Critical Issues in Assessment of Offshore Wind Farm Development on Dispersion and Settling of Scallop Larvae in the Northeast U.S. Coastal Ocean

Changsheng Chen
School for Marine Science and Technology
University of Massachusetts-Dartmouth, New Bedford, MA 02744

Robert C Beardsley
Department of Physical Oceanography
Woods Hole Oceanographic Institution, Woods Hole, MA 02543

Kevin Stokesbury
School for Marine Science and Technology
University of Massachusetts-Dartmouth, New Bedford, MA 02744
Could the offshore wind renewal energy development affect the connectivity of scallop between Georges Bank/South South Channel and Mid-Atlantic Bight?
Population Dynamics Model of Sea Scallop
(Tian et al, 2009)

4 pelagic stages: egg, trochophore, veliger, and pediveliger
2 benthic stages: juvenile, and adult.
Spawning stocks determined by interpolating scallop abundance data onto the model grids. Scallop data (white circle) are from Stokesbury et al., (2004) and Thouzeau et al. (1991).
Scallop larval dispersion and settling down animation
Schematic of the Upper and Deep Circulations
Northeast Coastal Ocean Forecast System (NECOFS)

North American Meso-scale (NAM) Weather Model

Local Weather Model (WRF)

Regional FVCOM (GOM-FVCOM: 0.3-15 km)

Surface Wave Model (FVCOM-SWAVE)

Satellite SST
Satellite SST, SSH
Buoy or Survey
Buoy Winds
Insolation

BC's

Global-FVCOM
Global-FVCOM
River discharges
Groundwater

Heat Flux
Wind Stress
P-E
U,V

Nested

Assimilation

Wind Stress
Assimilation

U,V, Waves
Langmuir Cells

MASS Coastal FVCOM
(MASS Coastal FVCOM: up to 10 m)

Scituate, MA
Mass Bay/Boston Harbor
Hampton River, NH
Saco, ME

Storm Surge (hurricanes, Nor'easter)

Inundation Models

KEY

Existing Models
NECOFS
Data
Products

Products:
Weather: winds, air temperature, air humidity, air pressure, heat flux, E-P
Oceans: sea level, currents, T, S, wave heights, wave frequencies, icing
Lands: inundation areas

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Global-FVCOM (2-50 km)

GOM-FVCOM (0.3-15 km)

Mass-Coastal FVCOM (10 m-5 km)

Scituate, MA (up to 10 m)
Boston Harbor, MA (up to 10 m)
Hampton, NH (up to 10 m)
Saco Bay (up to 10 m)

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New NECOFS system with inclusion of a nested subdomain wind turbine-resolving FVCOM

NS-FVCOM with wind turbines

Enlarged view of the grid
Hundred-year storm
The February 1978 Nor’easter storm
(a hundred storm over New England Shelf)
The August 1991 Hurricane Bob
February 1978 Storm: Difference in Significant Wave Height (m) with and without wind turbines
February 1978 Storm:
Difference in vertically averaged currents (m/s) with and without wind turbines
August 1991 Hurricane Bob: Difference in Significant Wave Height (m) with and without wind turbines
Critical needs for assessing the impact of the offshore wind farm development on the regional ecosystem

• Assess the impact of wind energy taking on the local and regional wind fields;
• Assess quantitatively the impact of the wind energy dissipation due to the offshore wind farm on the local and regional circulation and water transport.
• Conduct a long-term simulation to estimate the maximum impact of the offshore wind farm development and operations on the spawning, transport, settlement and growth stages of scallop larvae.
Are we ready for this work?

• A high-resolution atmospheric and ocean fully coupled NECOFS system has been successfully developed, which is capable of resolving the spatial scale of wind turbines;

• We have built a long term physical field over the period of 1978-present;

• We have developed the ecosystem model to simulate the dispersion, settlement and growth of the scallop larvae.
Summary

• An assessment of the potential impact of the offshore wind farm development on the connectivity of scallop larvae between Georges Bank/South South Channel and Mid-Atlantic Bight could provide us insights into the possible change of the marine fisheries environment after offshore wind turbines are deployed.

• The atmospheric and ocean coupled FVCOM model system under the framework of NECOFS is available to make an assessment of the wind energy taking from the offshore wind farm on the local and regional atmospheric and ocean environments.