Passive particle runs, larval movement, sea surface temperature, and velocity videos from Gulf of Maine coastal models from May to September of 2014

Website: https://www.bco-dmo.org/dataset/707065
Data Type: model results
Version: 3
Version Date: 2021-10-06

Project
» An integrated theoretical and empirical approach to across-shelf mixing and connectivity of mussel populations (MuLTI-2)
» Intertidal community assembly and dynamics: Integrating broad-scale regional variation in environmental forcing and benthic-pelagic coupling (GOMEPRO)

Contributors	Affiliation	Role
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Abstract
This dataset includes model output animations from two coastal Gulf of Maine models. The eastern coastal Gulf of Maine model has bounds of 41.666667 to 44.666667 latitude (Massachusetts Bay to east of Penobscot Bay) and extends from the intertidal zone (5 m above the mean sea level) to approximately 60 km offshore. The animations from the eastern model include 20 .avi video files from May to September of 2014 of passive particle runs (4 per month) and larval movement animations. The animations from the western model include sea surface temperature (SST) and velocity monthly animations from May to September of 2014.

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Coverage

Spatial Extent: **N**:45.1 **E**:-66.430738 **S**:44.1 **W**:-69.109341
Temporal Extent: 2014-05-01 - 2014-09-28

Dataset Description

Details of the model output animations and metadata are available in a data table served from this landing page. See the "Data Files" section to download a zip file containing "Coastal Gulf of Maine model output and documentation."

Methods & Sampling

The two coastal models are based on the Finite Volume Coastal Ocean Model (FVCOM) version 2.7, and the results from both models are (will continue to be) validated using a combination of datasets, including temporal data of sea surface height, temperature, salinity and current velocity as well as spatial distributed current profiles and CTD transects in both cross-shelf and along shelf directions (see the datasets from linked projects). The predicted particle trajectories are calculated using the FVCOM i-state configuration model (FISCM), an offline Lagrangian model developed by Geoff Cowles of the University of Massachusetts Dartmouth.

Code used to generate these output is currently being documented. It will be made available at the end of the project.

For more information about FVCOM see: http://fvcom.smast.umassd.edu/fvcom/

Data Processing Description

BCO-DMO data manager notes:
* data version 2: 2018-11-26 replaces data version 1 and adds an additional animation of real time larval tracking
* data version 3: 2021-10-06 repaces data version 2 and adds additional output from a second coastal GoM model. Additional columns describing model output added to the dataset.

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Data Files

File
model_output.csv (Comma Separated Values (.csv), 5.07 KB) MD5:f2ee1fe8ea51b07ba6965e8a60889426 Primary data file for dataset ID 707065

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Supplemental Files

File
Coastal Gulf of Maine model output and documentation filename: model_output_v3.zip (ZIP Archive (ZIP), 1,006.17 MB) MD5:0aaf3d97ee1e90bcadebed62c5af8ee4 This zip file contains output and a readme files for two Coastal Gulf of Maine models. There are three types of animations. SST with velocity overlays, passive particle trajectories, and larval movements. Metadata for these animations including file name is available in a data table accessible from the dataset landing page "Coastal Gulf of Maine model output" https://www.bco-dmo.org/dataset/707065. There are a total of 20 particle runs, 4 per month in May, June, July, August and September 2014. The eastern Gulf of Maine coastal model: from -69.109341 to -66.430738 longitude (west of Penobscot Bay to Passamaquoddy Bay) and extending from the intertidal zone (5 m above the mean sea level) to approximately 60 km offshore. The western Gulf of Maine coastal model: from 41.666667 to 44.666667 latitude (Massachusetts Bay to east of Penobscot Bay) and extending from the intertidal zone (5 m above the mean sea level) to approximately 60 km offshore.

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Parameters

Parameter	Description	Units
Model_Name	Model name	unitless
Description	Description of video file (e.g. "SST with velocity overlay"). Type of data in video file (particle or SST&V).	unitless
Run	Run identifier	unitless
Start_Date	Start date of the run in format yyyy-mm-dd	unitless
Start_Time	Start time of the run in format hh:mm	unitless
End_Date	End date of the run in format yyyy-mm-dd	unitless
filename	Filename	unitless
file_size_MB	Video file size	megabytes (MB)
video_file_link	Link to download the video file of the run	unitless

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Project Information

An integrated theoretical and empirical approach to across-shelf mixing and connectivity of mussel populations (MuLTI-2)

