Indonesia: Insights into a Field Campaign Aiming to Map the Underwater Environment of Pramuka Island Using an Underwater Laser Scanner, a Multibeam Echosounder and an Airborne Bathymetric LiDAR

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SUMMARY

Unlike traditional echosounders, which transmit acoustic waves, the newly developed underwater laser scanner ULi from the German Fraunhofer Institute for Physical Measurement Techniques (IPM), employs optical radiation to perform high-resolution bathymetric and structural mapping in aquatic environments. Subsequently, the present study aims to characterize the measurement capabilities and the performance of the sensor relative to established acoustic technique in optically favourable and natural conditions. Therefore, a field campaign in the coastal waters around Pramuka Island, Indonesia, which exhibit low turbidity and high optical transparency with a secchi depth of up to 13 m, was conducted. To additionally map the water-land transition zone of the island, an airborne bathymetric lidar was used. Hence, the joint usage of all sensors, will be assessed.

To enable a direct comparison between optical and acoustic sensing approaches, the underwater laser scanner was simultaneously operated with a conventional multibeam echosounder (MBES). Hence, both systems were deployed over identical test transects within the near-shore waters of Pramuka Island. To map the water-land transition zone, an overlap between the underwater laser scanner and the airborne bathymetric lidar, was realized.

The subsequent data analysis focused on an evaluation of the achieved point density, spatial resolution, ranging capability and sensitivity to environmental parameters such as turbidity. Preliminary results demonstrate that the airborne lidar system and the underwater laser scanner provide a high spatial detail and surface fidelity, especially when comparing the data retrieved from the underwater laser scanner to the data collected by the MBES. This particularly applies to shallow areas (< 10 m depth) where optical propagation remains effective. However, a rapid degradation of signal quality from the optical systems was observed with increasing depth, highlighting the strong

dependency of the sensors on water clarity. Conversely, the MBES maintained a reliable coverage independent of optical conditions, though at a lower spatial resolution.

The results confirm that the underwater laser scanner and the airborne bathymetric laser scanner can deliver highly detailed and accurate underwater topographic data when operated in clear and shallow water environments. The complementary characteristics of optical and acoustic methods emphasize the potential of combined approaches for a comprehensive underwater and shore mapping from airborne and shipborne data.