Examples of High Performance Calculations within the MARBEC research institute.

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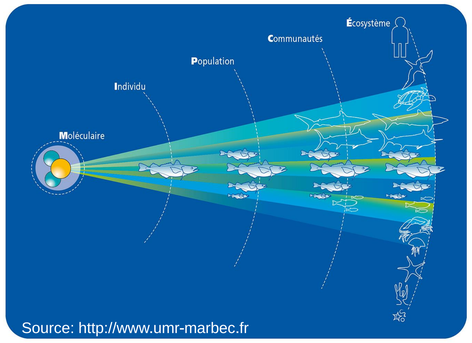
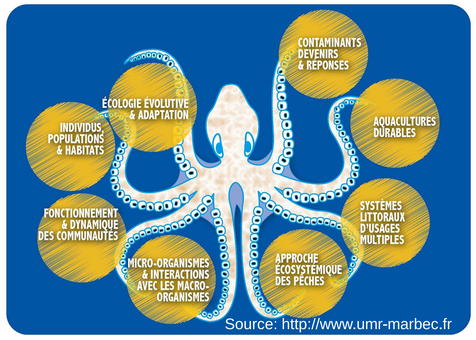
MARBEC = MARine Biodiversity, Exploitation and Conservation

Objects of study:
- Study of marine biodiversity in lagoon, coastal and offshore ecosystems, at
- Focus on different integration levels, molecular, individual, population and community aspects and
- Focus on the way humans use this biodiversity.

Objectives:
- To describe marine biodiversity, understand its dynamics and the functioning of marine ecosystems
- To analyze the impact of anthropogenic pressure on these ecosystems and develop responses scenarii to global change
- To reconcile exploitation (especially fisheries and aquaculture) and conservation and respond to societal expectations (expertise, innovation, remediation).



Source: http://www.umr-marbec.fr



Source: http://www.umr-marbec.fr

References

Christophe Lett, Philippe Verley, Christian Mullon, Carolina Parada, Timothée Brochier, et al.. A Lagrangian tool for modelling ichthyoplankton dynamics.. Environmental Modelling and Software, Elsevier, 2008, 23 (9), pp.1210-1214.

Maury O, 2010: An overview of APECOSM, a spatialized mass balanced "Apex Predators ECOSystem Model" to study physiologically structured tuna population dynamics in their ecosystem. Progress in Oceanography, 84, 113-117

Shin, Yunne-Jai and Cury, Philippe, 2011: Using an individual-based model of fish assemblages to study the response of size spectra to changes in fishing. Canadian Journal of Fisheries and Aquatic Sciences. 61. 414-431. 10.1139/f03-154.

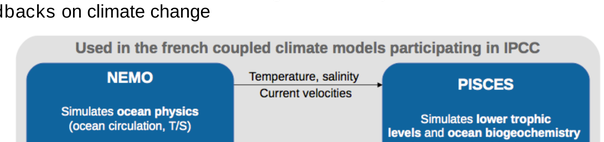
Travers-Trolet M, Shin YJ, Shannon LJ, Moloney CL, Field JG, 2014: Combined Fishing and Climate Forcing in the Southern Benguela Upwelling Ecosystem: An End-to-End Modelling Approach Reveals Dampened Effects. PLOS ONE 9(4): e94286.

www.osmose-model.org
http://www.ichthyop.org/

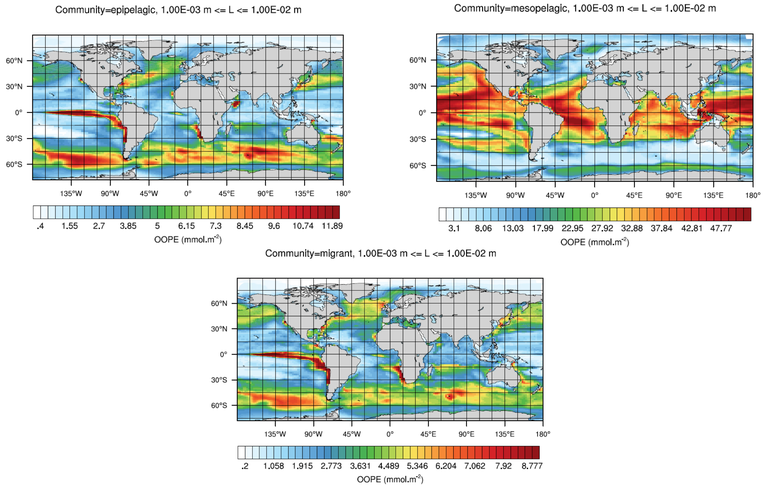
APECOSM model

Description:
- Spatialized, size-structured model that simulates higher trophic levels through energy budgets
- Coupled with an ocean biogeochemistry model (NEMO-PISCES) that is used in French coupled climate models (IPSL and CNRM models).

