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NURC/SACLANTCEN milestone experiments toward solving
inverse problems in ocean acoustics

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This paper reviews milestone experiments conducted by Saclant Undersea Research Centre to support the development and validation of techniques for obtaining and taking into account environmental information in sonar. The experiments brought together underwater acousticians, geophysicists and oceanographers with the aim to collect comprehensive acoustic and environmental ground-truth data. Environmental-adaptive signal processing was first demonstrated in a deep water area (WESTSARDINIA'89&90). From ducted propagation measurements, a model-based matched filter (MBMF) receiver that fully incorporates the physics of wave propagation determined a source range, depth and Doppler. For environmental inversion the broadband extension of matched-field processing was investigated in a shallow water area south of Elba island (YELLOWSHARK'94&95). Geoacoustic properties of the sea bottom were determined by finding the best fit between predicted and observed sound fields at multiple frequencies using genetic search algorithms. The same inversion results were obtained by MBMF processing of broadband linearly-frequency-modulated signals enabling the use of an array of a few hydrophones instead of a dense and large vertical array. This motivated the development of drifting acoustic buoys which were tested successfully over the southern continental shelf off Marettimo island, Sicily (ENVERSE'97&98). A recent experiment demonstrated an integrated concept of Rapid Environmental Assessment (MREA/BP'07) using sparse arrays of hydrophones and pressure/temperature sensors, hand-deployed from small vessels.