Source code, license, example input and visualization files for beta-LTRANS-ADCIRC, a particle tracking model that runs with ADCIRC circulation model prediction.

Website: https://www.bco-dmo.org/dataset/658655
Data Type: model results
Version: 1
Version Date: 2016-09-13

Project
» Interacting Effects of Local Demography and Larval Connectivity on Estuarine Metapopulation Dynamics (EstuarineMetaDyn)

Contributors	Affiliation	Role
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Leuttich, Richard	University of North Carolina at Chapel Hill (UNC-Chapel Hill)	Co-Principal Investigator
Copley, Nancy	Woods Hole Oceanographic Institution (WHOI BCO-DMO)	BCO-DMO Data Manager

Abstract
Source code, license, example input and visualization files for beta-LTRANS-ADCIRC, a particle tracking model that runs with ADCIRC circulation model prediction.

Table of Contents

Dataset Description

From http://northweb.hpl.umces.edu/LTRANS.htm

beta-LTRANS-ADCIRC is based on the **Larval TRANSport Lagrangian model (LTRANS v.2b),** an off-line particle-tracking model that runs with the stored predictions of a 3D hydrodynamic model. In this case, LTRANS v.2b has been substantially modified to be able to run with the finite-element circulation predictions of ADCIRC. Although LTRANS was built to simulate oyster larvae, it can easily be adapted to simulate passive particles and other planktonic organisms. LTRANS v.2 is written in Fortran 90 and is designed to track the trajectories of particles in three dimensions. It includes a 4th order Runge-Kutta scheme for particle advection and a random displacement model for vertical turbulent particle motion. Reflective boundary conditions, larval behavior, and settlement routines are also included. A brief description of the beta-LTRANS-ADCIRC particle-tracking model can be found here (68 KB .pdf). For more information on LTRANS, please see the LTRANS web page. and the application of LTRANS to oyster larvae transport, see a summary web page with animations, the publications North et al. (2008, 2011), and the LTRANS v.2 User's Guide. Please cite North et al. (2011) when referring to LTRANS v.2b. The updates that were made for LTRANS v.2b are listed here.

Elizabeth North of University of Maryland Center for Environmental Science Horn Point Laboratory implemented beta-LTRANS-ADCIRC. Funding was provided by the National Science Foundation Biological Oceanography Program. Steven Suttles and Jason Spires provided valuable assistance.

beta-LTRANS-ADCIRC Code: beta-LTRANS-ADCIRC Open Source Code. We would appreciate knowing who is using LTRANS. If you would like to share this information with us, please send us your name, contact information, and a brief description of how you plan to use this model to enorth@umces.edu with 'LTRANS-ADCIRC' in the subject line.

Access restrictions: This software is open-source and licensed as stated by MIT/X License, but utilizes external dependencies and program which have different restrictions. Please see the beta-LTRANS-ADCIRC license file and website for more information.

PDF of original beta-LTRANS-ADCIRC webpage: http://dmoserv3.bco-dmo.org/data_docs/EstuarineMetaDyn/betaLTRANS-ADCIRC...

Code:

betaLTRANS_ADCIRC_License.txt	**License file**. This license was based on the ROMS license. Please note that this license applies to all sections of beta-LTRANS-ADCIRC except those listed in the 'External Dependencies and Programs' section below.
betaLTRANS-ADCIRC.zip **betaLTRANS-ADCIRC.tgz**	**Code and Input Files**. This zip or tarball file contains the beta-LTRANS-ADCIRC code, license, example input and visualization files. Section II of the LTRANS v.2 User's Guide contains instructions for setting up and running LTRANS v.2b in Linux and Windows environments. Before using this model, please read the **External Dependencies and Programs** section below. This version of LTRANS is parameterized to run with the input files from a test case of ADCIRC which was set up for Shinnecock Inlet. These ADCIRC files are provided in this zip/tar file.

