AST-21: Data and Communications

Friday 17th, 2020

Welcome

- Susan and Toshio sharing chairing today
- Brian King is the moderator

Data Management

Status report from the working group on "Fast salinity drift"

Working group was established at ADMT-20 in Villefranche 2019 : Matthew B. Alkire (UW), TVS Udaya Bhaskar (INCOIS), Cecile Cabanes (IFREMER), John Gilson (SIO), Birgit Klein(BSH), Kanako Sato (JAMSTEC), Megan Scanderbeg (UCSD), Annie Wong (UW)

Aim: Investigate the behaviour of Seabird CTD fast salty drifters, temporal behaviour of drift and limits of correctability, including analysis of potential depth dependence of drift

Term "fast salty drift" is used for floats which show unusually rapid, strong salinity drift early in their life with $\Delta s > 0.05$ psu or $\Delta s > 0.01$ psu per cycle.

These issues have been identified to be most prevalent in SBE serial number ranges 5800-6800, 8000-8800 and of late a more recent range with unclear span >9400, the upper 10000 to early 11000s

Ideas from ADMT-20 how to examine vertical dependence of drift:

I. Look for examples of fast salty drift in deep floats in stable near bottom water masses. Run OWC in multiple levels (2000, 3000, 4000, 5000 dbar) and see how corrections differ or agree

   John has worked on SIO Deep Solo floats in the SW Pacific Deep Argo Pilot array and reported on their behaviour (7 floats total)

II. Elsewhere look for examples of fast salty drift in Core Argo floats were tight TS-regions exist (Indian Ocean, Atlantic Ocean central waters) and compare shallow versus deep levels to look for vertical dependence

   In the Atlantic shallower reference levels in the Central Waters have been used by European DM- operators in comparison to deep (2000 dbar) levels and the behaviour has been analyzed (Birgit, Cecile, Guilio, Kamila). But conclusions are difficult due to high variability levels Atlantic. JAMSTEC: North Pacific 6 of 25 show depth dependence. Uday (INCOIS) working in Indian Ocean.

III. Share lists of salty drifting floats (deployed since 2015) in order to group floats in near-by regions

   Reports are being collected on the European level (BODC, BSH, Coriolis, LOPS, OGS) and have been made available at a github repository; JAMSTEC has started list of all fast salty drifters deployed since 2014.

Tentative Conclusions Up Front:

- Depth dependence identified in Deep Solo data for strong salty drift ($\Delta S>0.2$ psu, 2 of 3 floats). Drift is weaker with increasing depth (2000dbar vs 5000dbar), prior to catastrophic failure (e.g. $\Delta S>0.1$psu per cycle).

- Several Core Argo float examples from NA, NP appear to show depth dependance when salinty drift is strong (stronger drift at deeper levels). More averaging across floats/regions is required for confidence.

- In some strong drift examples, the onset of depth-dependence occurs soon after drift begins

- Hints that the rate of change of drift is important.

- For cases with mild to moderate drift, less conclusive results ($\Delta S<0.05$ psu).

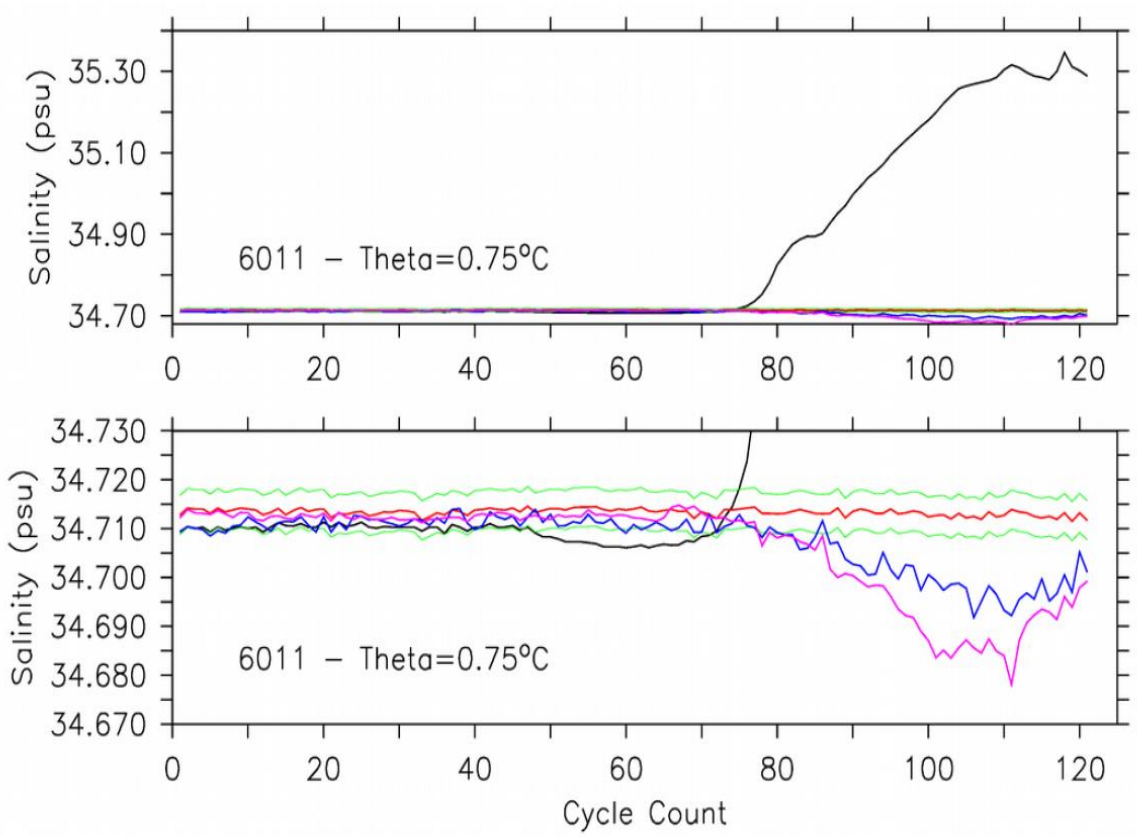
- More examples are necessary

Strongly Drifting Examples
$\Delta S > 0.05$ psu,
ΔS per cycle > 0.01 psu

Argo salinity data with these behaviours are typically marked bad (flag="4") in DMQC

Here we are not judging whether this data should instead be good, but seeing if depth-dependence of drift can be identified. And if it is seen, what amplitude of Anomalous salinity drift exhibits depth-dependence.

Example (WMO5903448) of a strongly drifting float ΔS > 0.05 from John's analysis of **Deep Solo floats** from SW Pacific:



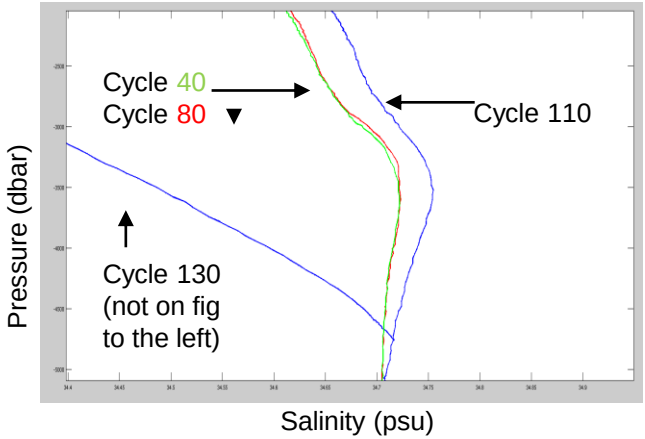
Raw data returned from float

Adjusted salinity (cycle by cycle) using deep pressure levels (4000-5000 dbar)

Associated error levels ±0.004psu

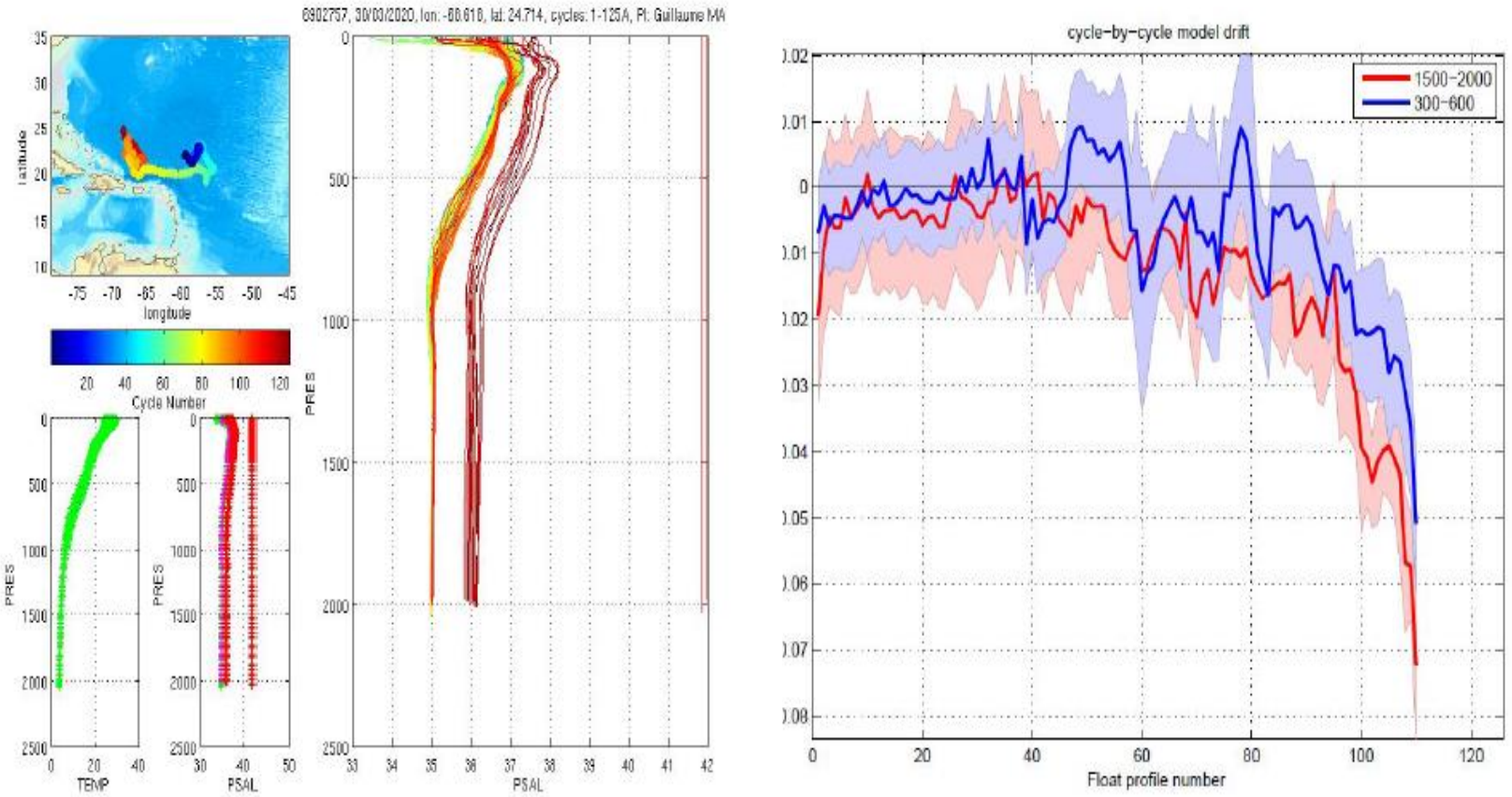
Adjusted salinity (cycle by cycle) using middle pressure layers (3000-4000 dbar)

Adjusted salinity (cycle by cycle) using shallow pressure layers (2000-3000 dbar)



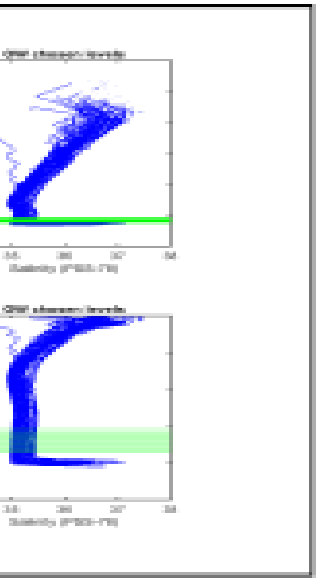
- Before cycle 73, variations in the corrections from the three reference levels does not agree exactly but within errors.
- Corrections derived from different levels diverge once ΔS > +0.1psu -> clear sign of depth dependence
- Shallower levels initially exhibit larger drift compared to deep reference levels, but then once drift becomes extreme (Cycle 130 > 0.6psu drift, inset), the deepest pressures drift strongest.
- Odd feature of reduced divergence after cycle 110, when rate of drift levels off

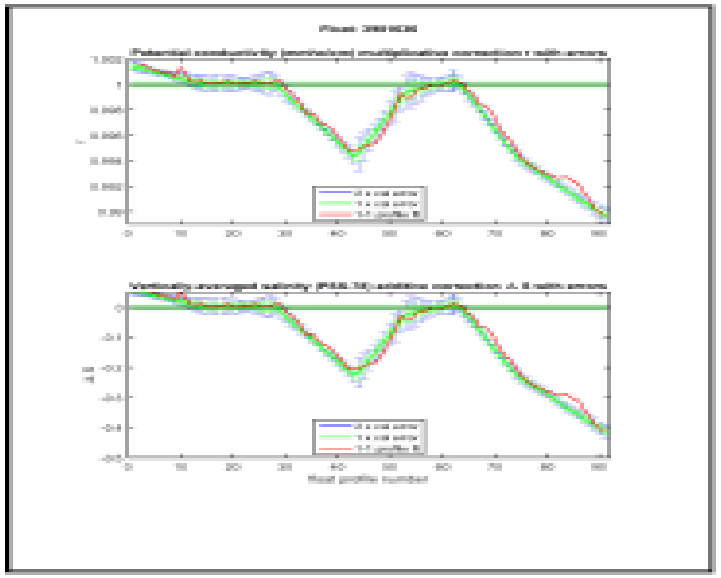
Example (WMO6902757) of a strongly drifting **Core float** ΔS > 0.05 from Cecile's analysis of floats from Atlantic:

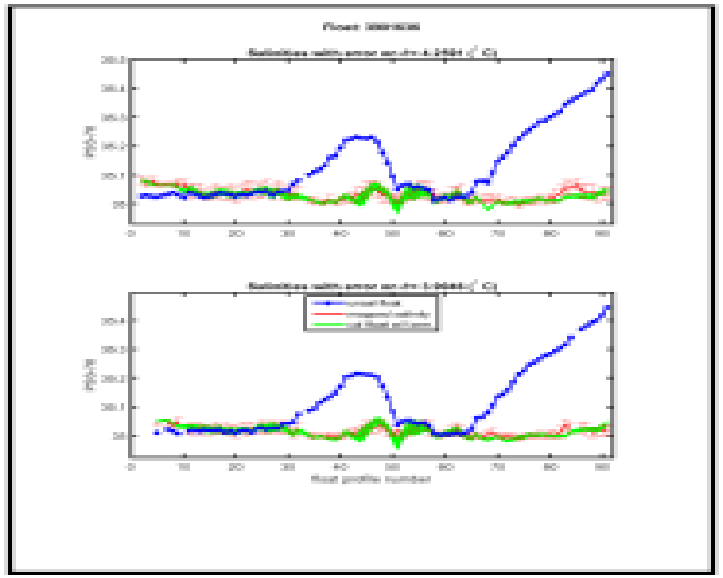


- Onset of drift around cycle 43 and worsening after cycle 95 which are flagged as '4' in DMQC
- Shallow reference levels in the central waters (300-600 dbar) compared to deepest levels (1500-2000m)
- More obvious divergence of deep and shallow reference levels when drift becomes large.

Example of floats with non-linear increase of drift or reversal of drift in strongly drifting cases (Birgit, WMO 3901636)







Strong up-and-down in Core float in the Atlantic (WMO3901636, Birgit) with reference levels at 2000 dbar.

Other groups see the same behaviour (e.g. SIO)

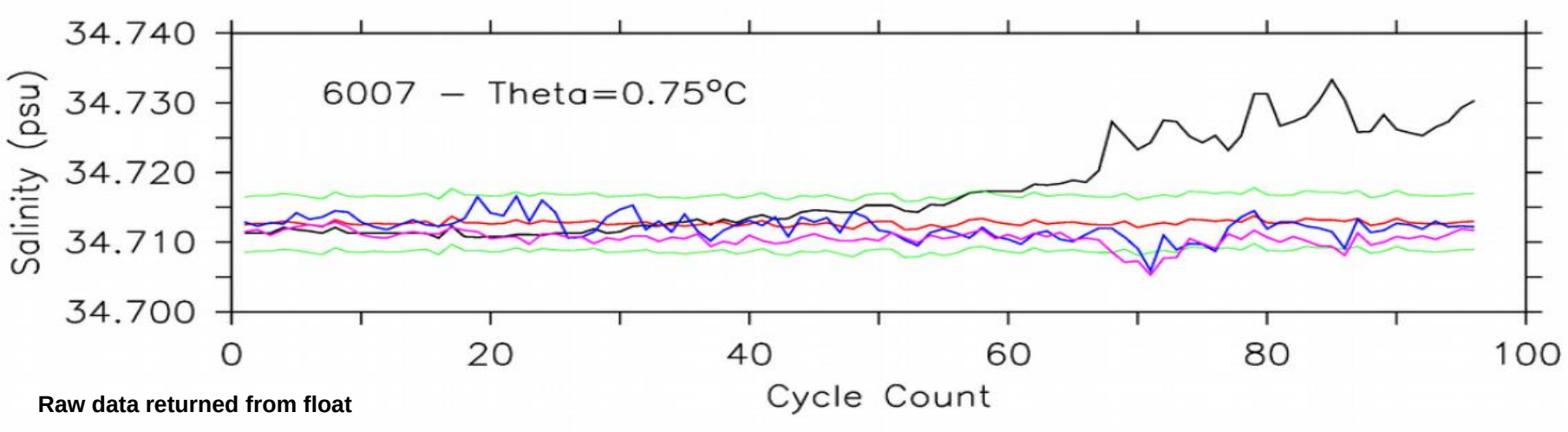
Seabird has indicated this behaviour is part of the cell failure, and not a recovery of the cell.

Mild/Moderately Drifting Examples
$\Delta S < 0.05$ psu

Argo salinity data with these behaviours are typically marked good (flag="1") in DMQC after a point-wise linear depth-independent correction

Can depth-dependent salinity drift be seen?

