Recent advancements of a Cariaco Basin ROMS model nested in global HYCOM

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HYCOM
HYbrid Coordinate Ocean Model

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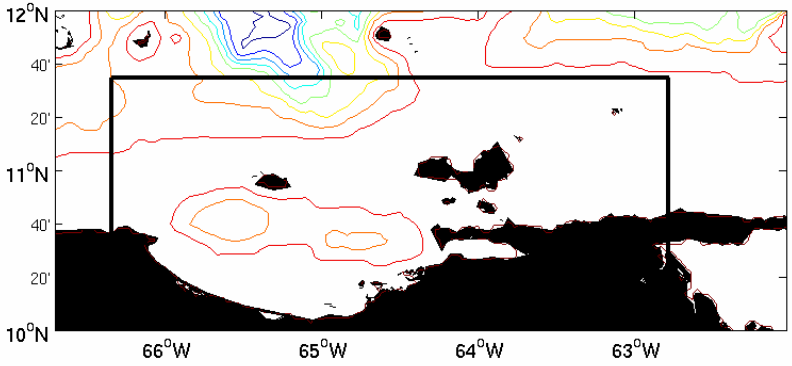
CARIACO

CArbon Retention In A Colored Ocean

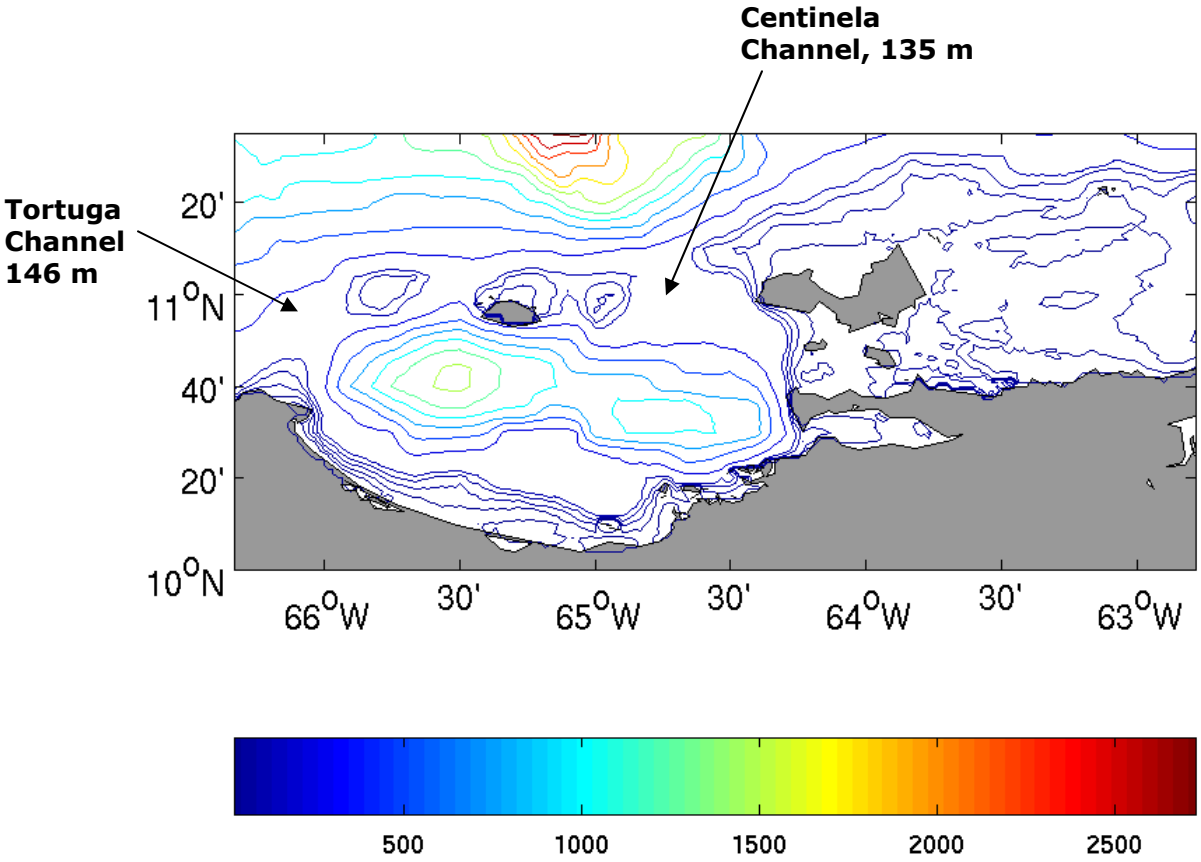
Model basics

- Regional Ocean Model System (ROMS) nested in 1/12° Global NCODA 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.
- 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).

Model domain (black line)

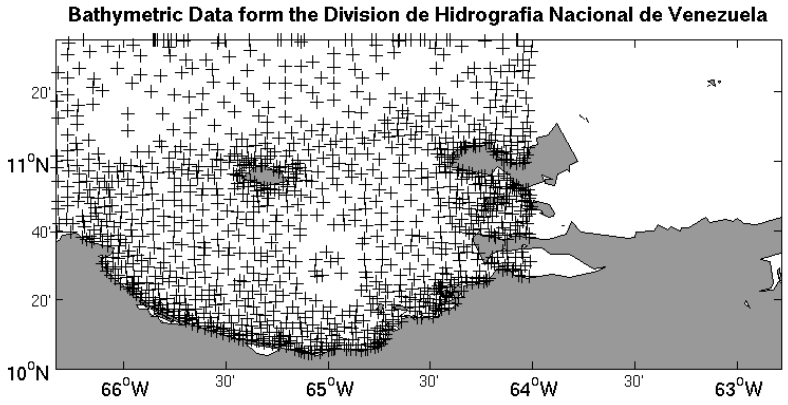


Cariaco Basin



- Semi-enclosed basin
- Two shallow passages connect it to the open ocean
- Maximum depth ~ 1400 m
- Anoxic from ~500 m to bottom
- Basin water ventilation in the first 150 m of the water column

