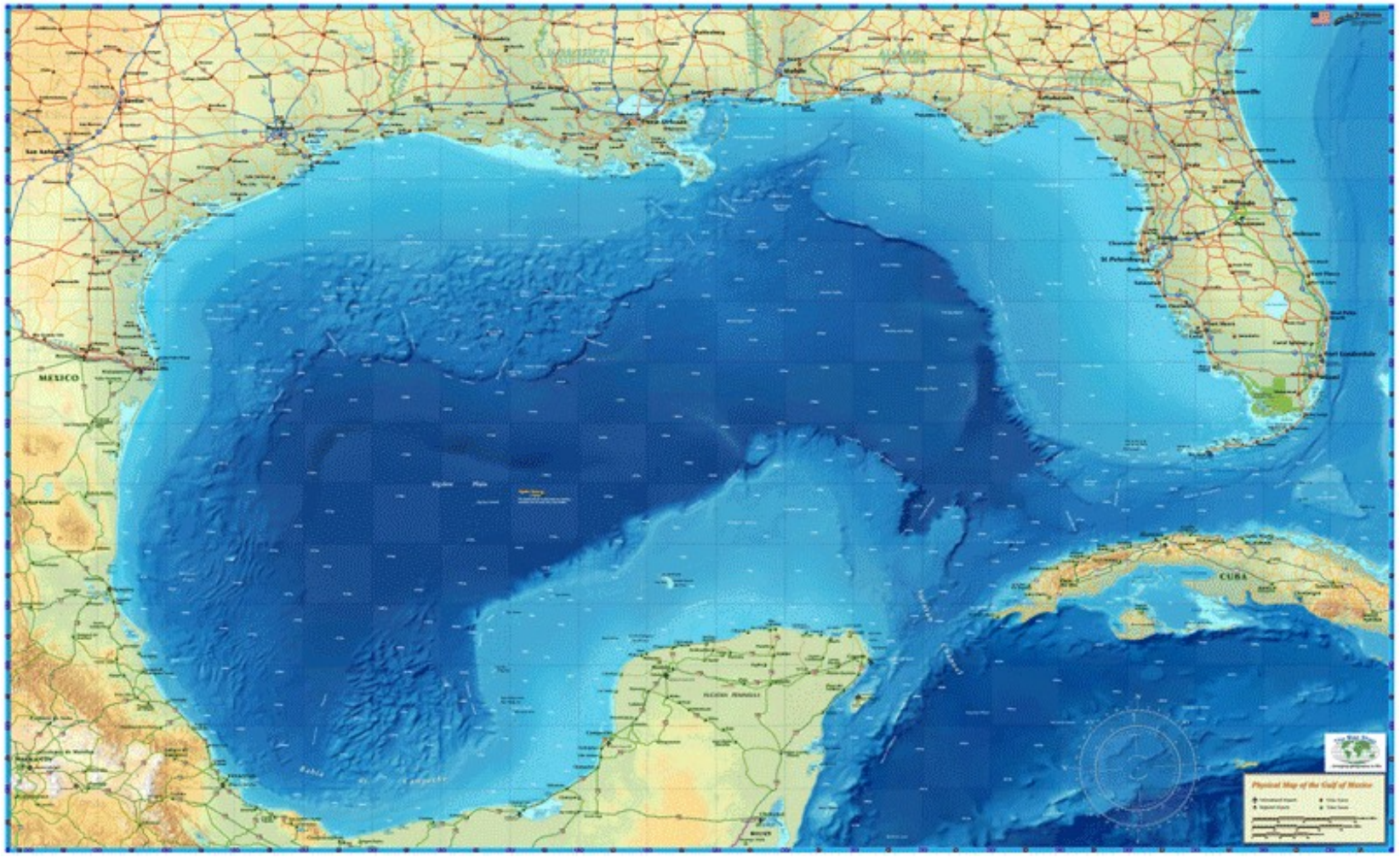
OCEAN STATE ESTINATE FOR THE GULF OF MEXICO – A REANALYSIS OF ITS OCEANOGRAPHYC CONCDITIONS



CICESE MR

CIGoM
Consorcio de Investigación del Golfo de México

NASGRP

Dr. Joao Marcos Azevedo C. de Souza
With the collaboration of: Dr. enric Pallas-Sanz, Dr. Aljaz Maslo; Dra. Sheila Estrada-Allis; Dr. Julio Sheinbaum, Dr. Alejandro Pares, Dr. Julio Candela, Dra. Paula Perez-Brunius, Lorena Guerrero, Ana Ramirez, and many others...

- Make physical, chemical and biological measurements to establish a base line of the actual estate and natural variability of the GoM ecosystem.

- Generate and use state-of-the-art technologies to continuously observe the ocean - some times in real time. These technologies can be uesed in the case of an oil spill to, with numerical models, estimate its dispersion and posible impacts.

- Develop physical, biogechemical and transport models that include oil degradation processes and provide risk maps, arrival times and impact estimates taking into acount the oil characteristics and the position and depth of possible spills.

Environmental base line and monitoring.

Dra. Sharon Herzka

Dr. Juan Carlos Herguera

Oil natural degradation

Dr. Alexei Licea

Oil spill scenarios

Dra. Paula Pérez

Physical and biogechemical models

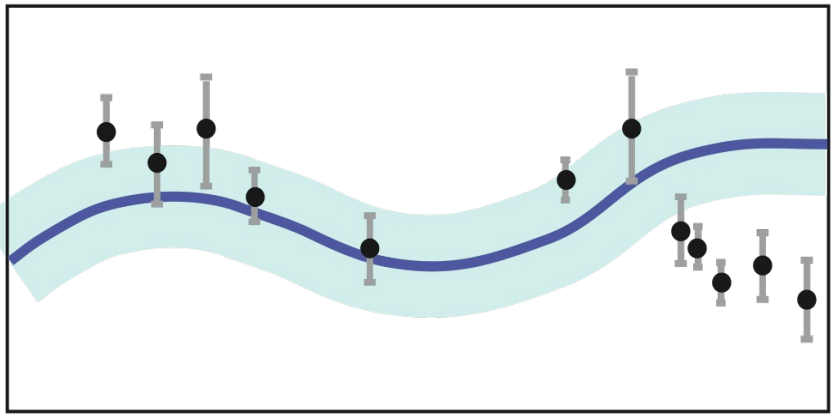
Dr. Julio Sheinbaum

Observation platforms

Dr. Francisco Ocampo

Data Assimilation in 60s ! “ROMS IS4DVar”

The “Forecast” or “Hindcast”

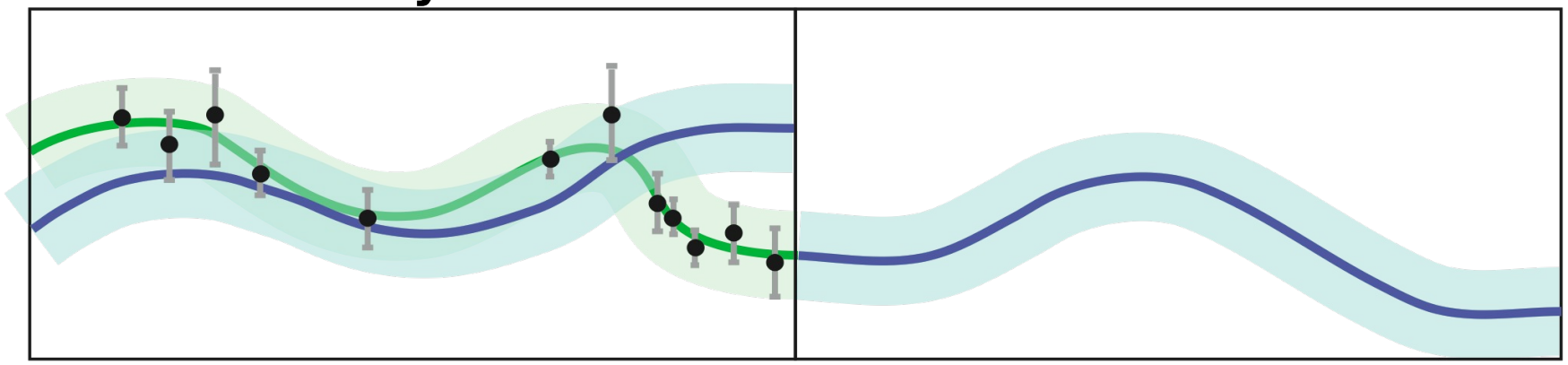


Generating a series of analyses trough several assimilation cycles in the past...

REANALYSIS

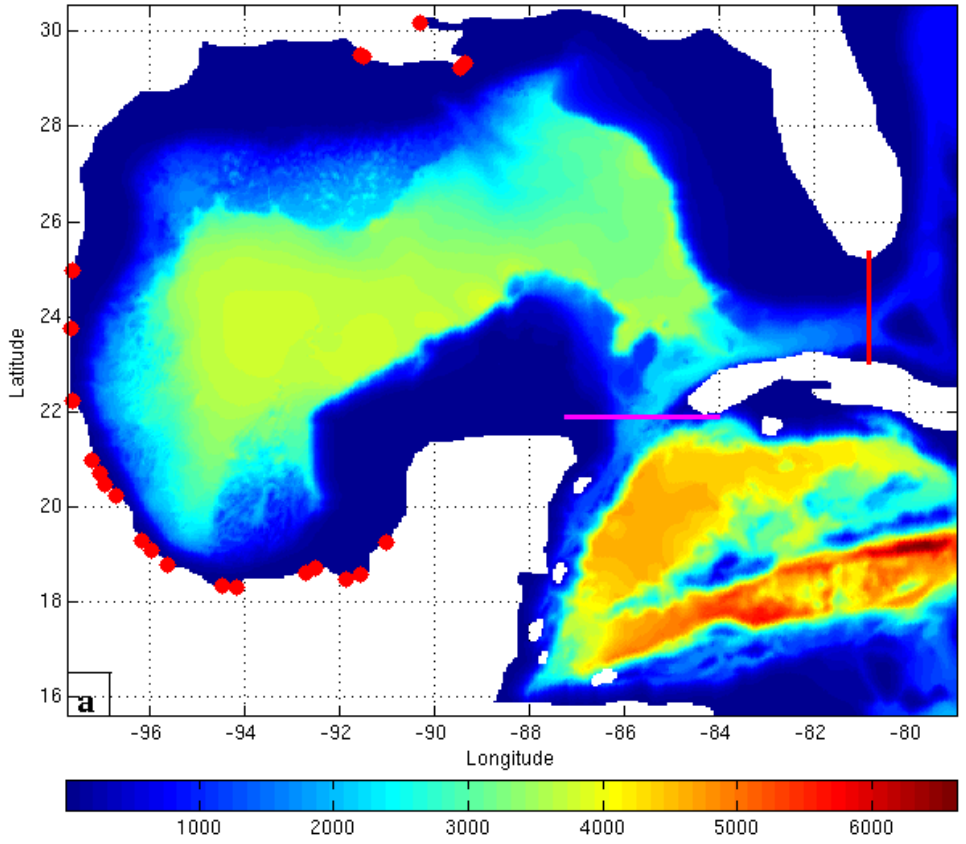
Assumes the model is able to represent all the major physical processes important for the region of interest !

