Vertical thermohaline structure of mesoscale eddies in the four major Eastern Boundary Upwelling Systems

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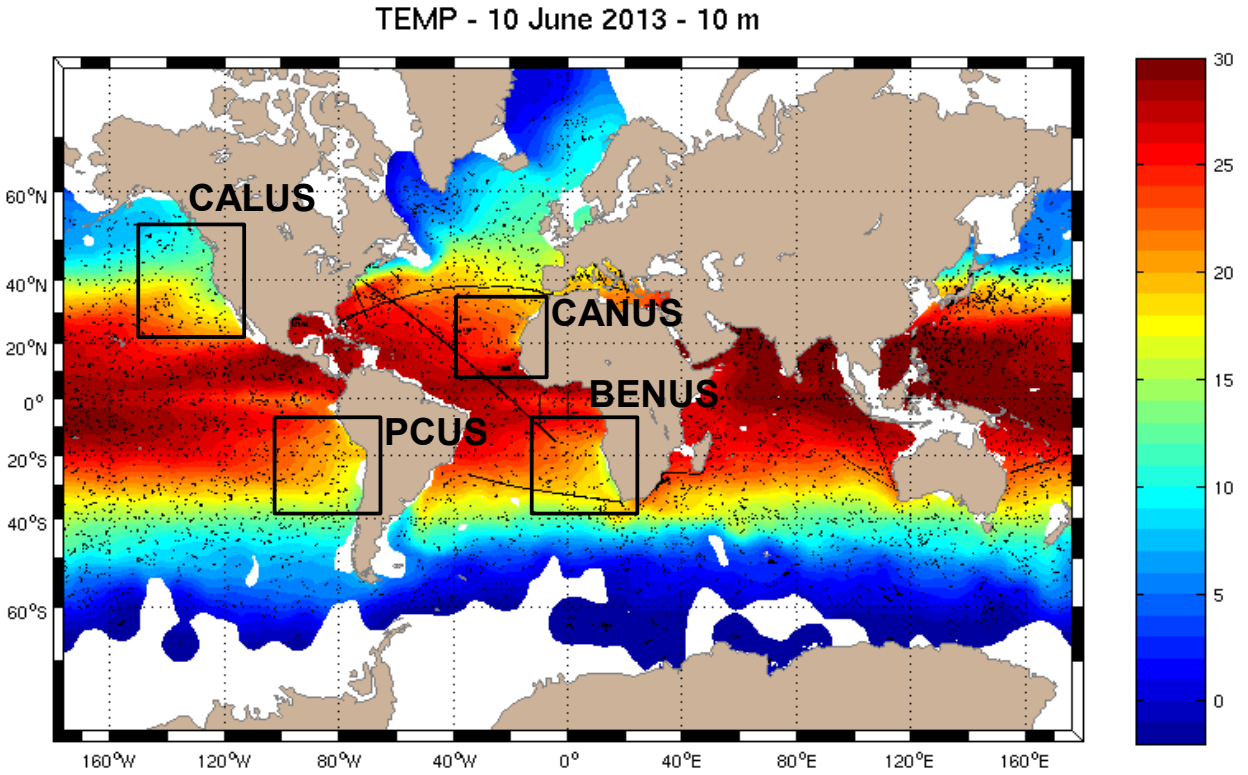
Introduction

Eastern Boundary Upwelling Systems (EBUS) are caracterized by:



→ **Cold and productive water upwelled near the coast**

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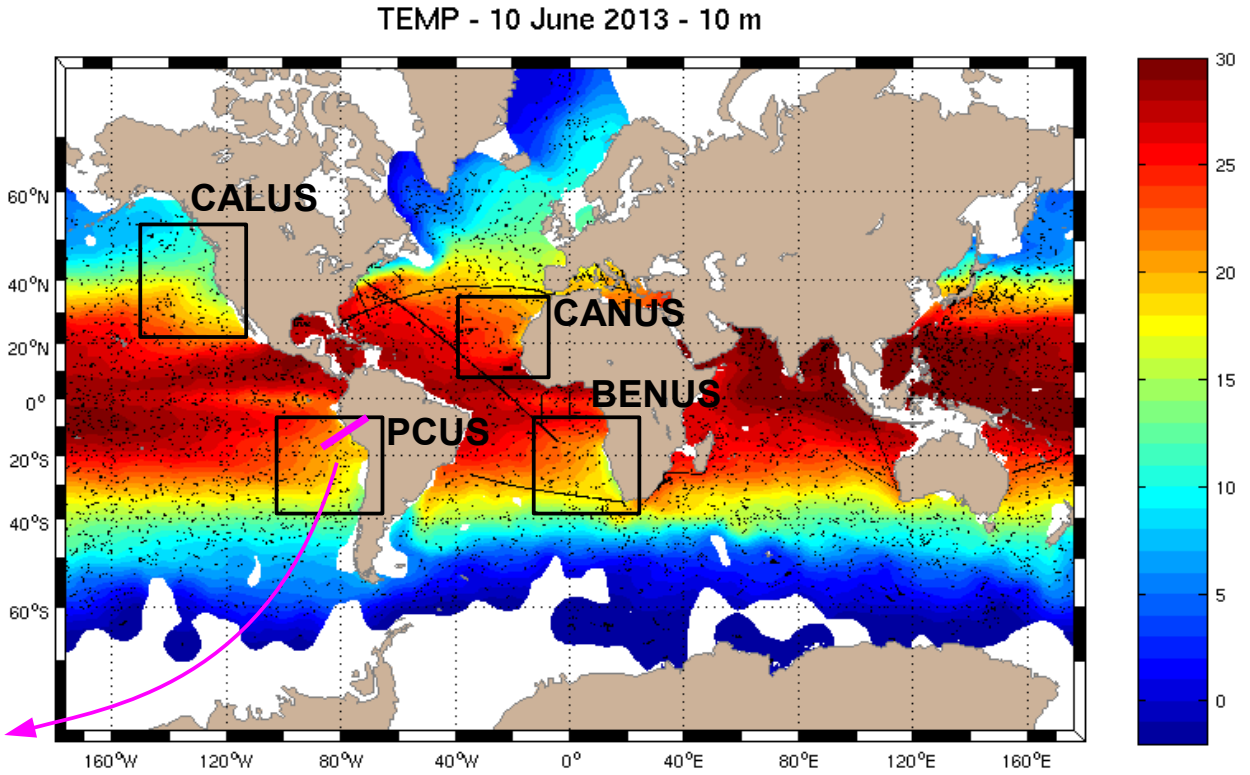

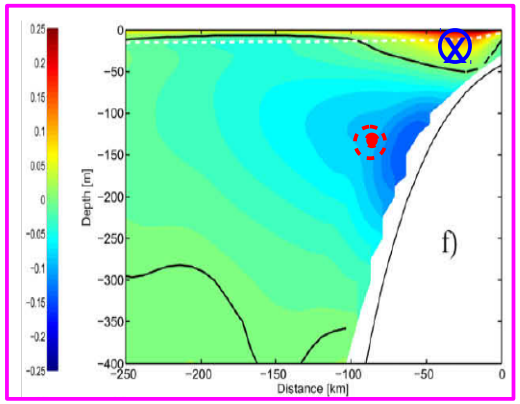

[Colas, 2008]

→ **Cold and productive water upwelled near the coast**
→ **Equatoward surface currents**
→ **Poleward subsurface currents**

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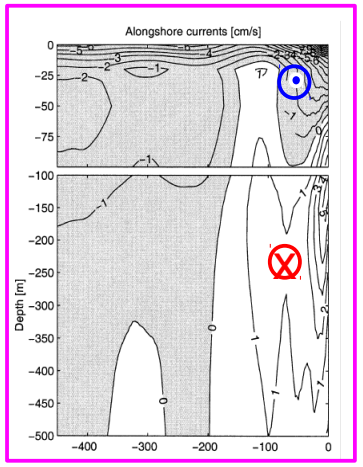
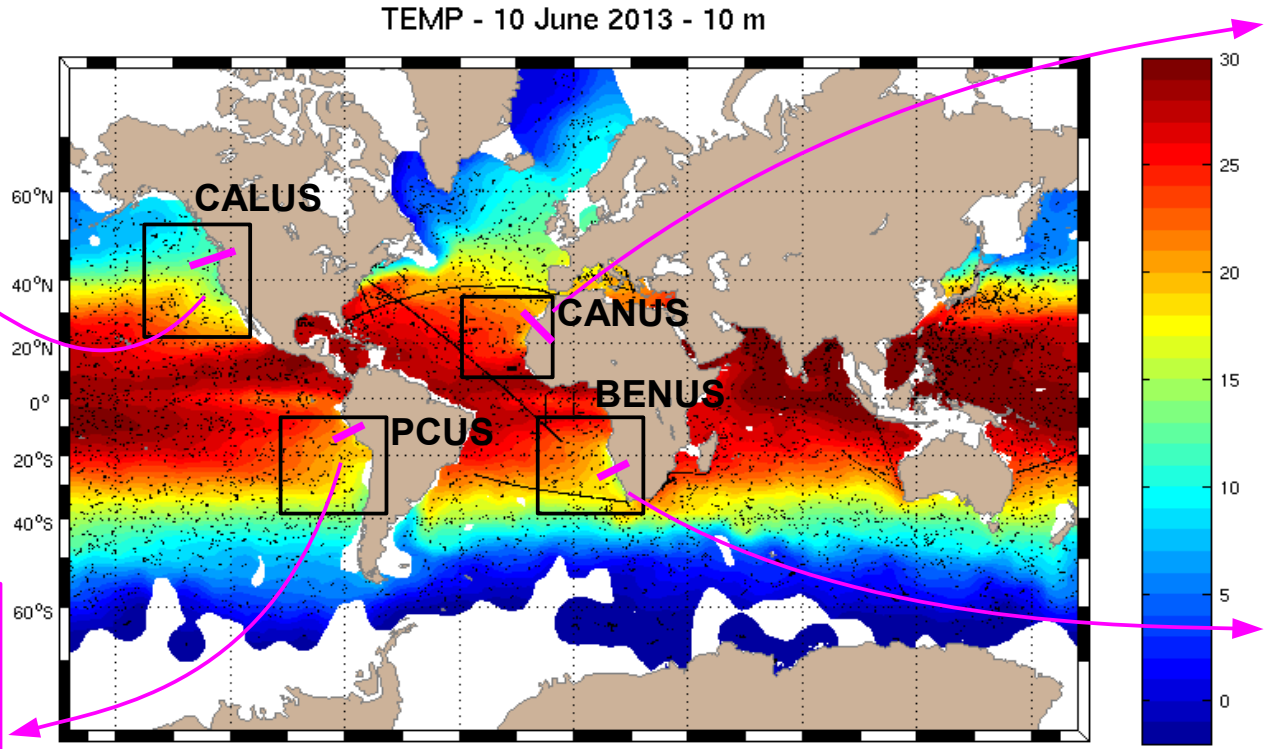
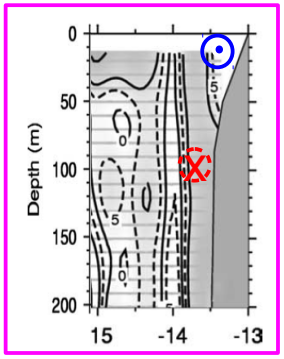


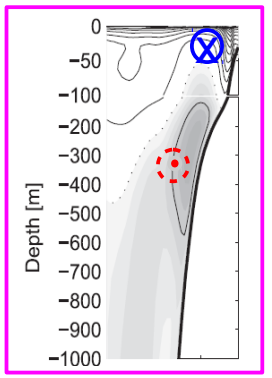
[Marchesiello, 2002]

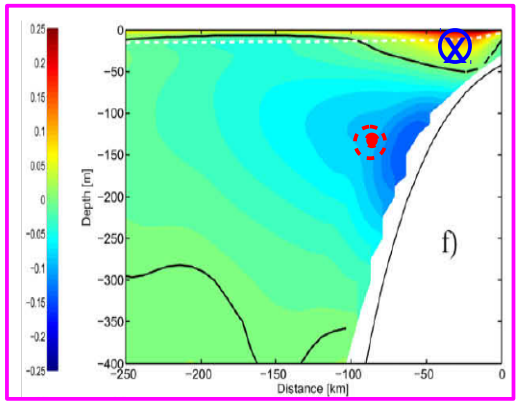


[Barton, 2004]



[Veitch, 2010]



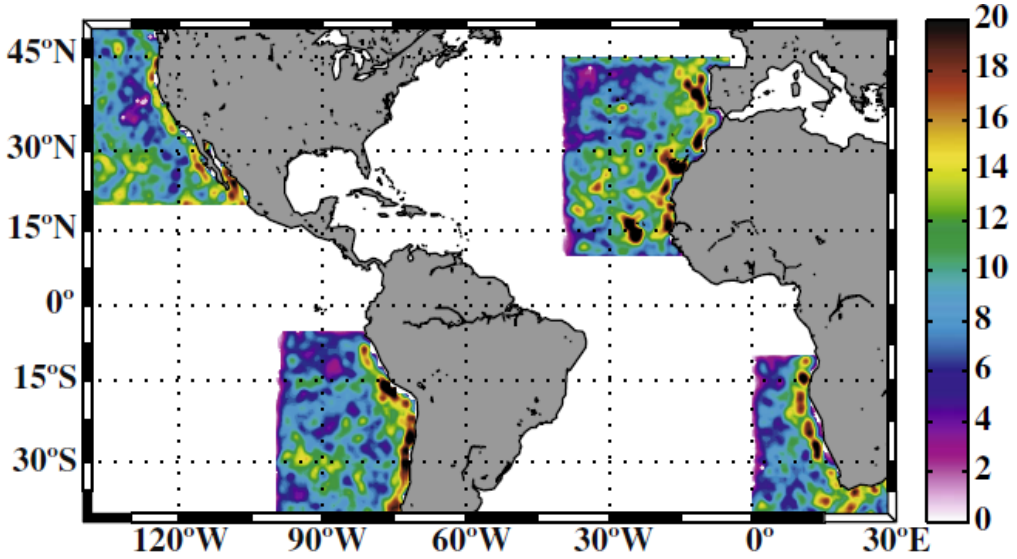


[Colas, 2008]

→ Cold and productive water upwelled near the coast
→ Equatoward surface currents
→ Poleward subsurface currents
→ Strong vertical shear

Introduction

Eddy genesis



[Chaigneau et al., 2009]

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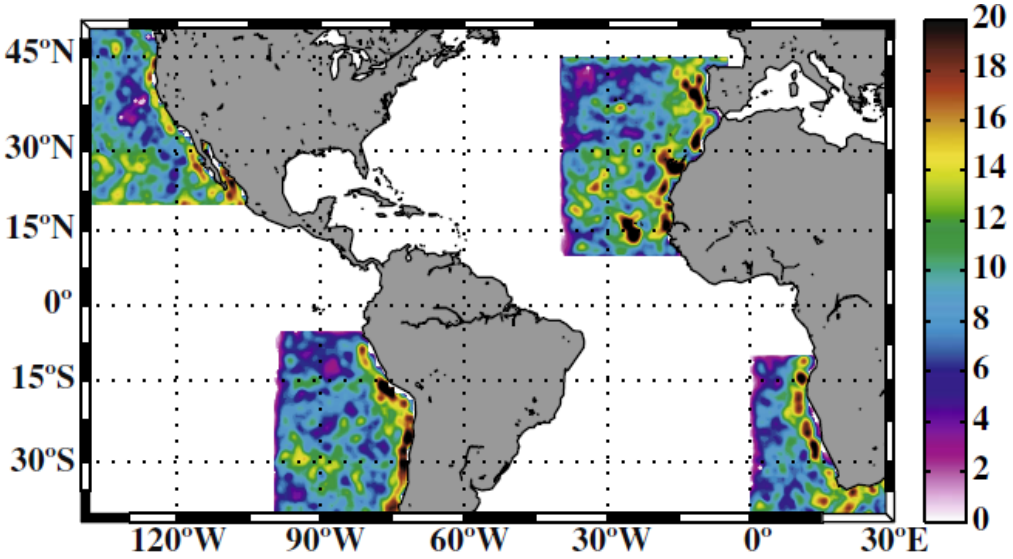
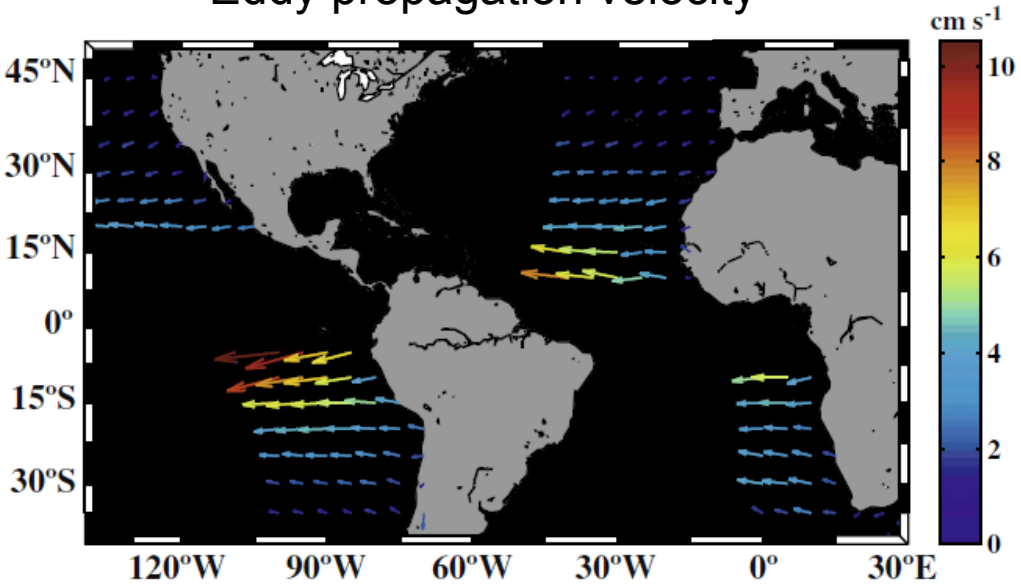
Eddy genesis



Eddy propagation velocity



[Chaigneau et al., 2009]

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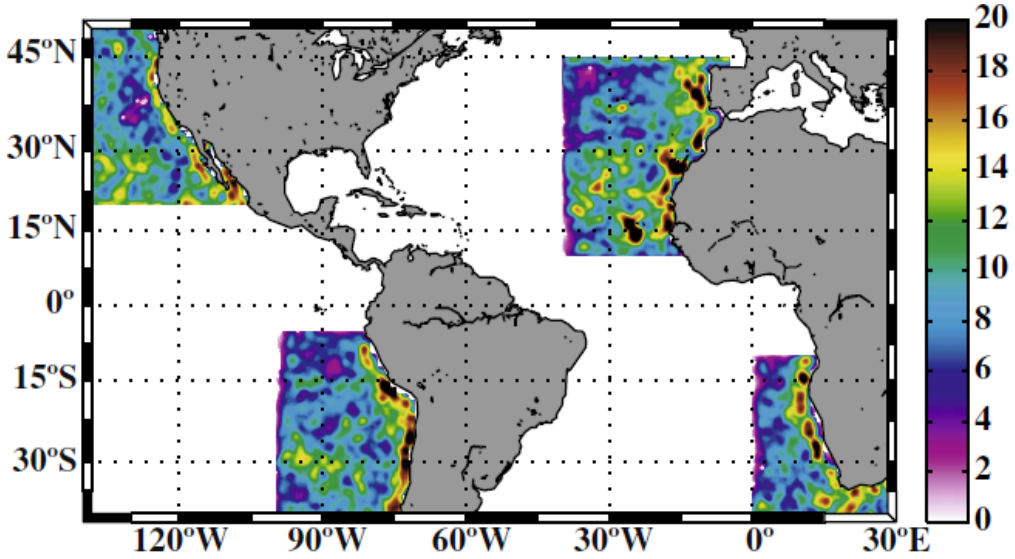
Eddy genesis



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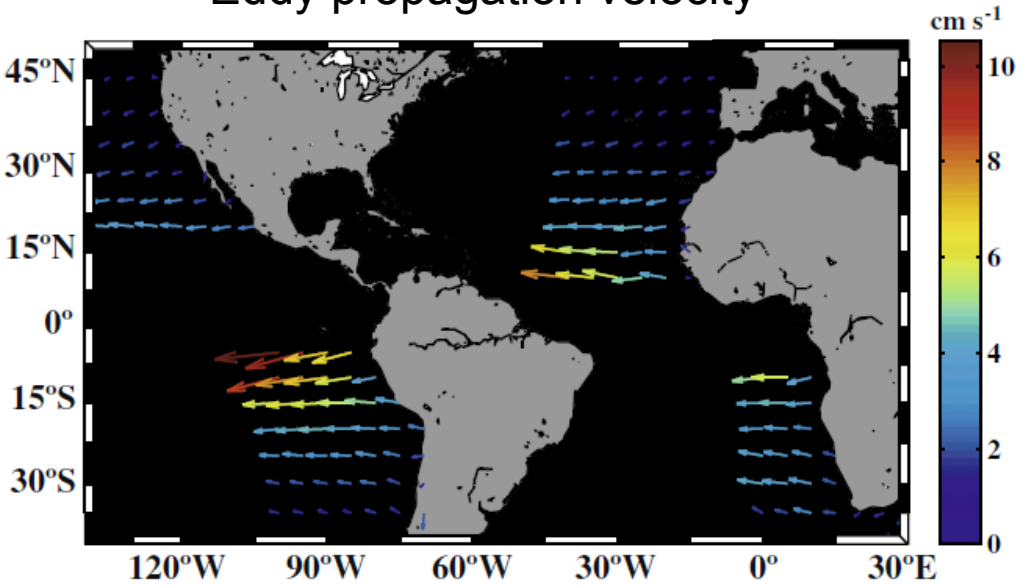

[Chaigneau et al., 2009]

Do eddies also share similar vertical structure ?

Objective

Depict the eddy vertical structure in the 4 EBUS, combining altimetry and ARGO floats profiles

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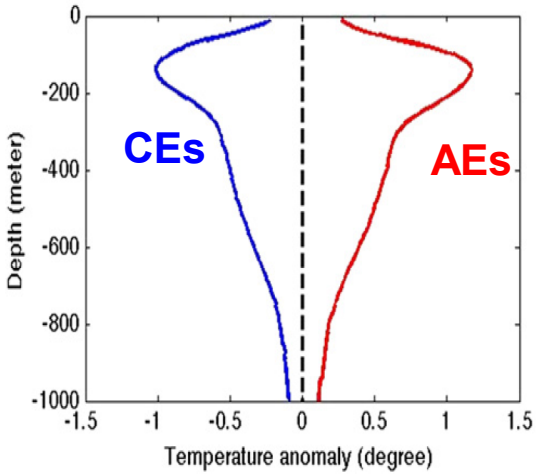
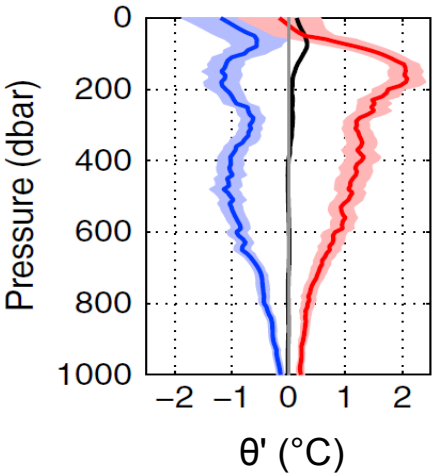
Depict the eddy vertical structure in the 4 EBUS, combining altimetry and ARGO floats profiles

North-West Pacific



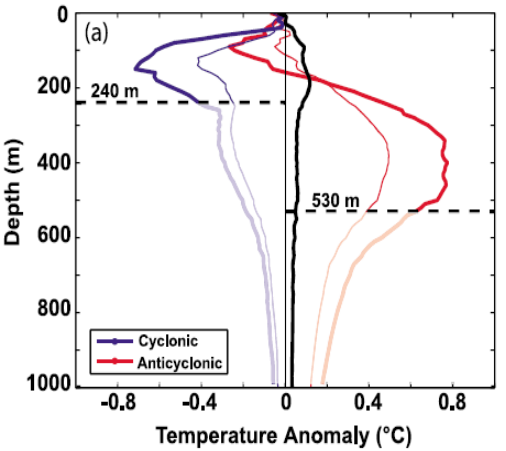
[Yu et al., 2012]

North-West Pacific



[Yang et al., 2013]

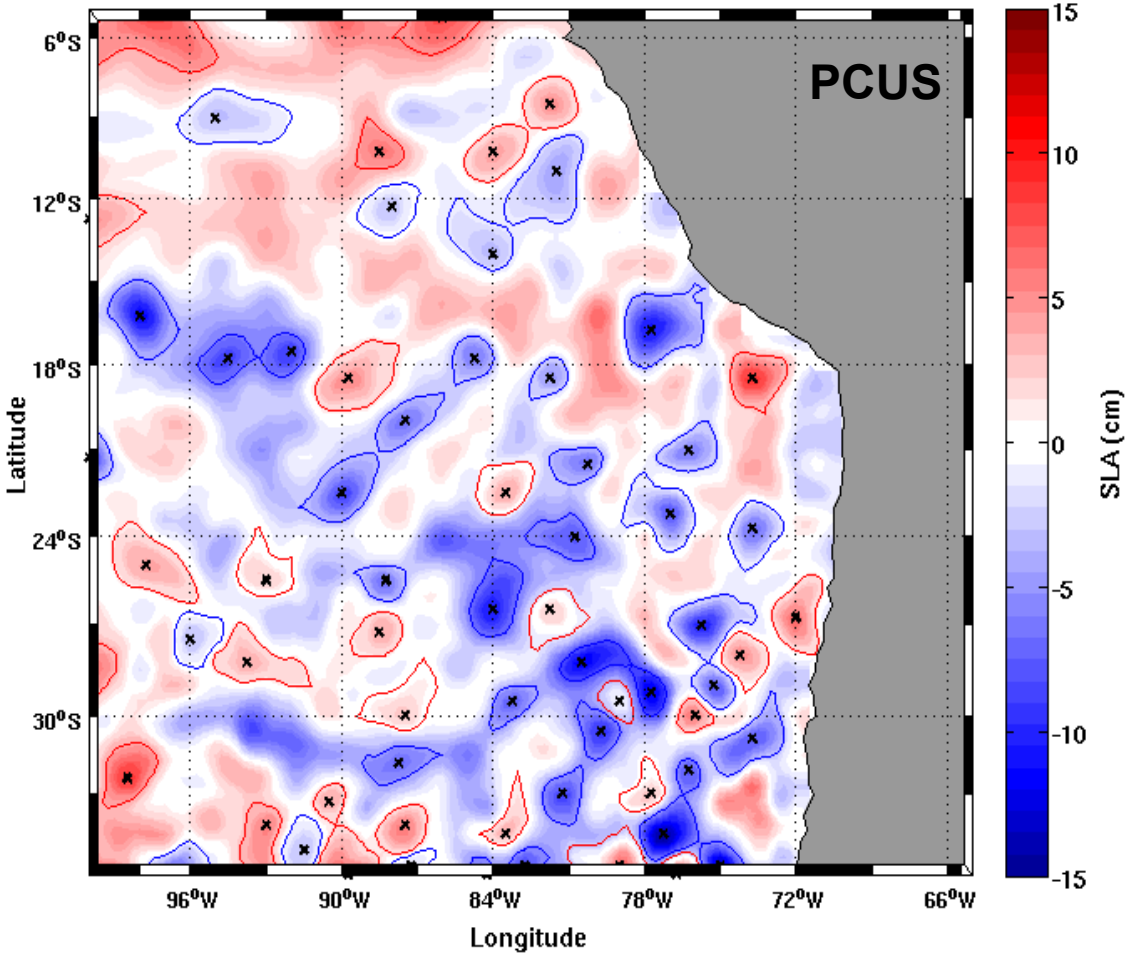
South-East Pacific



[Chaigneau et al., 2011]

