ROMS-BEC model data: Factors controlling the competition between Phaeocystis and diatoms in the Southern Ocean and implications for carbon export fluxes

Model

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These data were used for the publication **"Factors controlling the competition between *Phaeocystis* and diatoms in the Southern Ocean and implications for carbon export fluxes"** (https://doi.org/10.5194/bg-2019-488). Further information on the model setup and the analysis framework can be found in the paper. More model output is available upon email request.

File list and variables contained in each file:

- **SO_d025_grid.nc**
  Grid file of 0.25° Southern Ocean ROMS-BEC setup.
  lat_rho: latitude in deg N (variable corresponding to "lat" in all files below)
  lon_rho: longitude in deg E (variable corresponding to "lon" in all files below)
  h: bathymetry
  mask_rho: land sea mask
  pm, pn: inverse length of each grid cell in x- and y-direction (m-1)

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_env_variables_50m_DJFM_mean.nc**
  December-March and top 50m average diatom, *Phaeocystis*, and coccolithophore carbon biomass, temperature, NO3, SiO2, and Fe concentrations, as well as December-March average mixed layer PAR levels (MLPAR) in the Baseline simulation.
  DIATC: diatom carbon (mmol m-3)
  PHAEOC: *Phaeocystis* carbon (mmol m-3)
  COCCOC: coccolithophore carbon (mmol m-3)
  temp: temperature (°C)
  MLD: mixed layer depth (m)
  SiO3: silicic acid (mmol m-3)
  NO3: nitrate (mmol m-3)
  FE: iron (mmol m-3)
  MLPAR: mixed layer PAR (W m-2)
  lat: latitude in deg N
  lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_HashiokaPlots_srf_8daily.nc**
  Surface 8 daily averages of variables needed to reproduce "Hashioka" plots (Fig. 5 & 6 in manuscript, see section 3 in paper) in Baseline simulation (note that the year runs from July-June in file).
  temp: sea surface temperature (°C)
  DIAT_LIGHT_LIM: limitation of diatom growth by light
  DIAT_FE_LIM: limitation of diatom growth by iron
  DIAT_N_LIM: limitation of diatom growth by nitrogen
  DIAT_P_LIM: limitation of diatom growth by phosphorus
  DIAT_SIO3_LIM: limitation of diatom growth by silicic acid
  PHAEO_LIGHT_LIM: limitation of *Phaeocystis* growth by light
  PHAEO_FE_LIM: limitation of *Phaeocystis* growth by iron
  PHAEO_N_LIM: limitation of *Phaeocystis* growth by nitrogen
  PHAEO_P_LIM: limitation of *Phaeocystis* growth by phosphorus
  PHAEO_TFUNC: limitation of *Phaeocystis* growth by temperature
  DIATC: diatom carbon (mmol m-3)
  PHAEOC: *Phaeocystis* carbon (mmol m-3)
  ZOOC: zooplankton carbon (mmol m-3)
  GRAZE_DIAT: grazing rate on diatoms (mmol m-3 s-1)
  GRAZE_PHAEO: grazing rate on *Phaeocystis* (mmol m-3 s-1)
  DIAT_AGG: aggregation rate of diatoms (mmol m-3 s-1)

PHAEO_AGG: aggregation rate of *Phaeocystis* (mmol m-3 s-1)
time: time in 8-daily intervals (45 entries for one year)
lat: latitude in deg N
lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_PFTC_50m_mean_monthly.nc**
  Monthly top 50 m average carbon concentration of phytoplankton PFTs in the Baseline simulation (note that the year runs from July-June in file).
  DIATC: diatom carbon (mmol m-3)
  PHAEOC: *Phaeocystis* carbon (mmol m-3)
  COCCOC: coccolithophore carbon (mmol m-3)
  SPC: small phytoplankton carbon (mmol m-3)
  DIAZC: diazotroph carbon (mmol m-3)
  time: time in months
  lat: latitude in deg N
  lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_PFTC_top200m_int_annual.nc**
  Annual mean top 200 m integrated carbon concentration of phytoplankton PFTs in the Baseline simulation.
  DIATC: diatom carbon (mmol m-2)
  PHAEOC: *Phaeocystis* carbon (mmol m-2)
  COCCOC: coccolithophore carbon (mmol m-2)
  SPC: small phytoplankton carbon (mmol m-2)
  DIAZC: diazotroph carbon (mmol m-2)
  lat: latitude in deg N
  lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_PFTchl_50m_mean_monthly.nc**
  Monthly top 50 m average chlorophyll concentration of phytoplankton PFTs in the Baseline simulation (note that the year runs from July-June in file).
  DIATCHL: diatom chlorophyll (mg chl m-3)
  PHAEOCHL: *Phaeocystis* chlorophyll (mg chl m-3)
  COCCOCHL: coccolithophore chlorophyll (mg chl m-3)
  SPCHL: small phytoplankton chlorophyll (mg chl m-3)
  DIAZCHL: diazotroph chlorophyll (mg chl m-3)
  time: time in months
  lat: latitude in deg N
  lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_*PFT*chl_srf_daily.nc**
  Daily average surface chlorophyll concentration of phytoplankton PFTs (diatoms, Phaeocystis, coccolithophore, small phytoplankton, diazotrophs) in the Baseline simulation (note that the year runs from July-June in file). One PFT per file.
  DIATCHL: diatom chlorophyll (mg chl m-3)
  PHAEOCHL: *Phaeocystis* chlorophyll (mg chl m-3)
  COCCOCHL: coccolithophore chlorophyll (mg chl m-3)
  SPCHL: small phytoplankton chlorophyll (mg chl m-3)
  DIAZCHL: diazotroph chlorophyll (mg chl m-3)
  time: time in days (360 day calendar)
  lat: latitude in deg N
  lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_PFTnutrlim_srf_annual.nc**
  Annual average surface growth limitation of *Phaeocystis* and diatoms with respect to surrounding nutrient concentrations in the Baseline simulation.
  DIAT_FE_LIM: limitation of diatom growth by iron
  DIAT_N_LIM: limitation of diatom growth by nitrogen
  DIAT_P_LIM: limitation of diatom growth by phosphorus
  DIAT_SIO3_LIM: limitation of diatom growth by silicic acid