The “Analysis”



Assimilation cycle

The background solution – NL ROMS configuration



- 4.5km / 1km horizontal resolution;
- 36 / 48 vertical levels;
- Modified vertical scheme – more resolution near the surface;
- Hourly surface forcing from CFSR;
- Diurnal boundary conditions from GLORYS;
- 19 river inputs – 2 dated and 17 climatological;
- Spectral forcing 11 tide constituents from TPXO;

Reanalysis from 2011 forward !!!

How to validate our results and compare models?

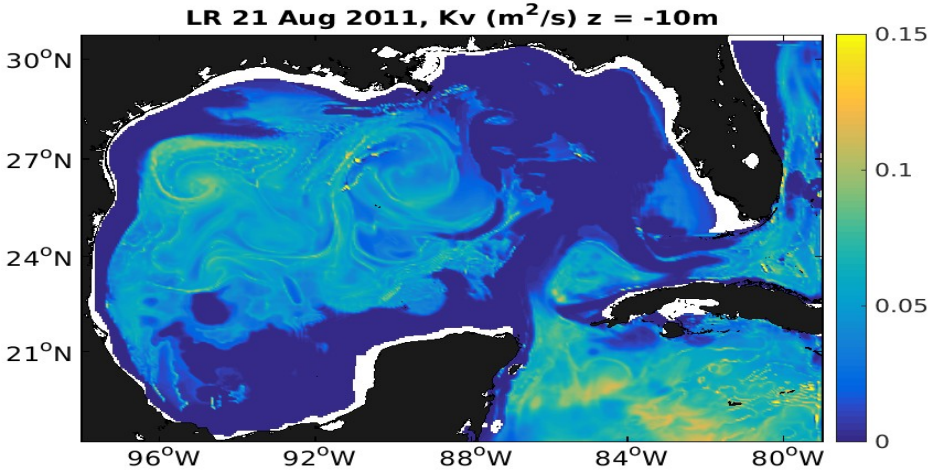
- ✓RMSE against AVISO SSH and MODIS SST.
- ✓Comparison with mooring data and WOD.
- ✓Analysis of specific processes that we judge important.
- ✓LAGRANGIAN DATA.

Kv (m^2/s)

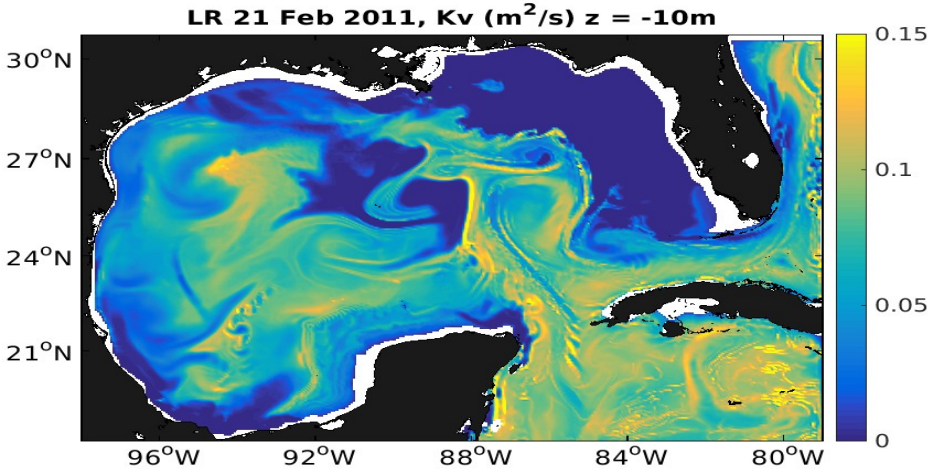
Low Resolution

High Resolution

summer



winter



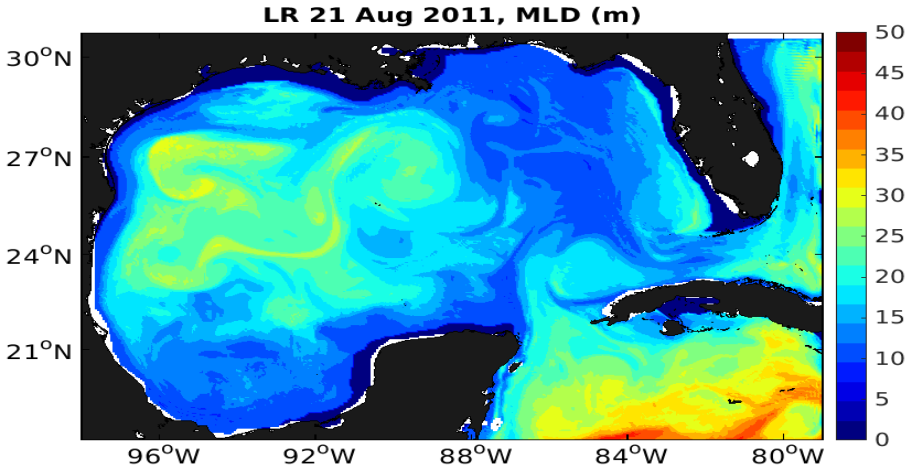
Dra. Sheila Estrada-Allis – post-doc CIGOM

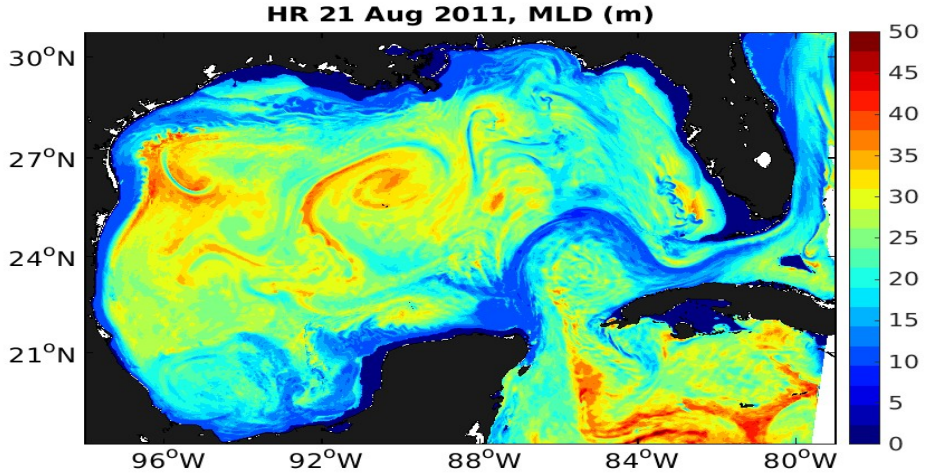
MLD (m)

