ANDRO actual contents and format April 18 2013

The ANDRO atlas ASCII file, named ANDRO_20130322.dat (available on http://www.coriolis.eu.org/ or http://wwz.ifremer.fr/lpo/, the Coriolis or LPO sites) contains the float parking pressure (actually a representative parking pressure RPP which is generally an average of the measured pressures during float drift at depth) and temperature, deep and surface displacements, and associated times, deep and surface associated velocities with their (roughly) estimated errors.

ANDRO data originates from AOML, Coriolis, JMA, CSIRO, BODC, MEDS, INCOIS, KORDI, KMA and CSIO, covering the period from the beginning of Argo until 1 January 2010. This second update of ANDRO comprises a total of 6 271 floats contributing 612 462 displacements.

ASCII ANDRO file (one line for one cycle) has 37 columns whose contents are described in Table 1 (based on the YoMaHa'05 format, see Lebedev, 2007 e.g.):

Julian time (days) corresponds to the number of days elapsed since 0000 UTC January 1st 2000. Adding 18262.000 will convert it into the Julian time used by Argos (relative to 0000 UTC January 1st 1950).

Surface velocities and corresponding errors are estimated as in Lebedev et al. (2007), using a linear least squares regression: if T_i and Y_i (i=1,…, N) are the times and latitudes of the surface fixes for the current cycle, $\hat{V}_{surf} = \frac{\sum (Y_i - \overline{Y})(T_i - \overline{T})}{\sum (T_i - \overline{T})^2}$ where $\overline{T}$ and $\overline{Y}$ denote the mean of the T_i and Y_i. Under a Gaussian distribution assumption, the error ε_V on $\hat{V}_{surf}$ is given by: $\varepsilon_V^2 = \frac{\sum (Y_i - \overline{Y} - \hat{V}_{surf}(T_i - \overline{T}))^2}{(N-2)\cdot \sum (T_i - \overline{T})^2}$ (and similar expressions for $\hat{U}_{surf}$ and ε_U^2). Clearly, these estimates may not be adequate where inertial motions are important and the time span of the surface fixes is comparable to the inertial period. In that case, one should use instead a least square fit of a uniform current and a circular inertial motion as proposed by Park et al. (2004).

The deep velocity components u_{deep} and v_{deep} are estimated (in cm s^{-1}) respectively as $\hat{U}^{n}_{deep} = (X^{n}_{first} - X^{n-1}_{last}) \cdot coef \cdot \cos(\pi Y^{n}_{deep}/180)/\Delta T$ and $\hat{V}^{n}_{deep} = (Y^{n}_{first} - Y^{n-1}_{last}) \cdot coef/\Delta T$ where $\Delta T = T^{n}_{first} - T^{n-1}_{last}$ (T^{n}_{first} is the time of the first fix at sea surface during the current cycle, T^{n-1}_{last} the time of the last fix at sea surface during the previous cycle) and $coef = 1852 \cdot 60/864$ since latitudes Y_i are given in degrees and times in days. Lebedev et al. (2007) give an estimate of the error on the deep velocity due to the vertical shear between the surface and the parking pressure as the float descents or ascents. The assumptions made are that the shear is constant in vertical and the rates of descent and ascent are also constant (W = 10 cm s^{-1}). Neglecting the time differences between T^{n-1}_{last} and Descent Start Time (DST) and the difference between Ascent End Time (AET) and T^{n}_{first}, one obtains, $\hat{U}^{n}_{deep} - u^{n}_{deep} = \alpha(1-\alpha)^{-1}(\hat{U}^{n-1}_{surf,last} + \hat{U}^{n}_{surf,first} - 2\hat{U}^{n}_{deep})/2$ with $\alpha = RPP \cdot W^{-1} \cdot \Delta T^{-1}$, and a similar expression for $\hat{V}^{n}_{deep} - v^{n}_{deep}$. However, in general and for Argos floats, the two previous time differences are not at all negligible since on average (see Ollitrault & Rannou, 2013) they are of the order of 1 h (whence a 2 km displacement with a 0.5 m s^{-1} surface current) and comparable to the displacement induced by the current shear in vertical (2.5 km with a shear of 0.5 m s^{-1} over 1000 m). Furthermore, the surface current may change direction while the float is at the surface and what is needed are the surface velocities just before diving and just after surfacing. Our linearly estimated $\hat{U}^{n-1}_{surf,last}$ and $\hat{U}^{n}_{surf,first}$ may be grossly in error. With Iridium floats, only one fix is generally available preventing any surface velocity estimation. With 2 or 3 GPS fixes available (which happens occasionally if an upload failure occurs), this cause of error would be less annoying since the surface phase would last order of 1 h at most (this pleads for at least 2 GPS locations at the surface for future floats). Thus the error estimates given in the present version of ANDRO are to be taken with caution and are probably underestimated.