New Bathymetry: DBDB2 + in situ data

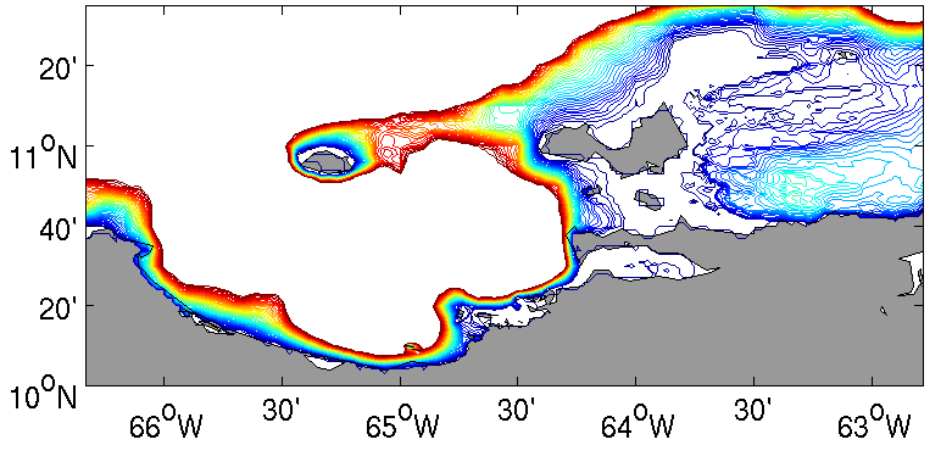


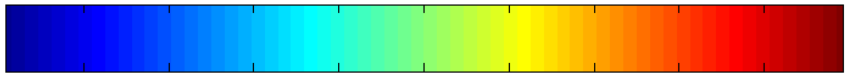
DBDB2: too deep in channels

New bathymetry: OI merged DBDB2 + in situ

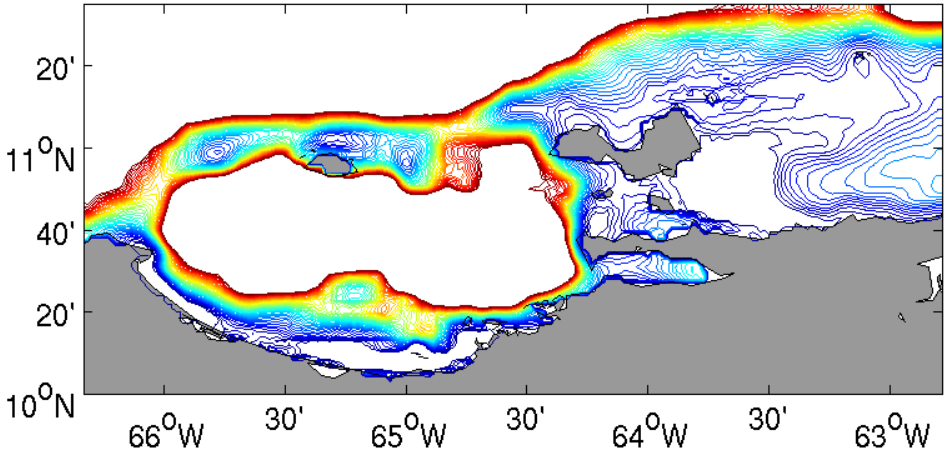
Tortuga Channel: 146m
Centinela Channel: 135m

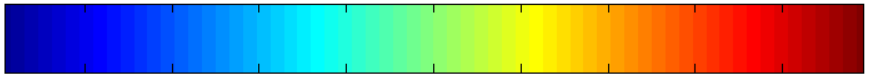
DBDB2





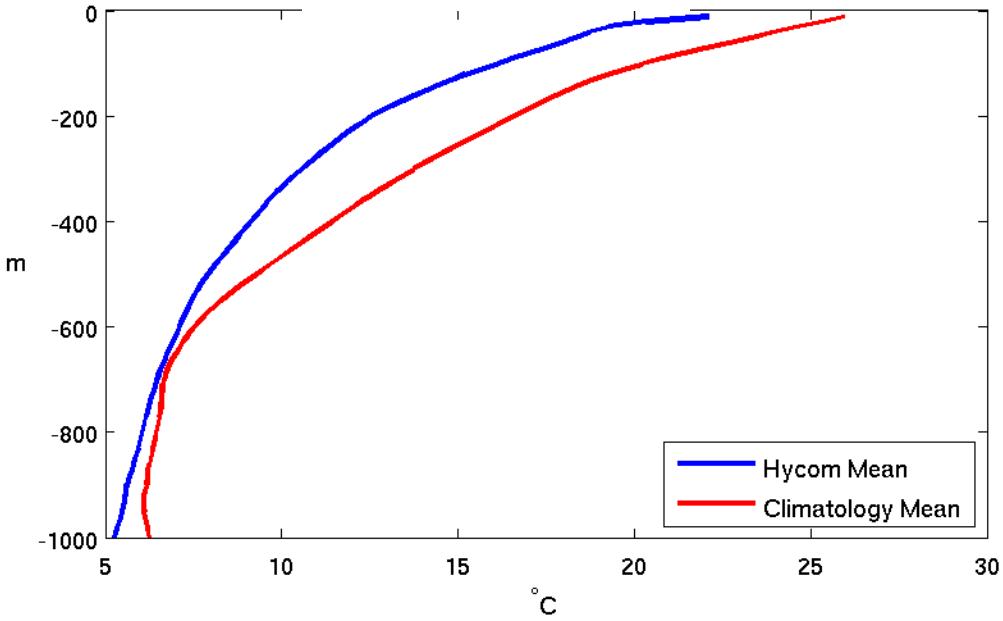
Corrected model bathymetry





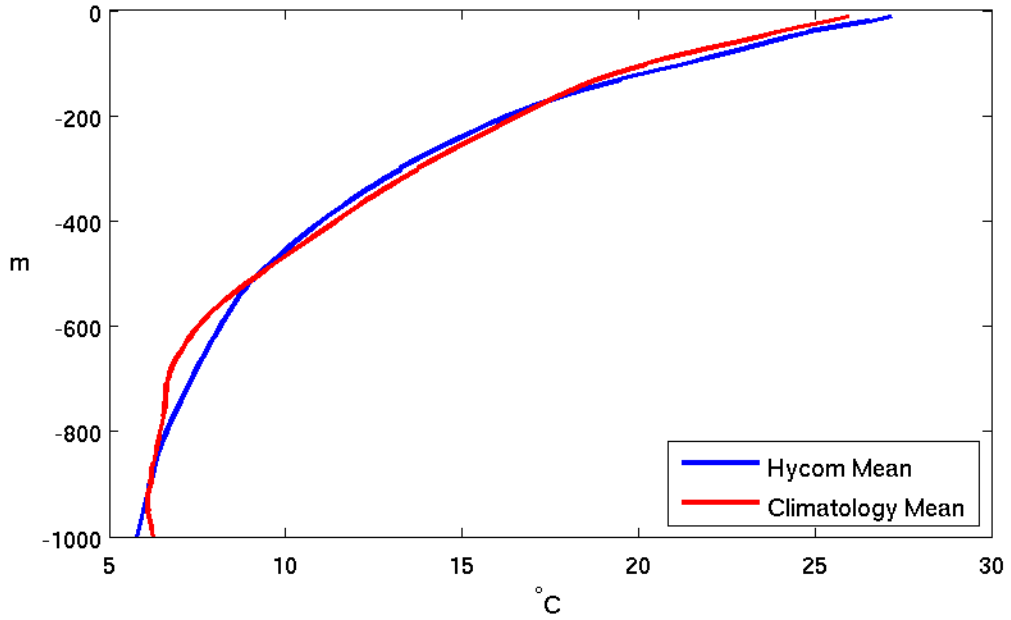
HYCOM temperature compared to climatology

