

Sensitivity of West Florida Shelf Simulations to Initial and Boundary Conditions Provided by HYCOM Data-Assimilative Ocean Hindcasts

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Goals

- **Assess impact of GODAE ocean hindcasts on coastal simulations nested within them**
 - Compare non-assimilative nested simulations of the West Florida Shelf (WFS) against moored ADCP velocity and temperature observations
 - Influence of Loop Current and eddies on WFS Circulation
 - Impact of nesting boundary location
- **Demonstrate positive impacts of GODAE products**
- **Demonstrate limitations of GODAE products**
- **Provide feedback for improving GODAE hindcasts**

Approach

- Nested WFS simulations using HYCOM
- Nest in experimental HYCOM outer model products
 - Three data-assimilative ocean hindcasts
 - **ATL-OI:** Atlantic optimum interpolation hindcast
 - 0.08° Atlantic domain
 - SSHA OI, Cooper-Haines vertical projection, SST relaxation
 - **GoM-NCODA:** Gulf of Mexico NCODA hindcast
 - 0.04° GoM domain nested in model-generated Atlantic Ocean climatology
 - **Global-NCODA:** global NCODA hindcast
 - 0.08°, fully global
 - One non-assimilative ocean simulation
 - **GoM-free:** Same domain as GoM-NCODA

WFS Nested Simulations

- **Major changes from outer models:**
 - COAMPS (27km) atmospheric forcing
 - Different vertical coordinate discretization strategy
 - Add layers to increase vertical resolution over the shelf
 - Use level (pressure) coordinates over the shelf
 - Tests revealed reduced pressure gradient error
 - » Classical seamount problem
 - » Unforced, initially at-rest WFS simulations
- **Run for 2004-2005**
- **Evaluation**
 - Compare simulated velocity to ADCP velocity measurements at USF COMPS moorings
 - Compare simulated temperature to measurements at these same moorings.
 - These fields sampled during model simulations

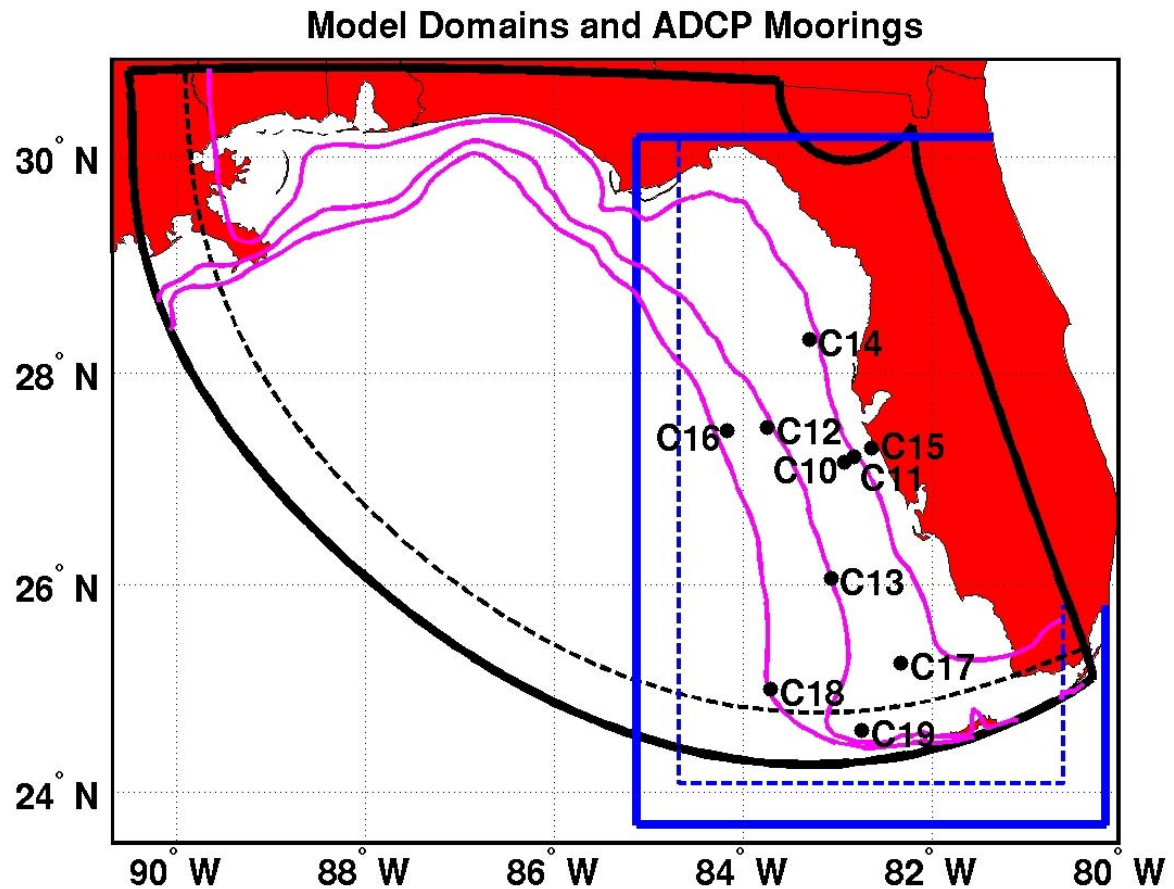
**USF Curvilinear
Domain (black)**

**Mercator Domain
(blue)**

**20, 50, 100 m
isobaths (magenta)**

**Nesting boundaries
(dashed)**

**USF ADCP moorings
shown**



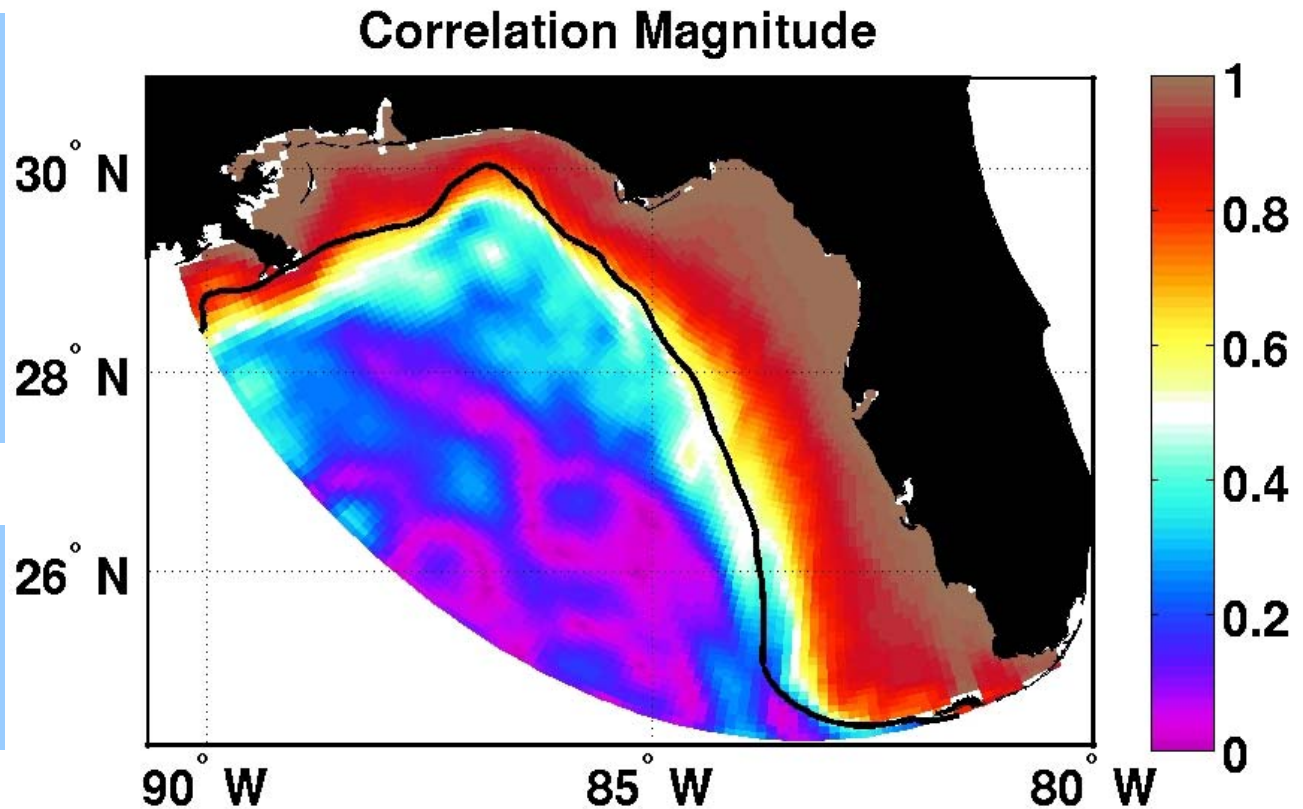
Two model domains illustrate impact of nesting boundary location on nested simulations along central WFS

