A generic framework for individual-based modelling and physical-biological interaction

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The increased availability of high-resolution ocean data globally has enabled more detailed analyses of physical-biological interactions and their consequences to the ecosystem. We present IBMlib, which is a versatile, portable and computationally effective framework for conducting Lagrangian simulations in the marine environment. The purpose of the framework is to handle complex individual-level biological models of organisms, combined with realistic 3D oceanographic model of physics and biogeochemistry describing the environment of the organisms without assumptions about spatial or temporal scales. The open-source framework features a minimal robust interface to facilitate the coupling between individual-level biological models and oceanographic models, and we provide application examples including forward/backward simulations, habitat connectivity calculations, assessing ocean conditions, comparison of physical circulation models, model ensemble runs and recently posterior Eulerian simulations using the IBMlib framework. We present the code design ideas behind the longevity of the code, our implementation experiences, as well as code performance benchmarking. The framework may contribute substantially to progresses in representing, understanding, predicting and eventually managing marine ecosystems.

General information
Publication status: Published
Organisations: National Institute of Aquatic Resources, Section for Marine Living Resources, Section for Oceans and Arctic, Universidade de Aveiro
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Contributors: Christensen, A., Mariani, P., Payne, M. R., Dias, J. M. (ed.)
Pages: e0189956
Publication date: 2018
Peer-reviewed: Yes

Publication information
Journal: P L o S One
Volume: 13
Issue number: 1
ISSN (Print): 1932-6203
Ratings:
BFI (2018): BFI-level 1
Scopus rating (2018): CiteScore 3.02 SJR 1.1 SNIP 1.123
Web of Science (2018): Indexed yes
Original language: English
Electronic versions:

Publishers version
DOIs:
10.1371/journal.pone.0189956
Source: FindIt
Source ID: 2395643868
Research output: Contribution to journal › Journal article – Annual report year: 2018 › Research › peer-review