MASTER OF SCIENCE
IN
PHYSICAL OCEANOGRAPHY

VERTICAL AND HORIZONTAL LENGTH SCALES OF SUSPENDED SEDIMENT IN THE NEARSHORE

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Suspended sediment measurements acquired using acoustic and optical sensors are analyzed to determine the vertical and horizontal coherence length scales in the nearshore zone across a barred beach during the SandyDuck experiment.

Suspended sediments over the vertical, from the seafloor to approximately 65 cm above the bed, are inferred from acoustical backscatter of a 1.3 Mhz signal at discrete 1.7 cm bins. The height of the bedload layer ranged from 1.7 – 3.4 cm above the bed floor for all stations investigated, which is twice the height of the theoretical wave boundary layer. The vertical coherence length was found to be an order of magnitude greater than the wave boundary layer and had a weak dependence with wave height, depth of water and orbital excursion (linear correlation coefficient of 0.6 statistically significant at 95% confidence).

The cross-shore horizontal coherence length scale of suspended sediment was determined using a two meter lagged array of six optical backscatter sensors at an elevation of approximately 18 cm above the bed. The horizontal coherence length scale was approximately 0.8 times the rms wave orbital excursion length for all cross shore stations. Both the vertical and horizontal coherence length scales are longest for infragravity waves and decrease with increasing frequency.

DoD KEY TECHNOLOGY AREA: Other (Littoral)

KEYWORDS: Suspended Sediment Length Scales, Suspended Sediment, Nearshore

LOW FREQUENCY ACTIVE SONAR (GENERIC UK) PERFORMANCE ASSESSMENT IN THE OPERATIONALLY SIGNIFICANT AREA OF THE NORTHWEST APPROACHES TO THE UNITED KINGDOM

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The goal of this research was to make a performance assessment for a generic UK Low Frequency Active Sonar (LFAS) operating in the northwest approaches to the UK. Five diverse and operationally significant sound speed and geoacoustic transects of the region in winter and summer were considered. The intention was to use an operational, ray theory based, acoustic propagation loss model for the performance assessment at 400 Hz and 800 Hz for various source/target depths. Prior to the assessment the ray model was compared with a finite element primitive equation transmission loss model (RAM) to, firstly, validate

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the propagation loss algorithms, and, secondly, to make any required corrections to the ray model propagation loss output as a result of variable geoacoustic conditions. Results show that the ray model compares favorably with RAM and only minor corrections were required. RAM was also used to evaluate the effect of the South East Icelandic Front in summer on acoustic propagation at the frequencies of interest. Results demonstrate that, depending upon source/receiver dispositions, the inclusion of range dependent sound speed profiles and geoacoustic parameters are a necessity. LFAS performance results demonstrate that the system is able to achieve good results with lower frequencies performing better than high frequencies. However, high reverberation levels are a severe limiting factor. Investigation into advanced signal processing techniques suggest that the utilization of inverse beamforming techniques has the potential to improve detection opportunities by suppressing reverberation.

DoD KEY TECHNOLOGY AREAS: Battlespace Environments, Sensors, Modeling and Simulation

KEYWORDS: Oceanography, Propagation Loss, Low Frequency Active Sonar, Performance Assessment, Northeast Atlantic, Inverse Beamforming

THE SOUTH CHINA SEA THERMOHALINE STRUCTURE AND CIRCULATION

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The South China Sea (SCS), the largest marginal sea in the West Pacific Ocean, is separated from adjacent oceans by a chain of islands. The deepest water is confined to a bowel-type trench, and the maximum depth is approximately 5,000 m. Most of the existing studies on the seasonal and interannual variability have been based only on surface temperature data. However a primary need is an understanding of the three-dimensional thermohaline circulation. The minimum curvature with spline method was used to establish a three-dimensional monthly-varying gridded data from the Navy's Master Oceanographic Observation Data Set (approximate 189,000 profiles), covering the area of 5°N - 25°N and 105°E - 125°E and from the surface to 400 m depth. For temperature, profiles were binned into 204 monthly data sets from 1968 to 1984 (17 years). Because of the paucity of salinity data, salinity profiles were binned into 12 climatological monthly data sets, and the monthly climatological mean was computed. After the gridded data set had been established, both composite analysis and the Empirical Orthogonal Function (EOF) analysis were used to identify the major thermohaline features. The first EOF mode accounts for 26.7% of the variance and represents the seasonal variation. The second EOF mode accounts for 17.7% of the variance and represents the interannual SCS warming/cooling phases. Furthermore, the P-vector method was used to invert three-dimensional velocity fields from the analyzed temperature and salinity data. Important dynamical processes, including the Kuroshio intrusion, the western boundary current (counter-current), the cross basin current (under counter-current), the mesoscale eddies, and the basin gyre are identified.

DoD KEY TECHNOLOGY AREA: Other (Physical Oceanography)

KEYWORDS: Water Mass, Thermohaline Structure, Seasonal Variation, Circulation