Potential of Argo Dataset to retrieve MLD variations

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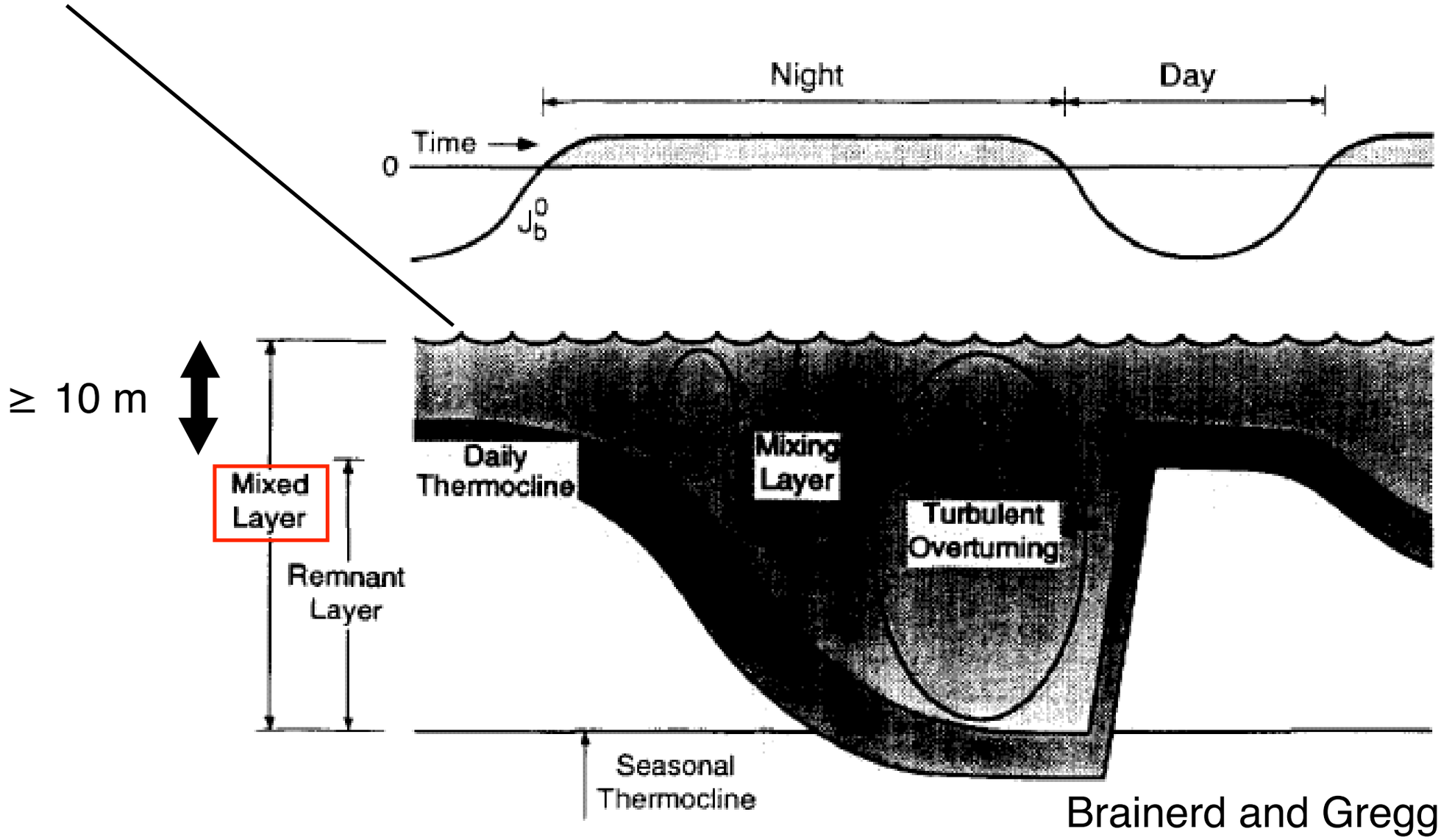
Outline

- ☐ Methodology and Tool
- ☐ Reconstructing fields and climatology from Argo
- ☐ Process studies --> examples
- ☐ Conclusions

Methodology --> computing MLD in a simple way (threshold + ref. depth)

daily ΔSST can reach 1 to 2°C in the first 1- 2 m of the surface
⊕ noise of the measurements near the surface



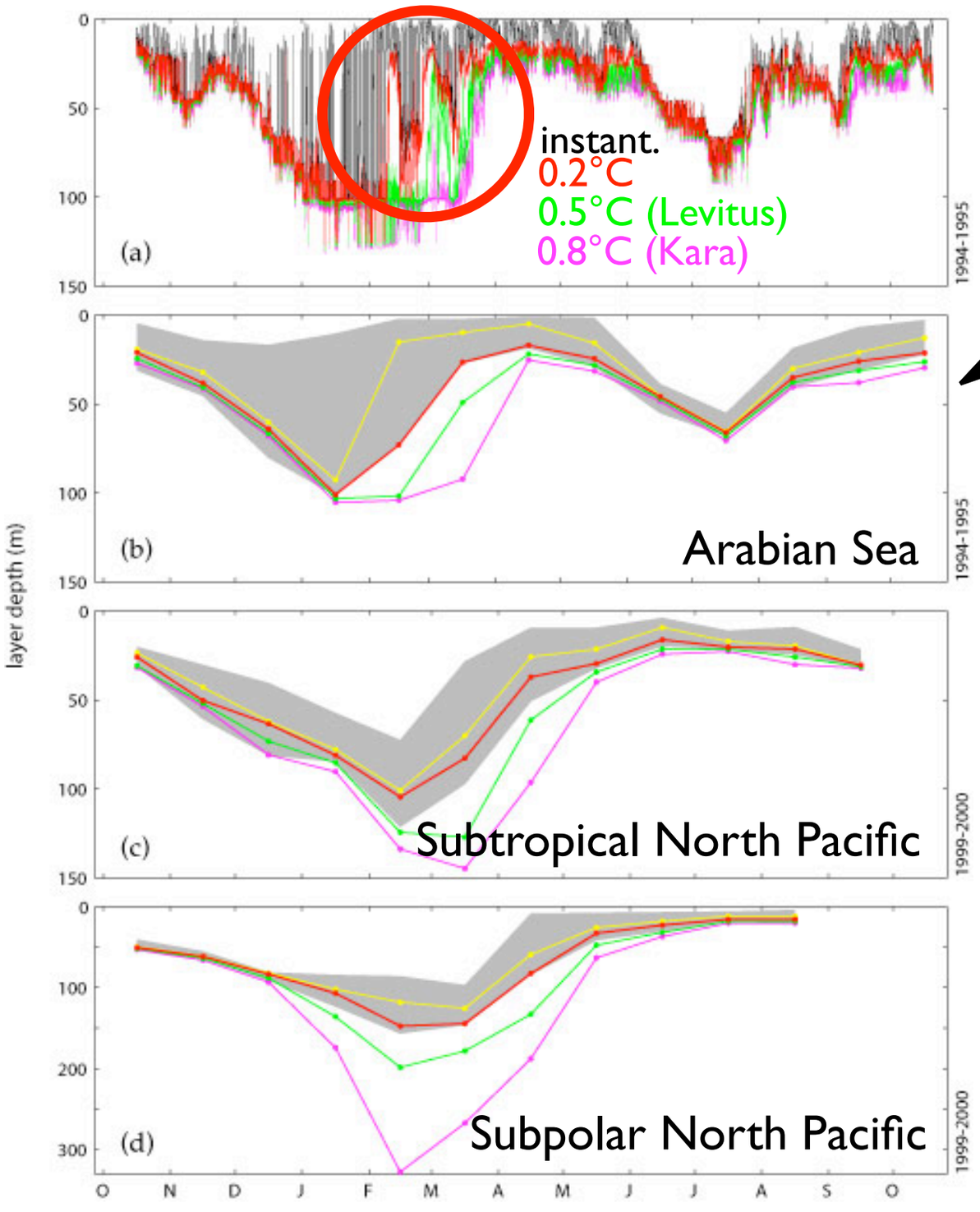
Brainerd and Gregg, DSR, 1995

Fig. 5. Diagram showing depth zones in a typical diurnal mixed layer cycle.

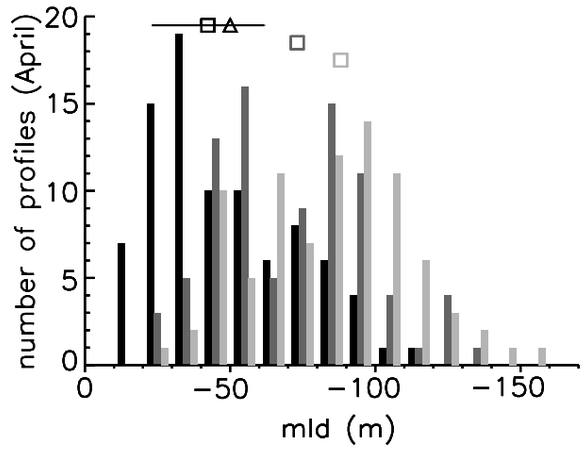
➔ reference depth at 10 m to mostly avoid the diurnal cycle

Methodology --> computing MLD in a simple way (threshold + ref. depth)

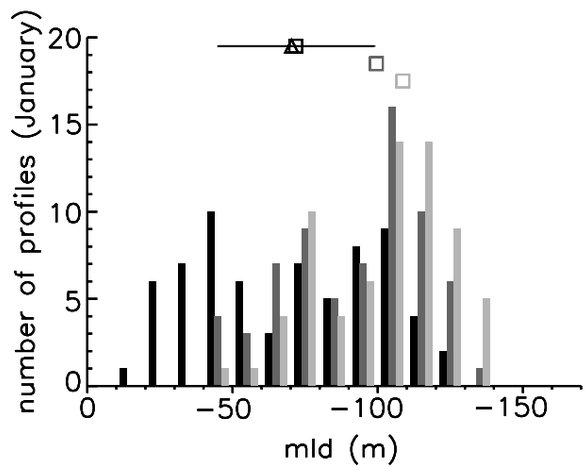
1. visual inspection of a representative sample of randomly-picked profiles, ML = vertically homogeneous layer in all tracers (T and S)

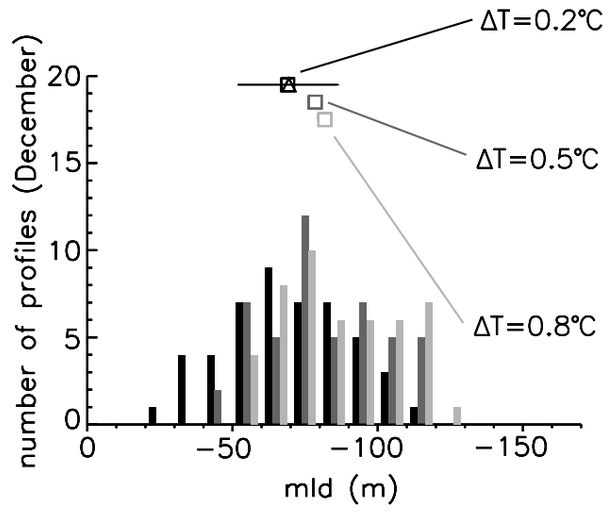


2. Time-series from moorings, seasonal cycle of ML



3. Distribution of MLDs in a grid box (158W,26N) for 3 temperature criterion





➔ $\Delta\rho_{(10m)}$=0.03 kg/m3

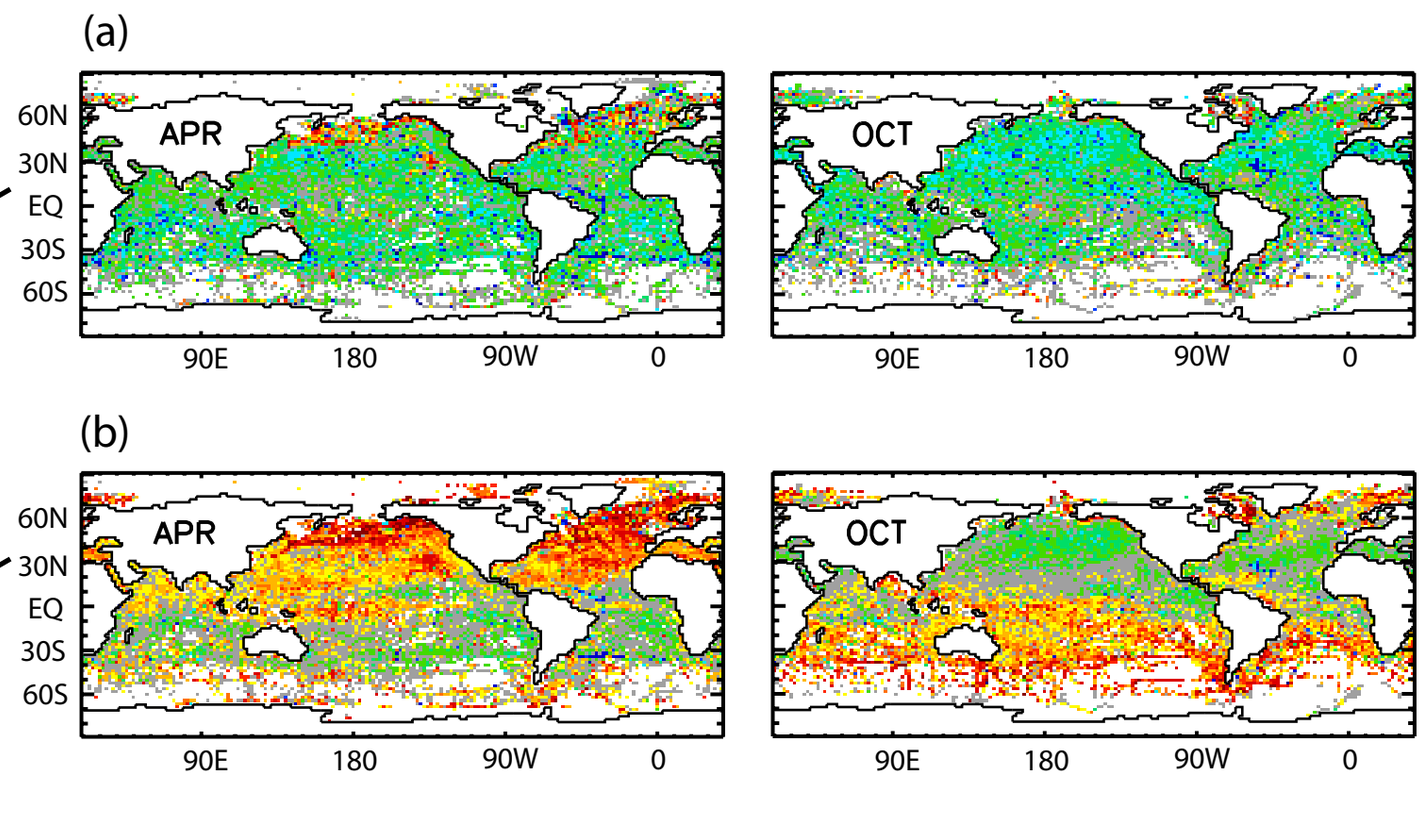
➔ $\Delta T_{(10m)}$=0.2 °C

Methodology --> computing MLD in a simple way, FROM INDIVIDUAL PROFILES

Effect of computing MLD on averaged or on individual profiles:

