

Le changement océanique

Dr Julie Deshayes



*Institut
Pierre
Simon
Laplace*

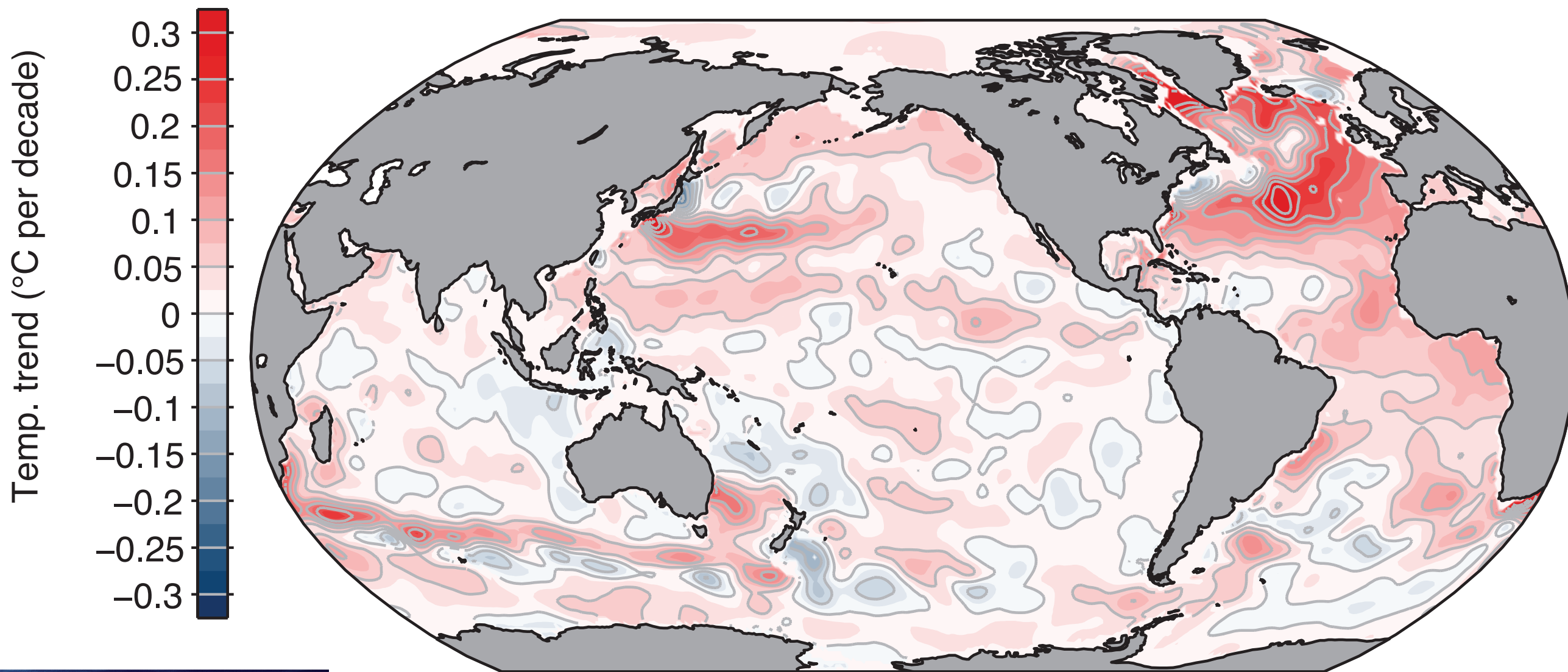
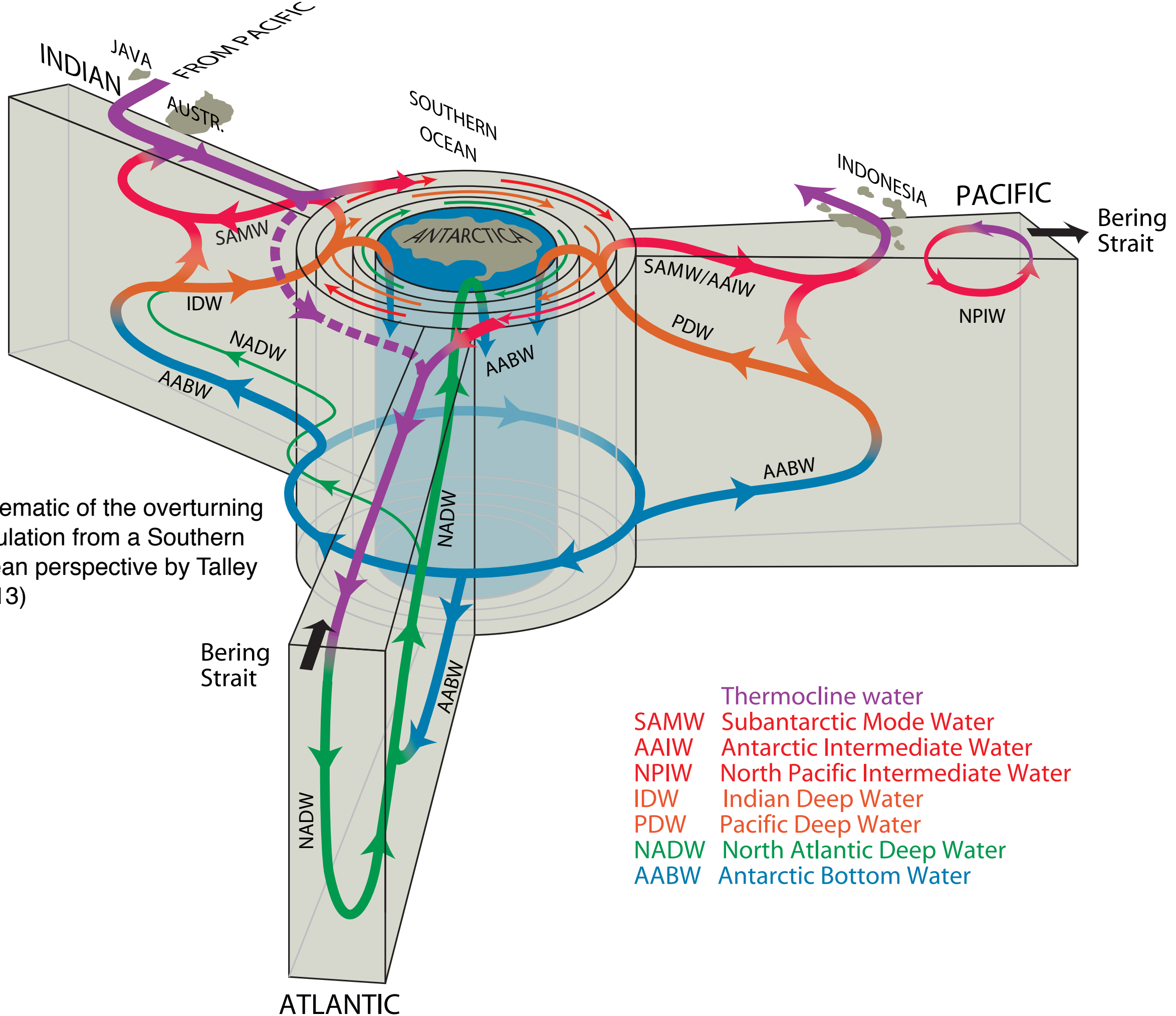


Figure 3.1 : Depth-averaged 0 to 700 m temperature trend for 1971-2010



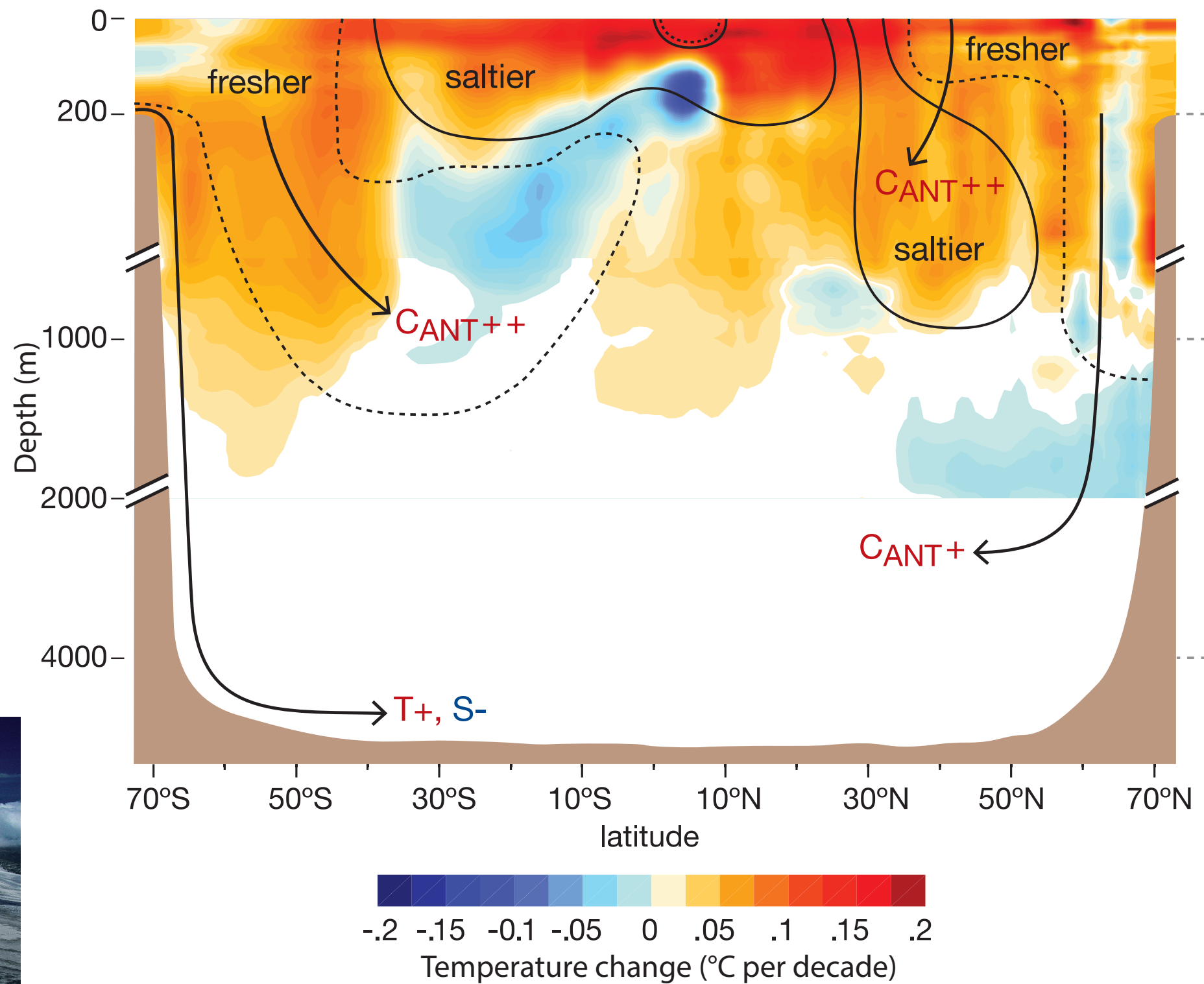


Figure 3.22 : Temperature trends in colour (red = warm- ing, blue = cooling); salinity trends indicated by contour lines (dashed = fresher; solid = saltier).

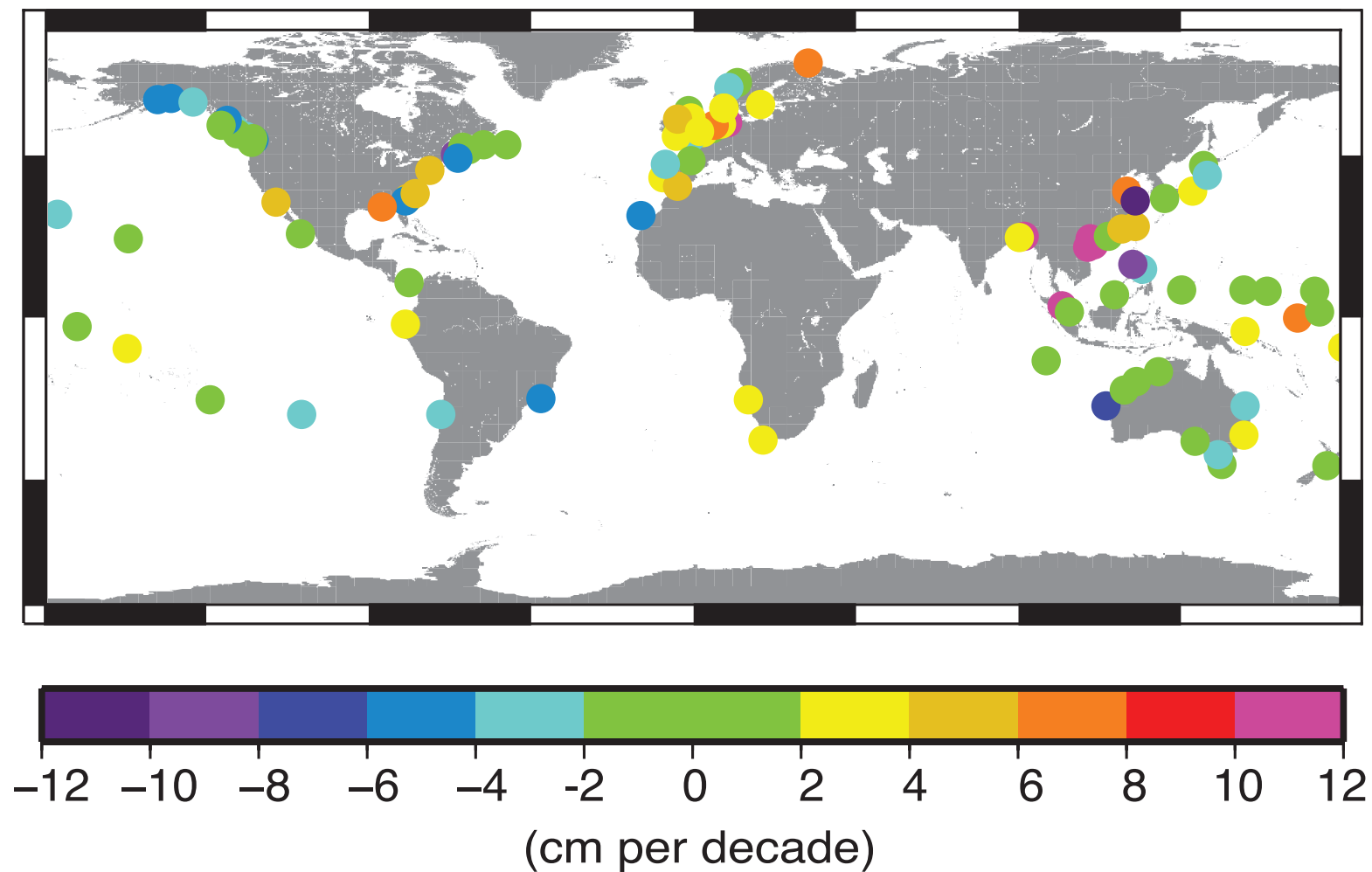
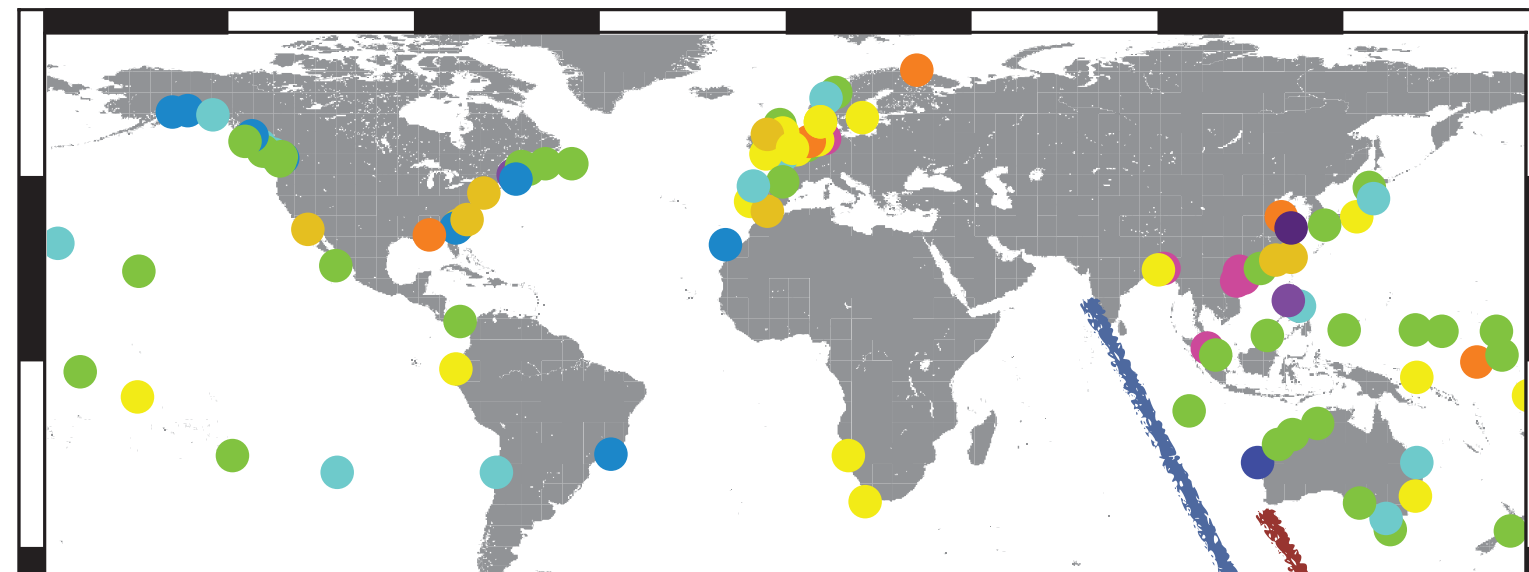


Figure 3.15 : Estimated trends in the height of a extreme sea level. Only trends significant at the 95% confidence level are shown.



