QC for radiometry

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A novel quality-control procedure for radiometric profiles measured by Bio-Argo floats: protocols and performances.

Emanuele Organelli[ab*], Hervé Claustre[ab], Annick Bricaud[ab], Catherine Schmechtig[c], Antoine Poteau[ab], Xiaogang Xing[de], Louis Prieur[ab], Fabrizio D'Ortenzio[ab], Giorgio Dall'Olmo[f]

Observation conditions

- **Solar elevation (LATITUDE, LONGITUDE, JULD)** => Night time

$$\text{IF } SOLAR\ ELEVATION(LATITUDE, LONGITUDE, JULD) < 2° \qquad \text{(Test 1)}$$

⇨ All QC =4, Processing stops

- **Records Number** => Not enough measurements to perform polynomial regression

$$IF\ \ NUMBER\ OF\ MEASUREMENTS < 5 \qquad \text{(Test 2)}$$

⇨ All QC =3, Processing stops

Dark signal identification

- Dark identification (Lilliefors normality test)

  if $p < 0.01$ (Test 3)

⇨ QC =3, Processing stops for those points

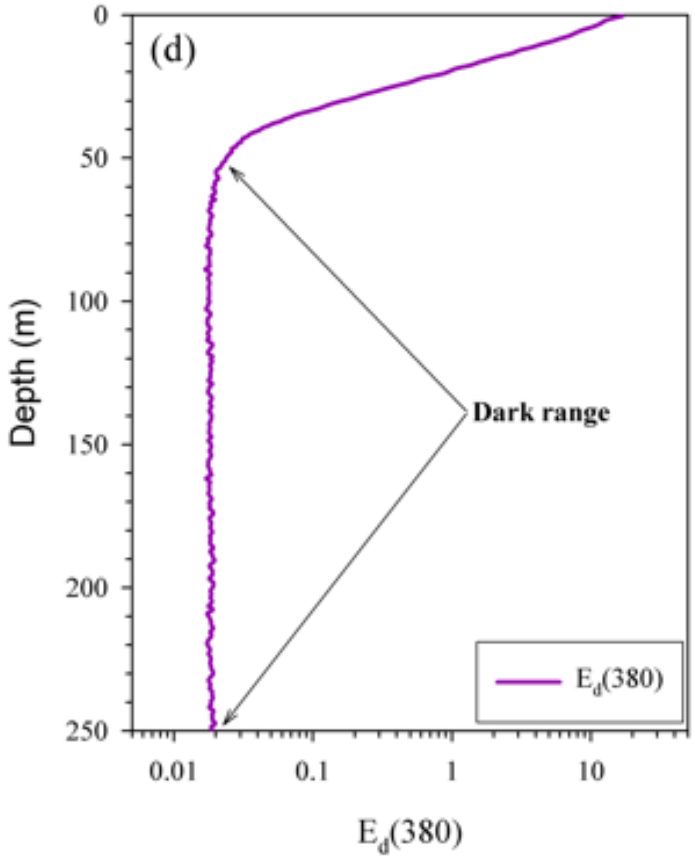
- Negative values (Test 4)

⇨ QC =3, Processing stops for those points

- Records Number => Not enough measurements to perform polynomial regression

$IF\ \ NUMBER\ OF\ MEASUREMENTS\ AFTER\ THE\ DARK\ IDENTIFICATION < 5$ (Test 5)