Coverage: Gulf of Maine: Frenchmen Bay (44 28.239 N -68 15.927 W) to Machais Bay (44 39.350 N -67 21.320 W)

Acronym "MuLTI-2" (Mussel Larval Transport Initiative-2)

Extracted from the NSF award abstract:

Existing larval transport models focus mainly on along-shelf transport and have done little to explicitly incorporate the effects of cross-shelf mixing and transport processes. Yet cross-shelf transits (both outgoing and incoming legs) are critical components of the dispersal paths of coastal invertebrates. This project will explore the role of cross-shelf mixing in the connectivity of blue mussel populations in eastern Maine. Previous work has shown that the Eastern Maine Coastal Current (EMCC) begins to diverge from shore southwest of the Grand Manan Channel and creates a gradient in cross-shelf mixing and larval transport, with cross-shelf mixing being more common on the northeastern end, episodic in the transitional middle area, and then becoming rare in the southwestern half of the region of the Gulf of Maine. As a result, the investigators predict that northeastern populations of mussels are seeded mostly from up-stream sources, while a significant component of self-seeding (local retention) exists in southwestern populations. Larvae settling in the intervening bays are expected to be derived from a mixture of local and up-stream sources. Using a combined empirical and theoretical approach hydrographic, current profile, and larval vertical migration data will be collected and used to develop and validate a high-resolution coastal circulation model coupled to a model of larval behavior. The investigators will model simulations in different years using the empirical data from mussel reproductive output and spawning times. Connectivity predicted from this model will be then tested against independent empirical estimates of connectivity based on trace element fingerprinting for larvae which can be connected to specific natal habitats. Regions of agreement and discrepancy in the model will be identified to guide additional data collection and model refinement. This iterative process will ensure an understanding of both larval transport patterns and processes, and provide estimates of inter-annual variability in connectivity for blue mussel populations in the Gulf of Maine.

Intertidal community assembly and dynamics: Integrating broad-scale regional variation in environmental forcing and benthic-pelagic coupling (GOMEPRO)

Coverage: Rocky intertidal shores and nearshore coastal waters throughout the Gulf of Maine

Rocky intertidal habitats in the Gulf of Maine (GoM) provide a model system to examine the structure and dynamics of natural communities. Throughout the Gulf of Maine, the same species are often found in these habitats but community structure, dynamics and productivity differ markedly among 3 distinct regions (southern, central and northern GoM). Past influential work, conducted primarily in the southern and central GoM, focused on the local processes driving intertidal community structure but produced very different conceptual models of how these communities are structured. This project examines whether regional differences in rocky shore community processes are driven by differences in recruitment that are shaped by regional variation in temperature and food availability and nearshore coastal oceanography. This project will improve the understanding of how large-scale environmental forces interact with local processes to control the distribution of species and the structure and dynamics of these communities. Understanding the interaction between processes operating at different scales is fundamentally important to developing more reliable models that can be used to predict community dynamics. In addition, data resulting from this project will have important implications for regional dynamics in commercially important species and for ecosystem and fisheries management within the GoM.

The overarching hypothesis of this project is that regional differences in community-level processes are driven by very different patterns of population connectivity and recruitment in a few key species, and that these differences are ultimately caused by regional variation in temperature and food availability and mediated by physical larval transport processes. Hence, the project will test the following hypotheses with manipulative field experiments, field sampling, connectivity estimates, and integrative modeling:
1) Locally-dispersing species dominate dynamics in regions with a net export of planktonic larvae (Northern GoM), while species with planktonic larvae dominate the dynamics in regions with high settlement and extensive connectivity among populations (Southern GoM).
2) Settlement density of species with planktonic larvae increases from northern to southern regions in accord with regional variation in food availability.
3) Population connectivity varies greatly among regions, with regions differing in the degree to which they are self-seeded or serve as larval sources vs. sinks; self-seeding leads to relatively localized population dynamics in the middle portion of the GoM.
4) Patterns of population connectivity are driven by physical transport processes and can be represented by coupling basic larval behavior models with circulation models.

At 18 different sites in the GoM across ~ 600 km, surveys will evaluate variation in recruitment, food availability and secondary productivity and experiments will assess community processes in wave-exposed and sheltered habitats. We will use hydrographic, current profile, and larval vertical distribution surveys to collect data for coupled larval/circulation models. Population connectivity will be both modeled and empirically evaluated (for one species) using elemental fingerprinting. A spatially explicit metacommunity model will integrate across all project components and test the relative importance of regional and local processes in controlling community organization and dynamics.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1333797
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