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Nonlinear Processes in Geophysics
Discussions

Interactive comment on "Tipping point analysis of ocean acoustic noise" *by* Valerie N. Livina et al.

Anonymous Referee #1

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This paper analyzes a 14-yr long acoustic time series by estimating its non-stationary and stationary statistical characteristics: seasonal cycles and long-term trends in five different frequency bands, lag-1 autocorrelation and variance in large sliding windows of sizes 3-9 years, as well as estimates of the potential function in the sliding windows of sizes from a few days to a year. The authors find statistically significant long-term trends in the acoustic system dynamics potentially attributable to anthropogenic influences on climate, and argue for a possibility of a future bifurcation based on the tipping-point analysis. On shorter time scales, the authors argue for a connection between the structure of the system's underlying potential and ENSO variability. A stochastic model is developed that is able to mimic diverse statistical properties of the observed acoustic data.

The paper is well written in general, but needs a few clarifications in some places, in particular with regards to the conclusions about the connection with ENSO and the

formulation of the stochastic model. The results (especially Figs. 4 and 5) look interesting, but I feel that interpretation of these results using buzzwords (anthro, ENSO) is somewhat arbitrary, and needs a broader discussion. In the same way, a few words about possible alternatives to the stochastic formulation the authors developed would also be in order.

Detailed comments:

(1) Fig. 4: The record is only 14-yr long, and there is definitely a lot of internal variability in the climate system that can contribute to decadal trends on top of any possible anthropogenic effects.

(2) Fig. 5: The text claims a connection with ENSO, but it's not immediately obvious from comparing the top and bottom panels of the figure. Could the authors produce a bit more quantitative measure of this association (for example, plotting a 1-D time series of the color plot and correlating it with ENSO indices)?

(3) Fig. 6: Such skewed distributions can be generated by the stochastic models with nonlinear deterministic part driven by the additive noise, but also with linear models driven by multiplicative noise. See Compo et al. (2015) and references therein (http://journals.ametsoc.org/doi/abs/10.1175/JCLI-D-15-0020.1). So the choice of the appropriate stochastic model may not be that obvious.

(4) Section 5, eq. (11). I am confused about the model. Should it be z-dot (not z-prime) on the left-hand side, as in (4)? But then are T(t) and P(t) added on top of the potential model driven by the red-noise (Phi)? In this case, they cannot be the part of Eq. (11). ?? Do the coefficients of the potential continuously depend on time (as implied by Fig. 5)? Or is the model trained on subsamples of data with a given potential structure (e.g., two-well, three-well)? Is it really a surprise that the model reproduces the observed statistics? This section needs to be clarified.

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