Inner Shelf: wind-driven (deterministic)

Offshore: eddy and LC variability (stochastic)

Middle/outer shelf: transition region

Solutions uncorrelated where stochastic LC and eddy variability dominates

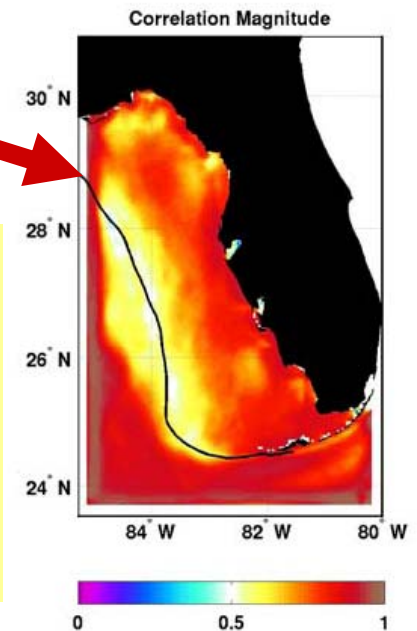
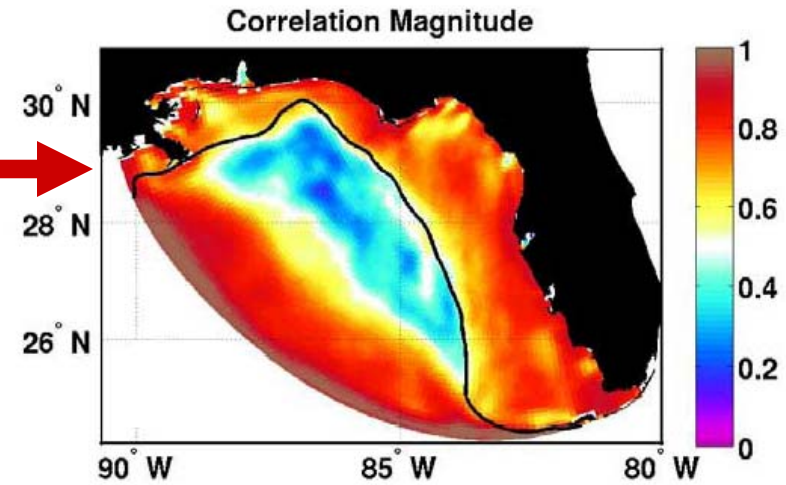


Surface velocity vector correlation magnitude between two nested experiments:
GoM-free (non-assimilative) vs. GoM-NCODA (assimilative)

Boundary conditions do not constrain nested model flow variability over continental slope and near the shelfbreak

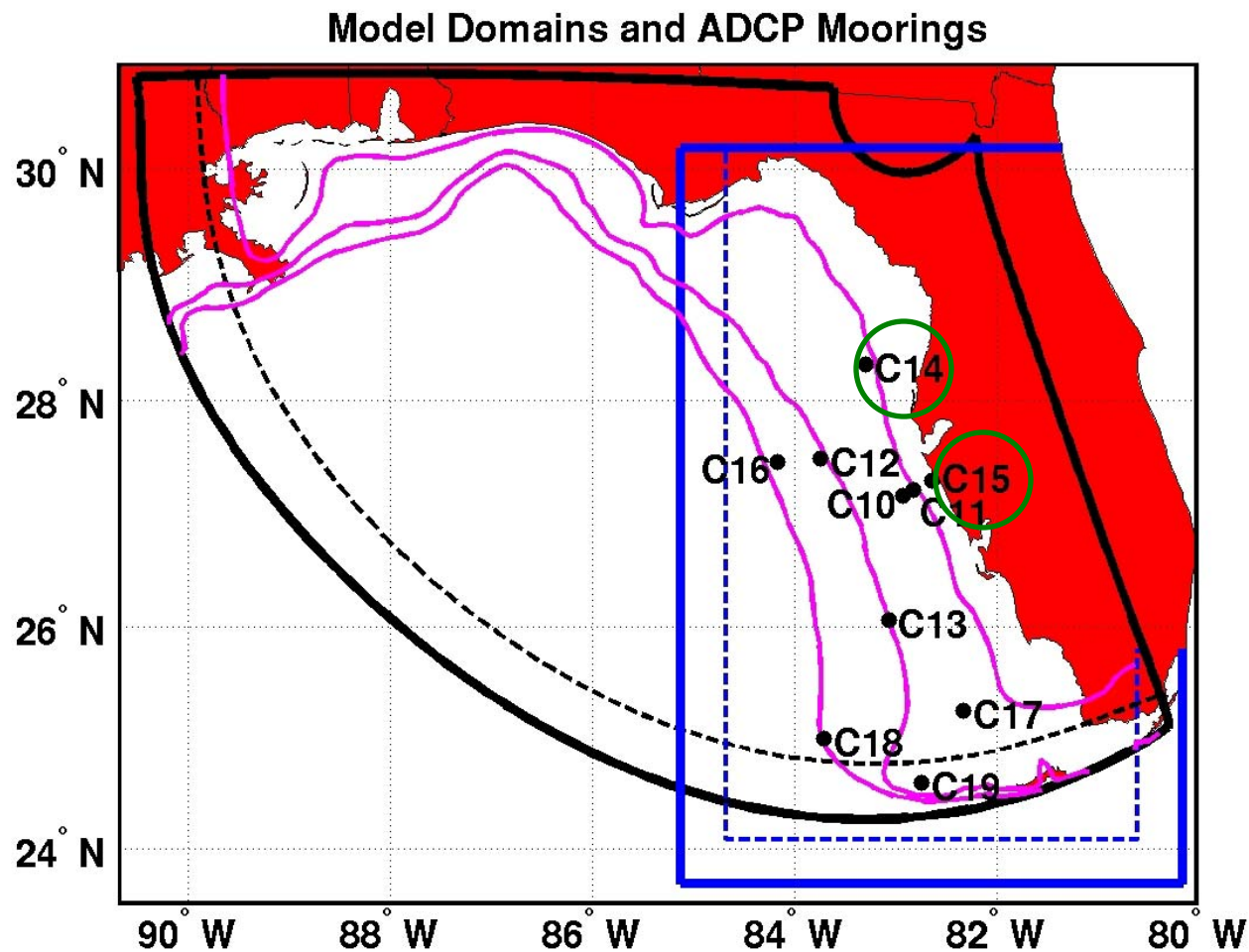
Boundary conditions partly constrain flow variability

