ANALYSIS OF FREQUENCY DEPENDENT ATTENUATION IN SHALLOW WATER

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An Abstract of a Thesis Submitted to the Graduate

Faculty of Rensselaer Polytechnic Institute

in Partial Fulfillment of the

Requirements for the Degree of

DOCTOR OF PHILOSOPHY

Major Subject: Mathematics

The original of the complete thesis is on file
in the Rensselaer Polytechnic Institute Library

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July 2007
(For Graduation August 2007)

ABSTRACT

This thesis is motivated by the experiments conducted near the site of AMCOR Borehole 6010 on the New Jersey Continental Shelf in 1988 and 1993. A major objective of these experiments was the evaluation of propagation predictability in sandy shallow water environments. In this thesis we use a non-linear frequency dependence of the sediment volume attenuation to determine estimates for the site specific surficial attenuation coefficient and the power-law exponent in the uppermost sediment layer. Previous studies in the literature determined that a site specific frequency power exponent of 1.5, relative to a reference frequency of 50 Hz over the frequency interval 50-1000 Hz, provided the best comparison with the measurements. In our approach we use 1 kHz as an attenuation reference frequency and employ different parameter ranges and optimization criteria. A metric of transmission loss variation with range is an effective attenuation coefficient (EAC) that can be extracted from the range and depth averaged transmission loss, both for measurements and for calculated data with the parabolic equation. Once we have determined the EAC for both measured and calculated data, preliminary parameter ranges are found based on a normalized standard deviation analysis. Then we fit measured-computed EAC pairs by the least square fit (LS). If the agreement were perfect, then the slope of the straight line fit through all the points given by the measured-computed pairs would be one. Finally, the frequency exponent in the power-law dependance is allowed to vary until agreement between measured and calculated EACs is achieved within acceptable bounds and the hypothesis that the LS slope is one is tested. For 400-1000 Hz, this procedure leads to a power exponent, in the range 1.7-2.0, which is consistent with other sand-silt regions. The estimates are robust with respect to variations in the water and sediment sound-speed profiles and the sediment layer thickness. The influence of measured range dependence on sound speed and bathymetry is examined. Signal time spread calculation code is checked on the Pekeris type waveguide. We provide further application, such as estimates of signal time spread for a recent experiment in the same ocean region.