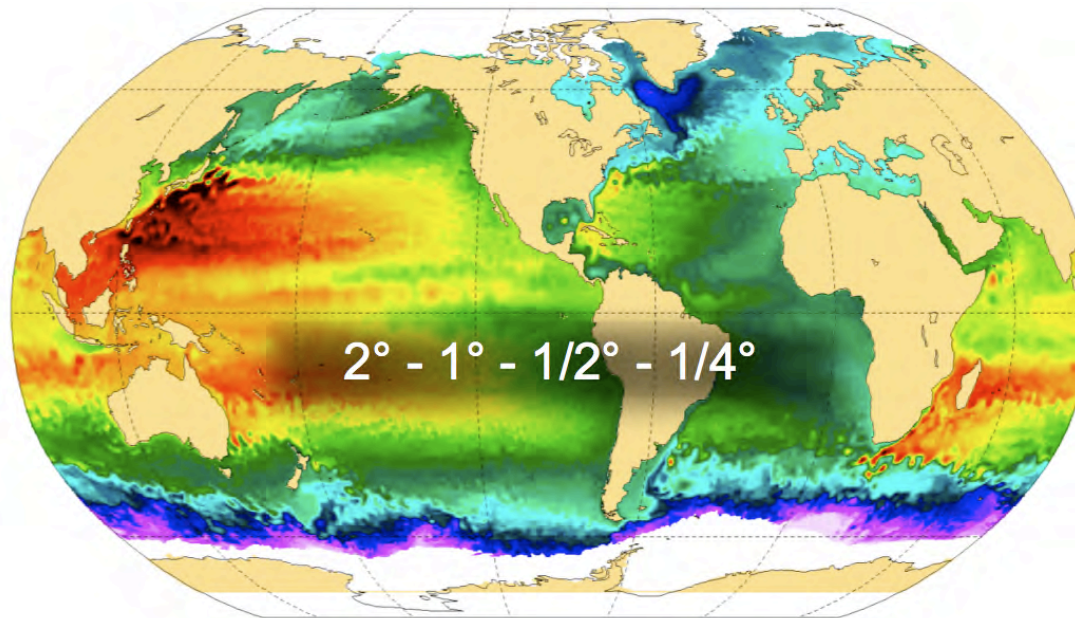


Valorizing and characterizing ARGO data with the DRAKKAR ensemble of global ocean simulations

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Mélanie JUZA
CNRS, LEGI, Grenoble, FRANCE



DRAKKAR Consortium
Ocean Modelling



IFM-GEOMAR



Objectives

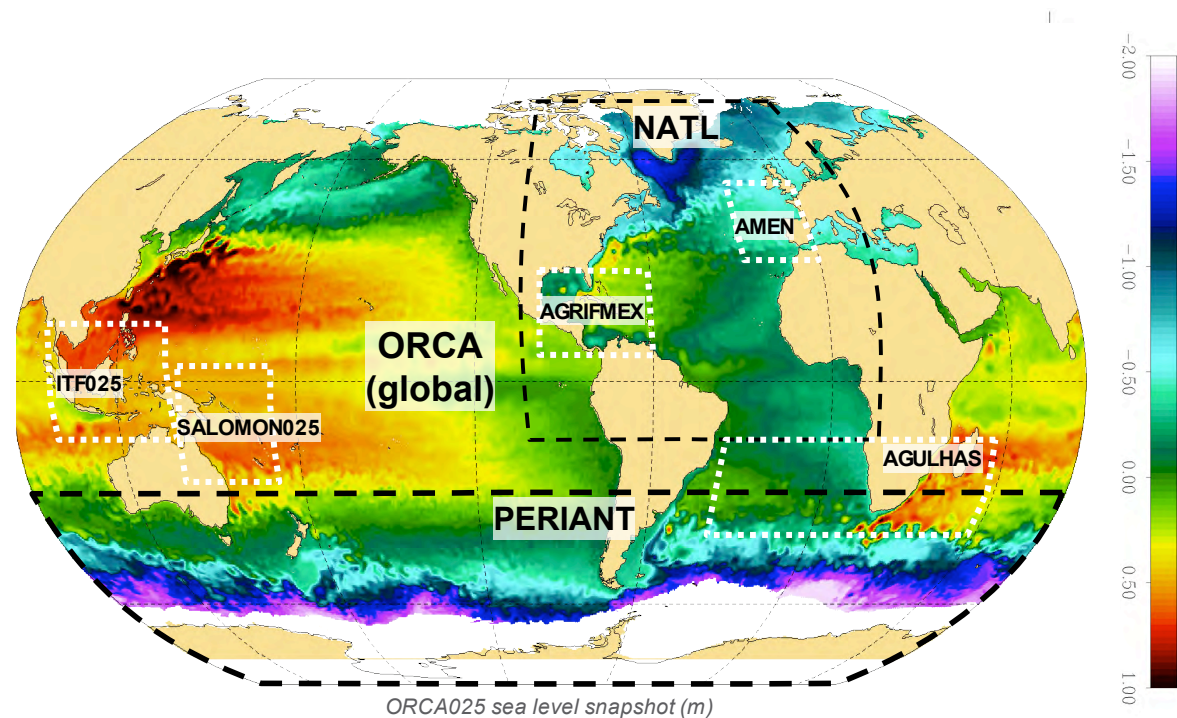
1. Make use of ARGO (and other hydrographic) observations to assess 50-year eddy-admitting global ocean simulations
2. Jointly use collocated real/model profiles to estimate the observation error of the ARGO array in the mixed layer

Outline

- DRAKKAR models – The global $\frac{1}{4}^\circ$ simulation
- Assessment of simulated mixed layer properties against ARGO
- Evaluation of ARGO sampling errors in the mixed layer
- Conclusion

DRAKKAR configurations

- NEMO ocean/sea-ice/ ^{14}C /CFC $_{11}$ z-level model with partial steps
- Global 2°, Global 1°, Global 1/2°, Global 1/4° (67.10⁶ points, 186 procs IBM SP4)
- Nested & standalone zooms
- Period: 1958-2004
- Forcing:
 - COARE bulk formulae
 - ERA40 atm. Variables
 - ISCCP radiative fluxes
 - Xie & Arkin precipitations
 - Dai & Trenberth runoffs



Interactions & teleconnections

Large-scale/low-frequency impact of mesoscale

Interpretation of observations (satellite, ARGO, OVIDE, etc)

