INFLUENCE OF BUBBLES ON NAVAL SYSTEMS OPERATING IN SHALLOW WATER: THE SCRIPPS PIER EXPERIMENT

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LONG-TERM GOALS
To predict the effects of bubbles, especially very high void fractions characteristic of surf zone regions, on MCM and weapons systems.

OBJECTIVES
The primary objective of the experiment was to measure properties of a bubble field, such as its spatial and temporal scales, its density, and its size distribution, within a near-shore environment. Data from this and future experiments will be interpreted along with the coastal oceanography and used to model the effect of bubbly environments on sonar system performance.

APPROACH
A collaborative, multi-institute experiment was performed in the vicinity of the Scripps Pier during Feb-March 1997, whose goal was the study of bubble field generation, transport, and distribution, as influenced by surf zone conditions. The collaboration involving NRL-SSC, IOS, APL-UW, SIO, NCPA, and NRL-DC, produced an ensemble of instrumentation at the site for measuring bubbles, ambient noise, temperature and salinity, currents and surface waves. APL-UW deployed an array of four upward-looking transducers (frequency 240kHz), which simultaneously measure vertical profiles of acoustic volume scattering from bubbles from four locations.

WORK COMPLETED
The Scripps Pier experiment and preliminary results of data analysis [1] were completed this year.

RESULTS
The transport of bubbles via rip currents emerged as a key feature surf zone bubble environment [1]. Images of volumetric backscattering strength vs time and depth (Fig. 1) reveal episodic events (by way of increased scattering level) which last O(100) s and can occur in intervals of O(10) min. Time lags for increased scattering at the four APL-UW locations were consistent with a seaward flow of rip currents equal to about 0.25 m/s.
### Influence of Bubbles on Naval Systems Operating in Shallow Water: The Scripps Pier Experiment

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IMPACT / APPLICATIONS
Data from the Scripps Pier Experiment are the most comprehensive to date that have been gathered in the surf zone environment. Results of this and perhaps future experiments this kind will no doubt have a strong influence on the design of sonar systems that must operate in very shallow water or surf zone environments.

TRANSITIONS
The results will be particularly useful to programs that address the influence of bubbles on naval systems operating near the sea surface, in the shallow water surf zone, or in vicinity of ship wakes.

RELATED PROJECTS
The work relates to other efforts within the ONR program entitled “Influence of Bubbles on Naval Systems Operating in Shallow Water”, being carried out by NRL-SSC, IOS, and SIO-MPL.

REFERENCES
Fig. 1 Depth vs time display of Sv (in decibels) as measured at 240kHz during coordinated Run 7 of the Scripps Pier Experiment. The plots are arranged such that their order, from top to bottom, represents the seaward direction, or increasing distance from shore. The abrupt increase in scattering level at minute 2.5 in the top plot is interpreted as a bubble cloud that subsequently spans the area delimited by the four transducer locations.