Vector correlation magnitude,
Surface velocity, 2004-2005
GoM-NCODA
Nested simulation vs. outer model



**Analyze
sensitivity of
the inner shelf
to boundary
conditions**

**Problem: vel.
and temp. time
series have
numerous gaps**

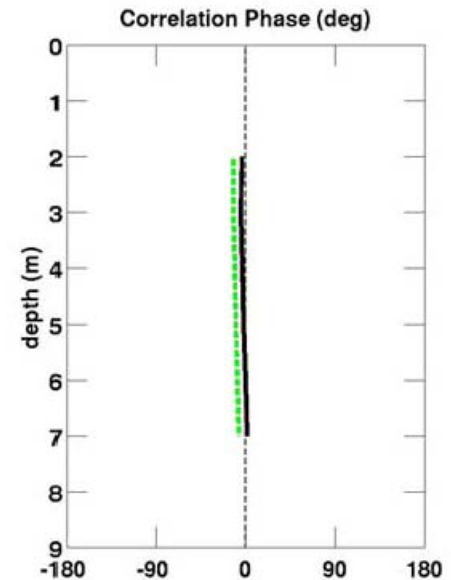
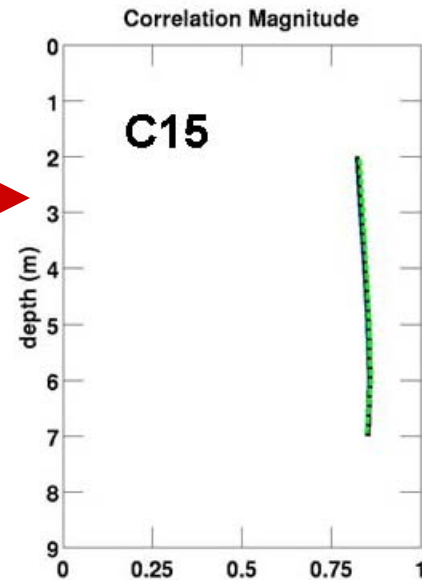
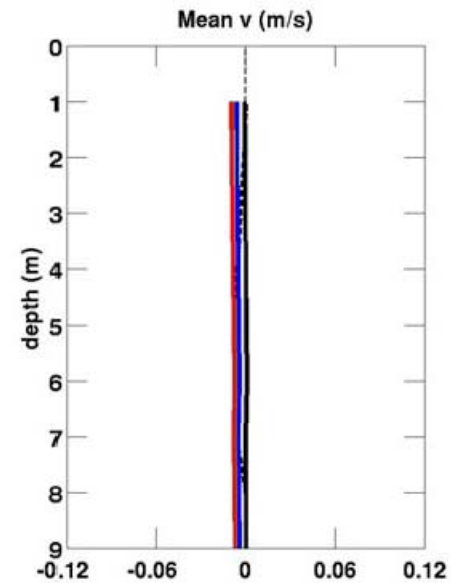
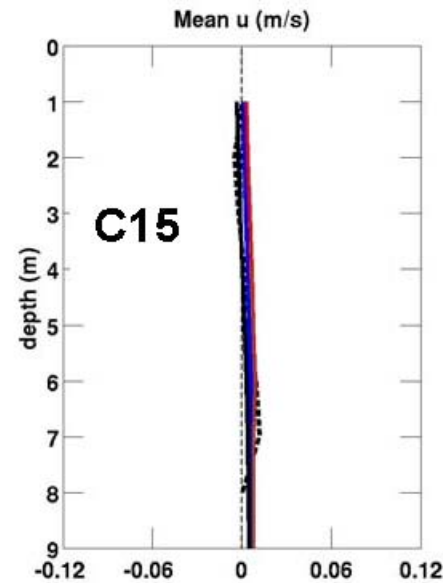


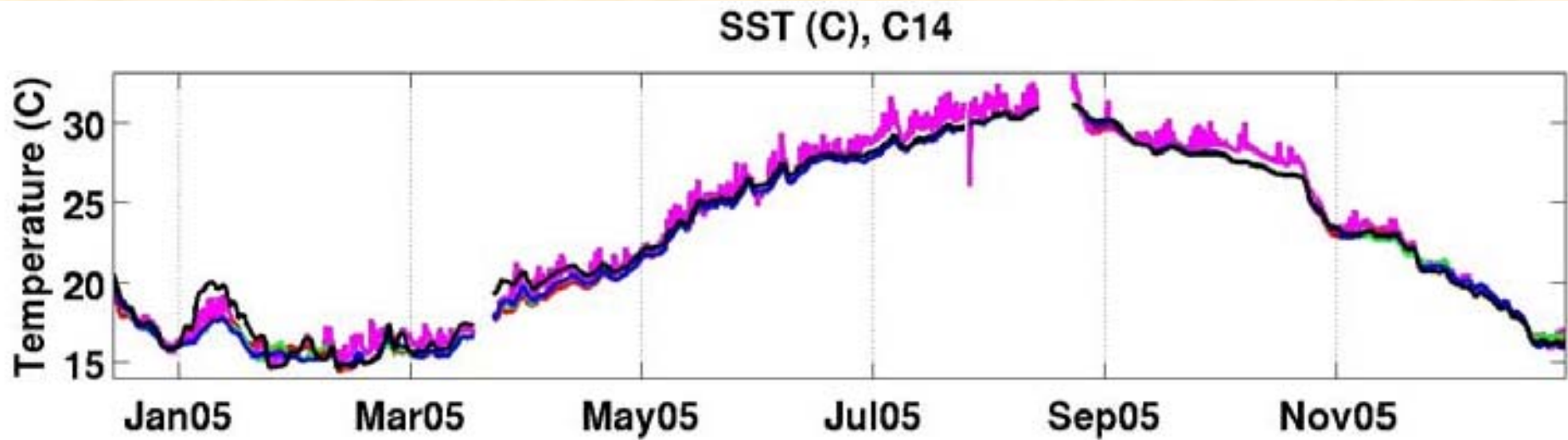
**Analyze velocity at C15 (2004-2005)
and T at C14 (Dec. 2004 through 2005)**

