Application of INstrumented Surrogate Munitions For Munitions MObility and Burial At Munitions Response Sites

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Munitions mobility and burial influence both management and remediation activities at contaminated underwater sites. Observations from the laboratory and field, along with a range of empirical, analytical, numerical and probabilistic models, inform our understanding of munitions phenomenology. Basic and applied research needs drove the development and application of prototype instrumented surrogates to characterize the physics necessary for modeling munitions mobility and burial in underwater environments. This presentation summarizes results from past and ongoing field experiments applying instrumented surrogate munitions at both test sites and munitions response sites in underwater environments. Both mobility and burial of instrumented surrogates were observed across a range of environmental conditions. In 2021-2022, NRL-built cylindrical surrogates fitted with IMU and a custom total stress and pore pressure sensor package were deployed in the sandy nearshore off Camp Pendleton, CA. Changes in surrogate munition burial depth were resolved on daily to hourly time-scales. In a second study, a suite of custom designed instrumented surrogates were deployed at two cohesive sediment sites in the lower Delaware Bay estuary from 2017 - 2019. Surrogates were equipped with inertial motion units (IMU) and tracked via a Vemco (Innovasea) VPS acoustic tracking system originally designed for fish tracking studies, with surrogate mobility and burial measured during six separate storm events. This same surrogate tracking technology is being adapted and applied to an ongoing munitions mobility and burial experiment at NSF Indian Head, MD, a riverine munition response site. The wide application of instrumented surrogates to varying environmental types and underwater sites will provide much needed observations for predicting munitions mobility and burial at munitions response sites. Since remediation efforts typically take many years to perform at considerable financial costs, long-term site management that includes predicting munitions phenomenology represents a future mission critical technology.