A Cariaco Basin ROMS model nested in HYCOM

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HYCOM
HYbrid Coordinate Ocean Model

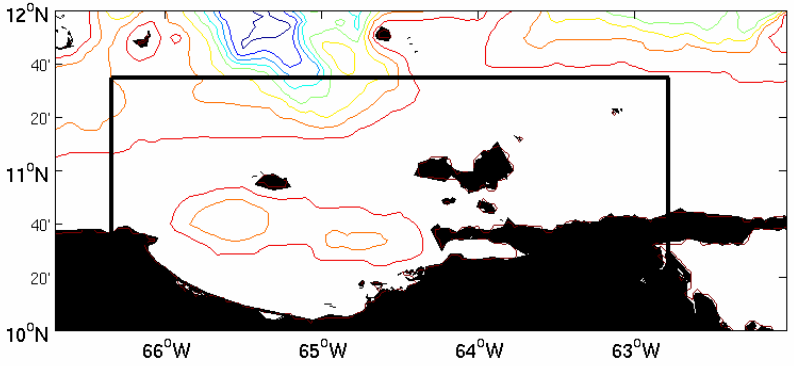
CARIACO
CArbon Retention In A Colored Ocean

NSF

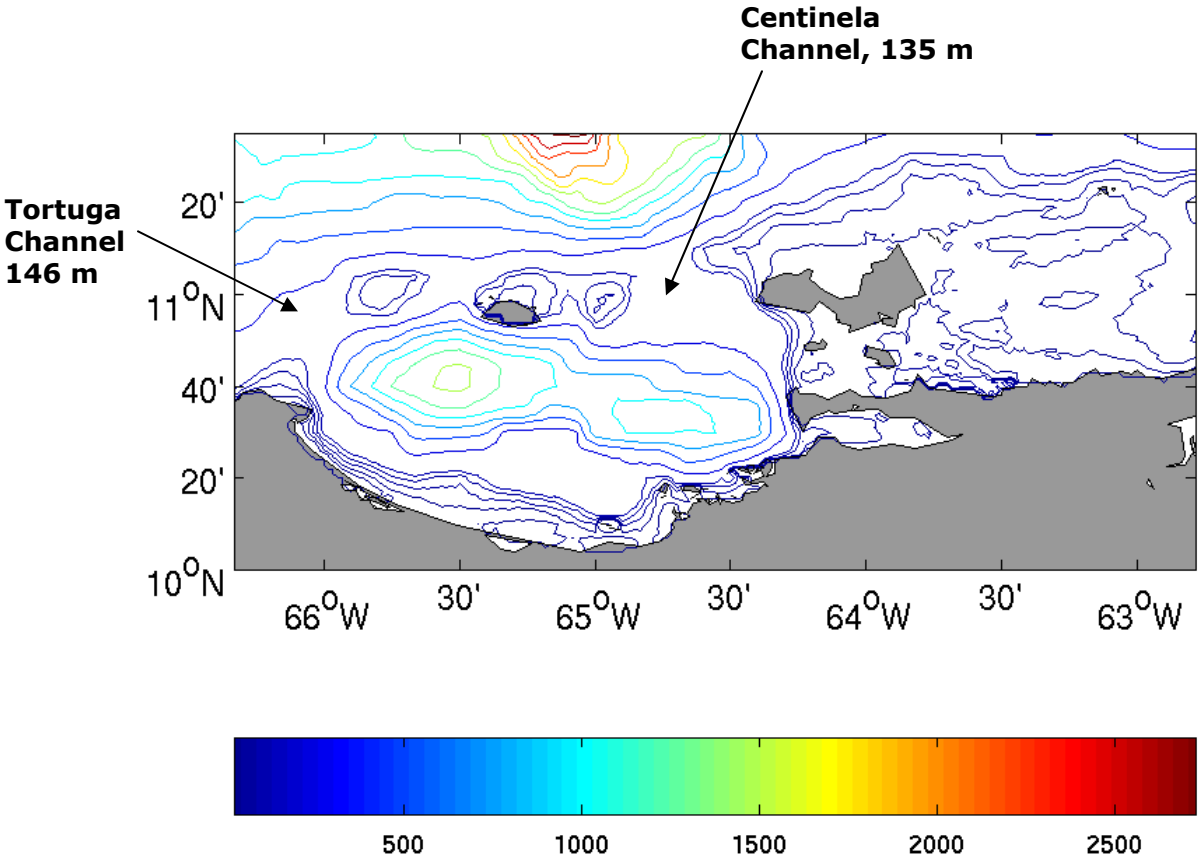
Tallahasee , 8 November 2006

Model basics

- Regional Ocean Model System (ROMS) nested in 1/12° North Atlantic HYCOM.
- 3D, free-surface, hydrostatic, primitive equation ocean model.
- 32 vertical terrain-following (s) levels.
- 1/60° resolution (1.82 km x 1.85 km).
- Bathymetry: merged DBDB2 + in situ data.
- Open boundary conditions (T,S, currents and elevation) from HYCOM.
- Initial conditions for temperature and salinity from climatology
- Atmospheric forcings: NCEP thermodynamic forcing (air temperature, relative humidity, cloud fraction and short wave radiation) and winds. Heat flux correction by cloud-free SST (DINEOF).

