Initial Progress on HYCOM Nested West Florida Shelf Simulations

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Major Goals and Plans

- **Test Model Performance in the Coastal Ocean:**
  - **Nesting algorithm**
  - **Vertical coordinate choice**
  - **Vertical mixing choice**
  - **Impact of pressure gradient error over steep topography**
- **West Florida Shelf Study**
  - **Strong offshore forcing due to loop current and associated eddies**
  - **Collaboration with R. Weisberg, USF**
  - **Compare HYCOM to observations and to other model simulations (POM, ROMS)**

West Florida Shelf Simulation (1)

- Initial/Boundary Conditions
  - From Atlantic basin simulation
    - 1/12 degree horizontal grid
    - 26 vertical layers
    - High-frequency forcing
    - SSH assimilation
    - Available after mid-September 2002

- Domain and Mesh
  - West Florida Shelf, Pensacola to Florida Bay
  - Rectangular grid, 1/12 degree resolution
    - Same resolution and grid points used for the Atlantic basin simulation
  - 22 vertical layers
    - same target isopycnic densities as the Atlantic basin simulation except that the four densest layers were removed

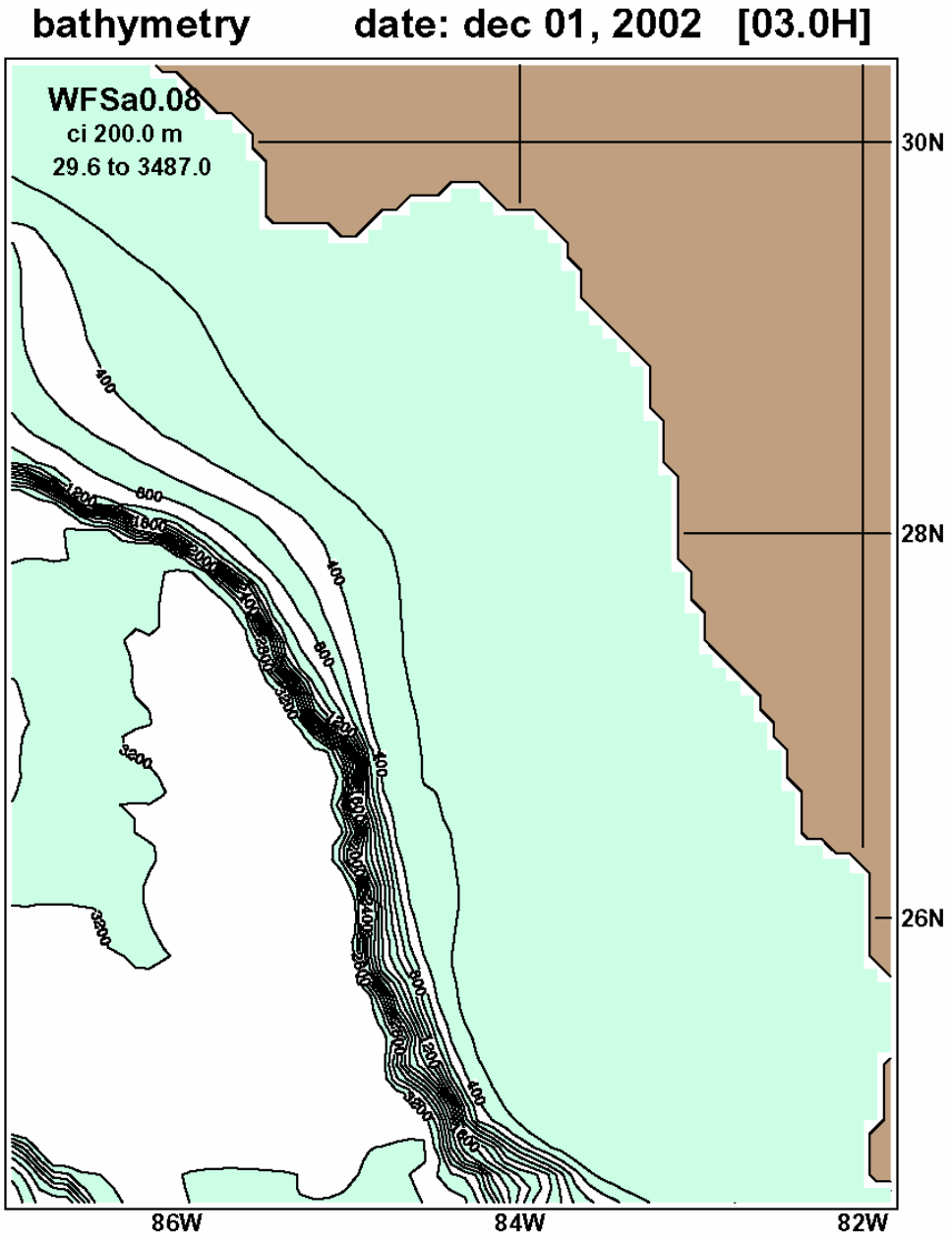
West Florida Shelf Simulation (2)

- **Bathymetry**
  - From ETOPO5
  - Limited to >10m isobath
    - Minimum depth of 30m
  - Same bathymetry used for the basin-scale simulation
- **Forcing**
  - ECMWF climatology plus FNMOC high-frequency anomalies
    - Same forcing used for the basin-scale simulation
  - Tidal forcing not implemented
- **Time Interval**
  - October 2 through December 2, 2002
- **Observations for Validation**
  - None available from USF for this initial test

West Florida Shelf Simulation (3)

