Gael Forget
MIT, Jan. 15th 2016

Independent Activities Period

Introduction to ocean data-model analysis

Class overview

I. observations
II. gridded products
III. numerical models
IV. completion of activities

(1) data interpolation

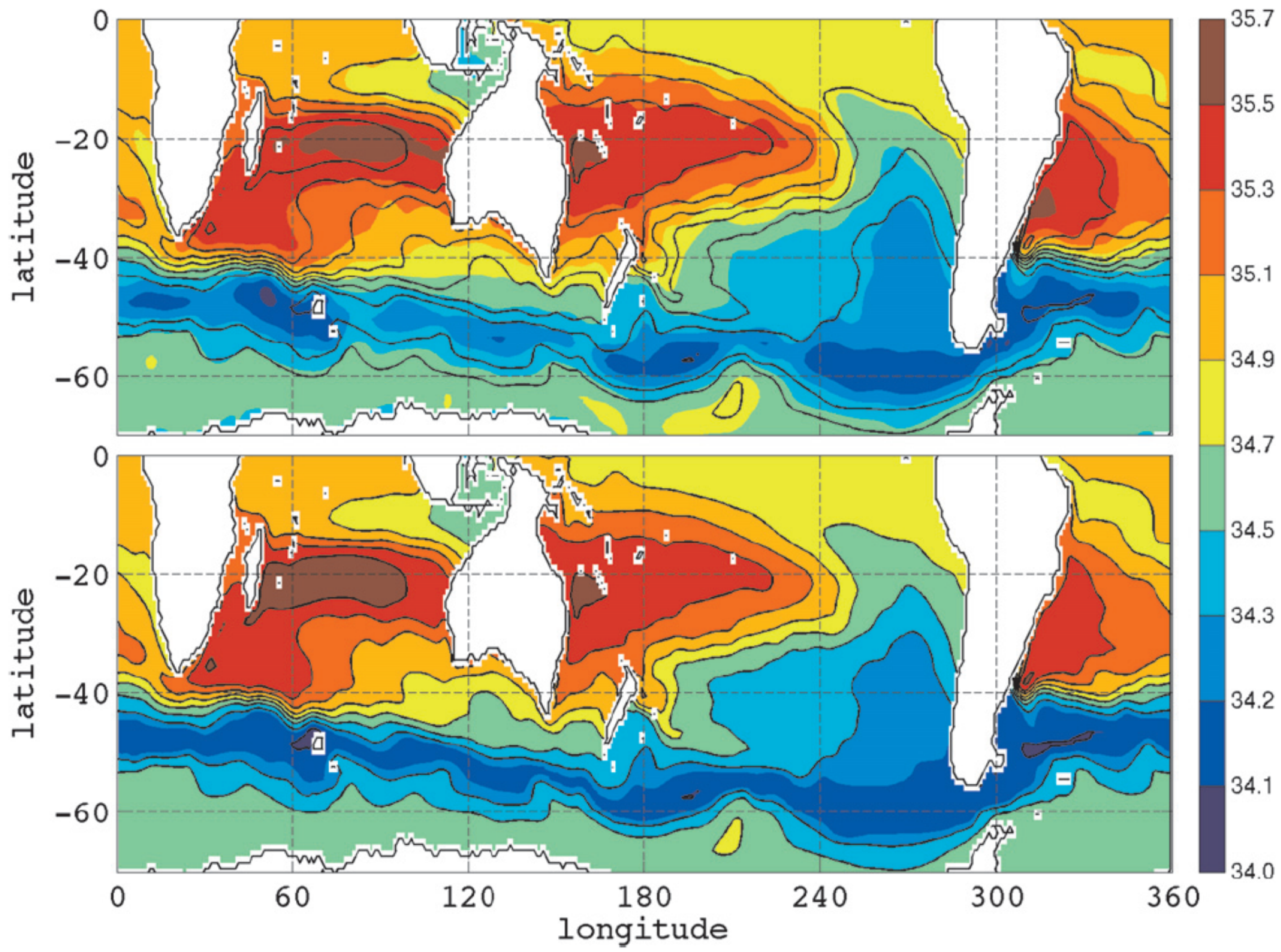
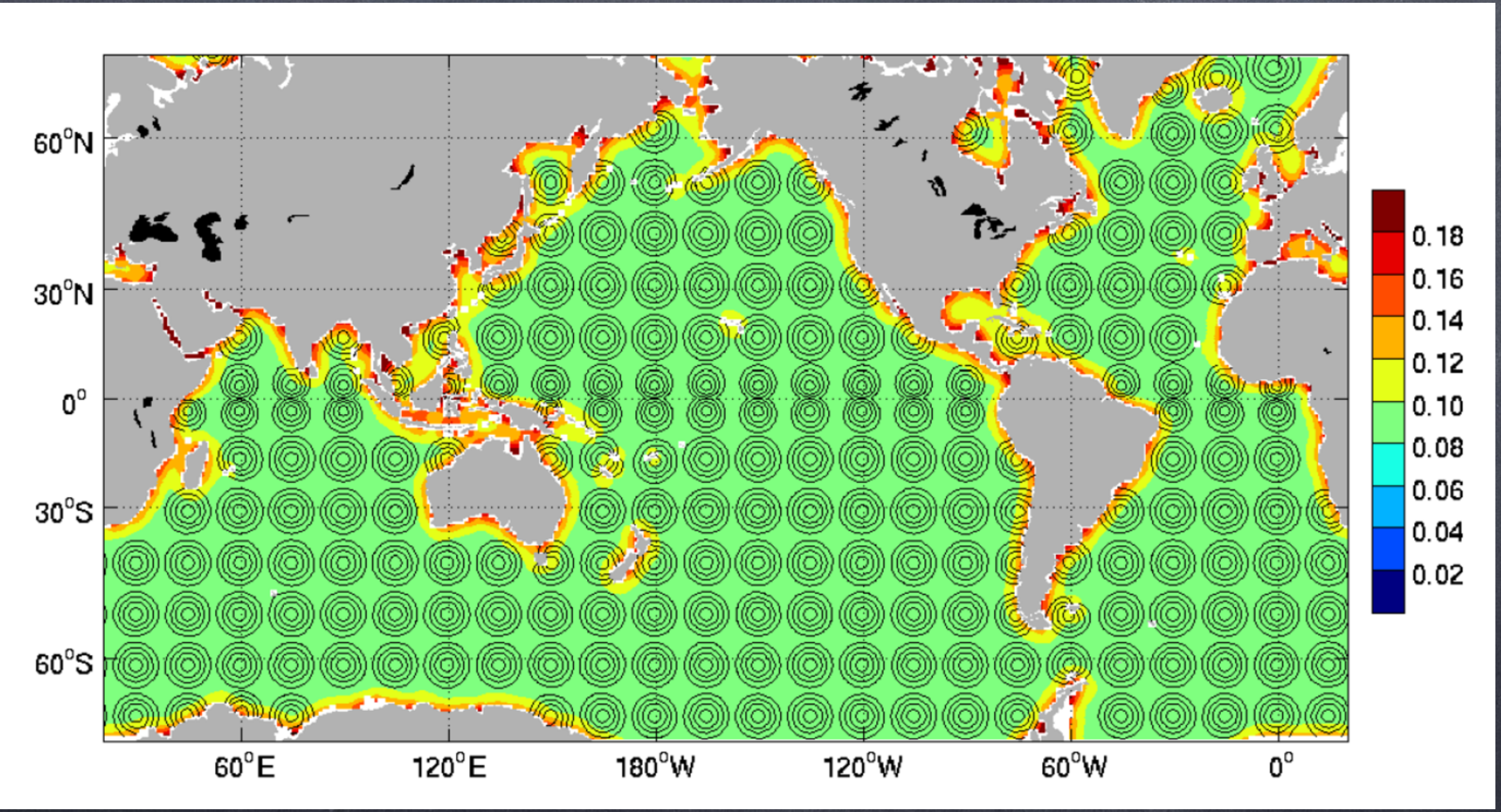