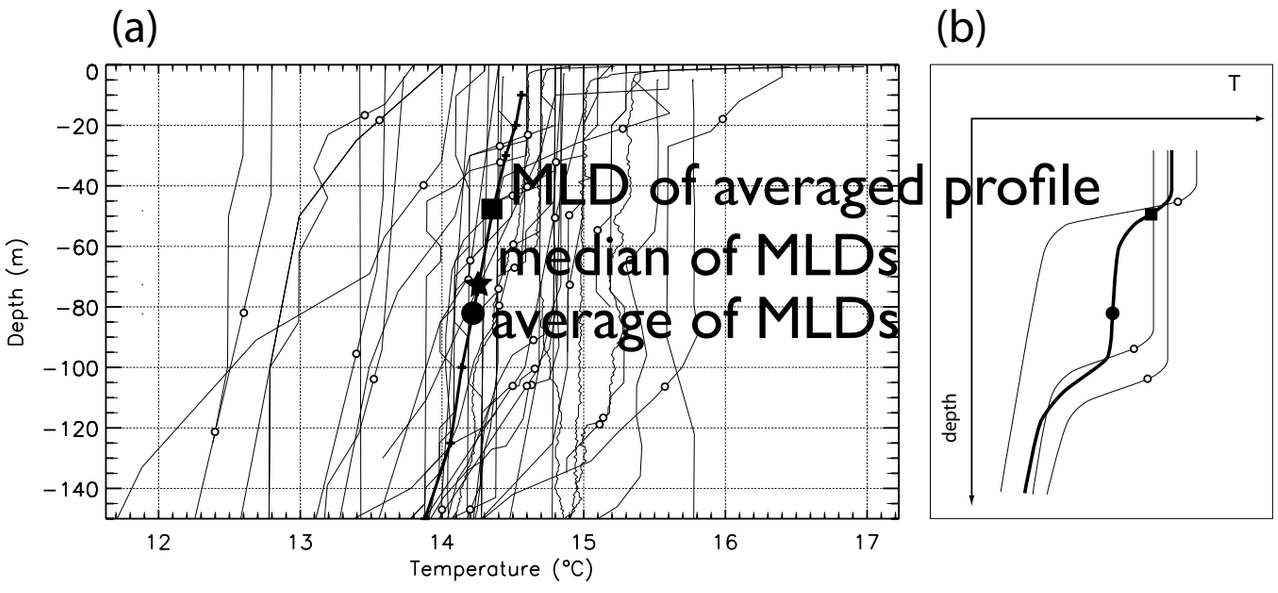
$MLD_{T02}(<profiles>) - <MLD_{T02}(profiles)>$

$MLD_{T05}(<profiles>) - <MLD_{T02}(profiles)>$



relative difference MLD(<profile>) - <MLD(profile)> (%)

−100 −75 −50 −40 −30 −20 −10 10 20 30 40 50 75 100



Example for a grid box in North Atlantic in March

➔ A proper instantaneous calculation :

- with individual profiles
- with a median reduction

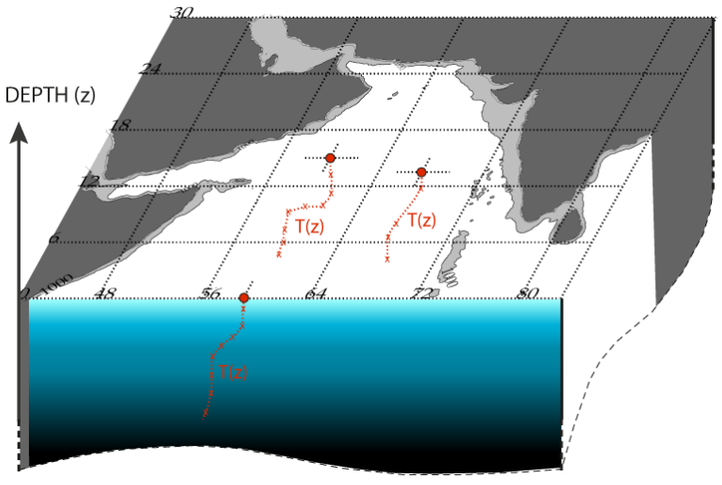
Tool

TOOL : **G**enerator of **A**tlas from **I**n situ **O**bservations (GAIO, code IDL, ~ 60 routines, 25,000 lines)

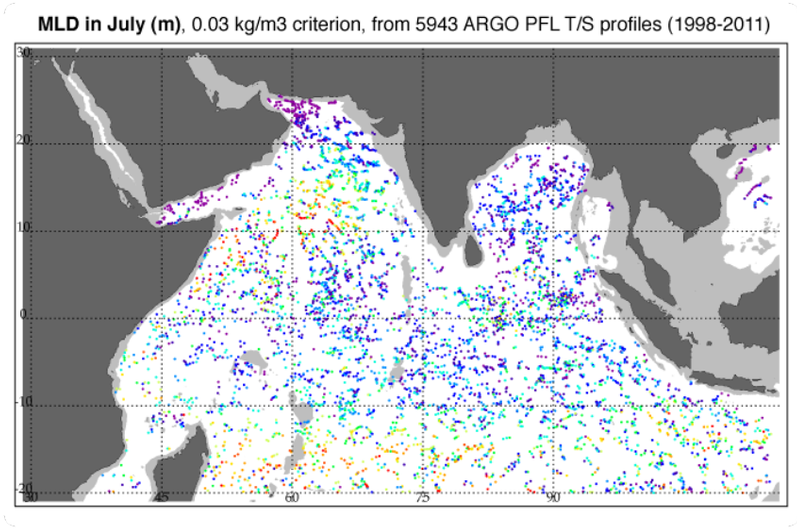
Working from **T/S/O2 profiles**, so-called **Level 1 datasets** (e.g. Argo) to get :

- **Level 2 datasets** : “advanced” ocean variables computed from each stations/profiles
  - Surface-measured Variables ..... T/S/O2 (10m depth)
  - MLD variables ..... DT02, DR003, DReqDT02, optim, BLT, TTD
  - Below-MLD measured vars ..... T/S/O2 10/25 m below MLDs
  - Below MLD Temperature-inversions ... Dinvmax, Tinvmax, Dt10
  - Isothermal depths D20, D26
  - CI-index ..... Cooling Inhibition index (Vincent et al. jgr 2012)
  - N2-average ..... Average of N2 over 400 m [TO INTEGRATE]
  - Heat Content ..... Heat content over 300 m
  - Sea Steric Height ..... SSH 1000/1500 m

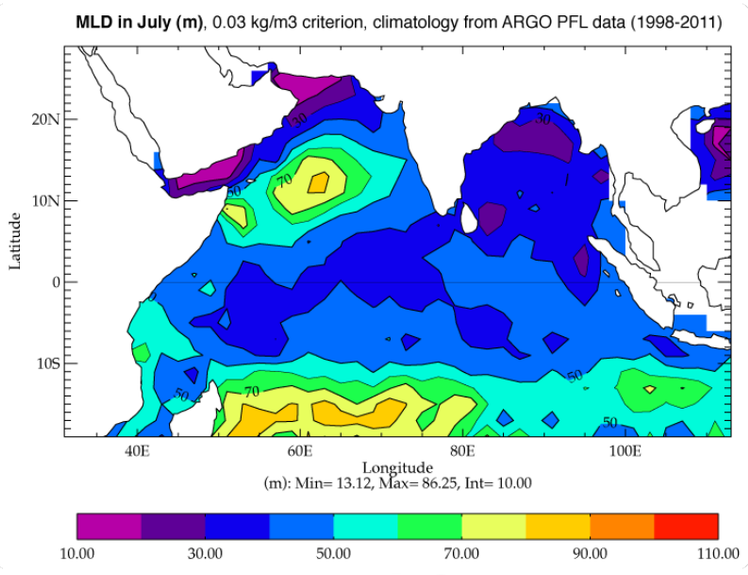
- **Level 3 datasets** : gridded fields(x,y,t) of those variables