Improve climate & operational ocean models

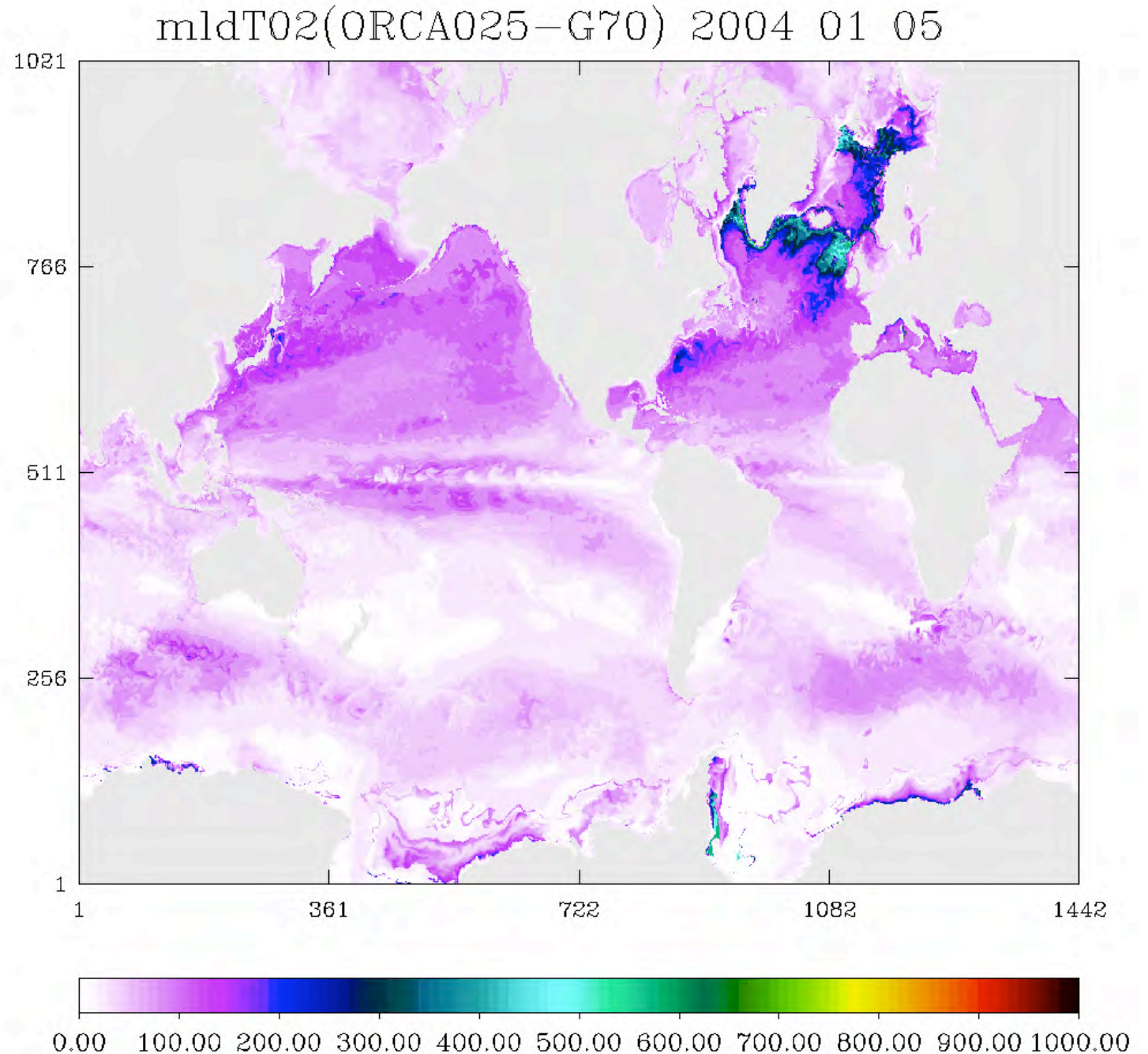
Foster cooperative studies

2004 Mixed Layer Depth

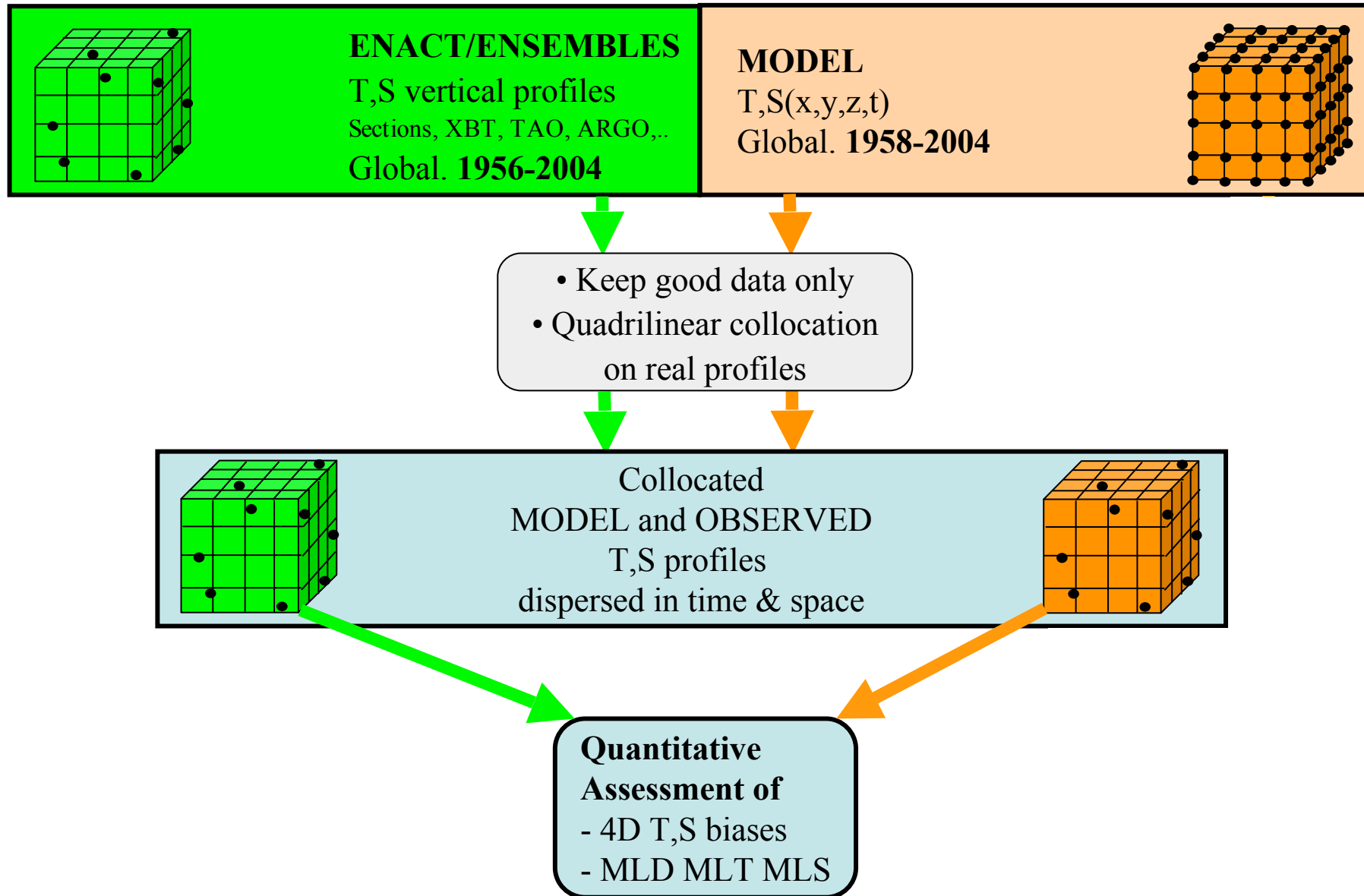
DRAKKAR
1/4° model

Strong impact of

- Mesoscale features
- Sea-ice edge

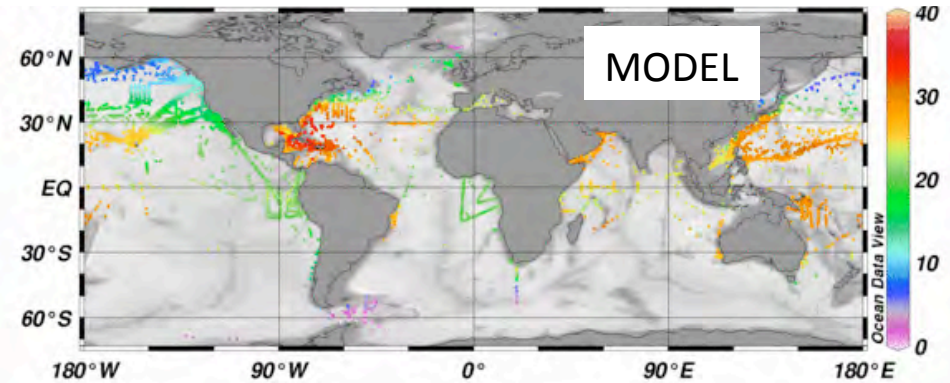
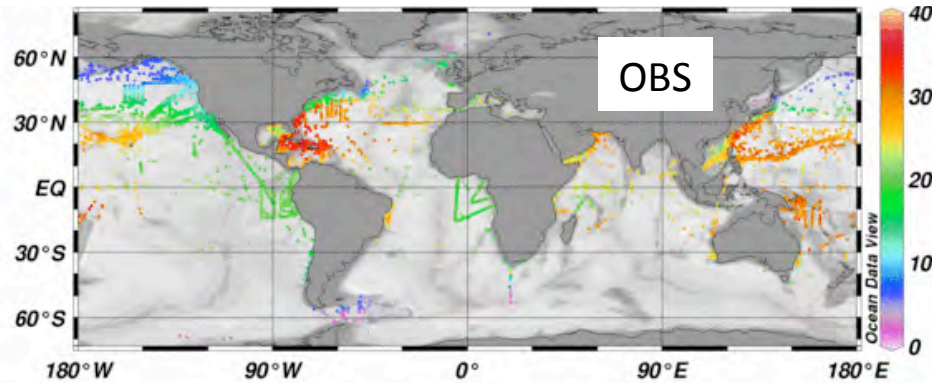


