

# Data Assimilation Schemes Comparison

- NCODA - J. Cummings / O. M. Smedstad
- ENOI - F. Counillon / L. Bertino
- ENROIF - M. Chin
- SEEK - P. Brasseur
- NCEP - C. Lozano
- C. Thacker

To systematically evaluate the performance of the assimilation schemes under development for HYCOM

- Initial twin experiments in the Gulf of Mexico (GOM) with the standard 1/12 degree test case
- Followed by a 1/12 deg resolution one year hindcast experiment

# Developments since the last HYCOM Meeting

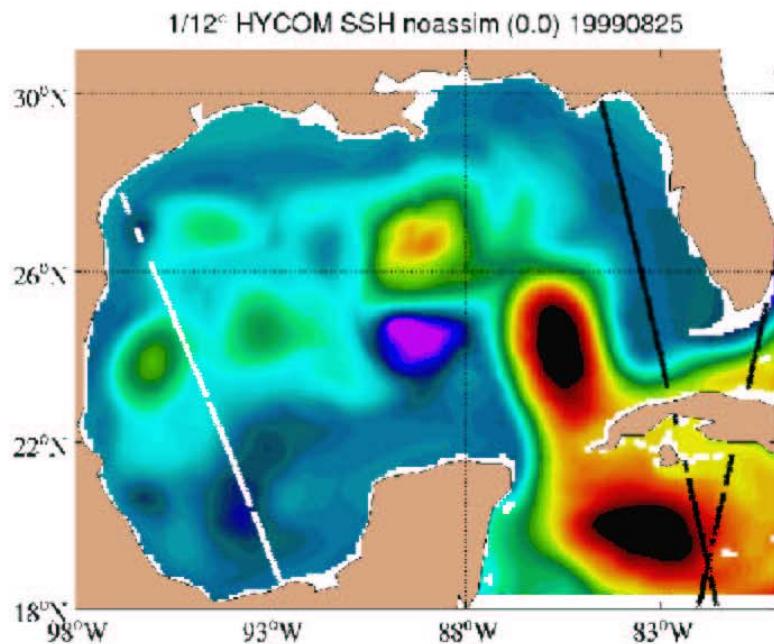
- ENOI upgraded to assimilate track data
- ROIF upgraded to Ensemble and grid-free ROIF and assimilates SLA and SST
- Modified ENOI and ENROIF schemes to use the same data pipeline and run scripts as NCODA
- Identical twin experiments with ENOI and ENROIF in addition to OI and NCODA
- In contact with Pierre Brasseur and C. Lozano to include SEEK and NCEP schemes in the experiments

# Latest GOM Identical Twin Experiments

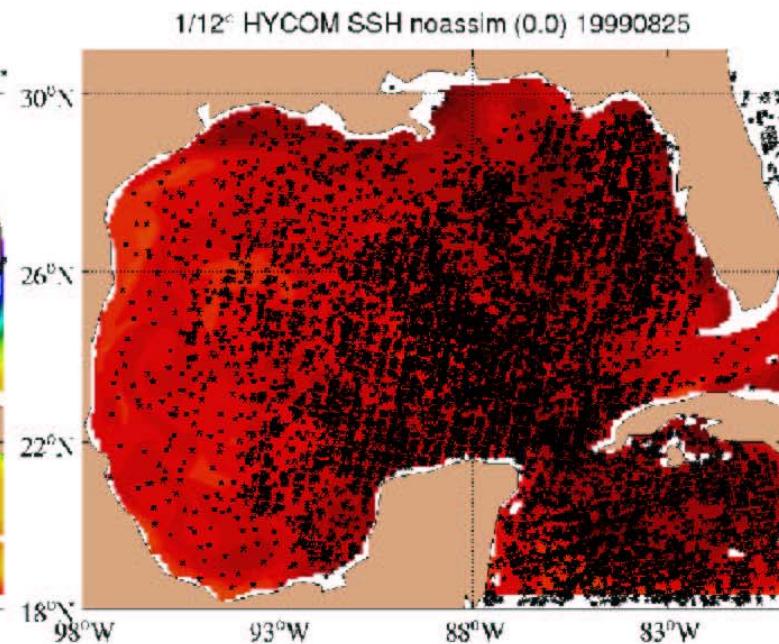
- Sample data SSH and SST from free running 1/12 HYCOM configured for the GOM
- Assimilate this data into a model started from a different state using
  - 1) OI – run at NRL
  - 2) NCODA – run at NRL
  - 3) ENOI – run at FSU
  - 4) ENROIF – run at FSU

# HYCOM Identical Twin SSH and SST Data

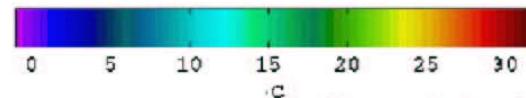
Ocean model sampled along observed tracks



Ocean model sampled at observed MCSST locations



1/25° Gulf of Mexico HYCOM

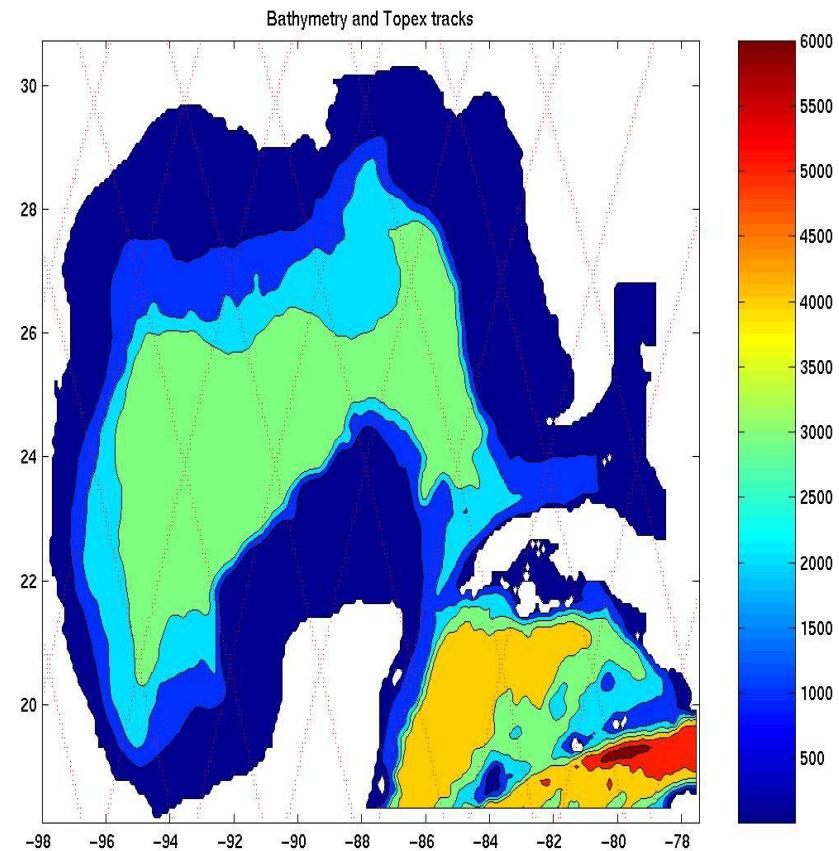


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# GOM Model Configuration for the Twin Experiments

