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Physical controls on the biological pump: Mixing matters!

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An investigation of various simulations of past climate changes reveals that the simulated potential of the marine biology to alter atmospheric CO2 concentrations is largely a function of model architecture. Possible explanations are discussed, including systematic differences in diapycnal diffusion and in resolved transport mechanisms of biologically processed matter in the different model categories. Sensitivity experiments with a high-resolution ecosystem-circulation model of the North Atlantic show that the amount of diapycnal mixing, described either explicitly or present implicitly in the numerical schemes, has been systematically too high in previous coarse-resolution circulation models. On the other hand, most models do not yet properly account for mixing processes involving mesoscale eddies, submesoscale filaments, double diffusion, or instabilities within the surface mixed layer. The sensitivity of the simulated biological production to different types and different levels of mixing is explored and strategies for model improvement are discussed.