Assessment of model biases

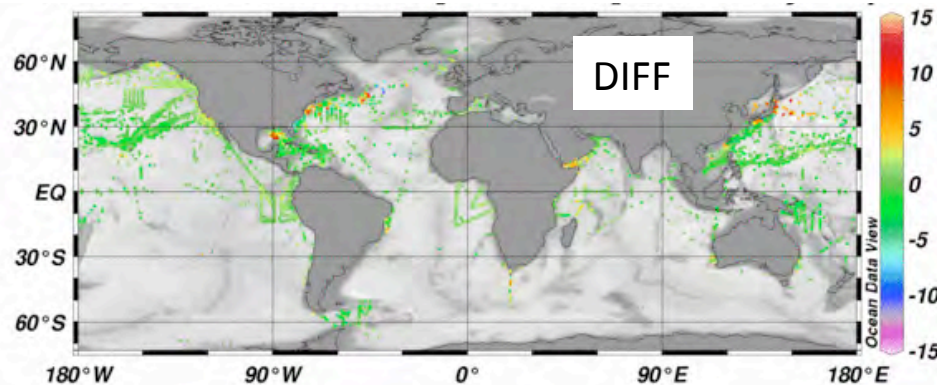


Heat content estimates 1975-2004

(GJ/m²)



ENSEMBLE/ORCA025-G70 - year 1975 - layer [50m-450m]



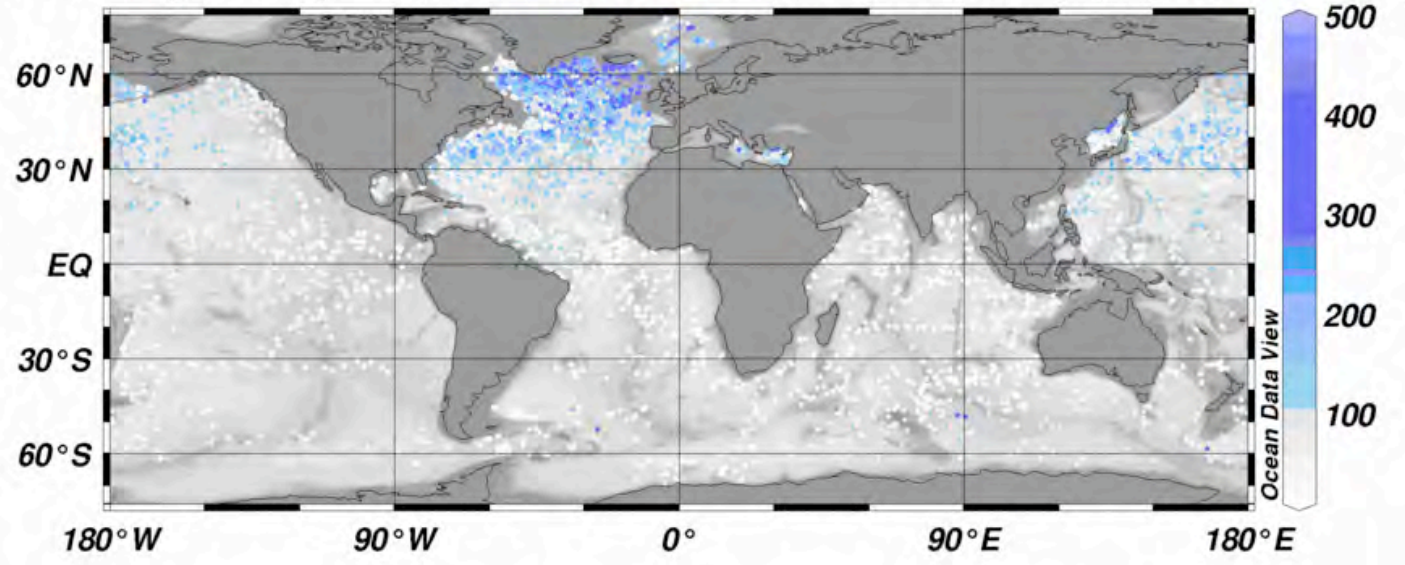
ENACT/ENSEMBLES

Sections, XBT, drifters, TAO, ARGO, ...