FIG. 6. Annual mean salinity map at 300 m in (top) *WOA01* and (bottom) OCCA. Overlaid black contours: annual mean isohalines in OCCA.

(Forget 2010)

(1) data interpolation

Through Statistical Models



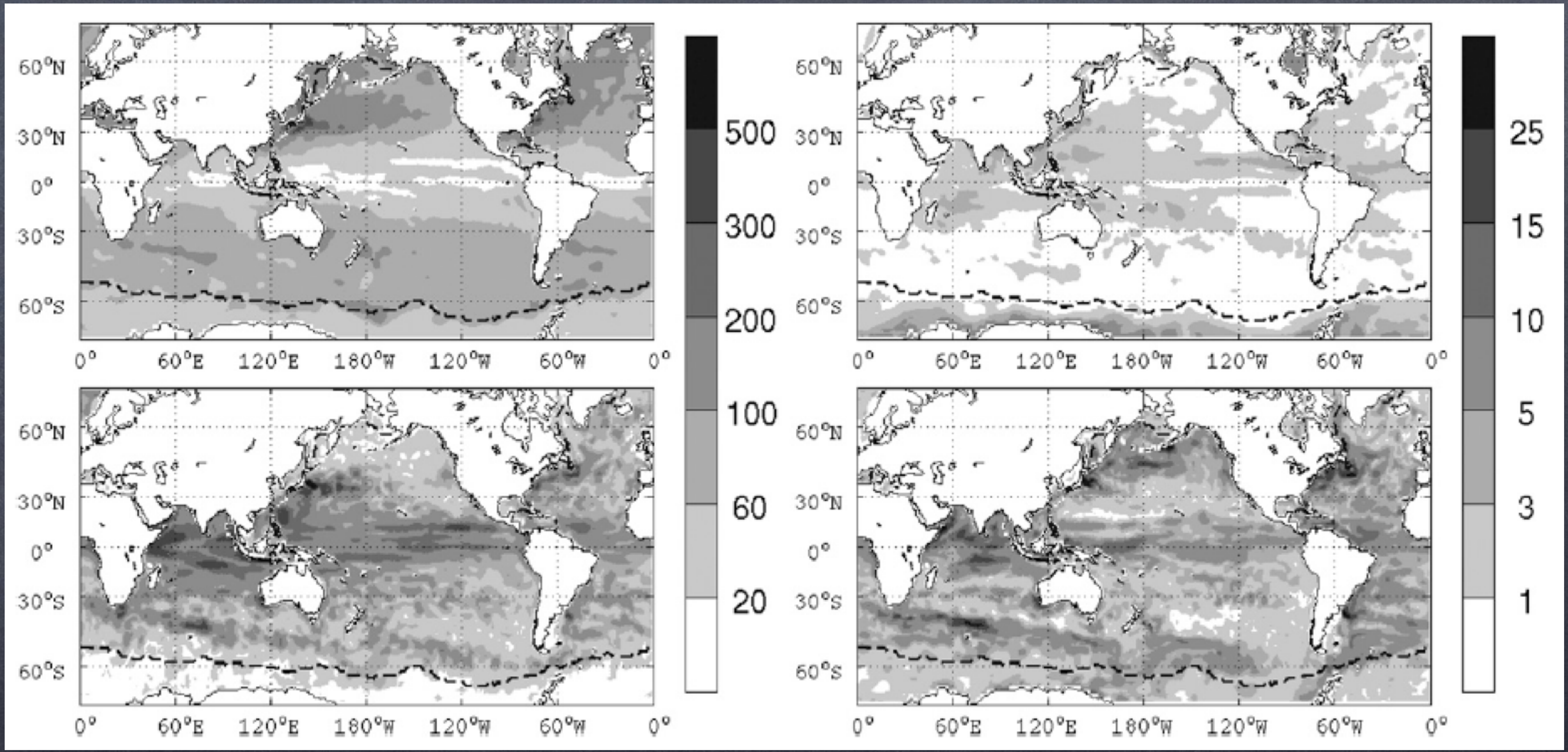
(Forget et al., GMD, 2015)