**Mean u and v
(simulated and
observed)**

**Velocity fluctuations not
sensitive to boundary
conditions**

**Velocity vector
correlation magnitude
and phase (simulated
vs. observed)**



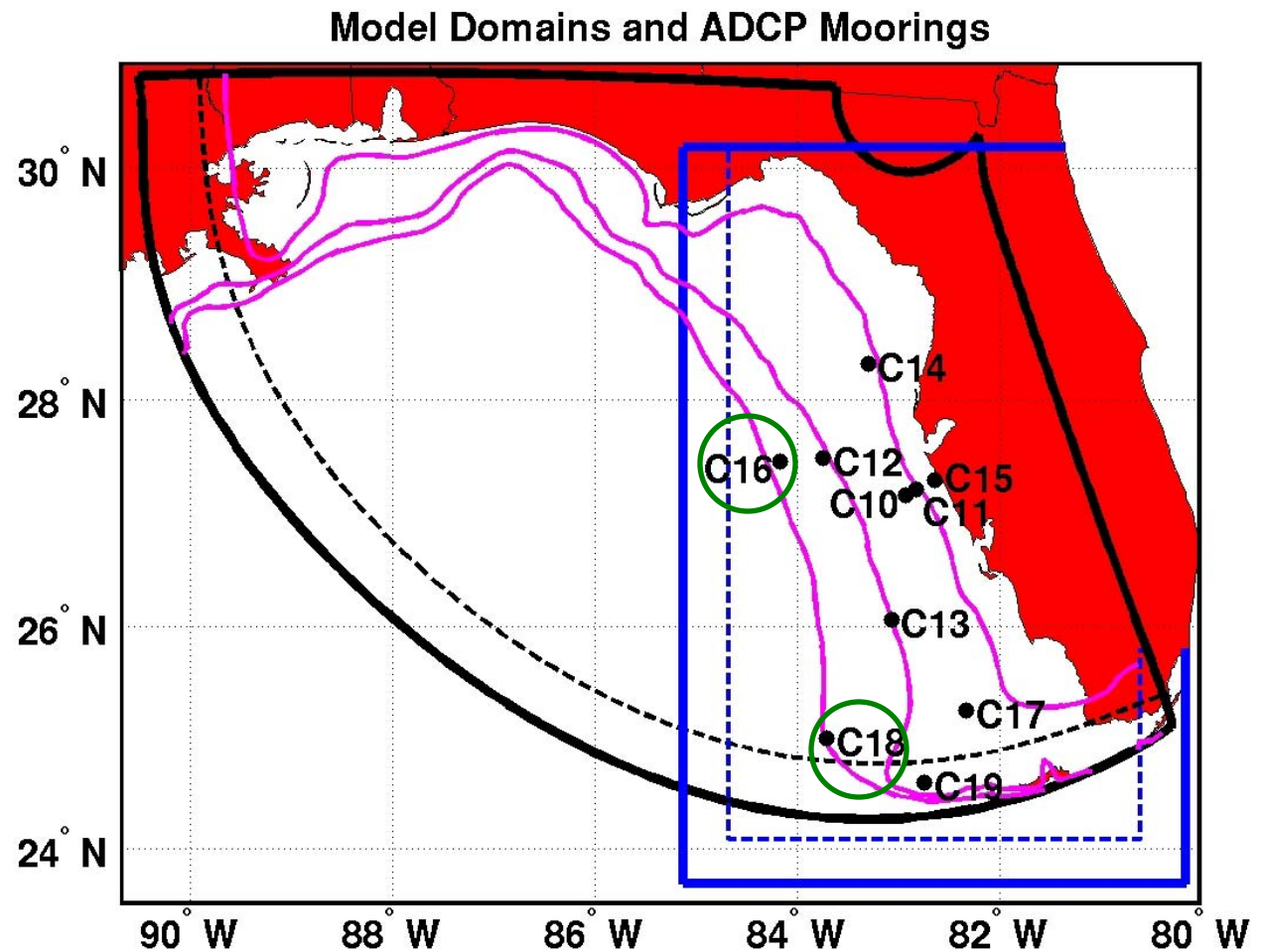


Sea surface temperature fluctuations generally not sensitive to boundary conditions

Exception during January 2005 when simulation nested in GLB-NCODA produces higher temperature

Observations are colored magenta

Analyze
sensitivity of
the outer shelf
to boundary
conditions

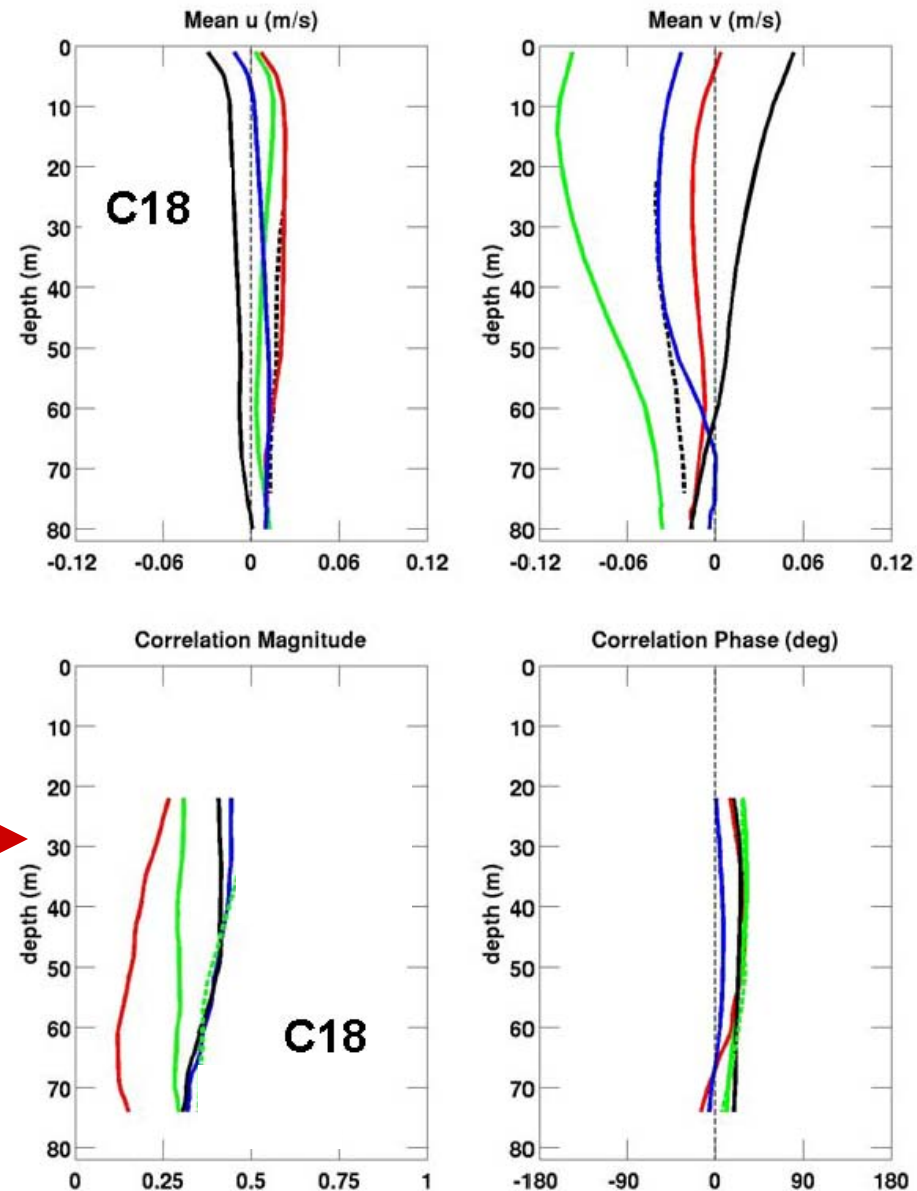


Analyze velocity at:
C16 (Dec. 2004-Dec. 2005)
C18 (Dec. 2004-June 2005)

