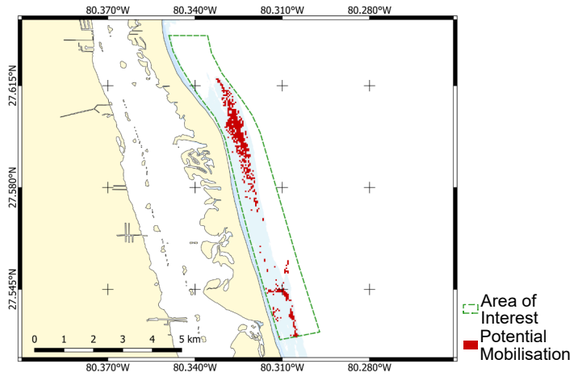

Figure 3: Exemplary result for the possible mobilization of an object

CONCLUSION

The main challenge of the project was to combine different models, covering a huge range of spatial and temporal scales. For this purpose, a new highly modular and parallelized sofware was developed, which already includes different wave- and burial models as well as a mobilization model. The software, written in C++, now easily can be extended to consider more different burial and mobilization models as well as input data from different sources.

Using the example of the full year 2016 including Hurricane Matthew at the site of Fort Pierce, it is shown that the model is able to predict burial and mobilization of different UXO and DMM. As input data, TELEMAC simulations were performed. Furthermore, the already existing DRAMBUIE model was strongly improved by results of other SERDP-projects to DRAMBUIE 3.0 and implemented.

It now considers current and wave action and different UXO shapes to compute the burial depth. A first demonstration of a drift model is developed and tested.

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CORVUS WORKS

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UXO mob

Model roundup and extension for the current- and wave-induced burial, re-exposure, mobilization and migration of UXO and DMM

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INTRODUCTION

The Fort Pierce U.S. Naval Amphibious Training Base (NATB) was established in 1942 to prepare for invasions in Europe and Japan. On North Hutchinson Island fortifications were built. In 1946 the land was cleaned up and returned to its original owners. Since that time the area was strongly developed. Several UXO and DMM were found on the beach. Those were, besides others 500 and 1000 lbs Bombs, 7.2-inch Demolition Rockets, Tiny Tim Rockets, some Rocket motors and Anti Tank Mines. It is assumed that nearly all objects are nearly buried. The question is: “Can objects be re-exposed?” and if so: “Can they be mobilized by currents and waves?” if yes: “Where do they migrate?”. The mobilization model UXOmob was coupled with the burial model DRAMBUIE 3.0, which is a strongly improved version of DRAMBUIE. The model was also coupled to the hydrodynamics and morphodynamics simulations, using TELEMAC.

TELEMAC

A numerical model was set up in the openTELEMAC software to estimate local morphodynamics and the impact of Hurricane Matthew (2016) over the beach, and nearshore troughs and bars of Fort Pierce, Florida (Figure 1). The model provides a link between global hydrodynamics and atmospheric conditions with local processes. Thus, producing realistic results for undertaking UXO and DMM mobilization analysis through the newly developed UXOmob modelling suite.

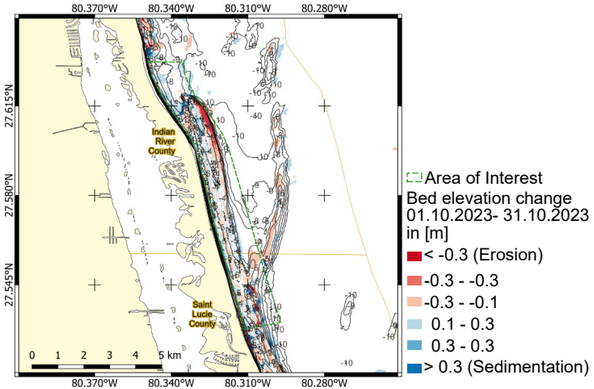

Figure 1: Modelled bed evolution after the Hurricane passage

DRAMBUIE

A new scour burial model DRAMBUIE 3.0 has been developed to predict the scour burial evolution of a range of objects, e.g. cylindrical mines, under current and/or wave flows. This model combines the equilibrium scour burial predictions suggested by Friedrichs et al. (2018) with a time stepping approach (Whitehouse, 1998). Initial validation against laboratory observations revealed the capability of DRAMBUIE 3.0 to capture the scour burial evolution for a range of conditions. For evaluation, the model has been applied to predict burial of UXOs at Fort Pierce NATB during Hurricane Matthew.

Figure 2 shows the burial at several locations along the beach profile (bottom subfigure) at South Beach. The largest burial was predicted at the sandbar (first column) followed by the lower shoreface (fourth column). The majority of the burial at the sandbar occurred within 10 hours before the storm. On the other hand, the UXO mostly buried after the storm had passed at the lower shoreface. This is mostly due to morphological changes that took place after the hurricane.

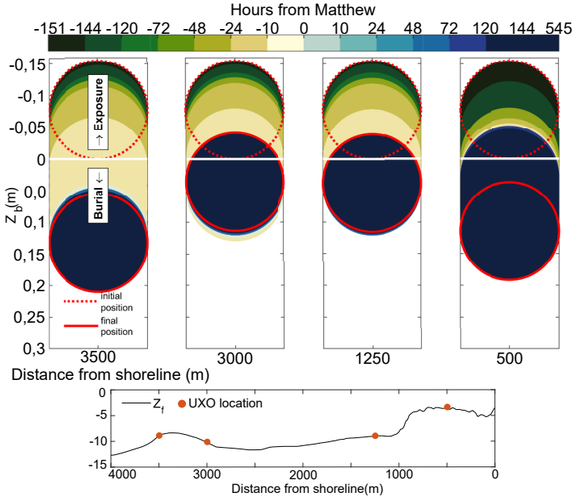

Figure 2: Modelled burial of UXO at sampled cross-shore positions at Fort Pierce before and after the passage of Hurricane Matthew

UXOMOB SOFTWARE

UXOmob processes geo-referenced, time-varying environmental parameters — including sediment grain sizes, wave frequencies, significant wave heights and morphology data — to simulate the effects of hydrodynamic forces on mobilization and burial events. It synthesizes wave elevation time series based on given parameters and predefined spectra, such as JONSWAP, and applies the mobilization model and the DRAMBUIE 3.0 burial model at a high temporal resolution. The simulation accounts for dynamic morphology changes, interpolating them at wave period intervals. The results include mobilization event counts and burial depths stored in a georeferenced, time-dependent netCDF file, for spatial and temporal analysis of burial processes, with final outputs stored as detailed geo-referenced TIFF files.