(1) data interpolation

Through Dynamical Models

surface fluxes

advection, diffusion



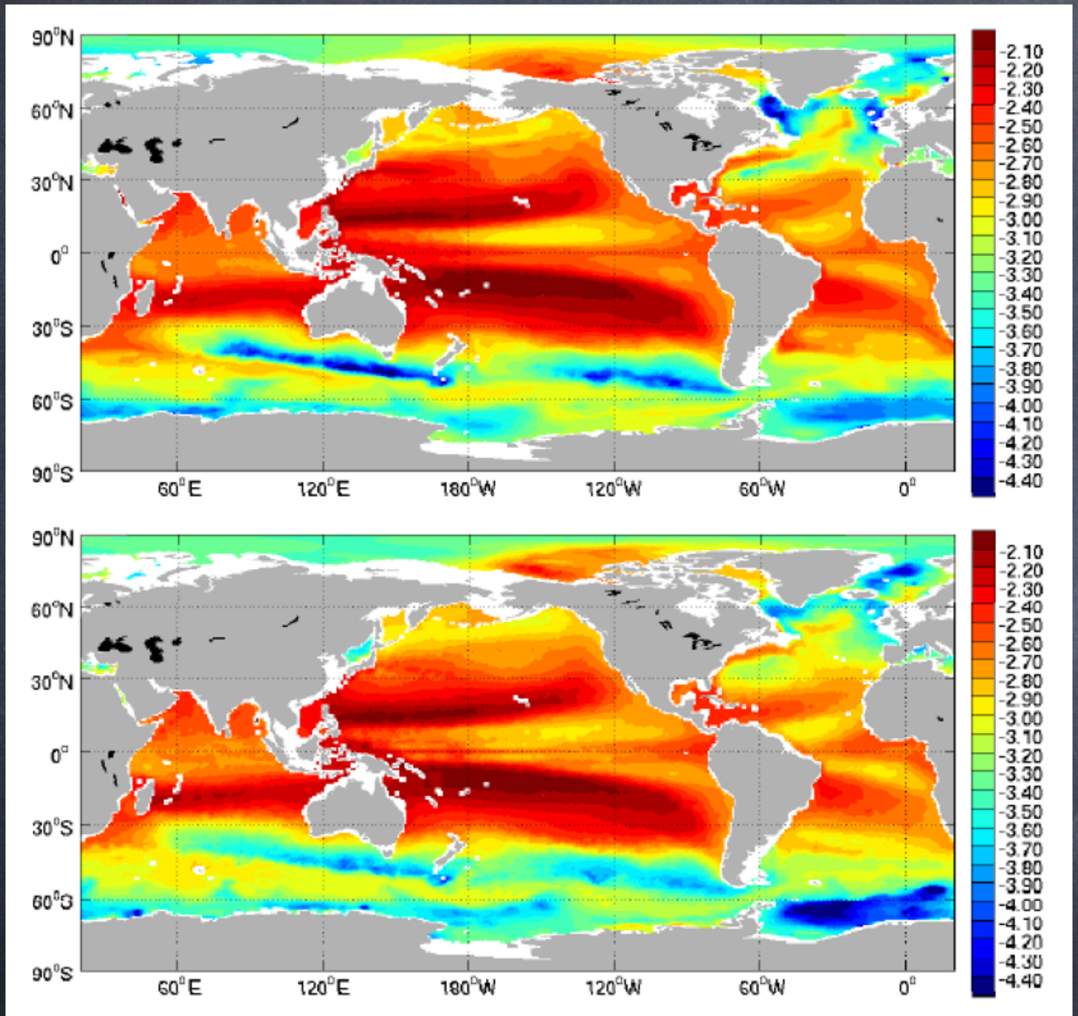
temperature

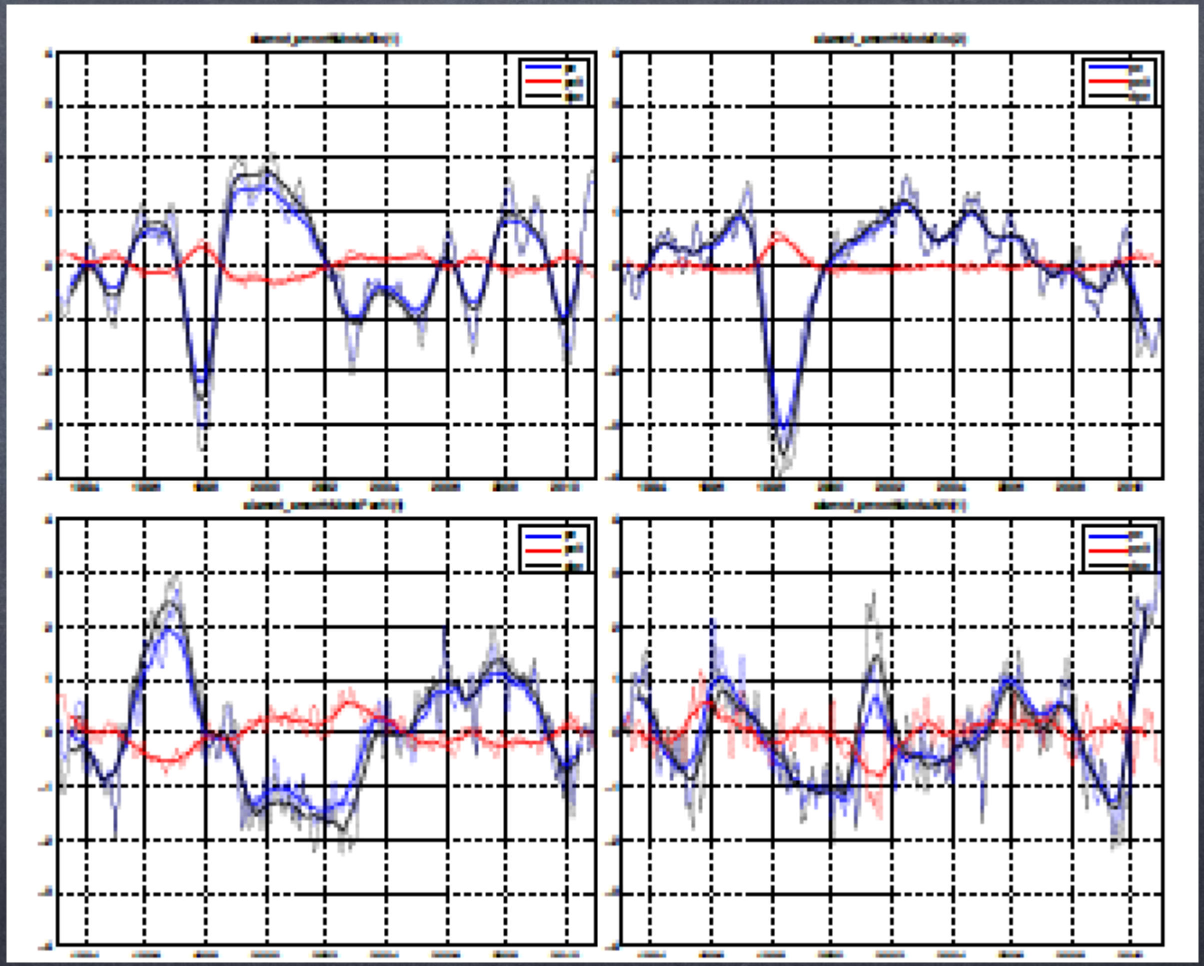
salinity

(Forget 2010)

(1) data interpolation

