Pressure offsets in Argo floats

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The starting point

All floats make a measurement of pressure while on the surface

This can be used to adjust pressure to remove sensor offsets

Different float models use this information in different ways

Some floats (PROVOR, SOLO) apply the surface offset to the pressure data on board the float, so "corrected" data are sent ashore. Others (APEX) send raw data, together with a note of the offset

The first problem

Until recently, APEX floats ignored and discarded negative pressure offsets !

Originally, the surface pressure was used for an engineering check, to avoid operating the CTD pump at depths less than 5 metres. A positive offset meant that the CTD pump should be switched off at higher sensor pressure; a negative offset was unimportant for the pump was reported as zero.

Since most offsets were positive, this wasn't a major operational problem and was slow to be fixed

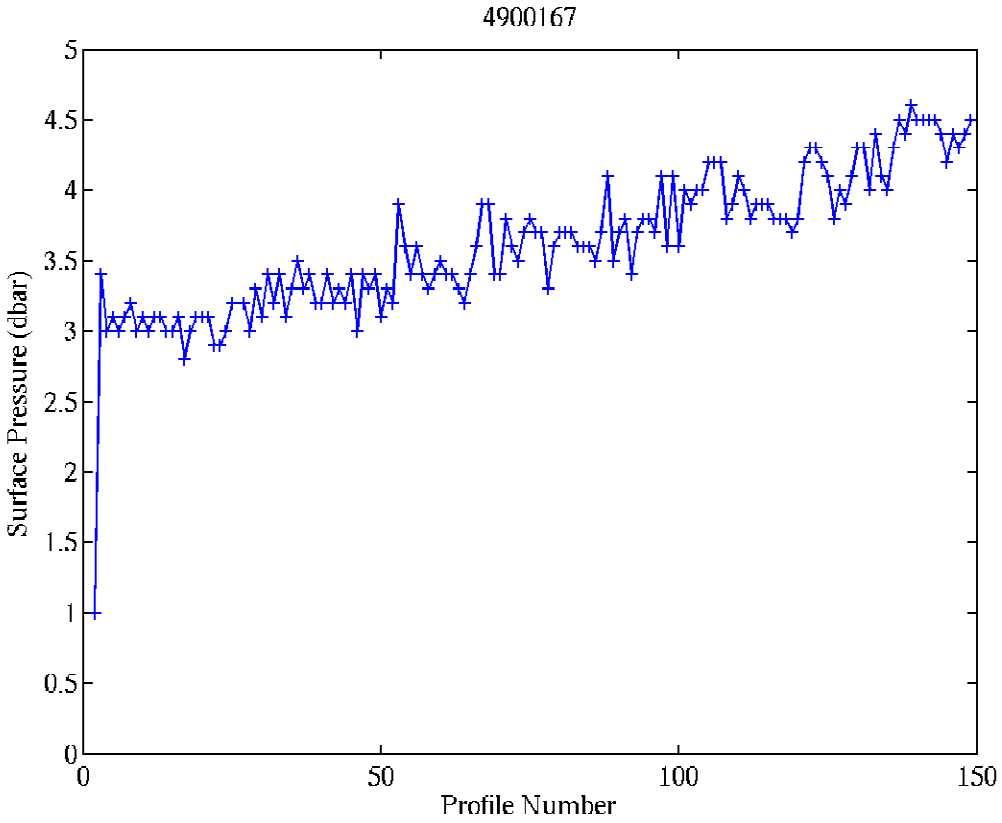


Figure 1. Reported sea surface pressure (SSP) vs. profile number from Argo Float 4900167, an APEX 260 with APF8 controller and an Ametek pressure sensor located in the Bering Sea. Note that even in the Bering Sea, the RMS variation about the long-term drift is a few tenths of a dbar.

