

# **MASTER OF SCIENCE IN METEOROLOGY AND PHYSICAL OCEANOGRAPHY**

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## **SURFACE COMBATANT INTEGRATION OF METOC DATA ACQUISITION AND PRODUCT DISTRIBUTION SYSTEMS WITHIN THE IT-21 COMMUNICATIONS ARCHITECTURE**

**Brian D. Cannon-Lieutenant Commander, United States Navy**

**B.S., University of South Carolina, 1990**

**Master of Science in Meteorology and Physical Oceanography-June 1999**

**Advisor: Kenneth L. Davidson, Department of Meteorology**

**Second Reader: Rex A. Buddenberg, Information Systems Academic Group**

In an at-sea demonstration, a prototype shipboard environmental observing system and a meteorological and oceanographic (METOC) data distribution software package are combined with the Automated Digital Network System (ADNS) to highlight the benefits of instituting an integrated data collection and distribution suite to ships, battlespace managers, and the METOC community. Limitations of traditional METOC support, inaccuracies and inherent deficiencies of shipboard observations, and current U.S. Navy weather observing policies are discussed and recommendations are proposed to improve the timeliness, accuracy, and archival of METOC information. A conceptual model for METOC support to and from surface combatants using advanced sensors, innovative software, and IT-21 communications is presented.

**DoD KEY TECHNOLOGY AREAS:** Battlespace Environments, Command, Control, and Communications, Computing and Software, Sensors

**KEYWORDS:** Automated Digital Network System, ADNS, MORIAH, METCAST, METOC, Meteorology, Oceanography, Communications

## **DETERMINING ENTRAINMENT RATE AND THE ROLE OF ENTRAINMENT IN STRATOCUMULUS CLOUDS**

**David W. McDowell-Lieutenant, United States Navy**

**B.S., University of Washington, 1990**

**Master of Science in Meteorology and Physical Oceanography-June 1999**

**Advisor: Qing Wang, Department of Meteorology**

**Second Reader: Robert Haney, Department of Meteorology**

An important process in predicting the evolution of the boundary layer is the entrainment rate, which has received little verification using observed data. The entrainment rate is therefore computed using aircraft measurements obtained off the coast of California during FIRE in 1987. The entrainment zone is defined and determined to be typically less than 10 meters deep. The structure above the boundary layer is found very complex and consists of a layered structure located in the first few hundred meters above the cloud top. These layers are 20-130 meters deep and possess properties that relate the layers to boundary layer processes. A conceptual model is presented to explain the formation of these layers.

The added presence of the layered structure above the cloud top complicates the determination of jump conditions and thus the calculation of entrainment velocity. In addition, jumps in conserved quantities vary considerably between soundings, which questions the validity of using a simple average to calculate the entrainment rate. Therefore, a new method for calculating entrainment velocity is presented, which

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## METEOROLOGY AND PHYSICAL OCEANOGRAPHY

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decreases the variation in jump conditions. This method is physically based and yields an entrainment rate with significantly less uncertainty.