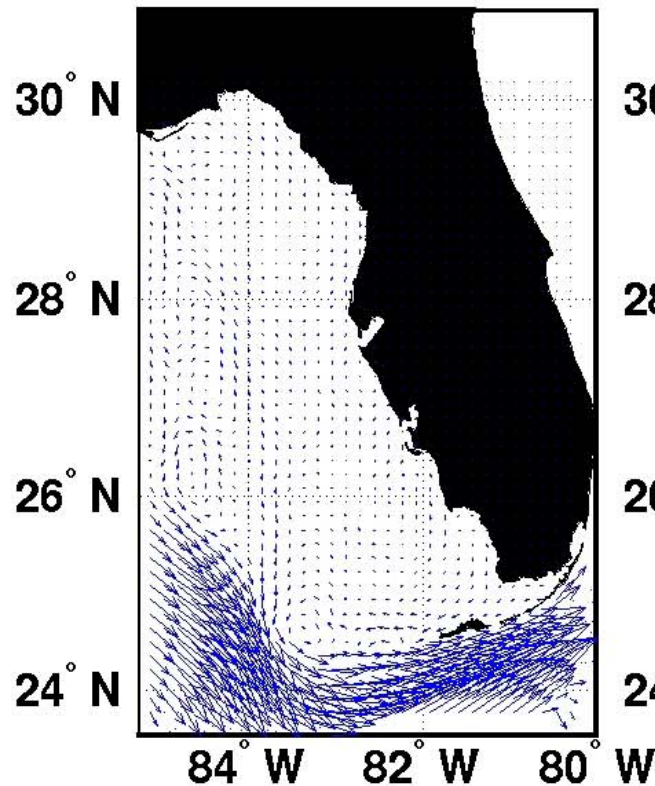
Mean u and v
(simulated and
observed)

GoM-free
GoM-NCODA
ATL-OI
GLB-NCODA
Observed (black dashed)

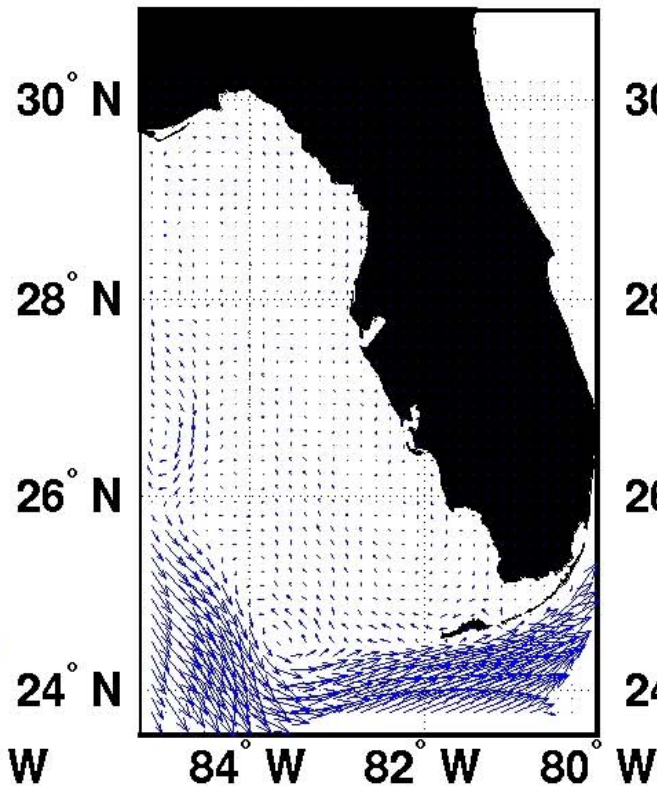
Velocity vector
correlation magnitude
and phase (simulated
vs. observed)



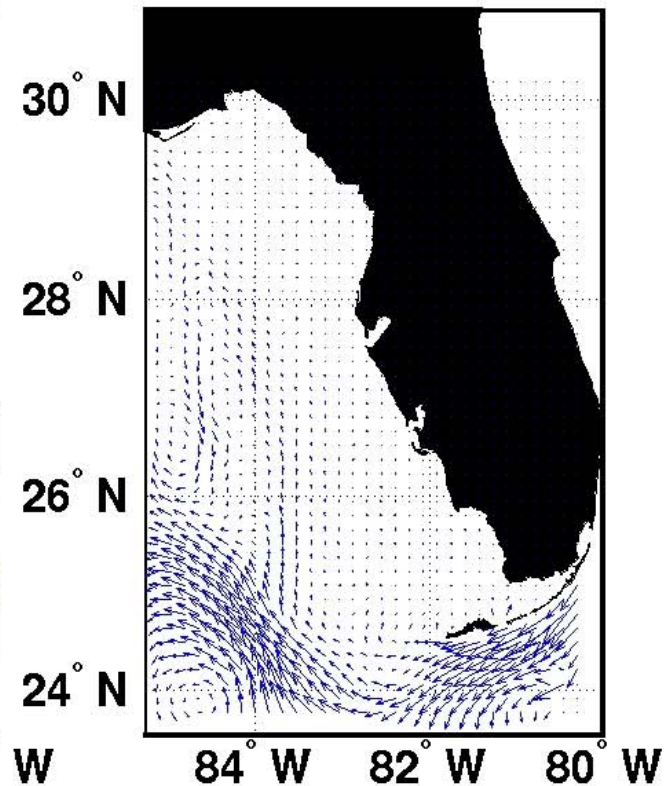
Mean Vel., GoM-NCODA



Mean Vel., Global-NCODA



Vel. Difference

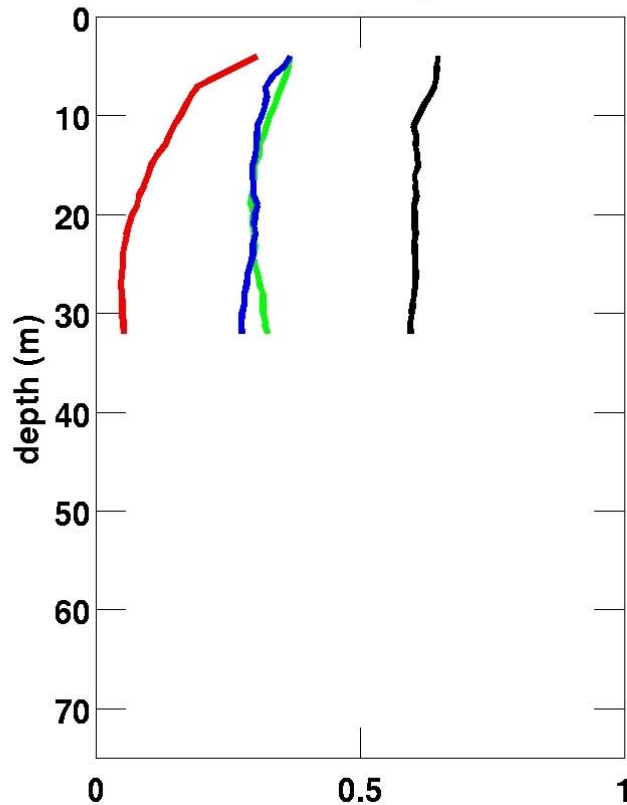


Mean surface velocity, Dec. 2004 through 2005

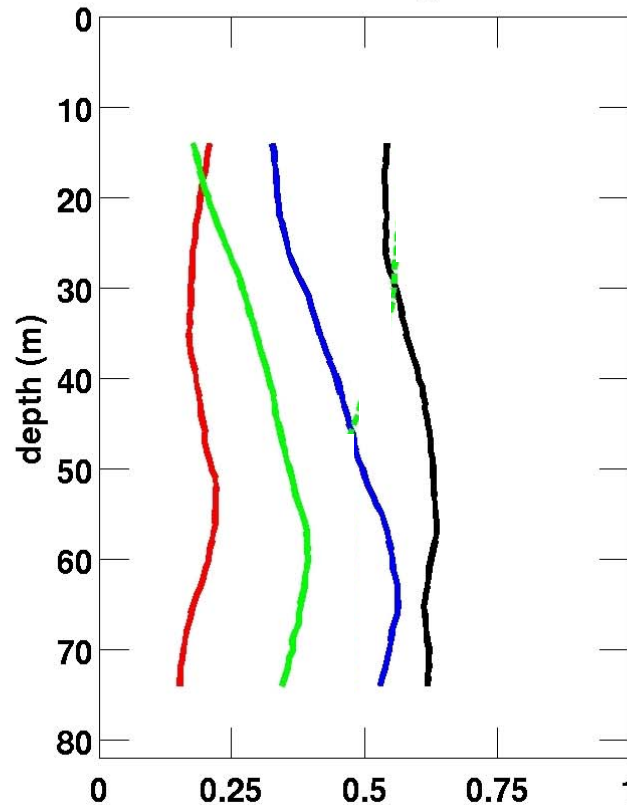
Difference in LC transport responsible for inducing the difference in mean flow along the outer shelf