Atlantic HYCOM



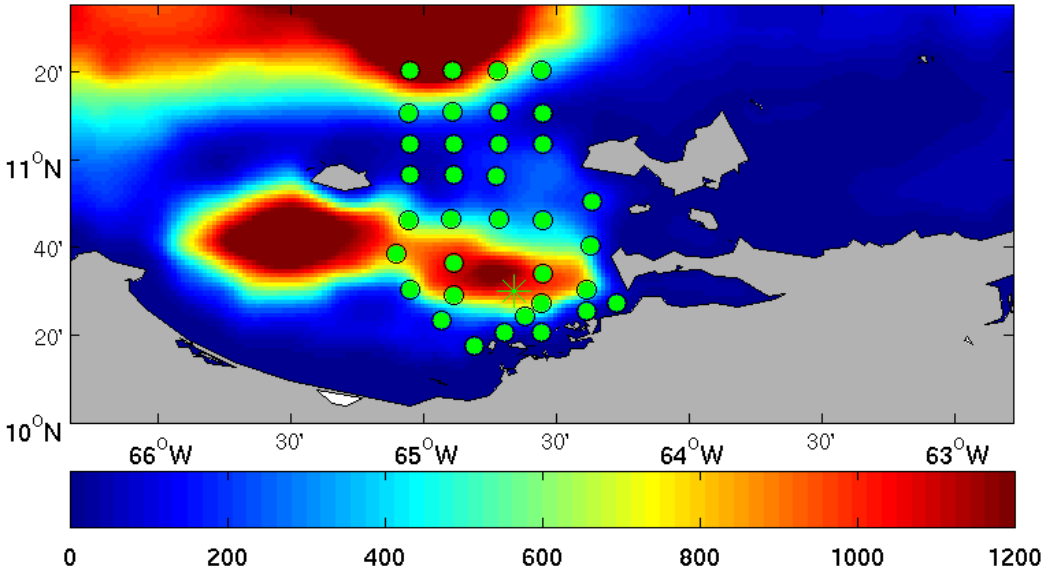
Figures show the 2004 temperature average (space and time) for HYCOM and climatology (based on Levitus data) at northern model boundary

Global NCODA HYCOM



Comparison with observations: 2004 hindcast

Observations location



Two sets of observations:

- Monthly CTDs at CARIACO station (*)
- Cruise in March 2004 (●)

Temperature

* Monthly CTDs	RMS	0.92°C
	Bias	0.11°C
● March cruise	RMS	0.72°C
	Bias	0.03°C

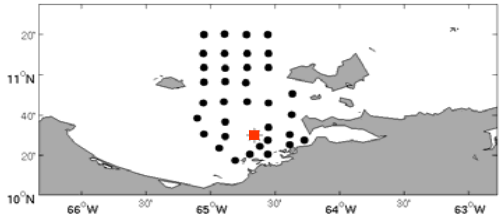
Salinity

* Monthly CTDs	RMS	0.3
	Bias	-0.24
● March cruise	RMS	0.33
	Bias	-0.28

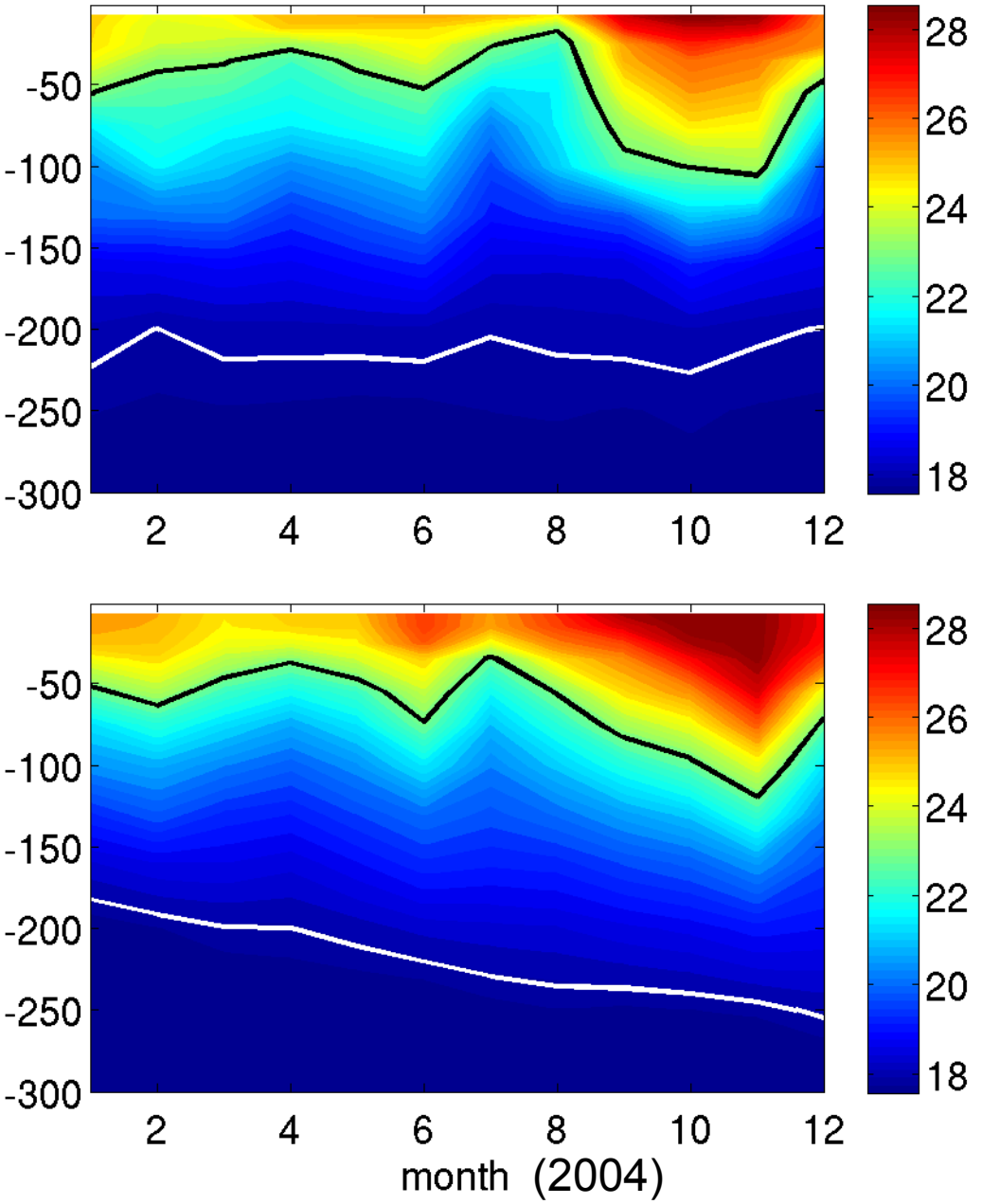
Data from Fundación La Salle
de Ciencias Naturales (Venezuela)

