In other cases, agencies within countries or groups of countries have also contributed floats to the ARGO program but they make use of an existing data processing centre.

ARGO data are processed and distributed through a network involving different factors

· **PI:** The scientists, who deploy the floats, then carry out delayed mode QC and return data to National Centres within 5 months of observations.

· **National Centres:** the data centres who collect, qualify, process and distribute the float data they are responsible for. Data are distributed to PIs and the GTS within 24 hours of the float surfacing. They also send the data to the Global Data Centres.

· **Global Data Centres:** two central points of ARGO data distribution on Internet for all the float data located in Coriolis/Ifremer/France and USGODAE/FNMOC/USA .Coordination between these centres occurs daily.

· **Argo Regional Centres:** Data centres in charge of the delayed mode quality control on float data. This QC is made on regional basis.

· **ARGO Information Centre (AIC):** centre located in Toulouse/France, in charge of informing on the ARGO program status and to provide all necessary information to users.

· **ARGO long term archive:** data centre located in NODC/USA in charge of insuring the long term archive of all the ARGO data.

A visual summary of the data flow from float to global archives is shown in Figure 1.

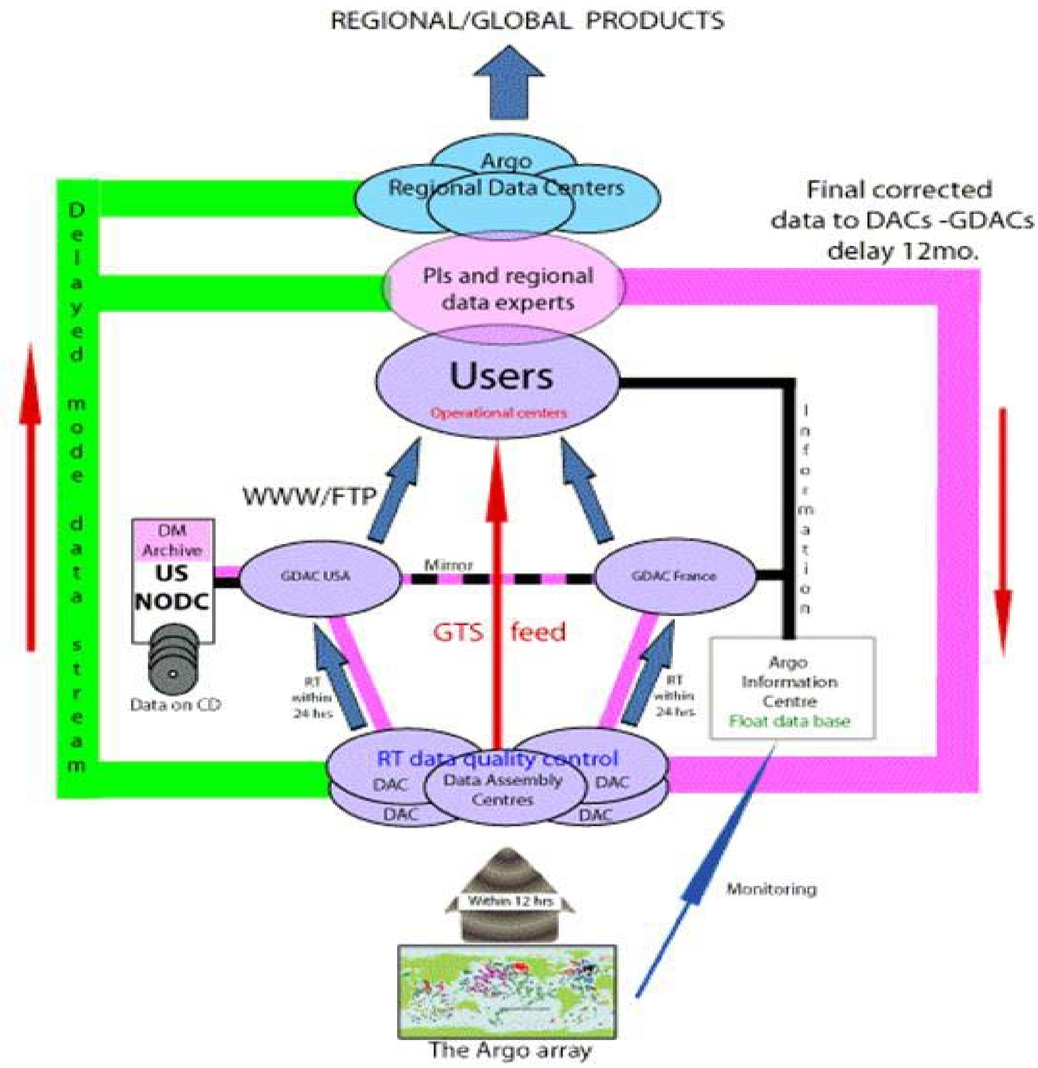

Fig 1 Argo Data Flow

2. ARGO Data Retrieval

ARGO floats normally repeat the cycle of surfacing from the parking depth every 10days, drifting at the surface for approximately a half-day, and then descending to the parking depth, where it will drift at the parking depth for another 10days (Figure 2). During the ascent to the surface from the parking depth, the float measures the temperature and salinity at preset pressure. After surfacing, it will immediately begin to transmit the observed data and float status information, and will continue to do so while it is afloat, using the ARGOS data transmission system. The ARGOS satellite will receive data from the ARGO floats as they drift on the sea surface, and will relay the data to the ground stations. The ground stations will calculate the positions of the floats based on the Doppler shift of the receive frequency, and will distribute both the received data and the time at which they were received to the users. Figure 2 Shows Schematic flow of ARGO data right from the ARGO drowning to receiving data at the receiving station from the ARGOS satellite.

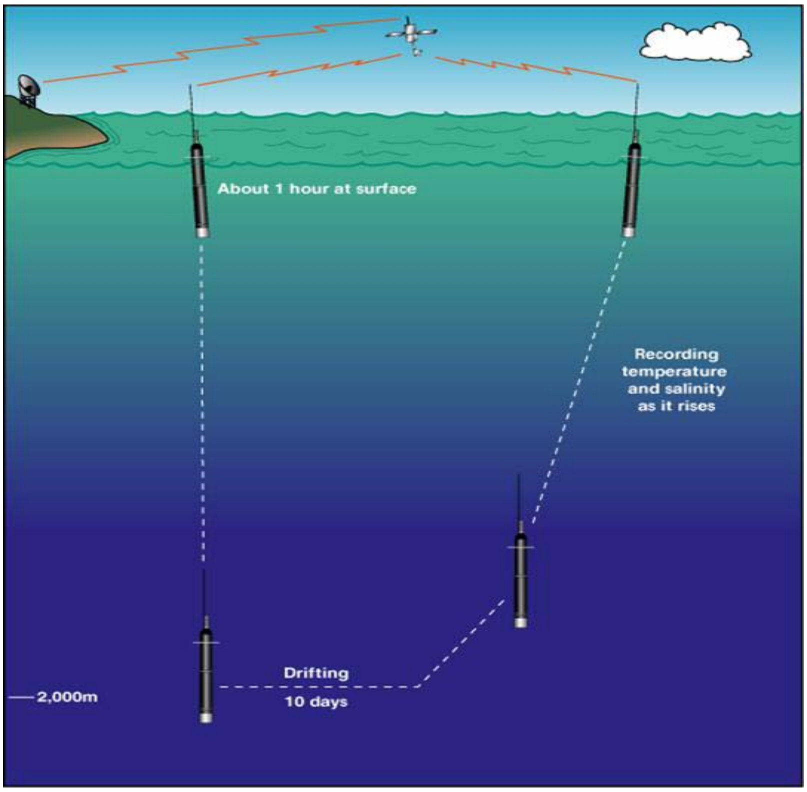

Fig 2 Schematic flow of Argo data

2.1 Native Hexadata Format

A sample ARGO data in its native format is given below.

```
02602 29779  65 32 K 2 2003-01-10 12:55:18   0.691   76.559  0.000 401647210
    2003-01-10 12:49:18  1      EE       05       31       40
                      89       2D       08       8D
                      35       9D       89       3E
                      07       CB       37       09
                      89       54       07       62
                      38       30       89       63
                      06       FF       38       E7
                      89       67       06       A0
    2003-01-10 12:50:48  1      9F       06       3A       40
                      89       68       06       3A
                      3B       5D       89       66
                      05       D5       3C       38
                      E1       C7       9E       3C
                      79       C3       8A       14
                      F0       B9       4A       12
                      F3       8E       39       F0
02602 29779  73 32 K 2 2003-01-10 14:34:18   0.706   76.542  0.000 401647210
    2003-01-10 14:28:18  1      4D       0B       70       B9
                      89       D2       00       E1
                      70       C9       89       D1
                      00       BE       70       D0
                      89       C9       00       A4
                      70       D7       89       C6
                      00       7C       70       E6
                      89       C4       00       6E
```

```
        2003-01-10 14:37:18  1      EE      05      31      40
                             89     2D      08      8D
                             35     9D      89      3E
                             07     CB      37      09
                             89     54      07      62
                             38     30      89      63
                             06     FF      38      E7
                             89     67      06      A0

02602 29779  57 32 M 2 2003-01-10 16:33:33   0.728   76.501  0.000 401647210
    2003-01-10 16:34:18  1      4D      0B      70      B9
                             89     D2      00      E1
                             70     C9      89      D1
                             00     BE      70      D0
                             89     C9      00      A4
                             70     D7      89      C6
                             00     7C      70      E6
                             89     C4      00      6E
    2003-01-10 16:38:48  1      D6      02      19      FE
                             88     89      29      68
                             1A     A2      88      89
                             26     FF      1C      C4
                             88     A2      23      22
                             1E     38      88      AD
                             1F     3B      21      A2
                             88     C9      1B      55
    2003-01-10 16:40:18  1      3B      03      24      58
                             88     C9      17      67
                             26     F4      88      BB
                             13     80      27      E7
                             88     B7      11      F0
                             29     61      88      BC
                             10     60      2A      AC
                             88     CB      0E      CF
02602 29779  65 32 H 2 2003-01-10 17:58:18   0.747   76.495  0.000 401647209
```


The ARGO float will begin its first descent after the start up (power on) and will descend to its parking depth. After staying for the prescribed no of days at the parking depth the float will begin to ascend and will measure water pressure, temperature and salinity as it rises to the surface. Once on the surface, it will begin to transmit observation data until the beginning to descend. India planned to deploy float with 3 different missions. Figure 3 below shows cycles in the missions of an Argo profiling float deployed by India.

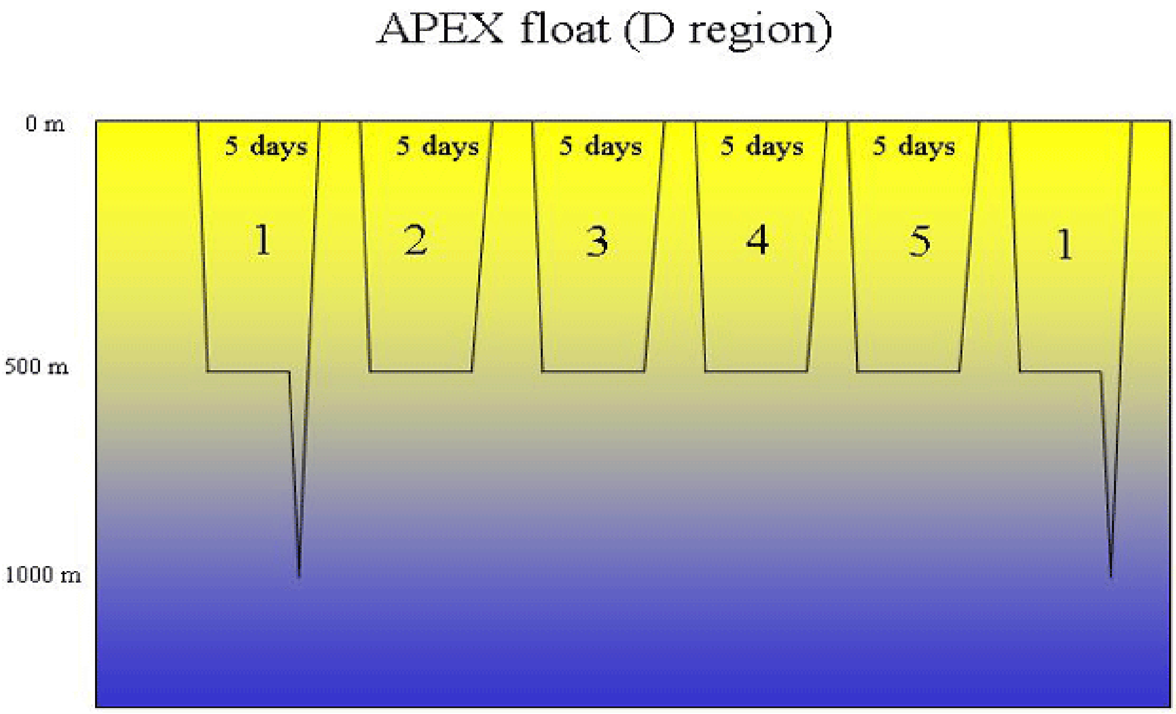

Fig 3a Cycles in Argo mission 1

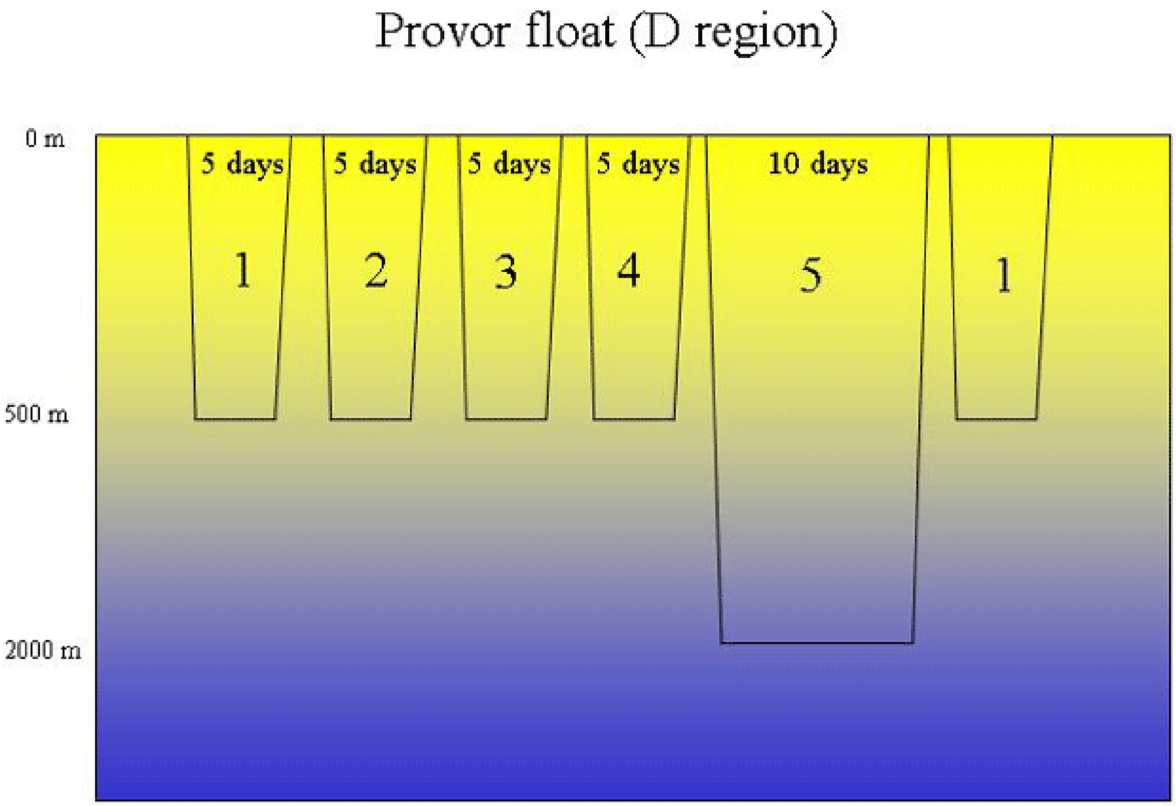

Fig 3b Cycles in Argo mission 2

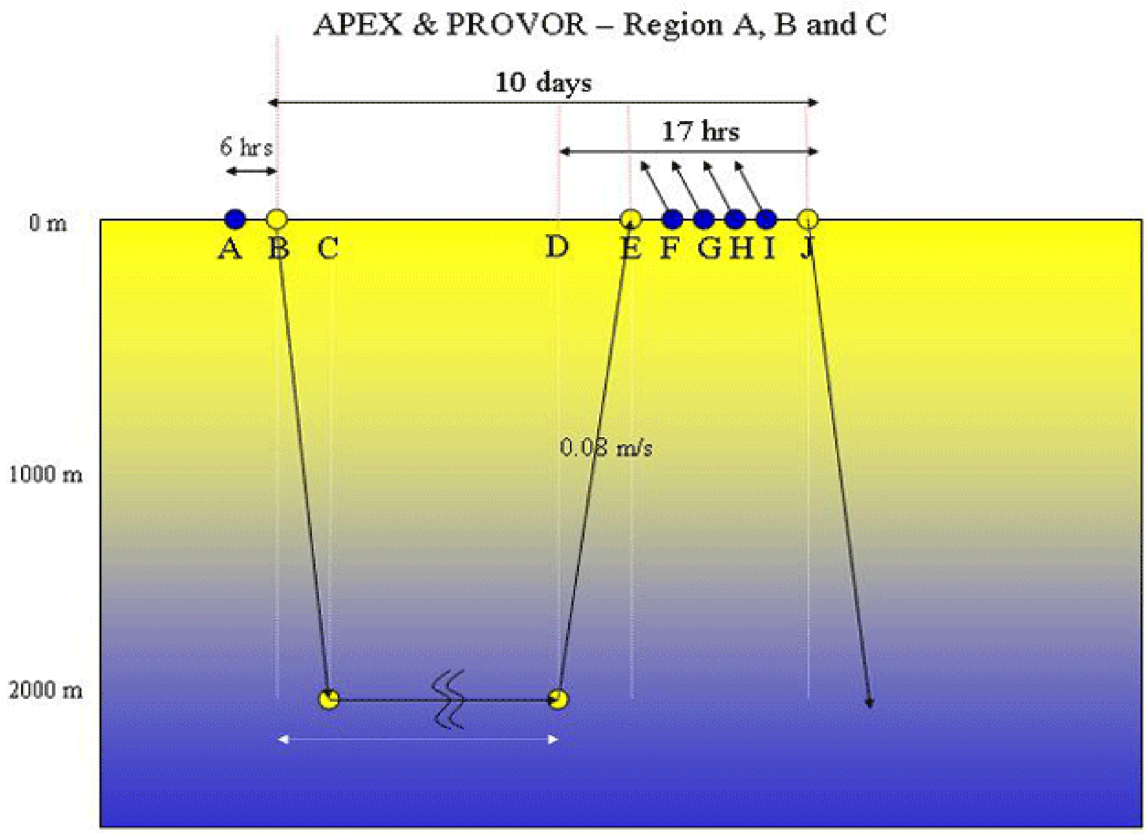

Fig 3c Cycles in Argo mission 3

2.2 Decoding Procedure

The Hexadecimal data thus obtained from the Satellite is treated in various ways as follows:

- Separation of the Header Information showing the date, time and position of the float while transmitting.
- Eliminating the Redundant packets and those which fail the Cyclic Redundancy Check (CRC).
- Sorting the Non Redundant and correct data.
- Clubbing the topples of hexadecimal temperature, salinity and pressure values to form the 32 bit information from the individual 16 bit information.
- Converting the 32bit hexadecimal data into decimal data, and further obtaining the temperature to a precision of 3 decimals, salinity to a precision of 3 decimals and pressure to a precision of 1 decimal.
- Processing the Message Block with the Message block no of '01' for the Technical Information.
- Reversing the decoded data to obtain data in the increasing order of depth and at the same time appending the Technical information to form the complete set of information for that particular profile.

The details of the decoding process is explained below.

2.3. Header Information Retrieval

The Header Information of the ARGO Hexadecimal data consists of information regarding the Program Id, PTTID, No of message blocks, No of bits in which information is encoded in, Satellite Name, Block no, Date, Time, Latitude, Longitude, and frequency of transmission. This information is embedded along with the profile data of temperature, salinity and pressure. This Header information is retrieved out separately so as to use it for the other purposes like surface currents calculations.
A sample of the header information looks as follows:

2602	29779	57	32	L	1	10/01/2003	09:25:18	0.665	76.620	0	401647198
2602	29779	57	32	D	1	10/01/2003	10:42:33	0.674	76.591	0	401647206
2602	29779	41	32	D	2	10/01/2003	12:19:18	0.690	76.572	0	401647198
2602	29779	73	32	J	2	10/01/2003	12:53:03	0.691	76.559	0	401647198
2602	29779	65	32	K	2	10/01/2003	12:55:18	0.691	76.559	0	401647210
2602	29779	65	32	J	3	10/01/2003	14:33:33	0.706	76.541	0	401647210
2602	29779	73	32	K	2	10/01/2003	14:34:18	0.706	76.542	0	401647210
2602	29779	41	32	H	1	10/01/2003	16:19:18	0.721	76.512	0	401647210
2602	29779	57	32	M	2	10/01/2003	16:33:33	0.728	76.501	0	401647210
2602	29779	65	32	H	2	10/01/2003	17:58:18	0.747	76.495	0	401647209
2602	29779	65	32	M	2	10/01/2003	18:14:03	0.746	76.487	0	401647210
2602	29779	73	32	L	3	10/01/2003	20:28:18	0.771	76.451	0	401647210

Once the set of the header information is retrieved, the data is sorted based on date and then by time. After this the information is used to locate the time and location of the float at that specified time. This information is immensely useful in calculating the ocean surface currents prevailed at that instant of time. The distance between two consecutive location along with time difference is calculated and then the velocity of the current is calculated. The repository of such calculations are immensely useful to study the current patterns at the specified locations.

2.4. Redundancy Elimination

After the header information is eliminated from the obtained hexadecimal data, we are left with the data in which the temperature, salinity and pressure information is encoded in the 16bit hexadecimal format. But as the Float transmits the data packets multiple times so as to ensure that all the data packets were received by the Satellite, we receive multiple packets with different date and time stamps. This multiple data packets should be treated for the redundancy and Cyclic Redundancy Check (CRC).
A sample of this data is as follows:

```
2003-01-10 12:49:18 1 EE 05 31 40 89 2D 08 8D 35 9D 89 3E 07 CB 37 09 89 54 07 62 38 30 89 63 06 FF 38 E7 89 67 06 A0
2003-01-10 12:50:48 1 9F 06 3A 40 89 68 06 3A 3B 5D 89 66 05 D5 3C 38 E1 C7 9E 3C 79 C3 8A 14 F0 B9 4A 12 F3 8E 39 F0
2003-01-10 12:52:18 1 A8 07 49 7A 89 9A 04 3F 53 24 8A 1F 03 EA 5A C9 8A 49 03 B7 5E 20 8A 67 03 89 61 B1 8A 6D 03 53
2003-01-10 12:53:48 1 02 08 64 7C 8A 75 03 19 65 38 8A 77 02 EA 67 53 89 6F 7D 8F 56 57 14 F4 05 00 D4 47 14 FE 04 A7
2003-01-10 12:56:48 1 C0 0A 70 76 89 D9 01 75 70 8D 89 D4 01 57 70 93 89 D4 01 40 70 A4 89 D3 01 1C 70 B4 89 D3 00 F9
2003-01-10 12:58:18 1 4D 0B 70 B9 89 D2 00 E1 70 C9 89 D1 00 BE 70 D0 89 C9 00 A4 70 D7 89 C6 00 7C 70 E6 89 C4 00 6E
2003-01-10 12:59:48 1 78 0C 71 17 89 BD 00 49 71 5F 89 BA 00 31 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
2003-01-10 13:01:18 1 11 01 0F 04 3D 10 34 01 8A 04 30 01 3E 92 20 19 10 A3 95 26 44 88 C5 13 F0 87 9A 4B 87 9F DA 65
2003-01-10 14:28:18 1 4D 0B 70 B9 89 D2 00 E1 70 C9 89 D1 00 BE 70 D0 89 C9 00 A4 70 D7 89 C6 00 7C 70 E6 89 C4 00 6E
2003-01-10 14:29:48 1 78 0C 71 17 89 BD 00 49 71 5F 89 BA 00 31 FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF FF
2003-01-10 14:31:18 1 E7 01 14 04 3D 10 34 01 8A 04 30 01 3E 92 20 19 10 A3 96 26 44 88 C5 13 F0 97 99 00 32 60 29 0F
2003-01-10 14:32:48 1 D6 02 19 FE 88 89 29 68 1A A2 88 89 26 FF 1C C4 88 A2 23 22 1E 38 88 AD 1F 3B 21 A2 88 C9 1B 55
2003-01-10 14:34:18 1 3B 03 24 58 88 C9 17 67 26 F4 88 BB 13 80 27 E7 88 B7 11 F0 29 61 88 BC 10 60 2A AC 88 CB 0E CF
2003-01-10 14:35:48 1 73 04 2B 93 88 D9 0D 44 2C 3B 88 E4 0B B3 2E 23 88 FA 0A EA 2F 14 89 12 0A 22 30 4C 89 19 09 56
2003-01-10 14:37:18 1 EE 05 31 40 89 2D 08 8D 35 9D 89 3E 07 CB 37 09 89 54 07 62 38 30 89 63 06 FF 38 E7 89 67 06 A0
2003-01-10 14:38:48 1 9F 06 3A 40 89 68 06 3A 3B 5D 89 66 05 D5 3C 18 89 59 05 6E 3E C1 89 56 05 0E 41 B5 89 77 04 AA
```

```
2003-01-10 14:40:18 1 A8 07 49 7A 89 9A 04 3F 53 24 8A 1F 03 EA 5A C9 8A 49 03 B7 5E 20 8A 67 03 89 61 B1 8A 6D 03 53
2003-01-10 16:26:48 1 9F 0E 3A 40 89 E8 06 3A 3B 5D 89 67 05 D5 3D 08 A9 59 05 6E 3E C1 89 56 05 0E 41 B5 89 77 04 AA
```

This process is done by passing each message block, excluding the CRC and block no, to a subroutine CRCCheck(), which will return a value 1 if out come of this subroutine and the embedded CRC are matching and 0 otherwise. Then these data block which have passed the CRC are maintained in a Linked List so as to check, the occurrence of multiple block. The Linked List will grow in size as the time progress and each time a new block is encountered for insertion it will be checked to see if it is already present in the existing list. At the end of this Procedure we will be remaining with a non redundant data blocks with correct CRC values.