## Configuration:

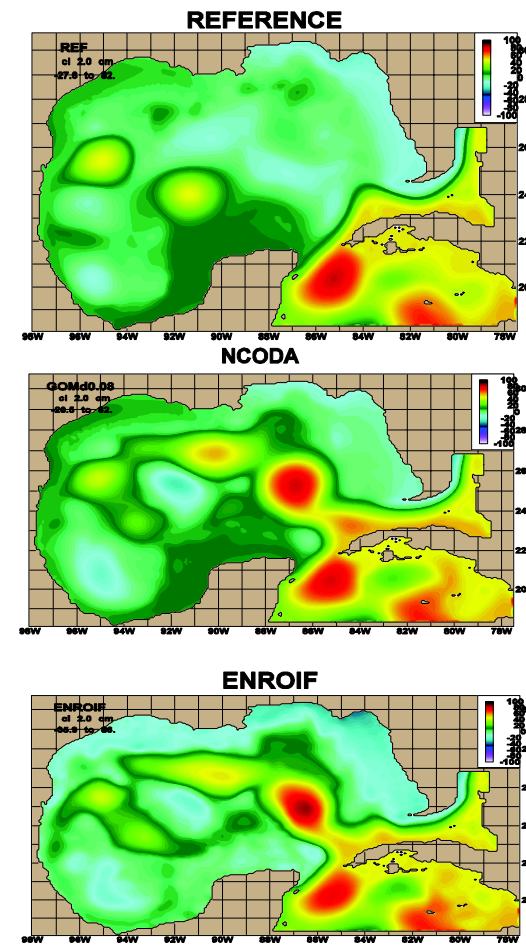
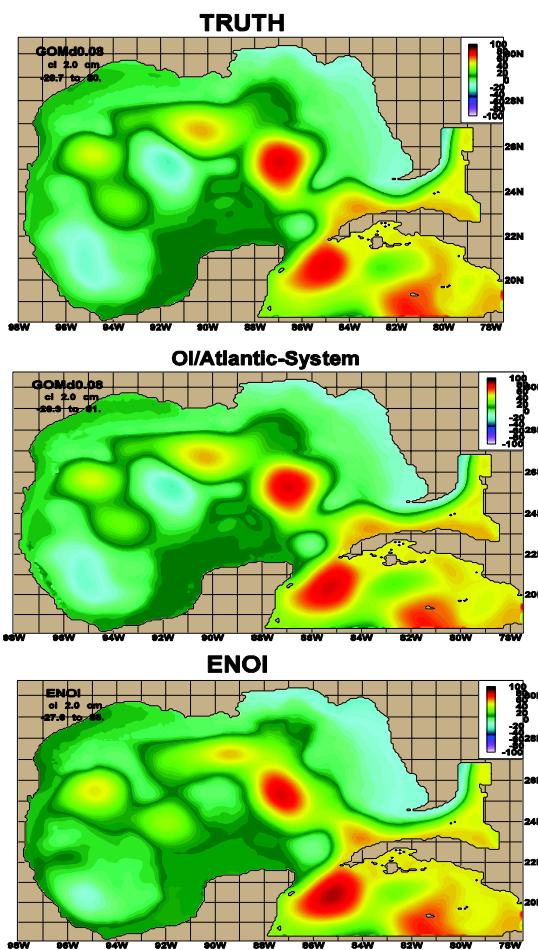
- 1/12° horizontal grid (258x175 pts; 6.5km average spacing)
- 89 to 98 W Longitude and 8 to 31 N Latitude
- 20 vertical layers
- Forcing from NOGAPS/FNMOC 1999-2000
- Monthly River Runoff
- Nested within 1/12 N. Atlantic domain
- HYCOM V. 2.1.36



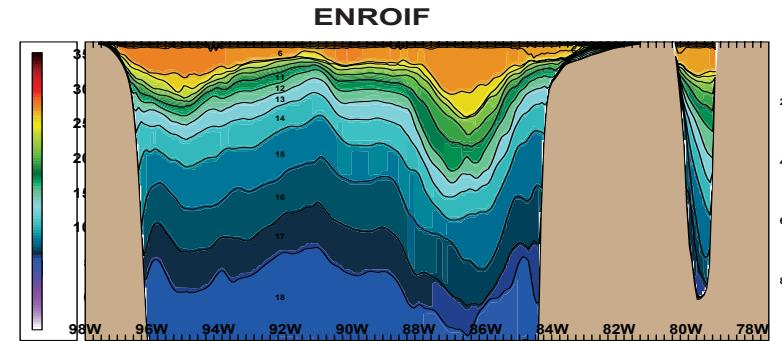
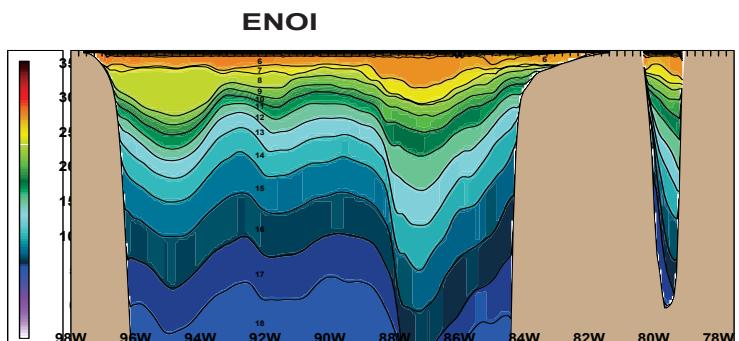
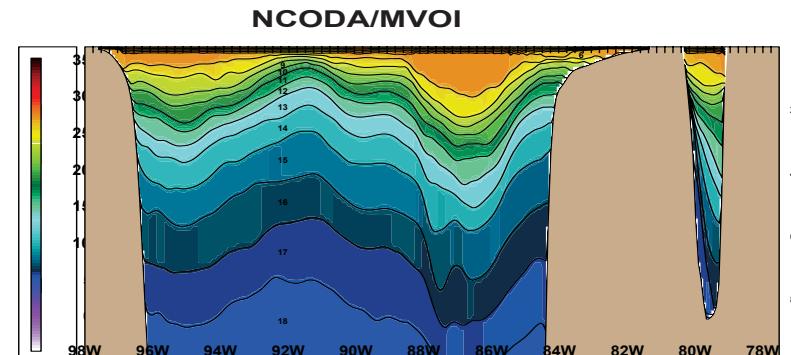
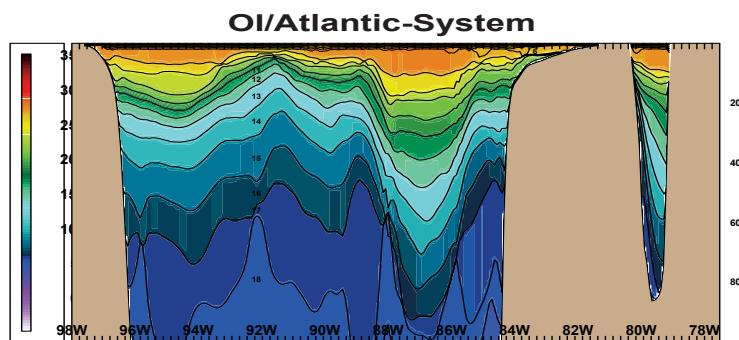
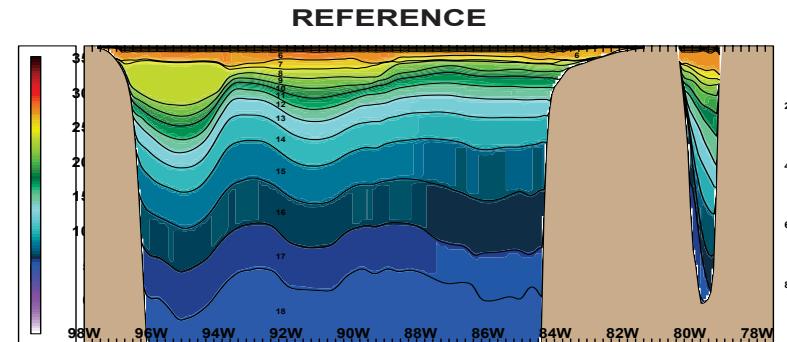
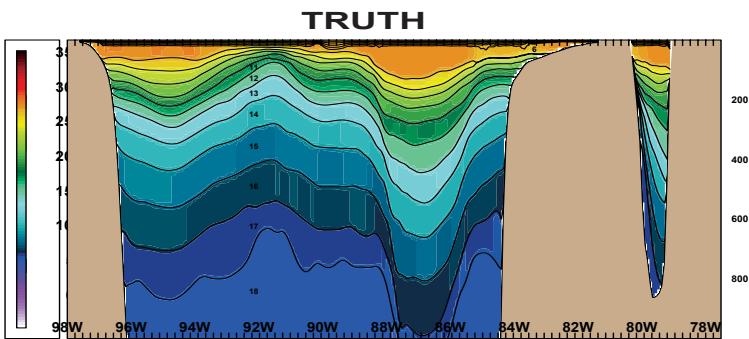
# Assimilation Schemes

