

## IMPLEMENTATION OF RECOMMENDATIONS

A review that summarised the current status of quality assurance and quality control (QA/QC) procedures across IMOS from the perspective of the ocean variables was undertaken through 2016 in consultation with IMOS facilities. The purpose of the review was to document the QA/QC procedures within IMOS, identify gaps in our procedures, identify priorities, and provide evidence on whether or not the QA/QC procedures IMOS has evolved are as effective and efficient as they need to be for a sustained observing system. In addition, the IMOS QA/QC review is a first step in developing and implementing “Best Practice” across the IMOS Programme.

The review identified a series of issues and provided recommendations to address those issues. This document is a plan for the implementation of these recommendations. Each issue is discussed individually by facility and variable and provides the steps needed to implement the recommendations. This includes the identification of the facilities and staff that should be involved. Some of the recommendations will include more than one option for its implementation while in other instances implementation will be dependent on funding availability before we can proceed. For the purpose of this document, Quality Assurance (QA) will be defined as the processes necessary to support the generation of high quality data and Quality Control (QC) will be defined as the follow-on steps that support the delivery of high-quality data, requiring both automation and human intervention.

The recommendations that apply to the passive acoustics and the wireless sensor network facilities can be found in Appendix 1.

A high level summary is as follows:

See Attachment 1

**ISSUE 1:** QA/QC across IMOS facilities per variable is inconsistent, particularly when there are several facilities (and organisations) undertaking QC with different standards. Including the use of different Quality Flags (QF) for the same variable (i.e. Sea Surface Temperature, SST).

**RECOMMENDATION:** Centralisation of the QA/QC of some variables, such as nutrients and phytoplankton has worked well, ensuring all data are treated the same and facilitating the identification of issues. The possibility of centralising or standardising QA/QC for other variables should be discussed as a way to solve inconsistencies in the data sets, such as sensor based observations from moorings and SOOP.

**FACILITIES:** Ships of opportunity (SOOP), National mooring network (ANMN), Autonomous Underwater Vehicle (AUV)

**VARIABLES AFFECTED:** SST, Total Suspended Solids (TSS), Dissolved Oxygen (DO), Chla/fluorescence.

### **ISSUE 1.1 SOOP SST**

#### **SPECIFIC ISSUES:**

- 1) Each agency applies their own QA/QC protocol to deliver SST from ships of opportunity, therefore the type and level of QC for this single variable differs depending on who undertakes the QA/QC. Of particular concern is the use of different QC flags by the BoM. This can lead to some confusion when stakeholders try to use SST data.
- 2) The delivery of SST is also done by different sub-facilities, sometimes with data provided by the same vessel. For example SST is delivered by SOOP ASF and BGC both from the Investigator. These data appears to have different QC protocols applied and different flags, and it is unclear if the data originates from the same sensor or from two different ones. Different data streams have different agreed reporting protocols and sampling frequencies so the option of standardizing will require shifts in international programs, so this is not an option. A clarifying note in the metadata may suffice, indicating primary or secondary status to datasets. For example, BGC and heat fluxes have SST in the file because it contributes to the calculation of the primary variable (such as air-sea heat flux), so the SST data will be secondary set.
- 3) The resolution of the data provided differs among agencies with EPA Vic delivering every second, AIMS every 10 seconds and BoM every minute or hour (depending on platform). Discussing if SST should be standardise to same time interval will be needed, particularly if that could lead to loss of information.

#### **PEOPLE INVOLVED**

ISSUE 1 & 3: Eric Schulz and Joel Cabrie (BoM); Jessica Benthuisen (AIMS); Randall Lee (Vic EPA); Ana Lara-Lopez (IMOS Office); Sebastien Mancini (AODN); Guillaume Galibert (AODN)

ISSUE 2: Bronte Tilbrook (CSIRO), Eric Schulz and Joel Cabrie (BoM), rep from MNF, Ana Lara-Lopez (IMOS Office), Sebastien Mancini (AODN)

#### **STEPS FOR IMPLEMENTATION AND TIMEFRAME**

Issues with the QC and the use of QF for SOOP SST should be discussed among all the sub-facilities and operational agencies involved (Vic EPA, BoM, AIMS, CSIRO) to find possible solutions. Centralisation has worked well with other variables (National Reference Stations (NRS) vessel based BGC variables such as nutrients and plankton) and it has merit to discuss this possibility in order to have consistent QA/QC of SST data sets.

Actions	Who	When
Call for a meeting to discuss and agree on a solution, including a discussion on the suitability and feasibility of centralising the QA/QC for SST and how it will be implemented	Lee (EPA), Cabrie(BoM), Schulz (BoM), Benthuisen (AIMS), MNF personnel, Mancini (AODN), Galibert (AODN), Lara-Lopez (IMOS Office)	2018Q2
Work on implementation of recommendations from meeting	Same as above	2018

## ISSUE 1.2 ANMN TSS

### SPECIFIC ISSUES FOR THIS VARIABLE

- 1) Initially none of the TSS samples were useful for the validation work of remote sensing because the values obtained for pigment and TSS concentration were from a pooled sample. These samples need to be collected at the surface if they are to be useful for the remote sensing community
- 2) There are issues with the collection of TSS at oceanic waters and the collection of blanks for TSS quality control. Some of the blank data collected to date has not been done properly, and thus it was decided not to process any blank.

It is unclear if TSS collection in oceanic (clear) waters is valuable, particularly if the volume currently collected is inadequate.

PEOPLE INVOLVED: Michele Skuza (AIMS), Craig Steinberg (AIMS), Claire Davies (CSIRO), Lesley Clementson (CSIRO), Peter Fearn (Curtin University, expert SRS), Ana Lara-Lopez (IMOS Office), Sebastien Mancini (AODN), other experts willing to provide advice.

### STEPS FOR IMPLEMENTATION AND TIMEFRAME

Issue	Actions	Who	When
Issue 1	Collect TSS samples in the surface	All NRS sub-facility leaders	2017Q3 IMPLEMENTED

Issue 2	Meeting to discuss and agree on a solution	Skuza (AIMS), Steinberg (AIMS), Clementson (CSIRO), Davies (CSIRO), Fearn (Curtin), Schoeder (CSIRO)	2017Q2 COMPLETED. All sites have received all equipment needed to start the trial, with the procedure and video sent to all sub-facilities
Issue 2	Review and analyse results after a year of implementation of revised protocols for final decision making, e.g. collection of blanks and continued collection of TSS in oceanic (clear) waters. After review, the protocol for TSS collection will need amending based on analyses.	All of the above	2018 Q3

### ISSUE 1.3 ANMN DO

#### SPECIFIC ISSUES FOR THIS VARIABLE

- 1) WQM O2 sensors and CTD SBE43 sensors suffer from high failure and winkler titrations are needed to cross check the WQM and CTD data.
- 2) Winkler titrations for cross checking sensors are only carried out in MAI and ROT due to the equipment needed to conduct them being present at these sites. The lack of these titrations on other NRS makes their data difficult to use, although there is potential for Qld NRS to do titrations with AIMS equipment.
- 3) This variable has little to no QC'd, with the exception of the Acidification moorings. Only QC applied with the toolbox is an automated global range test. No QC protocol exists on how to undertake QC of DO with the toolbox. However, there are protocols applied to data from acidification mooring sub-facility that could perhaps be adapted.