Data & Method

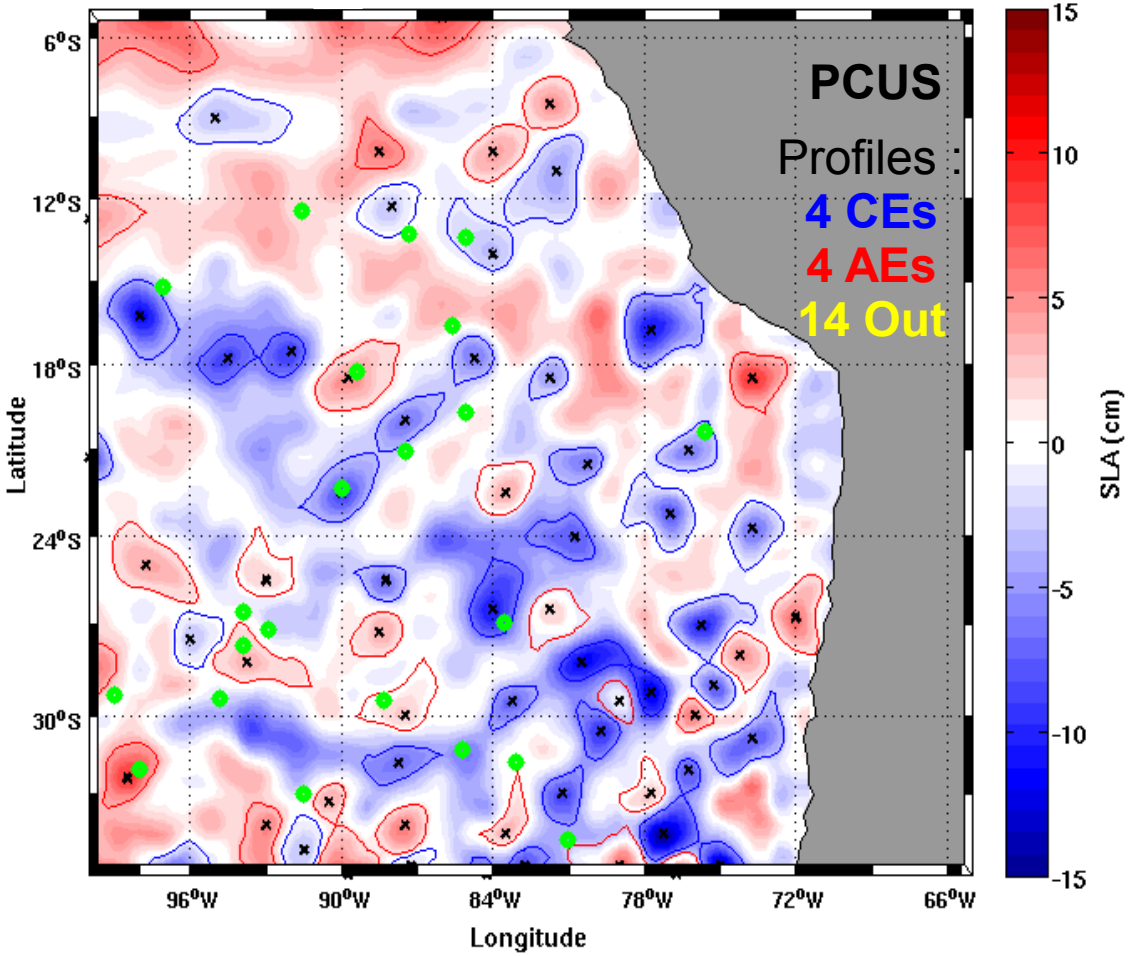
Weekly altimetry maps
2001 - 2012



Automated eddy detection skills (amplitude > 2 cm)
[Chaigneau et al., 2008]

