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Fine-scale dynamics shape the seascape from zooplankton to seabirds

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Ocean surface turbulence creates oases for marine life at varying scales. Understanding this patchiness is critical as it strongly influences inter-specific interactions. However, wide-ranging observations are lacking, particularly at scales <10 km. Here we use acoustic and GPS tracking data across a range of scales (100 m-100 km) to quantify the characteristic scales of turbulent structures and their aggregative power for zooplankton, forage fish and seabirds. We demonstrate that structures of ca. 300 m (internal wave dynamics) are most energetic followed by those of ca. 3-9 km (submesoscale). Ocean circulation models suggest that the 3-9 km patterns results from a combination of internal wave and submesoscale frontal dynamics. We show that surface-dynamic processes are responsible for significant aggregation of living organisms and shape their patchiness at similar scales. Predicted changes in surface stratification due to global change should thus affect biological interactions from plankton to top predators.

Keywords: oxygen minimum zone; Internal waves; submesoscale; zooplankton; fish; seabirds

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