U.S. Argo National Report to AST-18, March 2017.

Organization of U.S. Argo:

The U.S. Argo Program is supported with major funding provided by the National Oceanic and Atmospheric Administration (NOAA), and additional participation of the U.S. Navy. It is implemented by a U.S. Float Consortium that includes principal investigators from six institutions: Scripps Institution of Oceanography (SIO), Woods Hole Oceanographic Institution (WHOI), the University of Washington (UW), the Atlantic Oceanographic and Meteorological Laboratory (AOML), the Pacific Marine Environmental Laboratory (PMEL), and the Naval Research Laboratory (NRL/Monterey). Float technology development, production, deployment, array monitoring, and data system functions are distributed among these institutions on a collaborative basis.

In addition to U.S. Argo floats, Argo-equivalent floats have been provided from a number of U.S. float groups, programs, and principal investigators. A notable U.S. Argo-equivalent program is Southern Ocean Carbon and Climate Observations and Modeling (SOCCOM). SOCCOM, with support from the National Science Foundation and in partnership with U.S. Argo, has 65 operational floats at present (source: AIC) equipped with biogeochemical sensors in the Southern Ocean, and has plans to increase the size of its array to 200 floats in the coming years. The contributions of all Argo-equivalent partners are gratefully acknowledged.

The present 5-year cycle of U.S. Argo implementation began in July 2015, and extends through June 2020.

Objectives:

During the present 5-year cycle, U.S. Argo will sustain its contribution of half of the Core Argo array, while enhancing coverage on a regional basis (high latitudes, western boundary and equatorial regions, marginal seas) as recommended through sustained ocean observing system community activities and endorsed by the AST. These coverage enhancements will only be implemented if sufficient resources are available to maintain the original Argo coverage and the data quality of the Argo array. Further improvements in data quality, timeliness, and resolution are planned, along with ongoing extensions to float lifetimes and cost-effectiveness.

A major enhancement to Argo is the implementation of Deep Argo to extend sampling to the ocean bottom (to pressures as high as 6000 dbar). As a key component of the Deep Ocean Observing Strategy (DOOS), Deep Argo is needed to close regional and global budgets of heat, freshwater, and steric sea level, and for exploration of deep ocean circulation. Deployment of several regional Deep Argo pilot arrays is being undertaken to test floats and sensors, to aid in global array design, and to demonstrate the capability to deploy on a regional basis. U.S. Deep Argo deployments will be integrated with planned contributions of international partners.

Status:

The support level for U.S. Argo is determined on a year-to-year basis. Support levels for Core U.S. Argo have remained flat since 2004, during which time the number of floats deployed has diminished by about 11 floats per year due to inflation. Through technology improvements leading to increases in the mean lifetime of floats, the number of active U.S. floats remains approximately equal to the high levels achieved since 2008. Further increases in lifetime will be realized by a changeover in SOLO-II floats to hybrid lithium batteries to mitigate passivation losses. However, the present number of yearly deployments is not sufficient to sustain U.S. Argo. An augmentation by about 46 floats in 2016 increased the number of deployments last year and it is hoped this increase will continue.