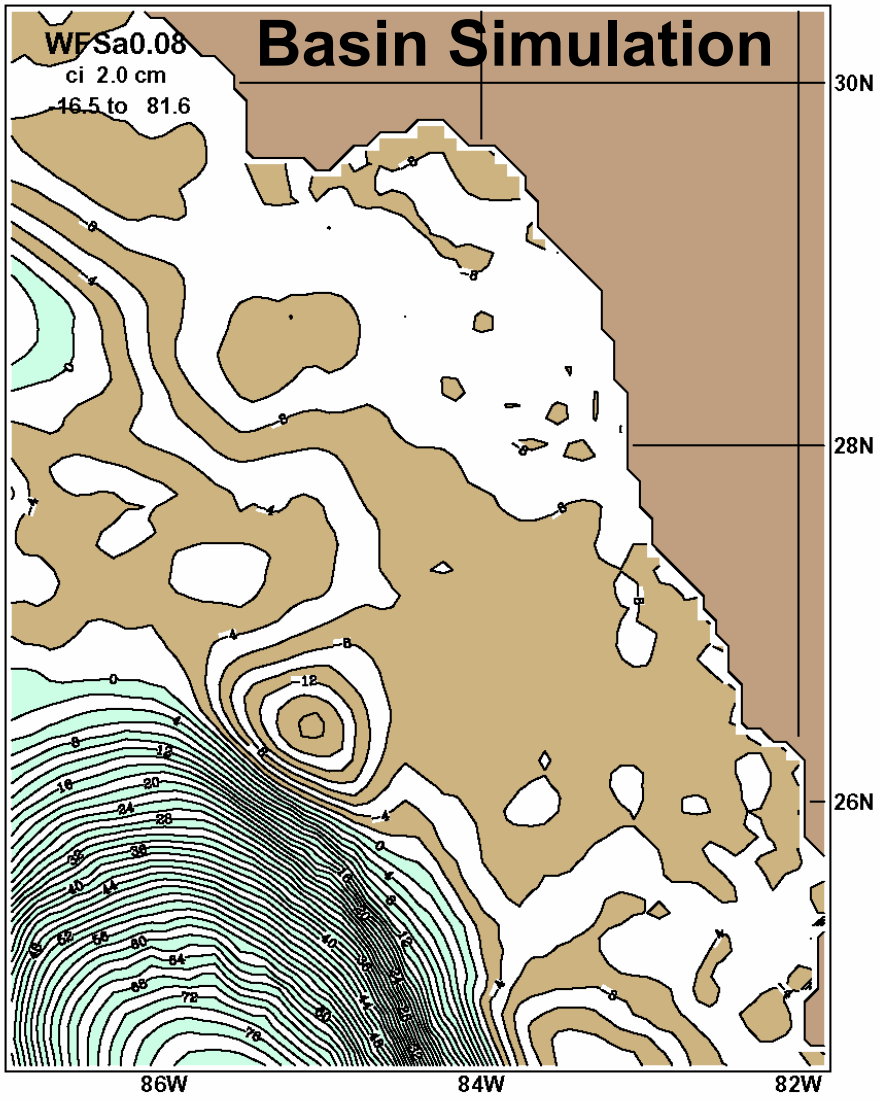
- **Will look at:**
  - **Nesting performance**
  - **Influence of vertical coordinate choice**
  - **Influence of vertical mixing choice**
  - **KPP bottom boundary layer model**

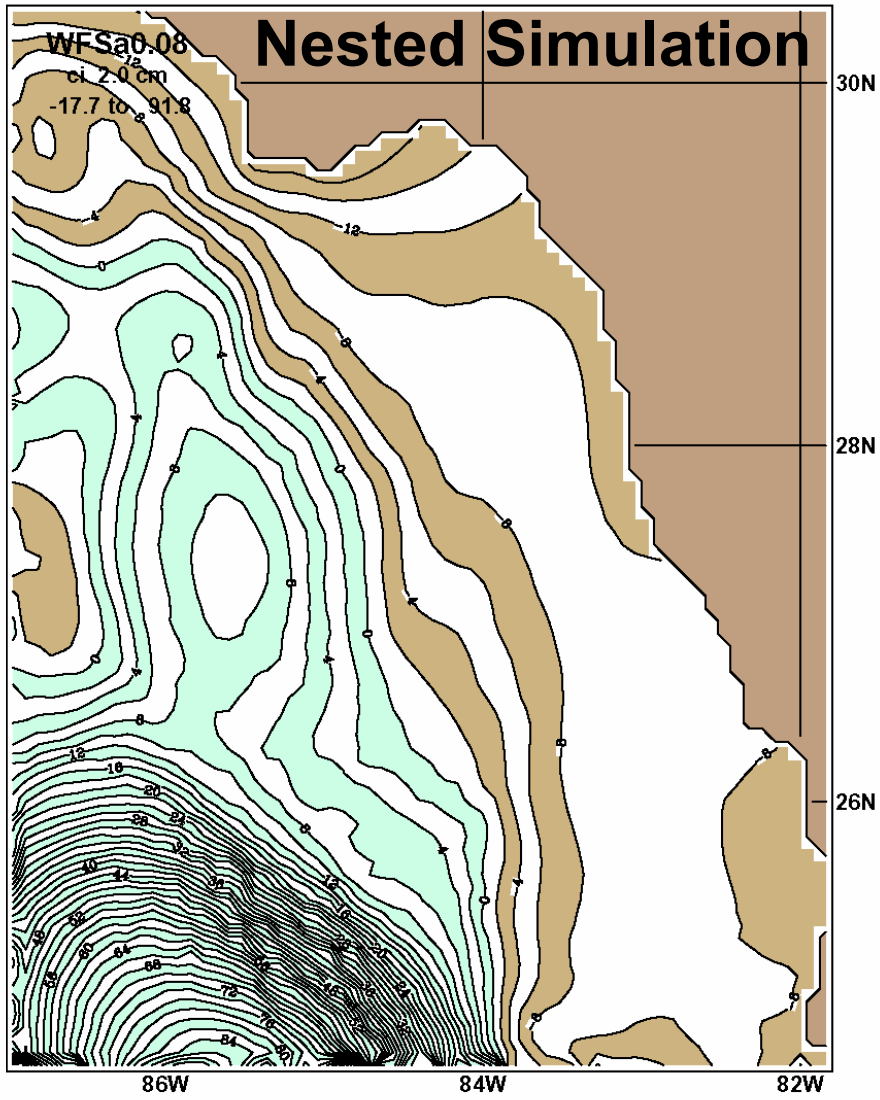
WFS Bathymetry



Nesting Performance

- A nested simulation was run with the identical grid, bathymetry, forcing, and vertical mixing choice (KPP) used by the Atlantic basin simulation that provided the initial/boundary conditions.
- Simulated fields differ substantially over the continental shelf/slope between the Atlantic basin and nested simulations.
- The only significant difference is that the Atlantic basin simulation uses SSH assimilation while the nested simulation does not.