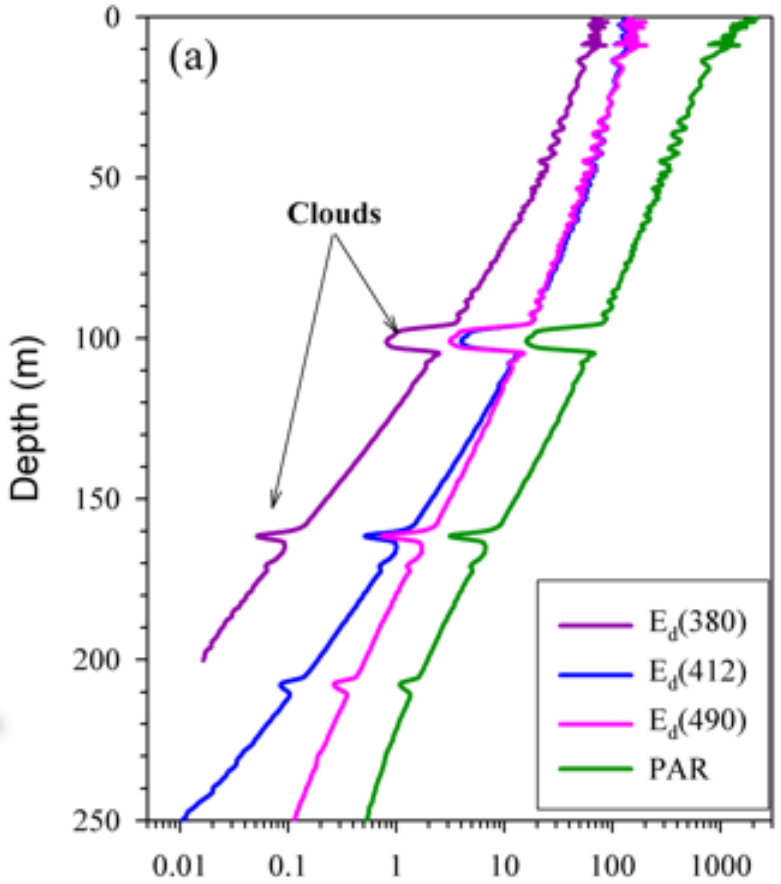
⇨ All QC =3, Processing stops



Identification of clouds, wave focusing and other noise (1)

- ✓ Once dark values and negative values are flagged and out of the processing
- ✓ A fourth-degree polynomial fit was computed between the Napierian logarithm of $E_d(\lambda)$ or PAR profiles versus depth
- ✓ Points whose residuals are out
  - ✓ ±2 times the standard deviation => QC=3
  - ✓ ±3 times the standard deviation => QC=4