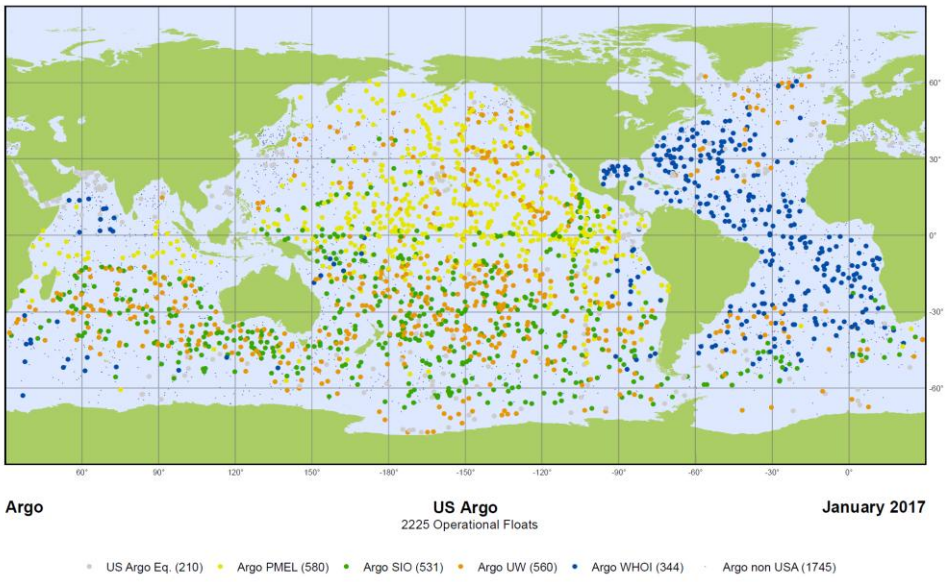

Fig. 1*: Location of operational U.S. Argo Program and U.S. Argo Equivalent floats as of January 2017. (Source: AIC)*

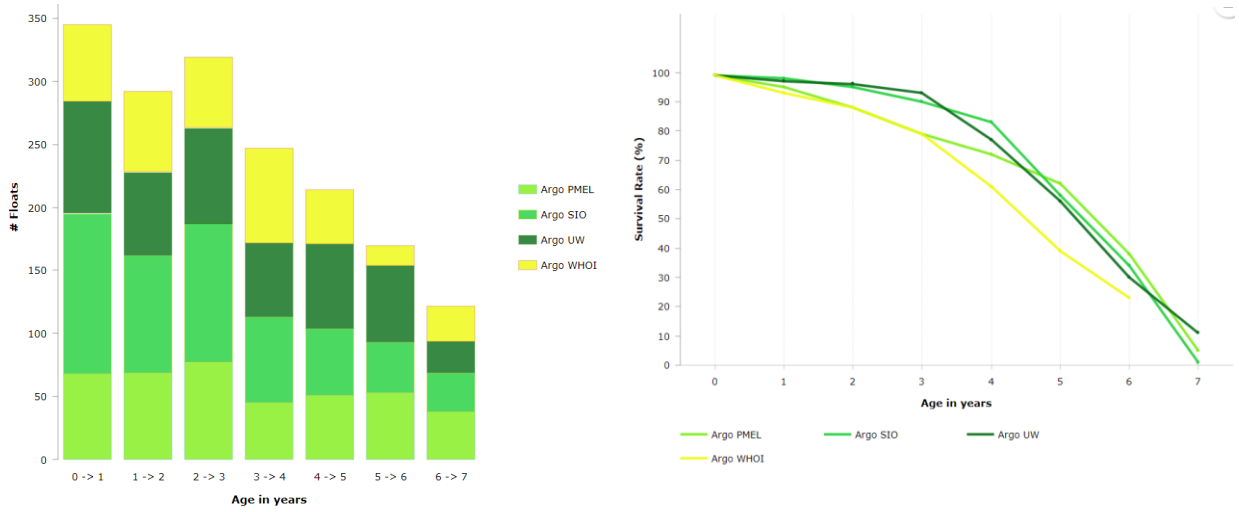

Fig. 2: *Left panel – Age distribution of operational U.S. Argo Program floats deployed since 2010. Right panel: Survival rate of U.S. Argo Program floats deployed since 2010. (Source: AIC)*

There are presently 2015 operational U.S. Argo Program floats (Fig. 1) as of January 2017. The age distribution of operational floats deployed since 2010 is shown in Fig. 2, along with the failure rate for that sample. Of those floats that are at least 56 months old, 50% remain active (Float half-life = 56 months).

Support for U.S. Argo includes float production and deployment, technology improvement, communications, data system development and implementation for real-time and delayed-mode data streams, and participation in international Argo coordination, Regional Centers, and outreach activities.

Deep Argo:

Since 2011, U.S. Argo carried out development and testing of Deep Argo floats. These instruments profile to pressures as great as 6000 dbar, and are capable of more than 100 cycles. Successful prototype float deployments were carried out in 2013 – 2015, Deployment of regional pilot arrays was carried out in the SW Pacific Basin (Fig. 3 upper panel) in early and mid- 2016, and in the South Australian Basin in late 2016 (Fig 3 lower panel).