L1



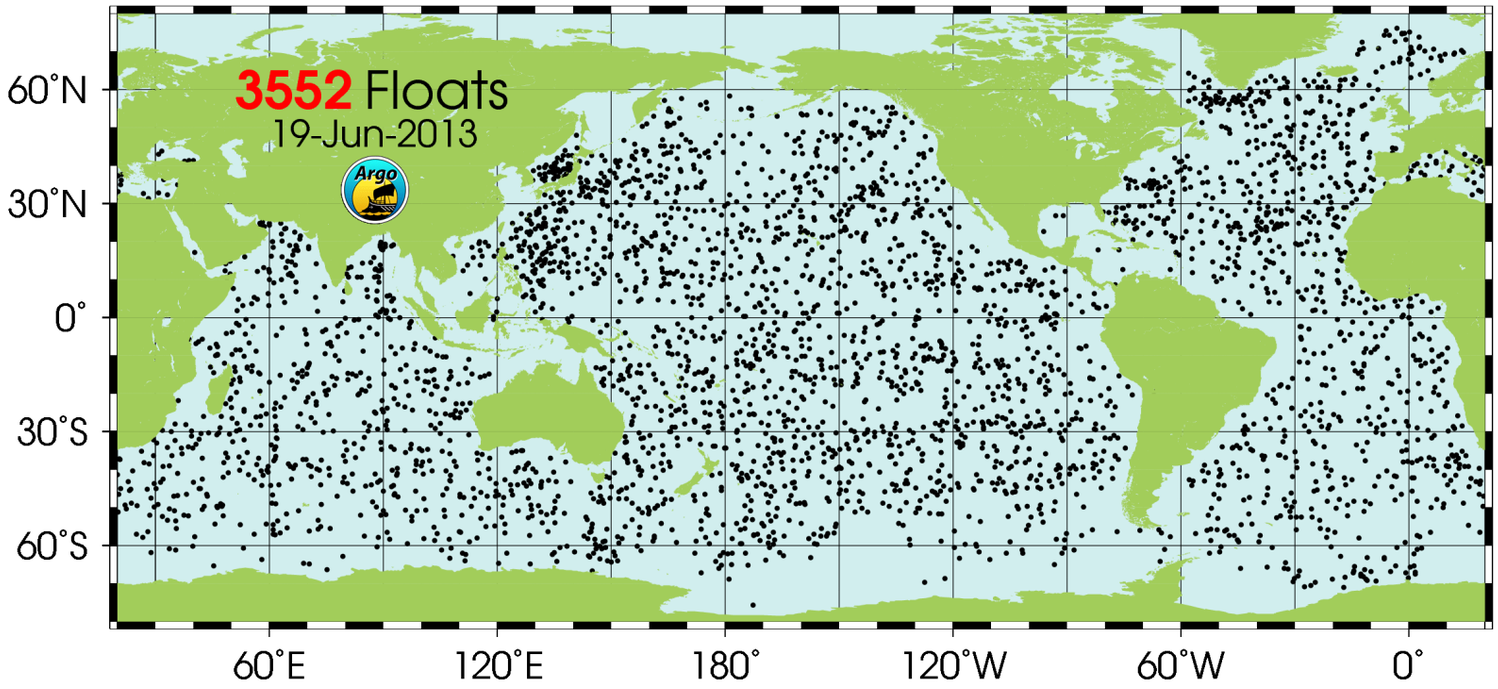
L2

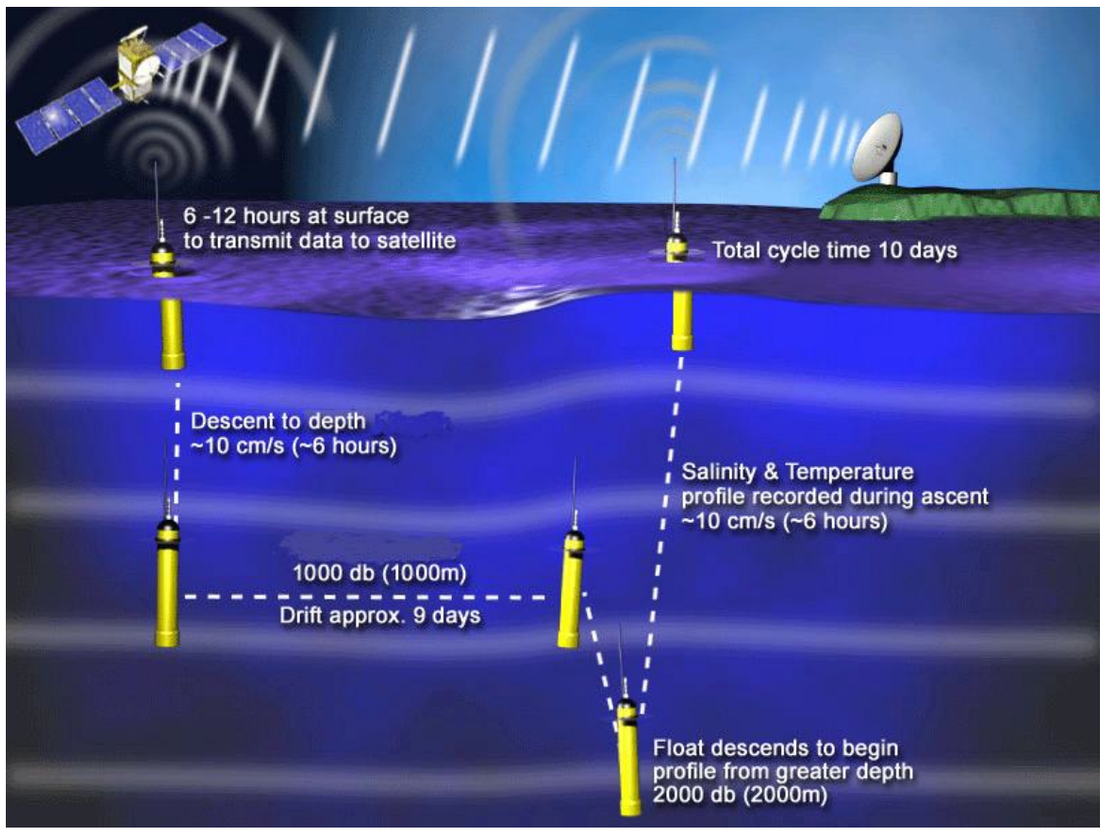


L3

www.ifremer.fr/cerweb/deboyer/mld

Reconstructing Fields and Climatologies from Argo --> Argo Dataset Characteristics





- International Argo Project homepage : **www.argo.net**

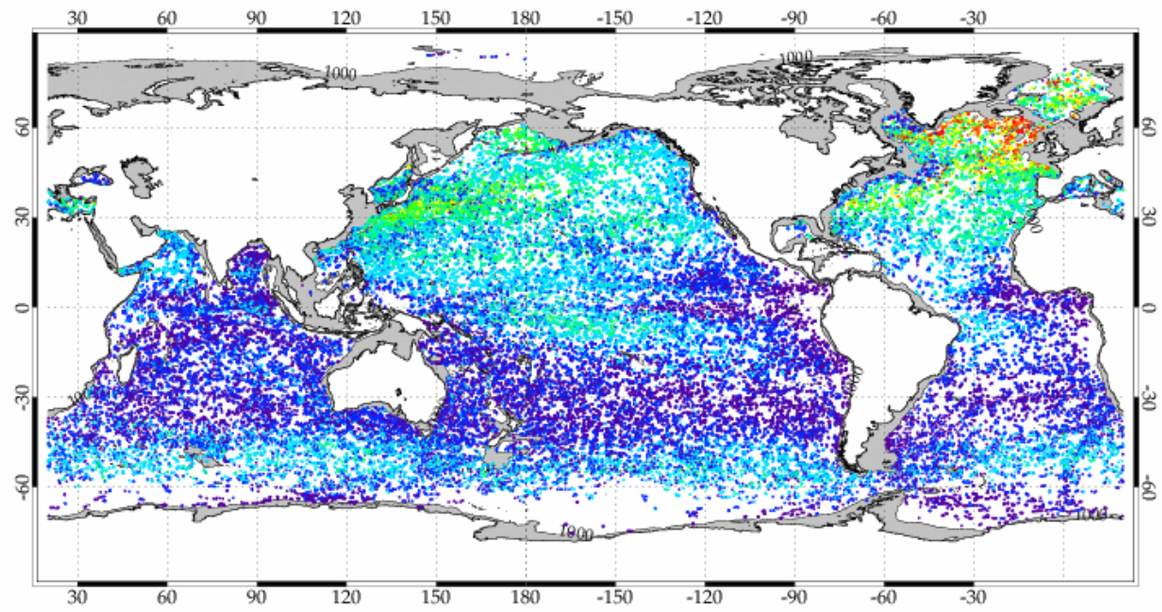
- Argo project office : **www.argo.ucsd.edu/**

- Argo Data :
  USA --> **www.usgodae.org/argo/argo.html**
  FRANCE --> **ftp://ftp.ifremer.fr/ifremer/argo/**

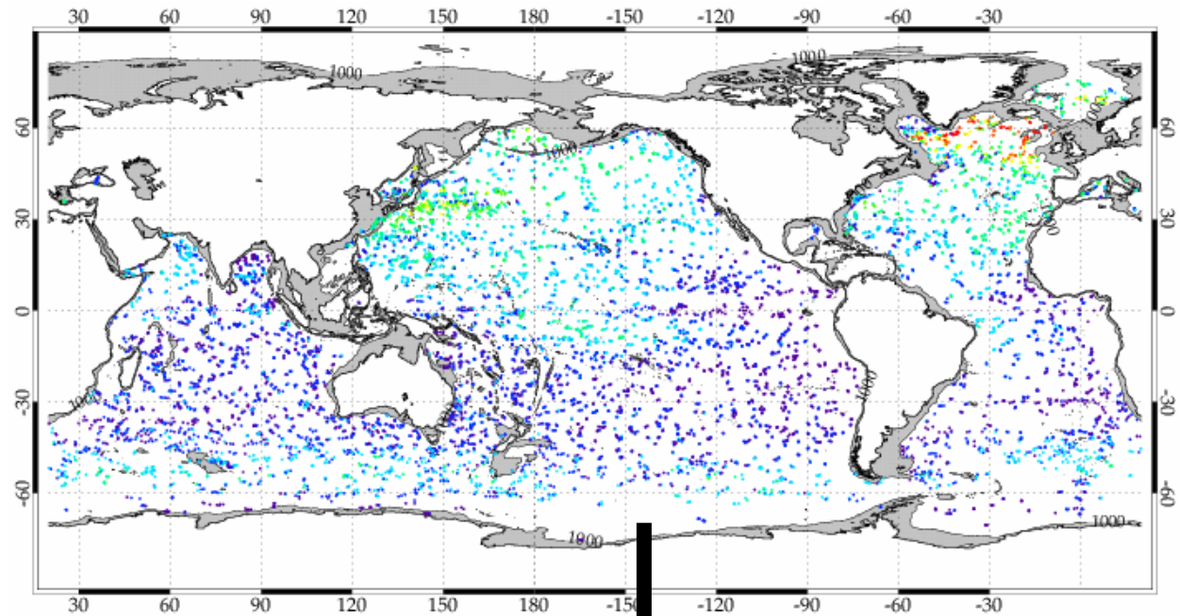
One goal of the argo program (Roemmich et al. 1998): complementary with Jason (e.g. for opera oceanog),
--> **10 days, 300 km**

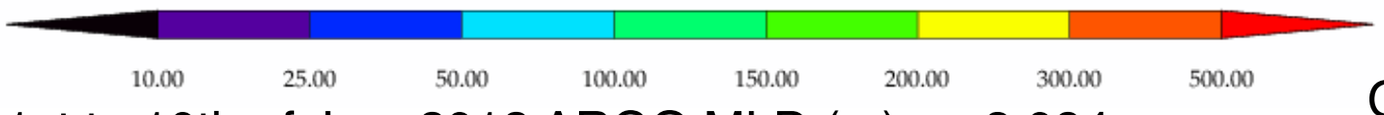
Reconstructing Fields and Climatologies from Argo --> pointwise data

