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Impact of submesoscale processes on phytoplankton community structure across oceanic fronts

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Although limited, recent observations suggest that submesoscale fronts act to structure phytoplankton communities. Here we use a modeling framework to explore a set of processes that might alter phytoplankton communities in fronts. The first process is the supply of nutrients by the vertical frontal circulation that could stimulate phytoplankton growth and favor «opportunist» species which are able to respond more rapidly to local nutrient injections (active process). The second process is the lateral mixing of different communities at the scale of mesoscale eddies and fronts (passive process). The third process is the reaction of the existing community to these active and passive processes. We use a diverse ocean ecosystem model to investigate the contribution of these processes to the phytoplankton community structure. The ecosystem model is trait-based and resolves 35 phytoplankton phenotypes, differentiated by their biogeochemical function and cell size (which sets their respective nutrient affinity, growth rates, light absorption, sinking rates and grazing). The physical model is a submesoscale-permitting, seasonally varying idealized representation of a two-gyre basin with a large scale jet, analogous to the Gulf Stream or the Kuroshio. We find that all three of the community structuring processes described above can be identified at different fronts in the model. We also find, that on average, diatom abundances are higher at submesoscale fronts, indicating a strong and consistently active response of opportunists to nutrient injections within these frontal features.