Example (WMO5902444) of a moderately drifting **Deep float** ΔS < 0.05 from John's analysis floats from SW Pacific:



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Adjusted salinity (cycle by cycle) using deep pressure levels (4000-5000 dbar)

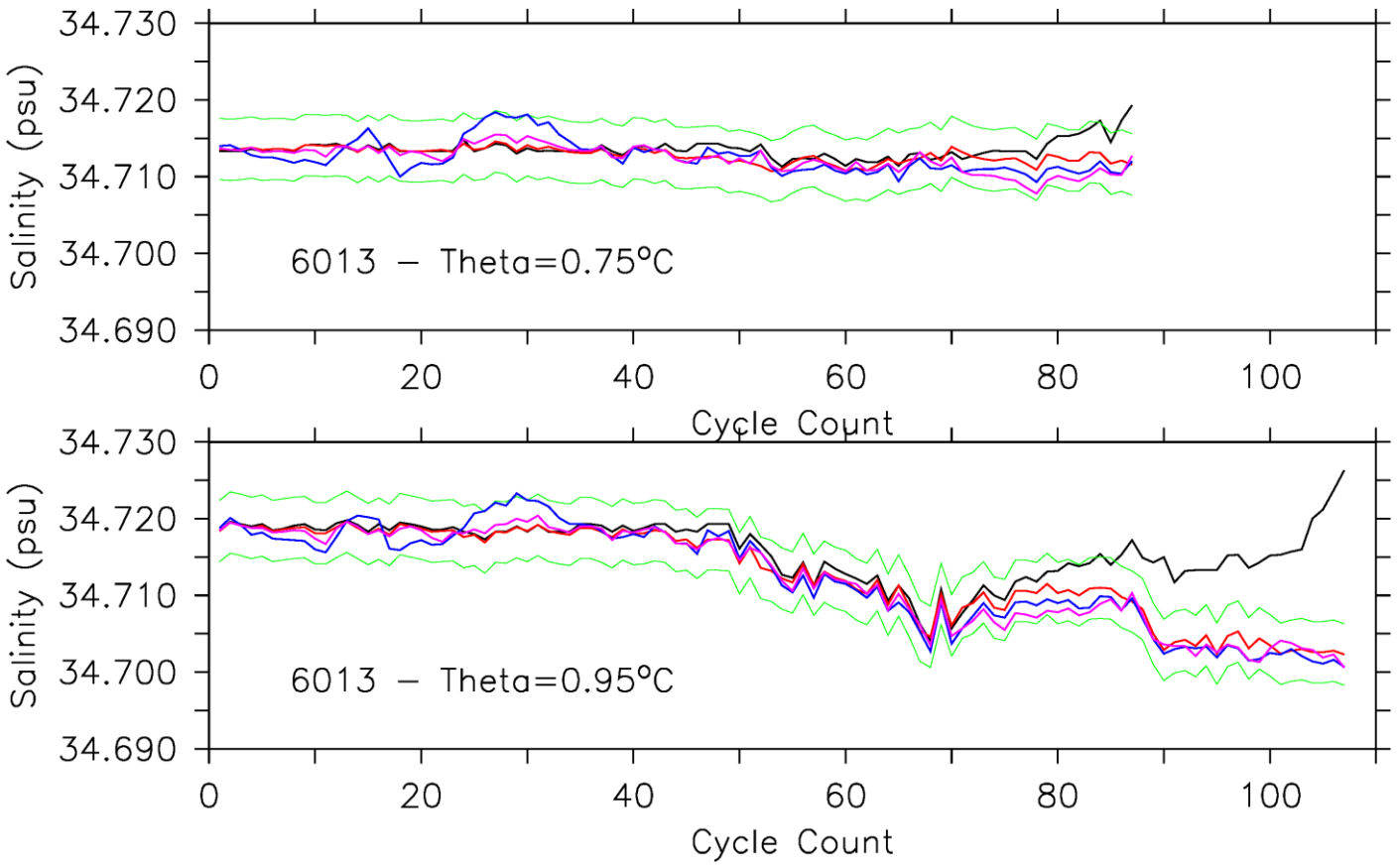
Associated error levels ±0.004psu

Adjusted salinity (cycle by cycle) using middle pressure layers (3000-4000 dbar)

Adjusted salinity (cycle by cycle) using middle pressure layers (2000-3000 dbar)

- Onset of drift around cycle 40 and mild salty drift but starts to show questionable cycle-to-cycle variability in cycle 68. In DMQC, PSAL flagged '4' after cycle 67.
- All three reference levels within error bars until cycle 67 and returns within errors 10 cycles later.
- Depth dependent differences in salinity offset not as clear here with smaller amplitude of drift. However the pattern remains consistent with stronger drifting examples.

Example (WMO5902457) of a moderately drifting **Deep float** ΔS < 0.05 from John's analysis floats from SW Pacific:



Raw data returned from float

Adjusted salinity (cycle by cycle) using deep pressure levels (4000-5000 dbar)

Associated error levels ±0.004psu

Adjusted salinity (cycle by cycle) using middle pressure layers (3000-4000 dbar)

Adjusted salinity (cycle by cycle) using middle pressure layers (2000-3000 dbar)

- Onset of drift around cycle 70
- All three reference levels within error bars although the 'pattern' of depth dependence appears near the start of drift.

Tentative suggestions for DMQC:

The anomalous salty drift threshold at which depth-dependence begins remains unclear. It is clear that at large positive salinity drift, depth-dependence can be observed, and that depth-dependence can start soon after salty drift starts.

The work here does not as of yet lead to modification of the procedures many DMQC groups already follow: to mark PSAL_QC and PSAL_ADJUSTED_QC as "4" (uncorrectable) when ΔS transitions towards +0.05 psu. DMQC guidance should reinforce that changes in salinity drift behaviour (e.g. Jumps, change in rate of drift) can indicate sensor failure.

It is suggested that a parsable string be standardized to fill the SCIENTIFIC_CALIBRATION_COMMENT variable, analagous to what was done with TNPD floats. Different strings may be suggested if depth-dependence is directly observed within the DMQC process, versus assumed based on drift strength.

Continued work is necessary with a goal of a distributable statement for Argo in early summer

Flagging and calculated adjusted Deep Argo data in real time

AST-21, April 2020

N. Zilberman, B. King, J. Gilson

Current status of Deep Argo DMQC

Deep Argo data at pressure < 2000 dbar are treated as Core Argo

Sea-Bird Real-time flag if pass real-time QC

- Pressure (PRES) = 1
- Temperature (TEMP) = 1
- Salinity (PSAL) = 1

RBR Real-time flag

- Pressure (PRES) = 3
- Temperature (TEMP) = 3
- Salinity (PSAL) = 3

Deep Argo data at pressure > 2000 dbar are grey listed

Sea-Bird Real-time flag if pass real-time QC

- Pressure (PRES) = 2
- Temperature (TEMP) = 2
- Salinity (PSAL) = 3

RBR Real-time flag

- Pressure (PRES) = 3
- Temperature (TEMP) = 3
- Salinity (PSAL) = 3

Pressure-dependent salinity correction

- Equation of measured conductivity

$$\boldsymbol{C_M = (g + h * f^2 + i * f^3 + j * f^4)/(1 + CT_{cor} * T + CP_{cor} * P)} \qquad \textbf{(1)}$$

f is instrument frequency, CT_{cor}=3.25e-06 is correction for thermal expansion,
T is temperature, CP_{cor}=-9.57e-08 (correction for compressibility of borosilicate glass)
P is pressure "M"= "Measured"

- Equation of adjusted conductivity

$$\boldsymbol{C_A = C_M * (1 + CT_{cor} * T + CP_{cor} * P)/(1 + CT_{cor} * T + CP_A * P)} \qquad \textbf{(2)}$$

"A"= "Adjusted"

CP_A is either a recommended estimate of CP_{cor} for all floats ~-1.1-1.3 e-07 or float-by-float estimate from DMQC operator

- Algorithm available to DMQC operators

Suggested action items for Deep Argo DMQC

- Keep real-time QC flag = 3 for **RBR** PRES, TEMP, and PSAL until performances are demonstrated
- Change real-time QC flag for **Sea-Bird** PRES, TEMP, and PSAL data at pressure > 2000 dbar to 1 if pass RT QC.
- Delayed-mode QC of **Sea-Bird** PSAL
  - PSAL_ADJUSTED is corrected for
    - Pressure-independent salinity offset, and pressure-dependent salinity offset due to compressibility of conductivity cell and pressure error
    - time-dependent salinity drift
  - PSAL_ADJUSTED_ERROR. Recommended minimum value of ~0.004 PSS 78
- Cookbook describing best practices for Deep Argo DMQC will be available

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- Temperature (TEMP) = 3
- Salinity (PSAL) = 3

Deep Argo data at pressure > 2000 dbar

Sea-Bird Real-time flag if pass real-time QC

- Pressure (PRES) = 2
- Temperature (TEMP) = 2
- Salinity (PSAL) = 3

RBR Real-time flag

- Pressure (PRES) = 3
- Temperature (TEMP) = 3
- Salinity (PSAL) = 3

Pressure-dependent salinity correction

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A brief update on Machine Learning of Argo (DM)QC

G. Maze, S. Tokunaga, T. Carval, R. Le Guen (IFREMER)

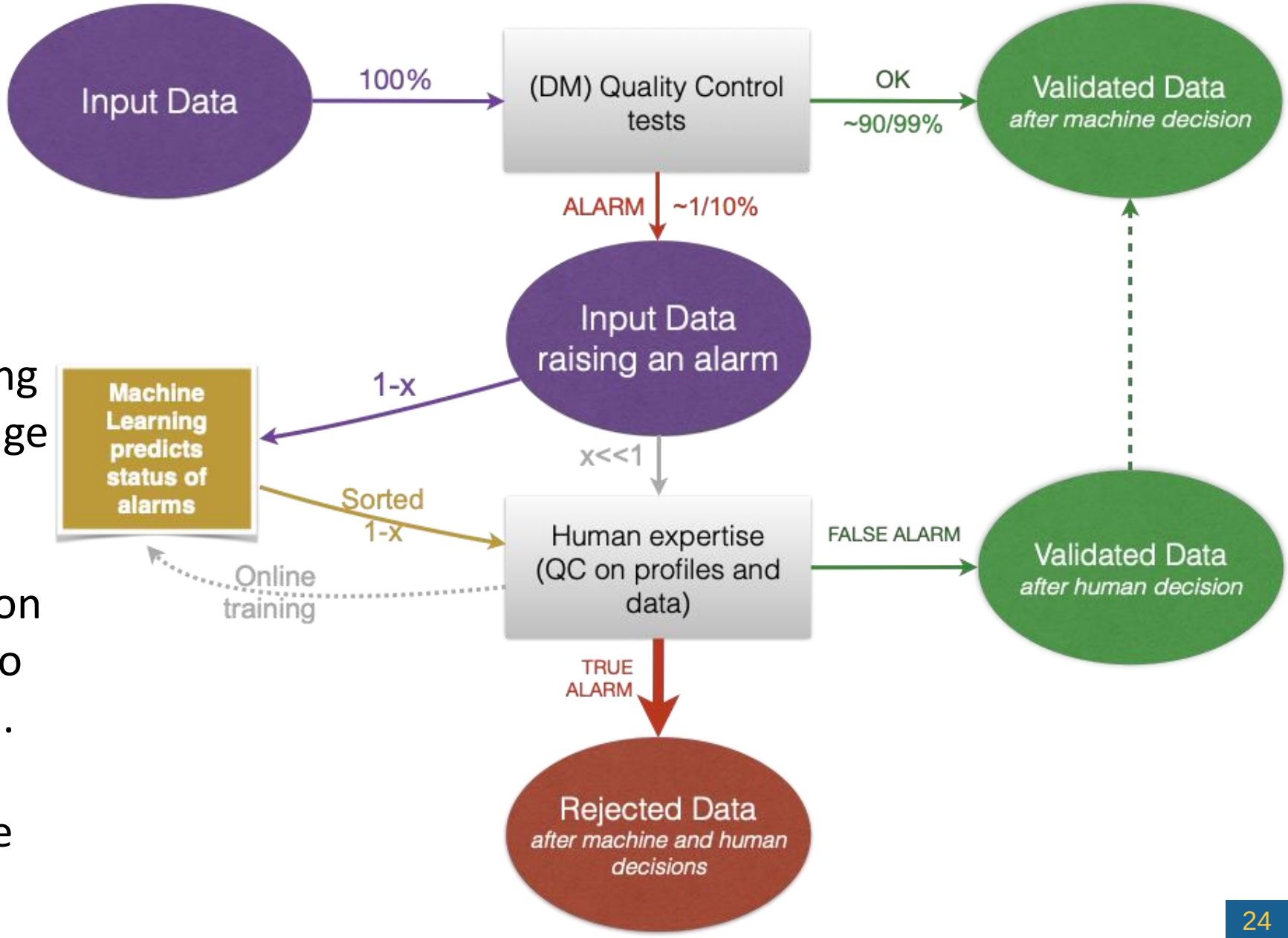
#EARISE

Improve QC workflow

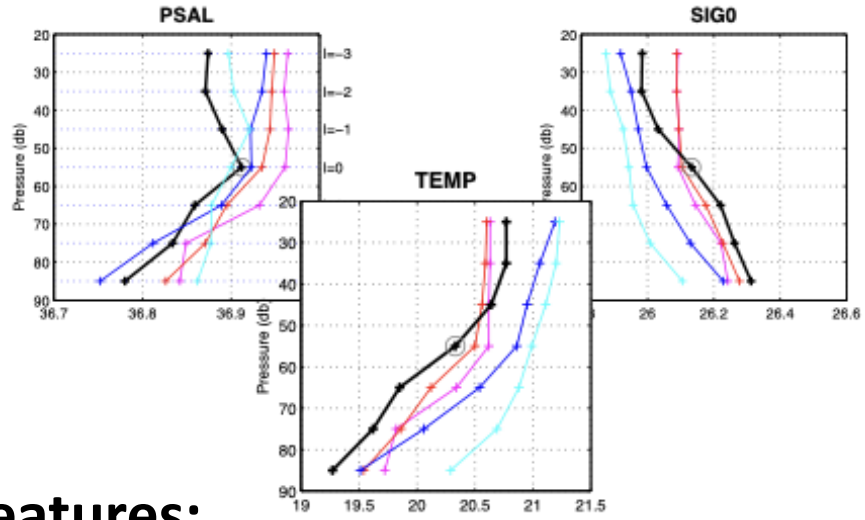
Data raising alarms with existing QC tests are redirected for triage to a ML algorithm.

A ML algorithm uses a collection of features to learn and then to predict the status of the alarm.

Selecting the most appropriate set of features is very difficult.



Improve QC workflow



Data raising alarms with existing QC tests are redirected for triage to a ML algorithm.

A ML algorithm uses a collection of features to learn and then to predict the status of the alarm.

Selecting the most appropriate set of features is very difficult.

Possible set of features:

- Meta-data (latitude, longitude, direction, month, year, cycle number)
- Per-point data:
  - Surrounding TEMP, PSAL, SIG0, vertical gradients
- Per-profile metrics such as:
  - average distance to several climatologies (first 120 points),
  - number of surrounding reference points (used to build clim.),
  - deepest observation point

Improve QC workflow

Data raising alarms with existing QC tests are redirected for triage to a ML algorithm.

A ML algorithm uses a collection of features to learn and then to predict the status of the alarm.

Selecting the most appropriate set of features is very difficult.

Results:

- Reduced workload by up to 25% at best
- Per-profile metrics are most useful
- Per-point metrics do not “generalize” well

Conclusions:

- “Learning” what is a bad data with so few examples (compared to the nb of good data) is very difficult: “generalisation skill” remains poor
- Improving or creating new tests is better than “plugging” ML afterward.
- Reducing workload and improving existing tests may not be consistent: per-point vs per-profile vs per-float approaches.
- Existing QC tests mostly fail because of inappropriate references. We improve reference selection with:
  - Un-supervised classification of profiles: release in 2020
  - Neural-network prediction of the ocean state: still in dev.

This work has been funded under European Projects MOCCA and EA-RISE

MOCCA project has received funding from the European Maritime and Fisheries Fund (EMFF) under grant agreement No EASME/EMFF/2015/1.2.1.1/SI2.709624

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no 824131.

Call INFRADEV-03-2018-2019: Individual support to ESFRI and other world-class research infrastructures.

Argo / Deep Argo
GO-SHIP QUALITY CTD CALIBRATION DATA

CCHDO / NOAA-NCEI

S. Diggs (SIO), S. Purkey (SIO)T. Boyer (NOAA)

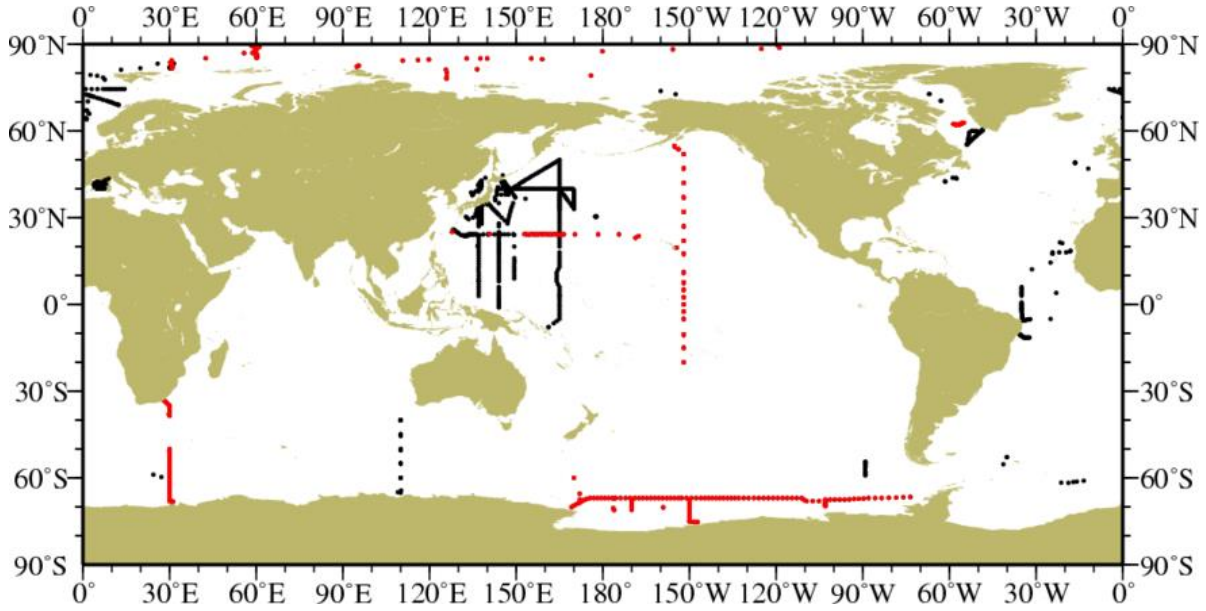
Argo: AST-21 Online Meeting

April 17, 2020

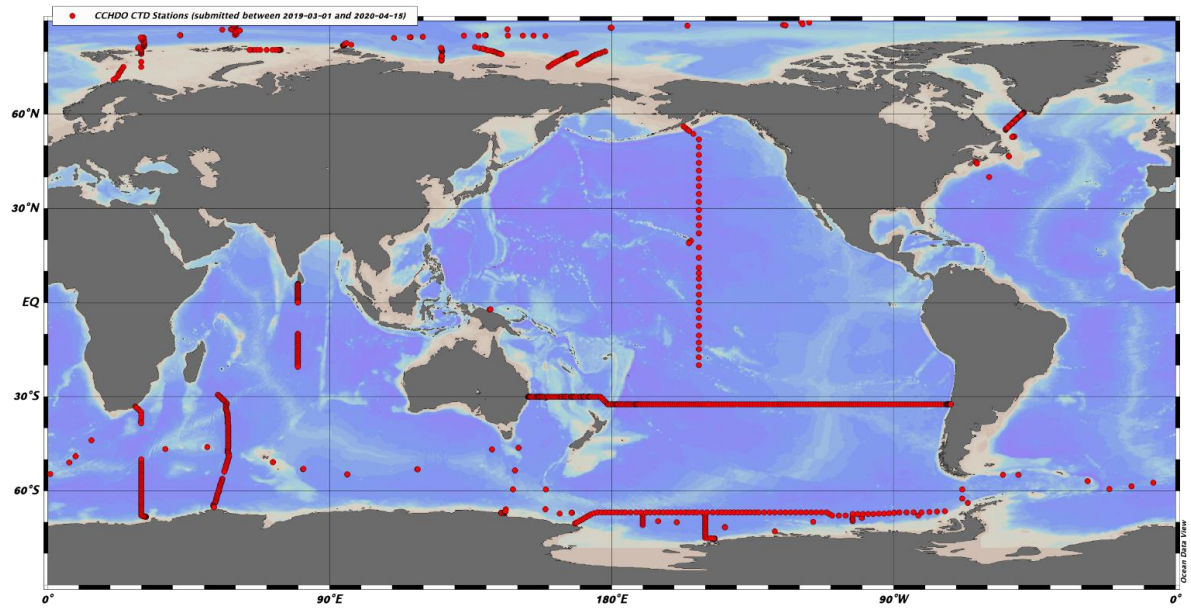
UC San Diego | SCRIPPS INSTITUTION OF OCEANOGRAPHY | NOAA

