Note on “near surface” and “in air” data processing in the Coriolis Matlab decoder

At the 18th Argo Data Management (Hamburg/Germany, 29 Nov - 1 Dec 2017), a decision was reached about how to store surface oxygen data in the Btraj files (see Annex A).

This note explains how “Near surface” and “In air” data are processed and stored by the Coriolis Argo Matlab decoder. Only float versions managed at Coriolis are concerned.

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# End of ascending profiles for NKE floats

NKE float profiles span from profile start depth to the surface. During the shallowest phase of the ascent, 3 mechanisms are simultaneously involved: buoyancy management, CTD pump management and specific “Near surface” and “In air” data sampling.

## Buoyancy management

At the end of the ascending phase, when the float reaches a 10 dbar depth, the buoyancy control mechanism is switched-off and no additional pump activity is performed during a 10 minutes period.

After this 10 minutes period, the float activates its pump during a given period of N seconds (N is set by the *CONFIG\_PumpActionTimeBuoyancyAcquisition\_csec* configuration parameter) to acquire the final buoyancy needed for transmission.

After this 10 minutes + N seconds period, the float starts the transmission phase.

## CTD pump management

The float switches-off the pump of the CTD sensor at a prescribed depth (set by the *CONFIG\_CTDPumpStopPressure\_dbar* configuration parameter). It is generally set to ~5 dbar for Argos floats; for Iridium floats it can be modified during each surface session (generally set between 2 and 5 dbar).

## specific “Near surface” and “In air” data sampling

### Provor CTS3 and Arvor floats

Some Provor CTS3 and Arvor float versions (Coriolis versions 5.43, 5.44, 5.45, 5.74, 5.75, 5.64 and 5.65) have the ability to sample 2 additionnal sets of data: the “Near surface” and the “In air” ones.

Both sets of data are sampled during the same cycle (whose repetition rate is set by the *CONFIG\_InAirMeasurementPeriodicity\_NUMBER* configuration parameter), at the same sampling period (*CONFIG\_InAirMeasurementSamplingPeriod\_seconds*) and during the same duration period (*CONFIG\_InAirMeasurementTime\_minutes*). Thus, for the concerned cycles, 2 sets (with the same number of samples) are collected. These measurements are dated by the decoder (the date of the first measurement of each float message is provided by the float, the following dates are set by the decoder according to the sampling period).

The sampling of “Near surface” data starts after the 10 minutes period of pump inactivity.

The sampling of “In air” data starts after the N seconds period of pump final activation.

End of Ascent threshold (typ : 10 dbar)

10mn acquisition before End of Ascent decided by float

**“Near Surface” measurement**

**Pump Action to retrieve nominal buoyancy**

**“In Air” measurement**

Transmission

*« In Air » acquisition strategy*

Float has reached surface, with small positive buoyancy

Float has nominal buoyancy for transmission

### Provor CTS5 floats

Provor CTS5 floats are able to sample “In air” data.

The sampling of “In air” data starts after the 10 minutes period of pump inactivity, at the beginning of the N seconds period of pump final activation.

# Split of profiles

## NKE PTS floats

The NKE PTS floats (Provor CTS3 and Arvor) provide a PTS profile which spans from profile starting depth until the surface.

As the CTD pump is switched-off during the ascent, this profile is split by the decoder at the pump cut-off pressure to create a “Primary sampling: averaged []” profile (stored in PROF file at N\_PROF=1 index) and a “Near-surface sampling: averaged, unpumped []” profile (stored in PROF file at N\_PROF>1 index).

The pressure value used to split the profile is retrieved:

* For Argos floats: from the *CONFIG\_CTDPumpStopPressurePlusThreshold\_dbar* configuration parameter;
* For Iridium floats: from the PTS value of the last ‘raw’ pumped measurement of the profile (transmitted by the float and stored in the TRAJ file with the MC=599).

## NKE DO floats

The NKE DO (only) floats (Provor CTS3 and Deep Arvor) provide a PTSO profile which spans from profile starting depth until the surface.