The data blocks after the elimination of redundancy is as follows:

```
2003-01-10 18:01:18 1 29 09 6c 6f 8a 81 02 1f 6f 0c 8a 49 01 f8 6f 68 8a 3c 01 d0 6f d7 8a 14 01 b4 70 55 89 df 01 99
2003-01-10 12:49:18 1 ee 05 31 40 89 2d 08 8d 35 9d 89 3e 07 cb 37 09 89 54 07 62 38 30 89 63 06 ff 38 e7 89 67 06 a0
2003-01-10 14:31:18 1 e7 01 14 04 3d 10 34 01 8a 04 30 01 3e 92 20 19 10 a3 96 26 44 88 c5 13 f0 97 99 00 32 60 29 0f
2003-01-10 14:34:18 1 3b 03 24 58 88 c9 17 67 26 f4 88 bb 13 80 27 e7 88 b7 11 f0 29 61 88 bc 10 60 2a ac 88 cb 0e cf
2003-01-10 14:38:48 1 9f 06 3a 40 89 68 06 3a 3b 5d 89 66 05 d5 3c 18 89 59 05 6e 3e c1 89 56 05 0e 41 b5 89 77 04 aa
2003-01-10 12:53:48 1 02 08 64 7c 8a 75 03 19 65 38 8a 77 02 ea 67 53 89 6f 7d 8f 56 57 14 f4 05 00 d4 47 14 fe 04 a7
2003-01-10 12:56:48 1 c0 0a 70 76 89 d9 01 75 70 8d 89 d4 01 57 70 93 89 d4 01 40 70 a4 89 d3 01 1c 70 b4 89 d3 00 f9
2003-01-10 12:58:18 1 4d 0b 70 b9 89 d2 00 e1 70 c9 89 d1 00 be 70 d0 89 c9 00 a4 70 d7 89 c6 00 7c 70 e6 89 c4 00 6e
2003-01-10 12:59:48 1 78 0c 71 17 89 bd 00 49 71 5f 89 ba 00 31 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
2003-01-10 14:32:48 1 d6 02 19 fe 88 89 29 68 1a a2 88 89 26 ff 1c c4 88 a2 23 22 1e 38 88 ad 1f 3b 21 a2 88 c9 1b 55
2003-01-10 12:52:18 1 a8 07 49 7a 89 9a 04 3f 53 24 8a 1f 03 ea 5a c9 8a 49 03 b7 5e 20 8a 67 03 89 61 b1 8a 6d 03 53
2003-01-10 14:35:48 1 73 04 2b 93 88 d9 0d 44 2c 3b 88 e4 0b b3 2e 23 88 fa 0a ea 2f 14 89 12 0a 22 30 4c 89 19 09 56
```

2.5. Sorting

The data obtained after the redundancy and CRC check is not in a sorted format and for the data to be converted to obtain the temperature, salinity and pressure information in a sequential order, one need to sort the data. So the out come of the redundancy check subroutine is then passed on to another Subroutine which will sort the data block in the ascending order that is starting from the '01' to the '0f' packet. Once this sorting of data blocks is finished that data is ready for decoding from the hexadecimal format to the decimal format which reveals the real temperature, salinity and pressure values.
The data blocks after the sorting is as follows:

```
2003-01-10 14:31:18 1 e7 | 01 | 14 04 3d 10 34 01 8a 04 30 01 3e 92 20 19 10 a3 96 26 44 88 c5 13 f0 97 99 00 32 60 29 0f
2003-01-10 14:32:48 1 d6 | 02 | 19 fe 88 89 29 68 1a a2 88 89 26 ff 1c c4 88 a2 23 22 1e 38 88 ad 1f 3b 21 a2 88 c9 1b 55
2003-01-10 14:34:18 1 3b | 03 | 24 58 88 c9 17 67 26 f4 88 bb 13 80 27 e7 88 b7 11 f0 29 61 88 bc 10 60 2a ac 88 cb 0e cf
2003-01-10 14:35:48 1 73 | 04 | 2b 93 88 d9 0d 44 2c 3b 88 e4 0b b3 2e 23 88 fa 0a ea 2f 14 89 12 0a 22 30 4c 89 19 09 56
2003-01-10 12:49:18 1 ee | 05  | 31 40 89 2d 08 8d 35 9d 89 3e 07 cb 37 09 89 54 07 62 38 30 89 63 06 ff 38 e7 89 67 06 a0
2003-01-10 14:38:48 1 9f  | 06 | 3a 40 89 68 06 3a 3b 5d 89 66 05 d5 3c 18 89 59 05 6e 3e c1 89 56 05 0e 41 b5 89 77 04 aa
2003-01-10 12:52:18 1 a8 | 07 | 49 7a 89 9a 04 3f 53 24 8a 1f 03 ea 5a c9 8a 49 03 b7 5e 20 8a 67 03 89 61 b1 8a 6d 03 53
2003-01-10 12:53:48 1 02 | 08 | 64 7c 8a 75 03 19 65 38 8a 77 02 ea 67 53 89 6f 7d 8f 56 57 14 f4 05 00 d4 47 14 fe 04 a7
2003-01-10 18:01:18 1 29 | 09 | 6c 6f 8a 81 02 1f 6f 0c 8a 49 01 f8 6f 68 8a 3c 01 d0 6f d7 8a 14 01 b4 70 55 89 df 01 99
2003-01-10 12:56:48 1 c0 | 0a  | 70 76 89 d9 01 75 70 8d 89 d4 01 57 70 93 89 d4 01 40 70 a4 89 d3 01 1c 70 b4 89 d3 00 f9
2003-01-10 12:58:18 1 4d | 0b | 70 b9 89 d2 00 e1 70 c9 89 d1 00 be 70 d0 89 c9 00 a4 70 d7 89 c6 00 7c 70 e6 89 c4 00 6e
2003-01-10 12:59:48 1 78 | 0c | 71 17 89 bd 00 49 71 5f 89 ba 00 31 ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff ff
```

2.6. 16bit to 32bit Information Retrieval

This is the most important of the entire decoding part of the ARGO data, from the hexadecimal format to the decimal format. The temperature, salinity and pressure data values are encoded into 32bit hexadecimal format. But due to the shortcoming of the Satellite transmission which can transmit 16bit information only, the 32 bit information is split into 16 bit information and sent via the blocks. After the data is

received its necessary to club the 16bit topples of temperature, salinity and pressure to get the encoded 32bit information. The process is as follows:
The obtained 16bit information is as shown below.

BTYE #	MSG 2	MSG 3	MSG 4	MSG 5	MSG 6	MSG 7	MSG 8
3 & 4	T1	T6	T11	T16	T21	T26	T31
5 & 6	S1	S6	S11	S16	S21	S26	S31
7 & 8	P1	P6	P11	P16	P21	P26	P32
9 & 10	T2	T7	T12	T17	T22	T27	T32
11 & 12	S2	S7	S12	S17	S22	S27	S32
13 & 14	P2	P7	P12	P17	P22	P27	P32
15 & 16	T3	T8	T13	T18	T23	T28	T33
17 & 18	S3	S8	S13	S18	S23	S28	S33
19 & 20	P3	P8	P13	P18	P23	P28	P33
21 & 22	T4	T9	T14	T19	T24	T29	T34
23 & 24	S4	S9	S14	S19	S24	S29	S34
25 & 26	P4	P9	P14	P19	P24	P29	P34
27 & 28	T5	T10	T15	T20	T25	T30	T35
29 & 30	S5	S10	S15	S20	S25	S30	S35
31 & 32	P5	P10	P15	P20	P25	P30	P35

For Instance we consider an dataset:

16bitT1	16bitT2	16bitS1	16bitS2	16bitP1	16bitP2
19	fe	88	89	29	68
1a	a2	88	89	26	ff
1c	c4	88	a2	23	22
1e	38	88	ad	1f	3b
21	a2	88	c9	1b	55

Once this information is obtained we club the 16bit T1 and 16T2 to obtain the 32 bit T value. After the clubbing of 16bit information the 32bit information looks as follows.

32bit T	32bitS	32bitP
19fe	8889	2968
1aa2	8889	26ff
1cc4	88a2	2322
1e38	88ad	1f3b
21a2	88c9	1b55

This way all the blocks of information transmitted form the float are converted to 32bit information and made ready for the conversion to decimal format so that real values of temperature, salinity and pressure values are obtained.

2.7. Conversion of Hexadecimal to Decimal

Once the process of conversion from 16bit to 32bit information is done, the job left unprocessed is the conversion to the decimal format so as to visualise the real values of temperature, salinity and pressure. Now each of these 32bit hexadecimal T, S and P are read and converted to decimal equivalent with precision of 3 decimals for T and S and 1 decimal for P.

T	S	P
6.654	34.953	1060.0
6.818	34.953	998.3

7.364	34.978	899.4
7.736	34.989	799.5
8.610	35.017	699.7

2.8. Processing the '01' Blocks for Technical Information

The '01' block is treated separately compared to the rest of the blocks as this block holds the technical details corresponds to the particular profile, like the bottom most position at which it starts to collect the data, the temperature and salinity at that place, the battery voltage etc. The Format for message number 1 only is as follows:
Byte #
01 **CRC**, described in section C.
02 **Message number**, Assigned sequentially to each 32 byte message (Total number of messages per profile is shown below). Messages are transmitted in sequential order starting with 1 and incrementing by one for the data set.
03 **Message block number**, begins as 1 and increments by one for every ARGOS message data set. This, combined with the ARGOS repetition rate (section VI), allows the user to track surface drift. Byte 03 will roll-over at 256 and will reset to 1 on each new profile.
04 & 05 **Serial number**, identifies the controller board number. (This may not be the same as instrument number.)
06 **Profile number**, begins with 1 and increases by one for every float ascent.
07 **Profile length**, is the number of six byte STD measurements in the profile. Total number of bytes of STD data from each profile depends on the sampling strategy chosen.
08 **Profile termination flag byte 2** –see appendix A
09 **Piston position**, recorded as the instrument reaches the surface.
10 **Format Number** (identifier for message one type)
11 **Depth Table Number** (identifier for profile sampling depths)
12 & 13 **Pump motor time,** in two second intervals. (multiply by 2 for seconds)
14 **Battery voltage,** at initial pump extension completion
15 **Battery current,** at initial pump extension completion one count = 13 mA
16 **Air pump current,** one count = 13 mA
17 **not used**
18 **Surface piston position** typically 25 counts more than byte 9 for excess buoyancy
19 **Air bladder pressure** measured in counts - approximately 148 counts
20 & 21 **Bottom temperature**, sampled just before instrument ascends.
22 & 23 **Bottom salinity**, sampled just before instrument ascends.
24 & 25 **Bottom pressure**, sampled just before instrument ascends.
26 **Bottom battery voltage**, no load
27 **Surface battery voltage,** no load
28 & 29 **Surface Pressure** as recorded just before last descent with an offset of +5 dbar
30 **Internal vacuum** measure in counts- approximately 101 counts
31 **Bottom piston position**
32 **SBE pump current**
Once this information is decoded the equivalent values in decimal format is obtained, from conversion.

2.9. Clubbing Technical and Profile Information

Now we are set for the complete profile information that is the technical and temperature, salinity and pressure data. The complete set of profile information looks as follow:

HEADDER INFORMATION FOR THE FLOAT

Cyclic Redundency Check Value	:	114
Message No	:	1
Message Block No	:	2
Serial Number	:	1083
Profile No	:	3
Profile Length	:	47
Profile Termination flag byte-2	:	0
Pistion Position	:	162
Format Number	:	4
Depth Table Number	:	48
Pump Motor Time	:	308
Battery Voltage	:	150
Battery Current	:	22
Air Pump current	:	26
A Value not used	:	19
surface Pistion Position	:	187
Air Bladder Pressure	:	144
Bottom Temperature	:	9.517
Bottom Salinity	:	35.040
Bottom Pressure	:	508.8
Bottom Battery Voltage	:	154
Surface Battery voltage	:	156
Surface Pressure	:	50
Interanal Vaccum	:	95
Bottom Pistion Position	:	41
SBE pump current	:	14

Press	Temp	Salin	Density
4.2	29.604	33.855	1021.0046
7.4	29.589	33.897	1021.0411
10.1	29.535	33.906	1021.0661
13.2	29.476	33.895	1021.0777
16.9	29.441	33.910	1021.1007
19.5	29.166	34.121	1021.3512
23.0	29.133	34.184	1021.4095
25.4	29.016	34.262	1021.5071
28.3	28.779	34.585	1021.8284
31.0	28.545	35.177	1022.3506
34.3	27.592	35.116	1022.6168
37.6	26.970	35.041	1022.7603

40.5	26.803	35.049	1022.8195
43.9	26.668	35.036	1022.8525
46.0	26.297	35.027	1022.9628
49.6	25.822	35.007	1023.0959
54.7	25.192	34.984	1023.2725
59.8	23.775	34.903	1023.6360
64.7	22.763	34.909	1023.9342
69.8	22.251	34.915	1024.0842
74.4	21.466	34.847	1024.2513
79.4	20.782	34.861	1024.4485
84.6	19.524	34.896	1024.8081
89.3	18.583	34.844	1025.0085
94.6	18.141	34.857	1025.1288
99.2	18.073	34.873	1025.1578
109.2	17.298	34.878	1025.3505
119.2	16.182	34.894	1025.6251
129.2	15.302	34.894	1025.8242
139.8	14.600	34.934	1026.0089
149.4	14.169	34.993	1026.1467
159.2	13.671	34.995	1026.2527
169.4	13.288	35.007	1026.3407
178.8	12.794	34.982	1026.4208
188.6	12.663	35.038	1026.4901
199.1	12.493	35.047	1026.5306
219.8	12.266	35.047	1026.5750
239.4	11.921	35.062	1026.6530
259.3	11.744	35.064	1026.6881
279.4	11.484	35.058	1026.7322
299.6	11.246	35.058	1026.7762
339.5	10.621	35.057	1026.8885
379.0	10.314	35.056	1026.9419
419.5	10.089	35.056	1026.9808
458.9	9.822	35.044	1027.0171
498.8	9.582	35.045	1027.0583
508.8	9.517	35.041	1027.0660

3. Real Time Quality Control

3.1 QC introduction

This section is regarding the Quality Control of Argo profile data sets.

The Argo data system has three levels of quality control.

- The first level is the Real-Time system that performs a set of agreed checks on all float measurements. Real-time data with assigned quality flags are available to users within the 24-48 hrs timeframe.
- The second level of quality control is the delayed-mode system.

- The third level of quality control is regional scientific analyses of all float data with other available data. The procedures for regional analyses are still to be determined.

3.2 Argo RTQC test Procedures on vertical profiles

Because of the requirement for delivering data to users within 24 hours of the float reaching the surface, the quality control procedures on the real-time data are limited and automatic. The test limits are briefly described here. More detail on the tests can be found in IOC Manuals and Guides #22 or at

http://www.meds-sdmm.dfo-mpo.gc.ca/ALPHAPRO/gtspp/qcmans/MG22/guide22_e.htm

Note that some of the test limits used here and the resulting flags are different from what is described in Manuals and Guides #22.

If data from a float fail these tests, certain of the data will not be distributed on the GTS. However, all of the data, including those having failed the tests, should be converted to the appropriate netCDF format are forwarded to the Global Argo Servers.

Presently, the TESAC code form is used to send the float data on the GTS (see http://www.meds-sdmm.dfo-mpo.gc.ca/meds/Prog_Int/J-COMM/J-COMM_e.htm). This code form only handles profile data and reports observations as a function of depth not pressure. It is recommended that the UNESCO routines be used to convert pressure to depth (Algorithms for computation of fundamental properties of seawater, N.P. Fofonoff and R.C. Millard Jr., UNESCO Technical Papers in Marine Science #44, 1983) If the position of a profile is deemed wrong, or the date is deemed wrong, or the platform identification is in error then none of the data should be sent on the GTS. For other failures, only the offending values need be removed from the TESAC message. The appropriate actions to take are noted with each test.

Quality control tests

1. Platform identification

Every centre handling float data and posting them to the GTS will need to prepare a metadata file for each float and in this is the WMO number that corresponds to each float ptt. There is no reason why, except because of a mistake, that an unknown float ID should appear on the GTS.

Action: If the correspondence between the float ptt cannot be matched to the correct WMO number, none of the data from the profile should be distributed on the GTS.

2. Impossible date test

The test requires that the observation date and time from the float be sensible.

- Year greater than 1997
- Month in range 1 to 12
- Day in range expected for month

- Hour in range 0 to 23
- Minute in range 0 to 59

Action: If any one of the conditions is failed, the date should be flagged as bad data and none of the data from the profile should be distributed on the GTS.

3. Impossible location test

The test requires that the observation latitude and longitude from the float be sensible.

Action: If either latitude or longitude fails, the position should be flagged as bad data and none of the data from the float should go out on the GTS.

- Latitude in range -90 to 90
- Longitude in range -180 to 180

4. Position on land test

The test requires that the observation latitude and longitude from the float be located in an ocean.

Use can be made of any file that allows an automatic test to see if data are located on land. We suggest use of at least the 5-minute bathymetry file that is generally available. This is commonly called ETOPO5 / TerrainBase and can be downloaded from http://www.ngdc.noaa.gov/mgg/global/global.html

Action: If the data are cannot be located in an ocean, the position should be flagged as bad data and they should not be distributed on the GTS.

5. Impossible speed test

Drift speeds for floats can be generated given the positions and times of the floats when they are at the surface and between profiles. In all cases we would not expect the drift speed to exceed 3 m/s. If it does, it means either a position or time is bad data, or a float is mislabeled. Using the multiple positions that are normally available for a float while at the surface, it is often possible to isolate the one position or time that is in error.

Action: If an acceptable position and time can be used from the available suite, then the data can be sent to the GTS. Otherwise, flag the position, the time, or both as bad data and no data should be sent.

6. Global range test

This test applies a gross filter on observed values for temperature and salinity. It needs to accommodate all of the expected extremes encountered in the oceans.

- Temperature in range -2.5 to 40.0 degrees C
- Salinity in range 0.0 to 41.0 PSU

Action: If a value fails, it should be flagged as bad data and only that value need be removed from distribution on the GTS. If temperature and salinity values at the same depth both fail, both values should be flagged as bad data and values for depth, temperature and salinity should be removed from the TESAC being distributed on the GTS.

7. Regional range test

This test applies to only certain regions of the world where conditions can be further qualified. In this case, specific ranges for observations from the Mediterranean and Red Seas further restrict what are considered sensible values. The Red Sea is defined by the region 10N,40E; 20N,50E; 30N,30E; 10N,40E and the Mediterranean Sea by the region 30N,6W; 30N,40E; 40N,35E; 42N,20E; 50N,15E; 40N,5E; 30N,6W.

Action: Individual values that fail these ranges should be flagged as bad data and removed from the TESAC being distributed on the GTS. If both temperature and salinity values at the same depth both fail, then values for depth, temperature and salinity should be removed from the TESAC being distributed on the GTS.

- Red Sea
- Temperature in range 21.7 to 40.0
- Salinity in range 0.0 to 41.0
- Mediterranean Sea
- Temperature in range 10.0 to 40
- Salinity in range 0.0 to 40.0

8. Pressure increasing test

This test requires that the profile has pressures that are monotonically increasing (assuming the pressures are ordered from smallest to largest).

Action: If there is a region of constant pressure, all but the first of a consecutive set of constant pressures should be flagged as bad data. If there is a region where pressure reverses, all of the pressures in the reversed part of the profile should be flagged as bad data. All pressures flagged as bad data and all of the associated temperatures and salinities are removed from the TESAC distributed on the GTS.

9. Spike test

Differences between sequential measurements, where one measurement is quite different than adjacent ones, is a spike in both size and gradient. The test does not consider the differences in depth, but assumes a sampling that adequately reproduces the temperature and salinity changes with depth. The algorithm is used on both the temperature and salinity profiles.

Test value = $| V2 - (V3 + V1)/2 | - | (V3 - V1) / 2 |$

where V2 is the measurement being tested as a spike, and V1 and V3 are the values above and below.

Temperature: The V2 value is flagged when

- the test value exceeds 6.0 degree C. for pressures less than 500 db or
- the test value exceeds 2.0 degree C. for pressures greater than or equal to 500 db

Salinity: The V2 value is flagged when

- the test value exceeds 0.9 PSU for pressures less than 500 db or
- the test value exceeds 0.3 PSU for pressures greater than or equal to 500 db

Action: Values that fail the spike test should be flagged as bad data and are removed from the TESAC distributed on the GTS. If temperature and salinity values at the same depth both fail, they should be flagged as bad data and the values for depth, temperature and salinity should be removed from the TESAC being distributed on the GTS.

10. Top and bottom spike test : obsolete

11. Gradient test

This test is failed when the difference between vertically adjacent measurements is too steep. The test does not consider the differences in depth, but assumes a sampling that adequately reproduces the temperature and salinity changes with depth The algorithm is used on both of the temperature and salinity profiles.

Test value = $| V2 - (V3 + V1)/2 |$

where V2 is the measurement being tested as a spike, and V1 and V3 are the values above and below.

Temperature: The V2 value is flagged when

- the test value exceeds 9.0 degree C. for pressures less than 500 db or
- the test value exceeds 3.0 degree C. for pressures greater than or equal to 500 db

Salinity: The V2 value is flagged when

- the test value exceeds 1.5 PSU for pressures less than 500 db or
- the test value exceeds 0.5 PSU for pressures greater than or equal to 500 db

Action: Values that fail the test (i.e. value V2) should be flagged as bad data and are removed from the TESAC distributed on the GTS. If temperature and salinity values at the same depth both fail, both should be flagged as bad data and then values for depth, temperature and salinity should be removed from the TESAC being distributed on the GTS.

12. Digit rollover test

Only so many bits are allowed to store temperature and salinity values in a profiling float. This range is not always large enough to accommodate conditions that are encountered in the ocean. When the range is exceeded, stored values rollover to the lower end of the range. This rollover should be detected and compensated for when profiles are constructed from the data stream from the float. This test is used to be sure the rollover was properly detected.

- Temperature difference between adjacent depths > 10 degrees C
- Salinity difference between adjacent depths > 5 PSU

Action: Values that fail the test should be flagged as bad data and are removed from the TESAC distributed on the GTS. If temperature and salinity values at the same depth both fail, both values should be flagged as bad data and then values for depth, temperature and salinity should be removed from the TESAC distributed on the GTS.

13. Stuck value test

This test looks for all measurements of temperature or salinity in a profile being identical.

Action: If this occurs, all of the values of the affected variable should be flagged as bad data and are removed from the TESAC distributed on the GTS. If temperature and salinity are affected, all observed values are flagged as bad data and no report from this float should be sent to the GTS.

14. Density inversion

This test uses values for temperature and salinity at the same pressure level and computes the density. The algorithm published in UNESCO Technical Papers in Marine Science #44, 1983 (referred to earlier) should be used. Densities are compared at consecutive levels in a profile.