The corrected and comprehensive data set used to generate the ANDRO atlas (see Ollitrault & Rannou, 2013 for details) is composed of 6302 (22-column) ASCII files, called DEP files (for "*DEPlacement*"), corresponding to 632 718 cycles (note that, in ANDRO, a displacement is generated only for two consecutive cycles). There is one DEP file per float, and most of our work on the Argo raw data, collected from the DACs, was done to produce the DEP files, which contain all the possible retrievable information. The DEP format is described in Tables 2 to 10. DEP files are also available on http://wwz.ifremer.fr/lpo/ (zipped as DEP_files_20130409.7z or DEP_files_20130409.zip).

Caution:

The salinity values found in the DEP files are not reliable, because no validation was done on them. Consequently, no salinity has been given in ANDRO.

Some floats have surface pressure offsets, given in the DEP files, but the measured parking pressures have not been corrected of these offsets. Consequently no (surface) pressure offset correction has been done on the RPP given in ANDRO. Future versions of ANDRO should take care of this. However, one may notice that only 76 floats do show offset ranges over their life time greater than 10 dbar and the worst surface pressure offset range measured is + 271 dbar (WMO # 7900223).

ANDRO suggestions:

Should you find any strange pressure or temperature values in the ANDRO data set, please tell us about (michel.ollitrault@ifremer.fr or jean-philippe.rannou@altran.com). Although we tried to be very careful, there are certainly a few errors remaining in ANDRO!

What would be worth adding in ANDRO? Salinity at parking? A better estimate of the deep displacements as explained briefly above (more details in Ollitrault & Rannou, 2013)?

References

Lebedev, K.V., Yoshinari, H., Maximenko, N.A. and P.W. Hacker, 2007: YoMaHa'07- Velocity data assessed from trajectories of Argo floats at parking level and at the sea surface. *IPRC Tech. Note* n°4(2).

Ollitrault, M. and J.P. Rannou, 2013: ANDRO: An Argo-based deep displacement dataset. *Journal Atmos. Ocean. Technology*, vol.30, n°4,759-788.

Park, J.J., Kim, K. and W.R. Crawford, 2004: Inertial currents estimated from surface trajectories of Argo floats. *Geophys. Res. Letters*, **31**, L13307, doi:10.1029/2004GL020191.

Column #	Content	Format (Matlab)	Default value
1	longitude $X^n_{deep} = (X^n_{first} + X^{n-1}_{last})/2$ of the location where the deep velocity is calculated	9.4f	-999.9999
2	latitude $Y^n_{deep} = (Y^n_{first} + Y^{n-1}_{last})/2$ of the location where the deep velocity is calculated	8.4f	-99.9999
3	Reference parking pressure p^n_{deep} (dbar) for this cycle	6.1f	-999.9
4	Parking temperature t^n_{deep} (°C) for this cycle	7.3f	-99.999
5	Parking salinity S^n_{deep} (PSU) for this cycle	7.3f	-99.999
6	Julian time T^n_{deep} (days) when deep velocity is estimated	9.3f	-9999.999
7	Eastward component of the deep velocity U^n_{deep} (cm s^{-1}) at p^n_{deep}, estimated as : $(X^n_{first} - X^{n-1}_{last}) \cdot coef \cdot \cos(\pi Y^n_{deep}/180)/(T^n_{first} - T^{n-1}_{last})$	7.2f	-999.99
8	Northward component of the deep velocity V^n_{deep} (cm s^{-1}) at p^n_{deep}, estimated as : $(Y^n_{first} - Y^{n-1}_{last}) \cdot coef/(T^n_{first} - T^{n-1}_{last})$	7.2f	-999.99
9	Error on the eastward component of the deep velocity $\varepsilon^n_{U\,deep}$ (cm s^{-1})	7.2f	-999.99
10	Error on the northward component of the deep velocity $\varepsilon^n_{V\,deep}$ (cm s^{-1})	7.2f	-999.99
11	longitude $X^n_{surf,first}$ of the location where the first surface velocity is calculated (over the first 6 h at surface)	9.4f	-999.9999
12	latitude $Y^n_{surf,first}$ of the location where the first surface velocity is calculated	8.4f	-99.9999
13	Julian time $T^n_{surf,first}$ (days) when first surface velocity is calculated	9.3f	-9999.999
14	Eastward component of first surface velocity $U^n_{surf,first}$ (cm s^{-1})	7.2f	-999.99
15	Northward component of first surface velocity $V^n_{surf,first}$ (cm s^{-1})	7.2f	-999.99
16	Error on the eastward component of the first surface velocity $\varepsilon^n_{U\,surf,first}$ (cm s^{-1})	7.2f	-999.99
17	Error on the northward component of the first surface velocity $\varepsilon^n_{V\,surf,first}$ (cm s^{-1})	7.2f	-999.99
18	longitude $X^n_{surf,last}$ of the location where the last surface velocity is calculated (over the last 6 h at surface)	9.4f	-999.9999
19	latitude $Y^n_{surf,last}$ of the location where the last surface velocity is calculated	8.4f	-99.9999
20	Julian time $T^n_{surf,last}$ (days) when last surface velocity is calculated	9.3f	-9999.999
21	Eastward component of last surface velocity $U^n_{surf,last}$ (cm s^{-1})	7.2f	-999.99
22	Northward component of last surface velocity $V^n_{surf,last}$ (cm s^{-1})	7.2f	-999.99
23	Error on the eastward component of the last surface velocity $\varepsilon^n_{U\,surf,last}$ (cm s^{-1})	7.2f	-999.99