The oxygen measurements are aligned, by the float firmware, at the CTD pressure levels.

The provided profile is split by the decoder along the sames rules as for the NKE PTS floats.

## NKE BGC floats

The NKE BGC floats (Provor CTS4 and CTS5) provide a profile for each sensor mounted on the float.

Each profile includes the measurements sampled by the sensor and have its own pressure axis, i.e. the measurements are not necessarily aligned at the CTD pressure levels.

The CTD sensor profile is split by the decoder along the same rules as for the NKE PTS floats. **This is not the case for the optode sensor profile.**

# “Near surface” and “In air” data processing and storage

## For NKE floats

### For NKE DO floats without the “Near Surface & In Air” feature

For these floats no additional information is stored in the TRAJ file.

### For NKE DO floats with the “Near Surface & In Air” feature

The “Near Surface & In Air” feature is activated on some cycles (which repetition rate is set by the *CONFIG\_InAirMeasurementPeriodicity\_NUMBER* configuration parameter).

When this feature is not activated, no additional information is stored in the TRAJ file (i.e. no duplication of the “Near-surface sampling: averaged, unpumped []” profile measurements).

When this feature is activated, additional information is stored in the TRAJ file:

* Concerning “Near surface” data set:
  + PPOX\_DOXY parameter is computed and added to the data (with oxygen intermediated parameters);
  + As these measurements are sampled after Ascent End Time (10 dbar) (associated MC=600) and before Transmission Start Time (associated MC=700), the reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700+10=710.
* Concerning “In air” data set:
  + PPOX\_DOXY parameter is computed and added to the data (with oxygen intermediated parameters);
  + As these measurements are sampled after Ascent End Time (10 dbar) (associated MC=600) and before Transmission Start Time (associated MC=700), the reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700+11=711.

### For NKE BGC floats

Only Provor CTS5 floats provide “In air” measurements.

For these data, additional information is stored in the TRAJ file:

* PPOX\_DOXY parameter is computed and added to these measurements (with oxygen intermediated parameters);
* As these measurements are sampled after Ascent End Time (10 dbar) (associated MC=600) and before Transmission Start Time (associated MC=700), the reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700+11=711.

Provor CTS5 floats also provide temperature measurements sampled during the transmission phase. They are stored in the TRAJ file with the MC=800-1=799.

## For Apex floats

### For Apex Argos floats

Some Apex Argos float versions (APF9 floats with Coriolis versions 093008, 021208, 032213, 082807, 020110 and 090810) provide surface measurements sampled by DO, FLNTU or FLBB sensors.

In some of the concerned float manuals we can read that "A new optode/FLNTU surface measurement is made each time a new message block is transmitted." (extract from float version 082807 manual). Thus in that case the reference MC to use is Transmission End Time (MC=800).

For these floats, additional information is stored in the TRAJ file:

* PPOX\_DOXY parameter is computed and added to these measurements (with oxygen intermediated parameters);
* The reference MC used is MC=800 and they are stored in the TRAJ file with the MC=800-1=799.

### For Apex Iridium floats

#### Apex APF9 floats

Some Apex Iridium float versions (APF9 floats with Coriolis versions 030410, 030512, 092813, 073014 and 102815) provide surface measurements sampled by DO or FLBB sensors.

In these float version manuals we can read that "Usually, only one telemetry cycle is required to upload the data to the remote host computer. However, sometimes the iridium connection is broken or the quality of the connection is so poor that the float will abort the telemetry attempt, wait a few minutes, and then try again. Data blocks 4 and 5 will be repeated for each telemetry cycle of a given profile." (note that surface measurements are in Data block 4).

In the .log files we also see that surface measurement is done just before GPS location determination and could be repeated when something failed during the transmission phase.

Thus in that case the reference MC to use is Transmission Start Time (MC=700).

For these floats, additional information is stored in the TRAJ file:

* PPOX\_DOXY parameter is computed and added to these measurements (with oxygen intermediated parameters);
* The reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700-1=699.

