Gliders data QC and corrections procedures Real Time & Delayed Mode

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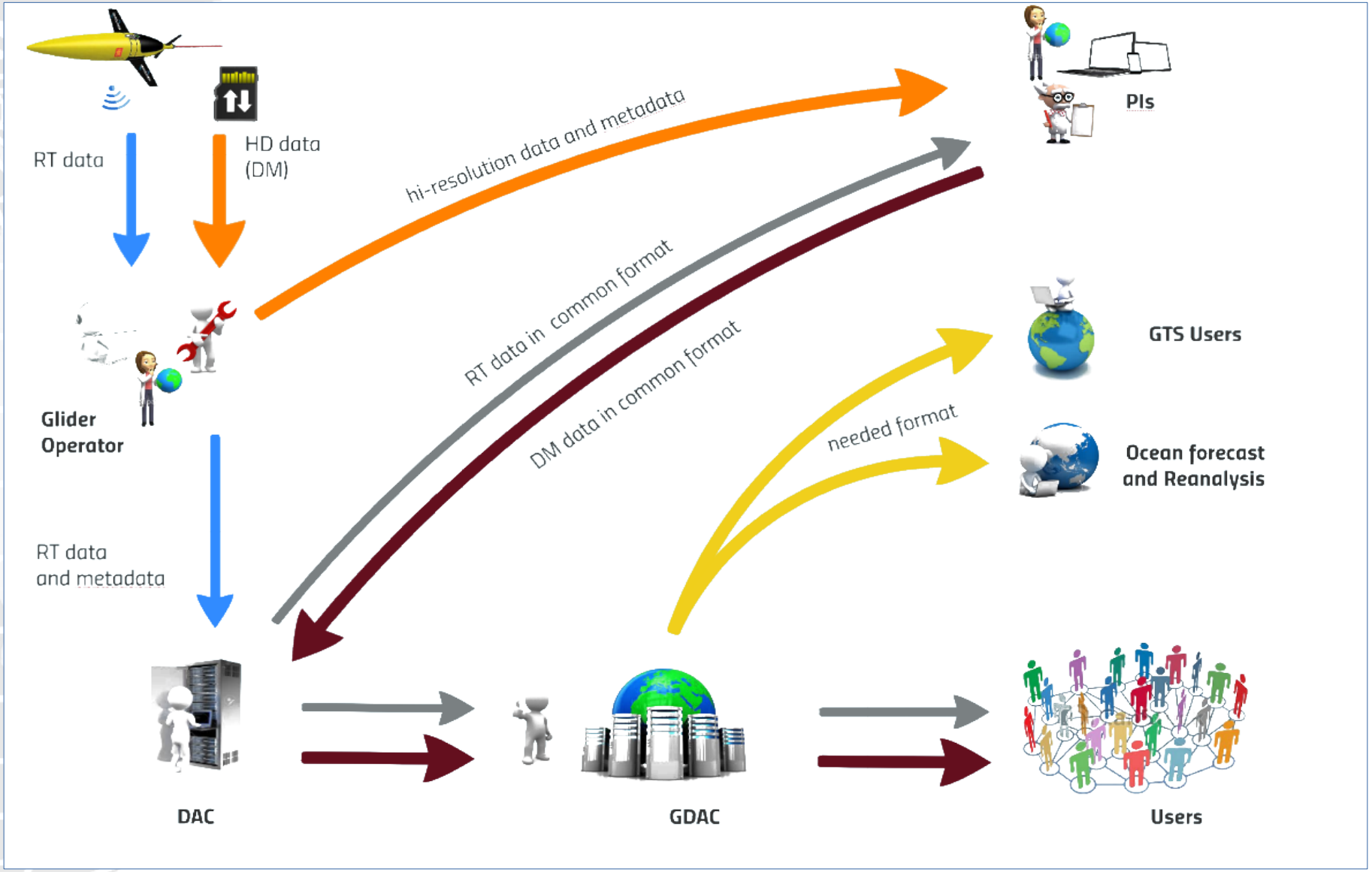
Outline

Review of some existing methods for RT & DM data QC and corrections on :

- Pressure / Temperature / Salinity
- Dissolved Oxygen
- Chlorophyll-A (Fluorescence)
- Nitrates

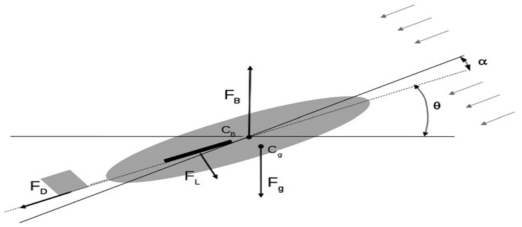
Data Flow


RT data
HD data
(DM)
hi-resolution data and metadata
RT data in common format
DM data in common format
needed format
PIs
GTS Users
Ocean forecast
and Reanalysis
Glider
Operator
RT data
and metadata
DAC
GDAC
Users