24	Error on the northward component of the last surface velocity $\varepsilon_{V_{surf,last}}^{n}$ (cm s^{-1})	7.2f	-999.99
25	Longitude of the last fix at the sea surface during the previous cycle X_{last}^{n-1}	9.4f	-999.9999
26	Latitude of the last fix at the sea surface during the previous cycle Y_{last}^{n-1}	8.4f	-99.9999
27	Julian time of the last fix at the sea surface during the previous cycle T_{last}^{n-1}	9.3f	-9999.999
28	Longitude of the first fix at the sea surface during the current cycle X_{first}^{n}	9.4f	-999.9999
29	Latitude of the first fix at the sea surface during the current cycle Y_{first}^{n}	8.4f	-99.9999
30	Julian time of the first fix at the sea surface during the current cycle T_{first}^{n}	9.3f	-9999.999
31	Longitude of the last fix at the sea surface during the current cycle X_{last}^{n}	9.4f	-999.9999
32	Latitude of the last fix at the sea surface during the current cycle Y_{last}^{n}	8.4f	-99.9999
33	Julian time of the last fix at the sea surface during the current cycle T_{last}^{n}	9.3f	-9999.999
34	Number of surface fixes N_{fix}^{n} during the current cycle	5d	-
35	Float WMO number	7d	-
36	Cycle number	3d	-
37	Profile number as given in the NetCDF prof file	3d	-99

Table 1: ANDRO format description

Column #	Contents	Format (Matlab)	Default value
1	Float WMO number	7d	
2	Cycle number	3d	
3	Information type	2d	
4	Julian (1950) date	14.8f	99999.99999999
5	Date flag	2d	99
6	Gregorian date	yyyy/mm/dd HH:MM:SS	9999/99/99 99:99:99
7	Ordering number	05d	
8	Longitude	8.3f	-999.999
9	Latitude	7.3f	-99.999
10	Position flag	2d	99
11	Location class	c	'9'
12	Satellite ID	c	'9'
13	Pressure	6.1f	9999.9
14	Pressure flag	3d	999
15	Temperature	6.3f	99.999
16	Temperature flag	3d	999
17	Salinity	6.3f	99.999
18	Salinity flag	3d	999
19	Grounded flag	02d	00
20	Data origin or state	2d	99
21	Gregorian date of last update	yyyy/mm/dd	
22	Profile number as given in NetCDF prof file	3d	-1

Table 2: DEP format description

The "ordering number" (column #7) is coded as follows:

- The first digit is used to store the profile number (data type #8 or #28):

  If only one profile is done during the current cycle, it is set to 0

  If more than one profile (ascending or descending) are done during the current cycle, it is set to 1 for the first profile, 2 for the second profile, …

- The 4 last digits are used to count, within a cycle, all the data of a given type.

