US NATIONAL DATA MANAGEMENT REPORT

20th ADMT

September 1st 2018 – September 1st 2019

STATUS

US Argo Data Assembly Center at AOML

The US Argo Data Assembly Center (DAC) at AOML is responsible for processing of Argo data obtained from all US floats. During the reporting period the DAC has received real-time data from 2,541 floats and sent more than 85,00 profiles to the GDACs. In addition to this, the US Argo DAC distributed meta, technical and trajectory files in the Argo NetCDF files to the GDACs as part of the real-time processing.

The DAC distributed over 75,000 Argo profiles to GTS in the BUFR format (excluded from this are NAVOCEANO floats, which are sent to GTS by NAVOCEANO), where 95 % of them reached the system within the 24 hours.

The distribution of real-time profiles to both GDACs was improved with, on average, about 95% of them available within 24 hours (see Figure 1).

The DAC also passes the files on to the GDACs that come from delayed-mode processing, BGC float processing and auxiliary files. For this purpose, the DAC maintains an ftp server for file exchanges, both for providing reprocessed R-mode and meta files as well as for receiving D-mode files, real-time submission of data from Iridium floats and the submission of deployment information.

The US Argo DAC added 307 new floats to the processing system, 40 of them were deployed in collaboration between AOML and WHOI . As part of this collaboration, the US Argo DAC is finding ships of opportunity and provides ship riders for selected cruises. Recent maps showing their positions with link to graphics of the data collected by the floats can be found at:

https://www.aoml.noaa.gov/phod/argo/opr/php_forms/deployment_maps.php

The US Argo DAC is maintaining a website that provides documentation and information about the operations: http://www.aoml.noaa.gov/phod/argo/index.php

