THE TRANSIENT OASIS: CONSEQUENCES OF SPATIAL AND TEMPORAL VARIABILITY IN MACRONUTRIENTS AND PHOTOSYNTHETIC PIGMENTS ON PARTICLE EXPORT IN HAWAIIAN LEE CYCLONES

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE UNIVERSITY OF HAWAI'I IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE

IN

OCEANOGRAPHY

DECEMBER 2006

By
Yoshimi M. Rii

Thesis Committee:

Robert R. Bidigare, Chairperson
David M. Karl
Susan L. Brown

ABSTRACT

Two cyclonic eddies were surveyed during the E-Flux I and III cruises in order to investigate the consequences of spatial and temporal variability in macronutrients and photosynthetic pigments on particle export. Cyclone *Noah*, a ~2.5-month-old eddy in the 'decay' stage that was sampled during E-Flux I, exhibited modest increases in macronutrients and photosynthetic pigments at the center of the eddy. Cyclone *Opal*, sampled during E-Flux III and in the 'mature' stage at ~1 month old, exhibited sharp increases in macronutrient concentrations at the center of the eddy concurrent with a dramatic 2-fold increase in total chlorophyll *a* (TChl *a*) concentration in the deep chlorophyll maximum layer (DCML), comprised mainly of large diatoms. However, euphotic zone depth-integrated TChl *a* concentration for both eddies were indistinguishable between the center of the eddy and surrounding waters. During an eight-day time-series in the center of *Opal*, TChl *a* concentration in the DCML decreased by ~50% with a simultaneous decrease in diatom biomass, potentially triggered by silicic acid limitation. Despite the large diatom bloom, cyclone *Opal* did not produce the expected increase in particulate carbon and nitrogen export but a ~4-fold increase in silica export. This study represents a direct observation of two eddies at different stages in their biological life cycle, which is controlled by various factors on multiple time scales. Results suggest that controls on the life cycle of a Hawaiian lee cyclone are likely a combination of physical (eddy dynamics), chemical (nutrient limitation), and biological (growth and grazing imbalance) processes. Further investigation of recently studied cyclones in comparison with cyclones *Noah* and *Opal* yields speculation of a relationship

with the spin-up duration of a cyclone and the resulting biological response. As Hawaiian lee cyclonic eddies may influence an area 100's of km in diameter in the subtropical North Pacific Ocean, it is clear from this study that variability in Hawaiian lee cyclones still remains an enigma.