



THE INTERNALLY STORED DATA OF THE ARVOR C: HOW TO EXTRACT THEM, HIGHER PROFILE RESOLUTION AND SOME MISSING INFORMATION

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1. Introduction

The Arvor-C is an autonomous profiling float that is designed to make repetitive in-situ measurements from the seafloor to the surface, providing complete three-dimensional high rate data.

The Arvor-C is based on the Provor and Arvor deep-sea profiling floats architecture, but is a coastal profiling float, designed to withstand pressures up to 450 dbars. It can perform up to 320 profiles when cycling at 200 meters depth with a repetition rate that can be configured from 1 profile every hour (André et al., 2010).

It behaves like a virtual mooring, for short to long term observations. It can take measurements at about the same location thanks to the optimized time of ascent and descent through the water column (speed is between 20 and 30 cm/s), the short time of transmission at the surface, and its anti-drift capability when grounded on the seabed.

The Arvor-C provides a standard set of measurements (pressure, temperature and conductivity), as well as a set of technical information. Multidisciplinary sensors can be integrated on this vertical vehicle. Once at surface, it uses a bi-band Iridium-Global Positioning System (GPS) antenna for data transmission, remote control and positioning. Data are averaged into 1-dbar (about 1 m) high slices to reduce the transmission duration.

Since the instrument is design to operate in shallow water and it is desirable to recover it after its use, in this report we describe the procedure to follow in order to download the full set of data that is stored inside the instrument during its mission. Section 2 illustrates the various commands to recover all the data. Additionally, analyzing, as an example, the data of a mission carried out in the very shallow waters of the Gulf of Trieste (TOSCA project, October 2012), in section 3, we make some considerations about the internally recorded profiles and about the missing information.

2. Download the internally stored data

As said, the Arvor C internally stores all the measurements and transmits to the land the parameters averaged every 1-meter (see the Arvor-C manual for the details;

\\oceano\sire\dati\float\tech_sheet\arvor-c\33-16-010_ARVOR-C_UTI_GB.pdf).

Therefore, once the instrument is recovered, it is interesting - and can result very important - to recuperate all the available information by using the commands described in Table 1. The commands can be sent to the instrument by using the Hyperterminal and results must be saved in a text file (Jérôme Sagot, NKE product manager, personal communication).

?NS	Serial number
?TI	Float's time
?VL	Float's firmware version
?VB	Internal vacuum and batteries voltage
?PM	Mission parameters
?LO	Float's programmed dates on surface
?RE	Float's 5 last reset
?DB	Raw data
?DT	Treated data
?SP	Hydraulic data (pump and valve activations during profiles)
?MT	Technical information (last profile)

Table 1. Commands for the recovery all the data of the Arvor C (Jérôme Sagot, NKE product manager, personal communication).

3. Data of the TOSCA project Arvor C mission

The data recorded during the mission in the Gulf of Trieste in the framework of the TOSCA project in October 2012 are considered as an example (mission b; imei 300234010247360).

The instrument sent 68 *.SBD files to OGS via e-mail. An example of the received e-mail can be found in appendix A. Only 30 files contained useful data because the instrument was accidentally recovered by a fisherman 4 days after deployment.

The useful internal data/profiles were also 30. The internally stored data are captured in rows (one row per measurement; see Appendix B) containing a progressive number, the number of the cycle, the phase (phase 5 is the ascent phase; i.e. while performing a CTD cast), day (progressive day starting from the day of the deployment, time (UTC), pressure (cbars), temperature (mdegC), salinity (mPSU) and a flag (1:good, 0: bad).

After downloaded the internal stored data, they were saved inside the *.mat files generated by the automatic procedure of the OGS server "oceano". In particular, the data recorded during the various phases were saved as structures named PacketX_raw, with X indicating the phase.

