NEMO prospective : Mercator Océan

Clément Bricaud, Yann Drillet, Jérome Chanut, Gilles Garric, Romain-Bourdallé-Badie, Guillaume Reffray, Coralie Perruche, Nicolas Ferry, Julien Paul, Eric Greiner, Charly Regnier, Mondher Chekki, Eric Dombrowsky

Mercator Ocean

Ocean Forecasters

Mercator Océan : Current status and futur needs

Why Mercator Océan is using NEMO ?

- Global real time ocean analysis and forecast for the physics and the biogeochemistry.
  - Global configurations from 1°to 1/12°coupled with LIM model.
  - PISCES biogeochemistry model, only at 1°
  - Weekly analysis cycle and daily update of the 7-days forecast
- Regional real time ocean analysis and forecast for the physics and the biogeochemistry
  - Regional configuration from 1/12° to 1/36°
  - PISCES Biogeochemistry model, not in all the system
  - Weekly analysis cycle or reinitialisation of the system and daily update of the 7-days forecast
- Global reanalysis
  - Global configuration at ¼° coupled with LIM model
  - PISCES biogeochemistry model, offline mode
  - Altimetry period (from 1992)
- Regional reanalysis
  - Regional configuration at 1/12°
  - PISCES biogeochemistry model, online mode, not in all the system
- Global and regional simulations
  - From 1° to 1/36° resolution
  - Coupled with biogeochemistry, with atmosphere, with sea ice, embedded configuration

Mercator Océan : Current status and futur needs

6 main topics identified for futur works

1. Increase the resolution
2. Improve forcing
3. Coupled physic and biogeochemistry
4. Ensemble simulations
5. Link between open ocean and coastal seas
6. NEMO environment and HPC

Increase the resolution

Needs : increase the resolution and/or the effective resolution of NEMO, to improve interaction with bathymetry, meso scale processes, vertical processes, assimilation of high resolution observation (SWOT**),** toward km resolution

- **AGRIF :** must be fully operational, all physical options, all vertical coordinates, coupled with other model (sea ice, bgc …), optimisation, parallelisation.
- **New grid :** distorded grid in NEMO. Increased localy the resolution to take into account geometry and/or physical processes, complementary to AGRIF
- **Z~ coordinates :** minimize numerical dissipation, global configuration including tide
- **Generalized vertical coordinate :** move locally from z to sigma coordinates
- **High order time and space scheme :** improve the effective resolution of NEMO
- **Relax some approximation :** as boussinesq/hydrostatic, impact of approximation on meso scale, tuned new parameterisation, quasi hydrostatic approximation could be a first step

Improve forcing (Atmosphere, waves, tide , sea ice…)

Needs : Evolution of the NEMO surface module including atmospheric forcing, runoff, waves, sea ice interaction, iceberg … Provide better resolution and higher frequency forcing, improve fresh water balance …

- **Atmospheric forcing** : spatial and temporal downscalling of the atmospheric forcing, atmospheric boundary layer.
- **Wave** : Coupling with wave model, improve surface velocities and vertical mixing
- **Runoff** : Improve runoff module to take into account new kind of observations, model output, nutrients, coupling with river model …
- **Sea ice** : Evolution of LIM sea ice ice model
- **Iceberg** model, **Ice shelf** model

Coupled physic and biogeochemistry

Needs : PISCES as the standard biogeochemistry model, adaptation and evolution for representation of higher frequency phenomena and regional/shelf modelisation.

- **Consistency with the physics** :
  - **For numerical scheme** : numerical scheme, use less diffusive advection scheme especially for higher resolution model, temporal scheme, z~ coordinates
  - **For physical processes** : high frequency processes as tide or diurnal cycle
- Improve biogeochemistry model toward **upper trophic levels**
- Biogeochemistry in **sea ice**
- Biogeochemistry adapted for **shelf seas**, river input, sedimentary module …

Ensemble simulations

Needs : for advanced data assimilation methods and ensemble forecasts

- Link with the **data assimilation** tools
- Capability to provide **perturbation**, to produce **ensemble** simulations
- Perform online ensemble **statistics**
- **Optimisation** of the ensemble production

Link between open ocean and coastal seas

Needs : improve interfaces between ocean model, provide better information for coastal and litoral model

- **Relocatable system and Agrif :** capability to perform embedded simulation and improvment on shelf seas
- Capability to couple or interface NEMO with **unstructured** model grid.
- **Physics** available in NEMO to be consistent with coastal and littoral model.

NEMO environment and optimisation

- Take care of the **computational cost** and the computer evolution. Optimised **I/O** and **communication**, develop several levels of parallelisation in the model.
- **« Simplified » the model** : suppressed obsolete options, keep manageable the evolution of the code and the new versions, take care of the uncompatible options and identify modules that must work in any case (IO server, AGRIF, surface module, time splitting …)
- Defined **reference configurations** used by the consortium membre including all available modules or options
- Keep a **readable** code. Model shared between research and operational
- Keep stabilized version of the code for users.
- Improve or maintain configuration **development** interface
- Improve interface with **data assimilation** as observation operator for new kind of observations