ECCO: a high-dimensional, multi-variate, curve fitting exercise





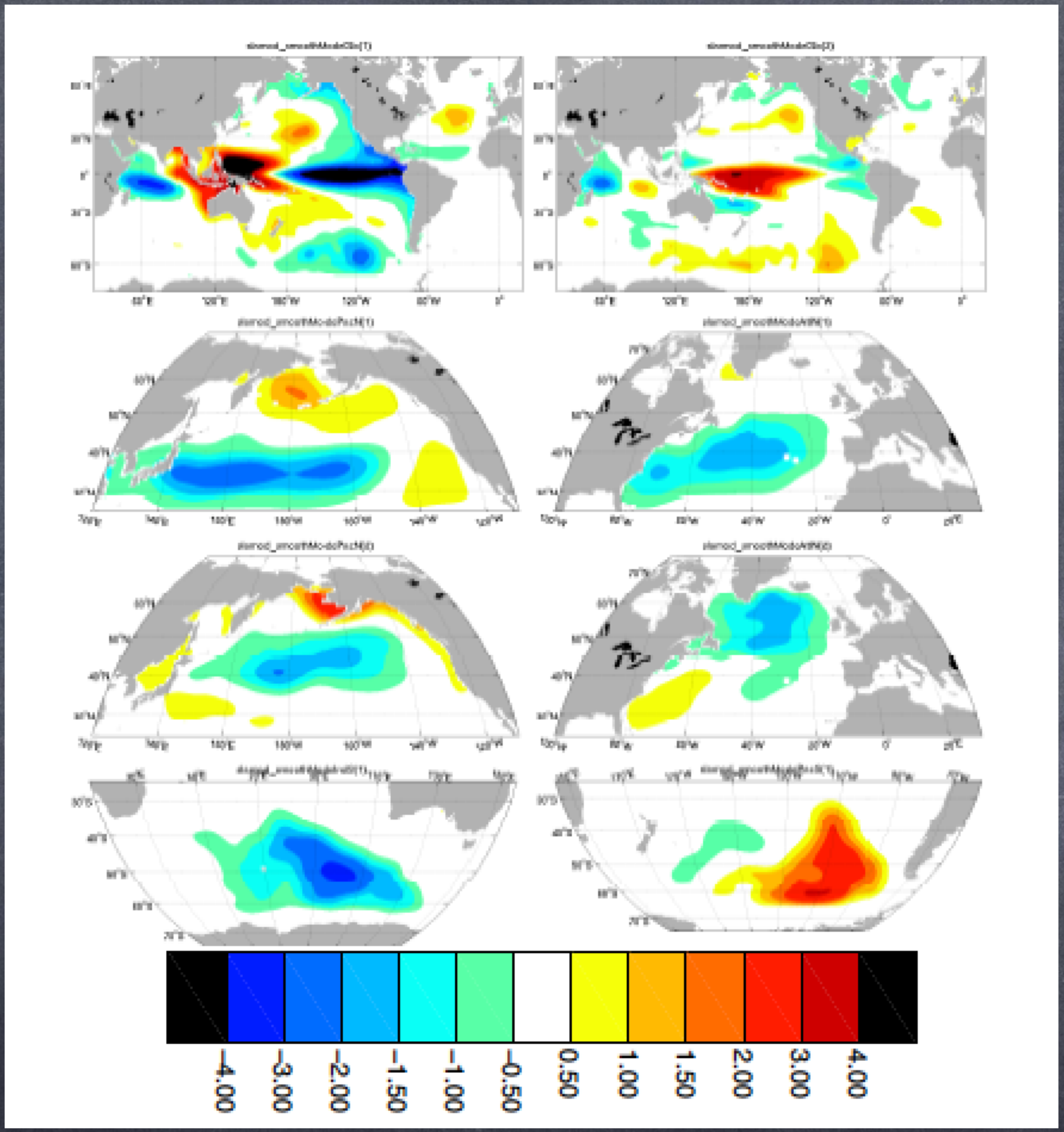
ex. #1: stratification

(Forget et al., OS, 2015)

ex. #2: sea level variability

(Forget and Ponte 2015)

(2) example applications



Statistical decomposition, etc.