Objectives:
- Impacts of climate change on fish biomass
- Impacts of higher trophic levels on biogeochemistry
- Feedbacks on climate change



Processes represented in the coupling of Apecosm with the NEMO-PISCES biogeochemical model

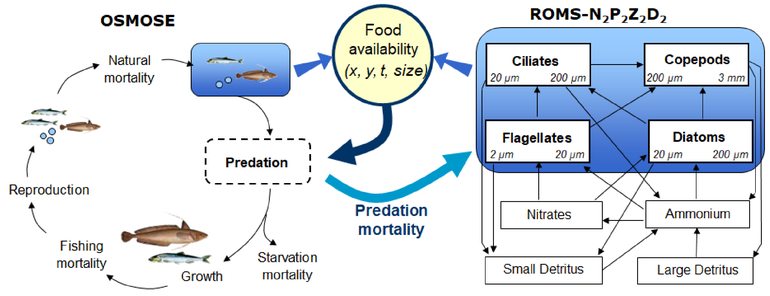


Number of mol per surface unit for different communities simulated by Apecosm

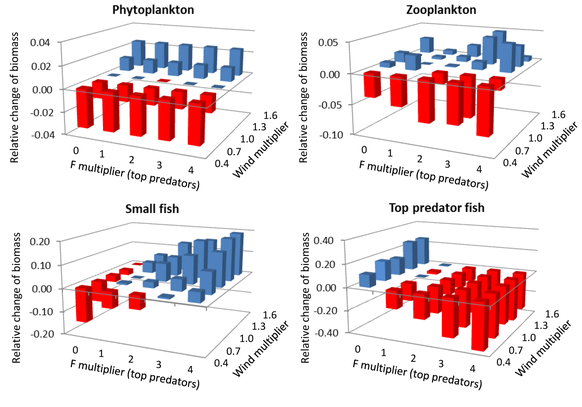
OSMOSE model

Description
- Multispecies and Individual-based model (IBM) that focuses on fish species
- Assumes opportunistic predation based on spatial co-occurrence and size adequacy between a predator and its prey
- Can be coupled with biogeochemical models (Eco3M, ROMS. etc.)

Objectives
- Provide ecological indicators on the health status of the ecosystems
- Assess the impacts of Marine Protected Areas
- Assess the impacts of fishing moratoriums
- Explore overexploitation scenarios
- Assess the combined effects of climate change and overexploitation



Processes represented within and for coupling of Osmose and biogeochemical models.
Source: www.osmose-model.org

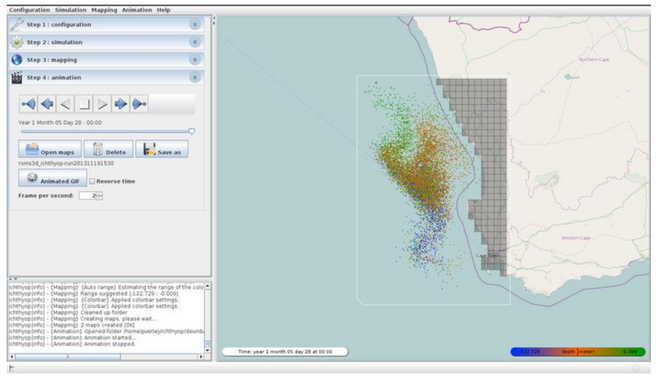


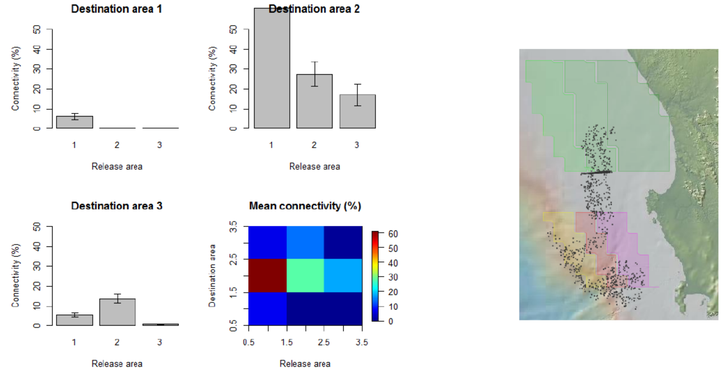
Change of biomass of the four main trophic groups for different wind and fishing scenarios.
Source: Travers-Trolet et al., 2014

ICHTHYOP model

Description
- Simulate horizontal and vertical dispersion.
- Simulate egg buoyancy and larvae growth.
- Simulate vertical migration (transport at iso-depth layers or diel vertical migration)

Objectives
- Study transport processes and their effect on larvae recruitment
- Track virtual drifters, record their positions and visualize them (on GoogleEarth for instance).
- Assess the connectivity between release zones and recruitment zones


Ichthyop Graphical Interface



Examples of connectivity calculations. Source: Ichthyop tutorial