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Impact of submesoscale flows on primary production and export fluxes of carbon in the South Atlantic Ocean

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Upper ocean stirring and mixing strongly affect the nutrient flux into the euphotic zone and therefore ocean primary production. Additionally, besides particle sinking, the export of organic and inorganic matter is hugely determined by advective fluxes imposed by physical flows. Since both production and export play a role in oceanic carbon storage, it is important to re-assess its main drivers in models of increased ocean realism. With spatial dimensions below 25 km, sharp fronts, filaments, strong jets and small eddies, submesoscale motions induce large vertical velocities, adding extra transport to the already large lateral stirring induced by the mesoscale (25 km-200 km) field. The impact of resolved submesoscale flows on some aspects of the south Atlantic Ocean carbon cycle is here studied based on a novel global ocean-biogeochemical simulation integrated with the models ICON-O and HAMOCC using a telescoping grid with a resolution refined to approximately 600 m in the south Atlantic. Tracer budgets are used to quantify the relative importance of physical versus biogeochemical processes in the evolution of ocean carbon, including the uptake at the surface and the export to the deep ocean. A comparison between our submesoscale-resolved ocean and biogeochemical simulations with coarser resolutions (10 km and 40 km) sheds some light on the submesoscale role on tracer evolution and highlights expected differences between current climate and mesoscale models and models including the submesoscale. Despite being limited by the short duration of our simulation, this study suggests that submesoscales shape vertical profiles of carbon and nutrients and thereby affect export fluxes and seasonal dynamics.