(Forget and Ponte 2015)

(2) example applications

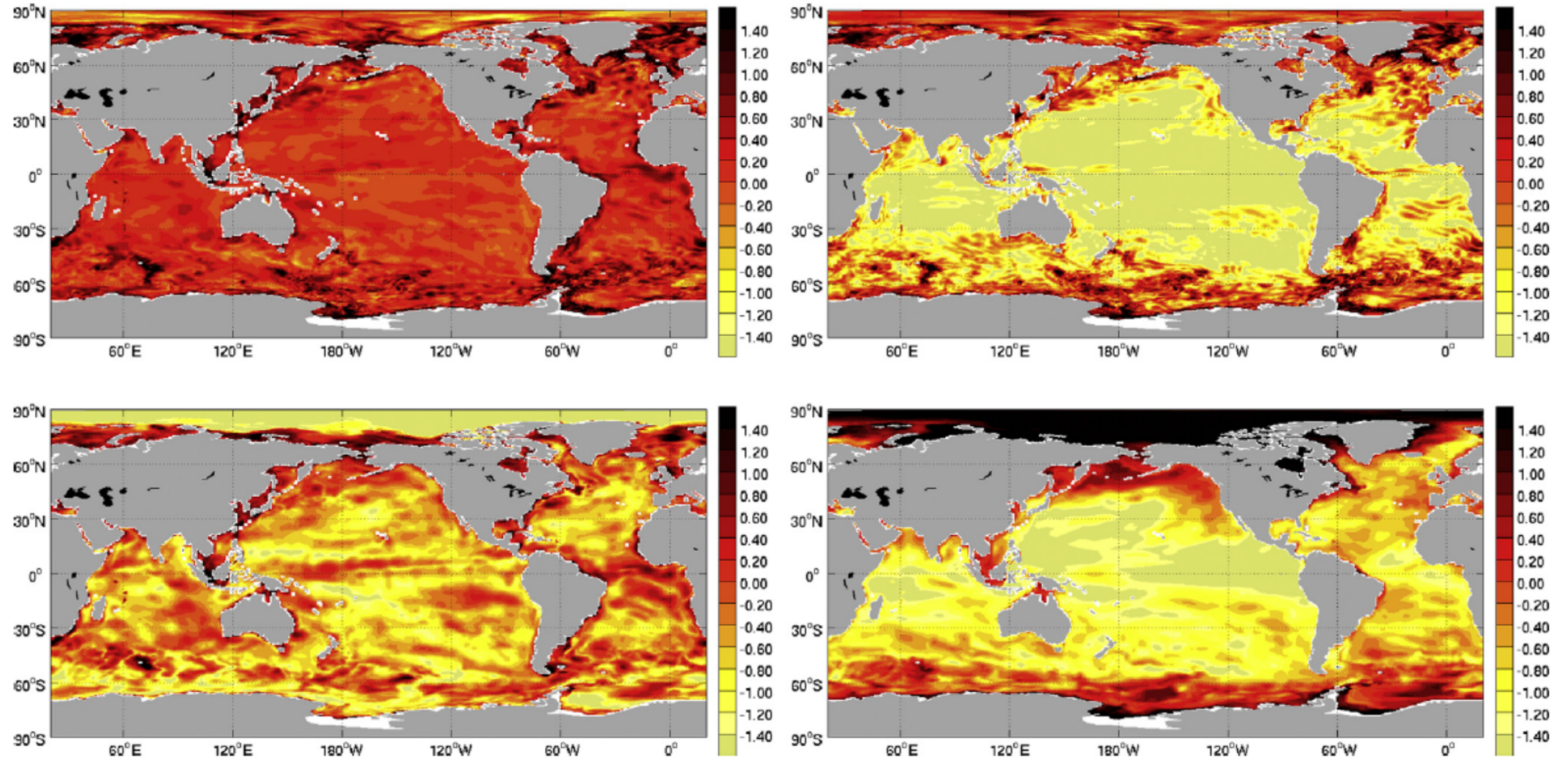


Fig. 18. Interannual ζ_ρ variance contributions diagnosed from the state estimate hydrostatic pressure budget (see Appendix F for details and notations). Top left: $\log\left(\frac{\mathcal{V}[\zeta_T^a]}{\mathcal{V}[\zeta_T]}\right)$ where $\mathcal{V}$ denotes interannual variance. Top right: $\log\left(\frac{\mathcal{V}[\zeta_T^d]}{\mathcal{V}[\zeta_T]}\right)$. Bottom left: $\log\left(\frac{\mathcal{V}[\zeta_T^f]}{\mathcal{V}[\zeta_T]}\right)$. Bottom right: $\log\left(\frac{\mathcal{V}[\zeta_S]}{\mathcal{V}[\zeta_T]}\right)$.

Budgets analyses, etc.

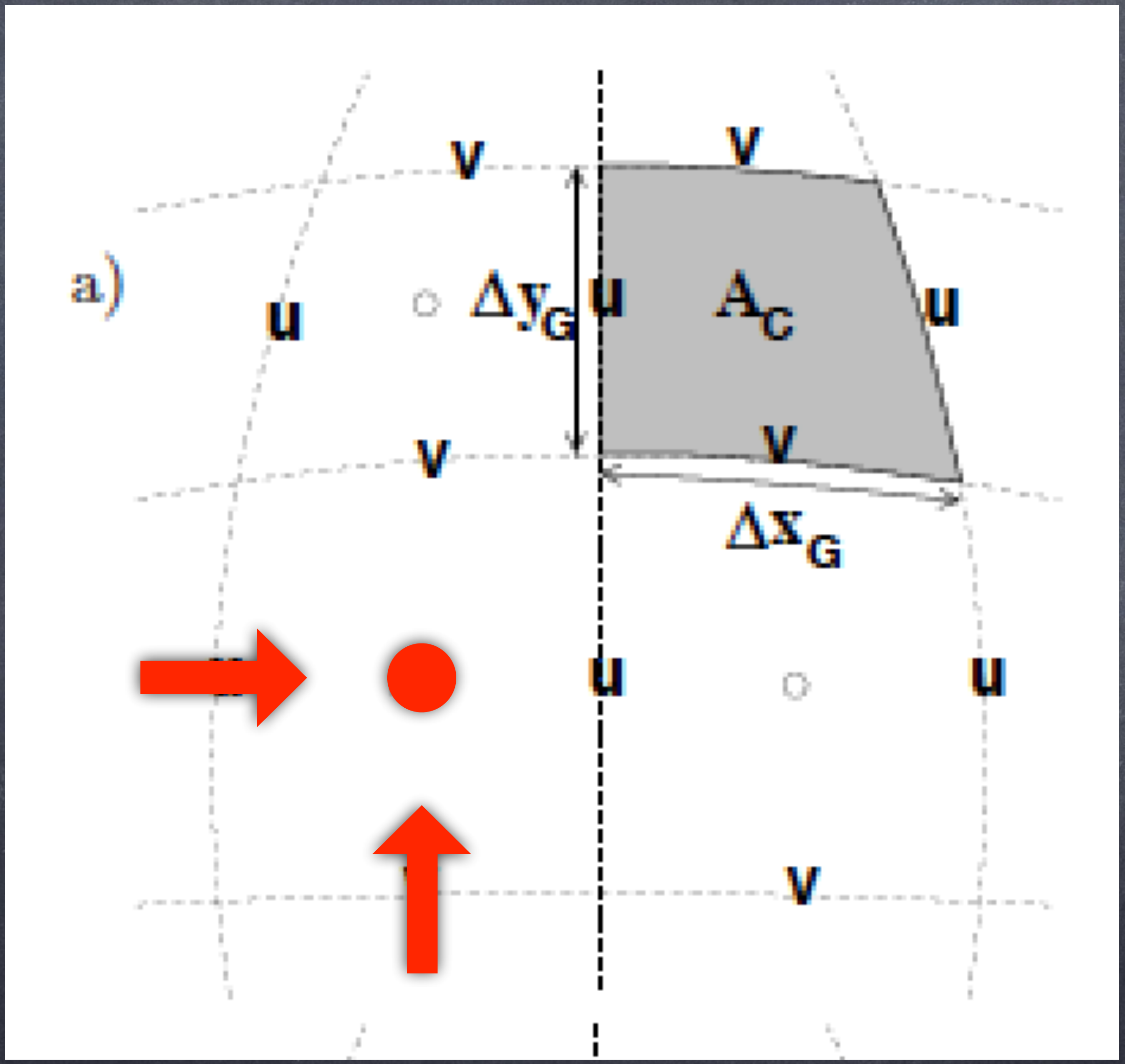
(Forget and Ponte 2015)