Focus on the seasonal cycle ARGO 1998-2004

ARGO mixed layer depth (from ENSEMBLES/ENACT) [m] @ Dummy=Top

ARGO data →

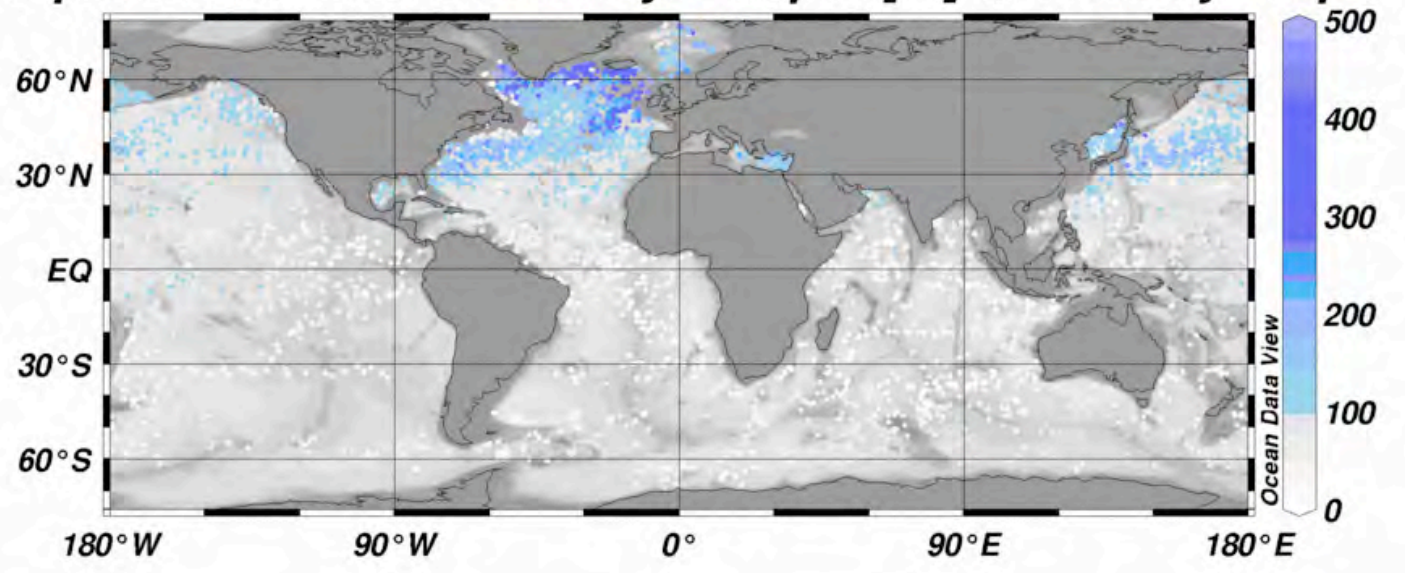


**Collocated
MLDs (m)
 $|T-T_0| < 0.2^\circ\text{C}$**

jan 1998-2004

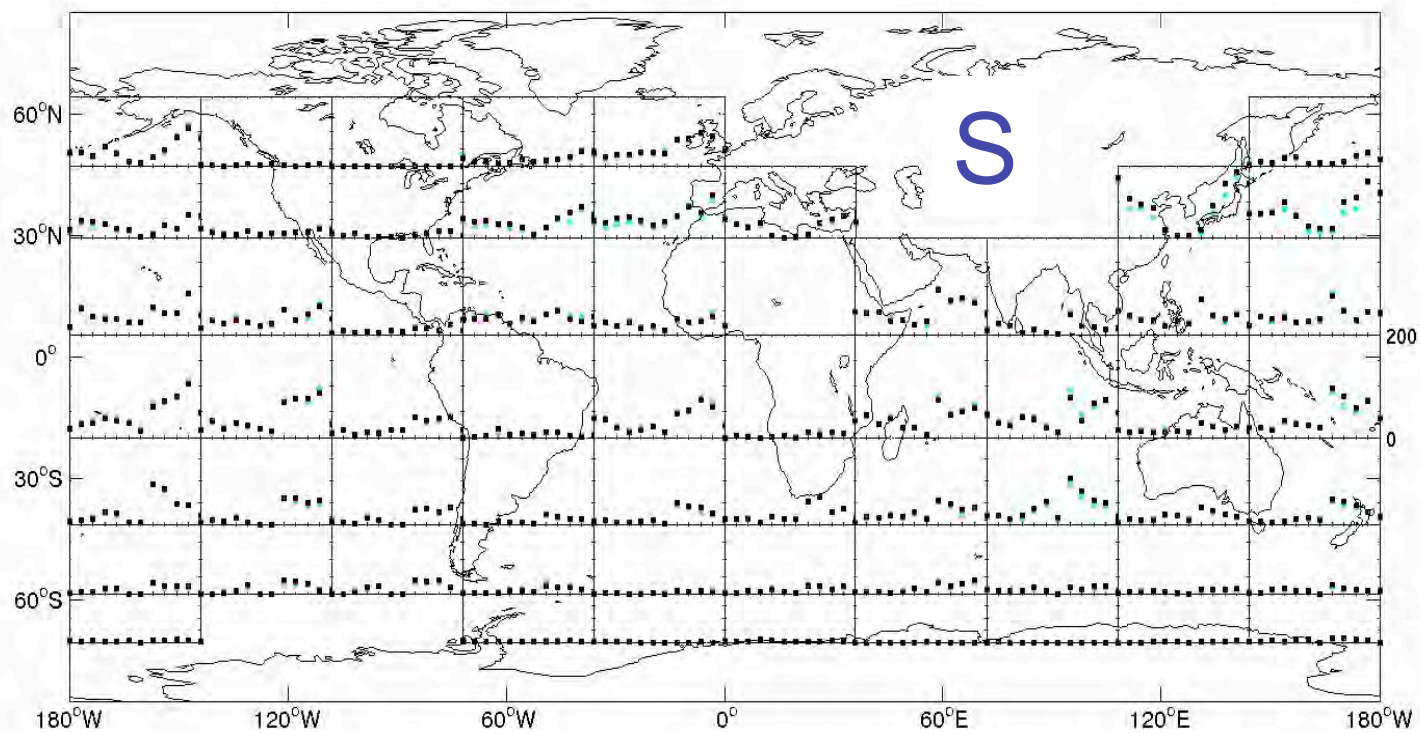
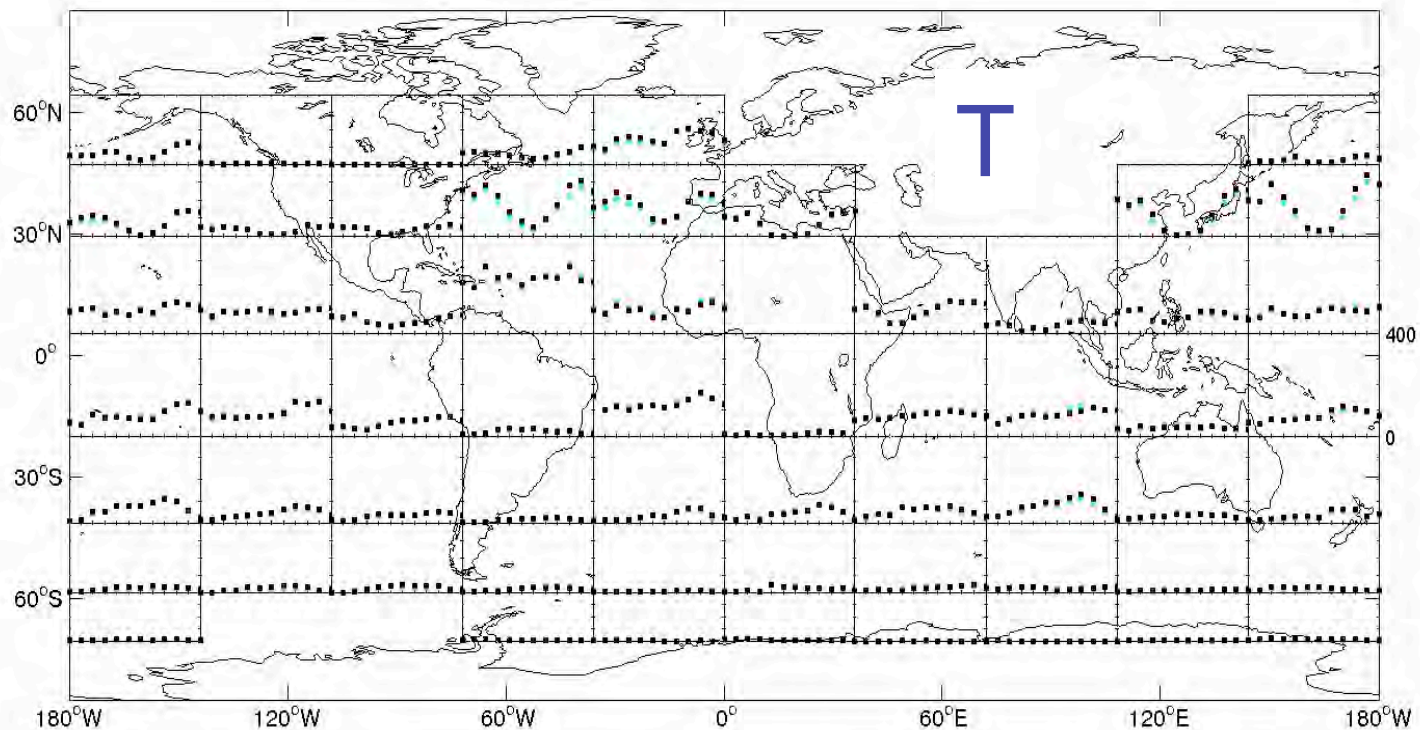
equivalent model mixed layer depth [m] @ Dummy=Top

DRAKKAR
 $\frac{1}{4}^\circ$ model →



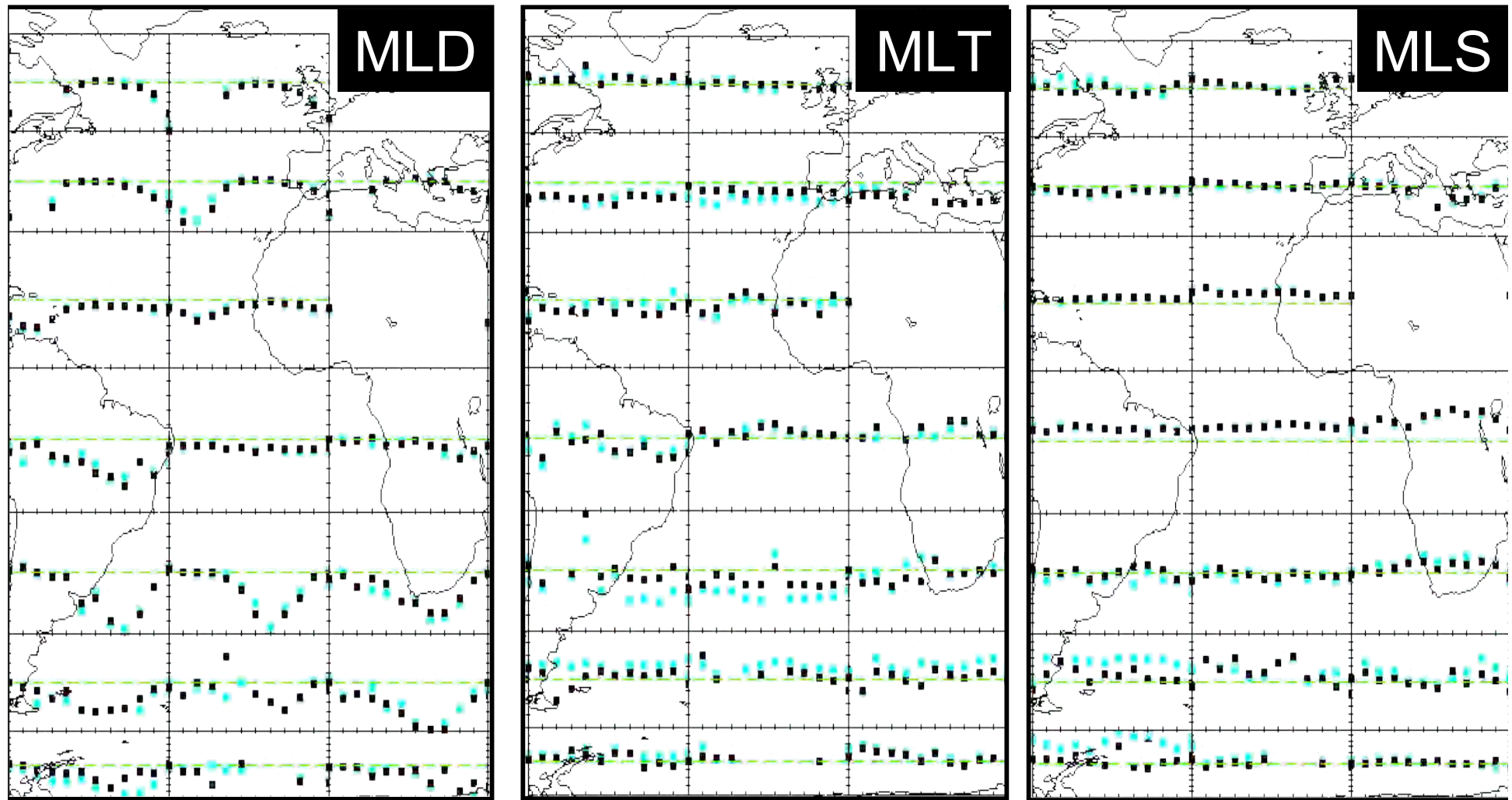
MIXED LAYER
30°x30°x1-month bins
(2000-2004)