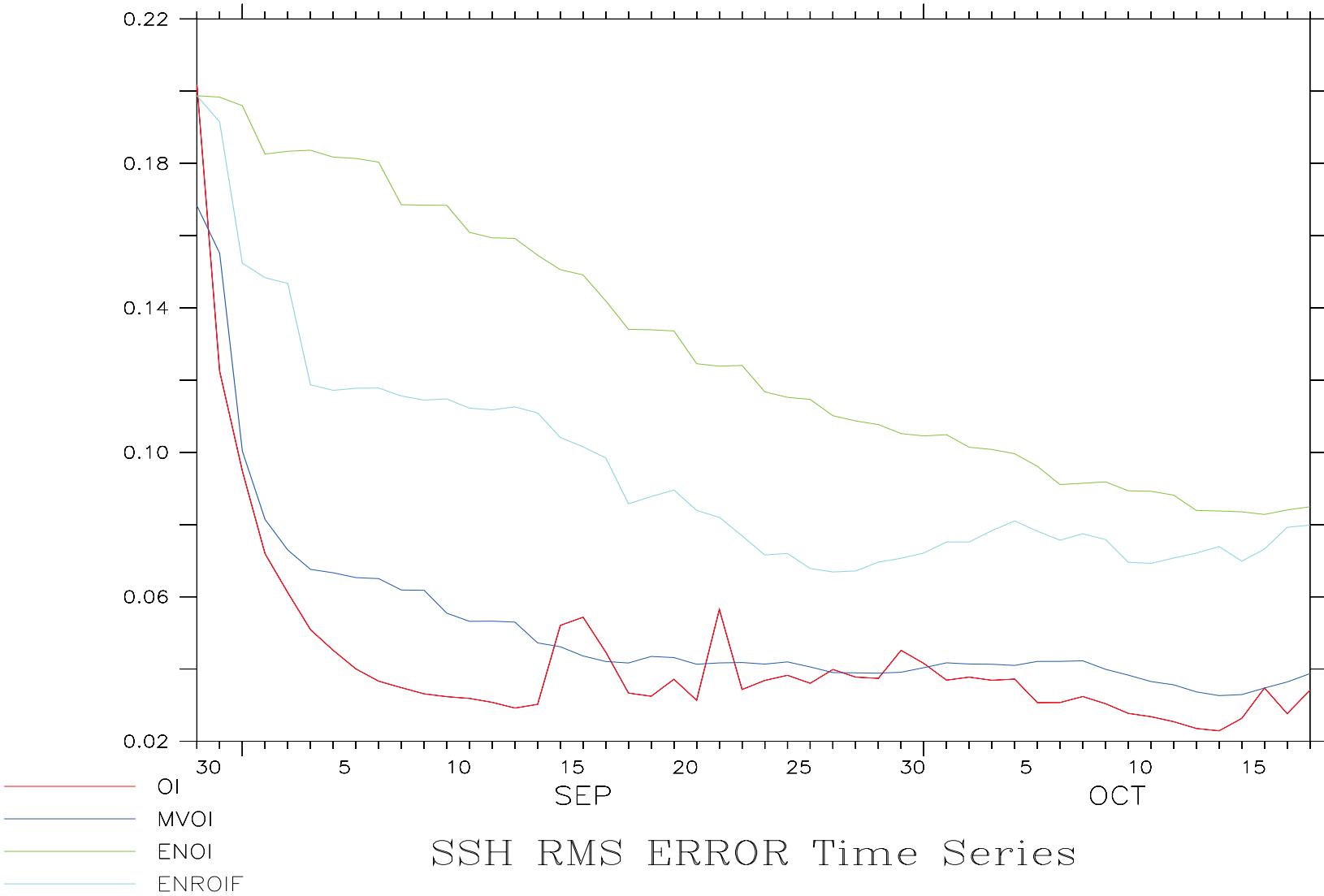
- NCODA – Multivariate Optimal Interpolation with simultaneous analysis of t, s, geo-potential, layer pressure and velocity components. Cooper Haines method for vertical projection
- ENOI – Ensemble Optimal Interpolation – multivariate 3D covariance based on static historical ensemble (93 members here) without assimilation. Vertical projection based on Statistics
- ENROIF-Reduced Order Information Filter (ROIF) is an implementation of "implicit Kalman filter", where the covariance matrix is represented by a set of spatial regression coefficients (Markov random field). Recently, "free-grid" and "ensemble-based" techniques have been incorporated (fenROIF). For this experiment, a fixed ensemble of 55 members is used for additional computational efficiency. Vertical projection based on statistics
- Ensembles obtained from a 11/2 year free running GOM HYCOM