Annual cycle: temperature at CARIACO Station

Observations



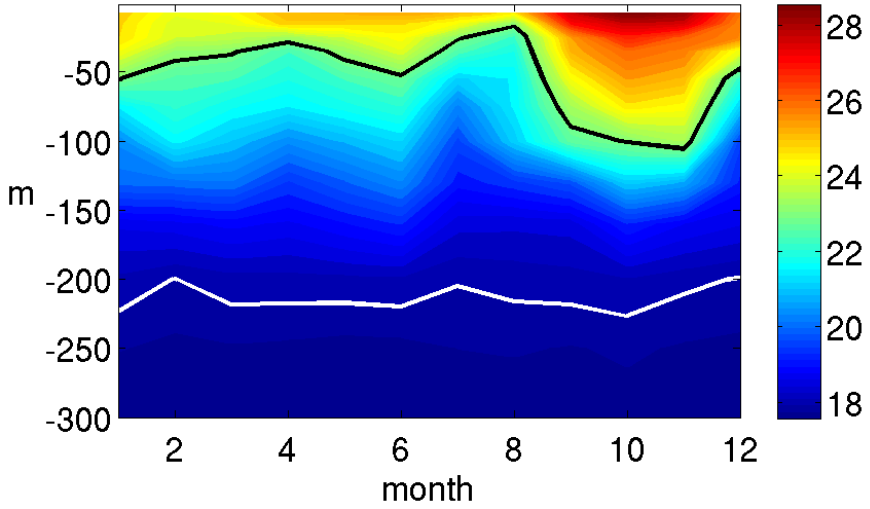
Cariaco Model
nested in global
NCODA HYCOM



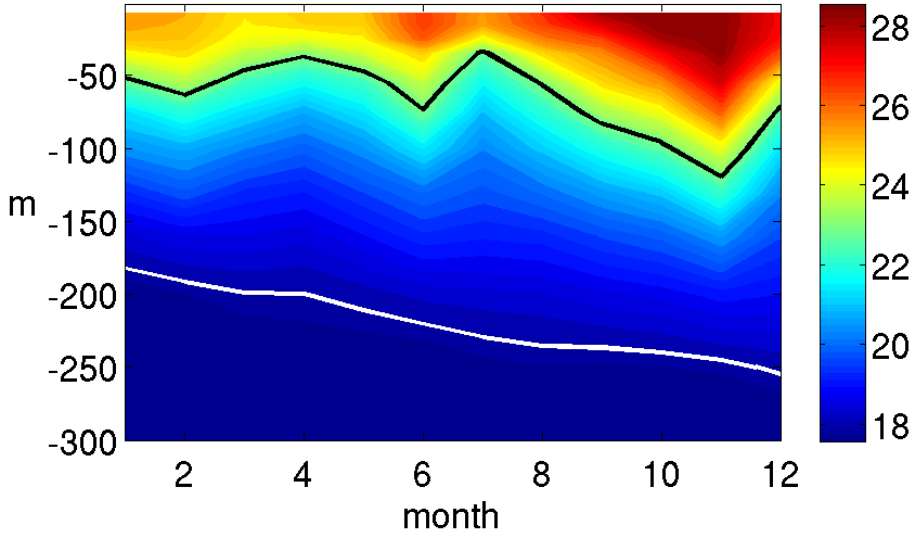
Black: 21°C isotherm
White: 18 °C isotherm