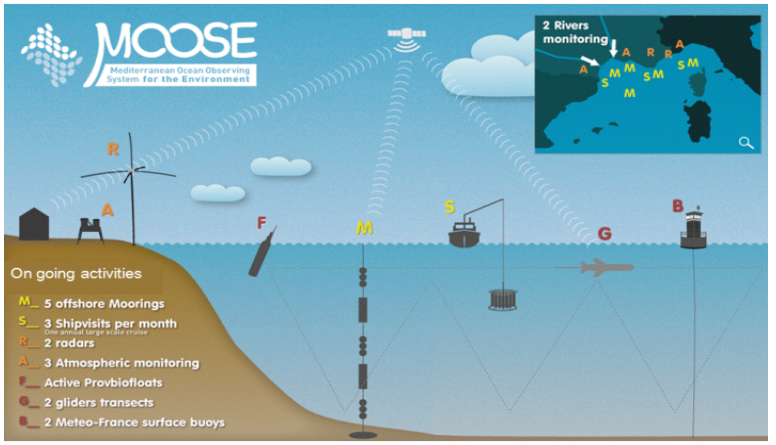
Pressure / Temperature / Salinity

- **RTQC : general tests (thresholds, spikes, position, etc.) → QC flags**
- **Delayed Mode :**
  - **Pressure correction when two sensors available (Slocums), pressure offset when air measurements available**
  - **Time and thermal inertia lag correction for T/S**
    - Garau et al. 2010 : method used by most of the Pis (SOCIB toolbox)

      + Liu et al. 2015 : further filtering
    - Dedicated workshop in Geesthacht in October 2013
    - Eriksen (2016) : improved correction thanks to high accuracy heat flow and flushing rate (gliders flight model consideration) estimates inside the conductivity cell : method used in recent UW Seaglider basestation processing.

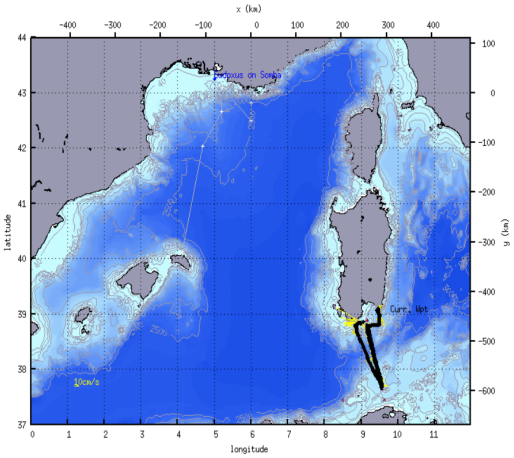


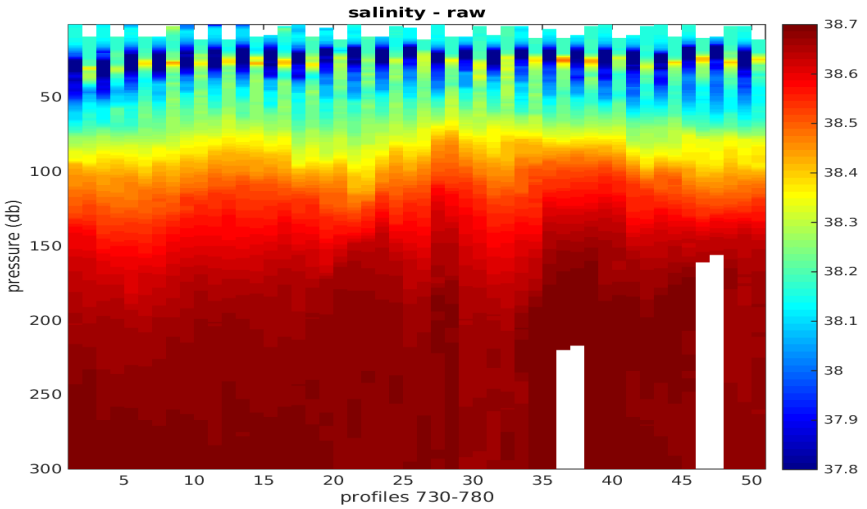
  - **Salinity post-calibration** in the frame of regional integrated observations systems

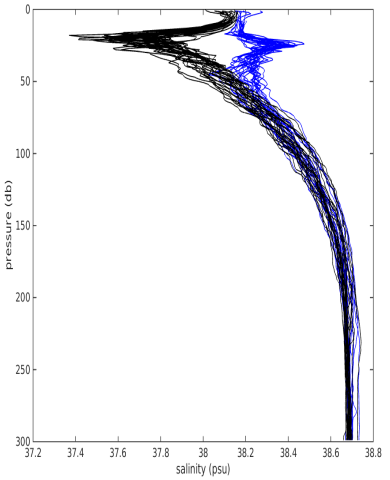


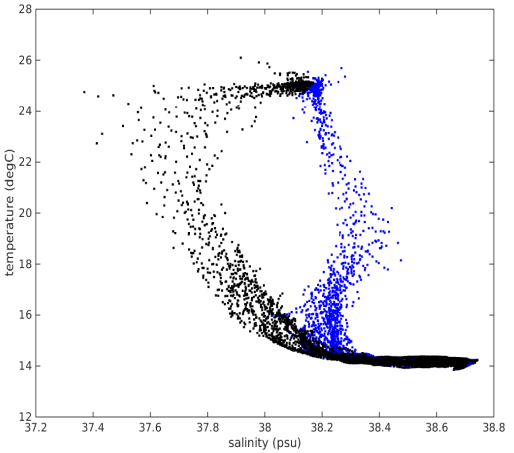
Time & thermal inertia lag correction: example