#### PEOPLE INVOLVED

Bronte Tilbrook (CSIRO), Tom Trull (CSIRO), Craig Steinberg (AIMS), David Hughes (CSIRO), other members of the ANMN SC, Ana Lara-Lopez (IMOS office), Sebastien Mancini (AODN).

#### STEPS FOR IMPLEMENTATION AND TIMEFRAME

Issue	Action	Who	When
Issue 1 & 2	Cease DO collection from the WQM and CTD sensors once these	All NRS sub-facilities	This will cease as sensors reach their use by date

	sensors need replacement. It is important that while these data sets continue to be collected, that the NRS can demonstrate the DO data is of reasonable quality (manufacturer calibrations are not sufficient).		
Issue 1 & 2	Implement the use of optical oxygen sensors on NRS with 6-12 monthly calibrations and data processing using well defined and available techniques, as set out for the acidification moorings. Starting with MAI.	Tilbrook (CSIRO), Trull (CSIRO), Steinberg (AIMS), Hughes (CSIRO)	TBA ( <u>dependent on budget availability</u> )
Issue 1 & 2	Test a fast response sensor such as Seabird SBE63 or Aanderaa 4330F sensors for profiling CTD. Initial tests at MAI using bottle samples provide a way to ensure the sensors can be used for profiling prior to purchasing.	Tilbrook (CSIRO), Trull (CSIRO), Steinberg (AIMS), Hughes (CSIRO)	TBA ( <u>dependent on budget availability</u> )

#### ISSUE 1.4 ANMN NRS Chl-a/Fluorescence

##### SPECIFIC ISSUES FOR THIS VARIABLE

- There were issues raised on low range Chl-a calibrations done at CSIRO using fluorescein, with some confusion about the reasons why fluorescein was used, given that the data provided is Chl-a and not fluorescence This led SARDI to implement a local low range Chl-a calibrations. This issue was clarified at the 2017 QC summit, explaining that the purpose of CSIRO fluorescein calibration was to test the linearity of the WQM sensors and to provide a response factor so that all WQM can be converted to read the same fluorescence signal. Conversion from fluorescence to Chla concentration involves an extra step to understand

the transfer function between fluorescein and extracted chl-a from a standard ('Seabird') culture to calibrate the WQM and convert fluorescence to Chla.

- An experimental project undertaken by CSIRO to help interpret the observations collected by the WQM fluorescence sensors was undertaken for MAI, YON and NSI using different algal cultures. This was not possible to do with the other NRS because their WQM were not sent to CSIRO for calibration and thus check their difference in linearity and estimate their response factor.
- A different issue is when WQM are replaced for other instruments, if the work on WQM fluorescence to Chla conversion will still be applicable to the new instruments. It is expected it will, as it follows the same formula because all field fluorometers (should) have a linear response to increasing in vivo Chla fluorescence concentrations. Hence the same protocol can be followed: Calibrate with fluorescein dye, then apply transfer function based on relation with standard culture.
- This variable is very little to not QC'd at all. Only QC applied with the toolbox is an automated global range test. No QC protocol exists on how to undertake QC of Chl-a/Fluorescence with the toolbox.

#### PEOPLE INVOLVED

Lesley Clementson (CSIRO), Mark Doubell (SARDI), Christina Schallenberg (UTas, expert), Ana Redondo-Rodriguez (SARDI), Craig Steinberg (AIMS), Robert Kay (CSIRO), Nick Mortimer (CSIRO), Ana Lara-Lopez (IMOS office), Sebastien Mancini (AODN), maybe other experts (e.g. Martina Doblin, UTS, Peter Thompson CSIRO).

#### STEPS FOR IMPLEMENTATION AND TIMEFRAME

This issue was discussed at the QC Summit in June 2017 and it was concluded that to improve fluorometer calibrations and convert to Chl-a the following steps should be implemented:

- Standardise with dye (fluorescein) to characterise/standardize response. This can be done in CSIRO
- Calculate or determine a multiplier for the difference between CSIRO calibration lab and Wetlabs Chl-a output
- Where possible determine the slope from in-situ samples, as per Lesley's method.

Action	Who	
All WQM from the mooring facility to be sent to CSIRO calibration facility	All ANMN, CSIRO calibration	2017Q2 COMPLETED AND WILL CONTINUE
Prepare a report outlining the steps to improve fluorometer calibrations outlined above (a-c)	Clementson (CSIRO), Mortimer (CSIRO), Schallenberg (CSIRO), Doubell (SARDI), Redondo-Rodriguez (SARDI), Kay (CSIRO), some expert for review and further advice	2018
Discuss the possibility of having a report on the results from the	Clementson (CSIRO)	2018

MAI, NSI and YON WQM fluorescence to Chla conversion		
Determine the necessary steps to implement recommendations from the report, particularly with regards to (b) and (c)	All of the above, plus Steinberg (AIMS), Hughes (CSIRO), Lara-Lopez (IMOS Office), Mancini (AODN)	2018
Discuss and clarify if results from the experimental project to convert WQM fluorescence to Chl-a data (Clementson's project) is to be used to process all WQM fluorescence data (including historical data), and if these conversions will be applicable to other instruments	All of the above	2018

### ISSUE 1.5 ANMN tem, sal, dep, current and all other in-water sensor based variables

#### SPECIFIC ISSUES FOR THIS VARIABLE

Currently the QC is performed using the MatLab toolbox by the different operating institutions. However, the application of the QC has not been standard and written documentation is needed. This made sensor-based data QC from this facility inconsistent. Progress has been made, with a written QC protocol for T, S and Z indicating how to QC a dataset with the toolbox in a standard way.

There is currently no documentations on the ANMN sensor QA protocols.

#### PEOPLE INVOLVED

Craig Steinberg (AIMS), Moninya Roughan (UNSW), John Middleton (SARDI), Ming Feng (CSIRO), David Hughes (CSIRO), Sommerville (IMOS office), Lara-Lopez (IMOS office), Guillaume Galibert (AODN), Marty Hidas (AODN)

#### STEPS FOR IMPLEMENTATION AND TIMEFRAME

ACTION	Who	When
Request all operating institutions to provide a written document of their current QA and QC practices	Steinberg (AIMS), Somerville (IMOS Office), Lara-Lopez (IMOS Office)	2018
Discuss best approach to produce a single standardised QA and QC approach for the facility that complies with the required QC level. NOTE: further discussion on the required QC level is needed and advice should be sought	ANMN SC, Node leaders, IMOS office, AODN	2018

Produce a written document of the finalised and agreed QA and QC protocol for the facility and plan implementation	All ANMN facility leaders, Galibert (AODN), Mancini (AODN), Somerville (IMOS office), Lara-Lopez (IMOS Office)	2018
Discuss and plan what could be done regarding re-processing historical data. This will need detailed scoping and will need a separate process	Facility leaders, Galibert (AODN)	TBA

**ISSUE 2:** The lack of a written document outlining QA/QC protocols in some facilities makes it very difficult to understand and assess their QA/QC processes. This includes QC procedures that have their methodology published in peer-reviewed papers but are not compiled into a single document and thus are hard to find.