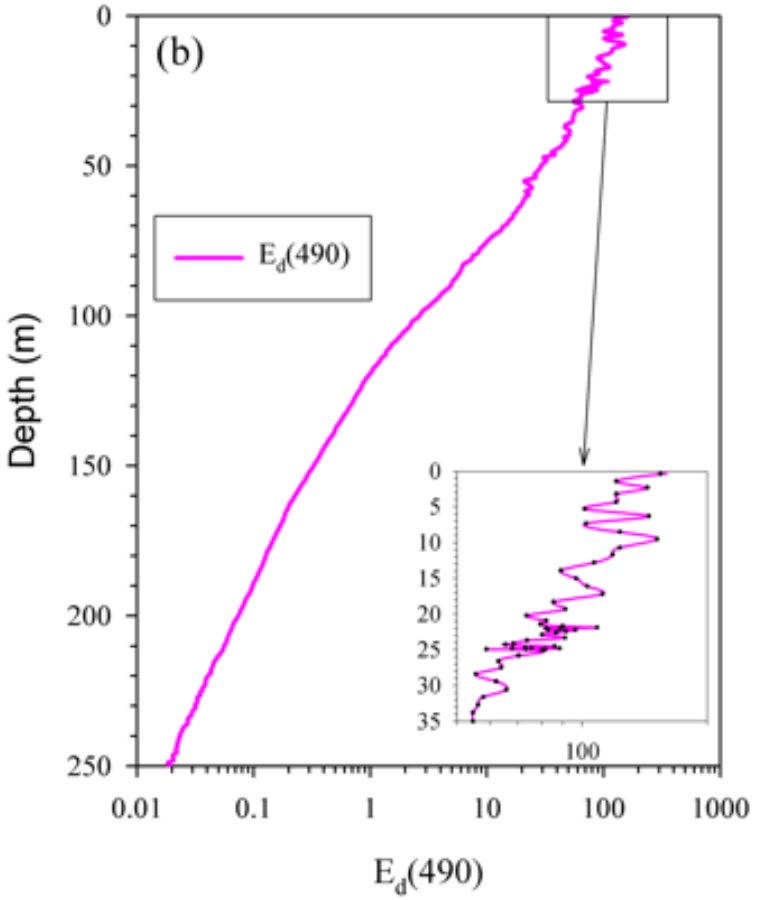
=> Remove major spikes and clouds



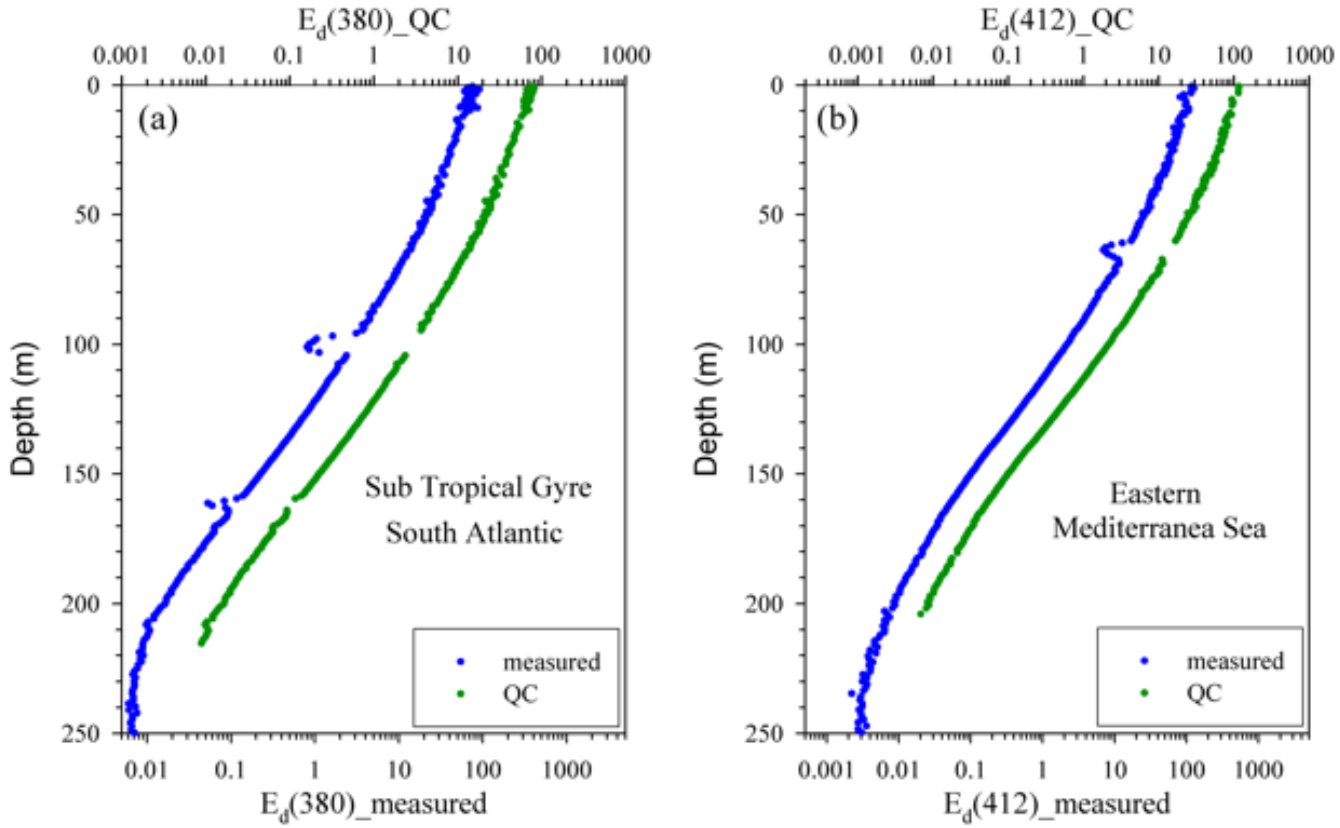
Identification of clouds, wave focusing and other noise (2)

