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Application of a highly reconfigurable surface robotic platform for freshwater plume characterization and sampling near tidewater glacier front in Arctic critical environment.

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Marine environmental observation is a broad topic that becomes crucial when considering critical environments, like the Arctic region which is particularly vulnerable to contamination due to the amplified effects of climate change in this area. The melting of tidewater glaciers, which has intensified in the last years, can generate a delivery of freshwater and suspended sediment into the fjord water. These phenomena can release contaminants that have accumulated in the ice over the past century, affecting fjords' ecosystems. Despite the importance of these processes, there is no regular monitoring in place to precisely locate and sample freshwater outflows from glaciers and to track the environmental changes they trigger. The lack of data is, very often, a penalizing factor on the one hand to understand the processes and the phenomena that are occurring and on the other to implement possible mitigation actions for the conservation of the ecosystems. The use of autonomous robotic systems as fundamental data-gathering tools allows new perspectives and a greater understanding of glacier-melting related processes thanks to the possibility of collecting data not otherwise obtainable, with unique spatio-temporal resolutions.

This contribution describes the technological enhancements to enable the use of a highly reconfigurable surface robotic platform (SWAMP ASV) as part of a data acquisition campaign that took place in July/August 2022 in cooperation with Institute of Oceanology, Polish Academy of Sciences (IO PAN), in semi-enclosed glacial bays that characterize the Hornsund fjord. Sampling were performed at three glacier fronts (Storbreen, Hornbreen and Hansbreen) with the purpose of identifying the position of the freshwater outflows, sending the robotic platform to the place where the plumes were present (otherwise not possible given the proximity to the glacier front and the significant calving activity in progress), collecting water samples for the subsequent analyses and evaluating the presence of heavy metals of anthropogenic origin, and simultaneously recording the chemical-physical and bathymetric parameters for a 3D characterization of the water masses and the environment. Preliminary results obtained from the acquired data will be discussed, together with the data management procedure implemented in a perspective of contributing to the global observation effort, also promoted by the United Nations.

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