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Spatio-temporal trends and effects of oceanic noise on whale acoustic occurrence off the west coast of South Africa

Oceanic noise has been globally shown to negatively affect marine organisms; yet, little to no noise research has been done around most African coasts including South Africa's. Here, we aimed to quantitatively describe seasonal spatio-temporal oceanic trends of ambient noise and its impact on acoustic occurrence of six whale species (Antarctic blue, fin, minke, southern right, humpback and sperm whales) off South Africa's west coast between 2014 and 2017. Passive acoustic monitoring data were collected using autonomous acoustic recorders deployed at 885, 1118 and 4400 m water depths. Depending on the maximum frequency of recordings, noise levels were categorized into the following frequency bands (Hz): 10–500, 500–1000, 1000–2000, 2000–3000, and 3000–4000. We evaluated effects of oceanographic conditions (wave height and period, current speed, zonal and meridional wind speed, total precipitation, month and hour) and vessel traffic on noise levels at different frequency bands for each recording site using random forest (RF) models. Pairwise correlation revealed strong correlation between frequency bands, we therefore used principal component analysis (PCA) to assess the directional relationship between frequency bands. PCA showed that 10–500 Hz frequency band was heading towards a different direction than other frequency bands. The lowest and highest frequency band for each recording site were used to model the effect of noise levels on whale acoustic occurrences. RF model results identified the following variables as the most important predictors of noise level: month for recorder deployed at 855 m water depth, month and wind speed for recorders deployed at 1118 m water depth, and ocean current speed for the recorder deployed at 4400 m water depth. Low frequency band (10–500 Hz) noise level highly influenced acoustic occurrence of all baleen whale species, while sperm whale acoustic occurrence was influenced by both low and high frequency bands. These results show that vessel traffic did not significantly contribute towards ambient noise level in this region, but it is important to continue to monitor noise levels given increases in blue economy related activities. We provide baseline noise level information for the west coast of South Africa.