-12 -10

Figure
Only t

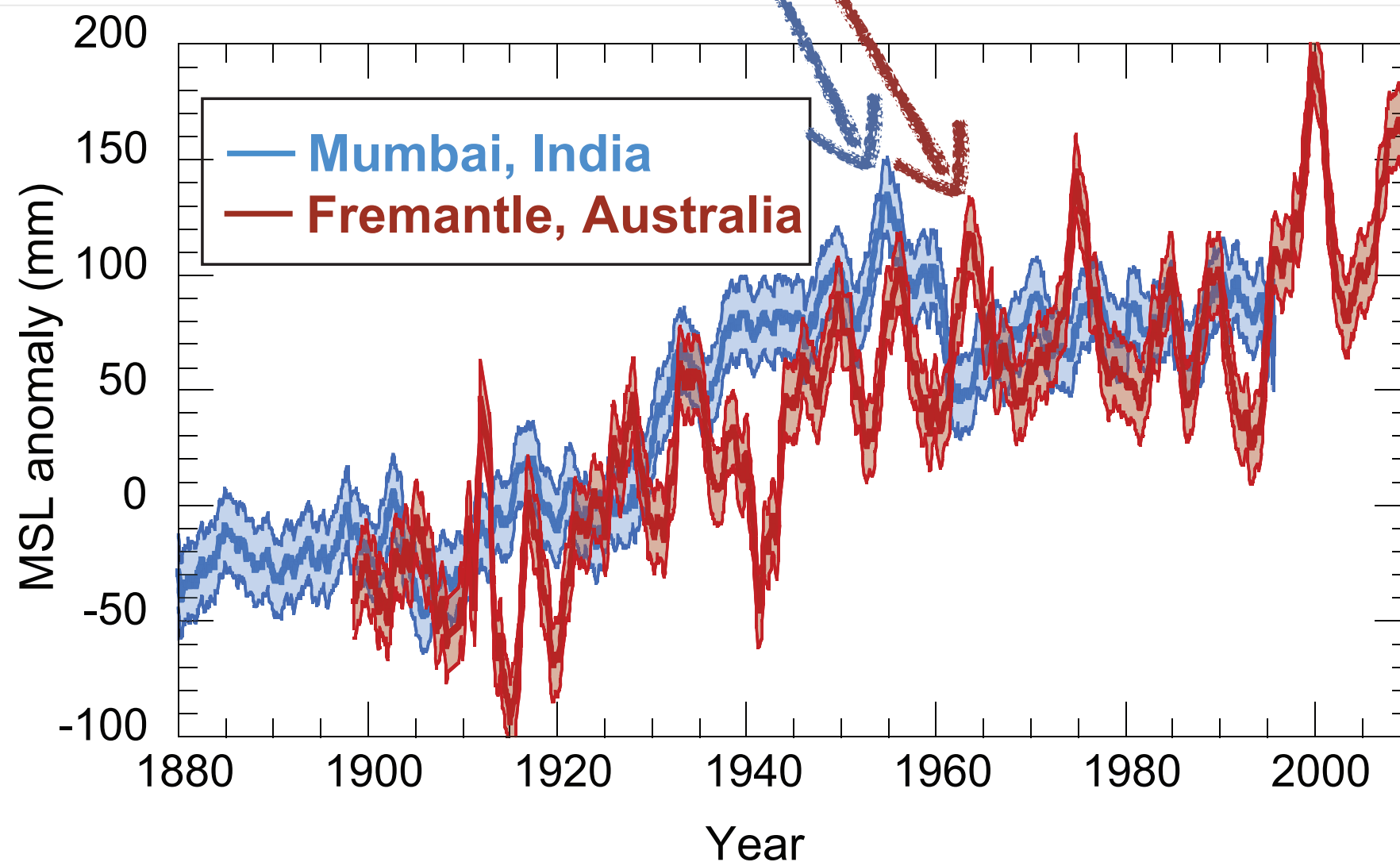
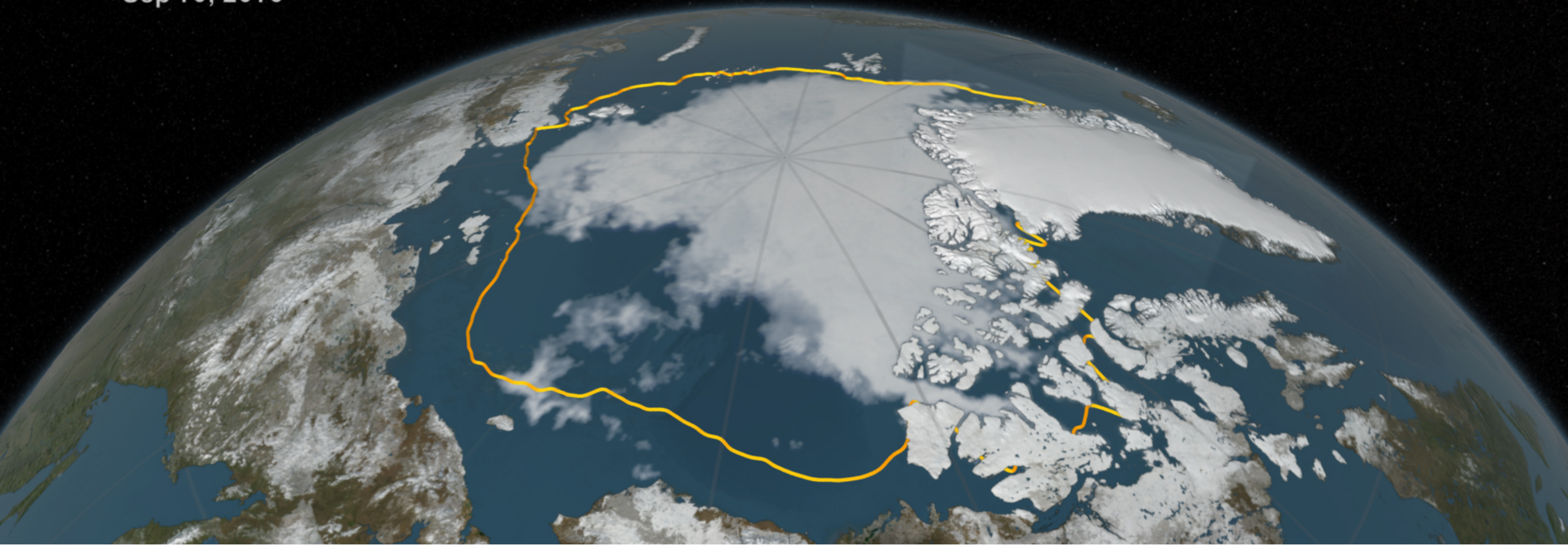
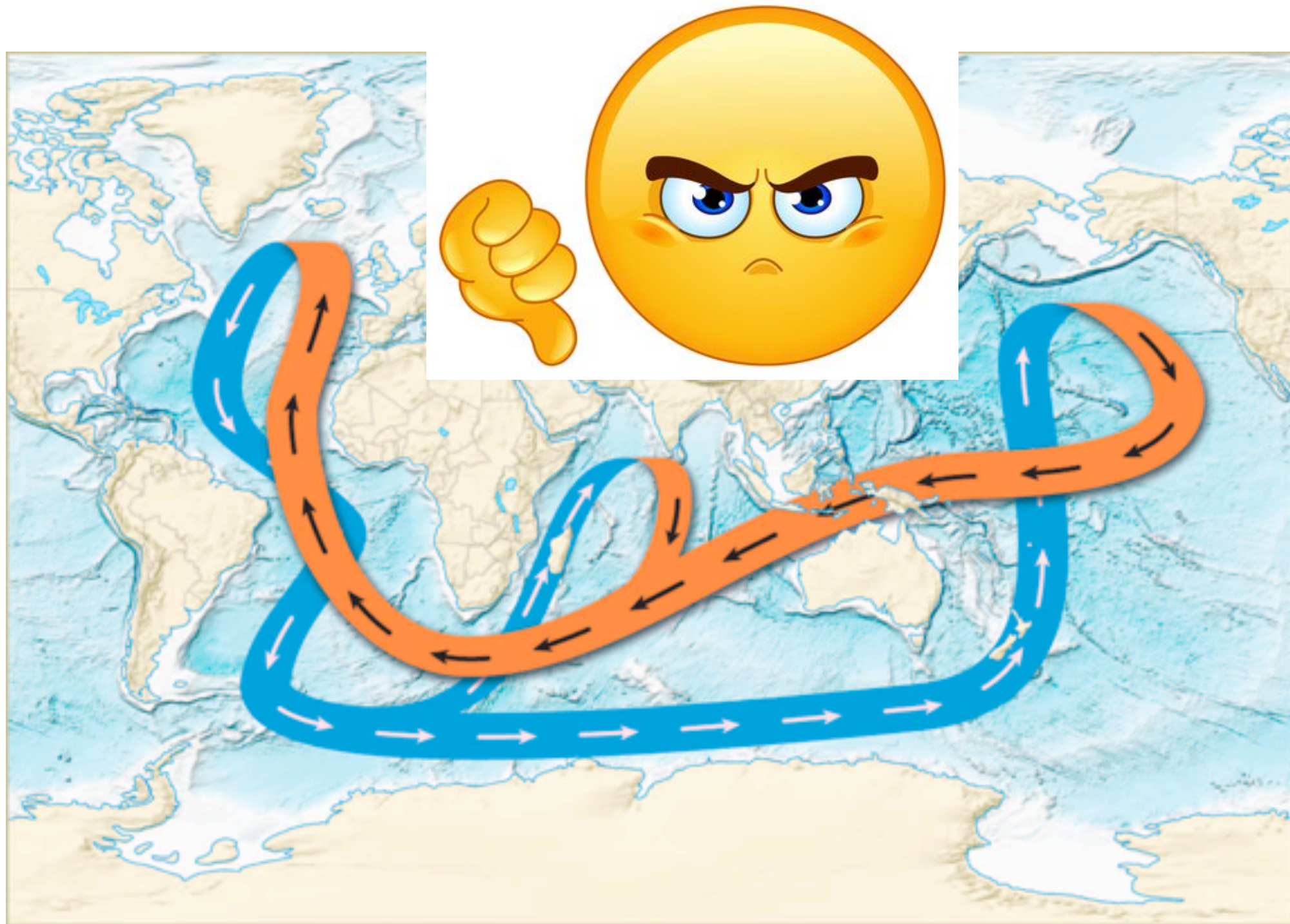


Figure 3.12 : 3-year running mean sea level anomalies relative to 1900–1905 from long tide gauge records. Error bars reflect the 5 to 95% confidence interval, based on the residual monthly variability about the 3-year running mean.

couverture estivale moyenne pour la periode 1981-2010

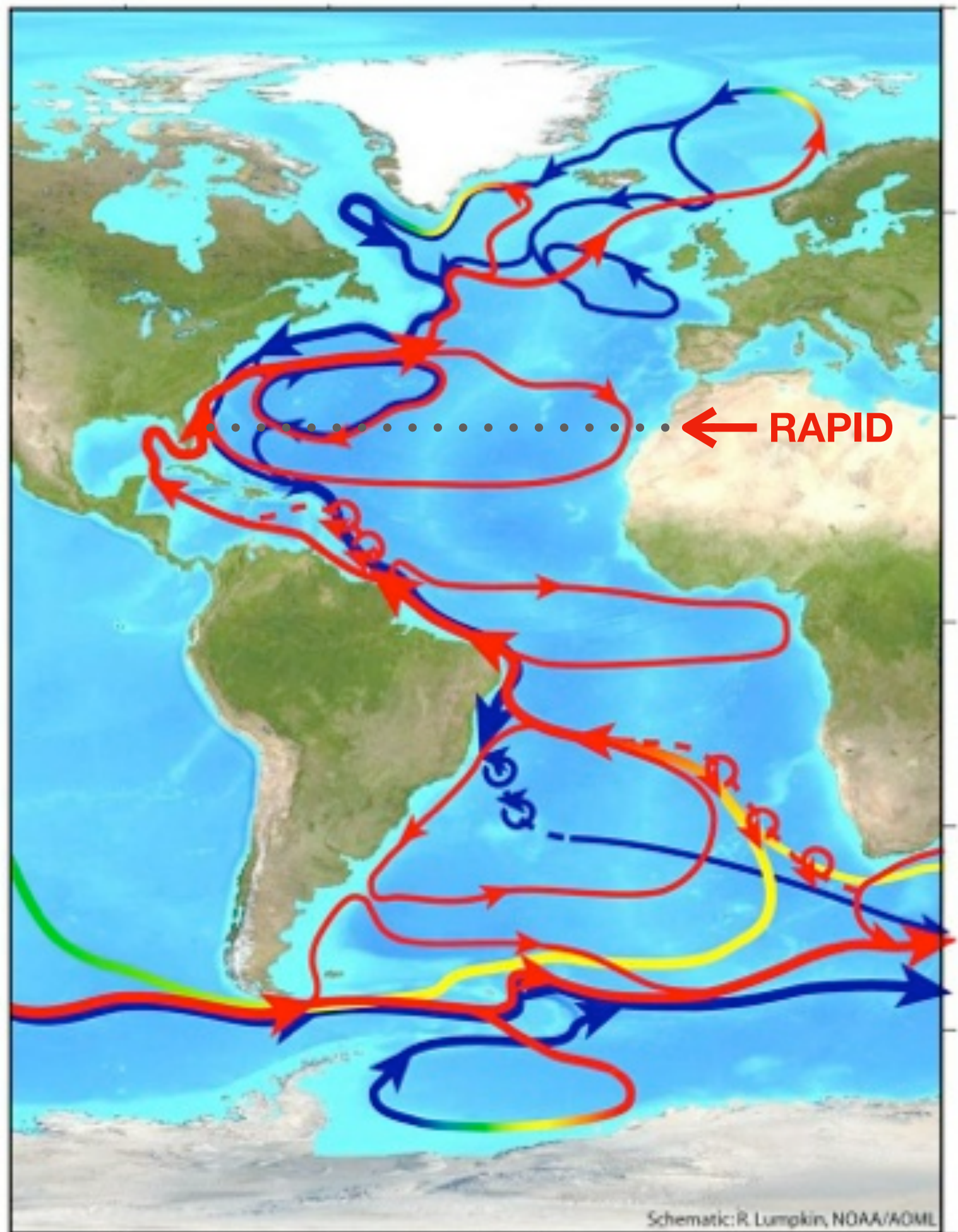
Sep 10, 2016



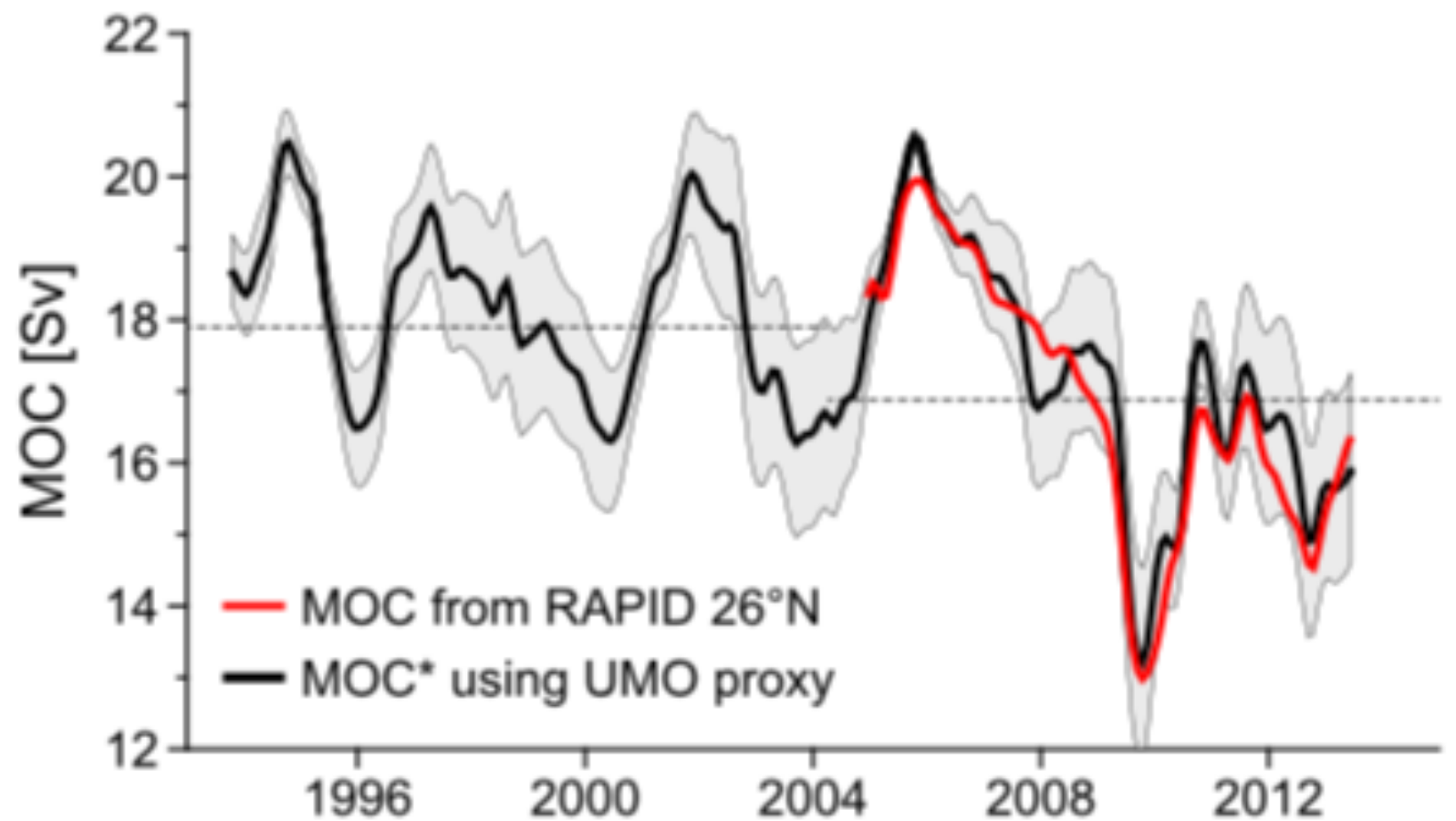


S. Lozier : “the ocean’s overturning limbs
are not spatially and temporally continuous”

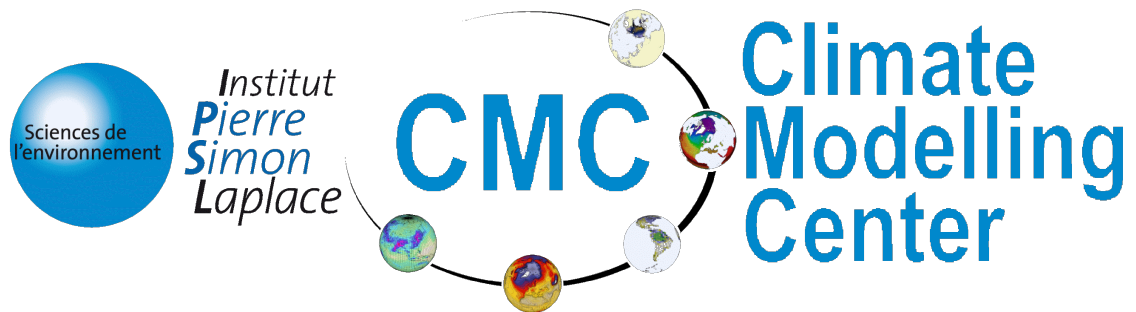
représentation schématique
de la circulation de
retournement dans
l'Atlantique Nord
(rouge = en surface,
bleu = en profondeur)



mesures directes (rouge) et reconstruction (noir) de la circulation de retournement dans l'Atlantique Nord (tiré de Frajka-Williams, 2015)

