Budget of dissolved organic carbon in the South China Sea assessed by an eddy-resolving ocean model

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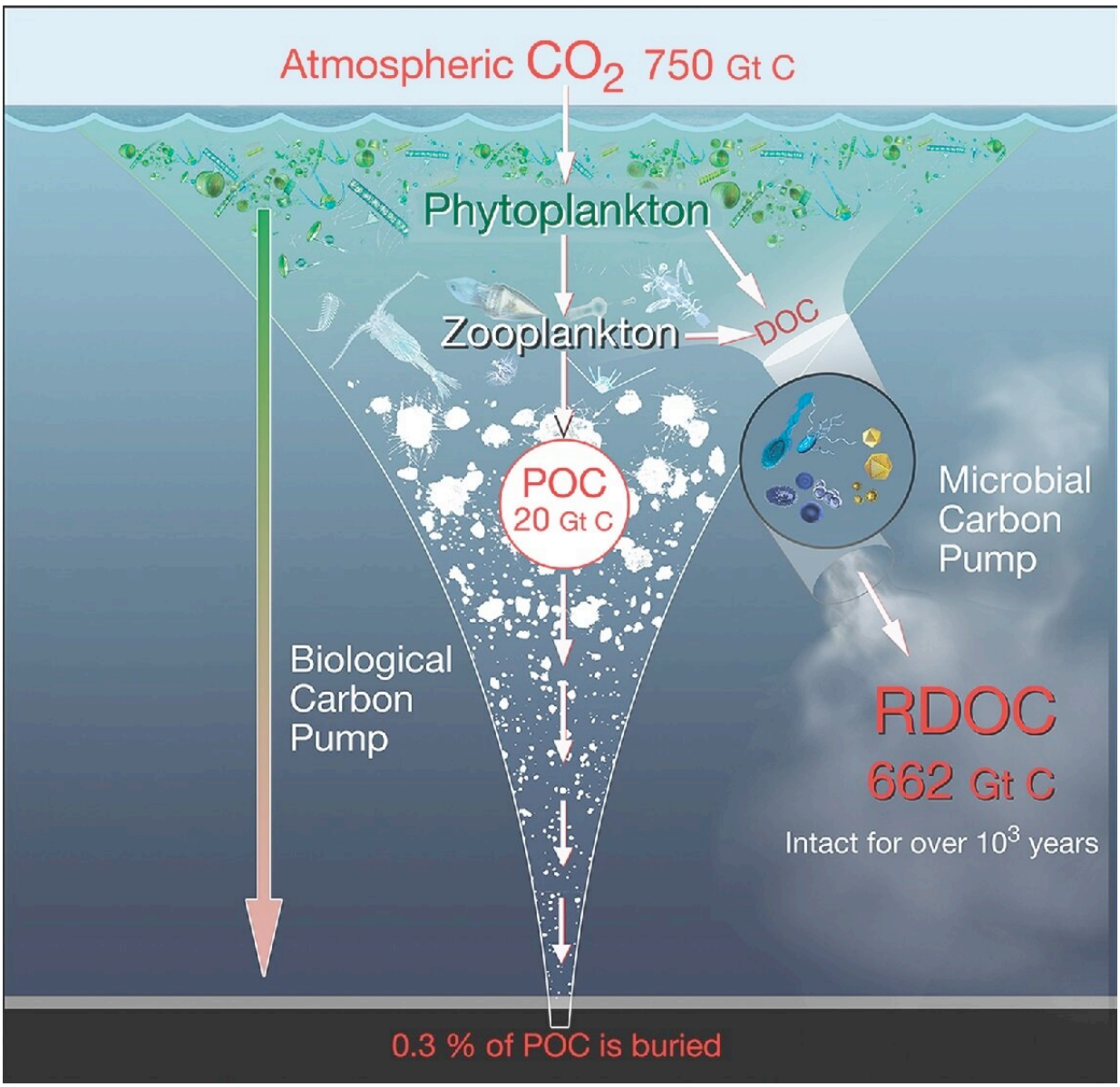