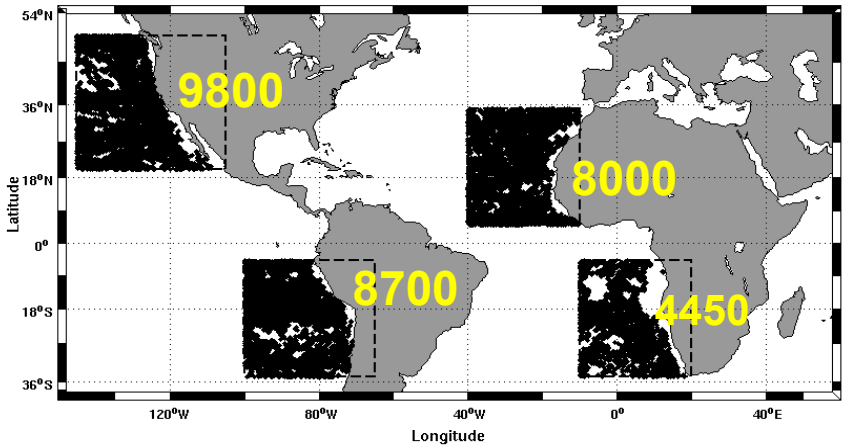
Data & Method

ARGO profiles + altimetry

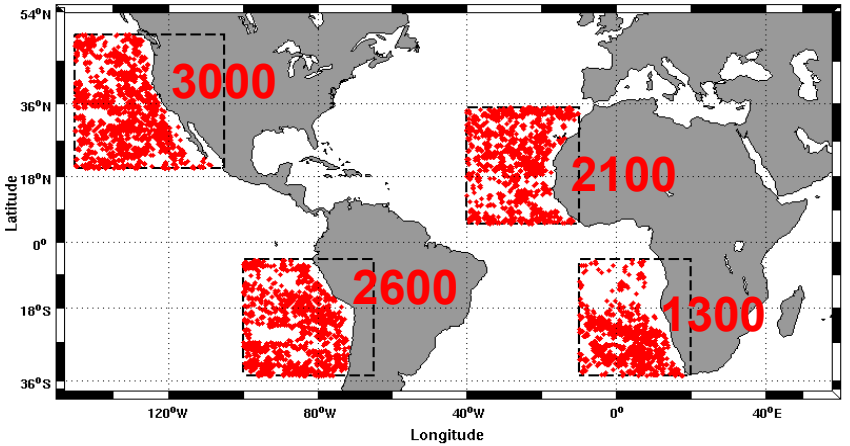


Classification of the ARGO profiles within CE, AE or outside eddies

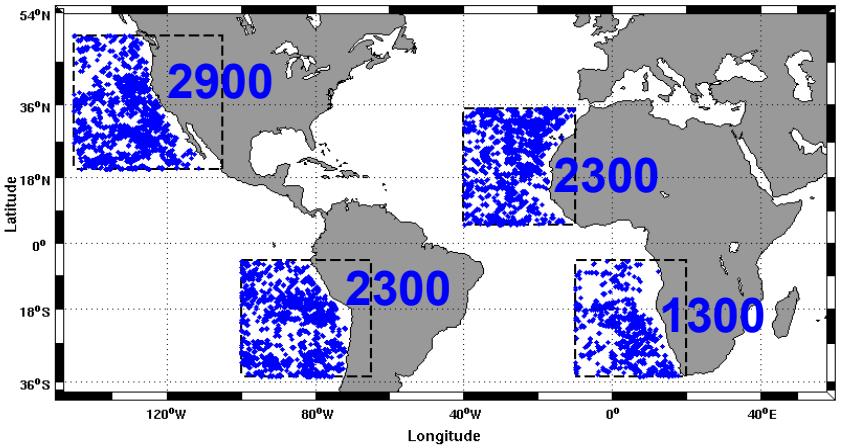
Data & Method



Outside Eddies (OEs)
~60 %

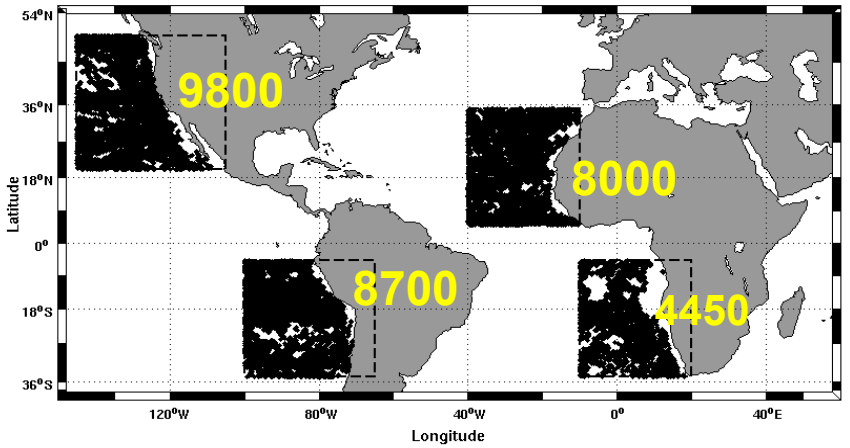


Anticyclonic Eddies (AEs)
~20 %

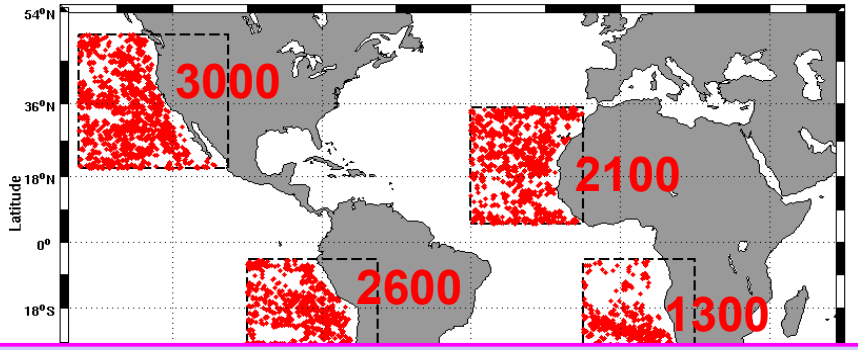


Cyclonic Eddies (CEs)
~20 %

Data & Method

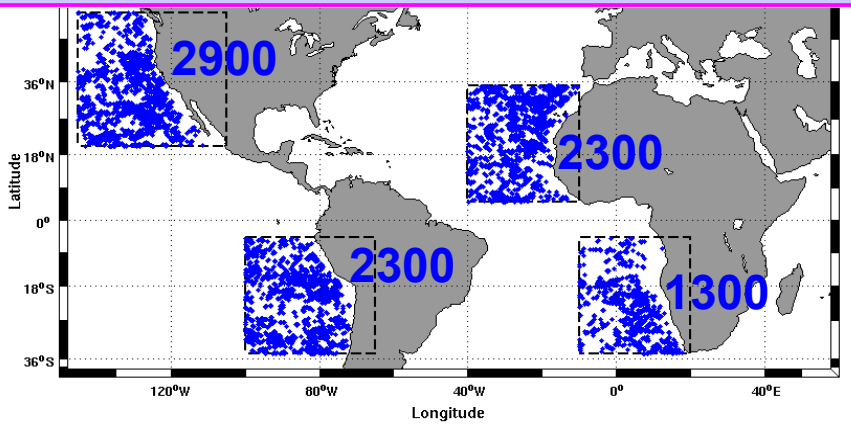


Outside Eddies (OEs)
~60 %



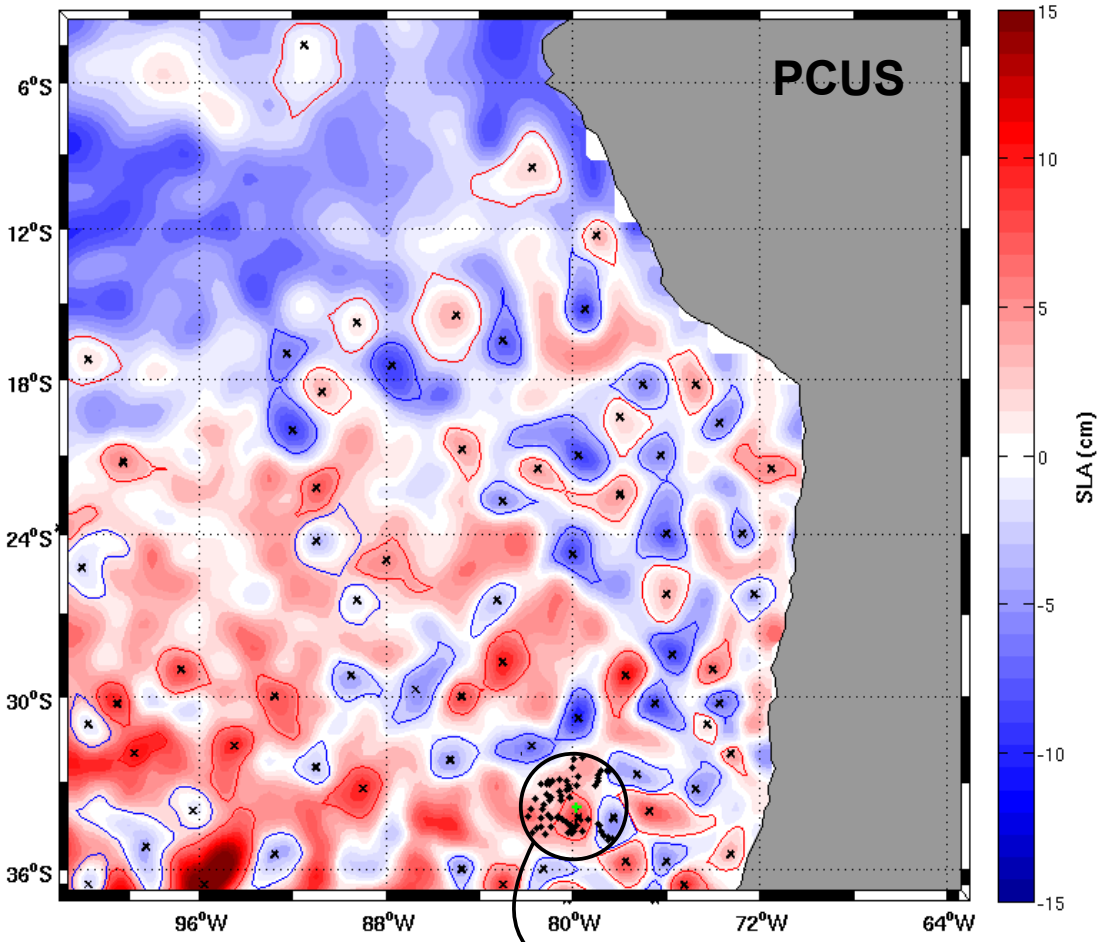
Anticyclonic Eddies (AEs)
~20 %

→ **Temperature and salinity anomalies**



Cyclonic Eddies (CEs)
~20 %

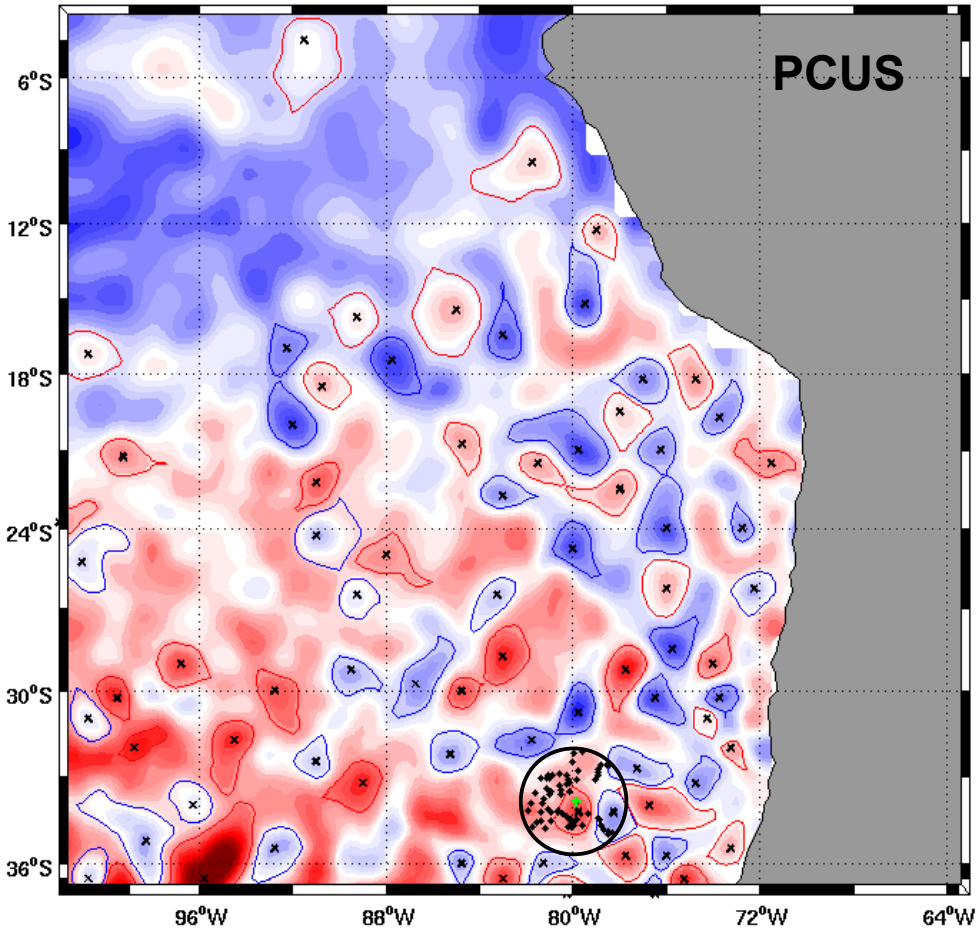
Data & Method

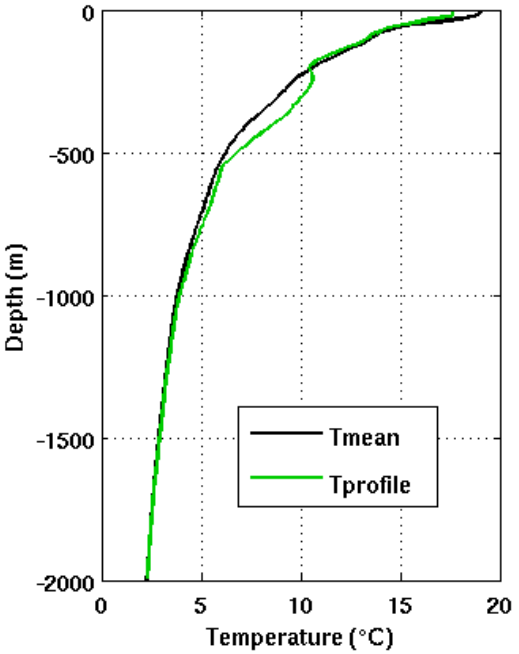


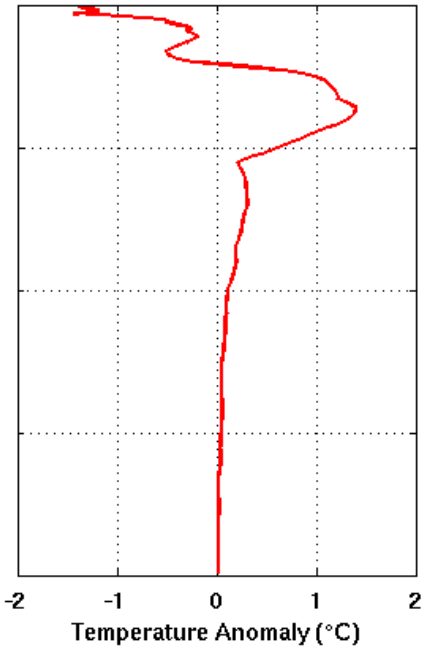
< 200 km
+/- 1 month

→ local mean

Data & Method

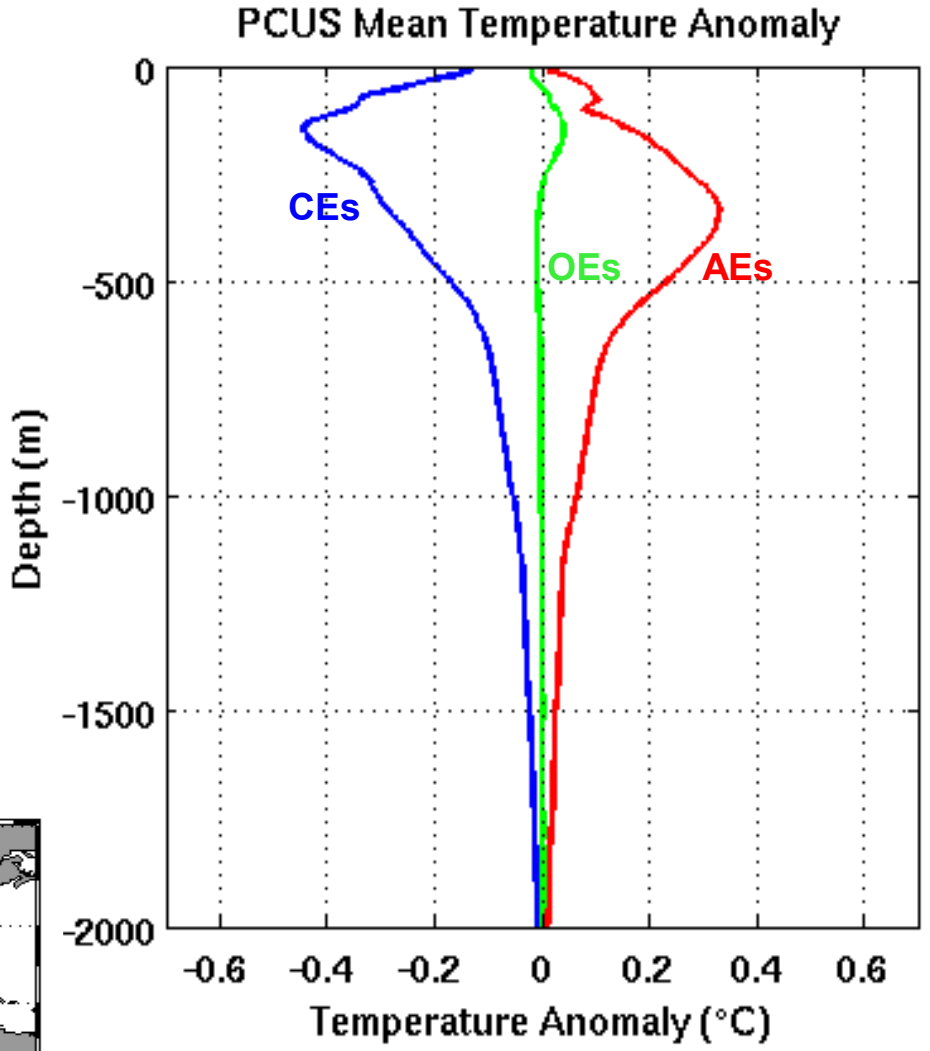


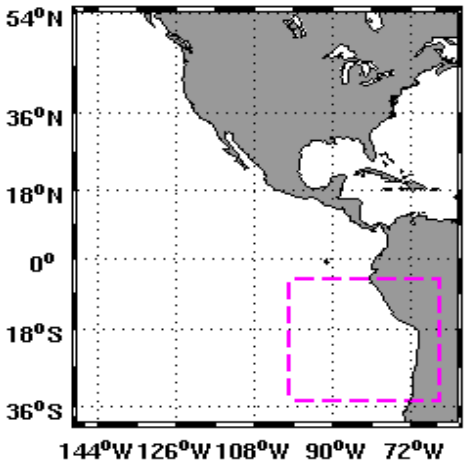




Done for all the availables profiles
→ within AEs
→ within CEs
→ outside eddies

Results : Mean temperature anomaly





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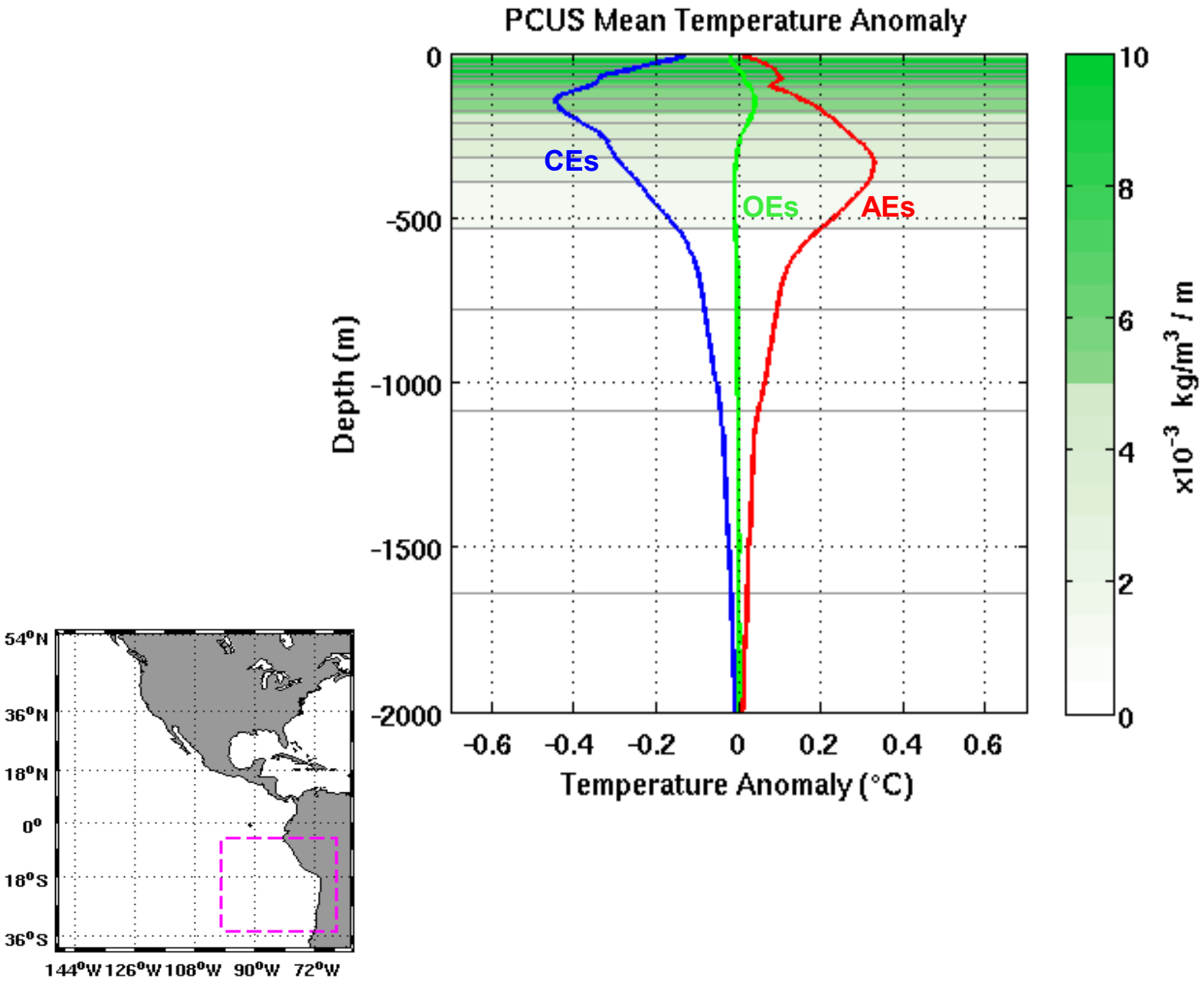
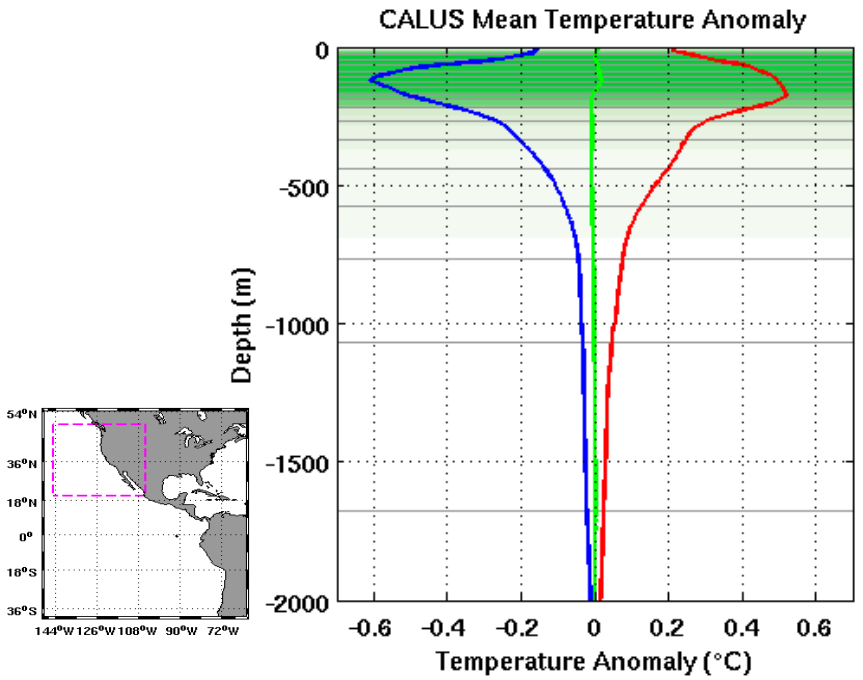
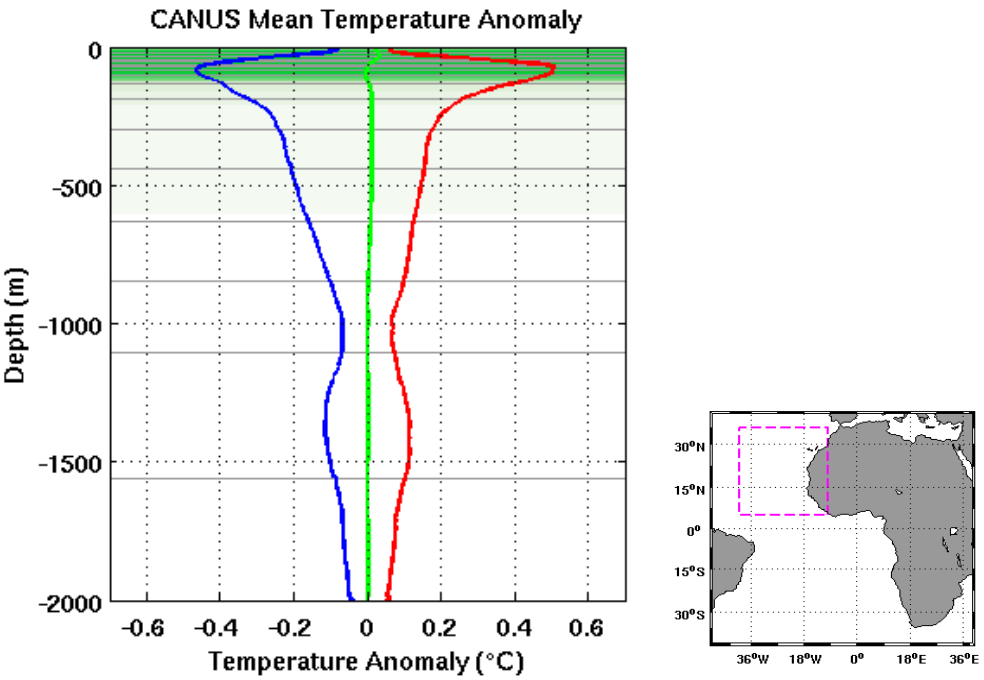
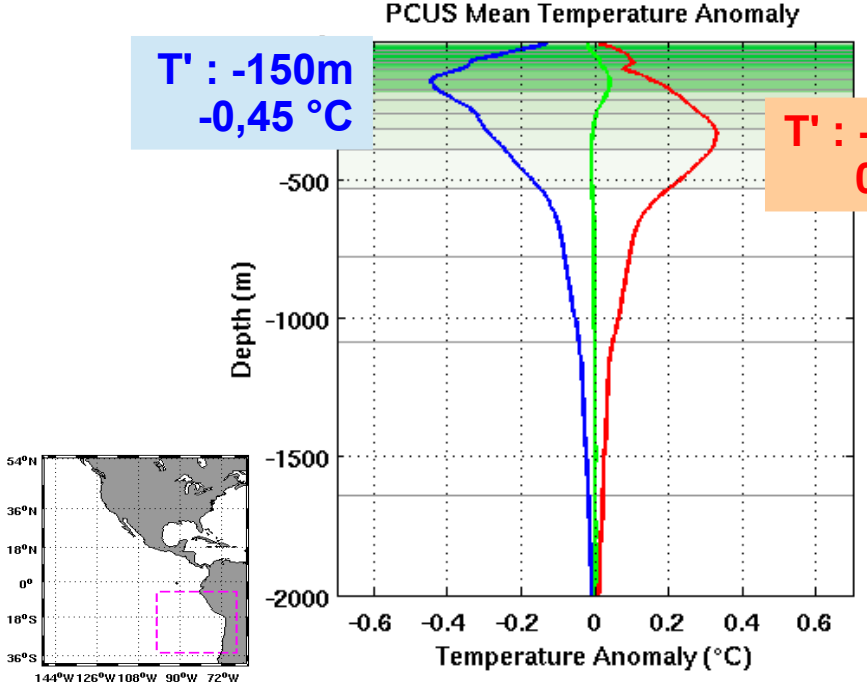
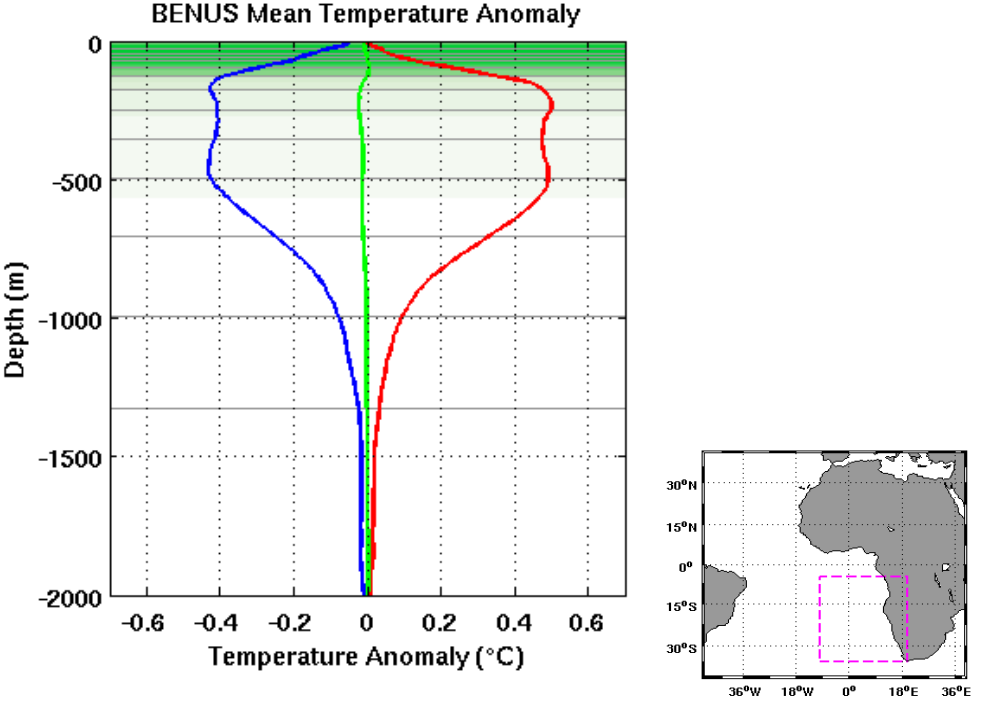