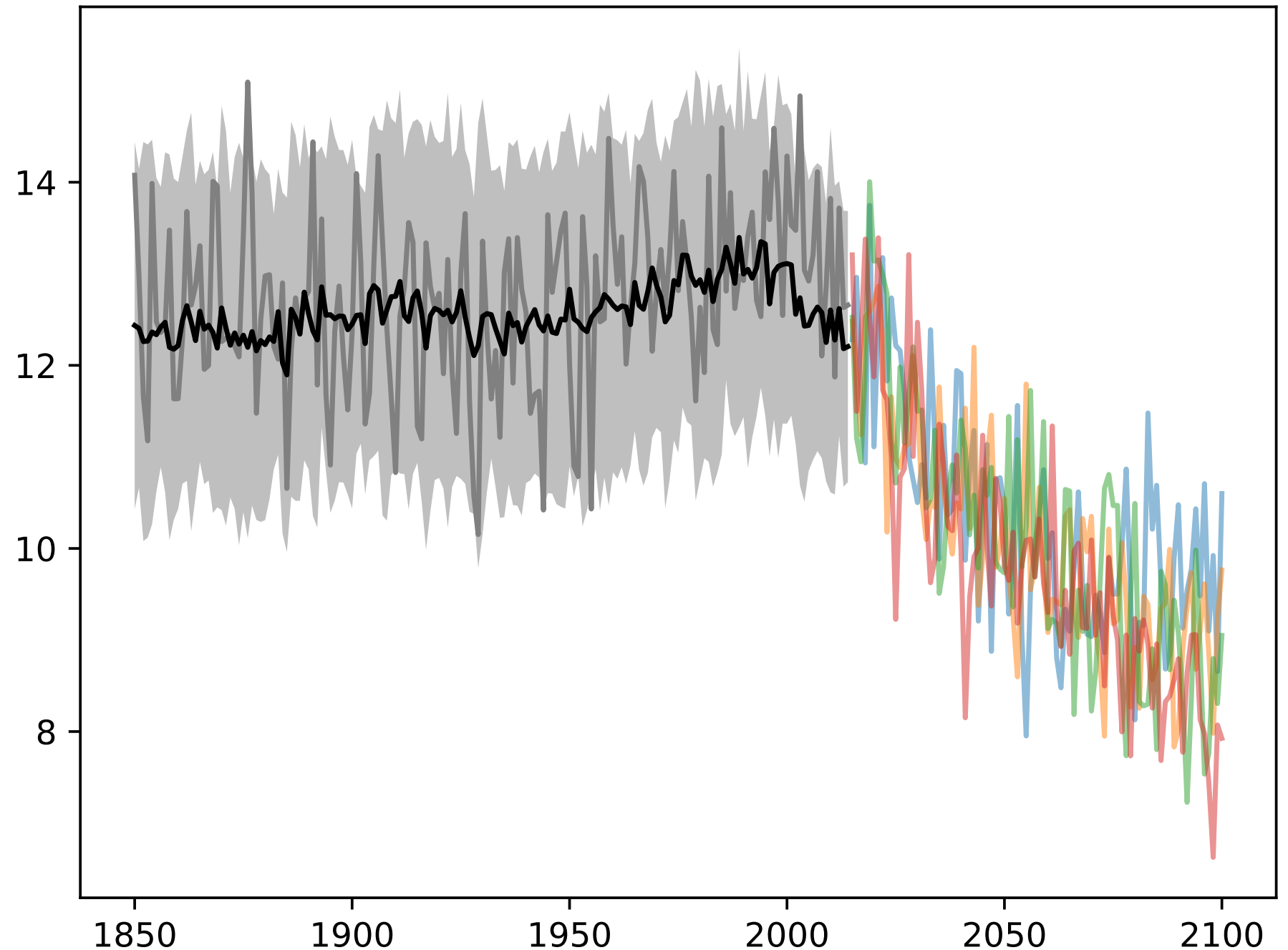


CMIP6 IPSL-CM6A-LR

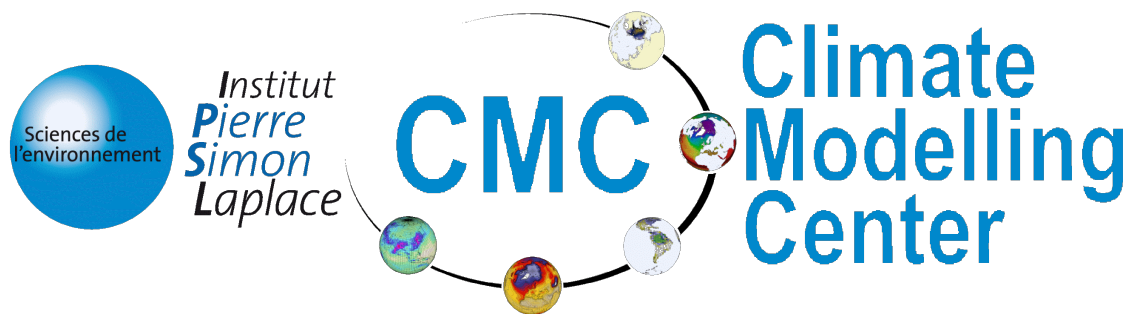


intensité de la
circulation de
retournement dans
l'Atlantique Nord

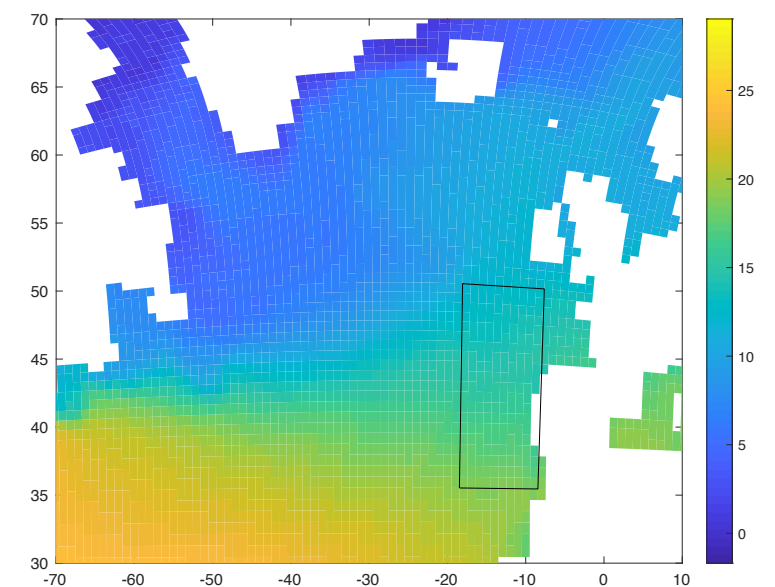
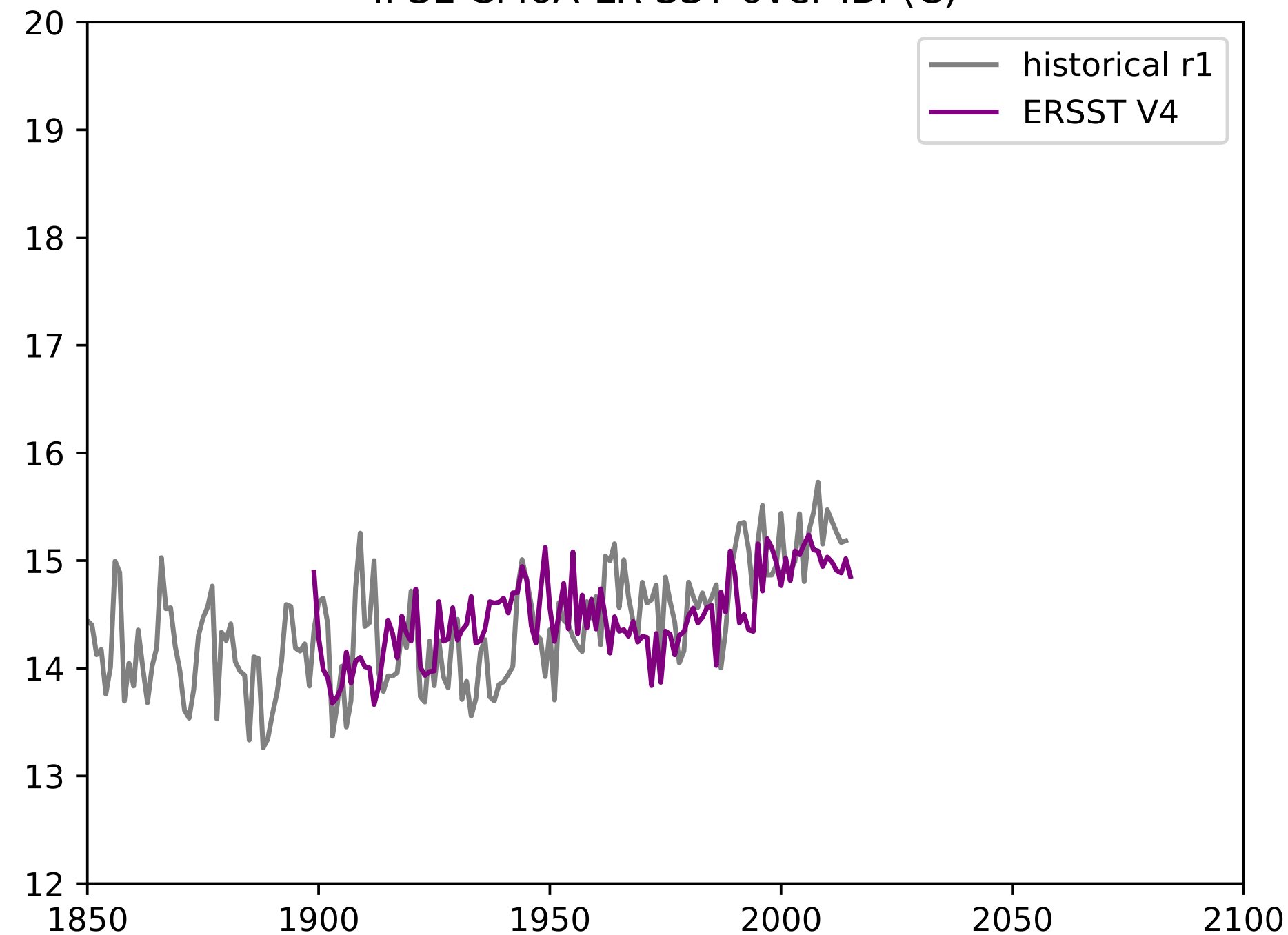
AMOC at 26N in Atlantic (Sv)



CMIP6 IPSL-CM6A-LR

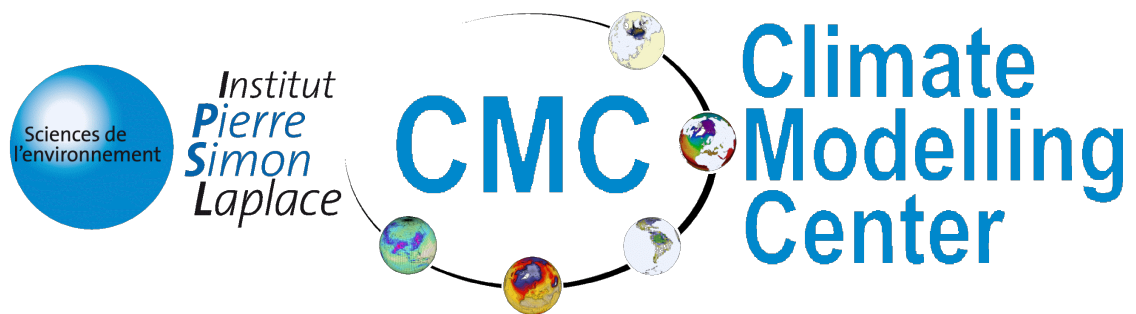


IPSL-CM6A-LR SST over IBI (C)

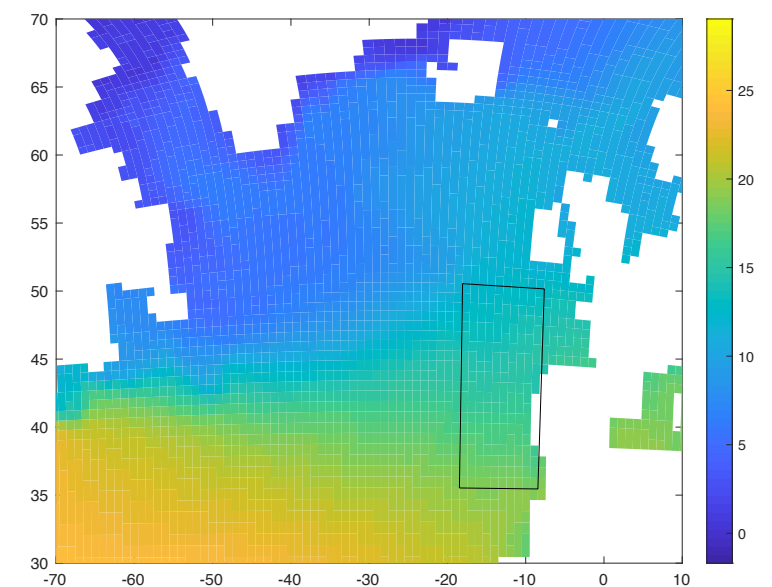
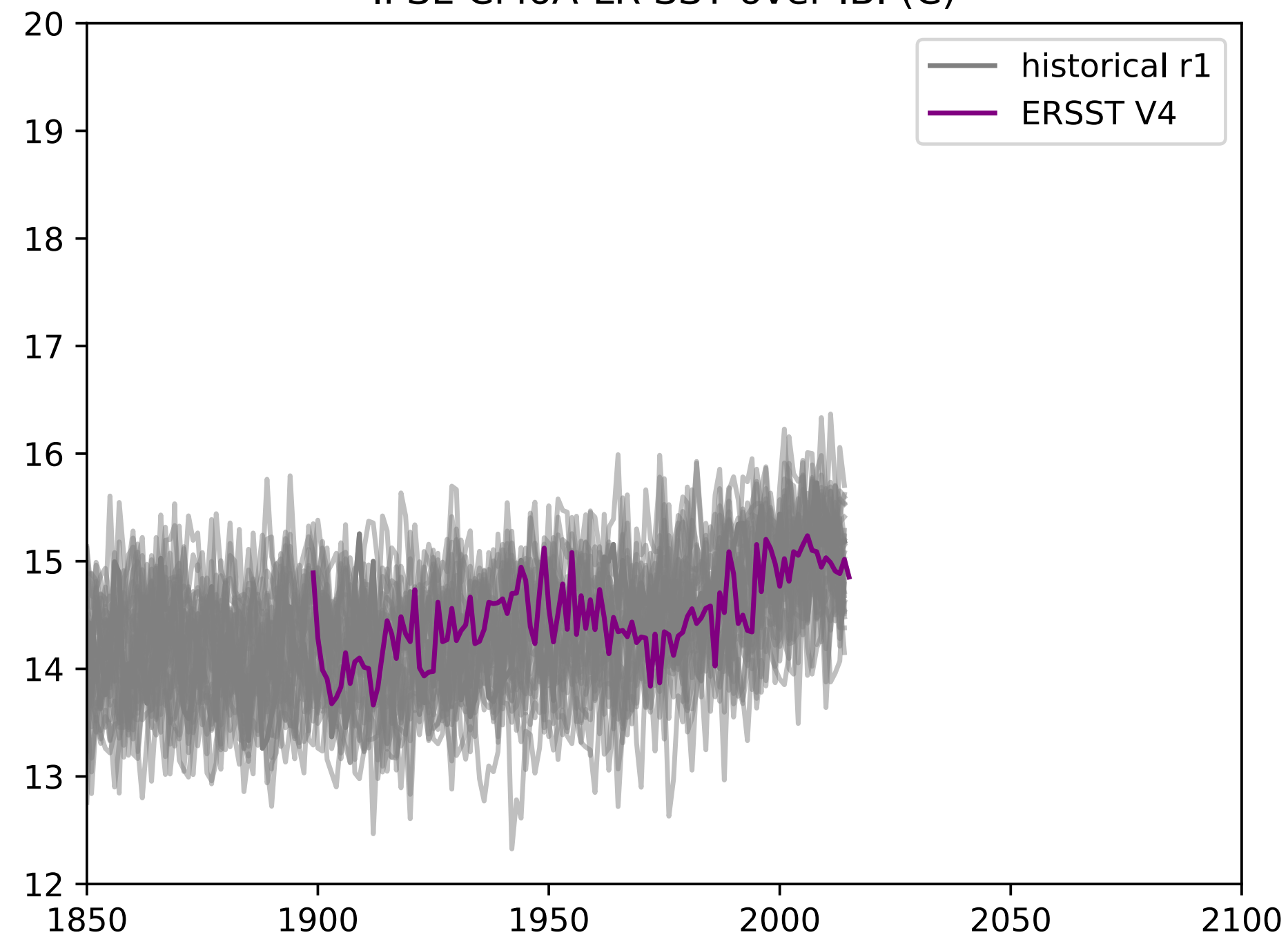


température de
surface de l'océan
dans la boîte noire

CMIP6 IPSL-CM6A-LR

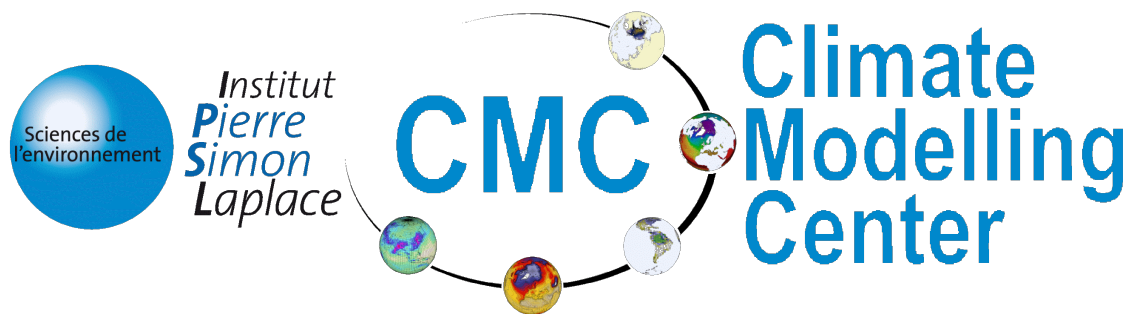


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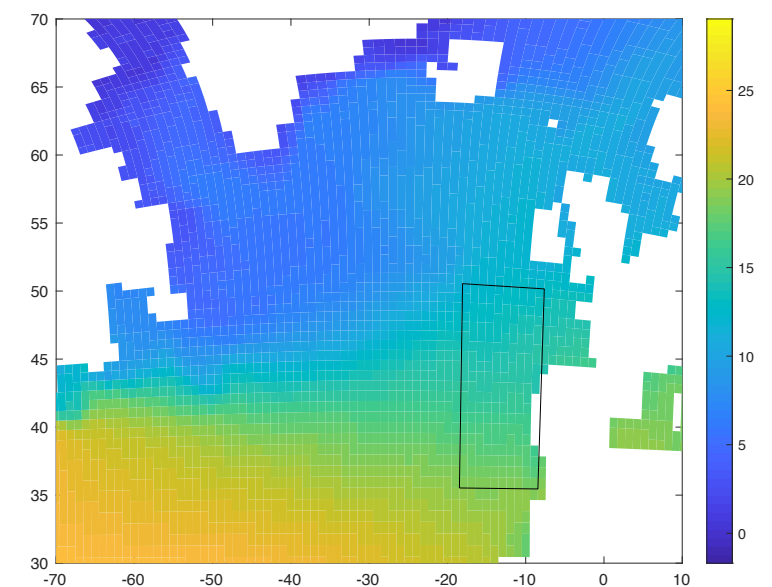
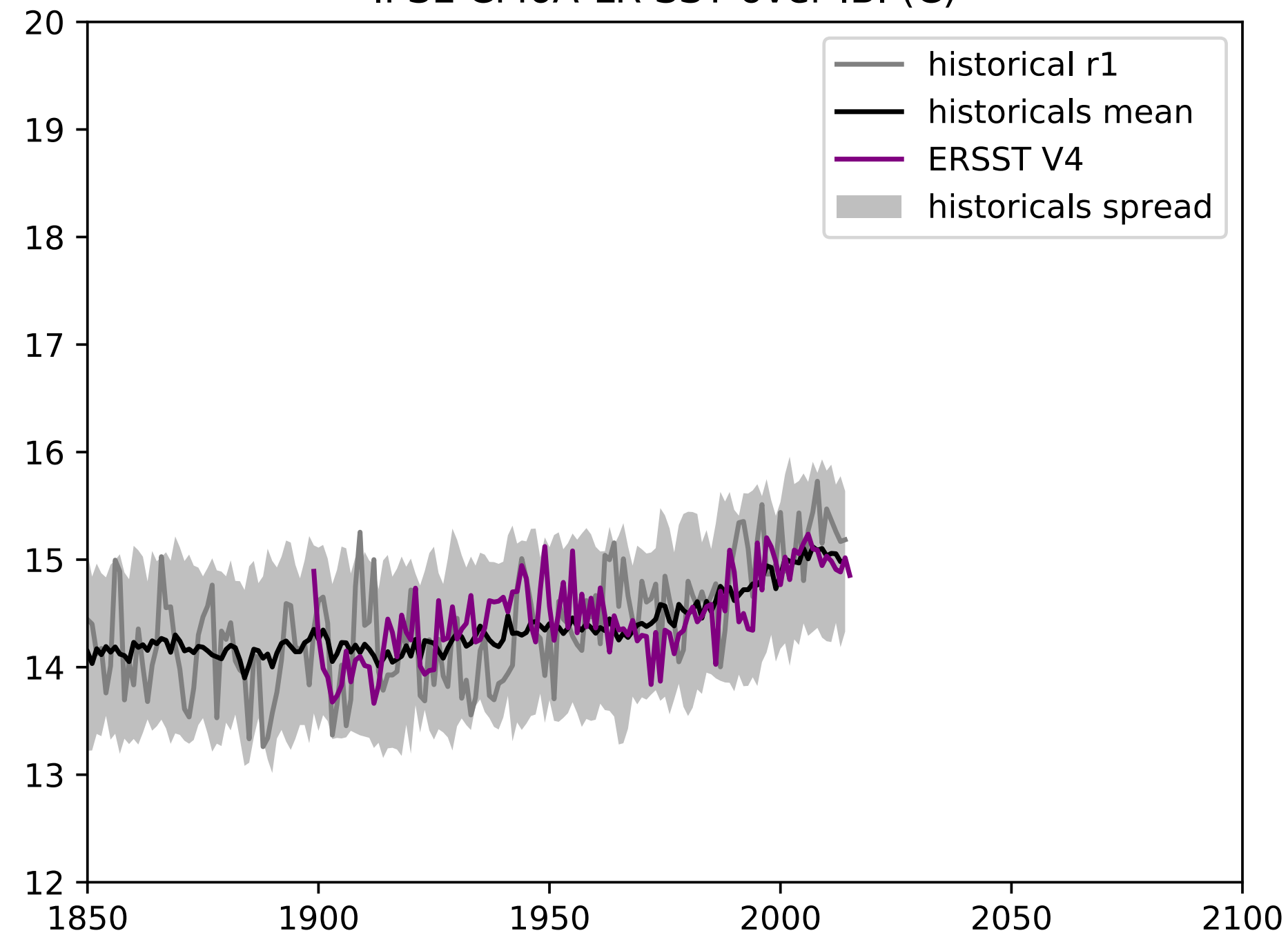


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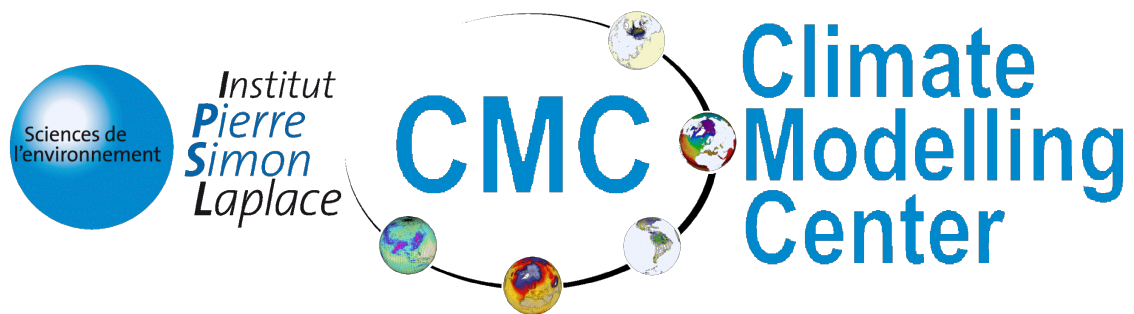


IPSL-CM6A-LR SST over IBI (C)