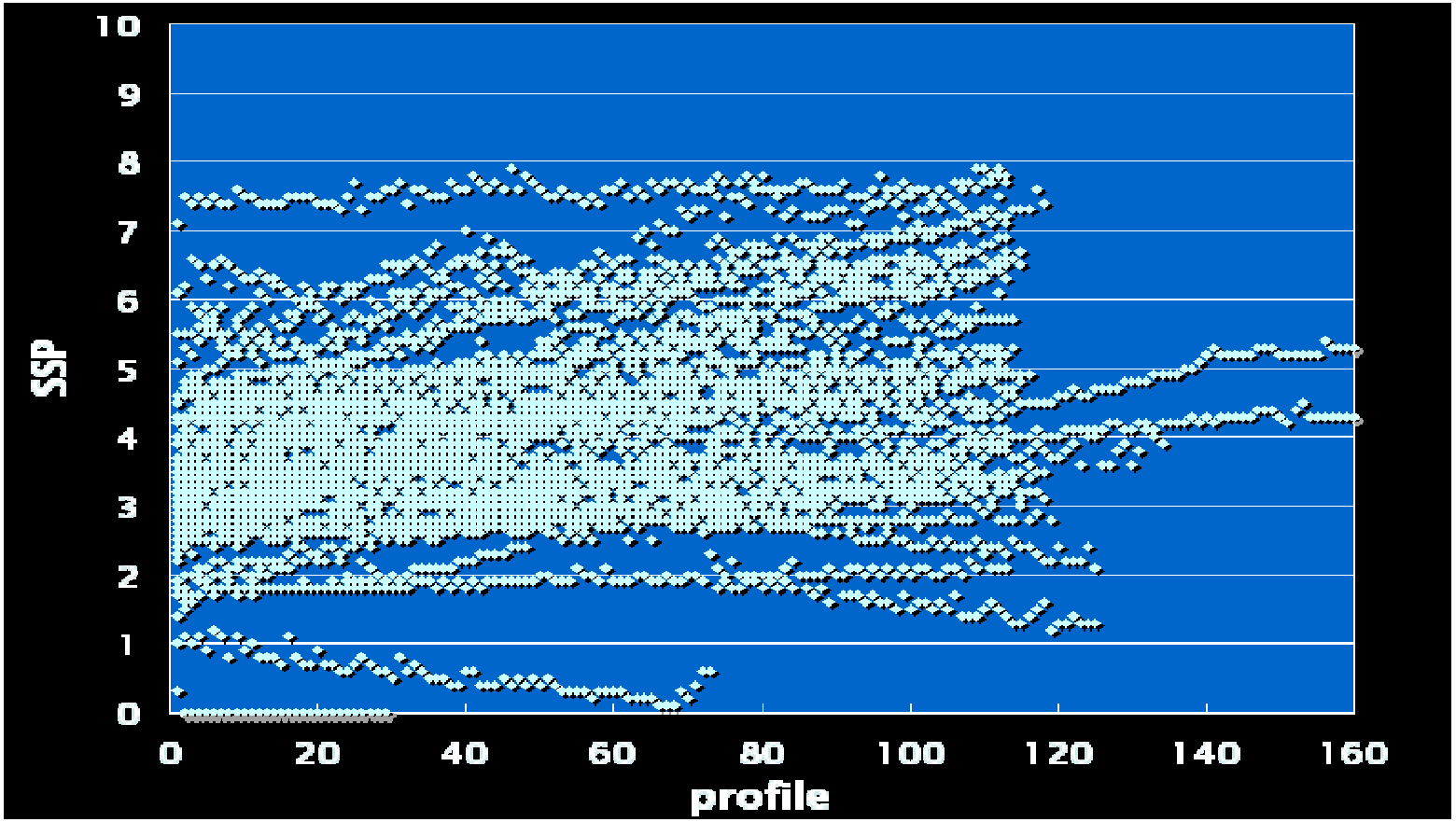