CORE CTD RefDB
(CCHDO/GO-SHIP + NCEI/WOD)

CTD data submitted: 2019-03-01 to 2020-04-15



CTD data deeper than 2000m added to World Ocean Database since March, 2019



992 GO-SHIP CTD stations

From CCHDO: 332 casts

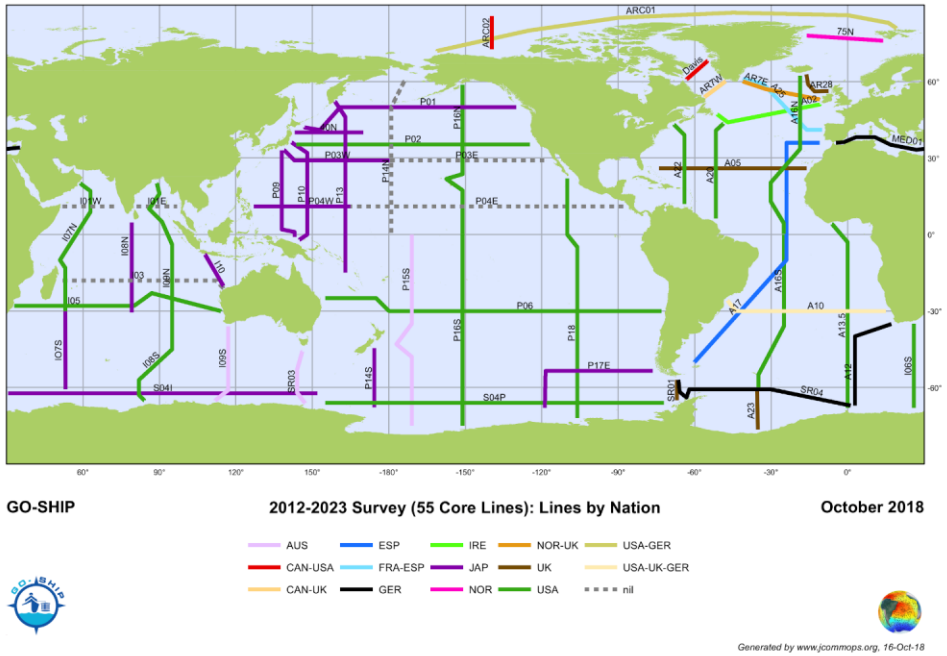
From other sources: 708 casts

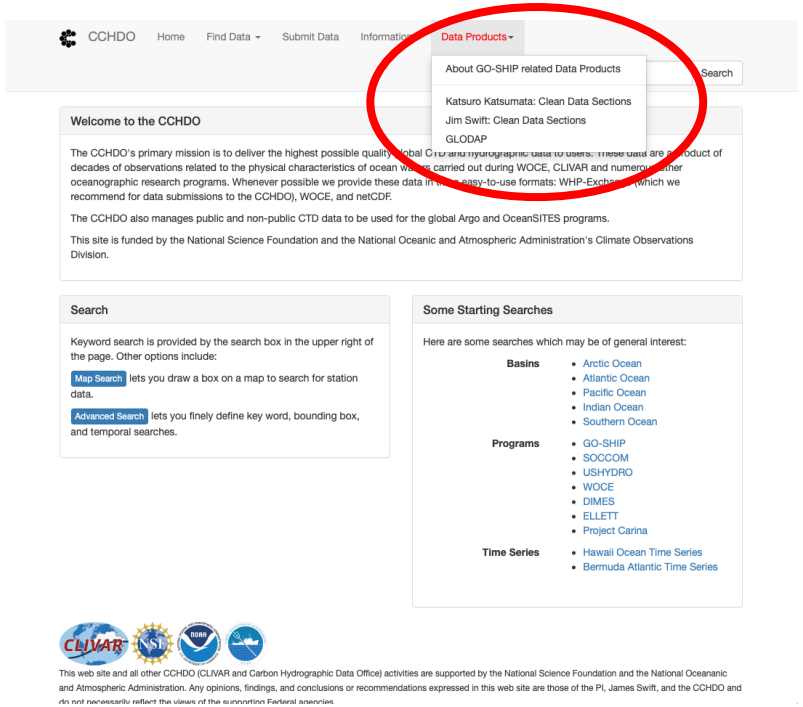
Other sources: International Council for Exploration of the Seas (ICES), Global Temperature and Salinity Profile Program (GTSPP), Japanese Oceanographic Data Center (JODC)

“Clean” Data Sections hosted by CCHDO

Deep Argo Reference Data

- New accessible high quality up-to data GO-SHIP data product produced by K. Katsumata, B. Sloyan, R. Cowley, S. Diggs, T. Moore, S. Purkey, J. Swift, L. Talley
  - 44 GO-SHIP lines of full depth highest quality CTDO data with accuracy of at least 0.001 C (Temperature) , 0.002 (salinity), and 2 dbar (pressure).
  - All CTD salinity data calibrated to salinity bottle samples and ssw batch salinity adjustments have been applied. This provides the highest salinity accuracy reference data.
  - Data available in in both a raw (station) and gridded format. Code is also available to easily modify data files.
- Data will be available on CCHDO by May 1, 2020 with DOI. The GO-SHIP data set will continuously be updated with new GO-SHIP data as it becomes available





Observational Estimates of Conductivity Cell Compressibility

Gregory C. Johnson, Sarah G. Purkey, & John Lyman
Virginie Thierry & Cecilie Cabanes
Taiyo Kobayashi, Kanako Saito, & Brian King
Kim Martini, Dave Murphy, & Norge Larson

- Comparisons of two Deep SOLO floats deployed May 2018 to nearby HOT cruise CTD data
- Comparisons of the Deep SOLO fleet to nearby historical WOCE/GO-SHIP CTD data
- Comparisons of Deep Arvor float data to nearby CTD data
- Comparisons of Deep Ninja and Deep APEX float data to nearby shipboard CTD data
- Comparisons of SBE-61 CTDs to co-located CTD data.

SBE-61 Calibration Equation

$$Co = (g + h * f^2 + i * f^3 + j * f^4)/(1 + \delta T + \epsilon * P)$$

f is frequency, T is temperature, & P is pressure

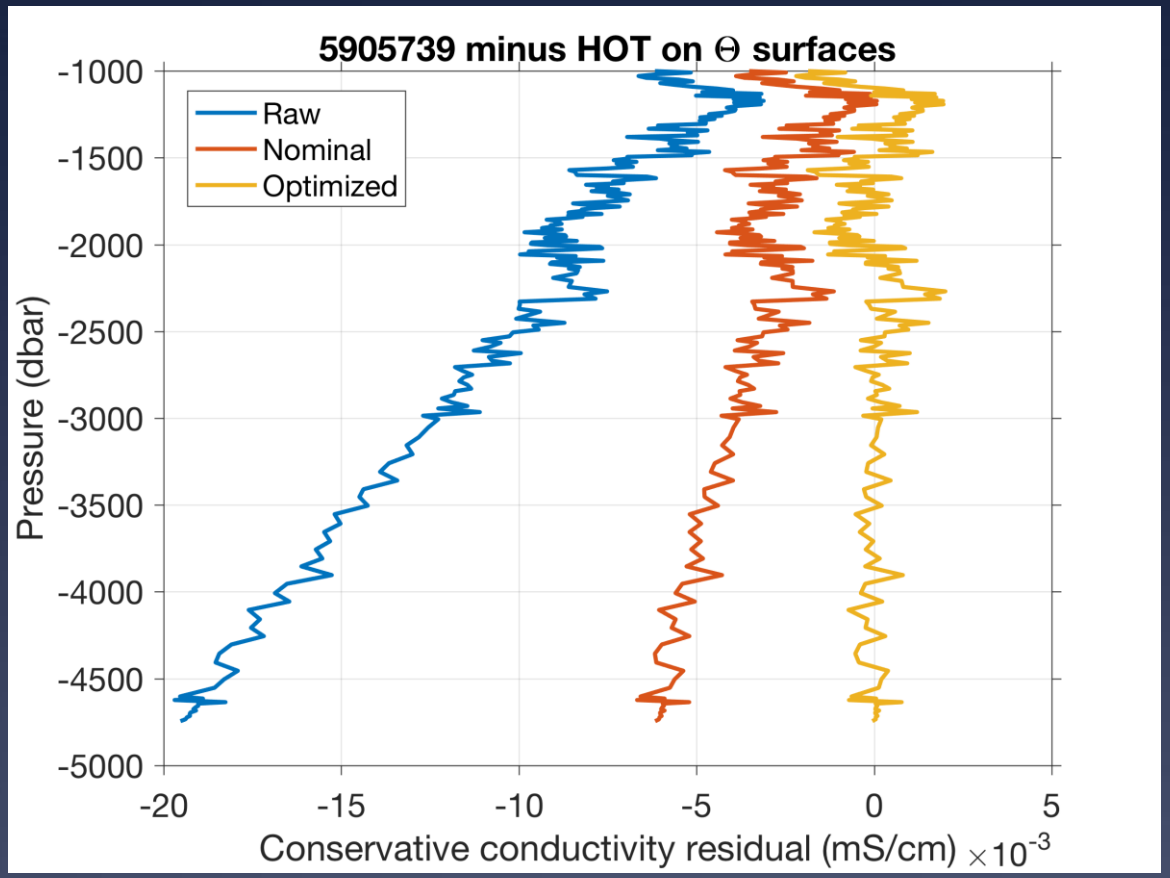
δ = +3.25e-06
ϵ = -9.57e-08

So 1000 dbar -> about 0.01% change vs. raw Co owing to ϵ (aka Cpcor), conductivity cell compressibility.

Estimating ϵ (Cpcor) from nearby shipboard reference CTD profiles

1. Compute absolute salinity, conservative temp., and "conservative cond." (Cco) for float & reference profiles
2. Cco computed using conservative temp & surface pressure
3. Back off nominal temp & pressure correction values to get uncorrected float CCo by multiplying by $(1 + \delta T + \epsilon * P)$
4. Interpolate CCo from reference profile to float Cco using conservative temperature as the vertical coordinate
5. Use differences of uncorrected and reference Cco above pressure threshold (1000-2000 dbar) to estimate new ϵ and multiplicative Co factor M (salinity offset)

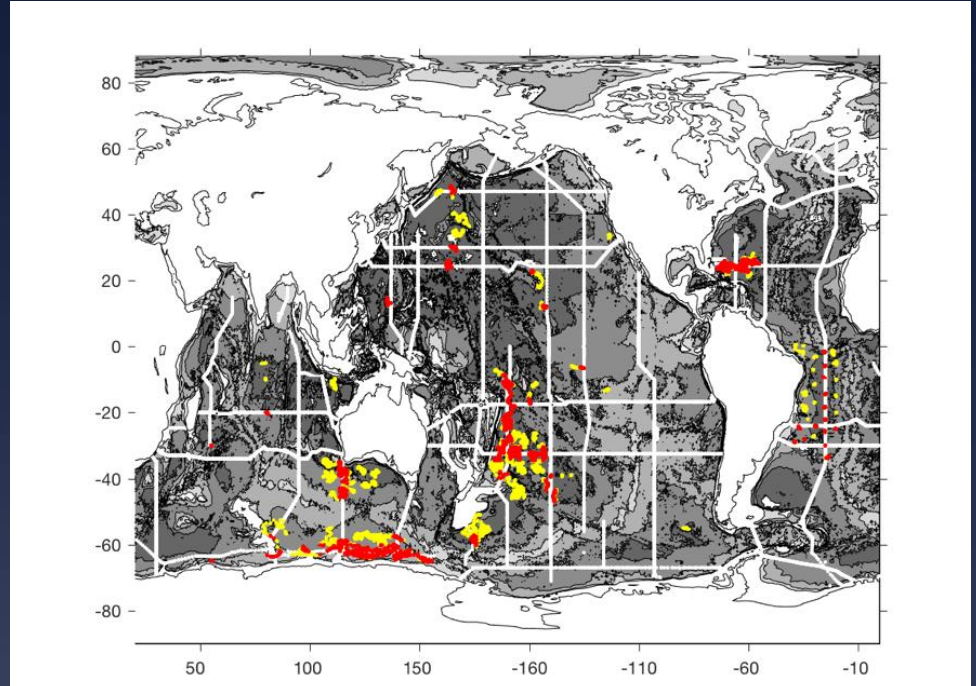
HOT/Aloha-Deep SOLO Comparisons

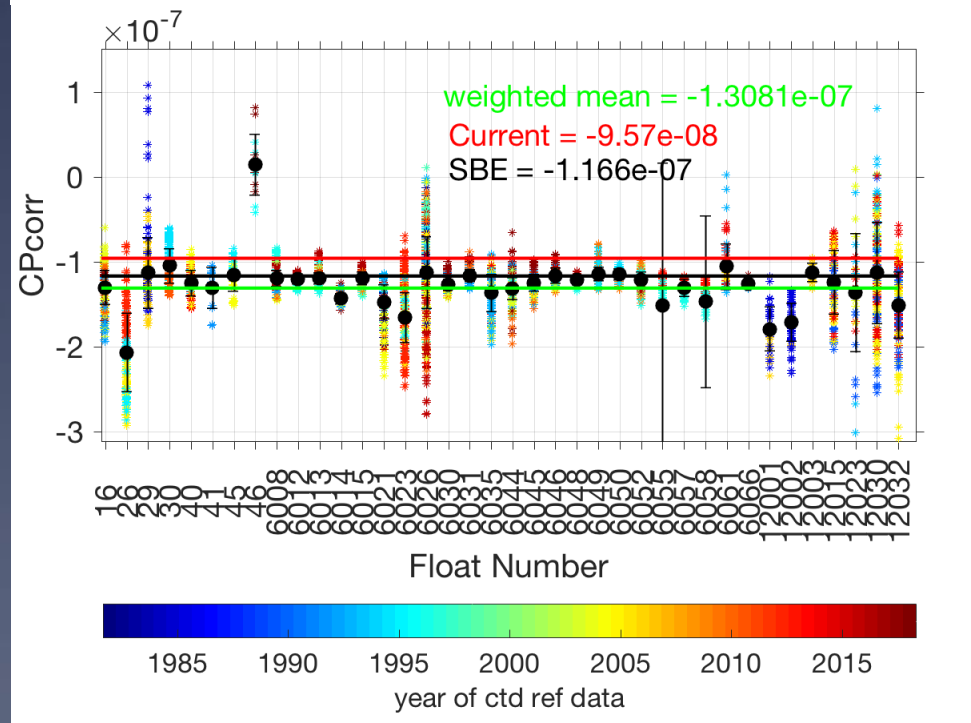


- Uncorrected pressure bias is about 0.02 mS/cm fresh (SA 0.02 g/kg) at max pressure
- Nominal correction about 0.007 mS/cm fresh (SA 0.007 g/kg) at max pressure
- Use a 1000-dbar pressure threshold for estimating optimized coefficients
- Optimized Cpcor = -12.94e-08 $dbar^{-1}$ for 5905738
- Optimized Cpcor = -13.67e-08 $dbar^{-1}$ for 5905739

Deep SOLO Fleet

- Following Johnson optimization method using SBE 61s from Deep SOLO (SIO and MRVs) with co-located reference data
- Only used floats with many matches, no notable correlation between CPcor calculated with time (ie drift) or distance reference data (ie spatial gradient)
- Upper figure: Location of reference data (gray), all float data (yellow) and float data used here within 200km of reference data (red) plotted over bottom bathometry (shading).
- Lower figure: Spread in the Cpcor values found with mean and one standard deviation (black).
- Weighted mean CPcor value found was -13.1e-8 $dbar^{-1}$.