Results : Mean temperature anomaly



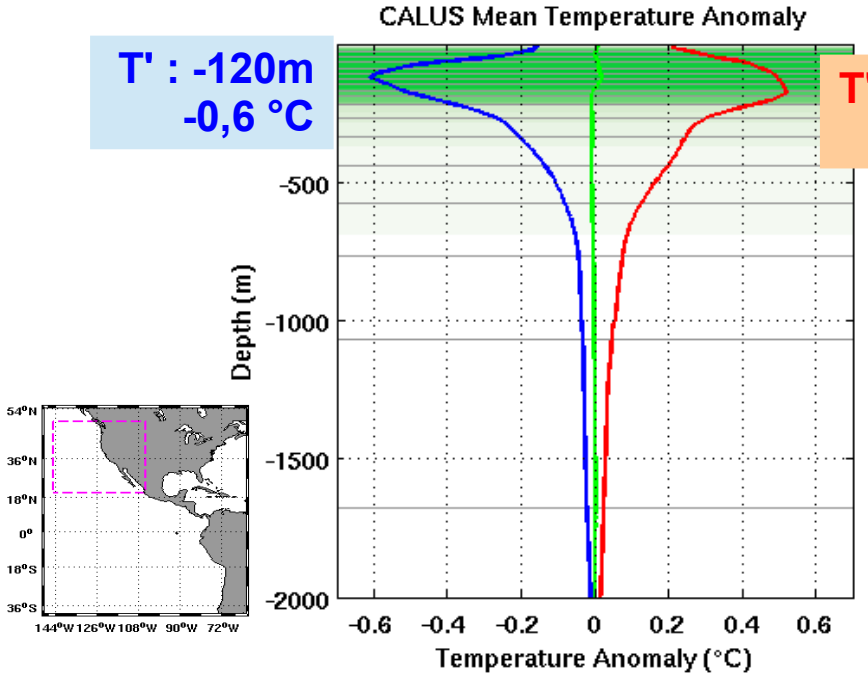




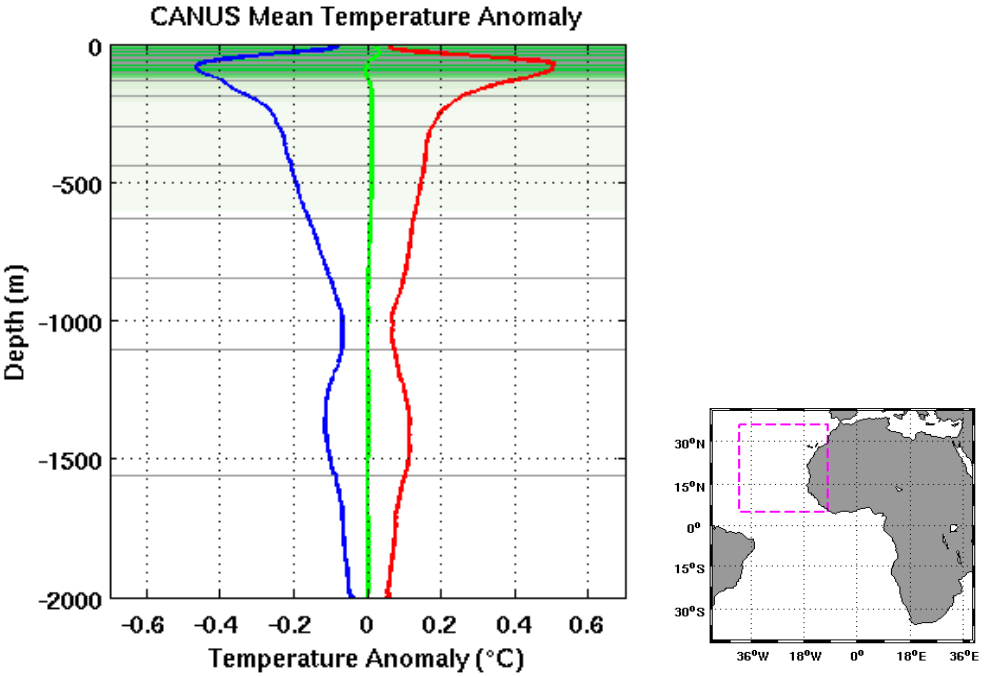


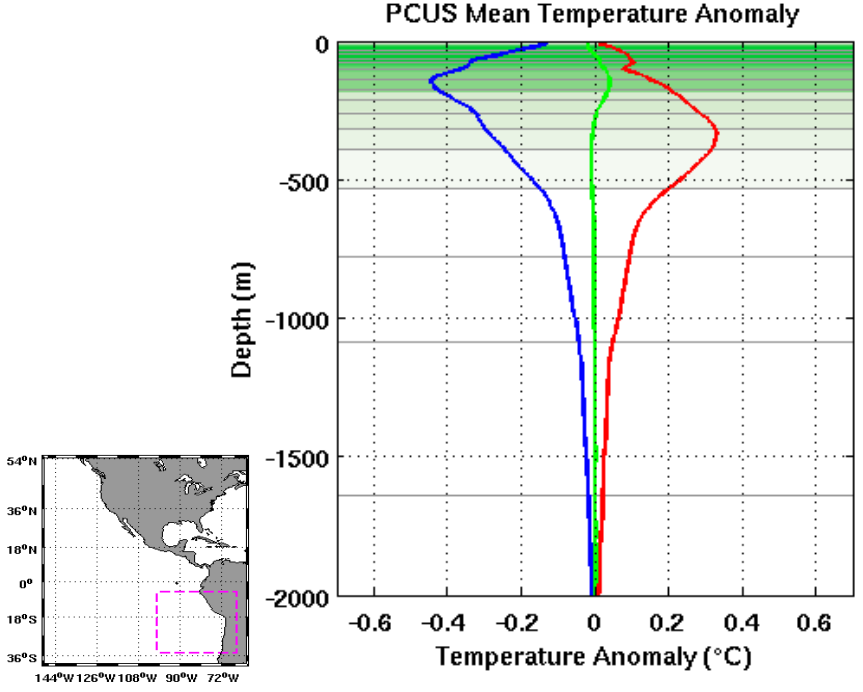
Results : Mean temperature anomaly

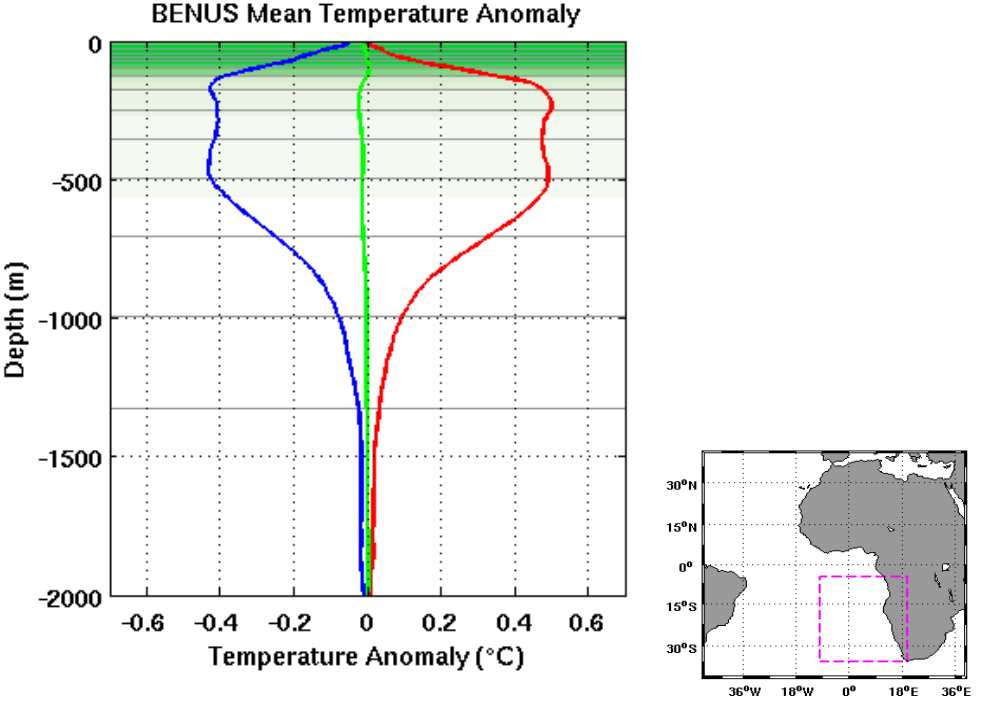
T' : -120m
-0,6 °C



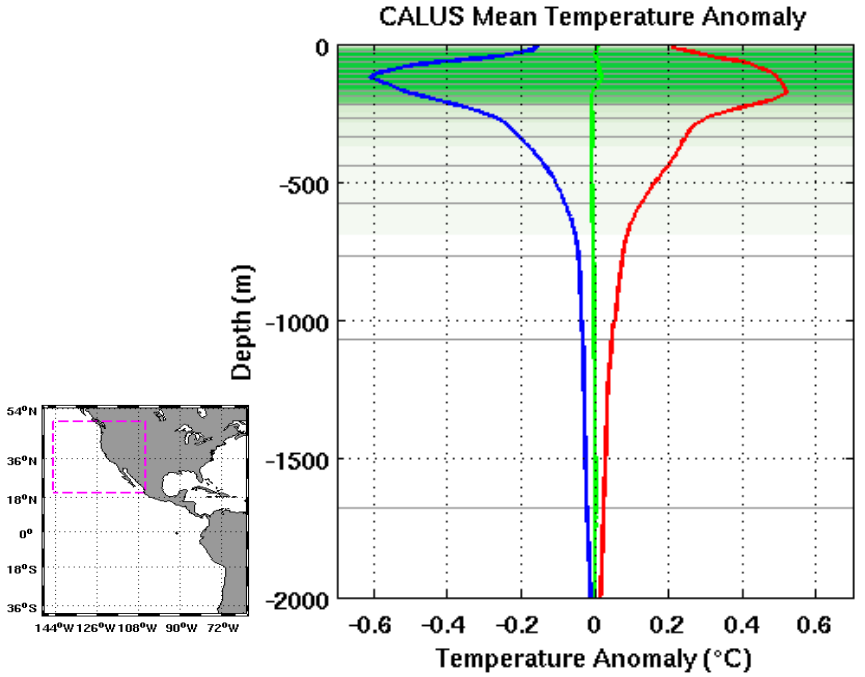
T' : -170m
0,5°C





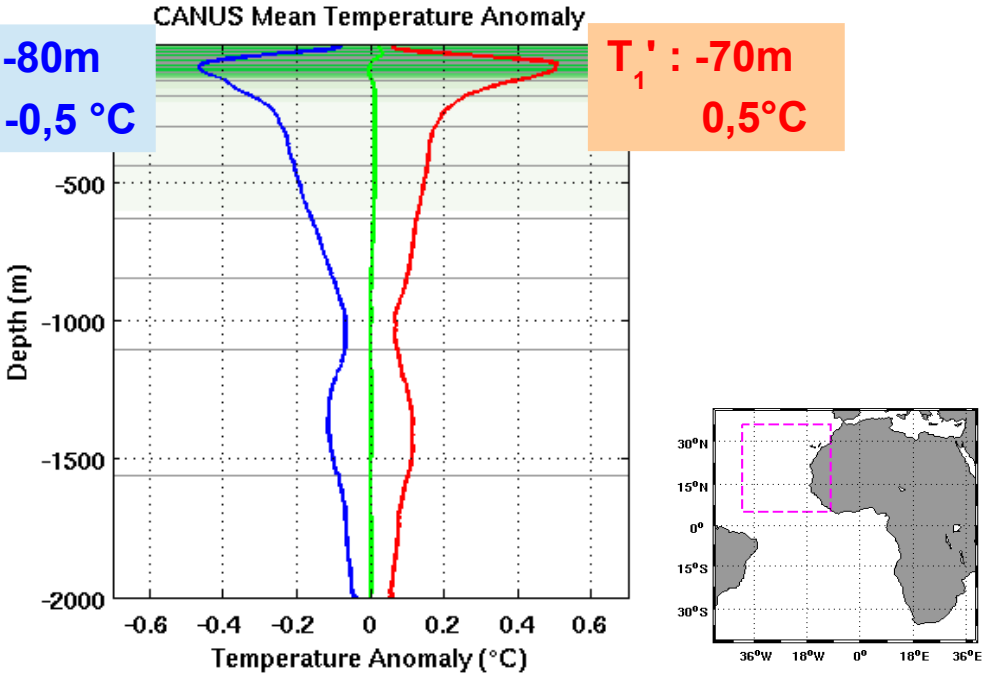


Results : Mean temperature anomaly



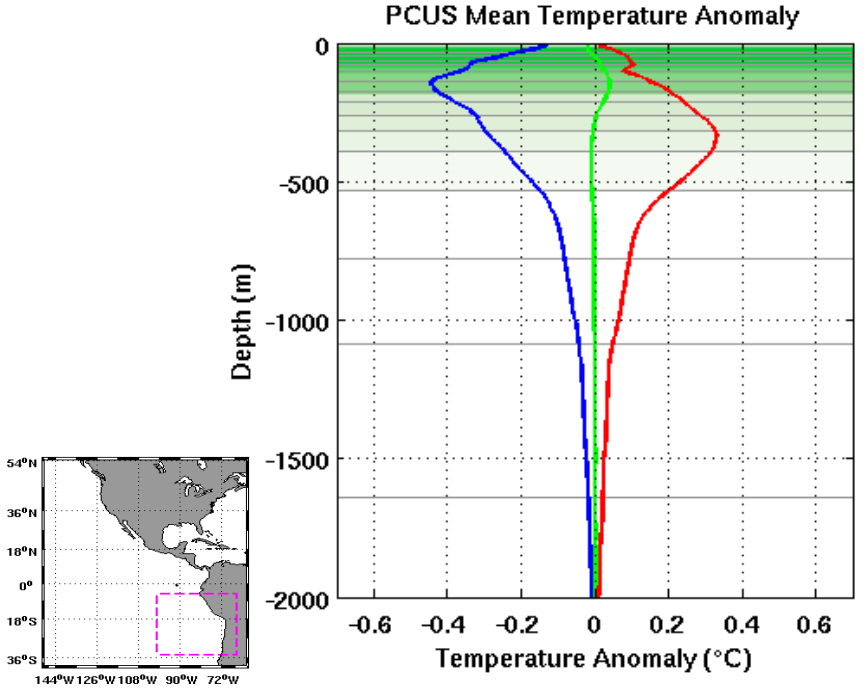
T_1' : -80m

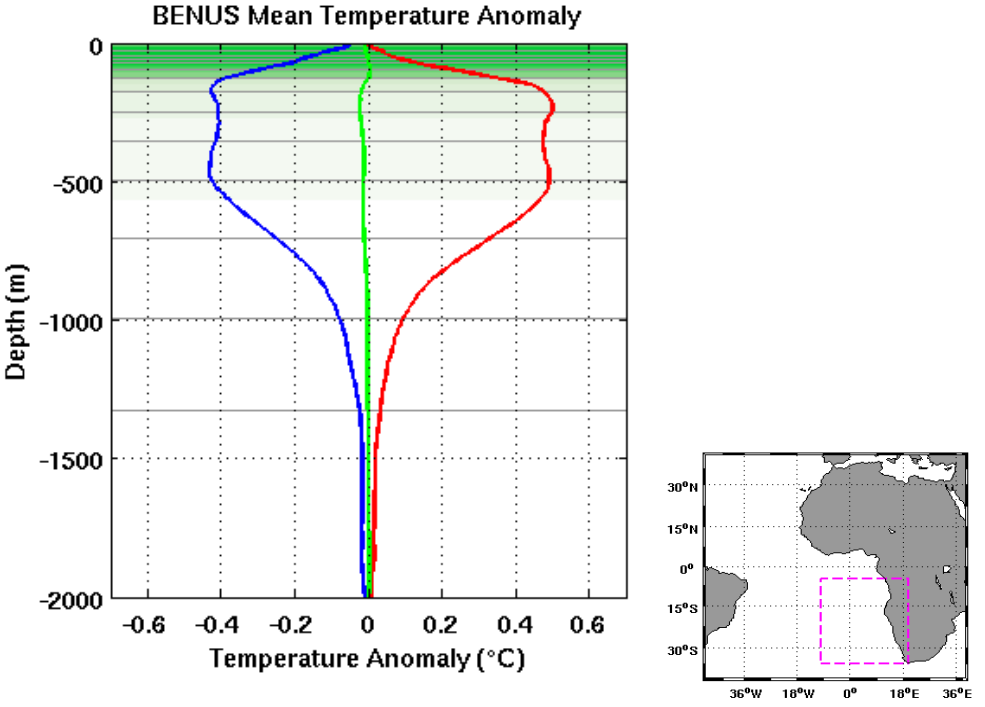
-0,5 °C



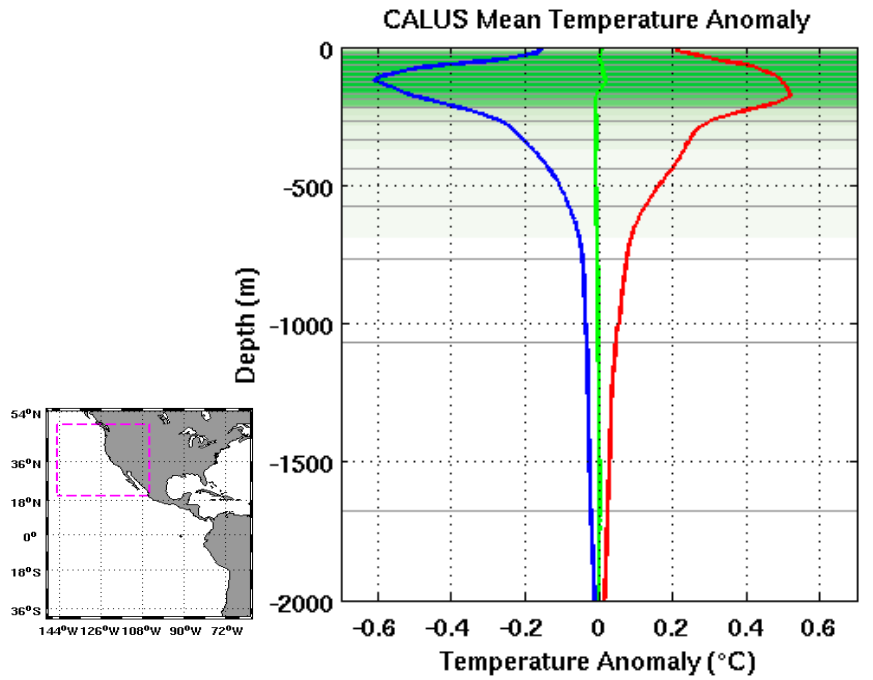
T_1' : -70m

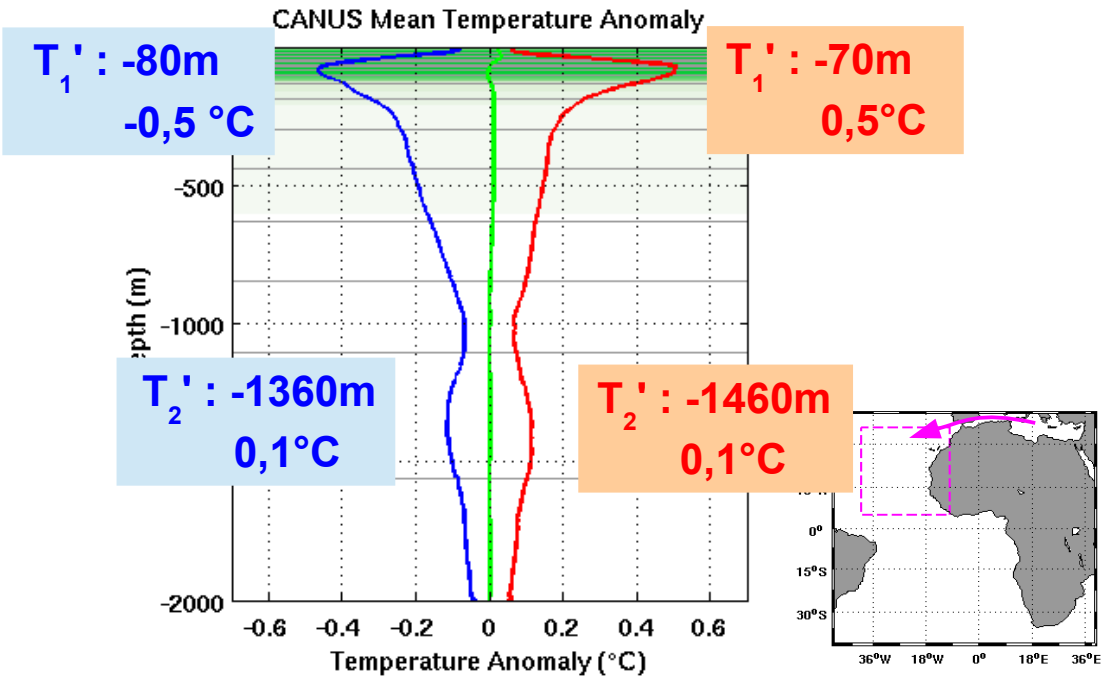
0,5°C

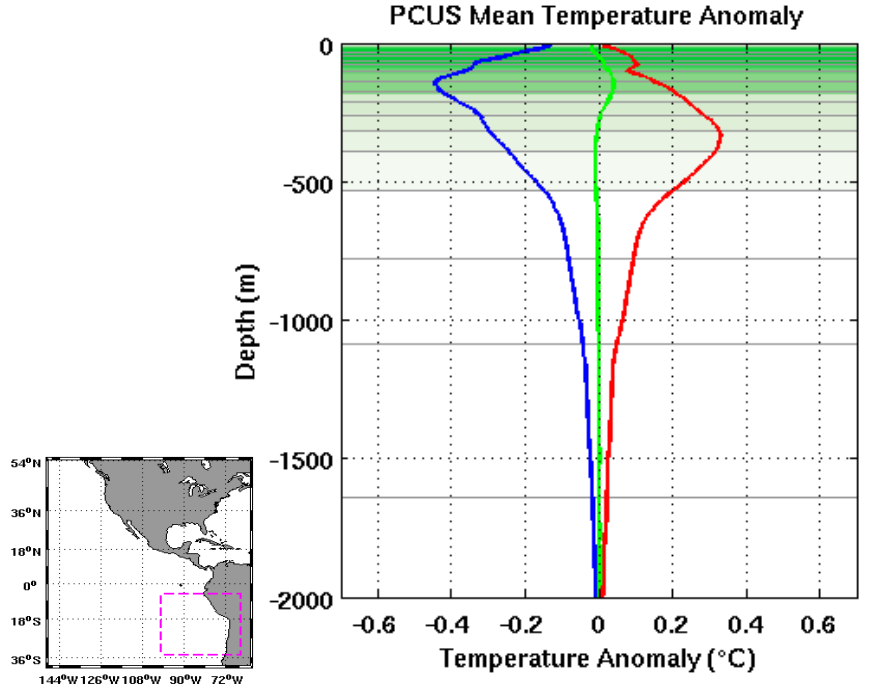


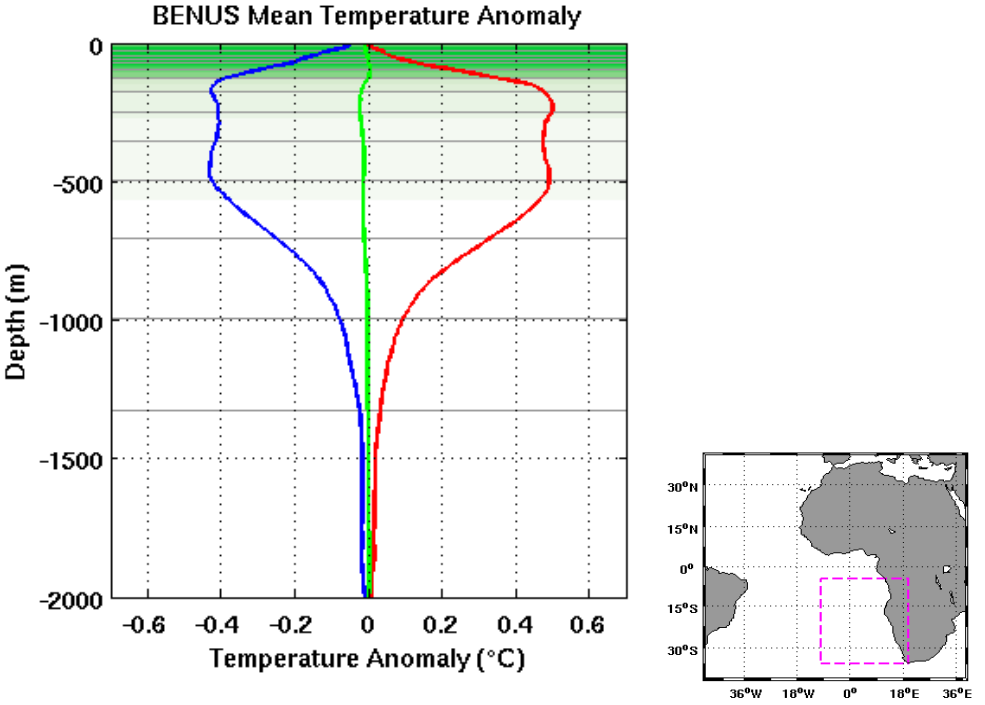


Results : Mean temperature anomaly









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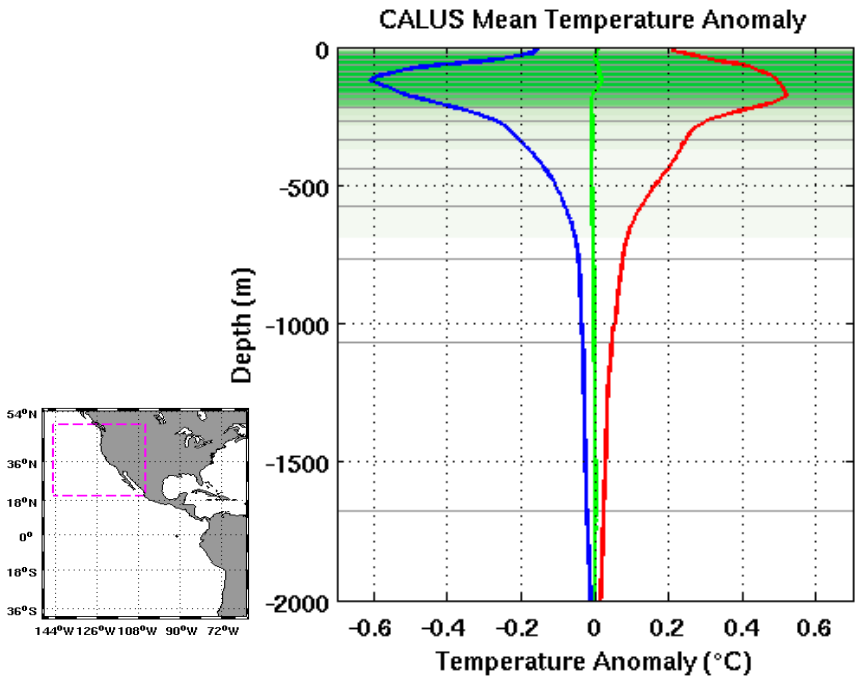
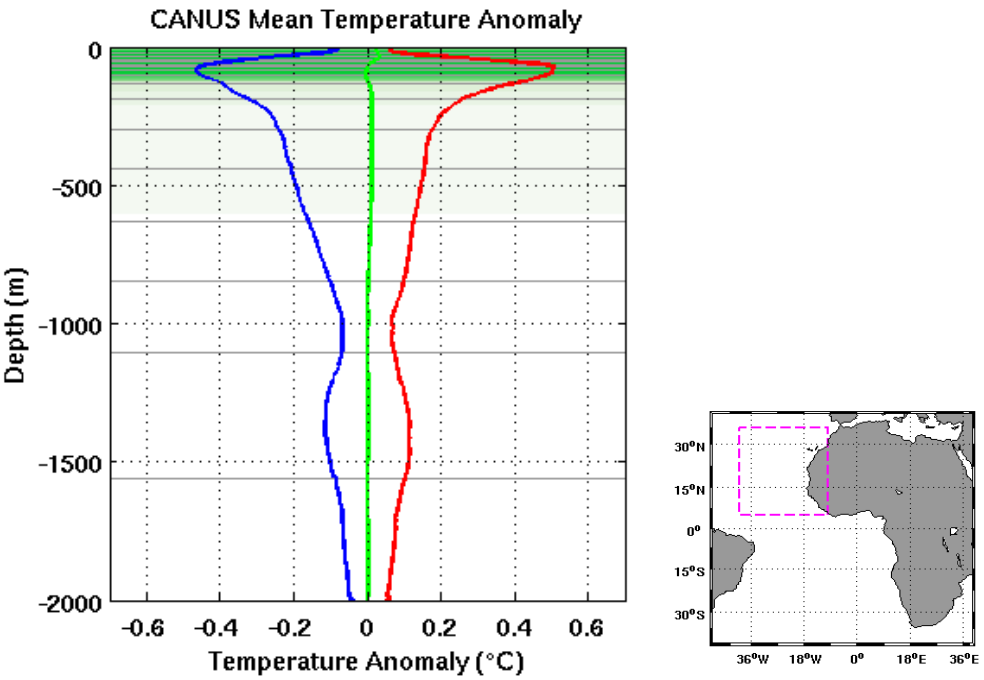
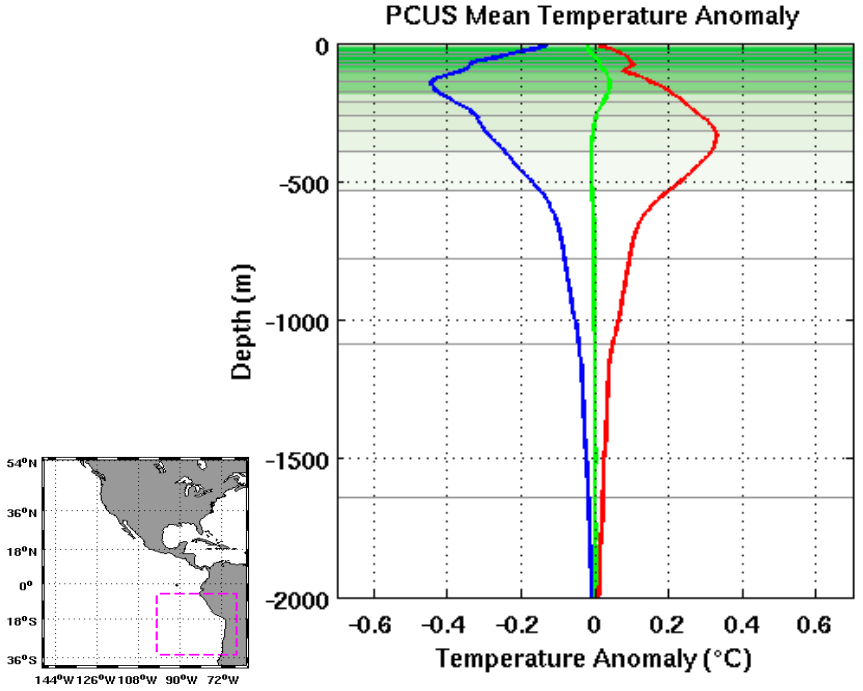
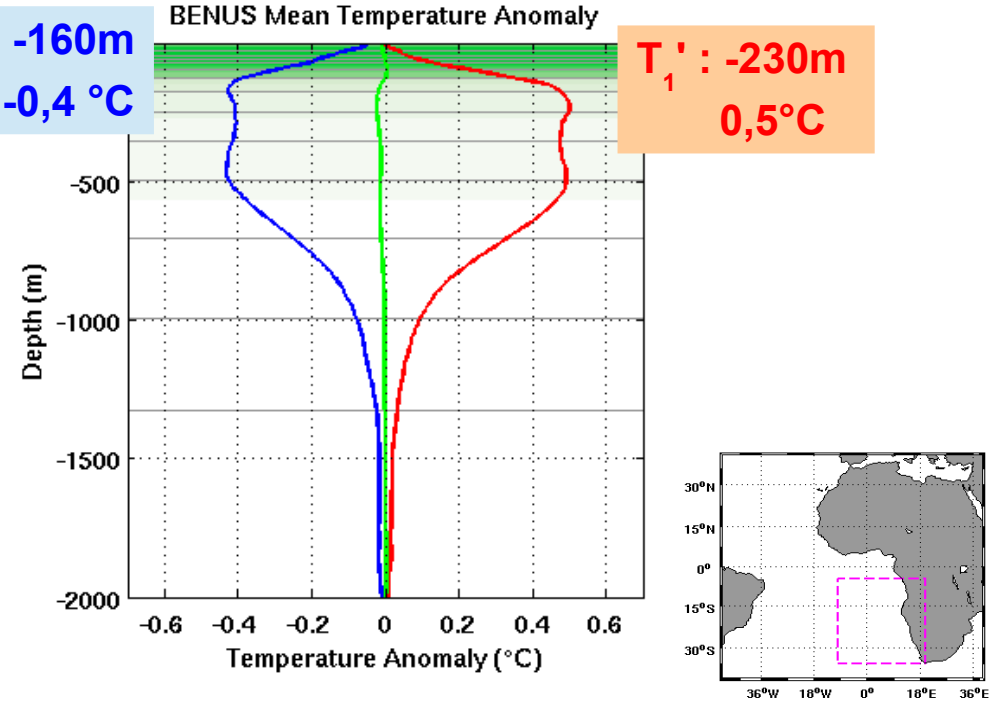




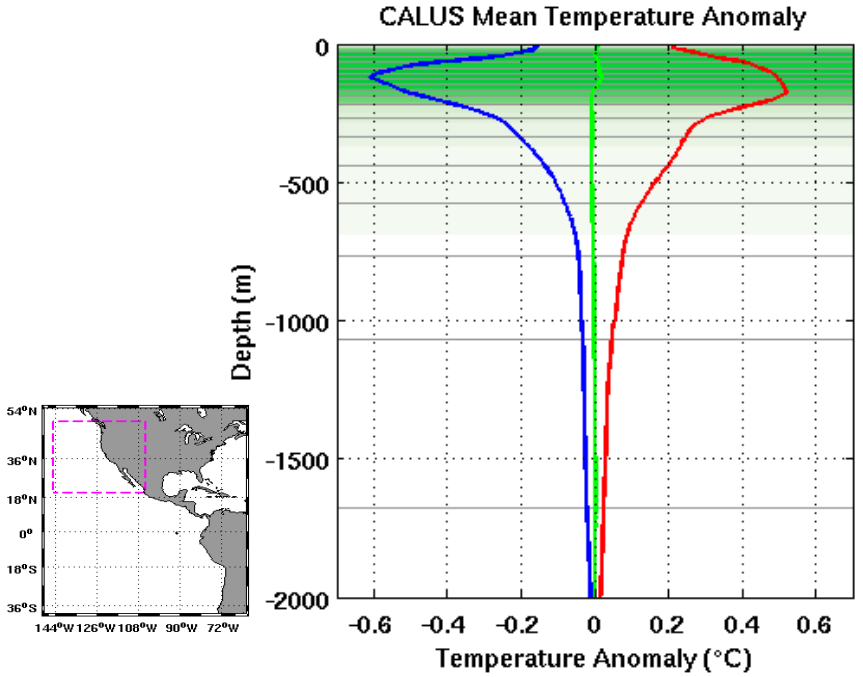


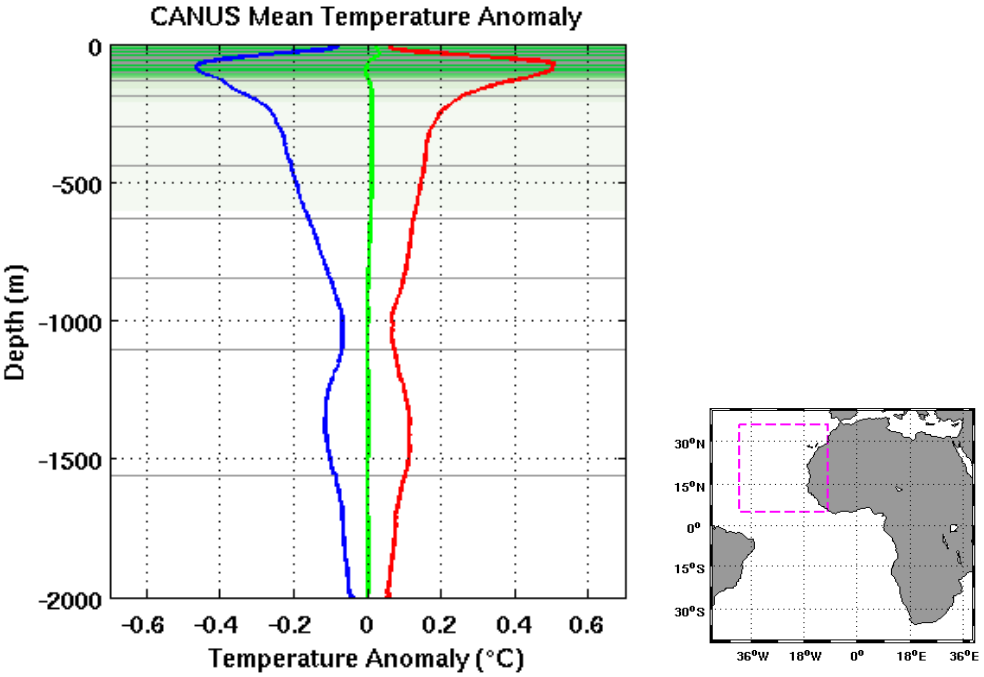
T_1' : -160m
-0,4 °C

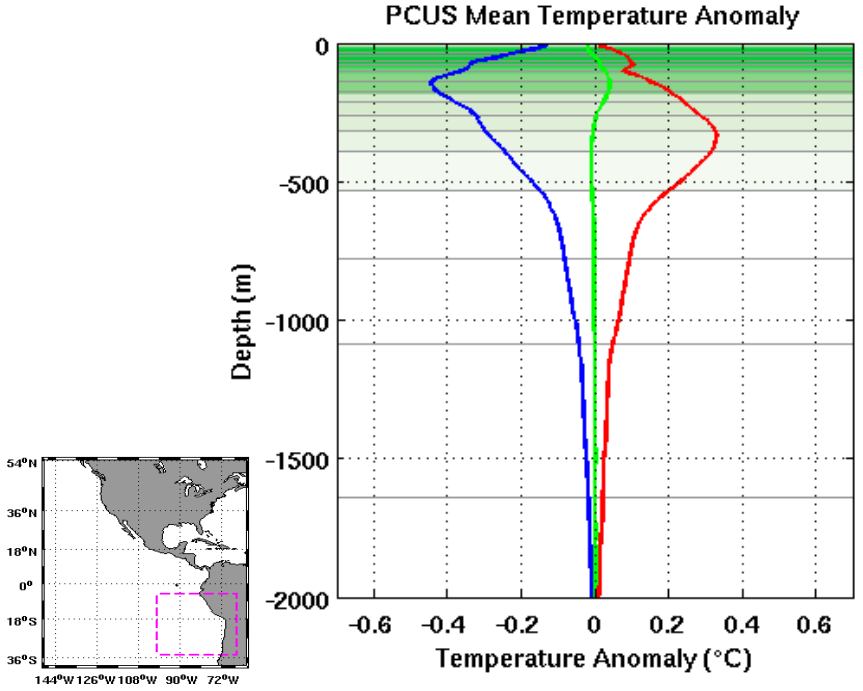


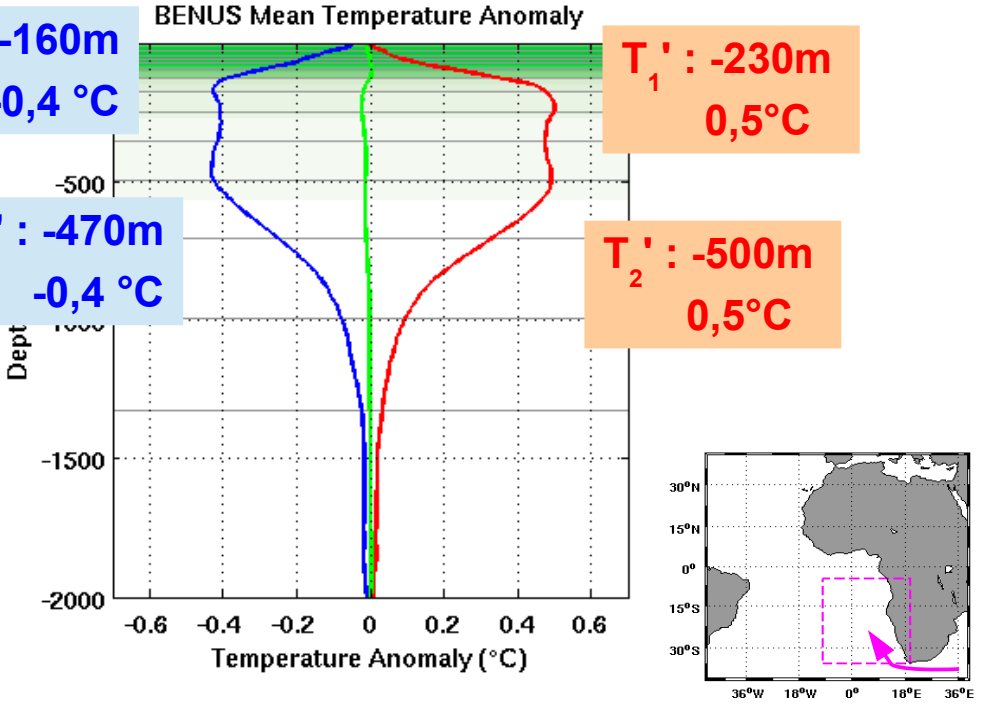
T_1' : -230m
0,5°C

Results : Mean temperature anomaly









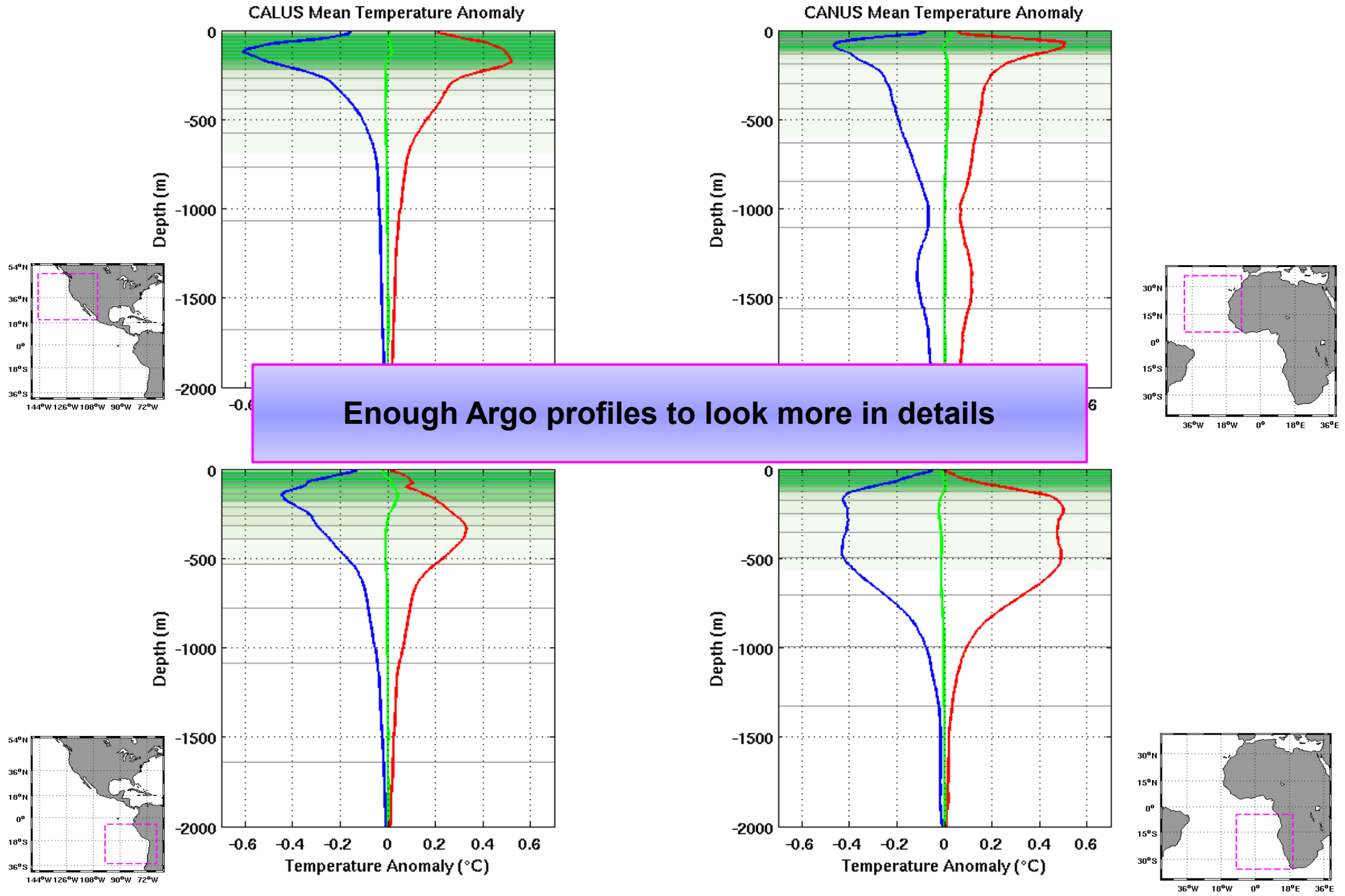
T_1' : -160m
-0,4 °C

T_2' : -470m
-0,4 °C

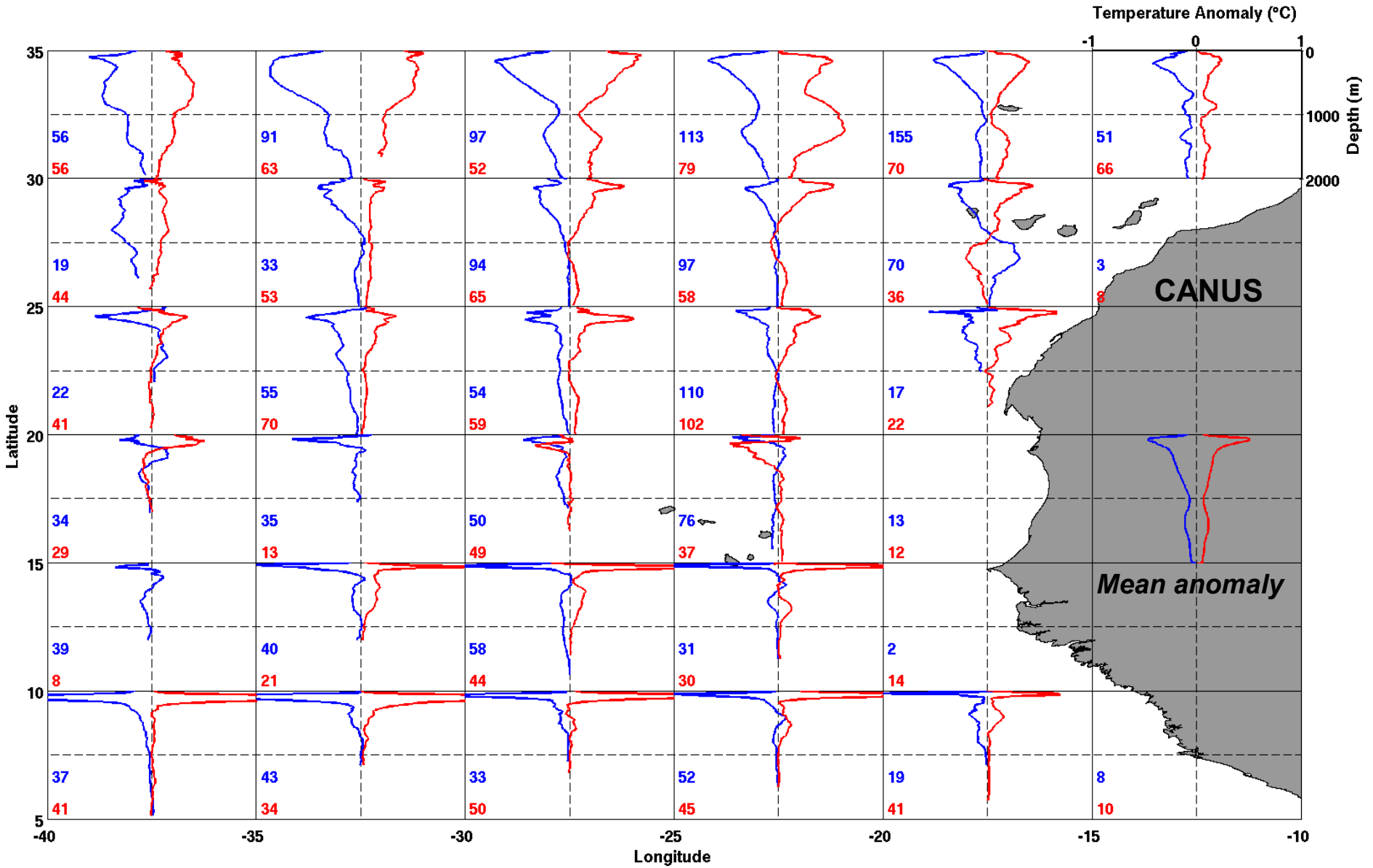
T_1' : -230m
0,5°C

T_2' : -500m
0,5°C

Results : Mean temperature anomaly



Results : Mean temperature anomaly in subregions (CANUS)