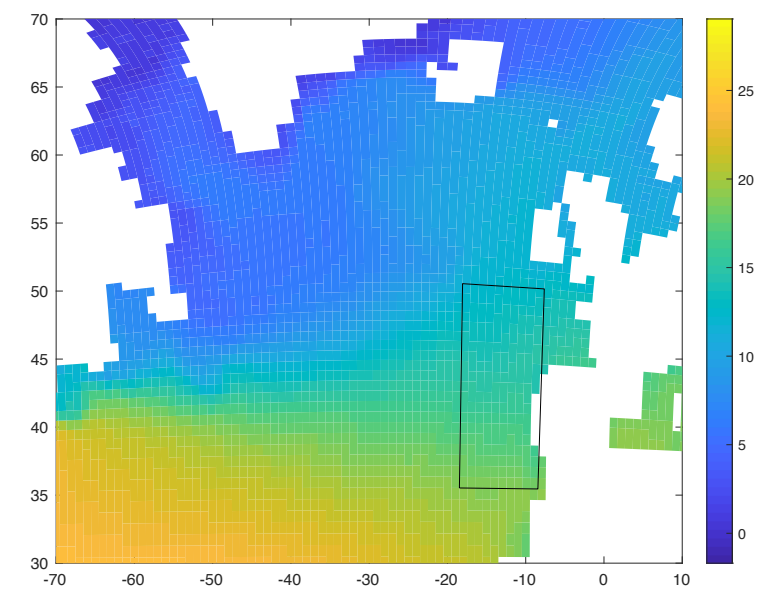
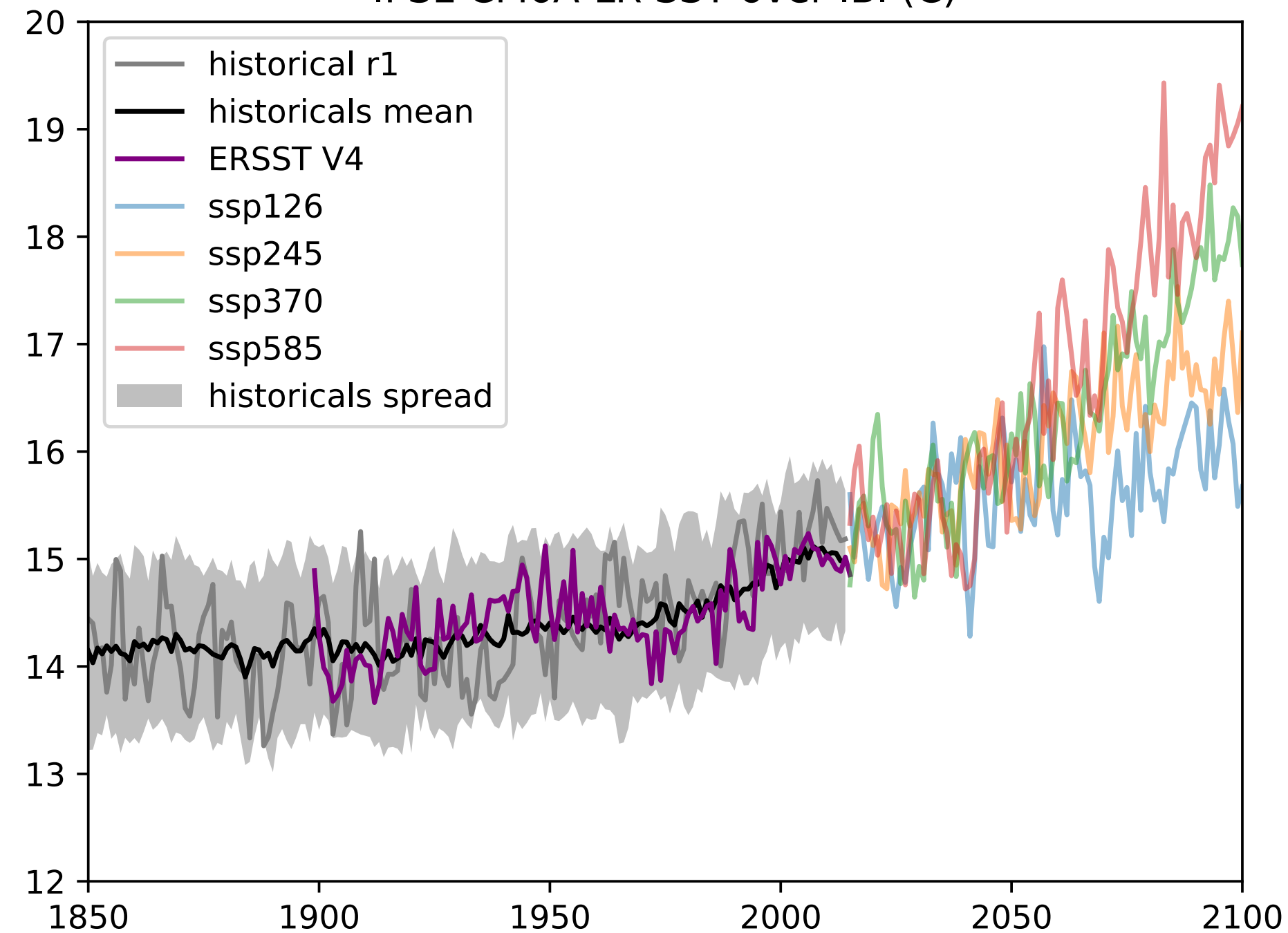


température de
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CMIP6 IPSL-CM6A-LR



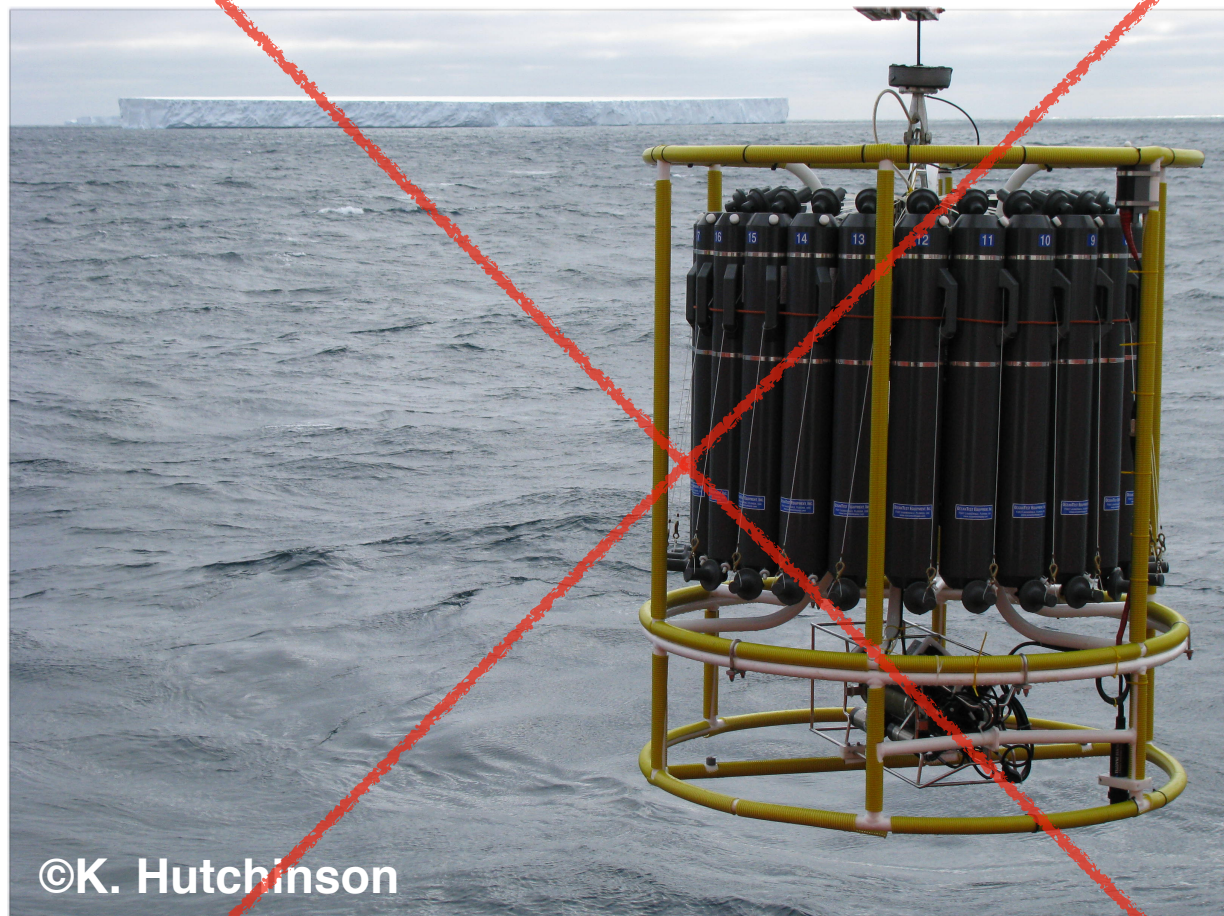
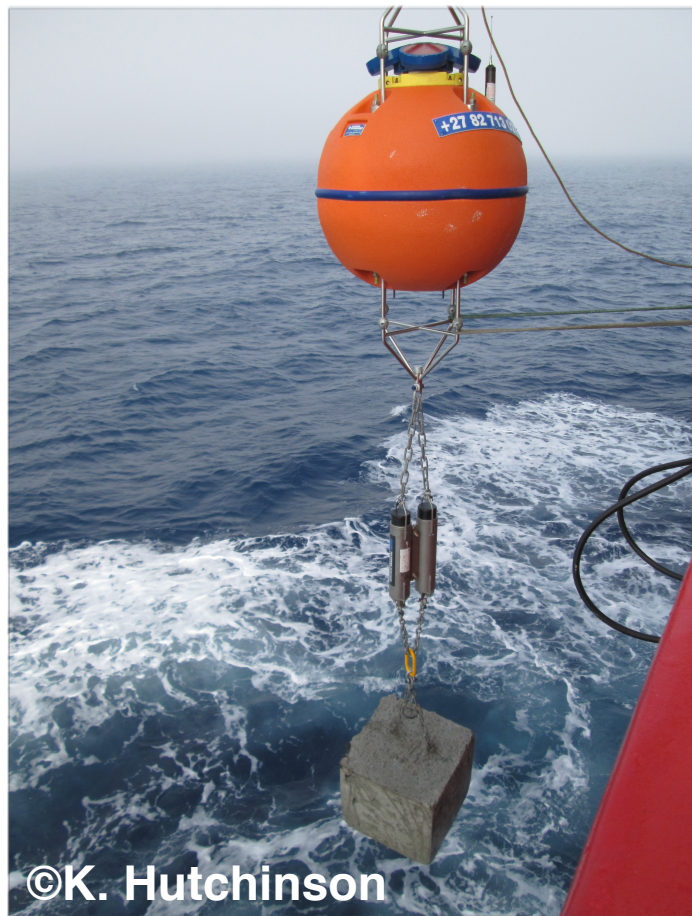
IPSL-CM6A-LR SST over IBI (C)

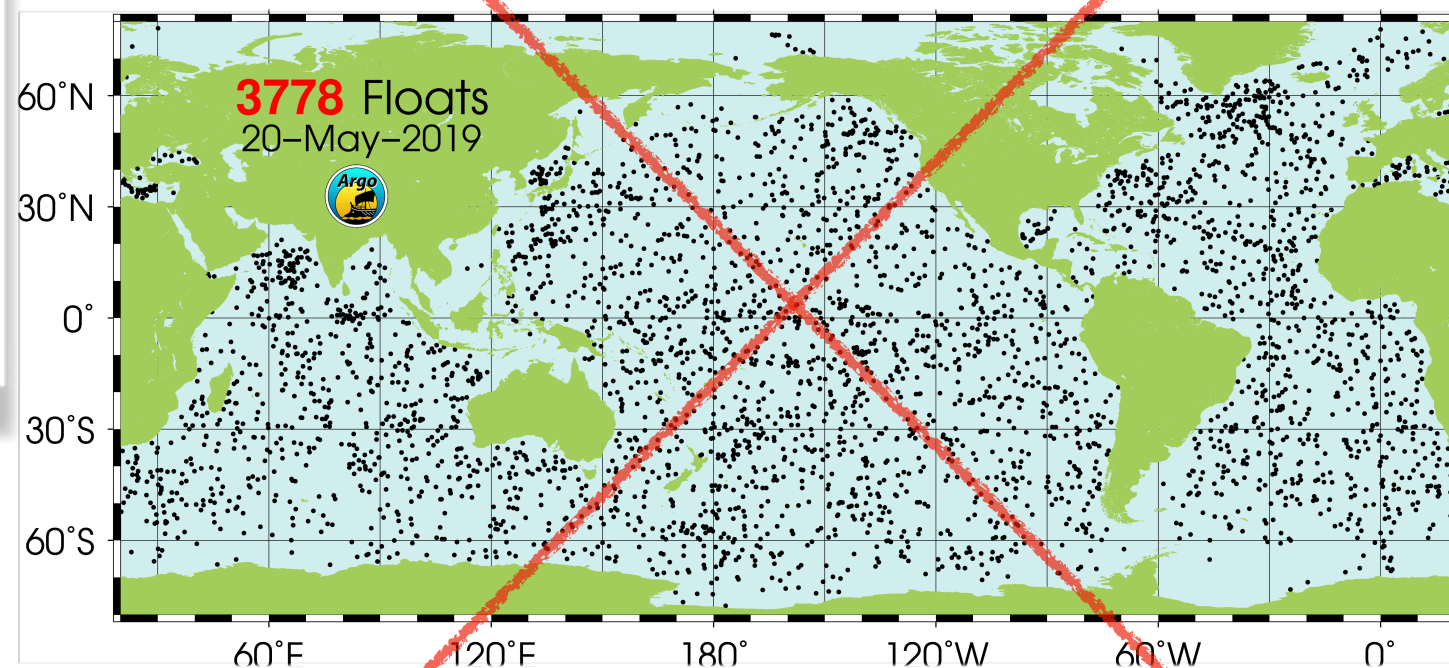
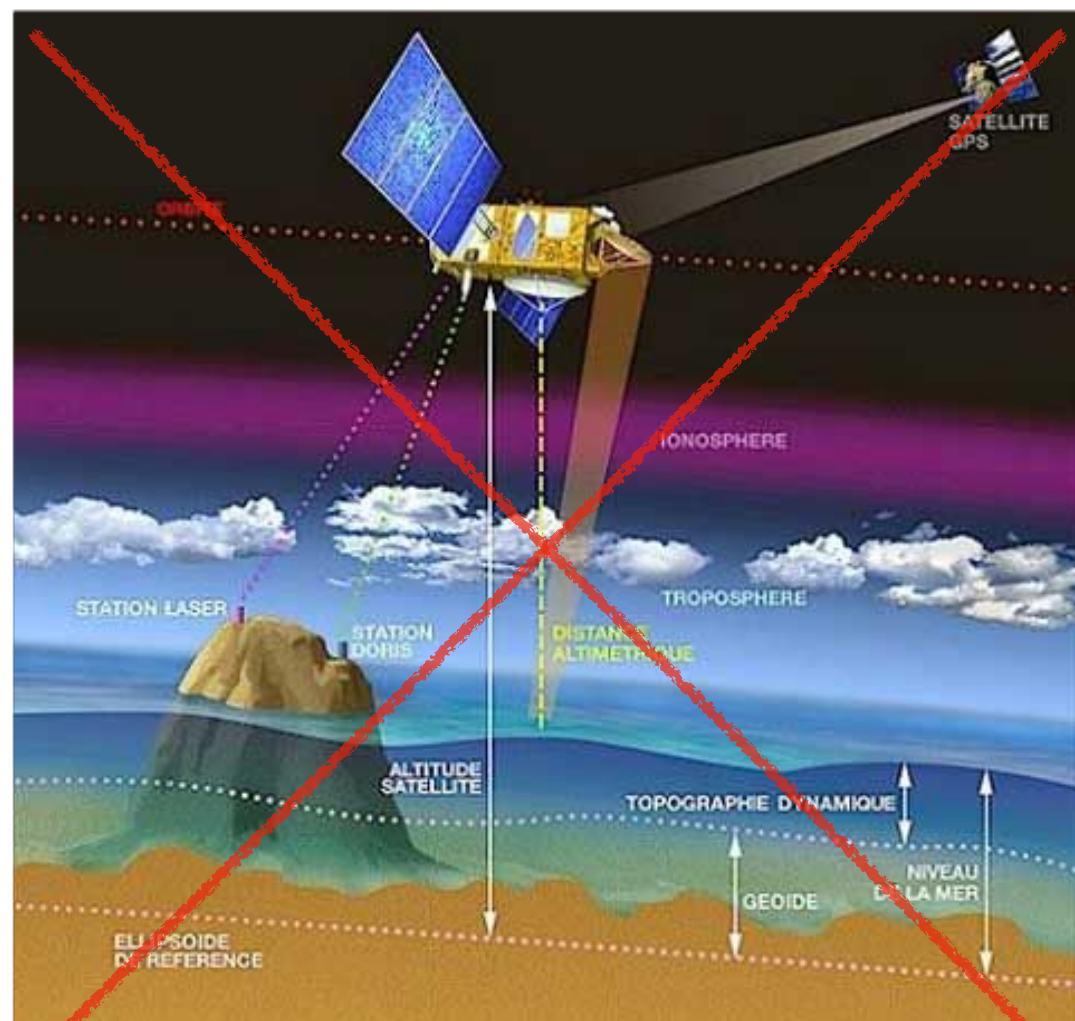
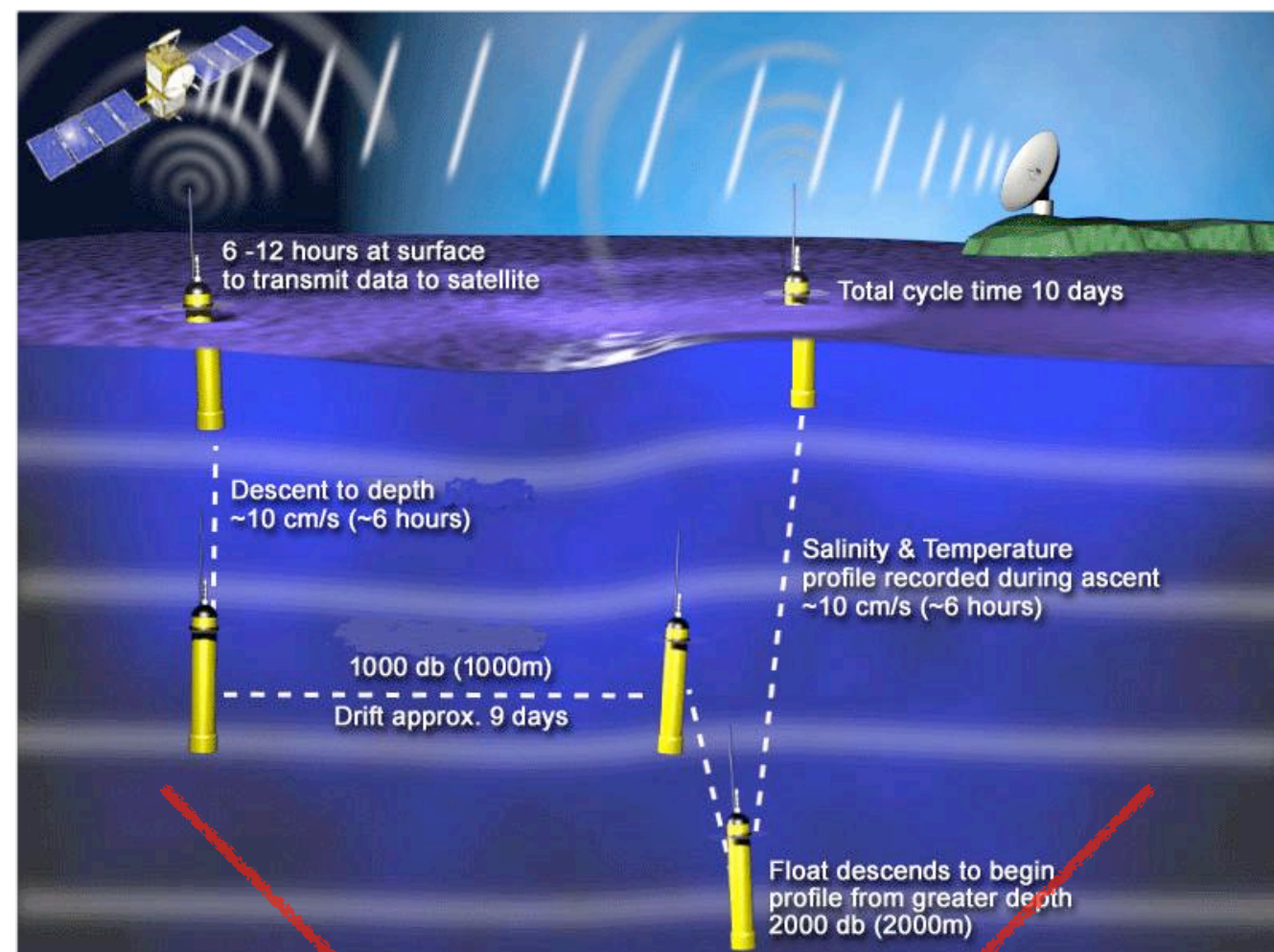
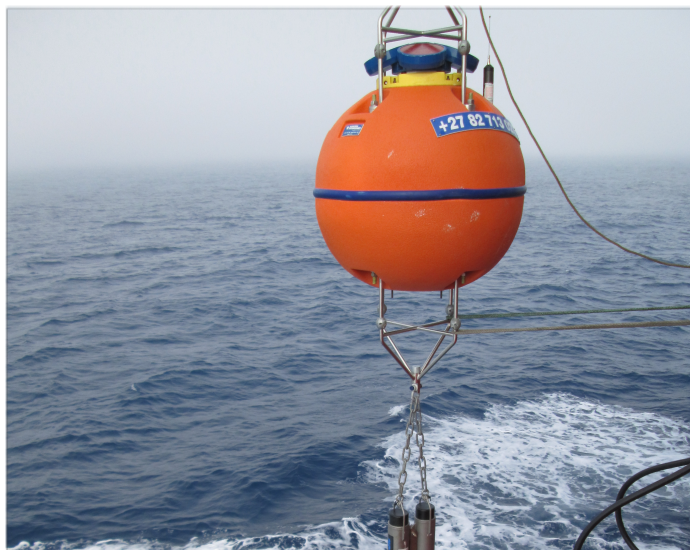