Jan 2006-2012 ARGO MLD (m), n=58,508

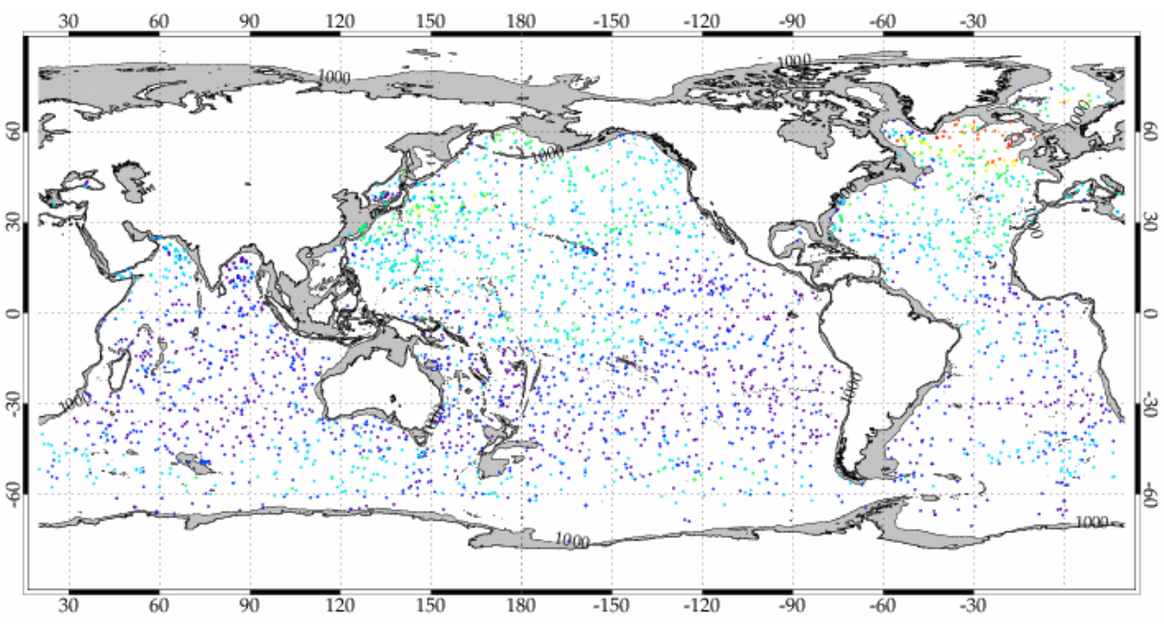


Jan 2012 ARGO MLD (m), n=9,578

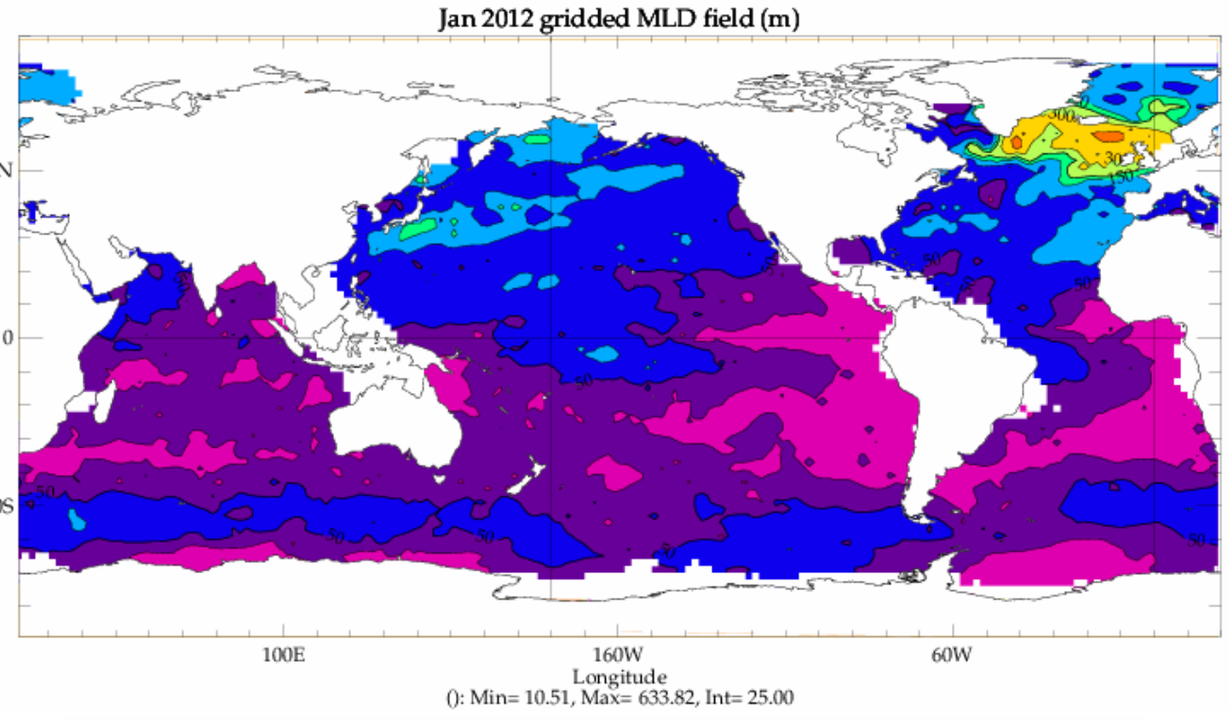




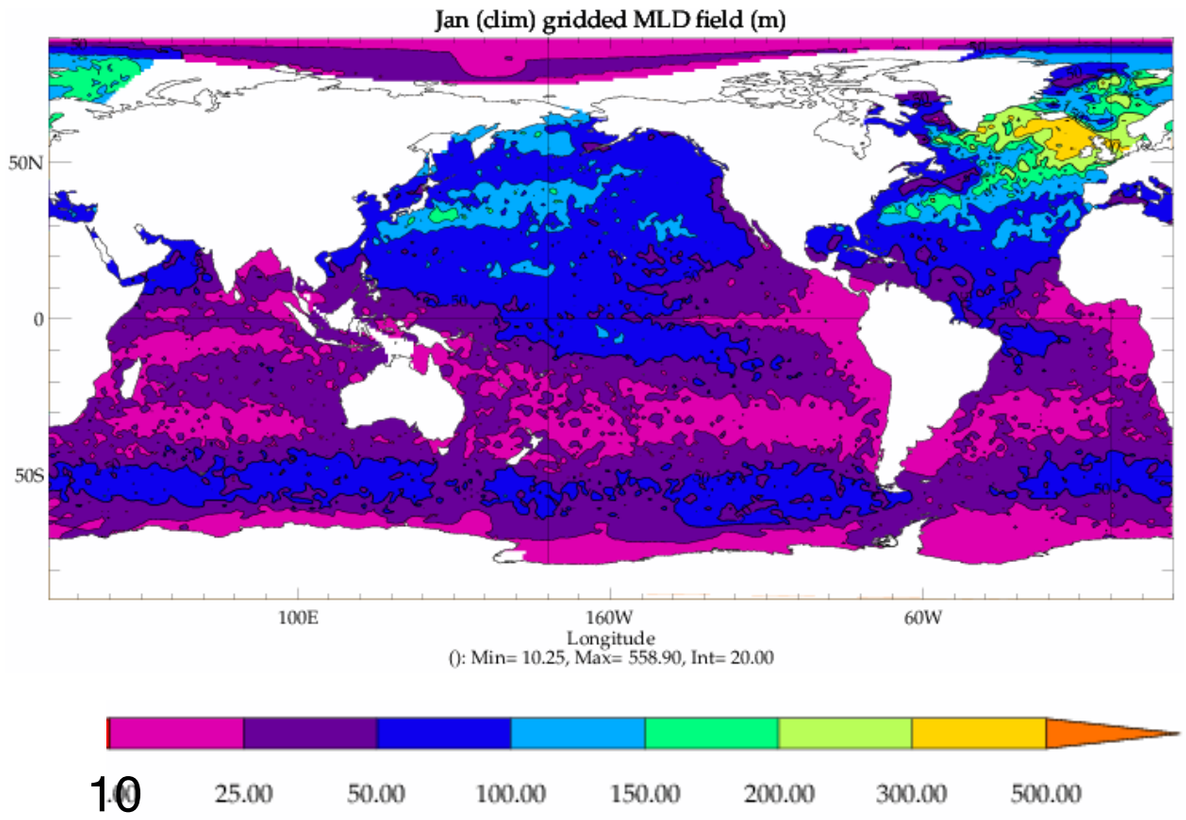
1st to 10th of Jan. 2012 ARGO MLD (m), n=3,084

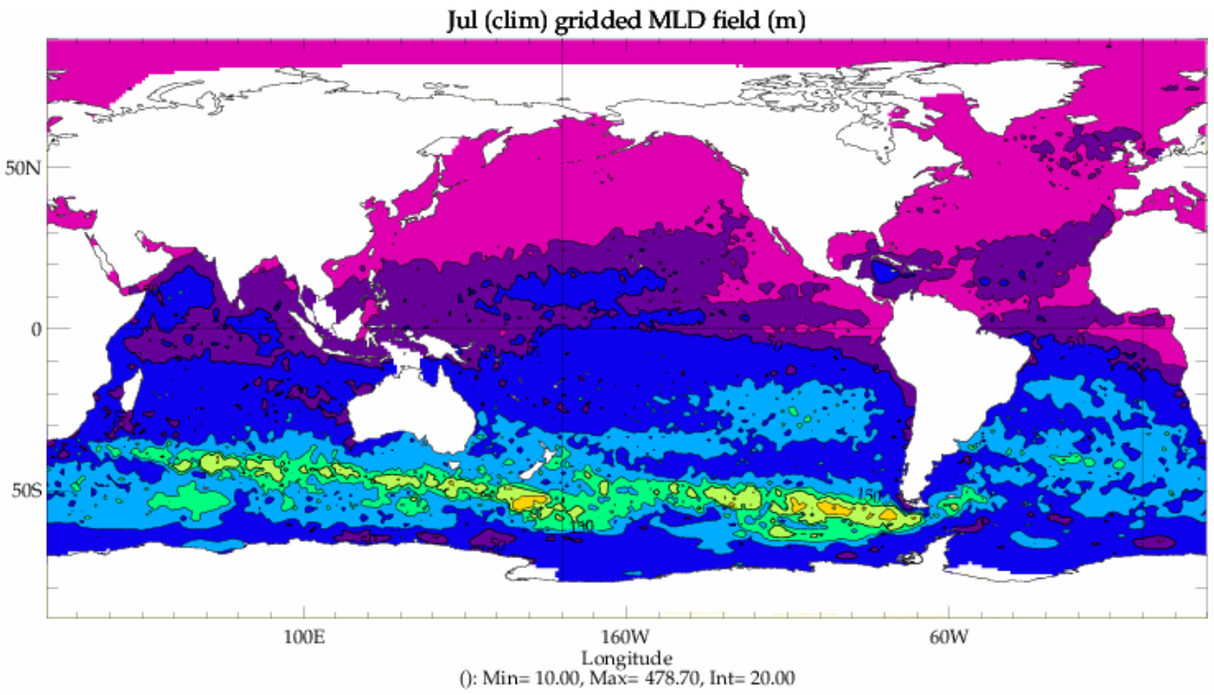


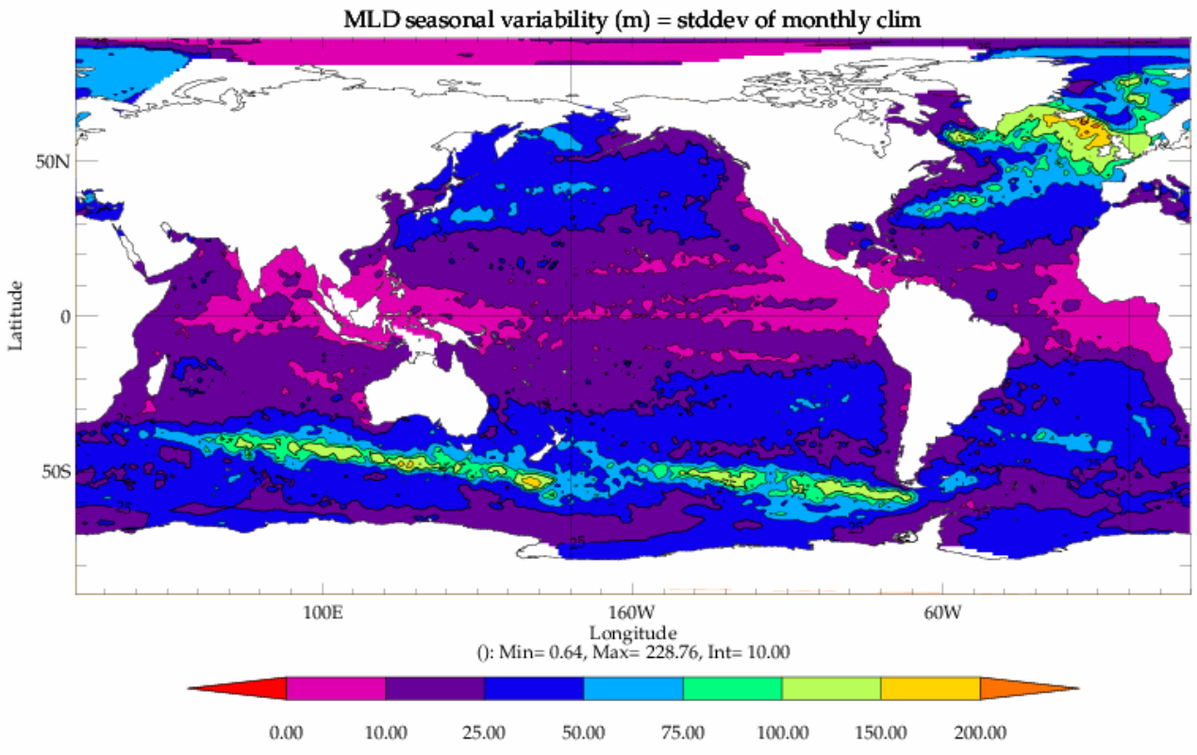
OKrig, Rcorr x,y = 1000, 800 km, 2deg resol



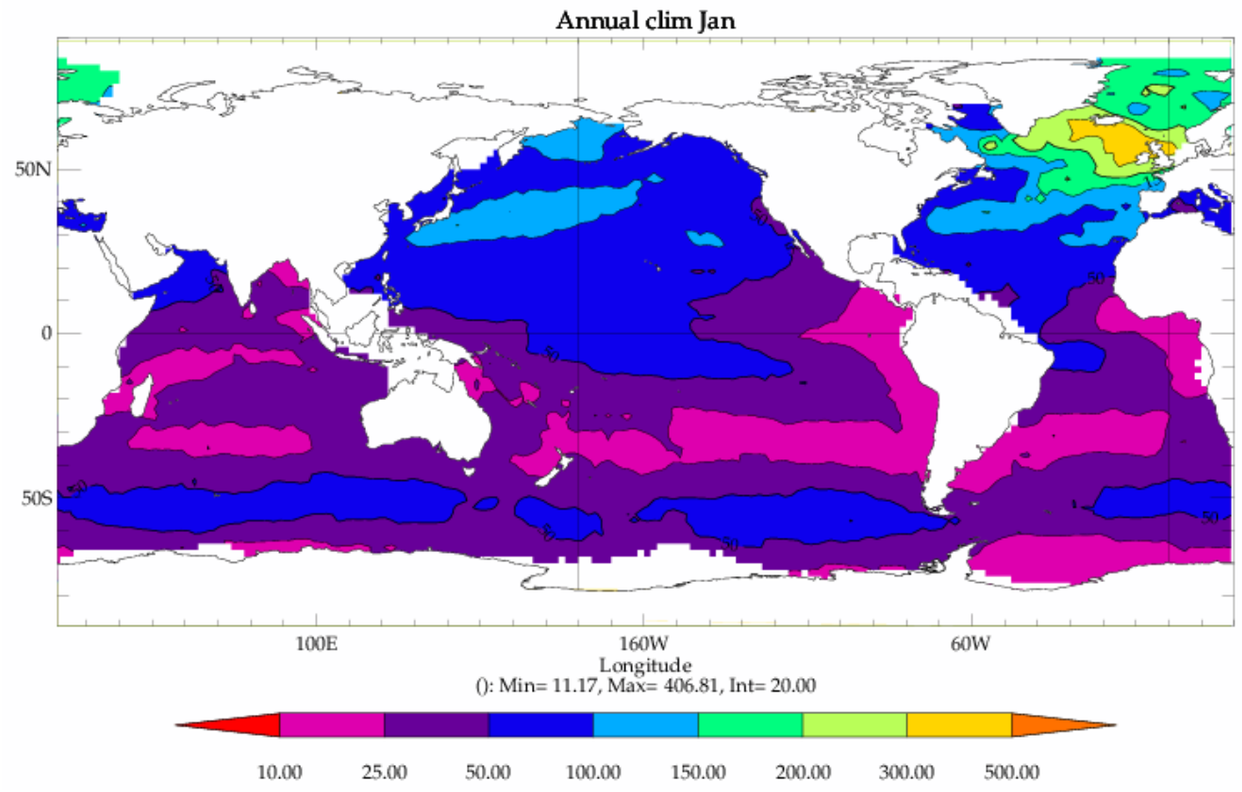
Reconstructing Fields and Climatologies from Argo --> seasonal