The comparison between the transmitted and the internally stored data (Figs. 1 and 2) reveals that the resolution in pressure of the internally stored data is higher than that of the sent data (averaged every 1 dbar). Surprisingly, the resolution was not as high as one would expect. The CTD data were collected every 65 cm on average. Considering an ascent speed of about 20-30 cm/s, this implies that the sampling rate of the CTD was set at about 1 sample every 3 seconds. In particular cases of very shallow waters, it is desirable to increase the CTD sampling rate to its maximum (1 Hz; see [technical specifications; http://www.seabird.com/products/spec_sheets/41data.htm](http://www.seabird.com/products/spec_sheets/41data.htm)). Unfortunately, the CTD sample processing time set at the factory require a minimum of 2 seconds (Jérôme Sagot, NKE product manager, personal communication). Therefore, it is not possible to decrease the sampling period, in order to acquire more raw data.

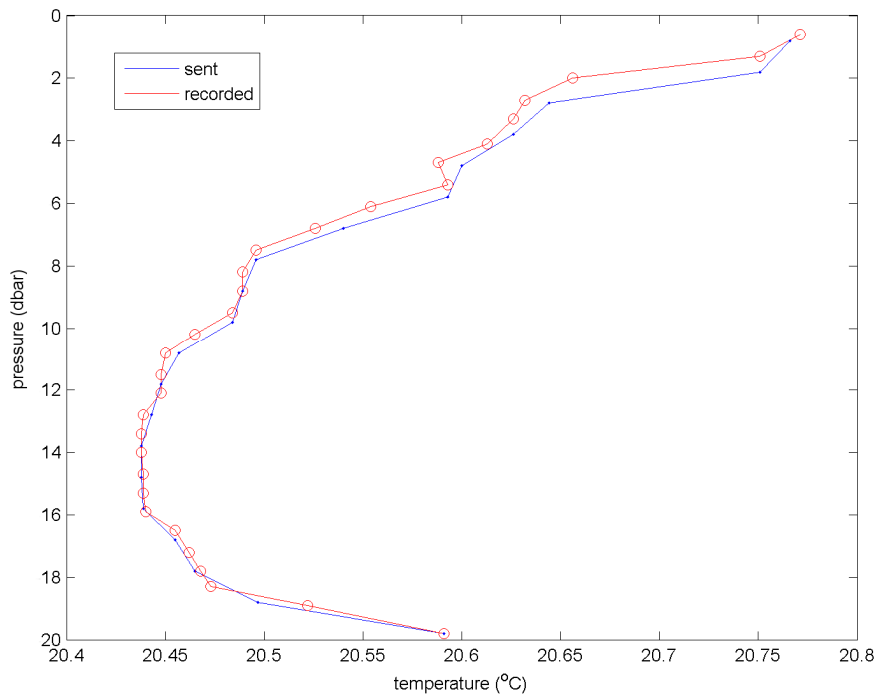


Fig. 1. Comparison between the sent (blue line) and the internally recorded (red line) temperature data.