#### Apex APF11 floats

Apex APF11 Iridium float versions, equipped with an oxygen sensor (Coriolis version 2.11.1) provide DO surface measurements

Hugh FARGHER from TWRC informed us that:

“The ‘MEASURE’ command is based on the SCOR Working Group 142 recommendation. In particular, on surfacing, 10 oxygen measurements are taken at 15-second intervals before & after inflating the are bladder. The resulting data (recorded in the science\_log file) should provide enough quality control data to ensure high long-term accuracy for oxygen readings.”

Thus, for these floats, additional information is stored in the TRAJ file:

* Concerning measurements sampled before bladder inflation:
  + PPOX\_DOXY parameter is computed and added to these measurements;
  + As these measurements are sampled after Ascent End Time (associated MC=600) and before Transmission Start Time (associated MC=700), the reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700+10=710.
* Concerning measurements sampled after bladder inflation:
  + PPOX\_DOXY parameter is computed and added to these measurements;
  + As these measurements are sampled after Ascent End Time (associated MC=600) and before Transmission Start Time (associated MC=700), the reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700+11=711.

## For Navis floats

Navis floats provide 3 distinct sets of “Near surface” or “In air” measurements:

* One set of “Near surface” samples;
* Two sets of “Surface” samples: one sampled with the bladder deflated, the second sampled with the bladder inflated.

For these data, additional information is stored in the TRAJ file:

* Concerning “Near Surface” samples (provided by the Aanderaa 4330 optode):
  + DOXY and PPOX\_DOXY parameters are computed and added to these measurements and stored in the TRAJ file;
  + DOXY parameter is computed and added to these measurements and stored in the PROF file, in the same profile as the remaining DOXY data (i.e. not in a dedicated “Near-surface sampling: []” profile).
  + As these measurements are sampled after Ascent End Time (associated MC=600) and before Transmission Start Time (associated MC=700), the reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700-10=690.
* Concerning “Surface Bladder deflated” samples:
  + PPOX\_DOXY parameter is computed and added to these measurements;
  + As these measurements are sampled after Ascent End Time (associated MC=600) and before Transmission Start Time (associated MC=700), the reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700+10=710.
* Concerning “Surface Bladder inflated” samples:
  + PPOX\_DOXY parameter is computed and added to these measurements;
  + As these measurements are sampled after Ascent End Time (associated MC=600) and before Transmission Start Time (associated MC=700), the reference MC used is MC=700 and they are stored in the TRAJ file with the MC=700+11=711.

# Annex A: Conclusion about how to store surface oxygen data in the Btraj files

At the 18th Argo Data Management (Hamburg/Germany, 29 Nov - 1 Dec 2017), a decision was reached to abolish MC=1100, and move the assignment of surface data in the Btraj files back to the “true” MCs in the following manner:

~~X – 10 = in-water samples, part of end of profile, shallower than nominal 10dbar~~

~~X – 20 = in-water samples, part of surface sequence~~

~~X – 30 = in-air samples, part of surface sequence~~

~~X – 1 = individual surface observations~~

X – 10 = in-water samples, part of end of profile, shallower than nominal 10 dbar

X + 10 = in-water samples, part of surface sequence (guidance in RT: before air-bladder inflation / before max. buoyancy)

X + 11 = in-air samples, part of surface sequence (guidance in RT: after air-bladder inflation / after max. buoyancy)

X – 1 = individual surface observations

Data to include should all be in PPOX\_DOXY.

~~Users should be warned that the distinction between x-10, x-20, x-30 is known definitively for some floats (e.g. some newer Apf9i APEX with Optode), but is only a best guess estimate for other floats (e.g. PROVORs).~~

Users should be warned that the distinction between X-10, X+10, X+11 is known definitively for some floats (e.g. some newer Apf9i APEX with Optode), but is only a best guess estimate for other floats (e.g. PROVORs).

The X + 10 / X + 11 codes apply only for X = 600 (AET), 700 (TST) and 800 (TET), i.e., when the float is at the surface.