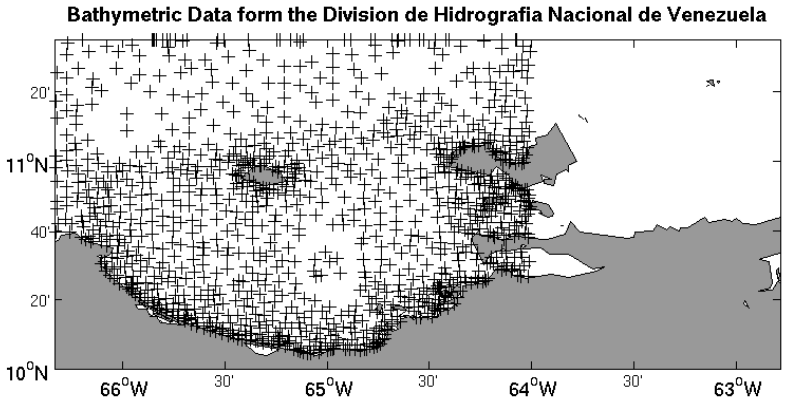


Cariaco Basin



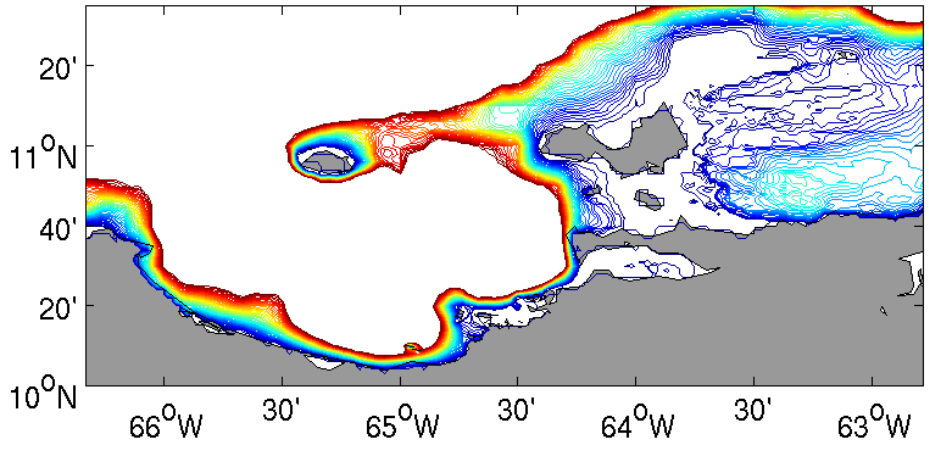
- Semi-enclosed basin
- Two shallow passages connect it to the open ocean
- Maximum depth ~ 1400 m
- Anoxic from ~300 m to bottom
- Basin water ventilation in the first 150 m of the water column

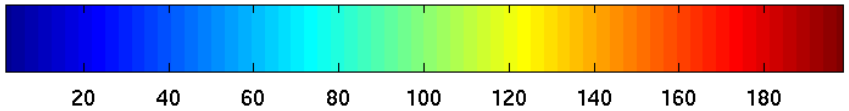
New Bathymetry: DBDB2 + in situ data



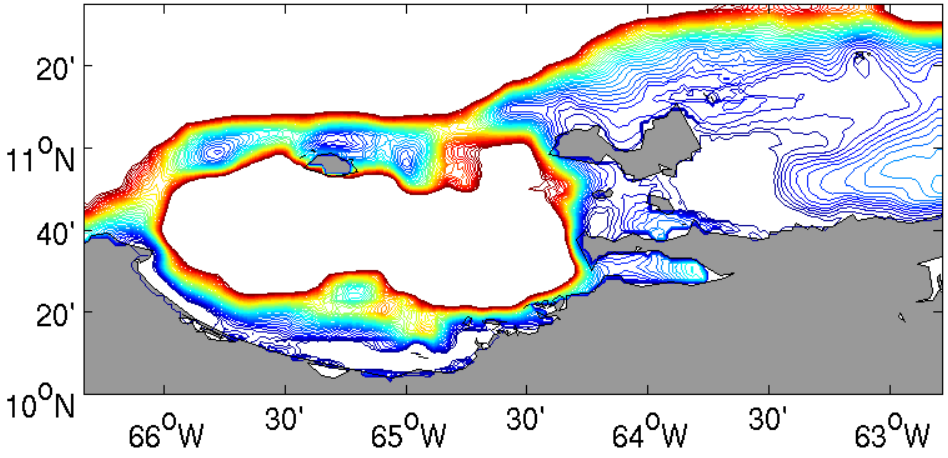
We have merged DBDB2 bathymetry with in situ observations using Optimal Interpolation