**RECOMMENDATION:** That all facilities without a written protocol produce one that includes the QA/QC procedures for all variables derived from this facility. The protocol will be made available on the IMOS or the AODN website so they can be easily accessible. Where additional support is needed IMOS will discuss with the facility.

**FACILITY SPECIFIC ISSUES:**

- **SOTS** (Tom Trull and Peter Jansen): this facility is particularly hard as there are many different variables collected. While there is QA/QC performed, none of their procedures can be found in a single document. Documentation of their procedures per variable should be produced. If additional resources are required, discuss with IMOS Office. **THIS IS CURRENTLY UNDERWAY IN THIS FACILITY**
- **Deep Water Moorings** (Bernadette Sloyan): this facility produces reports of the voyages in the MNF where moorings are deployed and includes information of the QA/QC protocols, however, their protocols are not written in a document that has the sole purpose of outlining their QA/QC activities. This needs to be addressed. If additional resources are required, discuss with IMOS Office.
- **Ocean Colour** (Thomas Shroeder, Lesley Clementson): There is currently no written protocol, on data collection and data processing. The radiometry task team was set up for calibration purposes and will produce a written report. This should be complemented by documenting QA/QC information currently undertaken in LJCO.
- **SSH:** (Chris Watson, Benoit Legresy): They follow standard procedure for the mooring and GPS processing and then there is a step in the data processing for the calibration purpose. However, there is no documentation. If additional resources are required, discuss with IMOS Office.
- **AUV** (Stefan Williams and benthic monitoring steering committee): There are no written protocols for this facility and no QC at all for the environmental variables it collects. The

facility leader is happy to apply a QC protocol from other facility if available, so it would be important to know the type of sensor they have fitted in the AUV and look for similar sensors within IMOS to see if similar QA/QC procedures can apply. Image analysis have their own QA/QC and has been published, but it will be helpful to compile everything into a single document. If additional resources are required, discuss with IMOS Office

- **Animal tagging** (Clive McMahon, Rob Harcourt, Xavier Hoenner, Ian Jonsen): The QA/QC of CTD data is undertaken by MEOP. This is an issue that could be solved by IMOS having a level of involvement in their QC. The QA/QC procedures from MEOP are published in several peer reviewed papers and are not compiled into a single document. This is an issue as it makes difficult to query their QA/QC procedures and not everyone will have subscription to the journals in which these procedures are published. In addition, the facility will develop automated QA/QC of tag locations. This new QA/QC procedure will improve the location of CTD casts, ensuring the best quality CTD locations are available for uptake by the research community. Discussions on how to best to give access to the QA/QC procedures in this facility is needed
- **Acoustic tracking** (Rob Harcourt, Michelle Heupel): New QA/QC procedures have been developed or are being developed by some facilities and are leading in their field (Acoustic tracking). The procedures are outlined in detail in a new publication at Nature Scientific Data (2018). However, the QC procedures have not been implemented to the data currently sitting in the animal tracking data base and this needs to be resolved. If additional resources are required to solve this issue, discuss with IMOS Office.
- **ANMN** (Craig Steinberg, Steering Committee, Claire Davies): Written protocols are needed for this facility. There are manuals for the vessel based water sampling and CTD, with QC protocols for some variables like plankton. The IMOS Matlab toolbox is used to QC sensor data and a protocol on how to QC T, S and Z has been written. However, the toolbox is only one of the components, a full QA/QC protocol will need to be produced. Discussion of who would be the appropriate person to undertake this task will be needed. If additional resources are required, discuss with IMOS Office.

PEOPLE INVOLVED: IMOS Office, facility leaders, technicians

#### STEPS FOR IMPLEMENTATION AND TIMEFRAME

A written document of QA/QC protocol by facility should be a requirement in their contract. While there is a requirement that facilities deliver QC data to the AODN, written documentation on the protocols they followed has never been specified before. However, documentation of their QA/QC protocols will give confidence to end-users of the consistent quality of IMOS data sets. **NOTE: The IOC-AtlantOS/ODIP Best Practices Group is building a secure, permanent Best Practices Repository to which organizations or projects could deposit their full text Best Practice Documents. A template has been drafted to use as guidance in the preparation of Best Practice Documents. This template will be used to guide IMOS facilities without written documentation in their preparation of their protocols. Additionally the repository will be used to house IMOS QA/QC protocols for the facilities.**

Actions	Who	When
Add the requirement to have a written QA/QC protocol to the operators (facility) contracts	Sommerville (IMOS Office), Neilson (IMOS Office)	2017Q3 COMPLETED
Request all facilities without a written protocol to provide one that addresses the required level of QC. Work on a suitable deadline and if additional resources are needed with each facility	Lara-Lopez (IMOS Office), Sommerville (IMOS Office)	2018
Discuss with AODN the best place to place the protocols so they are easy to locate by users. IOC-	Lara-Lopez (IMOS Office), Mancini (AODN)	2018

**ISSUE 3:** Calibration of sensors is inconsistent, with similar sensors sent to different places for their calibration even within one facility.

**RECOMMENDATION:** Availability of the calibration results from sensors through the AODN website, and the addition of target accuracies, error estimates per measurement (particularly needed for the reanalysis/data assimilation community), uncertainty flags and the elimination of biased errors where possible will improve confidence.

**FACILITIES:** AMNM, SOOP, Gliders, AUV, Deep Water Moorings

**VARIABLES AFFECTED:** SST, Temp, sal, Chla/fluorescence, currents, DO

#### SPECIFIC ISSUES

One of the issues is that facilities send their instruments to different places for calibrations rather than sending them to a central place, thus having different calibration protocols applied. This is also the case within facilities such as the ANMN with different sub-facilities sending similar instruments to different places. This excludes in between calibration checks, which should be undertaken regionally.

In addition, there is a general lack of information on the calibration results and calibration history of the different instruments for most facilities. It is important data users to have access to calibration results from the sensors used in an observing system, particularly when generating time-series. This will future proof the data collected, which could be accessed in the future.

