Overview of CTBT Hydroacoustic Studies at LLNL

Abstract

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LLNL conducts a variety of technical and policy studies for DOE in support of hydroacoustic verification technologies for a CTBT. This poster presents an overview of three of the technical studies that have a direct bearing on the performance of hydrophone monitoring systems for detecting and identifying nuclear detonations at sea.

We are developing computer models of the nuclear explosion source of hydroacoustic signals. This model includes the effects of coupling from the strong shock region immediately around the device into the ocean acoustic waveguide (the SOFAR = SOund Fixing and Ranging channel) that propagates acoustic waves to great distances with little attenuation. The model treats both underwater explosions and bursts low in the atmosphere above the ocean surface, and has been used to determine the expected strength of signals from explosions of both types. We describe our current efforts to produce "starter-fields" for acoustic propagation codes that will predict the early-time acoustic signature of explosions observed at ranges of thousands of kilometers.

DOE/LLNL also has operated a data acquisition system at a hydroacoustic station in the North Pacific since April 1993, and has a collection of nearly 2 1/2 years of continuous underwater acoustic recordings. We are using this collection in a study of the feasibility of using earthquake T phases to identify features along the acoustic path that block acoustic propagation. We have extracted observations of T phases from more than 100 earthquakes along the Pacific-Antarctic ridge for this study. We are attempting to characterize the variability of the T phase source to determine the suitability of T phases for obtaining statistical estimates of path attenuation. If path attenuation measurements with T phases are feasible, earthquake observations may help calibrate an installed IMS hydrophone network after several years of observation.

In our third project, we are developing joint detection, location and discrimination algorithms using hydroacoustic and seismic data. We compare observations of explosions (the 1994 Ship Shock trials) and earthquakes at a hydroacoustic station (Kaneohe) and a group of seismic stations along the coast of Southern California. Among other techniques, we use self-organizing neural nets to compare the performance of seismic-only, hydroacoustic-only and seismic-hydroacoustic discrminants.

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