Action: If the density calculated at the greater pressure is less than that calculated at the lesser pressure, both the temperature and salinity values should be flagged as bad data. Consequently, the values for depth, temperature and salinity at this pressure level should be removed from the TESAC distributed on the GTS.

15. Grey list

This test is implemented to stop the real-time dissemination of measurements from a sensor that is not working correctly.

The grey list contains the 7 following items :

- Float Id
- Parameter : name of the grey listed parameter

- Start date : from that date, all measurements for this parameter are flagged as bad and probably bad
- End date : from that date, measurements are not flagged as bad or probably bad
- Flag : value of the flag to be applied to all measurements of the parameter
- Comment : comment from the PI on the problem
- DAC : data assembly center for this float

Each DAC manages a black list, sent to the GDAC.

The merged black-list is available from the GDACs.

The decision to insert a float parameter in the grey list comes from the PI.

Example :

Float Id	Parameter	Start date	End date	Flag	Comment	Dac
2900226	PSAL	20030925		3		IN

- Grey list format : ascii csv (comma separated values)
- Naming convention : xxx_greylist.csv
  xxx : DAC name (ex : aoml_greylist.csv, coriolis_greylist.csv, jma_greylist.csv)
- PLATFORM,PARAMETER,START_DATE,END_DATE,QC,COMMENT,DAC
  4900228,TEMP,20030909,,3,,AO
  2900226,PSAL,20030925,,3,,IN

16. Gross salinity or temperature sensor drift

This test is implemented to detect a sudden and important sensor drift.

It calculates the average salinity on the last 100 dbar on a profile and the previous good profile. Only measurements with good QC are used.

Action : if the difference between the 2 average values is more than 0.5 psu then all measurements for this parameter are flagged as probably bad data (flag 3).

The same test is applied for temperature : if the difference between the 2 average values is more than 1 degree C then all measurements for this parameter are flagged as probably bad data (flag 3).

17. Frozen profile test

This test can detect a float that reproduces the same profile (with very small deviations) over and over again.

Typically the differences between 2 profiles are of the order of 0.001 for salinity and of the order of 0.01 for temperature.

A. Derive temperature and salinity profiles by averaging the original profiles to get mean values for each profile in 50dbar slabs (Tprof, T_previous_prof and Sprof, S_previous_prof). This is necessary, because the floats do not sample at the same level for each profile.

B. Substract the two resulting profiles for temperature and salinity to get absolute difference profiles :

- deltaT=abs(Tprof-T_previous_prof)
- deltaS=abs(Sprof-S_previous_prof)

C. Derive the maximum, minimum and mean of the absolute differences for temperature and salinity :

- mean(deltaT), max(deltaT), min(deltaT)
- mean(deltaS), max(deltaS), min(deltaS)

D. To fail the test, require that :

- max(deltaT) < 0.3
- min(deltaT) < 0.001
- mean(deltaT) < 0.02
- max(deltaS) < 0.3
- min(deltaS) < 0.001
- mean(deltaS) < 0.004

Action : if the profile fails the test, all measurements for this parameter are flagged as probably bad data (flag 3).

If the float fails the test on 5 consecutive cycles, it is inserted in the grey-list.

18. Deepest pressure test

This test requires that the profile has pressures that are not higher than DEEPEST_PRESSURE plus *5% 10% 100 dbar (to be defined).*

DEEPEST_PRESSURE value comes from the meta-data file of the float.

Action: If there is a region of incorrect pressures, all pressures and corresponding measurements should be flagged as bad data potentially recoverable (flag 3). All pressures flagged as bad data and all of the associated temperatures and salinities are removed from the TESAC distributed on the GTS.

Tests application order

The Argo real time QC tests are applied in the order described in the following table.

Order	test number	test name
1	18	Deepest pressure test
2	1	Platform Identification
3	2	Impossible Date Test
4	3	Impossible Location Test
5	4	Position on Land Test
6	5	Impossible Speed Test
7	6	Global Range Test

8	7	Regional Range Test
9	8	Pressure Increasing Test
10	9	Spike Test
11	10	Top and Bottom Spike Test : removed
12	11	Gradient Test
13	12	Digit Rollover Test
14	13	Stuck Value Test
15	14	Density Inversion
16	15	Grey List
17	16	Gross salinity or temperature sensor drift
18	17	Frozen profile

The QC flag value assigned by a test cannot override a higher value from a previous test.

Example : a QC flag 4 (bad data) set by test 11 (gradient test) cannot be decreased to QC flag 3 (bad data that are potentially correctable) set by test 15 (grey list).

3.3 Argo RTQC test Procedures on trajectories

The following tests are applied in real-time on trajectory data.

1. Platform identification

Every centre handling float data and posting them to the GTS will need to prepare a metadata file for each float and in this is the WMO number that corresponds to each float ptt. There is no reason why, except because of a mistake, that an unknown float ID should appear on the GTS.

Action: If the correspondence between the float ptt cannot be matched to the correct WMO number, none of the data from the profile should be distributed on the GTS.

2. Impossible date test

The test requires that the observation date and time from the float be sensible.

- Year greater than 1997
- Month in range 1 to 12
- Day in range expected for month
- Hour in range 0 to 23
- Minute in range 0 to 59

Action: If any one of the conditions is failed, the date should be flagged as bad data and none of the data from the profile should be distributed on the GTS.

3. Impossible location test

The test requires that the observation latitude and longitude from the float be sensible.

Action: If either latitude or longitude fails, the position should be flagged as bad data and none of the data from the float should go out on the GTS.

- Latitude in range -90 to 90
- Longitude in range -180 to 180

4. Position on land test

The test requires that the observation latitude and longitude from the float be located in an ocean.

Use can be made of any file that allows an automatic test to see if data are located on land. We suggest use of at least the 5-minute bathymetry file that is generally available. This is commonly called ETOPO5 / TerrainBase and can be downloaded from http://www.ngdc.noaa.gov/mgg/global/global.html

Action: If the data are cannot be located in an ocean, the position should be flagged as bad data and they should not be distributed on the GTS.

5. Impossible speed test

Drift speeds for floats can be generated given the positions and times of the floats when they are at the surface and between profiles. In all cases we would not expect the drift speed to exceed 3 m/s. If it does, it means either a position or time is bad data, or a float is mislabeled. Using the multiple positions that are normally available for a float while at the surface, it is often possible to isolate the one position or time that is in error.

Action: If an acceptable position and time can be used from the available suite, then the data can be sent to the GTS. Otherwise, flag the position, the time, or both as bad data and no data should be sent.

6. Global range test

This test applies a gross filter on observed values for temperature and salinity. It needs to accommodate all of the expected extremes encountered in the oceans.

- Temperature in range -2.5 to 40.0 degrees C
- Salinity in range 0.0 to 41.0 PSU

Action: If a value fails, it should be flagged as bad data and only that value need be removed from distribution on the GTS. If temperature and salinity values at the same depth both fail, both values should be flagged as bad data and values for depth, temperature and salinity should be removed from the TESAC being distributed on the GTS.

7. Regional range test

This test applies to only certain regions of the world where conditions can be further qualified. In this case, specific ranges for observations from the Mediterranean and Red Seas further restrict what are considered sensible values. The Red Sea is defined by the region 10N,40E; 20N,50E; 30N,30E; 10N,40E and the Mediterranean Sea by the region 30N,6W; 30N,40E; 40N,35E; 42N,20E; 50N,15E; 40N,5E; 30N,6W.

Action: Individual values that fail these ranges should be flagged as bad data and removed from the TESAC being distributed on the GTS. If both temperature and salinity values at the same depth both fail, then values for depth, temperature and salinity should be removed from the TESAC being distributed on the GTS.

Red Sea

- Temperature in range 21.7 to 40.0
- Salinity in range 0.0 to 41.0

Mediterranean Sea

- Temperature in range 10.0 to 40
- Salinity in range 0.0 to 40.0

4. Web Format Conversion

Once this entire process of conversion from the native Hexadecimal format to Ascii format is done and this data is passed through the quality control procedures the data is ready to put on the web site for use by various user community all over the world.

The following are the tables in the Data Base for which the above generated ARGO data has to be converted.

ARGO_Details Table:

WMOid_Date	Depth	Flag	Temp	Flat	Salinity	Flag	Density	Flag

ARGO_Observations Table:

WMOid_Date	WMOid	Latitude	Longitude	Date	Pos_Flag

The data in the process of conversion has to be prefixed and suffixed with pipes that is '|' so as to enable easy uploading in to the data base. Apart from these two table one more table containing the meta data regarding the floats is also created by the DBA. This metadata is updated once every new float is deployed. Subsequently the argo_details and argo_observation are updated corresponding to every cycle executed.

A sample data in the web form is show below:

ARGO_Details:

|2900226_02/01/2003|,|74.3|,|1|,|22.512|,|1|,|34.831|,|1|,| 1023.9465|,|1|

2900226_02/01/2003	,	69.4	,	1	,	23.276	,	1	,	34.869	,	1	,	1023.7561	,	1
2900226_02/01/2003	,	64.7	,	1	,	24.027	,	1	,	34.855	,	1	,	1023.5253	,	1
2900226_02/01/2003	,	60.0	,	1	,	25.108	,	1	,	34.913	,	1	,	1023.2444	,	1
2900226_02/01/2003	,	54.6	,	1	,	26.090	,	1	,	34.851	,	1	,	1022.8948	,	1
2900226_02/01/2003	,	49.7	,	1	,	26.451	,	1	,	34.753	,	1	,	1022.7078	,	1
2900226_02/01/2003	,	46.5	,	1	,	27.282	,	1	,	34.701	,	1	,	1022.4044	,	1
2900226_02/01/2003	,	43.1	,	1	,	27.755	,	1	,	34.714	,	1	,	1022.2615	,	1
2900226_02/01/2003	,	41.1	,	1	,	28.013	,	1	,	34.658	,	1	,	1022.1354	,	1
2900226_02/01/2003	,	37.6	,	1	,	28.253	,	1	,	34.533	,	1	,	1021.9630	,	1
2900226_02/01/2003	,	34.4	,	1	,	28.317	,	1	,	34.494	,	1	,	1021.9126	,	1
2900226_02/01/2003	,	31.2	,	1	,	28.332	,	1	,	34.479	,	1	,	1021.8964	,	1
2900226_02/01/2003	,	28.0	,	1	,	28.334	,	1	,	34.474	,	1	,	1021.8920	,	1

ARGO_Observations

2900232_05/11/2002	,	2900232	,	2.069	,	81.956	,	05/11/2002	,	1
2900232_05/12/2002	,	2900232	,	1.427	,	83.626	,	05/12/2002	,	1
2900232_10/11/2002	,	2900232	,	2.107	,	81.953	,	10/11/2002	,	1
2900232_10/12/2002	,	2900232	,	1.712	,	83.902	,	10/12/2002	,	1
2900232_20/11/2002	,	2900232	,	1.741	,	83.089	,	20/11/2002	,	1
2900232_20/12/2002	,	2900232	,	1.635	,	84.489	,	20/12/2002	,	1
2900232_25/11/2002	,	2900232	,	1.852	,	83.575	,	25/11/2002	,	1
2900232_25/12/2002	,	2900232	,	1.648	,	85.169	,	25/12/2002	,	1
2900232_26/10/2002	,	2900232	,	2.375	,	82.107	,	26/10/2002	,	1
2900232_30/11/2002	,	2900232	,	1.559	,	83.569	,	30/11/2002	,	1
2900232_31/10/2002	,	2900232	,	2.345	,	82.189	,	31/10/2002	,	1

5. Conversion to TESAC Format

At present real-time float data are broadcast on GTS in FM 64 TESAC format which is a Traditional Alphanumeric Code (TAC). These data are placed onto the GTS via various means. In many cases the profile data are encoded into TESAC format by various ARGO Data Centres (DACs) and forwarded to an appropriate GTS node (e.g. Service ARGOs, Japanese Meteorological Agency, Bureau of Meteorology) for GTS insertion. In some cases the data are encoded into TESAC format directly by Service ARGOs or CLS who insert the data onto GTS on behalf of the national programme(s). There are lot of advantages and disadvantages associated with the TESAC format.

Advantages/disadvantages of TESAC

Advantages

- Easy to understand
- Relatively simple to encode and decode
- Can be decoded manually for verification of content if required
- Well known code form which has been used extensively, including in the oceanographic community
- Directly assimilated into the models run at major meteorological centres

Disadvantages

- Vertical depth levels are determined from pressure data before transmission
- Precision of salinity (in PSU) is truncated from 3 decimal places to 2 decimal places
- Includes only temperature and salinity profile data: cannot include drift data, quality flags or metadata
- Practically impossible now to modify the code in order to add new variables

Once the entire process of decoding of ARGO data is done and uploaded onto the web for the various user to download and user for various applications, it is also required to convert the ARGO data to TESAC format for putting on GTS for transmission. This process requires the encoding of decimal data to TESAC format. A sample set of data before and after encoding to TESAC format is as follows:

ARGO data before encoding :

Float No.	Date	Time(IST)	Lat.	Lon
2900226	03/12/2002	18:21:28	7.015	85.495

Press	Temp	Sal
4.4	29.009	33.733
7.5	28.962	33.728
10.1	28.972	33.727
13.3	28.899	33.721
16.6	28.900	33.724
18.8	28.899	33.729
22.3	28.894	33.733
25.5	28.874	33.734
28.7	28.964	34.110
31.1	28.972	34.342
34.5	28.884	34.433
37.6	27.791	34.442
40.1	27.218	34.664
43.5	26.290	34.703
46.8	25.377	34.722
48.9	25.266	34.748
54.3	25.060	34.743
59.2	24.922	34.801
64.6	24.292	34.935
69.5	23.800	34.935
74.6	23.103	34.907
79.2	22.798	34.968
84.6	21.402	34.743
89.5	21.468	34.859
94.4	21.499	34.954
99.2	20.812	34.962
109.2	19.690	34.951
119.6	18.871	34.877
129.2	17.700	34.850
139.5	16.722	34.858
148.8	16.206	34.866
159.2	15.459	34.894
169.4	14.523	34.937
179.2	13.650	34.983
189.2	13.344	34.991
198.9	12.955	35.021
219.3	12.713	35.052
239.5	12.350	35.048

259.6	12.073	35.056
794.0	11.894	35.073
299.0	11.707	35.070
339.3	11.136	35.058
379.2	10.836	35.051
418.9	10.590	35.053
459.1	10.356	35.054
498.8	10.043	35.050
512.5	09.996	35.049
512.6	09.996	35.048

ARGO data after encoding to TESAC format :

TESAC Data Report. CALL SIGN :2900226
Date: 03/12/2002 Time: 18:21:28
Location: 7.015N - 85.495E

KKYY 03122 1821/ 17015 085495 88871 84660 20044 32900 43373
20075 32896 43372 20101 32897 43372 20133 32889 43372
20166 32890 43372 20188 32889 43372 20223 32889 43373
20255 32887 43373 20287 32896 43411 20311 32897 43434
20345 32888 43443 20376 32779 43444 20040 32721 43466
20435 32629 43470 20468 32537 43472 20048 32526 43474
20543 32506 43474 20592 32492 43480 20064 32429 43493
20695 32380 43493 20746 32310 43490 20079 32279 43496
20846 32140 43474 20895 32146 43485 20094 32149 43495
20992 32081 43496 21092 31969 43495 20119 31887 43487
21292 31770 43485 21395 31672 43485 20148 31620 43486
21592 31545 43489 21694 31452 43493 20179 31365 43498
21892 31334 43499 21989 31295 43502 20219 31271 43505
22395 31235 43504 22596 31207 43505 20279 31189 43507
22990 31170 43507 23393 31113 43505 20379 31083 43505
24189 31059 43505 24591 31035 43505 20498 31004 43505
25125 30999 43504 25126 30999 43504 Q2900226=

6. Flow Diagrams of Data Conversions

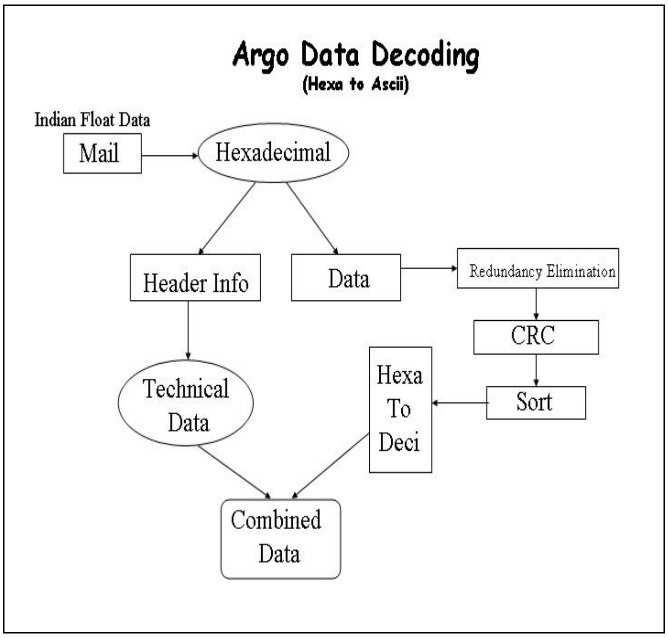

Fig 6.1 Hexadecimal Data Conversion

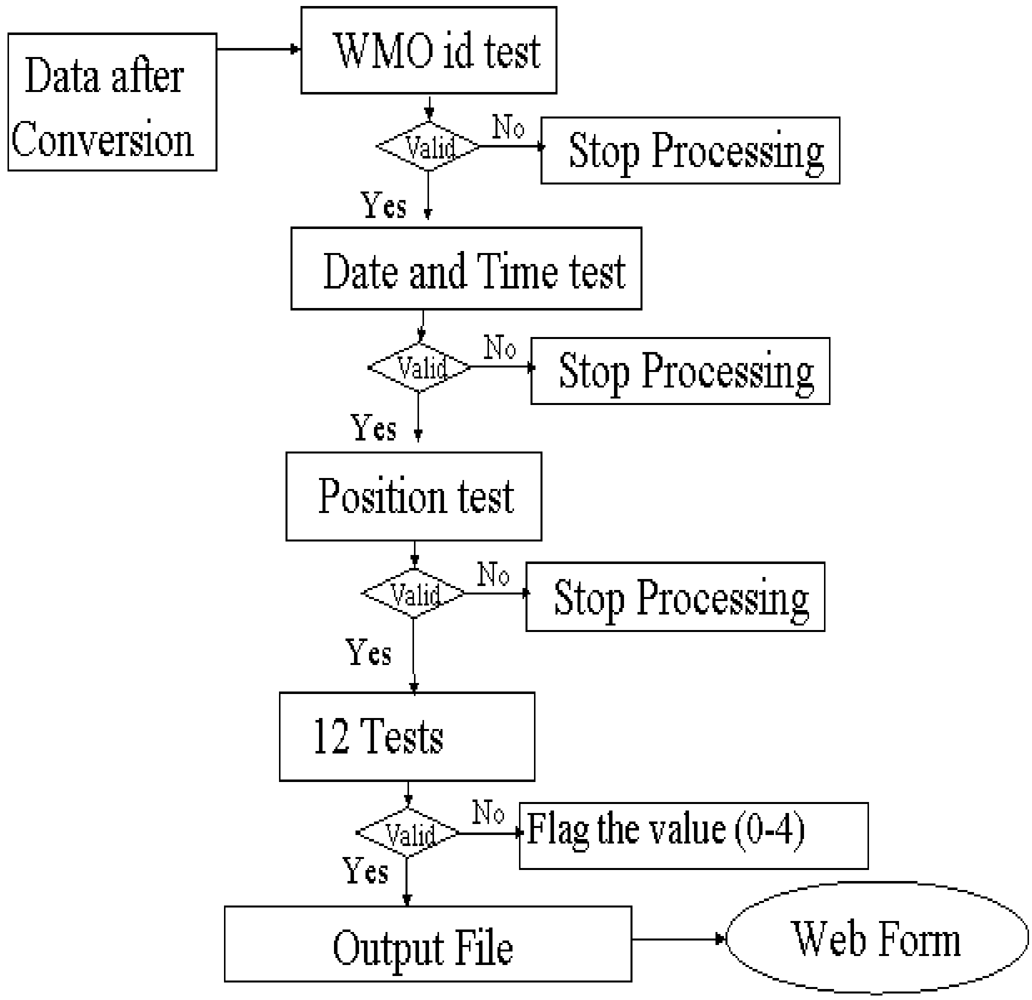

Fig 6.2 ARGO Real Time Quality Control

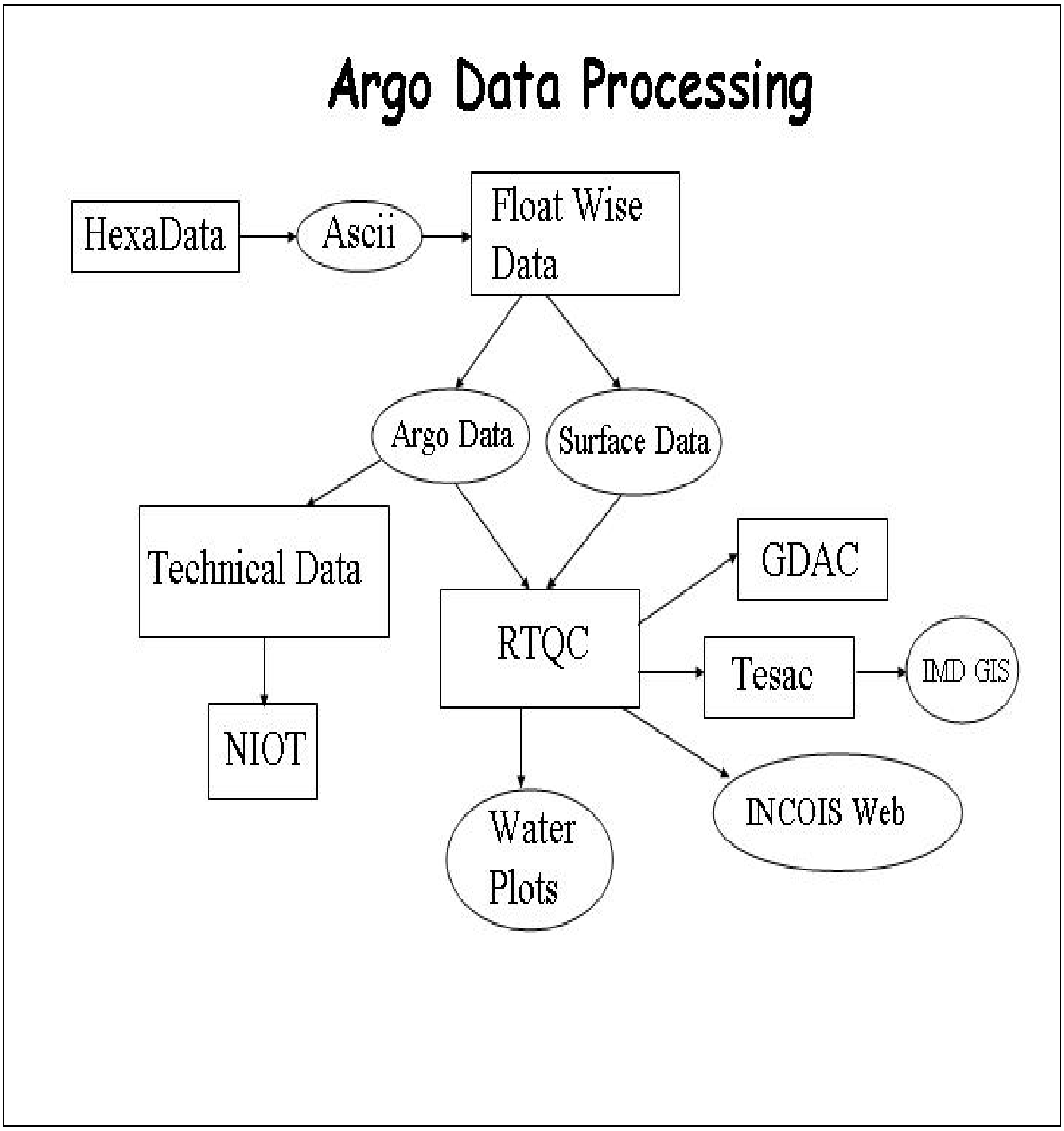

Fig 6.3 Argo Processing in Total

7. Acknowledgements:

We express out gratitude to Director, INCOIS, for his constant encouragement and support. We are indebt to all the colleagues of NIOT who made this data available by deploying the Argo floats during various cruises of ORV Sagar Kanya, FORV Sagar Sampada. The financial support of the Ministry of Earch Sciences, New Delhi under the Ocean Observations programme is gratefully acknowledged.

