

# Changes in the noise levels of the Indian Ocean and their relationship to shipping patterns

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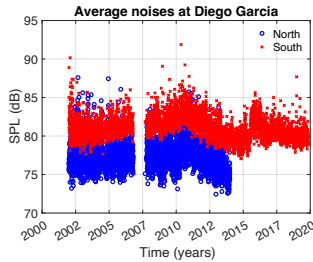
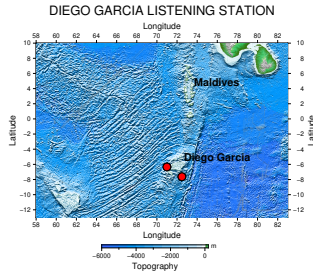


Figure: Average noise levels (55 Hz to 65 Hz) show increase and then decrease



# Work used average densities of shipping traffic to generate realizations of ship positions

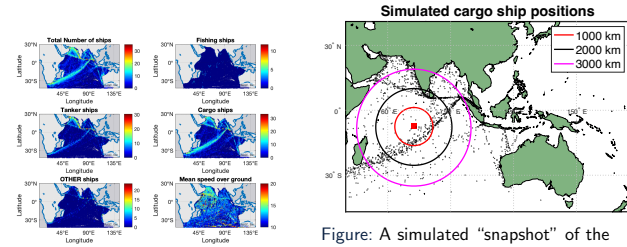


Figure: Total number of ships in December 2014 at a resolution of  $0.25^\circ \times 0.25^\circ$  ( exactEarth Ltd.).

Figure: A simulated “snapshot” of the cargo ship positions from the total number of ships in a month. The circles overlaid show radii of 1000 km, 2000 km, and 3000 km from CTBTO station at Diego Garcia South.

- Fields propagated from cargo, tanker, and fishing ship positions

Model uses ship source-depths  $\approx 10$  m, propagates field via RAM-Parabolic Equation (PE), source level from ANDES (SAIC, 1986), interpolates bathymetry from the Smith-Sandwell (15-arcseconds), and reanalysed T and S fields from Copernicus database to input sound speeds.

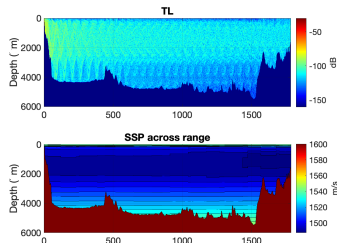


Figure: TL and SSPs for a 8 m source depth at  $(5.92^\circ, 81.131^\circ)$  off the southern coast of Sri Lanka.

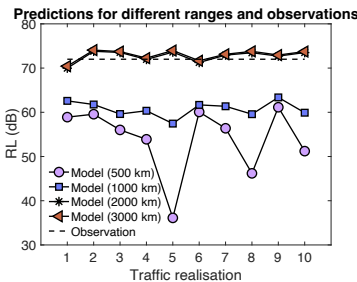


Figure: Predictions and Observations

Work is in progress to calculate noise levels for multiple years. However the number of ships increased much between 2013, 2014, and 2019, contrary to the decrease in noise levels. Ship (average SOG) do not show much differences between years.

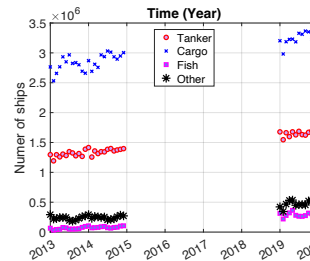


Figure: Total number of ships in 2000 km radius around Diego Garcia (S).

## Discussion

- Change in shipping potentially not the reason for change in noise levels
- Propagation model will be more extensively used than this preliminary work
- Correlation with oceanographic variables ?