Northeast North American Shelf Heat and Freshwater Transport

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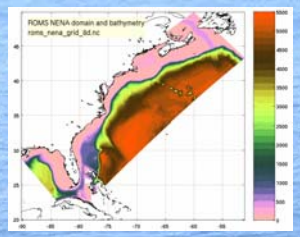
ROMS Model Configuration

A *Regional Ocean Modeling System* (ROMS) model is embedded within open boundary values provided by GODAE North Atlantic operational model *HYCOM*

ROMS operational model configuration:



Domain:

- Eastern Gulf of Mexico to Newfoundland, out to the Bahamas, New England Seamounts and the tail of the Grand Banks
- 10 km horizontal resolution; 30 vertical s-levels weighted toward the surface

Forcing:

- NCEP daily average reanalysis u_{10} *winds,* T_{air}, q_{air} *cloud,* P_{air}, *rain, shortwave and downward long-wave* from *OPeNDAP* server http://www.cdc.noaa.gov/cgi-bin/nph-nc/Datasets/ncep.reanalysis.dailyavgs
- Monthly mean river flow from USGS gauges for 30 largest rivers + Belle Isle Passage low salinity flow into the Gulf of St Lawrence
- Boundary tides from OSU Topex/Poseidon/Jason model
- Open boundary data from HYCOM http://hycom.rsmas.miami.edu/dodsC/ North Atlantic Best Estimate
  - daily *T,S, u,v (rotated to ROMS grid)* for radiation/nudging open boundary conditions
  - *sea level, depth average u,v* for Flather (1976) gravity wave open boundary conditions
  - 3-day Hycom average *T,S* for nudging in boundary buffer zone

Output:

- Output data on OPeNDAP server http://ahab.rutgers.edu:8080/dodsC/

Temperature and salinity of east coast shelf waters are affected by inflow from the Labrador Sea and Loop Current, cross-shelf exchange in the South Atlantic Bight (SAB) and Mid-Atlantic Bight (MAB), and the Gulf Stream.

Adequate simulation of the heat and freshwater budgets are a necessary condition for subsequently using the model for studies of shelf biogeochemistry and carbon cycling.

NOPP Project Objectives:

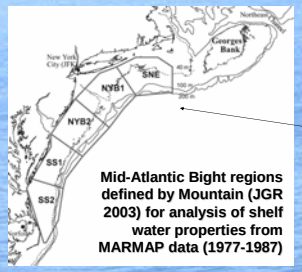
(1) Develop practical strategies for nesting coastal ROMS within HYCOM open boundary data for stable long-term and operational integrations (year 1-2)

(2) Quantify skill of nested ROMS and HYCOM-only at reproducing shelf heat and freshwater variability (year 1-2)

(3) Explore open boundary sensitivity with ROMS adjoint sensitivity tools (year 3-4)

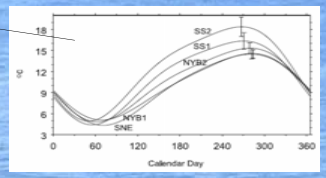
(4) Examine value of internal data assimilation in ROMS to boundary-forced only simulations (year 4-5)

Comparisons with mean seasonal variability of MAB shelf water properties



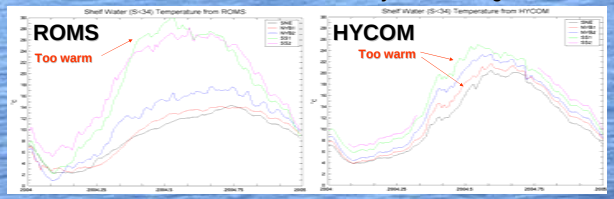
Mid-Atlantic Bight regions defined by Mountain (JGR 2003) for analysis of shelf water properties from MARMAP data (1977-1987)

Seasonal temperature cycle is dominated locally by air-sea flux

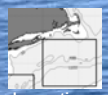


ROMS southern MAB too warm, central and north agree well

HYCOM over-estimates summer max by ~6°C throughout MAB

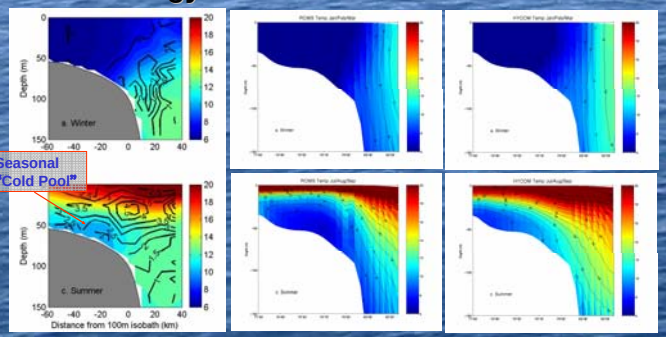


MAB Cross-shelf Temperature Structure



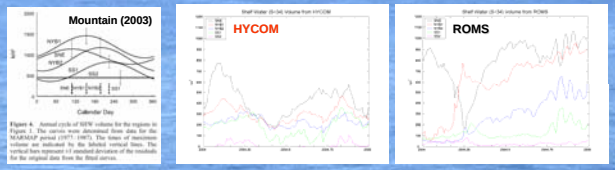
Climatological cross-sections (with std. dev. contours) from observations south of Cape Cod (Linder and Gawarkiewicz, JGR, 1998)

Overall temperature simulations are good. Neither model captures a clearly distinct "Cold Pool" in summer. Both have water too cold off the shelf edge in winter.



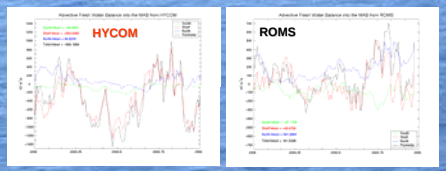
Shelf water volume and freshwater transport

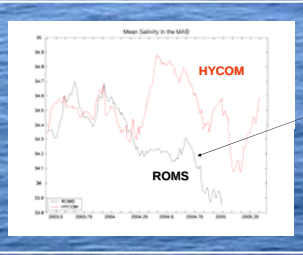
The volume of MAB *Shelf Water* (S<34) trapped inside the shelf/slope front varies. Observations show the volume anomaly propagates southward through MAB each year. Neither model captures this along-shelf transport signal.



On average, freshwater enters the MAB from the north, and leaves across the shelf front and the south in both models.

Net balance differs in sign. ROMS is gaining fresh water during 2004.





Mean salinity of shelf water in ROMS has strong freshening trend throughout 2004

ROMS freshening trend is bringing summer salinity closer to L&G climatology