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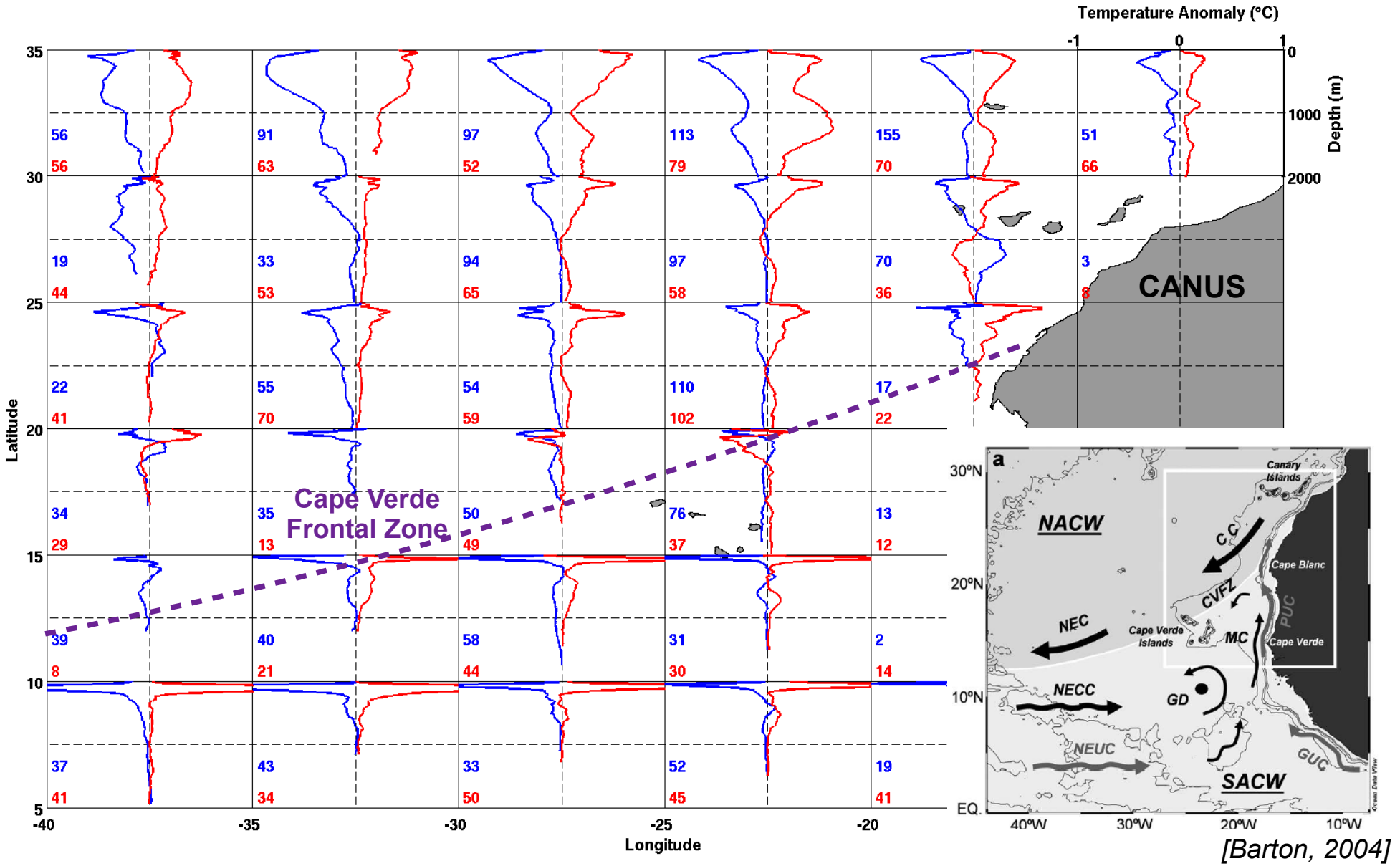
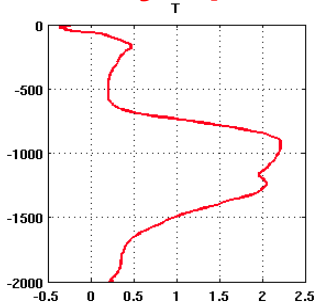
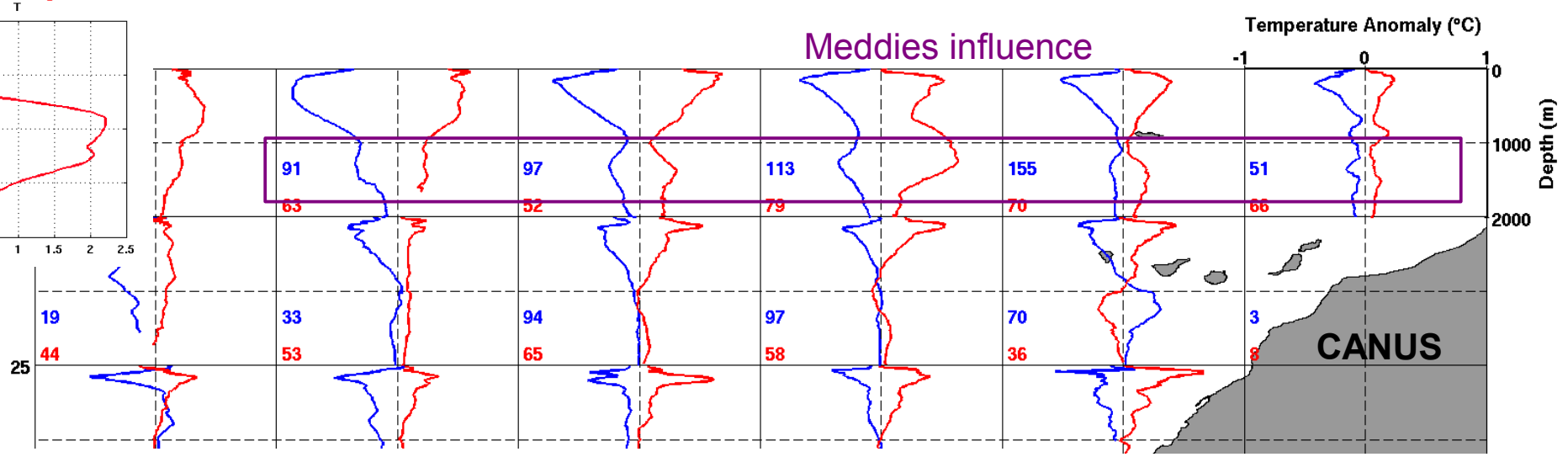


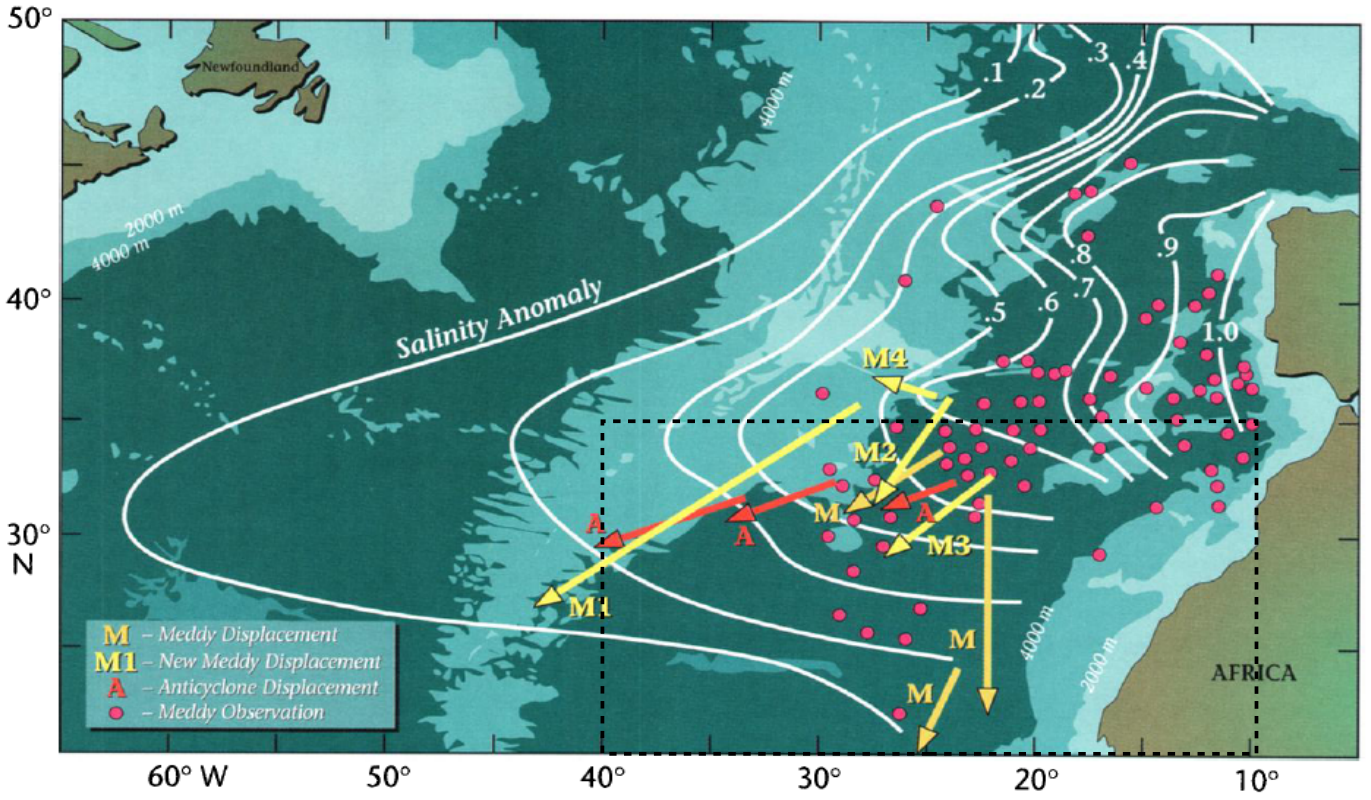
[Barton, 2004]

Results : Mean temperature anomaly in subregions (CANUS)

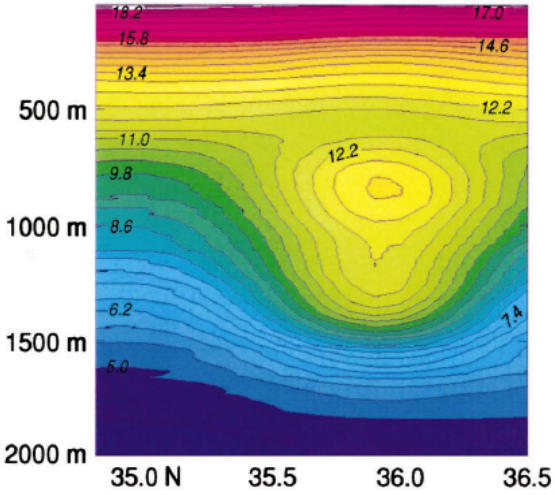
« Meddy » profile





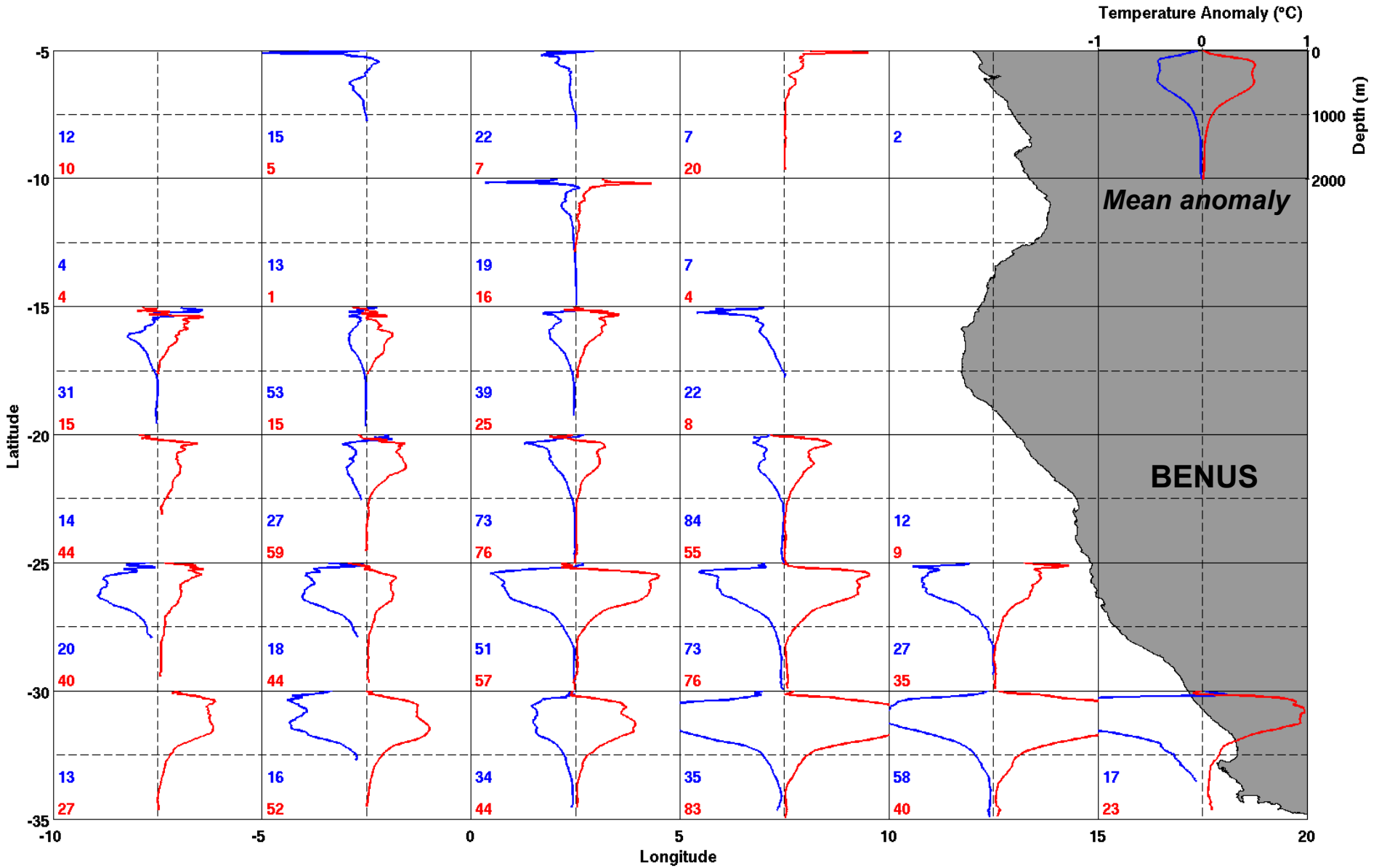


[Richardson, 1998]

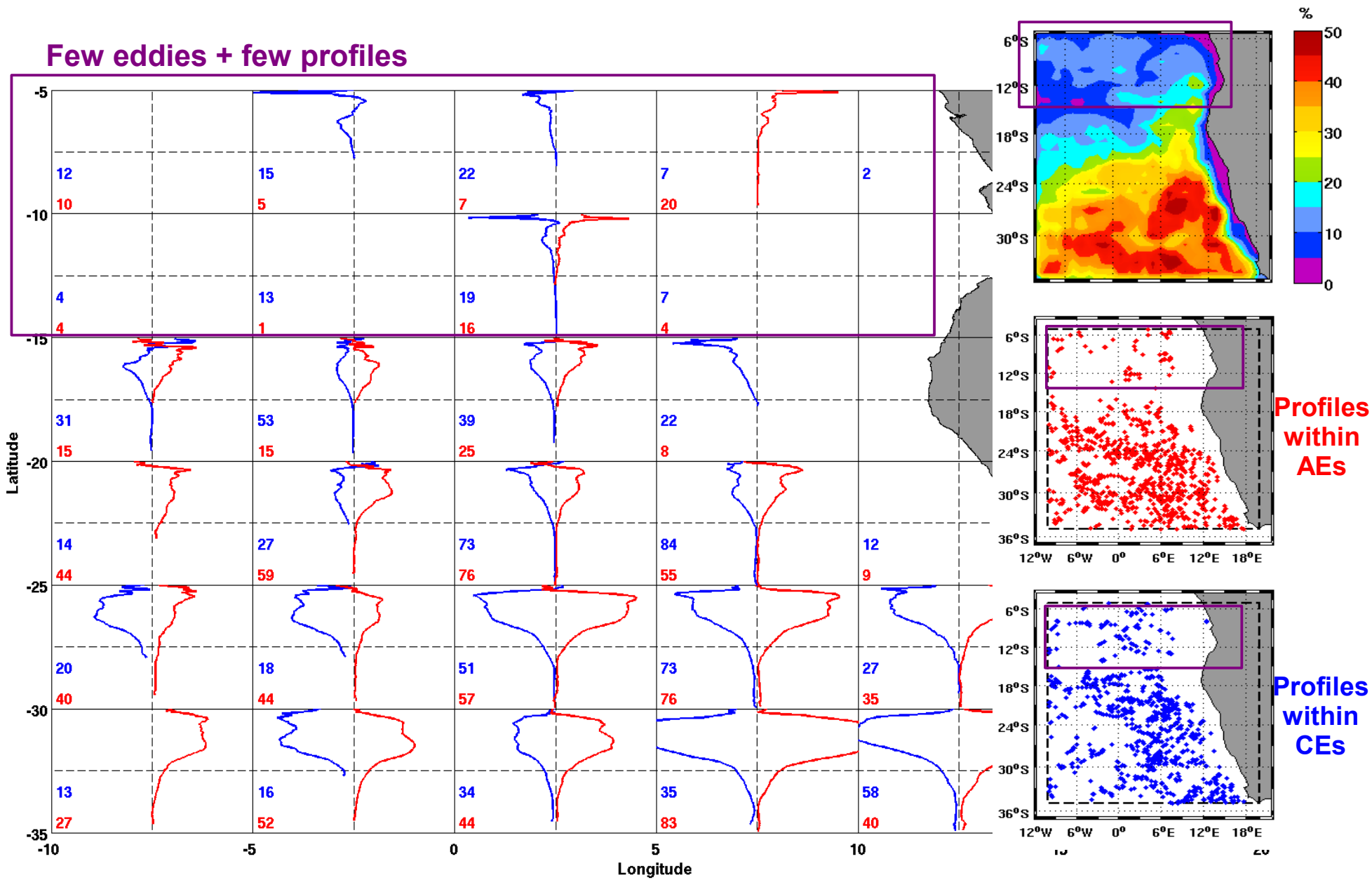


Temperature within a Meddy
[Richardson, 2000]

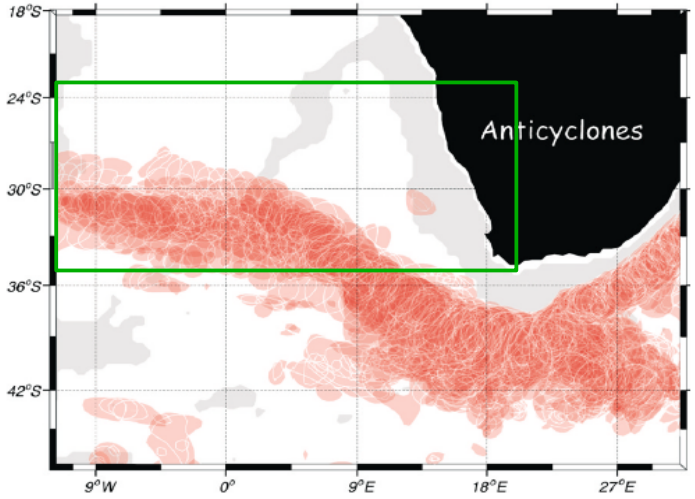
Results : Mean temperature anomaly in subregions (BENUS)

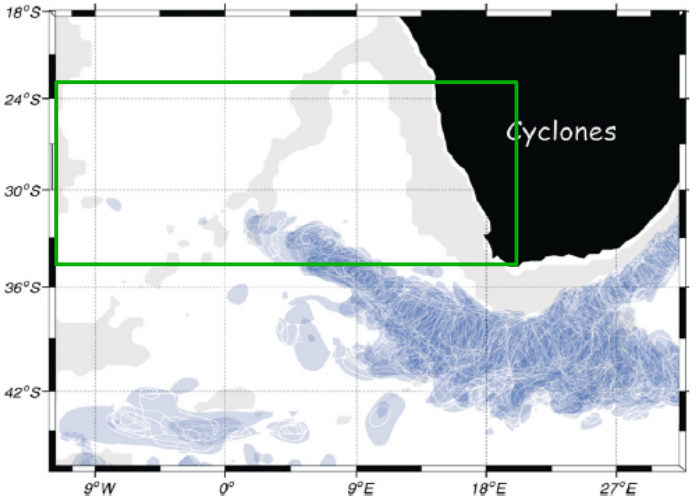


Results : Mean temperature anomaly in subregions (BENUS)



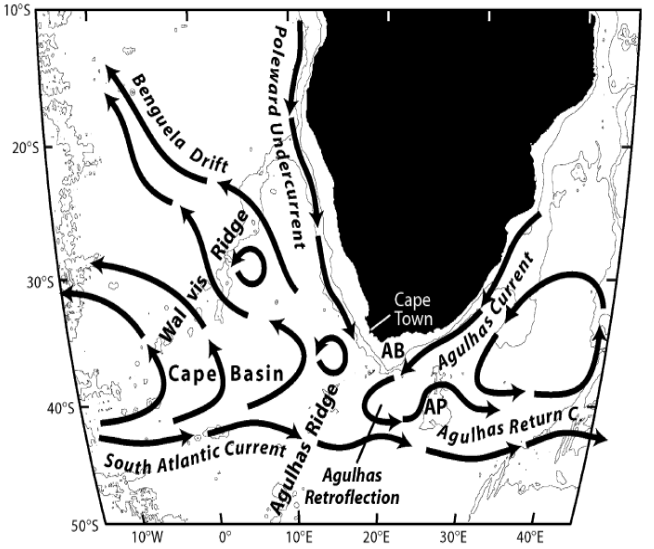
Results : Mean temperature anomaly in subregions (BENUS)

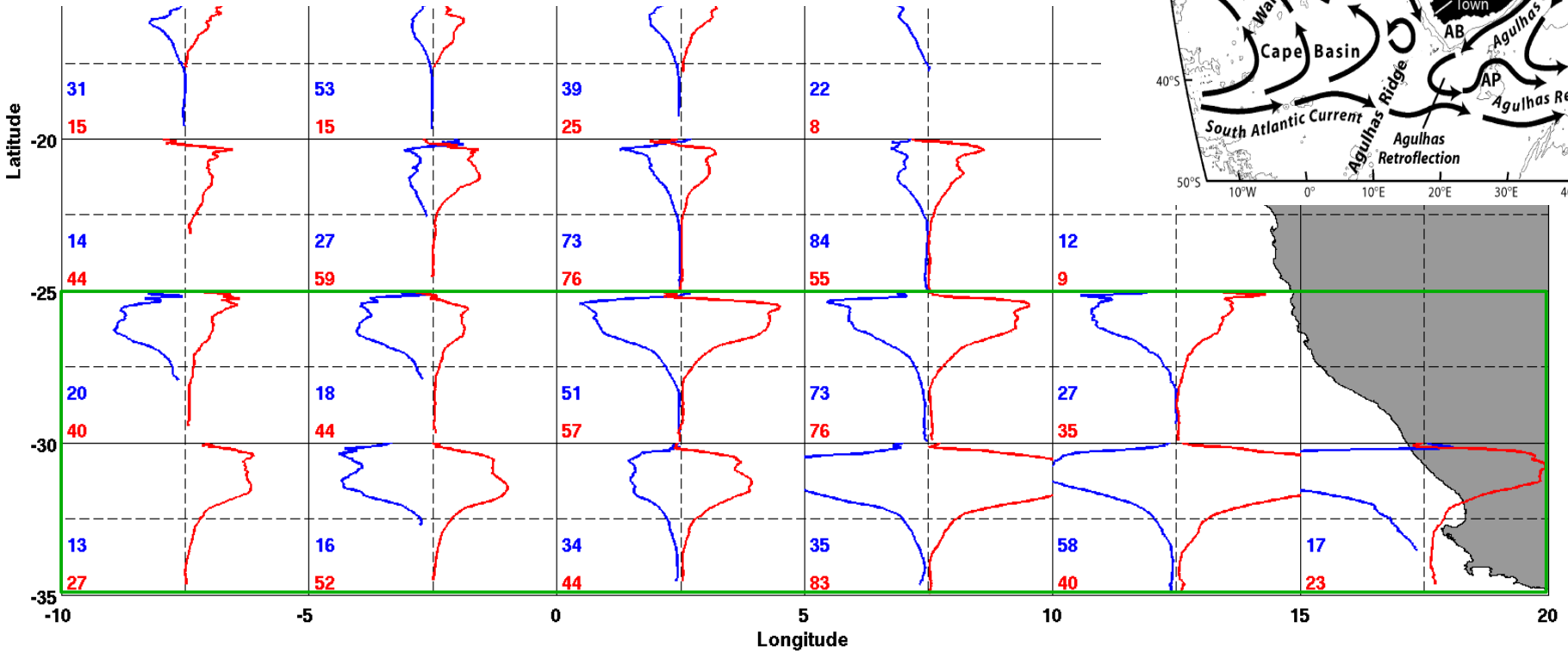




[Matano, 2003]

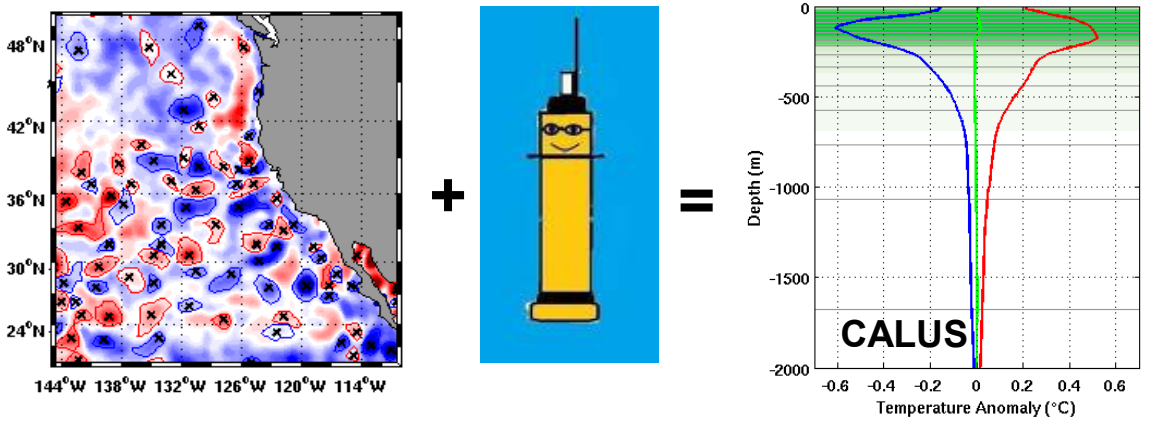
[Veitch, 2010]