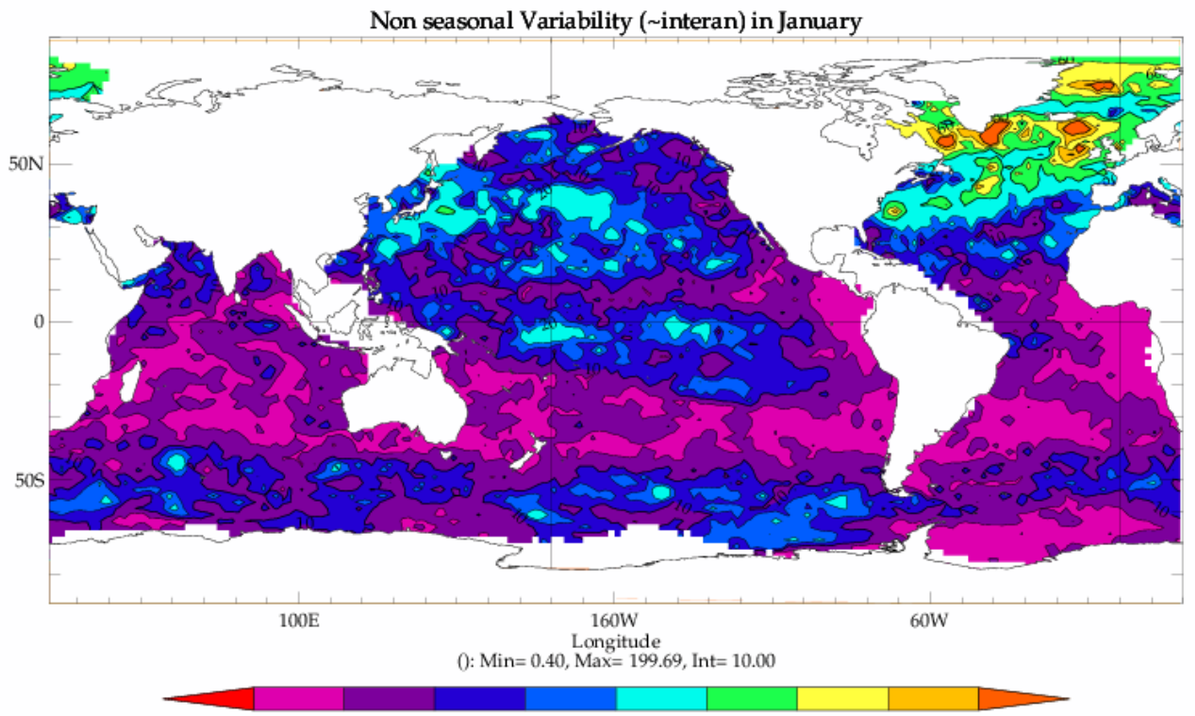






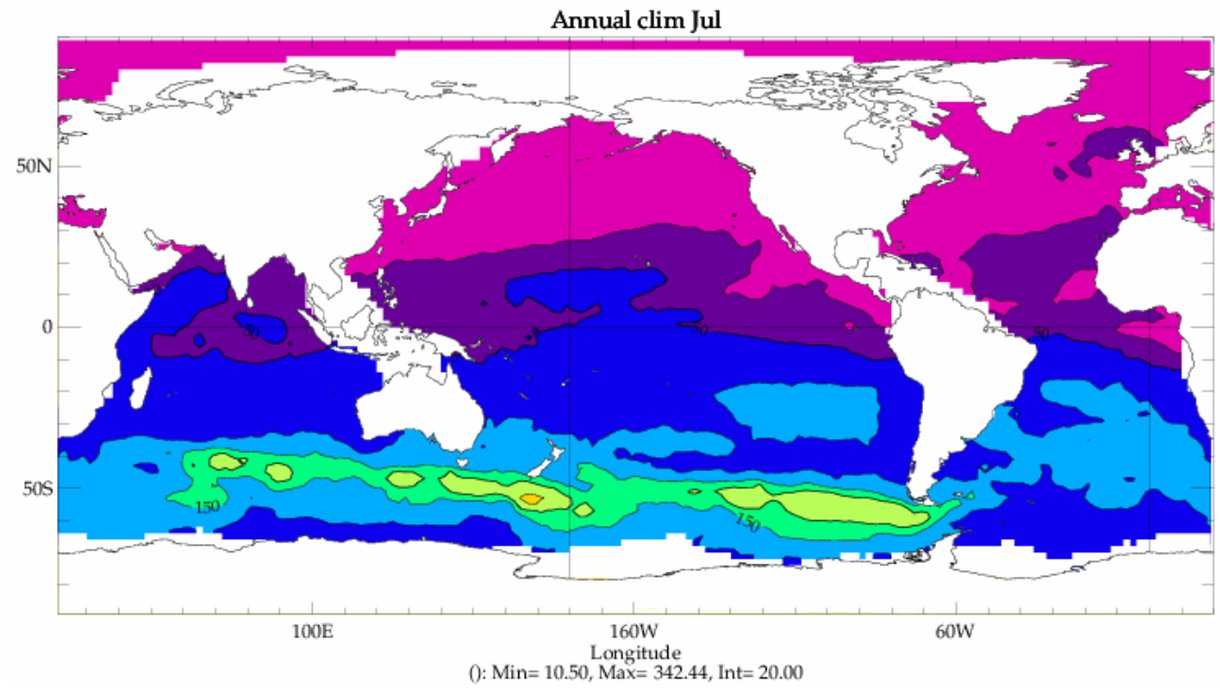
Reconstructing Fields and Climatologies from Argo --> interannual (monthly resol.)

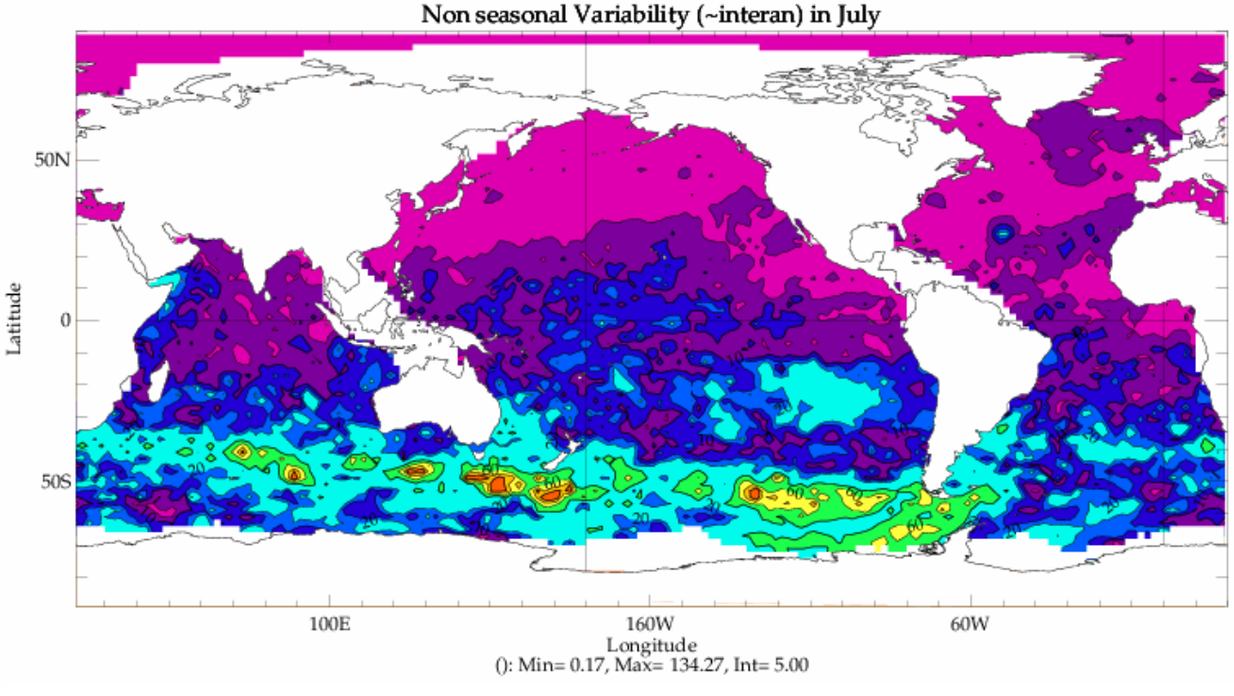




JAN/JUL annual clim, 2deg, 2006-2012

JAN/JUL interannual variability, 2deg, 2006-2012



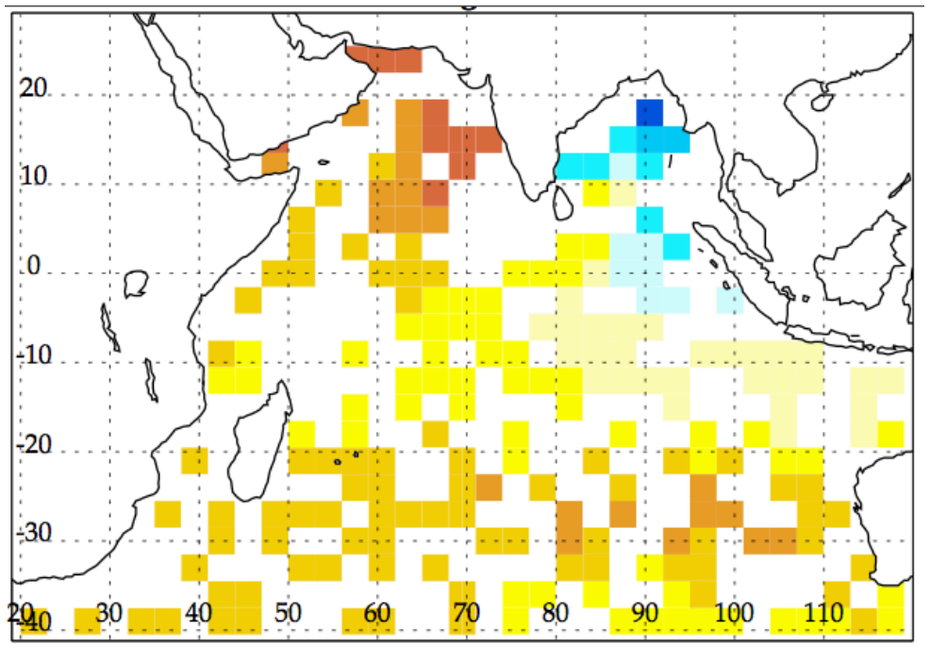


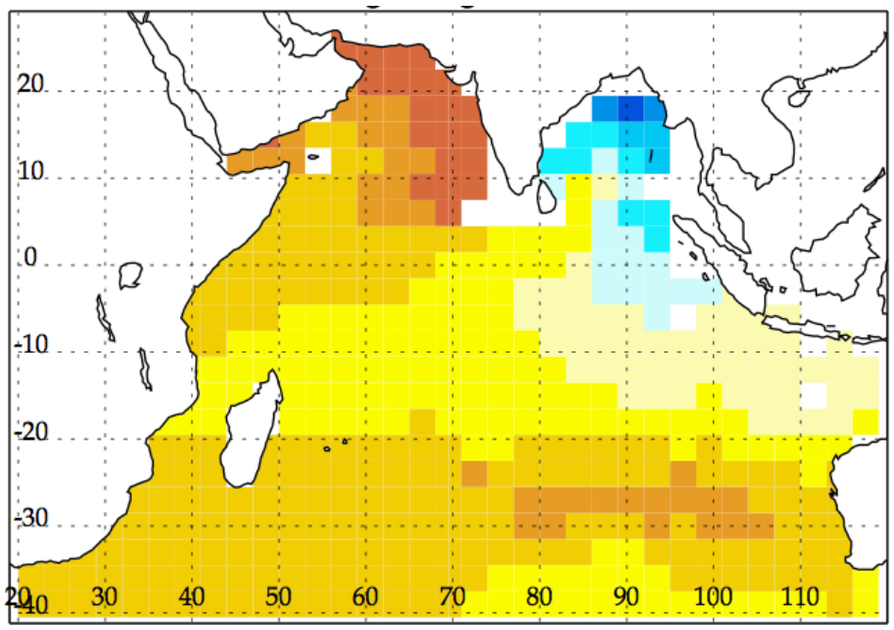
Interannual (non seasonal) variability studies :

- Rodger et al. 2007, Martinez et al. 2011, Keerthi et al. 2013

Reconstructing Fields and Climatologies from Argo --> intraseasonal (10 days resol.)

SSS 1-10 JUL 2007

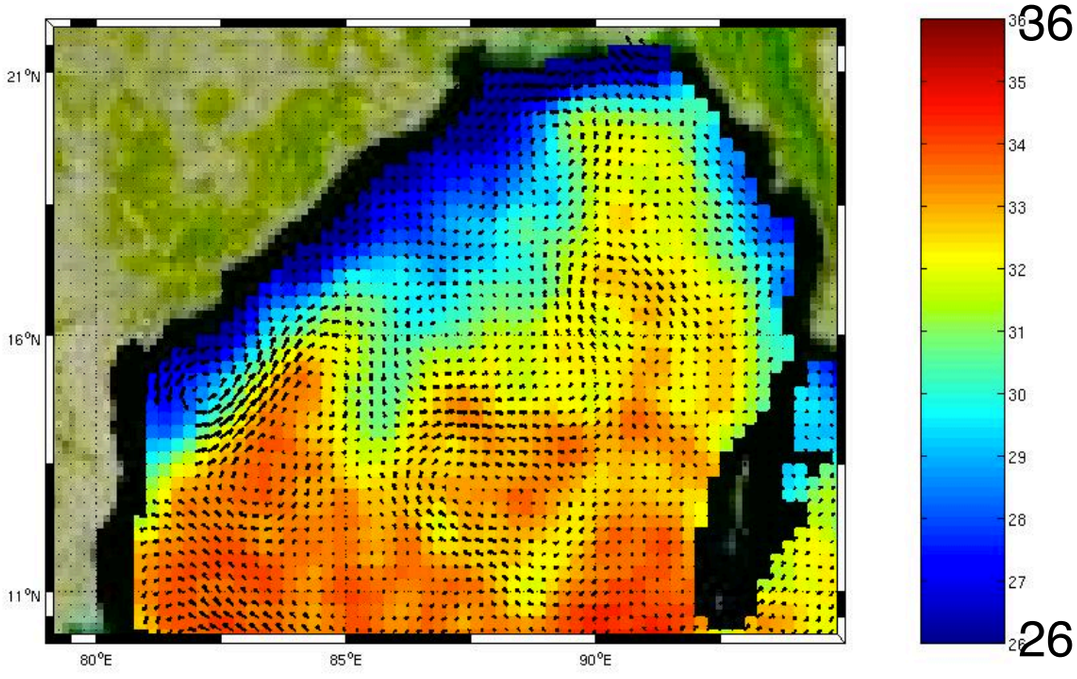




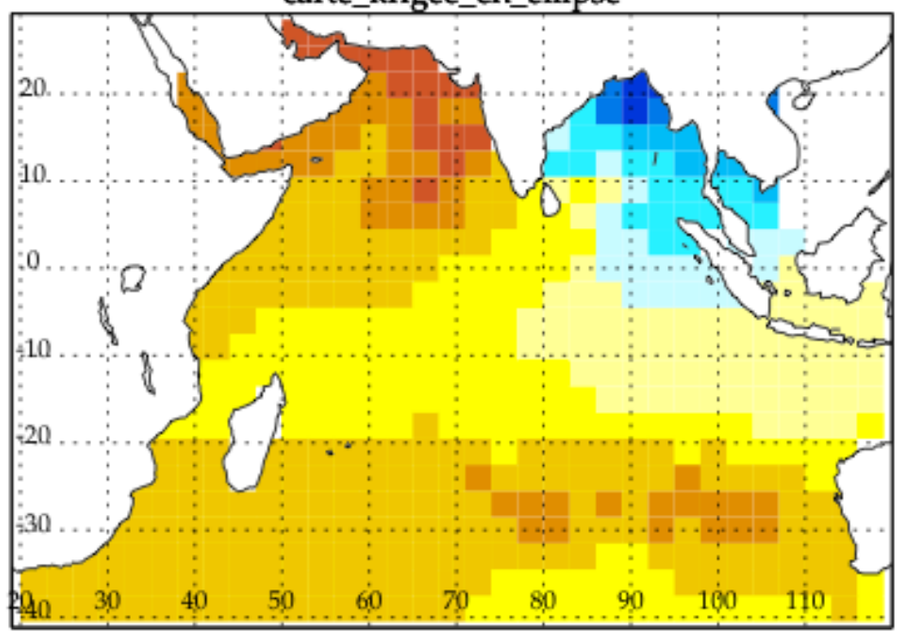
Min= 31.26 (3.126e+01) ; Max= 36.76 (3.676e+01)