# SSH (DAY-50)

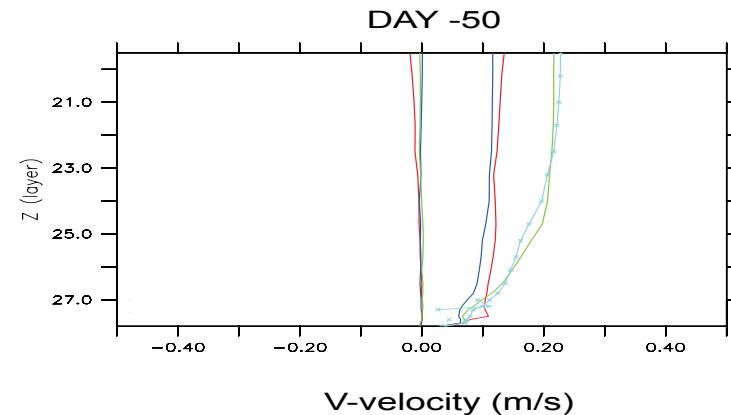
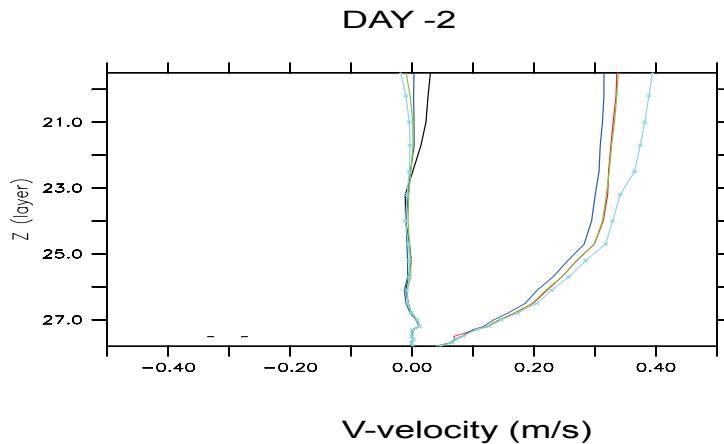
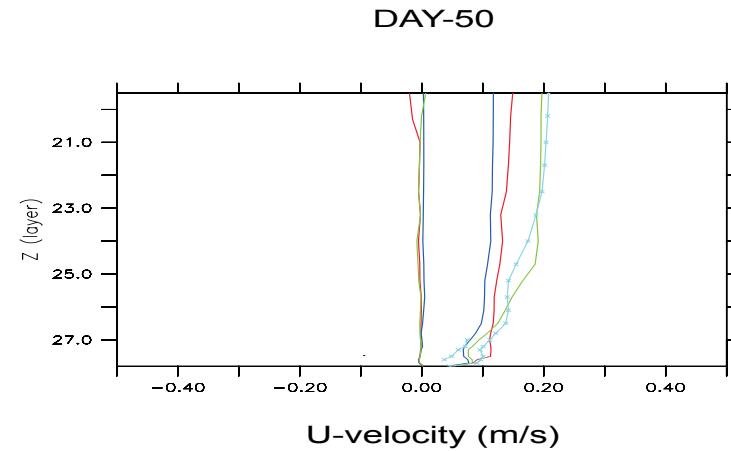
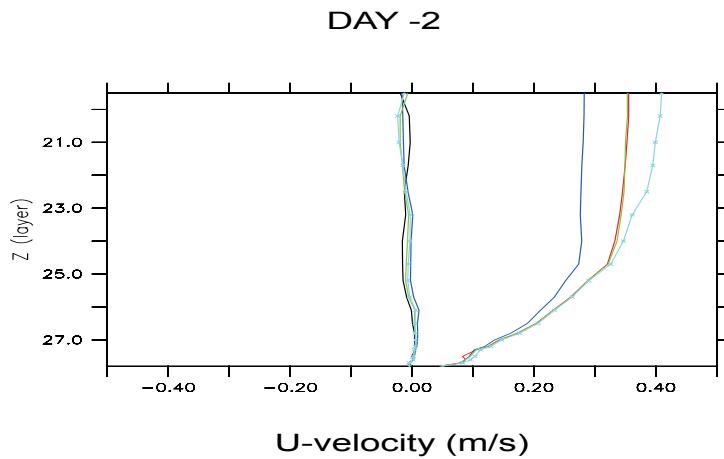


# Temperature zonal sec. 25.08n Oct 18, 1999 (Day 50)





## Mean and RMS Error - 3D U and V velocity



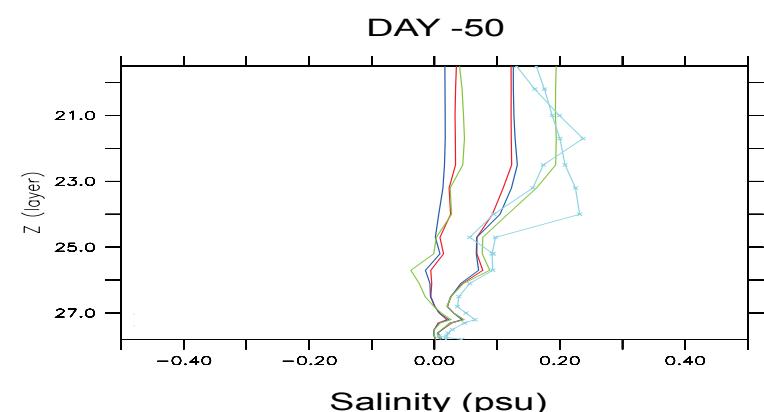
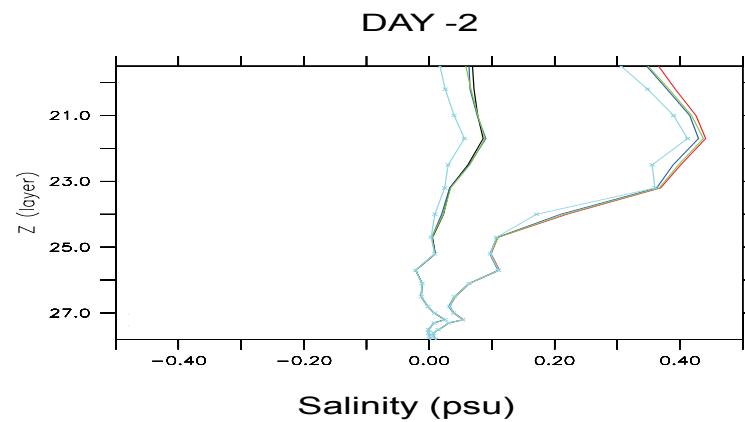
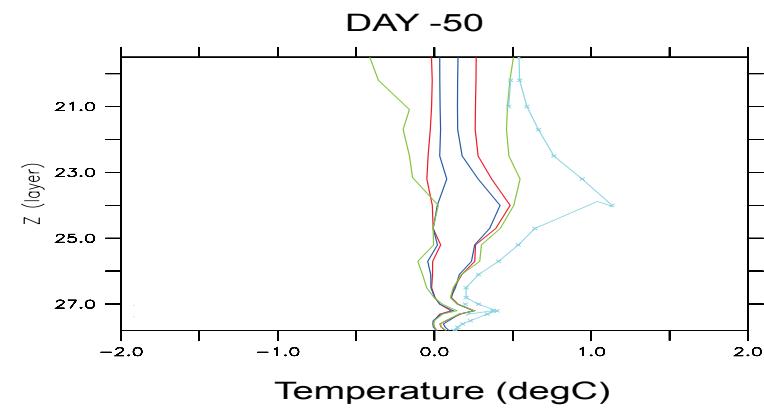
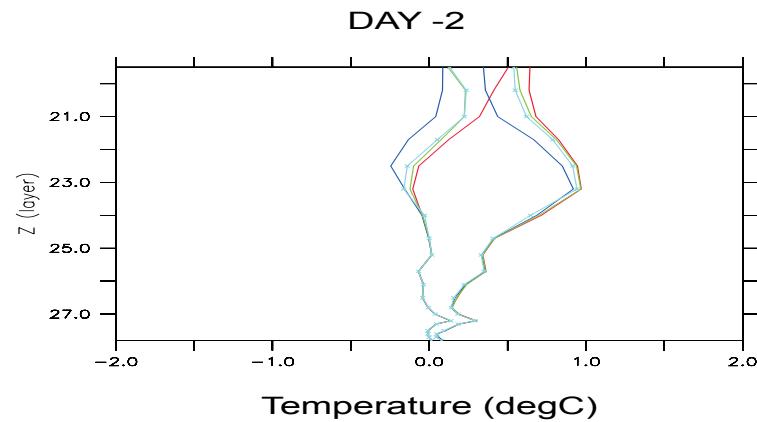
Red - OI