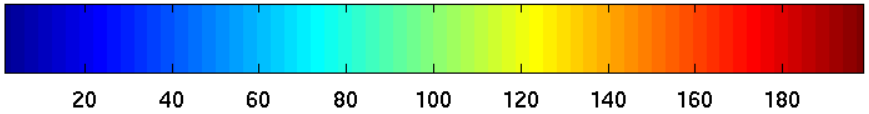
DBDB2 bathymetry





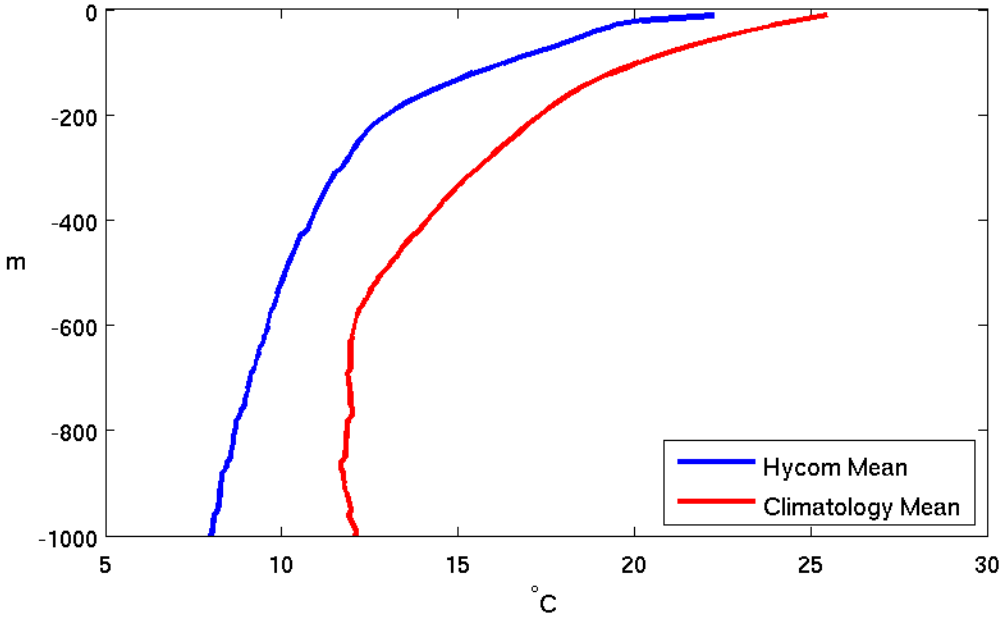
Corrected bathymetry





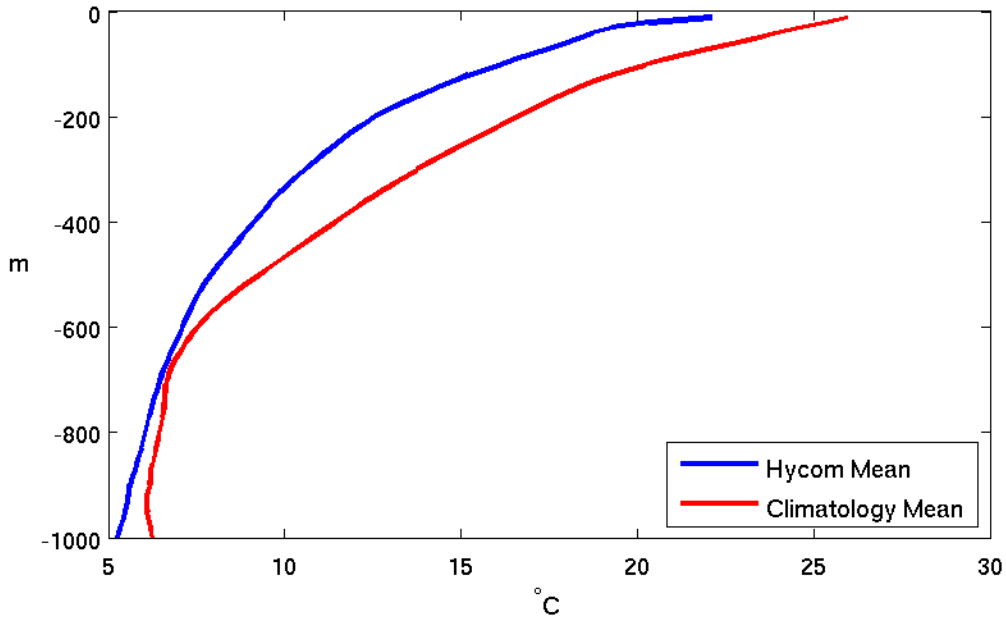
HYCOM temperature compared to climatology

Temperature averaged over Cariaco domain



Figures show the 2004 average for HYCOM and climatology (based on Levitus data)

Temperature averaged over the northern boundary of the Cariaco domain



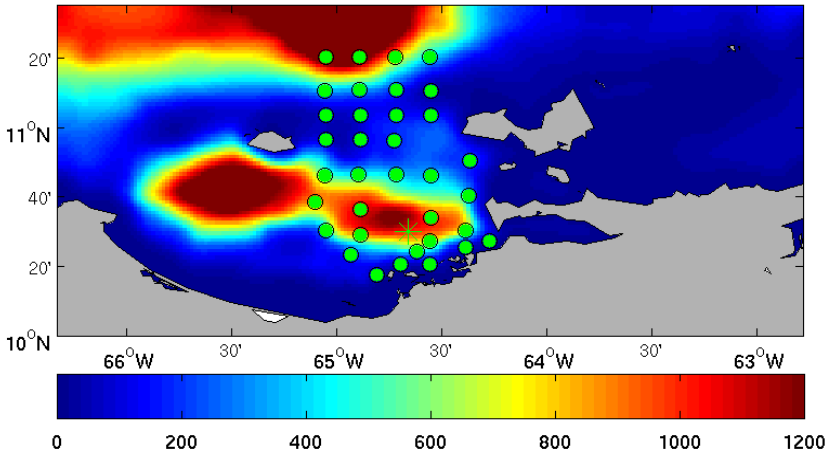
HYCOM Correction

- A monthly average of HYCOM is computed

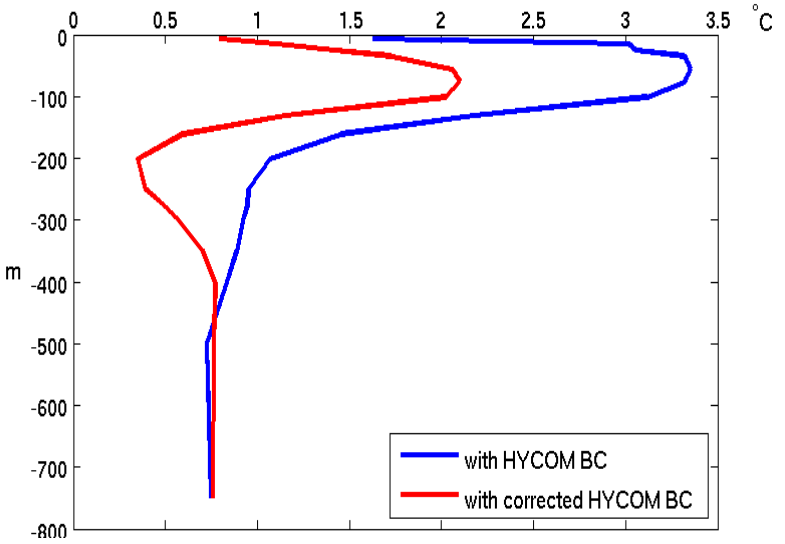
- Difference between the climatology and monthly averaged HYCOM is applied to HYCOM daily fields

2004 hindcast: comparison with observations
corrected and non-corrected boundary values

