A statistical method for the evaluation of long term trends in underwater noise measurements

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Deep ocean ambient sound levels have been the subject of recent studies, with particular interest in the identification of long term trends. This paper describes a statistical method for performing long term trend analysis and uncertainty evaluation of the estimated trends. Uncertainties are needed if the quality of the estimates are to be assessed and if the results from different studies or different methods are to be compared. The measured data span 14 years, from 2003 to 2017, and originate from the Southern Ocean close to Cape Leeuwin, Australia. The method uses a flexible discrete model that incorporates terms that capture seasonal variations in the data together with a moving-average statistical model to describe the serial correlation of residual deviations, with uncertainties validated using bootstrap resampling. The trend analysis is applied to time series representing monthly and daily aggregated statistical levels for five frequency bands to obtain estimates for the change in sound pressure level over the examined period with associated coverage intervals. The results show a statistically significant reduction in sound pressure levels over the examined period at that location. Some possible explanations for these changes are postulated, including the effects of shipping, wind speed, sea surface temperature and changes in Antarctic ice volume.

Reference: [1] Harris et al, JASA, in press.