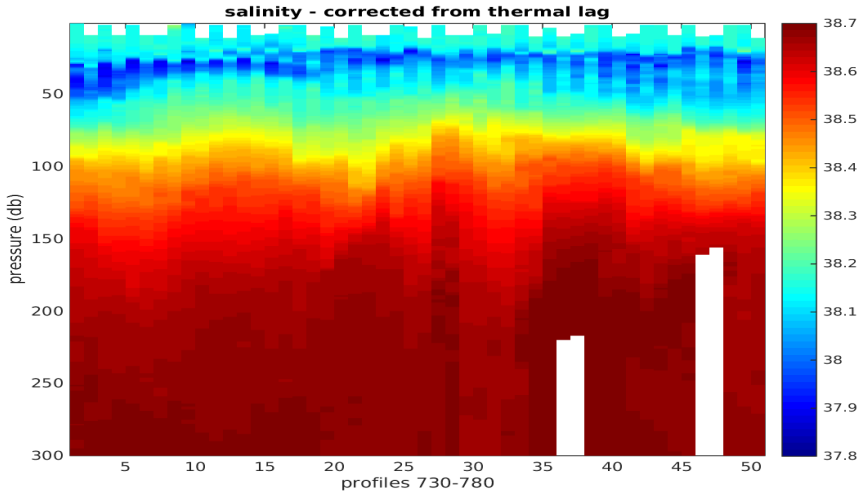
Eudoxus / Somba Aug.-Sept. 2014

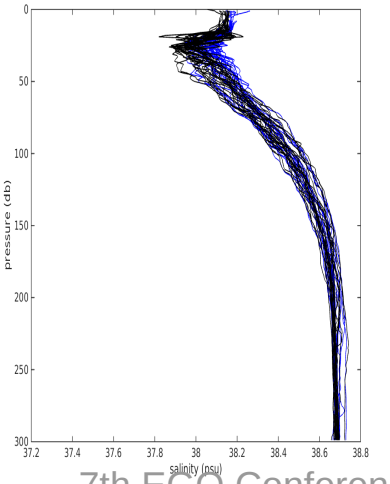


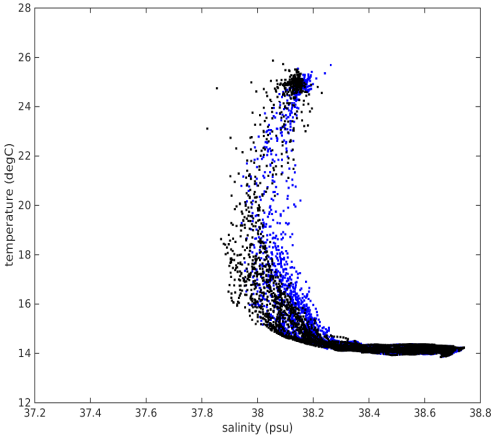






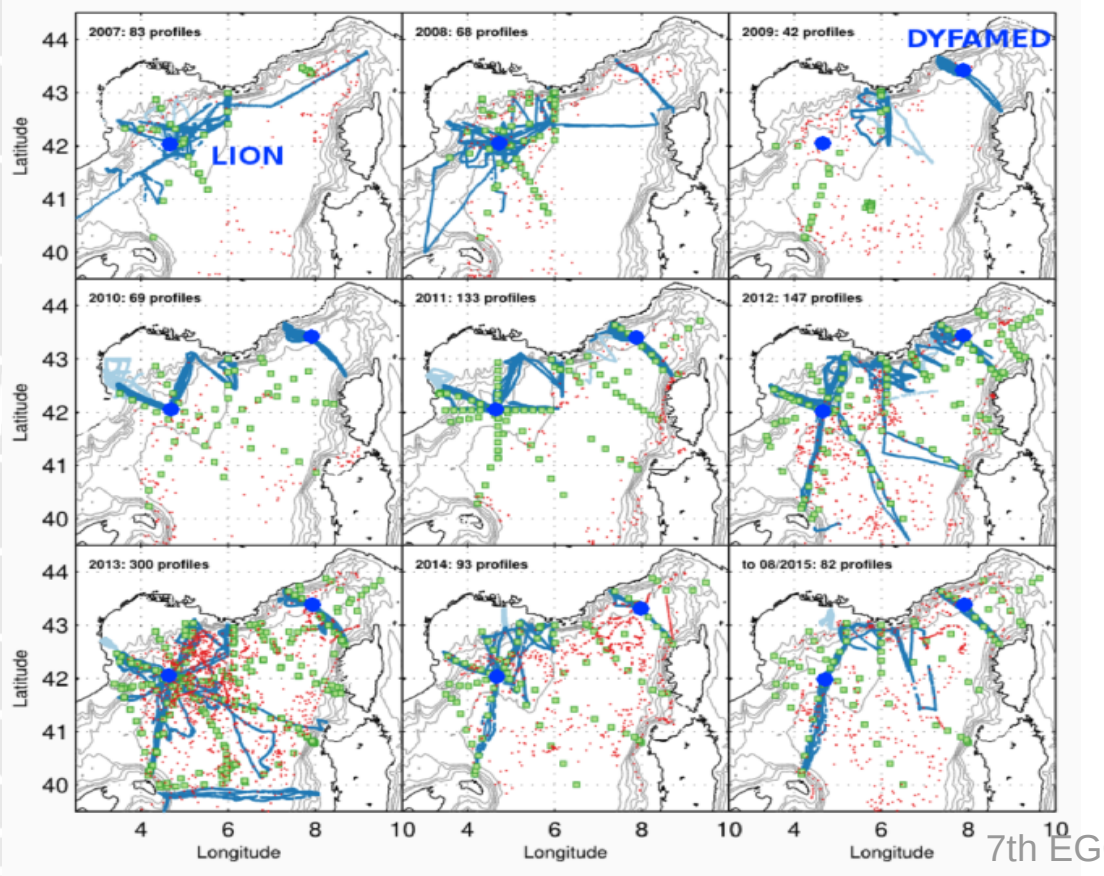


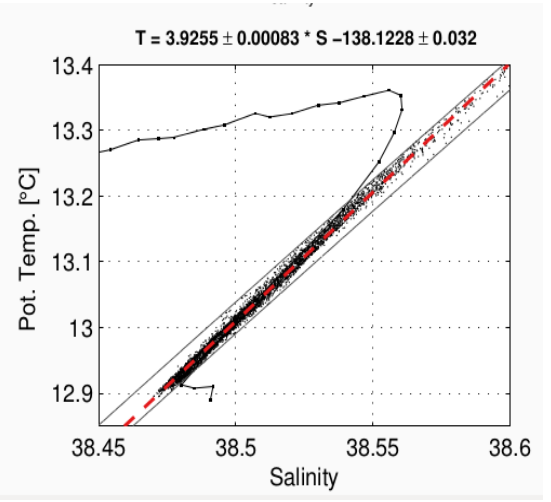




Salinity post-calibration : exemple of MOOSE integrated observation system

- Ground truth : mixing line evaluated each year with high accuracy double CTD casts acquired during Moose cruises
- Spatial/temporal correlation scales estimates → when CTD data available
- Comparison with mooring (1 data every 30min at 700m and 900m depth)





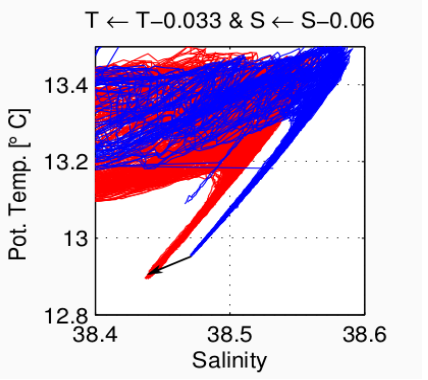
Multi-platform approach :

R/V :	14 cruises +1000 profiles