Number of
ARGO profiles
sampling the
whole mixed Layer



2000-2004 MIXED LAYER BIASES (30° x 30° x 1-month bins)

ORCA05-G70 - ORCA025-G70



50m too shallow



50m too deep



5°C too warm



5°C too cold



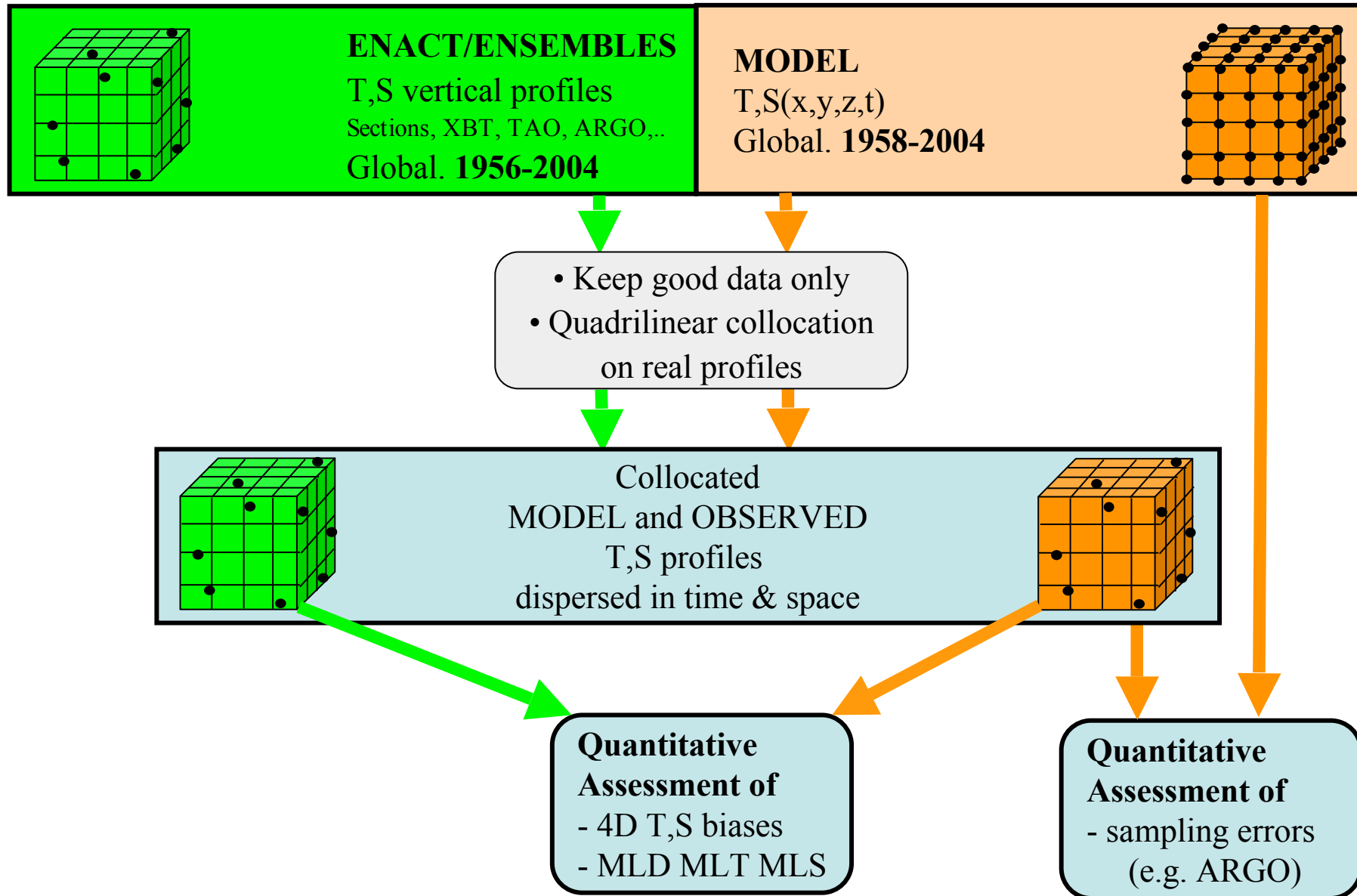
1 psu too salty



1 psu too fresh



ARGO sampling errors

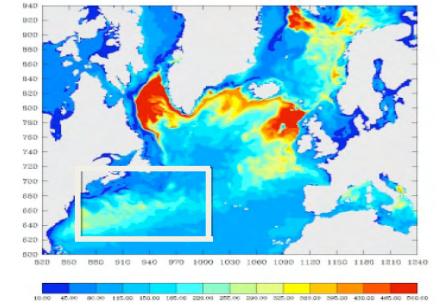


ARGO sampling errors