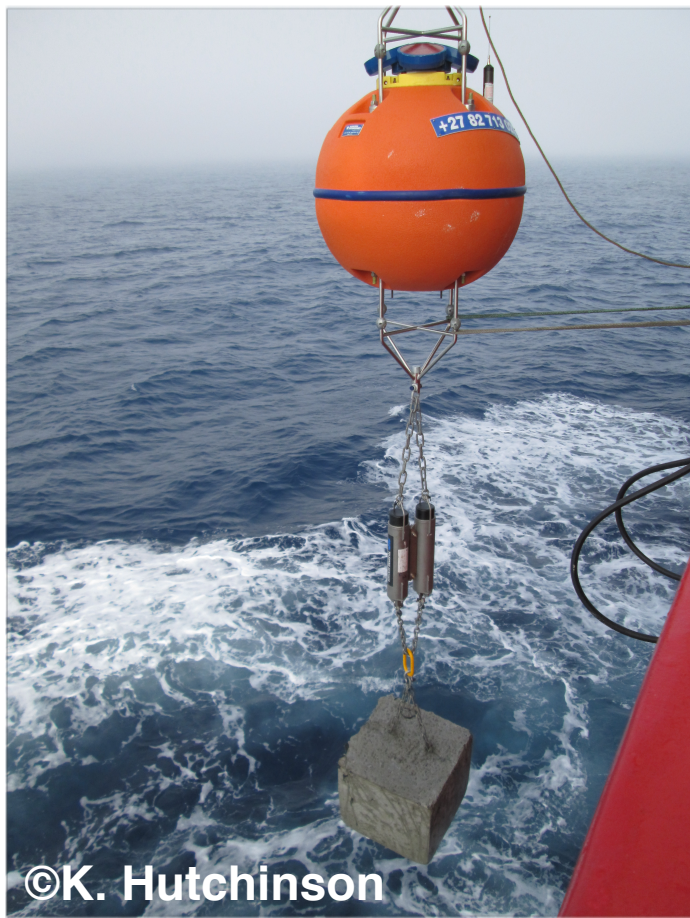
température de
surface de l'océan
dans la boîte noire

les courants profonds

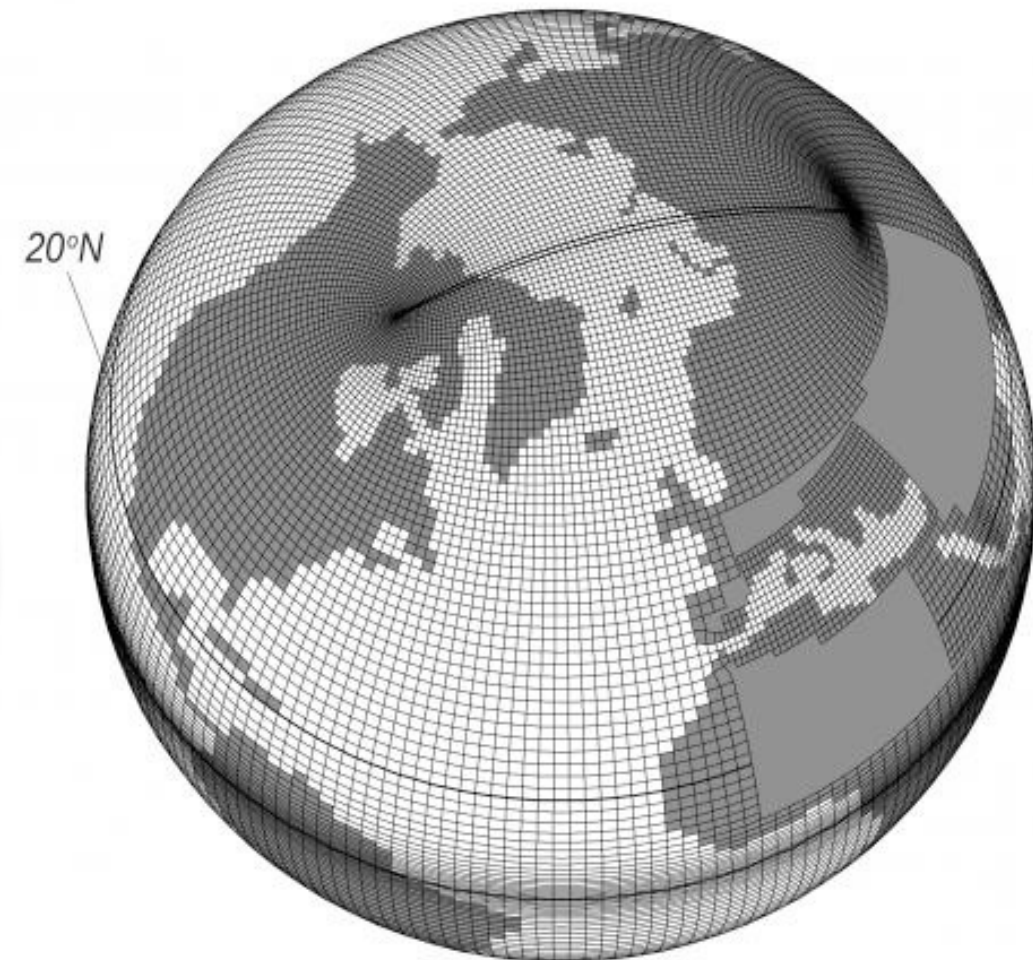
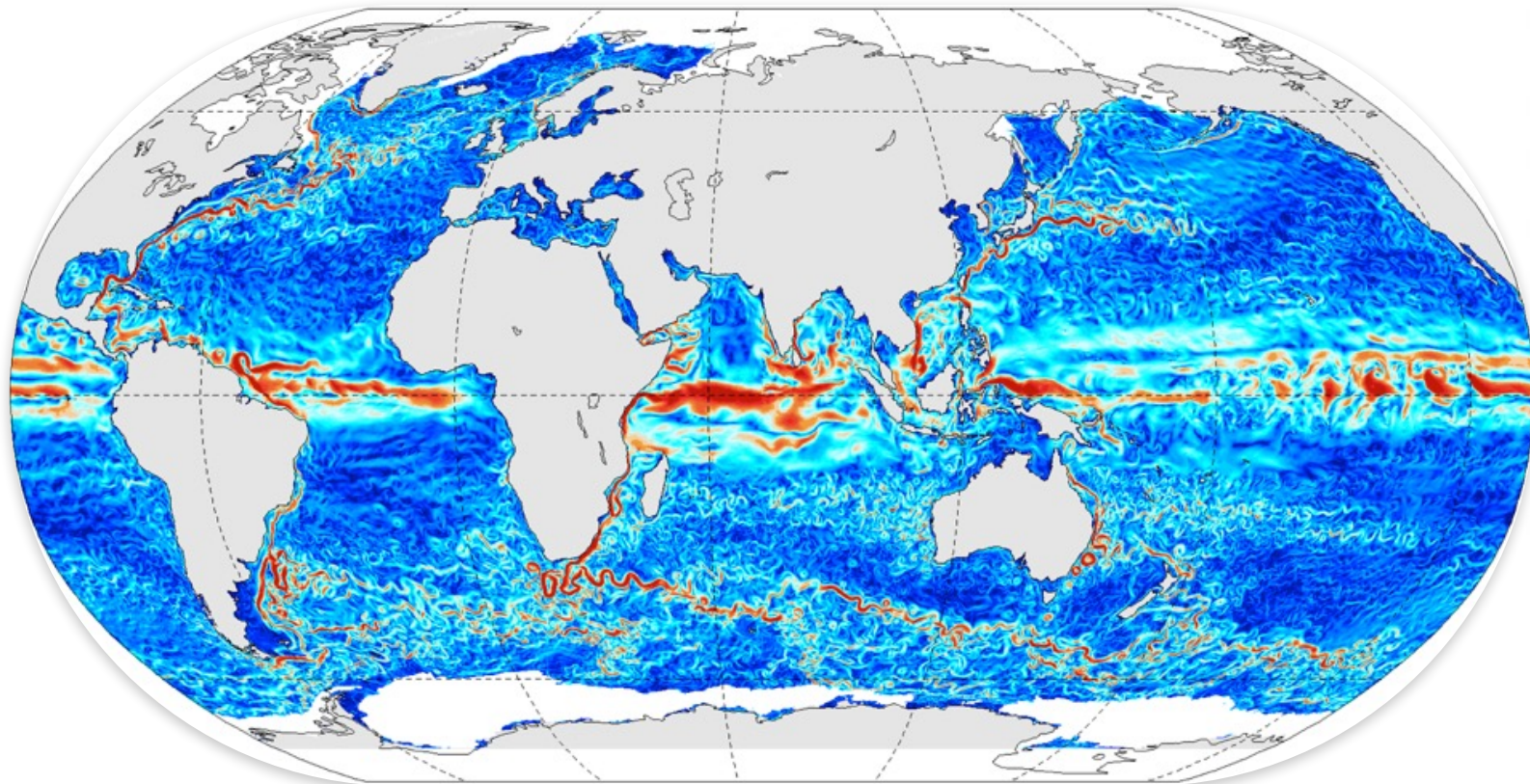


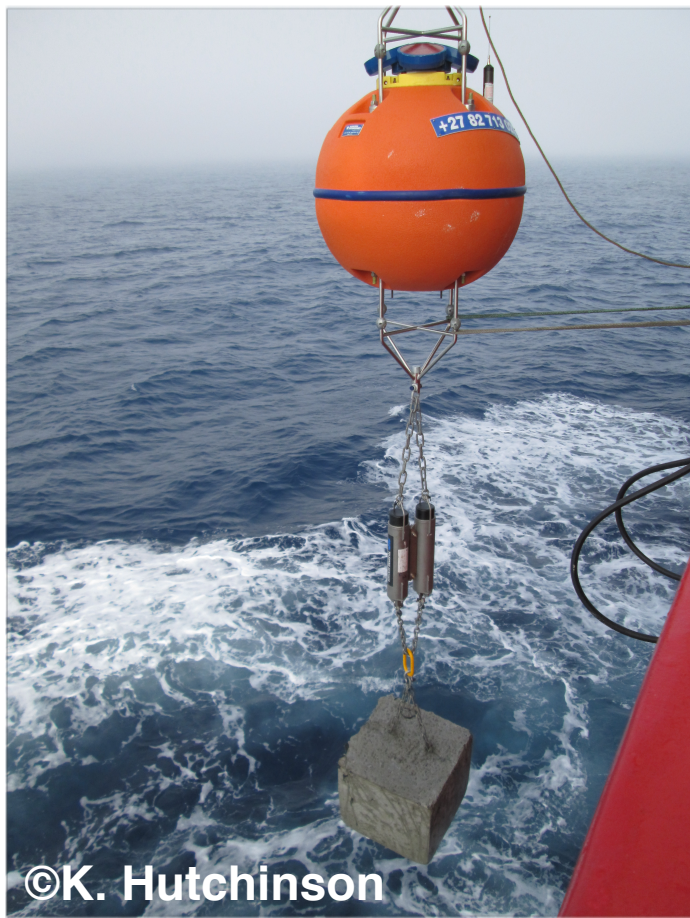




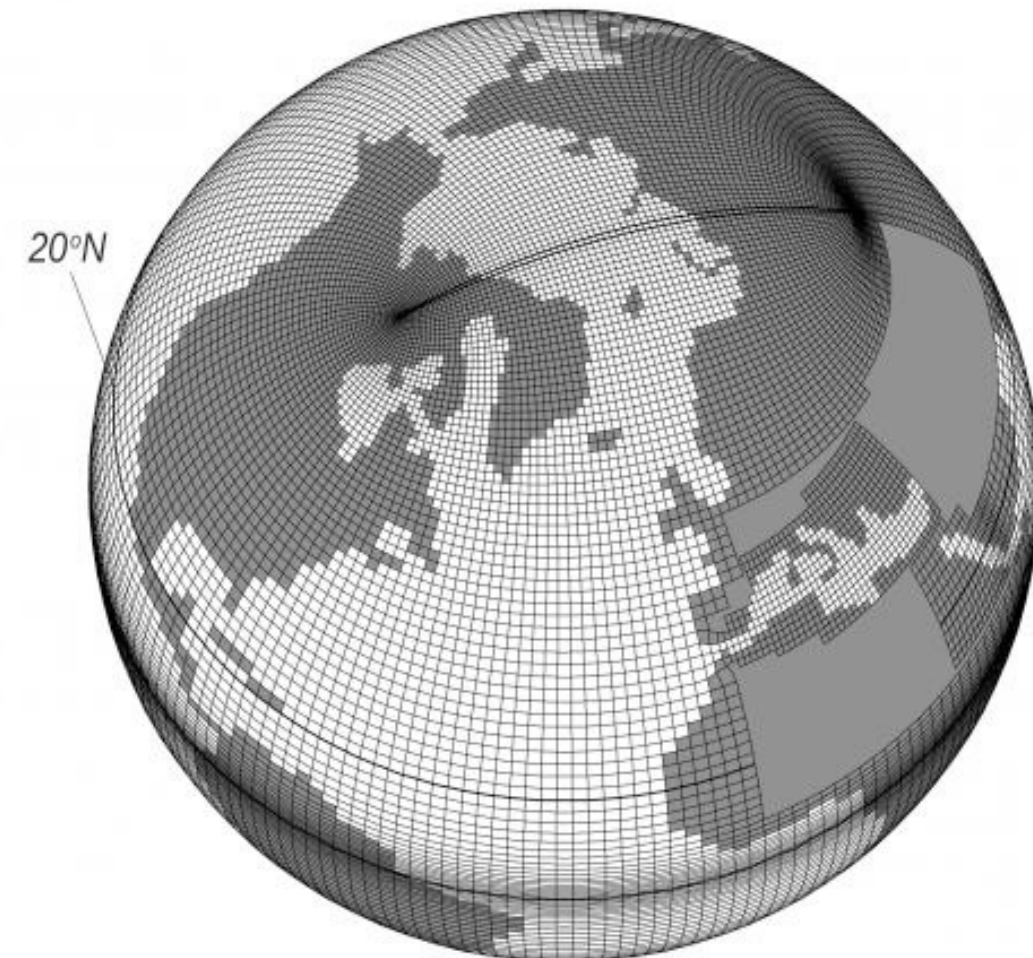
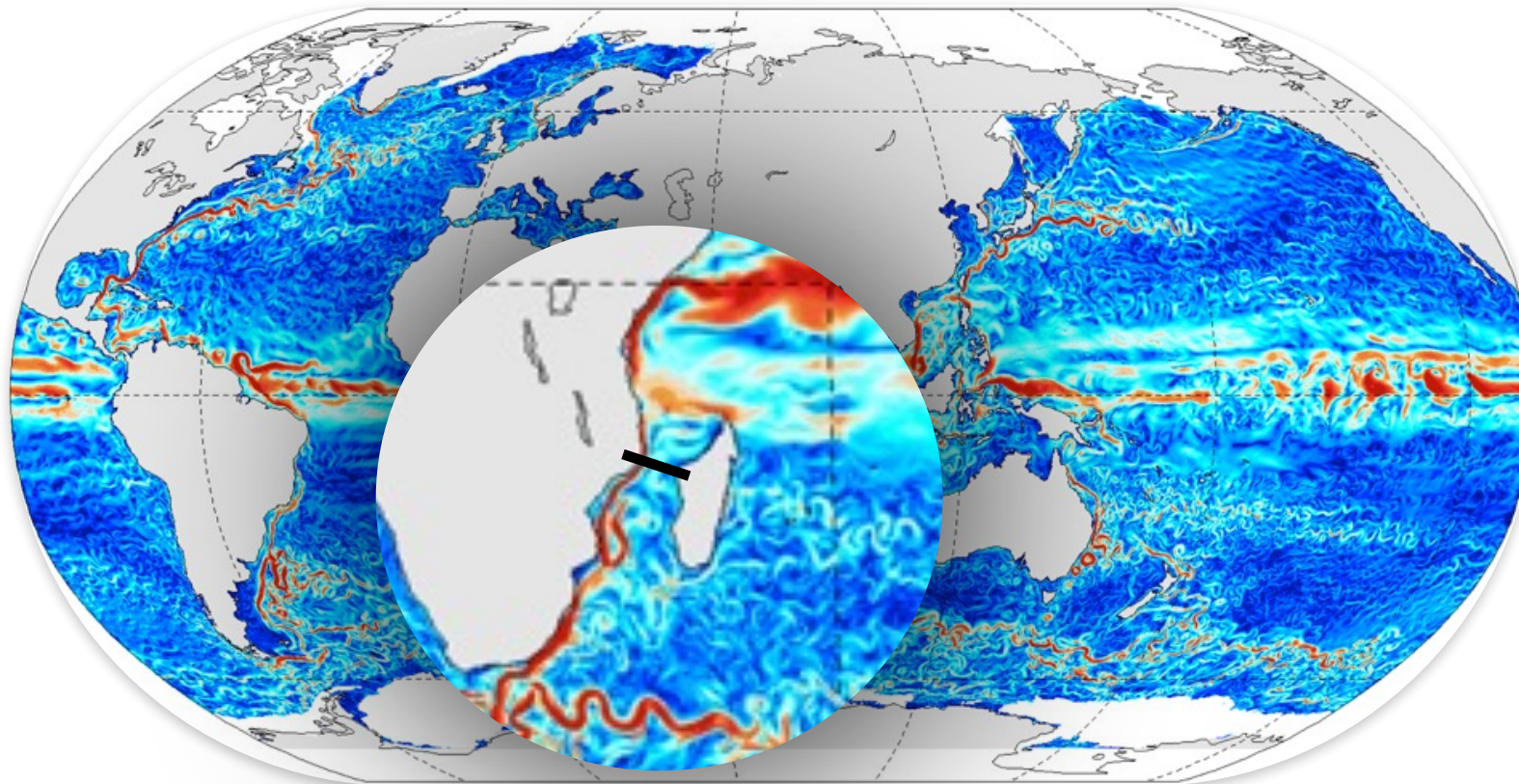