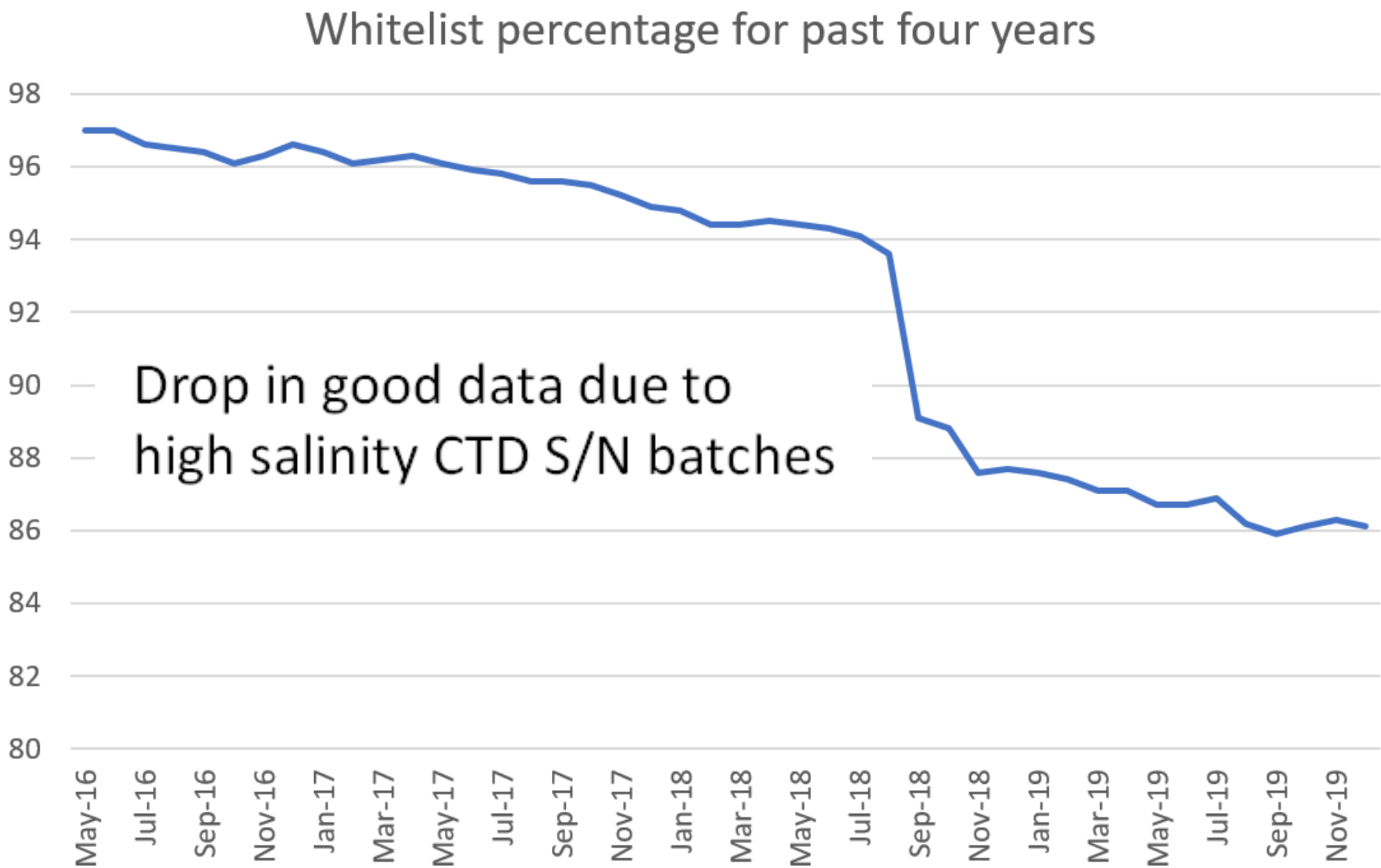
PMEL Evaluation of CTD Salty Drift for s/n 10,000-11,000

- 117 PMEL floats with SBE41CP CTDs in that range
  - 88 deployed
    - 46 deployed for > 1 year
      - 24 have undergone DMQC
        - 16 exhibit strong salty drift
    - 64 that have not undergone DMQC were visually inspected on 8 April 2020
      - 7 exhibit strong salty drift
      - 3 exhibit weaker salty drift

Feedback from ADMT

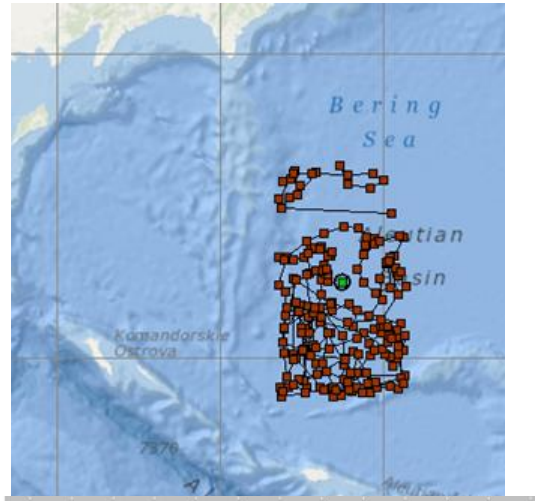
Sylvie Pouliquen & Megan Scanderbeg

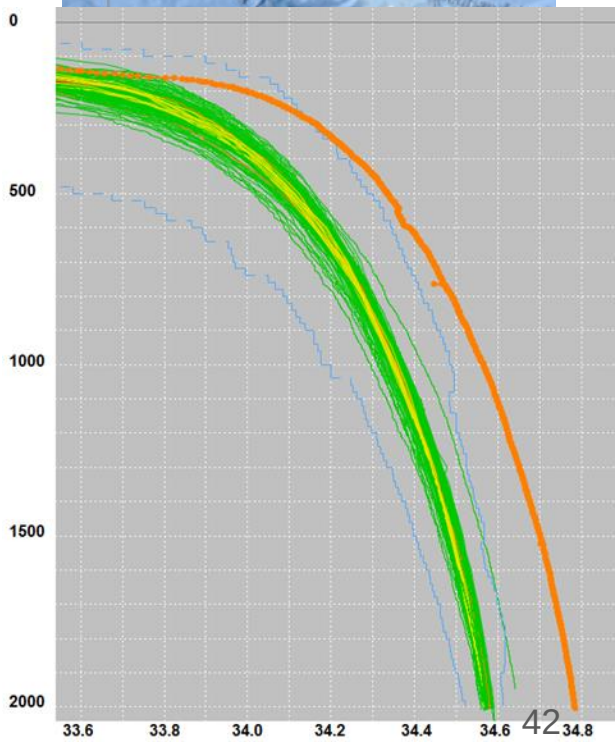
Quality Indicator	Status	Target	Description
DMQC Processing	79%	75%	# of DM observations vs # of DM eligible observations (> 12 months)
PSAL quality	81%	90%	# of monthly observations of best quality
TEMP quality	93%	90%	# of monthly observations of best quality
Whitelist	86%	95%	% of platforms whitelisted vs operational
Timeliness (GTS)	95%	90%	% of monthly observations distributed within 24 hrs
Timeliness (GDAC US)	91%	90%	% of monthly observations distributed within 24 hrs


Whitelist percentage for past four years
98
96
94
92
90
88
86
84
82
80
Drop in good data due to
high salinity CTD S/N batches
May-16
Jul-16
Sep-16
Nov-16
Jan-17
Mar-17
May-17
Jul-17
Sep-17
Nov-17
Jan-18
Mar-18
May-18
Jul-18
Sep-18
Nov-18
Jan-19
Mar-19
May-19
Jul-19
Sep-19
Nov-19

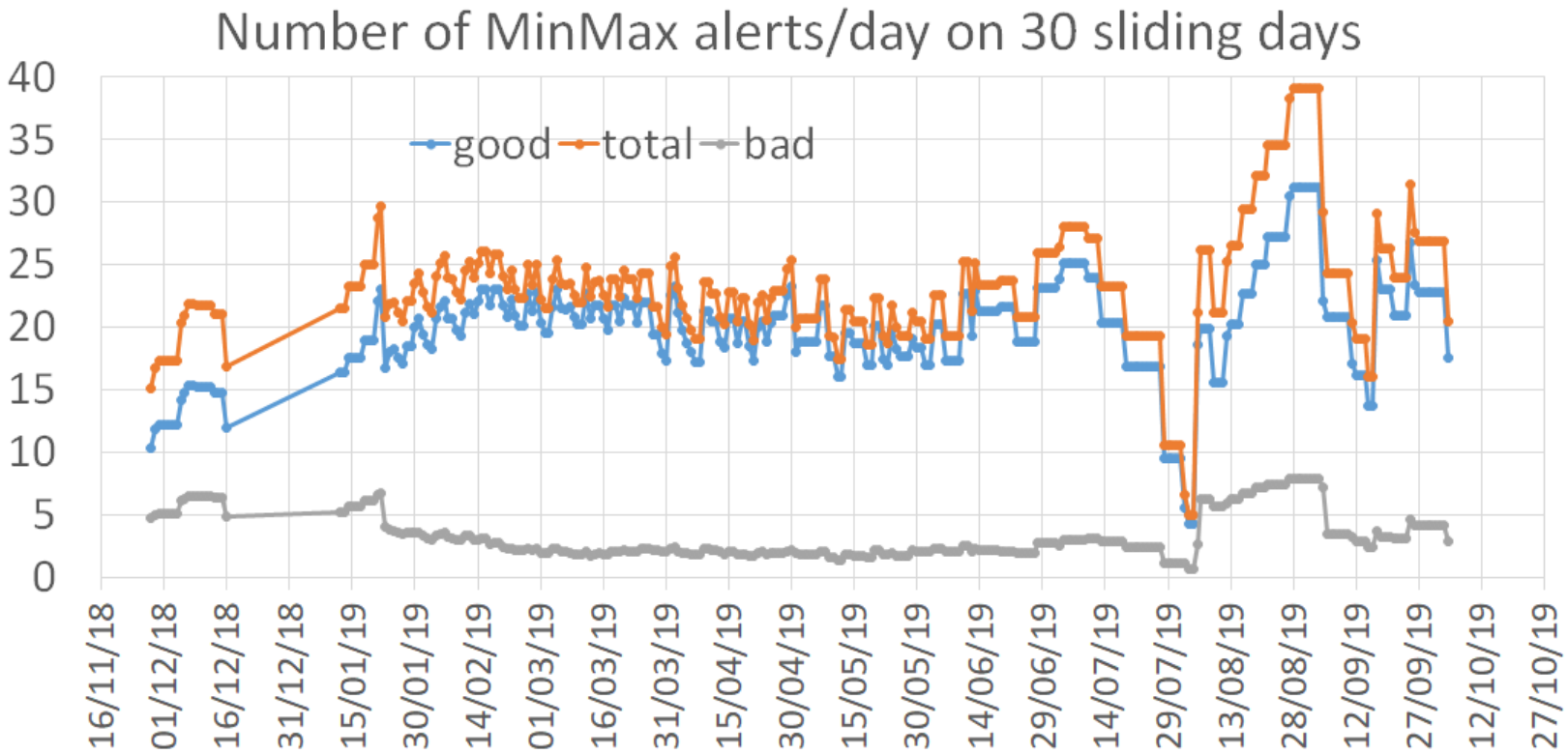
Facilitating triage for DM-operators: MinMAx test at Coriolis GDAC

- Run every hour on profiles that are more recent than 120 days
- A **drift** is suspected when:
  - the profile overcrosses the thresholds at depth,
  - often being parallel to one of the 2 MinMax thresholds.
- To confirm and log this suspicion, the operator display
  - surrounding salinity profiles (within 2 degrees and 5 years) from other platforms
  - theta-S diagram for the float's profiles
  - all salinity profiles of the float





Facilitating triage for DM-operators: MinMAx test at Coriolis GDAC



85 % of GOOD ALERTS

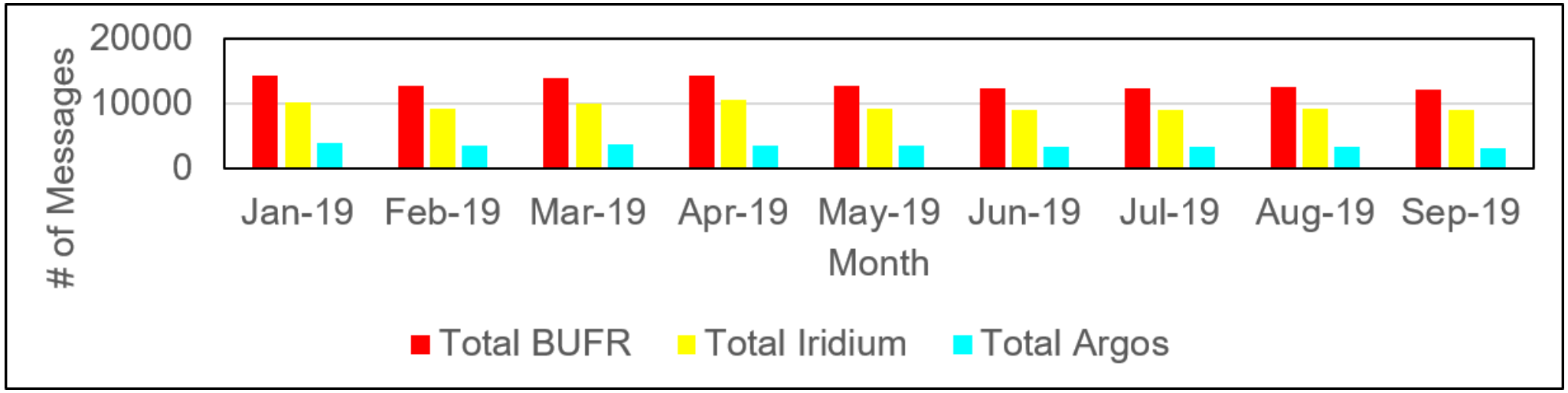
20 to 25 alerts/day

30 % of already seen profiles

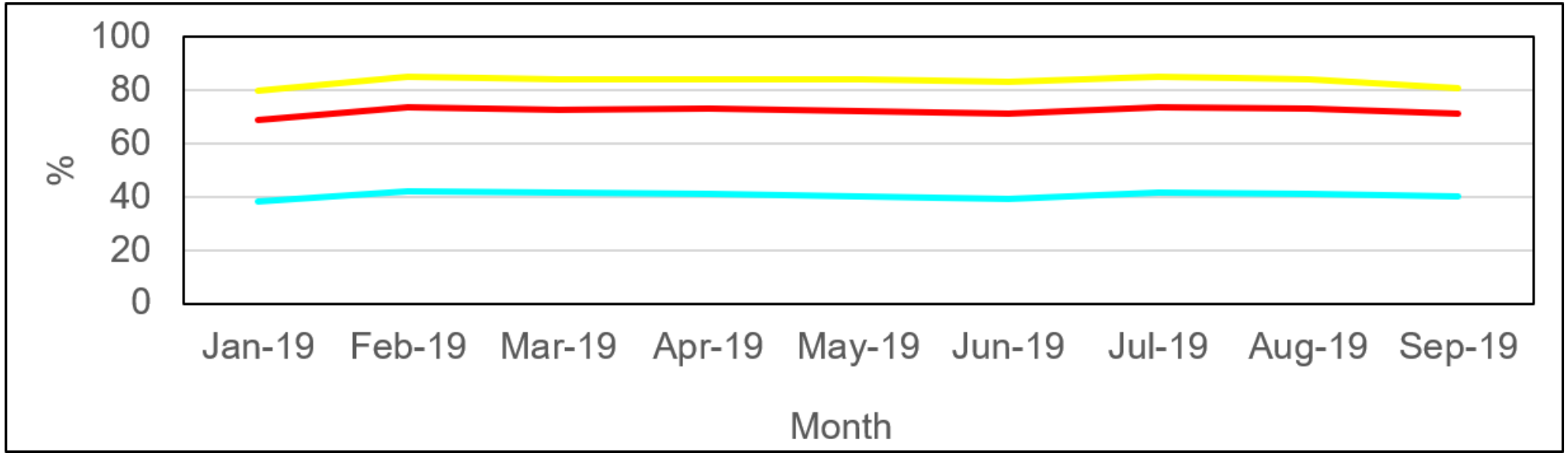
- Alerts included in the monthly report from Coriolis
- Endorsed by ADMT20
- Float to be inserted in greylist until DMQC performed

Argo reduced 24 hour target to 12 hours for Iridium data

Number of Argo BUFR data msgs on GTS

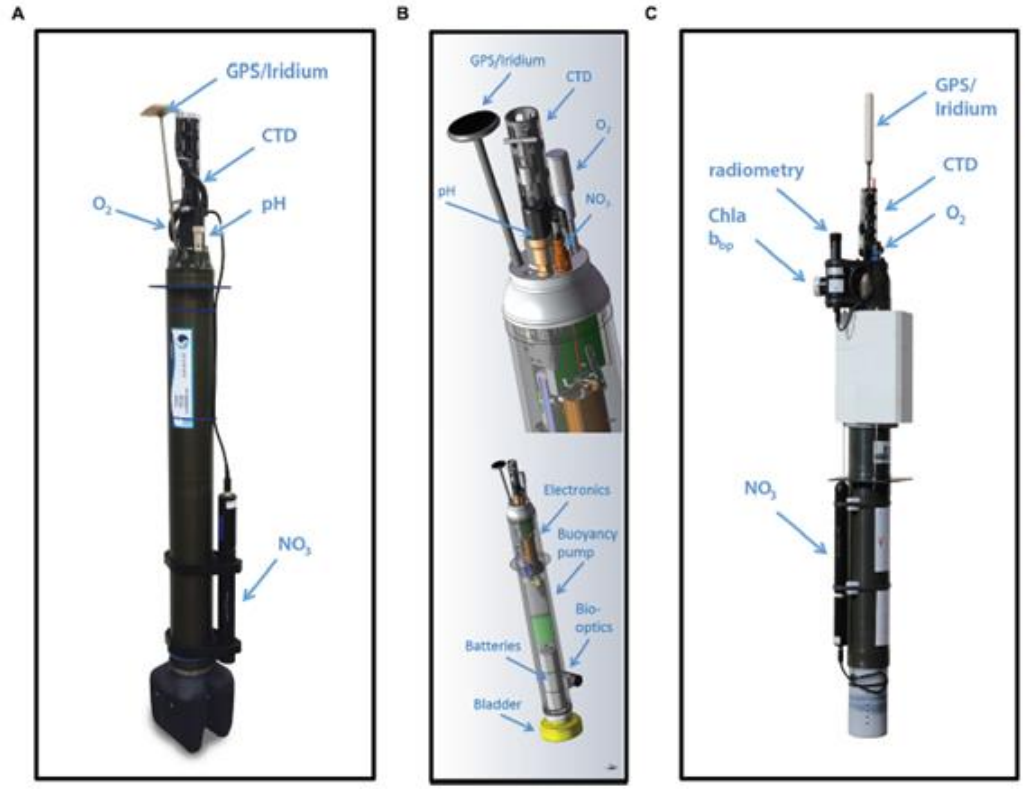


Percent of data on BUFR within 12 hours



BGC Argo & GTS

- Currently, no BGC-Argo data is sent on GTS
- Oxygen BUFR format is in testing process and should become available later in 2020
- If operational community wants other BGC data on GTS, ADMT will need to:
  - Develop BUFR format for each variable
  - Request WMO approval and test it
  - Could take ~2-3 years



- Will seek feedback from BGC Argo community and OceanPredict
- To AST: Is BGC data on GTS a priority? Should ADMT pursue developing BUFR formats for variables based on feedback from BGC and modeling communities?

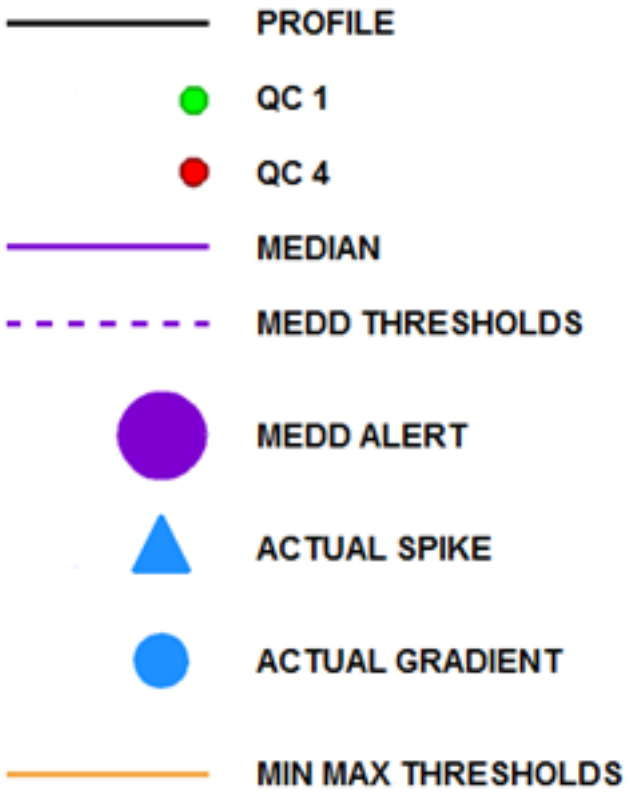
Deep Argo & GTS

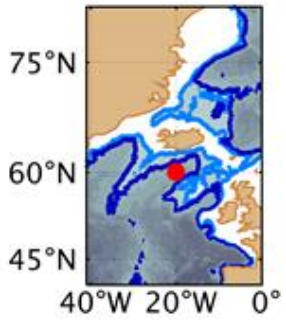
- Deep APEX, Arvor and Ninja floats follow the usual Argo profile
  - Data is available on GTS with QC flags of ‘2’ for temp < 2000 m and ‘3’ for psal < 2000 m
- Deep SOLO does deep profile upon descent
  - Deep profile is on GTS, but profile is from 10 days earlier
  - Same QC flags for T/S
- To OceanPredict :
  - Is 10 day delay in providing deep profiles an issue ?
  - Suggestion from ADMT to use QC=1 instead of 2 and 3 for SBE per Nathalie’s talk?

