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Why does acoustic thermometry not perform well on small aperture arrays such as H03S?

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Continuous long-term sound sources are recorded at hydroacoustic station H03S, a three-element hydrophone array south of Robinson Crusoe Island, between 23 April 2014 and 20 August 2017. The origin of the signal between 3-20Hz is investigated by using cross-correlation, array processing using plane wave beamforming, and spectral analysis. One-bit normalization is successfully applied as a cross-correlation preprocessing step in order to suppress undesired earthquake events in the data. Travel times retrieved from averaged cross-correlations do not yield a coherent array direction of arrival. Averaged envelopes of the cross-correlations, however, indicate a coherent signal approaching H03S from a south-southwest direction. Beamforming indicates two dominant back azimuth directions: 172°-224° (Antarctica) and 242° (Monowai Volcanic Seamount). This continuous source field creates possibilities to investigate the applicability of acoustic thermometry at hydrophones H03 S1-S2. The power spectral density yields a strong broadband signal in January - March, most likely related to iceberg noise. A narrow banded signal around 17Hz between April and September corresponds to whale calls. The best-beam sound pressure levels towards Antarctica are compared to ERA5 climatologies for sea-ice cover and normalized stress into the ocean, supporting the hypothesis of iceberg noise. Cross-correlation and array processing indicate significant directional variation in local modal propagation, most likely related to the steep slope in the bathymetry near H03S. In addition, it is demonstrated that the ambient noise field is not sufficiently equipartitioned. It is shown that this causes a large error in the estimated temperature, substantially due to the short receiver spacing. These large errors have not been addressed in previous studies on deep-ocean acoustic thermometry. Hence, it is shown that acoustic thermometry does not perform well on small arrays such as H03S.