- ✓ A fourth-degree polynomial fit was computed between the Napierian logarithm of $E_d(\lambda)$ or PAR profiles versus depth without QC=3 and QC=4
  - ✓ $r^2 \leq 0.990$ => QC=4
  - ✓ $0.990 < r^2 \leq 0.997$ => QC=3
  - ✓ $0.997 < r^2 \leq 0.999$ => QC=3
    - ✓ In ±2 times the standard deviation => QC=2
    - ✓ In ±3 times the standard deviation => QC=3
    - ✓ Out ±3 times the standard deviation => QC=4
  - ✓ $r^2 > 0.999$
    - ✓ In ±1 times the standard deviation => QC=1
    - ✓ In ±2 times the standard deviation => QC=2
    - ✓ In ±3 times the standard deviation => QC=3
    - ✓ Out ±3 times the standard deviation => QC=4

=> Wave focusing and minor spikes



QC Results


E_d(380)_QC
0.001 0.01 0.1 1 10 100 1000
0
50
100
150
200
250
Depth (m)
(a)
Sub Tropical Gyre
South Atlantic
measured
QC
0.01 0.1 1 10 100 1000
E_d(380)_measured
E_d(412)_QC
0.001 0.01 0.1 1 10 100 1000
(b)
Eastern
Mediterranea Sea
measured
QC
0.001 0.01 0.1 1 10 100 1000
E_d(412)_measured

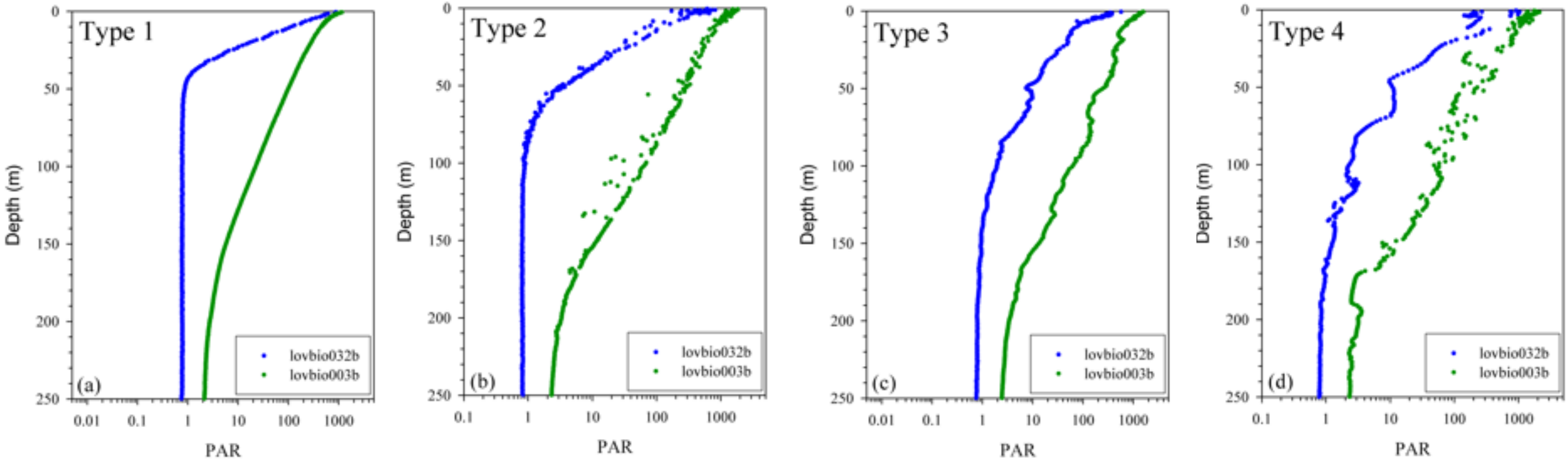
Profile QC

"Profile Type" identification based on the values of the determination coefficients (r^2) obtained from the polynomial fits.