(3) the gridded earth

the C-Grid discretization

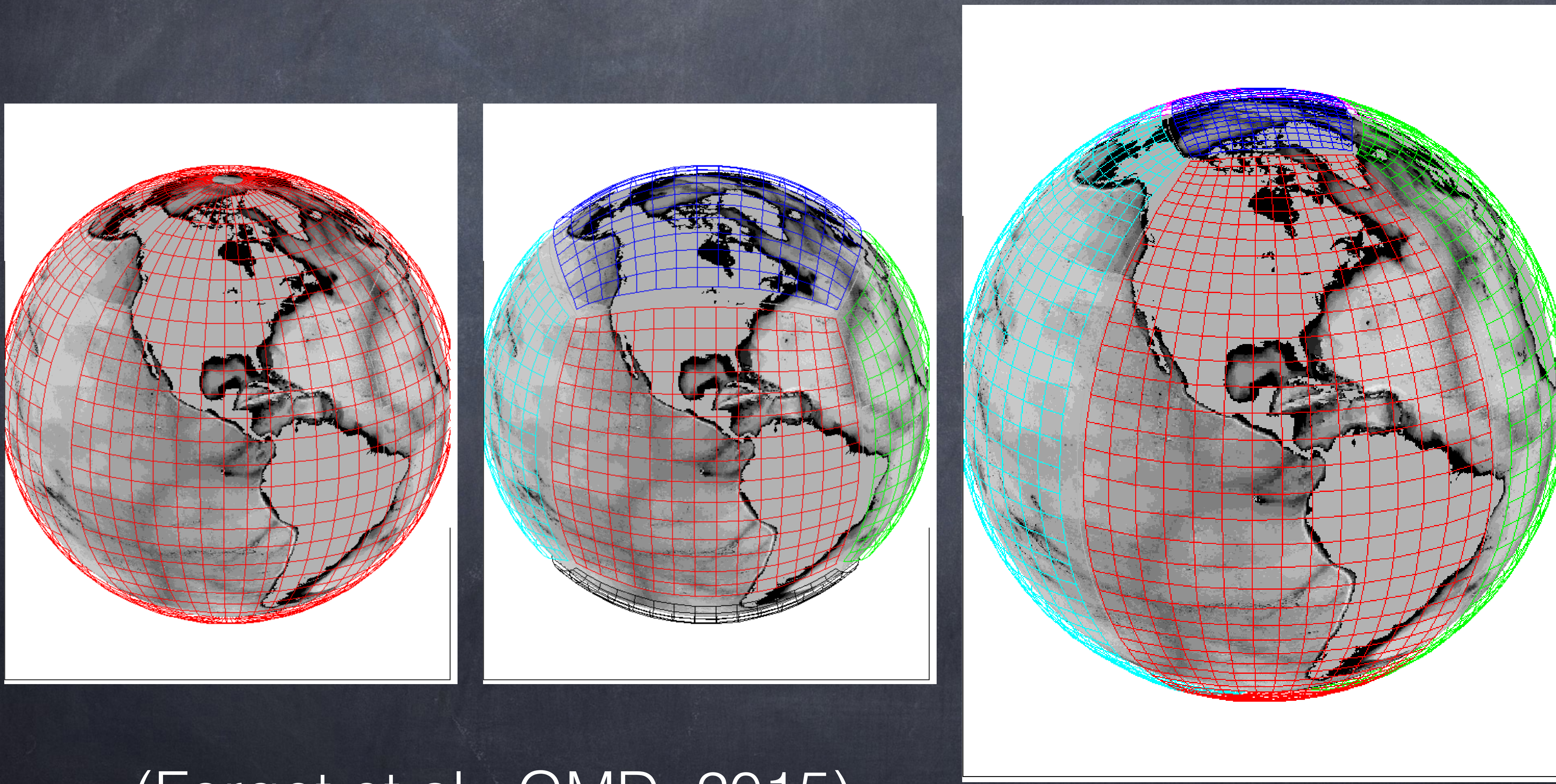
physical variables:
T, U, V, …

grid variables:
DXC, DYC,
RAC,
DXG,DYG,
…



(MITgcm documentation)