Low Resolution

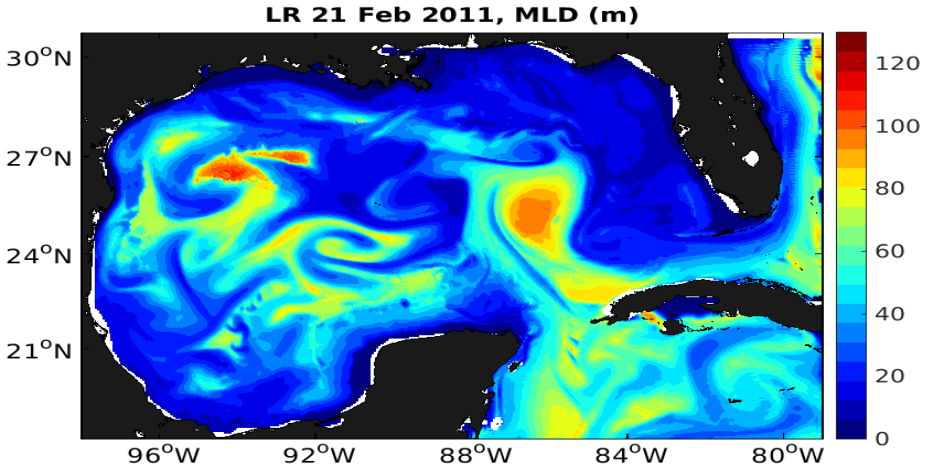
High Resolution

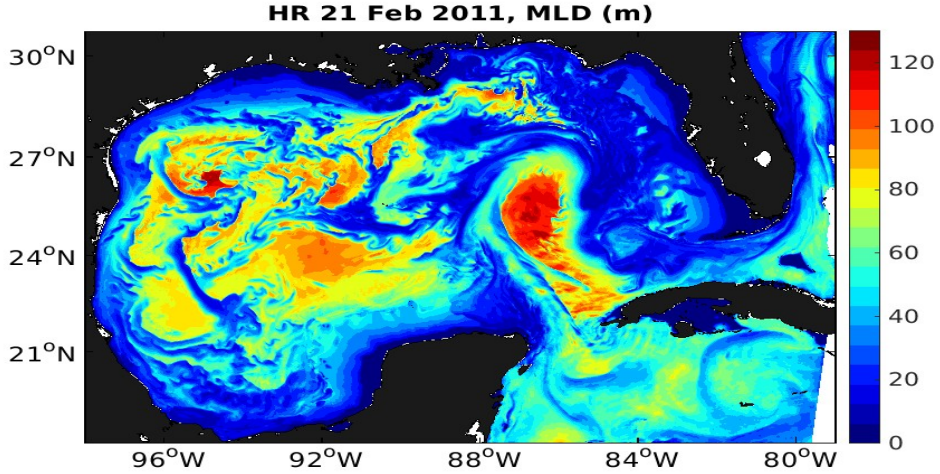
summer

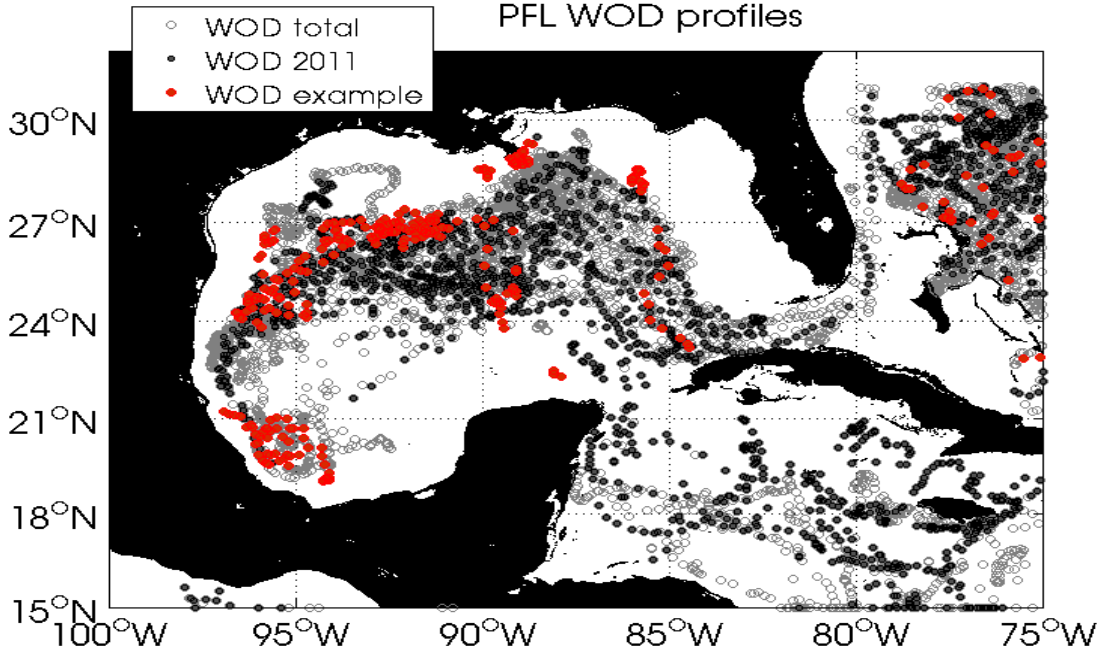


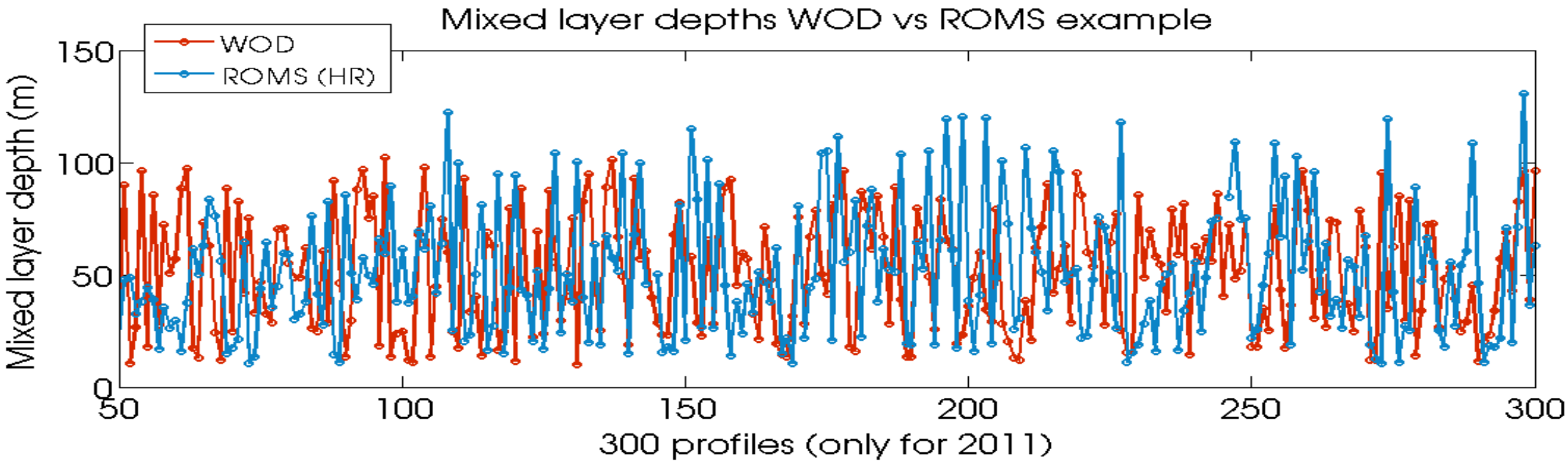


winter

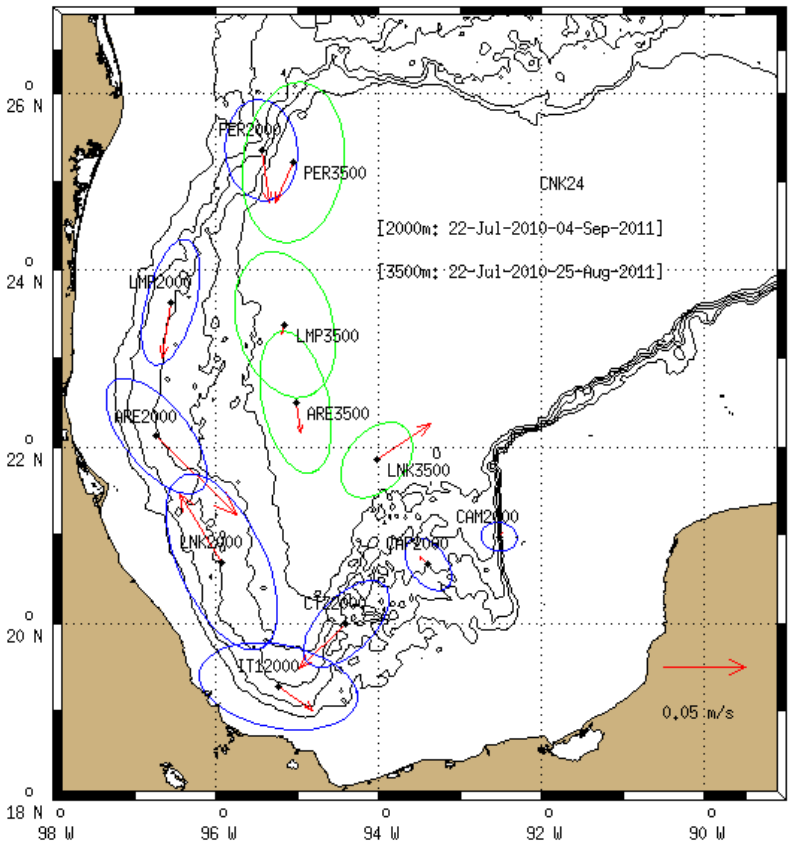


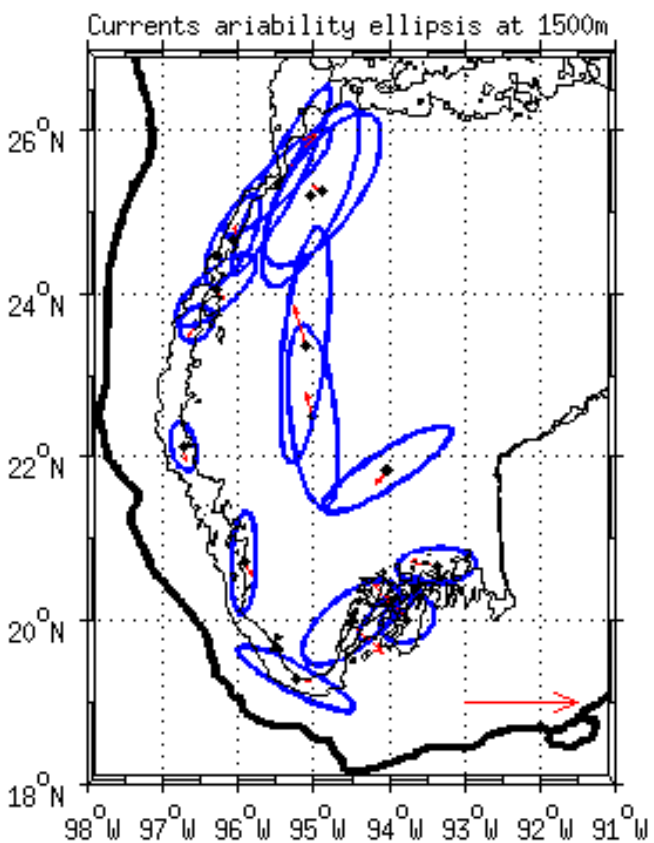


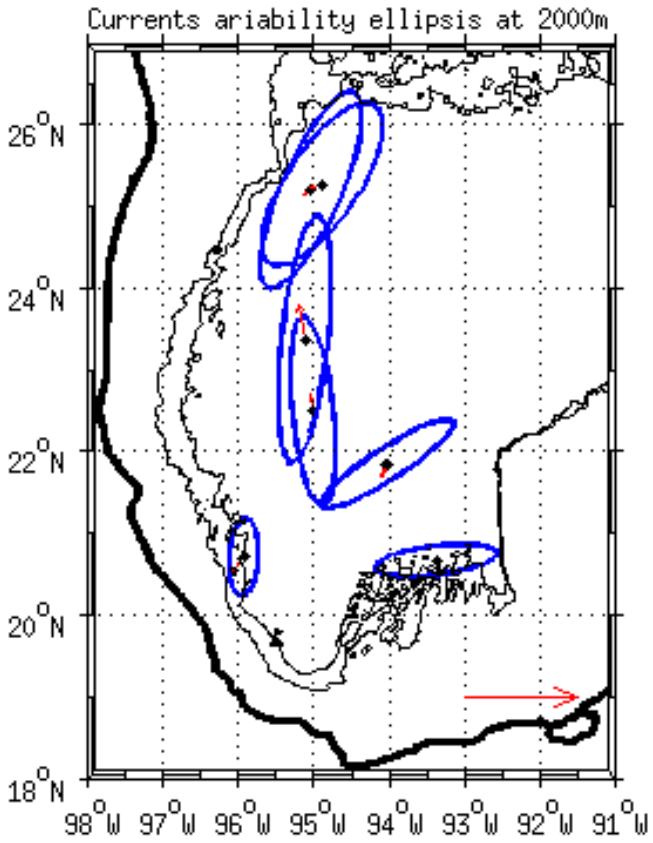

PFL WOD profiles
WOD total
WOD 2011
WOD example
30°N
27°N
24°N
21°N
18°N
15°N
100°W
95°W
90°W
85°W
80°W
75°W