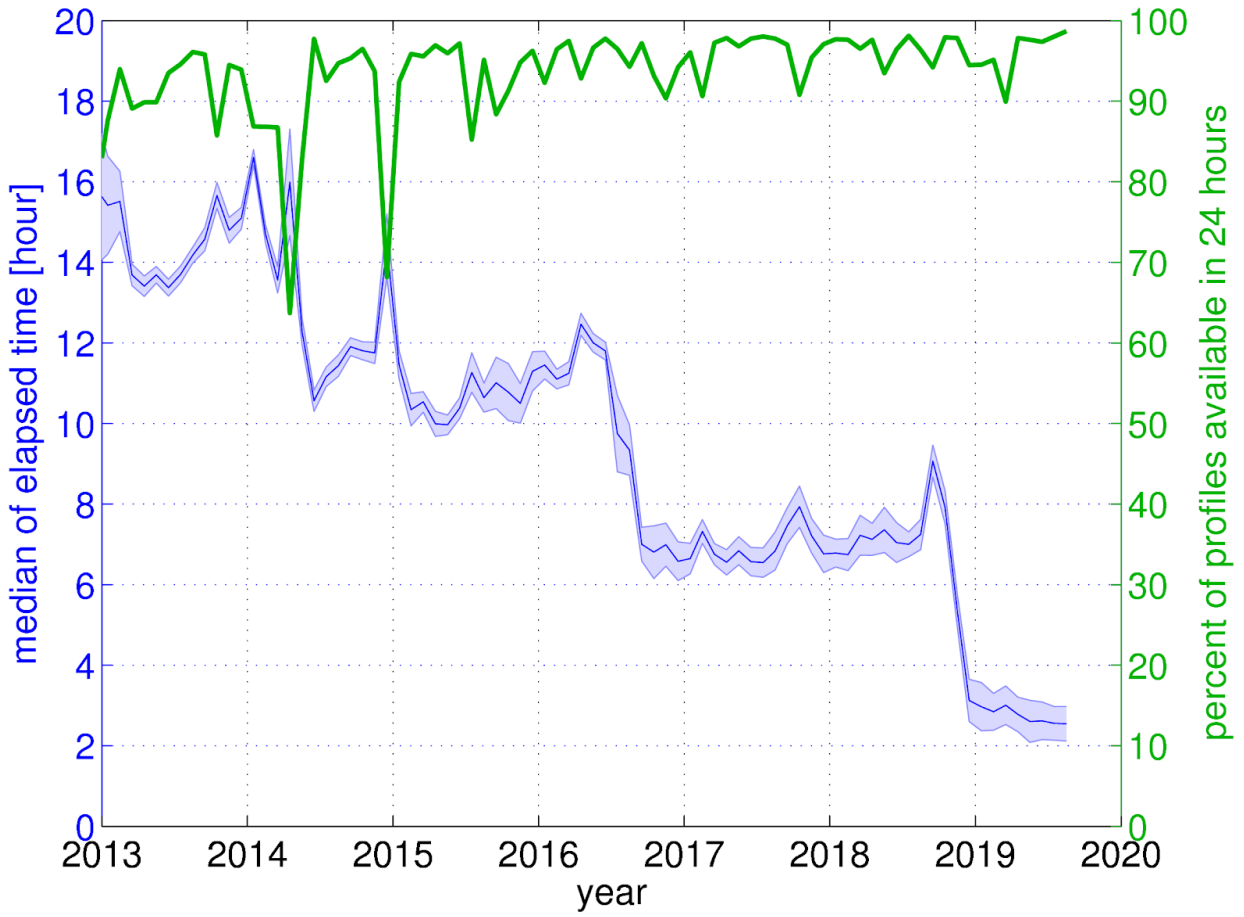

Figure 1: median of the difference between the time of the profile and the time of submission to the Argo GDACs (elapsed time, blue). The shading represents the standard error. The percentage of profiles available to users in 24 hours is also shown (green).

Developments at the US Argo DAC

The software use d for decoding data from Iridium floats that come in as msg files was updated to adapt to changes of these files with respect to detection of under ice profiles (which lack a GPS fix) and for re-processing of cycles without a GPS fix that are not related to a float being under ice (e.g., the more recent cycle with position is not provided at the same time as the cycle that does not have a position). Problems with the initial approach started because of more recently deployed that do not always indicate whether ice was detected or not.

The decoder and quality control software was updated to handle the issue of erroneous dates due to the GPS rollover problem, Essentially, two distinct cases occurred when the GPS reached 1024 weeks: (1) the year jumped to 2038; (2) the year jumped to 2099 and went from there to 2000. For the files with year 2038 or 2099, the fix was straightforward because the internal clock provided the date. Once the GPS year became 2000 in case (2) the float date was reset to match the GPS date. This will not be detected by any of the standard QC tests for profile files. To handle these cases correctly, it became necessary to use

the launch time of the affected float as a baseline. Once a case has been identified as a GPS rollover problem, the date is corrected (the time of day is not affected by the rollover; the date is adjusted by adding 1024 weeks). The correct date for case (1) can be determined using the other dates/times recorded by the float (e.g., ascend end time).

Various smaller changes to the quality control and software were implemented as well: (1) improvement of the regional test to better handle floats in the Red Sea and Mediterranean Sea; (2) ensure that the interpolated positions are never added to the trajectory files; (3) improvement of the algorithm determining which position is most suitable for the profile file. (4) ensure that profile files without a primary profile comply with the GDAC requirements. (5) change the handling of JULD_LOCAITON and POSITION_QC for profiles with a GPS fix that comes without a date/time (still waiting for acceptance of the best option in the absence of a variable JULD_LOCAITON_QC: POSITION_QC='1' and JULD_LOCATION=FillValue).

Suggested improvements of the information in the csv generated on the basis of objective analysis to improve flagging of the pprofile data. These improvements are the added entries START_IMMLEVEL, STOP_IMMLEVEL, PROFILE NUMBER. The software was changed to take advantage if these to take advantage of the robust matching of flags with the appropriate pressure levels (crucial for high resolution near surface profiles from STS sensors, for example). The only remaining problem has to do with cases where some levels are all fill value (and thus excluded from the objective analysis; which can lead to values in START_IMMLEVEL, STOP_IMMLEVEL that do not match the levels in the profile NetCDF file.

Sensor related information in the meta files controlling the processing system has been updated, mainly for some BGC sensors and new meta NetCDF files were created.

Multiple software changes were done to improve the availability of timing information, mainly for the trajectory files. In addition to this, new software was developed to process data from Argos SOLO floats when the hex data are insufficient to decode the profile and engineering data. Once completed, the missing cycles can be added to the trajectory files. In addition to that a software packages was developed to add error ellipses info into the trajectory files. After some final testing we will implement that software.