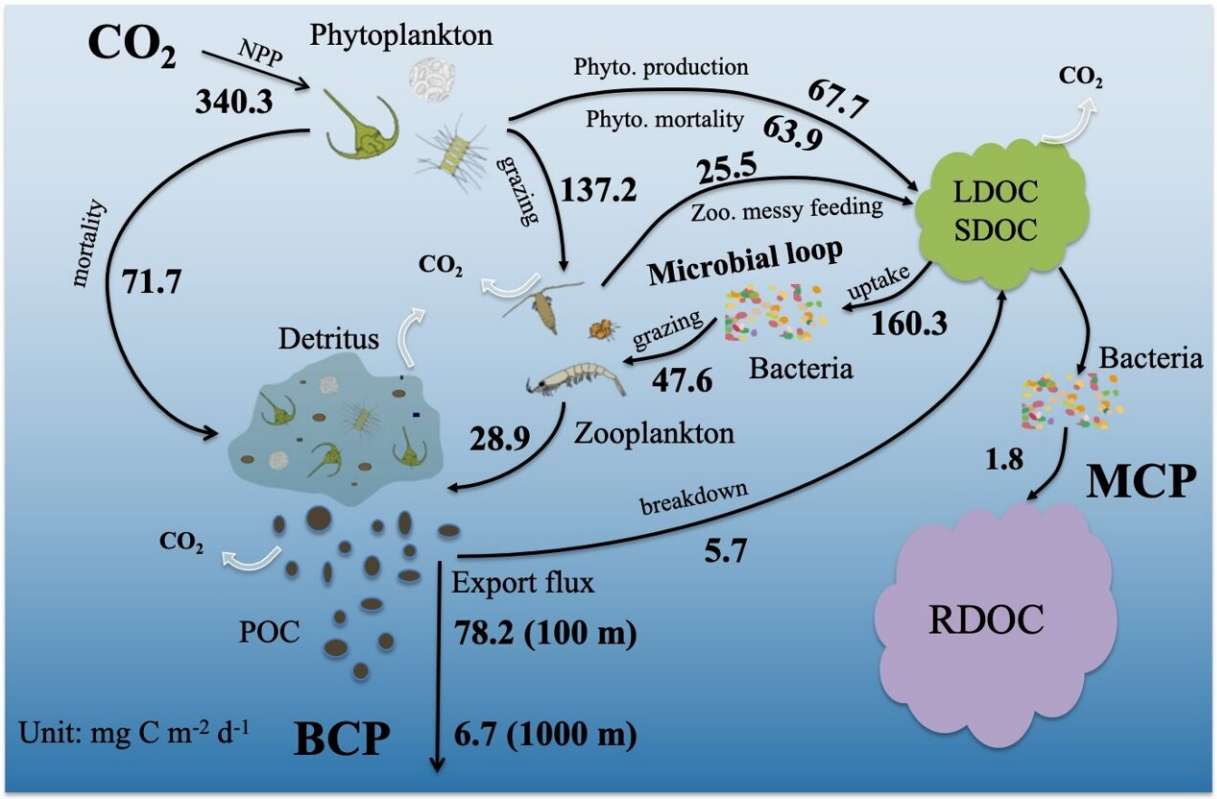
The BCP, which transports organic matter from the surface to the interior and floor of the ocean; the MCP, which converts parts of labile and semi-labile organic carbon (LDOC/SLDOC) into refractory DOC (RDOC) via microbial activities. Credit: Zhang et al.

Dissolved organic carbon (DOC) makes up the majority of marine organic carbon. Understanding its source and sink processes is of great significance to the global carbon cycle and will provide insights in achieving carbon neutrality. How do different physical and biogeochemical processes interact to contribute to the budgets of DOC and particulate organic carbon (POC)? Are there unique dynamics in different regions? The journal *Science China Earth Sciences* published online a carbon cycle study in the South China Sea led by Dr. Peng Xiu (South China Sea Institute of Oceanology, Chinese Academy of Sciences) and Dr. Wentao Ma (Second Institute of Oceanography, Ministry of Natural Resources). The purpose of this study is to quantitatively evaluate processes of carbon fixation, sequestration, and the interaction between the biological carbon pump and the microbial carbon pump.

"The South China Sea (SCS) is the largest semi-enclosed marginal sea in the western Pacific. We know that the alternation of northeast winter monsoon and southwest summer monsoon makes the distribution of phytoplankton chlorophyll concentration show clear seasonal pattern according to satellite products" Dr. Ma says. However, the budget of organic carbon in the SCS is less studied.

The team used an eddy-resolving marine physical-biogeochemical model to analyze the seasonal changes in phytoplankton photosynthesis and the storage of these fixed carbon in the SCS.

"Our research focused on two main carbon sequestration paths, one is the storage in deep sea through gravitational sinking and remineralization of the POC, which is known as the biological carbon pump (BCP), and the other one is the microbial carbon pump (MCP), which transforms DOC from labile to refractory forms through microbial activities." Dr. Xiu introduces.



Model calculates the flux of carbon fixation and transformation to POC and DOC. The NPP represents the carbon fixed by phytoplankton and provides sources for DOC and POC. The mortality of phytoplankton and grazing by zooplankton forms detritus that are exported to the depth. The flux from phytoplankton dynamics to LDOC/SLDOC pools can be separated into growth- and mortality-related fluxes. The zooplankton, bacteria and LDOC/SLDOC pools form a microbial loop that transforms DOC to POC. Meanwhile, the bacteria also transforms LDOC/SLDOC to RDOC. Photo credit: Wentao Ma.

Credit: Science China Press

The numerical simulations reported fluxes of carbon fixation by phytoplankton, export of POC by gravity, and DOC production and transformation by microbes. "The model results can be validated by observations from satellite to ship-based datasets." Dr. Ma says. The production of refractory DOC (RDOC) reaches 26% of the carbon sequestration rate of the biological carbon pump, and its contribution to carbon storage cannot be ignored. In addition, this study also found that the SCS has three typical areas with distinct DOC production dynamics in the northern coast, off the Luzon Strait and off the southeastern coast of Vietnam.

More information: Wentao Ma et al, Production of dissolved organic carbon in the South China Sea: A modeling study, *Science China Earth Sciences* (2021). DOI: 10.1007/s11430-021-9817-2

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