GROOM II

GLIDERS FOR RESEARCH, OCEAN OBSERVATION & MANAGEMENT : INFRASTRUCTURE AND INNOVATION

EuroSea

EuroGOOS

European Global Ocean Observing System

European Data Management Workshop

22d June 2022

Real Time QC : Toward harmonization in Europe

This project has received funding the European Union's Horizon 2020 research and innovation programme under grant agreement No 951842.

Agenda

- Workshop objectives
- EGO requirements
- OG1.0 strategy
- The current RTQC for gliders
- Toward unified methodology in Europe ?
  - *The needs and the benefits*
  - *The minimum agreement acceptable for everybody?*
- How to implement that ?
  - *Timeline and tools ?*

I. Workshop objectives

- Describes the requierments form EGO/GROOM and OG
- Identify the existing tools and approahces for glider RTQC
- Discuss how to move on with this critical question for real time data management at the European level and in the perspective of GROOM RI

- RTQC are not mandatory in the EGO format
- RTQC are applied by three Data assembly Centers : Coriolis, NMDC and SOCIB
- Other DACs (BODC, Sweden ?) do not apply RTQC on their data

Name	Definition
<PARAM>	float **<PARAM>**(TIME); <PARAM>:**standard_name** = "<X>"; <PARAM>:**units** = "<X>"; <PARAM>:**_FillValue** = <X>; <PARAM>:long_name = "<X>"; <PARAM>:valid_min = <X>; <PARAM>:valid_max = <X>; <PARAM>:comment = "<Y>"; <PARAM>:ancillary_variables = "XXX"; <PARAM>:cell_methods = "XXX";
<PARAM>_QC	byte **<PARAM>_QC**(TIME); <PARAM>_QC:**long_name** = "Quality flag"; <PARAM>_QC:**conventions** = "EGO reference table 2.1"; <PARAM>_QC:**_FillValue** = -128; <PARAM>_QC:**valid_min** = 0; <PARAM>_QC:**valid_max**= 9; <PARAM>_QC:**flag_values** = 0, 1, 2, 3, 4, 5, 8, 9; <PARAM>_QC:**flag_meanings** = "no_qc_performed good_data probably_good_data bad_data_that_are_potentially_correctable bad_data value_changed interpolated_value missing_value";

List of real time QC for Argo and Gliders applied by Coriolis processing chain

I. Current EGO requirement on RTQC

II. OG1.0 strategy on RTQC

- RTQC are not mandatory in the OG1.0
- If RTQC are applied it should be documented and reference in the file by a doi linking to the related publication of documentation

VARIABLE NAME	variable attributes	requirement status
<PARAM>	float <PARAM>(N_MEASUREMENT); <PARAM>:long_name = "<X>"; <PARAM>:standard_name = "<X>"; <PARAM>:vocabulary = "https://vocab.nerc.ac.uk/collection/OG1/current/[https://vocab.nerc.ac.uk/collection/OG1/current/]"; <PARAM>:_FillValue = <X>; <PARAM>:units = "<X>"; <PARAM>:ancillary_variables = "PARAM_QC"	mandatory <PARAM> contains the values of a parameter listed in the control vocabulary related to OceanGliders parameters. <X>: these fields are specified in the control vocabularies.
<PARAM>_QC	Byte <PARAM>_QC(N_MEASUREMENT); <PARAM>_QC:long_name = "quality flag"; <PARAM>_QC:FillValue = " "; <PARAM>_QC:RTQC_methodology = ""; vocabulary = ""; <PARAM>_QC:RTQC_methodology_vocabulary = ""; <PARAM>_QC:RTQC_methodology_doi = "";	mandatory

Note: It is anticipated to upgrade the ancillary variable related to QC by refining the ancillary variable name like < PARAM >_qc_generic, < PARAM >_qc_spike_test, <PARAM>_qc_land_test, etc.

