NEMO long term perspectives 2013

Participations from DFO (Y. Lu, Bedford Institute of Oceanography), CCCMA (B. Merryfield and N. Steiner), CMC-RPN (F. Dupont and G. Smith)

Expected applications

Operational Oceanography:

- **High-resolution ocean-ice forecasting models: global ¼ -> 1/12th degree; basins 1/12th -> 1/36th deg; shelf 1/36th -> 1/60th deg; limited area 100-500 m; vertical levels 50 -> 200, AGRIF**

- **Using the ocean-ice model for hindcast and reanalysis, for durations of 1-6 decades**

- **Coupling to wave and atmosphere**

- **Coupling the ocean-ice model with ecosystem module for hindcast and forecast**

- **Detailed analysis/forecast of high-resolution ocean & ice state for environmental services in Canadian waters**

Climate studies:

NEMO-PISCES-CICE (global 1/4th) as a component of CCCma's Climate and Earth System model (next generation) for:

1) long-term climate projections in support of IPCC,

2) seasonal and decadal climate forecasts,

3) regional climate simulations, etc.

Developments of interests

Operational Oceanography:

- Sea-ice model improvement: numeric and physics

- Ice-ocean-topography interaction, e.g., ice embedding (mass & dynamic), land-fast ice. What happens when ice (or the ice keel, not necessarily explicitly modelled) touched the bottom?

- Ice-wave interaction, integration of a wave model into NEMO, preferentially WW3; momentum & heat exchanges, breaking and non-breaking wave induced-mixing...

- Sea-ice data assimilation

- Tides and tidal data assimilation

- Introduction of 3-4th Semi-Lagrangian advection for momentum and tracers. Should allow for large Courant Number (>1) while the Eleurian and leapfrog approach is limited to C~0.25-0.5. Could be of interest for biogeochemistry.

- Wetting and drying

- Non-hydrostatic option

- Working AGRIF with all components (tides, BGC, LIM, CICE, multiple-nesting...)

- Inclusion of TEOS10 should lead the way to better total energy conservation

Developments of interests

Climate studies:

- most covered by previous list

- Energetically-consistent parameterization of small-scale turbulence which accounts for the wind energy pathway from its input at the surface to its removal by mesoscale eddies (due to baroclinic instability, through either parameterized or resolved eddies), and then to small-scale mixing in the deep ocean interior. Such a mixing scheme should be able to account for possible changes in wind energy input to the ocean under changing climate.

biogeochemistry (BGC)

- treatment of mixing, overflows likely important for biogeochemistry

- local implementation of a new BGC component based on the PISCES Architecture

1. concerns about the computational efficiency of tracer advection with **many** BGC fields.