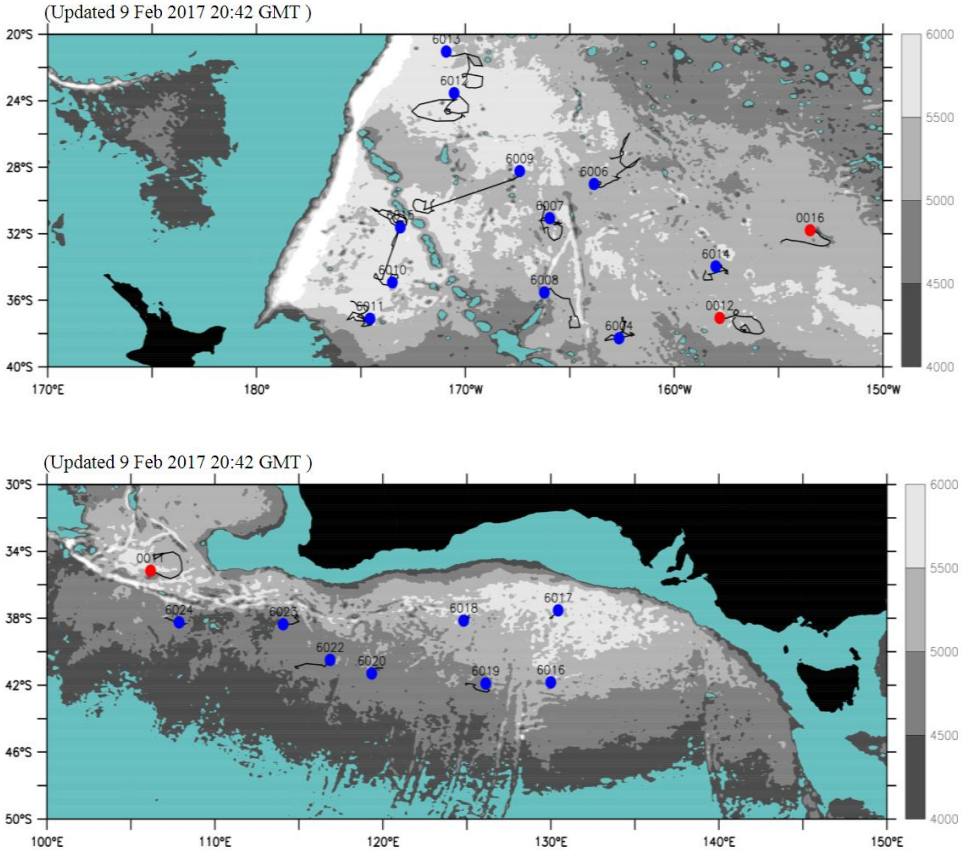

Fig. 3*: Location of 13 U.S. Deep Argo floats in the SW Pacific Basin (upper panel) and 8 in the South Australian Basin (lower panel). Deep SOLO floats are indicated in blue and Deep APEX floats in red.*

Testing of deep float models continues as well as testing of SBE-61 CTD accuracy. The SBE-61 has not yet achieved it aspirational goals of (± .001C, ±.002 psu, and ± 3 dbar) but is progressing relative to those goals (Fig. 4).

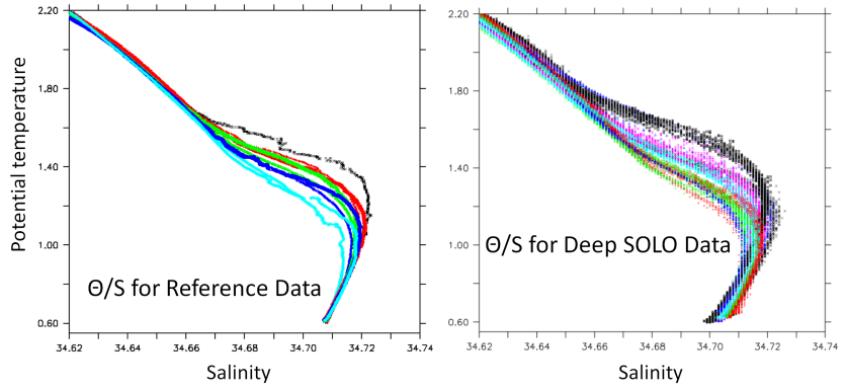

Fig. 4: *Deep Θ/S relation for CTD reference data (CLIVAR line P15S in 2009, left panel) in the SW Pacific Basin and for 11 Deep SOLO/SBE-61 floats in the SW Pacific Basin (right panel)*