**PEOPLE INVOLVED:** ANMN SC, Peter Jansen, Eric Schulz and Joel Cabrie (BoM), Jessica Benthuisen (AIMS), Stefan Williams (Syd Uni), Bronte Tilbrook (CSIRO), Robert Kay (CSIRO Cal Lab), Mark Underwood (CSIRO), Chari Pattiaratchi (UWA), Bernadette Sloyan (CSIRO), Ana Lara-Lopez (IMOS), Emma Sommerville (IMOS), Sebastien Mancini (AODN)

## STEPS FOR IMPLEMENTATION AND TIMEFRAME

Discussion on the best way to improve consistency in the calibration is necessary, including the possibility of centralizing the calibration

To resolve this issue there should be IMOS wide involvement, with all facilities that deal with sensors involved. There are two potential options:

**OPTION 1:** This option will take time and effort and will require additional resources. The timeframe provided is an estimate, but it may take longer. NOTE: There are existing examples of harmonization of calibration procedures in Europe through the JERICO project. This could be looked at to check what it involves and what could feasibly be implemented considering the level of work required and the resources available.

Action	Who	When
<p>Create an inventory by requesting all facilities to provide the following information:</p> <ol style="list-style-type: none"> <li>1) list of instruments and sensors (serial numbers, manufacturer, etc)</li> <li>2) Calibration history (results, place and dates of calibration)</li> </ol>	Lara-Lopez (IMOS Office) and all facilities	TBA
<p>Create a database that includes the inventory and calibration database information. This will require discussions with AODN. This inventory/calibration database could be made publicly available. Such a service would require on-line browser upload UI to a single DB. An alternative is to explore the possibility of expanding the AIMS deployment and instrument database to include that information and use it as a centralised service that can be accessible to all and used by all.</p>	Proctor (AODN), Moltmann (IMOS Office), Underwood (CSIRO), Steinberg (AIMS)	TBA
<p>Analyse the calibration database and identify and document cases where similar sensors are sent to different places and where calibration inconsistencies are an issue. This analysis will also give</p>	TBA	TBA

information on the calibration facilities used by IMOS and could request for their procedures.		
Discuss with the facilities options to make calibration more consistent and efficient, including the option of centralised calibration for all IMOS sensors, or try to harmonise calibration procedures (see NOTE above).	TBA	TBA

**OPTION 2:** This option will not resolve inconsistencies between calibration practices at different places, but will inform the user of the data and will be easier to implement.

Action	Who	When
Request all facilities and calibration providers to make available the calibration results and procedures. This could include scanned calibrations sheets.	All facilities and IMOS Office	2018
Make the historical and future calibration results available through the AODN. This could be easier to implement if calibrations and data need are submitted together so AODN can catalogue the calibrations appropriately.	AODN	2018

NOTE: additionally, it is suggested that calibration results should be included for each data file.

**RECOMMENDATION:** Given IMOS now have more than 10 years of experience with various sensors and combined with a rich history of calibration stability and sensor issues from the IMOS community updating the document “IMOS Data Streams and their Uncertainties” to incorporate knowledge learnt from practical experience will be very valuable.

PEOPLE INVOLVED: Mark Underwood (CSIRO), Robert Kay (CSIRO), facility leaders, IMOS office, Roger Proctor (AODN)

#### STEPS FOR IMPLEMENTATION AND TIMEFRAME

This recommendation is also relevant to the calibration issues and it is closely linked to the recommendation of providing target accuracies, error estimates per measurement (particularly needed for the reanalysis/data assimilation community), and uncertainty. This will be a very valuable exercise that will increase confidence in the data. OPTION 1 for implementation will help facilitate

this recommendation with the provision of a list of sensors per facility and if possible their calibration history.

#### STEPS FOR IMPLEMENTATION AND TIMEFRAME

Action	Who	When
Hold discussions with Mark Underwood to understand the necessary steps and requirements to undertake this work.	IMOS Office	2018

**ISSUE 4:** For some facilities (e.g. gliders) manual QC is lost when data is re-processed, and becomes a time consuming exercise to re-do.

**RECOMMENDATION:** Resolve issue to retain manual QC when data is reprocessed.

**FACILITIES:** Gliders

**VARIABLES AFFECTED:** Temp, sal, Chla/fluorescence, DO, turbidity, DOM, depth

**PEOPLE INVOLVED:** Paul Thompson (UWA), Mun Woo (UWA), Craig Steinberg (AIMS), Sebastien Mancini (AODN)

#### SPECIFIC ISSUES

There is a level of QC that is undertaken manually in some facilities, which is laborious. When data files need to be re-processed, the manual QC is lost in the new re-processed files. This has been a complaint from gliders and was an issue for the mooring network as well. The ANMN facility resolved the issue by storing any manual QC performed with the IMOS toolbox in order to re-apply it automatically when re-processing (and avoid time consuming tasks), perhaps a similar approach could be done with gliders.

#### STEPS FOR IMPLEMENTATION AND TIMEFRAME

Action	Who	When
Discuss with AODN and glider facility the possibility of implementing something similar to the ANMN to handle manual QC when reprocessing	Thompson (UWA), Woo (UWA), Steinberg (AIMS), Mancini (AODN)	2017Q4
Implement steps to retain manual QC. This will include retaining Flag level pass/fail information and where possible automating the reprocessing	Thompson, Woo, AODN	TBA

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**ISSUE 5:** Data from additional sensors used in some facilities (e.g. SOTS velocity and acoustic data) has not been delivered to AODN and discussion is needed if these data are to be available through the AODN.

**RECOMMENDATION:** Discuss with facilities the possibility of getting data from additional sensors into AODN

PEOPLE INVOLVED: ANMN SC, Tom Trull (CSIRO), Rob Harcourt (Macquarie Uni), Bronte Tilbrook (CSIRO), Rob McCauley (Curtin Uni), Bernadette Sloyan (CSIRO), Ana Lara-Lopez (IMOS Office), Roger Proctor (AODN)

SPECIFIC ISSUES

Some of IMOS facilities (particularly in moored equipment) have included extra sensors to collect particular data sets. In many instances the data from these extra sensors are not delivered to AODN and thus are not visible and available.

STEPS FOR IMPLEMENTATION AND TIMEFRAME

Action	Who	When
Request facilities with moored instruments information of any extra sensors on them, the type of sensor and data type	Facility leaders from ANMN (including OA moorings), SOTS, Deep Water Mooring, SSH mooring, acoustic animal tracking, Lara-Lopez (IMOS Office)	Q4 2017
Discuss with facilities gaining access to these additional datasets and with AODN what are the necessary steps to make these datasets available	Facility leaders with additional sensors, Proctor (AODN), IMOS Office	2018

NOTE: Acoustic data from SOTS have been delivered and are now available through the thredds server. Basic QC is done, and advice has been given by Rudy Kloser and documentation on the QC protocol will be provided in time.

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**ISSUE 6:** Some data needs analysis to obtain an EOY (e.g. passive and active acoustics).

