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Simulated impact of double-diffusive mixing on physical and biogeochemical upper-ocean properties

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Double-diffusive mixing is a mixing process caused by different diffusivities of two components in a fluid, in the oceanic case of temperature and salinity.

Double-diffusive mixing can occur even if the overall density stratification is stable, if either temperature or salinity is unstably stratified. Two parameterizations of double-diffusive mixing depending on the density ratio of the stratification are implemented in a global circulation model in a 1 by 1 degree horizontal resolution with 66 depth levels including a NPZD ecosystem model.

The impact on physical properties such as temperature and salinity distributions and surface heat fluxes is investigated as well as the influence on primary production, export and surface exchange of CO_2 and O_2. While the impact of double diffusion on upper-ocean temperature and salinity distributions is relatively small ($\pm 1^\circ$ C, $\pm$ 0.25 psu regionally and 4 * $10^{-2\circ}$ C, 1 * 10^{-2} psu as global rms over the top 50 m) and changes in surface heat flux amount to 0.0 5 W m^{-2} globally, primary production and export production are found to increase by up to 80 % and 120 %, respectively, in subtropical oligotrophic regions. In double-diffusive runs, the air-to-sea flux is enhanced so that the ocean takes up about 0.4 g C m^{-2} yr^{-1} more than in the control run.