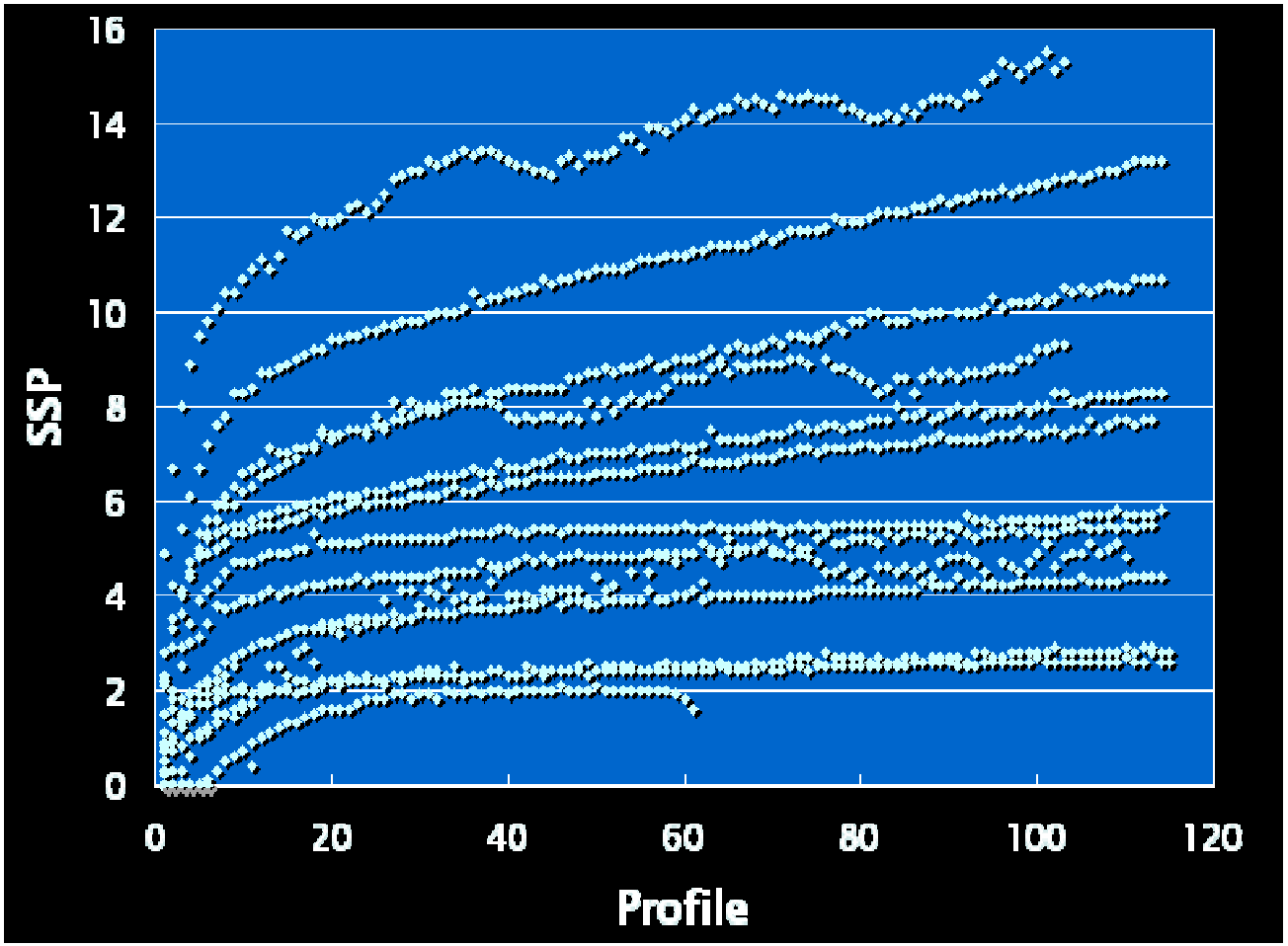