Plans:

The highest priority for U.S. Argo is to sustain the Core Argo array. Specific plans for float deployments in 2017, as they evolve, are posted on the AIC deployment planning links. A major U.S./New Zealand/Australia Argo deployment cruise from New Zealand to Mauritius and back on RV Kaharoa was carried out in late 2016. This voyage deployed 118 Core Argo floats in the South Indian Ocean and 8 Deep Argo floats in the South Australian Basin (Fig. 3 lower panel). A Kaharoa cruise to Chile is planned in October 2017 to deploy Core Argo floats in the South Pacific, with 5 Deep Argo floats to be added to the regional array in the SW Pacific Basin. Three additional Deep Argo floats will be deployed in the same basin along CLIVAR line P06 (30°S) in mid-2017 by RV Palmer. A third regional pilot array, consisting of 6 Deep Argo floats, will be deployed along the moored array (RAPID) in the North Atlantic in March by RV James Cook (Fig. 5)

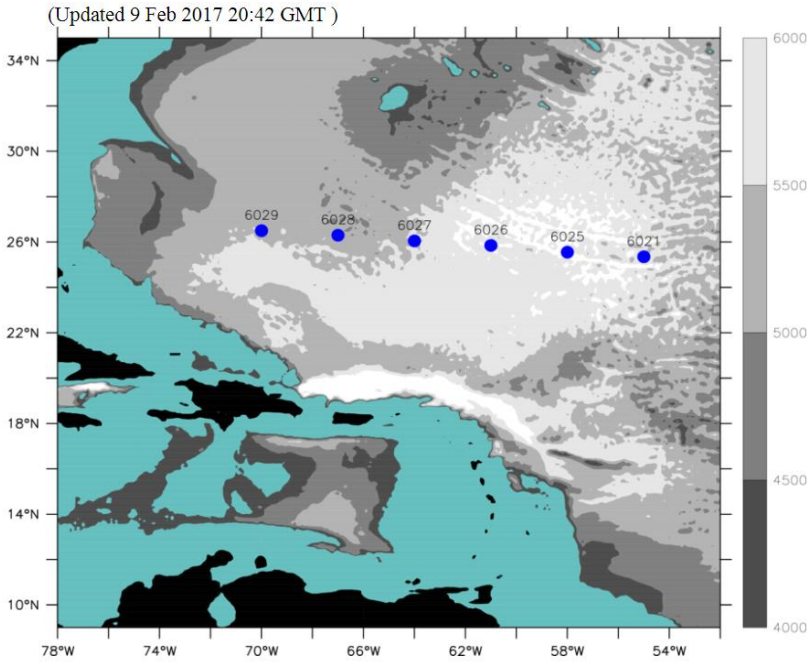

Fig. 5: Planned U.S. Deep SOLO deployments by RV James Cook in March 2017 in the NW Atlantic deep Argo regional pilot array.

The U.S. Argo Data Assembly Center (DAC) is based at NOAA/AOML. Real-time data from all U.S. Argo floats are transmitted via the GTS. GTS transmission uses parallel systems developed at AOML and housed at AOML and at Collect Localisation Satellites (CLS), implementing internationally-agreed quality control tests. The AOML data center serves as the national focus for data management and is the conduit for delayed-mode data to pass between the PIs and the GDACs. During 2016, processing of delayed-mode files continued but was slowed somewhat by adoption of new file formats.

In addition to the national DAC, a Global Data Assembly Center (GDAC) is run as part of the GODAE server, located at the Naval Research Laboratory, Monterey. The two GDACs at NRL/Monterey and IFREMER/Brest are mirror images in their assemblies of Argo data from all international partners, and are responsible for dissemination of the data. Several U.S. institutions participate in Argo Regional Center activities, including AOML's role as focus for the South Atlantic ARC.