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Using new observations and Machine Learning to improve organic sinking processes in the PlankTOM global ocean biogeochemical model

Anna Denvil-Sommer[1], Corinne Le Quéré[1], Erik Buitenhuis[1], Lionel Guidi[2], and Jean-Olivier Irisson[2]
[1]University of East Anglia, Norwich, UK (anna.sommer.lab@gmail.com)
[2]Centre National de la Recherche Scientifique, Laboratoire d'Océanographie de Villefranche-sur-Mer, Villefranche-sur-Mer, France

A lot of effort has been put in the representation of surface ecosystem processes in global carbon cycle models, in particular through the grouping of organisms into Plankton Functional Types (PFTs) which have specific influences on the carbon cycle. In contrast, the transfer of ecosystem dynamics into carbon export to the deep ocean has received much less attention, so that changes in the representation of the PFTs do not necessarily translate into changes in sinking of particulate matter. Models constrain the air-sea CO_2 flux by drawing down carbon into the ocean interior. This export flux is five times as large as the CO_2 emitted to the atmosphere by human activities. When carbon is transported from the surface to intermediate and deep ocean, more CO_2 can be absorbed at the surface. Therefore, even small variability in sinking organic carbon fluxes can have a large impact on air-sea CO_2 fluxes, and on the amount of CO_2 emissions that remain in the atmosphere.

In this work we focus on the representation of organic matter sinking in global biogeochemical models, using the PlankTOM model in its latest version representing 12 PFTs. We develop and test a methodology that will enable the systematic use of new observations to constrain sinking processes in the model. The approach is based on a Neural Network (NN) and is applied to the PlankTOM model output to test its ability to reconstruction small and large particulate organic carbon with a limited number of observations. We test the information content of geographical variables (location, depth, time of year), physical conditions (temperature, mixing depth, nutrients), and ecosystem information (CHL a, PFTs). These predictors are used in the NN to test their influence on the model-generation of organic particles and the robustness of the results. We show preliminary results using the NN approach with real plankton and particle size distribution observations from the Underwater Vision Profiler (UVP) and plankton diversity data from Tara Oceans expeditions and discuss limitations.