External Dependencies and Programs. beta-LTRANS-ADCIRC requires NetCDF libraries and uses the following programs to calculate random numbers (Mersenne Twister) and fit tension splines (TSPACK). Because beta-LTRANS-ADCIRC reads-in ADCIRC-generated NetCDF (.nc) files, it requires that the appropriate NetCDF libraries be installed on your computer (see files and links below). Also, please note that although the Mersenne Twister and TSPACK programs are included in the beta-LTRANS-ADCIRC in the Random_module.f90 and Tension_module.f90, respectively, they do not share the same license file as beta-LTRANS-ADCIRC Please review and respect their permissions (links and instructions provided below).

VF-NetCDF.zip	**Windows Visual Fortran NetCDF libraries**. These NetCDF files that are compatible with Visual Fortran were downloaded from the Unidata NetCDF Binaries Website for LTRANS v.1. The NetCDF 90 files were downloaded from Building the F90 API for Windows for the Intel ifort compilerwebsite. The VF-NetCDF.zip folder contains README.txt that describes where to place the enclosed files. If these files do not work, you may have to download updated versions or build your own by following the instructions at the UCAR Unidata NetCDF website.
NetCDF website	**Linux NetCDF libraries**. Linux users will likely have to build their own Fortran 90 libraries using the source code/binaries that are available on the UCAR Unidata NetCDF website.
mt19937ar.f	**Mersenne Twister random number generator**. This program was recoded into F90 and included in the Random_module.f90 in LTRANS. See the Mersenne Twister Home Page for more information about this open source program. If you plan to use this program in LTRANS, please send an email to: m-mat @ math.sci.hiroshima-u.ac.jp (remove space) to inform the developers as a courtesy.
TSPACK website	**TSPACK**: **tension spline curve-fitting package**. This program (ACM TOMS Algorithm 716) was created by Robert J. Renka and is used in LTRANS as part of the water column profile interpolation technique. The original TSPACK code can be found at the link to the left and is copyrighted by the Association for Computing Machinery (ACM). With the permission of Dr. Renka and ACM, TSPACK was modified for use in LTRANS by removing unused code and call variables and updating it to Fortran 90. The modified version of TSPACK is included in the LTRANS source code in the Tension Spline Module (tension_module.f90). If you would like to use LTRANS with the modified TSPACK software, please read and respect the ACM Software Copyright and License Agreement. For noncommercial use, ACM grants "a royalty-free, nonexclusive right to execute, copy, modify and distribute both the binary and source code solely for academic, research and other similar noncommercial uses" subject to the conditions noted in the license agreement. Note that if you plan commercial use of LTRANS with the modified TSPACK software, you must contact ACM at permissions@acm.org to arrange an appropriate license. It may require payment of a license fee for commercial use.

beta-LTRANS-ADCIRC **Utilities**. The following programs were developed to run LTRANS v.2 or visualize LTRANS v.2 model output. Unless specified otherwise within the program code, these open source programs are considered part of LTRANS and fall under the beta-LTRANS-ADCIRC license. Many thanks to LTRANS users who have made these contributions! If you would like to share a LTRANS utility or your modifications/additions to LTRANS source code, please send them to enorth@umces.edu.

LTRANS-ADCIRC_viz.BAS **End_polygons.bln**	**Surfer/Scripter code for visualizing beta-LTRANS-ADCIRC output** developed by E. W. North. The .BAS file is the program and associated .bln files are needed to visualize the location of bottom habitat. Here is an example animation (MB) of LTRANS v.2 model output made with Surfer using the code and example input files provided above. Surfer is a Windows program for contouring and 3D surface mapping. Scripter is an object oriented scripting language (Active X Automation) that comes with, and automates, Surfer. Information on Surfer is available here and a free demo is available here. Please note that the demo version will not allow export so it is likely that you will not be able to use the demo version to create .gif files for animations.
OceanView in R	OceanView, created by Dr. Karline Soetaert, is a set of R functions for visualizing 2-D and 3-D oceanographic data and model output. The package is on the official R site:http://cran.r-project.org/web/packages/OceanView. There is also a short manual with snapshots of the visualization functions, some of which use LTRANS output as examples:http://cran.r-project.org/web/packages/OceanView/vignettes/OceanView.pdf.
plot_results.m	**MATLAB code for visualizing LTRANS v.2b output.** Here is Matlab M-file which was designed by Yong Kim for LTRANS v.1 and adapted for LTRANS v.2b by Elizabeth North. It should work with beta-LTRANS-ADCIRC It makes a 3D plot of the model bathymetry (from .nc input grid file) and particle locations from LTRANS v.2b .csv output files. Here is an example animation (MB) of LTRANS v.2b model output made with MATLAB.