- ✓ 1st test same for all the radiometric channels,
  $r^2 < 0.995$ PROFILE_xxx_QC=4

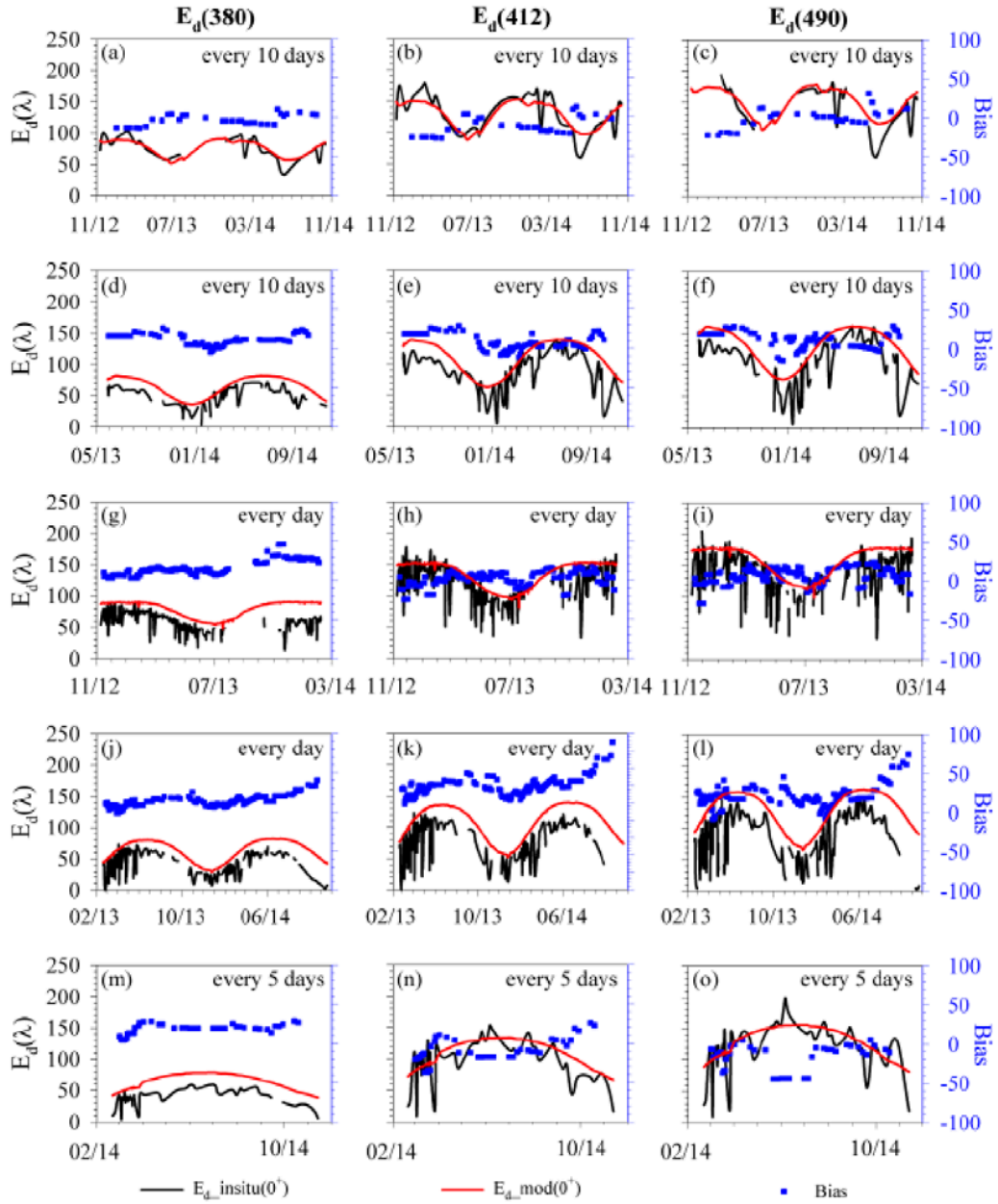
- ✓ 2nd test , second fourth-degree polynomial fit on partially cleaned profiles