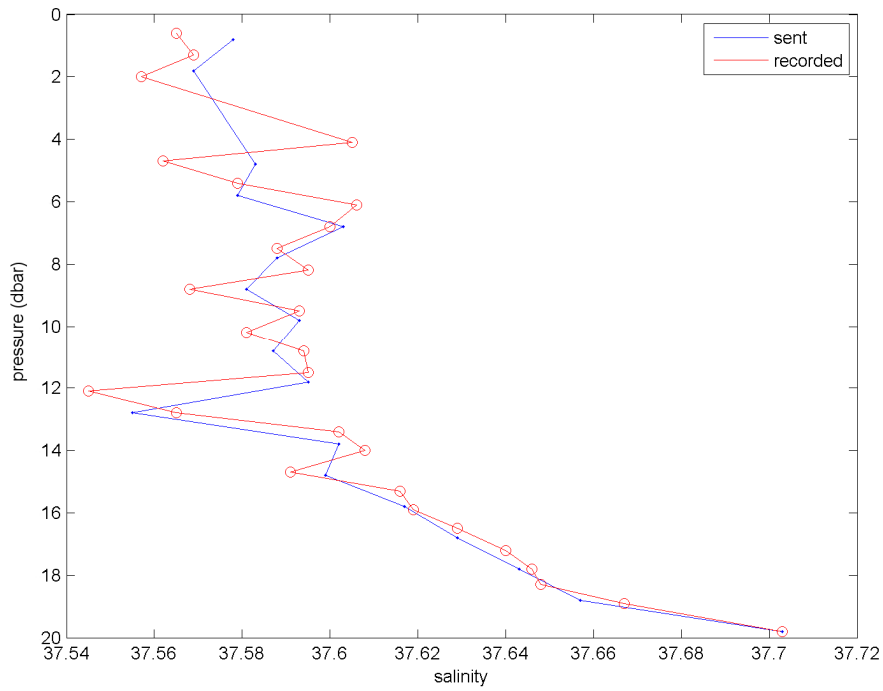


Fig. 2. As for Fig. 1, but for the salinity data.

Furthermore, the blue line in Fig. 1 is always below the red line from the surface down to 8 dbar (about 8 meters depth). Indicating that the method the float uses to compute the 1-meter average of the data is incorrect. The problem is that the pressure data are not averaged and transmitted with the iridium SBD message. Only the maximum pressure is transmitted (first point of the ascent profile). All the other pressures are referred to this point with steps of about 1dbar.

RECORDED DATA			TRANSMITTED DATA				
Pressure (dbar)	Temperature (°C)	salinity	averaged pressure (dbar)	averaged temperature (°C)	averaged salinity	computed pressure from the reference (dbar)	pressure difference (dbar)
19.8	20.591	37.703	19.8	20.591	37.703	19.8	0
18.9	20.522	37.667	18.6	20.498	37.658	18.8	-0.2
18.3	20.473	37.648					
17.8	20.468	37.646	17.5	20.465	37.643	17.8	-0.3
17.2	20.462	37.640					
16.5	20.455	37.629	16.5	20.455	37.629	16.8	-0.3
15.9	20.440	37.619	15.6	20.440	37.618	15.8	-0.2
15.3	20.439	37.616					
14.7	20.439	37.591	14.35	20.439	37.600	14.8	-0.45
14.0	20.438	37.608					
13.4	20.438	37.602	13.4	20.438	37.602	13.8	-0.4
12.8	20.439	37.565	12.45	20.444	37.555	12.8	-0.35
12.1	20.448	37.545					
11.5	20.448	37.595	11.5	20.448	37.595	11.8	-0.3
10.8	20.450	37.594	10.5	20.458	37.588	10.8	-0.3
10.2	20.465	37.581					
9.5	20.484	37.593	9.5	20.484	37.593	9.8	-0.3
8.8	20.489	37.568	8.5	20.489	37.582	8.8	-0.3
8.2	20.489	37.595					
7.5	20.496	37.588	7.5	20.496	37.588	7.8	-0.3
6.8	20.526	37.600	6.45	20.540	37.603	6.8	-0.35
6.1	20.554	37.606					
5.4	20.593	37.579	5.4	20.593	37.579	5.8	-0.4
4.7	20.588	37.562	4.4	20.601	37.584	4.8	-0.4
4.1	20.613	37.605					
3.3	20.626	35.816	3.3	20.626	35.816	3.8	-0.5
2.7	20.632	30.354	2.35	20.644	33.956	2.8	-0.45
2.0	20.656	37.557					
1.3	20.751	37.569	1.3	20.751	37.569	1.8	-0.5
mean difference							-0.33

Table 2. Recorded, averaged and transmitted data corresponding to the profiles of Figs. 1 and 2.

Table 2 considers the data corresponding to the plots in Figs 1 and 2: the first 3 columns represent the internally stored data, the second 3 columns are the 1-dbar averaged data. The pressure values computed from the transmitted maximum pressure are displayed in the seventh column while the last column shows the discrepancies between the measured pressures and the ones computed after receiving the data on land. This last column clearly explains the shifting effect of the transmitted reference pressure.