Mixed layer depths WOD vs ROMS example
WOD
ROMS (HR)
Mixed layer depth (m)
150
100
50
0
50
100
150
200
250
300
300 profiles (only for 2011)

Variability at the mooring locations

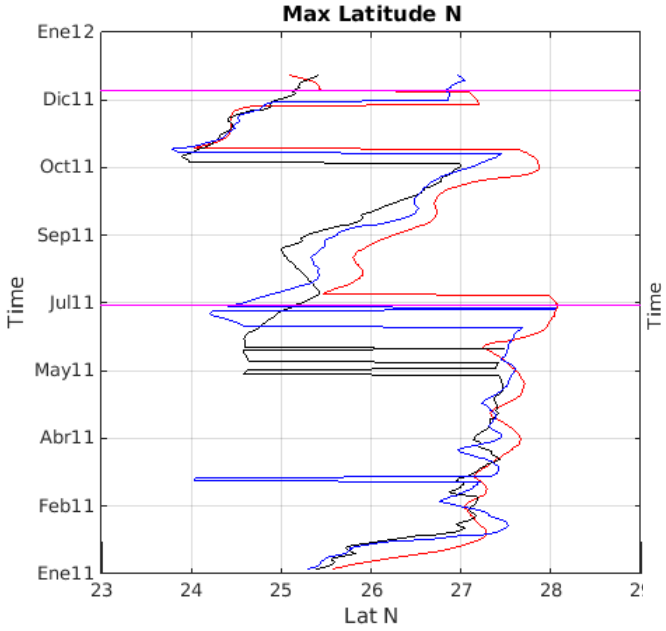


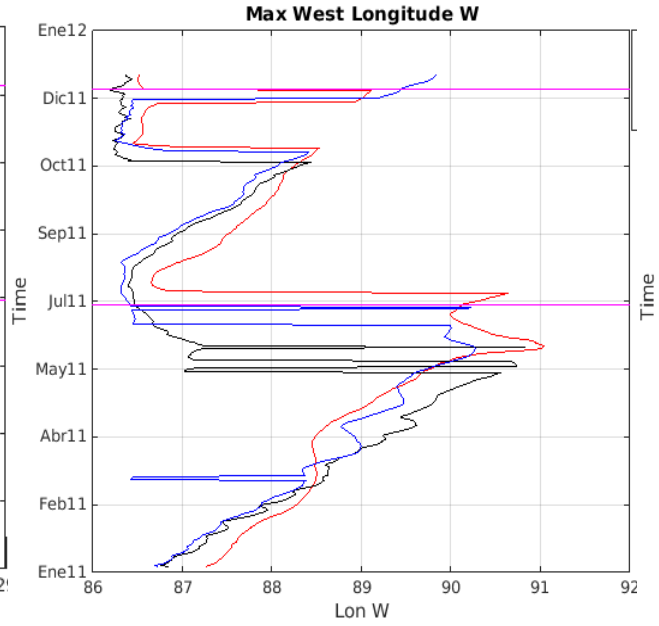


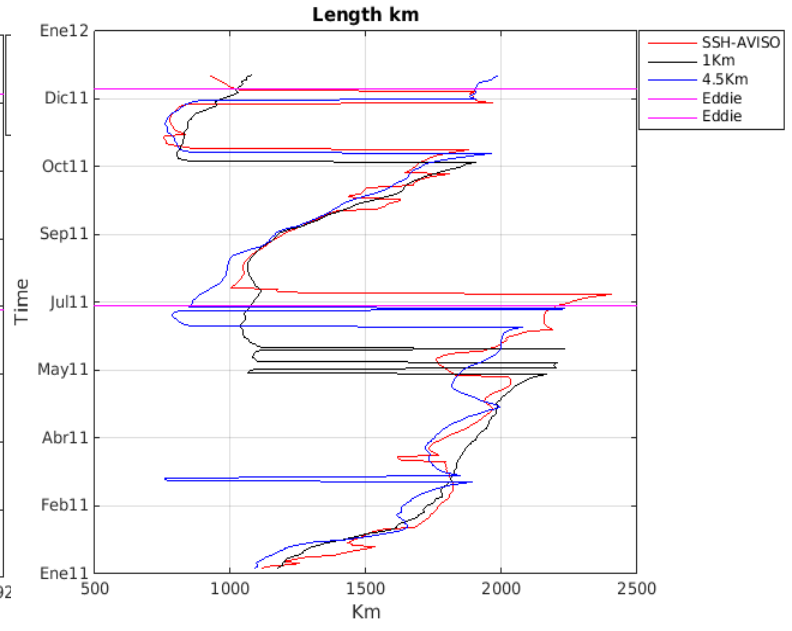


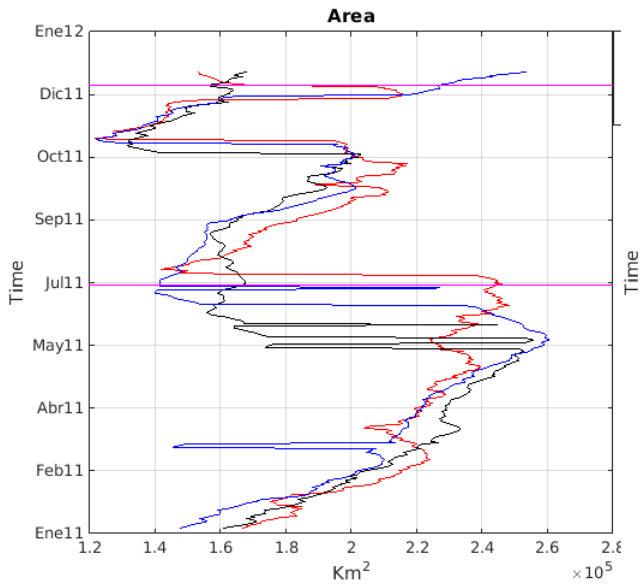
Loop-Current statistics – what is the influence of model resolution?

