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Hydroacoustic detection of dumped ammunition in the Ocean with multibeam snippet backscatter analyses. A case study from the 'Kolberger Heide' ammunition dump site (Baltic Sea, Germany)

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Dumped ammunition in the sea is a matter of great concern in terms of safe navigation and environmental threads. Because corrosion of the dumped ammunition's hull is ongoing, future contamination of the ambient water by their toxic interior is likely to occur. The location of such dump sites is approximately known from historical research and ship log book analyses. Subsequent remote sensing of ammunition dumping sites (e.g. mines) on the seafloor is preferentially performed with hydro-acoustic methods such as high resolution towed side scan or by the sophisticated synthetic aperture sonar approach with autonomous underwater vehicles. However, these are time consuming and expensive procedures, while determining the precise position of individual mines remains a challenging task. To mitigate these shortcomings we suggest using ship-born high-frequency multibeam sonar in shallow water to address the task of mine detection and precise localization on the seabed. Multibeam sonar systems have improved their potential in regard to backscatter analyses significantly over the past years and nowadays present fast and accurate tools for shallow water surveying to (1) detect mines in multibeam snippet backscatter data (2) determine their precise location with high accuracy intertial navigation systems.

A case study was performed at the prominent ammunition dumping site 'Kolberger Heide' (Baltic Sea, Germany) in the year 2014 using a modern hydro-acoustic multibeam echosounder system with 200-400 kHz (KONGSBERG EM2040c). With an average water depth of not even 20 m and the proximity to the shore line and dense waterways, this investigated area requires permanent navigational care. Previously, the study area was surveyed by the Navy with the very sophisticated HUGIN AUV equipped with a synthetic aperture sonar with best resolution by current technology. Following an evaluation of the collected data, various ammunition bodies on the sea floor could be clearly detected. Analyses of our shipborn multibeam snippet backscatter data now show the feasibility to detect the majority of such ammunition bodies by their distinct snippet backscatter anomaly and shape. By the use of SAPOS correction data, the navigation data of the appropriated multibeam echosounder was postprocessed, which leads to an absolute accuracy of the ammunition bodies of 0.1 m laterally. Thus, the multibeam dataset represents a study providing both, detection and precise positioning of individual mines on the seabed. Apart from the much greater efficiency of multibeam mapping sonar over towed sidescan, precise localization is important for future management of mines, may it be in regard to their dellaboration, or to evaluate if future sediment mass movement (sediment waves) may cover and obscure the ammunition bodies in the future.