The transmission of a different reference pressure, as for example the maximum pressure rounded toward the nearest half meter, could minimize the discrepancies with the internally recorded values.

Another point concerning the internally stored data that deserves to be mentioned and changed or implemented in the future version of the Arvor C is the way the instrument saves the information about the day. Indeed, it would be much more useful to have the day expressed in terms of day, month and year (dd-mm-yyyy) instead of the indication of a relative day (relative to an unspecified starting time). Additionally and extremely important, the information about the GPS position of the instrument is completely absent. It is not stored inside the internal memory, it is only included in the sent file (Jérôme Sagot, NKE product manager, personal communication).

4. References

André X., Le Reste S. and Rolin J.-F., 2010. Arvor-C: A Coastal Autonomous Profiling Float A New Step Toward an In-Situ Virtual Mooring: a Profiling Float With Seabed Stationing Capability for Real-Time Monitoring of Coastal Seas. *Sea Technology*, 51 (2), 10-13

Appendix A

```
From sbdservice@sbd.iridium.com Thu Oct 18 17:11:22 2012
Return-Path: <sbdservice@sbd.iridium.com>
Received: from inogssmtp.ogs.trieste.it (inogssmtp.ogs.trieste.it
[140.105.64.3])
by oceano.ogs.trieste.it (8.13.8/8.13.8) with ESMTTP id q9IFBL4P006879
for <float@oceano.ogs.trieste.it>; Thu, 18 Oct 2012 17:11:21 +0200
```




Received: from antivirus_check (localhost [127.0.0.1])
by inogssmtp.ogs.trieste.it (Postfix) with ESMTTP id D89D18006E
for <float@oceanog.ogs.trieste.it>; Thu, 18 Oct 2012 17:11:21 +0200 (CEST)
Received: from antispam_check (localhost [127.0.0.1])
by inogssmtp.ogs.trieste.it (Postfix) with ESMTTP id A5207800E9
for <float@oceanog.ogs.trieste.it>; Thu, 18 Oct 2012 17:11:21 +0200 (CEST)
X-Spam-Checker-Version: SpamAssassin 3.3.1 (2010-03-16) on
inogssmtp.ogs.trieste.it
X-Spam-Level: **
X-Spam-Status: No, score=2.0 required=5.0 tests=BAYES_50 autolearn=disabled
version=3.3.1
X-Spam-ScanDate: Thu, 18 Oct 2012 17:11:21 +0200
Received: from poseidon.ogs.trieste.it (poseidon.ogs.trieste.it
[140.105.70.50])
by inogssmtp.ogs.trieste.it (Postfix) with ESMTTP id 985E58006E
for <float@oceanog.ogs.trieste.it>; Thu, 18 Oct 2012 17:11:21 +0200 (CEST)
Received: from inogssmtp.ogs.trieste.it (inogssmtp.ogs.trieste.it
[140.105.64.3])
by poseidon.ogs.trieste.it (8.9.3 (PHNE_29774)/8.9.3) with ESMTTP id RAA09222
for <float@poseidon.ogs.trieste.it>; Thu, 18 Oct 2012 17:11:21 +0200
(METDST)
From: sbdservice@sbd.iridium.com
Received: from antivirus_check (localhost [127.0.0.1])
by inogssmtp.ogs.trieste.it (Postfix) with ESMTTP id 59F75800E9;
Thu, 18 Oct 2012 17:11:21 +0200 (CEST)
Received: from inogsmbox.ogs.trieste.it (inogsmbox.ogs.trieste.it
[140.105.64.2])
by inogssmtp.ogs.trieste.it (Postfix) with ESMTTP id 4C0168006E;
Thu, 18 Oct 2012 17:11:21 +0200 (CEST)
Received: by inogsmbox.ogs.trieste.it (Postfix)
id 3B704278120; Thu, 18 Oct 2012 17:11:21 +0200 (CEST)
Delivered-To: float@inogs.it
Received: from inogssmtp.ogs.trieste.it (inogssmtp.ogs.trieste.it
[140.105.64.3])
by inogsmbox.ogs.trieste.it (Postfix) with ESMTTP id 2E087277CCB
for <float@inogs.it>; Thu, 18 Oct 2012 17:11:21 +0200 (CEST)
Received: from antivirus_check (localhost [127.0.0.1])
by inogssmtp.ogs.trieste.it (Postfix) with ESMTTP id 1C85C8006E
for <float@inogs.it>; Thu, 18 Oct 2012 17:11:21 +0200 (CEST)
Received: from antispam_check (localhost [127.0.0.1])