sea surf. height date: dec 01, 2002 [02.6H]
Basin Simulation
WFSa0.08
ci 2.0 cm
-16.5 to 81.6
30N
28N
26N
86W
84W
82W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Nested Simulation
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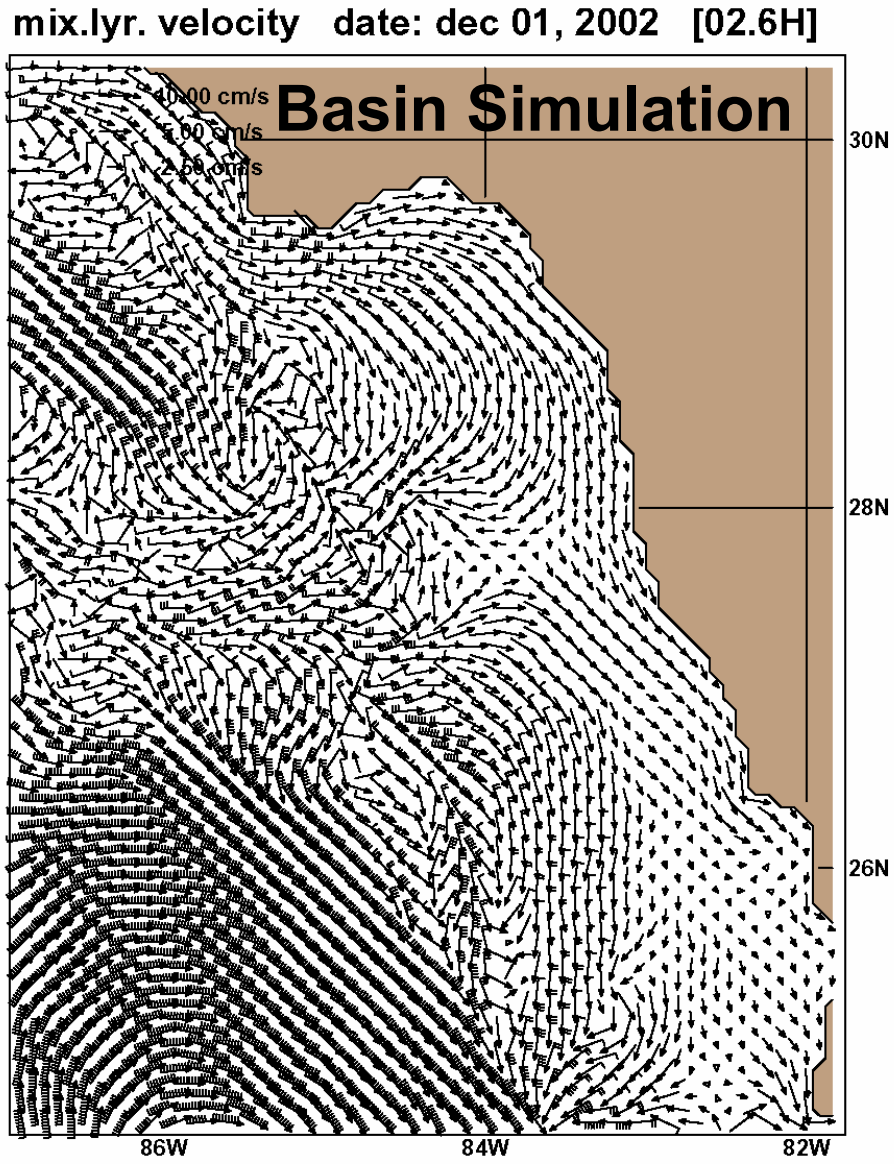
ci 2.0 cm
-17.7 to 91.8
30N
28N
26N
86W
84W
82W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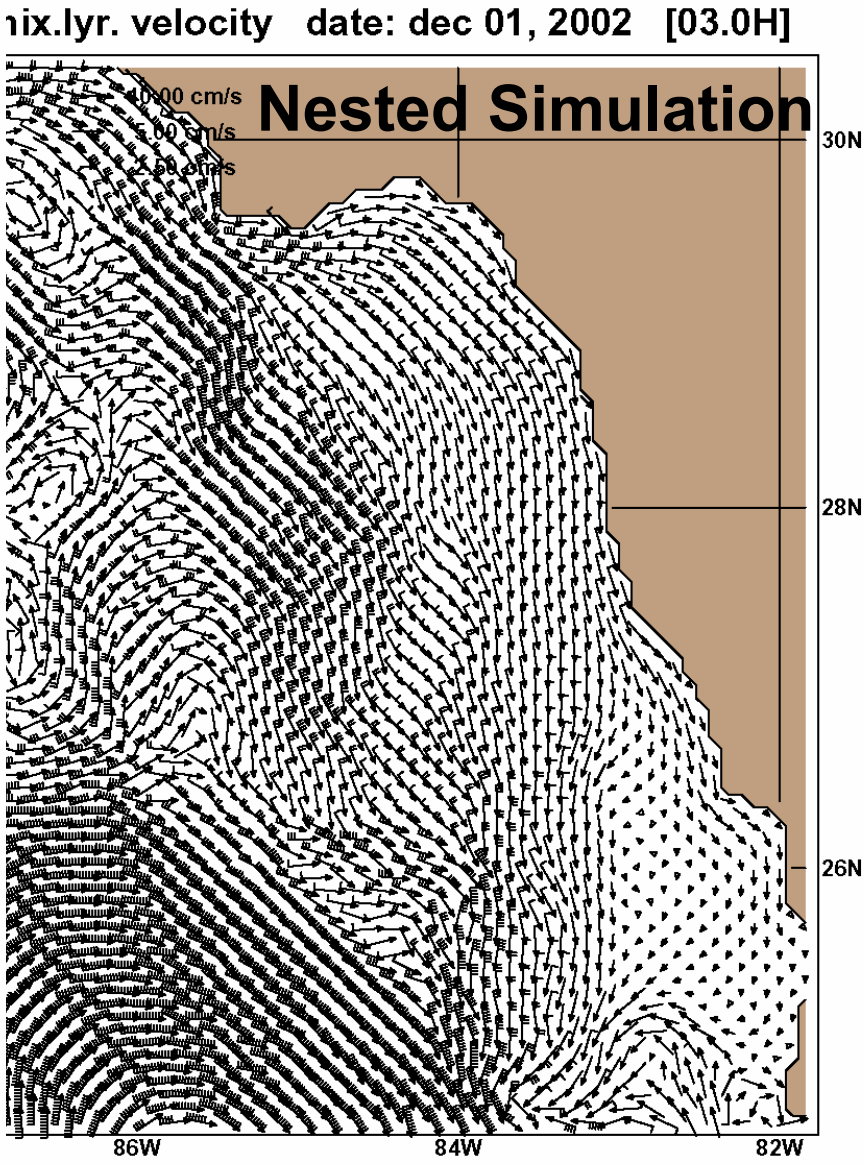
5.00 cm/s
2.50 cm/s
30N
28N
26N
86W
84W
82W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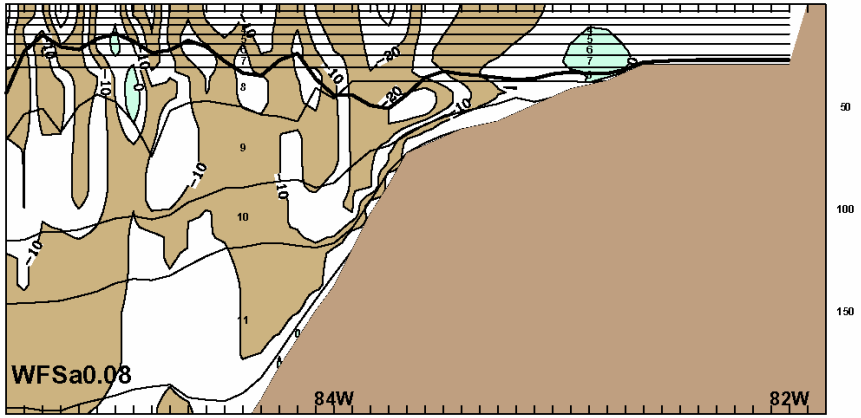
Nested Simulation
40.00 cm/s
5.00 cm/s
2.50 cm/s
30N
28N
26N
86W
84W
82W

