Initial Progress on HYCOM Nested West Florida Shelf Simulations

George Halliwell
MPO/RSMAS, University of Miami
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
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.
Vertical Coordinate Choice

- Two Choices Compared:
  - 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
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
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.