Observations location

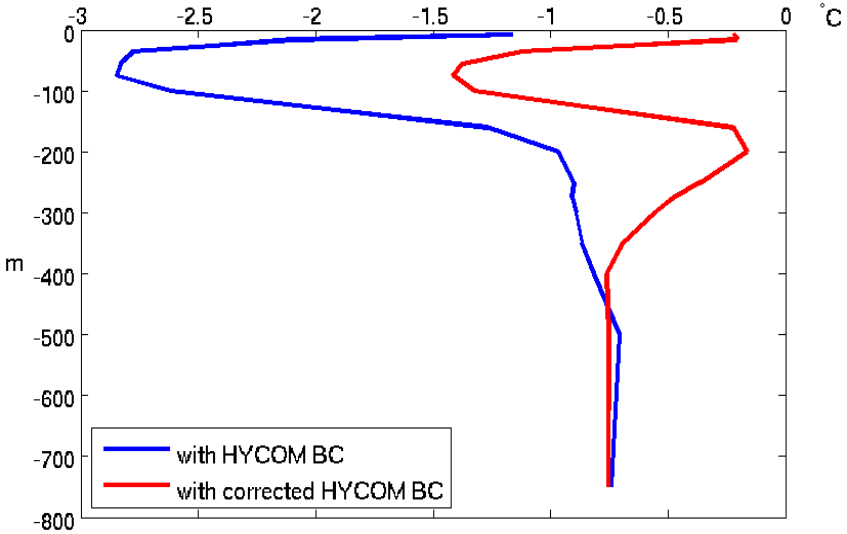


Temperature RMS

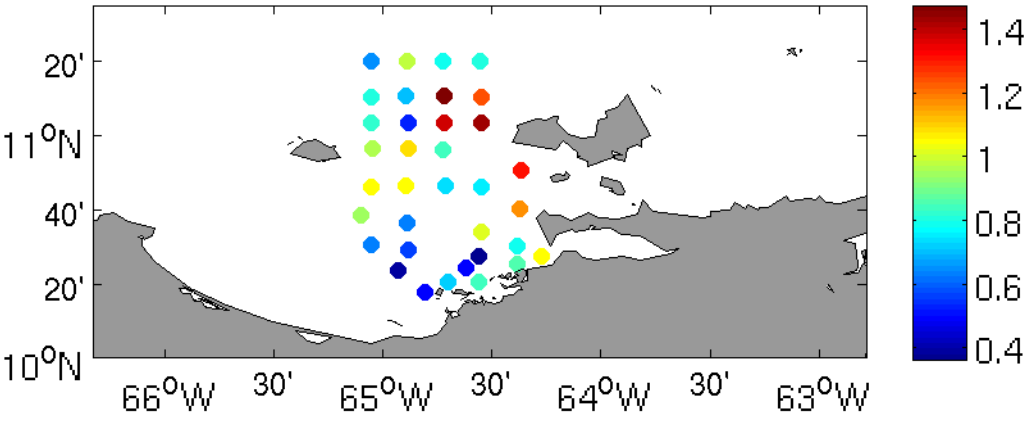


Cariaco station

Temperature bias



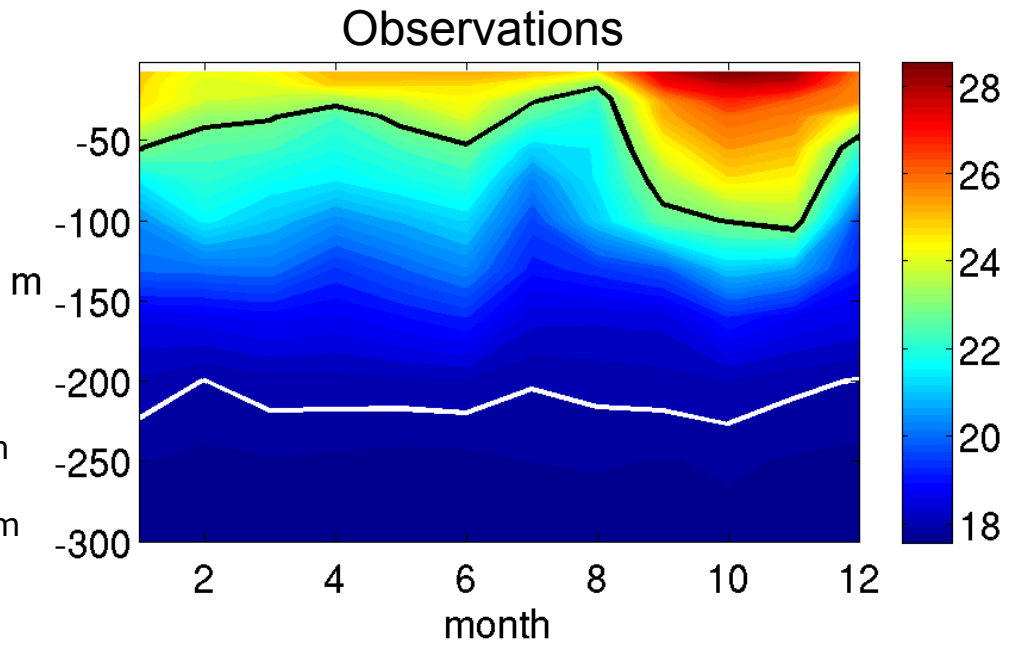
Temperature RMS over the first 100 m

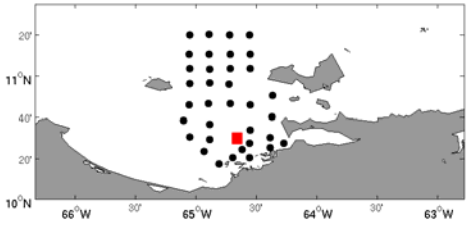


Annual cycle: temperature at Cariaco Station

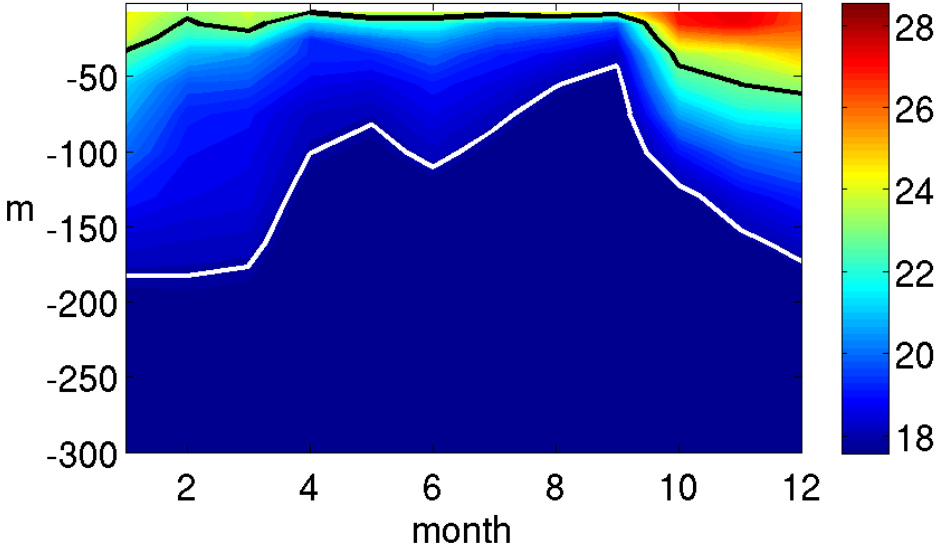