PHAEO_FE_LIM: limitation of *Phaeocystis* growth by iron
PHAEO_N_LIM: limitation of *Phaeocystis* growth by nitrogen
PHAEO_P_LIM: limitation of *Phaeocystis* growth by phosphorus
lat: latitude in deg N
lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_PFTprod_vert_int_annual_int.nc**
  Annually and vertically integrated NPP of phytoplankton PFTs in the Baseline simulation.
  DIAT_prod: diatom NPP (mmol m-2 yr-1)
  PHAEO_prod: *Phaeocystis* NPP (mmol m-2 yr-1)
  COCCO_prod: coccolithophore NPP (mmol m-2 yr-1)
  SP_prod: small phytoplankton NPP (mmol m-2 yr-1)
  DIAZ_prod: diazotroph NPP (mmol m-2 yr-1)
  lat: latitude in deg N
  lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_POC_prod_pathways_subareas_vert_integrated_annual.nc**
  Annual mean top 100m carbon fluxes in the Baseline simulation averaged over 30-90°S, 60-90°S, and the Ross Sea.
  POC_PROD_DIAT: diatom POC production (mmol m-2 s-1)
  POC_PROD_PHAEO: *Phaeocystis* POC production (mmol m-2 s-1)
  POC_PROD_COCCO: coccolithophore POC production (mmol m-2 s-1)
  POC_PROD_SP: small phytoplankton POC production (mmol m-2 s-1)
  POC_PROD_ZOO_LOSS: zooplankton POC production (mmol m-2 s-1)
  DIATC: diatom carbon (mmol m-2)
  PHAEOC: *Phaeocystis* carbon (mmol m-2)
  COCCOC: coccolithophore carbon (mmol m-2)
  SPC: small phytoplankton carbon (mmol m-2)
  ZOOC: zooplankton carbon (mmol m-2)
  DIAT_AGG: aggregation rate of diatoms (mmol m-2 s-1)
  PHAEO_AGG: aggregation rate of *Phaeocystis* (mmol m-2 s-1)
  COCCO_AGG: aggregation rate of coccolithophores (mmol m-2 s-1)
  SP_AGG: aggregation rate of small phytoplankton (mmol m-2 s-1)
  GRAZE_DIAT: grazing rate on diatoms (mmol m-2 s-1)
  GRAZE_PHAEO: grazing rate on *Phaeocystis* (mmol m-2 s-1)
  GRAZE_COCCO: grazing rate on coccolithophores (mmol m-2 s-1)
  GRAZE_SP: grazing rate on small phytoplankton (mmol m-2 s-1)
  DIAT_LOSS: Mortality rate of diatoms (mmol m-2 s-1)
  PHAEO_LOSS: Mortality rate of *Phaeocystis* (mmol m-2 s-1)
  COCCO_LOSS: Mortality rate of coccolithophores (mmol m-2 s-1)
  SP_LOSS: Mortality rate of small phytoplankton (mmol m-2 s-1)
  ZOO_LOSS: Mortality rate of zooplankton (mmol m-2 s-1)
  subarea_list: 30-90°S, 60-90°S, Ross Sea

