PHYSICAL REGULATION OF LAND-OCEAN CNP FLUX AND RELATIONSHIPS TO MACROALGAL BLOOMS ACROSS COASTAL ZONES OF MAUI, HAWAI'I

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ABSTRACT

Physical factors can enhance the exchange between dissolved inorganic nutrient reservoirs within the coastal zone and can control their residence times. This dissertation aims to understand the contribution of sedimentary nutrient subsidies to rapid macroalgal growth being experienced off West Maui, Hawaii. Field-based sediment porewater data are used with a porefluid hydrodynamic model to estimate groundwater nutrient fluxes; these results indicate that, under typical wave heights, 100 % of the macroalgal-biomass P and less than <5 % of the N can be supplied by sedimentary pools. Sedimentary N flux must have either been supplemented by other sources (e.g., N-fixation, or wastewater inputs), or retained for longer time periods within the coastal zone. Historical records of wind, rainfall, and wave data, used as proxies for water residence time and groundwater nutrient inputs to our site, suggest that episodes of high macroalgal growth are the result of increased nutrient residence time within the region, inversely related to the Pacific Decadal Oscillation Index.

Moreover, time-series data on dissolved nutrient concentrations were collected along nine distinct coastal sites along the southwest facing shorelines of Maui, Hawaii that have historically experienced different degrees of chronic macroalgal growth. Near-synchronous time-series measurements performed along these sites demonstrated that the spatiotemporal variability of dissolved nutrients originate from heterogeneous interactions between tides and coastal geomorphology, which regulate wave penetration and subsequently the transport and discharge of submarine groundwater to the coastal zone. The results indicate that nutrient enrichments within the coastal zone are temporally variable, but spatially coherent, along human-impacted sections of the coast.

Lastly, this dissertation explores the temporally-heterogeneous interactions between wind, waves, currents, and tides on groundwater flux, water residence time, and net ecosystem metabolism (NEM) at two coastal sites in Maui, Hawaii. Groundwater flux, CO_2 flux, water residence time, and NEM are highly variable over hourly timescales and (on average) over different times of the year. It is evident that the net autotrophy observed at our Kihei site is the result of enhanced discharge of nutrient-rich groundwater to the coastal zone.