Help of AMSR sat. for SSS (oct 2008)

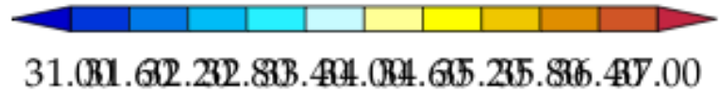
October 2008 SSS from AMSR and currents from Altimeters (Sudre & Morrow, 2008)



carte_krigee_en_ellipse



Min= 31.26 (3.126e+01) ; Max= 36.76 (3.676e+01)



Reconstructing Fields and Climatologies from Argo --> W (Ponte et al. 2013) “future”

Using Argo data to retrieve Vertical Velocity in surface Ocean layer (Goal = ~400m)

W = Wqg + Wm

<u>Observations we need to retrieve W :</u>

- **SST/SSS** at high resolution --> OK **(In Situ + Sat.)** wz potential use of AMSR for SSS

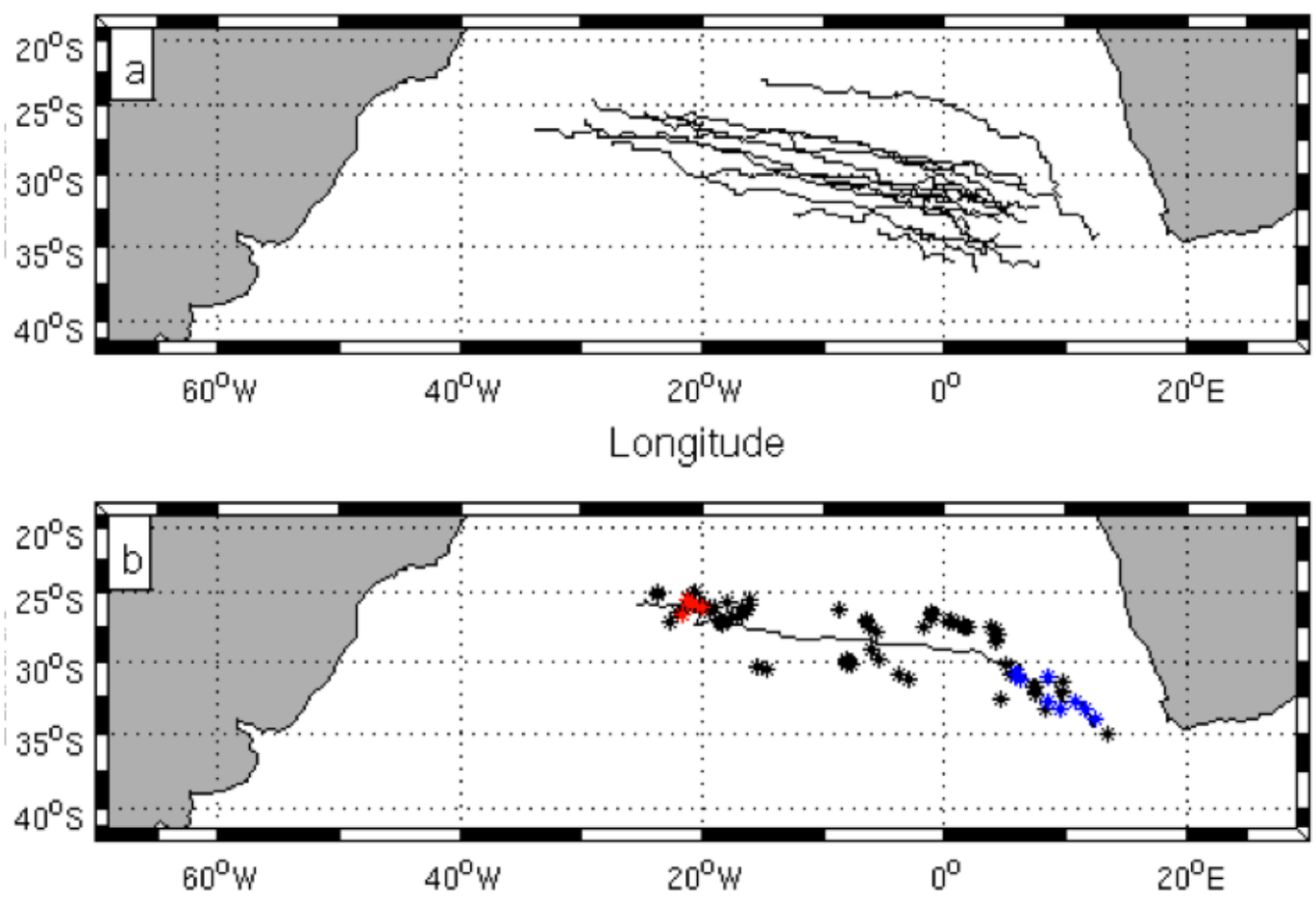
- **SSH** at high resolution (swot/compira) --> to come **(SAT.)**

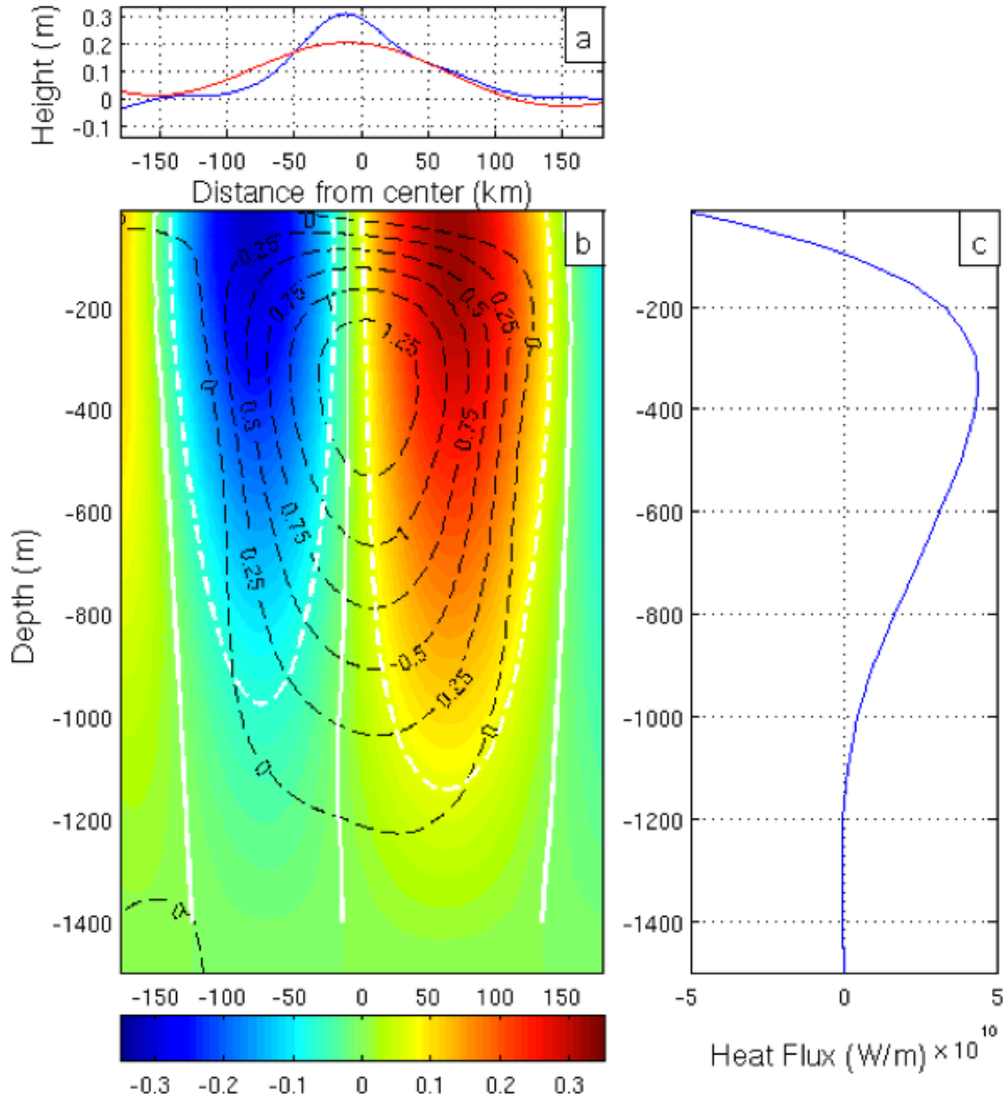
- **MLD** background state --> ~ 200 km, monthly resolution, OK **(In Situ)**

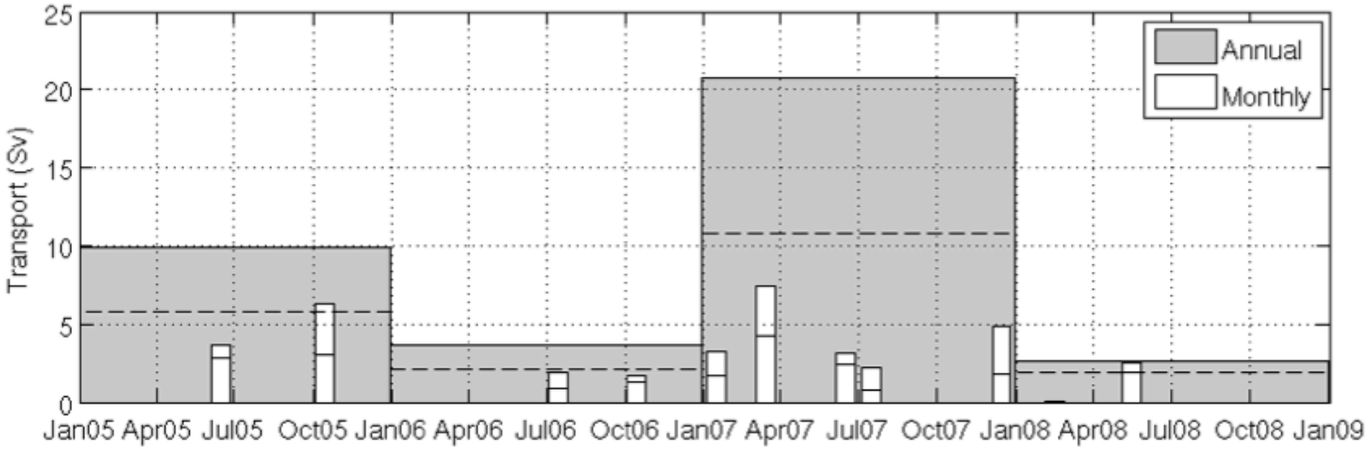
- **Ne** background state --> same as MLD OK **(In Situ)**

- **Av**, vertical diffusion coeff. in the MLD = f(N2, du/dz) --> to come **(In Situ + Sat.)** & sqg