Gliders :	+110 missions +40 000 profiles
Profiling floats :	50 floats +3500 profiles
Moorings :	LION & DYFAMED

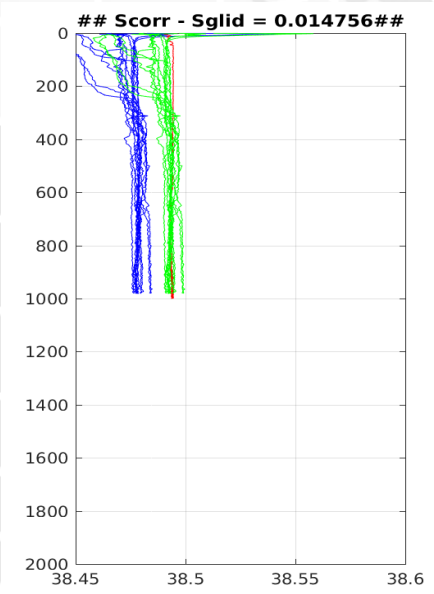
Bosse PhD thesis (2015)

Salinity post-calibration : exemple of MOOSE integrated observation system

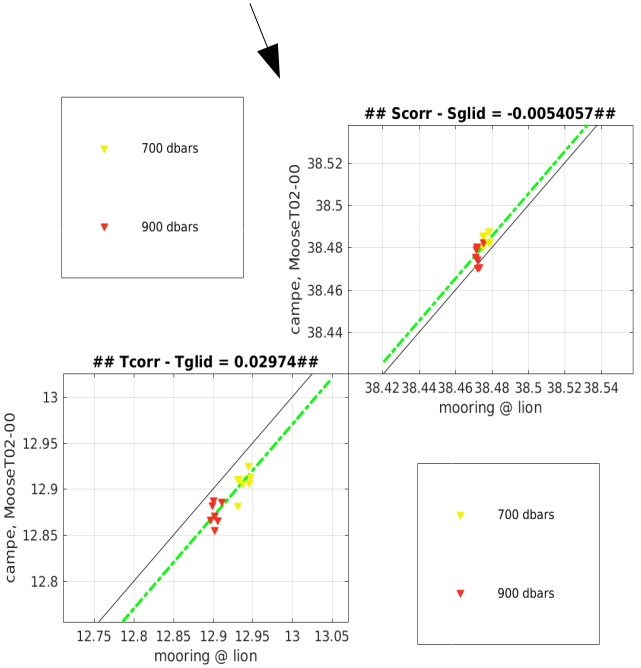
T/S offsets correction after landing events (2 identified issues over +110 missions)



Salinity offset correction thanks to CTD profile comparison



Mooring comparison at 700 and 900m depth

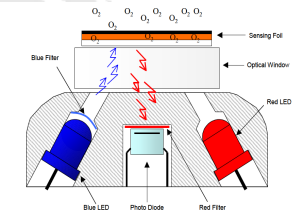


→ 2/3 of gliders data in NW Mediterranean can be calibrated against mooring data

Dissolved Oxygen (Optodes)

Argo document : « Processing Argo oxygen data at the DAC level cookbook » March 2016.