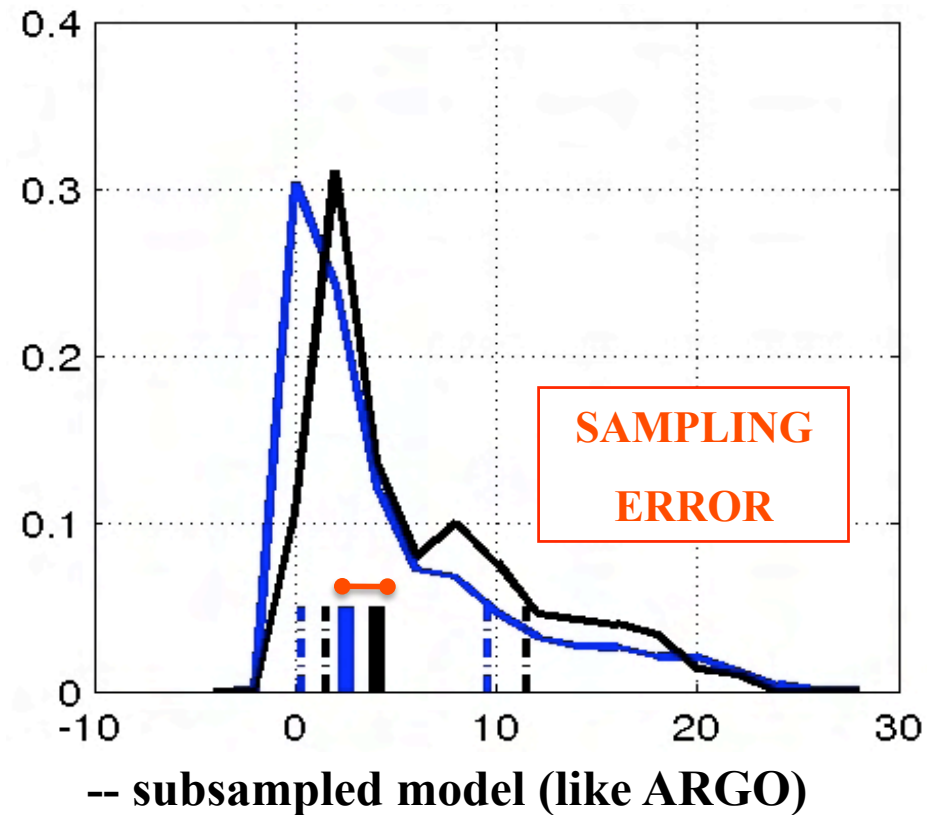
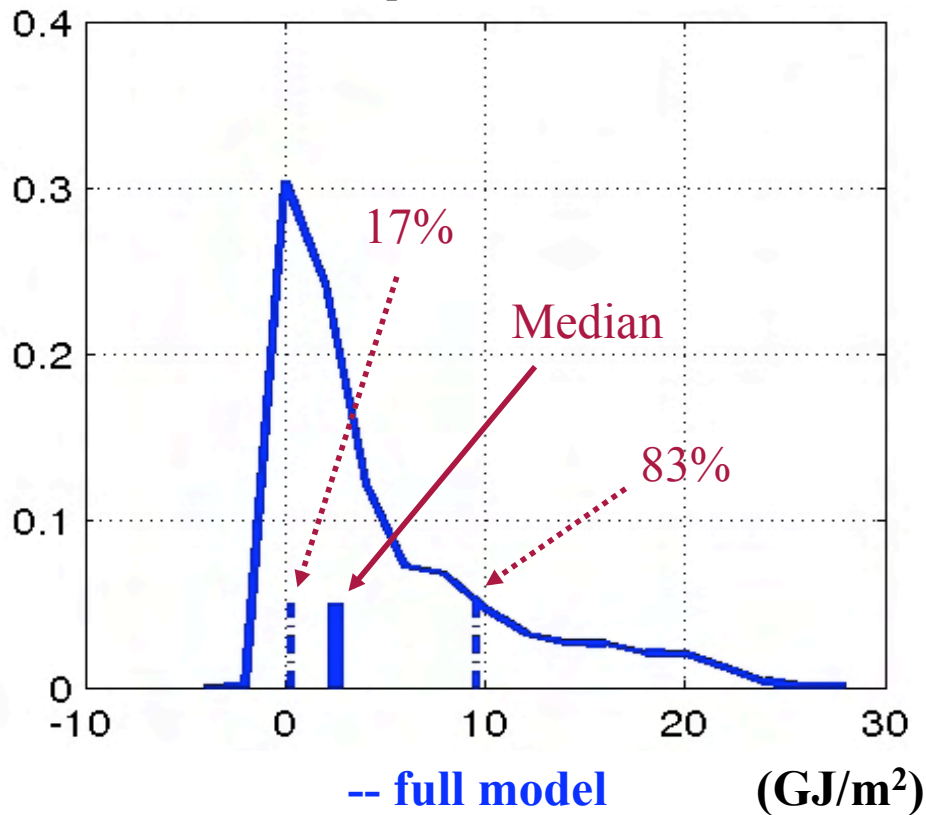
Mixed Layer Depth / Temperature / Salinity / Heat and Salt Contents

Example: MLHC in NW Atlantic

$$MLHC = \rho_0 C_p \int_{z=MLD}^0 \Delta T dz$$

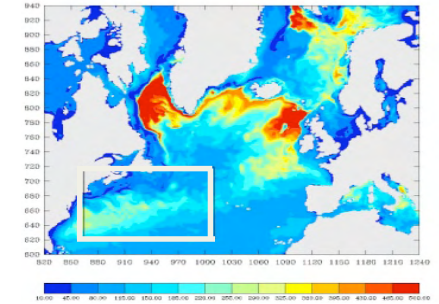
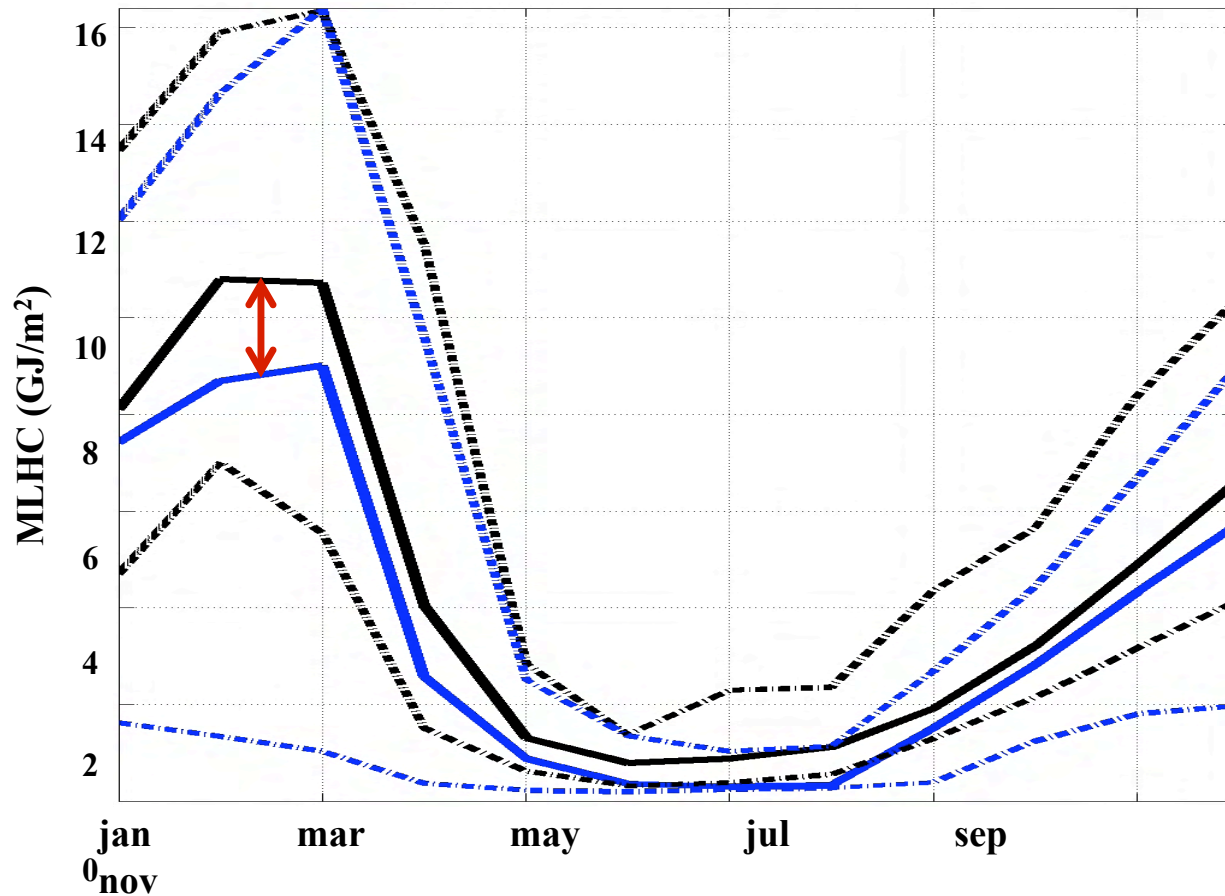


April 1998-2004



ARGO sampling error : MLHC

Monthly cycle of MLHC (1998-2004):