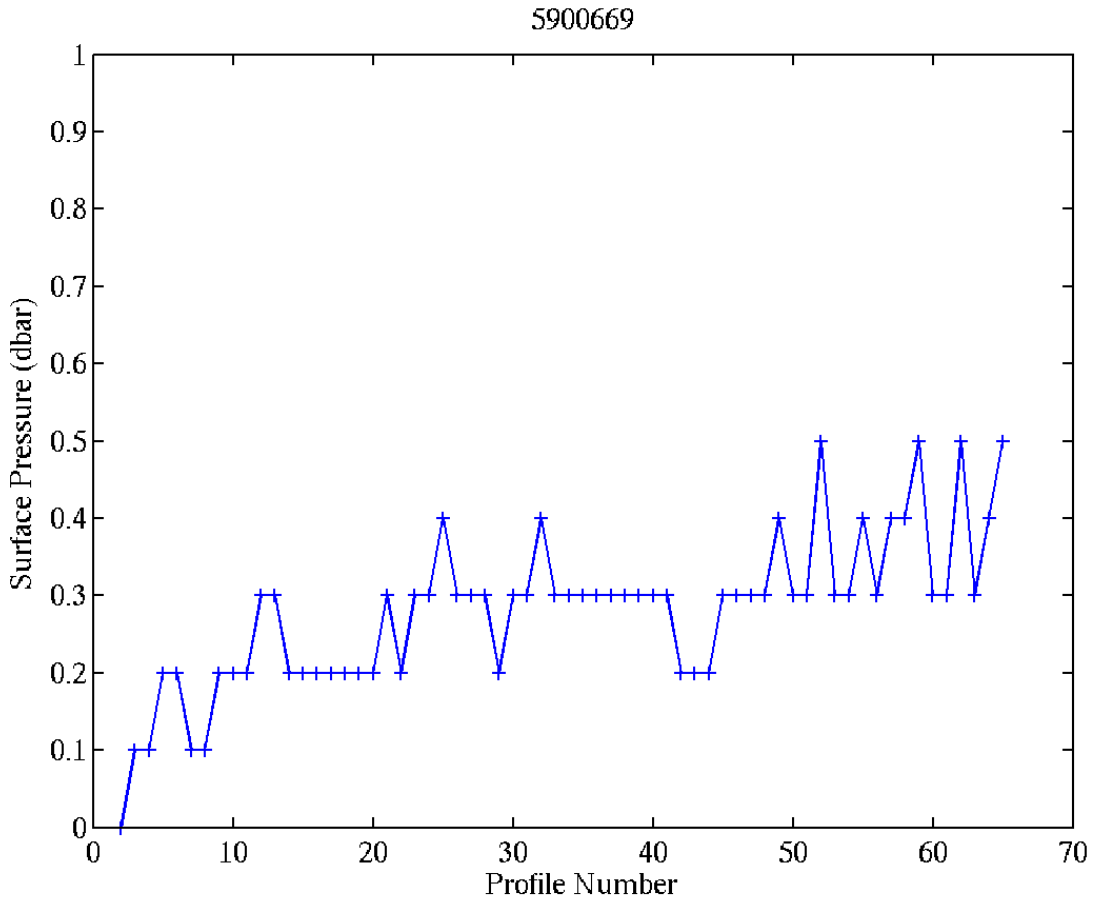
Figure 2. Reported sea surface pressure (SSP) vs. profile number from JAMSTEC Argo Floats equipped with Ametek pressure sensors.



