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## The use of expedition cruise ships and citizen science to bridge the gaps in plastic marine litter knowledge in remote areas.

Verena Meraldi<sup>1</sup>, Tudor Morgan<sup>1</sup>, Kai Sørensen<sup>2</sup>, and Bert van Bavel<sup>2</sup>

<sup>1</sup>Hurtigruten AS, Expedition, Monmouth, United Kingdom (tudor.morgan@hurtigruten.com)

<sup>2</sup>Norwegian Institute for Water Research (NIVA), Oslo, Norway (bert.vanbavel@niva.no)

Plastics and microplastics are regularly found in the marine environment around the world. Currently, the spatial and temporal dynamics of microplastics in remote areas, including polar regions, are poorly assessed and only limited long-term data is available on occurrence. Long-term data series are required to address changes in abundances of microplastics including variations in spatial and temporal distribution as well as to understand the influence of, for example, different seasons, changing weather or hydrological conditions. But there is very little data from remote regions of the world<sup>(1)</sup> including the Arctic and Antarctic.

One approach is to use ships of opportunity ([www.norsoop.com](http://www.norsoop.com)) to collect data over replicated transects: these include research vessels as well as commercial vessels and expedition cruise ships. Advances in technology enable assessment of microplastic abundance at large spatial scale using existing infrastructure in addition to the collection of oceanographic meta-data. As part of the Hurtigruten – NIVA collaboration, a microplastic sampling module and a marine monitoring system (Ferry Box) was fitted on Hurtigruten's Expedition vessel MS Roald Amundsen. The science center in this expedition ship, where single use plastic has been removed from all areas, provides a lab facility for preliminary plastic analysis and also a place for interaction with the passengers and engagement in citizen science. During the first year of operation, NIVA and Hurtigruten have collected microplastic samples in the Arctic and the Antarctic for long time periods. In addition, as part of a citizen science project, data and samples have been collected during beach clean-ups in remote areas and analysed on board using a handheld NIR smartphone scanner directly linked to a NIVA cloud database.

Average levels of microplastic within the Arctic (1.8-10 n/m<sup>3</sup>) and Antarctic (1.8-4.6) are still relatively low and consist mostly of fibres. The levels found in the Arctic study were comparable with the results from Lusher et al. 2015 and recent work in the Russian Arctic. Cellulose and cotton-based fibres dominate in the Antarctic samples and polyester is the dominant polymeric fibre. A citizen science project involving a beach clean-up and the subsequent analysis of the samples collected was performed on board MS Roald Amundsen in the Falkland/Malvinas Islands. The results showed large amounts of fishery related material including several polymer-based ropes and net pieces but also plastic utensils, food wrapping and plastic bottles.

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