Conclusions

- **Altimetry + Argo floats profiles**
  → efficient tool to reconstruct the eddy vertical structure



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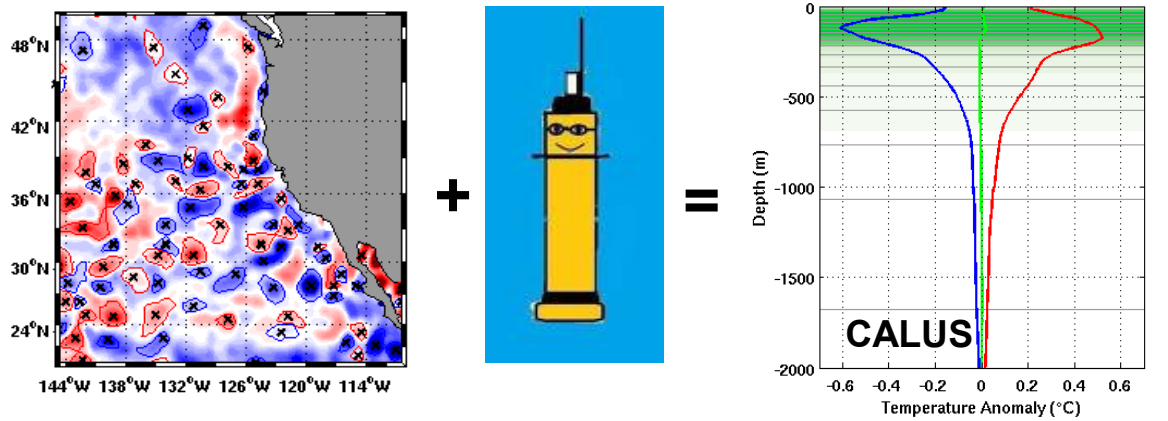
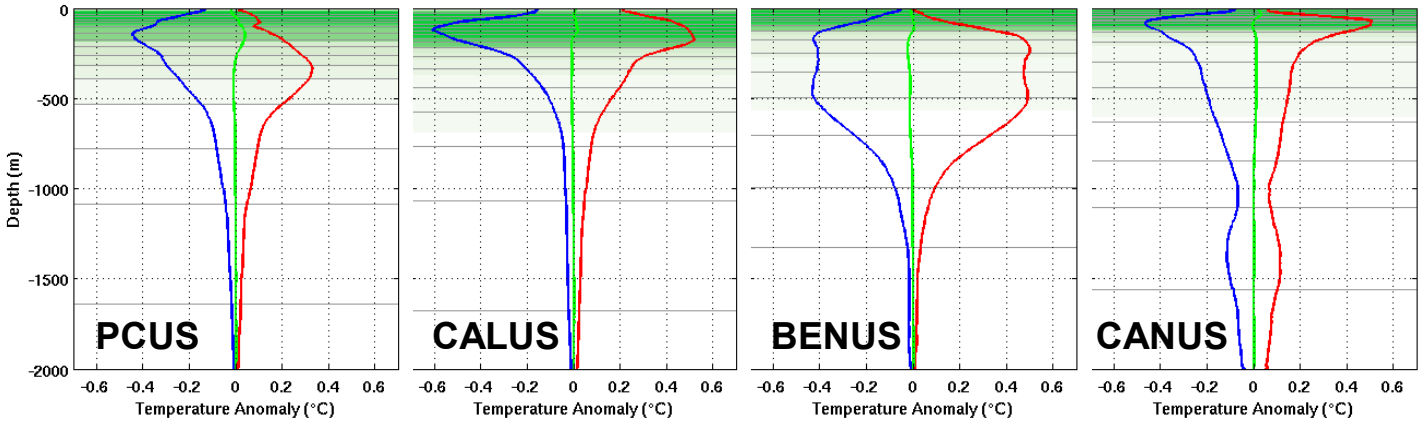


- **Strong differences between each EBUS**



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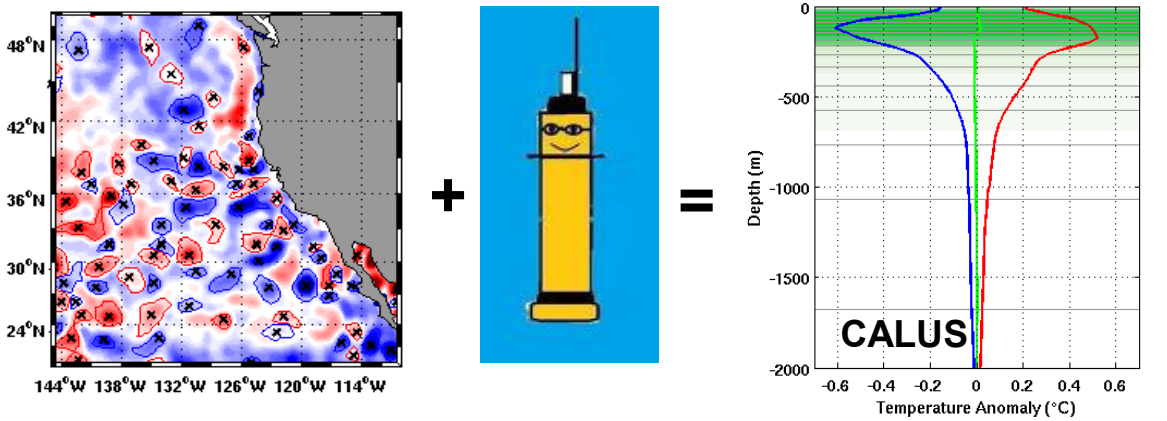

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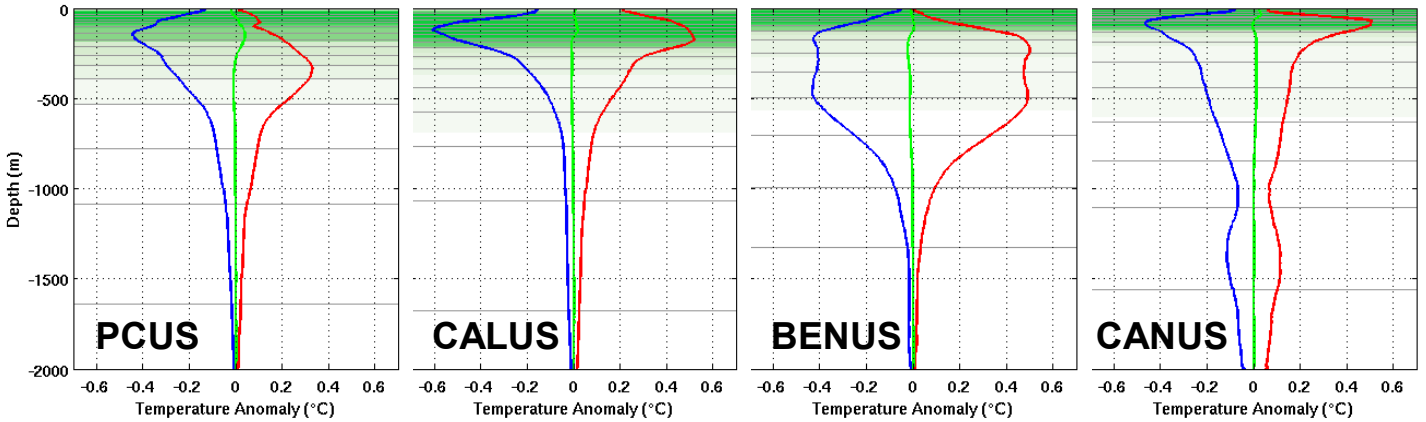
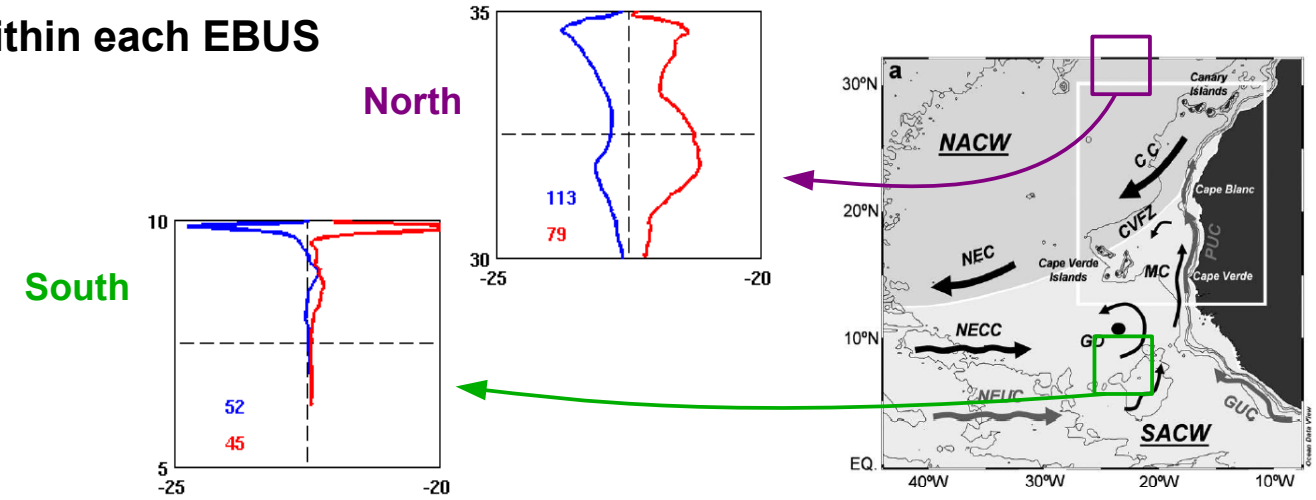
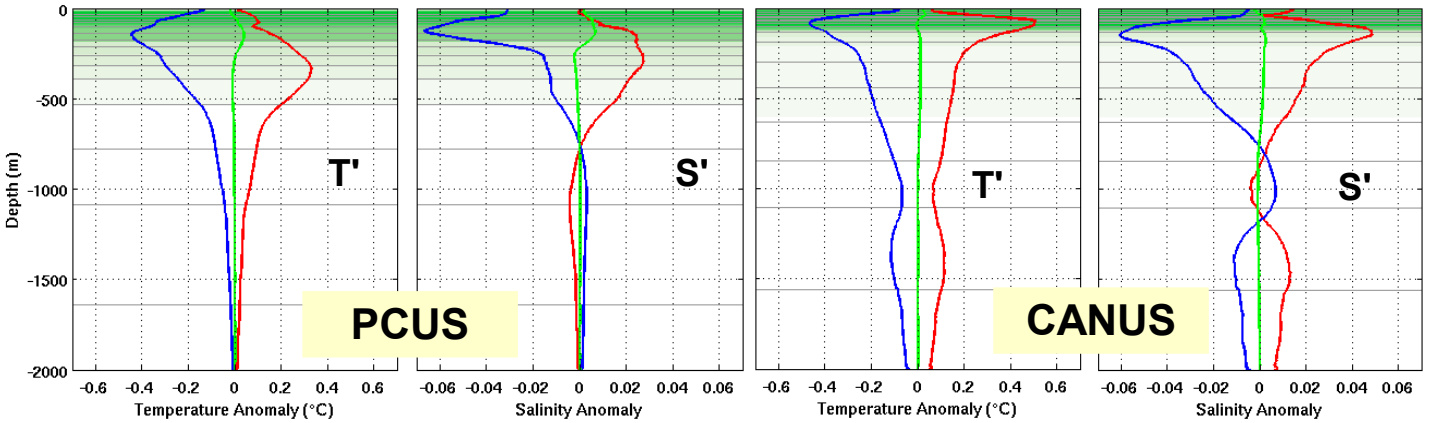


- **Strong heterogeneity within each EBUS**



Perspectives

- Work on salinity anomalies



Perspectives

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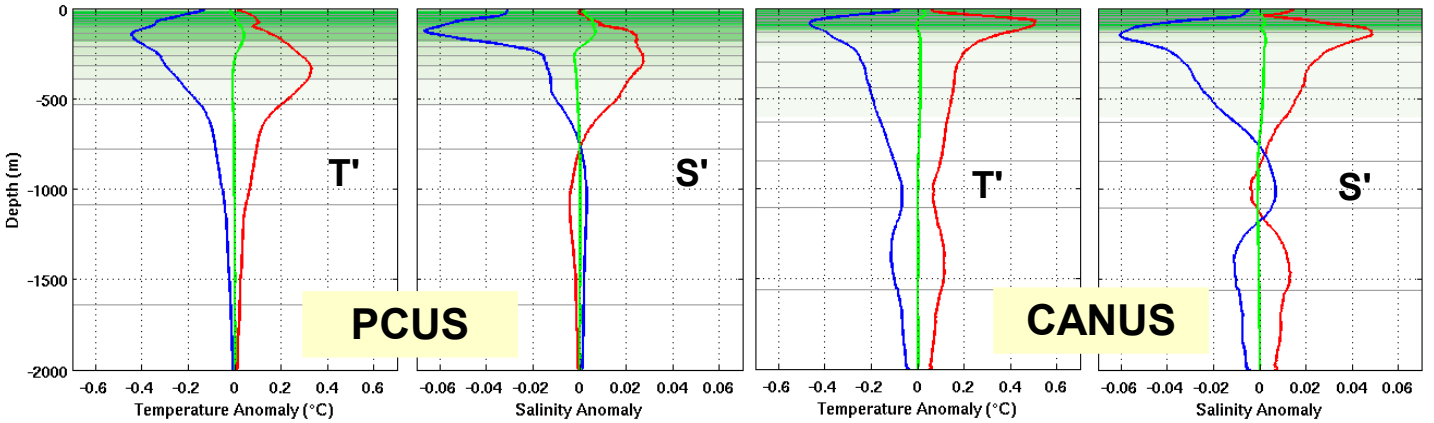
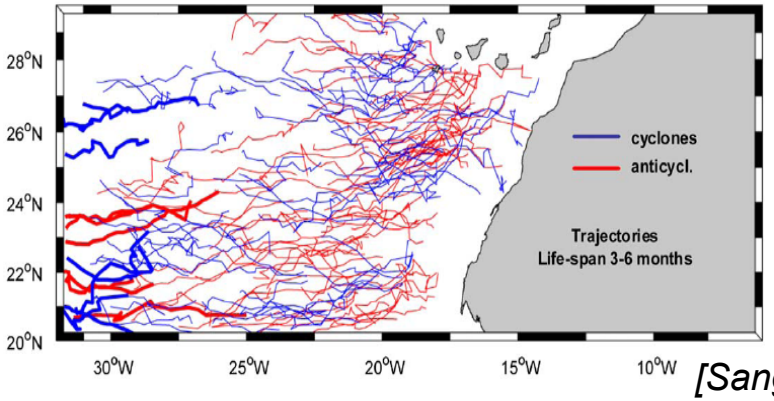


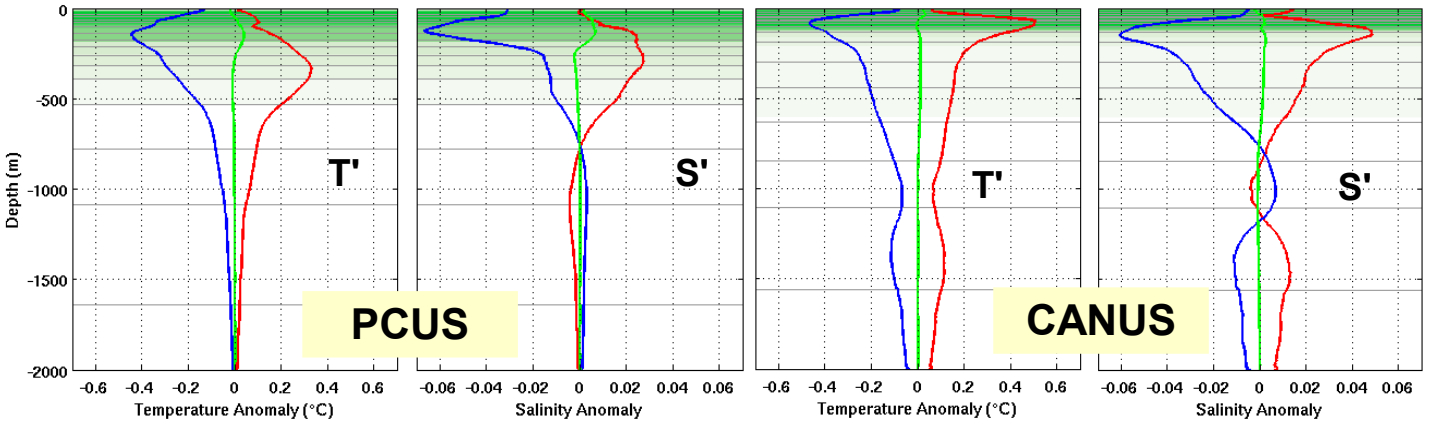
- Track eddies in time and space to depict the evolution of their vertical structure



[Sangra, 2009]

Perspectives

- Work on salinity anomalies



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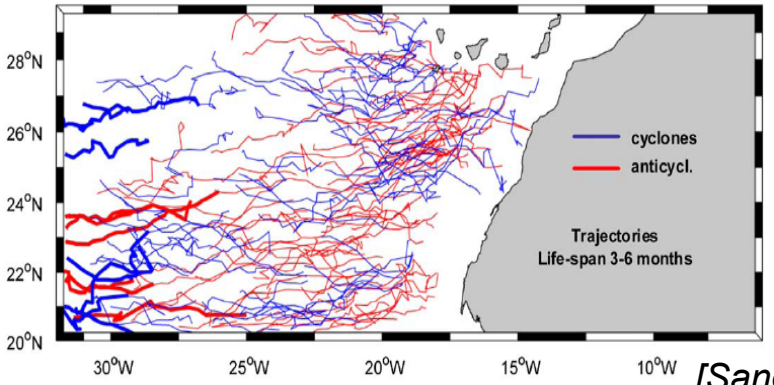
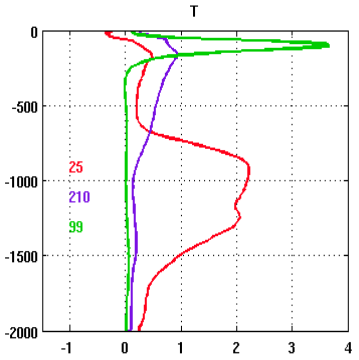
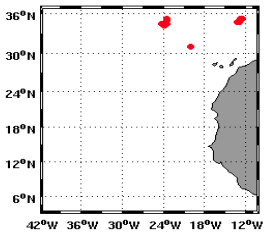


[Sangra, 2009]

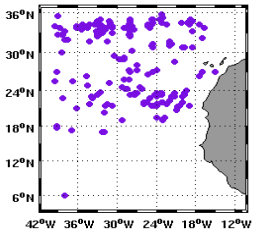
- Separate the different kinds of eddies

AEs

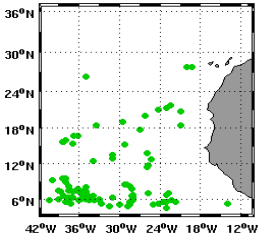




→ « Meddy » profile



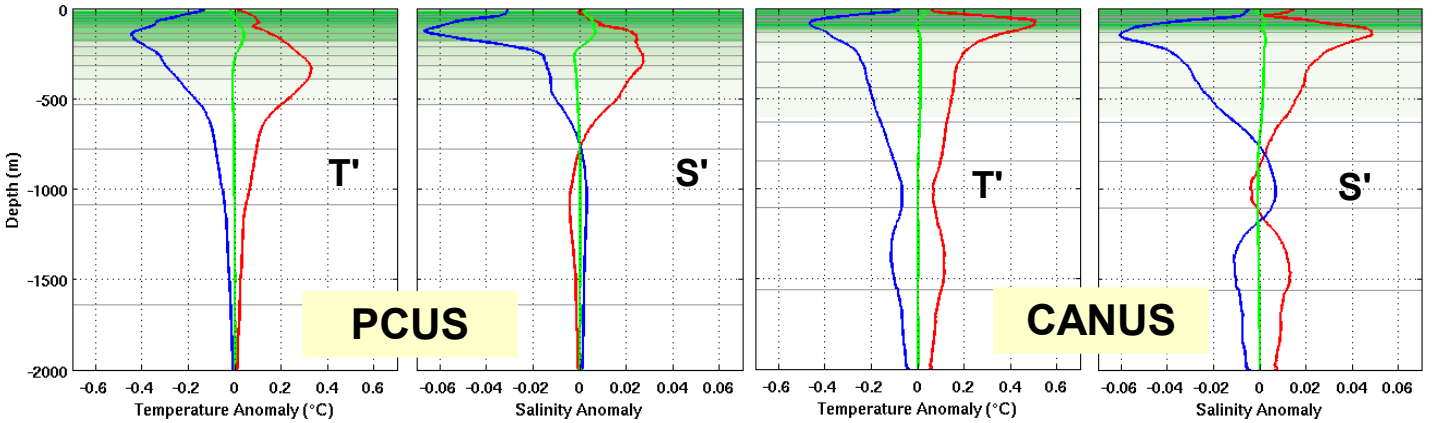
→ « North » profile



→ « South » profile

Perspectives

- Work on salinity anomalies



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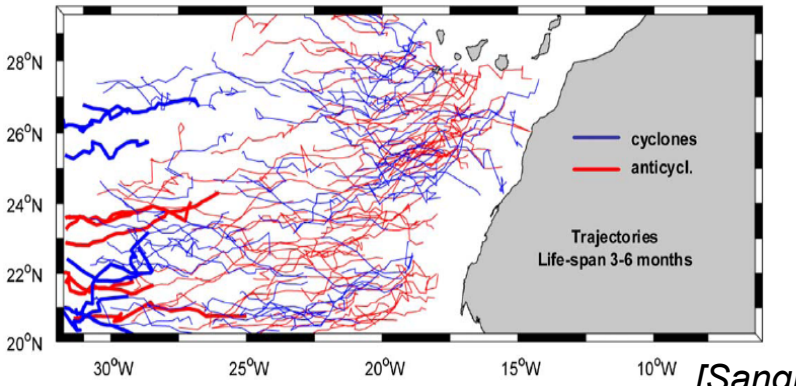

[Sangra, 2009]

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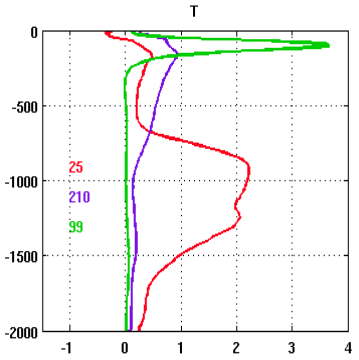
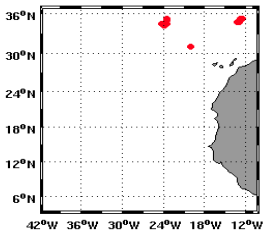
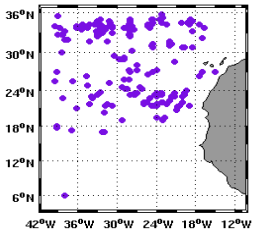




→ « Meddy » profile



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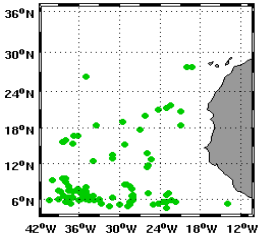
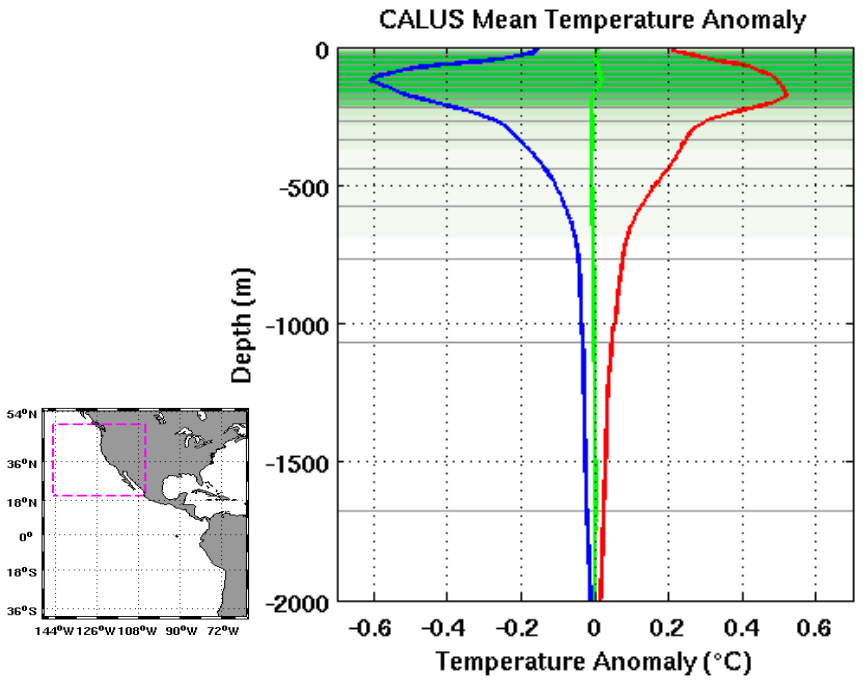


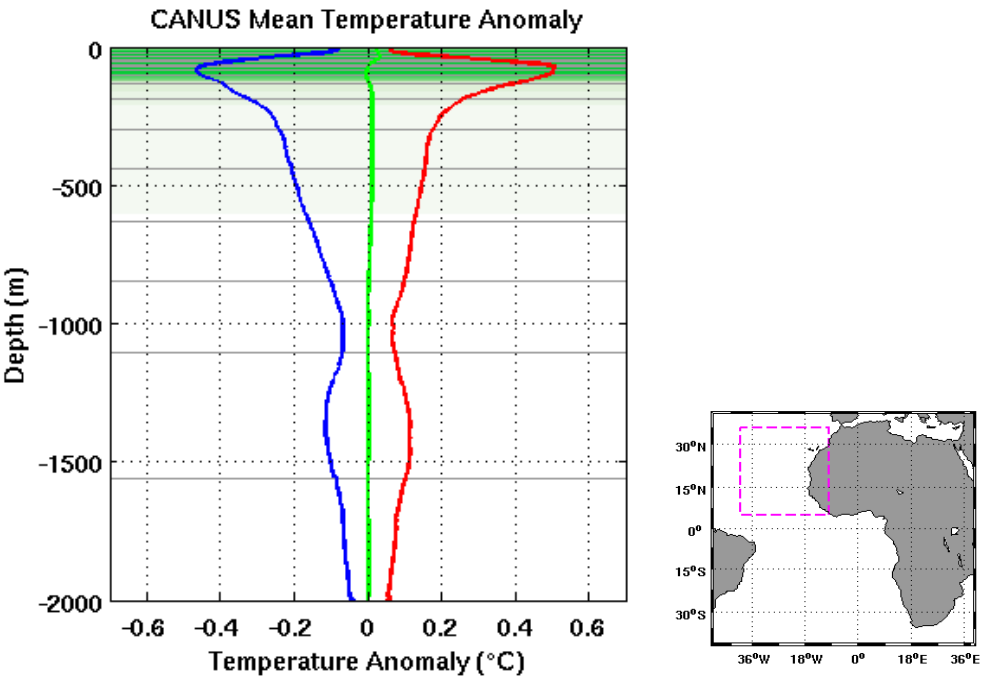
→ « South » profile

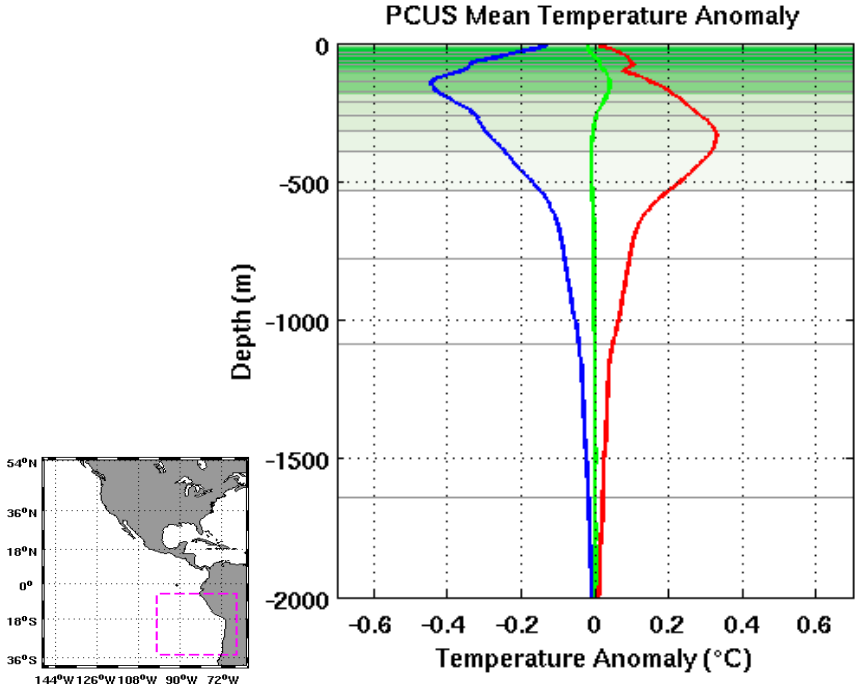
- Find the dynamicals mecanisms leading to such different structures