New RT QC test

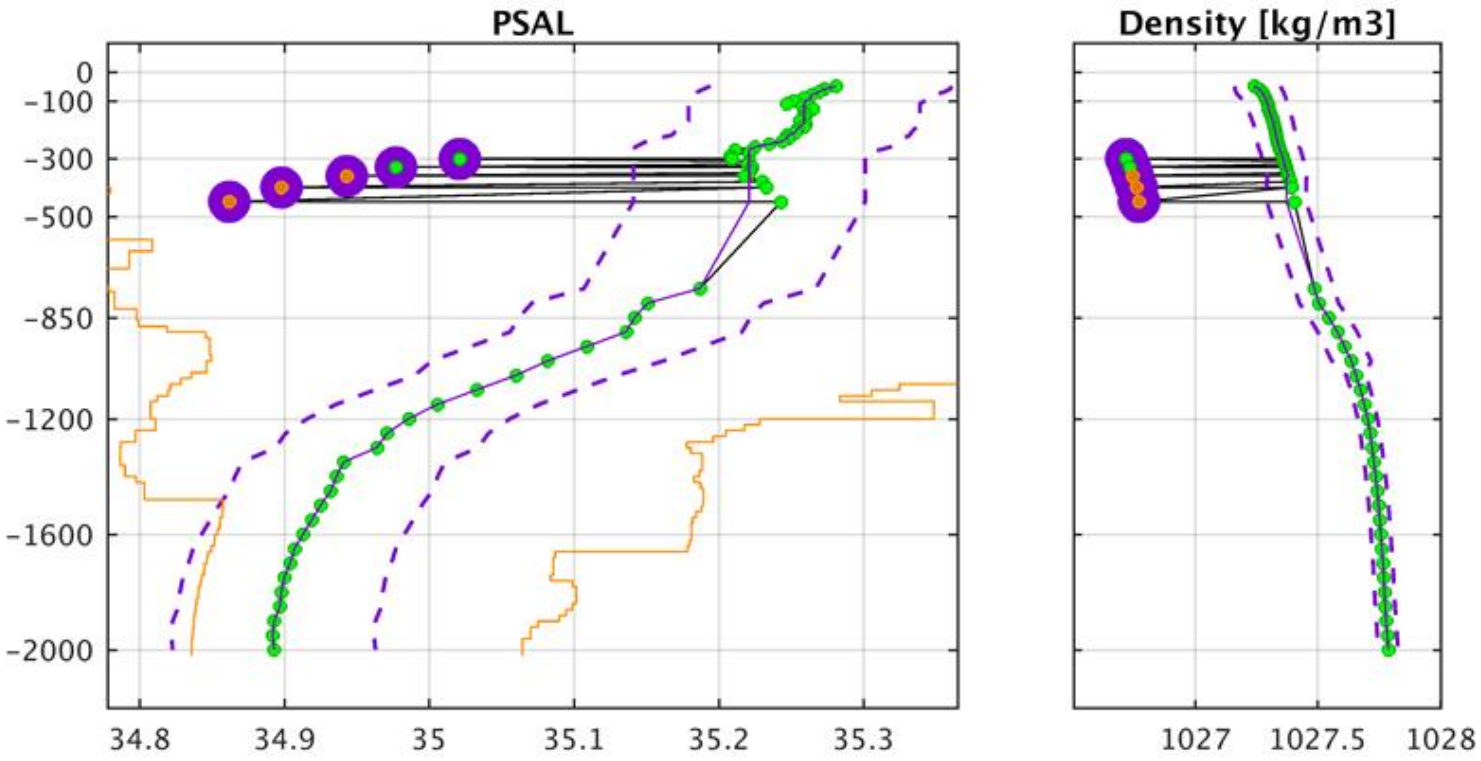
- Replace RT gradient test with MEDD test developed by D. Dobler at Ifremer
- MEDD test is based on three main steps:
  - Computation of a vertical sliding median
  - Compute thresholds located at a relative 2-D distance to the median
  - Apply this method to parameter (T or S) AND density because some features can look like a spike, but in real processes that are undersampled
- A spike is determined if both parameter and density shows spikes
- Robustness test performed on 1,11 Million of profiles – 2019/09/19
- MEDD test is more robust than gradient test (98,3% good detection versus 72.2%) , but still need spike test is robust (97,2% good detection) and catches features which may be missed by MEDD test

New RT QC test





bodc D69081 cycle 041
direction A (60.0N −20.0E)



GDAC status

- At Coriolis GDAC: there was a monthly average of 561 unique visitors, performing 4302 sessions and downloading 5.9 terabytes of data files in 2019
- Both GDACs had very good availability in past year: only down for 1 - 2 days

Branch	GB	Yearly increase
dac	338	28%
geo	103	17%
latest_data	21	33%
aux	2	53%
GDAC total	593	42%

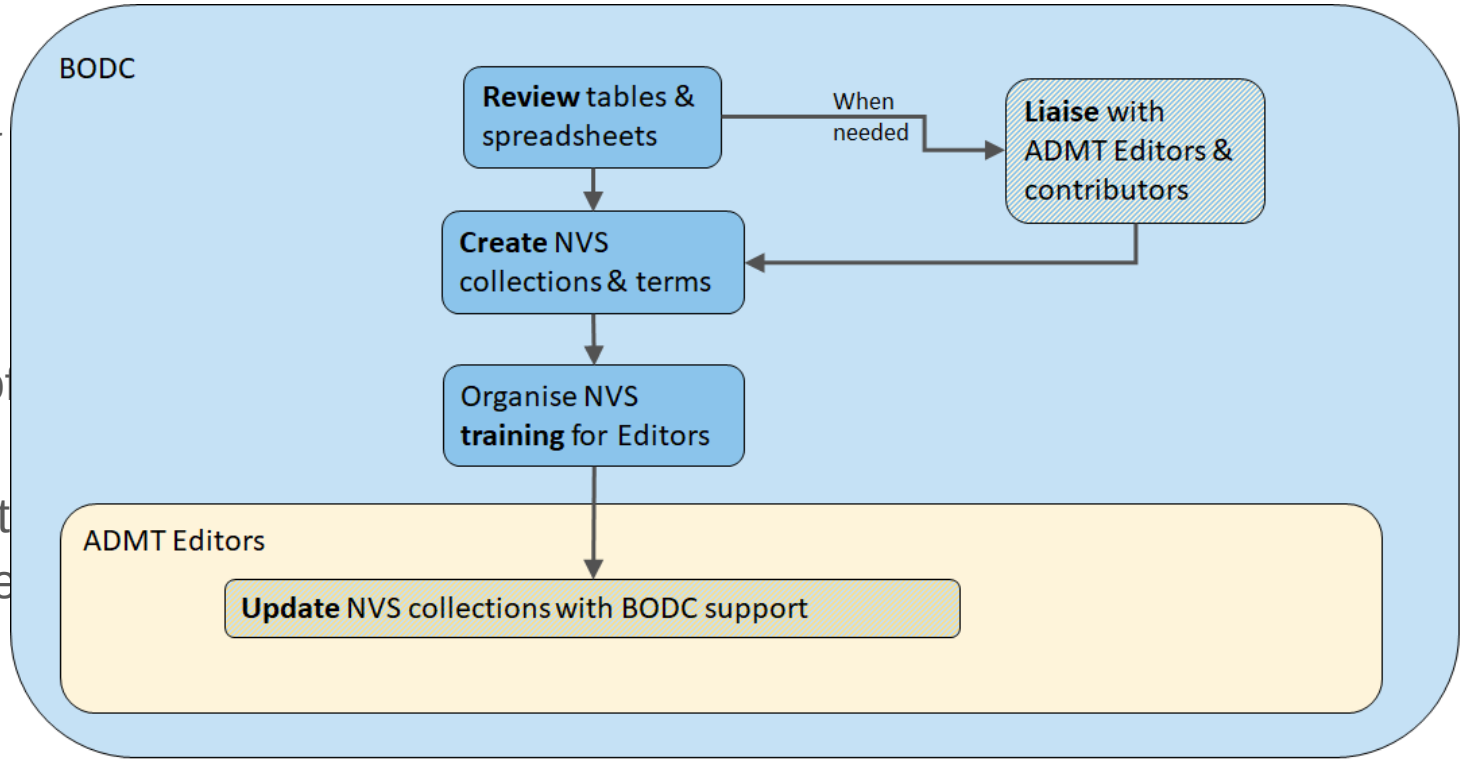
GDACs

- M profs replaced by S profs (synthetic BGC profiles) which are smaller in size and easier to use by scientists
- S profs produced at Coriolis, mirrored at US GDAC
- Need to implement previously suggested file checker updates, trajectory file checker and adjust current file checker as needed for proposed format changes (very minor). Exploring how to do this in a timely manner
- NCEI wants to work with US GDAC to find better way to create their monthly archive because FTP currently takes 21+ hours

Enhance FAIRness of ARGO data at GDAC : Argo tables: from spreadsheets to NVS

Why is it useful to Argo?

- Improve the quality of our metadata metadata holdings
- Enhance FAIRness of the Argo programme
- Decrease workload and likelihood of error
- Facilitate connections with other data systems though machine-2-machine interfaces



13

Trajectory files

- ADMT has voted to combine core and b-trajectory files into one trajectory file for following reasons:
  - File size is not a reason to split into c- and b-trajectory files due to the structure of traj file
  - BGC params are stabilizing and not expected to need to frequent reprocessing going forward
  - C- and b- traj files are connected in such a way that DACs need to understand what goes into both to create an accurate c-traj files
- There will need to be more coordination in countries where BGC and core processing is currently separate, including both RT and DMQC processes.
- Working group fine tuning proposal for v3.2 & will present proposal to ADMT
- This combined file will be a new version (v3.2) and floats without BGC params can stay in v3.1. There will be a transition period where both v3.1 and v3.2 traj files are accepted for BGC floats.
- To AST: do you endorse the combination of trajectory files?

ADMT -> AST

28 Suggest ARCs interact with AST on the network implementation aspects and review their Terms of Reference

29 Encourage deployment planning coordination at AST, especially in areas that seem over-sampled in the AIC report, or are targeted as pilot areas for DEEP or BGC

30 Communicate that it isn't necessary for operational centers to use greylist since QC flag information is available in BUFR msgs. => was planned at the OceanPredict Workshop

A paper that describes the core Argo dataset 1999-2019

Presentation for virtual AST21, 17 April 2020

Annie Wong, University of Washington

Goal:

- **To describe and assess the quality of the pressure, temperature, salinity and subsurface data from the Argo Program 1999-2019.**

- **To document the evolution of the instrumentations used in Argo, and problems encountered.**

- **A timely review to commemorate the 20th anniversary of the program; to record what we know, before they are lost or forgotten, on the eve of an expanding Argo.**

Timeline:

- **Sometime in 2018 – Susan Wijffels and Steve Riser drafted an outline for an Argo data paper.**
- **February 2019 – Annie started to help with the effort.**
- **March 2019 – Began collecting material and contacting potential contributing authors.**
- **March 2020 – First full draft sent to contributing authors and AST/ADMT national representatives to distribute.**
- **April 2020 – Feedback received from several groups (thank you), especially on PROVOR/ARVOR floats (thanks Sylvie, Xavier, etc.); waiting to hear from a few more groups.**
- **May 2020 – Aim to submit sometime towards end of May 2020.**

Outline:

- **Introduction**
- **Instrumentation – CTD and satellite communications**
- **The data system**
- **Argo data description**
- **- Vertical resolution, pressure ranges, geographical coverage**
- **- Temperature data**
- **- Pressure data**
- **- Salinity data**
- **- Assessment of Argo pressure and salinity bias against GO-SHIP**
- **- Positions, subsurface velocities, other park-phase data**
- **How to cite Argo data – the dynamic DOI**
- **Future challenges**
- **Discussions and Conclusions**

Authors list:

- Primary list – people who have contributed to the manuscript.
- Secondary list – people who have made substantive contributions to real-time and delayed-mode core Argo data management, plus program leaders, in the 11 DACs & 2 GDACs.

Acknowledgement:

- People who belong in the above list but who are no longer active (e.g. retired, departed for other jobs, deceased).
- A statement to acknowledge people who have contributed to float design, fabrication, testing, and deployment.

To be finalized:

- **Pre-deployment CTD checks**
  - **UW test results statistics?**
  - **Approximate % of CTDs that are tested – ask on argo-st?**
- **Future Challenges – Steve Riser, Guillaume Maze**
- **Authors list – 70% received; waiting for a few more groups**
- **Comments on first draft (in AST21_docs) – till end of April 2020**
- **Revised version – lead authors to okay**

Submission:

Target journal – Frontiers in Marine Science, Ocean Observation section

Article type – Systematic Review

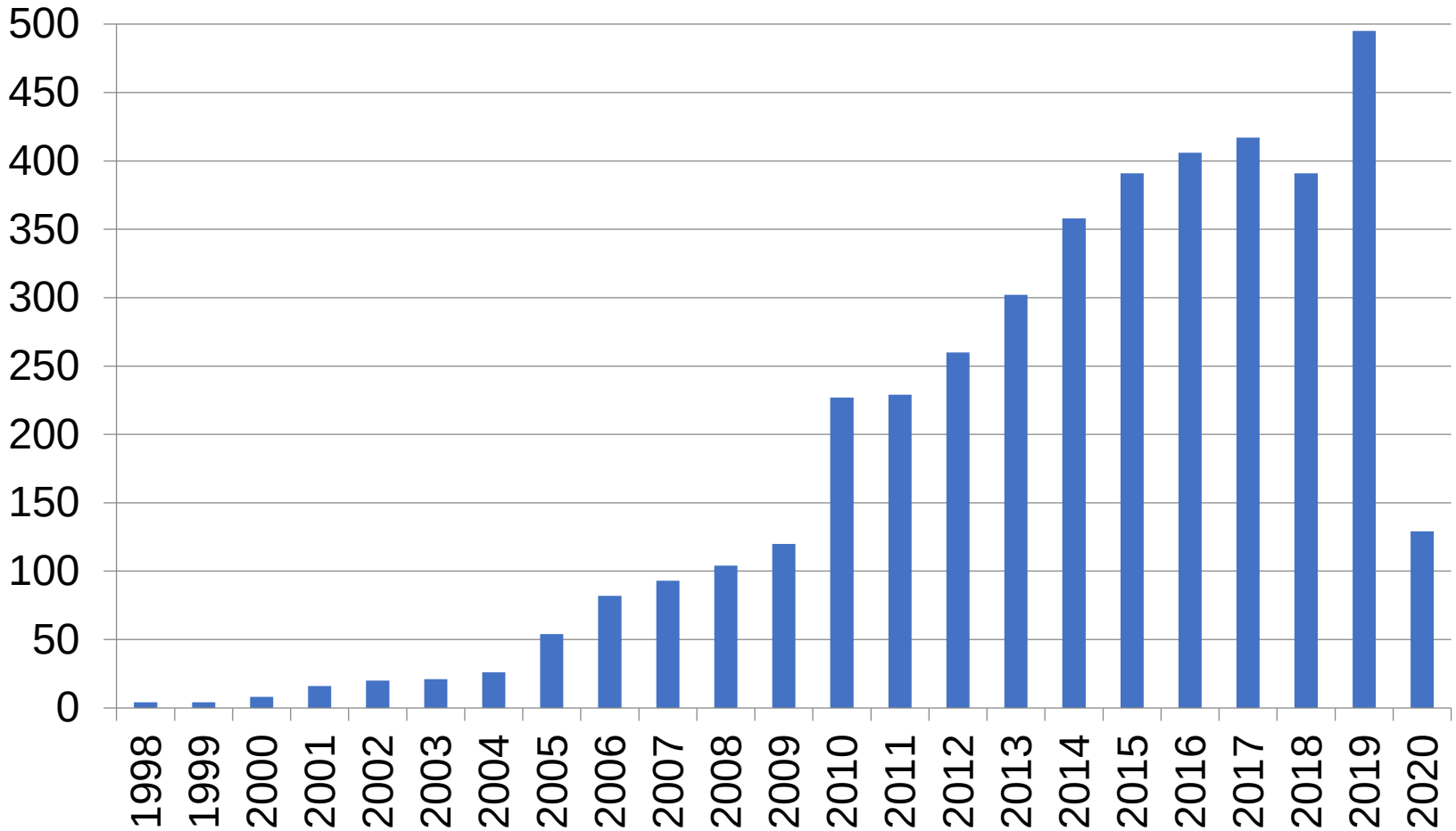
~ The End ~

- Discussion: 10 min

Communications

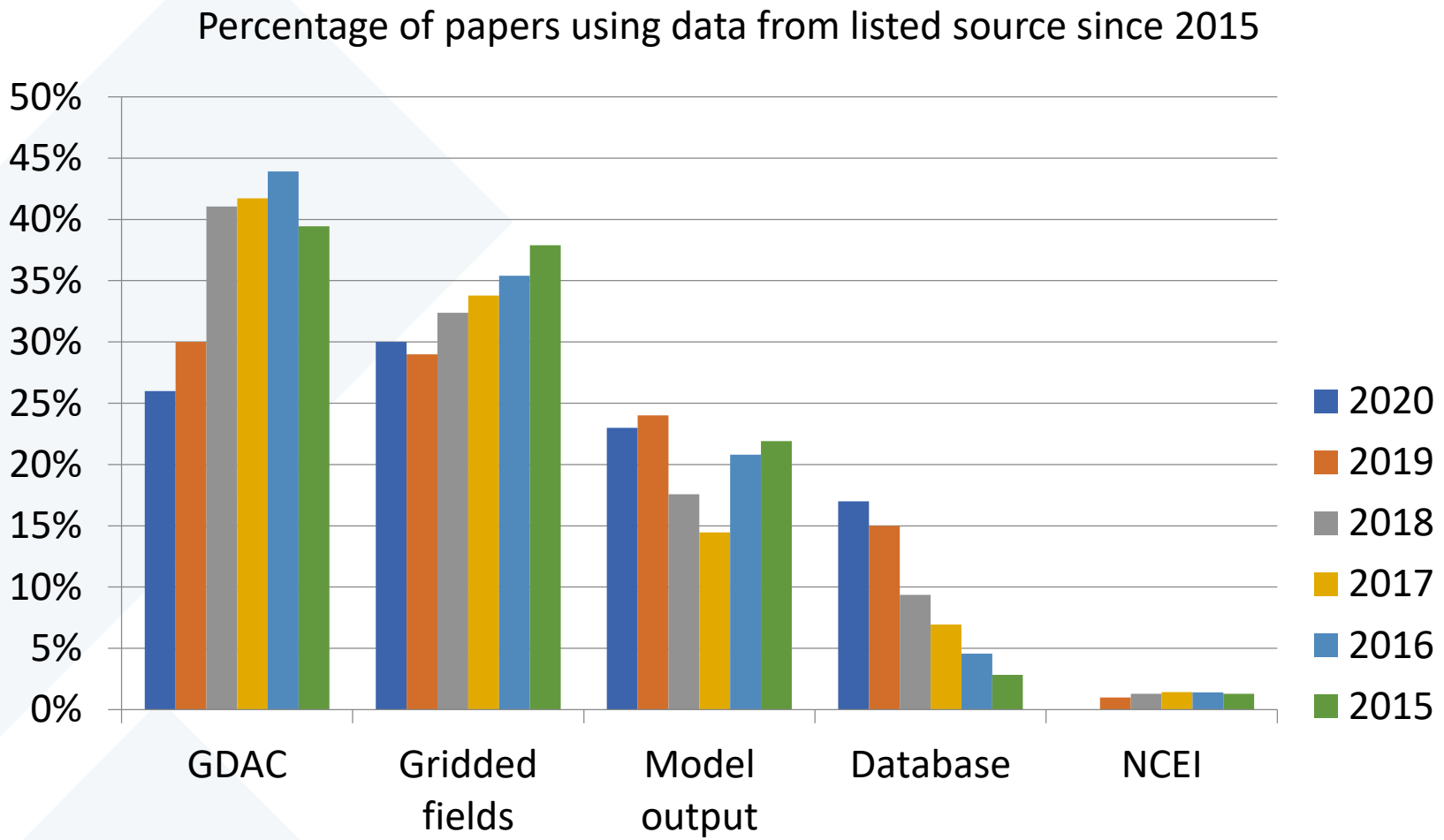
CURRENT STATUS OF ARGO BIBLIOGRAPHY

- 55 OceanObs19 papers in 2019
- Still had more papers in 2019 than 2017 without OO19 papers
- 2018 could be an anomaly as people prepared for OO19
- Likely that many papers continue using secondary sources of Argo without acknowledging it
- Still don't have access to Elsevier papers which should increase numbers as well