Annual cycle: Cariaco model with NAT HYCOM BC

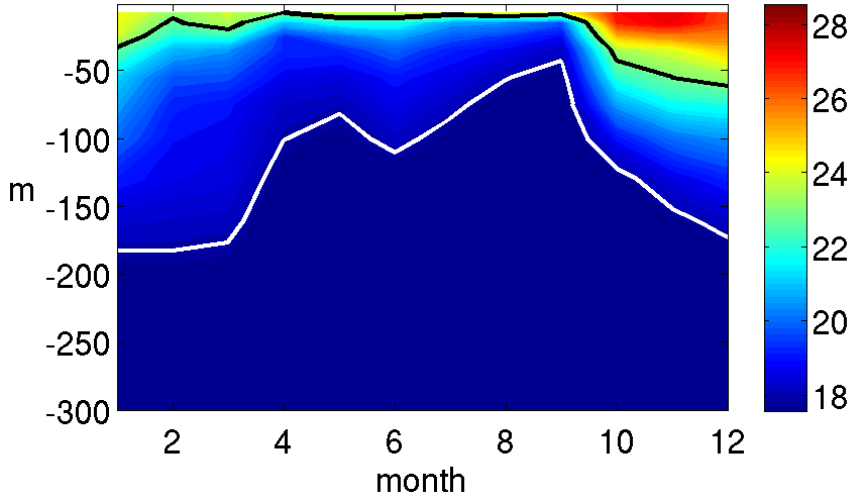
observations



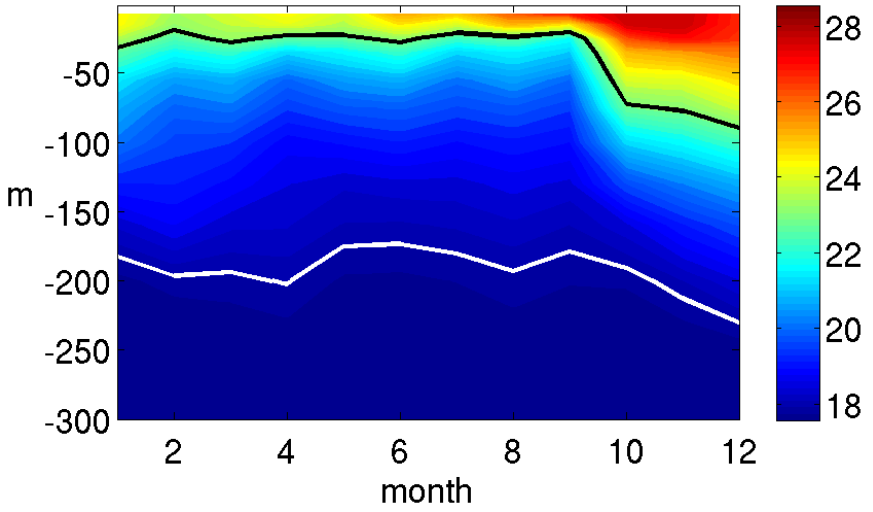
using global NCODA HYCOM BC



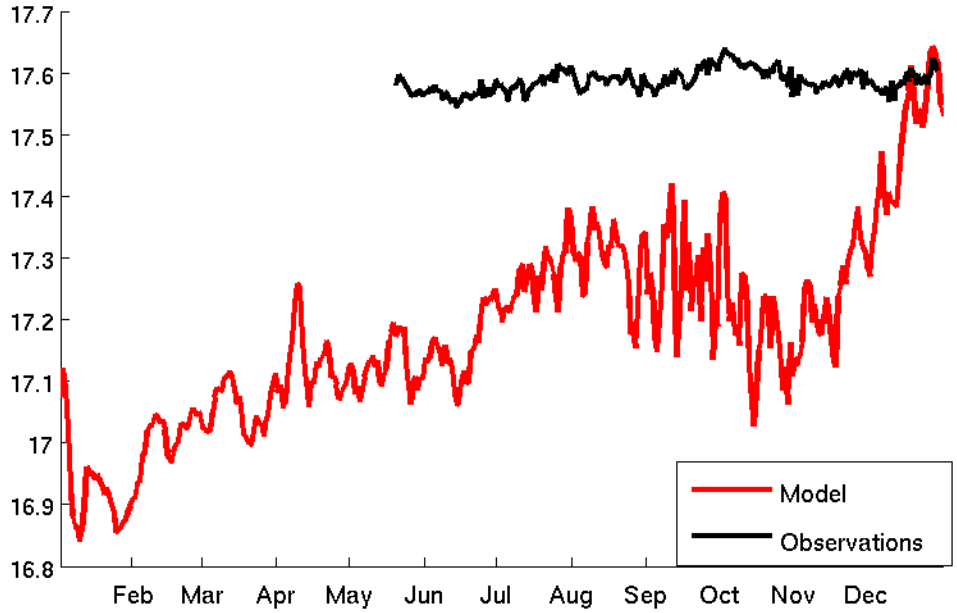
using NAT HYCOM BC



using corrected NAT HYCOM BC



Temperature bias at depth



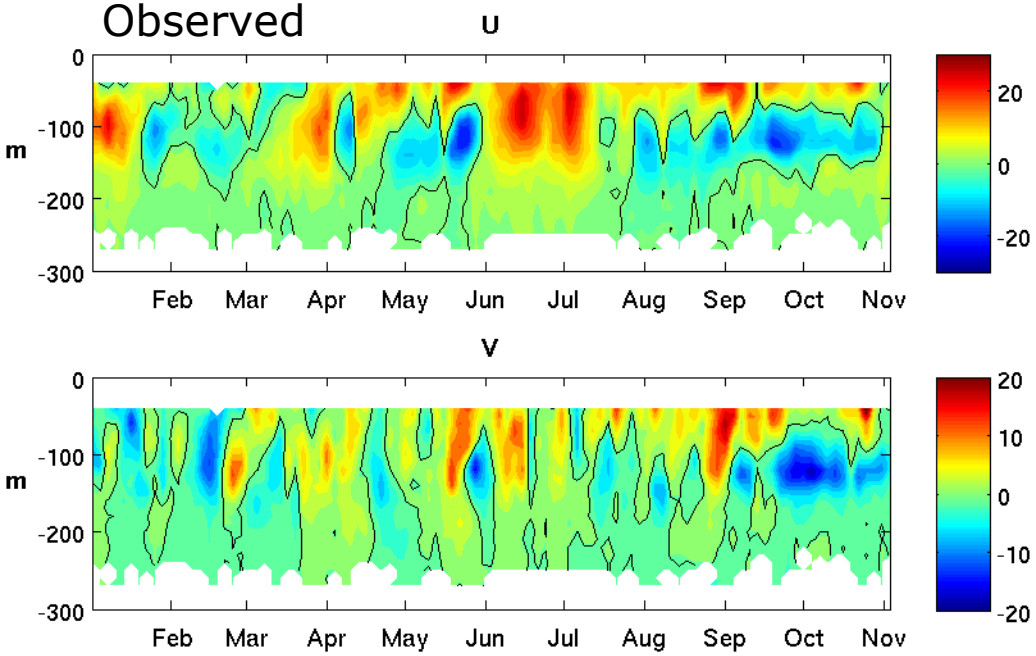
Temperature observed at Cariaco station (300 m depth)

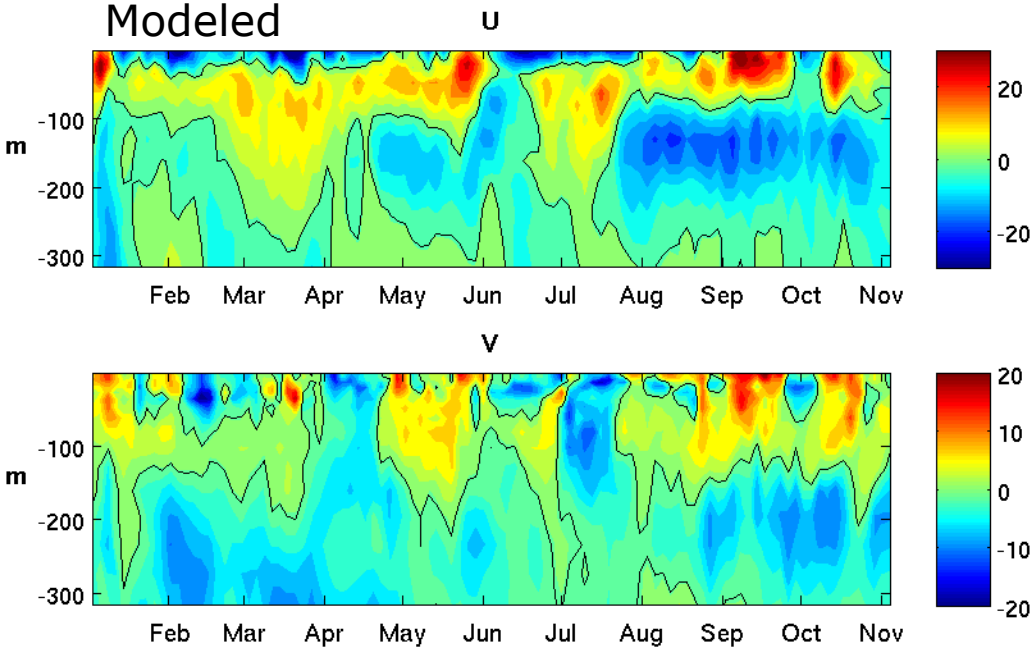
Cariaco model nested in global NCODA HYCOM at 300 m depth

