MASTER OF SCIENCE
IN
METEOROLOGY AND PHYSICAL OCEANOGRAPHY

AIR-SEA INTERACTIONS AND DEEP CONVECTION IN THE LABRADOR SEA

Laura S. Bramson-Lieutenant Commander, United States Navy
B.S., University of Miami, 1988
Master of Science in Meteorology and Physical Oceanography-December 1997
Advisors: Peter Guest, Department of Meteorology
Roland Garwood, Department of Oceanography

Deep convection in the oceans, particularly at high latitudes, plays an important role in the climate systems of the world's oceans and atmosphere. This study was conducted to examine atmospheric forcing effects on deep convection in the Labrador Sea. The Naval Postgraduate School one dimensional ocean mixed layer model was applied to the Labrador Sea from February 12 to March 10, 1997. The model was initialized and forced with oceanographic and atmospheric data collected onboard the R/V *Knorr* during the first field program of the Labrador Sea Deep Convection Experiment. An ocean mixed layer depth close to 1300 m was predicted and verified using the observed data. A sensitivity study was conducted using deviations from observations as input to determine how variations in atmospheric forcing could lead to the observed and deepened ocean mixed layer. Observed Conductivity, temperature and depth (CTD) data were used to verify the model's spatial and temporal predictions of mixed layer temperature, salinity and depth. Model predicted mixed layer depths were usually slightly deeper than those observed. The final model output predicted temperature rather accurately, but model predicted salinity values were consistently low. A variety of sensitivity studies gave new insight to the individual influences of surface fluxes, momentum stresses, precipitation, salinity and individual storm variations to the mixed layer temperature, salinity and depth of the Labrador Sea.

KEYWORDS: Labrador Sea, Deep Ocean Convection, Air-Sea Interactions

DoD TECHNOLOGY AREAS: Environmental Quality, Modeling and Simulation, Other (Meteorology and Oceanography)

ENVIRONMENTAL EFFECTS IN NAVAL WARFARE SIMULATIONS

Eric L. Gottshall-Lieutenant Commander, United States Naval Reserve
B.A., University of South Florida, New College, 1984
M.S., Northeastern University, 1986
Master of Science in Meteorology and Physical Oceanography-December 1997
Advisors: Peter C. Chu, Department of Oceanography
Thomas Halwachs, Department of Operations Research

Environmental effects have long been accepted as having an impact both on the tactical use of naval warfare platforms and on the naval warfare decision-making process. Increased use of modeling and simulation (M&S) for training and analysis requires better understanding of the unique attributes of meteorological and oceanographic (METOC) data and its application in M&S. The well-developed field of forecasting METOC variation over time can be leveraged to better optimize METOC data flow into NWS through the application of information entropy techniques.

A large-scale and a small-scale naval warfare simulation (NWS) represented by a RESA Pacific Rim scenario and the SAFECUR magnetic mine sweeping tactical decision aid (TDA), respectively, are evaluated for sensitivity to METOC

variation. Incompatibility of spatial and temporal scales and abstraction levels between METOC information and NWS applications is noted. Results of the studies indicate that many tactical effects of METOC variation may be transparent to command and control measures of effectiveness. Validation and verification of TDA's must include studies of sensitivity to full spectrum METOC variation. Averaging or linearly interpolating values over unknown regions is unwise given observed METOC data's non-linear characteristics.

KEYWORDS: Modeling and Simulation, Meteorology and Oceanography, METOC, Information Entropy, RESA, SAFECUR, Validation and Verification, Forecasting, Decision-making

DoD KEY TECHNOLOGY AREA: Modeling and Simulation

A LARGE-SCALE MODELING STUDY OF THE CALIFORNIA CURRENT SYSTEM

James T. Monroe-Lieutenant Commander, United States Navy
B.S., United States Naval Academy, 1987
Master of Science in Meteorology and Physical Oceanography-December 1997
Advisor: Mary L. Batteen, Department of Oceanography
Second Reader: Curtis A. Collins, Department of Oceanography

A high-resolution, multi-level, primitive equation ocean model is used to investigate the combined role of wind forcing, thermohaline gradients, and coastline irregularities on the formation of currents, meanders, eddies, and filaments in the California Current System (CCS) from 22.5° N to 47.5° N. An additional objective is to further characterize the formation of the Davidson Current, seasonal variability off Baja California, and the meandering jet south of Cape Blanco. The model includes a realistic coastline and is forced from rest using climatological winds, temperatures, and salinities.

The migration pattern of the North Pacific Subtropical High plays a significant role in the generation and evolution of CCS structures. In particular, variations in wind stress induce flow instabilities which are enhanced by coastline perturbations. An inshore train of cyclonic eddies, combined with a poleward undercurrent of varying seasonal depths, forms a discontinuous countercurrent called the Davidson Current north of Point Conception. Off Baja, the equatorward surface jet strengthens (weakens) during spring and summer (fall and winter). Model results also substantiate Point Eugenia as a persistent cyclonic eddy generation area. The model equatorward jet south of Cape Blanco is a relatively continuous feature, meandering offshore and onshore, and divides coastally-influenced water from water of offshore origin.

KEY WORDS: Primitive Equation Model, California Current System, Currents, Meanders, Eddies, Filaments

DoD KEY TECHNOLOGY AREA: Modeling and Simulation