Blue - MVOI

Green - ENOI

Cyan - EnROIF

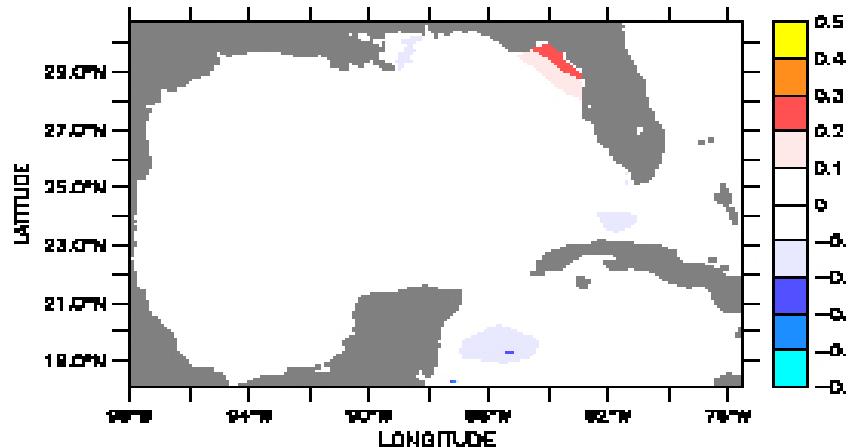
## Mean and RMS Error - 3D T and S



Red - OI  
Blue - MVOI  
Green - ENOI  
Cyan - EnROIF

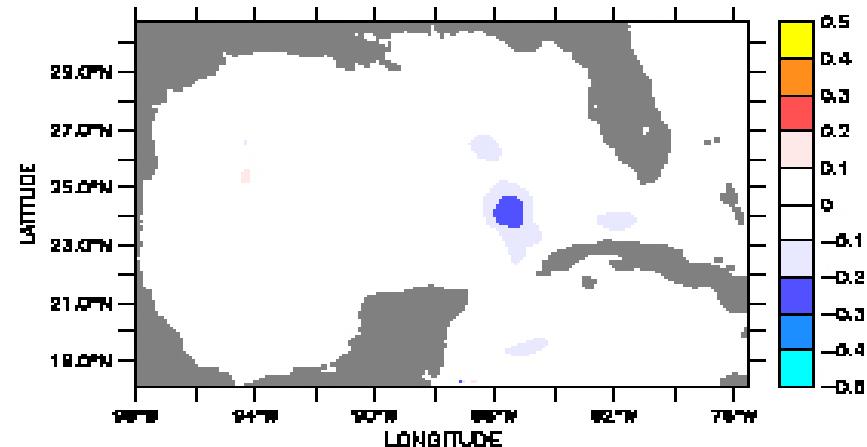
# Truth - Analyzed State Day 50

TIME : 18-OCT-1999 00:00



OI

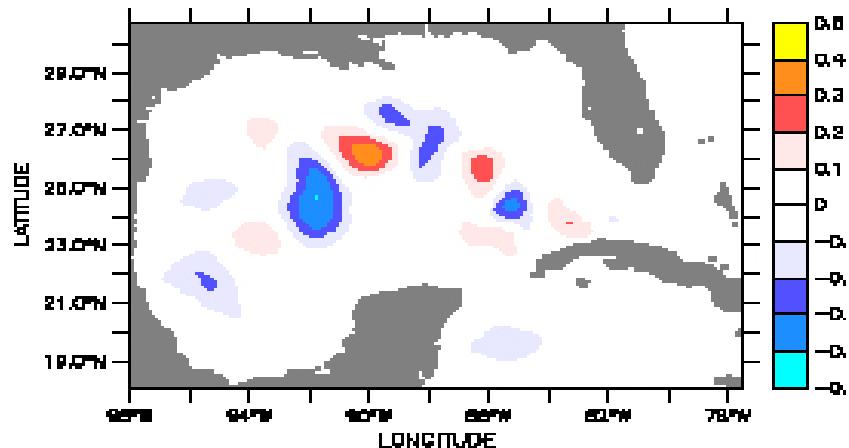
TIME : 18-OCT-1999 00:00



NCODA/MVOI

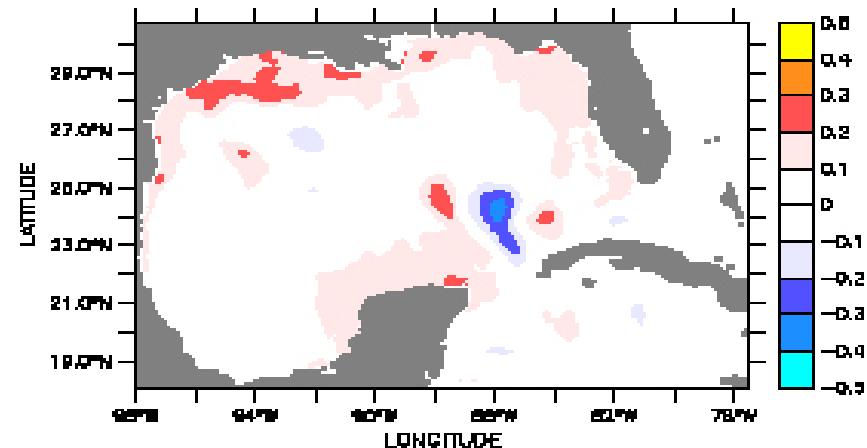