Cycle number	Meaning
-1	Float launch position
0	For APEX and ARVOR floats: surface drift prior to the first dive For PROVOR floats: first cycle For other floats: unused
999	End Of Life (EOL) cycle

Table 3: Specific values for “cycle number”(column #2)

Information type code	**Meaning**
0	Launch
1	Surface pressure measurement (done just before descent start)
2	Pressure offset (used to correct APEX pressure measurements)
3	End of Argos transmission and start of buoyancy reduction (TET)
4	Surface pressure measurement (done just after ascent end)
5	
6	Descent start to parking depth (DST)
7	First stabilization during descent to parking depth (FST)
8	Descending profile measurement (and all measurements done during descent to parking depth)
9	Maximum pressure measured before stabilization at parking depth
10	Measurements done at the end of the stabilization phase at parking depth
11	Descent end (DET)
12	Measurement done during the drifting phase at depth
13	Minimal pressure measured by the float during the drifting phase at depth
14	Maximal pressure measured by the float during the drifting phase at depth
15	Measurement done at the end of the drifting phase at depth
16	Mean of the measurements done during the drifting phase at depth
17	Median value of the measurements done during the drifting phase at depth
18	
19	
20	Reference depth of the displacement (RPP)
21	Descent start to profile pressure (DDST)
22	Maximum pressure measured before stabilization at profile depth
23	descent end at profile depth (DDET)
24	Measurement done just before profile start
25	
26	Ascent start, computed/estimated using float technical information (AST)
27	Ascent start extrapolated from dated ascending profile measurements
28	Ascending profile measurement (and all measurements done during ascent to surface)
29	Time at 100 dbar during ascent (for *NEMO*)
30	Time at the end of the DOWN TIME period directly transmitted by the APEX float
31	Ascent end computed/estimated using float technical information (AET)
32	Ascent end extrapolated from dated ascending profile measurements
33	Transmission start (TST)
34	Transmission start date directly transmitted by the APEX float
35	First Argos message reception (FMT)
36	Argos location
37	Surface measurement
38	Last Argos message reception (LMT)
39	
40	Transmission end and start of buoyancy reduction (TET, *identical to "3" for 2 consecutive cycles*)
…	
46	Estimated surface positions
…	
51	Spy measurements done during descent to park (*PROVOR Iridium*)
52	Spy measurements done during descent from park to profile (*PROVOR Iridium*)
53	Spy measurements done during ascent to surface (*PROVOR Iridium*)

Table 4: Meaning of "information type" codes (column #3)

Date flag code	Meaning
1	Dated by a satellite
2	Dated by the float
3	Computed/estimated by a program
4	Manually modified
5	Coming from a human operator
6	Modified by a program
7	
8	
9	
99	Default value
+10	Need to be corrected from clock drift
+20	Corrected from clock drift at launch
+40	Corrected from clock drift

Table 5: Meaning of "date flag" codes (column #5)

NB: This table replaces TABLE D4 published in JAOT (2013), vol.30, n°4,759-788.

Of course, all DEP files available on http://wwz.ifremer.fr/lpo/ have been edited accordingly

Position flag code	Meaning
0	Float launch position
1	Given by Argos or GPS satellite system
2	Created (by extrapolation)
3	Created (by interpolation)
4	
5	
6	
7	
8	
9	
99	Default value
+10	Linear interpolation
+20	Linear + inertial interpolation

Table 6: Meaning of "position flag" codes (column #10)

Location class code	Meaning
‘0’	Argos location class #0 (precision ≥ 1000 m)
‘1’	Argos location class #1 (350 m ≤ precision < 1000 m)
‘2’	Argos location class #2 (150 m ≤ precision < 350 m)
‘3’	Argos location class #3 (precision < 150 m)
‘A’	Argos location class A (computed from 3 Argos messages)
‘B’	Argos location class B (computed from 2 Argos messages)
‘Z’	Argos location class Z (invalid)
‘G’	GPS location
‘9’	Default value

Table 7: Meaning of “location class” codes (column #11)

Measurement flag code	Meaning
0	No QC performed
1	Good data
2	Probably good data
3	Bad data that are potentially correctable
4	Bad data
5	Value changed
6	
7	
8	Interpolated value
9	Missing value
999	Default value
+10	Manually modified
+20	Modified by a program
+40	Corrected of the offset
+80	Not correctable of the offset

Table 8: Meaning of “measurement flag” codes (columns #14, #16 and #18)

Grounded flag code	Meaning
UF	U: user digit (finally used digit)
	F: float digit (information transmitted by the float)
0	Unknown information
1	Not grounded
2	Grounded
99	Default value

Table 9: Meaning of "grounded flag" codes (column #19)

Data origin or state code	Meaning
1	From PROF or TRAJ NetCDF file (Real Time data)
2	From TECH NetCDF file
3	Directly from Argos raw data
4	From decoded Argos raw data
5	From DAC decoded ASCII files (.profile from optimare or .TXT from Coriolis)
6	From META NetCDF file
7	From DEP file
8	
9	
99	Default value
+10	Manually modified
+20	Modified by a program
+40	Corrected from cycle number errors

Table 10: Meaning of “data origin or state” codes (column #20)