DELAYED MODE QC:

The US Argo DAC receives the Delay mode Argo profiles from US delayed-mode operators and verifies their contents to ensure soundness of the files if requested.

Each US Argo institution has provided information on their delayed-mode processing which was added to this report.

NOAA/PMEL

As of 25 September 2019, PMEL had 186,159 D-files at the GDAC that were more than one year old, comprising 94% of the total of 197,302 PMEL profiles that were older than one year at that time. Last year, on 4 November 2018, PMEL had 161,550 D-files at the GDAC that were more than one year old, comprising 90% of the total of 178,865 PMEL profiles that were older than one year at that time. So, John Lyman's and Kristene McTaggart's DMQC efforts resulted in a net increase of 24,609 DMQC profiles for profiles older than one year, (one-third more than) the 18,437 profiles that became older than one year during that time. They have made good progress towards clearing the last 10% of the PMEL DMQC backlog.

John Lyman and Kristene McTaggart are continuing their DMQC work. John Lyman is also continuing work on streamlining our DMQC GUIs and processing. As an alternative to the SIO GUI1 routine, John has developed an alternative flagging routine that displays more windows with more plotting options, including plotting just the profiles that have bad flags verses all profiles that have been autocorrected. There is an option to QC all or some profiles, an option to save data in order to come back to it later without losing your work, and an option to view previously QC'd profiles. A very useful option displays buoyancy frequency to identify density inversions. This GUI allows us to evaluate profiles faster and with greater accuracy.

The PMEL float DMQC procedure currently consists of the following steps: We perform an automated correction, with visual check, of reported pressure drifts and correction for the effect of these pressure drifts on salinity, as well as an automated correction of conductivity cell thermal lag errors following Johnson et al. (2007). We do visual inspection and modification of quality control flags for adjusted pressure, temperature, and salinity using the SIO GUI. We overwrite the raw Param_QC flags during this step as required. We use OW Version1.1, currently with CTD (2018V02) and Argo (2018V01) reference databases, and adjust run parameters to get appropriate recommended salinity adjustments. Errors in OW are computed directly from the least squares fit. We accept or reject the OW recommendations on the basis of comparison with nearly historical profiles using a new PMEL GUI recently written for this step.

Scripps Institution of Oceanography

Scripps Institution of Oceanography (SIO) has evaluated, as part of delayed-mode quality control (DMQC), a total of 248,998 Argo stations (profiles). This is an increase of 17,486 stations (479 nominal float years) since the previous Argo Data Management Team (ADMT) Report (November 13, 2018). This count represents 98.5% of the SIO DMQC-eligible stations (older than 12 months). The above numbers include SIO Core and Deep Argo floats, all Argo New Zealand floats, 7 NAVOCEANO floats deployed from the Peruvian vessel Zimic, and 2 floats donated to Argo Mexico.

SIO expects to maintain a high DMQC completion percentage during the coming year and will continue to revisit the profile data of floats every 7-9 months. The consensus standard DMQC procedures for SOLO/SOLOII/Deep profile data were continued in 2019.

During the year, the trajectory data from 16 end-of-life SIO Argos SOLO floats were finalized through DMQC after which a Dtraj netCDF was created and passed to the GDAC. This process most notably included the estimation of float cycle timing, including float arrival and departure from the surface, and

the full quality control of all Argos position data. There are now 972 DMQC trajectory netCDF ('Dtraj') data files available at the GDAC from SIO Argos floats (98% complete). DMQC on the few remaining Argos SOLO trajectory data will be ongoing as the floats cease transmitting data. The DMQC of trajectory files from SOLOII/Deep floats with Iridium data transmission are completed as part of the standard 7-9 month DMQC revisiting pattern. The 'Dtraj' netCDF files from SIO Iridium floats include those cycles which have been DMQC'd as well as all subsequent transmitted realtime data, resulting in only a single necessary trajectory netCDF.

Although not often considered a DM file, the V3.1 meta file contains information shared between both the profile and trajectory netCDF, thus consistency across all three are required. Because of this fact, SIO has transmited DMQC meta files to the GDAC at the same rate as the trajectory files (98.9% total, 100% Iridium, 98.0% Argos).