by inogssmtp.ogs.trieste.it (Postfix) with ESMTTP id E200E800E9
for [<float@inogs.it>](mailto:float@inogs.it); Thu, 18 Oct 2012 17:11:20 +0200 (CEST)
Received: from inogssmtp-ext (inogssmtp-ext.ogs.trieste.it [140.105.64.4])
by inogssmtp.ogs.trieste.it (Postfix) with ESMTTP id DC0738006E
for [<float@inogs.it>](mailto:float@inogs.it); Thu, 18 Oct 2012 17:11:20 +0200 (CEST)
Received: from outbound.sbd.iridium.com ([12.47.179.11]:41822
helo=istbsp01.sbd.iridium.com)
by inogssmtp-ext with esmtps (TLSv1:AES256-SHA:256)
(Exim 4.76)
(envelope-from [<sbdservice@sbd.iridium.com>](mailto:sbdservice@sbd.iridium.com))
id 1Torkk-0005NQ-2i
for float@inogs.it; Thu, 18 Oct 2012 17:11:19 +0200
X-CTCH-RefID:
str=0001.0A0B0201.50801C17.008A:SCGMA481786,ss=1,re=-4.000,fgs=1024
Reply-To: [<sbdservice@sbd.iridium.com>](mailto:sbdservice@sbd.iridium.com)
To: float@inogs.it
Subject: SBD Msg From Unit: 300234010247360
MIME-Version: 1.0
Content-Type: multipart/mixed;boundary="SBD.Boundary.605592468"
Message-Id: [<19740413064121.2C067EE87B3E03B7@istbsp01.sbd.iridium.com>](mailto:19740413064121.2C067EE87B3E03B7@istbsp01.sbd.iridium.com)
Date: Thu, 18 Oct 2012 15:11:17 +0000 (GMT)
X-Virus-Scanned: ClamAV using ClamSMTP - INOGS [Thu Oct 18 17:11:21 2012
+0200 (CEST)]
X-Virus-Scanned: ClamAV using ClamSMTP - INOGS [Thu Oct 18 17:11:21 2012
+0200 (CEST)]
X-Virus-Scanned: ClamAV using ClamSMTP - INOGS [Thu Oct 18 17:11:21 2012
+0200 (CEST)]

SBM Message
--SBD.Boundary.605592468
Content-Type: text/plain;charset=US-ASCII
Content-Disposition: inline
Content-Transfer-Encoding: 7bit

MOMSN: 1532
MTMSN: 0
Time of Session (UTC): Thu Oct 18 15:11:16 2012
Session Status: 00 - Transfer OK
Message Size (bytes): 200

Unit Location: Lat = 45.678015 Long = 13.737377
CEPradius = 2

--SBD.Boundary.605592468

Content-Type: application/x-zip-compressed; name="SBMmessage.sbd"

Content-Disposition: attachment; filename="300234010247360_001532.sbd"

Content-Transfer-Encoding: base64

```
AAALhAvGc+gN/A4wDjAAUABQAFBEEAA8KIAB2ABJAQAETKAqoAA0oHEoAAAAAAAAAAAAAAAAA  
AAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAEw1ANMXZP  
3DFcT98xVU/1MUxP3TFCT+cxPk/tMTVP7TEzUAAxL1AXMTFQJjEYUCwxM1AxMTNQVzEYUKYx  
LVD8MS5RFzEiUSoxGVEpMRtRGzD9AAAAAAAAAAAAAAAAAAAAAAAAAAAA=
```