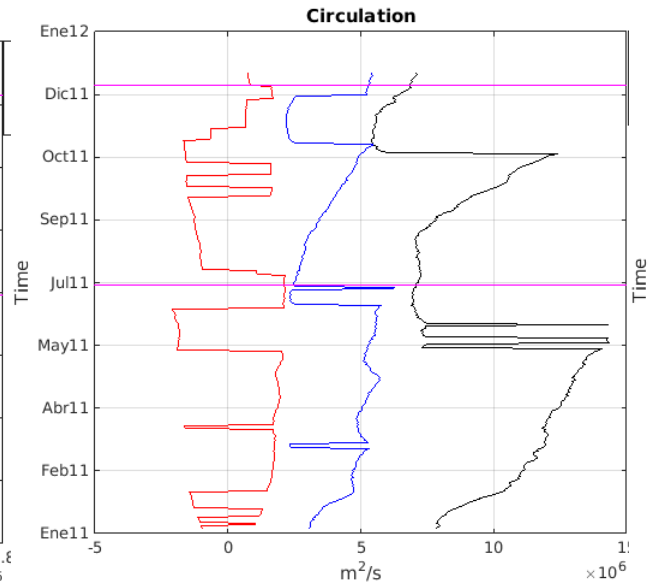
Bsc. Thesis – Angeles B. Garcia -Lucero

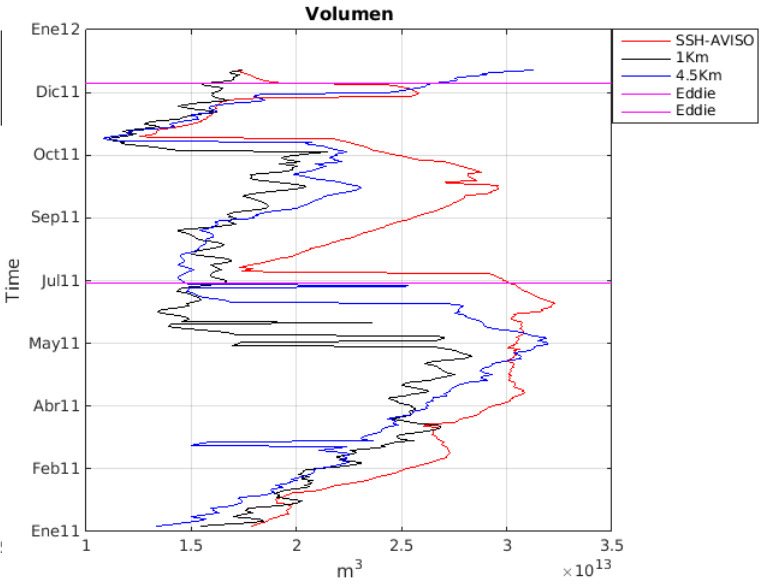




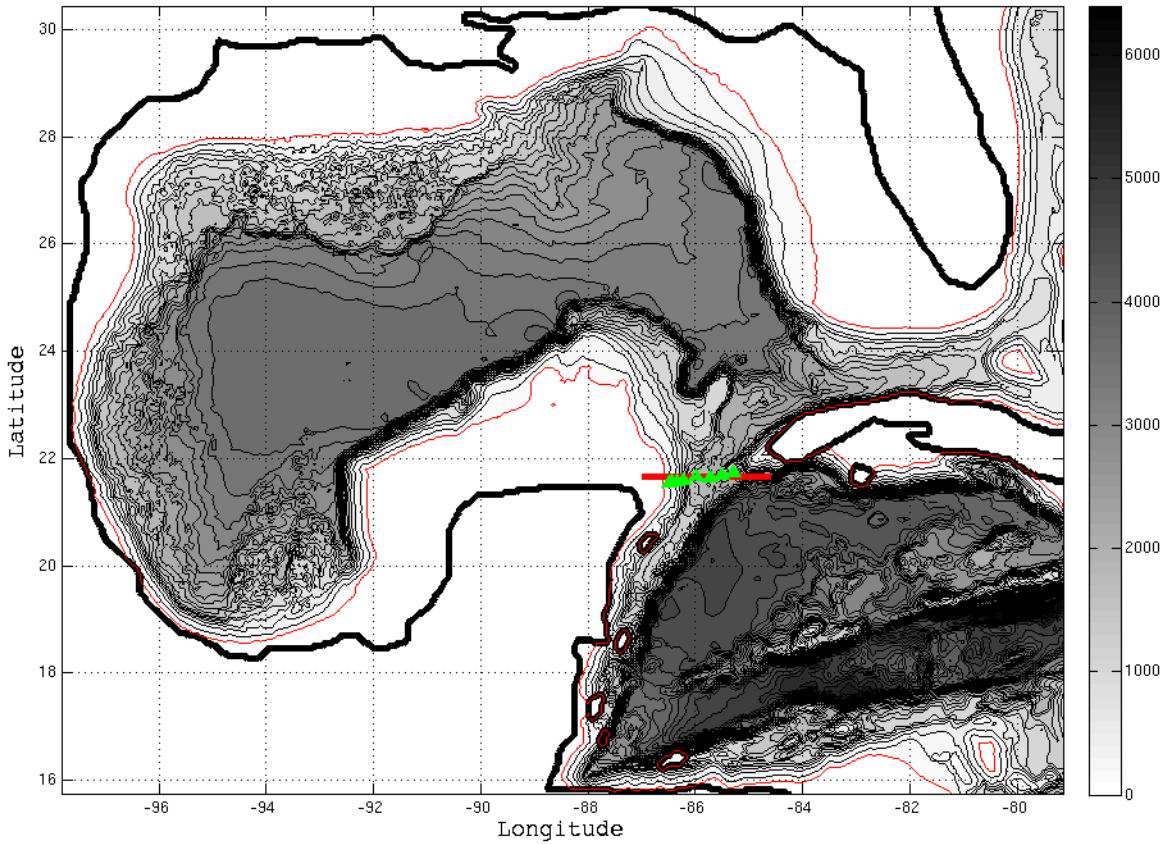


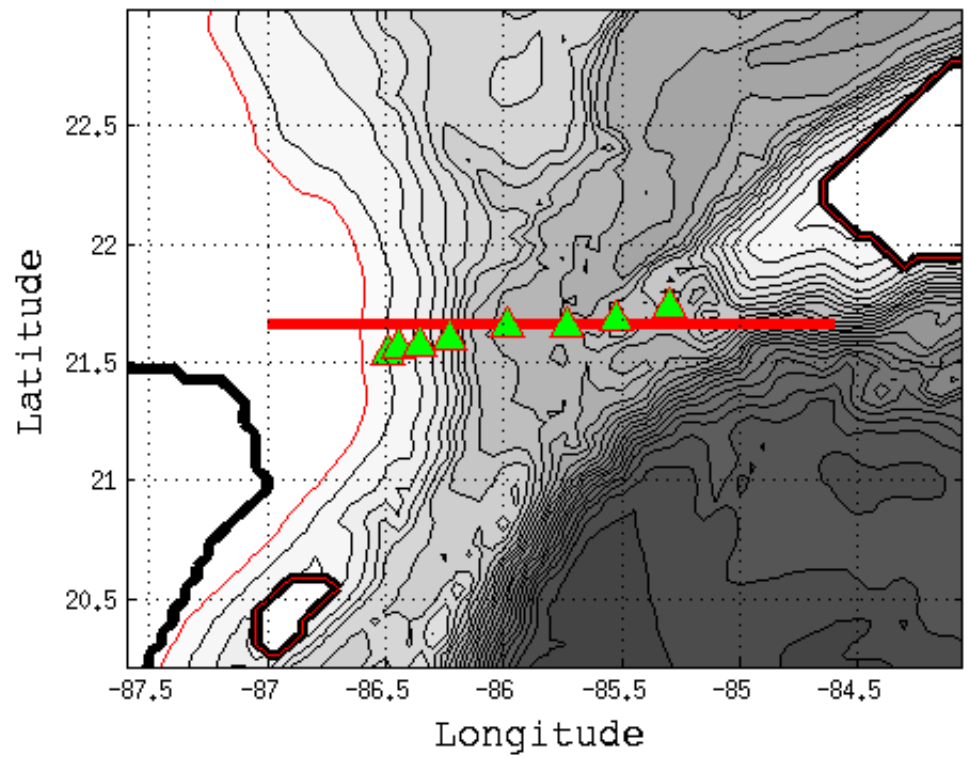


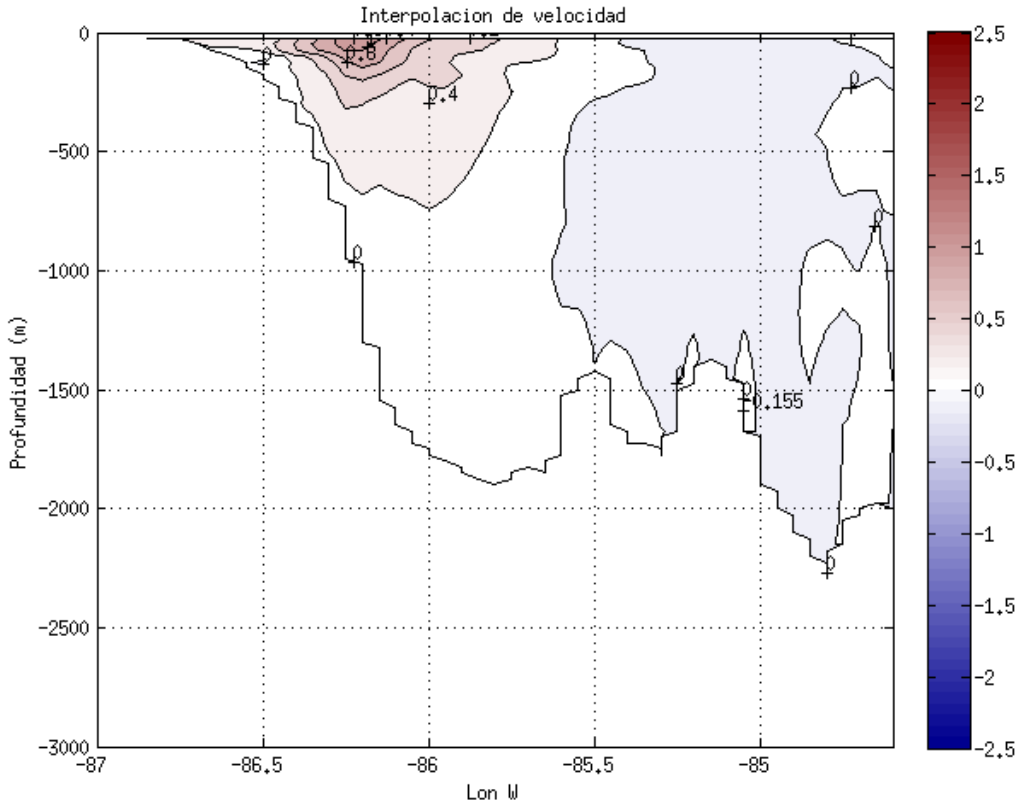


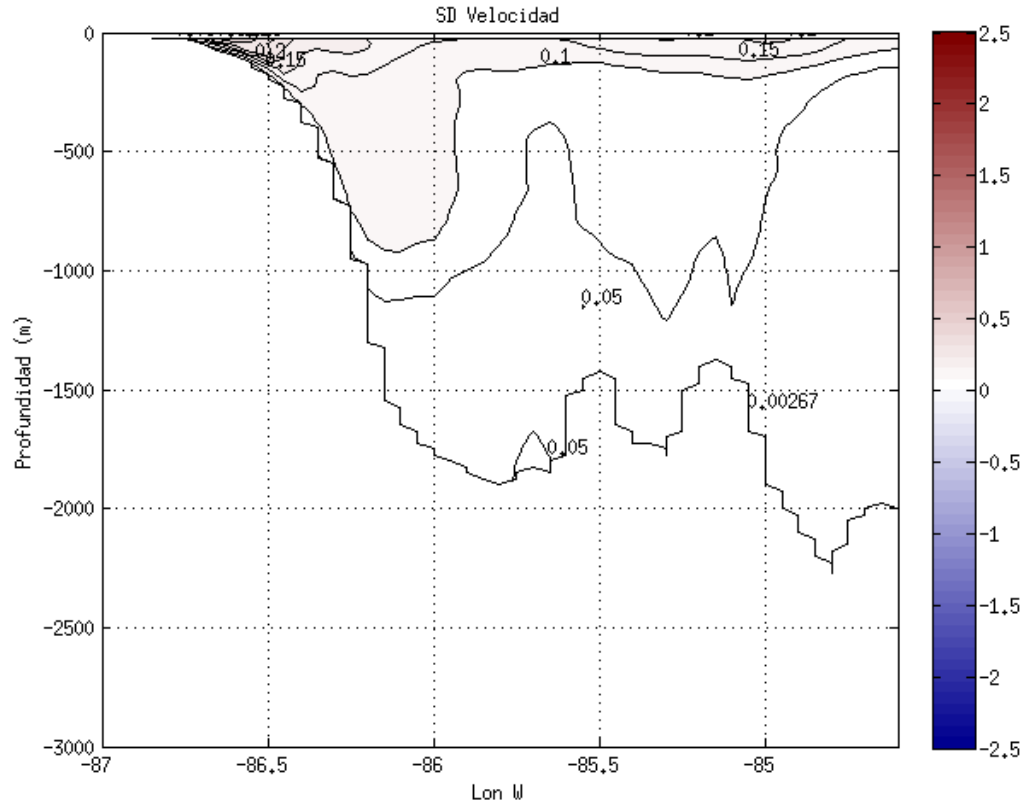


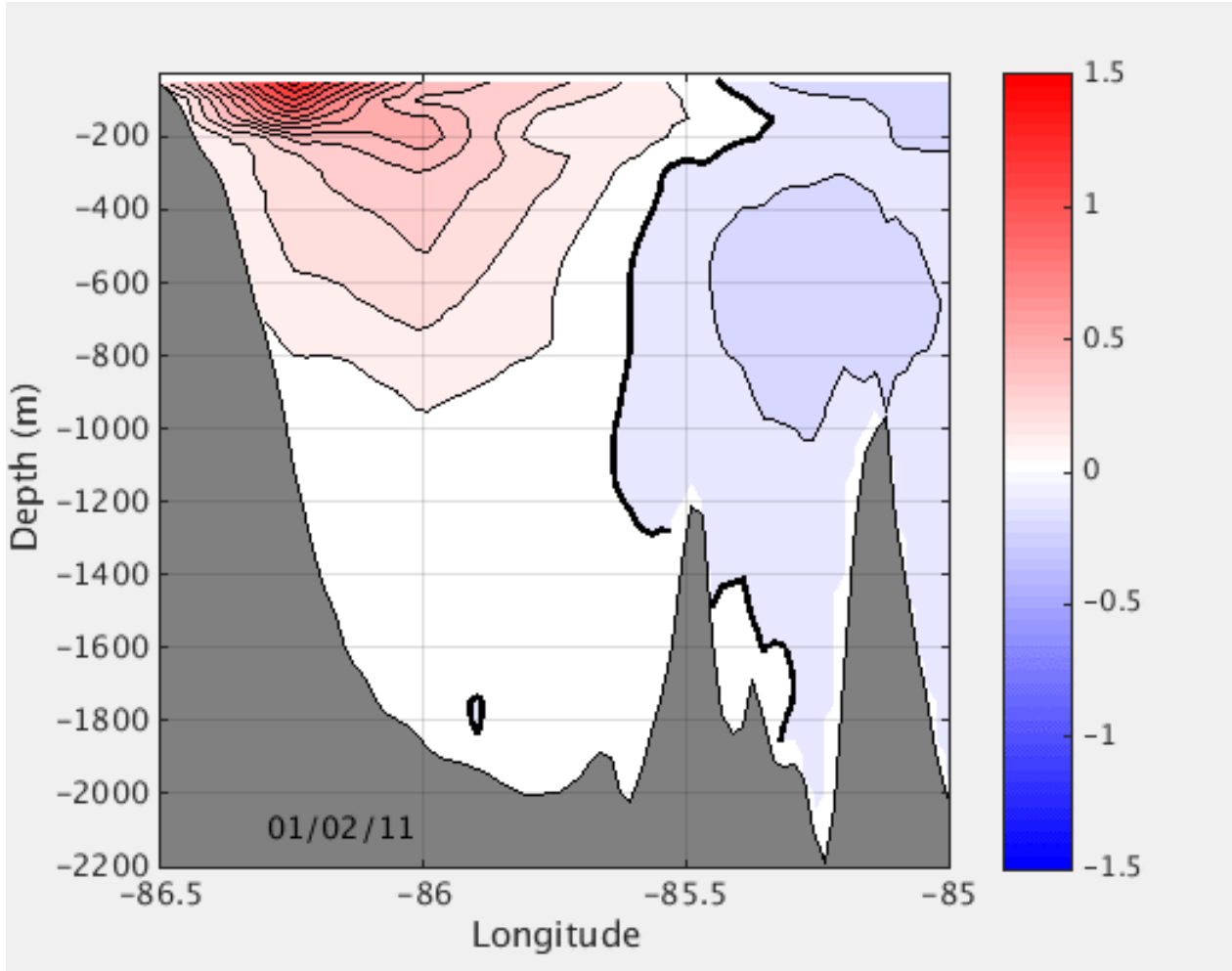
Flux through Yucatan



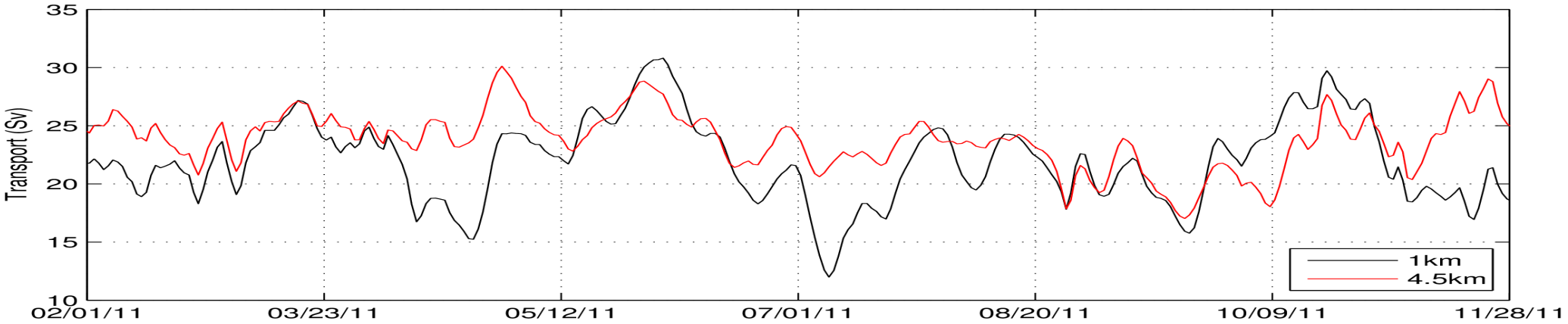


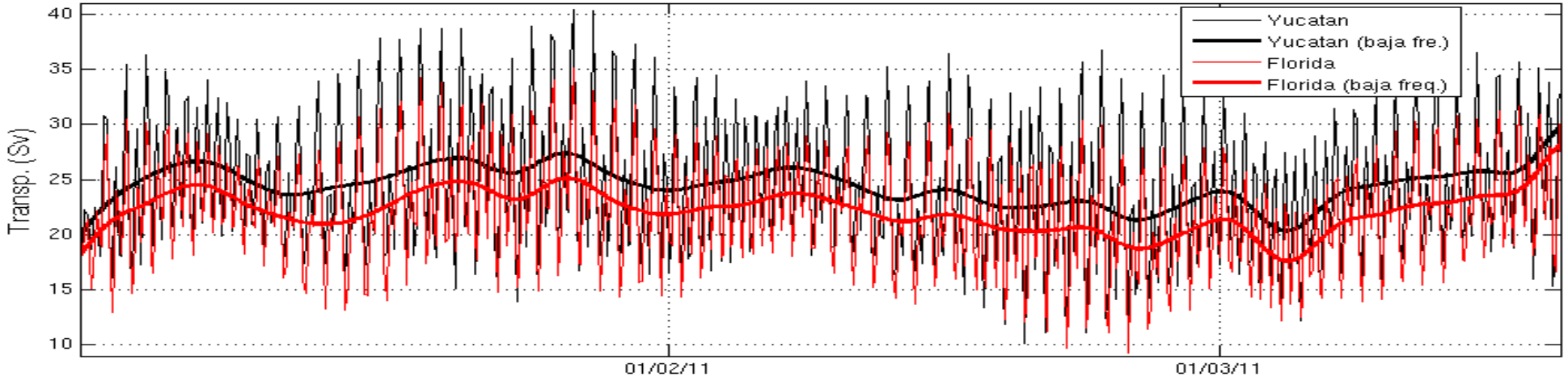

Interpolacion de velocidad
Profundidad (m)
Lon W
0