8. Referenced Documents:

ARGO Science Team, 1998: On the design and implementation of ARGO: An initial plan for a global array of profiling floats. International CLIVAR Project Office Report 21, GODAE Report 5. GODAE International Project Office, Melbourne, Australia, 32 pp.

[GDAC] US GODAE/IFREMER Data Servers as part of the ARGO data distribution network, Version 2.1,February 2002.

MANUALS AND GUIDES #22 GTSPP REAL-TIME QUALITY CONTROL MANUAL, 28 June, 2002: ARGO Real-time Quality Control Test Procedures.

Reference Doc: METOCEAN PROVOR ARGOs Formats, Ver. 1.0, METOCEAN Data Systems Limited.

USER MANUAL – APEX-SBE PROFILER, APEX-SBE INSTRUMENTS
Webb Research Corporation, 82 Technology Park Drive, E. Falmouth, MA 02536-4441 (508) 548-2077 FAX (508) 540-1686.

9. Table 1: Metadata of the floats deployed

S NO	PTT	PLTFRM NUM	PLTFRM MODEL	PLTFRM MAKER	PLTFRM SRL-NO	SENS MKR	SENS MDL	DT OF CRTN	LON & LAT	SENS SRL NO	CYC	PP	DP	DPL PLT FRM
1	29510	2900226	APEX_SBE	WEBB	846	SBE	SBE41	20/10/2002 10:05:00	85.00 06.00	754	5	500	1000	SK
2	29779	2900228	APEX_SBE	WEBB	846	SBE	SBE41	22/10/2002 12:52:00	80.00 00.00	758	5	500	1000	SK
3	29806	2900229	APEX_SBE	WEBB	846	SBE	SBE41	25/10/2002 11:35:00	69.00 -02.00	759	10	2000	2000	SK
4	29989	2900230	APEX_SBE	WEBB	846	SBE	SBE41	27/10/2002 02:40:00	63.00 -03.00	760	10	2000	2000	SK
5	29990	1900121	APEX_SBE	WEBB	846	SBE	SBE41	02/11/2002 02:00:00	56.00 -10.00	763	10	2000	2000	SK
6	30008	2900232	PROVOR_SBE	METOCEAN	841	SBE	SBE41	22/10/2002 00:00:00	82.00 02.50	MT-84	5,10	500	2000	SK
7	30020	2900233	PROVOR_SBE	METOCEAN	841	SBE	SBE41	23/10/2002 00:00:00	77.00 0.00	MT-85	5,10	500	2000	SK
8	30022	2900234	PROVOR_SBE	METOCEAN	841	SBE	SBE41	26/10/2002 00:00:00	65.50 -02.50	MT-86	10	2000	2000	SK
9	30024	2900235	PROVOR_SBE	METOCEAN	841	SBE	SBE41	28/10/2002 00:00:00	60.00 -03.00	MT-87	10	2000	2000	SK
10	30030	1900122	PROVOR_SBE	METOCEAN	841	SBE	SBE41	02/11/2002 00:00:00	76.00 -05.00	MT-88	10	2000	2000	SK
11	30586	2900256	APEX_SBE	WEBB	846	SBE	SBE41	01/06/2003 09:48:00	64.363 15.747	978	5	2000	2000	ASD
12	30587	2900257	APEX_SBE	WEBB	846	SBE	SBE41	02/06/2003 10:33:00	67.991 15.068	979	5	2000	2000	ASD
13	30589	2900258	APEX_SBE	WEBB	846	SBE	SBE41	02/06/2003 02:20:00	67.142 13.278	986	5	2000	2000	ASD

14	30596	2900259	APEX_SBE	WEBB	846	SBE	SBE41	30/05/2003 05:25:00	65.018 10.990	981	5	2000	2000	ASD
15	30604	2900260	APEX_SBE	WEBB	846	SBE	SBE41	30/05/2003 03:30:00	67.106 10.957	982	5	2000	2000	ASD
16	30609	2900261	APEX_SBE	WEBB	846	SBE	SBE41	10/06/2003 04:25:00	67.493 08.013	983	5	2000	2000	ASD
17	30615	2900262	APEX_SBE	WEBB	846	SBE	SBE41	10/06/2003 03:20:00	65.159 06.056	984	5	2000	2000	ASD
18	30617	2900263	APEX_SBE	WEBB	846	SBE	SBE41	11/06/2003 07:57:00	67.484 05.998	985	5	2000	2000	ASD
19	30632	2900264	APEX_SBE	WEBB	846	SBE	SBE41	12/06/2003 12:42:00	67.471 03.445	987	5	2000	2000	ASD
20	30634	2900265	APEX_SBE	WEBB	846	SBE	SBE41	02/09/2003 08:25:00	88.499 07.995	982	5	2000	2000	ASD
21	30635	2900266	PROVOR_SBE	METOCEAN	841	SBE	SBE41	22/06/2003 02:33:00	88.00 16.00	MT-127	5	1000	1000	ASD
22	30641	2900267	PROVOR_SBE	METOCEAN	841	SBE	SBE41	23/06/2003 07:52:00	86.00 12.00	MT-128	5	1000	1000	ASD
23	30657	2900268	PROVOR_SBE	METOCEAN	842	FSI		23/06/2003 07:55:00	86.00 12.00	MT-124	5	1000	1000	ASD
24	30670	2900269	PROVOR_SBE	METOCEAN	841	SBE	SBE41	21/06/2003 09:05:00	88.50 14.00	MT-129	5	1000	1000	ASD
25	30678	2900270	PROVOR_SBE	METOCEAN	841	SBE	SBE41	19/06/2003 10:47:00	86.00 10.00	MT-130	5	1000	1000	ASD
26	30734	2900271	PROVOR_SBE	METOCEAN	841	SBE	SBE41	20/06/2003 12:48:00	88.00 11.00	MT-131	5	1000	1000	ASD
27	30735	2900272	PROVOR_SBE	METOCEAN	841	SBE	SBE41	19/06/2003 08:34:00	86.50 08.00	MT-132	5	1000	1000	ASD
28	30736	2900273	PROVOR_SBE	METOCEAN	841	SBE	SBE41	18/06/2003 04:02:00	88.50 08.00	MT-133	5	1000	1000	ASD
29	30764	2900274	PROVOR_SBE	METOCEAN	841	SBE	SBE41	18/06/2003 02:23:00	88.00 06.00	MT-134	5	1000	1000	ASD

30	30765	2900275	PROVOR_SBE	METOCEAN	842	FSI		31/05/2003 05:25:00	63.20 14.10	MT-125	5	2000	2000	ASD
31	30766	2900276	PROVOR_SBE	METOCEAN	841	SBE	SBE41	31/05/2003 05:28:00	63.20 14.10	MT-135	5	2000	2000	ASD
32	28655	2900335	APEX_SBE	WEBB	846	SBE	SBE41	26/04/2004	67.00 14.00		5	1000	2000	SK
33	28657	2900336	APEX_SBE	WEBB	846	SBE	SBE41	27/04/2004	64.00 12.00		5	1000	2000	SK
34	28651	2900337	APEX_SBE	WEBB	846	SBE	SBE41	28/04/2004	62.00 16.00		5	1000	2000	SK
35	28653	2900338	APEX_SBE	WEBB	846	SBE	SBE41	29/04/2004	62.00 14.00		5	1000	2000	SK
36	28652	2900339	APEX_SBE	WEBB	846	SBE	SBE41	04/05/2004	60.00 14.00		5	1000	2000	SK
37	28658	2900340	APEX_SBE	WEBB	846	SBE	SBE41	01/05/2004	62.00 11.00		5	1000	2000	SK
38	28659	2900341	APEX_SBE	WEBB	846	SBE	SBE41	01/05/2004	60.00 10.00		5	1000	2000	SK
39	28696	2900342	APEX_SBE	WEBB	846	SBE	SBE41	02/05/2004	59.00 8.00		5	1000	2000	SK
40	28697	2900343	APEX_SBE	WEBB	846	SBE	SBE41	03/05/2004	62.00 6.00		5	1000	2000	SK
41	28698	2900344	APEX_SBE	WEBB	846	SBE	SBE41	04/05/2004	64.00 6.00		5	1000	2000	SK
42	28699	2900345	APEX_SBE	WEBB	846	SBE	SBE41	04/05/2004	66.00 6.00		5	1000	2000	SK
43	28656	2900346	APEX_SBE	WEBB	846	SBE	SBE41	05/05/2004	60.00 12.00		5	1000	2000	SK
44	28700	2900347	APEX_SBE	WEBB	846	SBE	SBE41	05/05/2004	64.00 4.00		5	1000	2000	SK
45	28701	2900348	APEX_SBE	WEBB	846	SBE	SBE41	06/05/2004	62.00 3.00		5	1000	2000	SK

46	28702	2900349	APEX_SBE	WEBB	846	SBE	SBE41	07/05/2004	60.00 2.00	5	1000	2000	SK
47	28703	2900350	APEX_SBE	WEBB	846	SBE	SBE41	08/05/2004	64.00 2.00	5	1000	2000	SK
48	28270	2900351	APEX_SBE	WEBB	846	SBE	SBE41	19/05/2004	86.00 6.00	5	1000	2000	SK
49	28269	2900352	APEX_SBE	WEBB	846	SBE	SBE41	20/05/2004	88.00 4.00	5	1000	2000	SK
50	28707	2900353	APEX_SBE	WEBB	846	SBE	SBE41	21/05/2004	88.00 2.00	5	1000	2000	SK
51	28706	2900354	APEX_SBE	WEBB	846	SBE	SBE41	21/05/2004	88.00 0.00	5	1000	2000	SK
52	28704	2900355	APEX_SBE	WEBB	846	SBE	SBE41	22/05/2004	89.00 2.00	5	1000	2000	SK
53	28705	2900356	APEX_SBE	WEBB	846	SBE	SBE41	23/05/2004	92.00 2.00	5	1000	2000	SK
54	28268	2900357	APEX_SBE	WEBB	846	SBE	SBE41	24/05/2004	90.00 2.00	5	1000	2000	SK
55	28271	2900358	APEX_SBE	WEBB	846	SBE	SBE41	25/05/2004	89.00 6.00	5	1000	2000	SK
56	28272	2900359	APEX_SBE	WEBB	846	SBE	SBE41	26/05/2004	87.00 8.00	5	1000	2000	SK
57	29749	2900459	APEX_SBE	WEBB	846	SBE	SBE41	29/09/2004	86.00 15.00	5	1000	2000	SK
58	21858	2900461	APEX_SBE	WEBB	846	SBE	SBE41	06/12/2004	77.00 -6.00	5	1000	2000	SK
59	21886	2900462	APEX_SBE	WEBB	846	SBE	SBE41	10/12/2004	76.00 -8.00	5	1000	2000	SK
60	21888	2900463	APEX_SBE	WEBB	846	SBE	SBE41	07/12/2004	76.00 -11.00	5	1000	2000	SK
61	21895	2900464	APEX_SBE	WEBB	846	SBE	SBE41	12/12/2004	75.00 -13.00	5	1000	2000	SK

62	21897	2900493	APEX_SBE	WEBB	846	SBE	SBE41	29/03/2005	77.20 -1.00	5	1000	2000	SK
63	21903	2900494	APEX_SBE	WEBB	846	SBE	SBE41	30/03/2005	77.20 -4.00	5	1000	2000	SK
64	21919	2900495	APEX_SBE	WEBB	846	SBE	SBE41	31/03/2005	77.20 -7.00	5	1000	2000	SK
65	21965	2900496	APEX_SBE	WEBB	846	SBE	SBE41	01/04/2005	76.00 -10.00	5	1000	2000	SK
66	21970	2900497	APEX_SBE	WEBB	846	SBE	SBE41	16/04/2005	76.50 -13.00	5	1000	2000	SK
67	21974	2900498	APEX_SBE	WEBB	846	SBE	SBE41	22/04/2005	75.50 -16.00	5	1000	2000	SK
68	22046	2900530	APEX_SBE	WEBB	846	SBE	SBE41	08/05/2005	77.00 5.00	5	1000	2000	SK
69	22051	2900531	APEX_SBE	WEBB	846	SBE	SBE41	08/05/2005	77.00 2.00	5	1000	2000	SK
70	22054	2900532	APEX_SBE	WEBB	846	SBE	SBE41	09/05/2005	77.00 - 1.00	5	1000	2000	SK
71	22057	2900533	APEX_SBE	WEBB	846	SBE	SBE41	10/05/2005	77.00 - 4.00	5	1000	2000	SK
72	21975	2900534	APEX_SBE	WEBB	846	SBE	SBE41	13/05/2005	77.00 5.33	5	1000	2000	SK
73	22014	2900539	APEX_SBE	WEBB	846	SBE	SBE41	25/05/2005	83.00 - 5.00	5	1000	2000	SK
74	21987	2900538	APEX_SBE	WEBB	846	SBE	SBE41	27/05/2005	83.00 - 2.00	5	1000	2000	SK
75	21978	2900535	APEX_SBE	WEBB	846	SBE	SBE41	29/05/2005	80.50 1.66	5	1000	2000	SK
76	21983	2900537	APEX_SBE	WEBB	846	SBE	SBE41	01/06/2005	83.00 2.00	5	1000	2000	SK
77	21979	2900536	APEX_SBE	WEBB	846	SBE	SBE41	05/06/2005	83.00 5.00	5	1000	2000	SK

78	25517	2900552	APEX_SBE	WEBB	846	SBE	SBE41	31/08/2005	70.00	17.00	5	1000	2000	SK
79	25502	2900553	APEX_SBE	WEBB	846	SBE	SBE41	01/09/2005	68.00	19.00	10	1000	2000	SK
80	25505	2900554	APEX_SBE	WEBB	846	SBE	SBE41	03/09/2005	63.80	21.00	5	1000	2000	SK
81	25507	2900555	APEX_SBE	WEBB	846	SBE	SBE41	0309/2005	62.00	18.60	5	1000	2000	SK
82	25512	2900556	APEX_SBE	WEBB	846	SBE	SBE41	04/09/2005	60.60	16.50	5	1000	2000	SK
83	25477	2900557	APEX_SBE	WEBB	846	SBE	SBE41	05/09/2005	60.00	14.00	10	1000	2000	SK
84	25463	2900558	APEX_SBE	WEBB	846	SBE	SBE41	05/09/2005	58.50	11.00	10	1000	2000	SK
85	25378	2900559	APEX_SBE	WEBB	846	SBE	SBE41	06/09/2005	57.50	5.00	10	1000	2000	SK
86	25295	2900560	APEX_SBE	WEBB	846	SBE	SBE41	07/09/2005	56.00	6.00	10	1000	2000	SK
87	25191	2900561	APEX_SBE	WEBB	846	SBE	SBE41	08/09/2005	55.00	2.60	10	1000	2000	SK
88	25190	2900562	APEX_SBE	WEBB	846	SBE	SBE41	08/09/2005	54.00	0.00	10	1000	2000	SK
89	25451	2900563	APEX_SBE	WEBB	846	SBE	SBE41	09/09/2005	57.00	0.00	10	1000	2000	SK
90	25452	2900564	APEX_SBE	WEBB	846	SBE	SBE41	10/09/2005	60.00	0.00	10	1000	2000	SK
91	25059	2900565	APEX_SBE	WEBB	846	SBE	SBE41	11/09/2005	63.00	0.00	10	1000	2000	SK
92	25188	2900566	APEX_SBE	WEBB	846	SBE	SBE41	11/09/2005	66.00	0.00	10	1000	2000	SK
93	25292	2900567	APEX_SBE	WEBB	846	SBE	SBE41	12/09/2005	69.00	0.00	10	1000	2000	SK

94	25286	2900568	APEX_SBE	WEBB	846	SBE	SBE41	12/09/2005	70.15 -2.25	10	1000	2000	SK
95	25246	2900569	APEX_SBE	WEBB	846	SBE	SBE41	13/09/2005	75.30 3.50	10	1000	2000	SK
96	25252	2900570	APEX_SBE	WEBB	846	SBE	SBE41	15/09/2005	78.00 0.00	10	1000	2000	SK
97	25270	2900571	APEX_SBE	WEBB	846	SBE	SBE41	15/09/2005	81.00 0.00	10	1000	2000	SK
98	25264	4900511	APEX_SBE	WEBB	846	SBE	SBE41	16/09/2005	83.50 1.50	10	1000	2000	SK
99	25262	4900510	APEX_SBE	WEBB	846	SBE	SBE41	16/09/2005	84.00 0.00	10	1000	2000	SK
100	25278	4900668	APEX_SBE	WEBB	846	SBE	SBE41	17/09/2005	88.00 4.00	10	1000	2000	SK
101	25279	4900669	APEX_SBE	WEBB	846	SBE	SBE41	18/09/2005	90.00 6.00	10	1000	2000	SK
102	25283	4900670	APEX_SBE	WEBB	846	SBE	SBE41	18/09/2005	90.00 8.50	10	1000	2000	SK
103	25519	4900671	APEX_SBE	WEBB	846	SBE	SBE41	19/09/2005	90.00 11.00	5	1000	2000	SK
104	25533	4900672	APEX_SBE	WEBB	846	SBE	SBE41	19/09/2005	90.00 14.00	5	1000	2000	SK
105	25535	4900673	APEX_SBE	WEBB	846	SBE	SBE41	20/09/2005	90.00 16.50	5	1000	2000	SK
106	25539	4900674	APEX_SBE	WEBB	846	SBE	SBE41	20/09/2005	89.50 18.00	5	1000	2000	SK
107	25541	4900675	APEX_SBE	WEBB	846	SBE	SBE41	05/09/2005	87.50 16.50	5	1000	2000	SK
108	27423	2900754	APEX_SBE	WEBB	846	SBE	SBE41	23/05/2006	67.00 12.00	10	1000	2000	SK
109	27419	2900755	APEX_SBE	WEBB	846	SBE	SBE41	24/07/2006	87.5 15.5	10	1500	1500	SM

110	27417	2900756	APEX_SBE	WEBB	846	SBE	SBE41	24/07/2006	89.3 16.5		10	1500	1500	SM
111	27435	2900757	APEX_SBE	WEBB	846	SBE	SBE41	03/08/2006	83.0 5.0		10	2000	2000	SK
112	27436	2900758	APEX_SBE	WEBB	846	SBE	SBE41	06/08/2006	83.0 2.5		10	2000	2000	SK
113	27425	2900760	APEX_SBE	WEBB	846	SBE	SBE41	12/08/2006	83.0 -5.00		10	2000	2000	SK
114	27446	2900759	APEX_SBE	WEBB	846	SBE	SBE41	11/08/2006	83.0 -3.00		10	2000	2000	SK
115	27426	2900761	APEX_SBE	WEBB	846	SBE	SBE41	16/08/2006	77.0 -5.00		10	2000	2000	SK
116	27427	2900762	APEX_SBE	WEBB	846	SBE	SBE41	18/08/2006	77.0 -2.5		10	2000	2000	SK
117	23582	2900763	APEX_SBE	WEBB	846	SBE	SBE41	15/09/2006	90.0 1.5		10	2000	2000	SK
118	23561	2900764	APEX_SBE	WEBB	846	SBE	SBE41	17/09/2006	85.0 0.0		10	2000	2000	SK
119	68328	2900765	APEX_SBE	WEBB	846	SBE OXY. SEN.		22/09/2006	89.0 15.0	3003	5	1500	1500	SK
120	68326	2900766	APEX_SBE	WEBB	846	SBE OXY. SEN.		28/09/2006	89.0 10.0	3001	10	2000	2000	SK
121	23603	2900767	APEX_SBE	WEBB	846	SBE	SBE41	02/10/2006	85.6 12.66	2937	10	2000	2000	SK
122	23619	2900768	APEX_SBE	WEBB	846	SBE	SBE41	02/10/2006	87.5 12.5	2939	5	1500	1500	SK
123	27428	2900769	APEX_SBE	WEBB	846	SBE	SBE41	14/03/2007 23:00:00	68.0 18.5	2826	10	2000	2000	SK
124	27429	2900770	APEX_SBE	WEBB	846	SBE	SBE41	15/03/2007	65.0	2827	10	2000	2000	SK

								23:00:00	18.0					
125	27431	2900771	APEX_SBE	WEBB	846	SBE	SBE41	15/03/2007 23:00:00	67.0 16.0	2829	10	2000	2000	SK
126	27430	2900772	APEX_SBE	WEBB	846	SBE	SBE41	16/03/2007 23:00:00	64.0 16.0	2828	10	2000	2000	SK
127	23550	2900773	APEX_SBE	WEBB	846	SBE	SBE41	17/03/2007 23:00:00	61.0 14.0	2933	10	2000	2000	SK
128	27432	2900774	APEX_SBE	WEBB	846	SBE	SBE41	18/03/2007 23:00:00	64.0 14.0	2830	10	2000	2000	SK
129	27433	2900775	APEX_SBE	WEBB	846	SBE	SBE41	18/03/2007 23:00:00	67.0 14.0	2831	10	2000	2000	SK
130	68325	2900776	APEX_SBE	WEBB	846	SBE OXY. SEN		19/03/2007 23:00:00	64.0 12.0	3000	10	2000	2000	SK
131	27434	2900777	APEX_SBE	WEBB	846	SBE	SBE41	19/03/2007 23:00:00	67.0 12.0	2832	10	2000	2000	SK
132	27422	2900778	APEX_SBE	WEBB	846	SBE	SBE41	12/03/2007 23:00:00	67.0 12.0	2742	10	2000	2000	SK

10. Table 2 : Quality Flags used for Real Time Quality Control (RTQC)

N	Meaning	Real Time Comment
0	No QC was performed	No QC was performed
1	Good Data	All Argo Real Time QC tests passed
2	Probably good data	Probably good data
3	Probably bad data that are potentially correctable	Test 15 or Test 16 or Test 17 failed and all other real-time QC tests passed. These data are not to be used without scientific correction. A flag '3' may be assigned by an operator during additional visual QC for bad data that may be corrected in delayed-mode.
4	Bad data	Data have failed one or more of the real-time QC tests, excluding Test 16. A flag '4' may be assigned by an operator during additional visual QC for bad data that are uncorrectable.
5	Value changed	Value changed
6	Not used	Not used
7	Not used	Not used
8	Interpolated value	Interpolated value
9	Missing value	Missing value