-- sub-sampled model

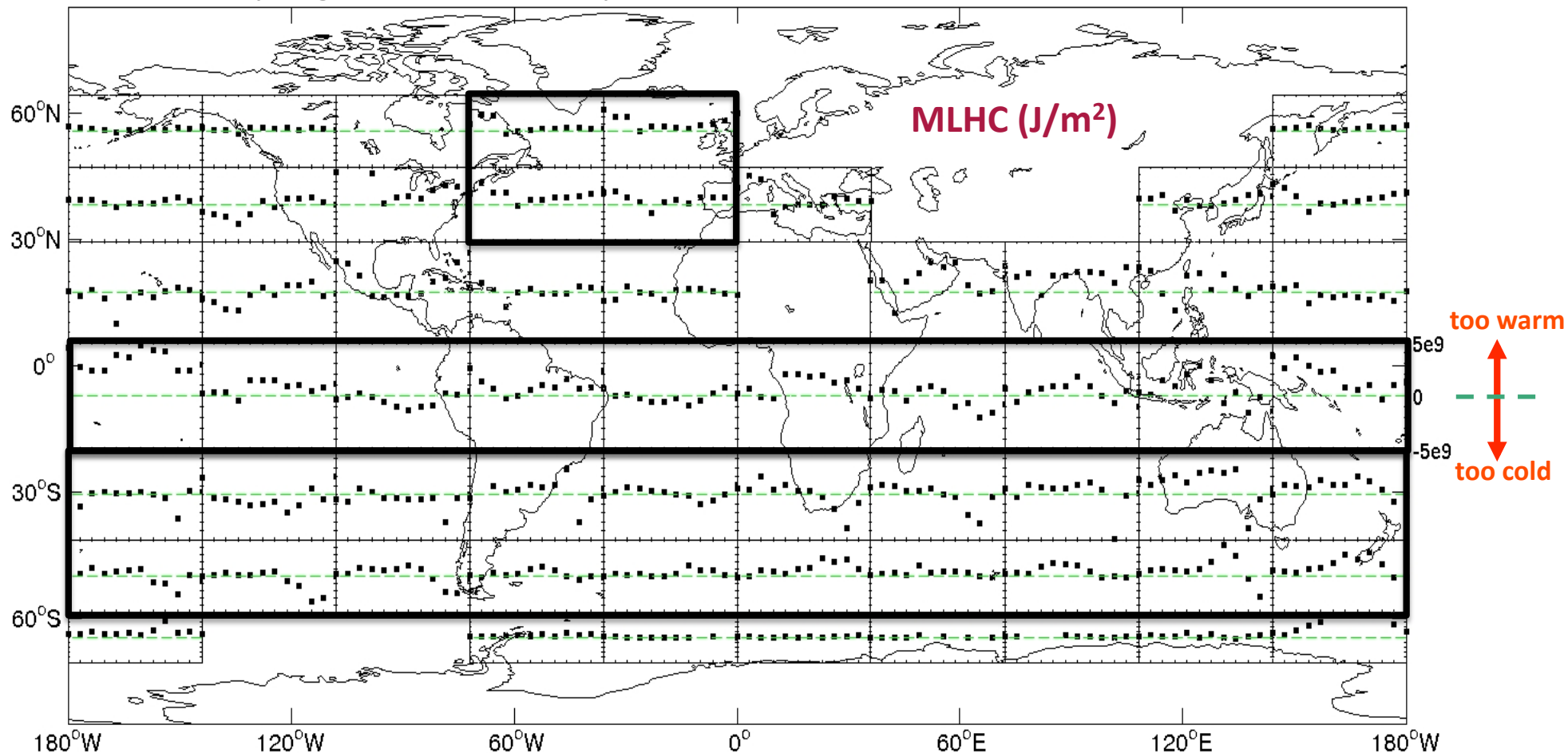
-- full model $1/4^\circ$

→ well observed seasonal cycle

→ small sampling error. JFM ~ 2 GJ/m²

ARGO sampling error : MLHC

ARGO sampling error on monthly MLHC (1998-2004)



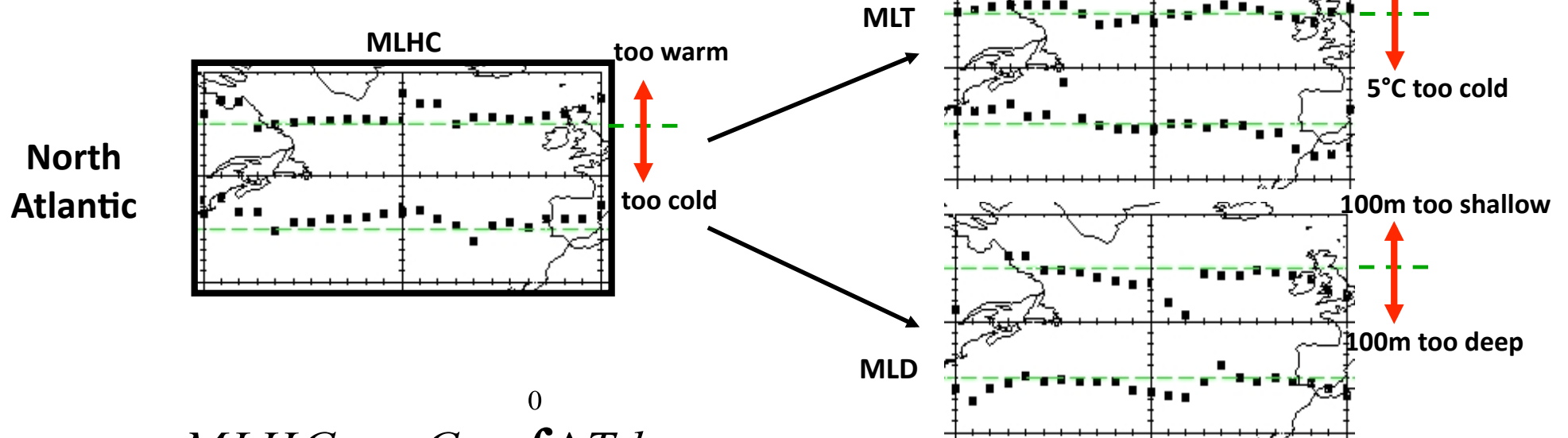
Error = $\langle \text{subsampling model} \rangle - \langle \text{full model} \rangle$

30° x 30° x 1 month bins (1998-2004)