Channel	Type 4	Type 3	Type 2	Type 1
$E_d(380)$	$r^2 \leq 0.990$	$0.990 < r^2 \leq 0.997$	$0.997 < r^2 \leq 0.999$	$r^2 > 0.999$
$E_d(412)$	$r^2 \leq 0.990$	$0.990 < r^2 \leq 0.997$	$0.997 < r^2 \leq 0.998$	$r^2 > 0.998$
$E_d(490)$	$r^2 \leq 0.990$	$0.990 < r^2 \leq 0.996$	$0.996 < r^2 \leq 0.998$	$r^2 > 0.998$
PAR	$r^2 \leq 0.990$	$0.990 < r^2 \leq 0.996$	$0.996 < r^2 \leq 0.998$	$r^2 > 0.998$

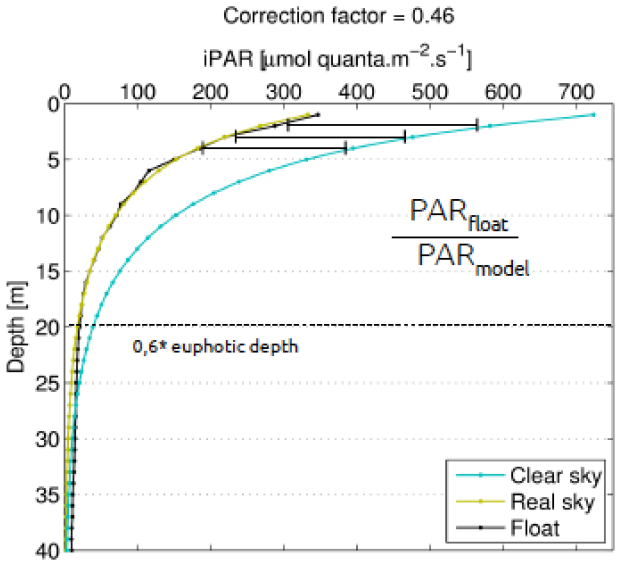


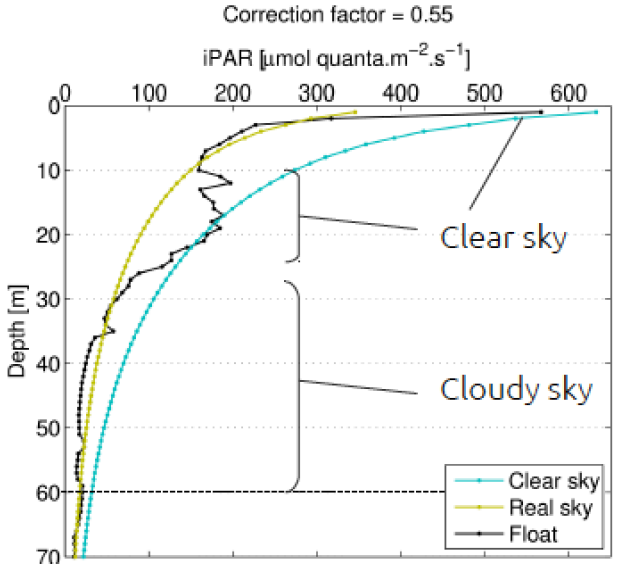
6570 profiles
For each channel,
For 65 floats