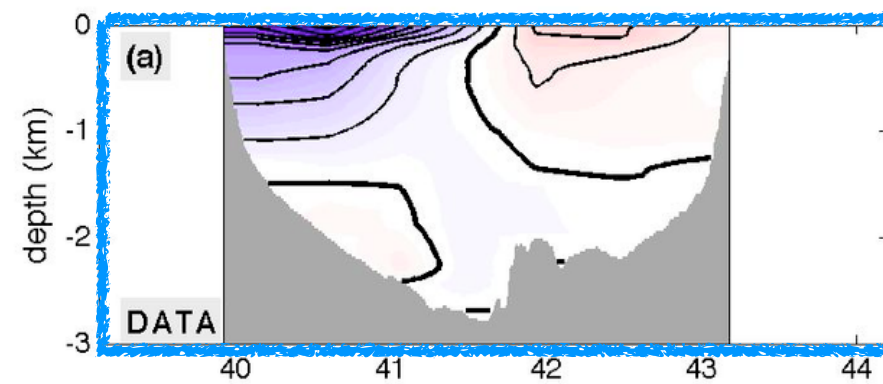
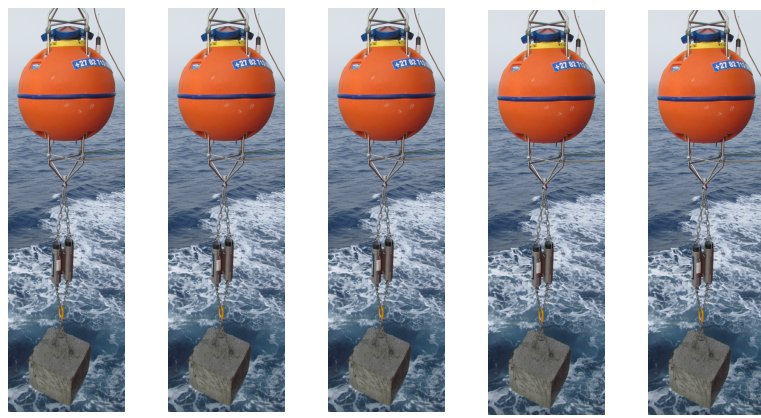
$$\begin{aligned}
 \frac{\partial u}{\partial t} + \vec{u} \cdot \nabla u - fv &= -\frac{1}{\rho_0} \frac{\partial P}{\partial x} + \nabla_h (K_{Mh} \cdot \nabla_h u) + \frac{\partial}{\partial z} \left(K_{Mv} \frac{\partial u}{\partial z} \right) \\
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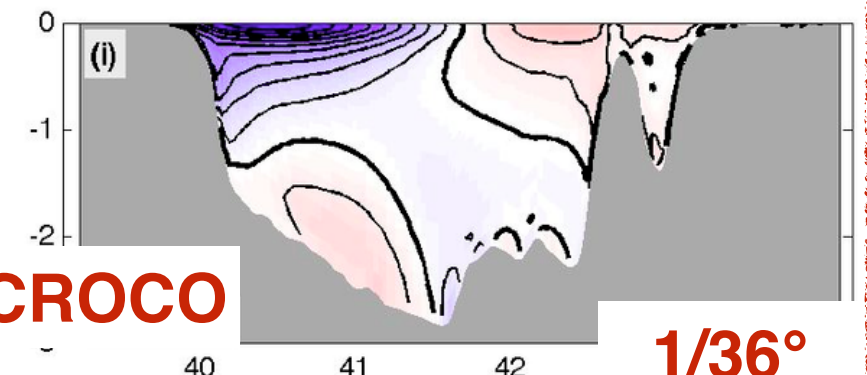
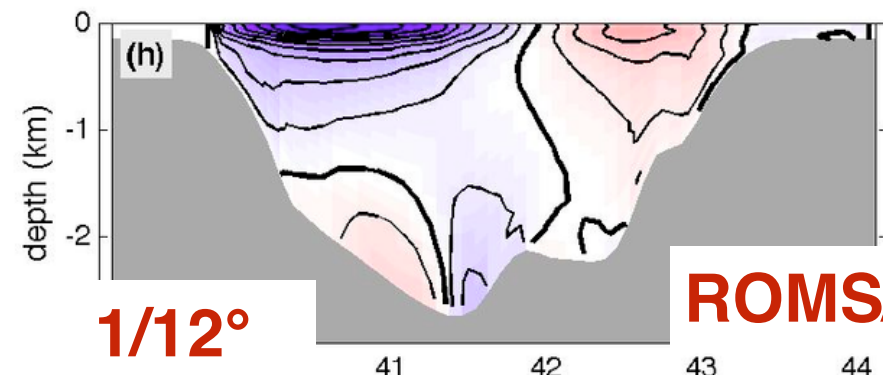
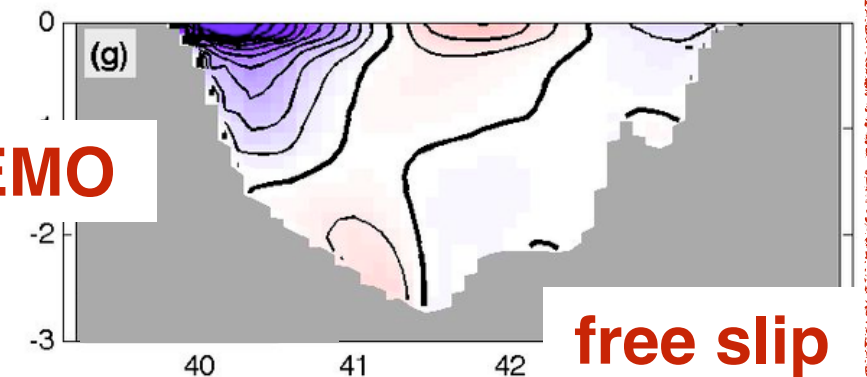
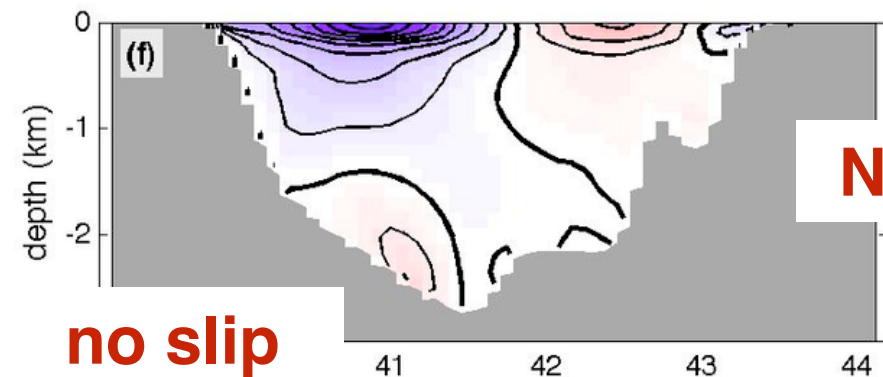
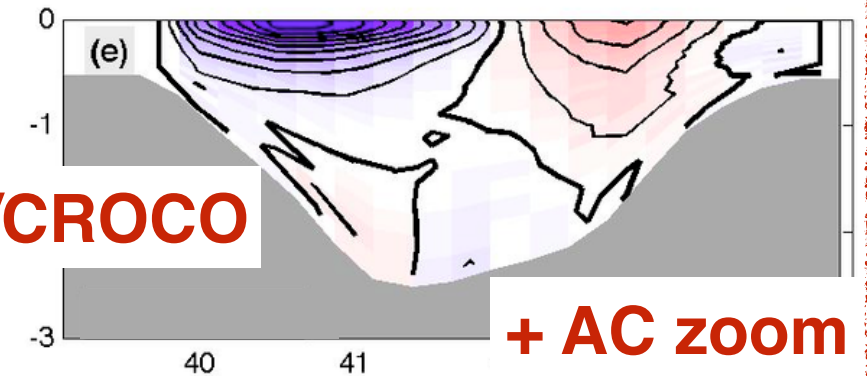
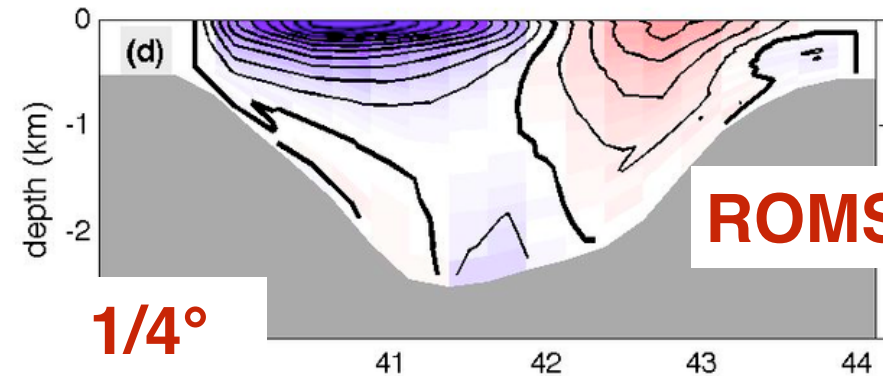
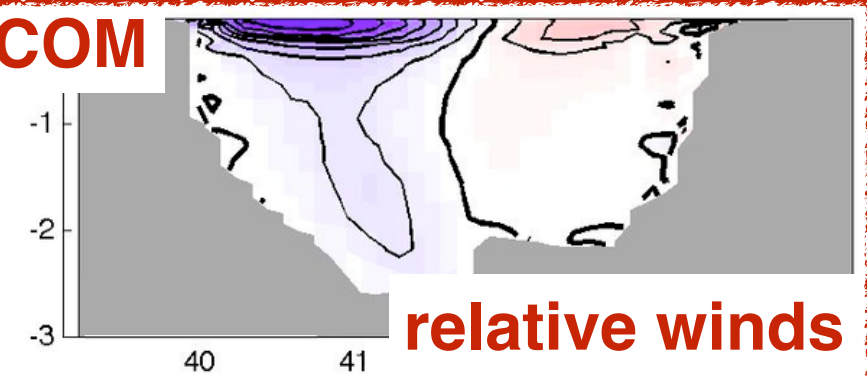
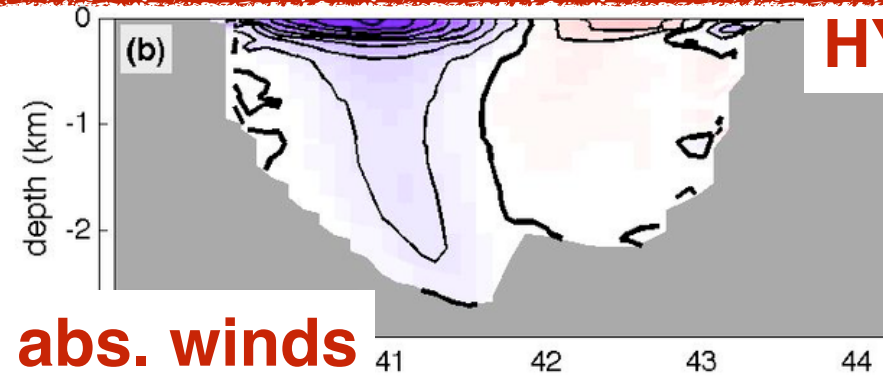


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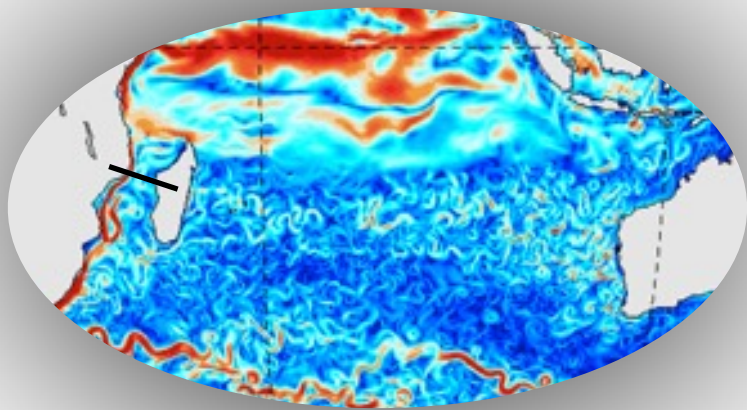


observations



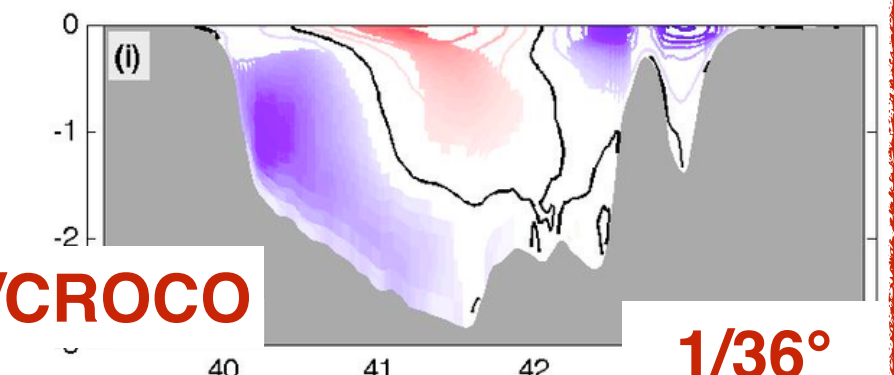
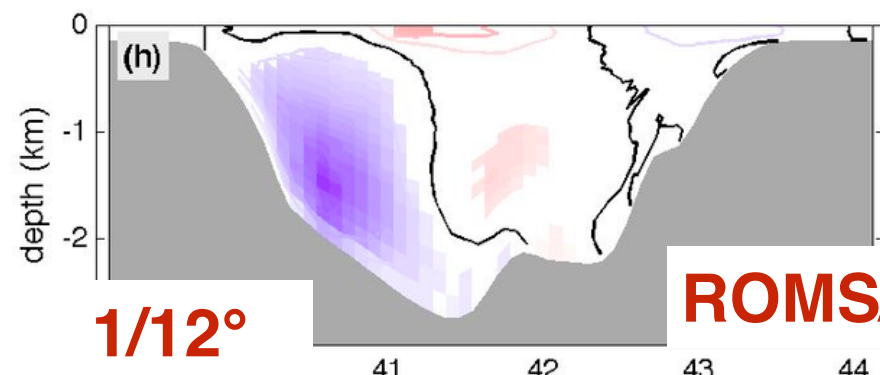
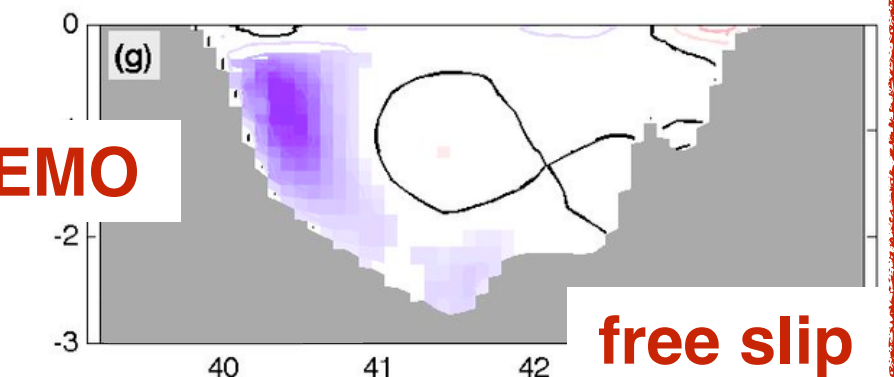
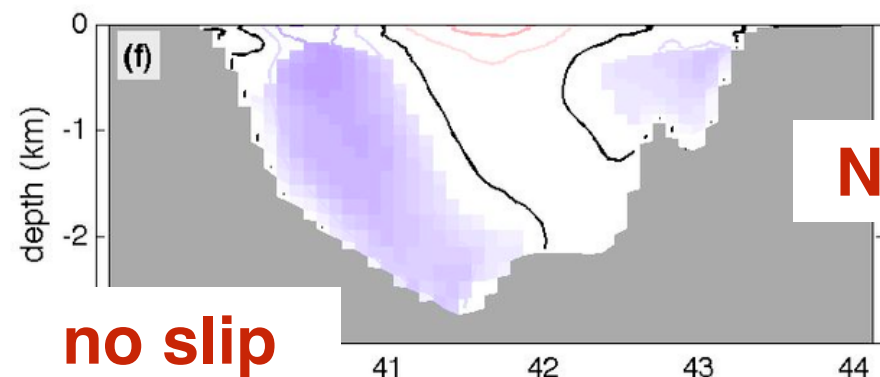
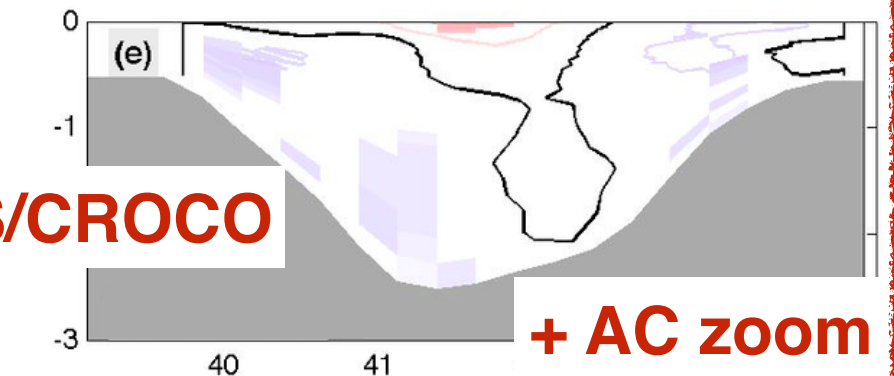
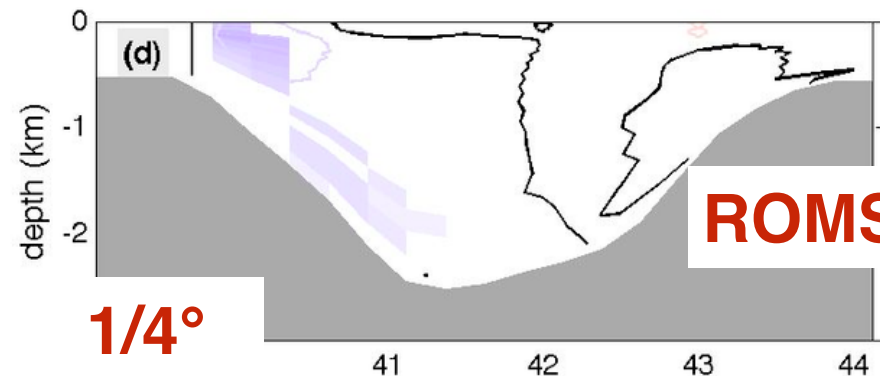
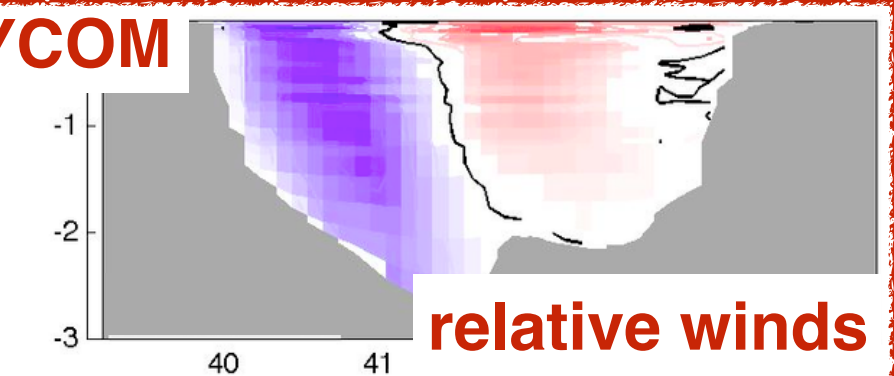
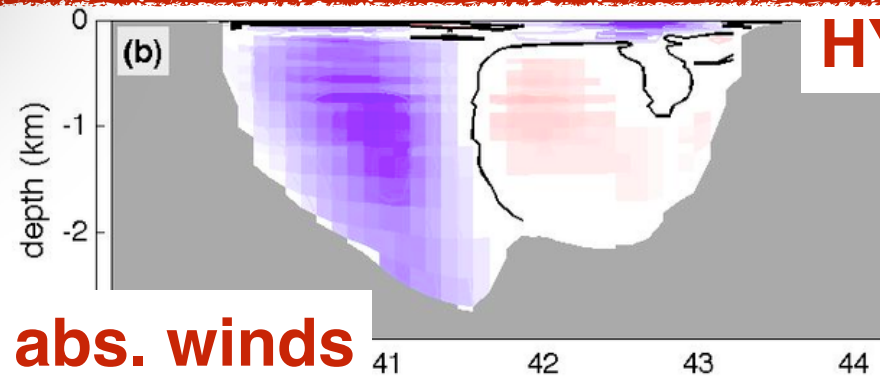
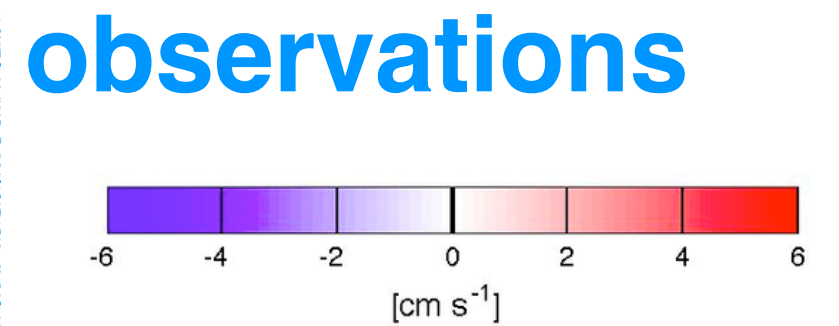
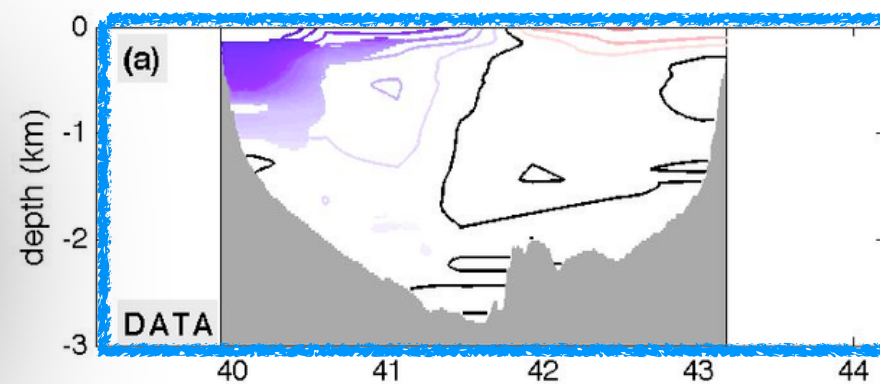
regional
eddy-
resolving
simulations

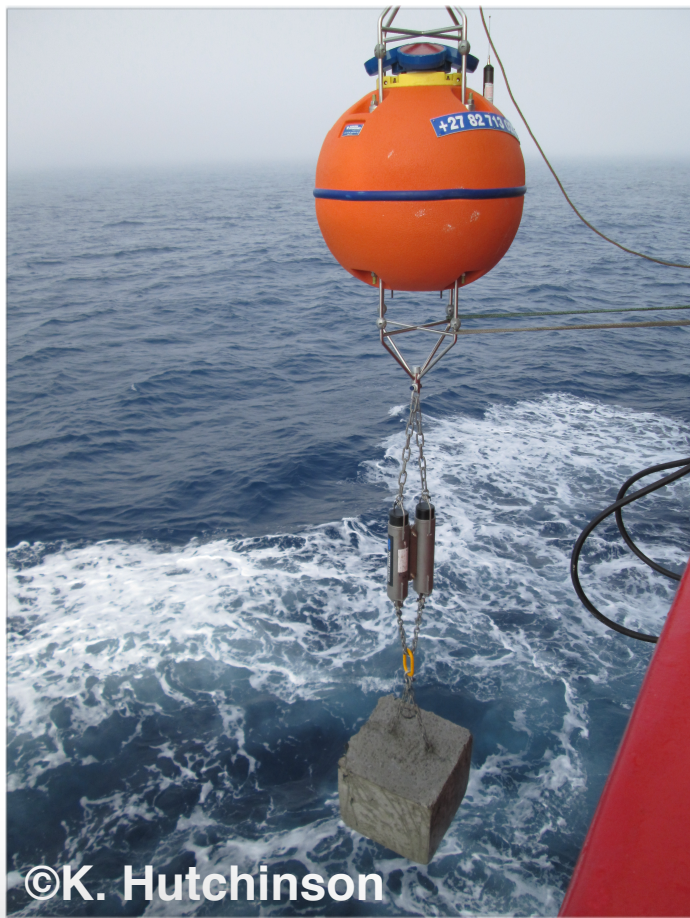
Pous et al. (2018)
mean circulation
through Mozambique
Channel