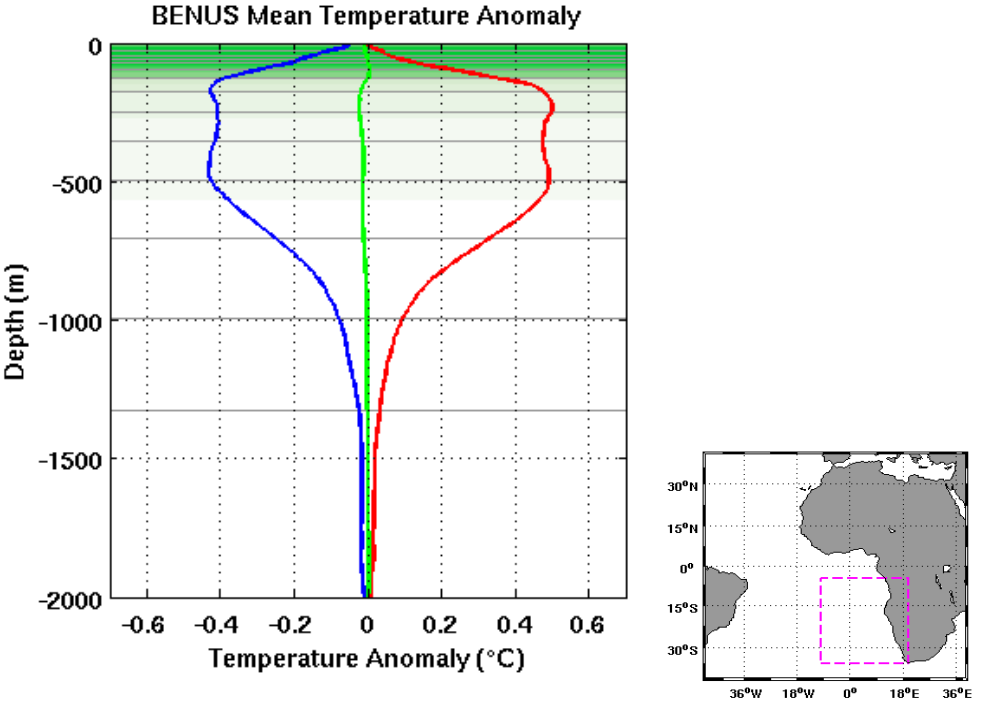
Any
Questions

Mean Temperature anomaly

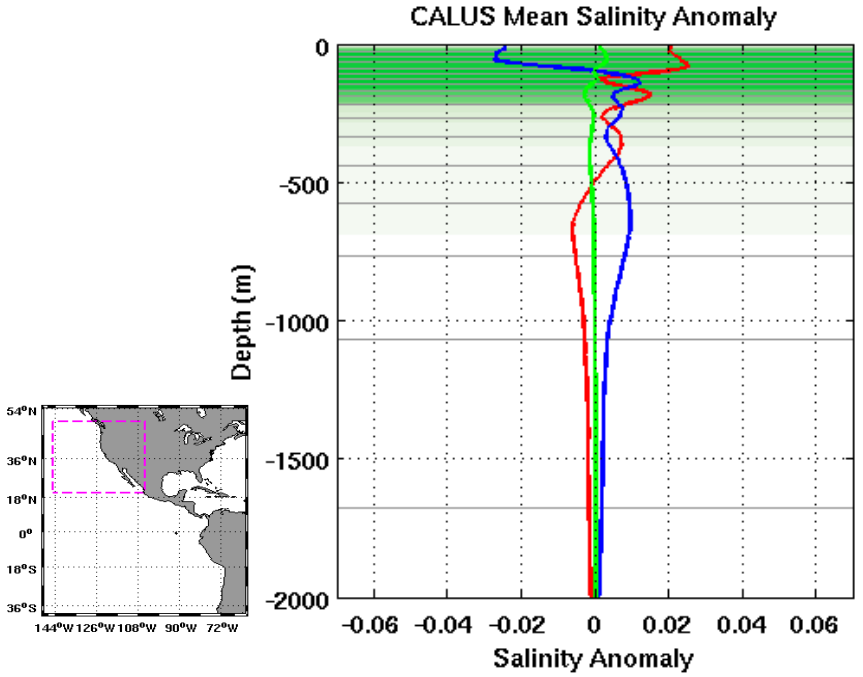


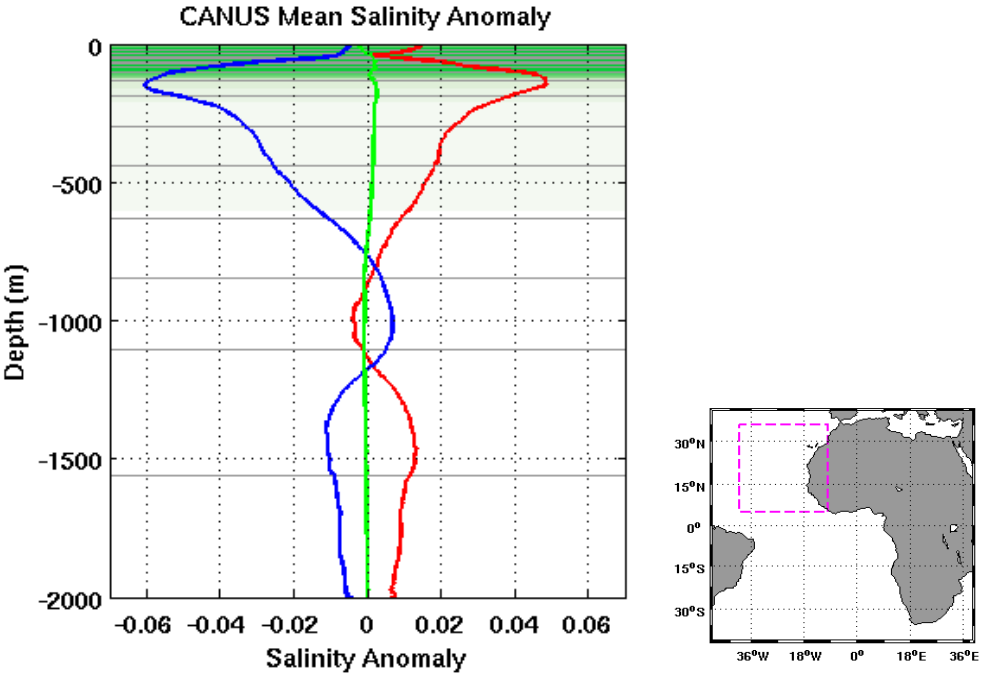


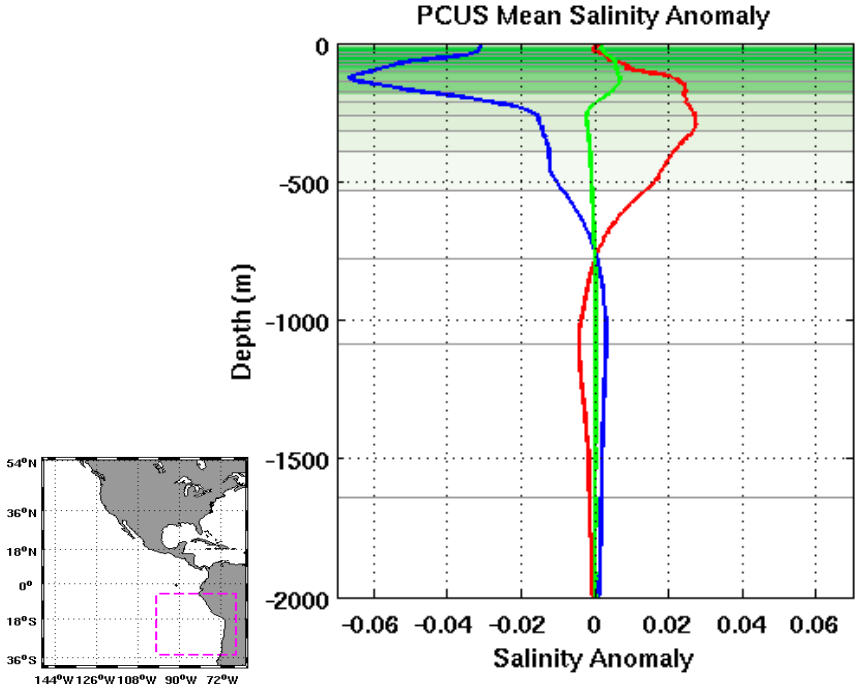


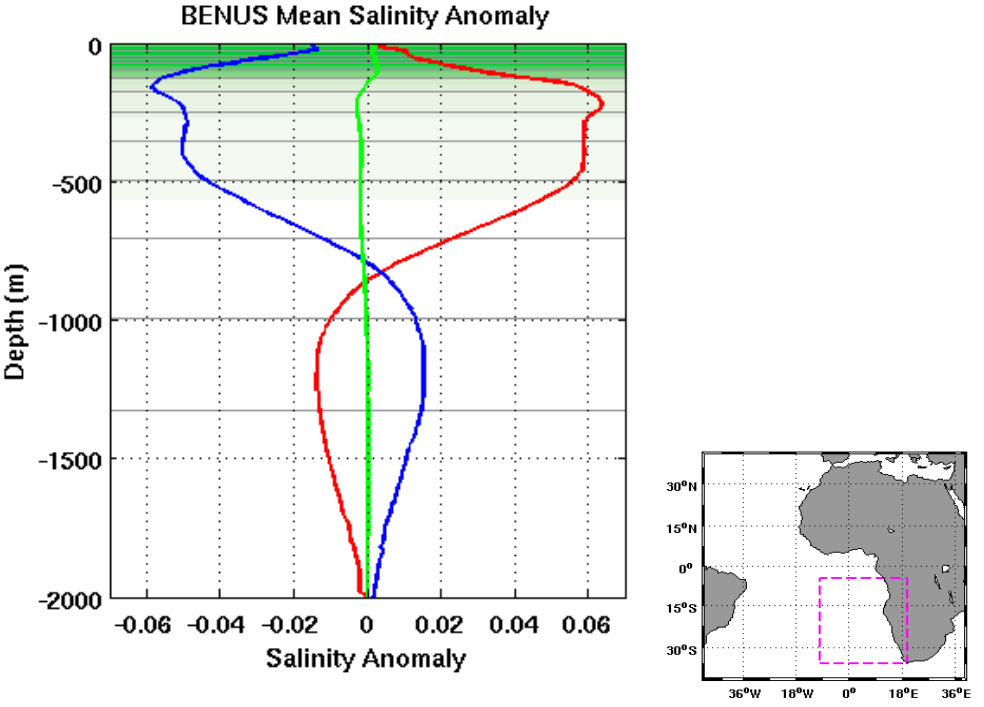


Mean Salinity anomaly

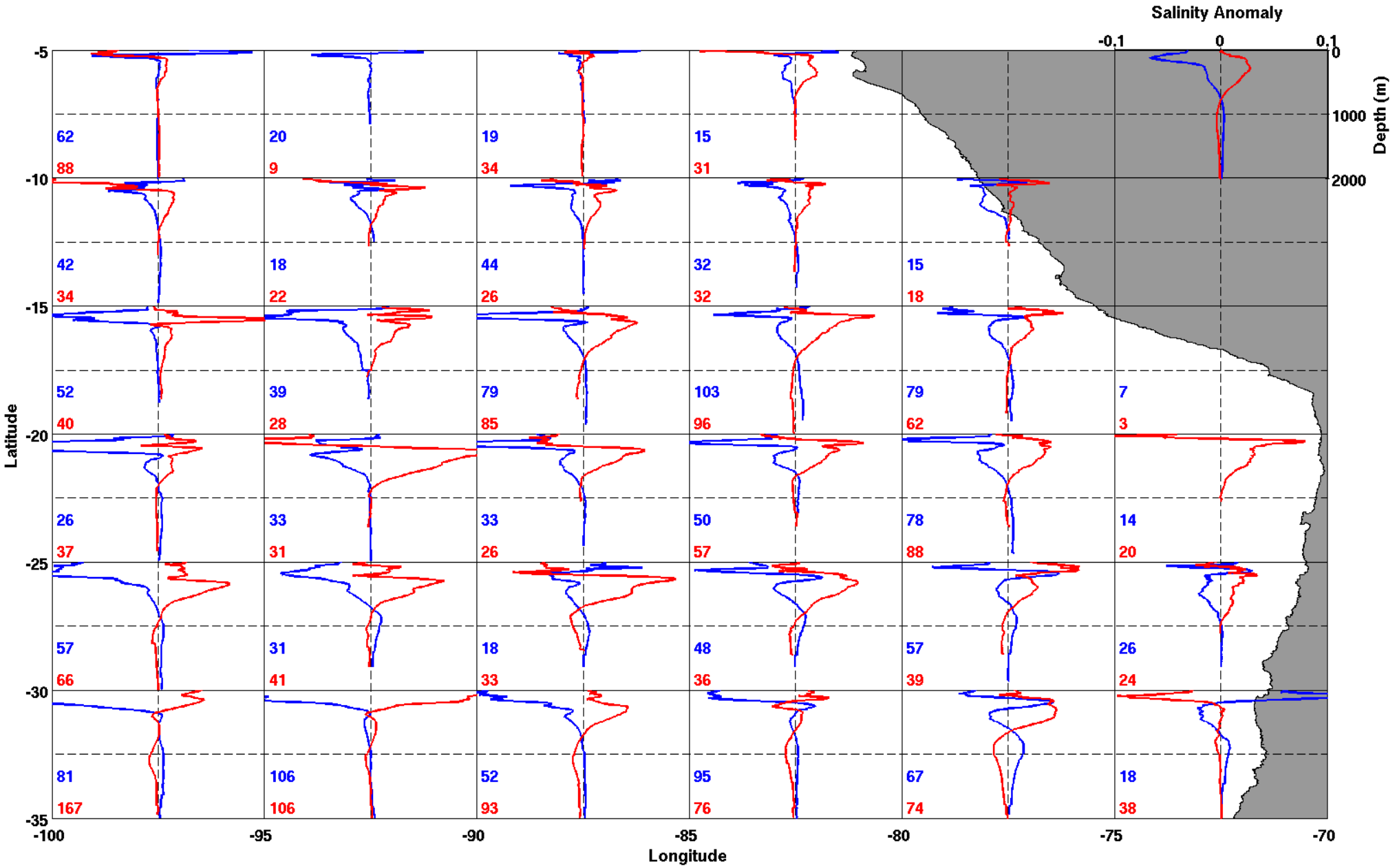




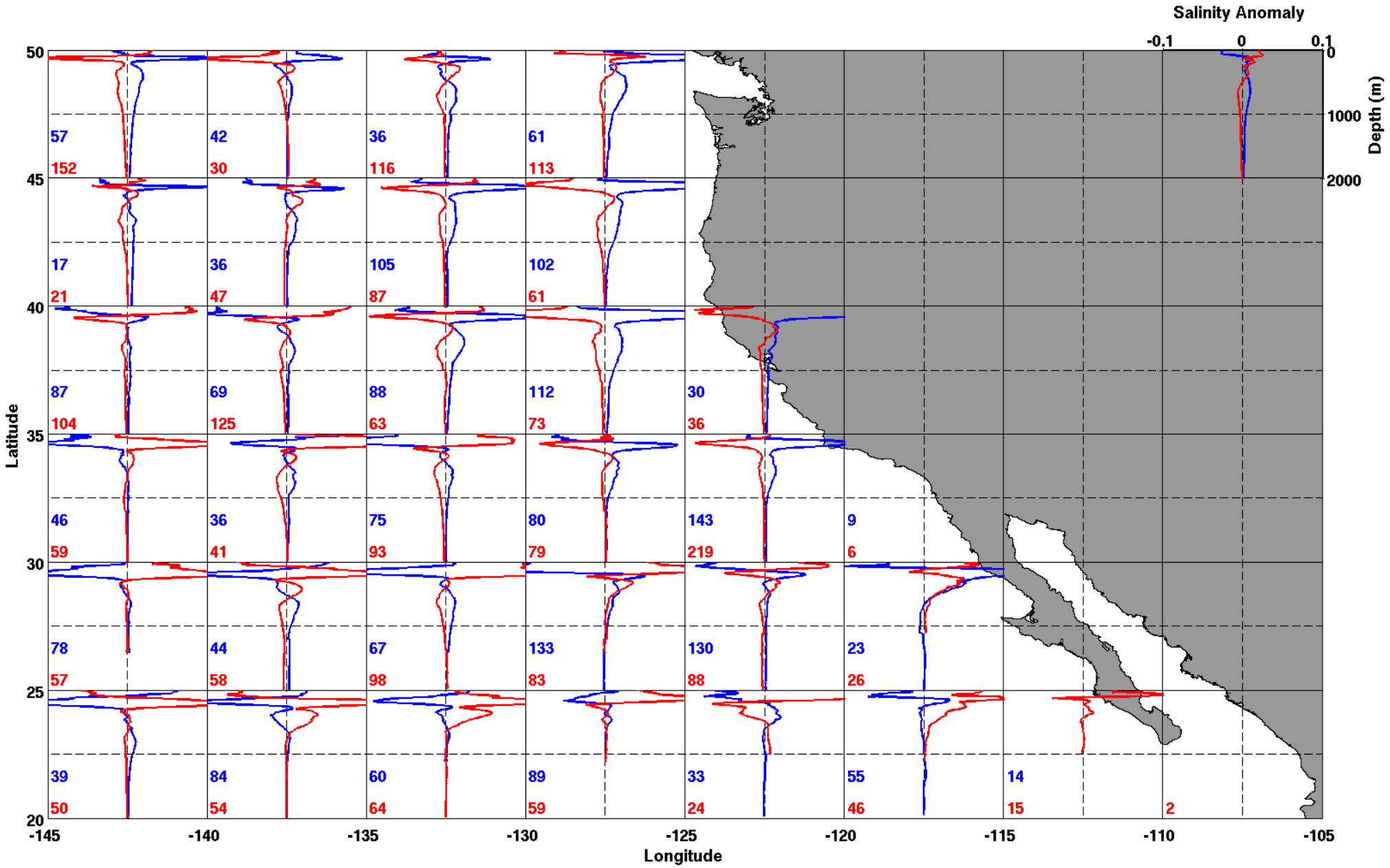




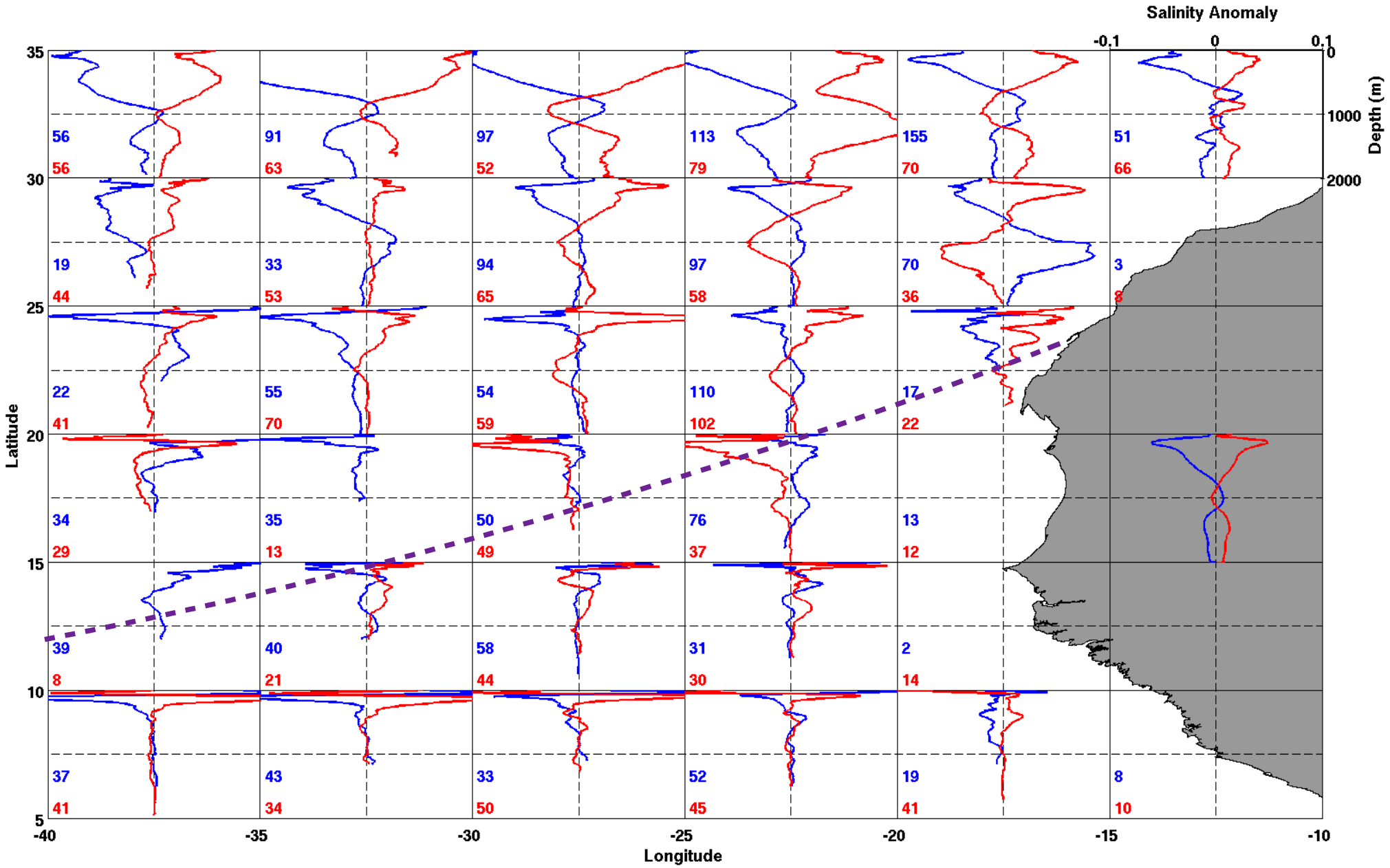
PCUS Subregions : Salinity anomaly



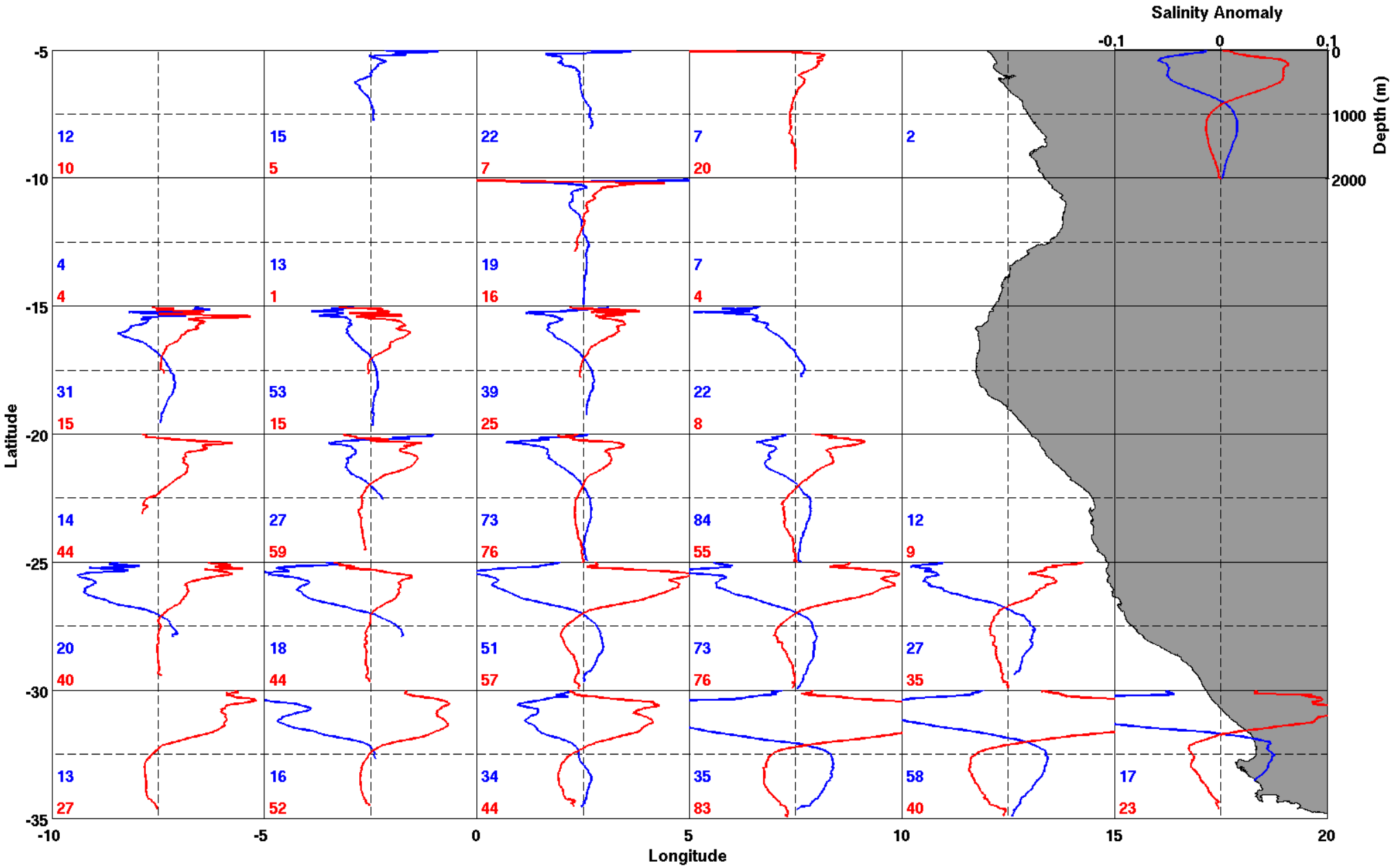
CALUS Subregions : Salinity anomaly



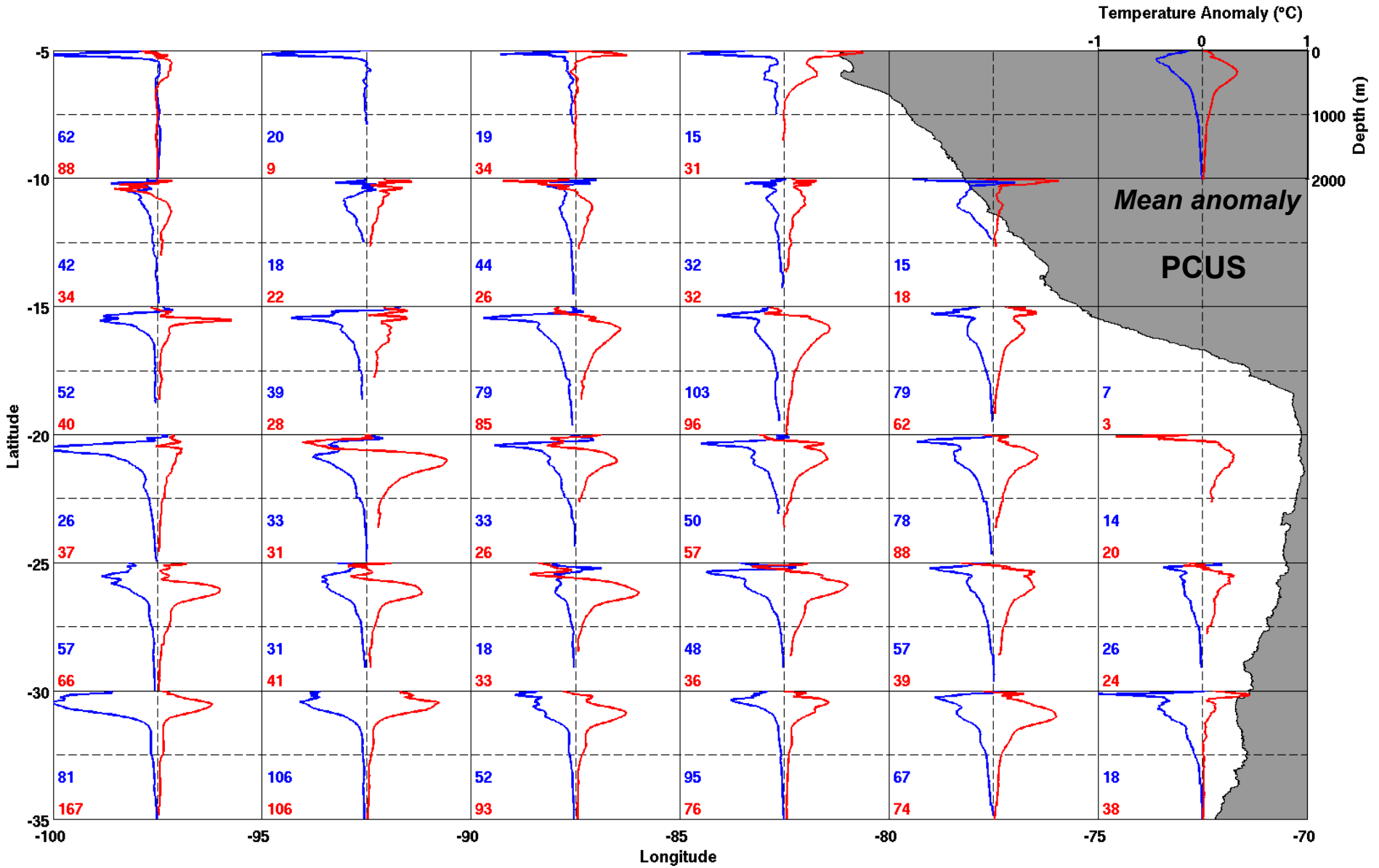
CANUS Subregions : Salinity anomaly



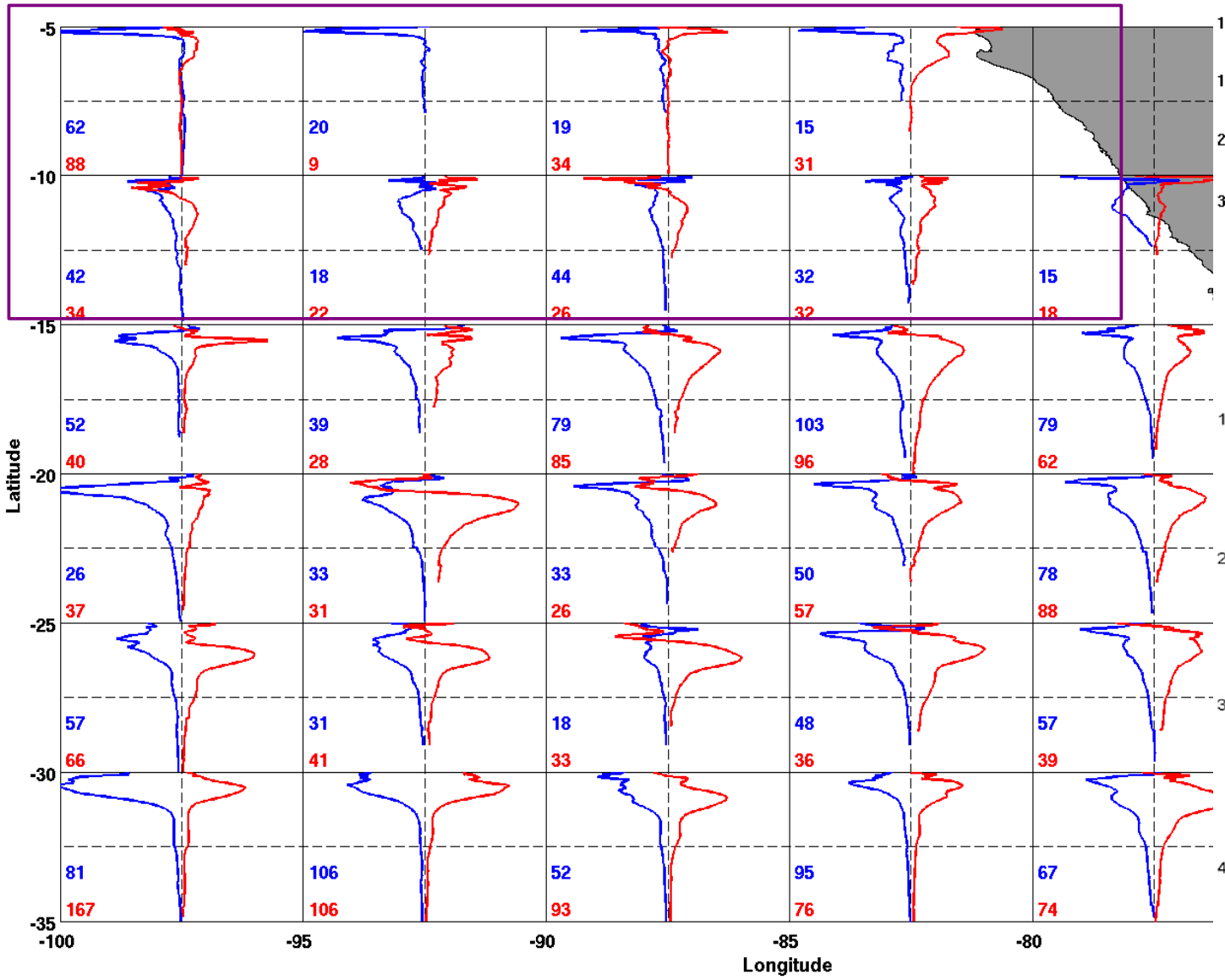
BENUS Subregions : Salinity anomaly

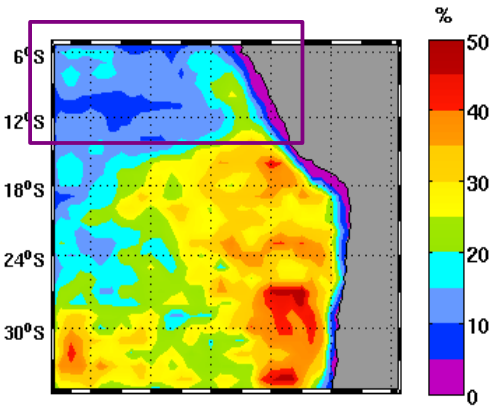


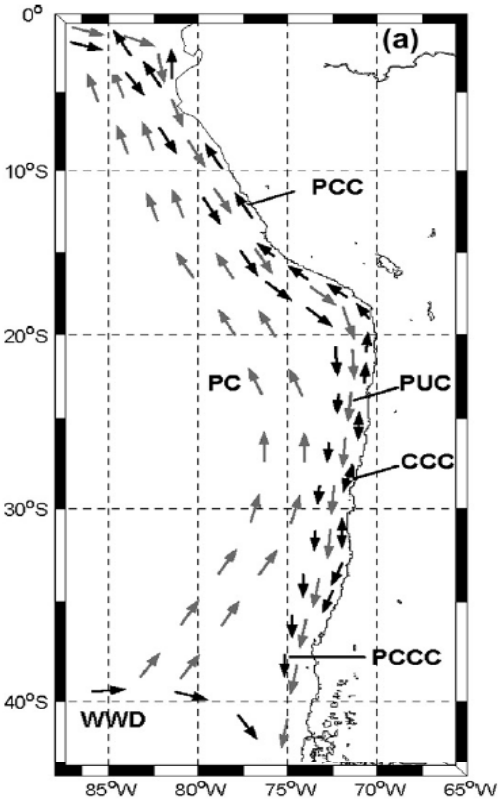
PCUS Subregions : Temperature anomaly



PCUS Subregions : Temperature anomaly

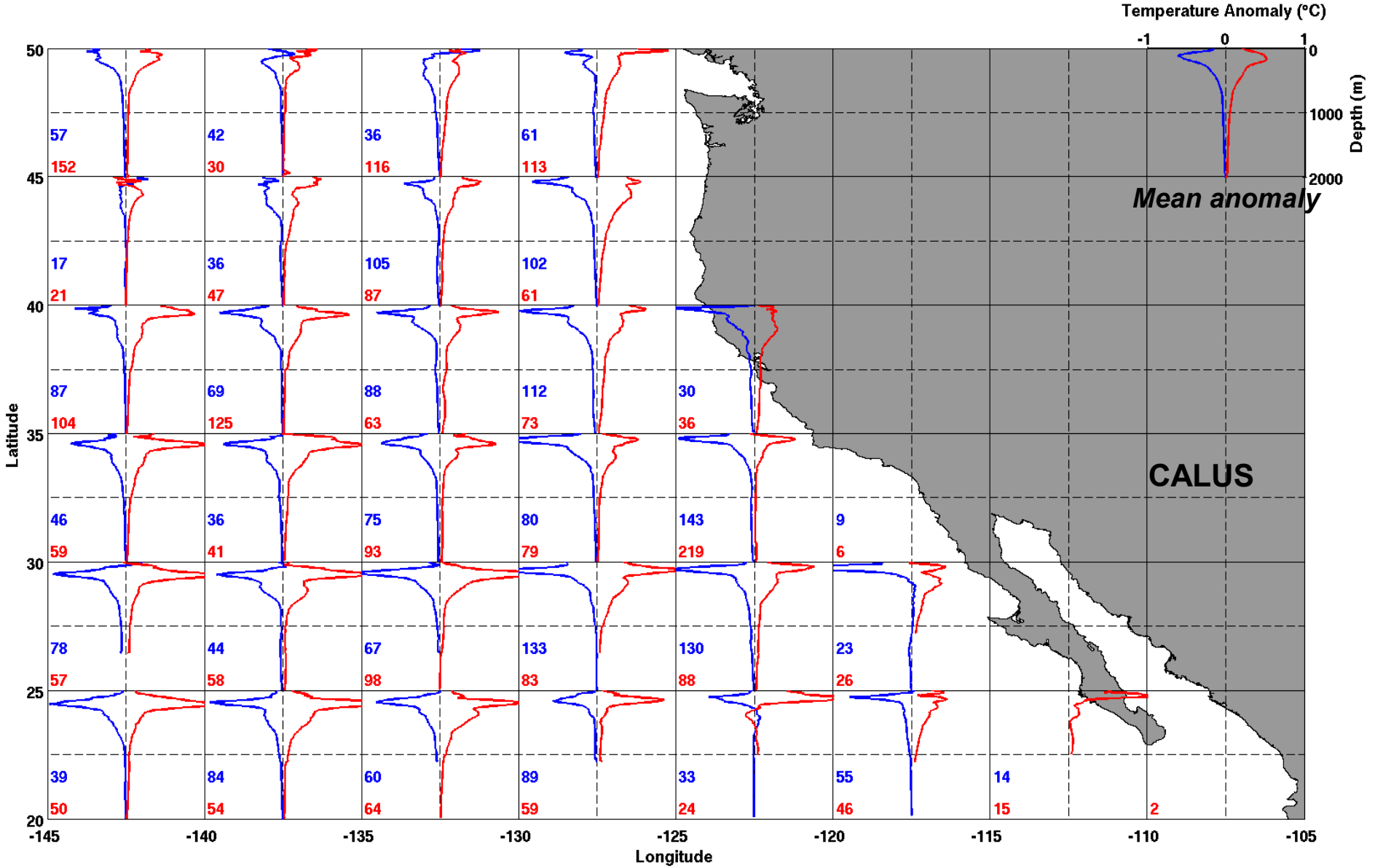




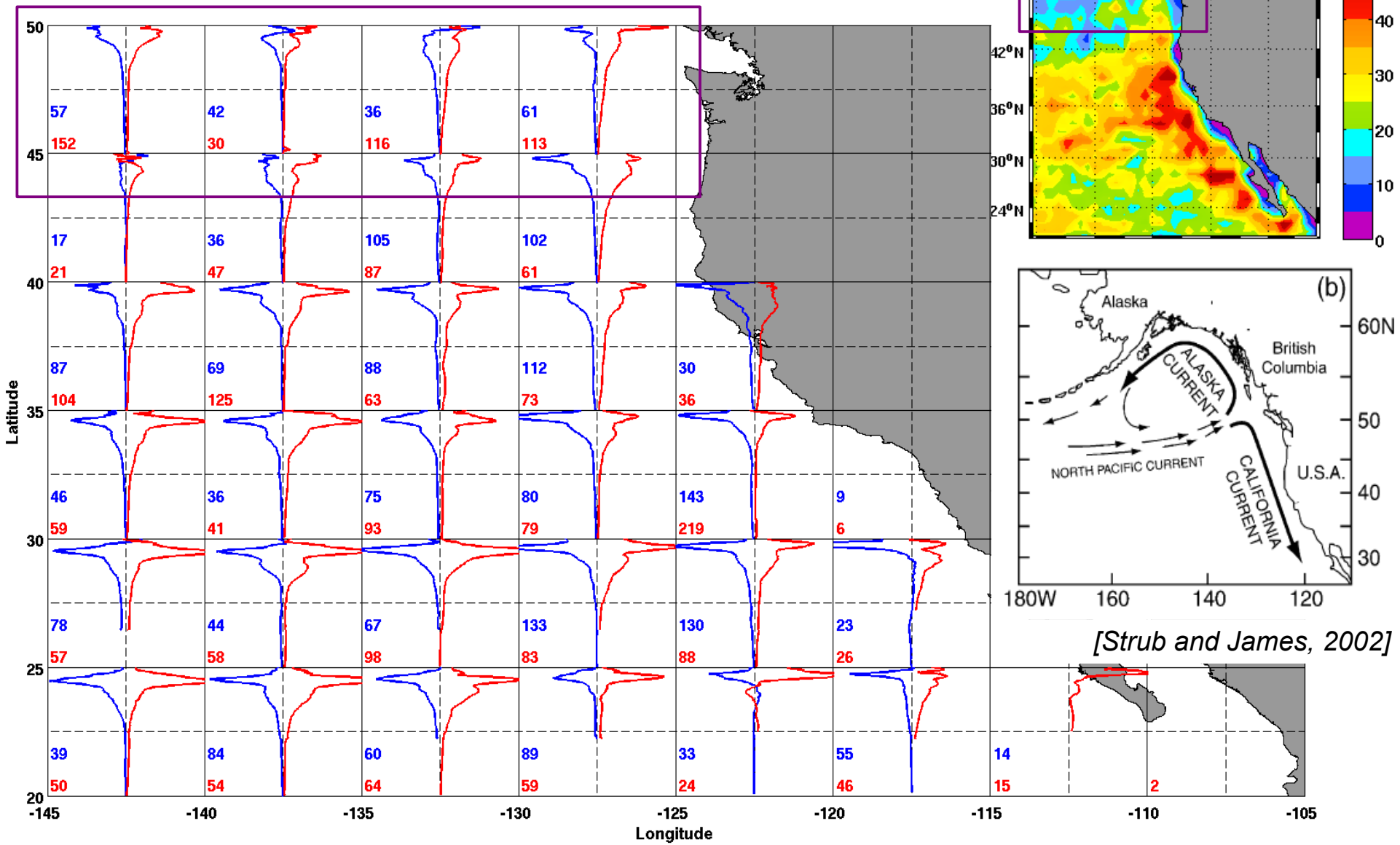


[Parada et al., 2012]

CALUS Subregions : Temperature anomaly



CALUS Subregions : Temperature anomaly

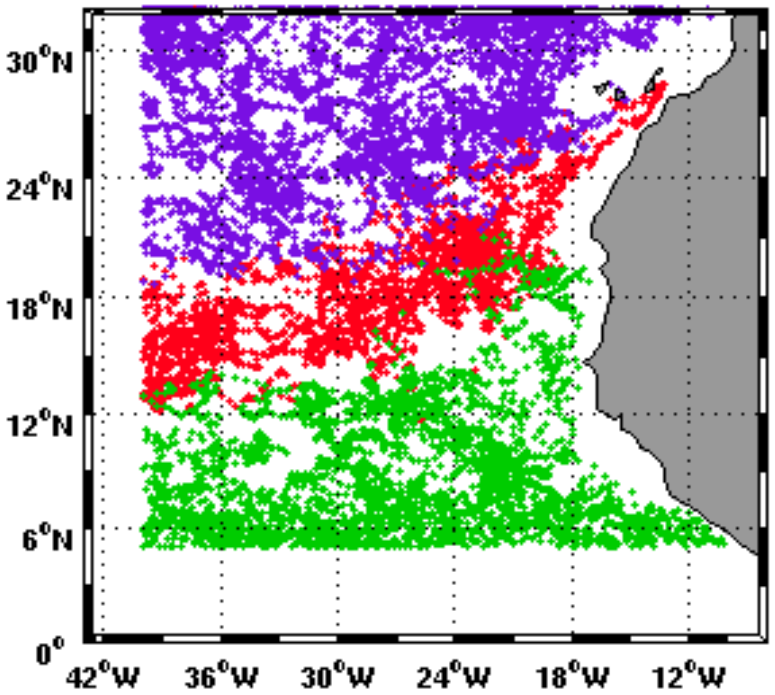