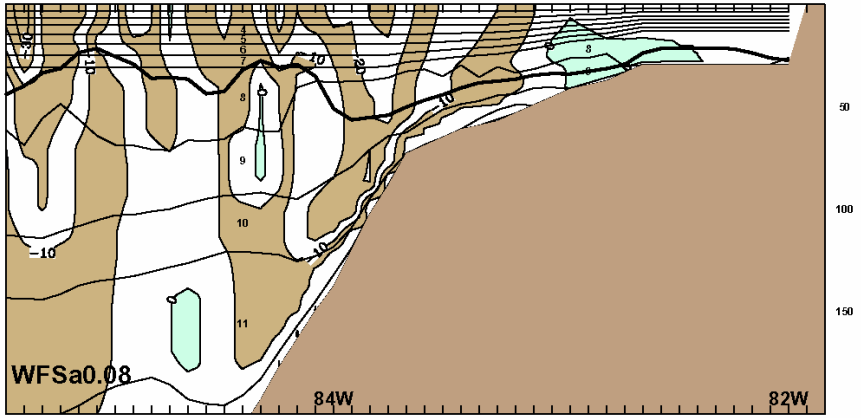
Vertical Coordinate Choice

- **Two Choices Compared:**
  - **z-isopycnic**
  - **Sigma-isopycnic**

v-velocity zonal sec. 26.16n date: dec 01, 2002 [03.0H]



v-velocity zonal sec. 26.16n date: dec 01, 2002 [03.1H]



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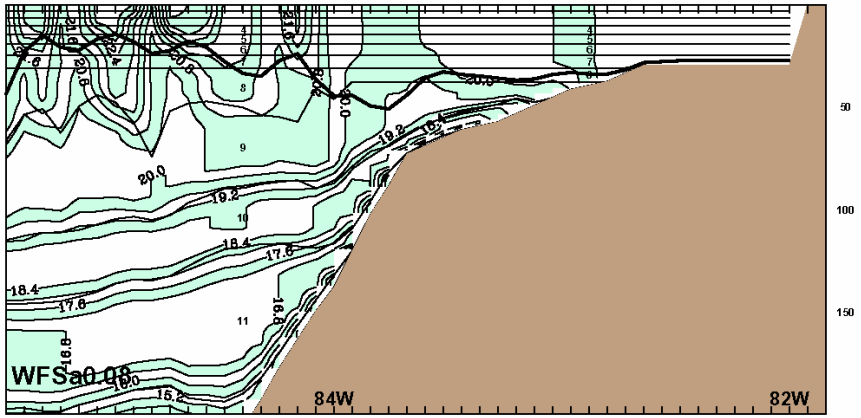