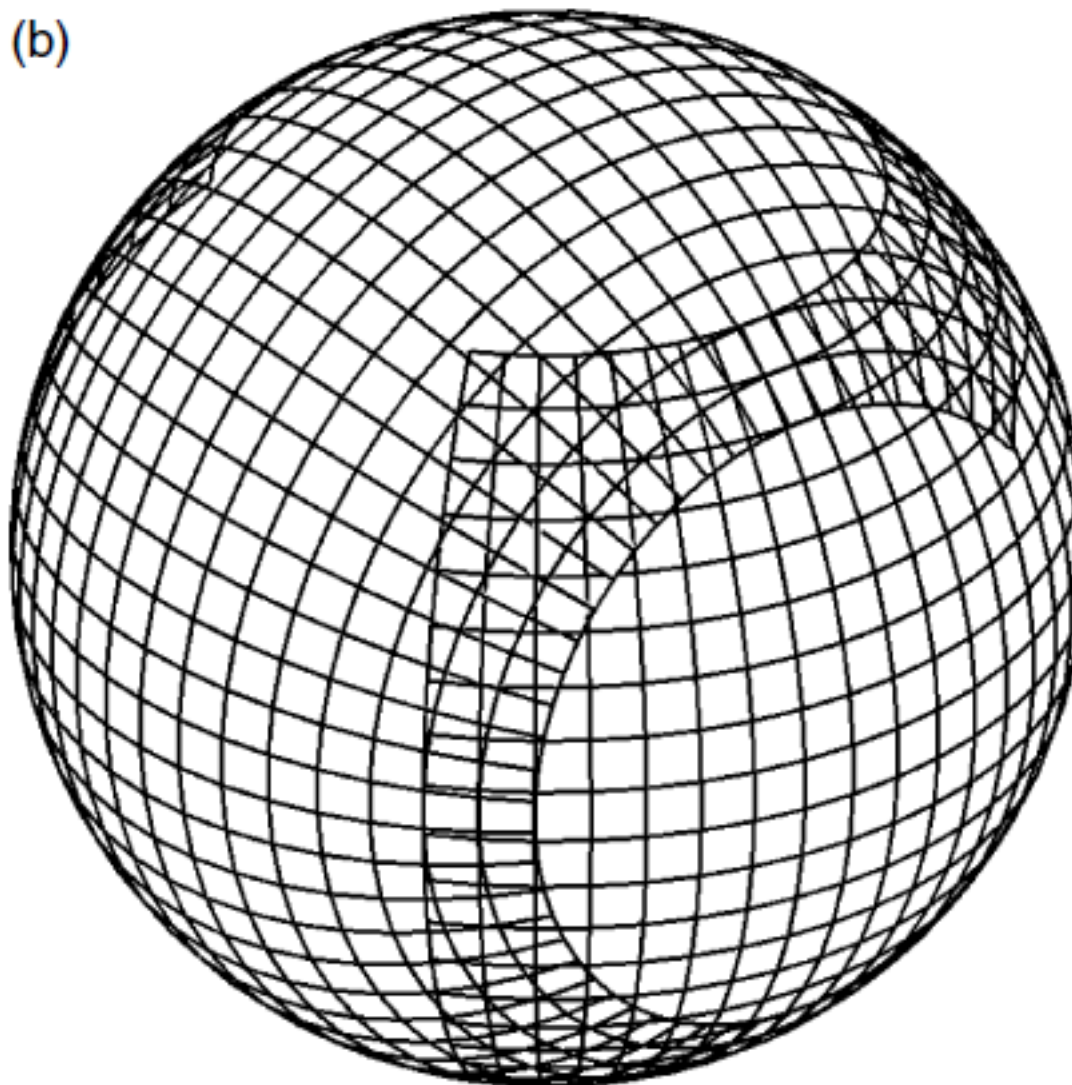2. common approaches with more namelist-controlled parameters (eg for sedimentation)

3. biogeochemistry within sea ice

(b)

Yin-Yang global setup with no singularities (Kageyama and Sato, 2004), akin to a tennis-ball. Next global atmospheric forecast system implemented at CMC at 10km will be Yin-Yang.

Is there any interest in implementing such a grid? Involves interpolation and exchanges on the overlap region. Canadian model GEM code is open source

Architecture and lesser points

1. **Parallelization: Mix of OMP and MPI, GPUs? GEM model is already OMP/MPI. The Canadian Meteorology Centre is looking to a GPU technology for its next generation of super-computer, it will be a step "backward" towards vectorization (check http://www.mmm.ucar.edu/wrf/WG2/GPU/WSM5.htm).**

Ordering of arrays?

2. **lesser points (and short term):**

different directories for each proc output (ln_dimgnnn or netcdf). Seems to confuse less the NFS servers.

CICE should get MPI_comm_opa communicator passed through the SBC interface and not assume MPI_COMM_WORLD by default (SAM2 problems)

Continue the work on wp (_wp to be added to all fixed value variables) and REAL(*,wp)

wish: to replace all timestep count by hours (nn_write, stock...), i.e., more friendly namelists, maybe even considering a GUI that manages namelists...