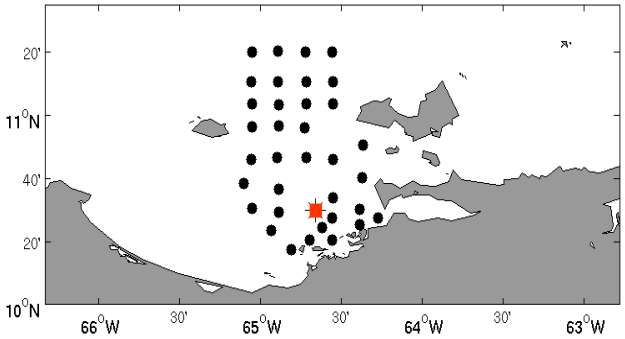
- Bias in IC at depth reduces through the year
- We prepare a new IC with this initial bias corrected

Data from University of South Florida

Comparison with ADCP currents





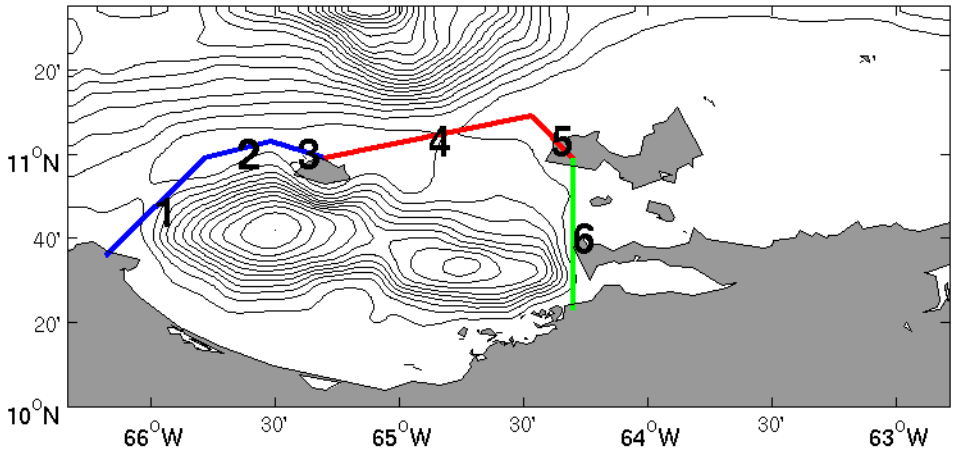


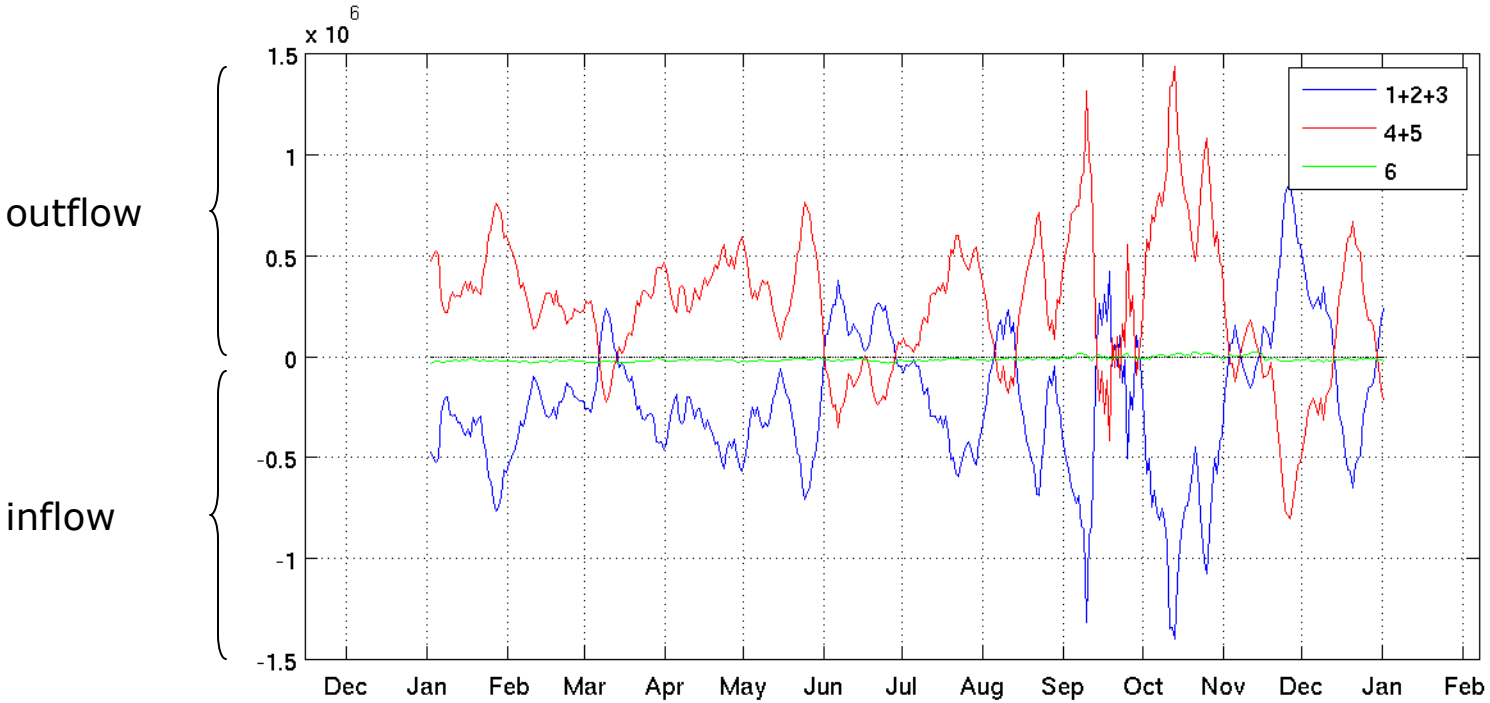
Mean error

RMS	0.07m/s
Correlation coef.	0.74
Angle	-6
Regression coef.	0.7

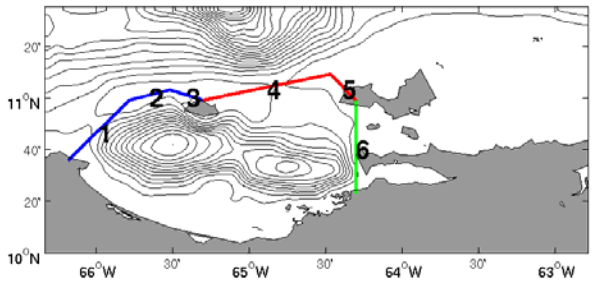