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_POC_prod_pathways_subareas_vert_integrated_monthly.nc**
  Monthly mean top 100m POC production of diatoms, *Phaeocystis*, coccolithophores, small phytoplankton, and zooplankton in the Baseline simulation (note that the year runs from July-June in file) averaged over 30-90°S, 60-90°S, and the Ross Sea.
  POC_PROD_DIAT: diatom POC production (mmol m-2 s-1)
  POC_PROD_PHAEO: *Phaeocystis* POC production (mmol m-2 s-1)
  POC_PROD_COCCO: coccolithophore POC production (mmol m-2 s-1)
  POC_PROD_SP: small phytoplankton POC production (mmol m-2 s-1)
  POC_PROD_ZOO_LOSS: zooplankton POC production (mmol m-2 s-1)
  time: time in months
  subarea_list: 30-90°S, 60-90°S, Ross Sea

- **CN_PhaeoBiogeography_ROMS_BEC_baseline_validation_monthly.nc**
  Monthly average SST, MLD, SiO3 concentration, NO3 concentration, total chlorophyll (all surface) and total NPP (vertically integrated) in the Baseline simulation (note that the year runs from July-June in file).

temp: sea surface temperature (°C)
MLD: mixed layer depth (m)
SiO3: silicic acid (mmol m-3)
NO3: nitrate (mmol m-3)
tot_chl: total chlorophyll (mg chl m-3)
tot_prod: total NPP (mmol m-2 d-1)
time: time in months
lat: latitude in deg N
lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_run_VARYING_kFe_PAR_Fe_monthly.nc**
  Monthly mean surface and top 50m average PAR levels and Fe concentrations in the sensitivity simulation VARYING_kFe (see Table 2 in paper for details; note that the year runs from July-June in file).
  PAR_top50m: diatom chlorophyll (mg chl m-3)
  PAR_srf: *Phaeocystis* chlorophyll (mg chl m-3)
  Fe_top50m: coccolithophore chlorophyll (mg chl m-3)
  Fe_srf: small phytoplankton chlorophyll (mg chl m-3)
  time: time in months
  lat: latitude in deg N
  lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_run_VARYING_kFe_*PFT*chl_srf_daily.nc**
  Daily average surface chlorophyll concentration of diatoms and *Phaeocystis* in the sensitivity simulation VARYING_kFe (see Table 2 in paper for details; note that the year runs from July-June in file). One PFT per file.
  DIATCHL: diatom chlorophyll (mg chl m-3)
  PHAEOCHL: *Phaeocystis* chlorophyll (mg chl m-3)
  time: time in days (360 day calendar)
  lat: latitude in deg N
  lon: longitude in deg E

- **CN_PhaeoBiogeography_ROMS_BEC_sensitivity_PFTchl_subareas_srf_annual.nc**
  Annual mean surface chlorophyll concentration of phytoplankton PFTs in the Baseline simulation (index 1) and in all sensitivity runs (index 2-22, see Table 2 in paper for the order). The output is given in the following order for the PFTs: diatoms, coccolithophores, small phytoplankton, and *Phaeocystis*. The output is averaged over the subareas 30-90°S (index 1), 60-90°S (index 2), and the Ross Sea (index 3).
  PFTchl: chlorophyll of each PFT (mg chl m-3)
  subarea_list: 30-90°S, 60-90°S, Ross Sea
  runID_list: 1=Baseline, 2-22=Sensitivity runs (see Table 2 of paper)
  PFT_list: 1=diatoms, 2=coccos, 3=small phytoplankton, 4=*Phaeocystis*

- **CN_PhaeoBiogeography_ROMS_BEC_sensitivity_PFTnpp_subareas_srf_annual.nc**
  Annual mean vertically integrated NPP of phytoplankton PFTs in the Baseline simulation (index 1) and in all sensitivity runs (index 2-22, see Table 2 in paper for the order). The output is given in the following order for the PFTs: diatoms, coccolithophores, small phytoplankton, and *Phaeocystis*. The output is averaged over the subareas 30-90°S (index 1), 60-90°S (index 2), and the Ross Sea (index 3).
  PFTnpp: vertically integrated NPP of each PFT (mmol m-2 s-1)
  subarea_list: 30-90°S, 60-90°S, Ross Sea
  runID_list: 1=Baseline, 2-22=Sensitivity runs (see Table 2 of paper)
  PFT_list: 1=diatoms, 2=coccos, 3=small phytoplankton, 4=*Phaeocystis*

- **CN_PhaeoBiogeography_ROMS_BEC_sensitivity_POCexport100m_subareas_srf_annual.nc**
  Annual mean POC export across 100m in the Baseline simulation (index 1) and in all sensitivity runs (index 2-22, see Table 2 in paper for the order). The output is averaged over the subareas 30-90°S (index 1), 60-90°S (index 2), and the Ross Sea (index 3).
  POC100: POC export across 100m (mmol m-2)
  subarea_list: 30-90°S, 60-90°S, Ross Sea
  runID_list: 1=Baseline, 2-22=Sensitivity runs (see Table 2 of paper)