GROOM RI EuroSea EuroGOOS European Global Ocean Observing System

- SOCIB toolbox : https://github.com/socib/glider_toolbox

- Coriolis processing chain

Test number	QC test binary ID	Test name
1	2	Platform Identification test
2	4	Impossible Date test
3	8	Impossible Location test
4	16	Position on Land test
5	32	Impossible Speed test
6	64	Global Range test
7	128	Regional Global Parameter test
8	256	Pressure Increasing test
9	512	Spike test
10	*1024*	*Top and Bottom Spike test (obsolete)*
11	2048	Gradient test
12	4096	Digit Rollover test
13	8192	Stuck Value test
14	16384	Density Inversion test
15	32768	Grey List test
16	65536	Gross Salinity or Temperature Sensor Drift test
17	131072	Visual QC test
18	261144	Frozen profile test
19	524288	Deepest pressure test
20	1044576	Questionable Argos position test

List of real time QC for Argo and Gliders applied by Coriolis processing chain

- UEA nacent work : http://www.byqueste.com/toolbox.html

  Conductivity lag for salinity and density spikes

III. Existing approaches

- SeaGliders Quality Control Manual : https://www.ego-network.org/dokuwiki/lib/exe/fetch.php?media=public:datamanagement:seagliderqualitycontrolmanual.pdf

Seaglider Quality Control Manual
SCHOOL OF OCEANOGRAPHY
and
APPLIED PHYSICS LABORATORY
UNIVERSITY OF WASHINGTON

Version 1.14 March 2017
Corresponding to Seaglider basestation version 2.10

- ❑ Validating GPS locations and times
- ❑ Correcting depth and pressure
- ❑ Computing initial vehicle velocity and glide angle
- ❑ Computing temperature, conductivity and salinity
    - ❑ Temperature bounds:
    - ❑ Temperature spikes:
    - ❑ Conductivity spikes
    - ❑ Salinity bounds
- ❑ Adjusting temperature, conductivity, and salinity
- ❑ Adjusting temperature
- ❑ Correcting trapped water temperature anomalies during apogee
- ❑ Detecting conductivity anomalies
- ❑ Correcting salinity for thermal-inertia effects
- ❑ Correcting pumped CTD data
- ❑ Correcting oxygen sensor data
- ❑ Correcting Wetlab sensor data

III. Existing approaches

- GliderTools ; https://doi.org/10.3389/fmars.2019.00738
  - *« The automated QC is done according to procedures modeled after the Argo data processing scheme (Schmid et al., 2007) »*
  - *Secondary QC for Physics Data: Filters and Smoothing (Is this still real time ?)*
  - *Fluorescence QC and Calibration*
  - *PAR Quality Control and Derivations*

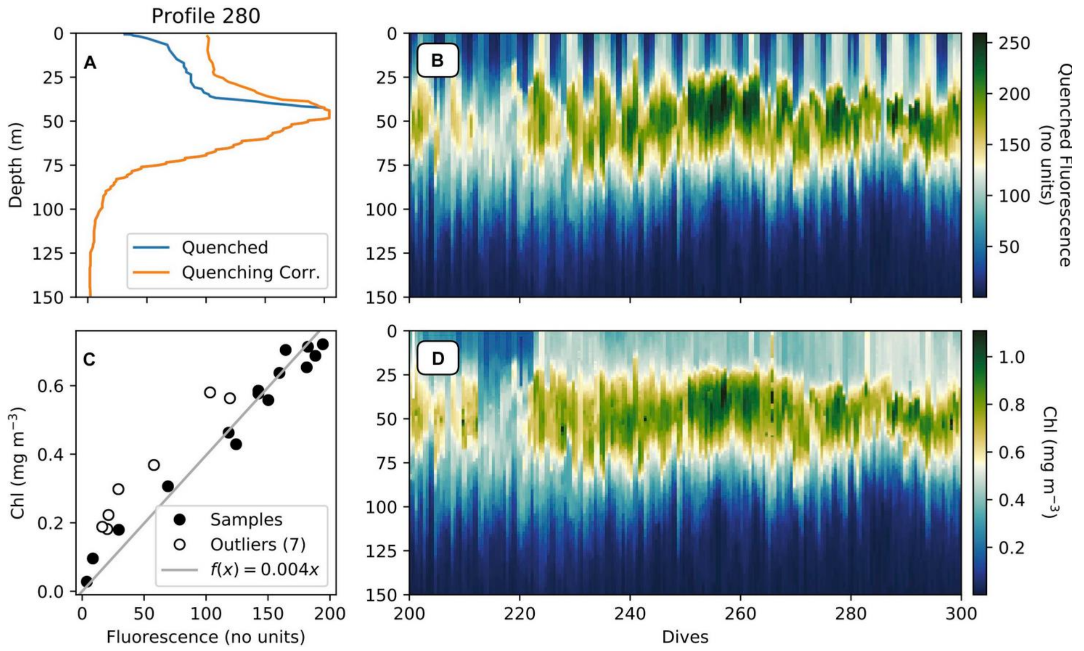

Figure : (A) Depth profiles of quenched and quenching-corrected fluorescence (unitless raw count), **(B)** Section plot of quenched fluorescence (no units), **(C)** Huber linear regression of glider fluorescence (no units) and *in situ* chlorophyll-a (mg m^{-3}), and **(D)** section of glider chlorophyll (mg m^{-3}).