-500
-1000
-1500
-2000
-2500
-3000
-87
-86.5
-86
-85.5
-85
0.8
0.4
0
0.155
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5


SD Velocidad
Profundidad (m)
Lon W
0
-500
-1000
-1500
-2000
-2500
-3000
-87
-86.5
-86
-85.5
-85
0.2
0.15
0.1
0.15
0.05
0.00267
0.05
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
-2.5

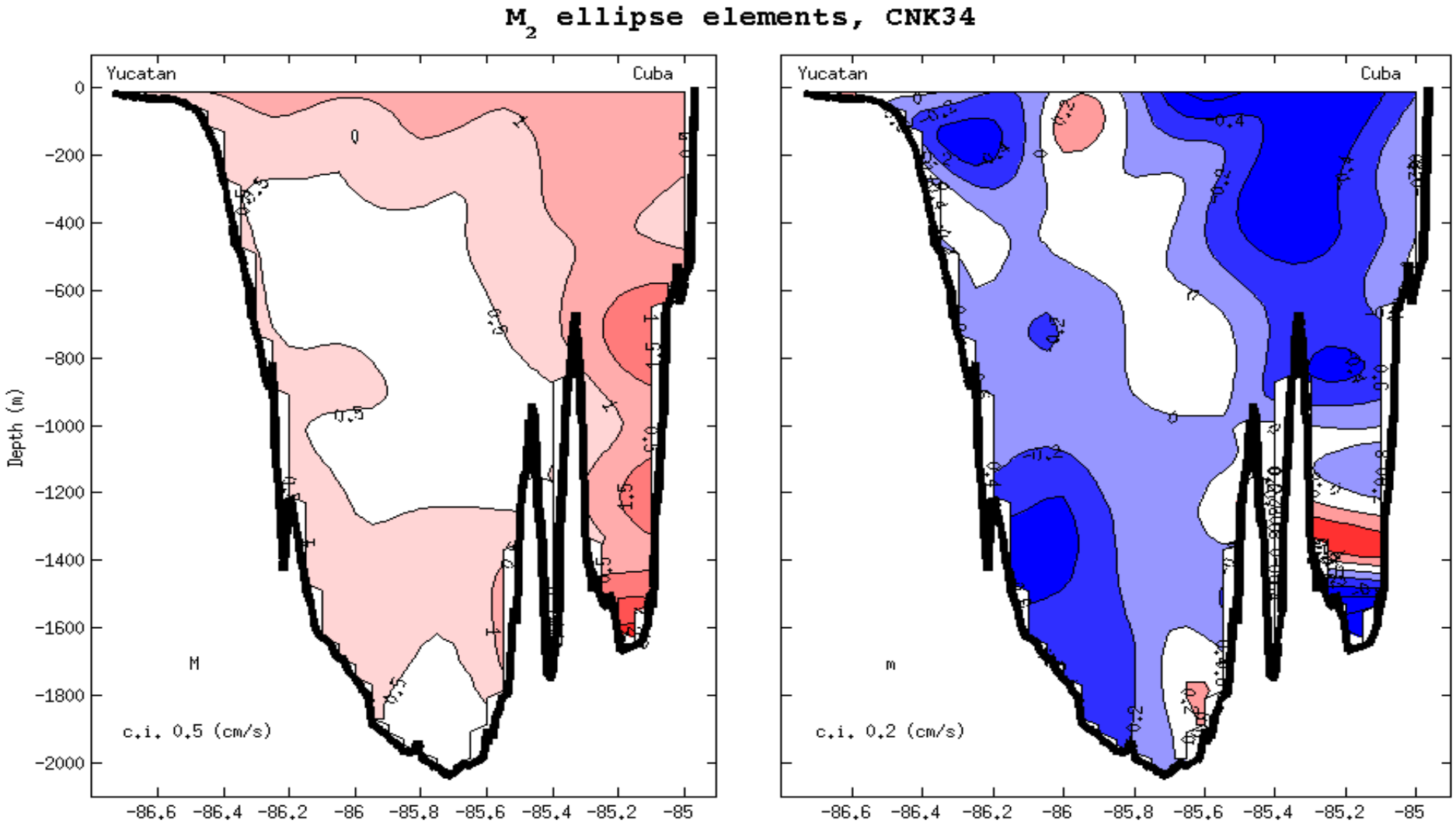

Depth (m)
-200
-400
-600
-800
-1000
-1200
-1400
-1600
-1800
-2000
-2200
-86.5
-86
-85.5
-85
Longitude
01/02/11
1.5
1
0.5
0
-0.5
-1
-1.5

