Faculty of Electrical Engineering & Computer Science
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Analysis and Modelling of RAFOS Signal propagation under the Antarctic Sea-Ice for positioning of Argo Floats.

ABSTRACT - Masterthesis

The Alfred-Wegener-Institute maintains a large-scale oceanographic observatory in the Southern Ocean, HAFOS (Hybrid Antarctic Float Observing System). Several deep sea moorings of this observatory host sound sources, allowing acoustic tracking of free floating under-ice profiling Argo floats. These floats contribute to the Argo project, which collects oceanographic data of the upper 2000m by over 3500 floats worldwide. As the Southern Ocean's seasonal ice coverage prohibits year round surfacing and satellite based position fixes, positioning during the float's under-ice periods is achieved using RAFOS signals, acoustical upsweeps from 259.38 Hz to 260.9 Hz, which can be detected by the float's RAFOS receiver. The float's position is determined by triangulation on basis of the distances, i.e. signal travel time, from the moored sound sources, which positions and sweep times are known. Distances are calculated from the travel time of the RAFOS signal.

Alongside the sound sources, HAFOS moorings host passive acoustic recorders. To investigate potential effects of environmental conditions, especially the ice coverage along the acoustic path, on the quality of received RAFOS signal, several such acoustic records were analyzed. Three sound source/recorder pairings in the Weddell Sea and four pairing located along the Greenwich Meridian were analyzed. Acoustic records were correlated with the known RAFOS reference signal to determine correlation heights as well as time-of-arrivals of RAFOS signals. Results reveal a correlation between sound pressure level decrease of the RAFOS signal and the formation of sea ice as well as a correlation of the received signal's sound pressure level and the correlation height. From the known source level of the sound sources and the received level in the recordings, transmission loss was calculated and compared to results from BELLHOP raytracing model runs to better understand the factors driving the observed variability. Model outputs suggest a high dependence of the received signal level on the relative depths of the sound source and receiver pairing. On the basis of the results from this thesis, mooring layouts for the sound sources might be improved in future deployments.