Data from University of South Florida

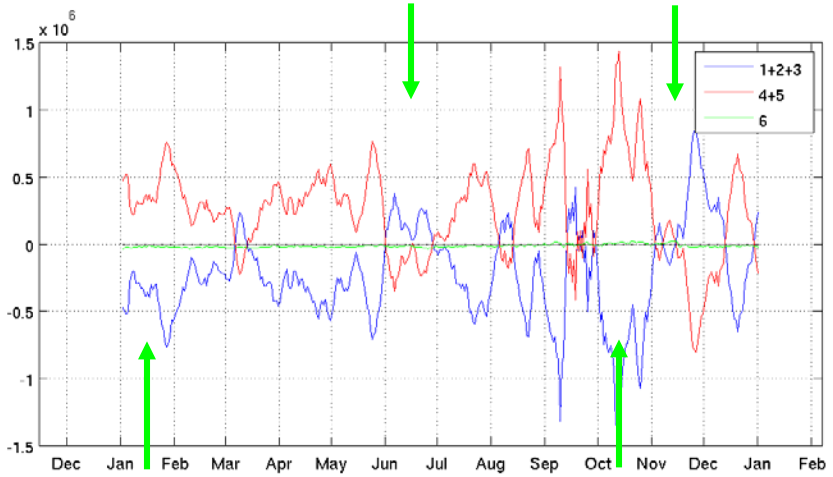
Ventilation through the channels





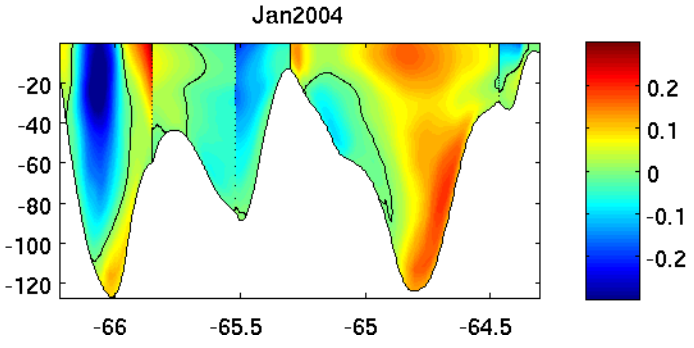
Two patterns in basin circulation

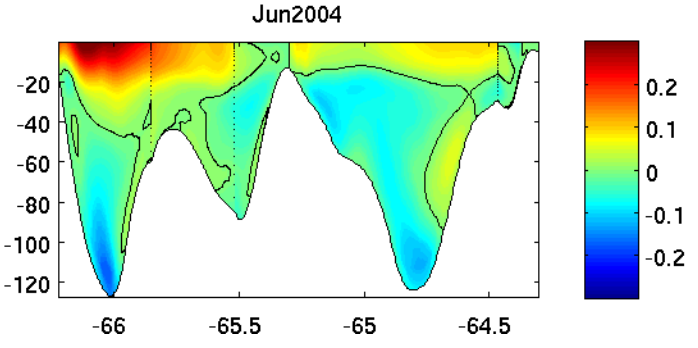




Normal current pattern:
Inflow at Tortuga and outflow at Centinela channel

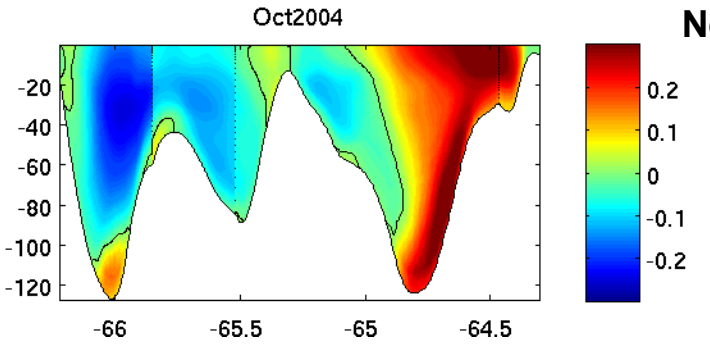
Reversed current pattern

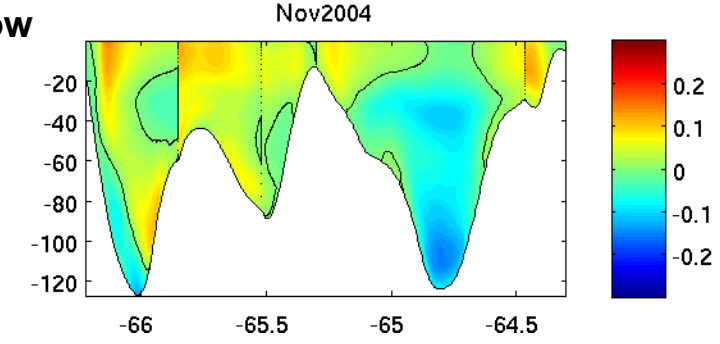




mean currents (m/s)

