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Comparison between towed absolute and shipborne 3C fluxgate magnetic measurements in shallow water. Applications for marine geophysical surveys.

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We compare marine magnetic measurements simultaneously acquired with absolute and three-component fluxgate sensors to evaluate their respective benefits for marine geophysical mapping and detection surveys.

Shom collected the data in shallow waters, in the Bay of Brest (France) and in the Iroise Sea, during two cruises in the Fall 2021. As per standard practice, an absolute Overhauser magnetometer was towed 180 m behind the 60 m-long Laplace and Lapérouse hydrographic vessels. In addition, two vector magnetometers were temporarily installed at the top of the ship's mast and on the roof of a 10 m-long launch. Scalar data were processed following Shom's standards: shift to sensor position, layback adjustments, removal of gyrations and spikes, filtering and calculation of magnetic anomalies by removing the IGRF model (Alken et al., 2021) and reducing external variations measured at a local reference station. Vector data were corrected for the strong magnetic fields generated by the hull and other steel components of the ship by the application of a "scalar compensation" using a least-squares regression analysis (Leliak, 1961) on data from figures of merit. The compensated vector data then need to be low-pass filtered to remove uncorrected variations of attitude and heading. Magnetic anomalies were finally computed by removing the median value for each profile and reducing external variations from the same local reference station.

Our first results show that maps of total-field anomalies derived from vector data acquired on the ship are very close to those of the absolute data upward-continued to the altitude of the mast. This similarity suggests that it is possible to perform good-quality magnetic surveys without the constraint of having to tow an instrument. The different processing steps however raise the detection threshold for anthropogenic objects lying on the seafloor or partially buried. Vector data acquired on smaller launchs are much more complicated to compensate as ranges of pitch, roll and heading variations are greater than for a large ship and potentially imperfectly sampled by the figures of merit.