Black: 21°C isotherm

White: 18°C isotherm

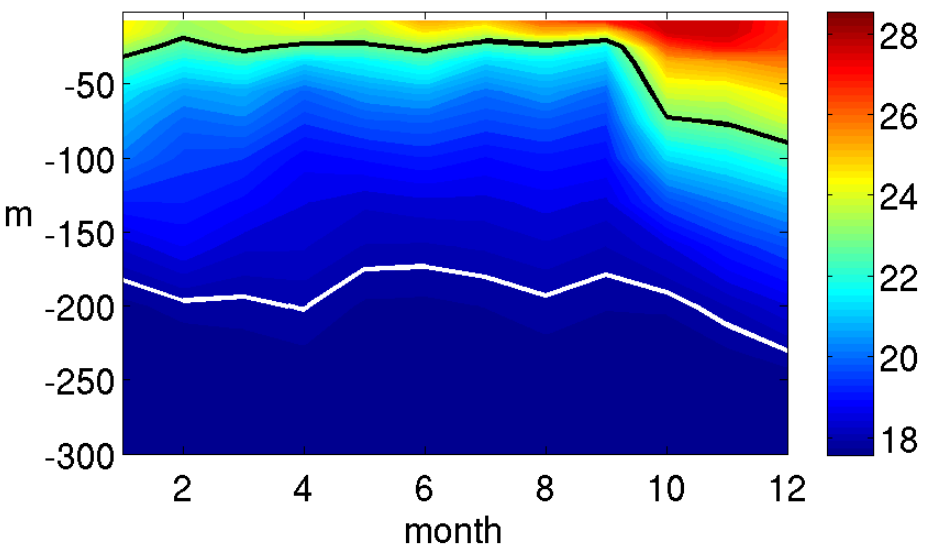




Model with uncorrected Boundary values

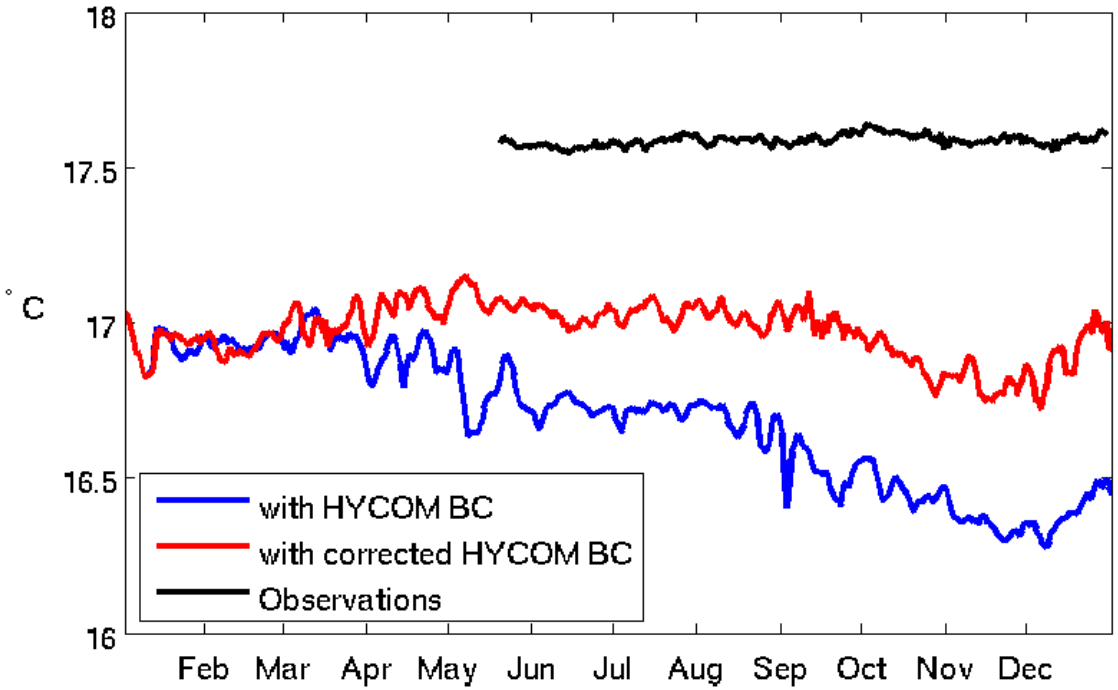


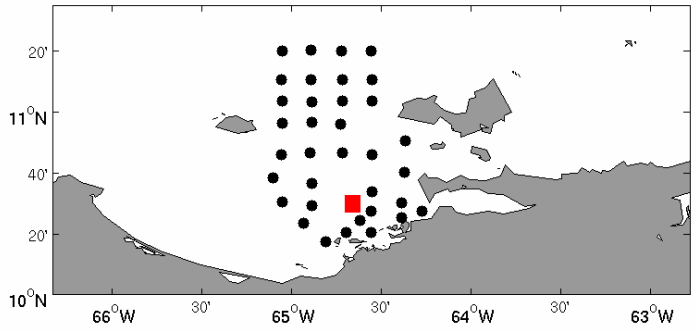
Model with corrected Boundary values



Temperature drift at Cariaco Station

Temperature time series at Cariaco station (300 m depth)