**RECOMMENDATION:** Discuss with relevant facilities the possibility of developing value added products that could deliver these EOY

**FACILITIES:** SOOP-BA, Passive Acoustic mooring (see appendix)

**VARIABLES AFFECTED:** zooplankton biomass, nekton biomass, nekton species, top predator species

#### ISSUE 6.1 SOOP-BA

**PEOPLE INVOLVED:** Rudy Kloser (CSIRO), Martin Cox (AAD), Sven Gastauer (ACE CRC), representative of Echoview, end-users (Parks Australia, Iain Suthers, Tom Trull, fisheries sector), Ana Lara-Lopez (IMOS Office), Roger Proctor (AODN); Beth Fulton (CSIRO), Julia Blanchard (IMAS)

#### SPECIFIC ISSUES

The data from this facility is QA/QC to an international standard and it is documented. However, these data is highly specialised and needs expert knowledge to interpret them, making the data hard to use by non-experts. Exploring the possibility of generating products that are suitable to the needs of end users is an option. There has been advance in this regard through the MESOPP program.

#### STEPS FOR IMPLEMENTATION AND TIMEFRAME

Action	Who	When
Organise a workshop with end-users and experts to discuss current and future needs for active acoustic data sets and development of products that can improve the uptake and use of these datasets.	Lara-Lopez (IMOS Office), Kloser (CSIRO), Mancini (AODN), other interested parties	2018
Implement recommendations from the workshop	IMOS Office, Kloser (CSIRO)	TBA

**ISSUE 7:** Some near real time (NRT) (sea state, wind, and others) as well as some delayed mode variables (AUV environmental data, SOTS sea state, Radar wind) have little to no QC.

**RECOMMENDATION:** Implementing and developing a set of standard automated test similar to QARTOD for near real-time QC NRT data streams not currently QC'ed. Develop QC protocols for facilities with no QC for delayed mode data.

**FACILITIES INVOLVED:** NRT: SOOP BGC, Gliders, ANMN, Radar, Biologging, DELAYED MODE: SOTS, AUV

**VARIABLES AFFECTED:** temperature, salinity, Chl-a, currents, sea state, O<sub>2</sub>, pCO<sub>2</sub>, Suspended particulates (backscatter), wind

## **ISSUE 7.1 NRT SOOP BGC**

It is understood that RMT Wakmatha NRT data has been through automated QC, it will be good to explore if their auto QC can be implemented to the other SOOP BGC vessels. If additional resources are required, discuss with IMOS Office

PEOPLE INVOLVED: Bronte Tilbrook (CSIRO), Ian Hawkes (MNF), someone from RMT Wakmatha, Benedicte Pasquer (AODN).

## **NRT GLIDERS**

PEOPLE INVOLVED: Chari Pattiaratchi (UWA), Mun Woo (UWA), Paul Thompson (UWA), Benedicte Pasquer (AODN)

## **NRT ANMN**

This facility has NRT QC for Darwin and Yongala NRS for some of their variables but not for others and there is documentation on their protocols within the sub-facility, however, has not made available to IMOS. The IMOS office will request the sub-facility to provide these documents to add to the IMOS website and AODN. For atmospheric variables, it could be possible to implement QC used by BOM.

PEOPLE INVOLVED: David Hughes (CSIRO), Craig Steinberg (AIMS), David Williams (AIMS), Eric Schulz (BOM).

## **NRT Radar**

There is currently no QC for NRT data on currents or other data from this facility. QC procedures have been developed in house for WERA but not SeaSonde. Currently tests are being performed on a new data format for ocean radar currents, which is being developed within the international HF radar community. Similarly, tests are being performed for the near real-time and offline quality-control procedures, in accordance with the IOOS (Integrated Ocean Observing System) "Manual for Real-Time Quality Control of High Frequency Radar Surface Current Data". **NOTE: This facility has finalised its NRT protocols for both systems and has been documented.**

PEOPLE INVOLVED: Simone Cosoli (UWA)

## **ISSUE 7.2 Delayed mode SOTS**

This facility does not include NRT data, however, some of their data sets such as waves, have rudimentary QA/QC and no written documentation.

PEOPLE INVOLVED: Peter Jansen (CSIRO), Tom Trull (CSIRO)

## **Delayed mode AUV all environmental variables**

AUV environmental sensors WQM and CTD have been calibrated but the data has not been QC. There is a possibility that if the sensors are the same ones used by another facility with existing protocols, that protocol could be implemented.

PEOPLE INVOLVED: Ana Lara-Lopez (IMOS Office), Stefan Williams (Syd Uni), AODN

STEPS TO FOR IMPLEMENTATION AND TIMEFRAME

Facility	Action	Who	When
NRT SOOP BGC	<p>Discuss with MNF, CSIRO and Wakmatha the possibility of implementing Wakmatha's automated NRT QC to the other BGC SOOP vessels. In case, there is no existing automated QC, refer to QARTOD as a guide</p> <p>Implement auto QC for NRT data</p>	Tilbrook (CSIRO), Pasquer (AODN), Lara-Lopez (IMOS Office)	<p>2018</p> <p>TBA</p>
NRT Gliders	<p>Discuss the possibility of implementing NRT Auto QC for gliders. QARTOD could be used as a guide</p> <p>Develop and implement auto QC for NRT data.</p> <p>TBA</p>	Woo (UWA), Pattiaratchi (UWA), Pasquer (AODN), Lara-Lopez (IMOS office)	<p>2018Q1</p> <p>TBA</p>
NRT ANMN	Request mooring operators with NRT QC to share their documented protocols and improve their QC if needed. Their procedures could be guided by QARTOD	ANMN facility leaders, Guillaume Galibert (AODN), Marty Hidas (AODN)	2018
NRT ANMN	For variables with very little QC such as wind and sea state, develop QC protocol using international best practices as guide (if in existence), including QARTOD and SAMOS.	ANMN facility leaders, Schulz (BOM)	TBA
NRT Radar	Discuss with the radar facility leader what is the status of their NRT QC procedures and	Cosoli (UWA), Lara-Lopez (IMOS Office)	2017Q4 This has been completed

	request any written documentation  Implement any QA/QC procedures developed		2018Q1
Delayed SOTS	Develop QC protocol for variables with very little QC such as wind and sea state using international best practices as guide, such as QARTOD. This should be outlined in written documentation.	Trull (CSIRO), Jansen (CSIRO), Lara-Lopez (IMOS office)	TBA
Delayed AUV environmental	Develop and document a QA/QC protocol for all the AUV environmental sensors.  Implement QA/QC to the AUV environmental sensors	Williams (Syd U), Pizarro (Syd U), Lara-Lopez (IMOS Office)	TBA

**ISSUE 8:** QC for some facilities (biologging) is outsourced to partner organisations

**RECOMMENDATION:** The AODN is currently harvesting the MEOP QC data (which includes IMOS), some thought should be given if the outsourcing of the QC is the best strategy for IMOS regarding the QA/QC of these data sets, and some involvement from IMOS should be discussed with MEOP.