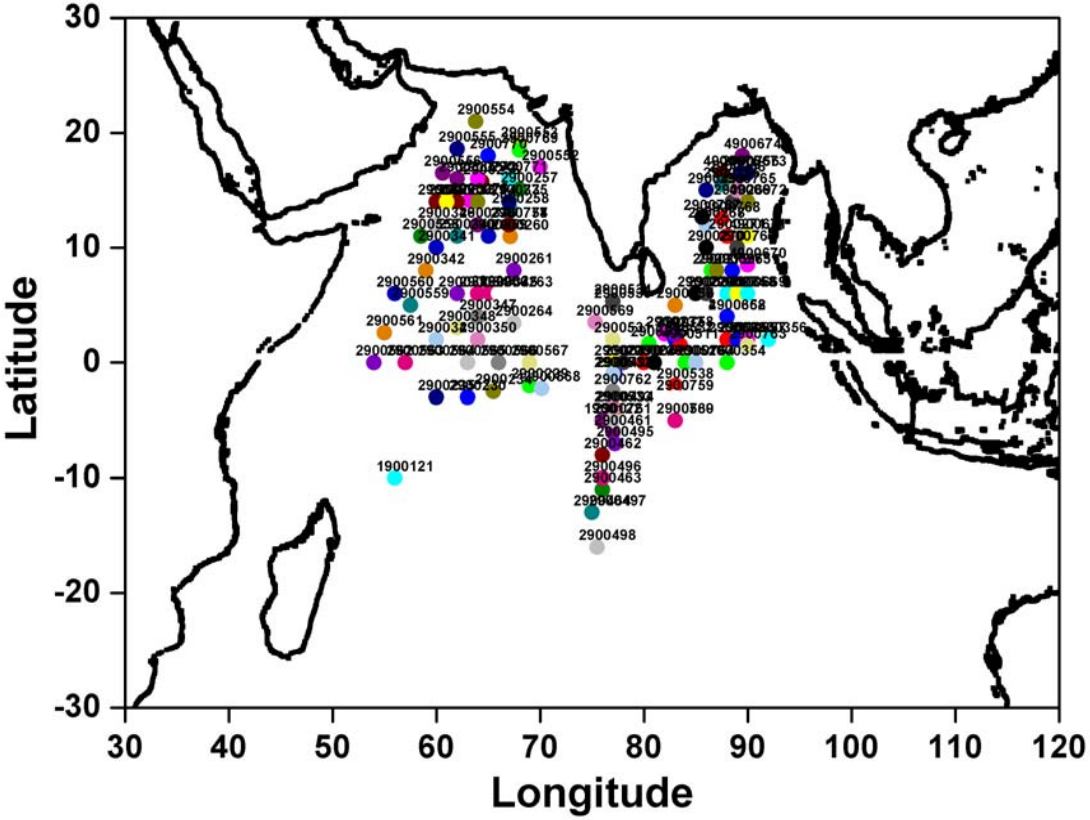

Fig 7 Argo Floats position of 132 floats deployed by India

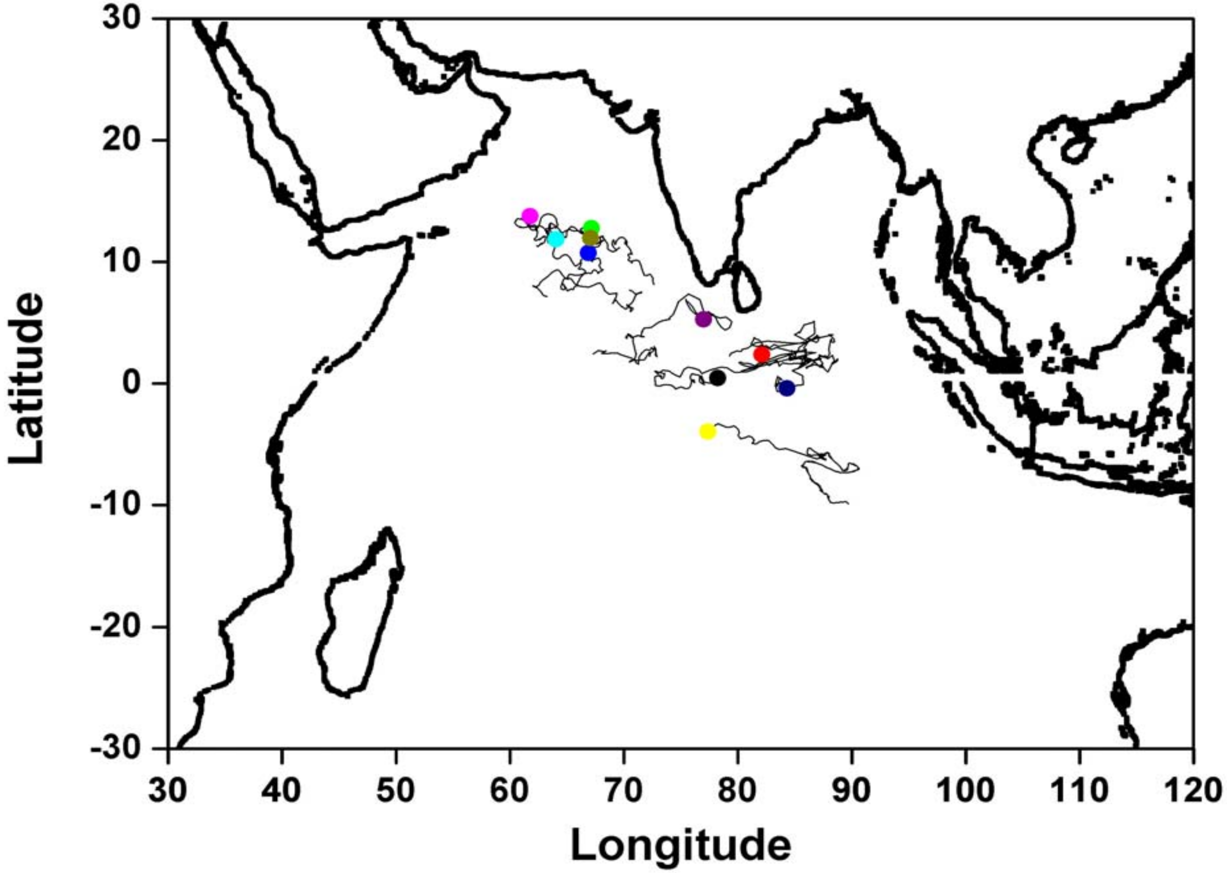

Fig 8 Trajectories of Selective floats for reference plots

Trajectory of 2900228 (Arg. Id 29779)

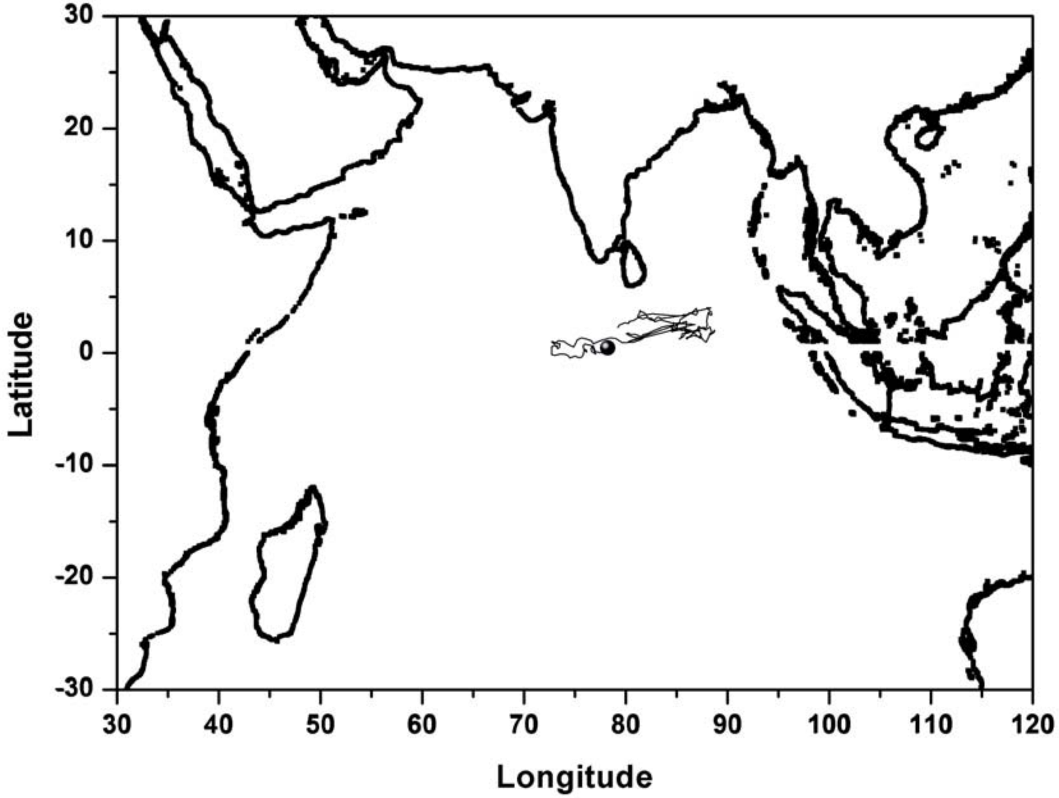

Fig 9a Trajectory during life time (11.11.2002 to 04.04.2007)

WMO ID 2900228 (Argos Id 29779)

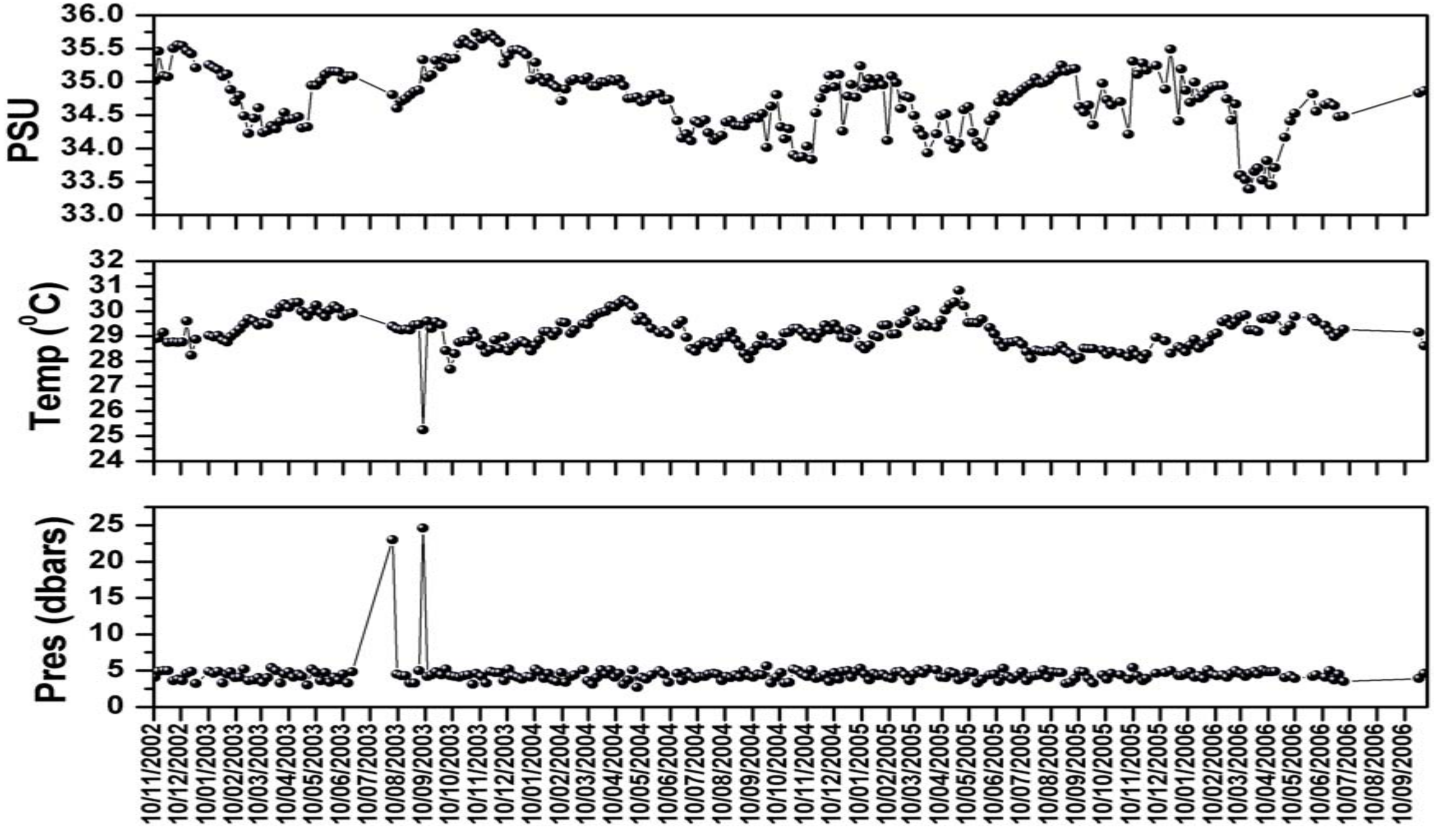

Fig 9b Time Series of surface pressure, temperature and salinity

WMO ID 2900228 (Argos Id 29779)

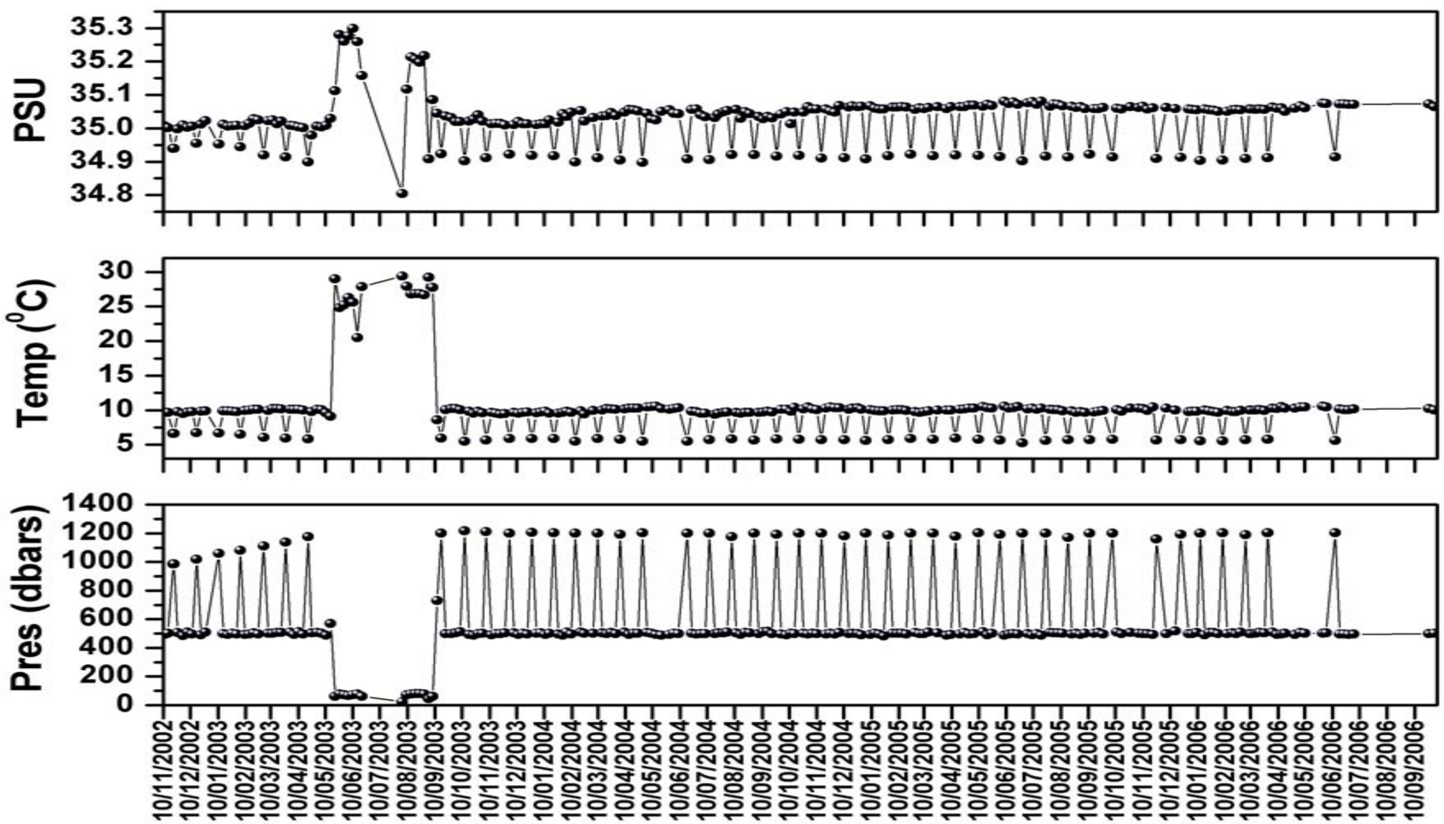

Fig 9c Time Series of bottom pressure, temperature and salinity

Trajectory of 2900232 (Argos Id 30008)

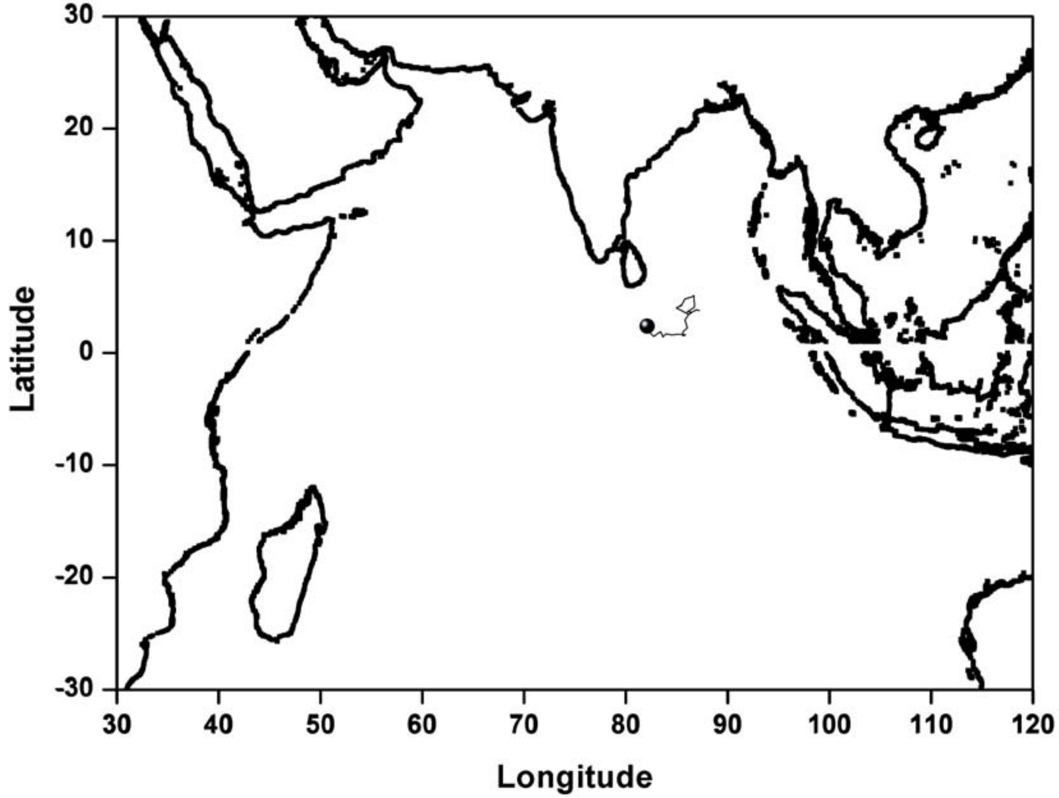

Fig 10a Trajectory during life time (26.10.2002 to 02.05.2003)

WMO Id 2900232 (Argos Id 30008)

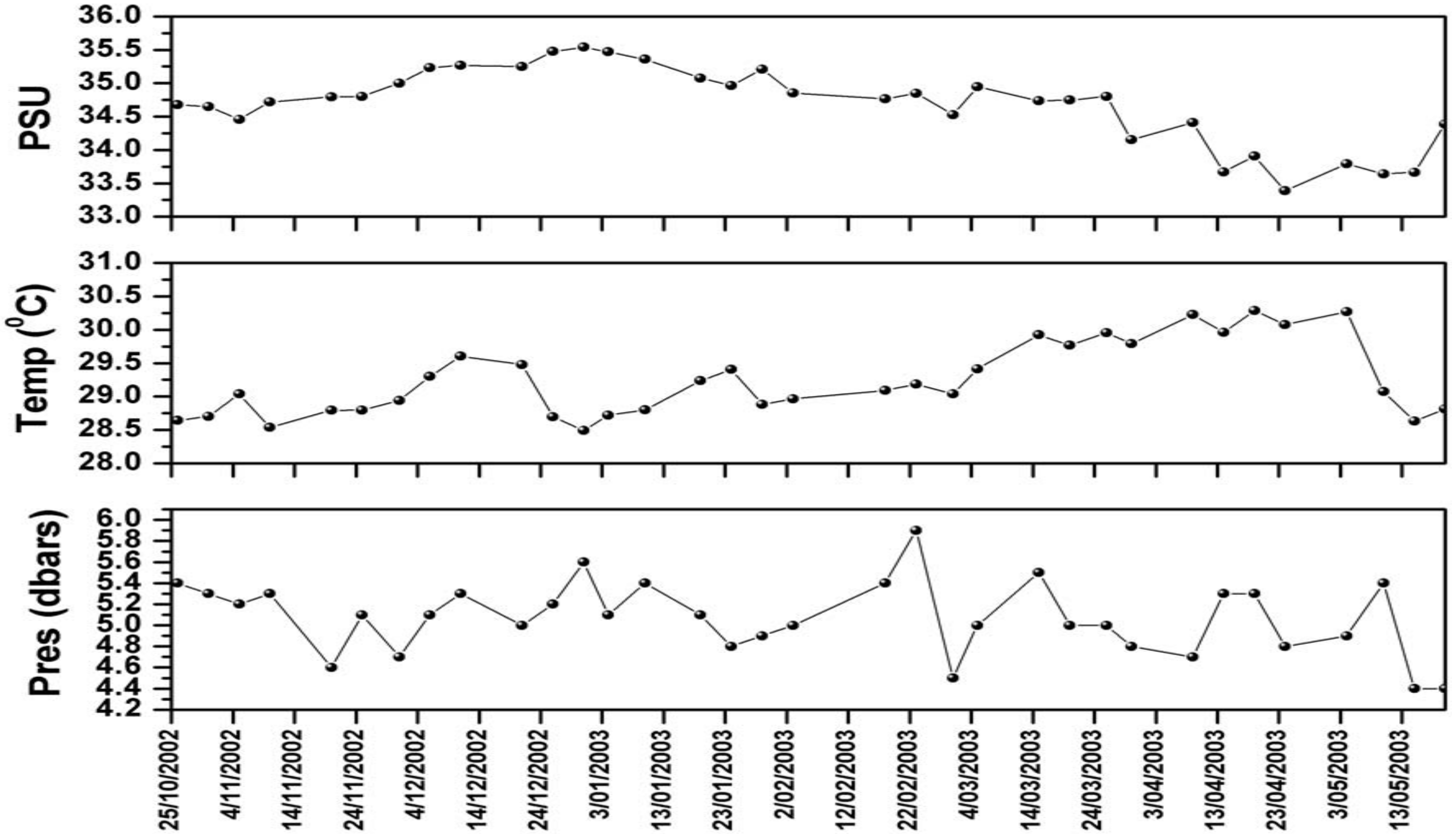

Fig 10b Time series of surface pressure, temperature and salinity

WMO Id 2900232 (Argos Id 30008)

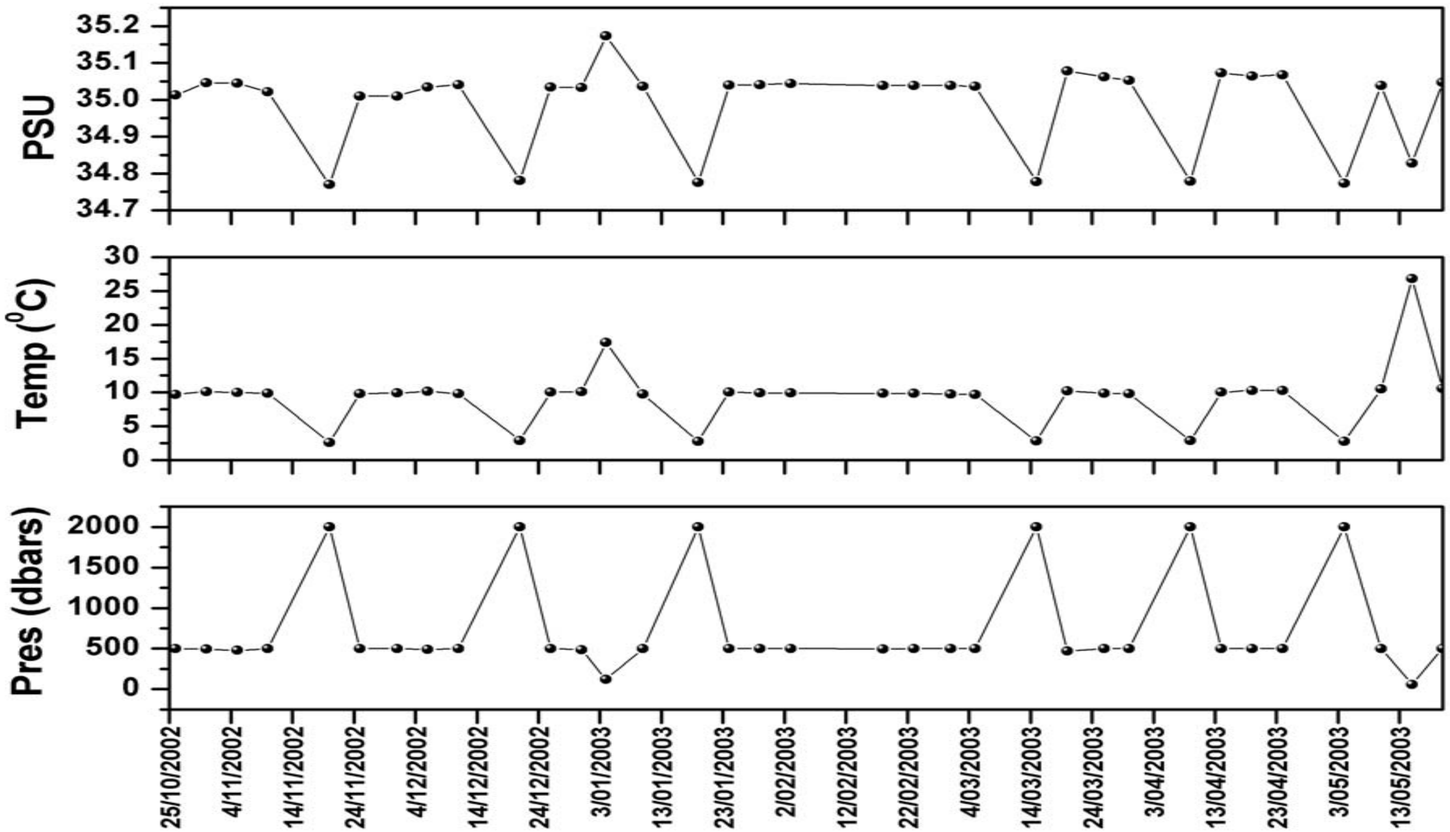

Fig 10c Time series of bottom pressure, temperature and salinity

Trajectory of 2900258 (Argos Id 30589)