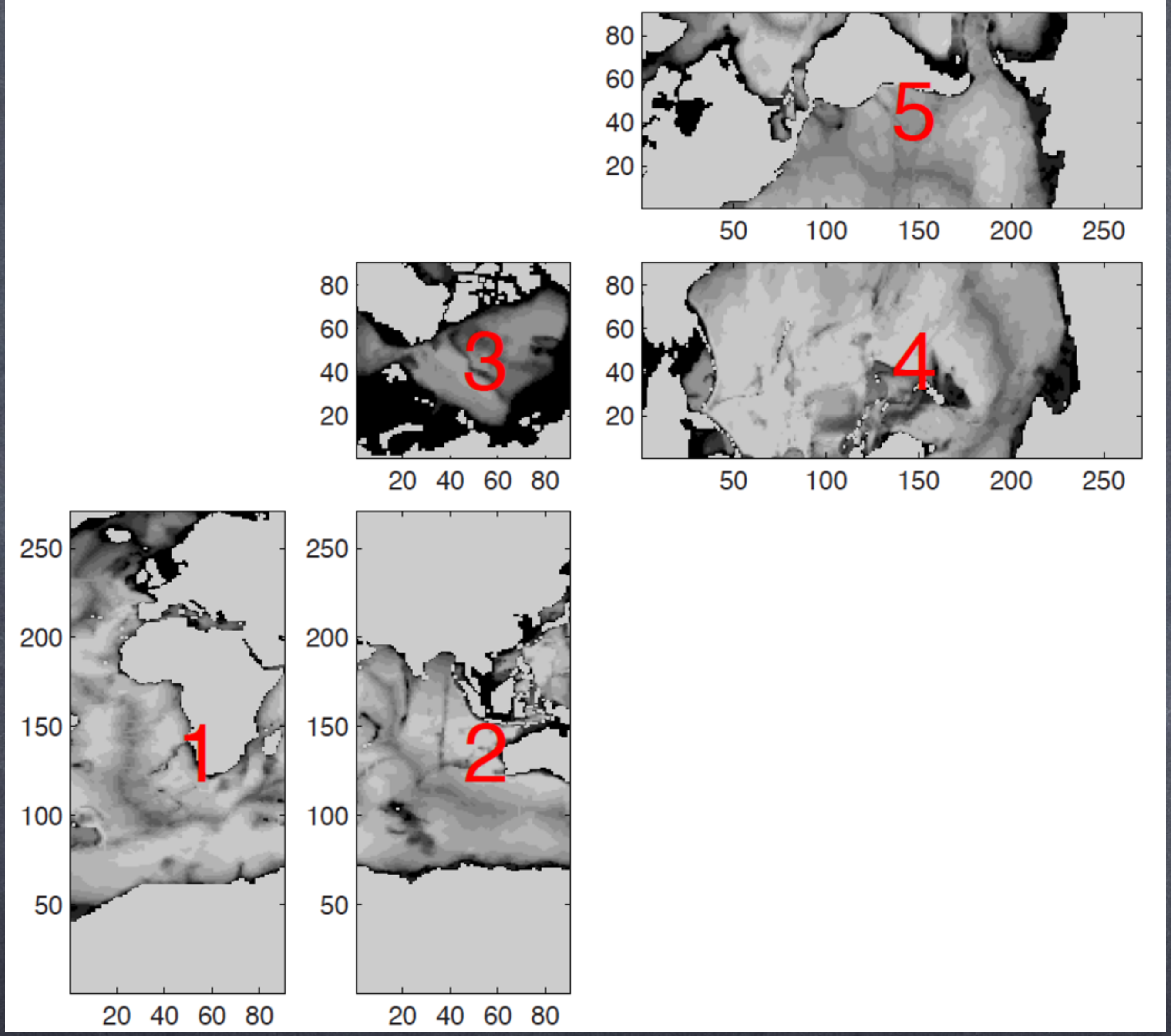
(3) the gridded earth



(Forget et al., GMD, 2015)

