PISCES reference version descriptions

NEMO ocean model

version 3.6 :

https://forge.ipsl.jussieu.fr/nemo/browser/NEMO/releases/release-3.6/NEMOGCM/NEMO/TOP_SRC/PISCES#P4Z

Version of Aumont et al. (2015) + :

- Ocean carbonate system changed to Mocsy 2.0 standards (Orr et Epitalon, 2015).
- Bug correction of particles accumulation in anoxic and nitrate-limited areas (`nitrfac2` in `p4zrem.F90`)
- Elimination of mass conservation based on adjustment of sediment losses to compensate exactly for sediment inputs

version 4.0 :

https://forge.ipsl.jussieu.fr/nemo/browser/NEMO/releases/release-4.0/src/TOP/PISCES

- Major update of the diagenetic module (marine sediment biogeochemistry, `ln_sediment`).
- Variable composition of POC (Aumont et al. 2017).
- Outsourcing of particle sinking management to TOP.
- Removal of `ln_oldprod` scheme, `ln_newprod` becomes the standard and only scheme (see Aumont et al. (2015))
- Changing impact of mixing layer on primary productivity. The effect of photoperiod (day length, `ln_p4z_dcyc`) and MLD is merged into a single parameterization based on Schatwell et al. 2012
- Add the full quota version of PISCES, (`ln_p5z`) (Kwiatkowski et al. 2018)
- Diurnal cycle management added in TOP (`ln_trcdm2dc`, daily mean to diurnal cycle on short wave).
- Removal of complex Fe chemistry, disappearance of `ln_fechem` (Tagliabue et Völker, 2009)
- Addition of prognostic ligands, `ln_ligand` (Völker and Tagliabue, 2014).

version 4.2.3 :

https://forge.nemo-ocean.eu/nemo/nemo/-/tree/4.2.3?ref_type=tags

- Diagenetic module : switch to Rosenbrock's implicit time scheme (orders 2, 3 and 4) involving a major rewrite of the diagenetic code. Also significant developments both in terms of cpu efficiency (twice as fast), and physics with an improved parameterization of sulfur and iron cycles in sediment. Tunings of different parameters.
- External inputs are now managed in TOP (`trcbc.F90`), the remaining inputs in PISCES (Iron from sediment and ice) are managed in `p4zbc.F90`.

- Reformulation of phytoplankton size and its effect on ½ saturation constants and grazing by microzooplankton.
- Phytoplankton N/P ratio reformulated in the full Quota version of PISCES.
- Reformulation of calcite dissolution according to Naviaux et al. 2019.
- Alkalinity damping control separated from nutrient damping control.
- Source of Fe from Antarctic continental ice (**Person et al., 2019**).

version 5.0 :

https://forge.nemo-ocean.eu/nemo/nemo/-/tree/5.0?ref_type=tags

- Add PISCES simple (`ln_p2z`). This is the NPZD version of the standard version of PISCES (`ln_p4z`). It models the marine biogeochemical cycles of 9 prognostic tracers with one generic group of phytoplankton and zooplankton and includes the Fe cycle for a better representation of primary production in iron-limited regions. Dedicated namelist parameters (TOP) can be found in the ORCA2_OFF_PISCES reference configuration.
- Pisces quota improvements (`ln_p5z`). The multi-prey parameterization applied to zooplankton grazing is modified for a more mechanistic setting. Tuning the different parameters.
- Phasing with RK3 time stepping.
- Reduction of PISCES memory footprint to reduce memory access.
- Reduction of the number of MPI communications.
- Improved performance: vectorization, numerical calculation, 1/day call of the POC lability calculation instead of a time-step call of the BGC model.
- The parameterization of phytoplankton size has been revised with a local temporal evolution equation (not transported).
- Sediment metamodel burial parameters added to the PISCES namelist.
- Calculation of diazotrophy removed from `p4zsed.F90` and done in the `p4zdiaz.F90`.
- Add debugging options by biogeochemical process (namelist + code).
- Switch from `newprod` to `oldprod` scheme for phytoplankton growth rate.
- New semi-lagrangian sinking scheme in TOP.

CROCO ocean model

version 1.3.1 :

https://gitlab.inria.fr/croco-ocean/croco/-/tree/v1.3.1?ref_type=tags

Version of **Aumont et al. (2015) + :**

- Ocean carbonate system changed to Mocsy 2.0 standards (**Orr et Epitalon, 2015**).
- Add the full quota version of PISCES, `key_pisces_quota` (**Kwiatkowski et al. 2018**).
- Variable composition of POC (**Aumont et al. 2017**).
- Add prognostic ligands, `key_ligand` (**Völker and Tagliabue, 2014**).
- New semi-lagrangian sinking scheme `ln_sink_new`

- Bug correction of particles accumulation in anoxic and nitrate-limited areas (`nitrfac2` in `p4zrem.F90`)
- Major update of the diagenetic module (marine sediment biogeochemistry, `key_sediment`).

version 2.0.1 :

https://gitlab.inria.fr/croco-ocean/croco/-/tree/v2.0.1?ref_type=tags

- Add PISCES simple (`key_pisces_light`). This is the NPZD version of the standard version of PISCES (`key_pisces`). It models the marine biogeochemical cycles of 9 prognostic tracers, one generic group of phytoplankton and zooplankton and includes the Fe cycle for a better representation of primary production in iron-limited regions.

version 2.1 : To be released 14th march 2025

- Reduction of PISCES memory footprint to reduce memory access.
- Reduction of the number of MPI communications.
- Improved performance: vectorization, numerical calculation, 1/day call of the POC lability calculation instead of a time-step call of the BGC model.
- Sediment metamodel burial parameters added to the PISCES namelist.
- Alkalinity damping control separated from nutrient damping control.
- Calculation of diazotrophy removed from `p4zsed.F90` and done in the `p4zdiaz.F90`.
- Changing impact of mixed layer on primary productivity. The effect of photoperiod (day length, `ln_p4z_dcyc`) and MLD is merged into a single parameterization based on **Schatwell et al. 2012**
- Add the parameterization of diurnal vertical migration of mesozooplankton DVM `ln_dvm_meso`.
- Reformulation of phytoplankton size and its effect on ½ saturation constants and grazing by microzooplankton.
- Phytoplankton N/P ratio reformulated in the full Quota version of PISCES.
- Reformulation of calcite dissolution according to **Naviaux et al. 2019**.
- Diagenetic module : switch to Rosenbrock's implicit time scheme (orders 2, 3 and 4) involving a major rewrite of the diagenetic code. Also significant developments both in terms of cpu efficiency (twice as fast), and physics with an improved parameterization of sulfur and iron cycles in sediment. Tunings of different parameters.
- Add debugging options by biogeochemical process (namelist + code).
- Rename the simple version of PISCES from `key_pisces_light` to `key_pisces_npzd`