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Tipping point analysis of ocean acoustic noise

Valerie N. Livina (1), Albert C. Brouwer (2), Peter Harris (1), Lian Wang (1), Kostas Sotirakopoulos (1), and Stephen Robinson (1)

(1) National Physical Laboratory, Teddington, United Kingdom (valerie.livina@npl.co.uk), (2) Preparatory Commission of the Comprehensive Nuclear-Test-Ban Treaty Organization, Vienna, Austria

We apply tipping point analysis to a large record of ocean acoustic data to identify the main components of the acoustic dynamical system and study possible bifurcations and transitions of the system. The analysis is based on a statistical physics framework with stochastic modelling, where we represent the observed data as a composition of deterministic and stochastic components estimated from the data using time series techniques. We analyse long-term and seasonal trends, system states and acoustic fluctuations to reconstruct a one-dimensional stochastic equation to approximate the acoustic dynamical system. We apply potential analysis to acoustic fluctuations and detect several changes in the system states in the past 14 years. These are most likely caused by climatic phenomena. We analyse trends in sound pressure level within different frequency bands and hypothesise a possible anthropogenic impact on the acoustic environment. The tipping point analysis framework provides insight into the structure of the acoustic data and helps identify its dynamic phenomena, correctly reproducing the probability distribution and scaling properties (power-law correlations) of the time series. Interestingly, a signature of El Niño events has been identified in the deep acoustic signal near the South-West Australian coast, which confirms the investigative power of the tipping point methodology.

Reference: [1] Livina V., A.Brouwer, P.Harris, L.Wang, K.Sotirakopoulos, S. Robinson, Tipping Point Analysis of Ocean Acoustic Noise, *Nonlinear Processes in Geophysics*, in press.