Processing of incoming SBD email messages, and submission to AOML via ‘phy’ flat file, has been increased to every hour. This has been done to reduce the latency time before the data is posted to the GDAC. Due to delays in receiving SBD emails, SIO is transitioning to adding directIP delivery of the SBD data through the Iridium system. By using both pathways, the reliability of the SIO data within 24 hours will be improved.

SIO has actively participated in moving forward the priorities of the Argo Program during the year, most notably by Megan Scanderbeg's continued work with the BGC trajectory file. SIO continues to update the Argo Climatological Dataset for OW salinity calibration. John Gilson has worked with Susan Wijffels (WHOI), updating the change in behavior over time (serial number ranges) of the SBE41 and SBE41CP CTD sensor stability. Nathalie Zilbermann and Dean Roemmich have worked with Seabird to improve the calibration of the SBE61 CTD (0-6000dbar capability).

The SIO IDG built and designed SOLOII/Deep SOLO float firmware has been unchanged over the course of the year, except for minor internal bug fixes.

University of Washington

In 2019, delayed-mode activities at the University of Washington (UW) were focused on processing the CTD data from the Iridium floats because these were suspicious of the recent salty drift problem identified in SBE CTDs. These Iridium floats included those from the SOCCOM project. Between January and June 2019, CTD data from 487 UW Iridium floats were processed in delayed-mode. 13% of these had been adjusted for sensor drifts.

At UW, the salinity adjustment tool was upgraded to the OWC tool in 2019, used with the most recent CTD_for_DMQC and Argo_for_DMQC reference databases distributed by Coriolis.

MBARI (Monterey Bay Aquarium Research Institute)

File count shows that the US DAC has 23707 BD files (all less than 1 year old & at the GDAC) as well as 39830 BR files that were processed by MBARI.

Wood Hole Oceanographic Institution

During the period Sep 1st 2018 to Sep 30 2019, WHOI deployed 61 Argo floats and reported 16785 profiles to the GDAC from 432 unique platforms. The total number of WHOI profiles at the GDAC is now 202,133 profiles (142772 D-files, 59361 R-files). Of the profiles eligible for DMQC, 76.3% have been completed.

The majority of the WHOI fleet are MRV S2A instruments (342 floats) and there are still a few older SOLO-WHOI floats active (3 floats). WHOI has continued testing and limited deployments of the new platform, the MRV ALTO. There currently are 23 ALTOs operating, with the oldest having delivered 92 profiles. Work has continued to improve reliability, the surface behavior and ice avoidance algorithm to enable more Arctic deployments in the future. Three were recently deployed into the Arctic in deep water and we await to see if they survive the winter. One float deployed on the shelf and profiling frequently, did survive and has delivered winter data. WHOI will also deploy a test RBR-oxygen equipped ALTO this upcoming year.

Deb West-Mack has ongoing work to address the backlog of R-trajectory files from the early SOLO-WHOI floats. Sachiko Yoshida at WHOI continues to work on DMQC of NAVO floats and core WHOI floats. Sachiko is testing the new OWC drift assessment tool to compare its performance with the previous OW method. Tuning horizontal and time scales can be one way to minimize OW errors and misjudgment on false drifting where the historical data coverage is relatively sparse and not sufficient enough to represent the stable water mass in the area. DMQC of the near surface profiles reported by S2As is underway. Large spikes in the 1st and 2nd cycles are commonly seen in salinity profiles from recent deployed S2A in the secondary high resolution profiles (upper 50 meter). The cause of this remains unknown. Wijffels worked with John Gilson to update the global analysis of salinity drift against CTD serial numbers, revealing that a new serial number range in the 8000's are also prone to faster than normal drift. Wijffels has also updated and made plots of N2 and salinity anomalies available to the Argo community.

In collaboration with float CTD manufacturer SBE and RBR, WHOI acquired both RBR and SBE CTDs against a ship board CTD system on the RV Armstrong in November, 2018. Analysis is underway and will be presented at the AST-20. Intercomparison data for the RBR Argo CTD will be also collected of the RV Investigator in October 2019 and the RV Armstrong in November 2019.

Germany/BSH

NAVOCEANO: 10 floats with 1990 profiles; 1843 D-files; 93%

NAAMES/US (E. Boss): 13 floats with 2854 profiles; 2736 D-files; 96%