FACILITIES INVOLVED: Animal satellite tagging

ESSENCIAL OCEAN VARIABLES: Temperature, salinity, depth, top predator information

PEOPLE INVOLVED: Robert Harcourt (MQ/SIMS), Clive McMahon (SIMS), Ian Jonsen (MQ/SIMS) Xavier Hoenner (AODN), Sebastien Mancini (AODN), Fabien Roquet (MEOP), Esmee van Wijk (CSIRO) someone from IMOS office.

SPECIFIC ISSUES: There is currently limited knowledge within IMOS of the QC work performed at MEOP. The AODN is currently harvesting the MEOP QC data (which includes IMOS), some thought should be given if the outsourcing of the QC is the best strategy for IMOS regarding the QA/QC of these data sets, and some involvement from IMOS should be discussed with MEOP. In addition, the QC procedures, while published in journals, it is hard to track. It will be important to identify potential people that could undertake QC for this facility in case IMOS decides to do it in house. *Please see the IMOS Task Teams webpage for more information on developments for this facility and QA/QC related issues.*

STEPS FOR IMPLEMENTATION:

Action	Who	When
Discuss and develop a strategy for IMOS to take over the QA/QC should MEOP stop QC'ing the biologging data.	Harcourt (MQ/SIMS), Jonsen (MQ/SIMS) Hoenner (AODN), Mancini (AODN), IMOS Office	2017Q4 TWO MEETINGS HAVE TAKEN PLACE TO DISCUSS THIS ISSUE, 14/11/17 AND 5/12/17. A QA/QC PROPOSAL HAS BEEN APPROVED (LINK)
Request MEOP to provide the specific journals where the QA/QC procedures are published and consolidate that information into a single document as a QA/QC protocol	Harcourt (MQ/SIMS), McMahon (SIMS), Hoenner (AODN), IMOS office	2017Q4 THIS HAS BEEN COMPLETED
Location QC finalise state-space model (SSM) for IMOS / ATN satellite data	Harcourt (MQ/SIMS), McMahon (SIMS), Hoenner (AODN), Jonsen (MQ/SIMS)	2018Q1
Test & implement automated data acquisition & SSM fitting on AODN		2018Q2
Test & implement QA/QC steps on AODN		2018Q3
Finalise documentation of QA/QC and publish on GitHub		2018Q4
CTD QC include CTD data in delayed modes within AODN-IMOS data management workflows	Jonsen (MQ/SIMS), Hoenner (AODN), Mancini (AODN), Roquet (FR), Picard (BP), McMahon (SIMS), van Wijk (CSIRO)	2018
Initial training in the post-processing procedures		2018Q2
Calibration of IMOS CTD-SRDs in the lab at the Service Hydrographique et Oceanographique de la Marine (SHOM, France) and test of CTD-SRDs at sea		2018Q2/Q3
Publish documentation of IMOS in-house QA/QC procedure for CTD data		2018Q4
Location QC ensure similar precision between SSM estimates & CLS Argos Kalman smoothed product	McMahon (SIMS), Hacourt (SIMS), Hoenner(AODN)	2019

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**ISSUE 9:** Visual validation of the automated/semi-automated QC from the Matlab toolbox and of any obvious errors, need to be performed by the Facilities/sub-facilities that use it.

**RECOMMENDATION:** There needs to be improvement on the visual validation of Toolbox QC results as well as more guidance and agreement on a standard use of the Toolbox. A task team (TT) will be proposed to develop a document that would try to describe a consistent methodology on how to QC a mooring dataset with the toolbox.

**FACILITIES INVOLVED:** ANMN

**VARIABLES AFFECTED:** Sensor based variables: SST, temperature, salinity, subsurface currents, dissolved oxygen, chl-a/fluorescence

**PEOPLE INVOLVED:** Craig Steinberg (AIMS), Moninya Rougham (SIMS/UNSW), Ming Feng (CSIRO), David Hughes (CSIRO), John Middleton (SARDI), Emma Somerville (IMOS office), Guillaume Galibert (AODN)

**SPECIFIC ISSUES**

This is an issue with all instruments and in particular with the WQMs where some obvious bad data were not being flagged. This issue has been discussed at several mooring meetings and a QC protocol document for IMOS moorings T, S and Z data using the toolbox has been prepared and is out for comment. However, this is only one document to address the proper use of the toolbox. A more comprehensive QA/QC document should be prepared by this facility (SEE ISSUE 2). In addition, a tool that compares neighbouring data from instruments above or below and compares before and after deployments, will greatly improve the QC.

**STEPS FOR IMPLEMENTATION:**

Action	Who	When
Finalise the Matlab toolbox protocol, this involves identifying mistakes/errors in the document, identifying any missing QC step, and including a specific dataset that typically illustrates or challenges the application of one of the detailed QC steps	Steinberg (AIMS), Galibert (AODN), Mancini (AODN)	TBA
Update toolbox to matched protocol	Galibert (AODN)	2017Q4
Organise training for Matlab toolbox operators	Galibert (AODN), Steinberg (AIMS)	2018

NOTE: the Matlab toolbox protocol is only part of the documentation of QA/QC protocols for this facility. A complete protocol will be necessary for all sensors used in the facility See Issue #1.

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**ISSUE 10:** Obtaining regular user feedback on the quality of the IMOS data.

**RECOMMENDATION:** Clearly define pathways to collect user feedback on the quality of IMOS data.

**FACILITIES INVOLVED:** All facilities including AODN and IMOS Office

**VARIABLES AFFECTED:** N/A

**PEOPLE INVOLVED:** AODN, IMOS Office, Facility leaders

**SPECIFIC ISSUES:**

Currently, users can contact the AODN using a single e-mail address [info@aodn.org.au](mailto:info@aodn.org.au) The type of enquiries are quite diverse with some examples provided below:

- Users highlighting issues with the data
- Users enquiring for more information about the dataset collection
- Users asking for guidance on the best tool to access/visualise the data

There is no regular user feedback on the quality of the IMOS data. Feedback has been received through different mechanisms, some are listed below:

- Contact directly the AODN via [info@aodn.org.au](mailto:info@aodn.org.au)
- Workshops organised by the AODN or other IMOS facilities
- Nodes meeting
- Informal discussion with members of the IMSO community
- ...

In order to address this issue, possible solutions could be

- Consolidate mechanisms to discover how users are interacting with IMOS data
- Receive detailed feedback on the quality of IMOS data, i.e. was the data appropriate to their use case? Did the user had to perform additional QC? Was there sufficient metadata and provenance information for the corresponding dataset collection?
- Contact people involved with recently published papers that cite IMOS data.
- Organise a user summit to hear about what they think about the overall services provided by IMOS (quality included)

#### STEPS FOR IMPLEMENTATION

Action	Who	When
Review existing mechanisms to obtain user feedback	IMOS Office, AODN, Facility leaders	TBA
Discussion on possible options to be implemented to obtain user feedback on the quality of IMOS data	AODN and IMOS Office	TBA
Implement agreed option(s)	AODN and IMOS Office	TBA

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**RECOMMENDATION:** Publication of the data in a peer review journal (such as the phytoplankton and zooplankton databases) is good practice and should be encouraged. This gives confidence in the data and also opens the opportunity for non-IMOS data contributions.