- Figure 3. Reported sea surface pressure (SSP) vs. profile number from JAMSTEC Argo Floats equipped with Paine pressure sensors.

191 PMEL APEX with Druck pressure

51 apparently negative offset
36 apparently near zero
104 apparently positive, but small < 1 dbar



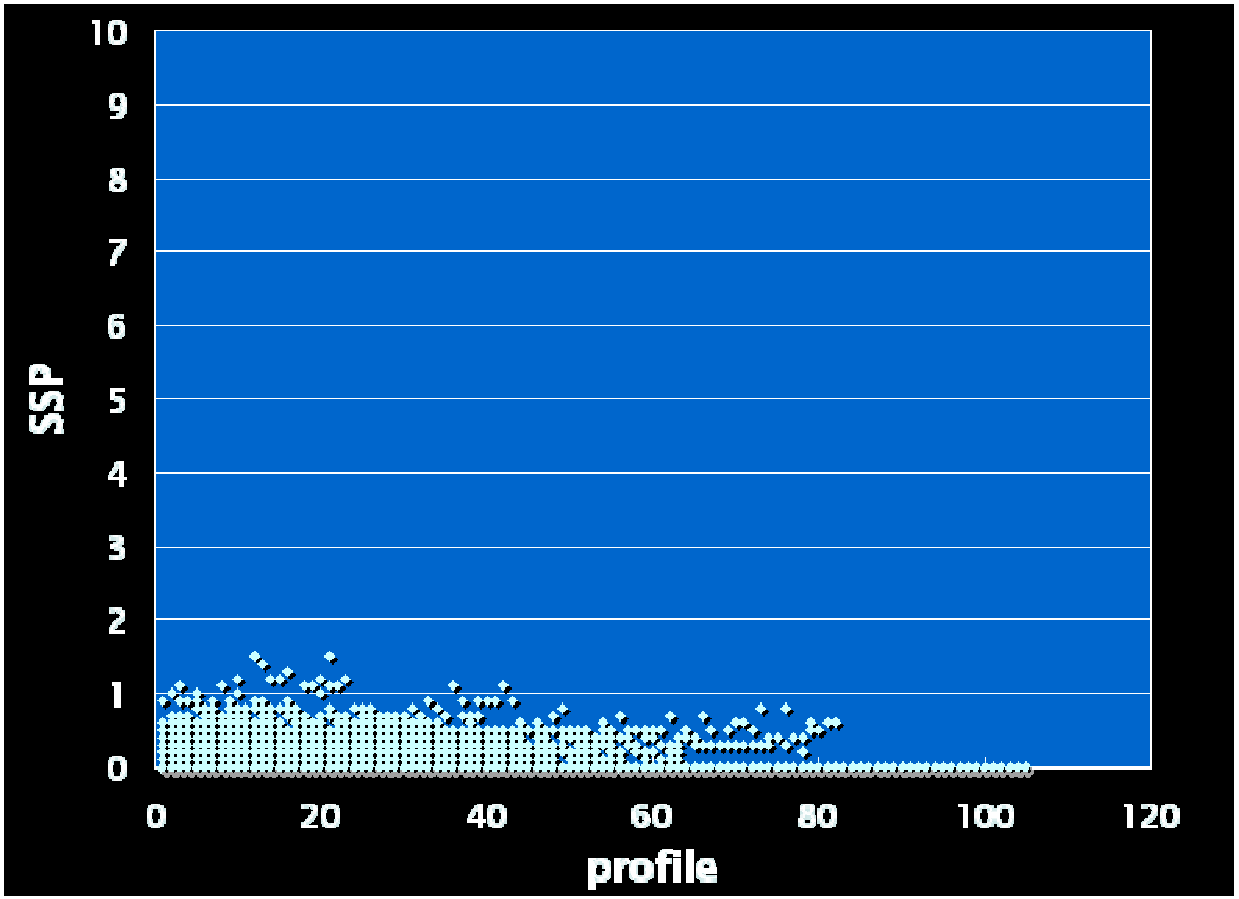


Figure 5. Reported sea surface pressure (SSP) vs. profile number from JAMSTEC Argo Floats equipped with Druck pressure sensors.

The view in DMQC: The “easy” cases

All Ametek and Paine pressure sensors on APEX floats **should be adjusted** for the surface offset. The offsets are nearly all positive and significant.

Warning to data users:

Some, but not all, R-files have the correction applied in PRES_ADJUSTED

Some D-files do not have this correction yet

“…users are advised to assess the impact of uncorrected data on their applications, and if necessary either wait for corrected data or apply corrections to the unadjusted pressure data based on surface pressure values stored in the float technical files”

A harder choice:

How should we adjust APEX floats with Druck sensor and truncated pressure offset ?

Later versions of the APEX float controller
(modified ‘APF-8’ and all ‘APF-9’)
correctly report +ve and -ve pressure offsets.

A detailed study of 200 such floats showed that the offsets with Druck sensors were generally small
(< 1 dbar) but with a small +ve bias.

Two choices for Druck pressure offsets from truncating APF-8 APEX controllers

1) Adjust all Druck offsets: then a small bias will be introduced because small negative offsets will not be corrected

2) Do not adjust small Druck offsets: then a small bias will be introduced because the mean of small offsets is +ve

Status of pressure data from truncating APF-8 APEX controllers

1) The definitive recommendation of how to adjust these data in DMQC has not been agreed.

2) For users performing calculations (eg heat content) that could be sensitive to pressure offsets

(i) the safest option is adjust all +ve offsets and to discard all profiles for which the surface pressure offset is reported as zero.

(ii) Repeat calculations with subsets of floats that do or do not truncate surface pressure (eg APEX/ PROVOR/ SOLO, or APF-8/APF-9

A new problem - Druck microleaks

At DMQC-3 in Sep 2008, this was thought to occur in less than 5% of sensors

Could occur in any SBE CTDs delivered since 2007
Applies to all float types

Arises from a change in manufacturing procedure by Druck

Recent stats: greater than 10% occurrence in floats deployed in 2008, could be up to 30%

Can take 500 days at 1000 dbar to show up, so full impact on Argo array may not yet be known

What does the problem look like ?
(Photo and data from Dana Swift, UW)