**DoD KEY TECHNOLOGY AREAS:** Battlespace Environments, Environmental Quality

**KEYWORDS:** Entrainment, Entrainment Rate, Stratocumulus, Boundary Layer, FIRE

### ESTIMATION OF THE SOURCE SIGNAL CHARACTERISTICS AND VARIABILITY OF BLUE WHALE CALLS USING A TOWED ARRAY

Therese C. Moore-Lieutenant, United States Navy

B.A., University of California, Santa Cruz, 1988

Master of Science in Meteorology and Physical Oceanography-June 1999

Advisors: Ching-Sang Chiu, Department of Oceanography

Curtis A. Collins, Department of Oceanography

A four-day experiment was conducted to study the feasibility of locating, tracking, and counting blue whales acoustically in the Monterey Bay National Marine Sanctuary (MBNMS) at long ranges using the shore-based NPS Ocean Acoustic Observatory (OAO) hydrophone array. In concert with the shore-based acoustic monitoring, an aircraft was assigned to locate whales and a research vessel was manned with observers and instrumented with a towed hydrophone array to determine whale locations and characterize their vocalizations in the near-field. Two transiting blue whales were observed and their vocalizations were recorded by the towed array in close proximity. In this thesis research, these towed array data were deconvoluted using modeled-based matched signal processing and least-squares fitting. The reconstructed source signals show time durations of  $14.4 \pm 2.2$  and  $10.6 \pm 1.6$  s and source levels of  $162.4 \pm 7.0$  and  $166.2 \pm 10.5$  dB re  $1 \mu\text{Pa}$  for the 90 Hz "A" calls and 51 Hz "B" calls, respectively. Furthermore, correlation methods were used to quantify call-to-call variability. The analysis shows that the waveform of the "B" calls and the magnitude of the waveform of the "A" calls are robust, suggesting that these quantities should be exploited in the design of long-range auto-detection techniques and long-range, model-based localization and tracking algorithms for the OAO array.

**DoD KEY TECHNOLOGY AREAS:** Environmental Quality, Sensors, Modeling and Simulation, Other (Bioacoustics)

**KEYWORDS:** Blue Whale Vocalizations, Signal Characteristics, Source Locations, Towed Array, SOSUS, Monterey Bay National Marine Sanctuary, NPS OAO

### LIGHT BULB SURVEY PROCEDURE AND SENSITIVITY STUDY FOR ESTIMATING ELEMENT LOCATIONS OF THE NPS OAO BOTTOM LYING HORIZONTAL ARRAY (U)

Michael R. Rocheleau-Lieutenant, United States Navy

B.S., United States Naval Academy, 1991

Master of Science in Meteorology and Physical Oceanography-June 1999

Advisors: Ching-Sang Chiu, Department of Oceanography

Curtis Collins, Department of Oceanography

Second Reader: Chris W. Miller, Undersea Warfare Academic Group

Abstract Confidential

**DoD KEY TECHNOLOGY AREA:** Sensors

**KEYWORDS:** Acoustic Array, Least Squares Estimate, Light Bulb Survey, Beam Pattern, Sensitivity Study

## METEOROLOGY AND PHYSICAL OCEANOGRAPHY

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### DECADAL VARIABILITY OF THERMOHALINE STRUCTURE AT THE SHEBA SITE

**Robin D. Tyner-Lieutenant Commander, United States Navy**

**B.S., United States Naval Academy, 1988**

**M.B.A., New Hampshire College, 1996**

**Master of Science in Meteorology and Physical Oceanography-June 1999**

**Advisor: Timothy P. Stanton, Department of Oceanography**

**Second Reader: Robert H. Bourke, Department of Oceanography**

Recent studies have documented changes in the thermohaline layer of the Canadian Basin. This study analyzes a year long set of temperature and salinity profiles from the SHEBA ice station, in comparison with the 40-year climatology from the EWG digital atlas, the most complete Arctic data compilation available. Significant anomalies were observed, including warming and shoaling of the Pacific layer south and east of the Chukchi Cap, absence of a Pacific layer north of the Chukchi Cap, upper halocline freshening, and large mixed layer salinity decreases in the Beaufort Sea in contrast to increases north of and over the Chukchi Cap. These anomalies suggest a shift in synoptic scale advective patterns in response to a weakened Beaufort High pressure system and a strengthened and expanded Eurasian Low pressure system. These circulation changes may restrict the flow of Pacific water through Herald Canyon, focusing it more through Barrow Canyon. Ice cover/thickness changes may also contribute to the observed anomalies.

**DoD KEY TECHNOLOGY AREA:** Other (Oceanography)

**KEYWORDS:** Decadal Variability, Upper Halocline, Temperature, Salinity, SHEBA, Beaufort Gyre, Canada Basin