- Example : Optodes 3538 :



$$DPHASE = A + B*BPHASE + C*BPHASE^2 + D*BPHASE^3$$

$$MOLAR\_DOXY = C_0 + C_1*DPHASE + C_2*DPHASE^2 + C_3*DPHASE^3 + C_4*DPHASE^4$$

where C0, C1, C2, C3, C4 are temperature dependant coefficients calculated as:

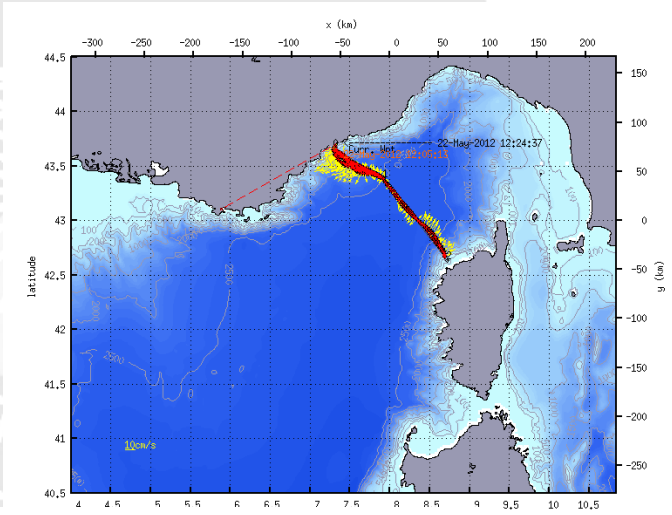
$$C_i = C_{i0} + C_{i1}*T + C_{i2}*T^2 + C_{i3}*T^3$$

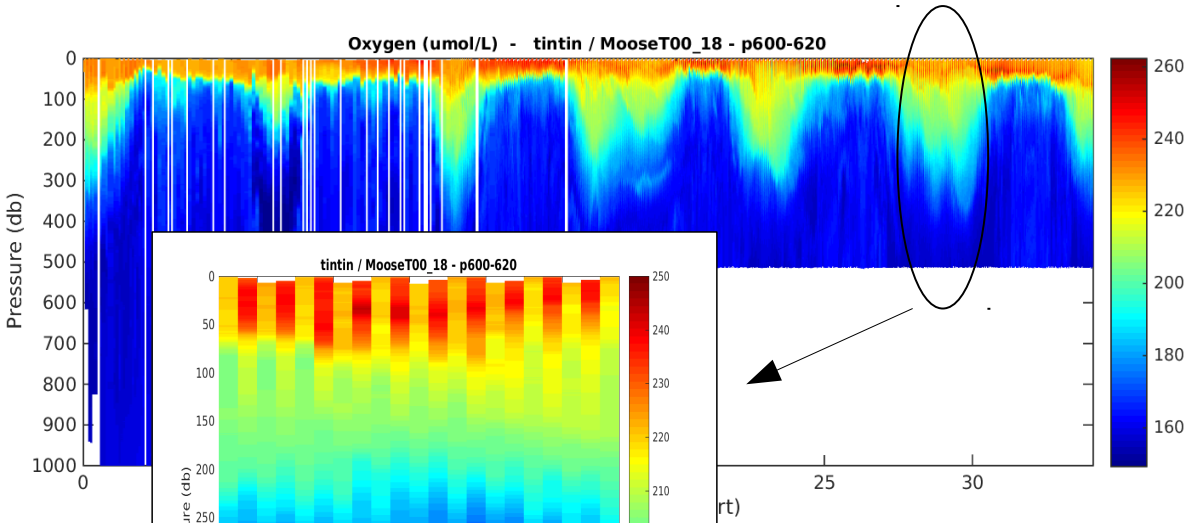
- RT :
  - Coriolis DAC is testing the Argo recommendations in RT for gliders data
    → **Importance of coefficients provision in the metadata**
  - **Rutgers:** time lag correction on internally computed Oxygen data
  - **University of Washington**: Argo recommendations, including recent air measurements correction (Johnson et al. 2015). No time lag correction ?

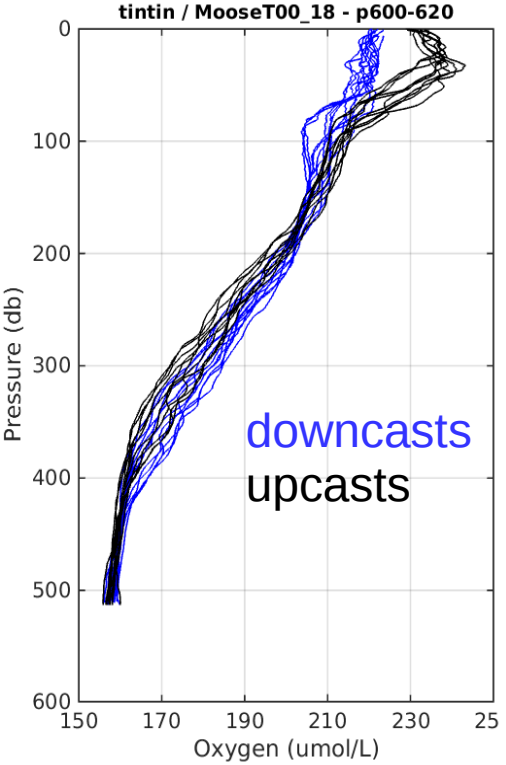
- DM (PIs) :
  - **ANFOG & LOCEAN/CNRS**: Argo recommendations + time lag correction based on phase measurements
  - **...**