Negative: inflow

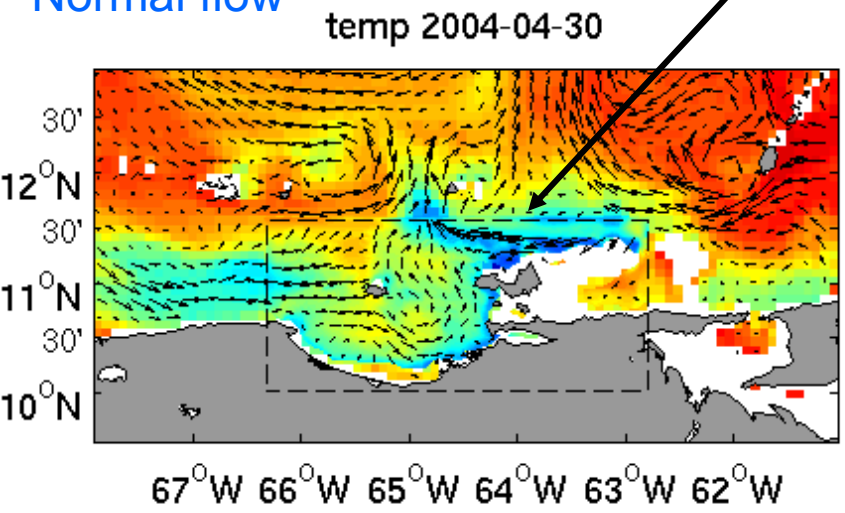


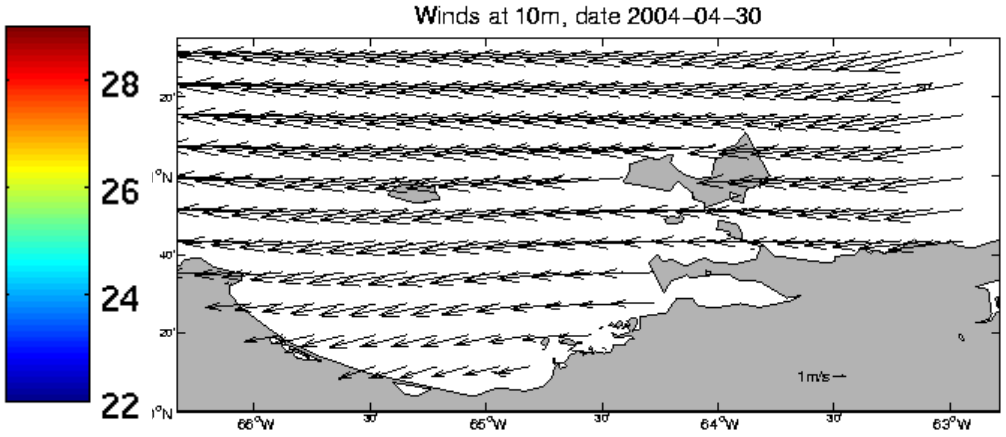


Current reversal: temperature and currents at 20m depth

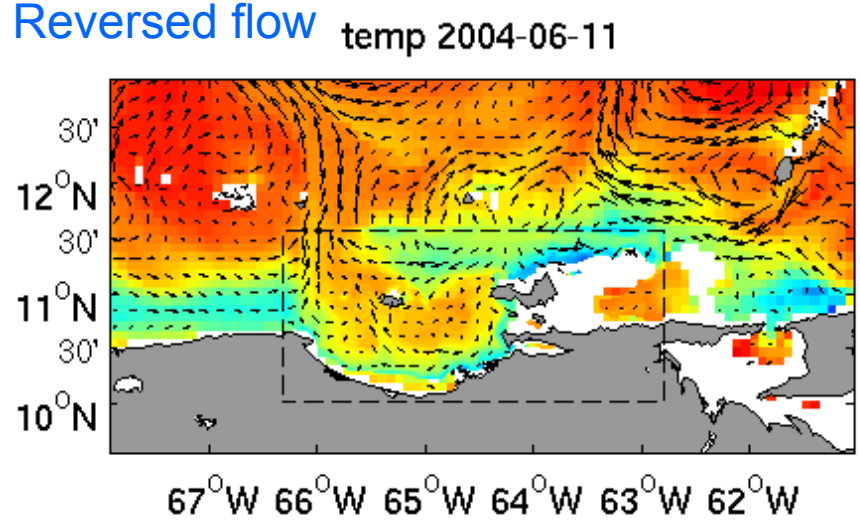
Normal flow

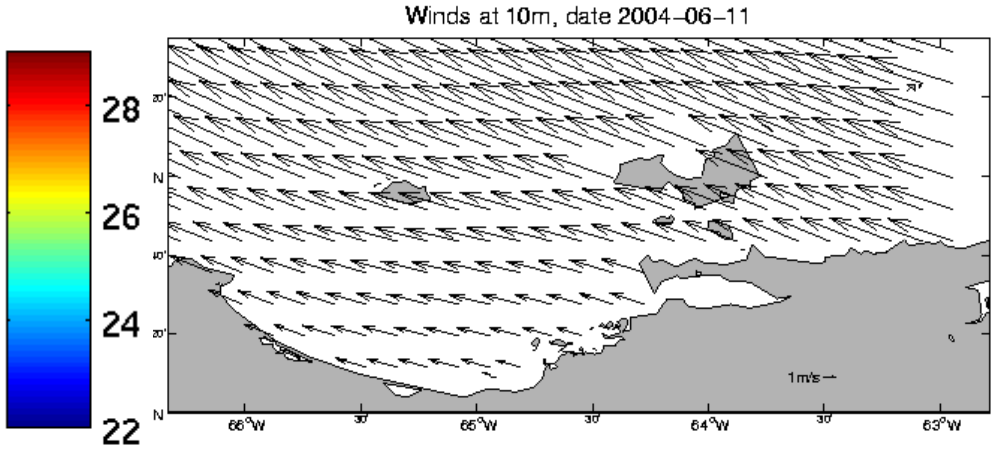
Quasi permanent upwelling





Reversed flow



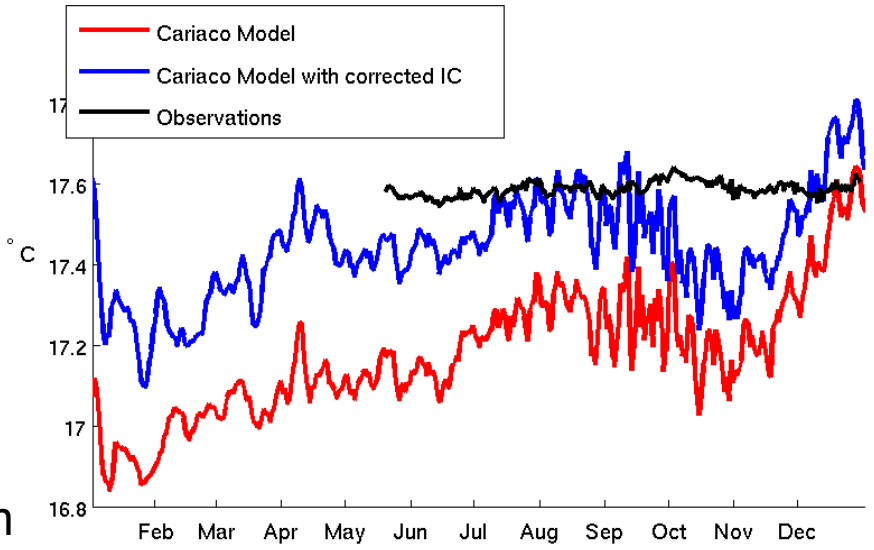


Conclusions

- New NCODA HYCOM run improves the results within the Cariaco basin
- Comparison with in situ T, S and currents observations shows good agreement
- Bathymetry plays an important role in the Cariaco Basin ventilation
- Overall anticyclonic circulation within the basin, but sometimes reversed

Future Work

- The role of open ocean circulation in basin's current reversals will be studied
- Correction of the IC to correct bias at depth?



temperature at 300 m