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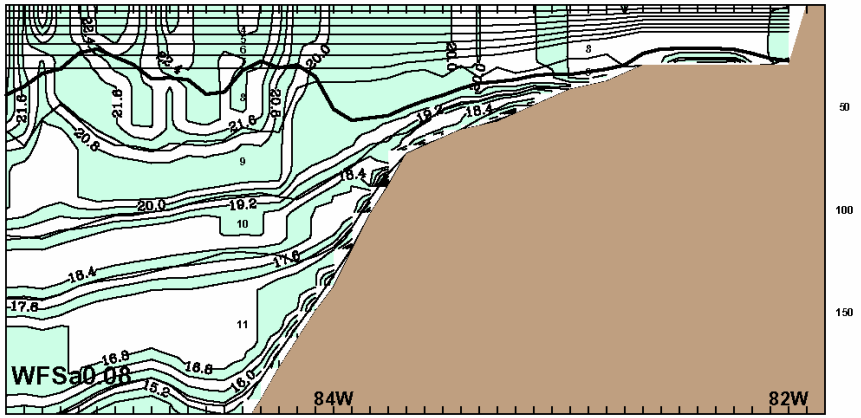


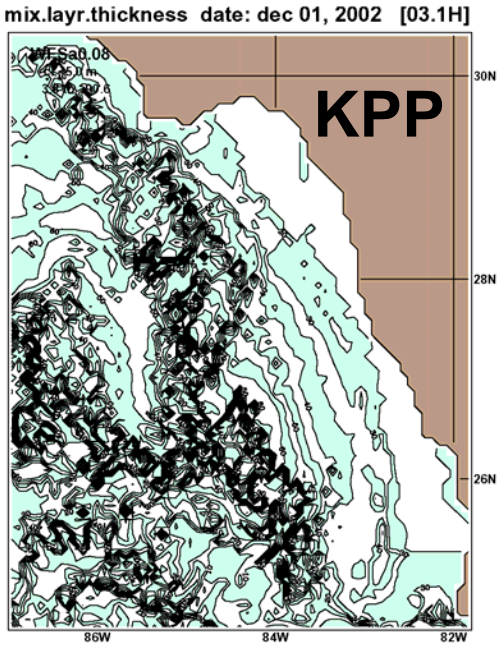
z-isopycnic

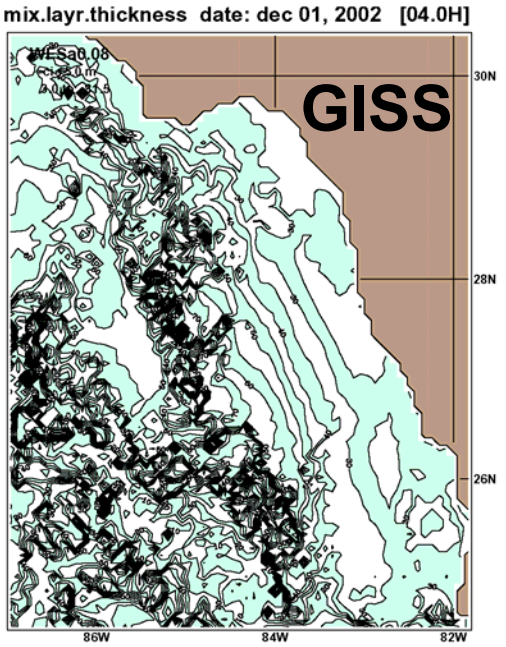
sigma-isopycnic

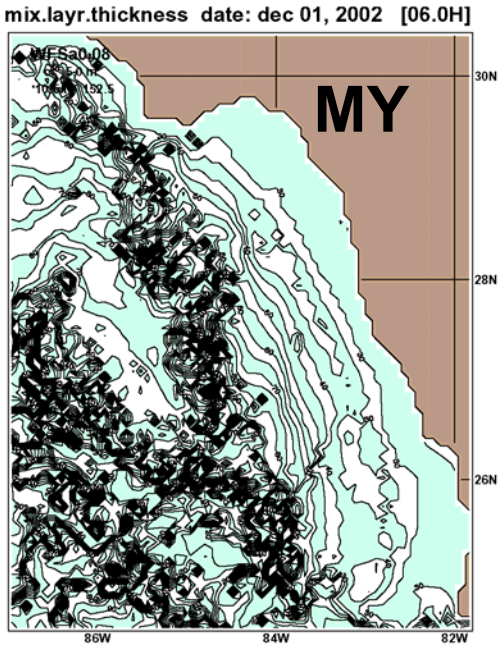
Vertical Mixing Choices to be Compared

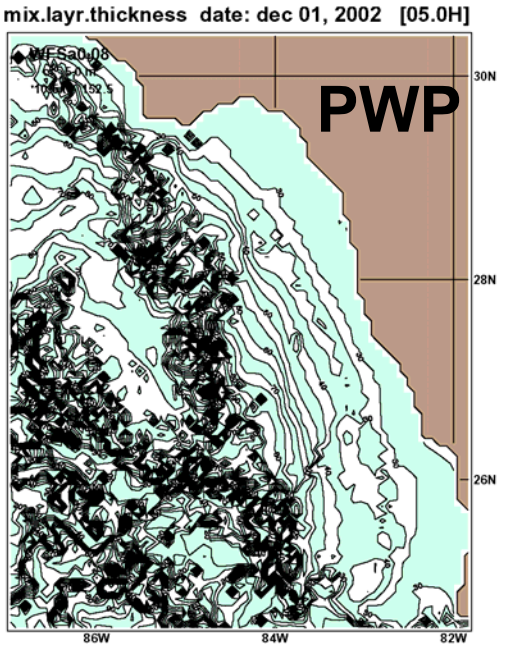
- **Vertical Mixing Models Tested**
  - **KPP (K-Profile Parameterization) (with bottom b.l.)**
  - **MY 2.5 (Mellor-Yamada level 2.5 turbulence closure)**
  - **GISS (NASA/GISS level 2 turbulence closure)**
  - **PWP (Price-Weller-Pinkel dynamical instability model)**