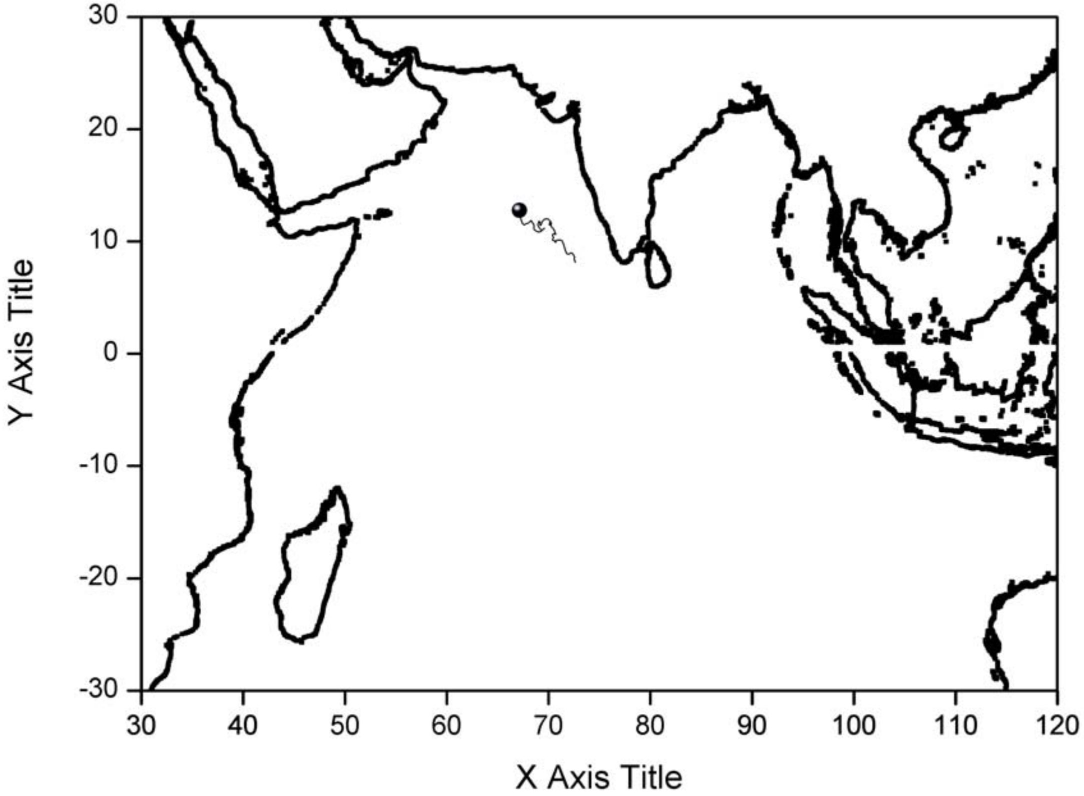

Fig 11a Trajectory during life time (10.06.2003 to 26.08.2004)

WMO Id 2900258 (Argos Id 30589)

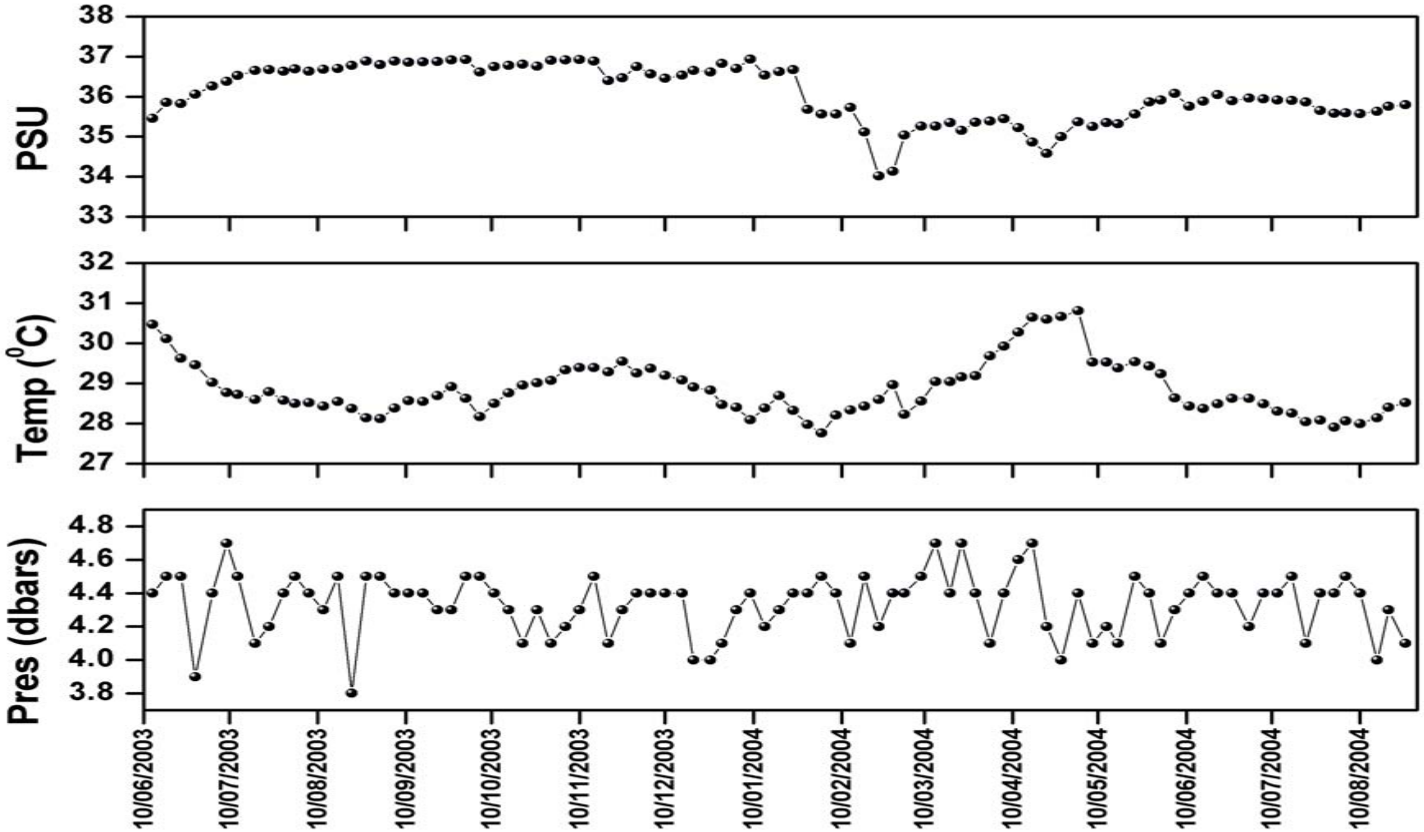

Fig 11b Time series of surface pressure, temperature and salinity

WMO Id 2900258 (Argos Id 30589)

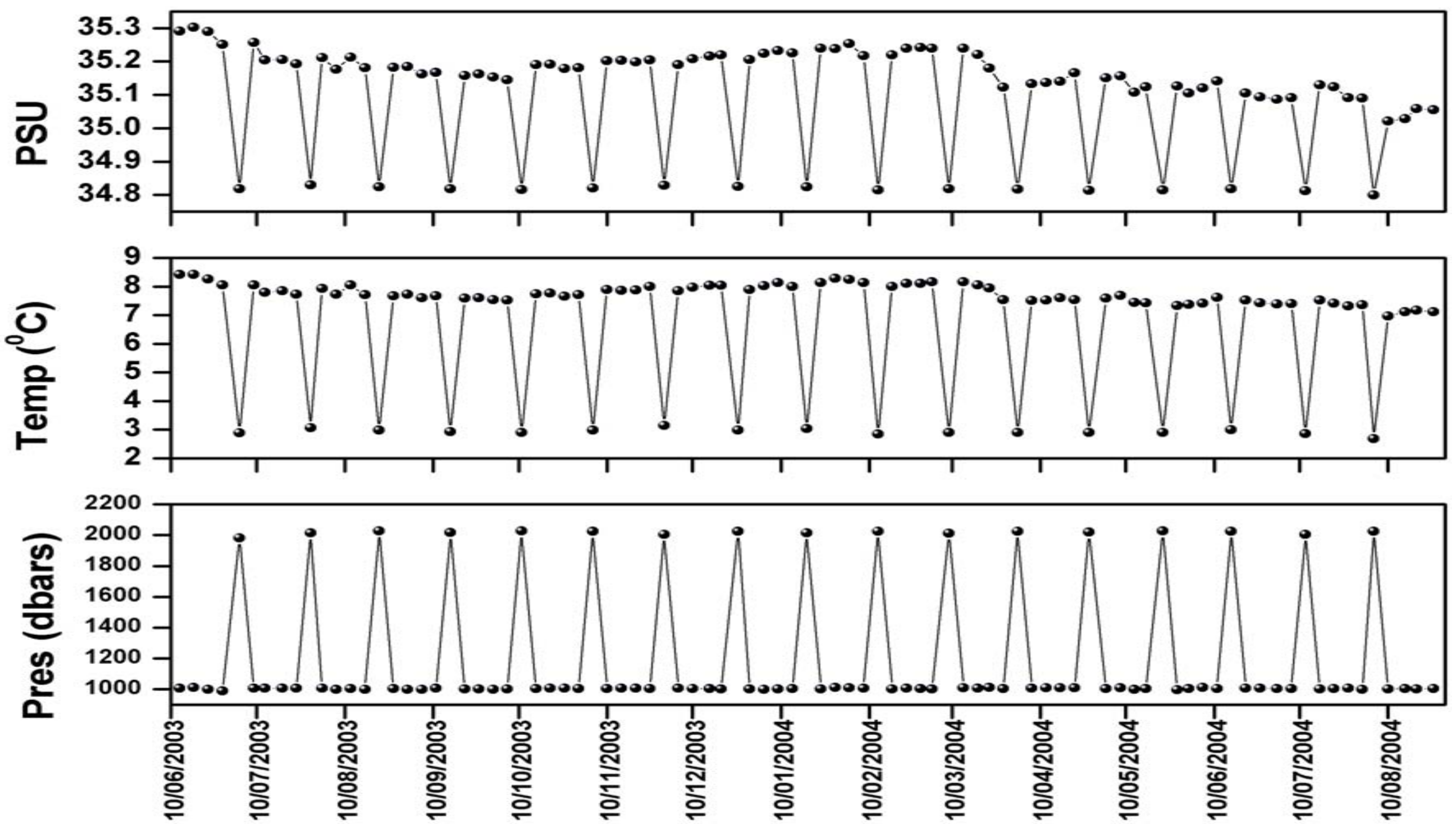

Fig 11c Time series of bottom pressure, temperature and salinity

Trajectory of 2900260 (Argos Id 30604)

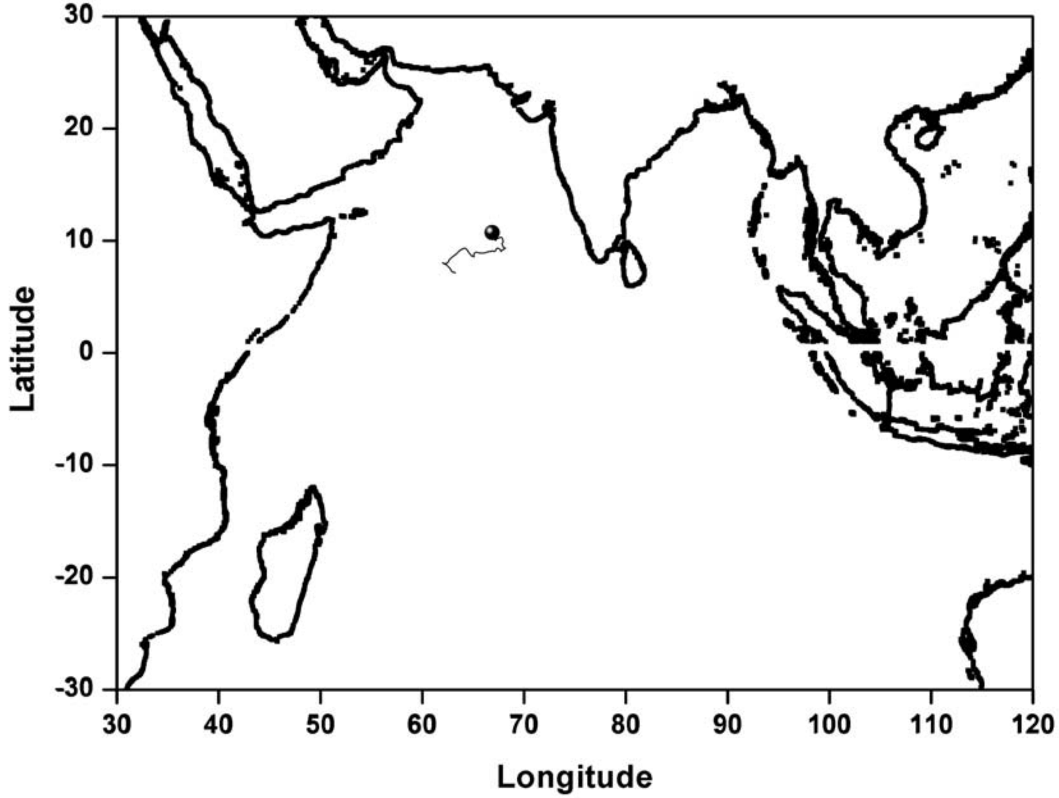

Fig 12a Trajectory during life time (09.06.2003 to 07.06.2004)

WMO Id 2900260 (Argos Id 30604)

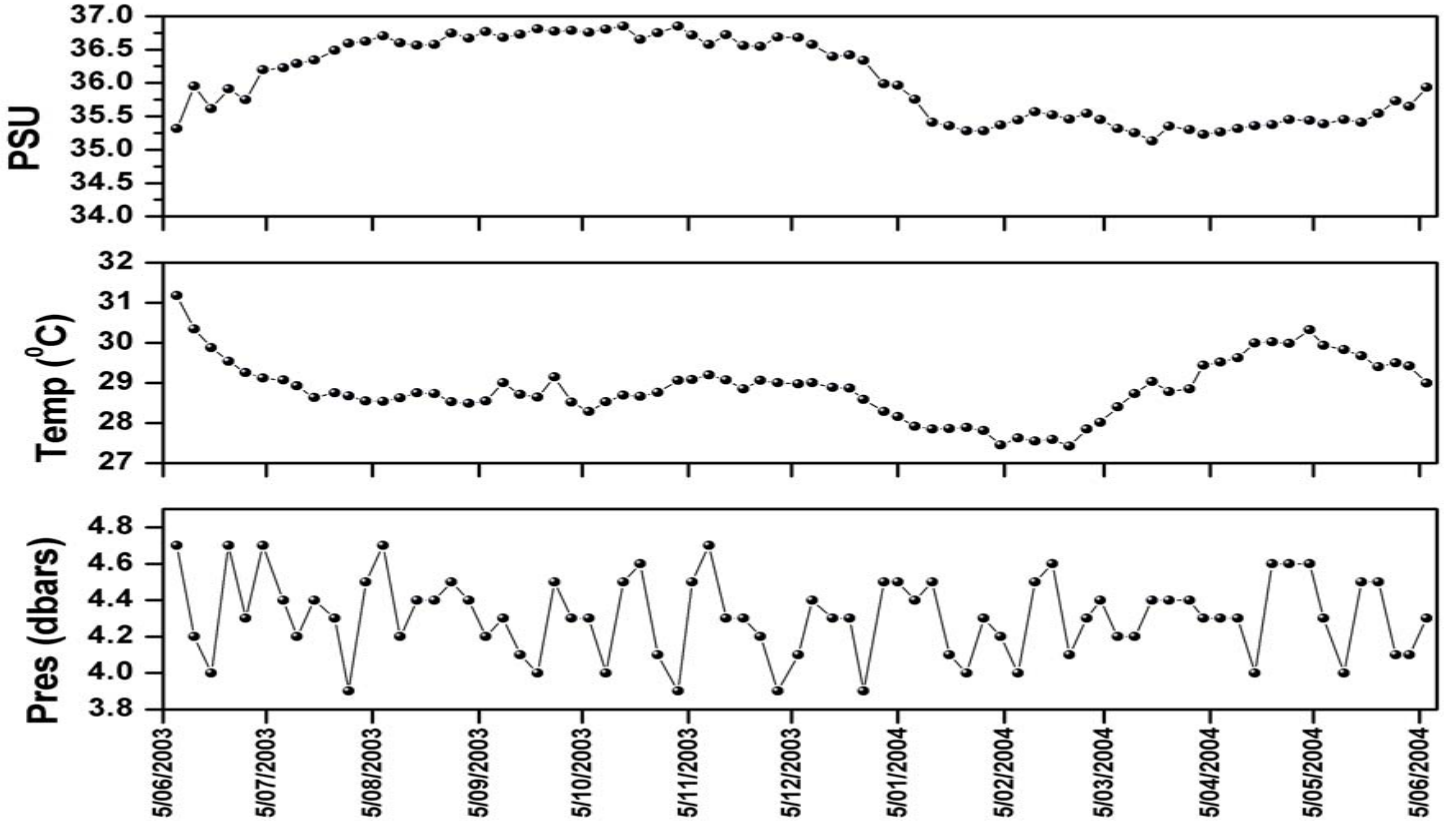

Fig 12b Time series of surface pressure, temperature and salinity

WMO Id 2900260 (Argos Id 30604)

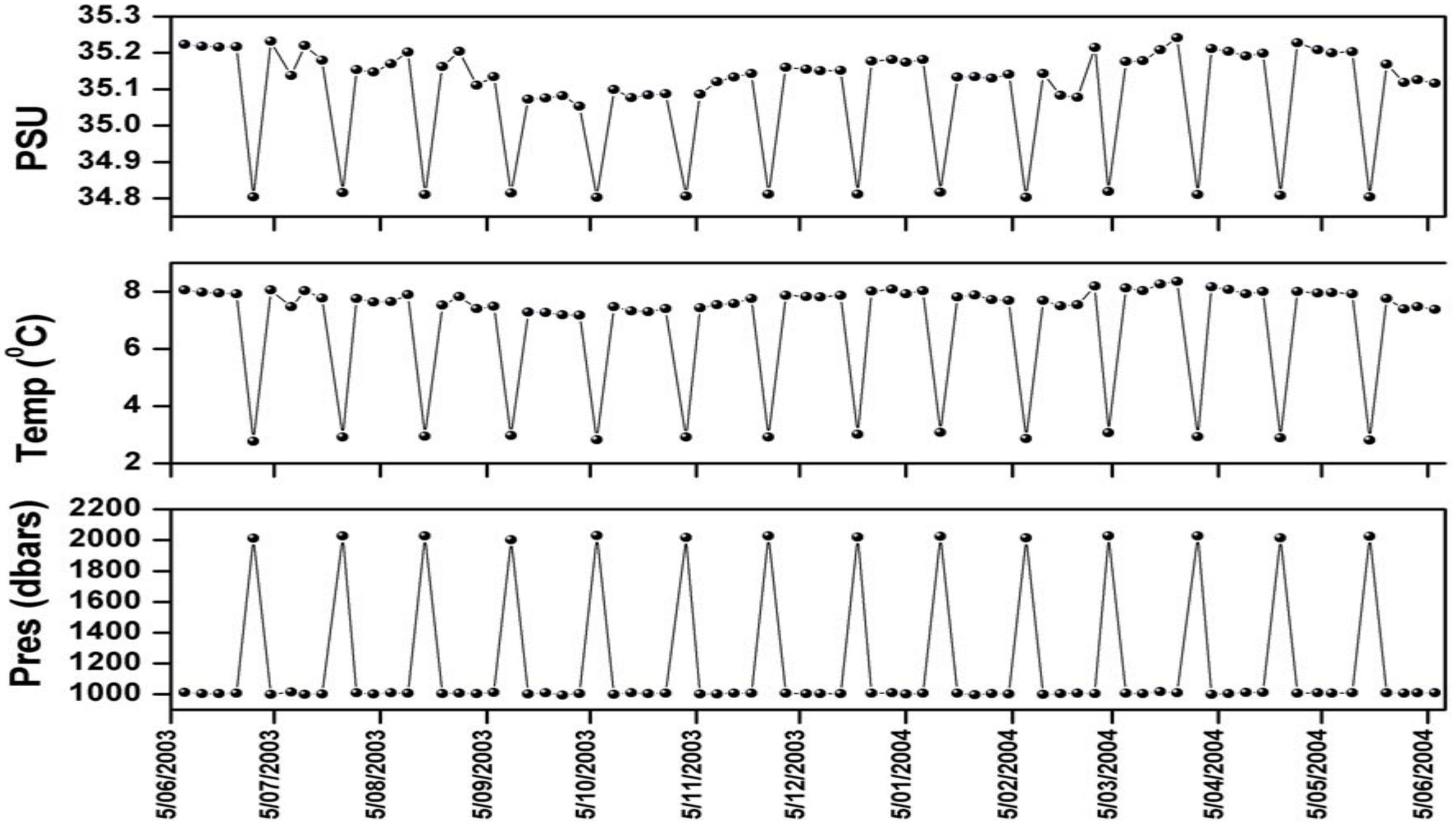

Fig 12c Time series of bottom pressure, temperature and salinity

Trajectory of 2900336 (Argos Id 28657)

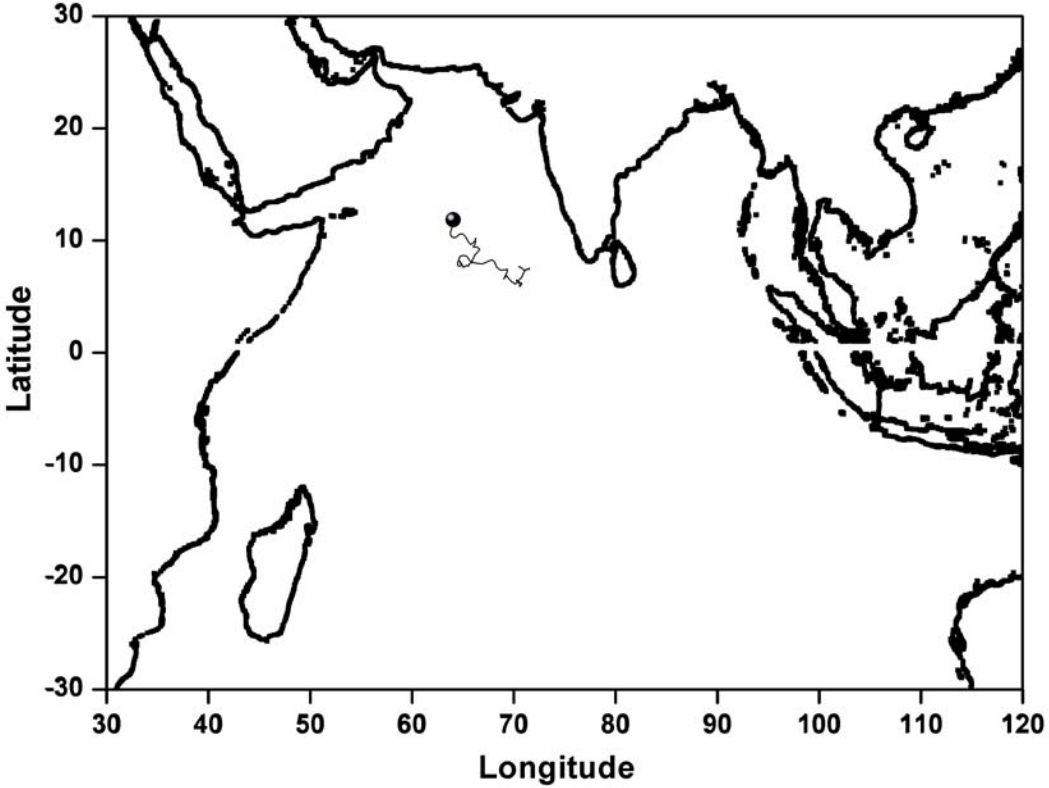

Fig 13a Trajectory during life time (07.05.2004 to 04.03.2006)

WMO Id 2900336 (Argos Id 28657)

