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Damping effect of flexible phytoplanktonic C:N ratio on primary production at basin-scale

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The spatial and temporal variations of the phytoplanktonic C:N ratio in an oceanic basin and its impact on primary production are described from 3D bio-physical modelling. A simple marine ecosystem model with variable phytoplanktonic C:N ratio (cell-quota model) is coupled to a 3D eddy-resolving model representing a double gyre circulation at basin-scale. The results are compared with those obtained with constant C:N ratio (Redfield model) in the same configuration. Realistic values of C:N ratios for phytoplankton and production are simulated, with mesoscale, seasonal, and zonal variations, and are in agreement with previous in situ measurements. Various metrics are used to describe the spatial and temporal scales of variability if the phytoplanktonic C:N ratio. Our main result is that taking into account phytoplanktonic plasticity through a variable C:N ratio (flexibility) smoothes the spatial and temporal variability of both phytoplankton concentration and primary production compared to Redfield model (damping effect). Especially, production is increased in the southern low-productive oligotrophic gyre and decreased in the northern high-productive gyre (of +39% and -34%, respectively, for the production in carbon).