Mixed Layer Thickness

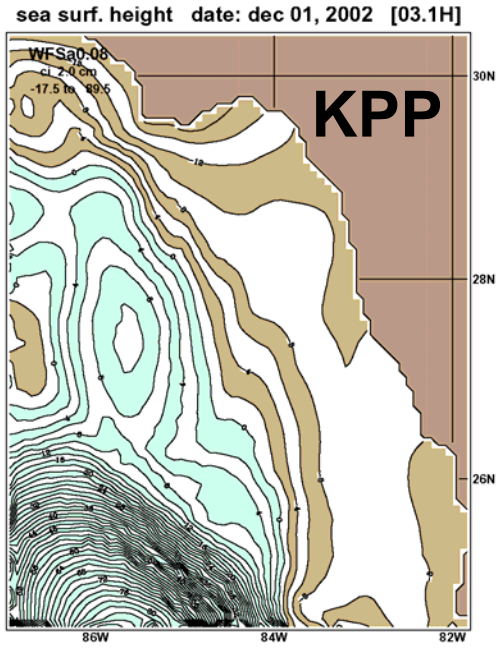








SSH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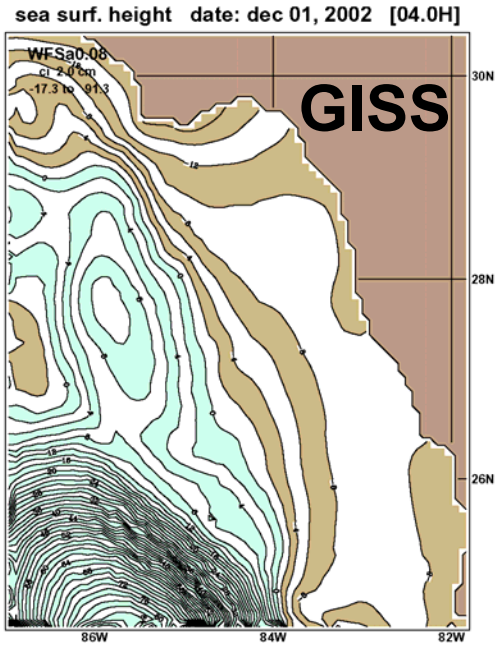
WFSa0.08
KPP
30N
28N
26N
86W
84W
82W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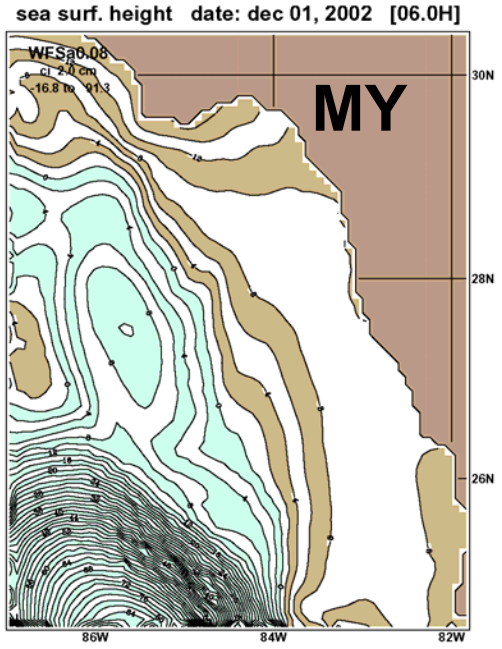
WFSa0.08
GISS
30N
28N
26N
86W
84W
82W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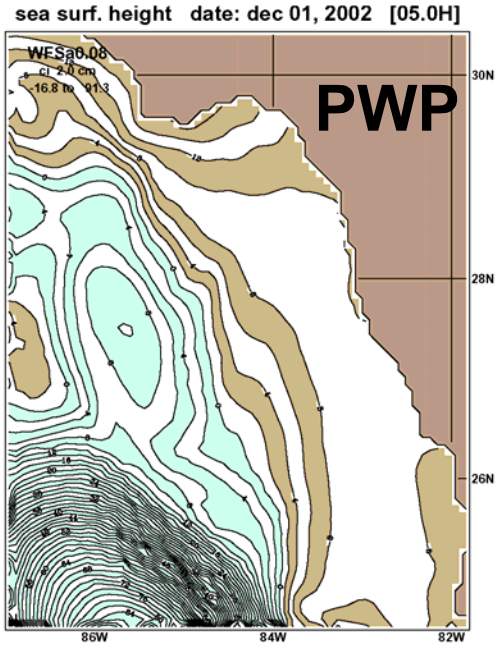
WFSa0.08
MY
30N
28N
26N
86W
84W
82W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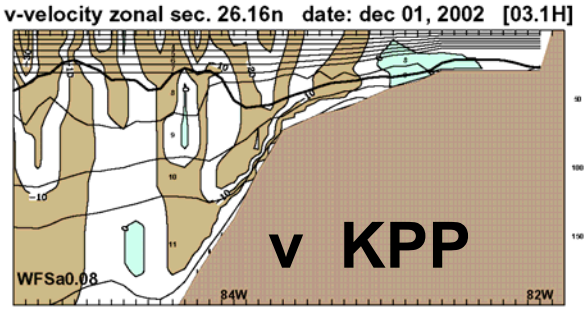
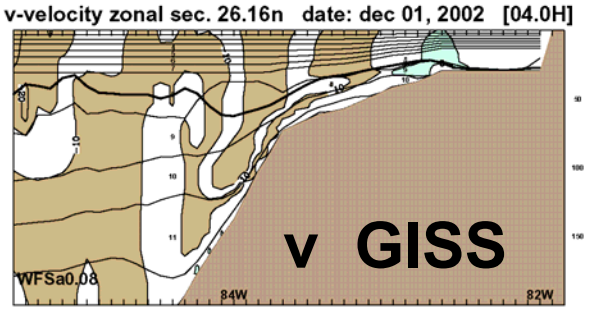
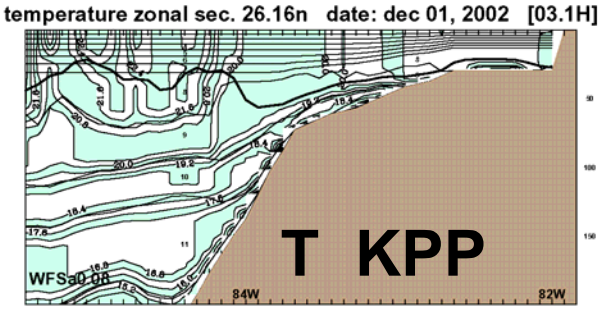
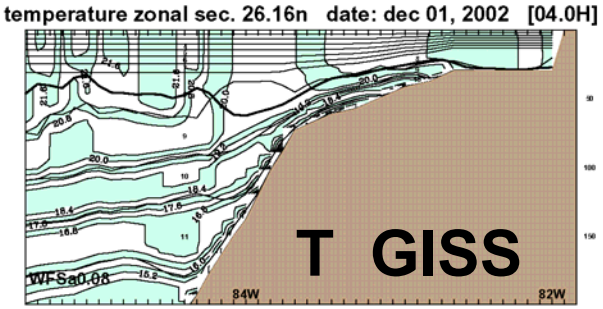
WFSa0.08
PWP
30N
28N
26N
86W
84W
82W