Tried searching for model output papers, but stopped because:

- Too time consuming
- Would need to include all such papers or else numbers would be artificially inflated
- Will include statement about this on new bibliography page and links to model outputs and data products so it is clear where else Argo data is used



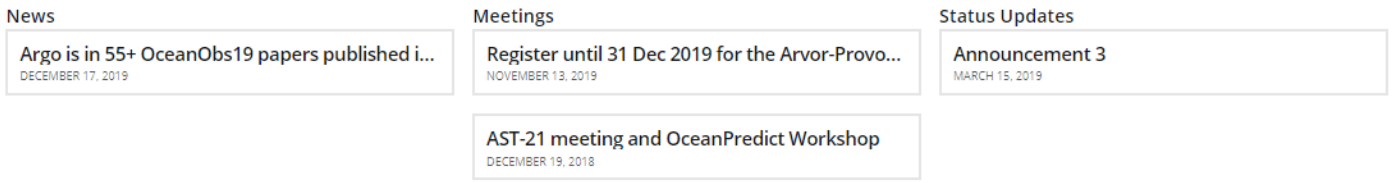
- Increase in ‘Database’ as more sets of curated profiles are available
- Increase in ‘Model output’ this year
- Decrease in ‘GDAC’ and ‘Gridded fields’

NEW ARGO STEERING TEAM WEBSITE

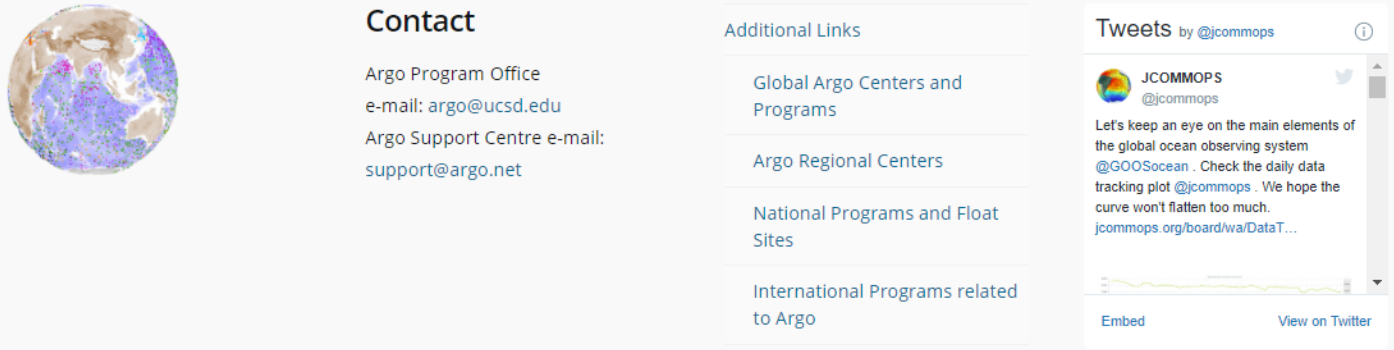
https://argo.sioword.ucsd.edu/

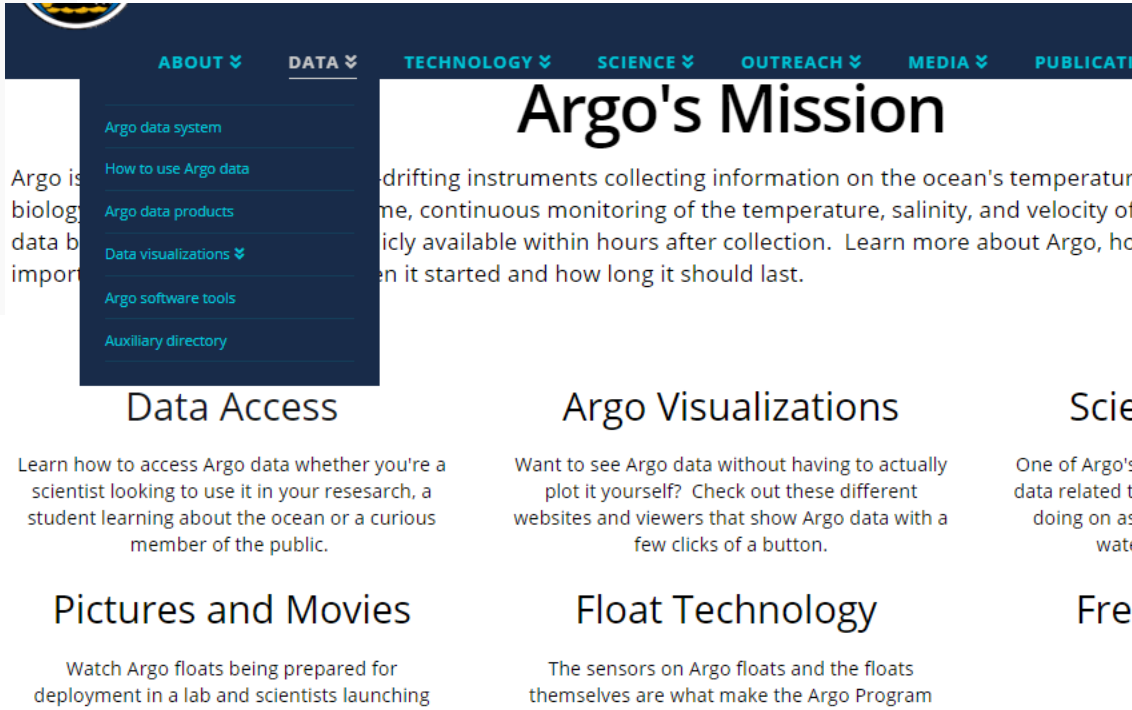
- Goal is to add public interface/wrapper on top of current website information
- Working with Scripps IT and comms to design and fill content
- Homepage:
  - Three rotating pics at top linking to: Argo's status/about, how floats work, & Argo and climate change
  - Middle section aimed at general public with links to: data, visualizations, science highlights, pictures/movies, FAQs and float tech
  - Story Map

HOMEPAGE CONTINUED



- Bottom of homepage for current Argo community: three columns of blog posts like Argo news section at top of current page
- Links at bottom as well as Twitter account





- Note on top menus: the top menu word (about, data, etc) links to a page and there are pages listed below
- Suggested to get most Google hits, but seems misleading to me. Thoughts welcome

REQUESTS FOR HELP

Looking for both content and review of my content

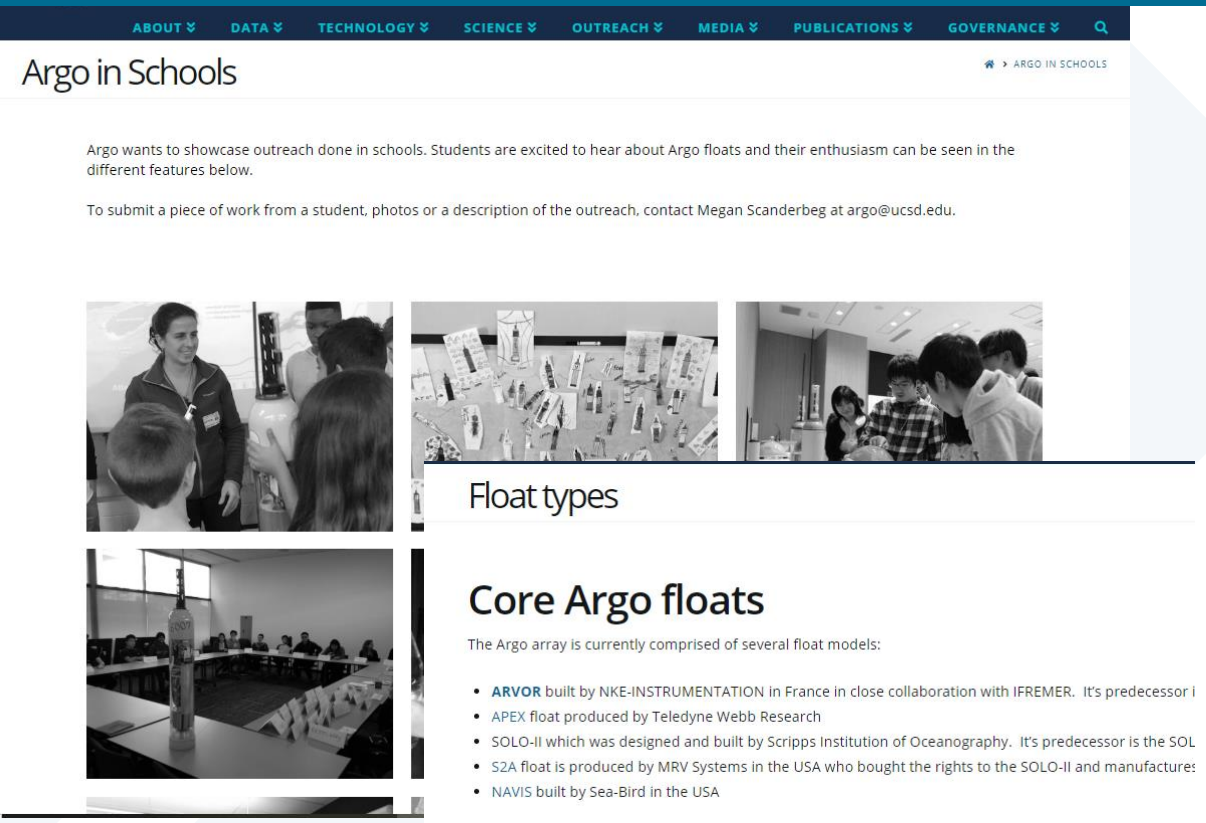
Content generation needed for following pages:

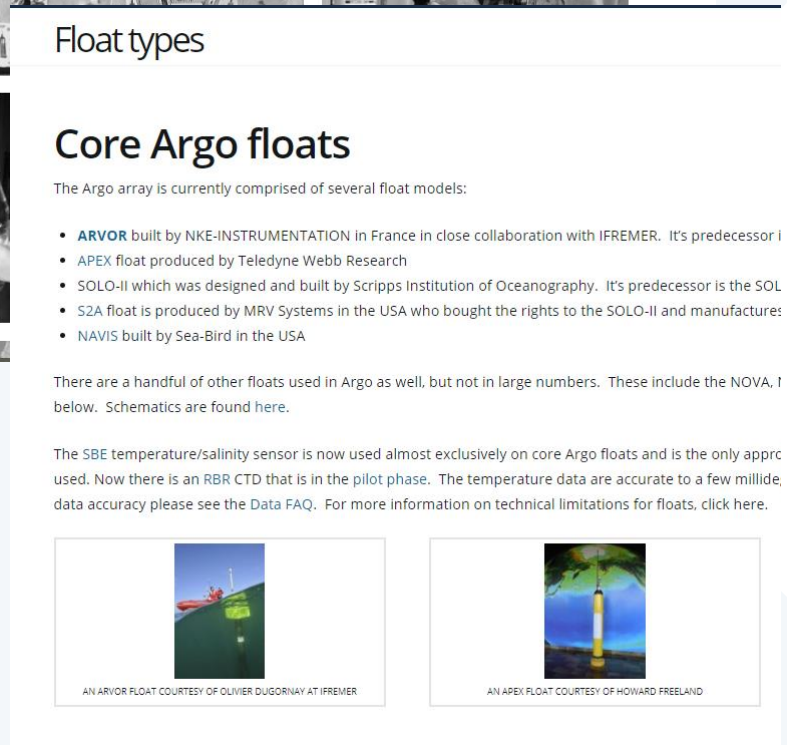
- Science highlights: few key findings from Argo (maybe 2 or 3 from core and 1 each from BGC and Deep)
- Cost/Argo's value: general comparison suggested by J. Gould to talk about Argo's cost relative to satellite missions, etc.
- Developing technology: sensors, Deep floats, BGC floats
- Argo software tools: G. Maze

Careful review and/or content additions:

- Climate change & global phenomenon pages: built off current page (which needs update), but need a simpler version in addition.
- About/status pages: are both needed? If not, maybe change one to more of a history or Argo and how it fits into global obs page?
- Governance: wording to go with new governance diagrams
- Technical limitations: float lifetimes, ice detection, etc.
- Argo & the modelling community: Peter?

STATUS AND TIMELINE





- Lots of content already created
- Most technical problems have been solved, but still working on how to store movies. May need to find another location for these (server in our lab?, JCOMMOPS?)
- Will push to finish in next 1 – 2 months, with input from identified helpers
- When agreed, Scripps IT will switch URL to www.argo.ucsd.edu
- All current links to specific pages will no longer work. Will notify Argo community.
- Will take a few months to optimize on search engines

AME BLEUE & HELPTHEPLANET & JCOMMOPS

PARTNERSHIP

H2O: Ame Bleue / Help The Planet / JCOMMOPS

- These 3 entities are partnering for an ambitious project along the UN decade for ocean science

- Free diving, Science, Ocean Observations
- Education (marine protected/educational areas), outreach & communication
- Common good missions

- Developed along a 4 year cruise (40 stops) 02/2021-07/2025
- Potentially renewed Pole to Pole through the Americas 2026-2030

- Ame Bleue: French NGO specialized in free diving and ocean literacy
- Help The Planet: Endowment Fund specialized in supporting environmental initiatives through private sphere

AME BLEUE

- Laurent Marie
- http://www.amebleue.fr/

HELP THE PLANET

https://www.help-the-planet.org/

- Pierre Milza

- Supported projects
  - H2O/Ame Bleue
  - ICU2 (2M glasses/India)
  - Hermione (La Fayette Ship)
  - Dignity Crafting
  - Explorer (Rennes – North Pole)

H20

- Meeting ocean people …

H20

- 45 m
- French flag (and built in France)
- Certified for ice areas
- OceanWings/Hydrogen/Fuel powered
- 3 decks

- Submarine (1 pilot + 2 passengers)
  - 18h, 2500m max. depth

- 25-30 permanent crew
  - Master, 2nd, engineer
  - Cook, medical
  - Divers, kids, cameramen, sponsors rep., scientists

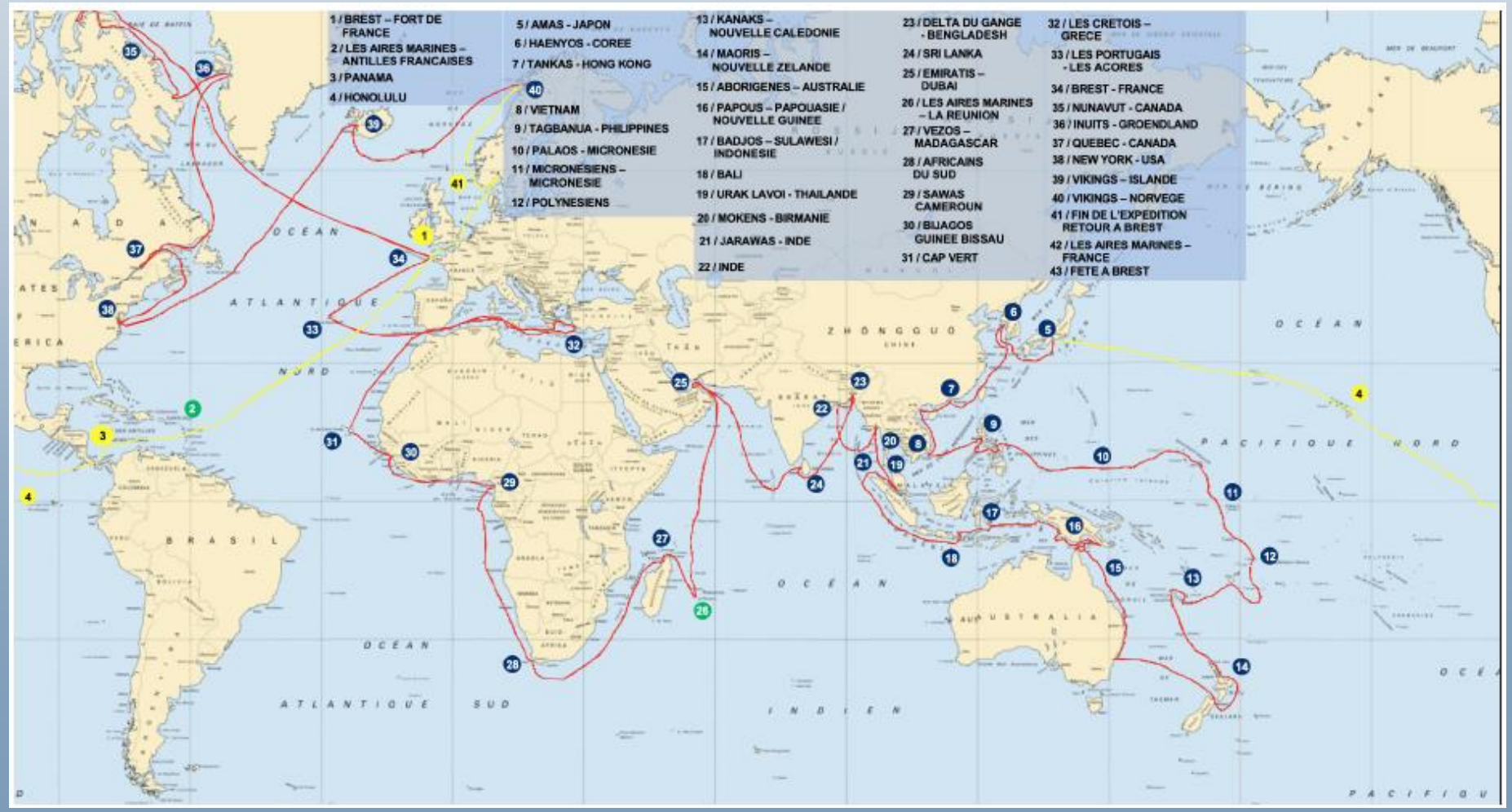
- 200 people on board in port

The Ship

H20

The Cruise - I

- 2021-2024
- Brest …
  … Paris/Olympic games

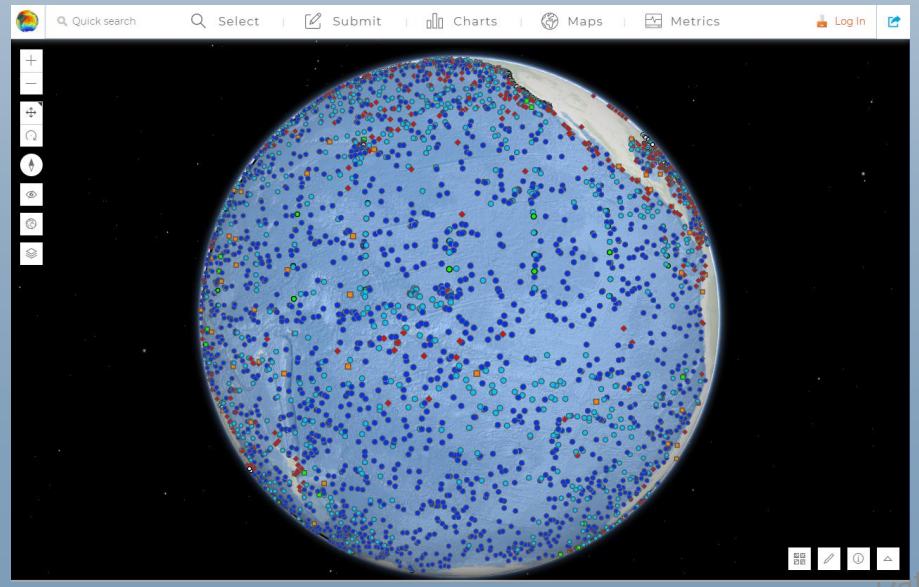


H20

Science

- Benthic biology
- Marine mammals studies (diversity indicator, hots spots, sound pollution, tracking)
- Bioluminescence
- Plankton
- Algae