Process studies --> Aghulas Rings heat transport

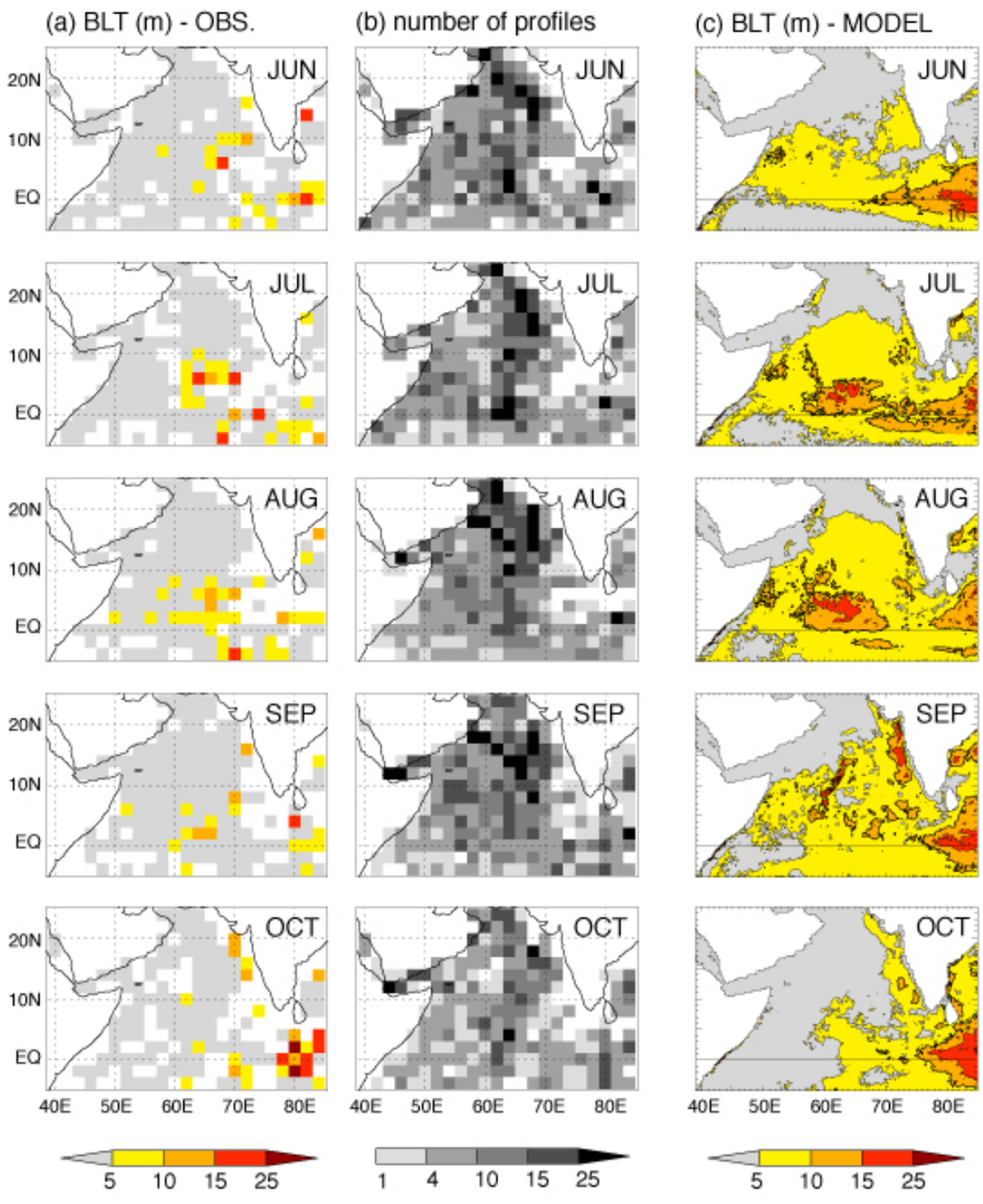


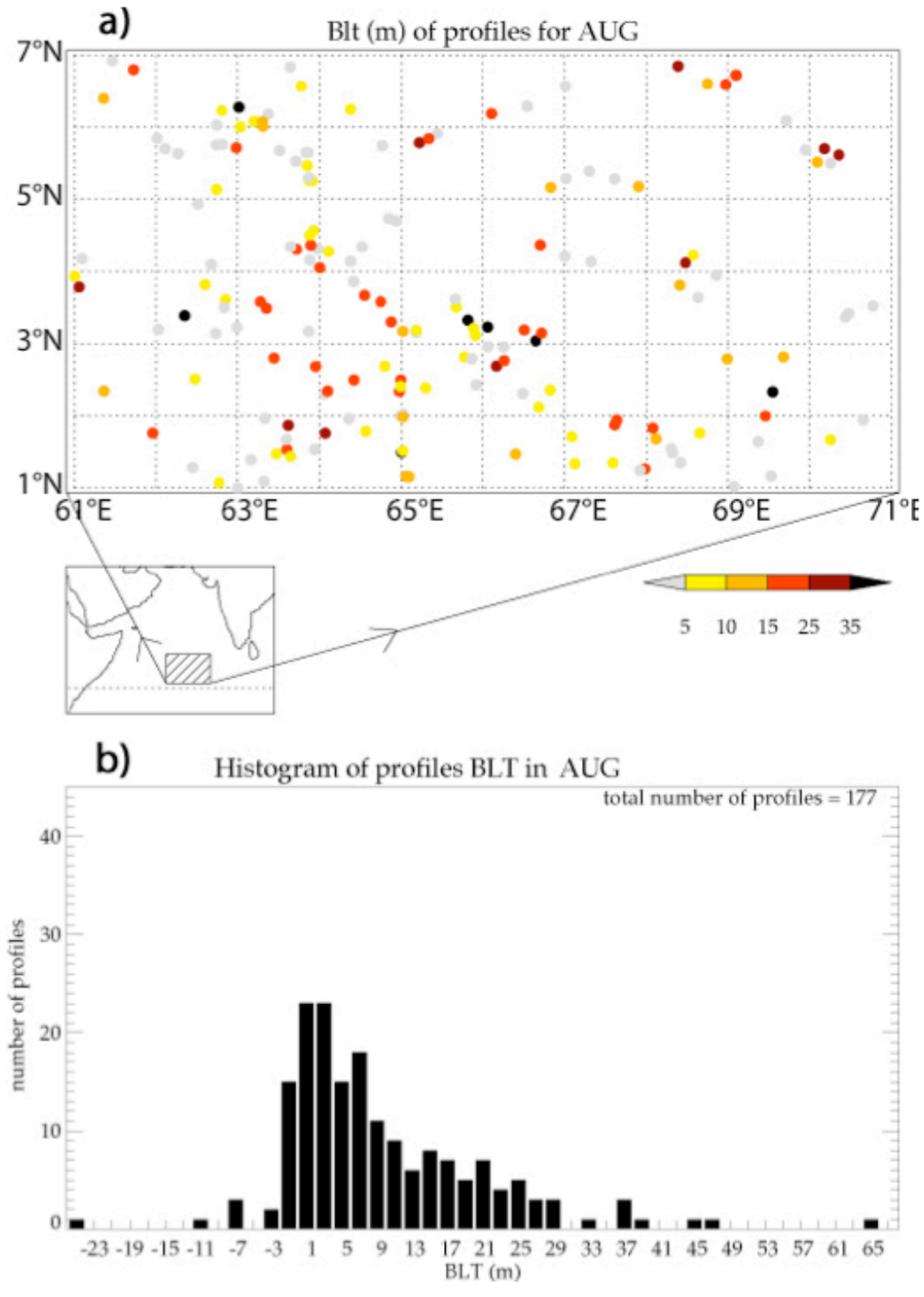




16 rings, ~49prof., ~6 month
0.062+/-0.012PW northw. the path
From Ind. to Atl. : 0.07PW and 9+/-8sv with large intern. Variab.
(Souza et al. 2011)

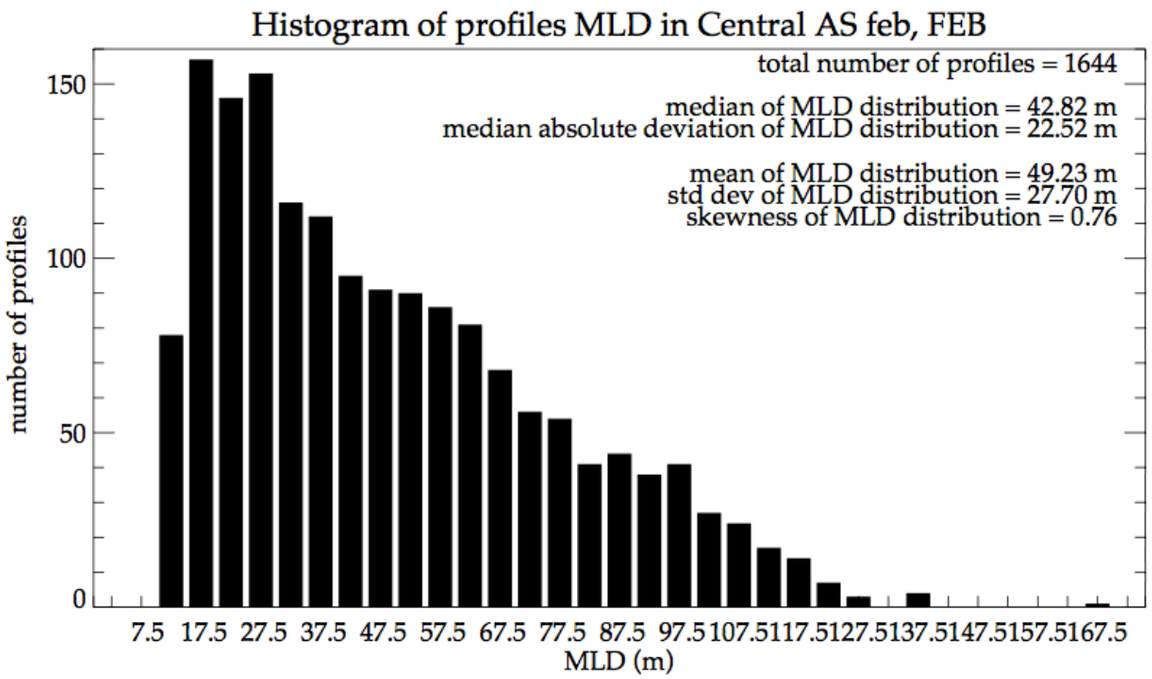
Process studies --> Barrier Layer in Arabian Sea



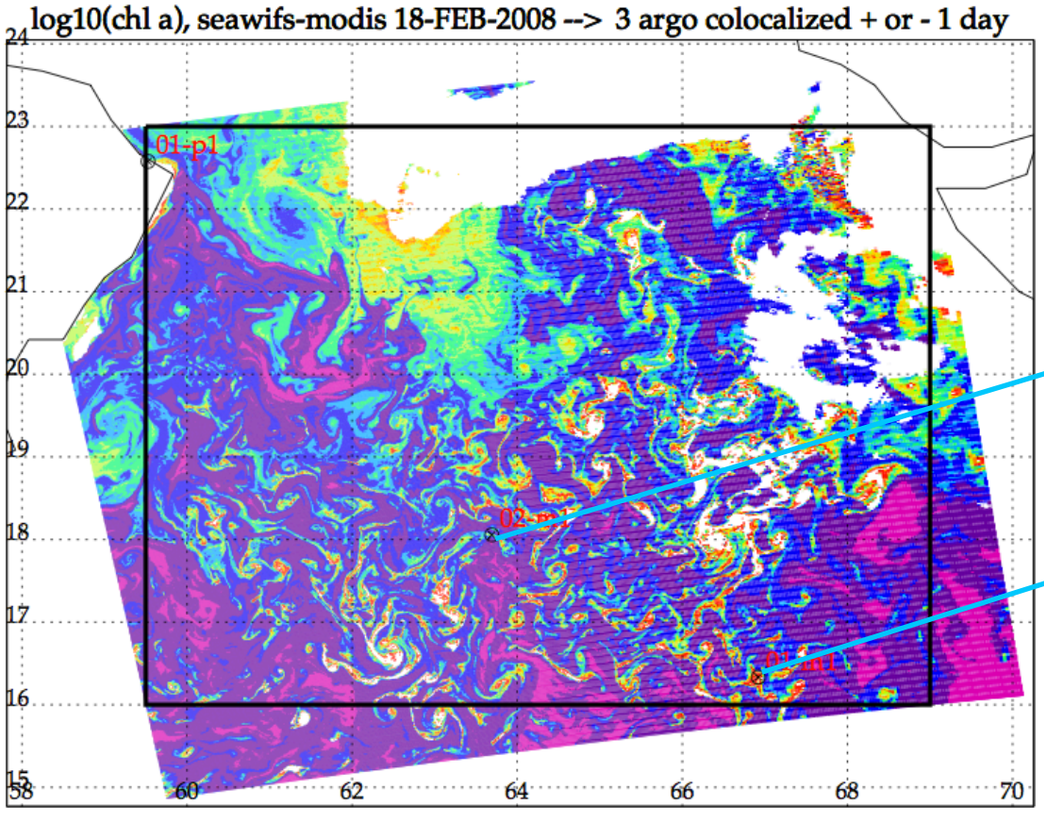


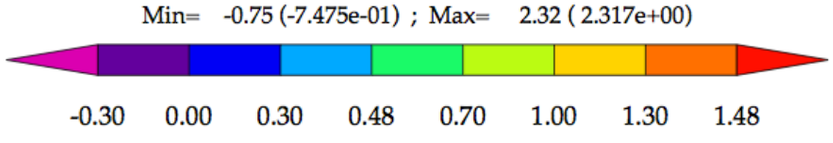
Mechanisms of BL seasonal formation and variability

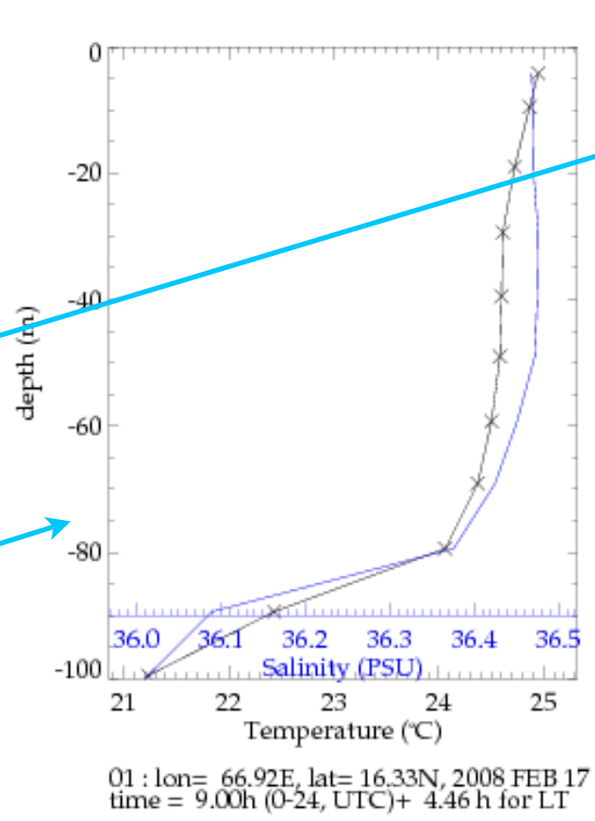
Process studies --> Winter MLD in Arabian Sea



