1.12 **HIGH-RESOLUTION COASTAL OCEAN MODEL AND APPLICATION TO CORAL REEF ECOSYSTEMS IN WESTERN BOUNDARY CURRENTS**

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1. INTRODUCTION

The Florida Straits and East Florida Shelf (EFS) are very dynamic environments for coastal ocean physical processes. While dominated by the Florida Current – Gulf Stream system, the region is also populated by several mesoscale and synoptic features such as the Tortugas gyre and frontal spin-off eddies. Because of its strong impact on biological activity along the Florida Keys reef tract and Dry Tortugas, the coastal ocean response to various types of forcings is key to understanding fundamental processes such as larval dispersion and recruitment (Lee et al., 1994). To study this large range of physical time and space variabilty, it is necessary to rely on a regional ocean model with nested high-resolution domains so that both mesocale and reef scale processes are included.

2. COASTAL OCEAN MODEL

The East Florida Princeton Ocean Model (EFS-POM) is implemented as part of the Southeast Atlantic Coastal Ocean Observing System (SEA-COOS) program. The model operates in baroclinic mode with climatological forcing for open boundary temperature and salinity and surface heat fluxes. The inflow and outflow conditions are set to a constant transport of 30Sv and the winds are from the ETA atmospheric model (archived fields with spatial resolution of ca. 180km, updated every 6 hours).

Because of the curvilinear nature of the grid, SEFCOM has an average spatial resolution of about 4-8km, with a maximum of 1-2km in the Florida Keys – Miami area (Fig. 1). 25 terrain-following sigma-levels are used in the vertical, giving a resolution of 0.5 to 100m depending on the water depth.

The nested high-resolution model for the Dry Tortugas is forced by temperature, salinity and velocity fields extracted from the regional model and mapped to the open boundaries. The atmospheric forcings are climatological heat fluxes and hourly winds from the Dry Tortugas C-MAN station (applied to the entire domain). The resolution is ca. 1km in the horizontal plane and varies from 0.1 to 10m in the vertical direction.

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3. RESULTS

A hindcast simulation for 1999 was performed to evaluate the ability of the model to investigate the Florida Current response under synoptic wind forcing. The predicted sea surface temperatures reproduce well the seasonal cycle and show reasonably good agreement with observations from C-MAN stations throughout the domain (Fig. 2). Analysis of sea surface height anomaly fields reveals the presence of frontal spin-off eddies along the cyclonic side of the Gulf Stream. These eddies bear a certain resemblance to those observed by Lee et al. (1991) on the EFS and are expected to be a significant mechanism for cross-shelf exchanges.

Using the fields from the EFS-POM 1999 simulation, the high-resolution Dry Tortugas model was run for the same period of time. The results demonstrate that biologically relevant information can be produced at scales representative of coral reef processes. For example, maps of near-bottom physical variables, such as temperature and turbulence, can be drawn and compared with benthic habitat structures. The predicted velocity fields also give the possibility to examine dispersion and recruitment of fish and coral larvae at different scales and determine self-seeding vs. export conditions (Fig. 4).

4. CONCLUSIONS

While still in the validation stage, both regional and high-resolution models show encouraging results. Improvement of the solutions will come from an increase in the spatial resolution, as well as in the accuracy of the open boundary and surface forcings. With further verification against observations, the high-resolution model should prove to be a valuable tool to predict the influence of physical variables on coral reef communities and help investigate pathways for larval dispersion and recruitment at local and regional scales.

5. REFERENCES

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Lee, T.N., J.A. Yoder and L.P. Atkinson, Gulf Stream Frontal Eddy Influence on Productivity of the Southeast U.S. Continental Shelf, *J. Geophys. Res.*, 96: 22,191-22,205, 1991.

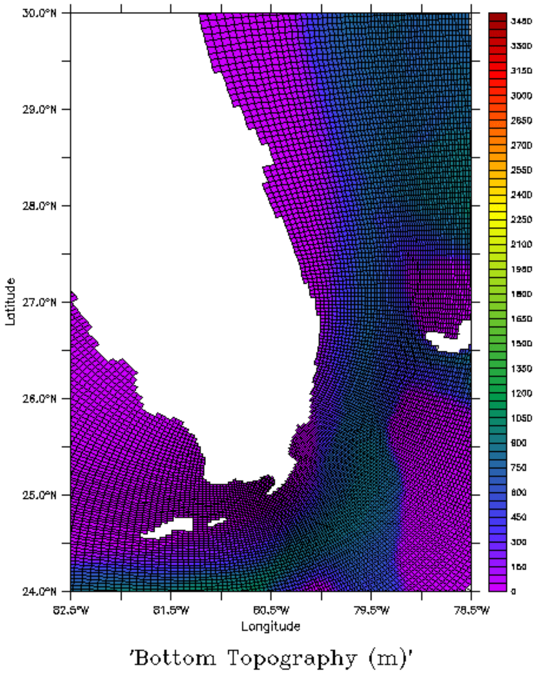

Fig. 1. Detail of the EFS-POM grid
in the Florida Keys - Miami region.

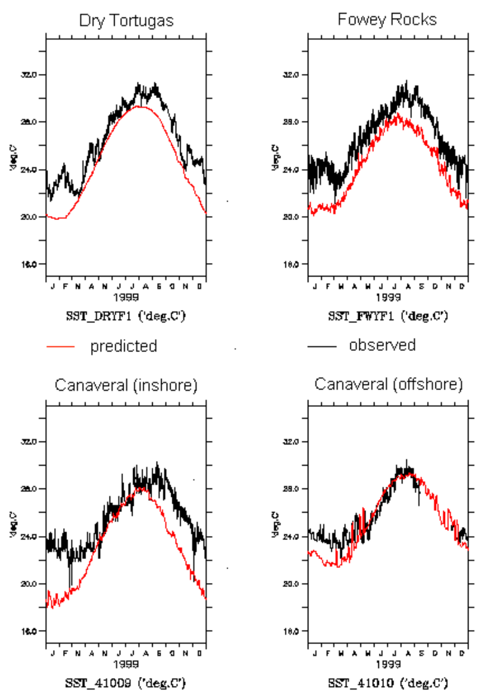

Fig. 2. Predicted vs. observed sea surface
temperatures at points in the domain.

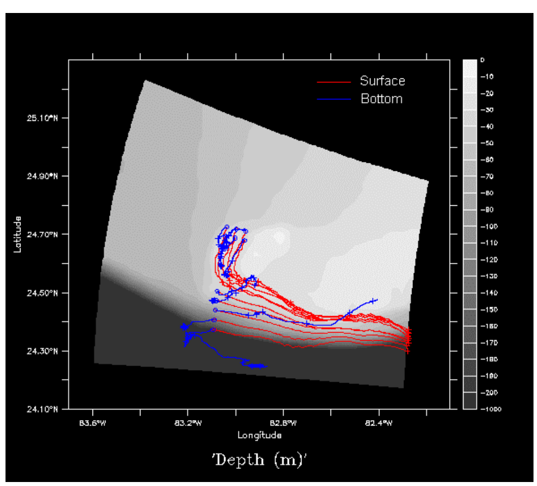

Figure 3. Surface and near-bottom trajectories
in the Dry Tortugas region during the period
from 01-AUG-99 to 31-AUG-99.