--SBD.Boundary.605592468--

Appendix B

Example of the second profile stored inside the Arvor C

72;1;2;0;12:22:53;	2;	0;	0;0
73;1;2;0;12:23:53;	2;	0;	0;0
74;1;2;0;12:24:53;	3;	0;	0;0
75;1;2;0;12:25:53;	3;	0;	0;0
76;1;2;0;12:26:53;	3;	0;	0;0
77;1;2;0;12:27:53;	3;	0;	0;0
78;1;2;0;12:28:53;	4;	0;	0;0
79;1;2;0;12:29:53;	4;	0;	0;0
80;1;2;0;12:30:53;	4;	0;	0;0
81;1;2;0;12:31:53;	4;	0;	0;0
82;1;2;0;12:32:53;	4;	0;	0;0
83;1;2;0;12:33:53;	5;	0;	0;0
84;1;2;0;12:34:53;	5;	0;	0;0
85;1;2;0;12:35:53;	5;	0;	0;0
86;1;2;0;12:36:53;	5;	0;	0;0
87;1;2;0;12:37:53;	23;	0;	0;0
88;1;2;0;12:38:53;	74;	0;	0;0
89;1;2;0;12:39:53;	147;	0;	0;0
90;1;3;0;12:40:40;	207;	0;	0;0
91;1;3;0;12:41:40;	207;	0;	0;0
92;1;3;0;12:42:40;	207;	0;	0;0
93;1;4;0;12:42:50;	207;	0;	0;0
94;1;4;0;13:12:55;	206;	0;	0;0
95;1;4;0;13:42:59;	204;	0;	0;0
96;1;4;0;14:13:03;	203;	0;	0;0
97;1;4;0;14:43:07;	202;	0;	0;0

98;1;4;0;14:55:19; 202; 0; 0;0
99;1;5;0;15:03:56; 195;20493;37662;1
100;1;5;0;15:04:00; 184;20444;37636;1
101;1;5;0;15:04:02; 178;20446;37631;1
102;1;5;0;15:04:04; 171;20448;37628;1
103;1;5;0;15:04:06; 164;20453;37620;1
104;1;5;0;15:04:08; 157;20445;37613;1
105;1;5;0;15:04:10; 150;20446;37608;1
106;1;5;0;15:04:12; 143;20455;37606;1
107;1;5;0;15:04:14; 135;20461;37597;1
108;1;5;0;15:04:16; 128;20455;37593;1
109;1;5;0;15:04:18; 121;20467;37597;1
110;1;5;0;15:04:20; 114;20480;37591;1
111;1;5;0;15:04:22; 106;20503;37593;1
112;1;5;0;15:04:24; 98;20516;37594;1
113;1;5;0;15:04:26; 91;20521;37595;1
114;1;5;0;15:04:28; 83;20524;37595;1
115;1;5;0;15:04:30; 76;20529;37595;1
116;1;5;0;15:04:32; 68;20547;37594;1
117;1;5;0;15:04:34; 60;20587;37595;1
118;1;5;0;15:04:36; 52;20646;37589;1
119;1;5;0;15:04:38; 44;20732;37590;1
120;1;5;0;15:04:40; 37;20759;37578;1
121;1;5;0;15:04:42; 29;20777;37571;1
122;1;5;0;15:04:44; 21;20780;37567;1
123;1;5;0;15:04:46; 13;20777;37571;1
124;1;5;0;15:04:48; 5;20781;37568;1
125;1;5;0;15:04:50; 0;20745;37515;1
126;1;5;0;15:04:52; 0;20685;37633;0
127;1;5;0;15:04:54; 1;20648;37656;0
128;1;5;0;15:04:56; 1;20641;37659;0
129;1;5;0;15:04:58; 0;20618;37672;0
130;1;5;0;15:05:00; 0;20563;37714;0
131;1;5;0;15:05:02; 0;20453;37810;0
132;1;5;0;15:05:03; 0;20453;37810;0
133;1;5;0;15:05:04; 0;20418;37837;0