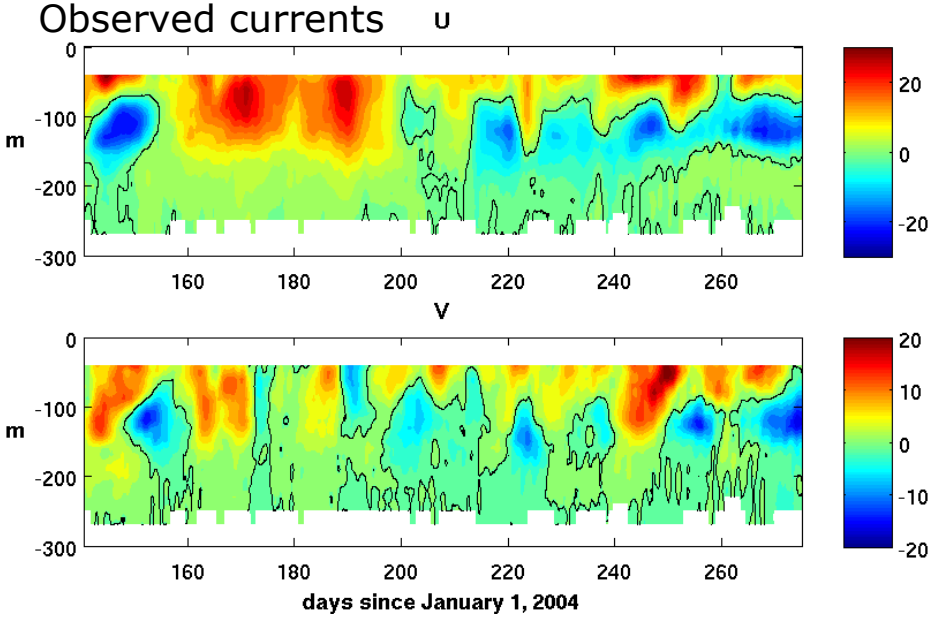


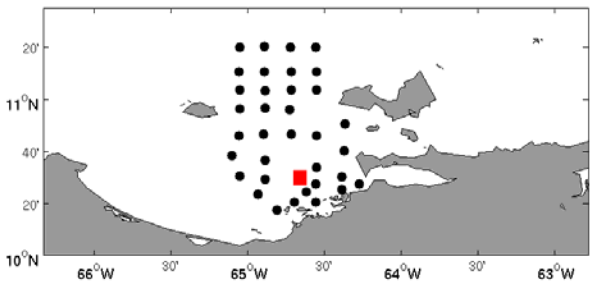


- Very small observed variation through the year
- Model with corrected boundary conditions maintains initial temperature
- Need to correct initial conditions