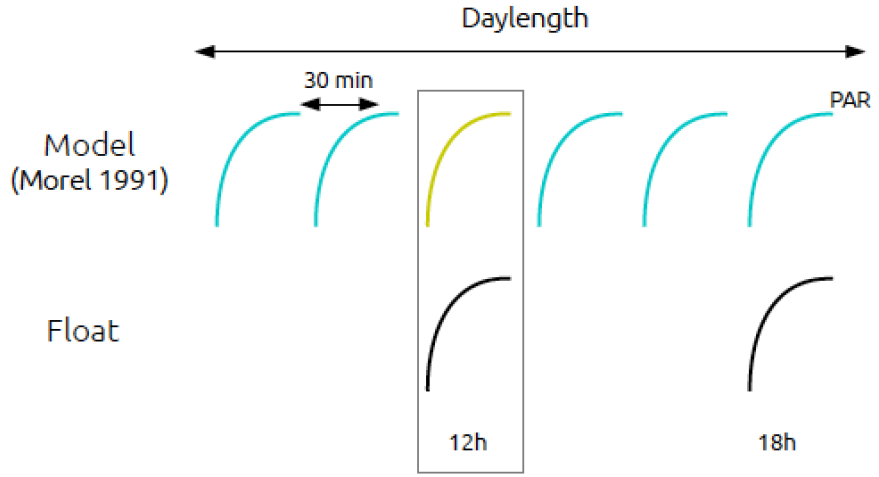
Channel	Type 1	Type 2	Type 3	Type 4
$E_d(380)$	58%	22%	7%	13%
$E_d(412)$	67%	9%	10%	14%
$E_d(490)$	56%	15%	9%	20%
PAR	57%	16%	9%	18%
ALL	60%	15%	9%	16%

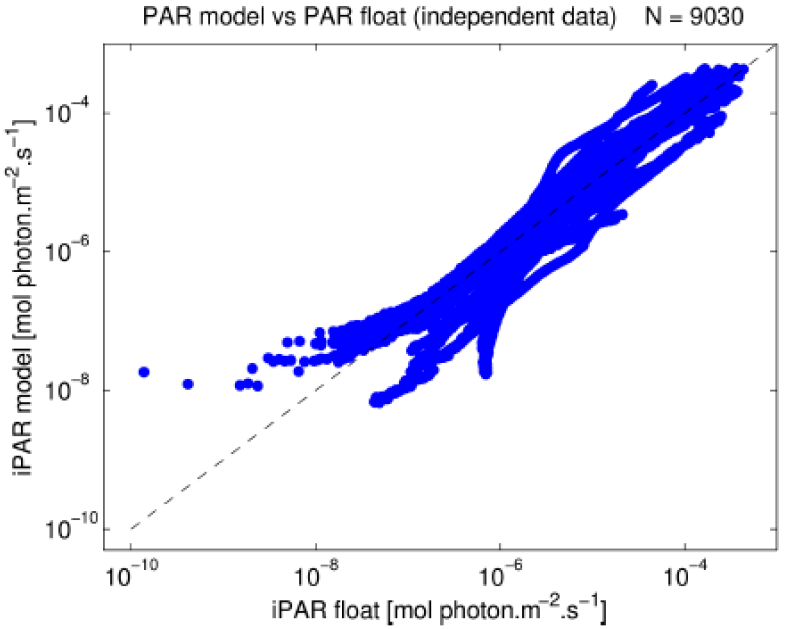

E_d(380)
E_d(412)
E_d(490)
(a) every 10 days
(b) every 10 days
(c) every 10 days
(d) every 10 days
(e) every 10 days
(f) every 10 days
(g) every day
(h) every day
(i) every day
(j) every day
(k) every day
(l) every day
(m) every 5 days
(n) every 5 days
(o) every 5 days
E_d(λ)
Bias
11/12 07/13 03/14 11/14
05/13 01/14 09/14
02/13 10/13 06/14
02/14 10/14
E_d_insitu(0+)
E_d_mod(0+)
Bias

PAR model


Correction factor = 0.46
iPAR [µmol quanta.m^{-2}.s^{-1}]
Depth [m]
$\frac{PAR_{float}}{PAR_{model}}$
0,6* euphotic depth
Clear sky
Real sky
Float


Correction factor = 0.55
iPAR [µmol quanta.m^{-2}.s^{-1}]
Depth [m]
Clear sky
Cloudy sky
Clear sky
Real sky
Float


Daylength
30 min
PAR
Model
(Morel 1991)
Float
12h
18h


PAR model vs PAR float (independent data) N = 9030
iPAR model [mol photon.m^{-2}.s^{-1}]
iPAR float [mol photon.m^{-2}.s^{-1}]