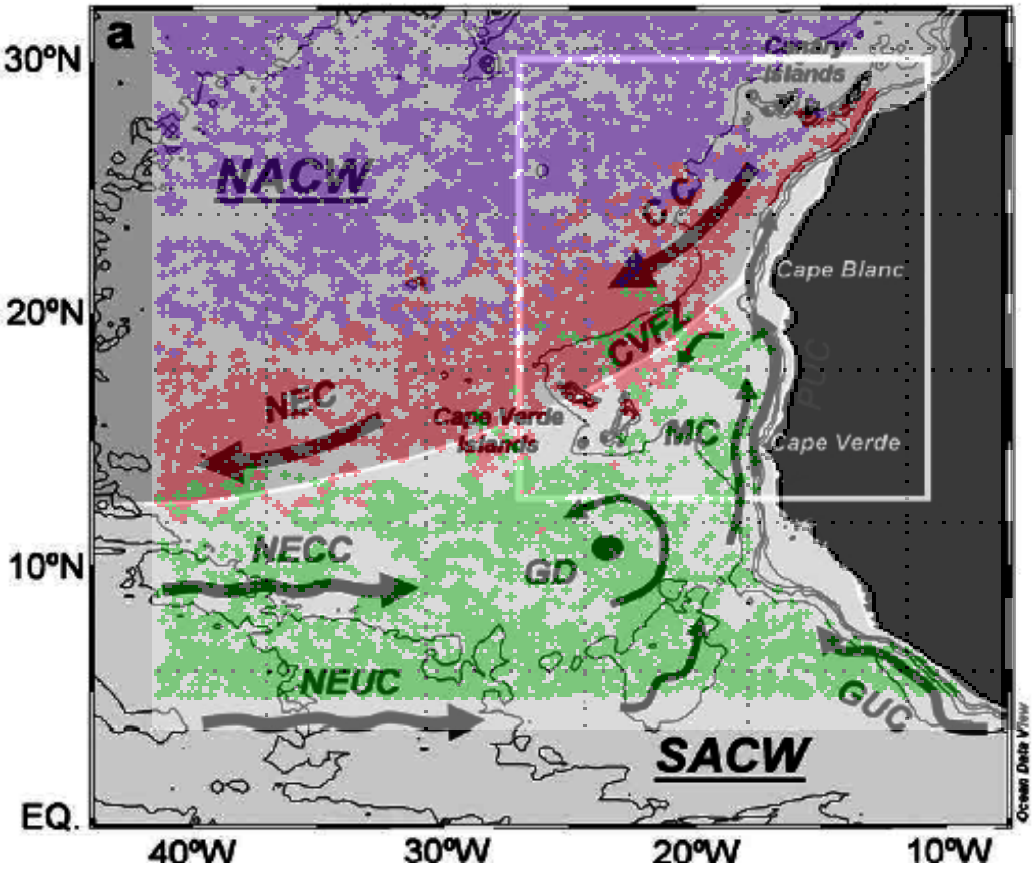
[Strub and James, 2002]

Clustering : « water classes »

- **Cluster analysis (comparing similarities)**

→ Between T and S profiles :



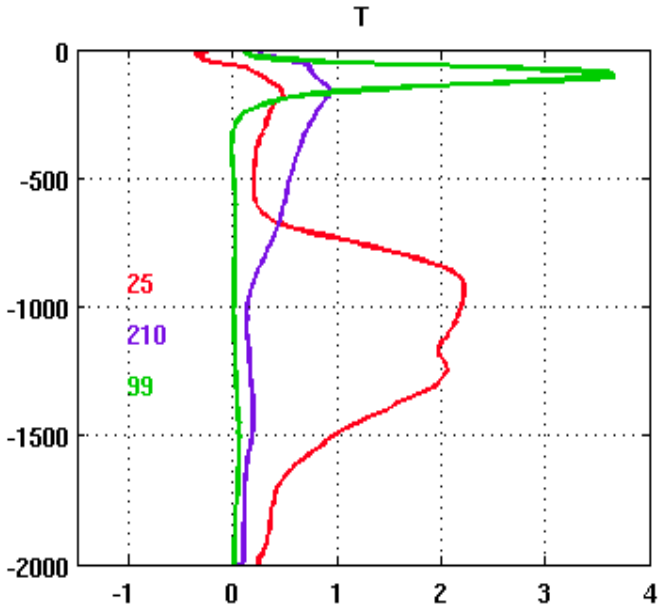


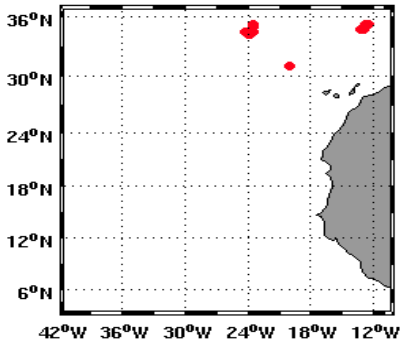
→ Consistent with the local circulation

Clustering : AEs of CANUS

- **Cluster analysis (comparing similarities)**

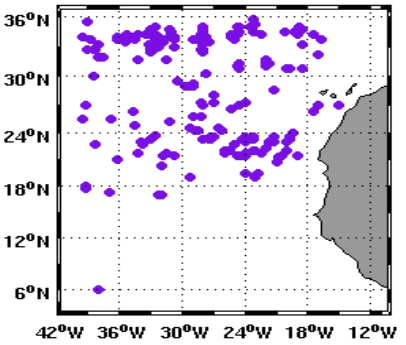
  → Between T and S profiles
  → Between T and S anomalies profiles within AEs

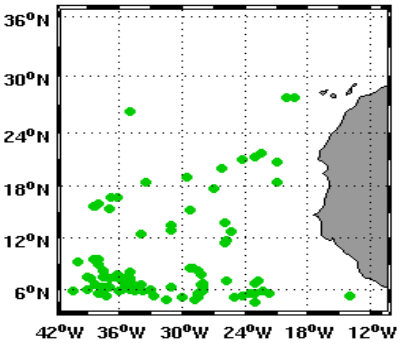




→ « Meddy » profile

→ « North » profile



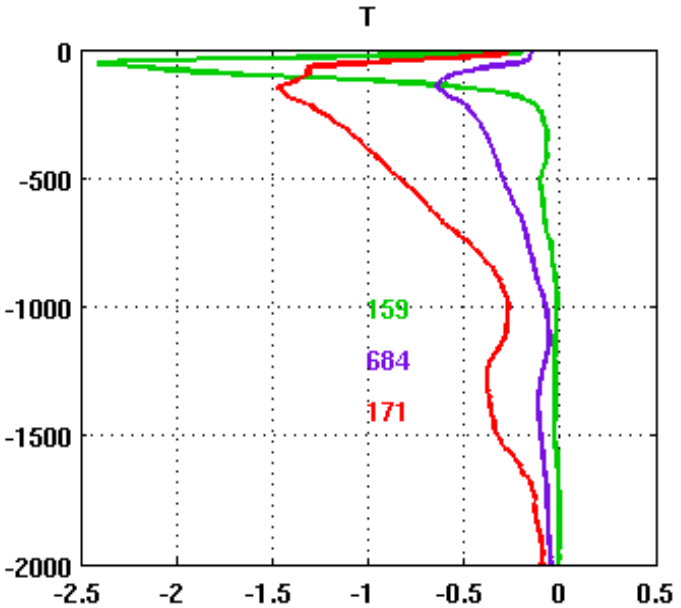


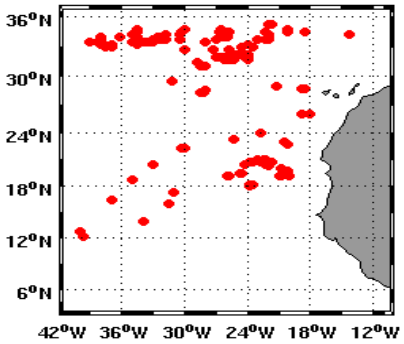
→ « South » profile

Clustering : CEs of CANUS

- **Cluster analysis (comparing similarities)**

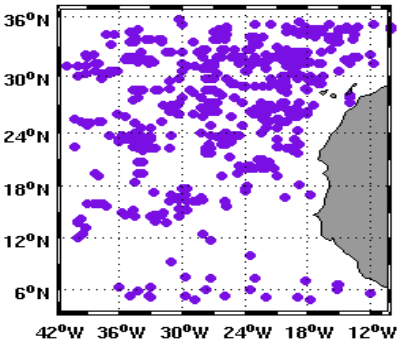
→ Between T and S profiles
→ Between T and S anomalies profiles within AEs
→ Between T and S anomalies profiles within CEs

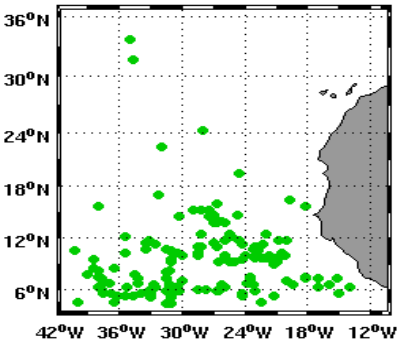




→ « Meddy ? » profile

→ « North » profile





→ « South » profile