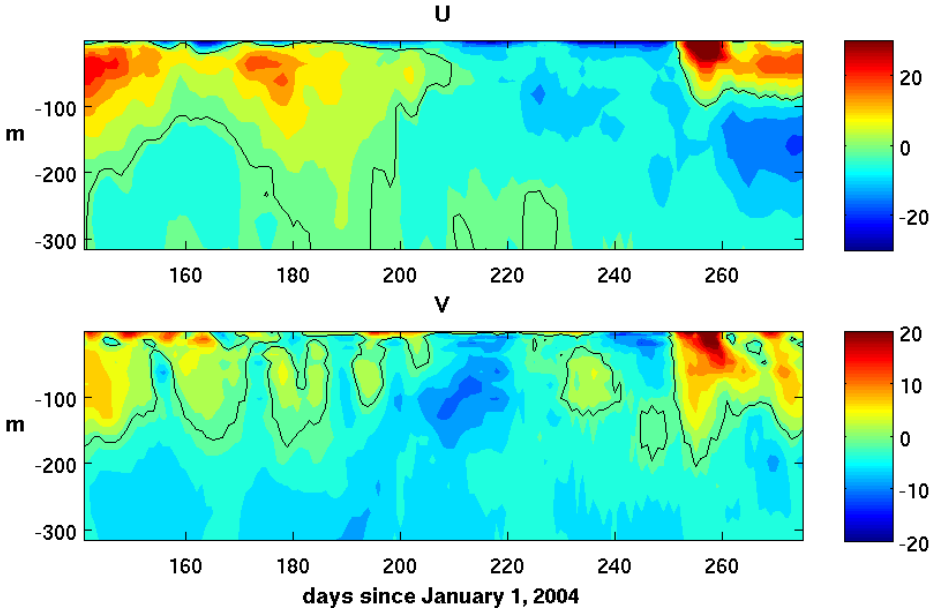
Comparison with ADCP at Cariaco Station

Observed currents

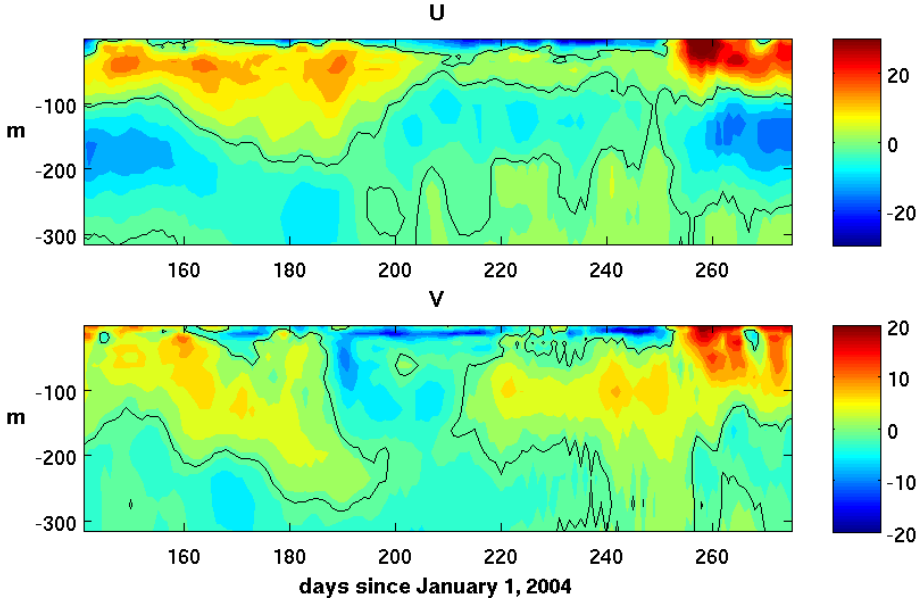




Uncorrected Boundary Values

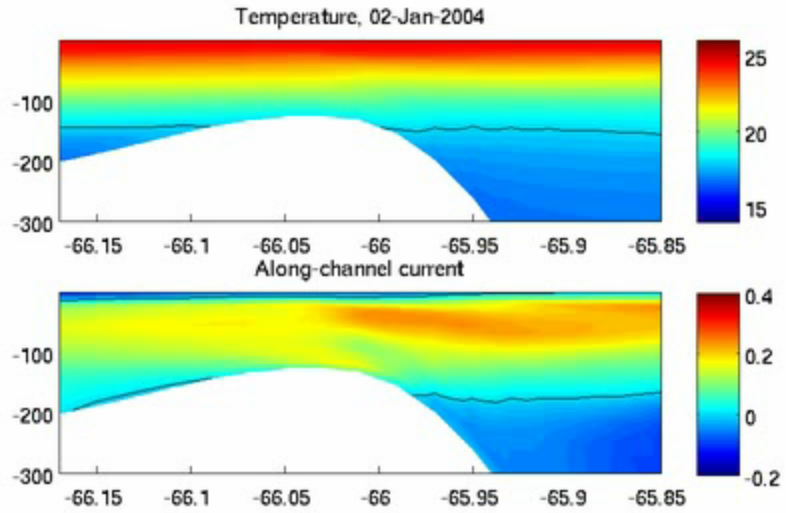


Model Corrected Boundary Values

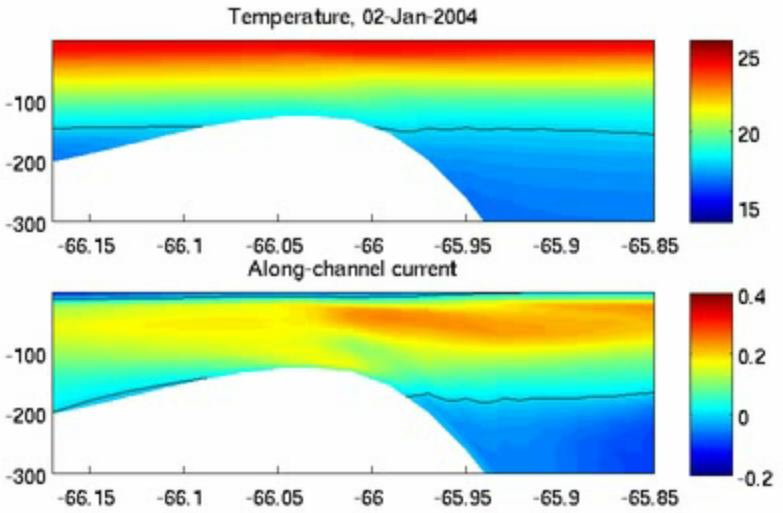


Flow through Tortuga Channel

Model with HYCOM boundary values

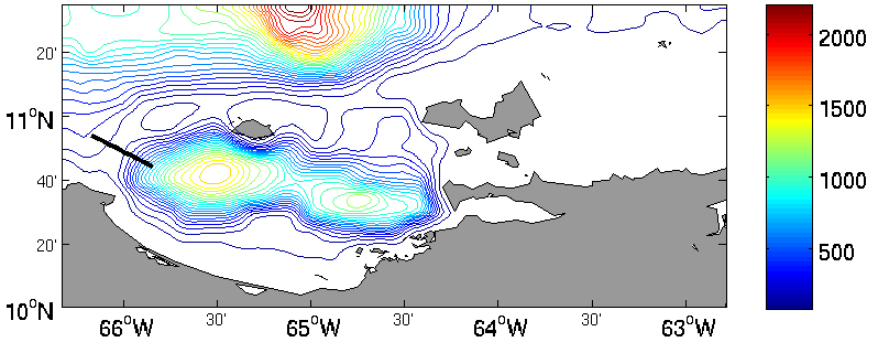


Model with corrected HYCOM boundary values

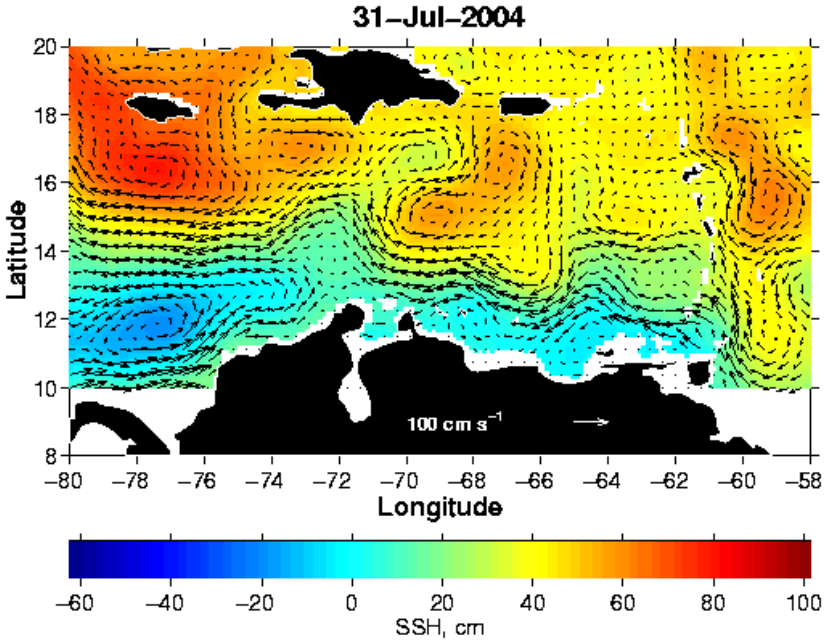


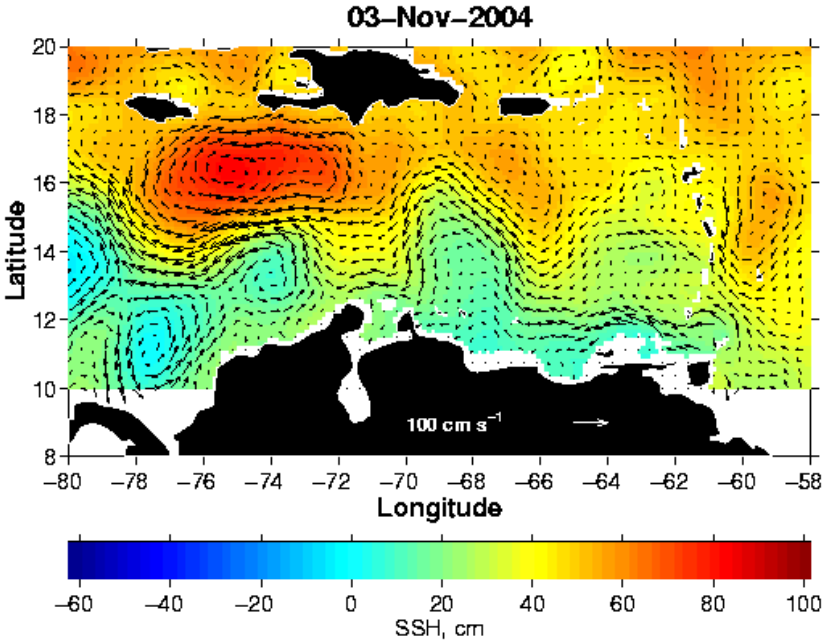
Positive values represent a current to the inside of the basin

Location of the section + bathymetry

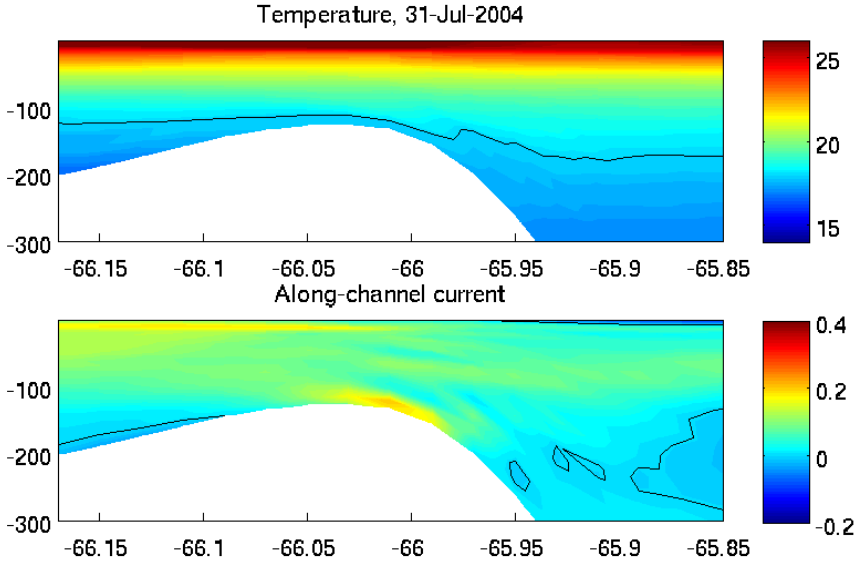


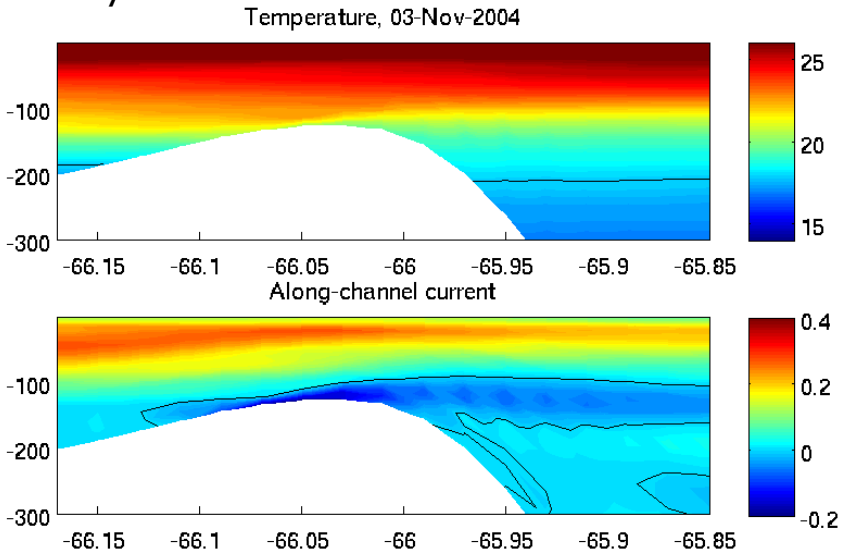
Impact of large scale circulation on Cariaco basin





Model with corrected boundary conditions





Conclusions

- Bathymetry plays an important role in the Cariaco Basin ventilation
- Cold water from HYCOM B.C. entering through Tortuga and Centinela Channels causes a temperature drift in the interior of the basin
- We are able to improve the results in the Cariaco basin model by adjusting the T and S boundary values from HYCOM to the climatology

Future Work

- We will perform a new run nested in the global HYCOM with NCODA assimilation, as results become available

- We will study the exchanges of the Cariaco basin with the open ocean, circulation patterns within the basin and annual cycle