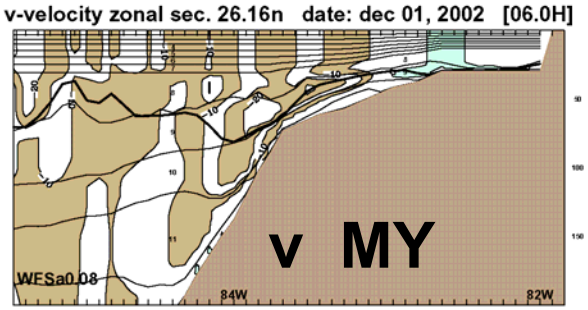
26.16N Cross-Sections

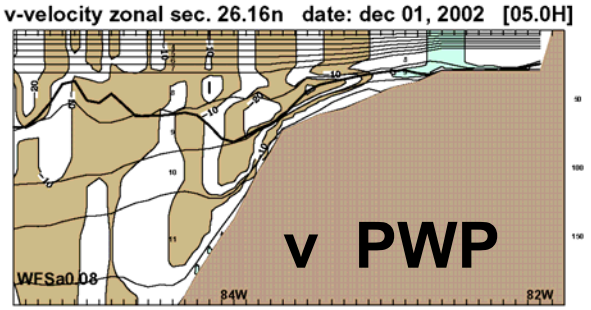


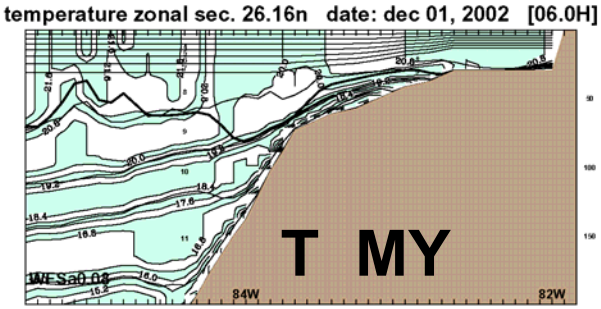


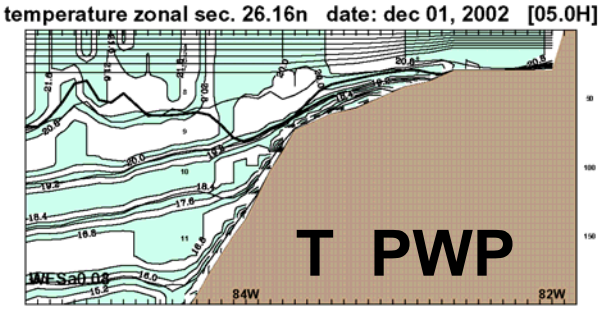








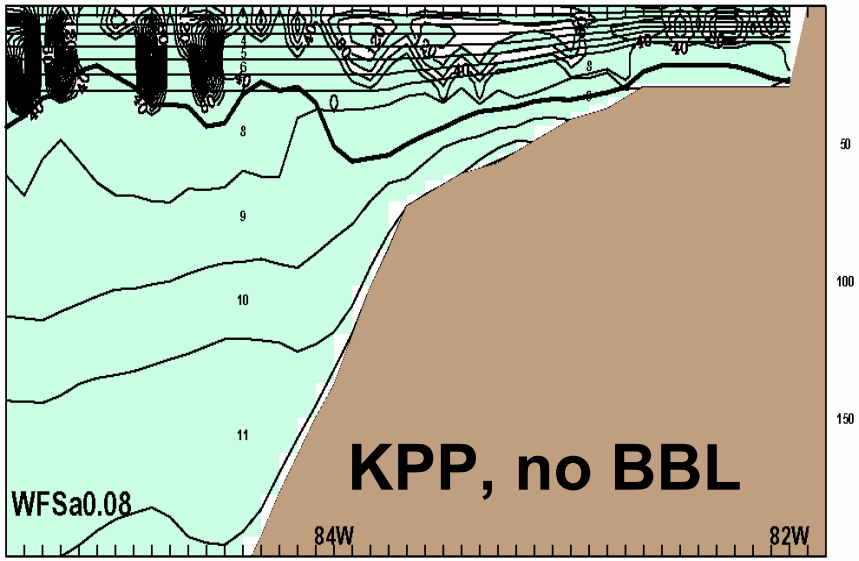




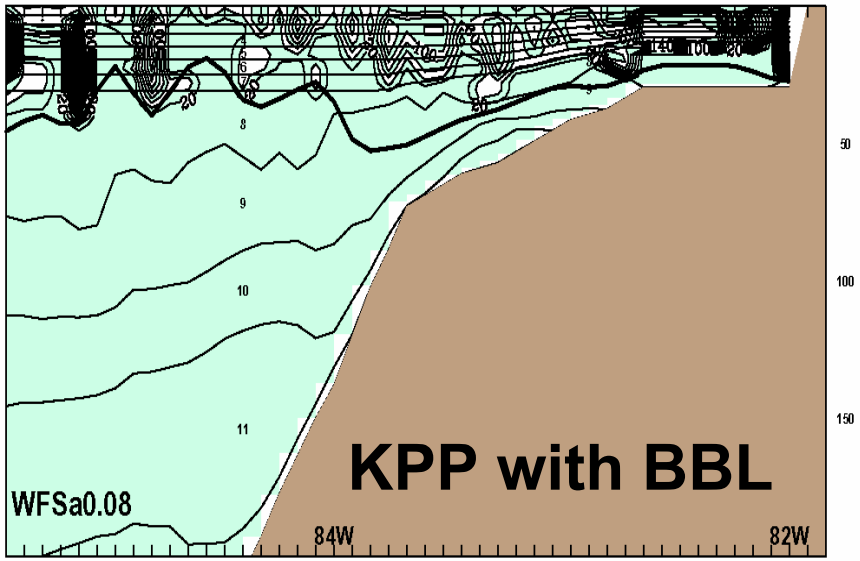
KPP Bottom Boundary Layer

- **Added Bottom B.L. Parameterization to the KPP Model**
  - **Follows procedures developed for the ROMS model at Rutgers U. by Scott Durski**
  - **Essentially implement the surface b.l. parameterization from the bottom up**
- **Cross sections of viscosity and temperature diffusivity are presented here**

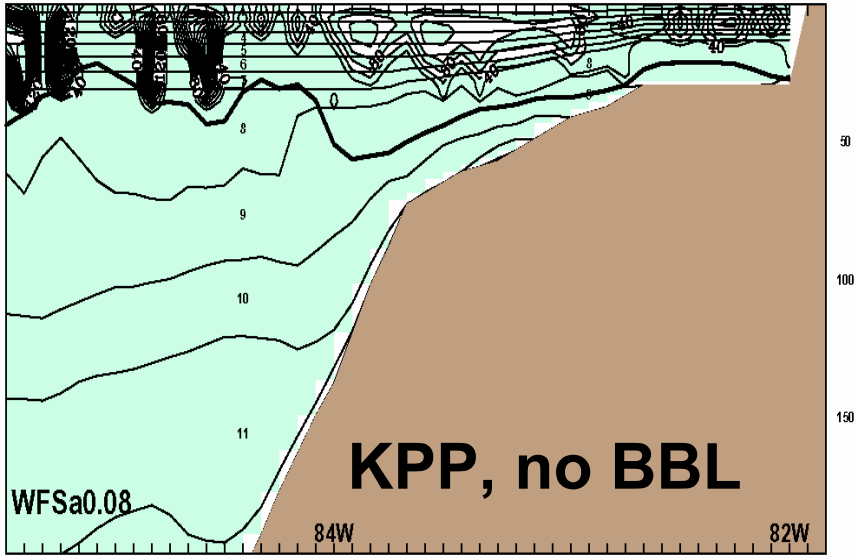
viscosity zonal sec. 26.16n date: dec 01, 2002 [03.1H]



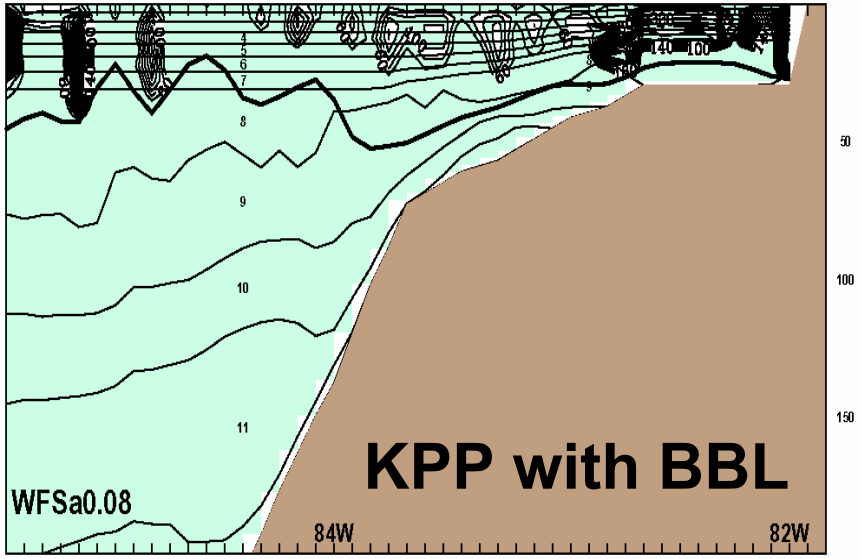
viscosity zonal sec. 26.16n date: dec 01, 2002 [03.2H]



t-diffusion zonal sec. 26.16n date: dec 01, 2002 [03.1H]



t-diffusion zonal sec. 26.16n date: dec 01, 2002 [03.2H]



Summary (1)

- Large differences between nested and Atlantic basin simulations must be understood
- Significant (but not huge) differences observed in the shelf flow field due to vertical coordinate and vertical mixing choices
- KPP bottom boundary layer code appears to be working, but needs more testing

- These simulations are preliminary – the next round of simulations will be conducted at higher resolution with improved bathymetry.

Summary (2)

- Nesting procedure must be improved
  - Allow non-rectangular curvilinear coordinates
  - Change the vertical coordinate properties of the nested model
    - Requires vertically re-mapping the fields from the larger-domain model that provides initial/boundary conditions

- The help of Ole Martin Smedstad, Joe Metzger, Alan Wallcraft, Pat Hogan, and Tammy Townsend is appreciated.