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Light and iron are controlling ecosystem dynamics and biogeochemical cycles in the present-day Southern Ocean: results of the NEMO-SWAMCO model

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The new ocean-sea-ice model NEMO (Nucleus for European Modelling of the Ocean) has been coupled to SWAMCO, a complex model of the marine planktonic system describing C, N, P, Si, Fe cycling within the upper ocean, the export production and the exchange of CO_2 between the ocean and atmosphere. The model, constrained by chemical (Fe, P, Si, N), physical (light, temperature, salinity) and biological (grazing) controls, explicitly details four relevant phytoplankton functional groups with respect to C, N, P, Si, Fe cycling and climate change. Those are diatoms, pico- nanoplankton, Coccolithophoridae and *Phaeocystis*. The 3D NEMO-SWAMCO model is implemented in the ocean domain south of latitude 30˚S and runs are performed for the period September 1999 - August 2002, making use of "Levitus" fields for nitrate, phosphate, silicic acid, dissolved inorganic carbon and alkalinity initial conditions. For biological state variables, initial conditions are retrieved from published observations and transformed for adjustment to the model currency. For this first test, iron is homogeneously set at 0.6 nM. Model verification is ensured by analyzing the coherency of the obtained monthly geographical distribution fields of ice cover, chlorophyll a and dissolved Fe simulations.

Model results are then analyzed in terms of geographical distribution and seasonal successions of plankton groups and daily production (diatoms, pico-nanophytoplankton, Coccolithophoridae, *Phaeocystis*; bacteria, hetero-nanoflagellates and microzoo-

plankton) and related CO_2 air-sea fluxes. This is conducted by extracting model results at latitudes corresponding to stations where time series data are available. Sensitivity tests on Fe and light parameterization gives support on the key role played by light and Fe in structuring the Southern Ocean ecosystem and related biogeochemical cycles.