This recommendation is entirely up to the facility leaders, but it should be encourage. Publishing the data also ensures that QC is done appropriately and documented and will increase the confidence of the data we serve.

**RECOMMENDATION:** A written report of results from some Task Teams (TT) such as the radiometry and acoustic tracking TT's are essential and expected. They represent important steps to improve our QA/QC procedures for those variables.

PEOPLE INVOLVED: TT leaders and IMOS Office (Ana Lara-Lopez and Tim Moltmann)  
 ZOOM TT: Jason Everett (UNSW), Anthony Richardson (UQ) and Mark Baird (CSIRO)  
 Radiometry TT: David Antoine (Curtin U), Thomas Schroeder (CSIRO)  
 Animal tracking TT: Michelle Heupel (AIMS)

**SPECIFIC ISSUES:**

All TT are meeting their milestones. The radiometry TT has provided their final report, the animal tracking TT will be providing their report at the end of the year and the ZOOM TT still has a year to go before their report is due.

**STEPS FOR IMPLEMENTATION:**

Task Team	Action	Who	When
Radiometry	Provide written report for this TT	Antoine (Curtin), Schroeder (CSIRO)	2017Q3 COMPLETED
	Provide feedback	Moltmann (IMOS office), Lara-Lopez (IMOS office)	2017 Q3
	Work on implementation plan for recommendations, based on feedback provided and where suitable	Antoine, Schroeder, Moltmann, Lara-Lopez	2018
Telemetry TT	Provide report	Heupel (AIMS), Harcourt (Mac U), others from TT	2017Q4
	Provide feedback on report and if any		

	recommendations discuss implementation	Moltmann (IMOS office), Lara-Lopez (IMOS office)	2018Q1
ZOOM	Provide report  Provide feedback on report and if any recommendations discuss implementation	Everett (UNSW), Richardson (CSIRO), Baird (CSIRO)  Moltmann (IMOS office), Lara-Lopez (IMOS office), Proctor (AODN)	2019  TBA

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ATTACHMENT 1 Summary

ISSUE	RECOMMENDATION	FACILITY	VARIABLE	PEOPLE	ACTION								
					2017		2018				2019 - BEYOND	TBA	
					Q3	Q4	Q1	Q2	Q3	Q4			
Inconsistent QA/QC standards	Investigate possibility of centralising	SOOP SST	SST	Lee (EPA), Cabrie (BoM), Schulz (BoM), Benthuyzen (AIMS), Galibert (AODN), Mancini (AODN), Lara-Lopez (IMOS Office), MNF personnel, Tilbrook (CSIRO)		Call for meeting to resolve issue, including possibility of centralised QC	Work on implementation based on outcomes from meeting						
		ANMN	TSS	Skuzza (AIMS), Steinberg (AIMS), Clementson (CSIRO), Davies (CSIRO), Fearn (Curtin), Schoeder (CSIRO), Lara-Lopez (IMOS)	Collect TSS samples in the surface  Meeting to discuss and agree on a solution with respect to blanks				Review results for final decision making, e.g. collection of blanks and TSS in oceanic (clear) waters Amend protocol for TSS collection based on analyses.				

					and oceanic water collection						
			DO	Tilbrook (CSIRO), Trull (CSIRO), Lara-Lopez (IMOS Office), Moltmann (IMOS Office), NRS subfacility	Cease DO collection from the WQM and CTD sensors once they need replacement						Implement the use of optical oxygen sensors on NRS and test fast response optical sensors for CTD
			Chl-a/fluoresc.	Clementson (CSIRO), Doubell (SARDI), Schallenberg (UTas, expert), Redondo-Rodriguez (SARDI), Steinberg (AIMS), Kay (CSIRO), Mortimer (CSIRO), Lara-Lopez (IMOS office), other experts	All WQM from the mooring facility to be sent to CSIRO calibration facility	Prepare a report outlining the steps to improve fluorometer calibrations	Determine the necessary steps to implement recommendations from the report	Discuss and clarify if results from the Clementson's project will be used to process all WQM fluorescence data (including historical), and if applicable to other			Discuss the possibility of having a report on the results from the MAI, NSI and YON WQM fluorescence to Chl-a conversion

								instru ments				
			temp, sal, depth, curren ts	ANMN SC, Lara-Lopez (IMOS Office), Mancini (AODN), Galibert (AODN), Hidas (AODN)				Discuss best approach and standardi se QA/QC procedur es between operating institutio ns	Produce a written document of the finalised and agreed QA/QC procedures for the facility and plan implementati on			Request all operating institutions to provide a written document of their current QA/QC procedures  Re-process historical data
The lack of a written document outlining QA/QC protocols for many facilities	That all facilities provide a written protocol with their QA/QC procedures for all variables derived from their facility.	SOTS, DEEP WATER MOORING, FAINMS, SRS OC, SRS SSH, PASS AC, AUV, ANI. TRACK, ANMN		Facility leaders, IMOS office, Mancini (AODN)	Add requirem ent to have a written QA/QC protocol to the operator s (facility) contracts		Request all facilities without a written protocol to provide one. Work on a suitable deadline with the facilities	Discuss with AODN the best place to put the protocols so they are easy to locate by users				

Calibration of sensors is inconsistent	Availability of the calibration results from sensors through the AODN website	all facilities, except Argo and XBT	all sensor based variables	All facilities, IMOS office, AODN		<p>OPTION 1: Create an inventory of sensors and calibration history for each facility involved</p> <p>OPTION 2: Request all facilities and calibration providers to make available the calibration results and procedures</p>						<p>OPTION 1: Create a database for sensor and calibration information</p> <p>Analyse calibration database to ID inconsistencies</p> <p>discuss options with facilities to standardise calibrations</p>
	Updating the document "IMOS Data Streams and their Uncertainties"	all facilities	all sensor based variables	all facilities, Underwood (CSIRO), IMOS Office		Hold discussions with Mark Underwood to understand the necessary steps and requirements to undertake this work						