LTRANS User's Guide and beta-LTRANS-ADCIRC Description (see Related Publicatsion section): Please send comments or suggestions regarding the User's Guide to enorth@umces.edu. They will be posted on the list of known LTRANS v.2 bugs and solutions (northweb.hpl.umces.edu/LTRANS/LTRANS-v2b/LTRANSv2b%20bugs%20and%20solutions.txt)

Data Processing Description

BCO-DMO Processing:
- Files were downloaded from PI's site to BCO-DMO
- File names were slightly changed to include PI's file directory
- Links on dataset page are to locally residing files

[table of contents | back to top]

Data Files

File	
Larval TRANSport Lagrangian model: beta-LTRANS-ADCIRC filename: betaLTRANS_ADCIRC.zip	(ZIP Archive (ZIP), 140.19 MB) MD5:b519d3ec4a996da1ab33105db86587e9
license_file	betaLTRANS_ADCIRC_License.txt
Code_and_Input_Files	betaLTRANS_ADCIRC.zip
Code_and_Input_Files	betaLTRANS_ADCIRC.tgz
Mersenne_Twister_random_number_generator	FORTRAN_mt19937ar.f
Surfer/Scripter_code_for_visualizing_beta-LTRANS-ADCIRC_output	LTRANS_v2_visualization_ADCIRC_closeup.BAS
Surfer/Scripter_code_for_visualizing_beta-LTRANS-ADCIRC_output	betaLTRANS_ADCIRC_End_polygons.bln
MATLAB_code_for_visualizing_LTRANS_v.2b_output	LTRANS-v2_plot_results.M
LTRANS-ADCIRC.csv Primary data file for dataset ID 658655	(Comma Separated Values (.csv), 1.31 KB) MD5:48761144e16bbff180596171e92eac6d
Windows Visual_ Fortran NetCDF libraries filename: VF-NetCDF.zip These NetCDF files that are compatible with Visual Fortran were downloaded from the Unidata NetCDF Binaries Website for LTRANS v.1. The NetCDF 90 files were downloaded from Building the F90 API for Windows for the Intel ifort compiler website. The VF-NetCDF.zip folder contains README.txt that describes where to place the enclosed files. If these files do not work, you may have to download updated versions or build your own by following the instructions at the UCAR Unidata NetCDF website.	(ZIP Archive (ZIP), 261.98 KB) MD5:e39d78f424490d362e5e337911f2540e

[table of contents | back to top]

Related Publications

Mitchell, I. (2013). Updates in LTRANS v.2b. University of Maryland Center for Environmental Science, Horn Point Laboratory. Cambridge, MD. 2 pp. http://northweb.hpl.umces.edu/LTRANS/LTRANS-v2b/Updates%20in%20LTRANS%20v2b.pdf
Methods

North, E. W. (2016). Print out of beta-LTRANS-ADCIRC website. Cambridge, MD. 3 pp. http://northweb.hpl.umces.edu/LTRANS-ADCIRC.htm
Methods

North, E. W., E. E. Adams, A. E. Thessen, Z. Schlag, R. He, S. Socolofsky, S. M. Masutani, and S. D. Peckham. (2015). The influence of droplet size and biodegradation on the transport of subsurface oil droplets during the Deepwater Horizon spill: a model sensitivity study. Environmental Research Letters 10: 024016 (doi:10.1088/1748-9326/10/2/024016). (http://iopscience.iop.org/1748-9326/10/2/024016/)
Results

North, E. W., E. E. Adams, S. Schlag, C. R. Sherwood, R. He, S. Socolofsky. (2011). Simulating oil droplet dispersal from the Deepwater Horizon spill with a Lagrangian approach. AGU Book Series: Monitoring and Modeling the Deepwater Horizon Oil Spill: A Record Breaking Enterprise 195: 217-226
Results