C16

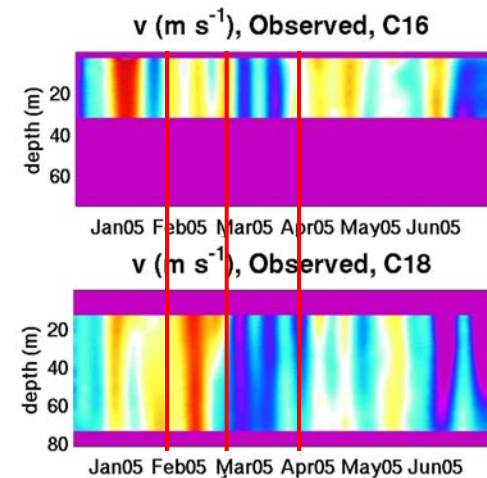
Correlation Magnitude

**C18**

Correlation Magnitude

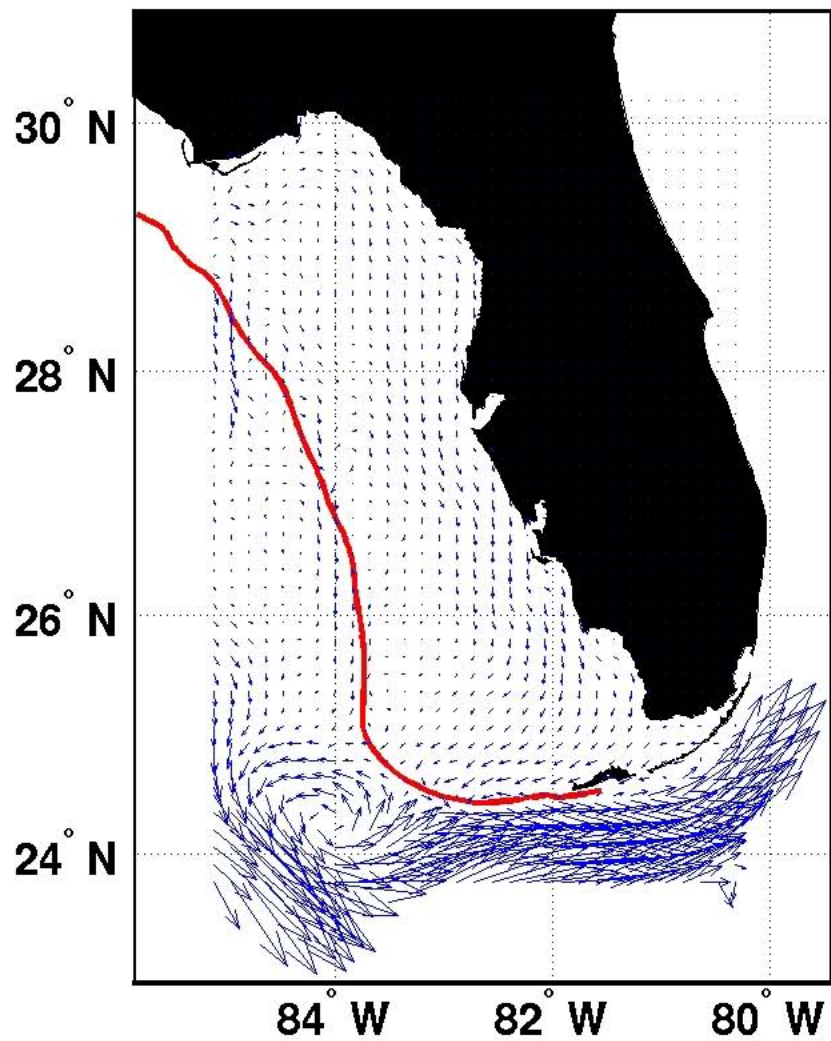


GoM-free
GoM-NCODA
ATL-OI
GLB-NCODA

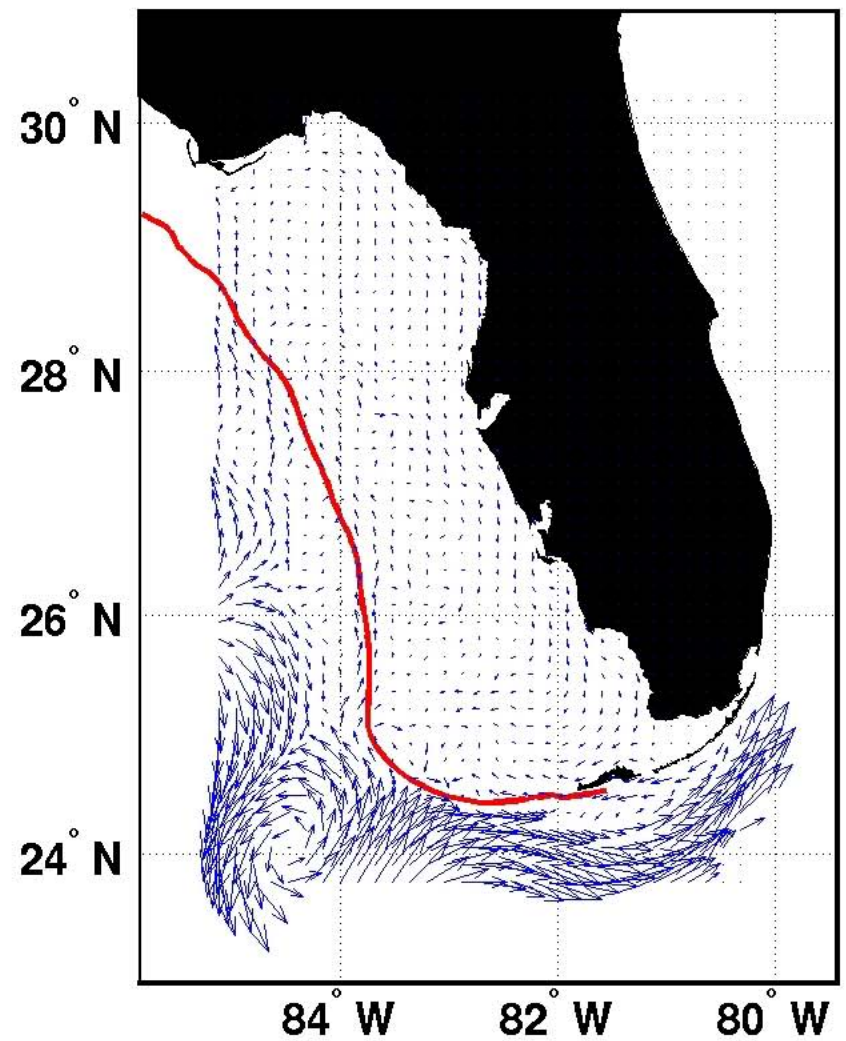


Vector correlation magnitude, Dec. 2004 through June 2005, simulated vs. obs.