→ Sampling errors of MLD and MLT

ARGO sampling error : MLHC, MLD, MLT

Contribution of MLD / MLT to the
ARGO sampling errors of MLHC

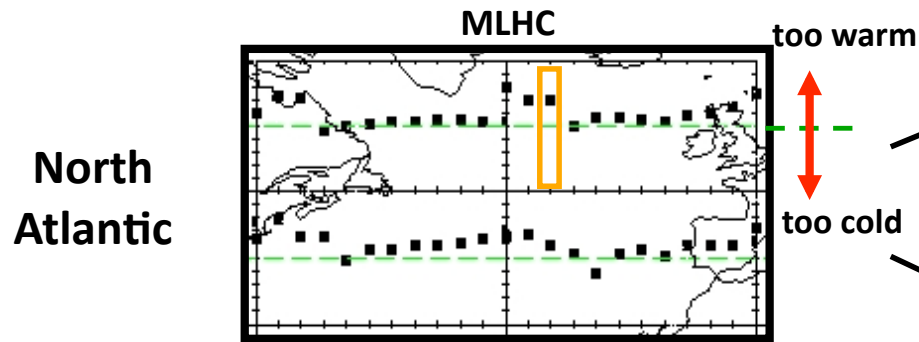


$$MLHC = \rho_0 C_p \int_{z=MLD}^0 \Delta T dz$$

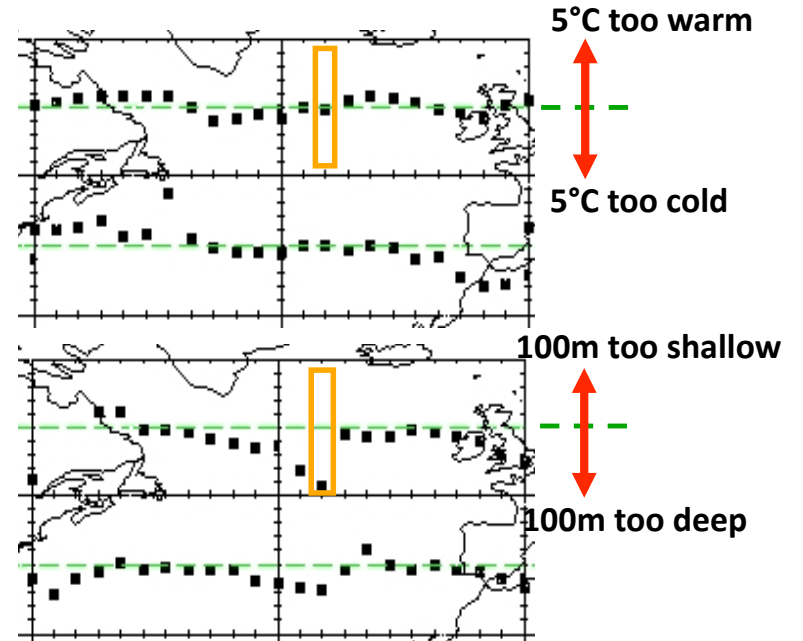
ARGO sampling error : MLHC, MLD, MLT

Contribution of MLD / MLT to the ARGO sampling errors of MLHC

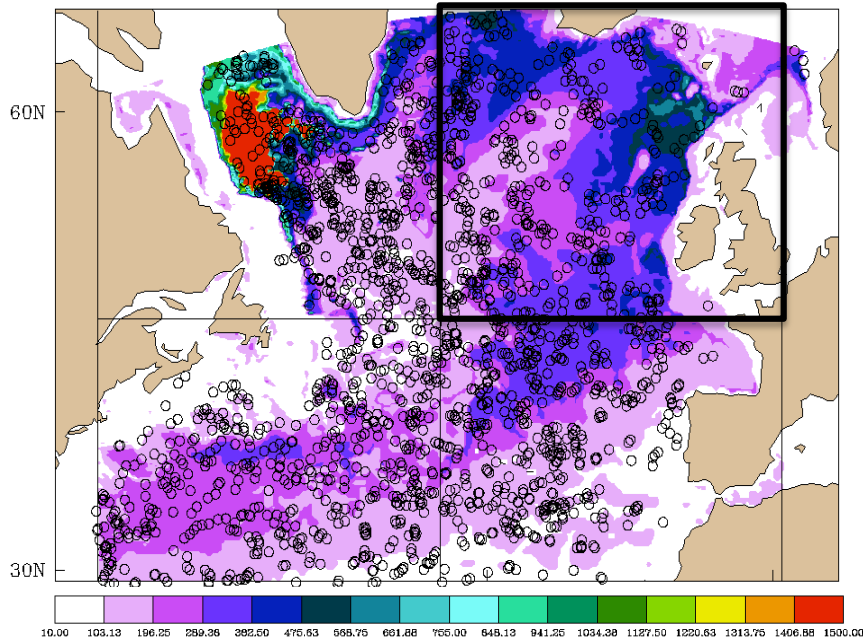
March



MLT



1/4° model MLD & ARGO floats positions – mar 1998-2004

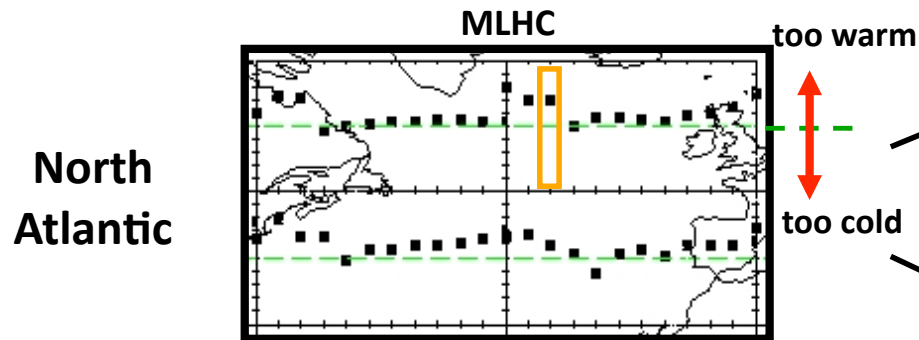


→ Quantity of data per bin? Moderate effect

→ Spatial distribution of ARGO floats?

ARGO sampling error : MLHC, MLD, MLT

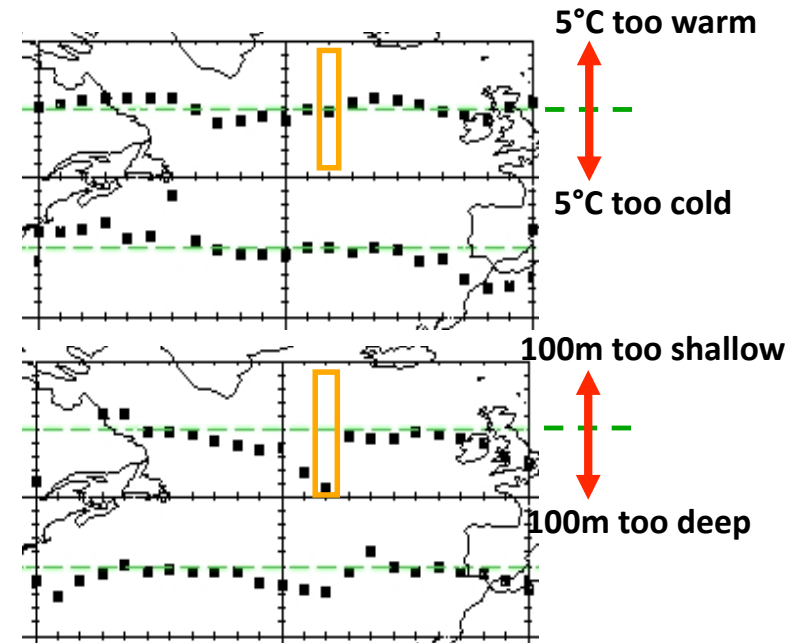
Contribution of MLD / MLT to the ARGO sampling errors of MLHC



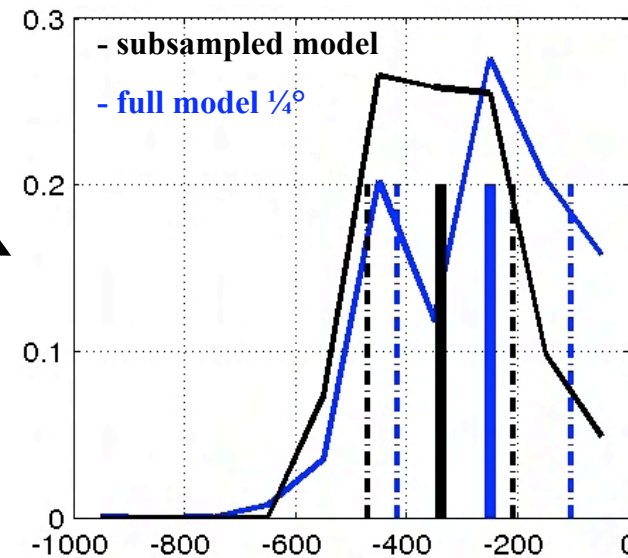
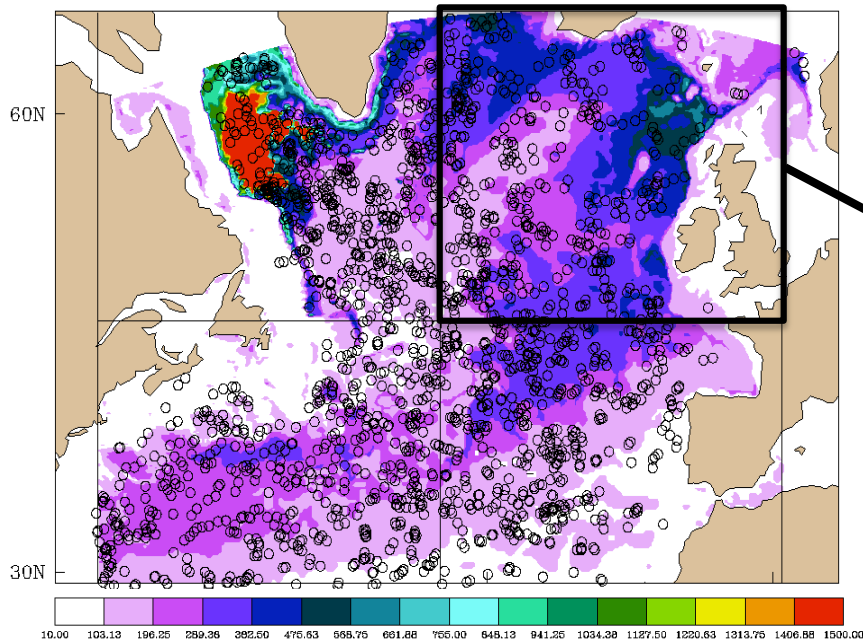
MLT

MLD

March



1/4° model MLD & ARGO floats positions – mar 1998-2004



Conclusions - Perspectives

- Complementarity of simulations and observations
- DRAKKAR assessment: altimetry, hydrography, SST, currentmeters, etc.
- 4D biases of T,S quantified → further model improvements
- Preliminary estimates of ARGO sampling errors in the mixed layer

	Typical	Max
Depth	+/- 10 m	+/- 100 m
Temperature	+/- 1 °C	+/- 5 °C
Heat content	+/- 1 GJ/m ²	+/- 5 GJ/m ²

+ and Salinity, Salt Content.

- This method: Moderate impact of quantity of ARGO data
Strong impact of spatial distribution
- Extend this assessment: to 2005-present (maximum ARGO coverage)
toward the last 50 years (interannual cycles)
- ARGO community suggestions? Approach, error estimates, future deployments..