Navigation Improvement in Post-Processing of Deep-Towed Multibeam Echo Sounder Data Used for Exploration of Hydrothermal Venting Sites

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SUMMARY

As widely known, only about a quarter of the oceans is surveyed with high-resolution echo sounders. For the other parts, only low-resolution data are available. This applies especially for deep-sea areas that are far away from land and without significance for the safety of navigation. But not only the mapping of such remote and deep areas is insufficient, also our general knowledge of the deep-sea is limited and needs to be improved. It is not even 50 years ago, that discharge sites of hydrothermal fluids (commonly also referred to as black smokers) have been discovered. They mainly occur in tectonic active areas (deep-sea environment) and form local mound structures and possibly larger sulphide deposits underneath. These metal-rich deposits are potentially interesting as marine resources but their exploration is challenging as their dimension are relatively small with only approximately 100 m to 200 m in diameter in relation to the deep-sea environment.

Ship-borne multibeam echo sounders (MBES) do not provide sufficient resolution to map hydrothermal sites and their associated mounds due to the large water depths in which they occur and therefore the great distance between echo sounder and seafloor. For the identification and mapping of hydrothermal discharge sites in sufficient resolution, MBES need to be mounted on underwater sensor platforms, which are deployed close to the seafloor. For this purpose, BGR (Federal Institute for Geosciences and Natural Resources, Germany) has developed the deep-towed MBES sled HOMESIDE. It is deployed about 100 m above the seafloor and allows to obtain high-resolution terrain models of 2 m resolution.

The navigation accuracy is crucial for the quality of the bathymetric data. HOMESIDE uses a state-of-the-art inertial navigation system (INS) with different aiding sensors like USBL, SVL, and CTD for positioning. Systematic navigation offsets by sensor malfunction or operational errors result in offsets, which are especially noticeable in overlapping swath data. Such mismatches of 10

m and more need to be post-processed. For the HOMESIDE data this is done using the INS post-processing software and the tool mbnavadjust of the open-source software MB-System. The results show that these tools are very well suited to improve the final terrain quality significantly, which is inevitable for a robust interpretation of the geomorphology and identification of sulphide mounds.

As the utilization of unmanned underwater platforms in hydrography has increased within the last years, the topic of navigation post-processing becomes more important. Unfortunately, only limited tools are available for comprehensive adjustment. In my paper, I will explain the developed workflow for the navigation improvement based on the bathymetric MBES data and show examples to demonstrate the data improvements. Such further navigation correction is necessary to utilize MBES on underwater platforms as exploration tool for hydrothermal sites and possible associated mineral deposits.