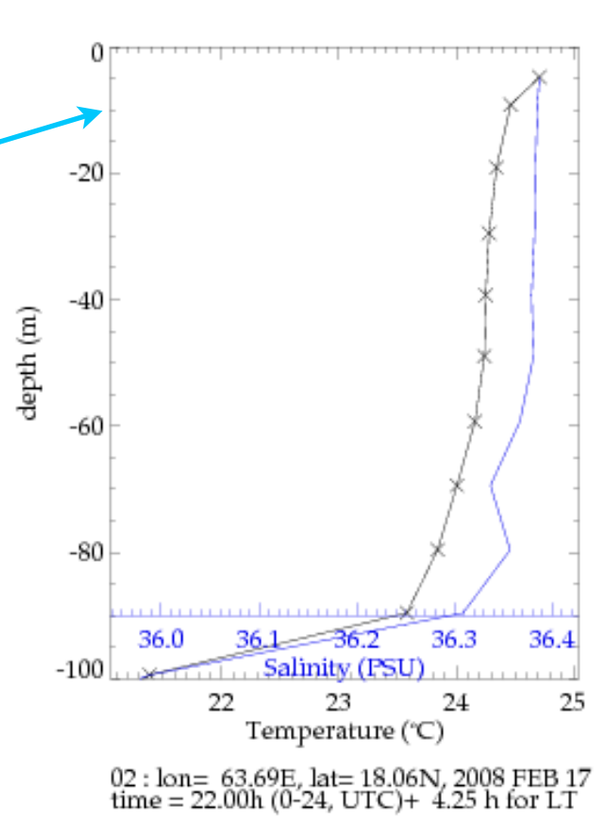
Restratification events observed during deep MLD background state in winter







01 : lon= 66.92E, lat= 16.33N, 2008 FEB 17
time = 9.00h (0-24, UTC)+ 4.46 h for LT

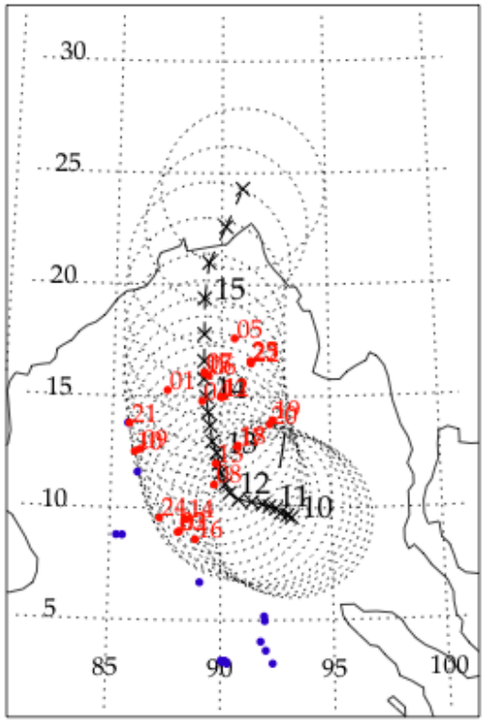


02 : lon= 63.69E, lat= 18.06N, 2008 FEB 17
time = 22.00h (0-24, UTC)+ 4.25 h for LT

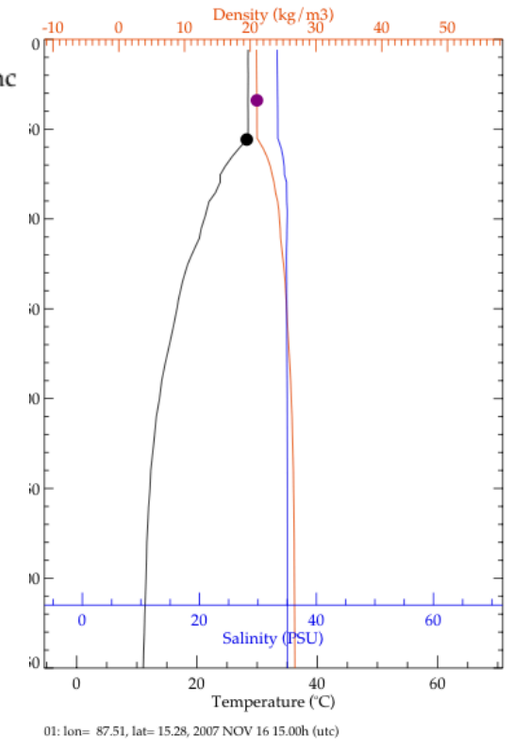
Process studies --> Cyclone colocalisation

RESULTS OF ARGO COLOCALIZATION ON A CYCLONE TRACK:

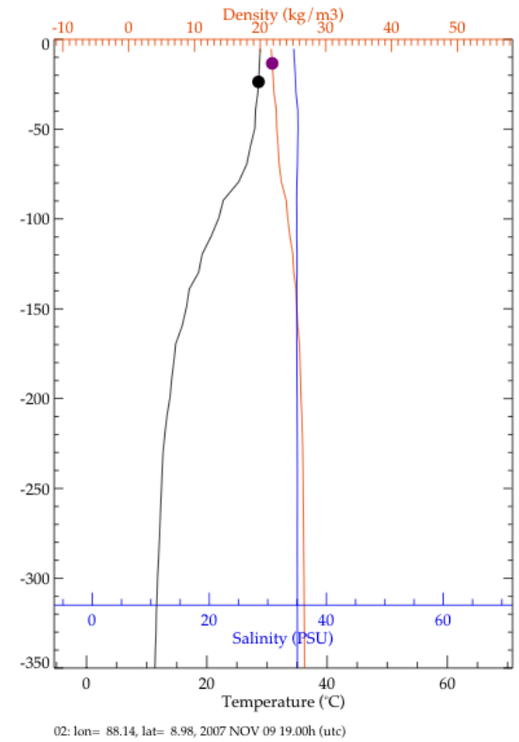
Cyclone track file = /home1/typhon/deboyer/DATA/OBS/ATMOSPHERE/CYCLONES/tcdata/iotracks.nc
Coloc radius = 400 km ; Time range = + or - 1 days
Cyclone number in the file = 664 ; Annual cyclone # = 6 ; start-end dates (UTC) = 20071110.25-20071116.00



> 26 floats identified in the area (1point=1profile), wmo # = 2900107, 2900532, 2900535, 2900537, 2900682,



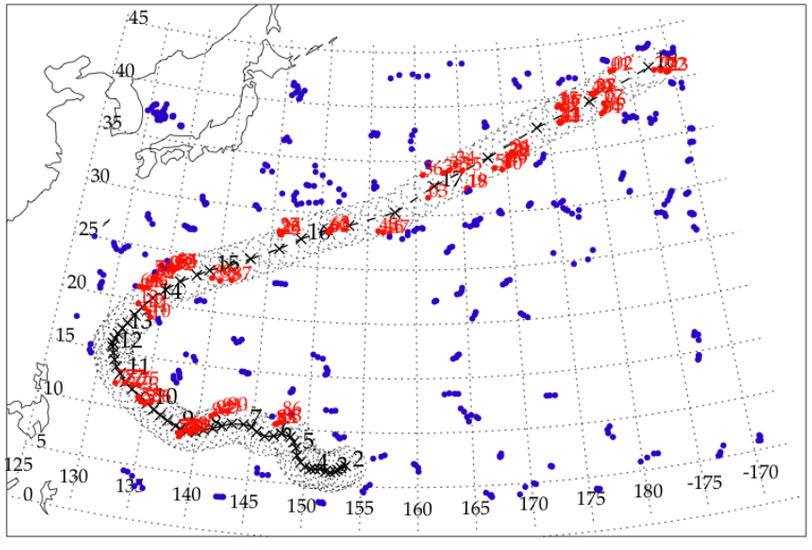
01: lon= 87.51, lat= 15.28, 2007 NOV 16 15.00h (utc)



02: lon= 88.14, lat= 8.98, 2007 NOV 09 19.00h (utc)

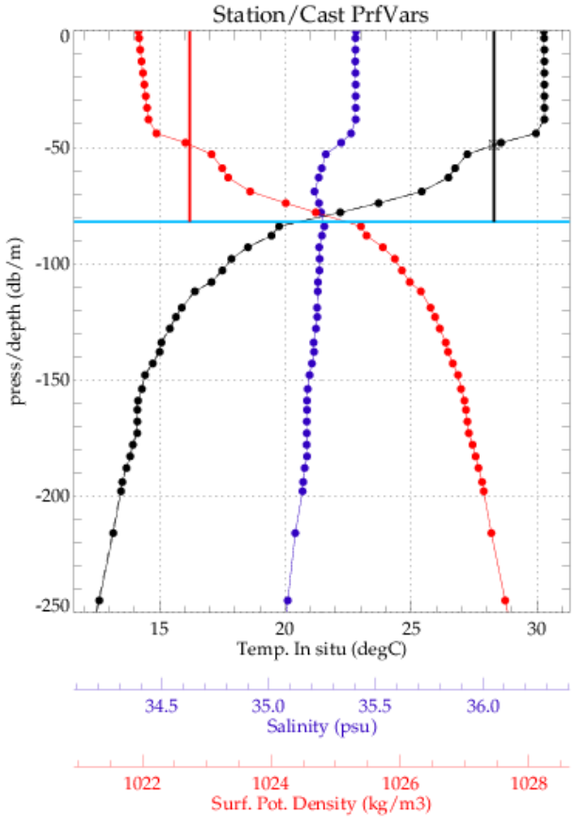
RESULTS OF ARGO COLOCALIZATION ON A CYCLONE TRACK:

Cyclone track file = /home1/typhon/deboyer/DATA/OBS/ATMOSPHERE/CYCLONES/ibtracs/d1_ibtracs_2H.dat
Coloc radius = 200 km ; Time range = + or - 10 days
Cyclone number in the file = 3015 ; start-end dates (UTC) = 20040402.00-20040418.00

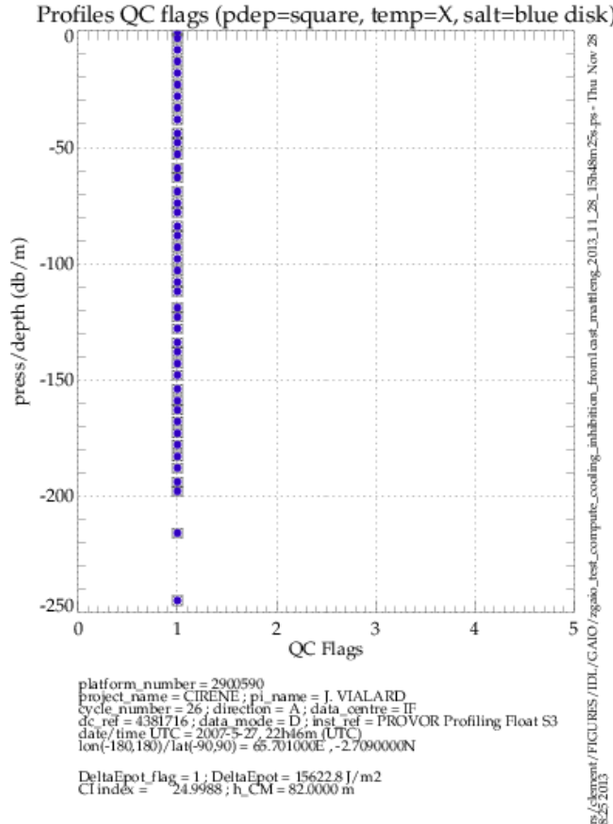


> 140 floats identified in the area (1point=1profile), wmo # = 21852, 29005, 29008, 29027, 29029, 29030, 29032, 29073, etc...

> 93 ARGO PROFILES FOUND ON THE CYCLONE TRACK :



n_levels_tot = 102 -:- min/max whole pdep = 0.00000/ 2002.00000 (0.00000/2002.00)
min/max whole prfvar (Temp. In situ (degC)) = 2.79800/ 30.29800 (2.79800/30.2980)



platform_number = 2900590
project_name = CIRENE ; pi_name = J. VIALARD
cycle_number = 26 ; direction = A ; data_centre = IF
dc_ref = 4381716 ; data_mode = D ; inst_ref = PROVOR Profiling Float S3
date/time UTC = 2007-5-27, 22h46m (UTC)
lon(-180,180)/lat(-90,90) = 65.701000E , -2.7090000N

DeltaEpot_flag = 1 ; DeltaEpot = 15622.8 J/m2
CI index = 24.9988 ; h_CM = 82.0000 m

n_levels_tot = 102 -:- min/max whole pdep = 0.00000/ 2002.00000 (0.00000/200
min/max whole prfvar (QC Flags) = 1.00000/ 1.00000 (1/1)

Conclusions, perspectives

- Use of **snapshots state of the ocean** (argo indiv. profiles) to extract wanted space/time scales

- **typical Argo resolution : 300 km, 10 days**

- Likely reachable scales for climatologies :
  - 1deg/month for annual clim
  - 2 deg/month for interannual
  - 3 deg/10 days for intraseasonal

One way to improve this estimation is noise/signal ratio approach in selected areas

- For **process studies**, “luck” can bring us local information for :
filaments (Arabian Sea), meso-scales structures (BL), eddies, cyclones