# SSH Innovation Day 50

TIME : 18-OCT-1999 00:00



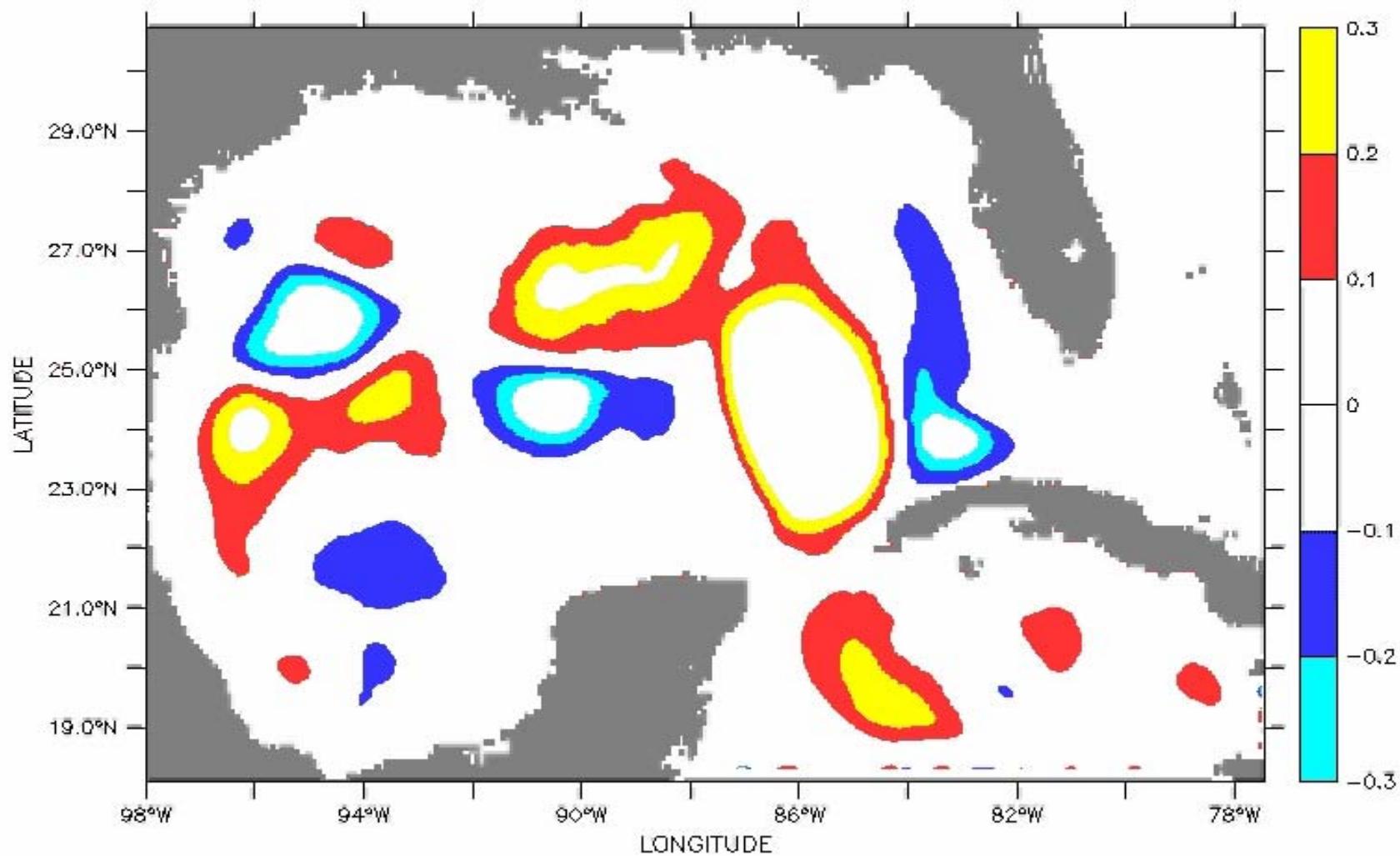
ENOI

TIME : 18-OCT-1999 00:00



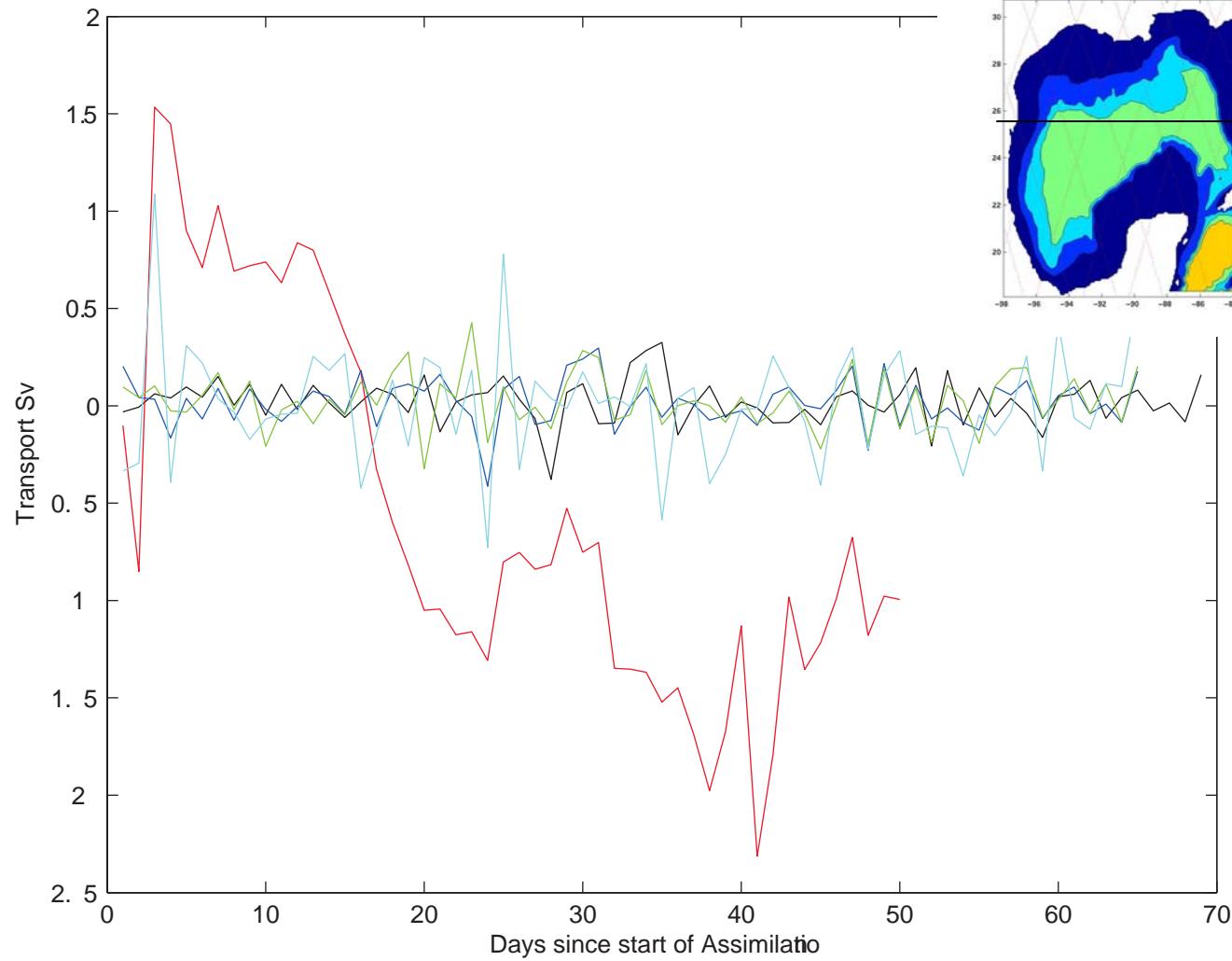
ENROIF

TIME : 30-AUG-1999 00:00

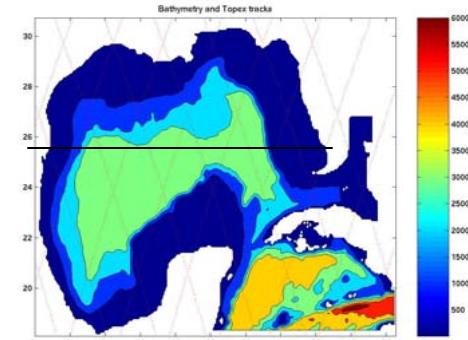


NCODA/MVOI— Truth — Analysis

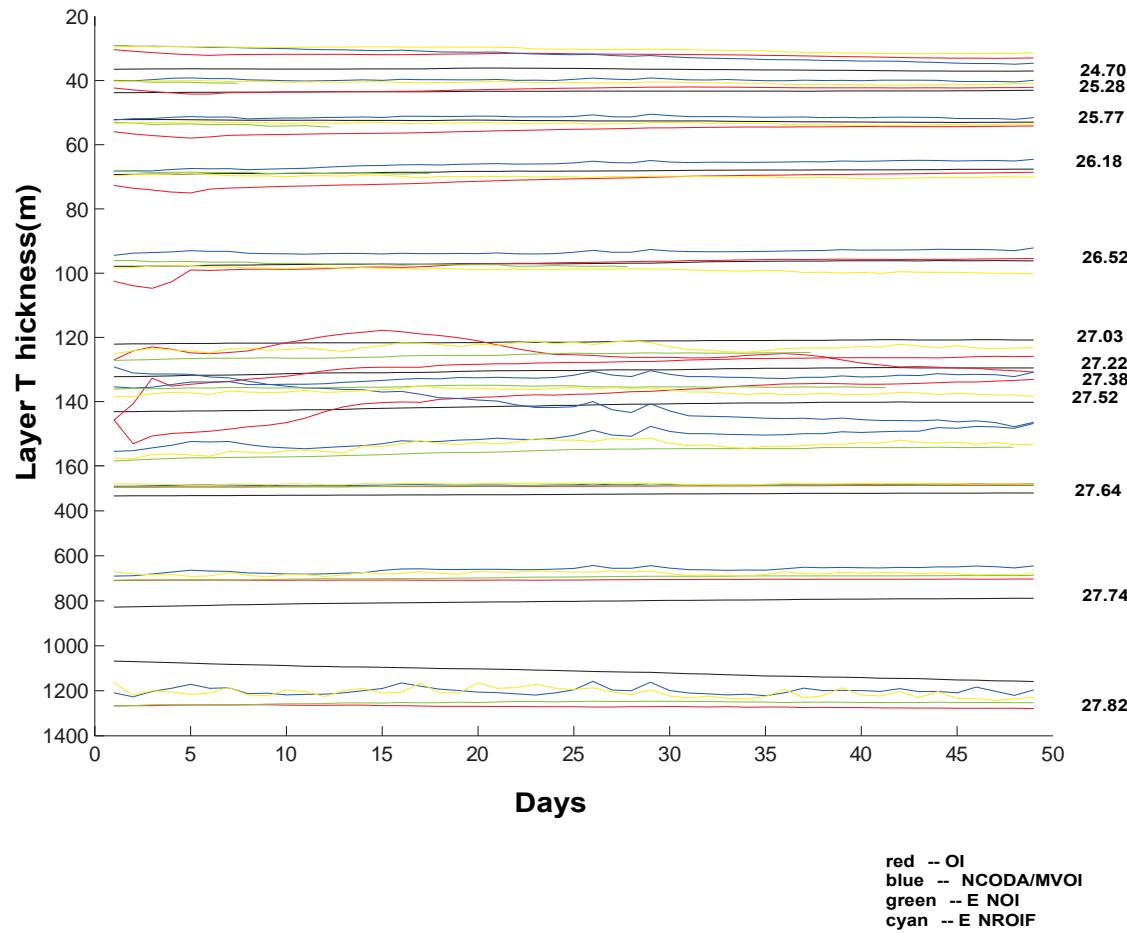
# Net transport across 26.8 N



red -- OI  
blue -- NCODA/MVOI  
green -- E NOI  
cyan -- E NROI