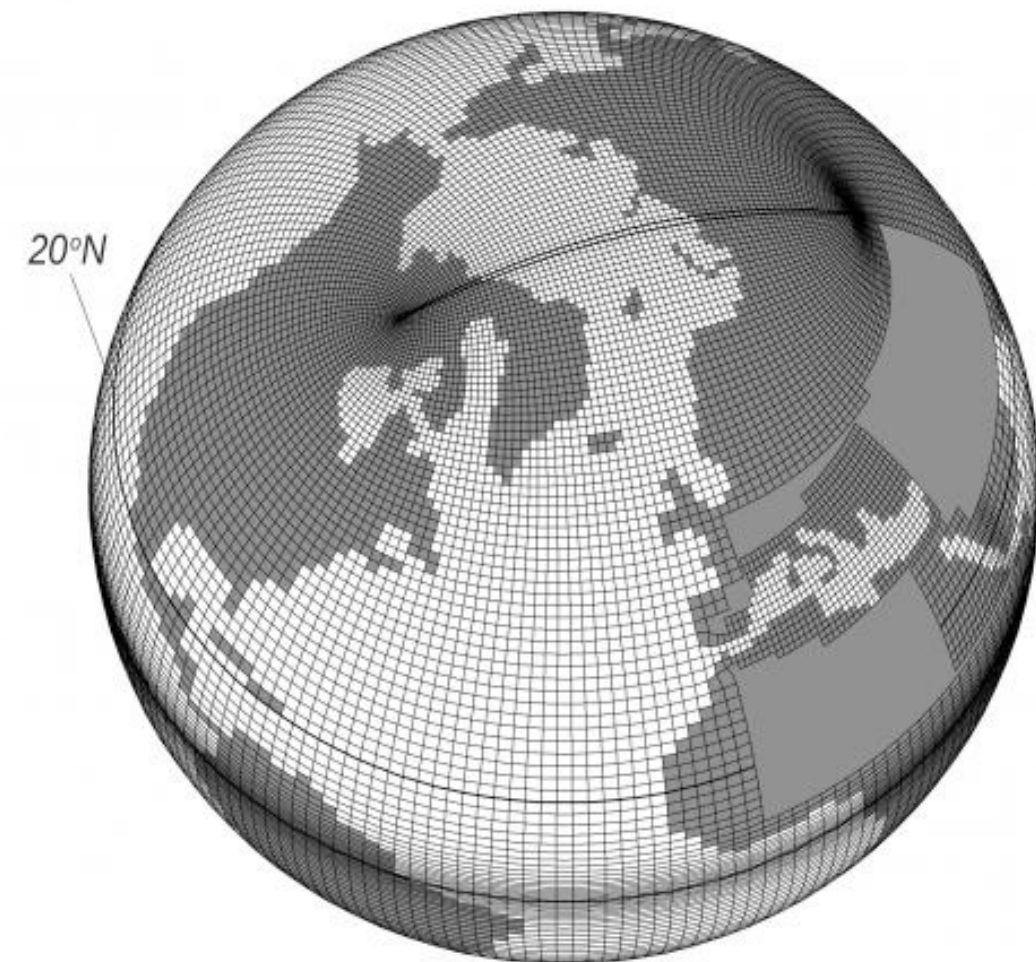
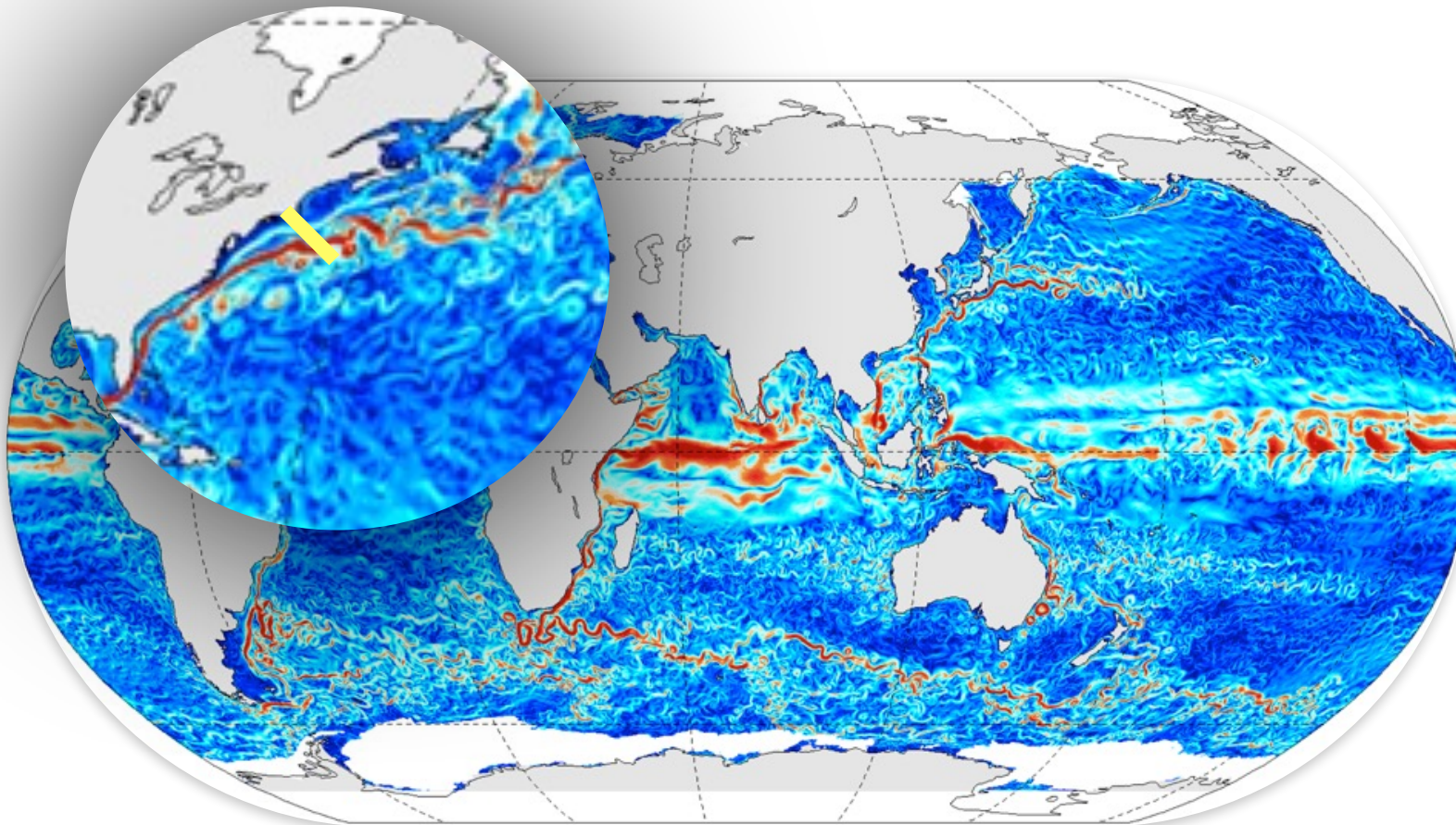
regional eddy- resolving simulations

Pous et al. (2018)
projection of total transport
in Channel onto velocities
normal to section at low
frequency
(period > 544 days)

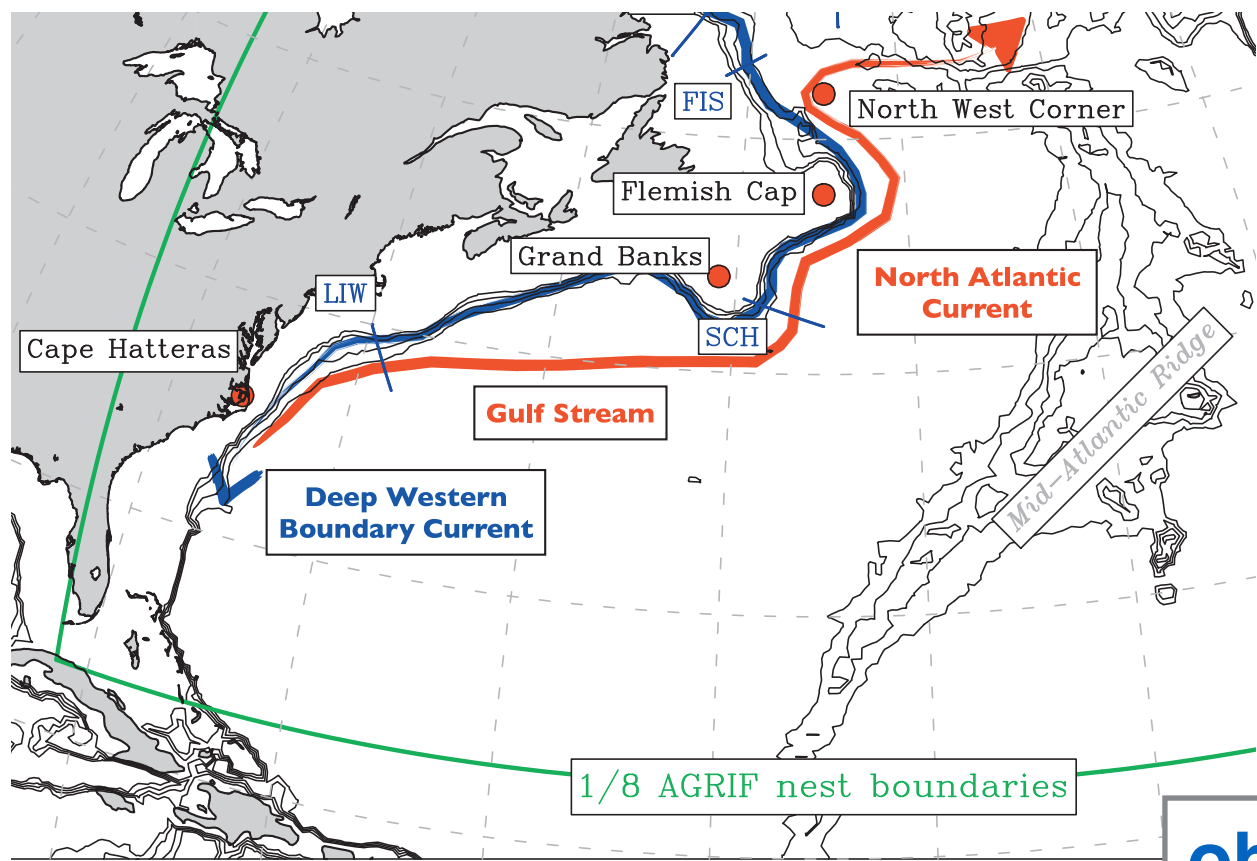




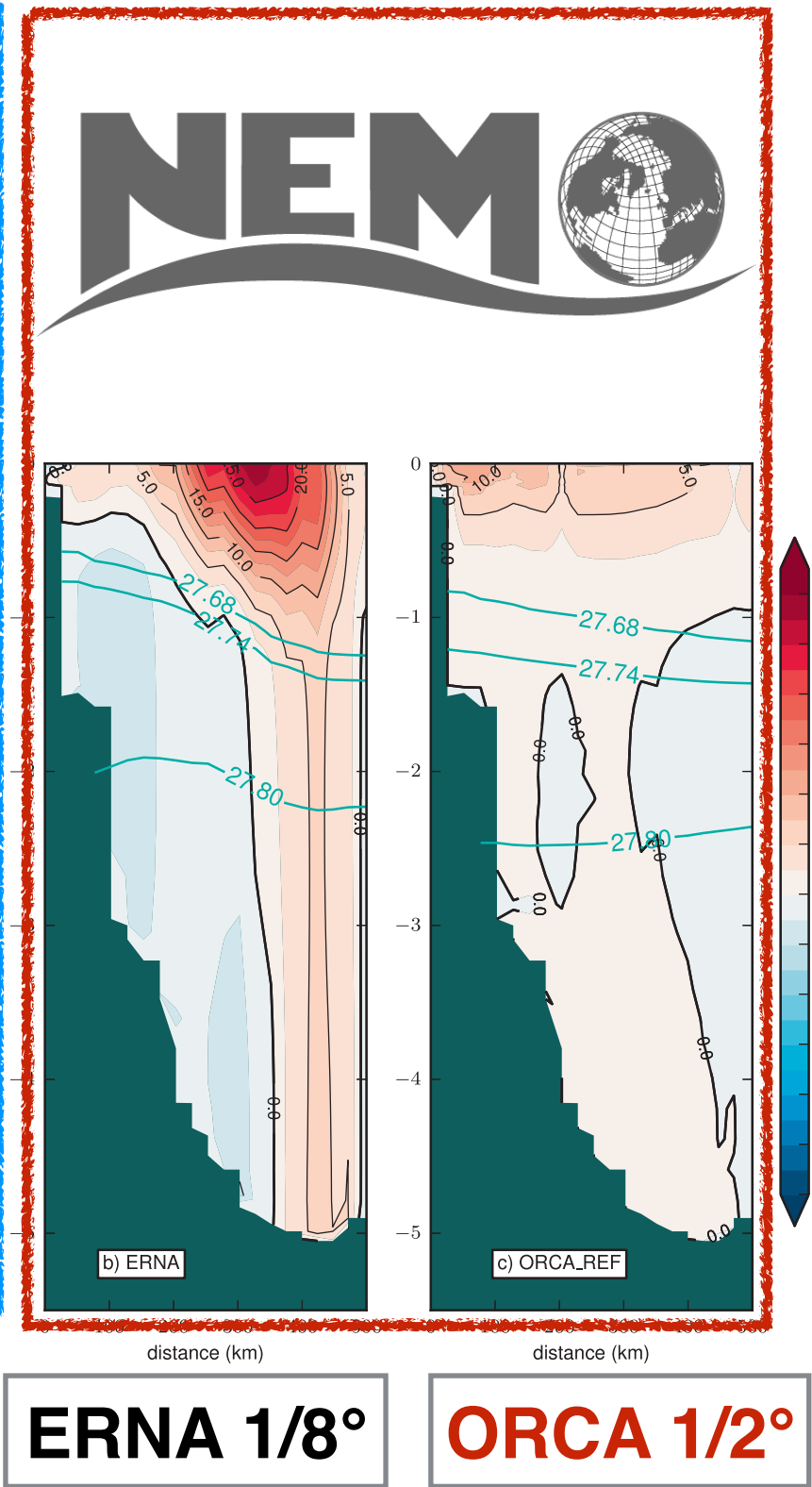
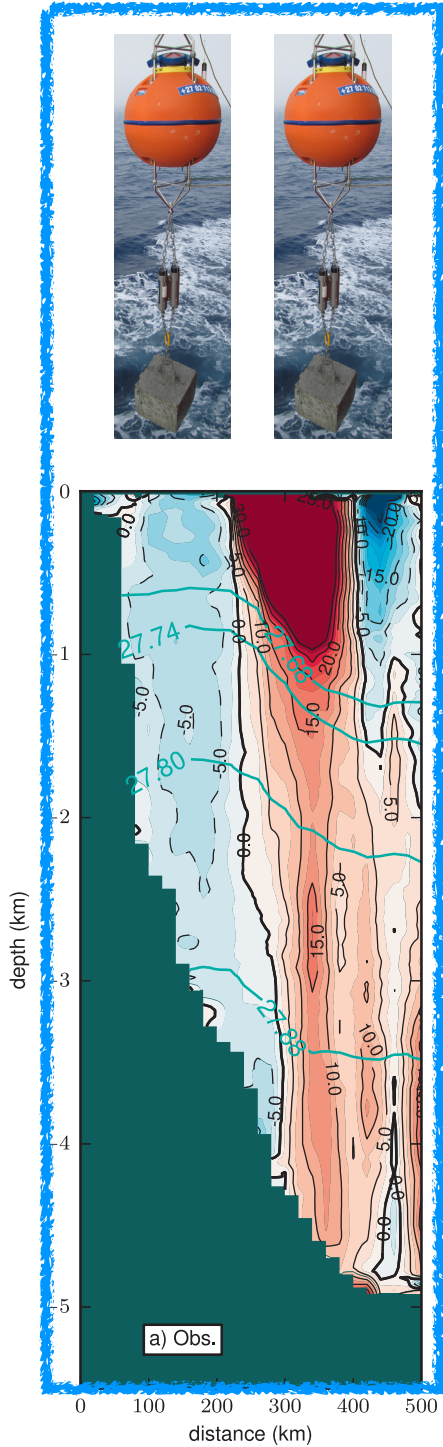
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Talandier et al. (2014, Ocean Modelling) :
 increasing spatial resolution improves
 circulation at the surface and at depth,
 as illustrated here along Line W



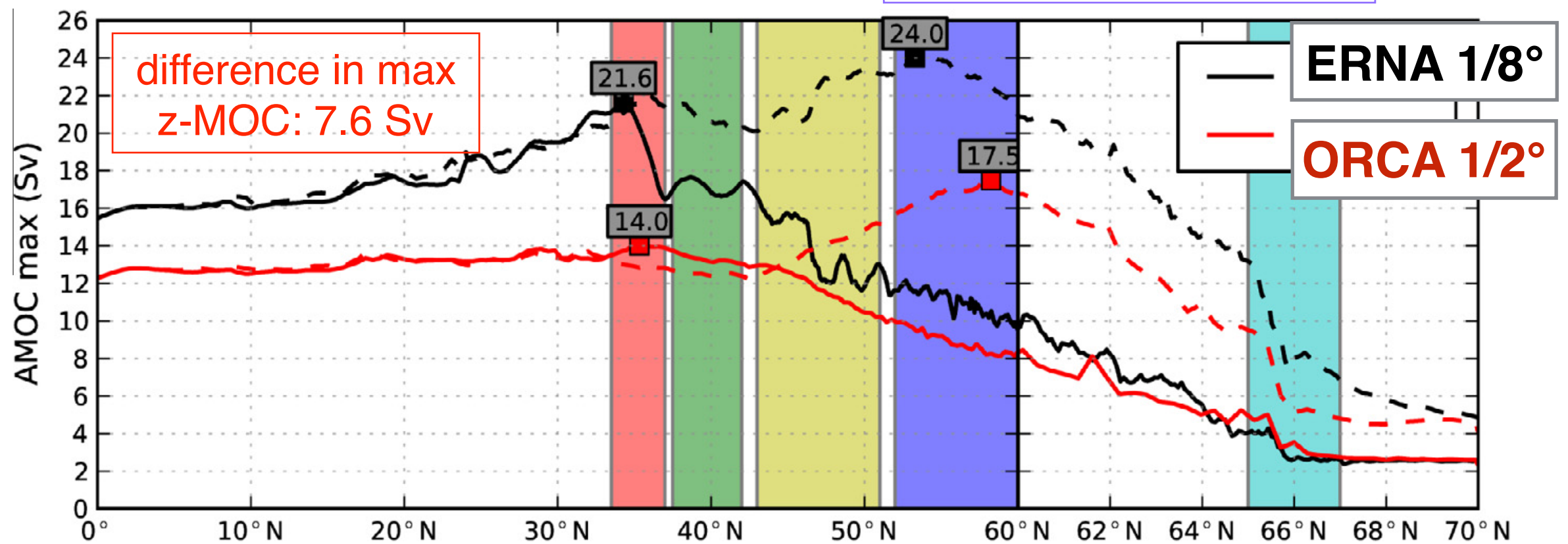
observations



ERNA = ORCA05 + 1/8 AGRIF 2-way zoom over North Atlantic

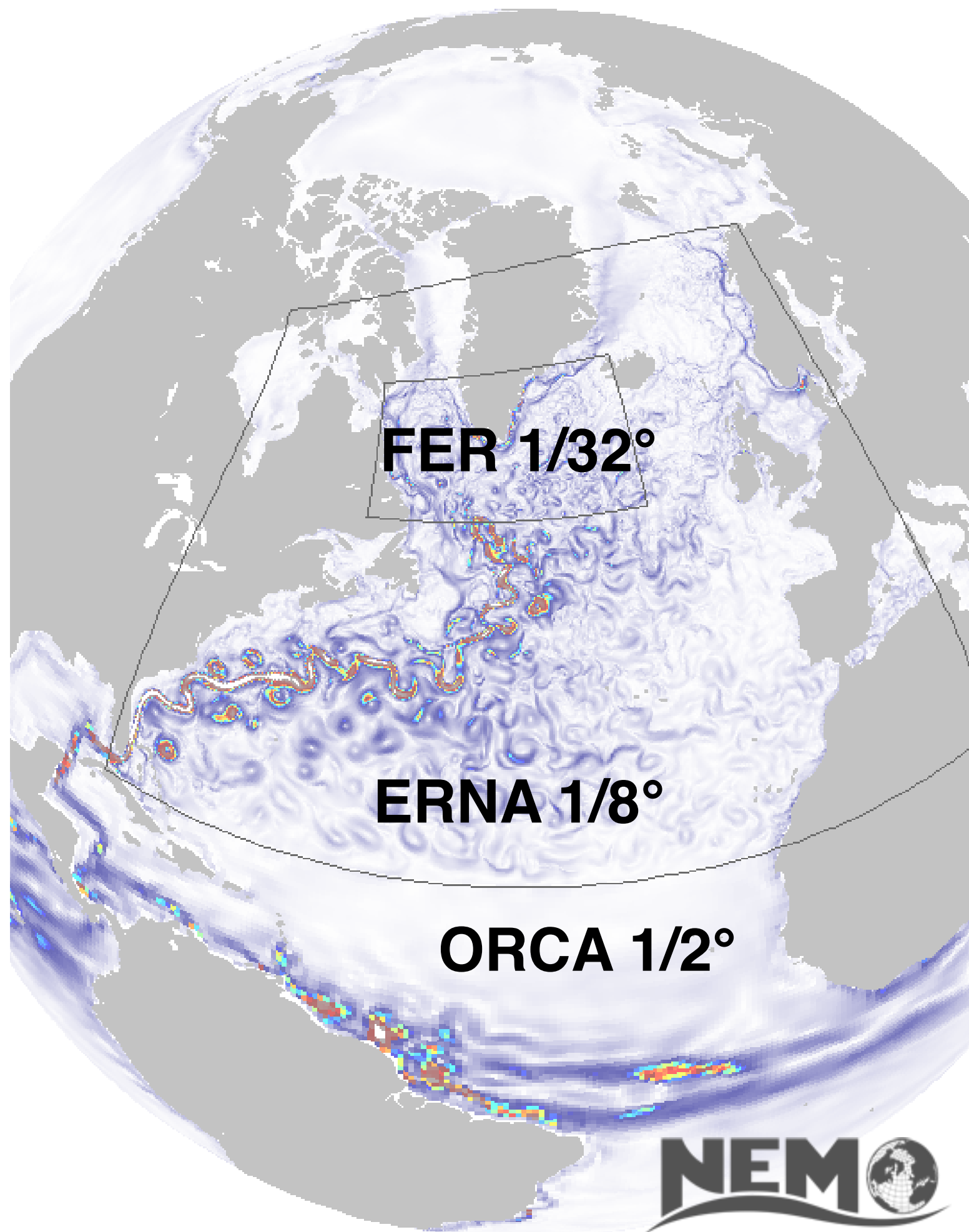
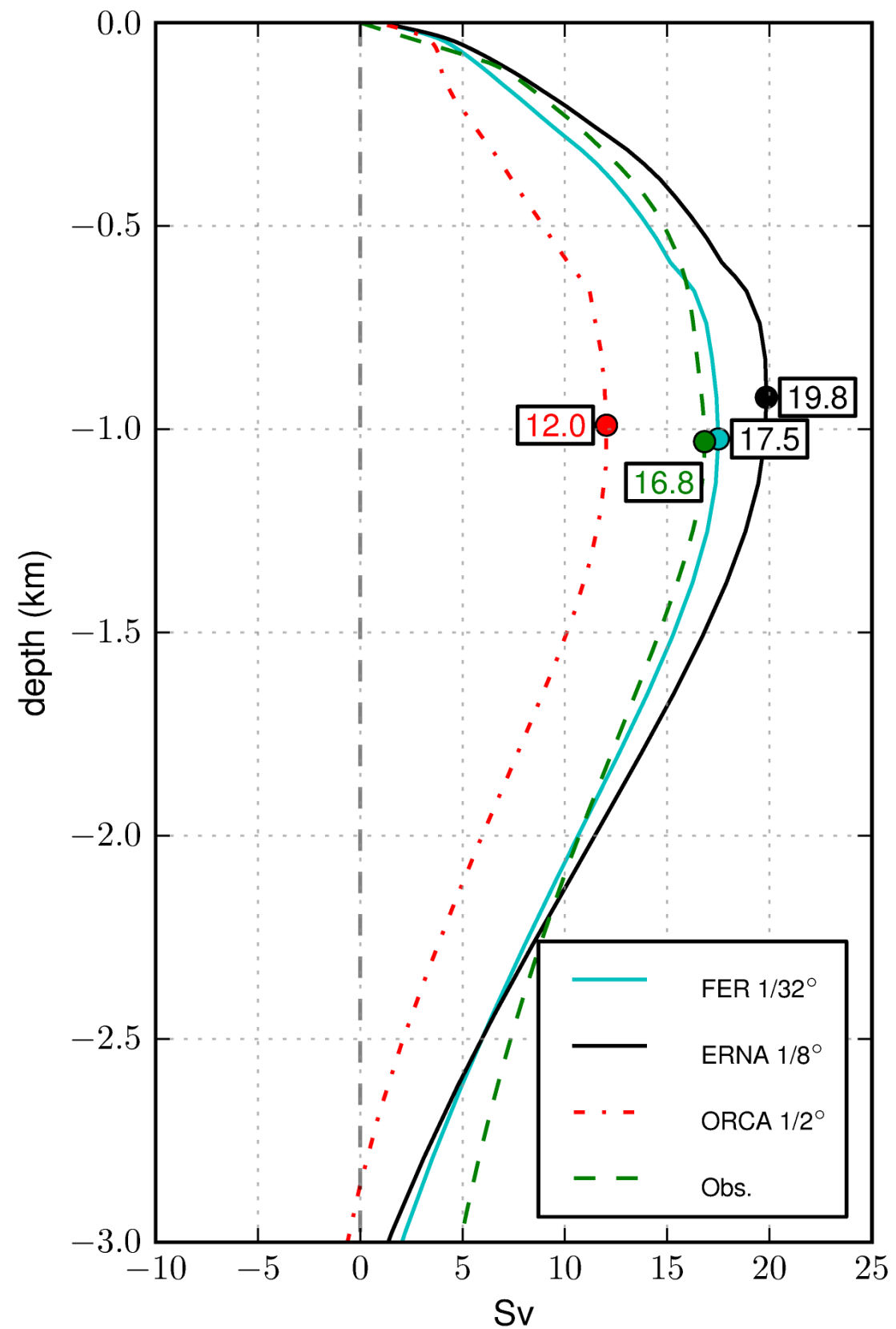