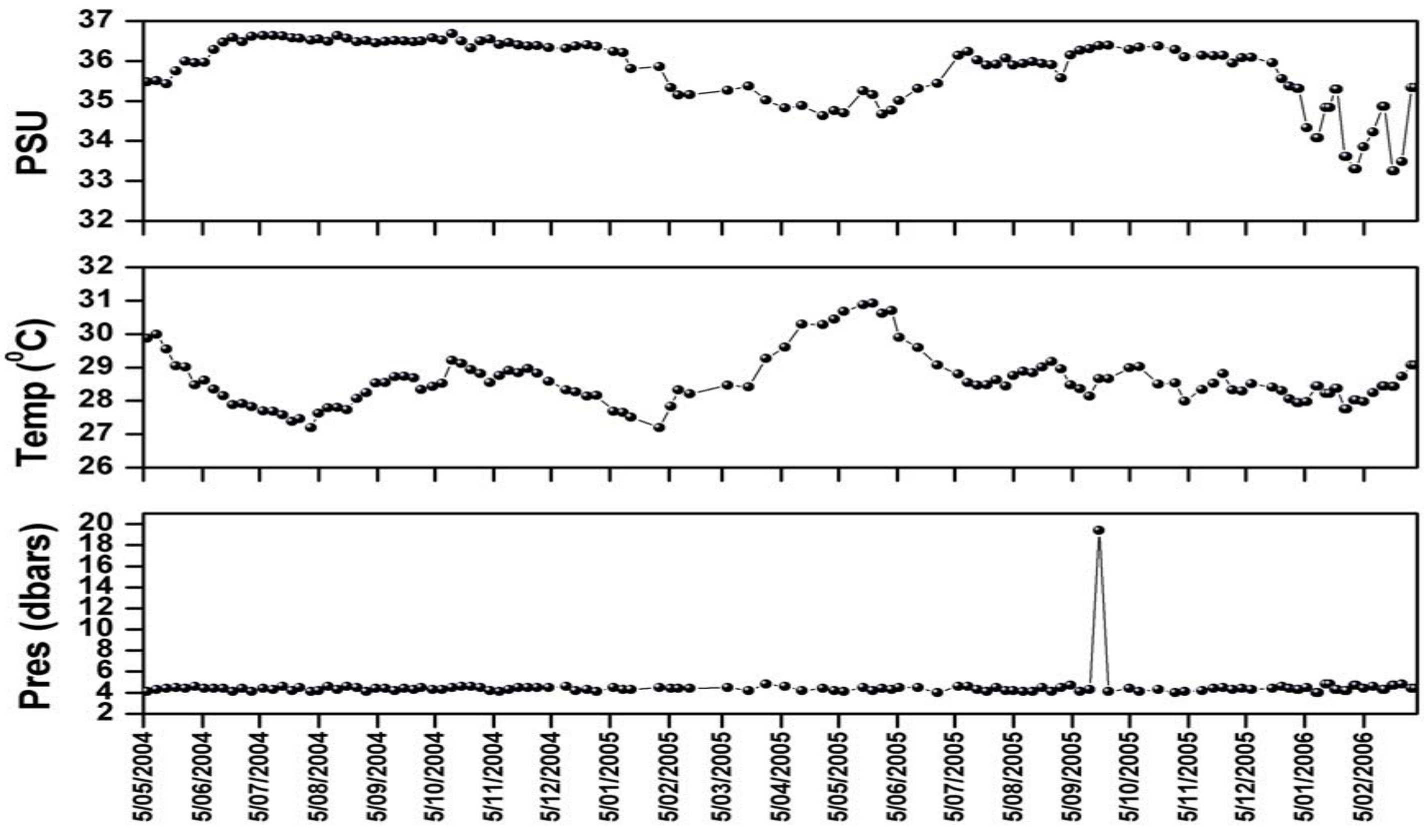

Fig 13b Time series of surface pressure, temperature and salinity

WMO Id 2900336 (Argos Id 28657)

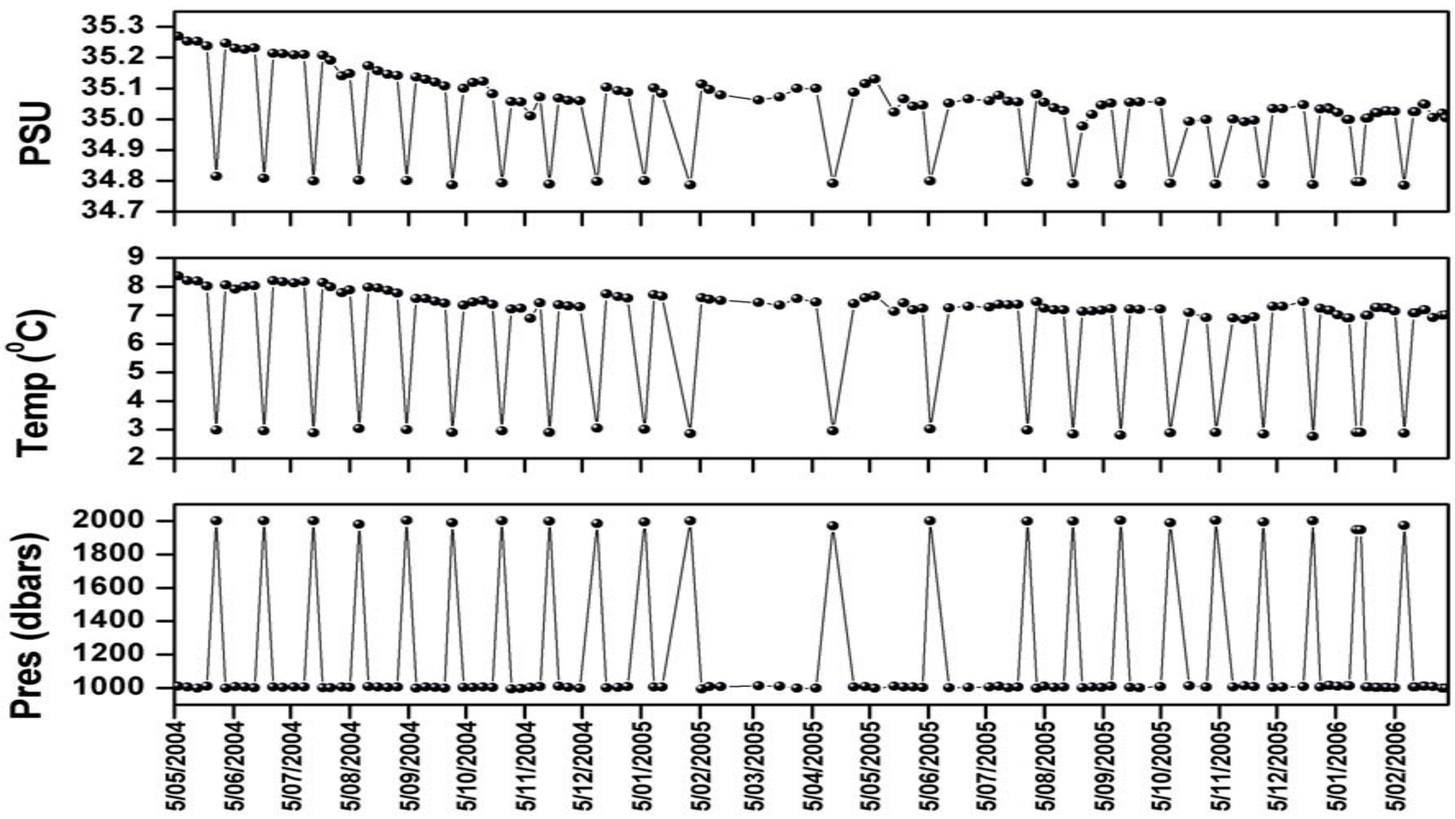

Fig 13c Time series of bottom pressure, temperature and salinity

Trajectory of 2900494 (Argos Id 21903)

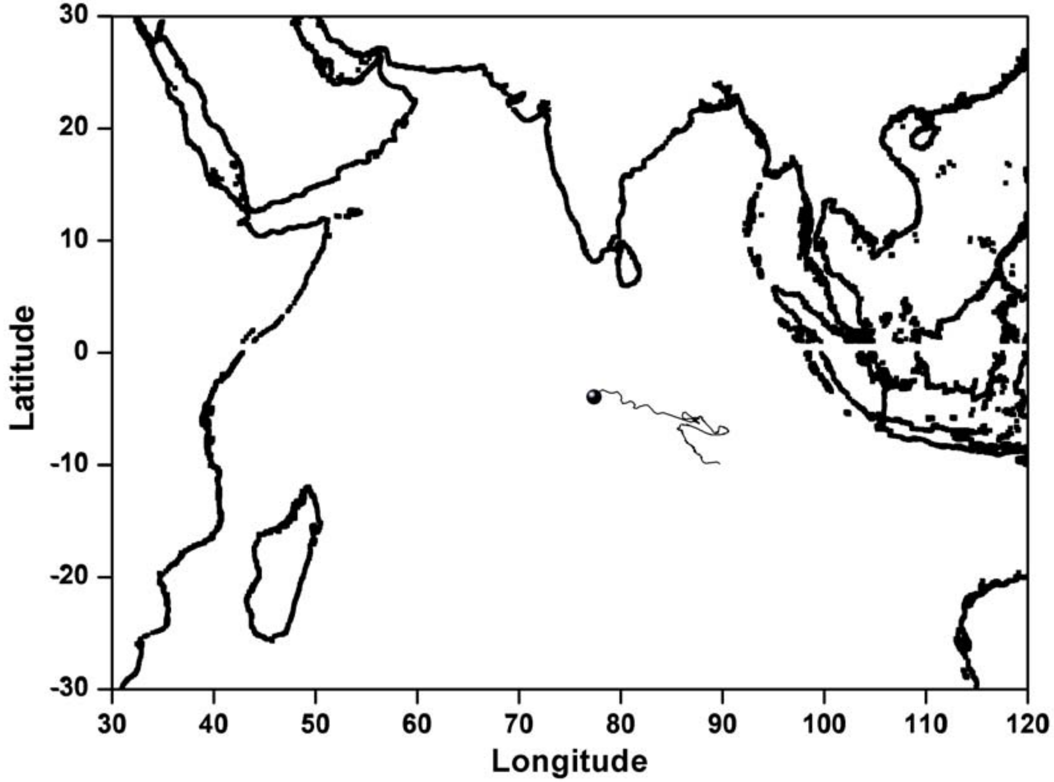

Fig 14a Trajectory during life time (31.03.2005 to 26.03.2007)

WMO Id 2900494 (Argos Id 21903)

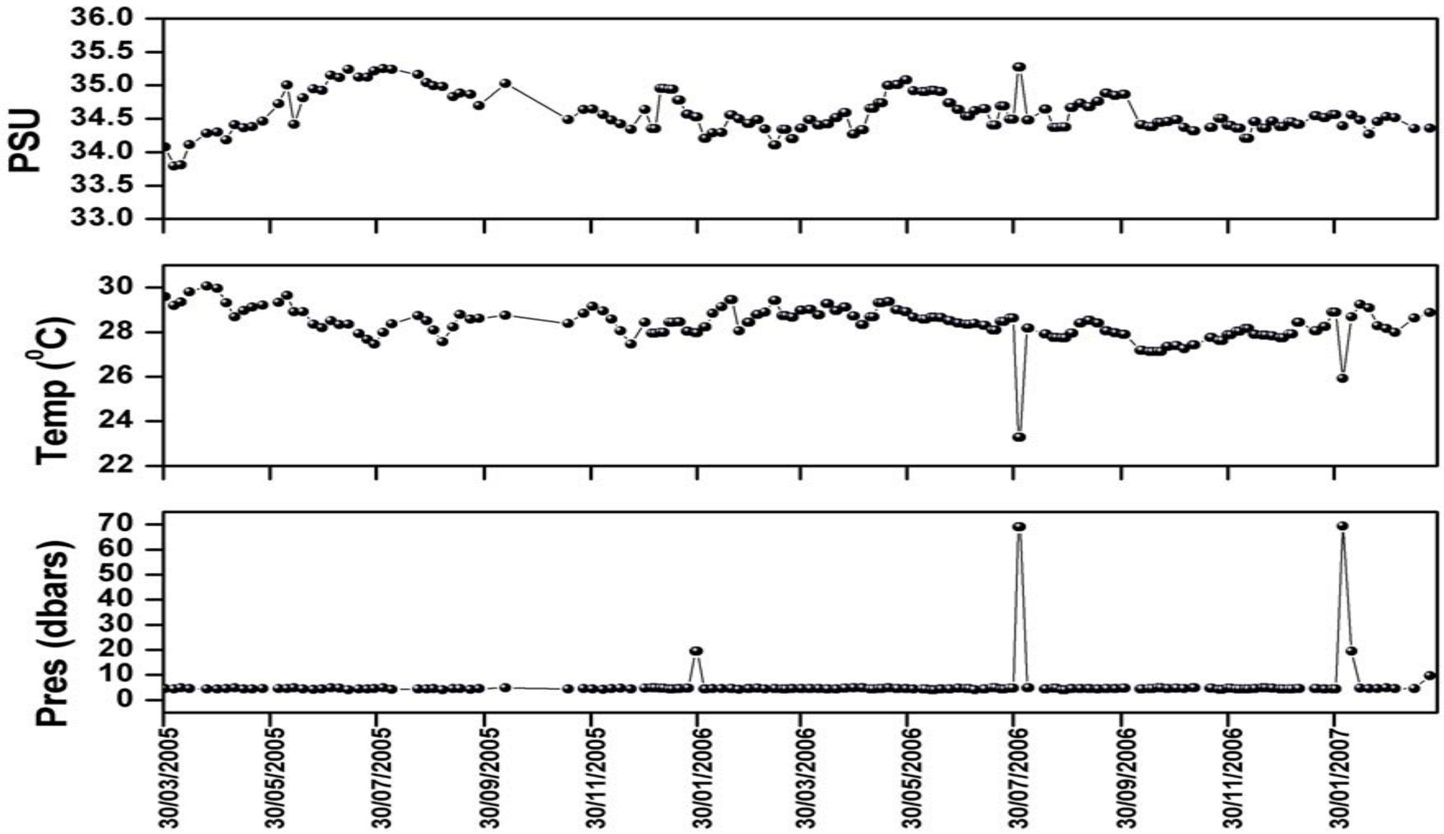

Fig 14b Time series of surface pressure, temperature and salinity

WMO Id 2900494 (Argos Id 21903)

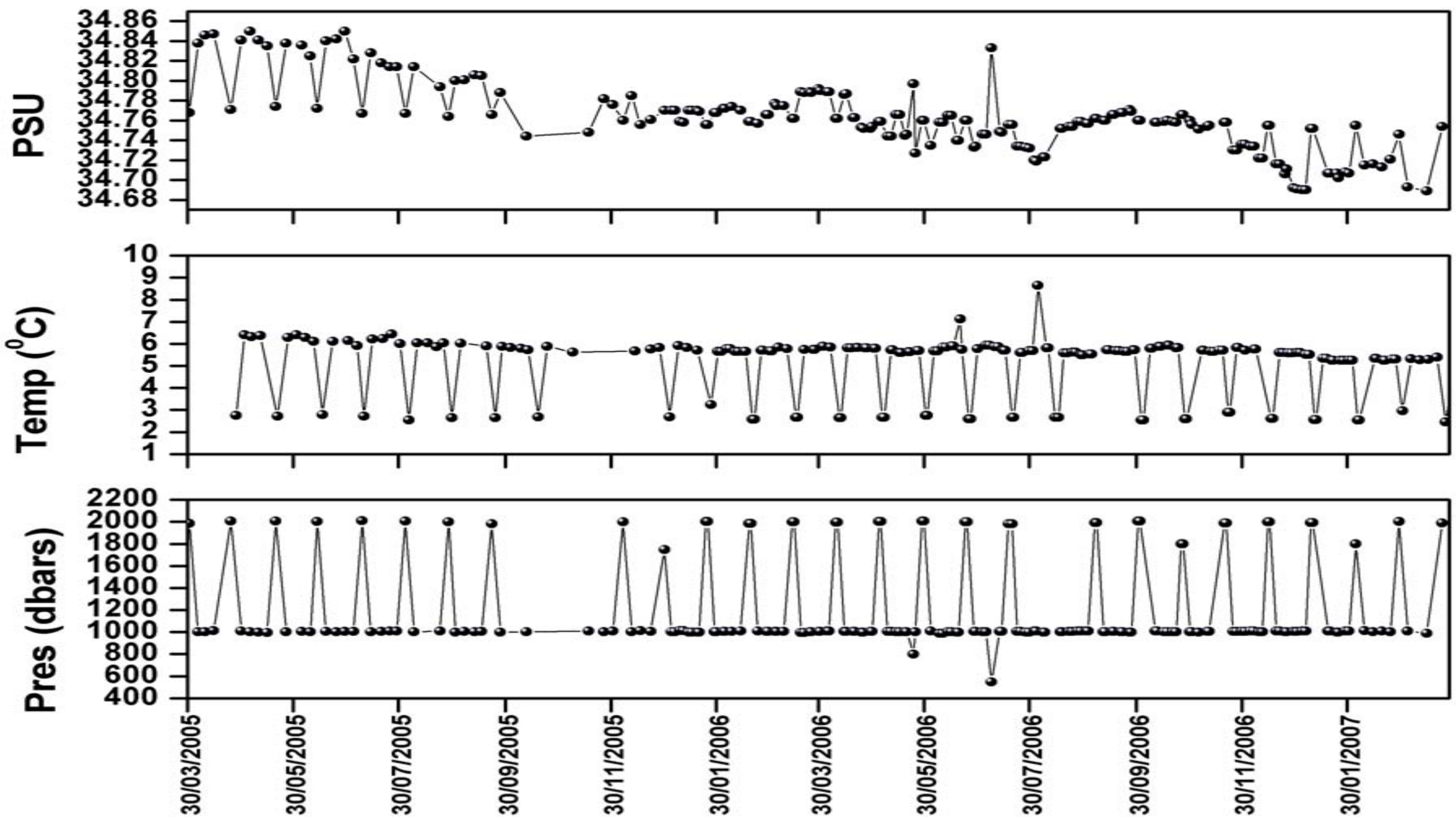

Fig 14c Time series of bottom pressure, temperature and salinity

Trajectory of 2900530 (Argos Id 22046)

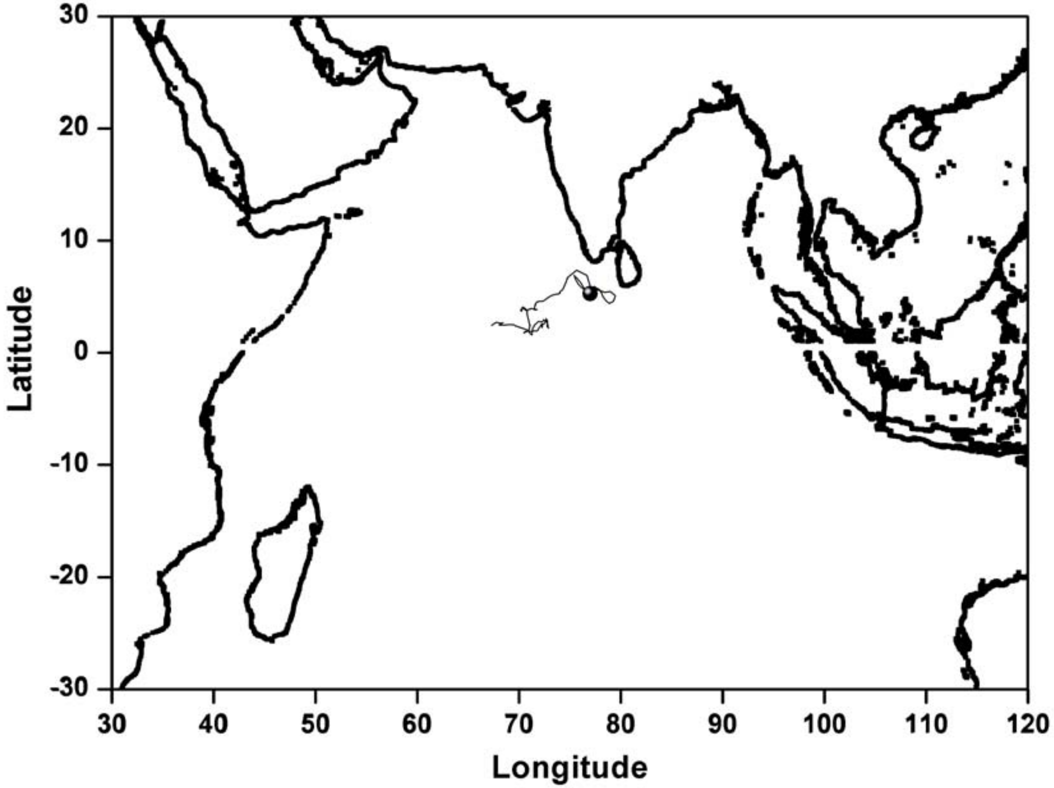

Fig 15a Trajectory during life time (13.05.2005 to 03.04.2007)

WMO Id 2900530 (Argos Id 22046)

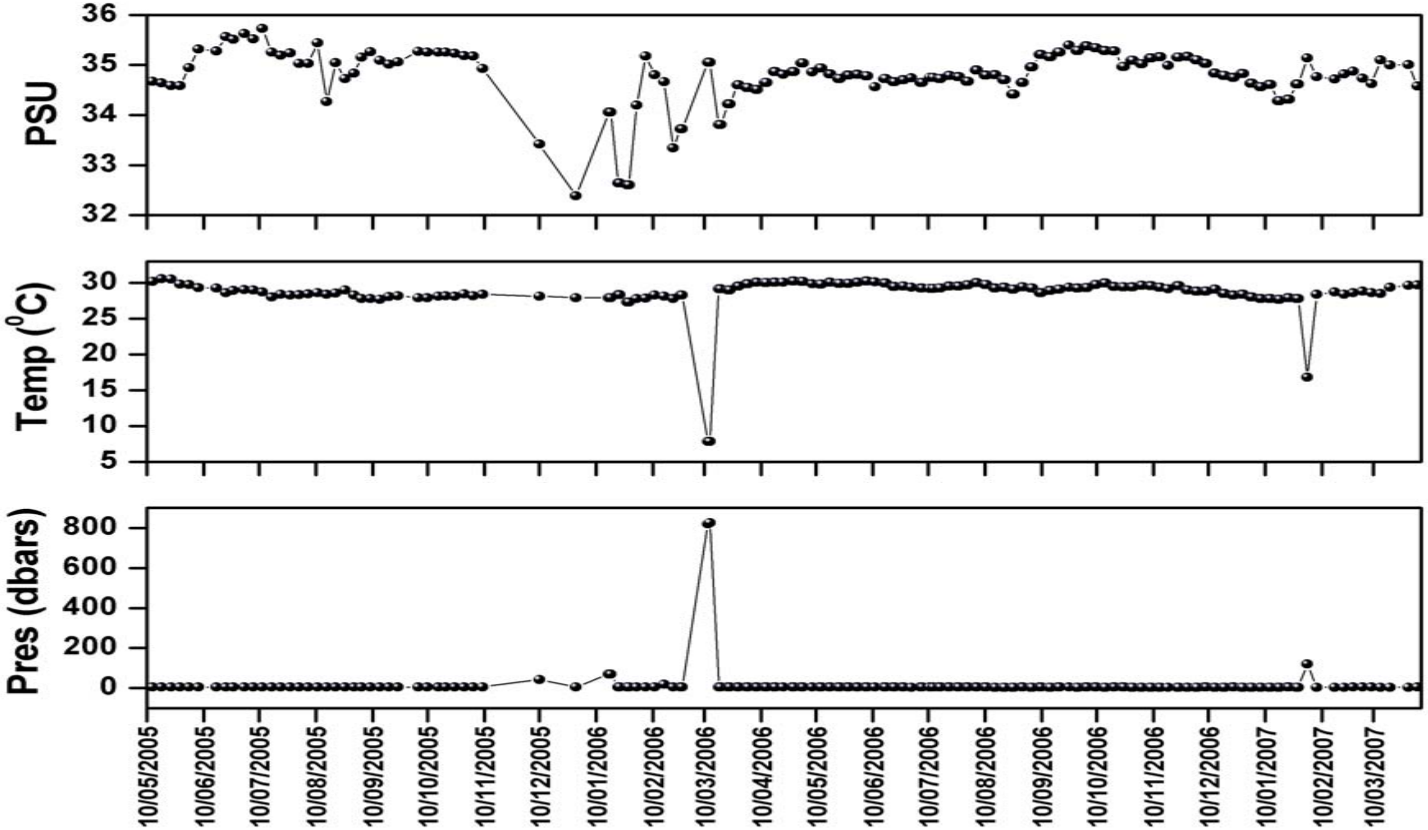

Fig 15b Time series of surface pressure, temperature and salinity

WMO Id 2900530 (Argos Id 22046)