North, E. W., Hood, R. R., Chao, S.-Y., & Sanford, L. P. (2006). Using a random displacement model to simulate turbulent particle motion in a baroclinic frontal zone: A new implementation scheme and model performance tests. Journal of Marine Systems, 60(3-4), 365–380. doi:10.1016/j.jmarsys.2005.08.003
Results

North, E. W., Schlag, Z., Hood, R. R., Zhong, L., Li, M., & Gross, T. (2006). Modeling dispersal of Crassostrea ariakensis oyster larvae in Chesapeake Bay. Maryland Department of Natural Resources, July 31, 2006. 55 p.
Results

North, E., Schlag, Z., Hood, R., Li, M., Zhong, L., Gross, T., & Kennedy, V. (2008). Vertical swimming behavior influences the dispersal of simulated oyster larvae in a coupled particle-tracking and hydrodynamic model of Chesapeake Bay. Marine Ecology Progress Series, 359, 99–115. doi:10.3354/meps07317
Results

North, E.W. (2016). beta-LTRANS-ADCIRC model description. University of Maryland Center for Environmental

Science, Horn Point Laboratory. Cambridge, MD. 9 pp.
Methods

Schlag, Z. R., and E. W. North. (2012). Lagrangian TRANSport model (LTRANS v.2) User's Guide. University of Maryland Center for Environmental Science, Horn Point Laboratory. Cambridge, MD. 183 pp.
http://northweb.hpl.umces.edu/LTRANS/LTRANS-v2/LTRANSv2_UsersGuide_6Jan12.pdf
Methods

Schlag, Z., E. W. North, and K. Smith. 2008. Larval TRANSport Lagrangian model (LTRANS) User's Guide. University of Maryland Center for Environmental Science, Horn Point Laboratory. Cambridge, MD. 146 pp.
http://northweb.hpl.umces.edu/LTRANS/LTRANS%20v.1/LTRANS_UsersGuide_5September08.pdf
Methods

[table of contents | back to top]

Parameters

Parameter	Description	Units
description	Brief description of the file available for download	unitless
file_download	Link to file	unitless

[table of contents | back to top]

Deployments

lab_North_EstuarineMetaDyn

Website	https://www.bco-dmo.org/deployment/658658
Platform	UMCES_HPL_labs
Start Date	2010-03-15
End Date	2016-02-29
Description	Laboratory-based research was conducted as part of the project titled "Interacting Effects of Local Demography and Larval Connectivity on Estuarine Metapopulation Dynamics" at: University of Maryland Center for Environmental Science, Horn Point Laboratory 2020 Horns Point Rd., Cambridge, MD

[table of contents | back to top]

Project Information

Interacting Effects of Local Demography and Larval Connectivity on Estuarine Metapopulation Dynamics (EstuarineMetaDyn)

Coverage: North Carolina Estuaries

Description from NSF award abstract:
The PIs will use the eastern oyster (*Crassostrea virginica*) in Pamlico Sound, North Carolina, as a model system and will attempt to optimize the design of networks of no-take reserves as a strategy for maintaining metapopulations of this commercially harvested species. The project specifically recognizes that network persistence depends on (1) the potential for growth, survival, and reproduction within reserves, and (2) the potential to distribute offspring among reserves. Thus, demographic processes within reserves and settling areas play important roles, along with variability of physical transport. The PIs plan to:
(1) test and refine 3D bio-physical models of connectivity due to oyster larval transport in a shallow, wind-dominated system;

(2) test, refine, and apply technology to detect natal origins of larvae using geochemical tags in larval shell; and (3) integrate regional connectivity and demographic rates to model metapopulation dynamics.

This study will produce new tools and test and refine others used for studying larval connectivity, a fundamentally important process in the maintenance of natural populations, and thus in biological conservation and resource management. The tools include a hydrodynamic modeling tool coupled with an open-source particle tracking model that will be available on-line with computer code and user guide. The project will use integrated modeling approaches to evaluate the design of reserve networks: results will be directly useful to improving oyster and ecosystem-based management in Pamlico Sound, and the methods will inform approaches to network design in other locations.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1155497

[table of contents | back to top]