difference in max
density-MOC (ie dense
water formation): 6.5 Sv



$$MOC(z, lat) = \int_W^E \int_H^z v(z, lat, lon) dz dlon$$

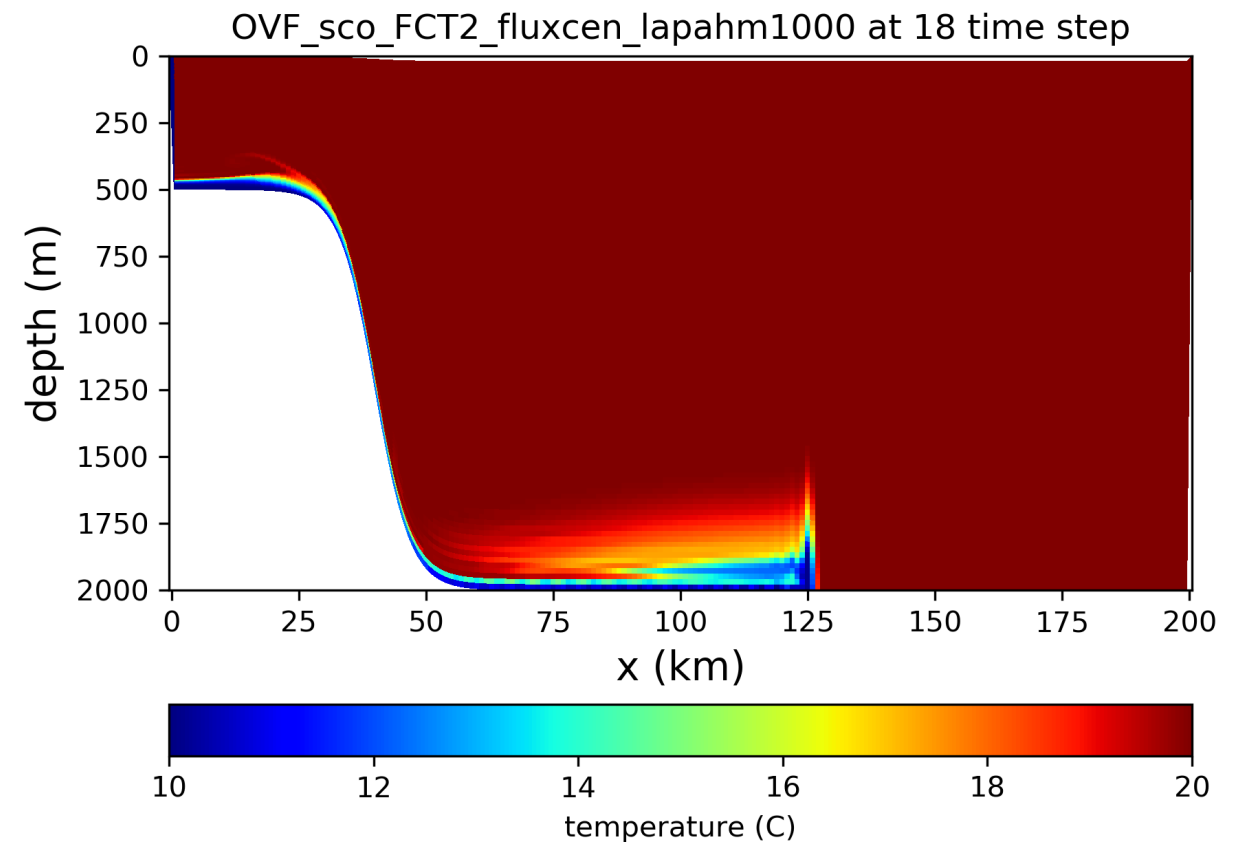
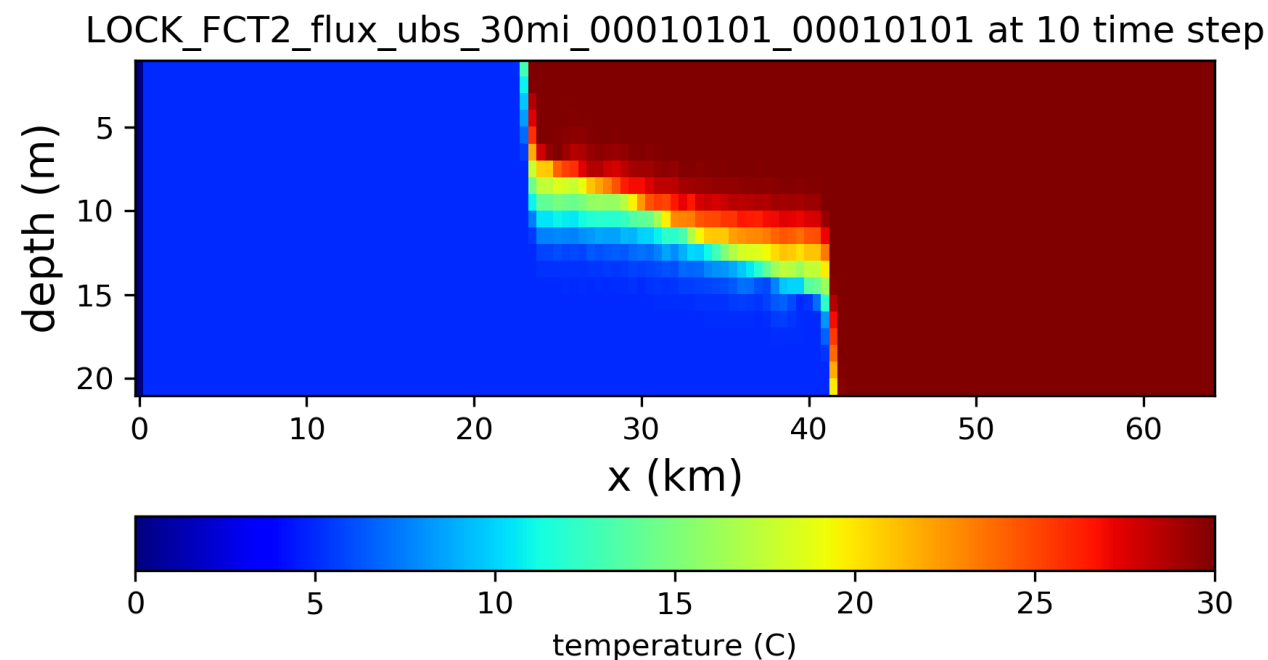
AMOC at 26N



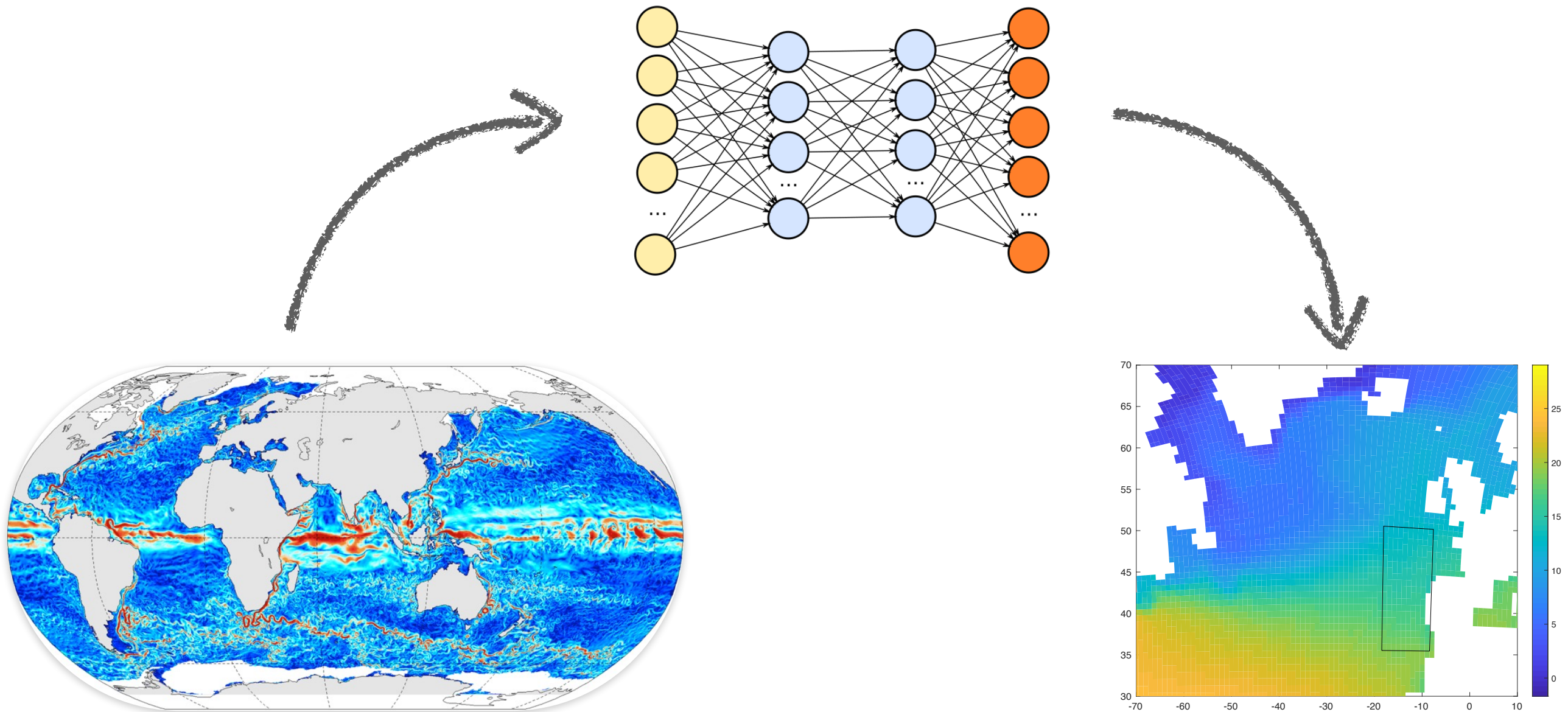
les challenges
de la modélisation
du climat
(vus par une océanographe)

améliorer la dynamique dans les océans profonds (advection et diffusion)

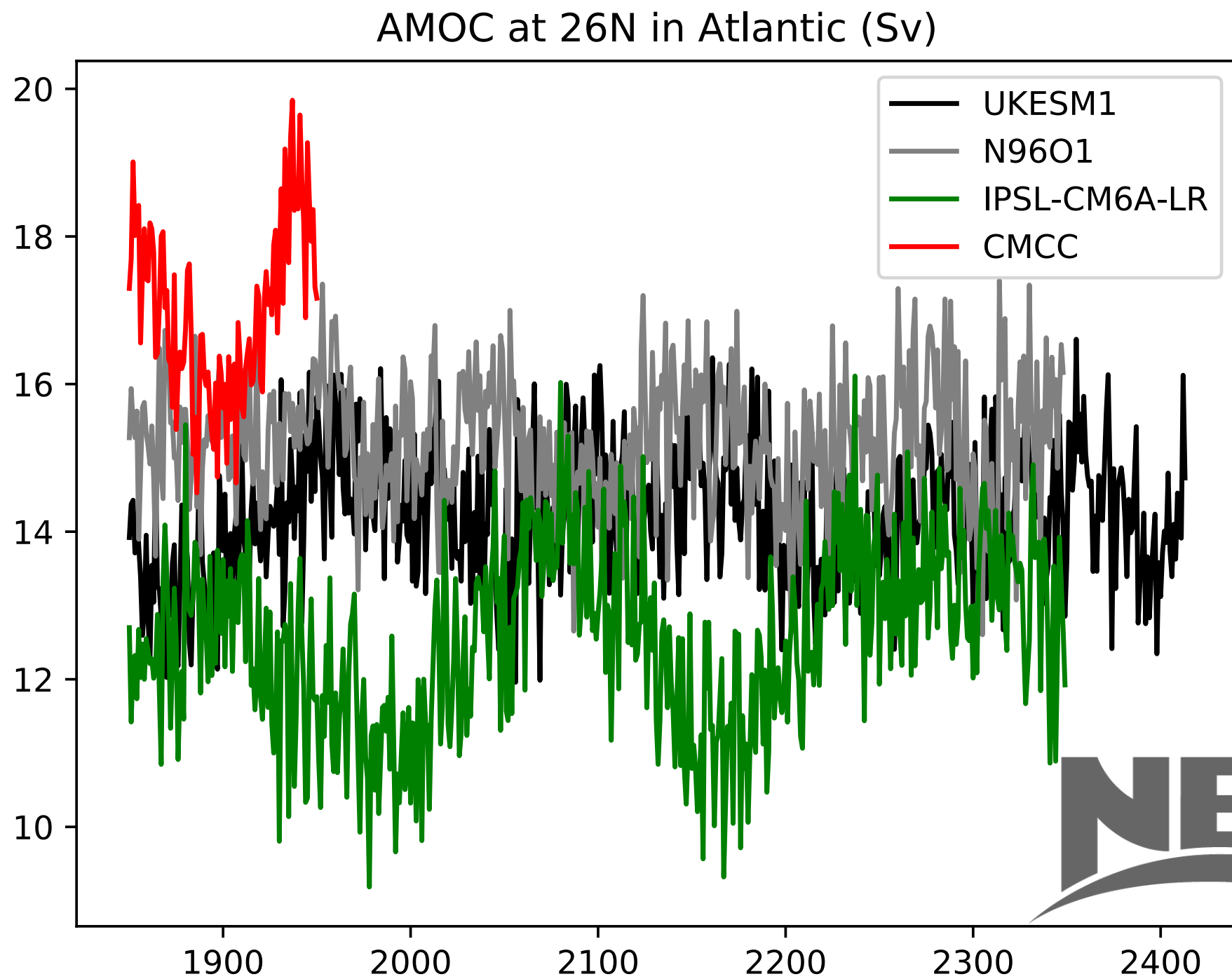
importance de la coordonnée verticale
mais manque de convergence des configurations
réalistes à haute résolution
>> travail sur des configurations très simplifiées pour
tester propriétés numériques des schémas



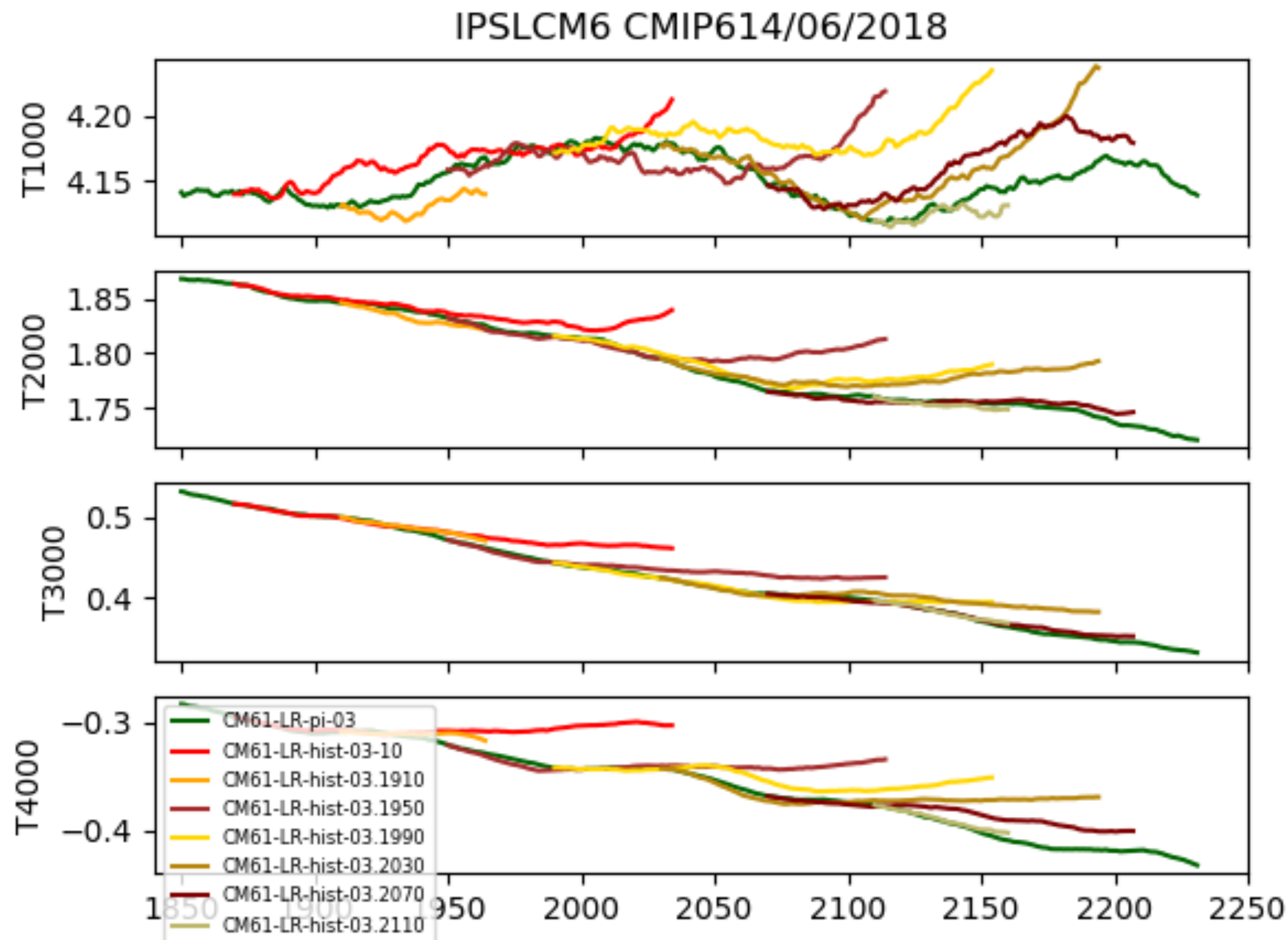
représenter l'effet des processus de fine échelle
(en surface ET en profondeur)



ajuster les paramètres (*tuning*)



mettre en circulation
(car les conditions initiales sont inconnues)
et réaliser des simulations longues (>1000 ans)



les challenges de la modélisation du climat (vus par une océanographe)

améliorer la dynamique dans les océans profonds
représenter l'effet des processus de fine échelle
ajuster les paramètres
mettre en circulation
réaliser des simulations longues

julie.deshayes@locean-ipsl.upmc.fr