

AIRBORNE SYNTHETIC APERTURE RADAR IMAGES OF
AN UPWELLING FILAMENT

A THESIS SUBMITTED TO THE GRADUATE DIVISION OF THE
UNIVERSITY OF HAWAII IN PARTIAL FULFILLMENT OF THE
REQUIREMENTS FOR THE DEGREE OF

MASTER OF SCIENCE
IN
OCEANOGRAPHY
DECEMBER 2003

By

David L. Johnson

Thesis Committee:

Pierre Flament, Chairperson
Eric Firing
Mark Merrifield

ABSTRACT

The Cape Mendicino upwelling filament was imaged in 1989 using the NASA/JPL AIRSAR multiband Synthetic Aperture Radar (SAR) and NOAA AVHRR thermal and optical radiometry. To first order, SAR images of the ocean are solely dependent on the surface wave field, but they ultimately reflect the synergy of a vast number of geophysical processes. The complexity of surface wave processes leaves a large gap between the information contained in SAR images, and our ability to describe them without conjectures. Investigated here are features associated with thermal fronts, vortices, geostrophic jets, and internal waves. SAR spectra suggest infragravity waves aligned with the wind swell. Cross jet SAR profiles were investigated in detail; comparison with results from a simple model suggest that some processes not included in the simulation are dominating in physical environment. Band dependent asymmetry of the profiles is consistent with convergence and accumulation of surfactants; band independent location of the peaks suggests that such convergence may be a jet driven process. The band independent position of humps in the profiles suggests critical reflection of strongly imaged intermediate ($\lambda > \lambda_{\text{Bragg}}$) waves or alternately a persistent and complex jet velocity profile. Apparently anomalously high damping of longer Bragg waves at some jet orientations is inconsistent with historical measurements of the modulus of elasticity of ocean surfactants and might indicate the hyperconcentration of surfactants within a zone of strong convergence. Net changes in radar cross-section across some sections of the jet could indicate a number a wave or current processes, which are discussed.