Revisiting the island mass effect: a systematic study in the tropical Pacific

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Most of the tropical Pacific is characterized by low phytoplankton biomass, and is often considered to be relatively homogeneous and static. In this mostly unproductive region, chlorophyll concentration however often increases in the vicinity of oceanic islands. Coined the Island Mass Effect (IME), these island-driven biological enhancements are very common across the tropical Pacific. But while the IME has been known for 60 years and the corresponding nutrient supply processes are well understood, the vast majority of islands remain unstudied and impacts at the basin scale are unknown. Additionally, little is known regarding changes in phytoplankton community structure despite implications for higher trophic levels. Here we revisit the impact of islands on phytoplankton by conducting the first systematic study of the IME in the tropical Pacific from a suite of physical and biological satellite data. An algorithm automatically identifying and characterizing the IME was developed and applied to hundreds of tropical Pacific islands. The algorithm identifies the zone of influence of each island from satellite chlorophyll, and contrasts biological and physical variables within and outside of this zone of influence. Physical variables were used to identify enrichment processes and include sea surface temperature, sea level, surface currents, winds, significant wave height, and precipitation. Information on phytoplankton community was obtained from the satellite PHYSAT method that clusters spectral anomalies into classes representing given phytoplankton characteristics. The ultimate goals are to 1) quantify the impact of islands on phytoplankton and physics in the tropical Pacific and 2) classify the islands as a function of enrichment processes and phytoplankton response.