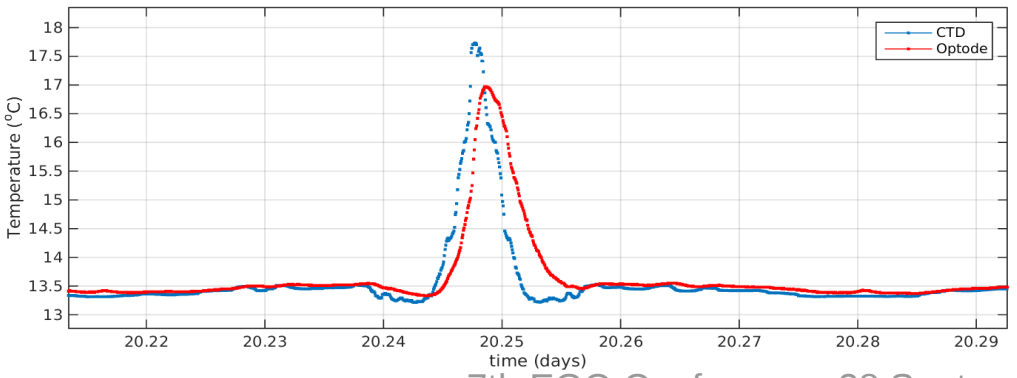
Dissolved Oxygen (Optodes)

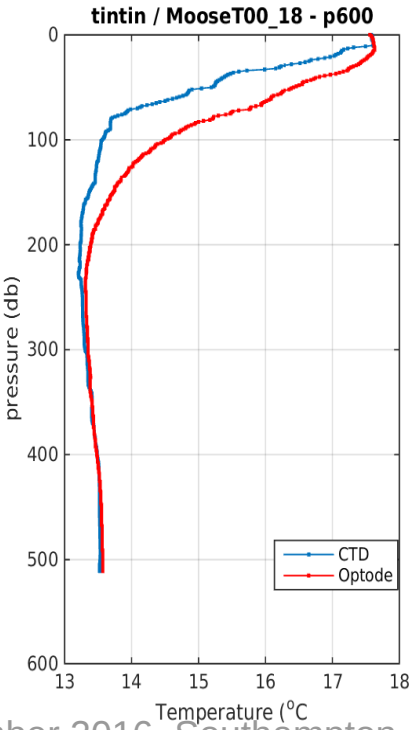
- Example : **tintin / MooseT00_18 (5 returns, April-May 2012)**





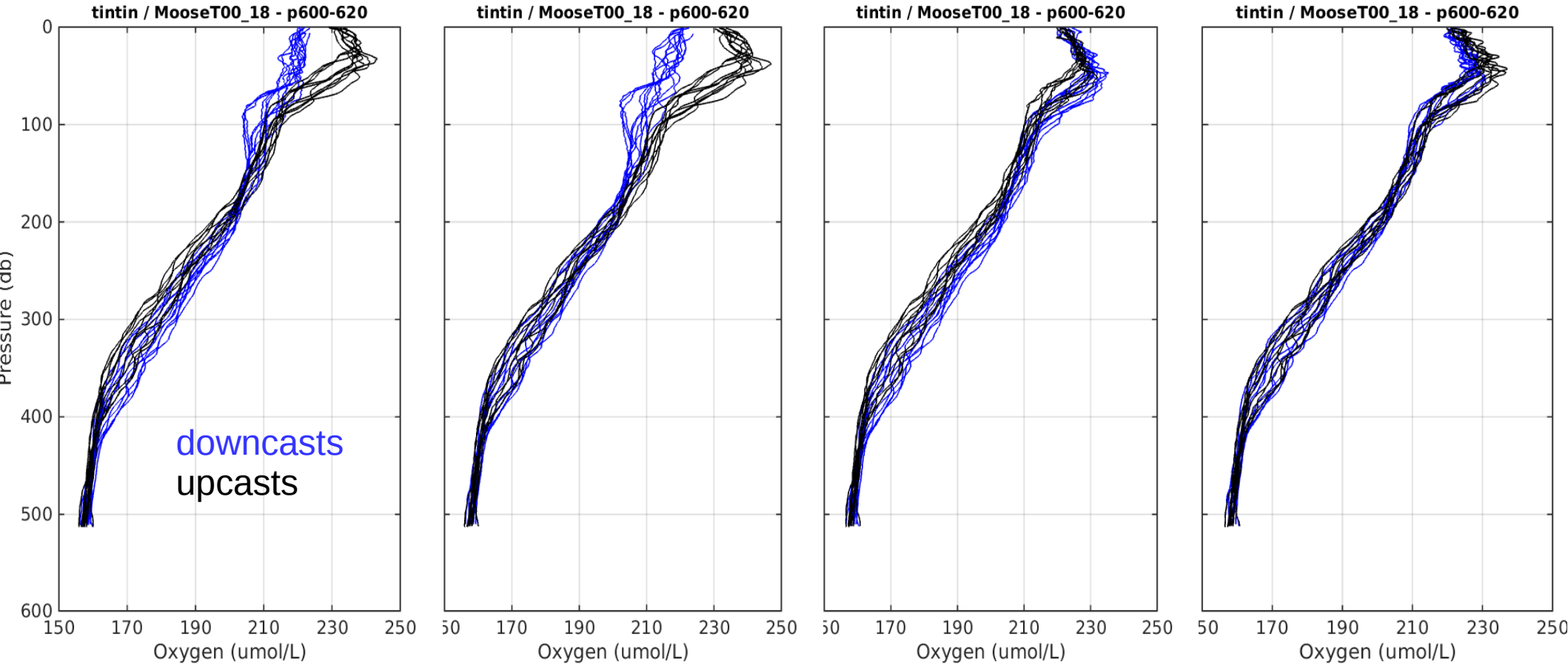






Dissolved Oxygen (Optodes)