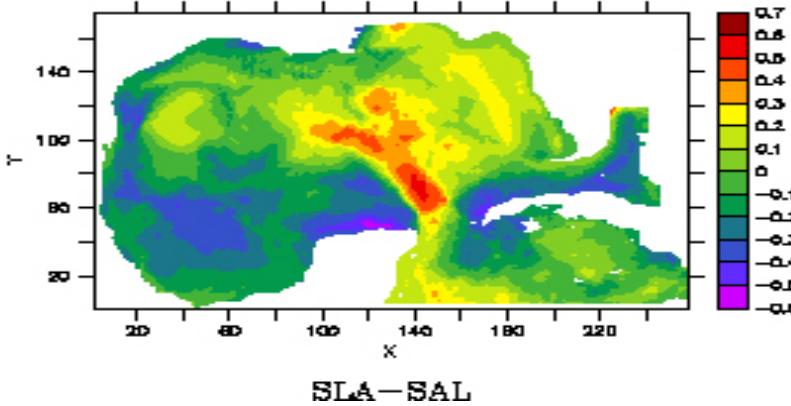
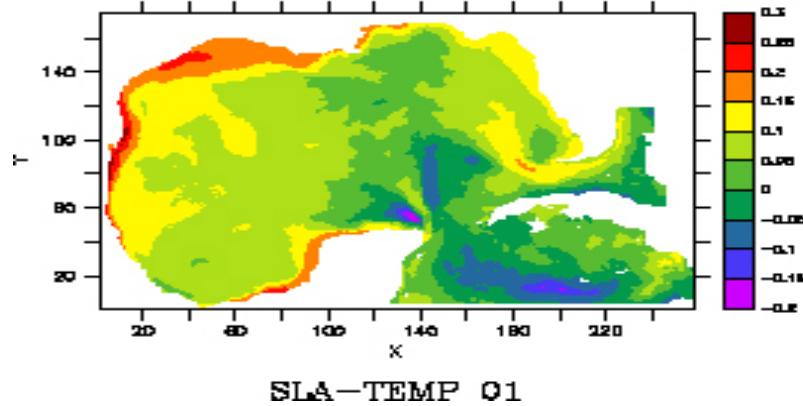
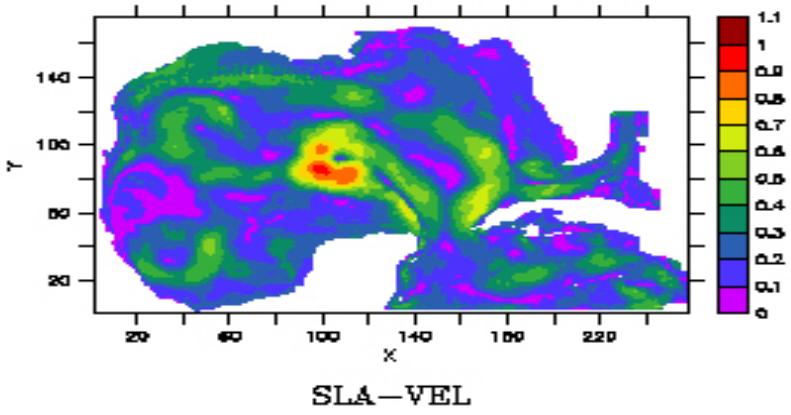
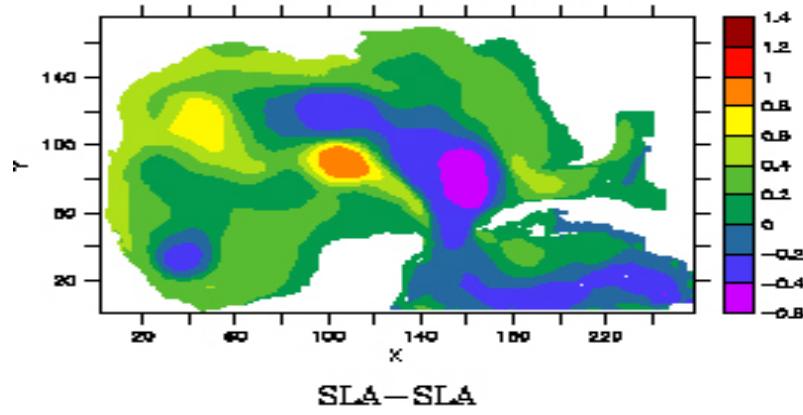
# Mean Layer Thickness



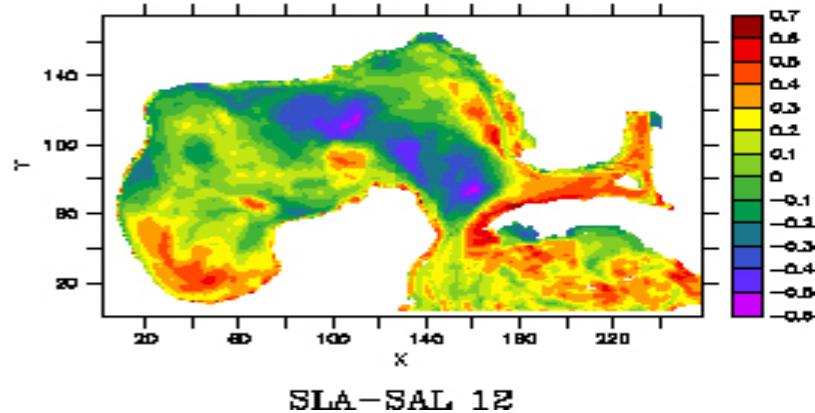
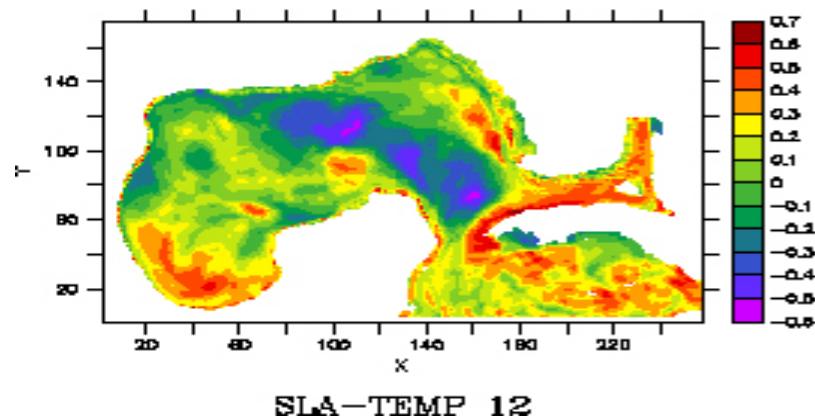
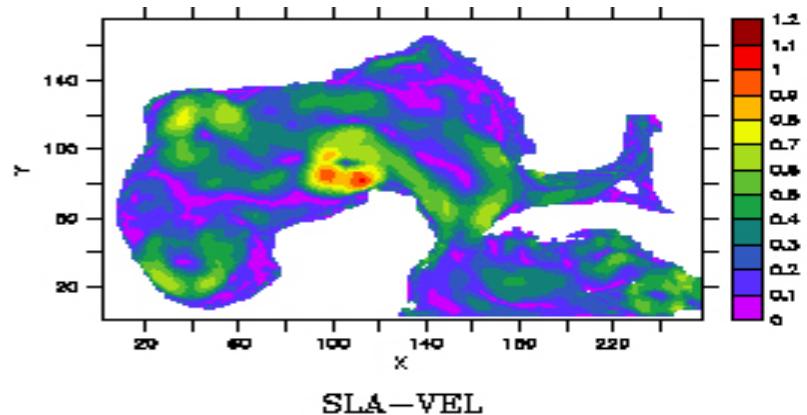
# Things to do:

- generate a longer ensemble - at least 3 years, preferably 5 years
- Runs to tune ENOI and ENROIF
- include SEEK and NCEP in the comparison
- Run twin experiments with data sampled from 1/25 GOM and assimilate into 1/12 GOM
- Year 2004 Hindcast

# Correlation of SSH at a representative point vs Velocity, Temperature and Salinity- Surface



# Correlation of SSH at a representative point vs Velocity, Temperature and Salinity – Layer 12



# HYDAE model intercomparis on on-line