For some facilities manual QC lost when data is re-processed	Resolve issue of manual QC	Gliders	Temp, sal, Chl-a, DO, turbid, DOM, depth	Thompson (UWA), Wool, (UWA), Steinberg (AIMS), Mancini (AODN)		Discuss with AODN and glider facility possibility of implementing similar steps used by ANMN to handle manual QC when reprocessing						Implement steps to retain manual QC
Additional sensor data in some facilities not delivered to AODN	Discuss with facilities the possibility of getting data from additional sensors into AODN	SOTS, ANMN (inc. pass ac and OA), deep water moorings, acoustic tracking	acoustic data, temp, current velocity, sea state	ANMN SC, Trull (CSIRO), Harcourt (Macquarie), Tilbrook (CSIRO), McCauley (Curtin), Sloyan (CSIRO), Lara-Lopez (IMOS Office), Mancini (AODN)		Request facilities with moored instruments information of any extra sensors, sensor type and data		Discuss with facilities access to these additional datasets	Work with AODN the necessary steps to make these datasets available			
Analysis of data needed to deliver an EOV (passive and active acoustics)	Discuss with facilities development of value added products to deliver EOVs	SOOP BA, Pass Ac	zooplankton, nekton spp	ACTIVE: Kloser (CSIRO), Cox (AAD), Gastauer (ACE CRC), Echoview rep, end-users, Lara-Lopez (IMOS Office), AODN				ACTIVE ACOUSTICS: Organise workshop with end-users and experts for advice on needs and possible	Implement recommendations from the workshop			

								value added product				
		Passive acoustics	top pred spp	McCaughey (Curtin), AAD, RAN, NESP, PARKS, AODN, IMOS OFFICE								TBA
Some near real time (NRT) data and some delayed mode data are not QC'd	Develop and implement standard automated tests similar to QARTOD for near real-time and develop and apply QC to variables with little or no QC	SOOP BGC	all NRT-data	Tilbrook (CSIRO), Pasquer (AODN), Lara-Lopez (IMOS Office), Hawkes (MNF), Wakmatha personel			Discuss with MNF, CSIRO and Wakmatha possible implementation of automated QC for NRT data		Implement auto QC for NRT data			Implement auto QC for NRT data
		Gliders	all NRT-data	Woo (UWA), Pattiaratchi (UWA), Pasquer (AODN), Lara-Lopez (IMOS office), Thompson (UWA)			Discuss the possibility of implementing NRT Auto QC for gliders. QARTOD could be used as a guide					Develop and implement auto QC for NRT data. TBA

		ANMN	all NRT-data	Steinberg (AIMS), Williams (AIMS), Schulz (BOM), Galibert (AODN), Hidas (AODN)			Request mooring operators with NRT QC to share their documented protocols and improve their QC if needed.				
		Radar	NRT current velocity	Cosoli (UWA), Lara-Lopez (IMOS Office)		Discuss with facility the status of their NRT QC procedures and request written documentation	Implement any QA/QC procedures developed				Implement any QA/QC procedures developed
		SOTS	sea state and wind parameters	Trull (CSIRO), Jansen (CSIRO), Lara-Lopez (IMOS office)							Develop QC protocol for wind and sea state using international best practices (if in existence) and document in writing.
		AUV	Temp, sal, Chl-a, CDOM	Williams (Syd U), Pizarro (Syd U), Lara-Lopez (IMOS Office)			Develop and document a QA/QC protocol for all the AUV		Implement QA/QC to the AUV environmental sensors		

							environmental sensors.					
QC for biologging outsourced to partner organisation	IMOS involvement in QC should be discussed with MEOP	Animal tracking biologging	temp, sal, depth, top pred	Harcourt (Macquarie), McMahon (UTAS), Hoenner (AODN), Mancini (AODN), Roquet (MEOP), Jonsen (SIMS), IMOS office.		Discuss and develop a strategy for IMOS to take over the QA/QC should MEOP stop QC'ing the biologging data.  Request MEOP to provide documentation of QA/QC procedures		Develop and implement automated QA/QC procedure for Argos location data				
Visual validation of QC from Matlab toolbox needs improvement and consistent	Improvement visual validation of Toolbox QC results and agree on a standard use of the Toolbox.	ANMN	SST, temp, sal, currents, DO, chl-a	ANMN SC, Galibert (AODN)				Update toolbox to matched protocol	Organise training for Matlab toolbox operators		Finalise the Matlab toolbox protocol  Include Matlab Toolbox protocol as an attachment to the ANMN QA/QC procedures when developed	

User feedback on IMOS data quality	Define pathways to collect user feedback	AODN, IMOS Office and all facilities	All	AODN, IMOS Office and all facility leaders								Review existing mechanisms
												Discuss options
												Implement agreed options
Task team reports	A written report of results from all Task Teams (TT) are essential and expected.	All TT	DO, Zoop, SRS OC, Animal acoustic track		Radiometry TT report due	Animal Acoustic tracking final report due					ZOOM TT report due	DO TT report provision needs discussion

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## Appendix 1

ISSUE 2: The lack of a written document outlining QA/QC protocols in some facilities makes it very difficult to understand and assess their QA/QC processes. This includes QC procedures that have their methodology in several peer-reviewed papers but are not compiled into a single document.

RECOMMENDATION: That all facilities without a written protocol produced one that includes the QA/QC procedures for all variables derived from this facility. The protocol will be made available on the IMOS or the AODN website so they can be easily accessible.

### FACILITY SPECIFIC ISSUES:

**FAIMMS** (Scott Bainbridge): QC is done but there is no protocol written

**Passive acoustics**: QC is done at a good level but there is no documentation, needs to be addressed.

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ISSUE 5: Data from additional sensors used in some facilities has not been delivered to AODN and discussion is needed if these data are to be available through the AODN.

RECOMMENDATION: Discuss with facilities the possibility of getting data from additional sensors into AODN

### SPECIFIC ISSUES

There has been a series of IMOS facilities (particularly in moored equipment) that have included extra sensors to collect particular data sets. Passive acoustic moorings integrated temperature loggers, the possibility of including these raw datasets into the AODN was discussed at the IMOS annual planning meeting. This should be revisited again.

Action	Who	When
Request facilities with moored instruments information of any extra sensors on them, the type of sensor and data type	Facility leaders from passive acoustics, Lara-Lopez (IMOS Office)	TBA
Discuss with facilities access to these additional datasets and with AODN what are the necessary steps to make these datasets available	Facility leaders with additional sensors, Proctor (AODN), IMOS Office	TBA

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ISSUE 6: Some EOVs need analysis of data to obtain data on an EOV (passive and active acoustics).

RECOMMENDATION: Discuss with facilities the possibility of developing value added products that could deliver these EOVs

**ANMN Passive acoustics**

PEOPLE INVOLVED: Rob McCauley (Curtin), AAD, RAN, NESP, MARINE PARKS, others.

SPECIFIC ISSUES:

The issues for these particular data sets are similar to active acoustics. In addition, there is a lack of coordination between this sub-facility and other potential partners and interest groups. Given the high profile that marine noise had in the SoE and the ability of using passive acoustics to monitor, making the data more accessible by providing products that end-users can easily understand could be a step forward in increasing the use and uptake of these datasets.

STEPS FOR IMPLEMENTATION AND TIMEFRAME

Similarly to active acoustics a workshop that includes end-users will be needed to discuss future needs and better coordination. TBA

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