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Biological Revelance of Submesoscale Processes in the Stratified, Oligotrophic Ocean

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Submesoscale processes have been shown to be important in regions of low stratification and deep mixed layers. Here, we investigate the importance the role of submesoscale processes on episodic nutrient injections in a region with shallow mixed layers and high stratification typical of the oligotrophic ocean. A simple, nitrogen-based plankton model is embedded in a ROMS configuration for the Hawaiian region centered on Station ALOHA (part of the Hawaii Ocean Time-series, HOT). As the grid resolution is increased, a slight shoaling of the average depth of the nutricline is observed and the frequency of episodic nitrate injections is increased due to the larger vertical velocity variance and larger buoyancy variance just below the mixed layer. As a consequence, large phytoplankton species, absent at lower resolutions, emerge. The modeled primary productivity at Station ALOHA is enhanced during these episodic injection events. These results are important in the context of the observed primary productivity patterns. In regions with low surface NO_3:PO4 ratios, episodic injections supply an excess of PO4 relative to Redfield stoichiometry. Phosphate is a limiting nutrient for nitrogen-fixing diazotroph growth at Station ALOHA, which may help explain the observed primary productivity pattern. Morever, the emergence of larger phytoplankton at the base of the euphotic zone demonstrates the potential importance of submesoscale processes in modulating community structure in oligotrophic regions.