III. Existing approaches

- IOOS Quartod package *:* https://ioos.noaa.gov/project/qartod/
  - *For optical data :* https://ioos.noaa.gov/ioos-in-action/oceanic-optics/

QARTOD

QUALITY ASSURANCE/QUALITY CONTROL OF REAL-TIME OCEANOGRAPHIC DATA

Announcements | Manuals | Key Objectives | Project Management | Implementation | Related Projects

Real-time Quality Control Manuals

These manuals are living documents that reflect the state-of-the-art QC testing procedures for real-time in-situ current observations.

- Real-Time Quality Control of pH Data Observations
- Real-Time Quality Control of Stream Flow Observations
- Real-Time Quality Control of Passive Acoustics Data
- Real-Time Quality Control of Phytoplankton Data
- Real-Time Quality Control of HF Radar Observations
- Real-Time Quality Control of Dissolved Nutrients Observations
- Real-Time Quality Control of Wind Data
- Real-Time Quality Control of Water Level Data
- Real-Time Quality Control of In-Situ Surface Wave Data
- Real-Time Quality Control of Ocean Optics Data
- Real-Time Quality Control of In-Situ Temperature and Salinity Data

itors of ocean observing systems
erly controlled by both users and

Table 2-2. Included and excluded variables addressed in this manual.

Variables Included	Variables Excluded
In-water radiance and irradiance	Phytoplankton species
Above-water radiance and irradiance	Zooplank
Beam attenuation	Total sus
Turbidity	Particulat
PAR	
Chlorophyll	
CDOM	
FDOM	
Backscattering and volume scattering	

Table 3-2. QC Tests in order of implementation and hierarchy.

Group 1 *Required*	Test 1	Timing/Gap Test
	Test 2	Syntax Test
	Test 3	Location Test
	Test 4	Gross Range Test
	Test 5	Decreasing Radiance, Irradiance, and PAR Test
Group 2 *Strongly Recommended*	Test 6	Photic Zone Limit for Radiance, Irradiance, and PAR Test
	Test 7	Climatology Test
	Test 8	Spike Test
	Test 9	Rate of Change Test
	Test 10	Flat Line Test
Group 3 *Suggested*	Test 11	Multi-Variate Test
	Test 12	Attenuated Signal Test
	Test 13	Neighbor Test

III. Existing approaches

- IMOS / ANFOG user manual : http://imos.org.au/fileadmin/user_upload/shared/ANFOG/ANFOG_DataManagement_UsersManual_v5.1_21Aug2018.pdf

Automatic tests

1. Impossible date test
2. Impossible location test
3. Range test
4. Spike test
5. Gradient test
6. Surface data

Manual QC

Examples of conditions where additional QC is applied:

glider out of the water

glider sitting in the seabed

noise experienced due to bio-fouling or other reasons

coarse outliers

III. Existing approaches

- CoTeDe : https://www.theoj.org/joss-papers/joss.02063/10.21105.joss.02063.pdf

« The tests of the most common QC procedures were implemented in CoTeDe in a modular fashion to facilitate expanding with new tests and to permit alternative arrangements. The user can choose from one of the built-in standard procedures, for example, the Argo recommendations (Wong et al., 2015), or compose a custom arrangement of tests. This freedom allows a better data assessment by fine-tuning the methods – A Spray underwater glider operating on the California coast might benefit from slightly different thresholds than used to QC the same Spray in the Mediterranean. »

https://github.com/castelao/CoTeDe

III. Existing approaches

- **What are the needs and what would be the benefits ?**

To increase overall quality of European Gliders data sets and improve user uptake.

To adopt, create and document Quality Control procedures (international standards) labeled as “OceanGliders” compliant

To facilitate know-how exchange and the adoption of best practices of Quality Control methodologies on gliders key essential variables (engineering, physical and biogeochemical)

To share tools/codes for Quality Control.

- **What would be the minimum agreement acceptable for everybody?**

IV. Toward a unified methodology in Europe ?

- Which approach ?
    - Minimum set of test ?
    - CoTeDe

- Which tools ?
    - Sharing code ?
    - Compare results ?

- Which timeline ?

- Which team ?
    - European ? Global ?
    - Who are the expert ?

- Key actions to progress the topic?
    - Who wants to contribute please?

V. How to implement it ?

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