Transport in Yucatan and Florida

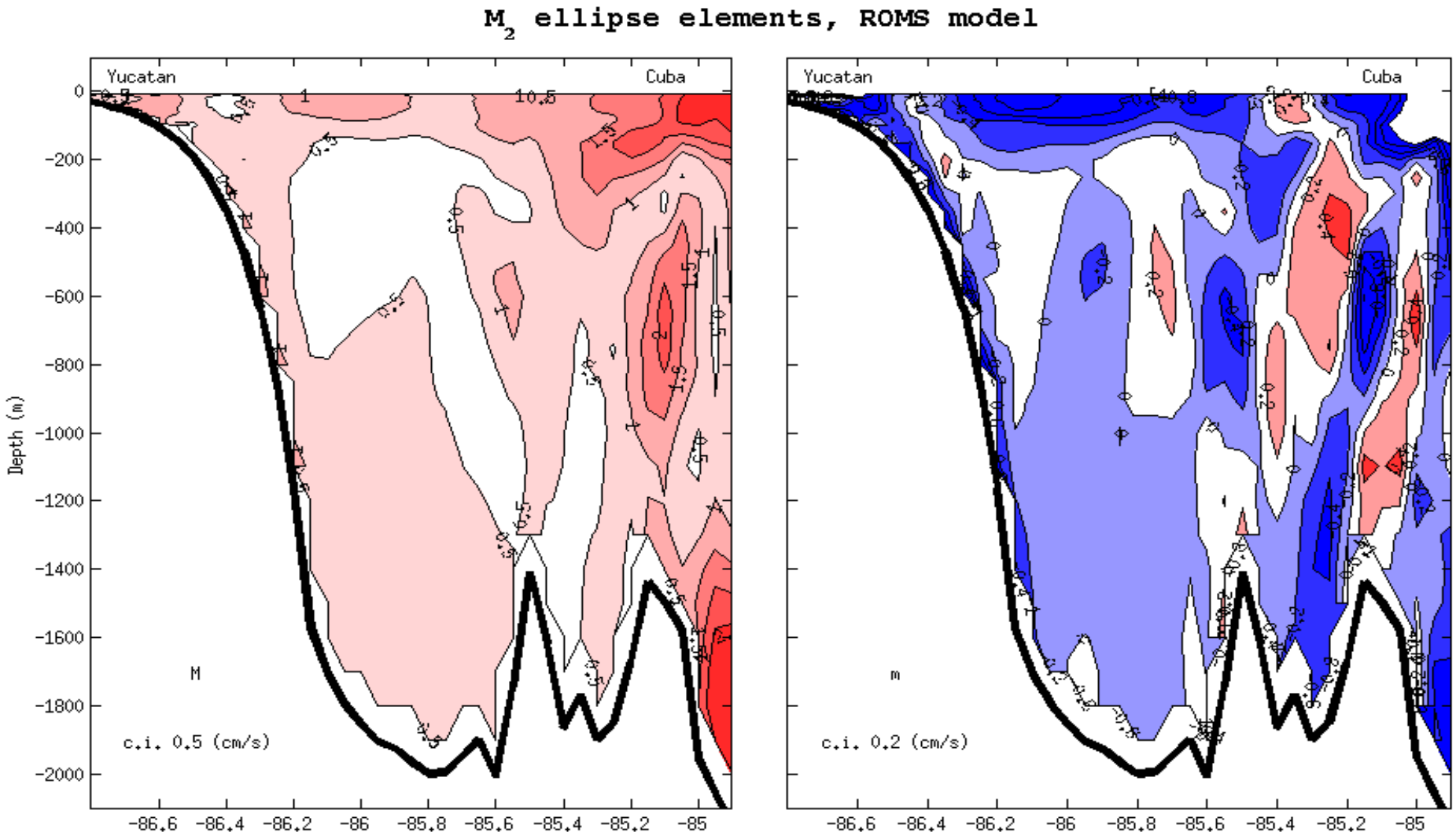




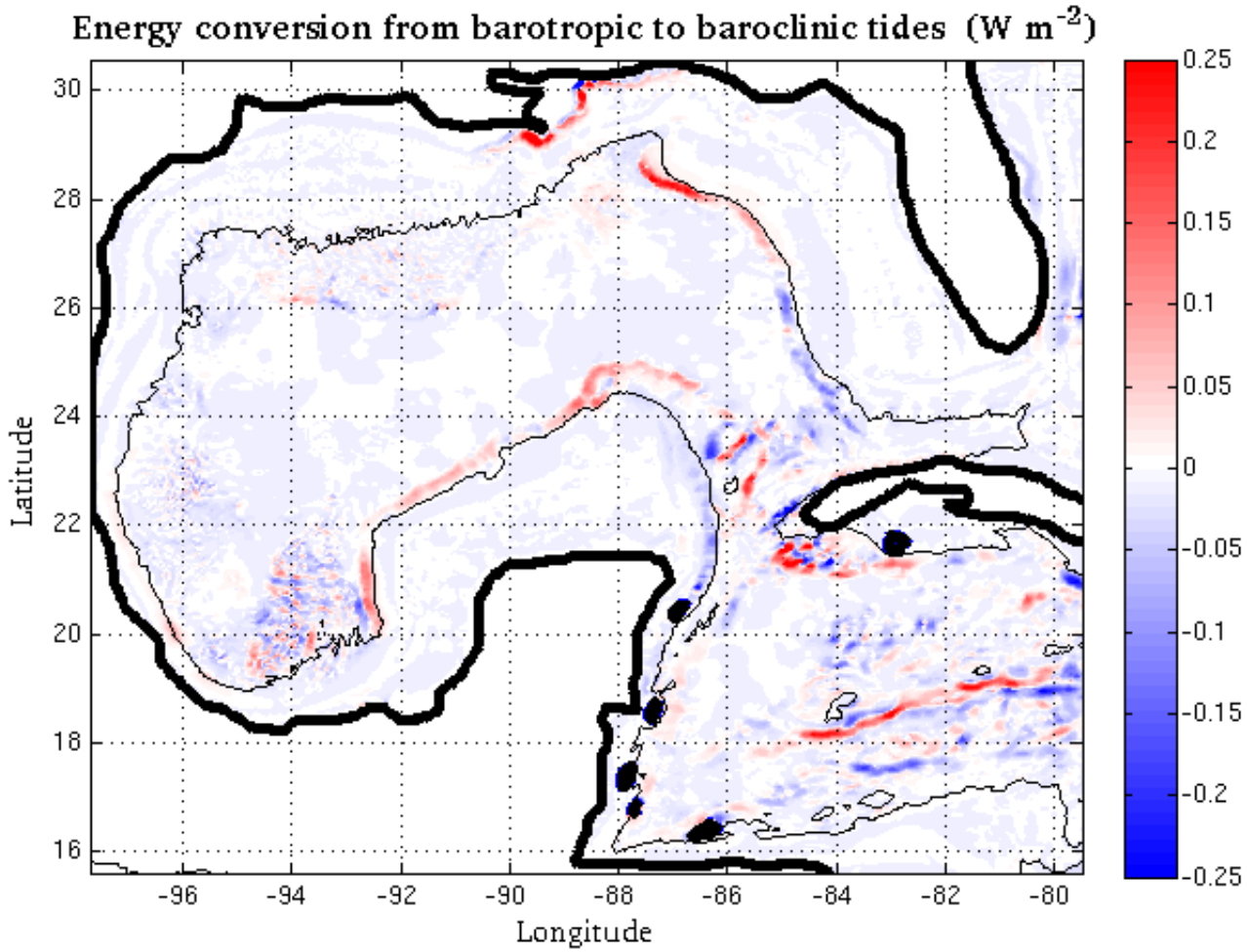
Internal tides Yucatan - Data



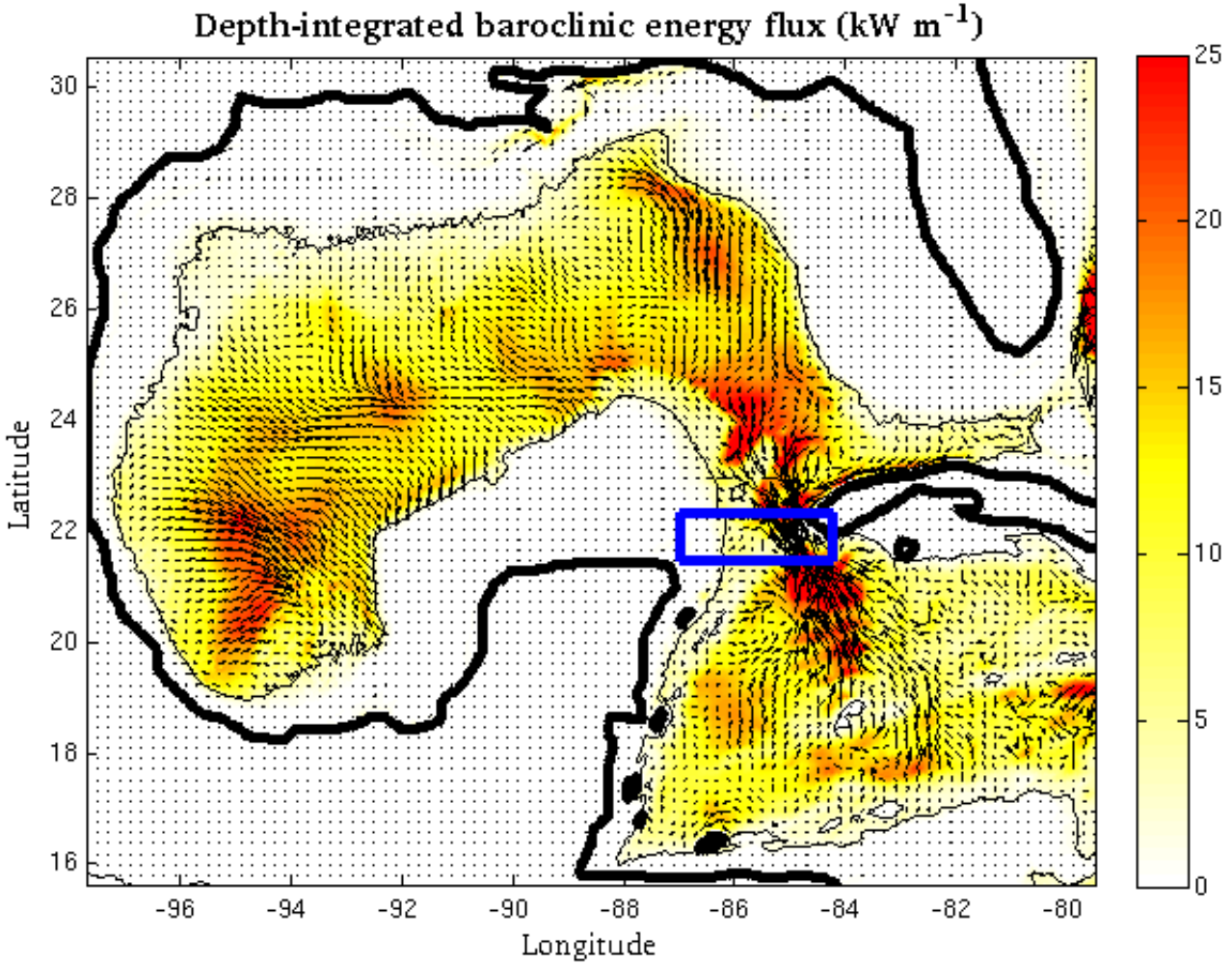
Internal tides Yucatan - Model

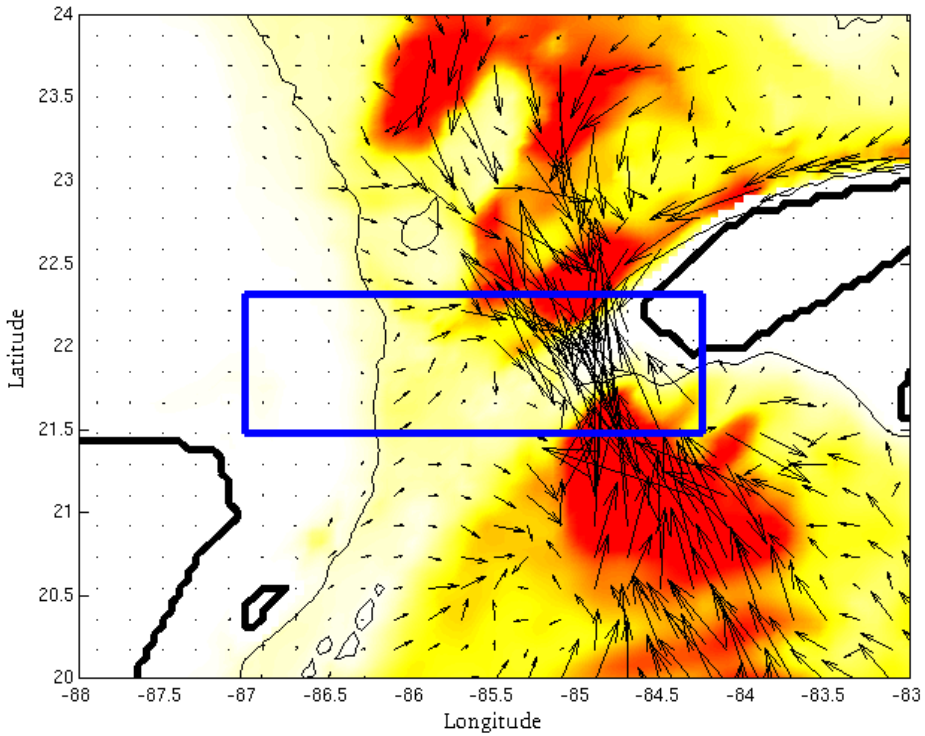


Internal tides Yucatan - Model



Internal tides Yucatan - Model





Connectivity analysis of the deep waters in the GoM using ROMS

VALIDATION:

- More than 800.000 particles
- Pseudo-Eulerian statistical comparison to the RAFOS floats:
  - Mean velocity, mean kinetic energy, eddy kinetic energy
- Kolmogorov–Smirnov statistical test: verification if the probability distribution of the numerical drifters follow the one from the observations