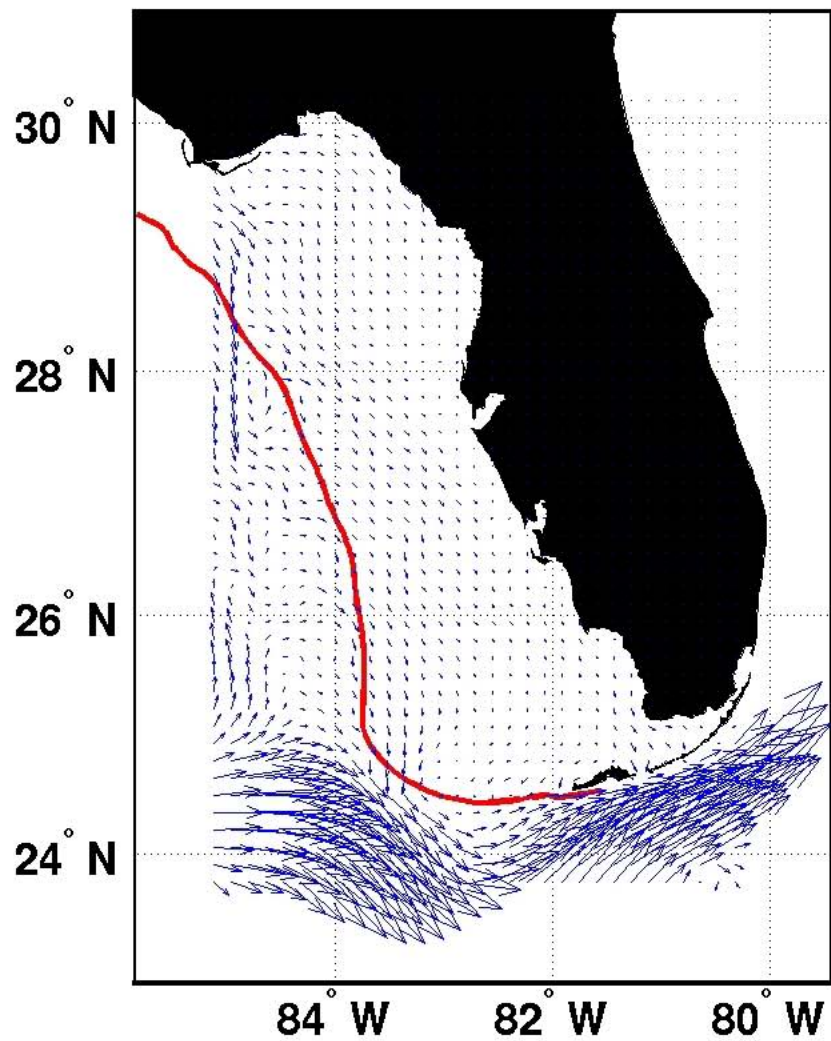
Mean Vel., GoM-free



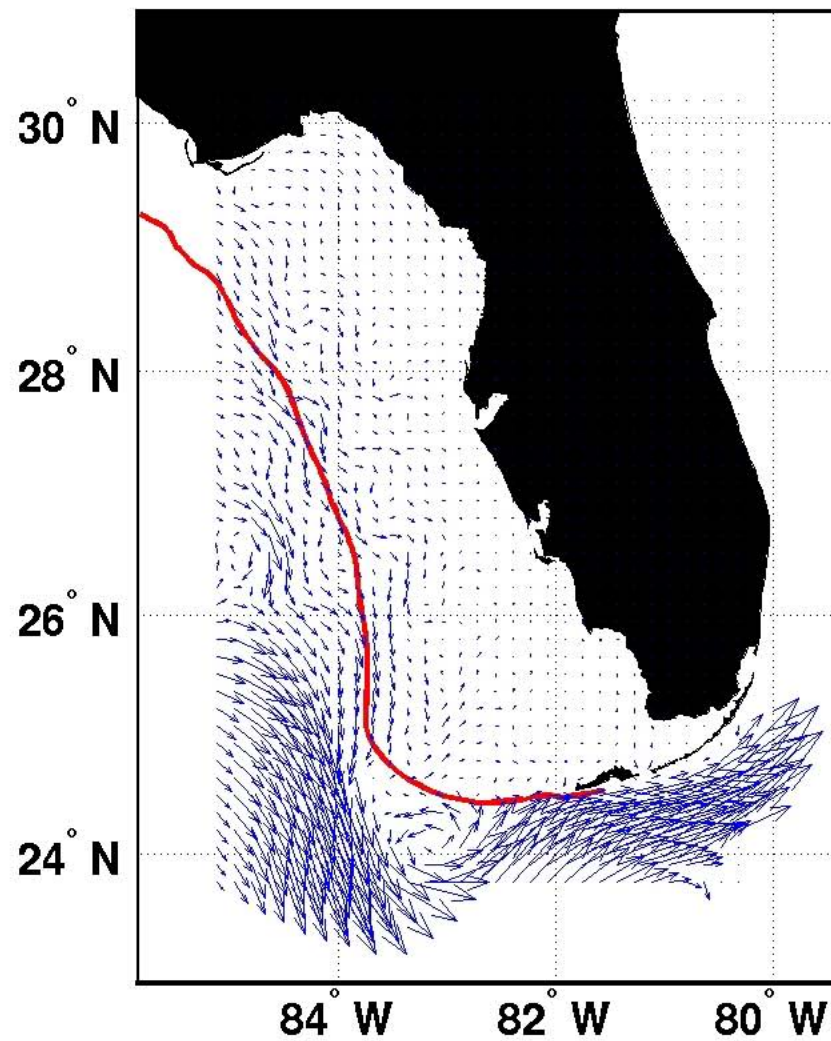
Mean Vel., GLB-NCODA



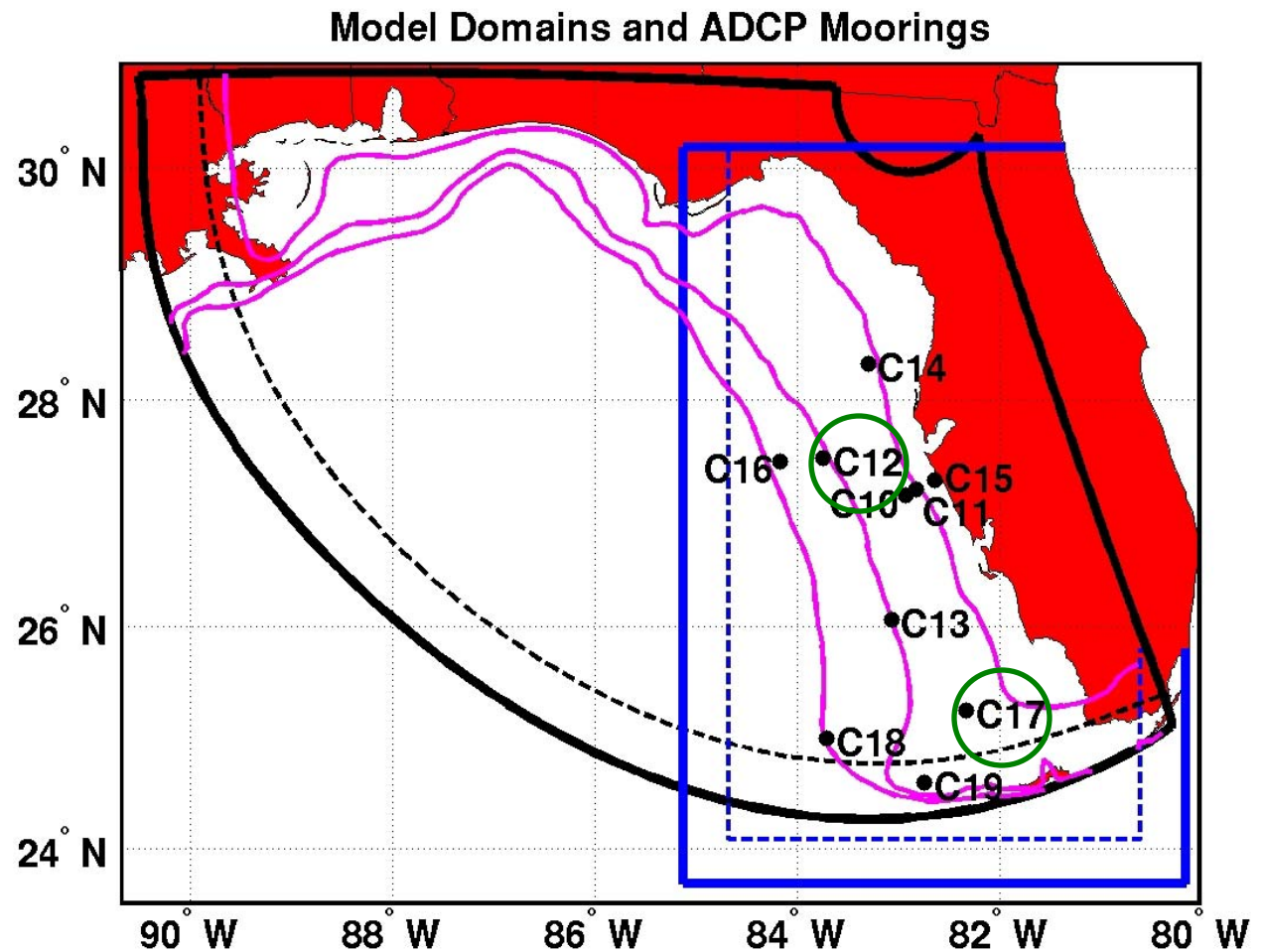
Mean Vel., GoM-free



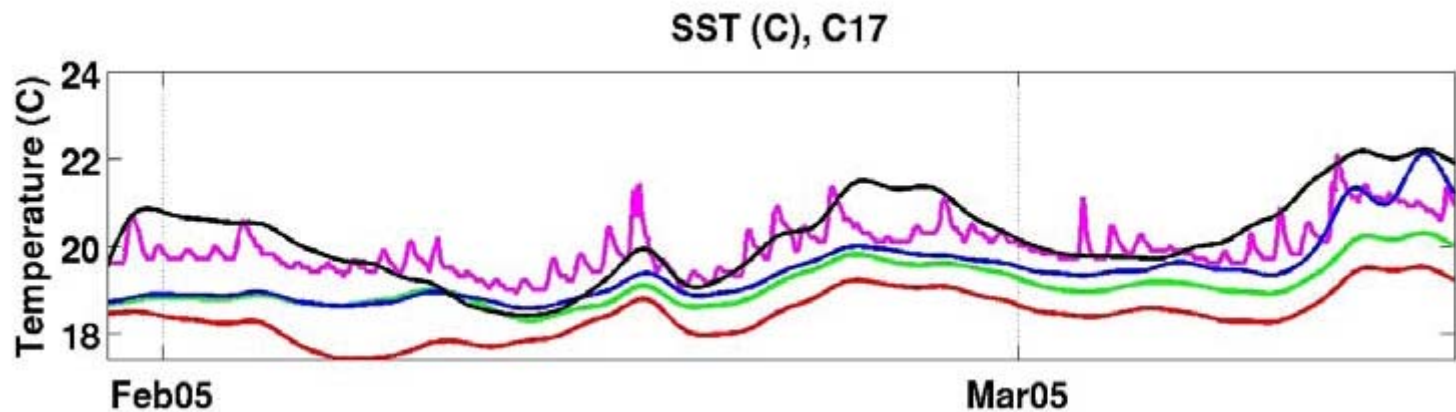
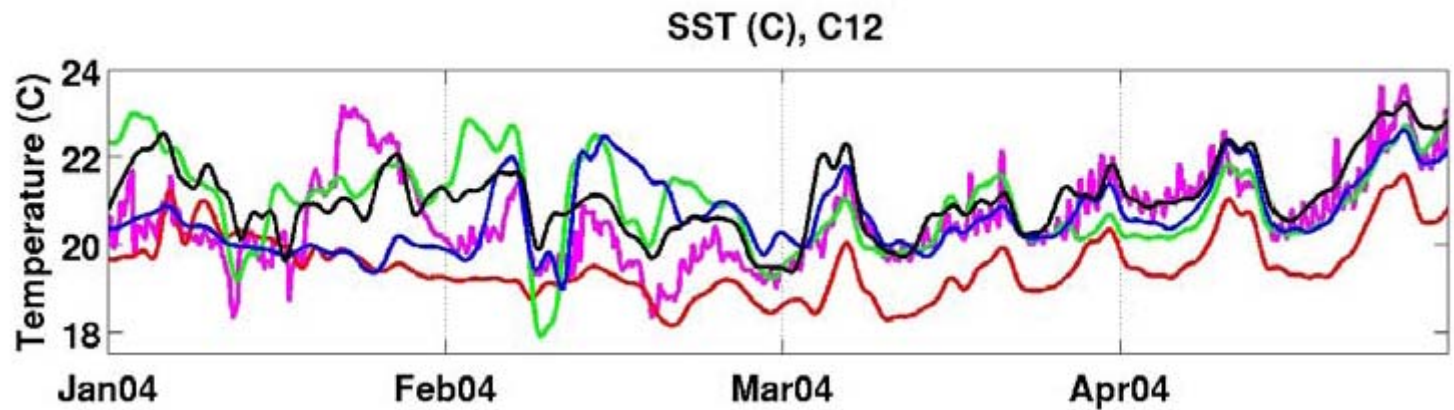
Mean Vel., GLB-NCODA



Analyze
sensitivity of
temperature
to boundary
conditions



Analyze T sensitivity at C12 and C17



GoM-free
GoM-NCODA
ATL-OI
GLB-NCODA
Observations

Cold bias in GoM-free

Results

- **Assess impact of GODAE ocean hindcasts on coastal simulations nested within them**
 - Influence increases with distance from coast as importance of stochastic eddy variability increases
- **Demonstrate positive impacts of GODAE products**
 - LC interaction with shelf at SW end of WFS
 - Reduced temperature bias in nested models
- **Demonstrate limitations of GODAE products**
 - LC transport difference between GoM-NCODA and GLB-NCODA although both produced the same path
- **Provide feedback for improving GODAE hindcasts**
 - Feature location generally good
 - Improvements needed in boundary current transport, vertical T-S structure of the upper ocean (improved observational coverage should help)