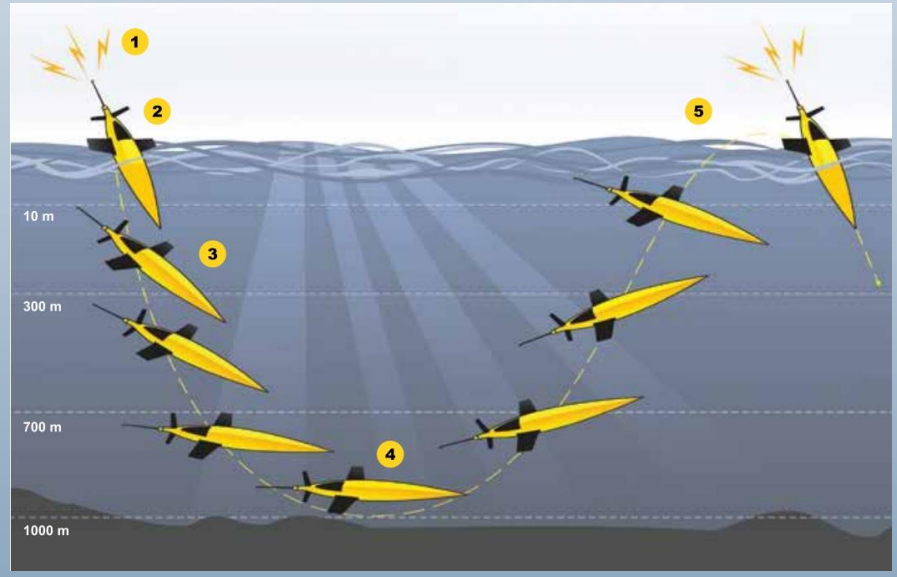
- JCOMMOPS (and GOOS international community)
  - Instrumentation: integrated contribution to the GOOS
  - Monitoring
  - Seamless, integrated, standard data/metadata flow, data access
  - Outreach/Education/Communication

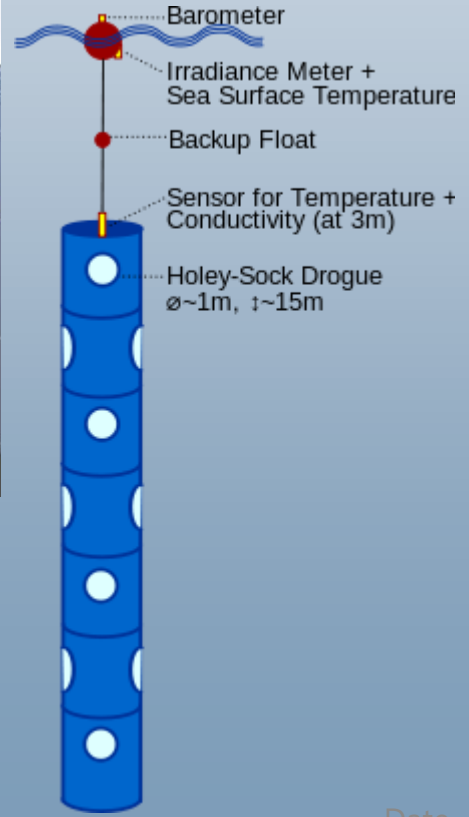


INSTRUMENTATION

- Automatic Weather Station
- Ferry box (+ plastic and carbon)
- CTD Reference
- SOOP line PX40 implementation
- 40 Floats (10 deep, 10 BGC, 20 core)
- 1 glider
- 20 drifters (+wave + air pressure)
- 1 ADCP
- Animal Tags

- Synergies with all GOOS/JCOMM Networks:
  - Opportunities deploymen/retrieval
  - Science projects (via call for proposal)
  - Moorings visit, light servicing
  - Special zones/pilots (hurricanes, tropical storms)
  - …





BUDGET

Funding

- >125 M€ (45 M€ ship)

- Sponsors: private sphere . Tax saving 60%. Overseen by French Ministry of Economy.
- not only a donation: involvement of civil society in the project, at sea, in ports, etc.

- For JCOMMOPS:
- Rule#1: Neutral vs the involvement required
- Rule #2: 1 FTE to strengthen JCOMMOPS.
- Rule #3: 1 FTE for IOC

JCOMMOPS BUDGET

5 years: 5-6 M €

- Staff (+ mission budget): 2.5 M €
  - 1 NEW UNESCO rep (communication, link with UNESCO activities, call for proposal) – UN Ocean Decade staff
  - 1 NEW data/IT manager
  - 1 NEW operations manager (material, ordering, shipping, maintenance, deployment, etc)
  - 1 NEW Project/Communiciation Manager
  - 1 FTE (JCOMMOPS team support)
- Instrumentation: 3M €
- Overhead (10%) 0.5 M€

IOC's Role

TBD: staff & communication

- 1 staff secured as a start.

- Funding to be channeled to IOC/JCOMMOPS budget for staff hiring

- Ship to fly IOC flag during the decade
- Link with UNESCO (through IOC exec. Secretary strategical role) & UN Ocean Decade

- International coordination
- Staff management, recruitment, reporting
- Communication, translations
- Call for proposals for promoting the science opportunity along legs

- Any other role/input/suggestions by IOC head of sections ?

WMO's Role

TBD: data flow pilot and instrumentation

- Data flow pilot: from instruments to WIS
- Instrumentation purchase ?
- Synergies between instrumentation pilot and modelling pilots
- …
- Ship to flies WMO flag ?

- TBD

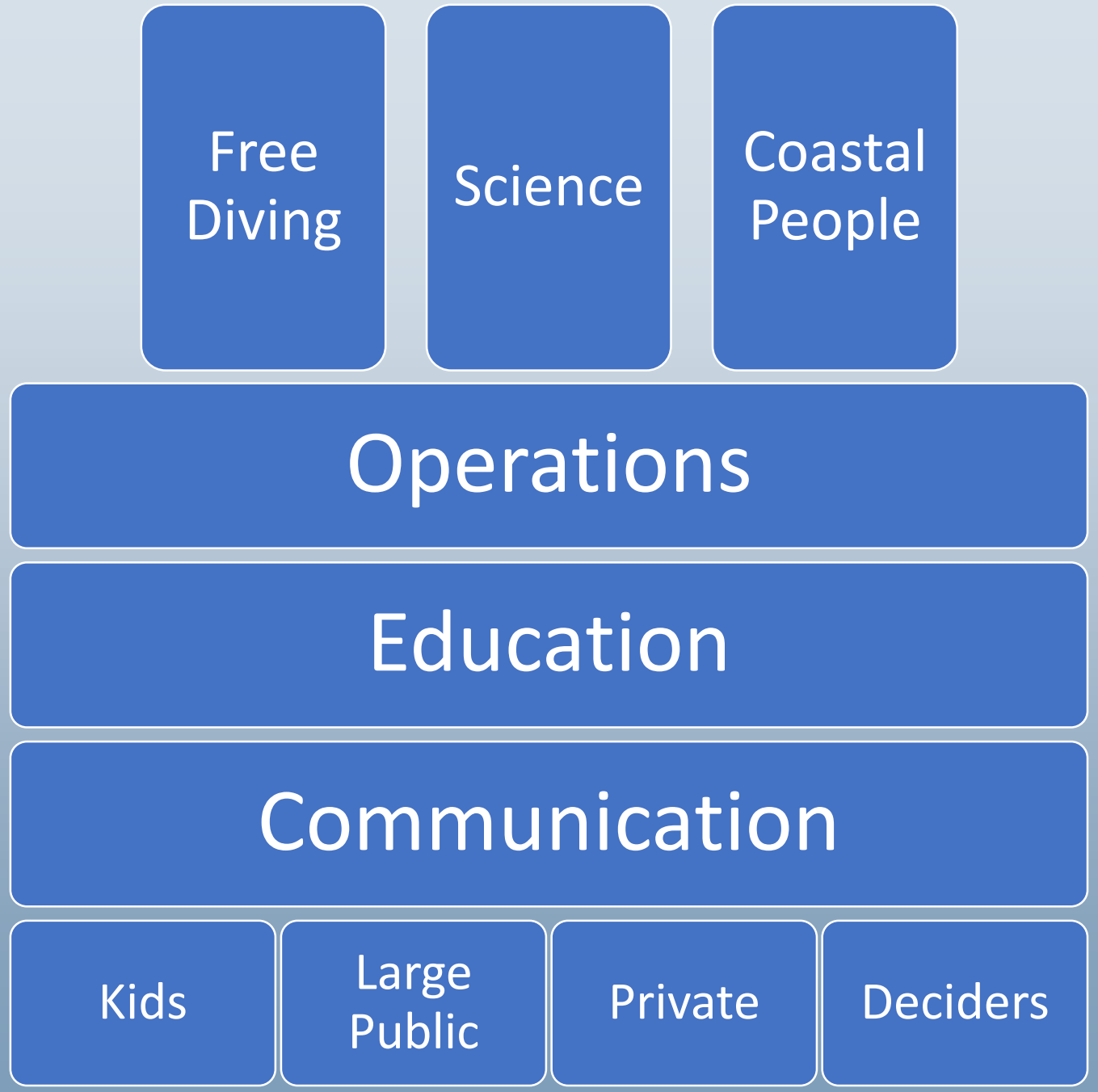
BENEFITS

- Tangible contribution to GOOS
  - Climate
  - Numerical Weather prediction
  - Ocean health analysis
- Universal instruments (adopted and used by any scientists – interactivity)
- Communication/outreach on ocean observation
- International cooperation (call for proposal to world scientists)
- Integrated data flow pilot
- Data access democratization

- High visibility for IOC, WMO, JCOMMOPS
- Substantial funding for JCOMMOPS securing a decade of activities

RISKS

- Project dimensioning vs means
- => to be analyzed in depth (by late 2019)


Free Diving
Science
Coastal People
Operations
Education
Communication
Kids
Large Public
Private
Deciders

Спасибо

Thank you

Gracias

Merci

谢谢

شُكْرًا

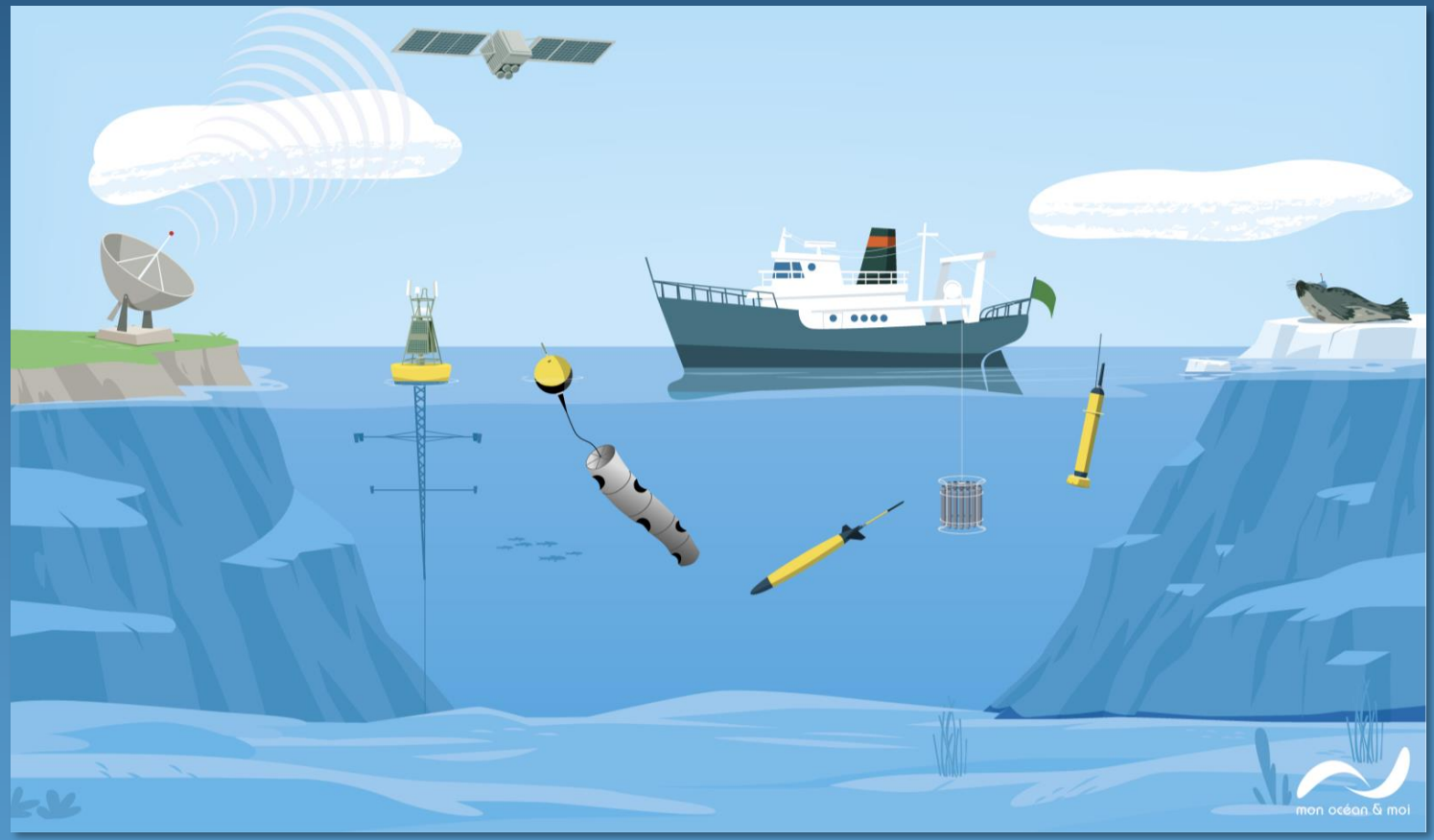
support@jcommops.org

- Argo communications group

Upcoming science conferences and technical workshops

2nd Ocean Observers Workshop

17-19 November, Balearic Islands, Spain



Claire Gourcuff, Emanuela Rusciano, Estérine Evrard, Marine Bollard

claire.gourcuff@euro-argo.eu
erusciano@jcommops.org

THE OCEAN OBSERVERS

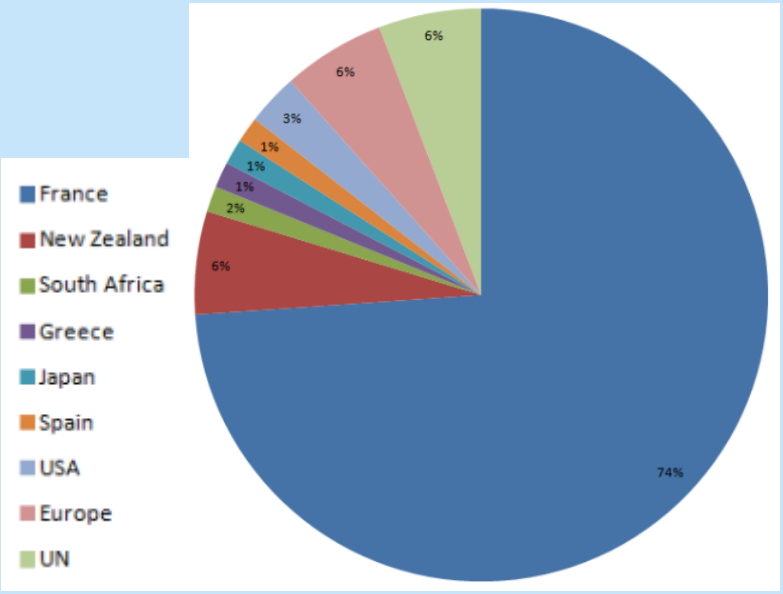
An international outreach and education network:

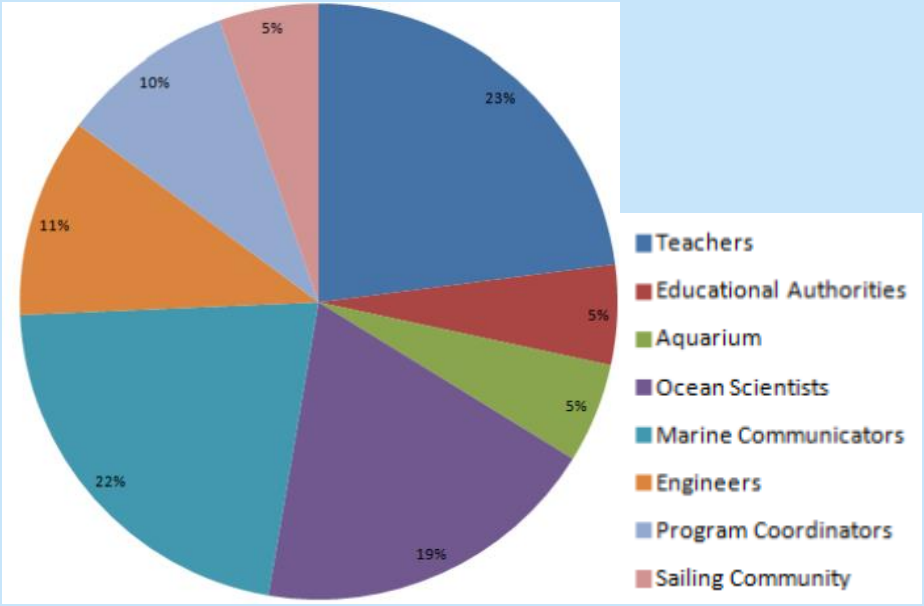
- related to ocean observations in general (not only Argo)
- made up of different actors (scientists, educational authorities, teachers, science communicators, sailing community, policy-makers, associations) involved in marine sciences outreach and education, all willing to:
    - gather and share science-based educational resources and experiences
    - explore the possibility to establish new collaborative partnerships

1ST OCEAN OBSERVERS WORKSHOP

Co-organised by EA-ERIC and JCOMMOPS in 2017:

- 70 persons attended the workshop
- 7 countries were represented
- Wide repartition between people from diverse sectors





1ST OCEAN OBSERVERS WORKSHOP

Main outcomes:

- Generate a multilanguage, open-source inventory of existing educational activities, initiatives, tools and materials (www.oceanobservers.org)
- Build a dynamic network favouring discussions and collaborations (*e.g.* EuroGOOS OL)
- Establish an international **working group** that would be in charge of continuing this first of its kind initiative:
  - WG members: 3 teachers from NZ, 2 communicators from SA & Spain, 2 scientists from Greece & NOAA/USA, representatives from EuroGOOS, EuroArgo & JCOMMOPS
  - WG activities accomplished during the last year:
    - WG ToR
    - Share educational experiences & activities carried out locally and regionally
    - Organize the content of the **2nd workshop next November**

2ND OCEAN OBSERVERS WORKSHOP

- Dates & location: **17-19 November 2020**, **Palma, Balearic Islands**
  - 3 full days
  - Different location -> new local communities

- Host: SOCIB

- Context & funding: Euro-Argo RISE H2020 EU project

- Objective:
  - Bring together all people interested in educational activities related to ocean observations:
    - Teachers, educational authorities
    - Scientists
    - Science communicators / mediation experts
    - Other stakeholders (e.g. policy makers, NGO, etc.)
  - Share experience & foster collaborations

WORKSHOP CONTENT

NB: this is a proposition – *needs to be discussed and agreed with the OOWG*

- A few plenary talks
- Opportunities for people to present educational activities they are leading
  - Plenary presentations (18 max)
  - Innovative “Poster” session (could be experiments, demos, etc.)
- Breakout sessions with practical activities on four different themes: (+ restitution)
  1. Citizen science for ocean observations/how to engage with local communities
  2. Practical experiments for activities with students
  3. Live tests of 2-3 existing web tools / lessons for educational purposes
  4. Scientific mediation (give some keys on scientific mediation and how to create links between scientists and public at large)
- Closing session:
  - Links with other initiatives (*e.g.* EuroGOOS Ocean Literacy, Unesco Ocean Literacy, etc.)
  - Open discussion on next steps
- Social events each day to encourage discussions between participants

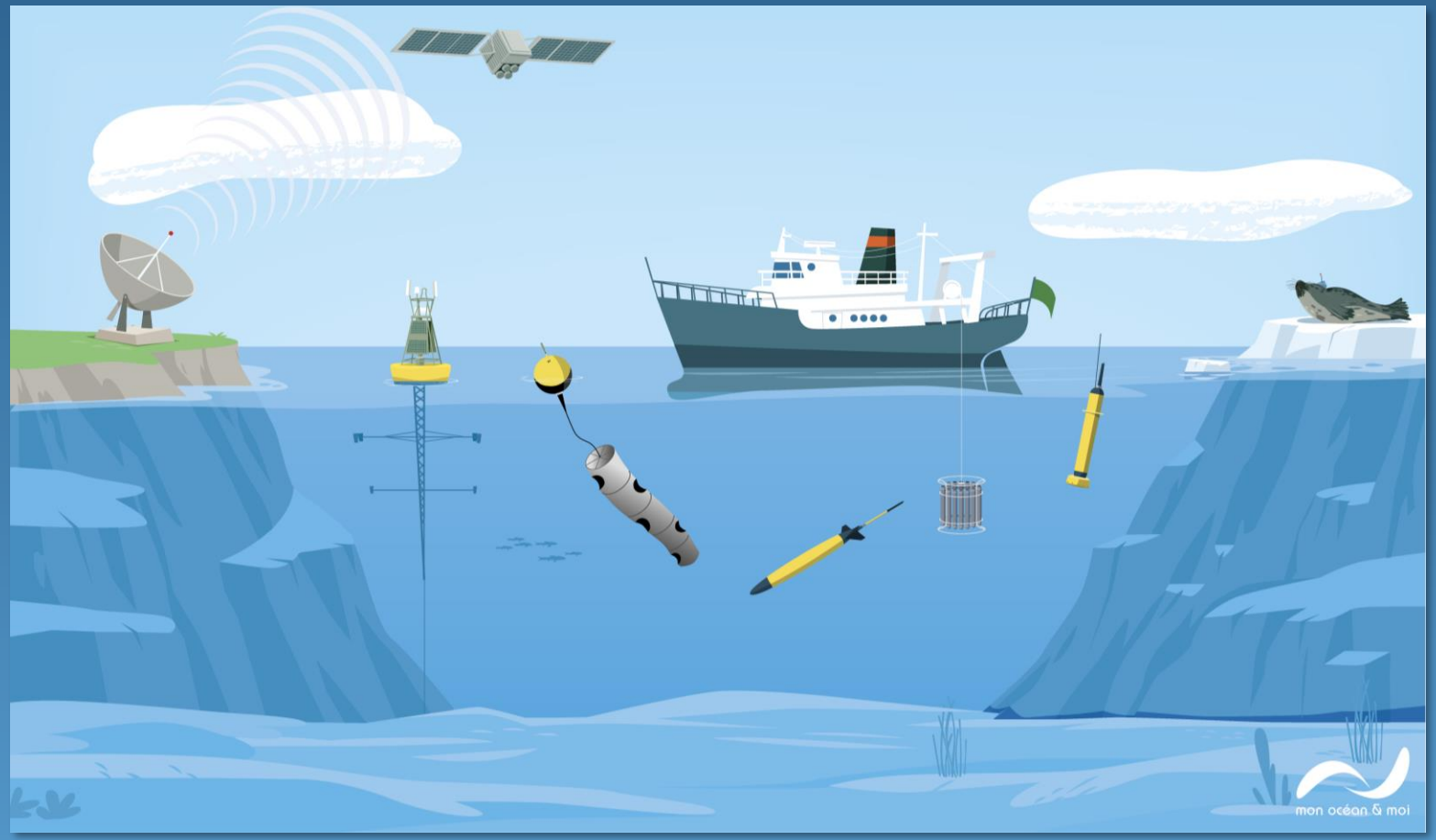
NEXT STEPS FOR THE WORKING GROUP :

- 2nd Ocean Observers Workshop:
  - Agree on the workshop content within the WG (meeting by the end of April)
  - Final definition of break-out sessions
  - Involve local communities (teachers, communicators, etc.)
  - Write and distribute a call for abstract / announcement

- Redesign of the *www.oceanobservers.org* website

Thank you!

www.oceanobservers.org



Status of proposed DMQC workshop
King, Wong, Gilson, Maze, Donnelly, Walicka

The conveners of DMQC6 (2018) had planned to combine with Euro Argo and BODC local hosts to convene a workshop that would have been the 2nd Euro-Argo and 7th International DMQC workshop. This was planned for May 2020 hosted by BODC

Planned agenda items for a 3.5 day workshop included:

Best practices for salty-drifting CTDs
Deep Argo QC
Presentation and training around a BODC-led python-conversion of the OWC tool
Development of a DMQC cookbook
Development of tools for code repositories and a QC forum
Other issues: machine learning; reference data; visualisation tools; etc
Interactive sessions

The decision was taken in early March to cancel the May workshop.

The organisers believe that a workshop is still necessary for distributing expertise across all Argo delayed-mode groups. We therefore propose the following way ahead:

1. Encourage the working group on best practices for salty-drifting CTDs to arrive at a set of recommendations by August 2020. Communicate this to argo-dm-dm. If the Miami meeting goes ahead in December, this can be presented and discussed during the ADMT plenary.

2. Encourage the working group on Deep Argo QC to arrive at a set of recommendations by August 2020. Communicate this to argo-dm. If the Miami meeting goes ahead in December, this can be presented and discussed during the ADMT plenary.

3. Encourage Cecile Cabanes to solicit and coordinate input for the DMQC Cookbook and circulate a draft by November 2020. If the Miami meeting goes ahead in December, this can be presented and discussed during the ADMT plenary.

4. Arrange an initial tele-conference sometime in May-June 2020 for BODC to present their Python version of the OWC tool to an initial group of interested parties, then discuss a better way to disseminate the Python tool to a wider audience.

5. Look for an opportunity to re-convene the DMQC7 workshop in 2021 in Europe. A good opportunity could be to hold the DMQC7 workshop alongside either the 7th Argo Science Workshop or the Deep Argo Workshop hosted by Euro-Argo in 2021.

A note on the congestion of meetings in 2021

A number of upcoming and rescheduled meetings have potential for significant overlap of participants. Energy and budget for travel will not sustain all these meetings being held separately.

Prior to AST21, the following meetings had been proposed, additional to the AST and ADMT plenary meetings

7th International Science Workshop (Euro Argo lead, offered in 2021, Tokyo+3 years)
3rd Deep Workshop (Euro Argo host, anticipated for 2021)
DMQC workshop, International + EuroArgo, advertised for 2020, deferred until 2021

The lead organisers of those 3 workshops are each aware of the proposals for the other workshops. With DMQC deferred, it is likely that there will be at least some pairing of those workshops, with details to be worked out once international travel resumes. The organisers will cooperate to devise effective and efficient meetings.

We note that ADMT-21 (Nov 2020) already has a number of add-on meetings (BGC, DACs)

During AST-21 further workshops have been suggested, eg a future technical workshop, held in China.

Euro-Argo RISE EU project

WP2

T/S

Improvement of the core Argo mission

- Floats lifetime & sensors' diversity
- Argo observation of boundary current regions
- Enhancement of DMQC methods

WP3

Extension to deep ocean

- Address sensors' accuracy & test new sensors
- Develop the DMQC methods

WP4

Extension to Biogeochemical parameters

O_2, NO_3, pH, Chl*a*, Ed, Bbp

- New BGC sensors and products development
- BGC Data Management development & organisation

WP5

Extension to high latitudes

- New technologies for under-ice measurements
- Cooperation with high latitude countries
- Southern Ocean regional data quality assessments

WP6

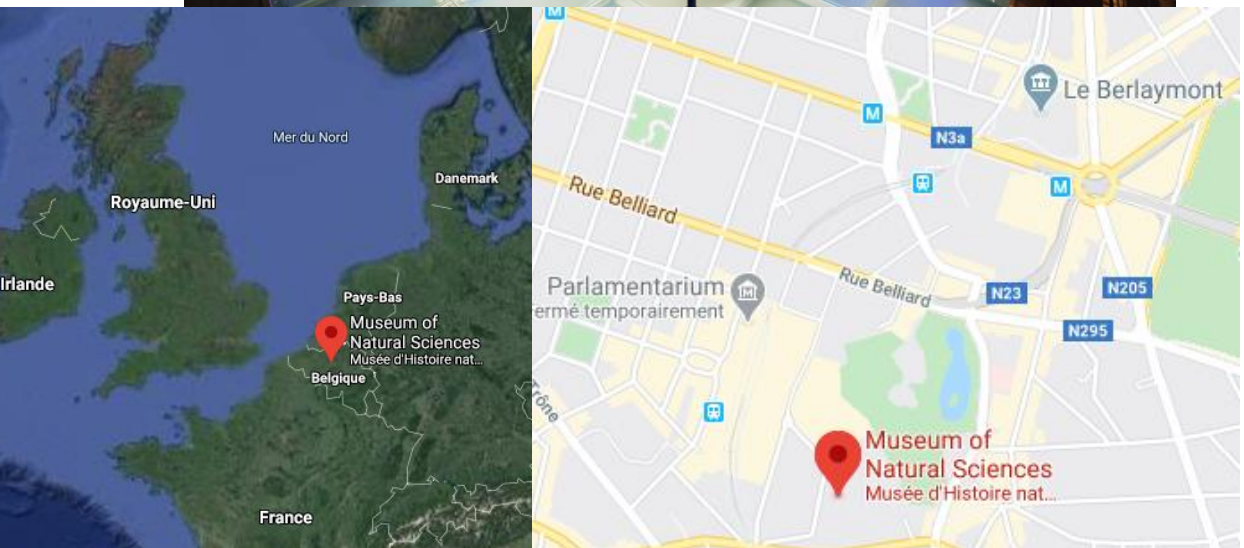
Extension to marginal seas

- Assess the potential of Argo in shallow coastal seas
- Develop regional partnership around Mediterranean, Baltic and Black Seas
- Engage with neighbouring countries

WP7 & 8

Euro-Argo visibility & Integration of Euro-Argo activities in the general context of GOOS and EOOS

Argo Science Workshop



Where : at the Royal Belgian Institute of Natural Sciences in Brussels /Belgium where the EuroGOOS office is hosted

When : June or September/October 2021

How: with Support of the Euro-Argo ERIC and European Commission through the Euro-Argo-Rise project

Could invite representatives of the European Commission to open the meeting

Could be identified as an event linked to the UN DECADE of the OCEANS

Deep Argo Workshop hosted by EuroArgo in 2021
Funded as part of the EuroSea meeting

Few possibilities

- Either organized as a stand alone meeting :
  - January 2021: too early for international travel regarding coronavirus situation I think
  - May or September 2021

- Or organized before or after another meeting
  - In may 2021 jointly with DMQC meeting
  - Jointly with the next Argo Science Workshop
  - Link with GOSHIP and/or Oceansites

My suggestion

- Organize the Deep-Argo workshop after or in parallel to a DMQC meeting with a common session on DMQC of Deep-Argo data
- Maintain a link with GOSHIP and OceanSites for DMQC and deployment issues, deep ocean observation strategy and joint scientific analyses -> invitation of GOSHIP and Oceansites representatives

ADMT-21: 29 NOVEMBER – 4 DECEMBER, 2020 IN MIAMI, FL

- Meeting set to take place at AOML campus. Hotel reservations to hold the meeting fell through after bigger conferences rescheduled due to COVID-19
- Difficult to predict at this point if meeting can occur in person due to COVID-19
- Prefer to set week aside for now and can always hold virtual sessions instead
- Registration live

Schedule	
Sunday afternoon	DAC workshop
Monday morning	DAC workshop
Monday afternoon	BGC ADMT
Tuesday	BGC ADMT
Tuesday evening	ADMT exec
Wednesday – Friday	ADMT plenary

PROPOSAL FOR AST-22 SCHEDULE

H. Claustre has secured the opportunity to have the AST-22 meeting in conjunction with Monaco Ocean Week in 22 – 26 March, 2021
https://www.monacooceanweek.org/en/program/

Good opportunity for outreach and connections on a global stage

OceanPredict community has decided to delay their workshop until 2021, but felt it would be better attended if participants could attend more than just one day. Below is a proposed schedule to try and accommodate this request. Feedback is requested.

Monday: Argo-OceanPredict
Tuesday 1/2 day: Argo - OceanPredict & parallel BGC Argo session
Tuesday 1/2 day: Argo-OceanPredict & BGC-Argo combined session
Wed: AST plenary open session
Thursday 1/2 day: AST open
Thursday 1/2 day: vendor session
Friday full day: AST closed

AST EXECUTIVE COMMITTEE MEMBER PROPOSAL

As Argo grows, it will need to rely more on the AST executive committee to make coordinate and communicate with Argo National Programs. The following proposal is meant to help with this:

- Co-chairs of Argo, as representative of the global full depth multidisciplinary network
- Co-chairs of Deep and BGC missions in charge on liaising the Deep and BGC mission with Core mission Homepage:
- Co-chairs of ADMT in charge of Data management aspects advising AST on these issues
- Argo Director
- Argo Technical coordinator
- Argo Program Office coordinator
- OceanPredict or modeling community representative
- Up to 10 AST members (currently 5) selected in order to provide an appropriate regional distribution and to reflect the major contributions to the Argo Program. They would be in charge of coordinating with other AST members in their region in the following ways:
  - from nations to Exec on items that the region would like to be addressed
  - from exec to Nation to spread decision and actions to be managed

AST MEMBERSHIP

ACTION ITEMS

Action	responsibility
Finalize Argo Environmental Impact statement(s) created by S. Riser, S. Wijffels and EuroArgo. Please send comments, especially ones that can help put some of the numbers into context for the general public. When finalized, the statement information will be featured on the redesigned AST website.	Riser, Wijffels, EuroArgo, AST, Scanderbeg
Ask M. Belbeoch to monitor O2 only floats separately from the 4-6 sensor BGC floats. Ask M. Belbeoch to track coverage & KPIs by BGC parameter.	Belbeoch
Ask BGC AST to explore ways to reduce the cost of BGC floats for countries purchasing only a small number of floats.	BGC AST
Ask Deep & BGC Mission Teams to do an in-depth analysis on the possibility of adding O2 sensors to all Deep floats.	Deep & BGC Mission teams

ACTION ITEMS

Action	responsibility
Following the COVID-19 crisis as well as the build-up of the BGC and Deep Argo Missions, the AST supports basin deployment planning discussions twice per year for each basin.	M. Belbeoch, National Programs
When COVID-19 crisis is over, ask AST to work together to try and determine how to distribute SBE CTDs in such a manner as to take into account National Program budgeting, float production ability, float deployment opportunities, etc.	AST & National Programs
Ask each PI/ National Program to consider asking for exceptions to budget constraints due to COVID-19 to continue buying and deploying floats. For example, perhaps floats can be purchased in advance.	PIs
AST is officially adopting the new governance model which describes a single infrastructure which can deliver data streams from all the missions. Post this information on the AST website, including Terms of Reference for AST, BGC Argo Mission Team and Deep Argo Mission Team and pathway papers for BGC and Deep.	AST, Scanderbeg

ACTION ITEMS

Action	responsibility
Ask AST members to be ready to reach out to their National IOC reps to gather their support for Argo.	AST members
Ask AST to support float platform workshops on a regular basis. Fei Chai has offered to host the next such workshop in China in the spring or fall of 2021	AST & float experts
AST reminds all PIs that if you add an experimental sensor to an Argo float, it cannot be deployed in an EEZ. This is critical to maintaining good standing with the IOC. When the sensor looks ready for a global pilot, please approach the AST to seek approval for global pilot phase.	Pis
AST exec committee	