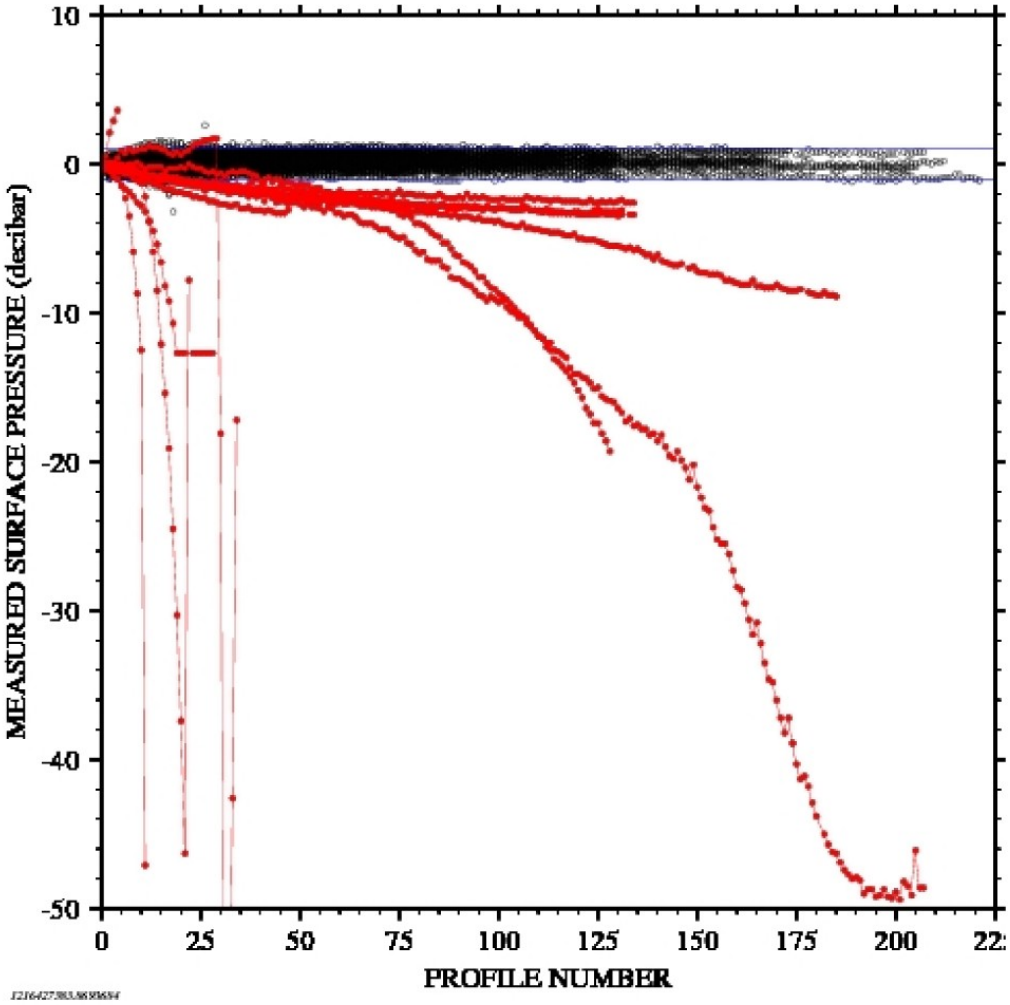


Figure 3

Figure 4

Argo's response

1) Float deployments suspended from April 2009, until a solution is found. See notices on Argo project office web site (http://www.argo.ucsd.edu/seabird_notice.html).

2) SBE working urgently on a solution with Druck. SBE has also been working on a new sensor with Kistler, which may be ready for deployment soon.

3) There is now a backlog of floats awaiting modified CTDs. When a reliable solution has been found, Argo will prioritise the deployment opportunities. This is being done with an emphasis on maintaining the global array. High-priority deployments will be first in line for reliable sensors.

Summary

1) The DMQC adjustment of Pressure for some APEX floats is still propagating through the system, as DMQC operators have time to implement the recommendations

2) There is no definitive agreement or practice on how to handle truncated negative offsets in APEX APF-8s

3) Users making pressure-critical calculations must consider the potential limitations of some profiles

4) Methods have been agreed to enable adjustment of pressure in APEX floats in RT streams. Uptake will be by RT DACs as programming resources permit.

5) The impact of the Druck microleak problem is not yet fully known (watch for updates at www.argo.ucsd.edu)