ECCO v4 grid

(3) the gridded earth



Computer representation

(3) the gridded earth

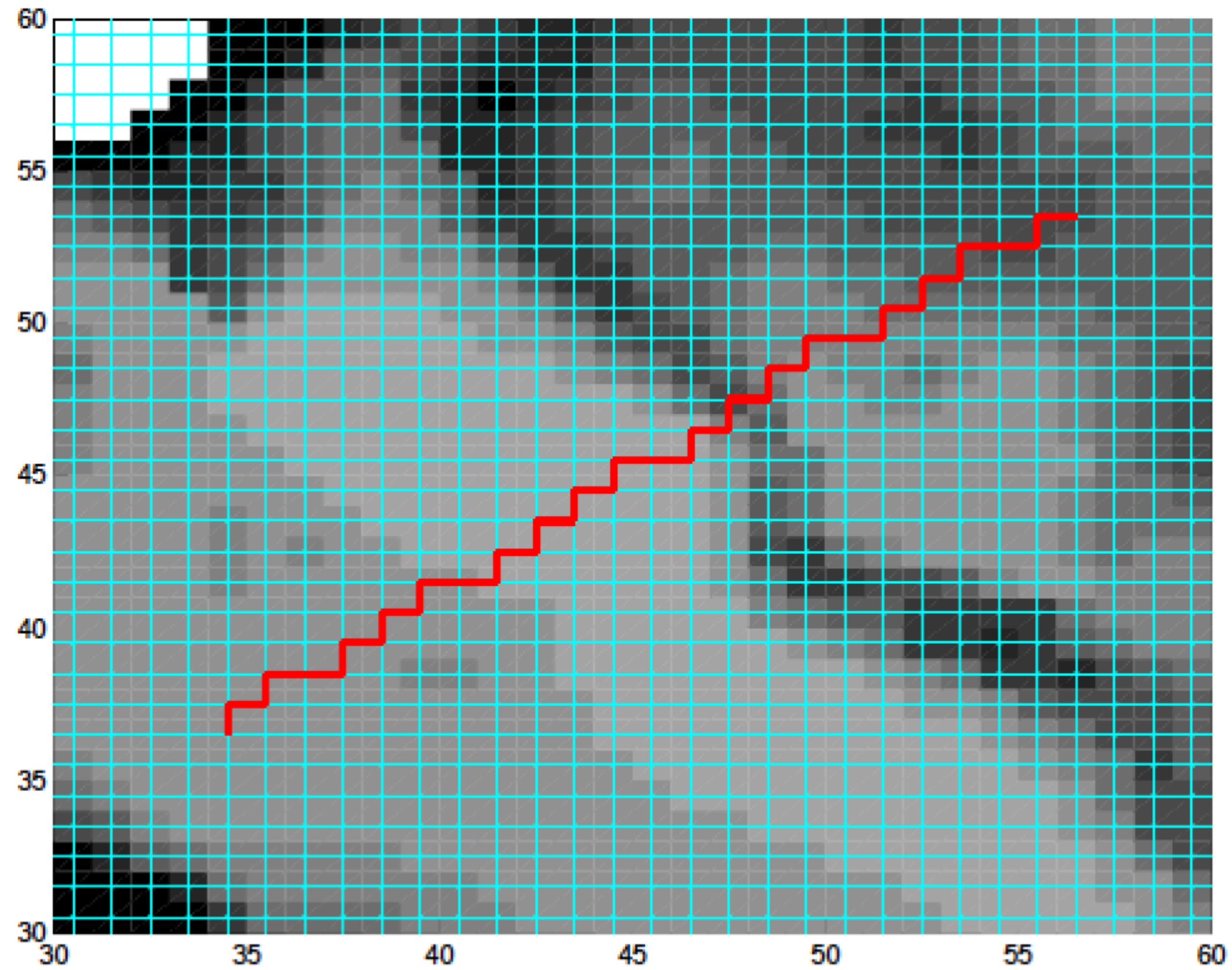
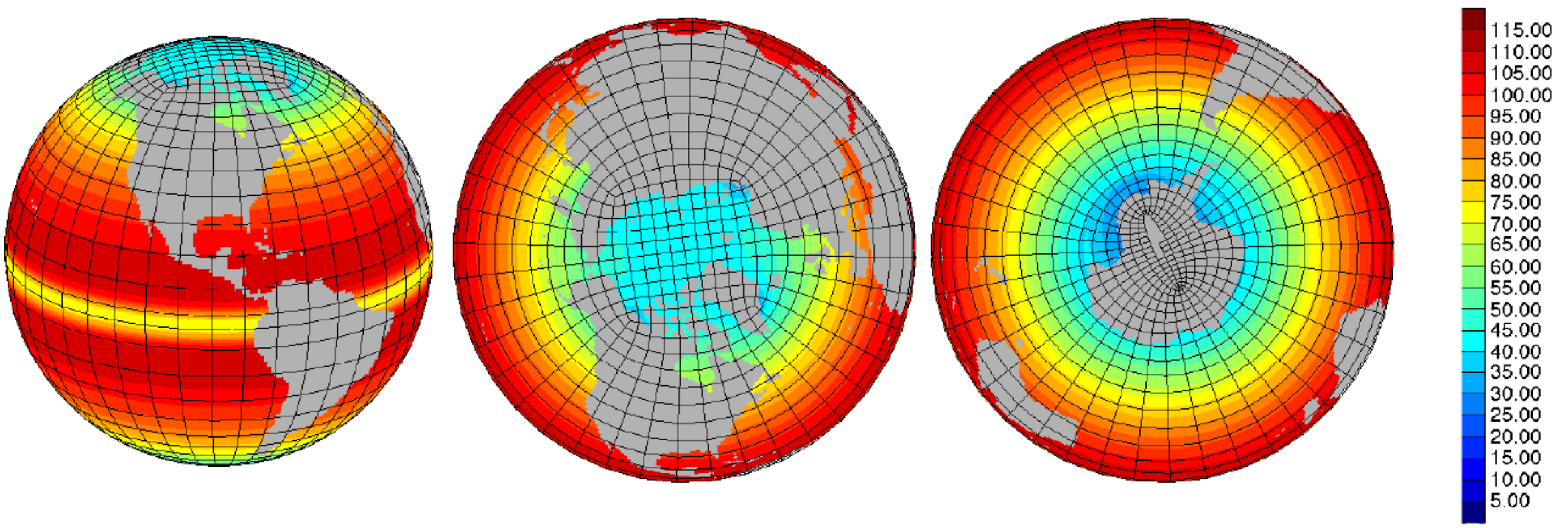


Figure 13: Example of a grid line path (in red) that approximates a transect between 45E-85N and 135W-85N. Location : central part of face 3 from Fig.12. Shading : ocean bottom depth. Blue lines : grid cell edges.

Computing transports

(in ECCO: DXG,DYG, …)

(3) the gridded earth



Computing averages

(in ECCO: RAC, mskC, …)

(4) activity period

```
fld =
        nFaces:   5
            f1:   [90x270 double]
            f2:   [90x270 double]
            f3:   [90x90 double]
            f4:   [270x90 double]
            f5:   [270x90 double]
```

The gcmfaces Matlab class and framework

(gcmfaces documentation)

(4) activity period

- From session #1 we have temperature time series (a) along one Argo float track and (b) of all float data averaged over a lat-lon box. Now we can add gridded data sets to provide context to the in situ observations.
- The goal of the session #2 activity is to derive from a gridded data set two time series that are comparable with (a) and (b). The ECCO v4 temperature climatology will be taken as an example.

(4) activity period

It is assumed here that Matlab toolboxes and netcdf data sets have been installed according to course-idma2016/guidelines/iap-idma-instructions. For this session, two functions were added in course-idma2016/matlab that will get us started:

- idma_interp_2d.m: interpolates a variable from the ECCO v4 `LLC' grid to a lat-lon grid (or any arbitrary locations).
- idma_area_mean.m: computes an area-weighted average over a lat-lon box (or an arbitrary region defined by a mask).

Open Matlab and load the ECCO v4 grid as explained in course-idma2016/guidelines/iap-idma-instructions, then:

- type `help idma_interp_2d.m' and proceed with its example
- type `help idma_area_mean.m' and proceed with its example