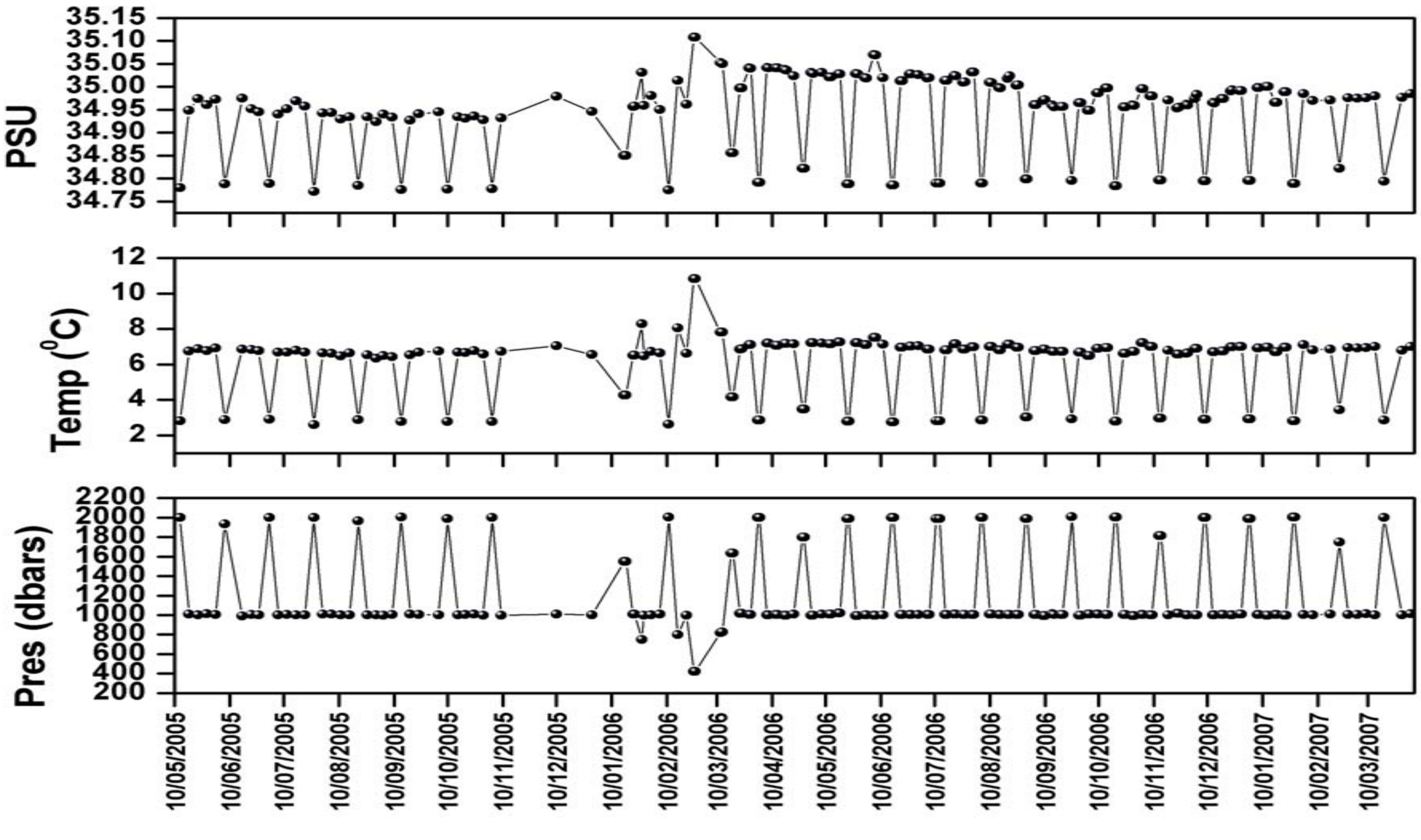

Fig 15c Time series of bottom pressure, temperature and salinity

Trajectory of 2900754 (Argos Id 27423)

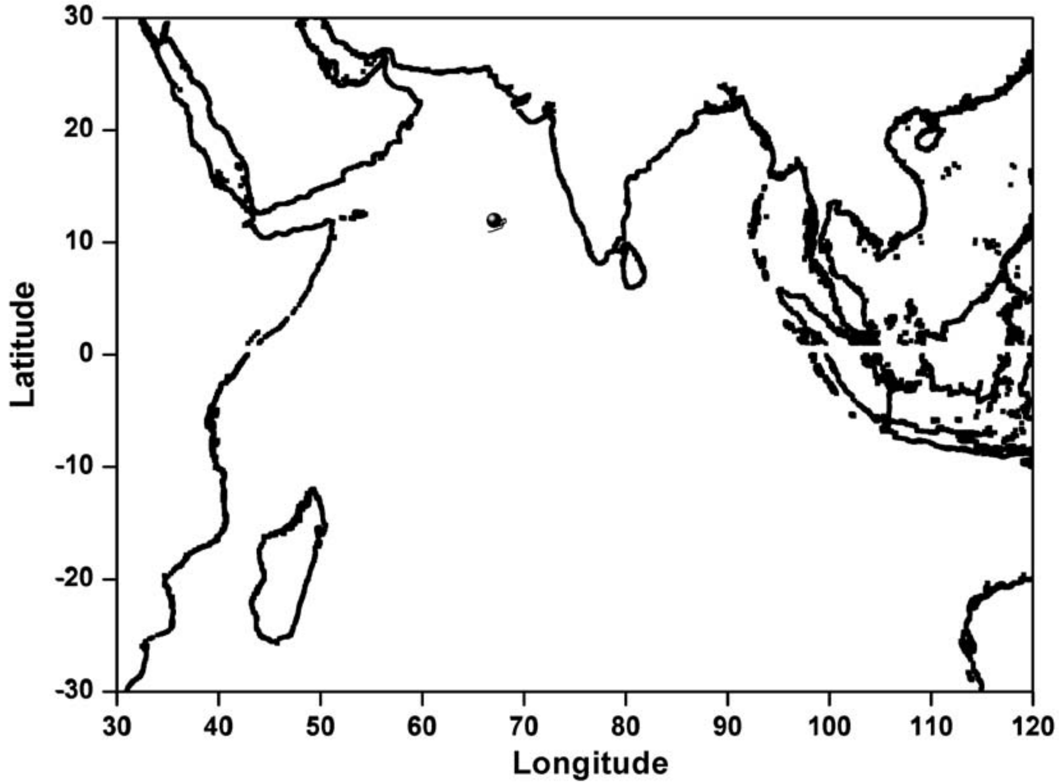

Fig 16a Trajectory during life time (28.05.2006 to 04.04.2007)

WMO Id 2900754 (Argos Id 27423)

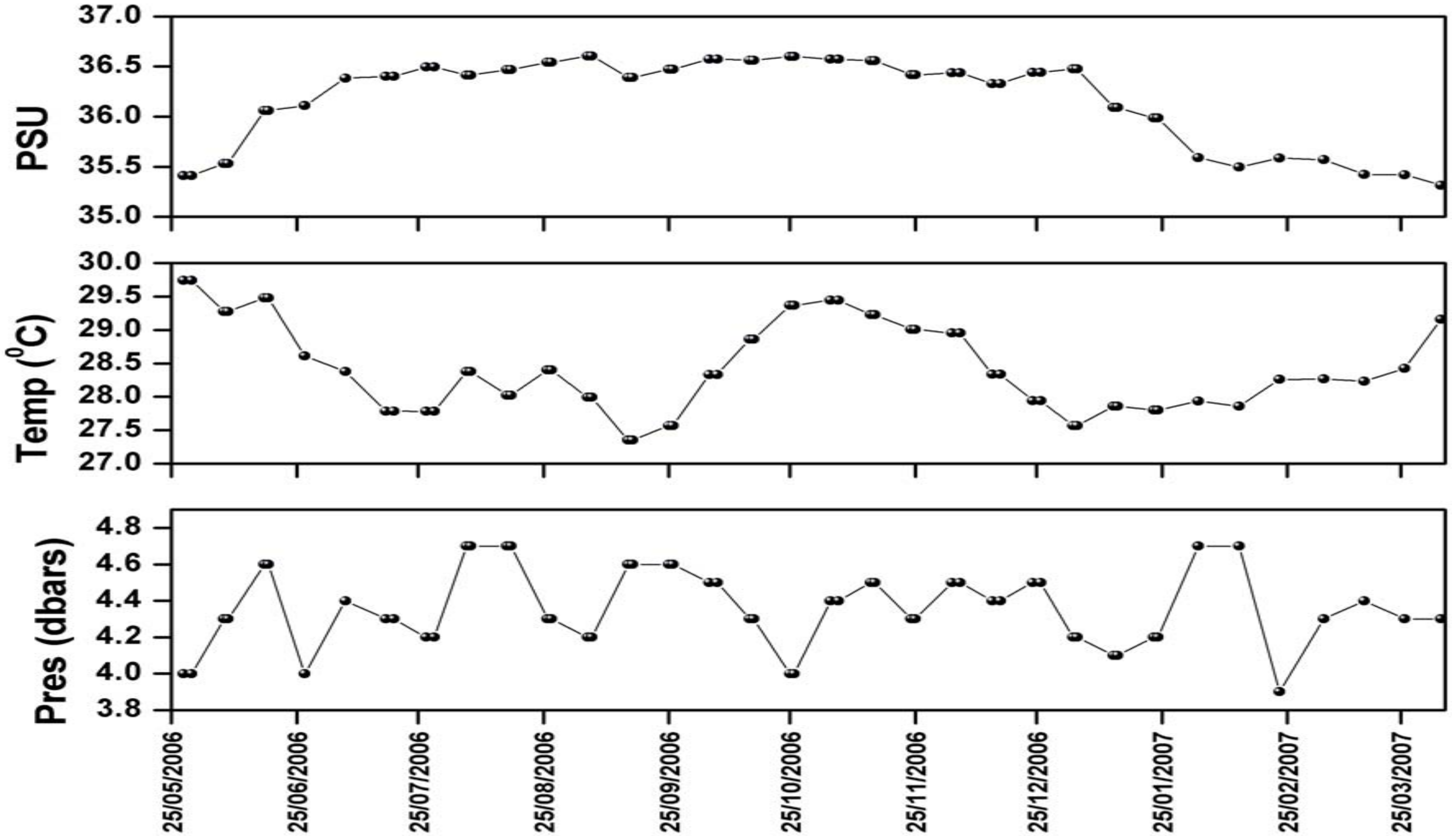

Fig 16b Time series of surface pressure, temperature and salinity

WMO Id 2900754 (Argos Id 27423)

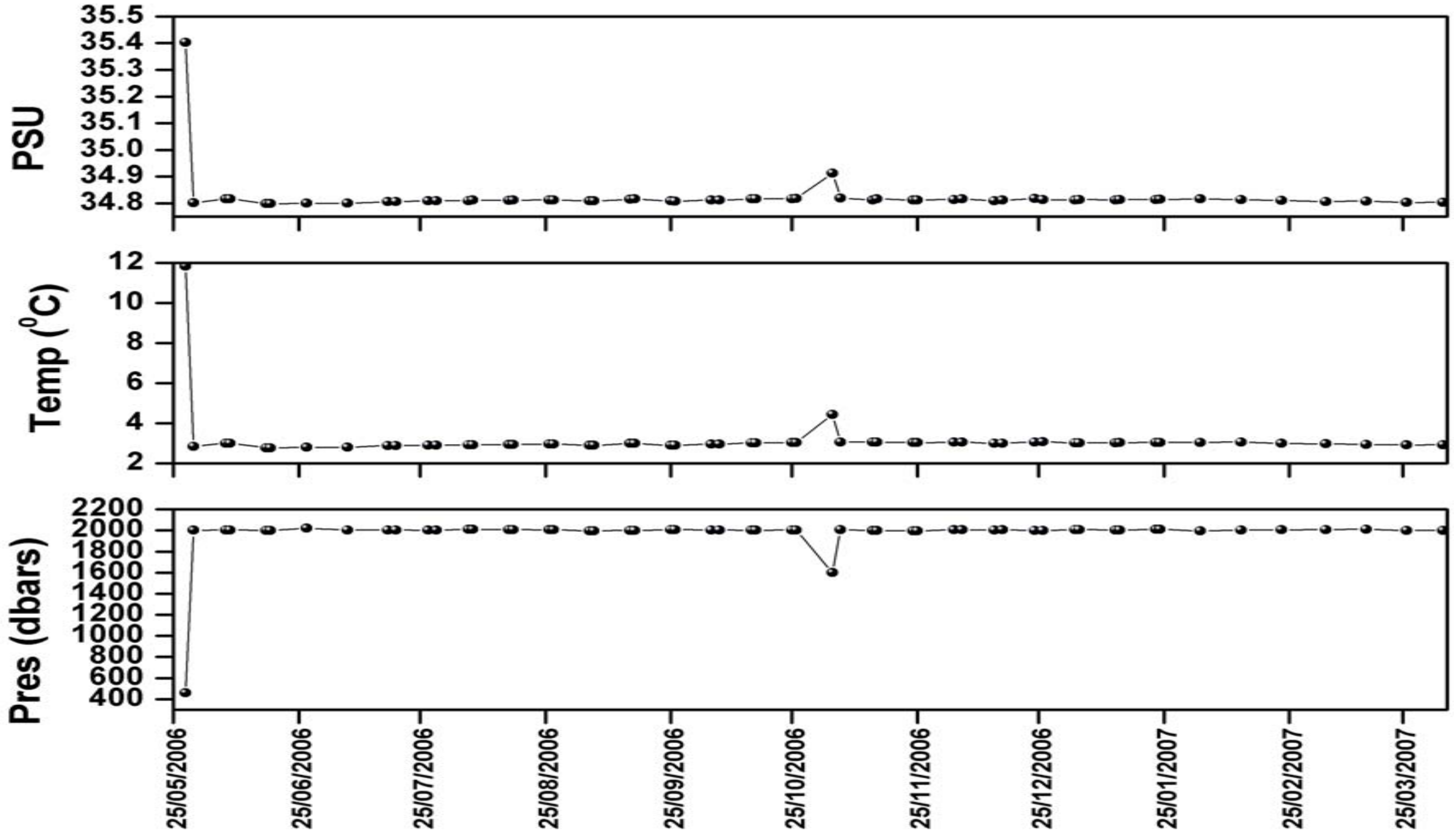

Fig 16c Time series of bottom pressure, temperature and salinity

Trajectory of 2900764 (Argos Id 23561)

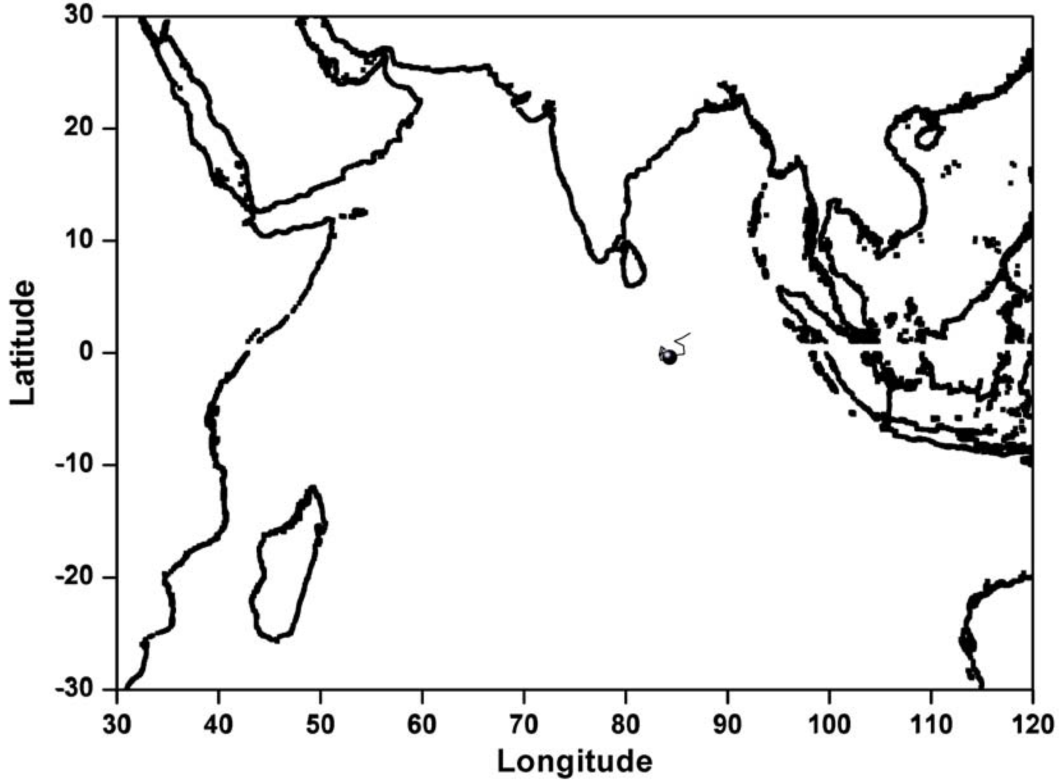

Fig 17a Trajectory during life time (26.10.2002 to 02.05.2003)

WMO Id 2900764 (Argos Id 23561)

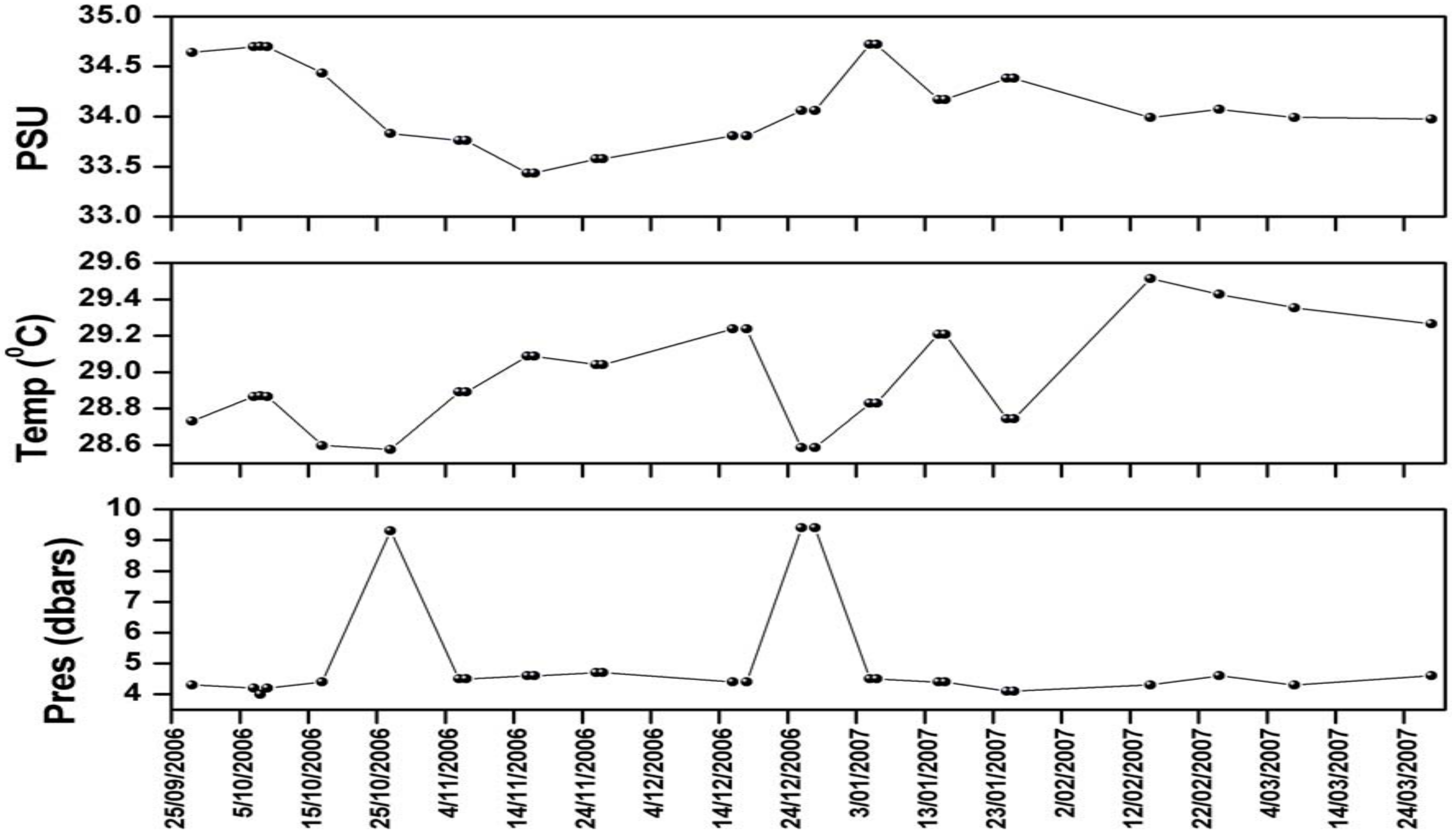

Fig 17b Time series of surface pressure, temperature and salinity

WMO Id 2900764 (Argos Id 23561)

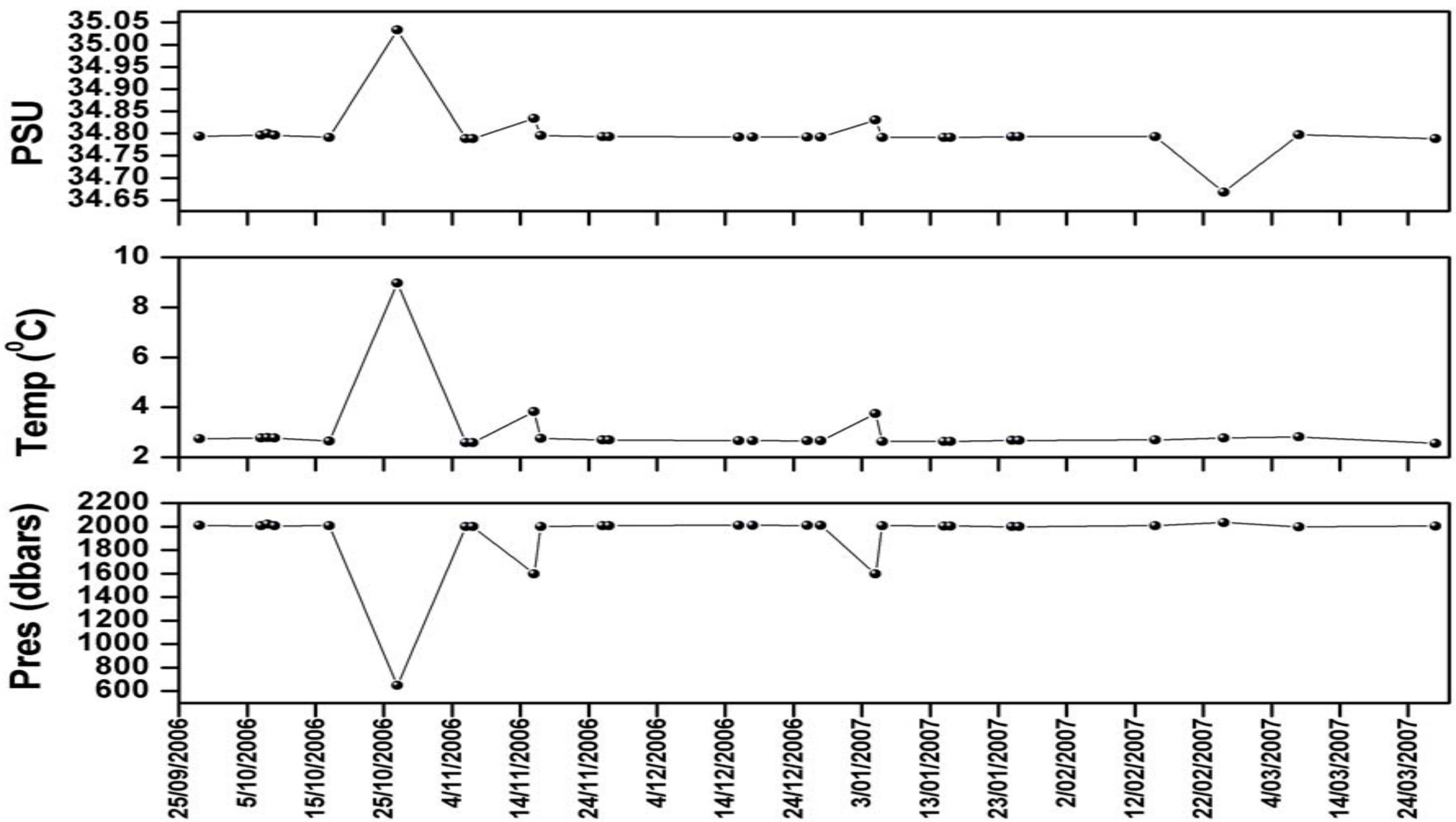

Fig 17c Time series of bottom pressure, temperature and salinity