Example : tintin / MooseT00_18 (5 returns, April-May 2012)



raw

phase cor. (28s)

CTD temp.

corrected

Chlorophyll-A (Fluorimeters)

- ANFOG : adjustment so that Chl-A=0 at depth
- Lavigne et al. 2013 :

  Harmonization for comparison between deployments :

  - Correction applied to each profile point so that the Chl-A integrated content coincide with concomittent ocean color satellite measurements
  - Depth adjustement : Chl-A = 0

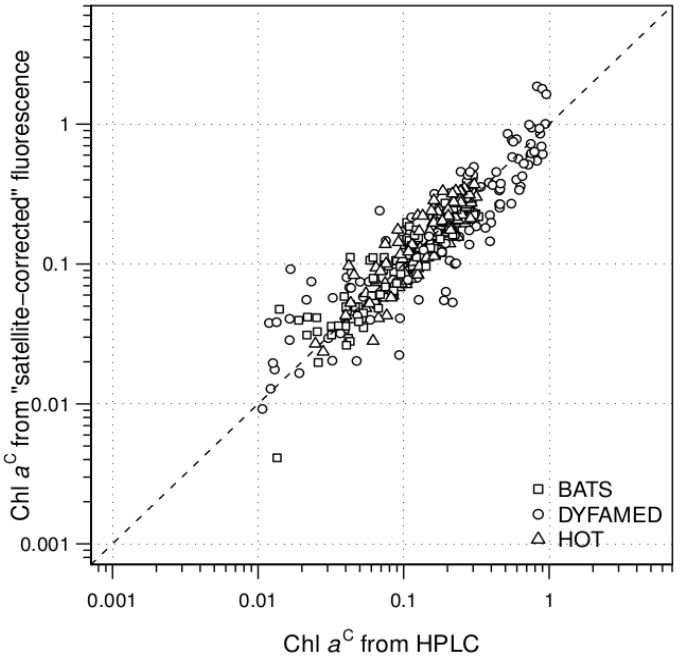
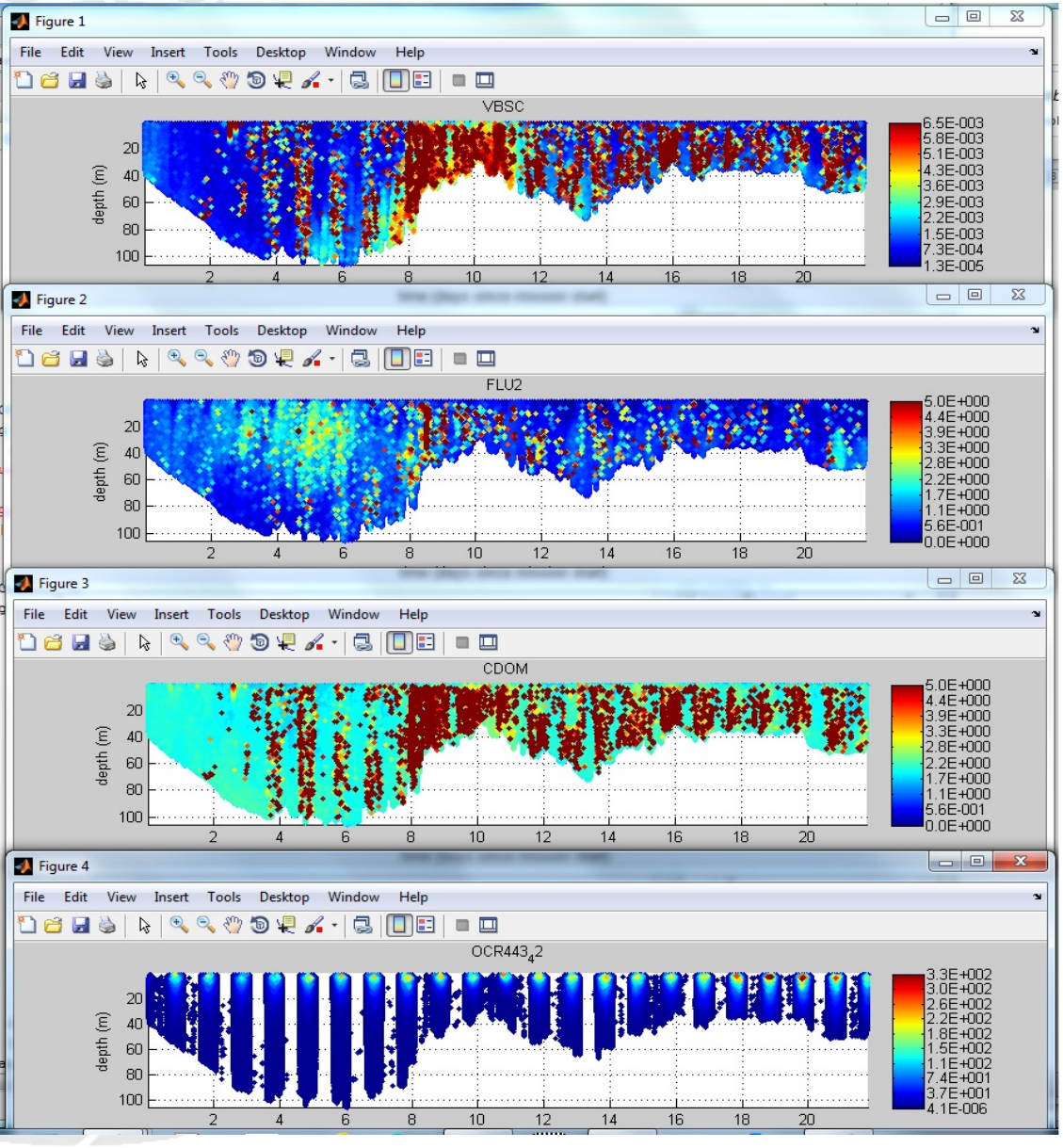