Dr. Aljaz Maslo - post-doc NASGRP

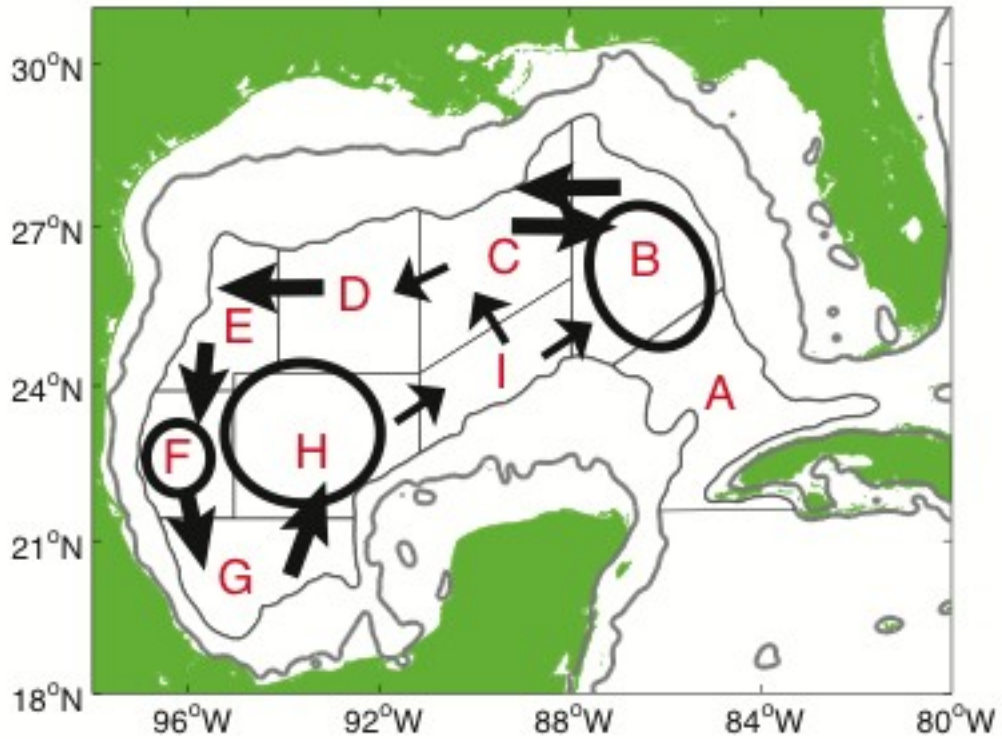
Connectivity analysis of the deep waters in the GoM using ROMS

LAGRANGIAN ANALYSIS OF THE DEEP CURRENTS IN THE GOM

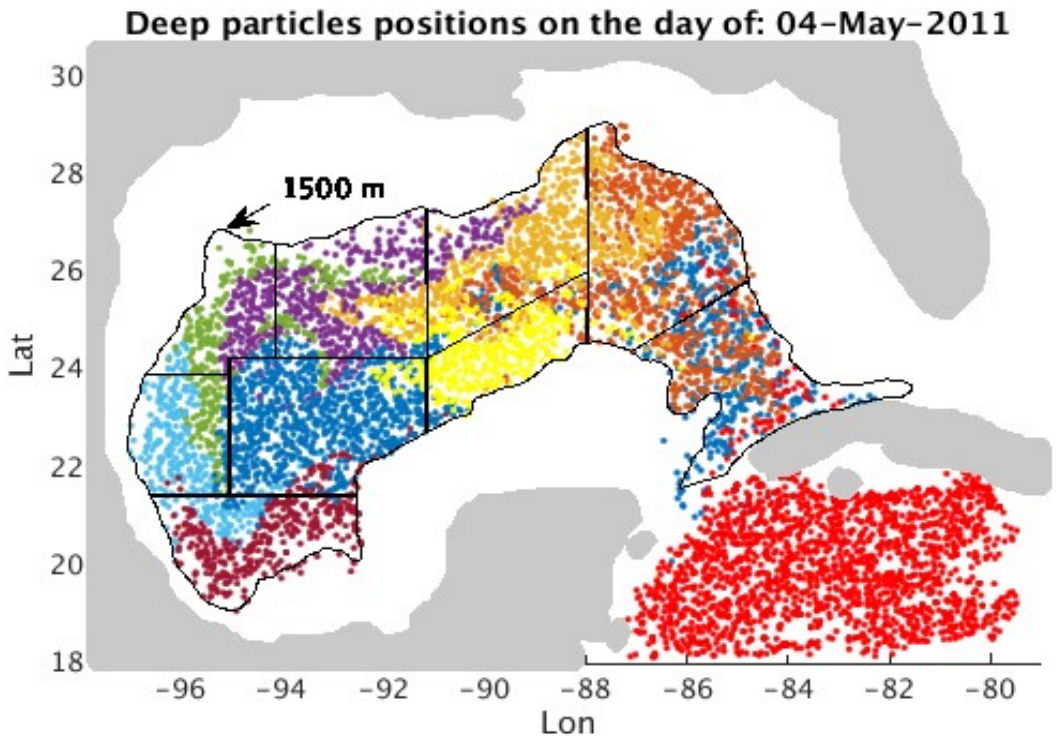
- Comparison between the RAFOS and the numerical floats connectivity matrices
- East/West connectivity
- Detailed picture of the retention capability, export and sink areas of the particles

VIDEO: Simulation of particles starting from different connectivity areas

Results from RAFOS data.
(Perez-Brunius et al.)



Preliminary Results from ROMS model - NLR.



VIDEO: Simulation of particles under the 1900 m depth

VIDEO: Simulation of particles in the surface layer and comparison with the real drifters