Fig. 5. Scatter plot of Chl a^C derived from "satellite-corrected" fluorescence profiles as a function of Chl a^C measured with HPLC, after having applied a monthly average filter. Chl a^C is expressed in mg m^{-3}.

Daylight related noise in Ecopuck fluorescence measurements



Noise of two types:

1) a block of extremely high values during daylight hours from the water surface to depth in all or most channels

2) strips of high values at the beginning and end of a daylight period

Hypothesis:

- biofouling ?
- periodicity : tidal currents ? No match
- high temperatures related

Paul Thomson, ANFOG

Nitrates (SUNA)

- Raw data are reprocessed using **raw UV spectrum data** (available only after gliders recovery) together with **calibration parameters** and an updated **algorithm for the deconvolution of nitrates concentration** from the observed UV absorption spectrum :
  - Sakamoto et al. (2009),
  - updated by Pasqueron de Frommervault et al. (2015) for the Mediterrannean Sea.
- Recomputed data are then corrected from drift and offset from linear regression of surface nitrate concentration
- Final check is performed using concomittent bottle measurements at DYFAMED station.

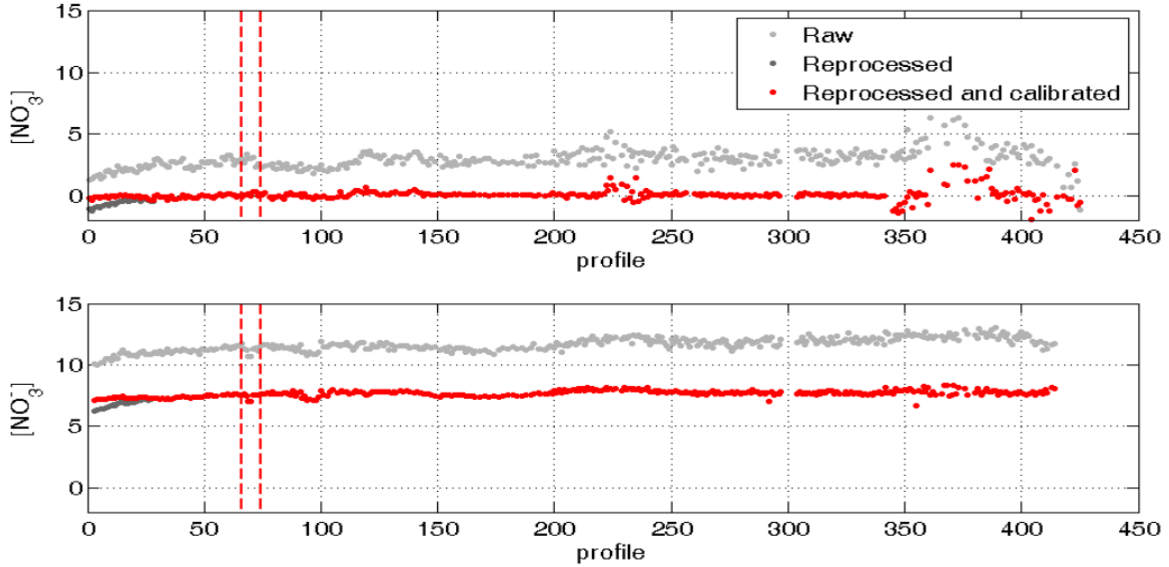


Figure 3 | Nitrate concentrations time-series in the 5-30 dbar layer (top) and in the 400-500 dbar layer (bottom). Dashed lines indicates the time interval that correspond to the matchup with DYFAMED measurment.

Concluding remarks

- Multiple methods of data QC and corrections within the EGO community, both in RT and in DM
- Although new sensors are emerging we are almost all using the same classical sensors
- Needs for the community to interact and define best practices :
  - for gliders data management
  - for deployments and calibration (2 points-calibrations checks, air measurements for oxygen, etc.)
  - ➔ Inputs needed
    - Reference and targeted documentation for gliders operators and DACs to be validated and promoted by the Glider Steering Team
    - Plans to be developed for best practices implementation together with the Glider Data Management Team